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| TO: | Jackie Wells |
| FROM: | Rob Willis |
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| SUBJECT: | Technical Memo – Supplemental Human Health Risk Assessment (HHRA) - 2023 Fish and Seal Mercury Data (and also including 2017 to 2020 interim flooding years fish and seal mercury data) |
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## Supplemental Human Health Risk Assessment (HHRA) - 2023 Fish and Seal Mercury Data (and also including 2017 to 2020 interim flooding years fish and seal mercury data)

### 1.0 Introduction

As part of ongoing efforts to continually update predictions regarding the potential for methylmercury (MeHg) levels to increase in Muskrat Falls study area aquatic biota, and the potential for increased MeHg exposure among human consumers of locally harvested aquatic country foods, this report presents the outcomes of human health risk assessment (HHRA) of 2023 aquatic EEM program data on MeHg concentrations in harvested fish and seal species.

This report herein also includes exposure point concentrations and human health risk estimates for the interim (partial) flooding years of 2017-2020. Information for these interim flooding years has not been previously reported in Muskrat Falls HHRA Program documentation to date.

Previous HHRA work conducted within the Muskrat Falls HHRA Program (i.e., Dillon, 2016a,b; 2018) focused on the assessment and characterization of baseline and predicted future MeHg exposure and risk. The prediction of MeHg exposure and human health risk in relation to the 2023 (and 2017-2020) aquatic EEM data builds upon the modelling framework developed within the comprehensive 2016 final baseline HHRA (i.e., Dillon, 2016b), and also incorporates and/or builds upon the outcomes of the various modelling studies, field programs, EEM data evaluations, and other studies that were conducted by independent technical experts throughout 2017 and 2018, and that are described in Dillon (2018) and various other documents posted to the NL Hydro website: https://nlhydro.com/about-us/publications/environmental-reports-for-the-lower-churchill-project/human-health-risk-assessment/.

The Muskrat Falls Human Health Program was initiated in 2013 and has been ongoing since that time. Key elements and milestones of the Human Health Program have been described in previous documentation (in particular, Dillon (2018; 2016b)) and in other documents posted to the above websites. This memo does not elaborate on information that is covered in detail within previous HHRA program documents.

It is acknowledged that while all Muskrat Falls study area HHRA studies to date focus on MeHg exposures, and the potential human health risks associated with such exposures, Muskrat Falls study area fish and seal mercury concentration data are primarily measured and expressed as total mercury (THg) concentrations, rather than MeHg concentrations. It is very common (for reasons relating to practicality and efficiency) to measure THg rather than MeHg in comprehensive mercury environmental monitoring programs. In the baseline HHRA (Dillon, 2016b), and the Dillon (2018) assessment of potential future MeHg exposures and risks, it was conservatively assumed that the THg present in fish and seal muscle tissue (meat) was comprised of 100% MeHg, and that the THg present in seal liver was comprised of 40% MeHg (based on literature review conducted during the baseline HHRA program and on empirical study area ringed seal tissue THg and MeHg data that were collected in support of the baseline HHRA). These assumptions continue to apply herein. For the sake of simplicity and consistency, this memo mainly refers to MeHg concentrations in fish and seal (even though the mercury concentrations are reported as THg), and MeHg exposures and risks, unless specifically referring directly to the fish and seal aquatic EEM datasets, which report THg.

## 2.0 Potential MeHg Exposures and Risks Within the Muskrat Falls Study Area – 2023 (and 2017-2020) Aquatic EEM Data

This section addresses potential MeHg exposures that may be incurred by study area community members due to the harvesting and consumption of fish and seal, and the potential health risks that may be anticipated as a result of such exposures. Assessment of potential MeHg exposures and risks, based on the 2023 (and 2017-2020) aquatic EEM program data, is supplemental to the final baseline HHRA (Dillon, 2016b), and the prediction of potential future MeHg exposures and risks that were presented in Dillon (2018). The 2023 (and 2017-2020) potential MeHg exposures and risks were estimated using the same exposure and risk model developed for the final baseline HHRA, which was also applied for the estimation of potential future MeHg exposures and risks.

Because the evaluation presented herein is based on measured MeHg concentrations in key fish and seal species from the study area in 2023, and in 2017-2020, the predicted peak MeHg increase factors reported in Table 2-3 of Wood (2018a) for Goose Bay and West Lake Melville were not necessary to apply. Nonetheless, these increase factors continue to represent the current best available estimates of potential future increases in MeHg concentrations within the edible tissues of locally harvested fish species and ringed seal. As previously noted in Dillon (2018), the peak MeHg increase factors were derived in a manner that is believed to be highly conservative, such that their application likely substantially overestimates future dietary MeHg exposures and risks within the study area communities. Also, the peak MeHg increase factors are temporary and are expected to occur within 2 to 3 years following reservoir impoundment. The various studies conducted in 2017 and 2018 (all of which are posted at: https://nlhydro.com/about-us/publications/environmental-reports-for-the-lower-churchill-project/human-health-risk-assessment/), collectively indicate that MeHg concentrations in study area aquatic biota are anticipated to gradually increase such that they would peak by post-reservoir impoundment years 2 or 3, persist for potentially 1 year, and then gradually decline thereafter back towards baseline levels.

As previously noted in Dillon (2018) and Wood (2018a,b), brook trout, rainbow smelt and ringed seal (meat and liver) are focused on with respect to the assessment of potential MeHg exposure and risk. These species are the most commonly consumed (as reported in HHRA program diet surveys), are

among the most abundant harvested species within the study area, and are the only harvested and consumed species likely to be affected by the Project (i.e., these species are most likely to experience increases in MeHg accumulation within their tissues as a result of the Project). The outcomes of Wood (2018b) and the HHRA Program diet surveys demonstrated that other fish species known to occur within the study area are either not harvested/consumed (based on diet survey results), or, if they are harvested and consumed, are unlikely to be influenced by the Project, given their habitat preferences, distribution, foraging preferences, life history, and prevalence and abundance within study area water bodies. However, burbot have been added as a species of interest for 2023. This was conducted due to observations of an apparently increased abundance of this species within the study area in recent years, compared to baseline years, and the corresponding potential that burbot may be consumed more frequently by study area residents than in the past (based on comments received from Health Canada on previous annual HHRA Technical Memos, as well as discussions with Indigenous stakeholders). Thus, brook trout, rainbow smelt, burbot and ringed seal are the only species that merit consideration at this time within the Muskrat Falls HHRA Program.

Of the study area communities considered in the baseline HHRA (Dillon, 2016b), all but Churchill Falls (CF) merit consideration with respect to current MeHg exposures and risks. CF is excluded from the current HHRA as the fish harvested and consumed by CF residents are extremely unlikely to come from the Muskrat Falls reservoir, areas downstream of the reservoir, Goose Bay or Western Lake Melville (given that the distance between CF and these water bodies is >250 km), and CF residents did not report the consumption of ringed seal meat or liver. Thus, for CF community members, current and future MeHg exposures and risks as a result of the Muskrat Falls Project are expected to equal baseline MeHg exposures and risks.

Throughout the duration of the Muskrat Falls aquatic EEM and HHRA programs, ringed seal meat and liver samples are collected from Lake Melville and provided to WSP by an Inuit hunter during the annual seal hunt and harvest. Trout, smelt, and burbot muscle tissue samples are collected by WSP personnel from a number of locations considered likely to display effects of the Muskrat Falls Project. These locations include: within the reservoir, below the reservoir, Churchill River main stem, Caroline Brook, Goose Bay (Rabbit Island), Lake Melville (Epinette Point, Mulligan Point), and outer Lake Melville (Trout Cove).

The HHRA of the 2023 and 2017-2020 aquatic EEM program MeHg data for brook trout, rainbow smelt, burbot and ringed seal meat and liver tissues was conducted using the same model that was developed for the baseline HHRA, and that was also utilized in the Dillon (2018) assessment of potential future MeHg exposures and risks. For the HHRA of the 2023 and 2017-2020 data, MeHg exposure point concentrations (EPCs) were calculated from the brook trout, rainbow smelt, burbot and ringed seal meat and liver MeHg (reported as THg) concentration datasets for these years. All aquatic EEM program MeHg data were provided to Dillon by WSP. Statistical data summaries for the 2023 and 2017-2020 brook trout, rainbow smelt, burbot and ringed seal meat and liver THg datasets are provided in Attachment A to this memo.

All EPCs (which, within the HHRA Program to date, have been upper 95% confidence limits on the arithmetic mean, or UCLM95) were calculated using the latest version of the U.S. EPA's ProUCL software. EPC calculation was conducted in the same manner as described in Dillon (2016b), and the EPC units are expressed in mg/kg wet weight (ww) of fish (or seal) tissue. An EPC is widely considered to be

the concentration of a chemical most likely to be contacted over time, and it is well established that the most appropriate and reliable statistic for an EPC in a HHRA is the upper 95% confidence limit on the arithmetic mean (UCLM95). However, other statistics can also be used as EPCs in HHRAs, if it is not possible to calculate adequately robust UCLM95 values (i.e., valid UCLM95 calculation can depend on various factors such as sample size, number of non-detectable values in a dataset, data QA/QC considerations and outcomes, data distribution types, skewness of the data, variability, and dispersion in the data). EPC calculation output is provided in Attachment A.

As previously noted, it was conservatively assumed herein, and throughout the HHRA Program to date, that the THg concentrations measured in fish and seal muscle tissue (meat) were comprised of 100% MeHg, and that the THg concentrations in seal liver were comprised of 40% MeHg.

For the calculation of 2023 and 2017-2020 MeHg exposures and risks, all other sources and rates of MeHg exposure that were evaluated in the baseline HHRA (i.e., other locally harvested country foods that are not influenced by the Muskrat Falls Project, and grocery store foods) remained constant or unchanged from what was assumed for baseline conditions. This was also the approach taken for the estimation of predicted future peak MeHg exposures and risks in Dillon (2018). For these “other” country food items and grocery store food items, it is considered very likely that current and future MeHg exposures would be no different from baseline MeHg exposures.

Tables 1a and 1b provide a summary of MeHg EPCs for brook trout, rainbow smelt, burbot and ringed seal meat and liver, for the baseline period, for the future predicted peak MeHg condition, and for Muskrat Falls Project operational years 2017 to 2023 (calculated from measured aquatic EEM program THg data for these years), where the 2017 to 2020 period represents post-baseline but pre-operational years where the reservoir had been only partially inundated during this time period and full electrical output was not yet being generated by the Muskrat Falls hydroelectric facility.

In Table 1b, ringed seal meat and liver THg data are provided separately for pups and non-pups, as well as for all seals (pups and non-pups) combined. At this time, these data are provided to illustrate the differences in THg (and MeHg) concentrations in pups versus non-pups. However, there is no basis at this time to separate seals into pups and non-pups for HHRA purposes, as it is reported by stakeholders that both pups and non-pups can be harvested and consumed, though pups are often reported to be harvested preferentially. The need for separating seal THg data into pups and non-pups will continue to be reviewed, and planned study area diet survey updates may provide useful information towards determining the appropriateness and representativeness of potentially conducting separate exposure and risk assessments for Hg in seal pups and non-pups.

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Table 1a: Summary of MeHg EPCs: Baseline, Potential Future Peak Conditions, 2017-2020 (Partial Flooding), 2021, 2022, 2023; mg/kg ww

| Key Species | Baseline EPC | Future Peak Predicted EPC (PIF x Baseline EPC) | 2017 EPC | 2018 EPC | 2019 EPC | 2020 EPC | 2021 EPC | 2022 EPC | 2023 EPC |
|---|---|---|---|---|---|---|---|---|---|
| brook trout | 0.07; N=340 [max=0.44] | 0.11; N=340 | 0.040; N=106 [max=0.18] | 0.05; N=118 [max=0.2] | 0.042; N=72 [max=0.12] | 0.047; N=115 [max=0.14] | 0.074; N=81 [max=0.24] | 0.034; N=84 [max=0.08] | 0.044; N=92 [max=0.12] |
| rainbow smelt | 0.12; N=142 [max=0.31] | 0.22; N=142 | 0.048; N=35 [max=0.09] | *0.16; N=39 [*max=0.95]<br><br>0.036; N=38 [max=0.09] | 0.035; N=38 [max=0.08] | 0.053; N=51 [max=0.19] | 0.054; N=73 [max=0.12] | 0.062; N=64 [max=0.16] | 0.062; N=27 [max=0.13] |
| Burbot | 0.18; N=29 [max=0.46] | Not included in future peak HHRA calculations; future burbot MeHg concentrations assumed to remain equal to baseline in future peak HHRA | Not included in aquatic EEMP THg analyses in 2017 | 0.05; N=13 [max=0.09] | 0.06; N=37 [max=0.20] | Not included in aquatic EEMP THg analyses in 2020 | Not included in aquatic EEMP THg analyses in 2021 | Not included in aquatic EEMP THg analyses in 2022 | 0.18; N=42 [max=0.74] |

Notes:
N=sample size (# of samples); max=maximum MeHg concentration.
The baseline period comprised 2010 to 2016.
All EPC units are in mg/kg ww and all EPCS are UCLM95 statistics determined using USEPA ProUCL v5.2 statistical software.
All fish mercury data were measured as THg concentrations (which, in the table, are referred to as MeHg concentrations). For HHRA purposes, it was conservatively assumed that THg measured in fish muscle tissue (meat) was comprised of 100% MeHg.
*One 2018 smelt sample contained a THg concentration of 0.95 mg/kg ww. This concentration is 3 to 10 times higher than all other smelt THg concentrations measured at any time during the aquatic EEM program and skews the EPC value high. While a measured concentration, it is anomalous and is not representative of typical smelt THg concentrations during baseline or operational Project periods. As such, this smelt sample was excluded from HHRA exposure and risk calculations. When this sample is removed, the EPC drops from 0.16 to 0.036 mg/kg ww. The second highest concentration in this 2018 dataset (0.09 mg/kg ww) is roughly 10 times lower than the maximum concentration of 0.95 mg/kg ww.

Table 1b: Summary of MeHg EPCs: Baseline, Potential Future Peak Conditions, 2017-2020 (Partial Flooding), 2021, 2022, 2023; mg/kg ww

| Key Species | Baseline EPC | Future Peak Predicted EPC (PIF x Baseline EPC) | 2017 EPC | 2018 EPC | 2019 EPC | 2020 EPC | 2021 EPC | 2022 EPC | 2023 EPC |
|---|---|---|---|---|---|---|---|---|---|
| ringed seal meat (all seals; pups and non-pups) | 0.34; N=159 [max=6.3] | 0.43; N=159 | 0.17; N=30 [max=0.69] | 0.18; N=31 [max=0.56] | 0.52; N=34 [max=2.7] | 0.16; N=29 [max=0.56] | 0.031; N=30 [max=0.08] | 0.058; N=30 [max=0.12] | 0.086; N=28 [max=0.17] |
| ringed seal liver (all seals; pups and non-pups) | 9.1; N=145 [max=110] | 11.5; N=145 | 33.5; N=30 [max=150] | 10.3; N=31 [max=35] | 8.9; N=33 [max=39] | 8.2; N=29 [max=29] | 0.30; N=30 [max=0.57] | 4.9; N=30 [max=20.5] | 0.59; N=28 [max=1.4] |
| Ringed Seal Meat and Liver Data – Separated into Pups Versus Non-Pups | | | | | | | | | |
| ringed seal meat (pups only) | 0.08; N=133 [max=0.35] | 0.1; N=133 | 0.062; N=17 [max=0.11] | <0.05; N=15 [max<0.05] | 0.048; N=22 [max=0.1] | 0.08; N=19 [max=0.19] | 0.031; N=30 [max=0.08]; only pups harvested in 2021 | 0.052; N=27 [max=0.10] | 0.086; N=28 [max=0.17]; only pups harvested in 2023 |
| ringed seal meat (non-pups only) | 1.5; N=26 [max=6.3] | 1.9; N=26 | 0.32; N=13 [max=0.69] | 0.24; N=16 [max=0.56] | 1.1; N=12 [max=2.7] | 0.32; N=10 [max=0.56] | Not calculable as only pups harvested in 2021 | EPC not calculable; N=3 [range: 0.01 – 0.12] | Not calculable as only pups harvested in 2023 |
| ringed seal liver (pups only) | 0.41; N=124 [max=1.8] | 0.52; N=124 | 0.38; N=17 [max=0.57] | 0.26; N=15 [max=0.44] | 0.31; N=21 [max=0.59] | 0.54; N=19 [max=1.2] | 0.30; N=30 [max=0.57]; only pups harvested in 2021 | 0.48; N=27 [max=1.1] | 0.59; N=28 [max=1.4]; only pups harvested in 2023 |
| ringed seal liver (non-pups only) | 41; N=21 [max=110] | 51; N=21 | 75; N=13 [max=150] | 16.8; N=16 [max=35] | 19.1; N=12 [max=39] | 20.4; N=10 [max=29] | Not calculable as only pups harvested in 2021 | EPC not calculable; N=3 [range: 0.13 – 20.5] | Not calculable as only pups harvested in 2023 |

Notes:
N=sample size (# of samples); max=maximum MeHg concentration.
The baseline period comprised 2010 to 2016.
All EPC units are in mg/kg ww and all EPCS are UCLM95 statistics determined using USEPA ProUCL v5.2 statistical software.
All seal mercury data were measured as THg concentrations (which, in the table, are referred to as MeHg concentrations). For HHRA purposes, it was conservatively assumed that THg measured in seal muscle tissue (meat) was comprised of 100% MeHg, and that THg measured in seal liver was comprised of 40% MeHg.

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It is noted that all brook trout, rainbow smelt and burbot EPCs for the baseline, partial flooding (2017-2020), future peak predicted, and operational year (2021, 2022 and 2023) periods are below the Health Canada maximum level for mercury in fish of 0.5 mg THg/kg ww fish (https://www.canada.ca/en/health-canada/services/food-nutrition/food-safety/chemical-contaminants/maximum-levels-chemical-contaminants-foods.html#a2). In addition, virtually all (only two exceptions) of the individual trout, smelt, and burbot samples reported in the baseline, 2017, 2018, 2019, 2020, 2021, 2022 and 2023 THg datasets [N=1008 for trout; N=469 for smelt; N=121 for burbot] are also below 0.5 mg/kg ww. The two exceptions are: i) the anomalous 2018 smelt sample that contained a THg concentration of 0.95 mg/kg ww; and, ii) one 2023 burbot sample that contained a THg concentration of 0.74 mg/kg ww.

From the EPCs presented in Table 1a,b and in Attachment B (which provides scatter plots of trout, smelt, and ringed seal meat and liver THg EPCs to date, for all years of the aquatic EEM program, from the baseline period to 2023, and including the predicted future peak THg EPCs), some apparent trends appear to be evident for some species (e.g., an apparent slight increasing trend for smelt), but data variability and/or data limitations appear to be obscuring potential THg concentration trends in the other species of interest, where EPCs from some years are higher or lower than those from previous years, with no clear patterns evident in the data. Scatter plots of THg EPCs are not provided at this time for burbot as burbot THg data were not collected in 2017, 2020, 2021 or 2022, and burbot were not included in the future peak estimates, as burbot was not reported to be a significant harvested and consumed species when the future peak modelling work was being conducted (i.e., 2017-2018). Thus, it is not possible to discern year over year trends for burbot with the data presently available.

The trends for seal meat and liver Hg EPCs are obscured by high data variability, and differing proportions of non-pups in different seal Hg datasets from the various monitoring years. Older seals consistently have higher Hg concentrations in both their muscle (meat) tissue and liver tissue, but particularly within their livers. Datasets for monitoring years with higher proportions of older seals have higher Hg EPCs than datasets for monitoring years where all harvested seals were pups.

## 2.1 HHRA Outcomes: Evaluation of 2017-2020 and 2023 MeHg Data

Outcomes of the HHRA of the 2023 (and 2017-2020) MeHg data for brook trout, rainbow smelt, burbot and ringed seal meat and liver generally showed either no change in MeHg hazard quotients relative to the baseline MeHg hazard quotients (the hazard quotient is the primary indicator of potential human health risk in a HHRA), or decreased MeHg hazard quotients relative to the baseline MeHg hazard quotients. Model-predicted hair and blood MeHg concentrations for the assessed human receptors and study area communities followed the same general pattern as the MeHg hazard quotients. Tables 2 to 5 summarize the changes in these key HHRA outcomes based on the assessment of 2023 and 2017-2020 brook trout, rainbow smelt, burbot and ringed seal meat and liver MeHg data, relative to baseline, predicted future peak conditions, 2021 and 2022 HHRA outcomes.

However, in two of the partial flooding years (2017 and 2019), baseline hazard quotient values were slightly exceeded in Happy Valley-Goose Bay (HVGB) and North West River/Mud Lake (NWR/ML) for some human receptor types (i.e., 2019 male and female toddler, male and female teen (male teen in

NWR/ML only though), and infant with teen mother; and, 2017 male and female child, male and female adult, female teen (HVGB only), infant with adult mother, and infant with teen mother (in NWR/ML only)). The higher MeHg hazard quotients in these years for these receptors did not exceed the corresponding future peak MeHg hazard quotient values for these same receptor types. In Sheshatshiu, monitoring year hazard quotients have not exceeded the baseline hazard quotients in any year from 2017 to 2023. This is primarily due to seal not being a common dietary item in this community; thus, the changes in MeHg exposure since baseline are largely a function of differing Hg levels in brook trout and rainbow smelt.

The higher hazard quotients in 2017 and 2019 in HVGB and NWR/ML are attributed to higher ringed seal liver and/or meat THg concentrations in these monitoring years, relative to baseline and other monitoring years, that are due to a higher number of adult (non-pup) seals being included in the seal harvest during those years. As these higher seal liver and meat concentrations occurred during pre-operation partial flooding years, it is considered highly unlikely that the elevated Hg levels in seals in 2017 and 2019 represent an effect of the Project, as increased Hg levels in top predators in a complex estuarine ecosystem is well known to take many years to become measurable or observable. Rather, the 2017 and 2019 seal Hg levels appear to be due to naturally high variability in seal Hg concentrations and is clearly influenced by higher proportions of adult seals in 2017 and 2019 relative to other years. It is difficult to directly attribute ringed seal Hg levels in any year of the Project to date, and in any future year of the Project, to being an effect of the Project. Ringed seals can have very large foraging ranges and their range size changes as a function of age, developmental stage, changes to availability of preferred prey/food resources, and habitat conditions (particularly ice presence and thickness). Limited seal telemetry data for lake Melville (N=7) indicates that Lake Melville seals (classified as only adults or subadults) may spend 36% to 100% of their time in Lake Melville (Brown et al., 2023). However, little can be inferred directly from these observations given the small sample size, the limited duration of the tracking study (roughly 4 to 9 months for the tagged Lake Melville seals), and the limited age categorization. It is known that ringed seal foraging ranges can span hundreds of kilometres and can vary considerably by individual and as a function of local changes to availability of food resources and preferred ice and habitat conditions (Natureserve Explorer; https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.101700/Pusa_hispida).

The HHRA of the 2023 and 2017-2020 MeHg data does not alter any of the conclusions made within the baseline HHRA, and the results presented in Tables 2 to 5 should be considered in the same context and perspective that was provided in the final baseline HHRA report (i.e., Dillon, 2016b).

Specifically, the HHRA outcomes suggest a low to negligible potential for human health risk resulting from MeHg exposures in any year of the aquatic EEM program, and the calculated MeHg exposures and risks are similar to what would be expected in numerous communities in North America where food consumption patterns comprise the ingestion of both store-bought foods and country food items that are of aquatic origin. HHRA outcomes also do not indicate a need for corrective action or risk management, such as specific consumption advisories, at this time. However, standard precautionary recommendations as per those made in Dillon (2016b) and Dillon (2018) continue to be considered prudent to apply. For example, despite the conservatism and the high likelihood that the HHRA substantially overestimates MeHg exposures and risks to nursing mothers, breast-feeding infants, females of child-bearing age and the developing fetus, standard universal advice that pregnant women, nursing mothers and women of child-bearing age avoid, restrict or temporarily cease their consumption

of certain country and store-bought food items that tend to be elevated in MeHg, is prudent, and should apply within the study area communities. It must be recognized that this well-established precautionary advice applies to pregnant women, nursing mothers and women of child-bearing age anywhere, and is not made for the study area communities because of baseline HHRA, future predicted peak HHRA, or 2017 to 2023 HHRA outcomes.

It must also be recognized that there are numerous and universally well-established benefits (to both the infant and mother) of breast-feeding, and HHRA outcomes indicate no reason whatsoever for there to be concerns regarding breast-feeding in relation to the levels of MeHg exposure within study area communities. In general, breast-feeding should never be stopped due to fears over chemical exposure unless specifically recommended by a physician. The benefits of breast-feeding far outweigh the potential health risks from chemical exposure in the overwhelmingly vast majority of cases. Given the HHRA outcomes, and recognizing the inherent conservatism and tendency for the HHRA approaches to overestimate exposure and risk, there is no cause for concern in relation to potential infant MeHg exposures that may be incurred via breast-feeding. Thus, any new or soon-to-be mothers within the study area communities should continue to be encouraged to breast-feed their infants and young toddlers, if they are able to. Following the standard universal precautionary measures for MeHg will further reduce what is an already low to negligible potential for significant MeHg exposure and risk.

In addition (as noted previously in Dillon, 2016a,b and Dillon, 2018), it may be prudent to recommend to those study area residents that consume ringed seal meat and liver, that only younger ringed seals (i.e., pups) be harvested for human consumption (as older seals tend to have higher THg and MeHg concentrations in both their muscle and liver tissue). This recommendation was initially made in 2016, during the baseline HHRA period, when Project-related effects could not have occurred. Typically, it is the younger seals that are preferentially harvested (based on information from a number of study area residents who engage in seal harvesting), but encouraging this practice would likely reduce the Hg exposures that may be incurred from seal meat and liver consumption.

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TABLE 2a: SUMMARY OF METHYLMERCURY (MeHg) HAZARD QUOTIENTS (HQs) FOR MUSKRAT FALLS STUDY AREA EXPOSURE/CONPSUMPTION SCENARIOS (COMMUNITIES) – BASELINE, POTENTIAL FUTURE PEAK CONDITIONS, 2017-2020, 2021, 2022, 2023: HAPPY VALLEY-GOOSE BAY (HVGB)

| Human Receptor Type | HQ Type | Baseline | Potential Future Peak | 2017 (partial flooding) | 2018 (partial flooding) | 2019 (partial flooding) | 2020 (partial flooding) | 2021(op.) | 2022 (op.) | 2023 (op.) |
|---|---|---|---|---|---|---|---|---|---|---|
| M Toddler | HQ1 | 1.3 | 1.39 | 1.1 | 1.1 | 1.34 | 1.1 | 1.1 | 1.1 | 1.1 |
| | HQ2 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | HQ3 | 0.64 | 0.69 | 0.57 | 0.56 | 0.67 | 0.56 | 0.53 | 0.53 | 0.54 |
| M Child | HQ1 | 1.5 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | HQ2 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | HQ3 | 0.77 | 0.8 | 0.8 | 0.73 | 0.75 | 0.75 | 0.73 | 0.74 | 0.73 |
| M Teen | HQ1 | 1.2 | 1.2 | 1.2 | 1.1 | 1.2 | 1.1 | 0.99 | 1.0 | 1.0 |
| | HQ2 | 0.25 | 0.26 | 0.25 | 0.22 | 0.25 | 0.23 | 0.21 | 0.21 | 0.21 |
| | HQ3 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| M Adult | HQ1 | 2.5 | 2.6 | 3.0 | 2.4 | 2.5 | 2.4 | 2.1 | 2.3 | 2.2 |
| | HQ2 | 0.53 | 0.55 | 0.64 | 0.51 | 0.53 | 0.51 | 0.45 | 0.48 | 0.46 |
| | HQ3 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| F Toddler | HQ1 | 1.4 | 1.5 | 1.2 | 1.2 | 1.4 | 1.2 | 1.1 | 1.1 | 1.2 |
| | HQ2 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | HQ3 | 0.68 | 0.74 | 0.60 | 0.60 | 0.72 | 0.60 | 0.57 | 0.56 | 0.58 |
| F Child | HQ1 | 1.6 | 1.7 | 1.7 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | HQ2 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | HQ3 | 0.79 | 0.83 | 0.82 | 0.76 | 0.77 | 0.77 | 0.75 | 0.76 | 0.75 |
| F Teen | HQ1 | 1.3 | 1.4 | 1.3 | 1.2 | 1.3 | 1.2 | 1.1 | 1.1 | 1.1 |
| | HQ2 | 0.28 | 0.29 | 0.28 | 0.25 | 0.29 | 0.26 | 0.24 | 0.24 | 0.24 |
| | HQ3 | 0.65 | 0.69 | 0.66 | 0.60 | 0.67 | 0.60 | 0.56 | 0.57 | 0.57 |
| F Adult | HQ1 | 3.0 | 3.1 | 3.6 | 2.9 | 2.9 | 2.8 | 2.6 | 2.7 | 2.6 |

| Human Receptor Type | HQ Type | Baseline | Potential Future Peak | 2017 (partial flooding) | 2018 (partial flooding) | 2019 (partial flooding) | 2020 (partial flooding) | 2021(op.) | 2022 (op.) | 2023 (op.) |
|---|---|---|---|---|---|---|---|---|---|---|
| | HQ2 | 0.63 | 0.66 | 0.77 | 0.61 | 0.63 | 0.60 | 0.54 | 0.57 | 0.55 |
| | HQ3 | 1.5 | 1.6 | 1.8 | 1.4 | 1.5 | 1.4 | 1.3 | 1.3 | 1.3 |
| Infant with F Teen Mother | HQ1 | 2.6 | 2.7 | 2.6 | 2.3 | 2.6 | 2.4 | 2.2 | 2.2 | 2.2 |
| | HQ3 | 1.3 | 1.4 | 1.3 | 1.2 | 1.3 | 1.2 | 1.1 | 1.1 | 1.1 |
| Infant with F Adult Mother | HQ1 | 5.8 | 6.1 | 7.1 | 5.6 | 5.8 | 5.5 | 5.0 | 5.3 | 5.0 |
| | HQ3 | 2.9 | 3.1 | 3.5 | 2.8 | 2.9 | 2.8 | 2.5 | 2.6 | 2.5 |

Notes:
M=Male; F=Female; 'op.' denotes operational year of the Muskrat Falls Project; 'partial flooding' indicates the years where the reservoir was not fully inundated and power generation was not yet occurring.
HQ values are rounded to two significant figures. HQ values are unitless.
Bolded values indicate exceedance of target HQ value of 1.0.
HQ1 refers to HQ based on use of the U.S. EPA (2001a,b) and NRC (2000) TRV (See Dillon, 2016b).
HQ2 refers to HQ based on use of the Health Canada (2010c; 2007) TRV for the general adult population (See Dillon, 2016b). This TRV was also applied to M and F teen receptors (>12 to <20 years).
HQ3 refers to HQ based on use of the Health Canada (2010c; 2007) TRV for women of child-bearing age (considered to be both teen and adult life stages) and children <12 years of age (See Dillon, 2016b).
NA=not applicable for a given receptor; due to application of the gender and age-specific TRVs for MeHg from Health Canada.

TABLE 2b: SUMMARY OF METHYLMERCURY (MeHg) HAZARD QUOTIENTS (HQs) FOR MUSKRAT FALLS STUDY AREA EXPOSURE/CONSUMPTION SCENARIOS (COMMUNITIES) – BASELINE, POTENTIAL FUTURE PEAK CONDITIONS, 2017-2020, 2021, 2022, 2023: SHESHATSHIU (SH)

| Human Receptor Type | HQ Type | Baseline | Potential Future Peak | 2017 (partial flooding) | 2018 (partial flooding) | 2019 (partial flooding) | 2020 (partial flooding) | 2021 (op.) | 2022 (op.) | 2023 (op.) |
|---|---|---|---|---|---|---|---|---|---|---|
| M Toddler | HQ1 | 1.0 | 1.1 | 0.97 | 0.98 | 0.97 | 0.98 | 1.0 | 0.97 | 0.98 |
| | HQ2 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | HQ3 | 0.50 | 0.53 | 0.49 | 0.49 | 0.48 | 0.49 | 0.50 | 0.48 | 0.49 |
| M Child | HQ1 | 1.4 | 1.5 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| | HQ2 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | HQ3 | 0.71 | 0.73 | 0.70 | 0.70 | 0.69 | 0.70 | 0.70 | 0.70 | 0.70 |
| M Teen | HQ1 | 0.95 | 0.97 | 0.93 | 0.93 | 0.93 | 0.93 | 0.94 | 0.93 | 0.93 |
| | HQ2 | 0.20 | 0.21 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| | HQ3 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| M Adult | HQ1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 |
| | HQ2 | 0.44 | 0.45 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 | 0.44 |
| | HQ3 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| F Toddler | HQ1 | 1.1 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 1.0 | 1.0 |
| | HQ2 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | HQ3 | 0.54 | 0.56 | 0.52 | 0.52 | 0.52 | 0.52 | 0.53 | 0.52 | 0.52 |
| F Child | HQ1 | 1.5 | 1.5 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| | HQ2 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | HQ3 | 0.73 | 0.76 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 |
| F Teen | HQ1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| | HQ2 | 0.23 | 0.23 | 0.23 | 0.23 | 0.22 | 0.23 | 0.23 | 0.23 | 0.23 |
| | HQ3 | 0.54 | 0.55 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 |
| F Adult | HQ1 | 2.5 | 2.5 | 2.5 | 2.5 | 2.4 | 2.5 | 2.5 | 2.5 | 2.5 |
| | HQ2 | 0.53 | 0.54 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 |
| | HQ3 | 1.2 | 1.3 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |

| Human Receptor Type | HQ Type | Baseline | Potential Future Peak | 2017 (partial flooding) | 2018 (partial flooding) | 2019 (partial flooding) | 2020 (partial flooding) | 2021 (op.) | 2022 (op.) | 2023 (op.) |
|---|---|---|---|---|---|---|---|---|---|---|
| Infant with F Teen Mother | HQ1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 |
| | HQ3 | 1.1 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Infant with F Adult Mother | HQ1 | 4.9 | 5.0 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 |
| | HQ3 | 2.4 | 2.5 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |

Notes:
M=Male; F=Female; 'op.' denotes operational year of the Muskrat Falls Project; 'partial flooding' indicates the years where the reservoir was not fully inundated and power generation was not yet occurring.
HQ values are rounded to two significant figures. HQ values are unitless.
Bolded values indicate exceedance of target HQ value of 1.0.
HQ1 refers to HQ based on use of the U.S. EPA (2001a,b) and NRC (2000) TRV (See Dillon, 2016b).
HQ2 refers to HQ based on use of the Health Canada (2010c; 2007) TRV for the general adult population (See Dillon, 2016b). This TRV was also applied to M and F teen receptors (>12 to <20 years).
HQ3 refers to HQ based on use of the Health Canada (2010c; 2007) TRV for women of child-bearing age (considered to be both teen and adult life stages) and children <12 years of age (See Dillon, 2016b).
NA=not applicable for a given receptor; due to application of the gender and age-specific TRVs for MeHg from Health Canada.

TABLE 2c: SUMMARY OF METHYLMERCURY (MeHg) HAZARD QUOTIENTS (HQs) FOR MUSKRAT FALLS STUDY AREA EXPOSURE/CONSUMPTION SCENARIOS (COMMUNITIES) – BASELINE, POTENTIAL FUTURE PEAK CONDITIONS, 2017-2020, 2021, 2022, 2023: NORTHWEST RIVER (NWR) AND MUD LAKE (ML)

| Human Receptor Type | HQ Type | Baseline | Potential Future Peak | 2017 (partial flooding) | 2018 (partial flooding) | 2019 (partial flooding) | 2020 (partial flooding) | 2021 (op.) | 2022 (op.) | 2023 (op.) |
|---|---|---|---|---|---|---|---|---|---|---|
| M Toddler | HQ1 | 1.5 | 1.7 | 1.4 | 1.4 | 1.6 | 1.4 | 1.3 | 1.3 | 1.3 |
| | HQ2 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | HQ3 | 0.77 | 0.82 | 0.7 | 0.69 | 0.80 | 0.7 | 0.66 | 0.66 | 0.67 |
| M Child | HQ1 | 1.6 | 1.7 | 1.7 | 1.5 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 |
| | HQ2 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | HQ3 | 0.80 | 0.83 | 0.83 | 0.77 | 0.78 | 0.78 | 0.76 | 0.77 | 0.76 |
| M Teen | HQ1 | 1.2 | 1.3 | 1.2 | 1.1 | 1.2 | 1.1 | 1.0 | 1.0 | 1.0 |
| | HQ2 | 0.25 | 0.27 | 0.26 | 0.23 | 0.26 | 0.23 | 0.22 | 0.22 | 0.22 |
| | HQ3 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| M Adult | HQ1 | 2.5 | 2.7 | 3.1 | 2.4 | 2.5 | 2.4 | 2.2 | 2.3 | 2.2 |
| | HQ2 | 0.54 | 0.57 | 0.65 | 0.52 | 0.53 | 0.51 | 0.46 | 0.49 | 0.47 |
| | HQ3 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| F Toddler | HQ1 | 1.6 | 1.8 | 1.5 | 1.5 | 1.7 | 1.5 | 1.4 | 1.4 | 1.4 |
| | HQ2 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | HQ3 | 0.82 | 0.88 | 0.74 | 0.74 | 0.86 | 0.74 | 0.71 | 0.70 | 0.72 |
| F Child | HQ1 | 1.7 | 1.7 | 1.7 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 |
| | HQ2 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | HQ3 | 0.83 | 0.86 | 0.86 | 0.79 | 0.80 | 0.80 | 0.78 | 0.79 | 0.78 |
| F Teen | HQ1 | 1.4 | 1.4 | 1.4 | 1.2 | 1.4 | 1.2 | 1.2 | 1.2 | 1.2 |
| | HQ2 | 0.29 | 0.30 | 0.29 | 0.26 | 0.30 | 0.27 | 0.25 | 0.25 | 0.25 |
| | HQ3 | 0.68 | 0.71 | 0.68 | 0.62 | 0.70 | 0.63 | 0.58 | 0.60 | 0.59 |
| F Adult | HQ1 | 3.0 | 3.2 | 3.7 | 2.9 | 3.0 | 2.9 | 2.6 | 2.7 | 2.6 |
| | HQ2 | 0.64 | 0.68 | 0.78 | 0.62 | 0.64 | 0.61 | 0.55 | 0.58 | 0.56 |
| | HQ3 | 1.5 | 1.6 | 1.8 | 1.5 | 1.5 | 1.4 | 1.3 | 1.4 | 1.3 |

| Human Receptor Type | HQ Type | Baseline | Potential Future Peak | 2017 (partial flooding) | 2018 (partial flooding) | 2019 (partial flooding) | 2020 (partial flooding) | 2021 (op.) | 2022 (op.) | 2023 (op.) |
|---|---|---|---|---|---|---|---|---|---|---|
| Infant with F Teen Mother | HQ1 | 2.6 | 2.8 | 2.7 | 2.4 | 2.7 | 2.4 | 2.3 | 2.3 | 2.3 |
| | HQ3 | 1.3 | 1.4 | 1.3 | 1.2 | 1.4 | 1.2 | 1.1 | 1.2 | 1.2 |
| Infant with F Adult Mother | HQ1 | 5.9 | 6.2 | 7.1 | 5.7 | 5.9 | 5.6 | 5.1 | 5.4 | 5.1 |
| | HQ3 | 2.9 | 3.1 | 3.6 | 2.8 | 2.9 | 2.8 | 2.5 | 2.7 | 2.6 |

Notes:
M=Male; F=Female; 'op.' denotes operational year of the Muskrat Falls Project; 'partial flooding' indicates the years where the reservoir was not fully inundated and power generation was not yet occurring.
HQ values are rounded to two significant figures. HQ values are unitless.
Bolded values indicate exceedance of target HQ value of 1.0.
HQ1 refers to HQ based on use of the U.S. EPA (2001a,b) and NRC (2000) TRV (See Dillon, 2016b).
HQ2 refers to HQ based on use of the Health Canada (2010c; 2007) TRV for the general adult population (See Dillon, 2016b). This TRV was also applied to M and F teen receptors (>12 to <20 years).
HQ3 refers to HQ based on use of the Health Canada (2010c; 2007) TRV for women of child-bearing age (considered to be both teen and adult life stages) and children <12 years of age (See Dillon, 2016b).
NA=not applicable for a given receptor; due to application of the gender and age-specific TRVs for MeHg from Health Canada.

TABLE 3a: SUMMARY OF PREDICTED HAIR MeHg CONCENTRATIONS (mg/kg ww) FOR HUMAN RECEPTORS ASSESSED IN THE HHRA – BASELINE, POTENTIAL FUTURE PEAK CONDITIONS, 2017-2020, 2021, 2022, 2023: HAPPY VALLEY-GOOSE BAY (HVGB)

| Receptor | Baseline | Potential Future Peak | 2017 (partial flooding) | 2018 (partial flooding) | 2019 (partial flooding) | 2020 (partial flooding) | 2021 (op.) | 2022 (op.) | 2023 (op.) |
|---|---|---|---|---|---|---|---|---|---|
| M Toddler | 1.4 | 1.6 | 1.3 | 1.3 | 1.5 | 1.3 | 1.2 | 1.2 | 1.2 |
| M Child | 1.7 | 1.8 | 1.8 | 1.7 | 1.7 | 1.7 | 1.6 | 1.7 | 1.7 |
| M Teen | 1.3 | 1.4 | 1.3 | 1.2 | 1.3 | 1.2 | 1.1 | 1.1 | 1.1 |
| M Adult | 2.8 | 3.0 | 3.4 | 2.7 | 2.8 | 2.7 | 2.4 | 2.6 | 2.4 |
| F Toddler | 1.5 | 1.7 | 1.4 | 1.3 | 1.6 | 1.4 | 1.3 | 1.3 | 1.3 |
| F Child | 1.8 | 1.9 | 1.9 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 |
| F Teen | 1.5 | 1.6 | 1.5 | 1.4 | 1.5 | 1.4 | 1.3 | 1.3 | 1.3 |
| F Adult | 3.4 | 3.5 | 4.1 | 3.2 | 3.3 | 3.2 | 2.9 | 3.0 | 2.9 |
| Pregnant F Teen | 1.0 | 1.1 | 1.0 | 0.9 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 |
| Pregnant F Adult | 2.3 | 2.5 | 2.8 | 2.3 | 2.3 | 2.2 | 2.0 | 2.1 | 2.0 |

Notes:
M=Male; F=Female; 'op.' denotes operational year of the Muskrat Falls Project; 'partial flooding' indicates the years where the reservoir was not fully inundated and power generation was not yet occurring.
Bolded values denote an exceedance over the applicable "no action" Health Canada hair guidance value(s) for THg/MeHg (2 mg/kg ww for pregnant F; F 0-49 yrs; M≤18 yrs; and, 5 mg/kg ww for F≥50 yrs; M >18 yrs).

TABLE 3b: SUMMARY OF PREDICTED HAIR MeHg CONCENTRATIONS (mg/kg ww) FOR HUMAN RECEPTORS ASSESSED IN THE HHRA – BASELINE, POTENTIAL FUTURE PEAK CONDITIONS, 2017-2020, 2021, 2022, 2023: SHESHATSHIU (SH)

| Receptor | Baseline | Potential Future Peak | 2017 (partial flooding) | 2018 (partial flooding) | 2019 (partial flooding) | 2020 (partial flooding) | 2021 (op.) | 2022 (op.) | 2023 (op.) |
|---|---|---|---|---|---|---|---|---|---|
| M Toddler | 1.1 | 1.2 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| M Child | 1.6 | 1.7 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 |
| M Teen | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| M Adult | 2.4 | 2.4 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| F Toddler | 1.2 | 1.3 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| F Child | 1.7 | 1.7 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 |
| F Teen | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| F Adult | 2.8 | 2.9 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 |
| Pregnant F Teen | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Pregnant F Adult | 2.0 | 2.0 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |

Notes:
M=Male; F=Female; 'op.' denotes operational year of the Muskrat Falls Project; 'partial flooding' indicates the years where the reservoir was not fully inundated and power generation was not yet occurring.
Bolded values denote an exceedance over the applicable "no action" Health Canada hair guidance value(s) for THg/MeHg (2 mg/kg ww for pregnant F; F 0-49 yrs; M≤18 yrs; and, 5 mg/kg ww for F≥50 yrs; M >18 yrs).

TABLE 3c: SUMMARY OF PREDICTED HAIR MeHg CONCENTRATIONS (mg/kg ww) FOR HUMAN RECEPTORS ASSESSED IN THE HHRA – BASELINE, POTENTIAL FUTURE PEAK CONDITIONS, 2017-2020,2021, 2022, 2023: NORTHWEST RIVER (NWR) AND MUD LAKE (ML)

| Receptor | Baseline | Potential Future Peak | 2017 (partial flooding) | 2018 (partial flooding) | 2019 (partial flooding) | 2020 (partial flooding) | 2021 (op.) | 2022 (op.) | 2023 (op.) |
|---|---|---|---|---|---|---|---|---|---|
| M Toddler | 1.7 | 1.9 | 1.6 | 1.6 | 1.8 | 1.6 | 1.5 | 1.5 | 1.5 |
| M Child | 1.8 | 1.9 | 1.9 | 1.7 | 1.8 | 1.8 | 1.7 | 1.7 | 1.7 |
| M Teen | 1.3 | 1.4 | 1.4 | 1.2 | 1.4 | 1.2 | 1.2 | 1.2 | 1.2 |
| M Adult | 2.9 | 3.0 | 3.5 | 2.8 | 2.8 | 2.7 | 2.5 | 2.6 | 2.5 |
| F Toddler | 1.9 | 2.0 | 1.7 | 1.7 | 1.9 | 1.7 | 1.6 | 1.6 | 1.6 |
| F Child | 1.9 | 1.9 | 1.9 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| F Teen | 1.5 | 1.6 | 1.5 | 1.4 | 1.6 | 1.4 | 1.3 | 1.3 | 1.3 |
| F Adult | 3.4 | 3.6 | 4.1 | 3.3 | 3.4 | 3.3 | 2.9 | 3.1 | 3.0 |
| Pregnant F Teen | 1.0 | 1.1 | 1.0 | 1.0 | 1.1 | 1.0 | 0.9 | 0.9 | 0.9 |
| Pregnant F Adult | 2.4 | 2.5 | 2.9 | 2.3 | 2.4 | 2.3 | 2.1 | 2.2 | 2.1 |

Notes:
M=Male; F=Female; 'op.' denotes operational year of the Muskrat Falls Project; 'partial flooding' indicates the years where the reservoir was not fully inundated and power generation was not yet occurring.
Bolded values denote an exceedance over the applicable "no action" Health Canada hair guidance value(s) for THg/MeHg (2 mg/kg ww for pregnant F; F 0-49 yrs; M≤18 yrs; and, 5 mg/kg ww for F≥50 yrs; M >18 yrs).

TABLE 4a: SUMMARY OF PREDICTED BLOOD MeHg CONCENTRATIONS (µg/L) FOR HUMAN RECEPTORS ASSESSED IN THE HHRA – BASELINE, POTENTIAL FUTURE PEAK CONDITIONS, 2017-2020, 2021, 2022, 2023: HAPPY VALLEY-GOOSE BAY (HVGB)

| Receptor | Baseline | Potential Future Peak | 2017 (partial flooding) | 2018 (partial flooding) | 2019 (partial flooding) | 2020 (partial flooding) | 2021 (op.) | 2022 (op.) | 2023 (op.) |
|---|---|---|---|---|---|---|---|---|---|
| M Toddler | 5.8 | 6.3 | 5.1 | 5.1 | 6.1 | 5.1 | 4.8 | 4.8 | 4.9 |
| M Child | 7.0 | 7.3 | 7.3 | 6.6 | 6.8 | 6.8 | 6.6 | 6.7 | 6.6 |
| M Teen | 5.2 | 5.5 | 5.2 | 4.8 | 5.4 | 4.8 | 4.5 | 4.6 | 4.6 |
| M Adult | 11.2 | 11.8 | 13.7 | 10.8 | 11.2 | 10.7 | 9.7 | 10.2 | 9.8 |
| F Toddler | 6.2 | 6.7 | 5.5 | 5.4 | 6.5 | 5.5 | 5.1 | 5.1 | 5.2 |
| F Child | 7.2 | 7.5 | 7.5 | 6.8 | 6.9 | 7.0 | 6.8 | 6.9 | 6.8 |
| F Teen | 5.9 | 6.3 | 6.0 | 5.4 | 6.1 | 5.5 | 5.1 | 5.2 | 5.2 |
| F Adult | 13.4 | 14.1 | 16.3 | 12.9 | 13.3 | 12.8 | 11.5 | 12.2 | 11.7 |
| Pregnant F Teen | 4.0 | 4.3 | 4.1 | 3.7 | 4.1 | 3.7 | 3.5 | 3.5 | 3.5 |
| Pregnant F Adult | 9.4 | 9.9 | 11.4 | 9.0 | 9.3 | 8.9 | 8.1 | 8.5 | 8.1 |

Notes:
M=Male; F=Female; 'op.' denotes operational year of the Muskrat Falls Project; 'partial flooding' indicates the years where the reservoir was not fully inundated and power generation was not yet occurring.
Bolded values denote an exceedance over the applicable "no action" Health Canada blood guidance value(s) for MeHg (8 µg/L for pregnant F; F 0-49 yrs; M≤18 yrs; and, 20 µg/L for F≥50 yrs; M>18 yrs).

TABLE 4b: SUMMARY OF PREDICTED BLOOD MeHg CONCENTRATIONS (µg/L) FOR HUMAN RECEPTORS ASSESSED IN THE HHRA – BASELINE, POTENTIAL FUTURE PEAK CONDITIONS, 2017-2020, 2021, 2022, 2023: SHESHATSHIU (SH)

| Receptor | Baseline | Potential Future Peak | 2017 (partial flooding) | 2018 (partial flooding) | 2019 (partial flooding) | 2020 (partial flooding) | 2021 (op.) | 2022 (op.) | 2023 (op.) |
|---|---|---|---|---|---|---|---|---|---|
| M Toddler | 4.6 | 4.8 | 4.4 | 4.4 | 4.4 | 4.4 | 4.5 | 4.4 | 4.4 |
| M Child | 6.5 | 6.6 | 6.3 | 6.3 | 6.3 | 6.3 | 6.4 | 6.3 | 6.3 |
| M Teen | 4.3 | 4.4 | 4.2 | 4.2 | 4.2 | 4.2 | 4.3 | 4.2 | 4.2 |
| M Adult | 9.4 | 9.6 | 9.3 | 9.3 | 9.3 | 9.3 | 9.4 | 9.3 | 9.3 |
| F Toddler | 4.9 | 5.1 | 4.7 | 4.7 | 4.7 | 4.7 | 4.8 | 4.7 | 4.7 |
| F Child | 6.6 | 6.8 | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 |
| F Teen | 4.9 | 5.0 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 |
| F Adult | 11.3 | 11.5 | 11.1 | 11.1 | 11.1 | 11.1 | 11.2 | 11.1 | 11.1 |
| Pregnant F Teen | 3.3 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 |
| Pregnant F Adult | 7.9 | 8.0 | 7.7 | 7.7 | 7.7 | 7.8 | 7.8 | 7.8 | 7.8 |

Notes:
M=Male; F=Female; 'op.' denotes operational year of the Muskrat Falls Project; 'partial flooding' indicates the years where the reservoir was not fully inundated and power generation was not yet occurring.
Bolded values denote an exceedance over the applicable "no action" Health Canada blood guidance value(s) for MeHg (8 µg/L for pregnant F; F 0-49 yrs; M≤18 yrs; and, 20 µg/L for F≥50 yrs; M>18 yrs).

TABLE 4c: SUMMARY OF PREDICTED BLOOD MeHg CONCENTRATIONS (µg/L) FOR HUMAN RECEPTORS ASSESSED IN THE HHRA – BASELINE, POTENTIAL FUTURE PEAK CONDITIONS, 2017-2020, 2021, 2022, 2023: NORTHWEST RIVER (NWR) AND MUD LAKE (ML)

| Receptor | Baseline | Potential Future Peak | 2017 (partial flooding) | 2018 (partial flooding) | 2019 (partial flooding) | 2020 (partial flooding) | 2021 (op.) | 2022 (op.) | 2023 (op.) |
|---|---|---|---|---|---|---|---|---|---|
| M Toddler | 7.0 | 7.5 | 6.3 | 6.2 | 7.3 | 6.3 | 6.0 | 5.9 | 6.1 |
| M Child | 7.3 | 7.6 | 7.5 | 6.9 | 7.0 | 7.1 | 6.9 | 7.0 | 6.9 |
| M Teen | 5.4 | 5.7 | 5.4 | 5.0 | 5.5 | 5.0 | 4.7 | 4.7 | 4.7 |
| M Adult | 11.4 | 12 | 13.9 | 11.0 | 11.4 | 10.9 | 9.9 | 10.4 | 9.9 |
| F Toddler | 7.5 | 8.0 | 6.7 | 6.7 | 7.8 | 6.7 | 6.4 | 6.3 | 6.5 |
| F Child | 7.5 | 7.8 | 7.8 | 7.1 | 7.2 | 7.3 | 7.1 | 7.2 | 7.1 |
| F Teen | 6.1 | 6.5 | 6.2 | 5.6 | 6.3 | 5.7 | 5.3 | 5.4 | 5.4 |
| F Adult | 13.6 | 14.4 | 16.6 | 13.2 | 13.6 | 13.0 | 11.8 | 12.4 | 11.9 |
| Pregnant F Teen | 4.2 | 4.4 | 4.2 | 3.8 | 4.3 | 3.9 | 3.6 | 3.7 | 3.7 |
| Pregnant F Adult | 9.5 | 10 | 11.5 | 9.2 | 9.5 | 9.1 | 8.2 | 8.7 | 8.3 |

Notes:
M=Male; F=Female; 'op.' denotes operational year of the Muskrat Falls Project; 'partial flooding' indicates the years where the reservoir was not fully inundated and power generation was not yet occurring.
Bolded values denote an exceedance over the applicable "no action" Health Canada blood guidance value(s) for MeHg (8 µg/L for pregnant F; F 0-49 yrs; M≤18 yrs; and, 20 µg/L for F≥50 yrs; M>18 yrs).

TABLE 5: SUMMARY OF PREDICTED FETAL BLOOD MeHg CONCENTRATIONS (µg/L) – BASELINE, POTENTIAL FUTURE PEAK CONDITIONS, 2017-2020, 2021, 2022, 2023

| Community | Predicted Fetal Blood Concentration (µg/L) Based on Pregnant Female Teen | Predicted Fetal Blood Concentration (µg/L) Based on Pregnant Female Adult |
|---|---|---|
| Happy Valley-Goose Bay (HVGB) | | |
| Baseline | 6.9 | 15.9 |
| Potential Future Peak | 7.2 | 16.8 |
| 2017 (partial flooding) | 6.9 | 19.4 |
| 2018 (partial flooding) | 6.3 | 15.3 |
| 2019 (partial flooding) | 7.1 | 15.8 |
| 2020 (partial flooding) | 6.3 | 15.2 |
| 2021 (op.) | 5.9 | 13.7 |
| 2022 (op.) | 6.0 | 14.4 |
| 2023 (op.) | 6.0 | 13.8 |
| Sheshatshiu (SH) | | |
| Baseline | 5.6 | 13.4 |
| Potential Future Peak | 5.8 | 13.6 |
| 2017 (partial flooding) | 5.5 | 13.2 |
| 2018 (partial flooding) | 5.5 | 13.2 |
| 2019 (partial flooding) | 5.5 | 13.1 |
| 2020 (partial flooding) | 5.6 | 13.2 |
| 2021 (op.) | 5.6 | 13.2 |
| 2022 (op.) | 5.5 | 13.2 |
| 2023 (op.) | 5.6 | 13.2 |

| Community | Predicted Fetal Blood Concentration (µg/L) Based on Pregnant Female Teen | Predicted Fetal Blood Concentration (µg/L) Based on Pregnant Female Adult |
|---|---|---|
| North West River (NWR) and Mud Lake (ML) | | |
| Baseline | 7.1 | 16.2 |
| Potential Future Peak | 7.5 | 17 |
| 2017 (partial flooding) | 7.1 | 19.6 |
| 2018 (partial flooding) | 6.5 | 15.6 |
| 2019 (partial flooding) | 7.3 | 16.1 |
| 2020 (partial flooding) | 6.6 | 15.5 |
| 2021 (op.) | 6.1 | 13.9 |
| 2022 (op.) | 6.2 | 14.7 |
| 2023 (op.) | 6.2 | 14.1 |

Notes:
'op.' denotes operational year of the Muskrat Falls Project; 'partial flooding' indicates the years where the reservoir was not fully inundated and power generation was not yet occurring.
Bolded concentrations exceed the Health Canada (Legrand et al., 2010) "no action" blood guidance value of 8 µg/L. Health Canada considers that <8 µg/L of MeHg in maternal blood is protective of the developing fetus as well as infants and young and older children (up to adolescence).

# MEMO

## 3.0 Uncertainties, Limitations and Conservative Assumptions

As described in detail previously in the baseline HHRA report (Dillon, 2016b), due to a number of uncertainties and data variability, the HHRA methodology and model utilize many conservative assumptions and approaches, which result in highly conservative and protective HHRA outcomes that intentionally overestimate human exposure to MeHg and inorganic Hg within the Muskrat Falls study area communities, by what is believed to be a substantial degree. In any HHRA, the magnitude of hazard quotient values (and other HHRA outcomes) must be balanced against the conservative assumptions and approaches used to estimate exposure and risk, as well as against the other LOEs evaluated in the HHRA. Intentionally overestimating exposure and risk is a common and necessary feature of all HHRAs, and is in keeping with a number of standard regulatory precautionary approaches and guiding principles used routinely in risk assessments and environmental impact assessments.

Section 4.0 of the baseline HHRA report (Dillon, 2016b) describes the key uncertainties, limitations and conservative assumptions in the overall HHRA methodology and model that has been used since the baseline period, and which continues to be applied. The status of these uncertainties and limitations, and their impact on HHRA outcomes, remains unchanged. However, one key current source of uncertainty is that the consumption rates and frequencies applied within the HHRA model remain based on 2014-2015 diet survey outcomes in the study area communities. Since roughly 10 years have elapsed since these surveys were conducted, it is possible that 2014-2015 diet survey outcomes no longer adequately represent current country food harvesting and consumption patterns (particularly with respect to fish and seal) within the Muskrat Falls study area communities. It is noted that planning is in progress for some communities and/or Indigenous organizations within the study area to conduct new or updated dietary surveys. These new surveys may yield outcomes that could inform the HHRA program and help ensure that consumption rates and frequencies utilized in the HHRA program for local country foods are accurate and representative of current dietary patterns within the study area communities.

This source of uncertainty was originally noted in the baseline HHRA (Dillon, 2016b) where it was acknowledged that there was uncertainty associated with the outcomes of the baseline diet surveys, and that future follow-up dietary surveys may be necessary to refine estimates of country food consumption patterns among the study area communities, and/or to account for potential future changes to study area country food consumption patterns.

## 4.0 References Cited

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# Attachment A: 2017-2020 and 2023 Brook Trout, Rainbow Smelt, Burbot and Ringed Seal (Meat and Liver) Data Summaries and Statistical Output

2017 Brook Trout THg Data

| year | section | area | species | length | st_length | thg |
|---|---|---|---|---|---|---|
| 2017 | 0 | GB | BK | 447 | 250 | 0.18 |
| 2017 | 0 | GB | BK | 270 | 250 | 0.05 |
| 2017 | 0 | GB | BK | 250 | 250 | 0.06 |
| 2017 | 0 | GB | BK | 243 | 250 | 0.02 |
| 2017 | 0 | GB | BK | 257 | 250 | 0.08 |
| 2017 | 0 | GB | BK | 256 | 250 | 0.08 |
| 2017 | 0 | GB | BK | 300 | 250 | 0.1 |
| 2017 | 0 | GB | BK | 292 | 250 | 0.07 |
| 2017 | 0 | GB | BK | 245 | 250 | 0.05 |
| 2017 | 0 | GB | BK | 153 | 250 | 0.02 |
| 2017 | 0 | LM | BK | 487 | 250 | 0.02 |
| 2017 | 0 | LM | BK | 433 | 250 | 0.02 |
| 2017 | 0 | LM | BK | 345 | 250 | 0.04 |
| 2017 | 0 | LM | BK | 329 | 250 | 0.02 |
| 2017 | 0 | LM | BK | 338 | 250 | 0.03 |
| 2017 | 0 | LM | BK | 362 | 250 | 0.04 |
| 2017 | 0 | LM | BK | 410 | 250 | 0.06 |
| 2017 | 0 | LM | BK | 338 | 250 | 0.02 |
| 2017 | 0 | LM | BK | 348 | 250 | 0.03 |
| 2017 | 0 | LM | BK | 318 | 250 | 0.02 |
| 2017 | 0 | LM | BK | 327 | 250 | 0.03 |
| 2017 | 0 | LM | BK | 391 | 250 | 0.07 |
| 2017 | 0 | LM | BK | 318 | 250 | 0.02 |
| 2017 | 0 | LM | BK | 332 | 250 | 0.04 |
| 2017 | 0 | LM | BK | 472 | 250 | 0.06 |
| 2017 | 0 | LM | BK | 276 | 250 | 0.02 |
| 2017 | 0 | LM | BK | 330 | 250 | 0.03 |
| 2017 | 0 | LM | BK | 308 | 250 | 0.04 |
| 2017 | 0 | LM | BK | 269 | 250 | 0.02 |
| 2017 | 0 | LM | BK | 235 | 250 | 0.02 |
| 2017 | 0 | LM | BK | 217 | 250 | 0.02 |
| 2017 | 0 | LM | BK | 206 | 250 | 0.05 |
| 2017 | 0 | LM | BK | 330 | 250 | 0.12 |
| 2017 | 0 | LM | BK | 307 | 250 | 0.02 |
| 2017 | 0 | LM | BK | 346 | 250 | 0.09 |
| 2017 | 0 | LM | BK | 334 | 250 | 0.07 |
| 2017 | 0 | LM | BK | 270 | 250 | 0.05 |
| 2017 | 0 | OM | BK | 342 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 367 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 241 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 323 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 319 | 250 | 0.06 |
| 2017 | 0 | OM | BK | 227 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 297 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 235 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 173 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 400 | 250 | 0.1 |
| 2017 | 0 | OM | BK | 272 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 269 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 265 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 256 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 278 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 268 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 284 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 241 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 222 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 235 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 245 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 220 | 250 | 0.05 |
| 2017 | 0 | OM | BK | 220 | 250 | 0.03 |
| 2017 | 0 | OM | BK | 328 | 250 | 0.03 |
| 2017 | 0 | OM | BK | 263 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 277 | 250 | 0.02 |
| 2017 | 0 | OM | BK | 322 | 250 | 0.06 |
| 2017 | 1 | BM | BK | 125 | 250 | 0.02 |
| 2017 | 1 | BM | BK | 138 | 250 | 0.02 |
| 2017 | 1 | BM | BK | 143 | 250 | 0.03 |

## 2017 BROOK TROUT THg DATA (mg THg/kg ww fish)

Summary Statistics (Excel)

| | | |
|---|---|---|
| N | 106 | Correlation Coefficient (length vs THg) |
| min | 0.02 (<0.02) | 0.46546 |
| max | 0.18 | |
| arithmean | 0.03 | |
| median | 0.02 | |
| # nd | 56 | |
| freq. nd (%) | 52.83019 | |

ProUCL 5.2 Summary Statistics

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/24/2024 11:20:32 AM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 106 | 0 | 0.02 | 0.18 | 0.034811 | 0.029131 | 0.026122 | 0.002537 | 0 | 2.604849 | 0.75038 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 106 | 0 | 0.02 | 0.02 | 0.02 | 0.02 | 0.04 | 0.05 | 0.07 | 0.08 | 0.119 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/24/2024 11:21:52 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| Raw Statistics | |
|---|---|
| Number of Valid Observations | 106 |
| Number of Distinct Observations | 11 |
| Minimum | 0.02 |
| Maximum | 0.18 |
| Mean of Raw Data | 0.034811 |
| Standard Deviation of Raw Data | 0.026122 |
| Khat | 2.962984 |
| Theta hat | 0.011749 |
| Kstar | 2.885416 |
| Theta star | 0.012065 |
| Mean of Log Transformed Data | -3.53595 |
| Standard Deviation of Log Transformed Data | 0.544079 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.792323 |
| Approximate Shapiro Wilk Test Statistic | 0.645646 |
| Approximate Shapiro Wilk P Value | 0 |
| Lilliefors Test Statistic | 0.31842 |
| Lilliefors Critical (0.0500000) Value | 0.086338 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | | | | | |
|---|---|---|---|---|---|
| 2017 | 1 BM | BK | 216 | 250 | 0.02 |
| 2017 | 1 BM | BK | 227 | 250 | 0.03 |
| 2017 | 1 BM | BK | 249 | 250 | 0.02 |
| 2017 | 1 BM | BK | 173 | 250 | 0.02 |
| 2017 | 1 BM | BK | 215 | 250 | 0.02 |
| 2017 | 1 BM | BK | 211 | 250 | 0.02 |
| 2017 | 1 BM | BK | 224 | 250 | 0.02 |
| 2017 | 1 BM | BK | 210 | 250 | 0.02 |
| 2017 | 1 BM | BK | 242 | 250 | 0.02 |
| 2017 | 1 BM | BK | 200 | 250 | 0.02 |
| 2017 | 1 BM | BK | 243 | 250 | 0.03 |
| 2017 | 1 BM | BK | 227 | 250 | 0.02 |
| 2017 | 1 BM | BK | 262 | 250 | 0.02 |
| 2017 | 1 BM | BK | 220 | 250 | 0.02 |
| 2017 | 1 BM | BK | 175 | 250 | 0.02 |
| 2017 | 1 BM | BK | 192 | 250 | 0.02 |
| 2017 | 1 BM | BK | 262 | 250 | 0.02 |
| 2017 | 1 BM | BK | 207 | 250 | 0.02 |
| 2017 | 1 BM | BK | 147 | 250 | 0.02 |
| 2017 | 1 BM | BK | 171 | 250 | 0.02 |
| 2017 | 1 BM | BK | 175 | 250 | 0.02 |
| 2017 | 1 BM | BK | 286 | 250 | 0.02 |
| 2017 | 1 BM | BK | 286 | 250 | 0.03 |
| 2017 | 1 BM | BK | 290 | 250 | 0.07 |
| 2017 | 1 BM | BK | 181 | 250 | 0.02 |
| 2017 | 1 BM | BK | 404 | 250 | 0.05 |
| 2017 | 1 BM | BK | 243 | 250 | 0.02 |
| 2017 | 1 BM | BK | 274 | 250 | 0.02 |
| 2017 | 1 BM | BK | 284 | 250 | 0.02 |
| 2017 | 1 BM | BK | 170 | 250 | 0.03 |
| 2017 | 1 BM | BK | 442 | 250 | 0.07 |
| 2017 | 1 BM | BK | 365 | 250 | 0.07 |
| 2017 | 1 BM | BK | 260 | 250 | 0.04 |
| 2017 | 1 BM | BK | 273 | 250 | 0.02 |
| 2017 | 1 BM | BK | 288 | 250 | 0.02 |
| 2017 | 1 BM | BK | 352 | 250 | 0.07 |
| 2017 | 1 BM | BK | 282 | 250 | 0.04 |
| 2017 | 2 AM | BK | 88 | 250 | 0.02 |
| 2017 | 2 AM | BK | 80 | 250 | 0.02 |

Correlation Coefficient R 0.91567
A-D Test Statistic 13.18286
A-D Critical (0.0500000) Value 0.758898
K-S Test Statistic 0.352631
K-S Critical(0.0500000) Value 0.08853
Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R 0.852291
Approximate Shapiro Wilk Test Statistic 0.715972
Approximate Shapiro Wilk P Value 0
Lilliefors Test Statistic 0.359056
Lilliefors Critical (0.0500000) Value 0.086338
Data not Lognormal at (0.0500000) Significance Level

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

UCL Statistics for Uncensored Full Data Sets

User Selected Options
Date/Time of Computation ProUCL 5.2 6/24/2024 11:22:57 AM
From File WorkSheet.xls
Full Precision ON
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 106 | Number of Distinct Observations | 11 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.02 | Mean | 0.034811 |
| Maximum | 0.18 | Median | 0.02 |
| SD | 0.026122 | Std. Error of Mean | 0.002537 |
| Coefficient of Variation | 0.75038 | Skewness | 2.604849 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.645646 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk P Value | 0 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.31842 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.099843 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.039022 | 95% Adjusted-CLT UCL (Chen-1995) | 0.039671 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.039129 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 13.18286 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.758898 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.352631 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.08853 | Data Not Gamma Distributed at 5% Significance Level | |

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.962984 | k star (bias corrected MLE) | 2.885416 |
| Theta hat (MLE) | 0.011749 | Theta star (bias corrected MLE) | 0.012065 |
| nu hat (MLE) | 628.1527 | nu star (bias corrected) | 611.7081 |
| MLE Mean (bias corrected) | 0.034811 | MLE Sd (bias corrected) | 0.020494 |
| | | Approximate Chi Square Value (0.05) | 555.3347 |
| Adjusted Level of Significance | 0.047736 | Adjusted Chi Square Value | 554.6019 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.038345 | 95% Adjusted Gamma UCL | 0.038396 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.715972 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk P Value | 0 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.359056 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.079006 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -3.91202 | Mean of logged Data | -3.53595 |
| Maximum of Logged Data | -1.7148 | SD of logged Data | 0.544079 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.037281 | 90% Chebyshev (MVUE) UCL | 0.039421 |
| 95% Chebyshev (MVUE) UCL | 0.042001 | 97.5% Chebyshev (MVUE) UCL | 0.045582 |
| 99% Chebyshev (MVUE) UCL | 0.052617 | | |

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | | |
|---|---|---|---|---|
| | | | | Selected UCL is arithmetic mean of non-parametric UCL estimates, where alpha=0.05: |
| 95% CLT UCL | 0.038985 | 95% BCA Bootstrap UCL | 0.039623 | 0.040364 |
| 95% Standard Bootstrap UCL | 0.03901 | 95% Bootstrap-t UCL | 0.039845 | |
| 95% Hall's Bootstrap UCL | 0.04016 | 95% Percentile Bootstrap UCL | 0.039057 | |
| 90% Chebyshev(Mean, Sd) UCL | 0.042423 | 95% Chebyshev(Mean, Sd) UCL | 0.045871 | |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.050656 | 99% Chebyshev(Mean, Sd) UCL | 0.060056 | |

Suggested UCL to Use

| | | |
|---|---|---|
| 95% Student's-t UCL | 0.039022 | (rejected as data distribution is non-parametric and student's-t ucl assumes normality) |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| year | section | area | species | length | st_length | thg |
|---|---|---|---|---|---|---|
| 2018 | 0 | GB | BK | 320 | 250 | 0.09 |
| 2018 | 0 | GB | BK | 240 | 250 | 0.01 |
| 2018 | 0 | GB | BK | 258 | 250 | 0.05 |
| 2018 | 0 | GB | BK | 361 | 250 | 0.06 |
| 2018 | 0 | GB | BK | 320 | 250 | 0.01 |
| 2018 | 0 | GB | BK | 344 | 250 | 0.04 |
| 2018 | 0 | GB | BK | 323 | 250 | 0.08 |
| 2018 | 0 | GB | BK | 406 | 250 | 0.07 |
| 2018 | 0 | GB | BK | 276 | 250 | 0.05 |
| 2018 | 0 | GB | BK | 318 | 250 | 0.06 |
| 2018 | 0 | LM | BK | 300 | 250 | 0.08 |
| 2018 | 0 | LM | BK | 213 | 250 | 0.03 |
| 2018 | 0 | LM | BK | 262 | 250 | 0.12 |
| 2018 | 0 | LM | BK | 376 | 250 | 0.08 |
| 2018 | 0 | LM | BK | 327 | 250 | 0.06 |
| 2018 | 0 | LM | BK | 310 | 250 | 0.06 |
| 2018 | 0 | LM | BK | 295 | 250 | 0.04 |
| 2018 | 0 | LM | BK | 285 | 250 | 0.03 |
| 2018 | 0 | LM | BK | 270 | 250 | 0.04 |
| 2018 | 0 | LM | BK | 235 | 250 | 0.04 |
| 2018 | 0 | LM | BK | 319 | 250 | 0.04 |
| 2018 | 0 | LM | BK | 267 | 250 | 0.03 |
| 2018 | 0 | LM | BK | 273 | 250 | 0.03 |
| 2018 | 0 | LM | BK | 325 | 250 | 0.04 |
| 2018 | 0 | LM | BK | 353 | 250 | 0.05 |
| 2018 | 0 | LM | BK | 351 | 250 | 0.06 |
| 2018 | 0 | LM | BK | 376 | 250 | 0.03 |
| 2018 | 0 | LM | BK | 350 | 250 | 0.12 |
| 2018 | 0 | LM | BK | 387 | 250 | 0.07 |
| 2018 | 0 | LM | BK | 343 | 250 | 0.1 |
| 2018 | 0 | LM | BK | 392 | 250 | 0.04 |
| 2018 | 0 | LM | BK | 400 | 250 | 0.09 |
| 2018 | 0 | LM | BK | 359 | 250 | 0.12 |
| 2018 | 0 | LM | BK | 350 | 250 | 0.05 |
| 2018 | 0 | LM | BK | 298 | 250 | 0.04 |
| 2018 | 0 | LM | BK | 300 | 250 | 0.07 |
| 2018 | 0 | LM | BK | 315 | 250 | 0.03 |
| 2018 | 0 | LM | BK | 301 | 250 | 0.04 |
| 2018 | 0 | LM | BK | 364 | 250 | 0.05 |
| 2018 | 0 | LM | BK | 315 | 250 | 0.05 |
| 2018 | 0 | OM | BK | 321 | 250 | 0.01 |
| 2018 | 0 | OM | BK | 367 | 250 | 0.01 |
| 2018 | 0 | OM | BK | 326 | 250 | 0.04 |
| 2018 | 0 | OM | BK | 324 | 250 | 0.15 |
| 2018 | 0 | OM | BK | 398 | 250 | 0.15 |
| 2018 | 0 | OM | BK | 390 | 250 | 0.06 |
| 2018 | 0 | OM | BK | 380 | 250 | 0.04 |
| 2018 | 0 | OM | BK | 320 | 250 | 0.04 |
| 2018 | 0 | OM | BK | 368 | 250 | 0.06 |
| 2018 | 0 | OM | BK | 335 | 250 | 0.04 |
| 2018 | 0 | OM | BK | 351 | 250 | 0.06 |
| 2018 | 0 | OM | BK | 362 | 250 | 0.06 |
| 2018 | 0 | OM | BK | 320 | 250 | 0.04 |
| 2018 | 0 | OM | BK | 362 | 250 | 0.05 |
| 2018 | 0 | OM | BK | 325 | 250 | 0.09 |
| 2018 | 0 | OM | BK | 404 | 250 | 0.1 |
| 2018 | 0 | OM | BK | 425 | 250 | 0.12 |
| 2018 | 0 | OM | BK | 316 | 250 | 0.02 |
| 2018 | 0 | OM | BK | 331 | 250 | 0.06 |
| 2018 | 0 | OM | BK | 345 | 250 | 0.03 |
| 2018 | 0 | OM | BK | 315 | 250 | 0.02 |
| 2018 | 0 | OM | BK | 279 | 250 | 0.05 |
| 2018 | 0 | OM | BK | 236 | 250 | 0.03 |
| 2018 | 0 | OM | BK | 234 | 250 | 0.02 |
| 2018 | 0 | OM | BK | 230 | 250 | 0.02 |
| 2018 | 0 | OM | BK | 238 | 250 | 0.03 |
| 2018 | 0 | OM | BK | 223 | 250 | 0.02 |

## 2018 BROOK TROUT THg DATA (mg THg/kg ww fish)

Summary Statistics (Excel)

| | | | |
|---|---|---|---|
| N | 118 | Correlation Coefficient (length vs THg) | |
| min | 0.01 (<0.01) | | 0.413381 |
| max | 0.20 | | |
| arithmean | 0.04 | | |
| median | 0.03 | | |
| # nd | 30 | | |
| freq. nd (%) | 25.42373 | | |

ProUCL 5.2 Summary Statistics

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/24/2024 12:13:42 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 118 | 0 | 0.01 | 0.2 | 0.042034 | 0.029514 | 0.036387 | 0.00335 | 0.029652 | 1.658061 | 0.865665 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 118 | 0 | 0.01 | 0.01 | 0.01 | 0.03 | 0.06 | 0.06 | 0.09 | 0.12 | 0.15 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/24/2024 12:14:39 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 118 |
| Number of Distinct Observations | 14 |
| Minimum | 0.01 |
| Maximum | 0.2 |
| Mean of Raw Data | 0.042034 |
| Standard Deviation of Raw Data | 0.036387 |
| Khat | 1.55978 |
| Theta hat | 0.026949 |
| Kstar | 1.525774 |
| Theta star | 0.027549 |
| Mean of Log Transformed Data | -3.52288 |
| Standard Deviation of Log Transformed Data | 0.864758 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.903378 |
| Approximate Shapiro Wilk Test Statistic | 0.815046 |
| Approximate Shapiro Wilk P Value | 0 |
| Lilliefors Test Statistic | 0.189332 |
| Lilliefors Critical (0.0500000) Value | 0.081891 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.99069 |

| | | | | | |
|---|---|---|---|---|---|
| 2018 | 0 OM | BK | 343 | 250 | 0.03 |
| 2018 | 0 OM | BK | 206 | 250 | 0.04 |
| 2018 | 0 OM | BK | 440 | 250 | 0.01 |
| 2018 | 1 BM | BK | 85 | 250 | 0.01 |
| 2018 | 1 BM | BK | 108 | 250 | 0.01 |
| 2018 | 1 BM | BK | 114 | 250 | 0.01 |
| 2018 | 1 BM | BK | 219 | 250 | 0.02 |
| 2018 | 1 BM | BK | 80 | 250 | 0.01 |
| 2018 | 1 BM | BK | 111 | 250 | 0.01 |
| 2018 | 1 BM | BK | 155 | 250 | 0.01 |
| 2018 | 1 BM | BK | 156 | 250 | 0.01 |
| 2018 | 1 BM | BK | 176 | 250 | 0.01 |
| 2018 | 1 BM | BK | 256 | 250 | 0.01 |
| 2018 | 1 BM | BK | 172 | 250 | 0.01 |
| 2018 | 1 BM | BK | 180 | 250 | 0.03 |
| 2018 | 1 BM | BK | 177 | 250 | 0.03 |
| 2018 | 1 BM | BK | 203 | 250 | 0.01 |
| 2018 | 1 BM | BK | 185 | 250 | 0.01 |
| 2018 | 1 BM | BK | 217 | 250 | 0.02 |
| 2018 | 1 BM | BK | 290 | 250 | 0.01 |
| 2018 | 1 BM | BK | 142 | 250 | 0.05 |
| 2018 | 1 BM | BK | 256 | 250 | 0.2 |
| 2018 | 1 BM | BK | 199 | 250 | 0.05 |
| 2018 | 1 BM | BK | 213 | 250 | 0.01 |
| 2018 | 1 BM | BK | 175 | 250 | 0.03 |
| 2018 | 1 BM | BK | 283 | 250 | 0.01 |
| 2018 | 1 BM | BK | 235 | 250 | 0.14 |
| 2018 | 1 BM | BK | 201 | 250 | 0.01 |
| 2018 | 1 BM | BK | 162 | 250 | 0.04 |
| 2018 | 1 BM | BK | 130 | 250 | 0.02 |
| 2018 | 1 BM | BK | 199 | 250 | 0.03 |
| 2018 | 1 BM | BK | 122 | 250 | 0.1 |
| 2018 | 1 BM | BK | 239 | 250 | 0.04 |
| 2018 | 1 BM | BK | 228 | 250 | 0.01 |
| 2018 | 1 BM | BK | 242 | 250 | 0.01 |
| 2018 | 1 BM | BK | 195 | 250 | 0.01 |
| 2018 | 1 BM | BK | 248 | 250 | 0.01 |
| 2018 | 1 BM | BK | 306 | 250 | 0.01 |
| 2018 | 1 BM | BK | 177 | 250 | 0.01 |
| 2018 | 1 BM | BK | 351 | 250 | 0.01 |
| 2018 | 1 BM | BK | 280 | 250 | 0.01 |
| 2018 | 1 BM | BK | 80 | 250 | 0.01 |
| 2018 | 1 BM | BK | 315 | 250 | 0.01 |
| 2018 | 1 BM | BK | 228 | 250 | 0.01 |
| 2018 | 1 BM | BK | 199 | 250 | 0.01 |
| 2018 | 1 BM | BK | 185 | 250 | 0.01 |
| 2018 | 1 BM | BK | 173 | 250 | 0.01 |
| 2018 | 1 BM | BK | 266 | 250 | 0.01 |
| 2018 | 2 AM | BK | 144 | 250 | 0.02 |
| 2018 | 2 AM | BK | 172 | 250 | 0.01 |
| 2018 | 2 AM | BK | 133 | 250 | 0.07 |

A-D Test Statistic 3.475229
A-D Critical (0.0500000) Value 0.769491
K-S Test Statistic 0.190529
K-S Critical(0.0500000) Value 0.086328
Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R 0.95058
Approximate Shapiro Wilk Test Statistic 0.876223
Approximate Shapiro Wilk P Value 1.20E-14
Lilliefors Test Statistic 0.208192
Lilliefors Critical (0.0500000) Value 0.081891
Data not Lognormal at (0.0500000) Significance Level

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

UCL Statistics for Uncensored Full Data Sets

User Selected Options
Date/Time of Computation ProUCL 5.2 6/24/2024 12:15:50 PM
From File WorkSheet.xls
Full Precision ON
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 118 | Number of Distinct Observations | 14 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.042034 |
| Maximum | 0.2 | Median | 0.03 |
| SD | 0.036387 | Std. Error of Mean | 0.00335 |
| Coefficient of Variation | 0.865665 | Skewness | 1.658061 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.815046 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk P Value | 0 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.189332 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.094701 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.047588 | 95% Adjusted-CLT UCL (Chen-1995) | 0.04809 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.047673 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 3.475229 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.769491 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.190529 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.086328 | Data Not Gamma Distributed at 5% Significance Level | |

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.55978 | k star (bias corrected MLE) | 1.525774 |
| Theta hat (MLE) | 0.026949 | Theta star (bias corrected MLE) | 0.027549 |
| nu hat (MLE) | 368.108 | nu star (bias corrected) | 360.0826 |
| MLE Mean (bias corrected) | 0.042034 | MLE Sd (bias corrected) | 0.034029 |
| | | Approximate Chi Square Value (0.05) | 317.1074 |
| Adjusted Level of Significance | 0.047966 | Adjusted Chi Square Value | 316.6135 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.04773 | 95% Adjusted Gamma UCL | 0.047805 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.876223 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk P Value | 1.20E-14 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.208192 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.074937 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -3.52288 |
| Maximum of Logged Data | -1.60944 | SD of logged Data | 0.864758 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.050742 | 90% Chebyshev (MVUE) UCL | 0.05451 |
| 95% Chebyshev (MVUE) UCL | 0.059855 | 97.5% Chebyshev (MVUE) UCL | 0.067273 |
| 99% Chebyshev (MVUE) UCL | 0.081844 | | |

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | | |
|---|---|---|---|---|
| | | | | Selected UCL is arithmetic mean of non-parametric UCL estimates, where alpha=0.05: |
| 95% CLT UCL | 0.047544 | 95% BCA Bootstrap UCL | 0.047966 | |
| 95% Standard Bootstrap UCL | 0.047542 | 95% Bootstrap-t UCL | 0.048502 | 0.04921 |
| 95% Hall's Bootstrap UCL | 0.048569 | 95% Percentile Bootstrap UCL | 0.047712 | |
| 90% Chebyshev(Mean, Sd) UCL | 0.052083 | 95% Chebyshev(Mean, Sd) UCL | 0.056635 | |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.062953 | 99% Chebyshev(Mean, Sd) UCL | 0.075363 | |

Suggested UCL to Use

| | | |
|---|---|---|
| 95% Student's-t UCL | 0.047588 | (rejected as data distribution is non-parametric and student's-t ucl assumes normality) |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| year | section | area | species | length | st_length | thg |
|---|---|---|---|---|---|---|
| 2019 | 0 | GB | BK | 282 | 250 | 0.09 |
| 2019 | 0 | GB | BK | 270 | 250 | 0.11 |
| 2019 | 0 | GB | BK | 245 | 250 | 0.06 |
| 2019 | 0 | GB | BK | 231 | 250 | 0.08 |
| 2019 | 0 | GB | BK | 225 | 250 | 0.05 |
| 2019 | 0 | GB | BK | 204 | 250 | 0.05 |
| 2019 | 0 | LM | BK | 210 | 250 | 0.02 |
| 2019 | 0 | LM | BK | 254 | 250 | 0.03 |
| 2019 | 0 | OM | BK | 330 | 250 | 0.01 |
| 2019 | 0 | OM | BK | 218 | 250 | 0.01 |
| 2019 | 0 | OM | BK | 235 | 250 | 0.01 |
| 2019 | 0 | OM | BK | 205 | 250 | 0.01 |
| 2019 | 0 | OM | BK | 235 | 250 | 0.01 |
| 2019 | 0 | OM | BK | 234 | 250 | 0.01 |
| 2019 | 0 | OM | BK | 227 | 250 | 0.01 |
| 2019 | 0 | OM | BK | 376 | 250 | 0.02 |
| 2019 | 0 | OM | BK | 396 | 250 | 0.01 |
| 2019 | 0 | OM | BK | 362 | 250 | 0.04 |
| 2019 | 0 | OM | BK | 376 | 250 | 0.03 |
| 2019 | 0 | OM | BK | 355 | 250 | 0.03 |
| 2019 | 0 | OM | BK | 333 | 250 | 0.01 |
| 2019 | 0 | OM | BK | 418 | 250 | 0.01 |
| 2019 | 0 | LM | BK | 298 | 250 | 0.02 |
| 2019 | 0 | LM | BK | 286 | 250 | 0.03 |
| 2019 | 0 | LM | BK | 255 | 250 | 0.04 |
| 2019 | 0 | LM | BK | 274 | 250 | 0.04 |
| 2019 | 0 | LM | BK | 264 | 250 | 0.03 |
| 2019 | 0 | LM | BK | 273 | 250 | 0.03 |
| 2019 | 0 | LM | BK | 260 | 250 | 0.03 |
| 2019 | 0 | LM | BK | 237 | 250 | 0.02 |
| 2019 | 0 | LM | BK | 226 | 250 | 0.03 |
| 2019 | 0 | LM | BK | 258 | 250 | 0.03 |
| 2019 | 0 | LM | BK | 231 | 250 | 0.02 |
| 2019 | 0 | LM | BK | 252 | 250 | 0.02 |
| 2019 | 0 | LM | BK | 258 | 250 | 0.03 |
| 2019 | 0 | LM | BK | 245 | 250 | 0.02 |
| 2019 | 0 | LM | BK | 243 | 250 | 0.02 |
| 2019 | 0 | LM | BK | 246 | 250 | 0.02 |
| 2019 | 0 | LM | BK | 248 | 250 | 0.03 |
| 2019 | 0 | LM | BK | 216 | 250 | 0.03 |
| 2019 | 0 | LM | BK | 277 | 250 | 0.03 |
| 2019 | 0 | LM | BK | 140 | 250 | 0.02 |
| 2019 | 0 | LM | BK | 125 | 250 | 0.02 |
| 2019 | 0 | LM | BK | 205 | 250 | 0.04 |
| 2019 | 0 | LM | BK | 197 | 250 | 0.02 |
| 2019 | 0 | LM | BK | 126 | 250 | 0.02 |
| 2019 | 0 | LM | BK | 170 | 250 | 0.03 |
| 2019 | 0 | LM | BK | 186 | 250 | 0.04 |
| 2019 | 0 | LM | BK | 239 | 250 | 0.04 |
| 2019 | 1 | BM | BK | 101 | 250 | 0.01 |
| 2019 | 1 | BM | BK | 240 | 250 | 0.12 |
| 2019 | 1 | BM | BK | 247 | 250 | 0.04 |
| 2019 | 1 | BM | BK | 281 | 250 | 0.05 |
| 2019 | 1 | BM | BK | 84 | 250 | 0.03 |
| 2019 | 1 | BM | BK | 220 | 250 | 0.06 |
| 2019 | 1 | BM | BK | 132 | 250 | 0.03 |
| 2019 | 1 | BM | BK | 147 | 250 | 0.03 |
| 2019 | 1 | BM | BK | 222 | 250 | 0.11 |
| 2019 | 1 | BM | BK | 145 | 250 | 0.02 |
| 2019 | 1 | BM | BK | 126 | 250 | 0.03 |
| 2019 | 1 | BM | BK | 199 | 250 | 0.02 |
| 2019 | 1 | BM | BK | 174 | 250 | 0.03 |
| 2019 | 1 | BM | BK | 273 | 250 | 0.08 |
| 2019 | 1 | BM | BK | 184 | 250 | 0.02 |
| 2019 | 1 | BM | BK | 222 | 250 | 0.06 |
| 2019 | 1 | BM | BK | 261 | 250 | 0.09 |
| 2019 | 1 | BM | BK | 190 | 250 | 0.11 |

## 2019 BROOK TROUT THg DATA (mg THg/kg ww fish)

Summary Statistics (Excel)

| | | |
|---|---|---|
| N | 72 | Correlation Coefficient (length vs THg) |
| min | 0.01 (<0.01) | 0.036154 |
| max | 0.12 | |
| arithmean | 0.04 | |
| median | 0.03 | |
| # nd | 9 | |
| freq. nd (%) | 12.5 | |

ProUCL 5.2 Summary Statistics

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/24/2024 12:28:00 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67! | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 72 | 0 | 0.01 | 0.12 | 0.035 | 0.027671 | 0.02659 | 0.003134 | 0.014826 | 1.696779 | 0.759722 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 72 | 0 | 0.01 | 0.02 | 0.02 | 0.03 | 0.04 | 0.048 | 0.078 | 0.099 | 0.1129 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/24/2024 12:28:47 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 72 |
| Number of Distinct Observations | 10 |
| Minimum | 0.01 |
| Maximum | 0.12 |
| Mean of Raw Data | 0.035 |
| Standard Deviation of Raw Data | 0.02659 |
| Khat | 2.280744 |
| Theta hat | 0.015346 |
| Kstar | 2.194972 |
| Theta star | 0.015946 |
| Mean of Log Transformed Data | -3.58737 |
| Standard Deviation of Log Transformed Data | 0.679556 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.885941 |
| Approximate Shapiro Wilk Test Statistic | 0.776699 |
| Approximate Shapiro Wilk P Value | 4.89E-15 |
| Lilliefors Test Statistic | 0.269021 |
| Lilliefors Critical (0.0500000) Value | 0.104396 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.966261 |

| | | | | | |
|---|---|---|---|---|---|
| 2019 | 1 BM | BK | 242 | 250 | 0.02 |
| 2019 | 1 BM | BK | 145 | 250 | 0.01 |
| 2019 | 1 BM | BK | 178 | 250 | 0.06 |
| 2019 | 1 BM | BK | 175 | 250 | 0.01 |
| 2019 | 1 BM | BK | 125 | 250 | 0.02 |

| | |
|---|---|
| A-D Test Statistic | 2.259355 |
| A-D Critical (0.0500000) Value | 0.761769 |
| K-S Test Statistic | 0.19518 |
| K-S Critical(0.0500000) Value | 0.106256 |
| Data not Gamma Distributed at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.967521 |
| Approximate Shapiro Wilk Test Statistic | 0.91288 |
| Approximate Shapiro Wilk P Value | 3.34E-05 |
| Lilliefors Test Statistic | 0.147114 |
| Lilliefors Critical (0.0500000) Value | 0.104396 |
| Data not Lognormal at (0.0500000) Significance Level | |

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/24/2024 12:30:17 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 72 | Number of Distinct Observations | 10 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.035 |
| Maximum | 0.12 | Median | 0.03 |
| SD | 0.02659 | Std. Error of Mean | 0.003134 |
| Coefficient of Variation | 0.759722 | Skewness | 1.696779 |

Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.776699 | Shapiro Wilk GOF Test |
| 1% Shapiro Wilk P Value | 4.89E-15 | Data Not Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.269021 | Lilliefors GOF Test |
| 1% Lilliefors Critical Value | 0.120727 | Data Not Normal at 1% Significance Level |
| Data Not Normal at 1% Significance Level | | |

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.040223 | 95% Adjusted-CLT UCL (Chen-1995) | 0.040824 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.040327 |

Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 2.259355 | Anderson-Darling Gamma GOF Test |
| 5% A-D Critical Value | 0.761769 | Data Not Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.19518 | Kolmogorov-Smirnov Gamma GOF Test |
| 5% K-S Critical Value | 0.106256 | Data Not Gamma Distributed at 5% Significance Level |
| Data Not Gamma Distributed at 5% Significance Level | | |

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.280744 | k star (bias corrected MLE) | 2.194972 |
| Theta hat (MLE) | 0.015346 | Theta star (bias corrected MLE) | 0.015946 |
| nu hat (MLE) | 328.4272 | nu star (bias corrected) | 316.076 |
| MLE Mean (bias corrected) | 0.035 | MLE Sd (bias corrected) | 0.023624 |
| | | Approximate Chi Square Value (0.05) | 275.8879 |
| Adjusted Level of Significance | 0.046667 | Adjusted Chi Square Value | 275.1261 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.040098 | 95% Adjusted Gamma UCL | 0.040209 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.91288 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk P Value | 3.34E-05 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.147114 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.095531 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -3.58737 |
| Maximum of Logged Data | -2.12026 | SD of logged Data | 0.679556 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.040871 | 90% Chebyshev (MVUE) UCL | 0.043858 |
| 95% Chebyshev (MVUE) UCL | 0.047997 | 97.5% Chebyshev (MVUE) UCL | 0.053741 |
| 99% Chebyshev (MVUE) UCL | 0.065024 | | |

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | | |
|---|---|---|---|---|
| | | | | Selected UCL is arithmetic mean of non-parametric UCL estimates, where |
| 95% CLT UCL | 0.040155 | 95% BCA Bootstrap UCL | 0.040556 | alpha=0.05: |
| 95% Standard Bootstrap UCL | 0.040065 | 95% Bootstrap-t UCL | 0.040862 | 0.041602 |
| 95% Hall's Bootstrap UCL | 0.040639 | 95% Percentile Bootstrap UCL | 0.040278 | |
| 90% Chebyshev(Mean, Sd) UCL | 0.044401 | 95% Chebyshev(Mean, Sd) UCL | 0.04866 | |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.05457 | 99% Chebyshev(Mean, Sd) UCL | 0.06618 | |

Suggested UCL to Use

| | | |
|---|---|---|
| 95% Student's-t UCL | 0.040223 | (rejected as data distribution is non-parametric and student's-t ucl assumes normality) |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| year | section | area | species | length | st_length | thg |
|---|---|---|---|---|---|---|
| 2020 | 0 | GB | BK | 249 | 250 | 0.02 |
| 2020 | 0 | GB | BK | 252 | 250 | 0.01 |
| 2020 | 0 | GB | BK | 252 | 250 | 0.03 |
| 2020 | 0 | GB | BK | 235 | 250 | 0.01 |
| 2020 | 0 | GB | BK | 380 | 250 | 0.08 |
| 2020 | 0 | GB | BK | 344 | 250 | 0.1 |
| 2020 | 0 | GB | BK | 292 | 250 | 0.05 |
| 2020 | 0 | GB | BK | 255 | 250 | 0.03 |
| 2020 | 0 | GB | BK | 237 | 250 | 0.02 |
| 2020 | 0 | GB | BK | 288 | 250 | 0.01 |
| 2020 | 0 | GB | BK | 320 | 250 | 0.07 |
| 2020 | 0 | GB | BK | 313 | 250 | 0.07 |
| 2020 | 0 | GB | BK | 195 | 250 | 0.01 |
| 2020 | 0 | GB | BK | 471 | 250 | 0.02 |
| 2020 | 0 | GB | BK | 220 | 250 | 0.03 |
| 2020 | 0 | GB | BK | 215 | 250 | 0.04 |
| 2020 | 0 | GB | BK | 260 | 250 | 0.03 |
| 2020 | 0 | GB | BK | 242 | 250 | 0.04 |
| 2020 | 0 | GB | BK | 292 | 250 | 0.01 |
| 2020 | 0 | GB | BK | 211 | 250 | 0.06 |
| 2020 | 0 | GB | BK | 254 | 250 | 0.01 |
| 2020 | 0 | GB | BK | 240 | 250 | 0.01 |
| 2020 | 0 | GB | BK | 257 | 250 | 0.01 |
| 2020 | 0 | GB | BK | 240 | 250 | 0.08 |
| 2020 | 0 | LM | BK | 238 | 250 | 0.05 |
| 2020 | 0 | LM | BK | 239 | 250 | 0.03 |
| 2020 | 0 | LM | BK | 305 | 250 | 0.06 |
| 2020 | 0 | LM | BK | 293 | 250 | 0.01 |
| 2020 | 0 | LM | BK | 308 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 388 | 250 | 0.02 |
| 2020 | 0 | OM | BK | 329 | 250 | 0.1 |
| 2020 | 0 | OM | BK | 305 | 250 | 0.02 |
| 2020 | 0 | OM | BK | 350 | 250 | 0.07 |
| 2020 | 0 | OM | BK | 280 | 250 | 0.07 |
| 2020 | 0 | OM | BK | 306 | 250 | 0.14 |
| 2020 | 0 | OM | BK | 313 | 250 | 0.09 |
| 2020 | 0 | OM | BK | 300 | 250 | 0.14 |
| 2020 | 0 | OM | BK | 242 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 153 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 333 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 256 | 250 | 0.02 |
| 2020 | 0 | OM | BK | 226 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 230 | 250 | 0.02 |
| 2020 | 0 | OM | BK | 386 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 217 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 243 | 250 | 0.05 |
| 2020 | 0 | OM | BK | 213 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 208 | 250 | 0.03 |
| 2020 | 0 | OM | BK | 228 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 208 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 243 | 250 | 0.04 |
| 2020 | 0 | OM | BK | 216 | 250 | 0.02 |
| 2020 | 0 | OM | BK | 235 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 265 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 264 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 300 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 217 | 250 | 0.01 |
| 2020 | 0 | OM | BK | 244 | 250 | 0.02 |
| 2020 | 0 | OM | BK | 250 | 250 | 0.01 |
| 2020 | 0 | LM | BK | 313 | 250 | 0.06 |
| 2020 | 0 | LM | BK | 315 | 250 | 0.08 |
| 2020 | 0 | LM | BK | 347 | 250 | 0.11 |
| 2020 | 0 | LM | BK | 356 | 250 | 0.05 |
| 2020 | 0 | LM | BK | 322 | 250 | 0.06 |
| 2020 | 0 | LM | BK | 390 | 250 | 0.1 |
| 2020 | 0 | LM | BK | 345 | 250 | 0.08 |
| 2020 | 0 | LM | BK | 311 | 250 | 0.06 |

## 2020 BROOK TROUT THg DATA (mg THg/kg ww fish)

Summary Statistics (Excel)

| | | |
|---|---|---|
| N | 115 | Correlation Coefficient (length vs THg) |
| min | 0.01 (<0.01) | 0.402282 |
| max | 0.14 | |
| arithmean | 0.04 | |
| median | 0.03 | |
| # nd | 23 | |
| freq. nd (%) | 20 | |

ProUCL 5.2 Summary Statistics

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/24/2024 12:53:29 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 115 | 0 | 0.01 | 0.14 | 0.040087 | 0.028187 | 0.033416 | 0.003116 | 0.029652 | 1.167919 | 0.833599 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 115 | 0 | 0.01 | 0.01 | 0.01 | 0.03 | 0.06 | 0.07 | 0.09 | 0.11 | 0.1386 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/24/2024 12:54:17 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| Raw Statistics | |
|---|---|
| Number of Valid Observations | 115 |
| Number of Distinct Observations | 14 |
| Minimum | 0.01 |
| Maximum | 0.14 |
| Mean of Raw Data | 0.040087 |
| Standard Deviation of Raw Data | 0.033416 |
| Khat | 1.565528 |
| Theta hat | 0.025606 |
| Kstar | 1.530485 |
| Theta star | 0.026192 |
| Mean of Log Transformed Data | -3.5689 |
| Standard Deviation of Log Transformed Data | 0.862196 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.919363 |
| Approximate Shapiro Wilk Test Statistic | 0.826488 |
| Approximate Shapiro Wilk P Value | 0 |
| Lilliefors Test Statistic | 0.183963 |
| Lilliefors Critical (0.0500000) Value | 0.082938 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.98378 |

| | | | | | |
|---|---|---|---|---|---|
| 2020 | 0 LM | BK | 270 | 250 | 0.06 |
| 2020 | 0 LM | BK | 362 | 250 | 0.09 |
| 2020 | 0 LM | BK | 240 | 250 | 0.04 |
| 2020 | 0 LM | BK | 281 | 250 | 0.07 |
| 2020 | 0 LM | BK | 277 | 250 | 0.04 |
| 2020 | 0 LM | BK | 264 | 250 | 0.01 |
| 2020 | 0 LM | BK | 378 | 250 | 0.02 |
| 2020 | 0 LM | BK | 273 | 250 | 0.02 |
| 2020 | 0 LM | BK | 248 | 250 | 0.05 |
| 2020 | 0 LM | BK | 235 | 250 | 0.04 |
| 2020 | 0 LM | BK | 291 | 250 | 0.05 |
| 2020 | 0 LM | BK | 317 | 250 | 0.04 |
| 2020 | 0 LM | BK | 264 | 250 | 0.08 |
| 2020 | 0 LM | BK | 260 | 250 | 0.06 |
| 2020 | 0 LM | BK | 261 | 250 | 0.05 |
| 2020 | 0 LM | BK | 260 | 250 | 0.01 |
| 2020 | 1 BM | BK | 330 | 250 | 0.13 |
| 2020 | 1 BM | BK | 205 | 250 | 0.01 |
| 2020 | 1 BM | BK | 133 | 250 | 0.01 |
| 2020 | 1 BM | BK | 181 | 250 | 0.01 |
| 2020 | 1 BM | BK | 272 | 250 | 0.11 |
| 2020 | 1 BM | BK | 237 | 250 | 0.01 |
| 2020 | 1 BM | BK | 207 | 250 | 0.01 |
| 2020 | 1 BM | BK | 186 | 250 | 0.04 |
| 2020 | 1 BM | BK | 231 | 250 | 0.09 |
| 2020 | 1 BM | BK | 218 | 250 | 0.03 |
| 2020 | 1 BM | BK | 221 | 250 | 0.03 |
| 2020 | 1 BM | BK | 177 | 250 | 0.05 |
| 2020 | 1 BM | BK | 309 | 250 | 0.04 |
| 2020 | 1 BM | BK | 149 | 250 | 0.02 |
| 2020 | 1 BM | BK | 277 | 250 | 0.02 |
| 2020 | 1 BM | BK | 225 | 250 | 0.01 |
| 2020 | 1 BM | BK | 274 | 250 | 0.03 |
| 2020 | 1 BM | BK | 217 | 250 | 0.05 |
| 2020 | 1 BM | BK | 176 | 250 | 0.04 |
| 2020 | 1 BM | BK | 207 | 250 | 0.01 |
| 2020 | 1 BM | BK | 207 | 250 | 0.03 |
| 2020 | 1 BM | BK | 259 | 250 | 0.02 |
| 2020 | 1 BM | BK | 208 | 250 | 0.02 |
| 2020 | 1 BM | BK | 177 | 250 | 0.01 |
| 2020 | 1 BM | BK | 159 | 250 | 0.04 |
| 2020 | 1 BM | BK | 314 | 250 | 0.08 |
| 2020 | 1 BM | BK | 209 | 250 | 0.03 |
| 2020 | 1 BM | BK | 177 | 250 | 0.01 |
| 2020 | 1 BM | BK | 223 | 250 | 0.01 |
| 2020 | 1 BM | BK | 240 | 250 | 0.12 |
| 2020 | 1 BM | BK | 290 | 250 | 0.12 |
| 2020 | 1 BM | BK | 126 | 250 | 0.03 |

| | |
|---|---|
| A-D Test Statistic | 3.851646 |
| A-D Critical (0.0500000) Value | 0.769389 |
| K-S Test Statistic | 0.191312 |
| K-S Critical(0.0500000) Value | 0.08711 |

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.947219 |
| Approximate Shapiro Wilk Test Statistic | 0.8651 |
| Approximate Shapiro Wilk P Value | 7.77E-16 |
| Lilliefors Test Statistic | 0.207038 |
| Lilliefors Critical (0.0500000) Value | 0.082938 |

Data not Lognormal at (0.0500000) Significance Level

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/24/2024 12:55:28 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 115 | Number of Distinct Observations | 14 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.040087 |
| Maximum | 0.14 | Median | 0.03 |
| SD | 0.033416 | Std. Error of Mean | 0.003116 |
| Coefficient of Variation | 0.833599 | Skewness | 1.167919 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.826488 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk P Value | 0 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.183963 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.095912 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.045255 | 95% Adjusted-CLT UCL (Chen-1995) | 0.045575 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.045311 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 3.851646 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.769389 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.191312 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.08711 | Data Not Gamma Distributed at 5% Significance Level | |

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.565528 | k star (bias corrected MLE) | 1.530485 |
| Theta hat (MLE) | 0.025606 | Theta star (bias corrected MLE) | 0.026192 |
| nu hat (MLE) | 360.0714 | nu star (bias corrected) | 352.0116 |
| MLE Mean (bias corrected) | 0.040087 | MLE Sd (bias corrected) | 0.032403 |
| | | Approximate Chi Square Value (0.05) | 309.5342 |
| Adjusted Level of Significance | 0.047913 | Adjusted Chi Square Value | 309.0334 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.045588 | 95% Adjusted Gamma UCL | 0.045662 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.8651 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk P Value | 7.77E-16 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.207038 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.075895 | Data Not Lognormal at 10% Significance Level | |
| Data Not Lognormal at 10% Significance Level | | | |

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -3.5689 |
| Maximum of Logged Data | -1.96611 | SD of logged Data | 0.862196 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.048417 | 90% Chebyshev (MVUE) UCL | 0.05204 |
| 95% Chebyshev (MVUE) UCL | 0.057177 | 97.5% Chebyshev (MVUE) UCL | 0.064308 |
| 99% Chebyshev (MVUE) UCL | 0.078316 | | |

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | | |
|---|---|---|---|---|
| | | | | Selected UCL is arithmetic mean of non-parametric UCL estimates, where alpha=0.05: |
| 95% CLT UCL | 0.045213 | 95% BCA Bootstrap UCL | 0.045913 | |
| 95% Standard Bootstrap UCL | 0.045149 | 95% Bootstrap-t UCL | 0.045421 | 0.046568 |
| 95% Hall's Bootstrap UCL | 0.045395 | 95% Percentile Bootstrap UCL | 0.045217 | |
| 90% Chebyshev(Mean, Sd) UCL | 0.049435 | 95% Chebyshev(Mean, Sd) UCL | 0.05367 | |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.059547 | 99% Chebyshev(Mean, Sd) UCL | 0.071092 | |

Suggested UCL to Use

| | | |
|---|---|---|
| 95% Student's-t UCL | 0.045255 | (rejected as data distribution is non-parametric and student's-t ucl assumes normality) |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| year | date | location | section | area | species | length | weight | thg |
|---|---|---|---|---|---|---|---|---|
| 2023 | 2023-08-16 | Mulligan Point | 0 | LM | BK | 222 | 117 | 0.01 |
| 2023 | 2023-08-16 | Mulligan Point | 0 | LM | BK | 257 | 183.1 | 0.01 |
| 2023 | 2023-08-16 | Mulligan Point | 0 | LM | BK | 268 | 204.8 | 0.03 |
| 2023 | 2023-08-16 | Mulligan Point | 0 | LM | BK | 354 | 491.8 | 0.02 |
| 2023 | 2023-08-16 | Mulligan Point | 0 | LM | BK | 288 | 282.5 | 0.02 |
| 2023 | 2023-08-16 | Mulligan Point | 0 | LM | BK | 336 | 439.7 | 0.01 |
| 2023 | 2023-08-16 | Mulligan Point | 0 | LM | BK | 376 | 666.5 | 0.01 |
| 2023 | 2023-08-16 | Mulligan Point | 0 | LM | BK | 350 | 455.7 | 0.02 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | BK | 364 | 645 | 0.02 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | BK | 377 | 610.4 | 0.03 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | BK | 369 | 558.2 | 0.05 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | BK | 402 | 802.1 | 0.05 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | BK | 261 | 186 | 0.03 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | BK | 258 | 165.4 | 0.02 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | BK | 245 | 163 | 0.04 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | BK | 235 | 150 | 0.02 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | BK | 233 | 132.8 | 0.02 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | BK | 270 | 205.8 | 0.05 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | BK | 240 | 128.8 | 0.03 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | BK | 230 | 139.4 | 0.06 |
| 2023 | 2023-08-20 | Mulligan Point | 0 | LM | BK | 273 | 237.6 | 0.08 |
| 2023 | 2023-08-21 | Rabbit Island | 0 | GB | BK | 245 | 145.4 | 0.02 |
| 2023 | 2023-08-22 | Rabbit Island | 0 | GB | BK | 163 | 45.6 | 0.04 |
| 2023 | 2023-08-22 | Rabbit Island | 0 | GB | BK | 232 | 147.8 | 0.09 |
| 2023 | 2023-08-22 | Rabbit Island | 0 | GB | BK | 250 | 164.4 | 0.06 |
| 2023 | 2023-08-22 | Rabbit Island | 0 | GB | BK | 330 | 374 | 0.12 |
| 2023 | 2023-08-22 | Rabbit Island | 0 | GB | BK | 255 | 156.6 | 0.1 |
| 2023 | 2023-08-22 | Rabbit Island | 0 | GB | BK | 230 | 137 | 0.04 |
| 2023 | 2023-08-24 | Rabbit Island | 0 | GB | BK | 255 | 184.4 | 0.05 |
| 2023 | 2023-08-24 | Rabbit Island | 0 | GB | BK | 337 | 383.4 | 0.08 |
| 2023 | 2023-08-24 | Rabbit Island | 0 | GB | BK | 310 | 370.5 | 0.08 |
| 2023 | 2023-08-24 | Rabbit Island | 0 | GB | BK | 324 | 403.5 | 0.08 |
| 2023 | 2023-08-24 | Rabbit Island | 0 | GB | BK | 262 | 194.9 | 0.03 |
| 2023 | 2023-08-24 | Rabbit Island | 0 | GB | BK | 233 | 136.1 | 0.06 |
| 2023 | 2023-08-26 | Trout Cove | 0 | OM | BK | 218 | 120.4 | 0.02 |
| 2023 | 2023-08-26 | Trout Cove | 0 | OM | BK | 225 | 139.8 | 0.03 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 375 | 619.8 | 0.08 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 241 | 140.4 | 0.03 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 282 | 206.3 | 0.02 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 262 | 166.8 | 0.03 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 301 | 250.2 | 0.04 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 480 | | 0.04 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 320 | | 0.09 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 310 | | 0.03 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 335 | | 0.03 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 360 | | 0.02 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 315 | | 0.03 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 330 | | 0.06 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 350 | | 0.04 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 355 | | 0.05 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 300 | | 0.02 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 355 | | 0.04 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 480 | | 0.04 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 500 | | 0.09 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 350 | | 0.06 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 490 | | 0.07 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 365 | | 0.05 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 390 | | 0.08 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 370 | | 0.1 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 370 | | 0.07 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 363 | | 0.08 |
| 2023 | 2023-09-23 | Trout Cove | 0 | OM | BK | 395 | | 0.1 |

## 2023 BROOK TROUT THg DATA (mg THg/kg ww fish)

Summary Statistics (Excel)

| | | |
|---|---|---|
| N | 92 | Correlation Coefficient (length vs THg) |
| min | 0.01 (<0.01) | 0.478942 |
| max | 0.12 | |
| arithmean | 0.04 | |
| median | 0.03 | |
| # nd | 6 | |
| freq. nd (%) | 6.521739 | |

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/25/2024 3:07:37 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 92 | 0 | 0.01 | 0.12 | 0.038804 | 0.030742 | 0.026555 | 0.002769 | 0.014826 | 1.038634 | 0.684321 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1 | 50%ile(Q2 | 75%ile(Q3 | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 92 | 0 | 0.01 | 0.02 | 0.02 | 0.03 | 0.05 | 0.06 | 0.08 | 0.09 | 0.1018 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/25/2024 3:08:24 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 92 |
| Number of Distinct Observations | 11 |
| Minimum | 0.01 |
| Maximum | 0.12 |
| Mean of Raw Data | 0.038804 |
| Standard Deviation of Raw Data | 0.026555 |
| Khat | 2.299798 |
| Theta hat | 0.016873 |
| Kstar | 2.232051 |
| Theta star | 0.017385 |
| Mean of Log Transformed Data | -3.48211 |
| Standard Deviation of Log Transformed Data | 0.702599 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.936636 |
| Approximate Shapiro Wilk Test Statistic | 0.862034 |
| Approximate Shapiro Wilk P Value | 4.44E-12 |
| Lilliefors Test Statistic | 0.205975 |
| Lilliefors Critical (0.0500000) Value | 0.092572 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BK | 225 | 116.6 | 0.03 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BK | 115 | 37.9 | 0.01 |
| 2023 | 2023-09-26 | Mainstem | 1 | BM | BK | 119 | 62.9 | 0.02 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BK | 250 | 130 | 0.04 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BK | 285 | 246.3 | 0.03 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BK | 190 | 66.1 | 0.01 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BK | 280 | 210 | 0.03 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BK | 160 | 38.3 | 0.02 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BK | 200 | 73.9 | 0.02 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BK | 170 | 47 | 0.01 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BK | 190 | 69.6 | 0.01 |
| 2023 | 2023-09-28 | Caroline Brook | 1 | BM | BK | 150 | 36.6 | 0.04 |
| 2023 | 2023-09-28 | Caroline Brook | 1 | BM | BK | 186 | 53 | 0.02 |
| 2023 | 2023-09-29 | Caroline Brook | 1 | BM | BK | 192 | 64.5 | 0.01 |
| 2023 | 2023-09-29 | Caroline Brook | 1 | BM | BK | 218 | 113 | 0.01 |
| 2023 | 2023-09-29 | Caroline Brook | 1 | BM | BK | 181 | 50.9 | 0.01 |
| 2023 | 2023-09-30 | Caroline Brook | 1 | BM | BK | 181 | 57.1 | 0.01 |
| 2023 | 2023-09-30 | Caroline Brook | 1 | BM | BK | 280 | 234.8 | 0.02 |
| 2023 | 2023-09-30 | Caroline Brook | 1 | BM | BK | 241 | 138.8 | 0.03 |
| 2023 | 2023-09-30 | Caroline Brook | 1 | BM | BK | 202 | 79.4 | 0.01 |
| 2023 | 2023-10-01 | Mainstem | 1 | BM | BK | 261 | 184 | 0.02 |
| 2023 | 2023-10-01 | Caroline Brook | 1 | BM | BK | 231 | 104.9 | 0.02 |
| 2023 | 2023-10-01 | Caroline Brook | 1 | BM | BK | 201 | 85.9 | 0.01 |
| 2023 | 2023-10-01 | Caroline Brook | 1 | BM | BK | 222 | 100.7 | 0.02 |
| 2023 | 2023-10-01 | Caroline Brook | 1 | BM | BK | 211 | 89.8 | 0.02 |
| 2023 | 2023-10-01 | Caroline Brook | 1 | BM | BK | 216 | 98 | 0.01 |
| 2023 | 2023-10-02 | Mackenzie River | 1 | BM | BK | 337 | 377.4 | 0.03 |
| 2023 | 2023-10-04 | Mackenzie River | 1 | BM | BK | 260 | 136.6 | 0.06 |
| 2023 | 2023-10-05 | Mackenzie River | 1 | BM | BK | 260 | 181.1 | 0.04 |
| 2023 | 2023-10-06 | Mackenzie River | 1 | BM | BK | 280 | 229.6 | 0.03 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.981841 |
| A-D Test Statistic | 1.797165 |
| A-D Critical (0.0500000) Value | 0.763298 |
| K-S Test Statistic | 0.141121 |
| K-S Critical(0.0500000) Value | 0.094312 |

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.972317 |
| Approximate Shapiro Wilk Test Statistic | 0.917951 |
| Approximate Shapiro Wilk P Value | 3.44E-06 |
| Lilliefors Test Statistic | 0.120997 |
| Lilliefors Critical (0.0500000) Value | 0.092572 |

Data not Lognormal at (0.0500000) Significance Level

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/25/2024 3:09:23 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 92 | Number of Distinct Observations | 11 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.038804 |
| Maximum | 0.12 | Median | 0.03 |
| SD | 0.026555 | Std. Error of Mean | 0.002769 |
| Coefficient of Variation | 0.684321 | Skewness | 1.038634 |

Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.862034 | Shapiro Wilk GOF Test |
| 1% Shapiro Wilk P Value | 4.44E-12 | Data Not Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.205975 | Lilliefors GOF Test |
| 1% Lilliefors Critical Value | 0.107052 | Data Not Normal at 1% Significance Level |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.043405 | 95% Adjusted-CLT UCL (Chen-1995) | 0.043679 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.043455 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 1.797165 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.763298 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.141121 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.094312 | Data Not Gamma Distributed at 5% Significance Level | |

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.299798 | k star (bias corrected MLE) | 2.232051 |
| Theta hat (MLE) | 0.016873 | Theta star (bias corrected MLE) | 0.017385 |
| nu hat (MLE) | 423.1628 | nu star (bias corrected) | 410.6974 |
| MLE Mean (bias corrected) | 0.038804 | MLE Sd (bias corrected) | 0.025973 |
| | | Approximate Chi Square Value (0.05) | 364.72 |
| Adjusted Level of Significance | 0.047391 | Adjusted Chi Square Value | 364.0364 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.043696 | 95% Adjusted Gamma UCL | 0.043778 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.917951 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk P Value | 3.44E-06 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.120997 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.084711 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -3.48211 |
| Maximum of Logged Data | -2.12026 | SD of logged Data | 0.702599 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.045659 | 90% Chebyshev (MVUE) UCL | 0.048737 |
| 95% Chebyshev (MVUE) UCL | 0.053049 | 97.5% Chebyshev (MVUE) UCL | 0.059033 |
| 99% Chebyshev (MVUE) UCL | 0.070788 | | |

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 0.043358 | 95% BCA Bootstrap UCL | 0.043152 | Selected UCL is arithmetic mean of non-parametric UCL estimates, where alpha=0.05: |
| 95% Standard Bootstrap UCL | 0.043249 | 95% Bootstrap-t UCL | 0.043576 | 0.044419 |
| 95% Hall's Bootstrap UCL | 0.043463 | 95% Percentile Bootstrap UCL | 0.043261 | |
| 90% Chebyshev(Mean, Sd) UCL | 0.04711 | 95% Chebyshev(Mean, Sd) UCL | 0.050872 | |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.056094 | 99% Chebyshev(Mean, Sd) UCL | 0.066351 | |

Suggested UCL to Use

| | | |
|---|---|---|
| 95% Student's-t UCL | 0.043405 | (rejected as data distribution is non-parametric and student's-t ucl assumes normality) |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| year | section | area | species | length | st_length | thg |
|---|---|---|---|---|---|---|
| 2017 | 0 | LM | RS | 185 | 150 | 0.08 |
| 2017 | 0 | LM | RS | 139 | 150 | 0.06 |
| 2017 | 0 | LM | RS | 141 | 150 | 0.02 |
| 2017 | 0 | LM | RS | 147 | 150 | 0.02 |
| 2017 | 0 | LM | RS | 127 | 150 | 0.03 |
| 2017 | 0 | LM | RS | 158 | 150 | 0.03 |
| 2017 | 0 | LM | RS | 131 | 150 | 0.04 |
| 2017 | 0 | LM | RS | 141 | 150 | 0.03 |
| 2017 | 0 | LM | RS | 148 | 150 | 0.04 |
| 2017 | 0 | LM | RS | 152 | 150 | 0.03 |
| 2017 | 0 | LM | RS | 136 | 150 | 0.03 |
| 2017 | 0 | LM | RS | 187 | 150 | 0.06 |
| 2017 | 0 | LM | RS | 151 | 150 | 0.05 |
| 2017 | 0 | LM | RS | 139 | 150 | 0.03 |
| 2017 | 0 | LM | RS | 138 | 150 | 0.02 |
| 2017 | 0 | OM | RS | 162 | 150 | 0.03 |
| 2017 | 0 | OM | RS | 179 | 150 | 0.05 |
| 2017 | 0 | OM | RS | 203 | 150 | 0.08 |
| 2017 | 0 | OM | RS | 152 | 150 | 0.04 |
| 2017 | 0 | OM | RS | 191 | 150 | 0.09 |
| 2017 | 0 | OM | RS | 168 | 150 | 0.08 |
| 2017 | 0 | OM | RS | 159 | 150 | 0.03 |
| 2017 | 0 | OM | RS | 156 | 150 | 0.04 |
| 2017 | 0 | OM | RS | 152 | 150 | 0.03 |
| 2017 | 0 | OM | RS | 144 | 150 | 0.03 |
| 2017 | 0 | OM | RS | 185 | 150 | 0.06 |
| 2017 | 0 | OM | RS | 160 | 150 | 0.02 |
| 2017 | 0 | OM | RS | 142 | 150 | 0.05 |
| 2017 | 0 | OM | RS | 146 | 150 | 0.04 |
| 2017 | 0 | OM | RS | 141 | 150 | 0.04 |
| 2017 | 0 | OM | RS | 138 | 150 | 0.03 |
| 2017 | 0 | OM | RS | 133 | 150 | 0.03 |
| 2017 | 0 | OM | RS | 134 | 150 | 0.03 |
| 2017 | 0 | OM | RS | 134 | 150 | 0.03 |
| 2017 | 0 | OM | RS | 136 | 150 | 0.05 |

## 2017 RAINBOW SMELT THg DATA (mg THg/kg ww fish)

Summary Statistics (Excel)

| | | | |
|---|---|---|---|
| N | 35 | Correlation Coefficient (length vs THg) | |
| min | 0.02 (<0.02) | 0.706707 | |
| max | 0.09 | | |
| arithmean | 0.04 | | |
| median | 0.03 | | |
| # nd | 2 | | |
| freq. nd (%) | 5.714286 | | |

ProUCL 5.2 Summary Statistics

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/24/2024 2:36:15 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 35 | 0 | 0.02 | 0.09 | 0.041429 | 0.037994 | 0.018652 | 0.003153 | 0.014826 | 1.193175 | 0.450222 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1 | 50%ile(Q2 | 75%ile(Q3 | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 35 | 0 | 0.024 | 0.03 | 0.03 | 0.03 | 0.05 | 0.052 | 0.072 | 0.08 | 0.0866 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/24/2024 2:37:09 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 35 |
| Number of Distinct Observations | 7 |
| Minimum | 0.02 |
| Maximum | 0.09 |
| Mean of Raw Data | 0.041429 |
| Standard Deviation of Raw Data | 0.018652 |
| Khat | 5.939174 |
| Theta hat | 0.006976 |
| Kstar | 5.44915 |
| Theta star | 0.007603 |
| Mean of Log Transformed Data | -3.27033 |
| Standard Deviation of Log Transformed Data | 0.412281 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.918024 |
| Shapiro Wilk Test Statistic | 0.835414 |
| Shapiro Wilk Critical (0.0500000) Value | 0.934 |
| Approximate Shapiro Wilk P Value | 4.73E-05 |
| Lilliefors Test Statistic | 0.244257 |
| Lilliefors Critical (0.0500000) Value | 0.1478 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.960418 |
| A-D Test Statistic | 1.587479 |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/24/2024 2:39:34 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operatio | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 35 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.02 | Mean | 0.041429 |
| Maximum | 0.09 | Median | 0.03 |
| SD | 0.018652 | Std. Error of Mean | 0.003153 |
| Coefficient of Variation | 0.450222 | Skewness | 1.193175 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.835414 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.91 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.244257 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.172 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.04676 | 95% Adjusted-CLT UCL (Chen-1995) | 0.047294 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.046866 |

Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 1.587479 | Anderson-Darling Gamma GOF Test |
| 5% A-D Critical Value | 0.749448 | Data Not Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.241968 | Kolmogorov-Smirnov Gamma GOF Test |
| 5% K-S Critical Value | 0.148955 | Data Not Gamma Distributed at 5% Significance Level |

Data Not Gamma Distributed at 5% Significance Level

| | |
|---|---|
| A-D Critical (0.0500000) Value | 0.749448 |
| K-S Test Statistic | 0.241968 |
| K-S Critical(0.0500000) Value | 0.148955 |

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.95775 |
| Shapiro Wilk Test Statistic | 0.904334 |
| Shapiro Wilk Critical (0.0500000) Value | 0.934 |
| Approximate Shapiro Wilk P Value | 0.005256 |
| Lilliefors Test Statistic | 0.230959 |
| Lilliefors Critical (0.0500000) Value | 0.1478 |

Data not Lognormal at (0.0500000) Significance Level

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 5.939174 | k star (bias corrected MLE) | 5.44915 |
| Theta hat (MLE) | 0.006976 | Theta star (bias corrected MLE) | 0.007603 |
| nu hat (MLE) | 415.7422 | nu star (bias corrected) | 381.4405 |
| MLE Mean (bias corrected) | 0.041429 | MLE Sd (bias corrected) | 0.017747 |
| | | Approximate Chi Square Value (0.05) | 337.1743 |
| Adjusted Level of Significance | 0.0425 | Adjusted Chi Square Value | 335.2063 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.046868 | 95% Adjusted Gamma UCL | 0.047143 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.904334 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.944 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.230959 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1356 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -3.91202 | Mean of logged Data | -3.27033 |
| Maximum of Logged Data | -2.40795 | SD of logged Data | 0.412281 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.047234 | 90% Chebyshev (MVUE) UCL | 0.050157 |
| 95% Chebyshev (MVUE) UCL | 0.054189 | 97.5% Chebyshev (MVUE) UCL | 0.059785 |
| 99% Chebyshev (MVUE) UCL | 0.070778 | | |

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.046614 | 95% BCA Bootstrap UCL | 0.046857 |
| 95% Standard Bootstrap UCL | 0.046442 | 95% Bootstrap-t UCL | 0.047933 |
| 95% Hall's Bootstrap UCL | 0.047333 | 95% Percentile Bootstrap UCL | 0.046571 |
| 90% Chebyshev(Mean, Sd) UCL | 0.050887 | 95% Chebyshev(Mean, Sd) UCL | 0.055171 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.061118 | 99% Chebyshev(Mean, Sd) UCL | 0.072798 |

Selected UCL is arithmetic mean of non-parametric UCL estimates, where alpha=0.05:

0.048132

Suggested UCL to Use

95% Student's-t UCL 0.04676 (rejected as data distribution is non-parametric and student's-t ucl assumes normality)

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| year | section | area | species | length | st_length | thg |
|---|---|---|---|---|---|---|
| 2018 | 0 | GB | RS | 94 | 150 | 0.03 |
| 2018 | 0 | LM | RS | 169 | 150 | 0.09 |
| 2018 | 0 | LM | RS | 153 | 150 | 0.01 |
| 2018 | 0 | LM | RS | 182 | 150 | 0.01 |
| 2018 | 0 | LM | RS | 168 | 150 | 0.01 |
| 2018 | 0 | LM | RS | 165 | 150 | 0.01 |
| 2018 | 0 | LM | RS | 203 | 150 | 0.01 |
| 2018 | 0 | LM | RS | 167 | 150 | 0.02 |
| 2018 | 0 | LM | RS | 193 | 150 | 0.03 |
| 2018 | 0 | OM | RS | 150 | 150 | 0.02 |
| 2018 | 0 | OM | RS | 159 | 150 | 0.03 |
| 2018 | 0 | OM | RS | 153 | 150 | 0.03 |
| 2018 | 0 | OM | RS | 178 | 150 | 0.04 |
| 2018 | 0 | OM | RS | 165 | 150 | 0.04 |
| 2018 | 0 | OM | RS | 170 | 150 | 0.05 |
| 2018 | 0 | OM | RS | 164 | 150 | 0.06 |
| 2018 | 0 | OM | RS | 154 | 150 | 0.07 |
| 2018 | 0 | OM | RS | 167 | 150 | 0.01 |
| 2018 | 0 | OM | RS | 144 | 150 | 0.02 |
| 2018 | 0 | OM | RS | 141 | 150 | 0.01 |
| 2018 | 0 | OM | RS | 133 | 150 | 0.03 |
| 2018 | 0 | OM | RS | 133 | 150 | 0.05 |
| 2018 | 0 | OM | RS | 131 | 150 | 0.02 |
| 2018 | 0 | OM | RS | 136 | 150 | 0.02 |
| 2018 | 0 | OM | RS | 153 | 150 | 0.04 |
| 2018 | 0 | OM | RS | 151 | 150 | 0.02 |
| 2018 | 0 | OM | RS | 138 | 150 | 0.04 |
| 2018 | 0 | OM | RS | 139 | 150 | 0.02 |
| 2018 | 0 | OM | RS | 128 | 150 | 0.03 |
| 2018 | 0 | OM | RS | 135 | 150 | 0.03 |
| 2018 | 0 | OM | RS | 142 | 150 | 0.03 |
| 2018 | 0 | OM | RS | 132 | 150 | 0.05 |
| 2018 | 0 | OM | RS | 124 | 150 | 0.03 |
| 2018 | 0 | OM | RS | 131 | 150 | 0.02 |
| 2018 | 0 | OM | RS | 125 | 150 | 0.04 |
| 2018 | 0 | OM | RS | 113 | 150 | 0.01 |
| 2018 | 0 | OM | RS | 174 | 150 | 0.04 |
| 2018 | 0 | OM | RS | 175 | 150 | 0.04 |

## 2018 RAINBOW SMELT THg DATA (mg THg/kg ww fish)

Summary Statistics (Excel)

| | | |
|---|---|---|
| N | 38 | Correlation Coefficient (length vs THg) |
| min | 0.01 (<0.01) | 0.043441 |
| max | 0.09 | |
| arithmean | 0.03 | |
| median | 0.03 | |
| # nd | 4 | |
| freq. nd (%) | 10.52632 | |

ProUCL 5.2 Summary Statistics

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/26/2024 11:53:35 AM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 38 | 0 | 0.01 | 0.09 | 0.030526 | 0.025721 | 0.018001 | 0.00292 | 0.014826 | 1.208344 | 0.589691 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 38 | 0 | 0.01 | 0.014 | 0.02 | 0.03 | 0.04 | 0.04 | 0.05 | 0.0615 | 0.0826 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/26/2024 11:55:32 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| | |
|---|---|
| Raw Statistics | |
| Number of Valid Observations | 38 |
| Number of Distinct Observations | 8 |
| Minimum | 0.01 |
| Maximum | 0.09 |
| Mean of Raw Data | 0.030526 |
| Standard Deviation of Raw Data | 0.018001 |
| Khat | 3.075982 |
| Theta hat | 0.009924 |
| Kstar | 2.850685 |
| Theta star | 0.010708 |
| Mean of Log Transformed Data | -3.660434 |
| Standard Deviation of Log Transformed Data | 0.611567 |
| Normal GOF Test Results | |
| Correlation Coefficient R | 0.93979 |
| Shapiro Wilk Test Statistic | 0.884945 |
| Shapiro Wilk Critical (0.0500000) Value | 0.938 |
| Approximate Shapiro Wilk P Value | 7.13E-04 |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/26/2024 11:56:39 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 200000% |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 38 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.030526 |
| Maximum | 0.09 | Median | 0.03 |
| SD | 0.018001 | Std. Error of Mean | 0.00292 |
| Coefficient of Variation | 0.589691 | Skewness | 1.208344 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.884945 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.916 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.169557 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.1653 | Data Not Normal at 1% Significance Level | |
| Data Not Normal at 1% Significance Level | | | |

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.035453 | 95% Adjusted-CLT UCL (Chen-1995) | 0.035941 |

| | |
|---|---|
| Lilliefors Test Statistic | 0.169557 |
| Lilliefors Critical (0.0500000) Value | 0.1421 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.982617 |
| A-D Test Statistic | 0.933383 |
| A-D Critical (0.0500000) Value | 0.754163 |
| K-S Test Statistic | 0.142962 |
| K-S Critical(0.0500000) Value | 0.144106 |
| Data follow Appr. Gamma Distribution at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.962693 |
| Shapiro Wilk Test Statistic | 0.910956 |
| Shapiro Wilk Critical (0.0500000) Value | 0.938 |
| Approximate Shapiro Wilk P Value | 5.49E-03 |
| Lilliefors Test Statistic | 0.178276 |
| Lilliefors Critical (0.0500000) Value | 0.1421 |
| Data not Lognormal at (0.0500000) Significance Level | |

| | |
|---|---|
| 95% Modified-t UCL (Johnson-1978) | 0.035548 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.933383 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.754163 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.142962 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.144106 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 3.075982 | k star (bias corrected MLE) | 2.850685 |
| Theta hat (MLE) | 0.009924 | Theta star (bias corrected MLE) | 0.010708 |
| nu hat (MLE) | 233.7746 | nu star (bias corrected) | 216.6521 |
| MLE Mean (bias corrected) | 0.030526 | MLE Sd (bias corrected) | 0.01808 |
| | | Approximate Chi Square Value (0.05) | 183.587 |
| Adjusted Level of Significance | 0.0434 | Adjusted Chi Square Value | 182.3292 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.036024 | 95% Adjusted Gamma UCL | 0.036273 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.910956 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.947 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.178276 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1303 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -3.66043 |
| Maximum of Logged Data | -2.40795 | SD of logged Data | 0.611567 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.037935 | 90% Chebyshev (MVUE) UCL | 0.040641 |
| 95% Chebyshev (MVUE) UCL | 0.045084 | 97.5% Chebyshev (MVUE) UCL | 0.051251 |
| 99% Chebyshev (MVUE) UCL | 0.063365 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.03533 | 95% BCA Bootstrap UCL | 0.035526 |
| 95% Standard Bootstrap UCL | 0.035303 | 95% Bootstrap-t UCL | 0.036252 |
| 95% Hall's Bootstrap UCL | 0.036552 | 95% Percentile Bootstrap UCL | 0.035526 |
| 90% Chebyshev(Mean, Sd) UCL | 0.039287 | 95% Chebyshev(Mean, Sd) UCL | 0.043255 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.048763 | 99% Chebyshev(Mean, Sd) UCL | 0.059582 |

Suggested UCL to Use

95% Adjusted Gamma UCL 0.036273

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| year | section | area | species | length | st_length | thg |
|---|---|---|---|---|---|---|
| 2019 | 0 | LM | RS | 220 | 150 | 0.07 |
| 2019 | 0 | LM | RS | 188 | 150 | 0.05 |
| 2019 | 0 | LM | RS | 134 | 150 | 0.02 |
| 2019 | 0 | LM | RS | 130 | 150 | 0.02 |
| 2019 | 0 | LM | RS | 178 | 150 | 0.08 |
| 2019 | 0 | LM | RS | 151 | 150 | 0.03 |
| 2019 | 0 | LM | RS | 151 | 150 | 0.04 |
| 2019 | 0 | LM | RS | 120 | 150 | 0.02 |
| 2019 | 0 | LM | RS | 146 | 150 | 0.02 |
| 2019 | 0 | LM | RS | 116 | 150 | 0.03 |
| 2019 | 0 | LM | RS | 111 | 150 | 0.01 |
| 2019 | 0 | LM | RS | 108 | 150 | 0.02 |
| 2019 | 0 | LM | RS | 150 | 150 | 0.04 |
| 2019 | 0 | LM | RS | 109 | 150 | 0.01 |
| 2019 | 0 | LM | RS | 123 | 150 | 0.03 |
| 2019 | 0 | LM | RS | 120 | 150 | 0.02 |
| 2019 | 0 | OM | RS | 156 | 150 | 0.03 |
| 2019 | 0 | OM | RS | 170 | 150 | 0.01 |
| 2019 | 0 | OM | RS | 155 | 150 | 0.01 |
| 2019 | 0 | OM | RS | 135 | 150 | 0.01 |
| 2019 | 0 | OM | RS | 136 | 150 | 0.01 |
| 2019 | 0 | OM | RS | 149 | 150 | 0.01 |
| 2019 | 0 | OM | RS | 121 | 150 | 0.01 |
| 2019 | 0 | OM | RS | 131 | 150 | 0.01 |
| 2019 | 0 | LM | RS | 164 | 150 | 0.04 |
| 2019 | 0 | LM | RS | 213 | 150 | 0.03 |
| 2019 | 0 | LM | RS | 185 | 150 | 0.04 |
| 2019 | 0 | LM | RS | 183 | 150 | 0.05 |
| 2019 | 0 | LM | RS | 181 | 150 | 0.06 |
| 2019 | 0 | LM | RS | 141 | 150 | 0.03 |
| 2019 | 0 | LM | RS | 154 | 150 | 0.03 |
| 2019 | 0 | LM | RS | 140 | 150 | 0.03 |
| 2019 | 0 | LM | RS | 158 | 150 | 0.03 |
| 2019 | 0 | LM | RS | 166 | 150 | 0.04 |
| 2019 | 0 | LM | RS | 167 | 150 | 0.04 |
| 2019 | 0 | LM | RS | 160 | 150 | 0.03 |
| 2019 | 0 | LM | RS | 152 | 150 | 0.05 |
| 2019 | 0 | LM | RS | 160 | 150 | 0.04 |

## 2019 RAINBOW SMELT THg DATA (mg THg/kg ww fish)

Summary Statistics (Excel)

| | | |
|---|---|---|
| N | 38 | Correlation Coefficient (length vs THg) |
| min | 0.01 (<0.01) | 0.670138 |
| max | 0.08 | |
| arithmean | 0.03 | |
| median | 0.03 | |
| # nd | 7 | |
| freq. nd (%) | 18.42105 | |

ProUCL 5.2 Summary Statistics

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/24/2024 5:49:24 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 38 | 0 | 0.01 | 0.08 | 0.030263 | 0.025448 | 0.017319 | 0.002809 | 0.014826 | 0.880072 | 0.572262 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 38 | 0 | 0.01 | 0.01 | 0.02 | 0.03 | 0.04 | 0.04 | 0.05 | 0.0615 | 0.0763 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/24/2024 5:50:17 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 38 |
| Number of Distinct Observations | 8 |
| Minimum | 0.01 |
| Maximum | 0.08 |
| Mean of Raw Data | 0.030263 |
| Standard Deviation of Raw Data | 0.017319 |
| Khat | 3.041962 |
| Theta hat | 0.009949 |
| Kstar | 2.819351 |
| Theta star | 0.010734 |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/24/2024 5:51:28 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 38 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.030263 |
| Maximum | 0.08 | Median | 0.03 |
| SD | 0.017319 | Std. Error of Mean | 0.002809 |
| Coefficient of Variation | 0.572262 | Skewness | 0.880072 |

Normal GOF Test

| | |
|---|---|
| Mean of Log Transformed Data | -3.671105 |
| Standard Deviation of Log Transformed Data | 0.622606 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.951065 |
| Shapiro Wilk Test Statistic | 0.898035 |
| Shapiro Wilk Critical (0.0500000) Value | 0.938 |
| Approximate Shapiro Wilk P Value | 0.001969 |
| Lilliefors Test Statistic | 0.163957 |
| Lilliefors Critical (0.0500000) Value | 0.1421 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.980986 |
| A-D Test Statistic | 1.156159 |
| A-D Critical (0.0500000) Value | 0.754223 |
| K-S Test Statistic | 0.175629 |
| K-S Critical(0.0500000) Value | 0.144117 |

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.953489 |
| Shapiro Wilk Test Statistic | 0.889648 |
| Shapiro Wilk Critical (0.0500000) Value | 0.938 |
| Approximate Shapiro Wilk P Value | 0.001035 |
| Lilliefors Test Statistic | 0.209484 |
| Lilliefors Critical (0.0500000) Value | 0.1421 |

Data not Lognormal at (0.0500000) Significance Level

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.898035 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.916 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.163957 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.1653 | Data appear Normal at 1% Significance Level | |

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.035003 | 95% Adjusted-CLT UCL (Chen-1995) | 0.035313 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.03507 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 1.156159 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.754223 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.175629 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.144117 | Data Not Gamma Distributed at 5% Significance Level | |

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 3.041962 | k star (bias corrected MLE) | 2.819351 |
| Theta hat (MLE) | 0.009949 | Theta star (bias corrected MLE) | 0.010734 |
| nu hat (MLE) | 231.1891 | nu star (bias corrected) | 214.2706 |
| MLE Mean (bias corrected) | 0.030263 | MLE Sd (bias corrected) | 0.018024 |
| | | Approximate Chi Square Value (0.05) | 181.3945 |
| Adjusted Level of Significance | 0.0434 | Adjusted Chi Square Value | 180.1444 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.035748 | 95% Adjusted Gamma UCL | 0.035996 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.889648 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.947 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.209484 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1303 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -3.67111 |
| Maximum of Logged Data | -2.52573 | SD of logged Data | 0.622606 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.037963 | 90% Chebyshev (MVUE) UCL | 0.040673 |
| 95% Chebyshev (MVUE) UCL | 0.045187 | 97.5% Chebyshev (MVUE) UCL | 0.051453 |
| 99% Chebyshev (MVUE) UCL | 0.063762 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.034884 | 95% BCA Bootstrap UCL | 0.035526 |
| 95% Standard Bootstrap UCL | 0.034818 | 95% Bootstrap-t UCL | 0.035308 |
| 95% Hall's Bootstrap UCL | 0.035503 | 95% Percentile Bootstrap UCL | 0.035263 |
| 90% Chebyshev(Mean, Sd) UCL | 0.038691 | 95% Chebyshev(Mean, Sd) UCL | 0.042509 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.047808 | 99% Chebyshev(Mean, Sd) UCL | 0.058217 |

Suggested UCL to Use

95% Student's-t UCL 0.035003

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| year | section | area | species | length | st_length | thg |
|---|---|---|---|---|---|---|
| 2020 | 0 | GB | RS | 116 | 150 | 0.01 |
| 2020 | 0 | LM | RS | 143 | 150 | 0.01 |
| 2020 | 0 | LM | RS | 156 | 150 | 0.05 |
| 2020 | 0 | OM | RS | 116 | 150 | 0.01 |
| 2020 | 0 | OM | RS | 115 | 150 | 0.02 |
| 2020 | 0 | OM | RS | 170 | 150 | 0.01 |
| 2020 | 0 | OM | RS | 167 | 150 | 0.01 |
| 2020 | 0 | OM | RS | 162 | 150 | 0.01 |
| 2020 | 0 | OM | RS | 162 | 150 | 0.06 |
| 2020 | 0 | OM | RS | 162 | 150 | 0.06 |
| 2020 | 0 | OM | RS | 164 | 150 | 0.04 |
| 2020 | 0 | OM | RS | 162 | 150 | 0.08 |
| 2020 | 0 | OM | RS | 150 | 150 | 0.07 |
| 2020 | 0 | OM | RS | 155 | 150 | 0.09 |
| 2020 | 0 | OM | RS | 170 | 150 | 0.19 |
| 2020 | 0 | OM | RS | 165 | 150 | 0.01 |
| 2020 | 0 | OM | RS | 159 | 150 | 0.05 |
| 2020 | 0 | OM | RS | 145 | 150 | 0.02 |
| 2020 | 0 | OM | RS | 119 | 150 | 0.01 |
| 2020 | 0 | OM | RS | 167 | 150 | 0.02 |
| 2020 | 0 | OM | RS | 160 | 150 | 0.03 |
| 2020 | 0 | OM | RS | 152 | 150 | 0.01 |
| 2020 | 0 | LM | RS | 166 | 150 | 0.02 |
| 2020 | 0 | LM | RS | 137 | 150 | 0.01 |
| 2020 | 0 | LM | RS | 172 | 150 | 0.07 |
| 2020 | 0 | LM | RS | 141 | 150 | 0.04 |
| 2020 | 0 | LM | RS | 175 | 150 | 0.05 |
| 2020 | 0 | LM | RS | 147 | 150 | 0.06 |
| 2020 | 0 | LM | RS | 153 | 150 | 0.02 |
| 2020 | 0 | LM | RS | 143 | 150 | 0.03 |
| 2020 | 0 | LM | RS | 139 | 150 | 0.06 |
| 2020 | 0 | LM | RS | 136 | 150 | 0.07 |
| 2020 | 0 | LM | RS | 149 | 150 | 0.02 |
| 2020 | 0 | LM | RS | 152 | 150 | 0.06 |
| 2020 | 0 | LM | RS | 138 | 150 | 0.05 |
| 2020 | 0 | LM | RS | 139 | 150 | 0.05 |
| 2020 | 0 | LM | RS | 131 | 150 | 0.03 |
| 2020 | 0 | LM | RS | 151 | 150 | 0.03 |
| 2020 | 0 | LM | RS | 164 | 150 | 0.08 |
| 2020 | 0 | LM | RS | 154 | 150 | 0.01 |
| 2020 | 0 | LM | RS | 131 | 150 | 0.02 |
| 2020 | 0 | LM | RS | 450 | 150 | 0.04 |
| 2020 | 0 | LM | RS | 141 | 150 | 0.06 |
| 2020 | 0 | LM | RS | 156 | 150 | 0.17 |
| 2020 | 0 | LM | RS | 139 | 150 | 0.08 |
| 2020 | 0 | LM | RS | 141 | 150 | 0.04 |
| 2020 | 0 | LM | RS | 146 | 150 | 0.03 |
| 2020 | 0 | LM | RS | 182 | 150 | 0.1 |
| 2020 | 0 | LM | RS | 117 | 150 | 0.03 |
| 2020 | 0 | LM | RS | 159 | 150 | 0.03 |
| 2020 | 1 | BM | RS | 128 | 150 | 0.02 |

## 2020 RAINBOW SMELT THg DATA (mg THg/kg ww fish)

Summary Statistics (Excel)

| | | | |
|---|---|---|---|
| N | 51 | Correlation Coefficient (length vs THg) | |
| min | 0.01 (<0.01) | | 0.104437 |
| max | 0.19 | | |
| arithmean | 0.04 | | |
| median | 0.03 | | |
| # nd | 4 | | |
| freq. nd (%) | 7.843137 | | |

ProUCL 5.2 Summary Statistics

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/25/2024 10:09:22 AM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 51 | 0 | 0.01 | 0.19 | 0.044118 | 0.032386 | 0.037104 | 0.005196 | 0.029652 | 2.044546 | 0.841024 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 51 | 0 | 0.01 | 0.01 | 0.02 | 0.03 | 0.06 | 0.06 | 0.08 | 0.095 | 0.18 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/25/2024 10:10:14 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| Raw Statistics | |
|---|---|
| Number of Valid Observations | 51 |
| Number of Distinct Observations | 12 |
| Minimum | 0.01 |
| Maximum | 0.19 |
| Mean of Raw Data | 0.044118 |
| Standard Deviation of Raw Data | 0.037104 |
| Khat | 1.765741 |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/25/2024 10:11:11 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 51 | Number of Distinct Observations | 12 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.044118 |
| Maximum | 0.19 | Median | 0.03 |
| SD | 0.037104 | Std. Error of Mean | 0.005196 |

| | |
|---|---|
| Theta hat | 0.024985 |
| Kstar | 1.674946 |
| Theta star | 0.02634 |
| Mean of Log Transformed Data | -3.43004 |
| Standard Deviation of Log Transformed Data | 0.811464 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.887906 |
| Approximate Shapiro Wilk Test Statistic | 0.795797 |
| Approximate Shapiro Wilk P Value | 4.58E-09 |
| Lilliefors Test Statistic | 0.178913 |
| Lilliefors Critical (0.0500000) Value | 0.123488 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.973451 |
| A-D Test Statistic | 0.936523 |
| A-D Critical (0.0500000) Value | 0.765006 |
| K-S Test Statistic | 0.120849 |
| K-S Critical(0.0500000) Value | 0.126099 |

Data follow Appr. Gamma Distribution at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.969567 |
| Approximate Shapiro Wilk Test Statistic | 0.919976 |
| Approximate Shapiro Wilk P Value | 0.002022 |
| Lilliefors Test Statistic | 0.141901 |
| Lilliefors Critical (0.0500000) Value | 0.123488 |

Data not Lognormal at (0.0500000) Significance Level

| | | | |
|---|---|---|---|
| Coefficient of Variation | 0.841024 | Skewness | 2.044546 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.795797 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk P Value | 4.58E-09 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.178913 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.142805 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.052825 | 95% Adjusted-CLT UCL (Chen-1995) | 0.054253 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.053073 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.936523 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.765006 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.120849 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.126099 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.765741 | k star (bias corrected MLE) | 1.674946 |
| Theta hat (MLE) | 0.024985 | Theta star (bias corrected MLE) | 0.02634 |
| nu hat (MLE) | 180.1056 | nu star (bias corrected) | 170.8445 |
| MLE Mean (bias corrected) | 0.044118 | MLE Sd (bias corrected) | 0.034089 |
| | | Approximate Chi Square Value (0.05) | 141.6183 |
| Adjusted Level of Significance | 0.045294 | Adjusted Chi Square Value | 140.8463 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.053222 | 95% Adjusted Gamma UCL | 0.053514 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.919976 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk P Value | 0.002022 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.141901 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.113002 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -3.43004 |
| Maximum of Logged Data | -1.66073 | SD of logged Data | 0.811464 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.057428 | 90% Chebyshev (MVUE) UCL | 0.061731 |
| 95% Chebyshev (MVUE) UCL | 0.069475 | 97.5% Chebyshev (MVUE) UCL | 0.080222 |
| 99% Chebyshev (MVUE) UCL | 0.101334 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.052664 | 95% BCA Bootstrap UCL | 0.054706 |
| 95% Standard Bootstrap UCL | 0.052799 | 95% Bootstrap-t UCL | 0.055481 |
| 95% Hall's Bootstrap UCL | 0.05677 | 95% Percentile Bootstrap UCL | 0.053726 |
| 90% Chebyshev(Mean, Sd) UCL | 0.059704 | 95% Chebyshev(Mean, Sd) UCL | 0.066765 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.076564 | 99% Chebyshev(Mean, Sd) UCL | 0.095813 |

Suggested UCL to Use

95% Approximate Gamma UCL 0.053222

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| year | date | location | section | area | species | length | weight | thg |
|---|---|---|---|---|---|---|---|---|
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | RS | 70 | 2.5 | 0.02 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | RS | 97 | 6.1 | 0.02 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | RS | 87 | 4.2 | 0.01 |
| 2023 | 2023-08-19 | Mulligan Point | 0 | LM | RS | 88 | 4.8 | 0.02 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 202 | 52.7 | 0.13 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 176 | 32.9 | 0.12 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 207 | 52.7 | 0.09 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 169 | 40.9 | 0.06 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 160 | 26.5 | 0.03 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 120 | 13.1 | 0.03 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 125 | 13.2 | 0.05 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 130 | 13.5 | 0.03 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 150 | 19.1 | 0.05 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 134 | 17 | 0.04 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 135 | 15 | 0.05 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 130 | 14 | 0.02 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 109 | 8.8 | 0.03 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 112 | 10.7 | 0.02 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 133 | 13.6 | 0.04 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 125 | 14.4 | 0.07 |
| 2023 | 2023-09-20 | Wilburn Bay | 0 | GB | RS | 124 | 12.4 | 0.03 |
| 2023 | 2023-09-20 | Grand River Point | 0 | GB | RS | 188 | 47.2 | 0.06 |
| 2023 | 2023-09-20 | Grand River Point | 0 | GB | RS | 142 | 17.9 | 0.06 |
| 2023 | 2023-09-20 | Grand River Point | 0 | GB | RS | 125 | 20.5 | 0.06 |
| 2023 | 2023-09-20 | Grand River Point | 0 | GB | RS | 122 | 12.2 | 0.03 |
| 2023 | 2023-09-20 | Grand River Point | 0 | GB | RS | 174 | 35.4 | 0.07 |
| 2023 | 2023-10-02 | Mackenzie River | 1 | BM | RS | 180 | 55.2 | 0.12 |

## 2023 RAINBOW SMELT THg DATA (mg THg/kg ww fish)

Summary Statistics (Excel)

| | |
|---|---|
| N | 27 |
| min | 0.01 |
| max | 0.13 |
| arithmean | 0.05 |
| median | 0.04 |
| # nd | 0 |
| freq. nd (%) | 0 |

Correlation Coefficient (length vs THg)
0.802894

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/25/2024 3:30:10 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 27 | 0 | 0.01 | 0.13 | 0.05037 | 0.041539 | 0.032638 | 0.006281 | 0.029652 | 1.197411 | 0.647961 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1 | 50%ile(Q2 | 75%ile(Q3 | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 27 | 0 | 0.02 | 0.022 | 0.03 | 0.04 | 0.06 | 0.068 | 0.102 | 0.12 | 0.1274 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/25/2024 3:31:12 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 27 |
| Number of Distinct Observations | 10 |
| Minimum | 0.01 |
| Maximum | 0.13 |
| Mean of Raw Data | 0.05037 |
| Standard Deviation of Raw Data | 0.032638 |
| Khat | 2.748982 |
| Theta hat | 0.018323 |
| Kstar | 2.468231 |
| Theta star | 0.020408 |
| Mean of Log Transformed Data | -3.18113 |
| Standard Deviation of Log Transformed Data | 0.6408 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.930567 |
| Shapiro Wilk Test Statistic | 0.860352 |
| Shapiro Wilk Critical (0.0500000) Value | 0.923 |
| Approximate Shapiro Wilk P Value | 0.001522 |
| Lilliefors Test Statistic | 0.178173 |
| Lilliefors Critical (0.0500000) Value | 0.1665 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.977255 |
| A-D Test Statistic | 0.548121 |
| A-D Critical (0.0500000) Value | 0.752913 |
| K-S Test Statistic | 0.163859 |
| K-S Critical(0.0500000) Value | 0.169696 |

Data appear Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.981963 |
| Shapiro Wilk Test Statistic | 0.96027 |
| Shapiro Wilk Critical (0.0500000) Value | 0.923 |
| Approximate Shapiro Wilk P Value | 0.400183 |
| Lilliefors Test Statistic | 0.138665 |
| Lilliefors Critical (0.0500000) Value | 0.1665 |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/25/2024 3:32:21 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operatio | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 27 | Number of Distinct Observations | 10 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.05037 |
| Maximum | 0.13 | Median | 0.04 |
| SD | 0.032638 | Std. Error of Mean | 0.006281 |
| Coefficient of Variation | 0.647961 | Skewness | 1.197411 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.860352 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.894 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.178173 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.1941 | Data appear Normal at 1% Significance Level | |

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.061084 | 95% Adjusted-CLT UCL (Chen-1995) | 0.062249 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.061325 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.548121 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.752913 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.163859 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.169696 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.748982 | k star (bias corrected MLE) | 2.468231 |
| Theta hat (MLE) | 0.018323 | Theta star (bias corrected MLE) | 0.020408 |
| nu hat (MLE) | 148.4451 | nu star (bias corrected) | 133.2845 |
| MLE Mean (bias corrected) | 0.05037 | MLE Sd (bias corrected) | 0.032061 |
| | | Approximate Chi Square Value (0.05) | 107.6132 |
| Adjusted Level of Significance | 0.0401 | Adjusted Chi Square Value | 106.1396 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.062386 | 95% Adjusted Gamma UCL | 0.063253 |

Lognormal GOF Test

Data appear Lognormal at (0.0500000) Significance Level

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.96027 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.935 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.138665 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1533 | Data appear Lognormal at 10% Significance Level | |
| Data appear Lognormal at 10% Significance Level | | | |

| | | | |
|---|---|---|---|
| Lognormal Statistics | | | |
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -3.18113 |
| Maximum of Logged Data | -2.04022 | SD of logged Data | 0.6408 |

| | | | |
|---|---|---|---|
| Assuming Lognormal Distribution | | | |
| 95% H-UCL | 0.066421 | 90% Chebyshev (MVUE) UCL | 0.070501 |
| 95% Chebyshev (MVUE) UCL | 0.079539 | 97.5% Chebyshev (MVUE) UCL | 0.092082 |
| 99% Chebyshev (MVUE) UCL | 0.116721 | | |

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

| | | | |
|---|---|---|---|
| Nonparametric Distribution Free UCLs | | | |
| 95% CLT UCL | 0.060702 | 95% BCA Bootstrap UCL | 0.062222 |
| 95% Standard Bootstrap UCL | 0.060515 | 95% Bootstrap-t UCL | 0.062619 |
| 95% Hall's Bootstrap UCL | 0.062048 | 95% Percentile Bootstrap UCL | 0.061482 |
| 90% Chebyshev(Mean, Sd) UCL | 0.069214 | 95% Chebyshev(Mean, Sd) UCL | 0.07775 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.089596 | 99% Chebyshev(Mean, Sd) UCL | 0.112868 |

| | | |
|---|---|---|
| Suggested UCL to Use | | |
| 95% Student's-t UCL | 0.061084 | (rejected as data distribution best represented by gamma, based on GOF test outcomes) |

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| year | date | location | section | area | species | length | weight | thg |
|---|---|---|---|---|---|---|---|---|
| 2018 | 15-Sep-18 | Caroline Brook | 1 | BM | BB | 139 | 14.8 | 0.07 |
| 2018 | 16-Sep-18 | Below Muskrat | 1 | BM | BB | 201 | 41.6 | 0.05 |
| 2018 | 16-Sep-18 | Below Muskrat | 1 | BM | BB | 156 | 19.9 | 0.03 |
| 2018 | 18-Sep-18 | Caroline Brook | 1 | BM | BB | 330 | 219.7 | 0.09 |
| 2018 | 24-Sep-18 | Edwards Brook | 2 | AM | BB | 185 | 33.4 | 0.04 |
| 2018 | 24-Sep-18 | Edwards Brook | 2 | AM | BB | 174 | 30 | 0.03 |
| 2018 | 24-Sep-18 | Edwards Brook | 2 | AM | BB | 147 | 16.3 | 0.03 |
| 2018 | 25-Sep-18 | Edwards Brook | 2 | AM | BB | 163 | 23.4 | 0.03 |
| 2018 | 25-Sep-18 | Edwards Brook | 2 | AM | BB | 186 | 32.1 | 0.01 |
| 2018 | 25-Sep-18 | Edwards Brook | 2 | AM | BB | 168 | 25.1 | 0.04 |
| 2018 | 25-Sep-18 | Edwards Brook | 2 | AM | BB | 168 | 24.1 | 0.04 |
| 2018 | 26-Sep-18 | Upper Brook | 2 | AM | BB | 179 | 31.1 | 0.03 |
| 2018 | 29-Sep-18 | Upper Brook | 2 | AM | BB | 133 | 13.3 | 0.03 |

## 2018 BURBOT THg DATA (mg THg/kg ww fish)

**Summary Statistics (Excel)**

| | |
|---|---|
| **N** | 13 |
| **min** | 0.01 |
| **max** | 0.09 |
| **arithmean** | 0.04 |
| **median** | 0.03 |
| **# nd** | 1 |
| **freq. nd (%)** | 7.692308 |

**Correlation Coefficient (length vs THg)**

0.627737

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2024-10-08 2:07:07 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 13 | 0 | 0.01 | 0.09 | 0.04 | 0.03559 | 0.020412 | 0.005661 | 0.0148258 | 1.389529 | 0.51031 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 13 | 0 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.046 | 0.066 | 0.078 | 0.0876 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 2024-10-08 2:09:40 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 13 |
| Number of Distinct Observations | 6 |
| Minimum | 0.01 |
| Maximum | 0.09 |
| Mean of Raw Data | 0.04 |
| Standard Deviation of Raw Data | 0.020412 |
| Khat | 4.439853 |
| Theta hat | 0.009009 |
| Kstar | 3.466554 |
| Theta star | 0.011539 |
| Mean of Log Transformed Data | -3.335699 |
| Standard Deviation of Log Transformed Data | 0.521339 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.898281 |
| Shapiro Wilk Test Statistic | 0.827953 |
| Shapiro Wilk Critical (0.0500000) Value | 0.866 |
| Approximate Shapiro Wilk P Value | 0.009999 |
| Lilliefors Test Statistic | 0.269231 |
| Lilliefors Critical (0.0500000) Value | 0.2337 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.948978 |
| A-D Test Statistic | 0.850729 |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 2024-10-08 2:11:19 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 13 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.04 |
| Maximum | 0.09 | Median | 0.03 |
| SD | 0.020412 | Std. Error of Mean | 0.005661 |
| Coefficient of Variation | 0.51031 | Skewness | 1.389529 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.827953 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.814 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.269231 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2714 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.05009 | 95% Adjusted-CLT UCL (Chen-1995) | 0.051644 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.050454 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.850729 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.736658 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.261775 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.237569 | Data Not Gamma Distributed at 5% Significance Level | |

Data Not Gamma Distributed at 5% Significance Level

| | |
|---|---|
| A-D Critical (0.0500000) Value | 0.736658 |
| K-S Test Statistic | 0.261775 |
| K-S Critical(0.0500000) Value | 0.237569 |

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.913962 |
| Shapiro Wilk Test Statistic | 0.863981 |
| Shapiro Wilk Critical (0.0500000) Value | 0.866 |
| Approximate Shapiro Wilk P Value | 0.026787 |
| Lilliefors Test Statistic | 0.294634 |
| Lilliefors Critical (0.0500000) Value | 0.2337 |

Data not Lognormal at (0.0500000) Significance Level

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 4.439853 | k star (bias corrected MLE) | 3.466554 |
| Theta hat (MLE) | 0.009009 | Theta star (bias corrected MLE) | 0.011539 |
| nu hat (MLE) | 115.4362 | nu star (bias corrected) | 90.1304 |
| MLE Mean (bias corrected) | 0.04 | MLE Sd (bias corrected) | 0.021484 |
| | | Approximate Chi Square Value (0.05) | 69.24042 |
| Adjusted Level of Significance | 0.03009 | Adjusted Chi Square Value | 66.63586 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.052068 | 95% Adjusted Gamma UCL | 0.054103 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.863981 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.889 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.294634 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.2147 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -3.335699 |
| Maximum of Logged Data | -2.407946 | SD of logged Data | 0.521339 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.056237 | 90% Chebyshev (MVUE) UCL | 0.058275 |
| 95% Chebyshev (MVUE) UCL | 0.066416 | 97.5% Chebyshev (MVUE) UCL | 0.077715 |
| 99% Chebyshev (MVUE) UCL | 0.099911 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.049312 | 95% BCA Bootstrap UCL | 0.052308 |
| 95% Standard Bootstrap UCL | 0.049193 | 95% Bootstrap-t UCL | 0.056896 |
| 95% Hall's Bootstrap UCL | 0.112422 | 95% Percentile Bootstrap UCL | 0.05 |
| 90% Chebyshev(Mean, Sd) UCL | 0.056984 | 95% Chebyshev(Mean, Sd) UCL | 0.064677 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.075355 | 99% Chebyshev(Mean, Sd) UCL | 0.09633 |

Suggested UCL to Use

| | |
|---|---|
| 95% Student's-t UCL | 0.05009 |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| year | date | location | section | area | species | length | weight | thg |
|---|---|---|---|---|---|---|---|---|
| 2019 | 01-Jul-19 | Lower Brook | 2 | AM | BB | 148 | 24 | 0.12 |
| 2019 | 01-Jul-19 | Lower Brook | 2 | AM | BB | 200 | 62.1 | 0.01 |
| 2019 | 01-Jul-19 | Lower Brook | 2 | AM | BB | 133 | 14.3 | 0.01 |
| 2019 | 01-Jul-19 | Lower Brook | 2 | AM | BB | 104 | 8.9 | 0.03 |
| 2019 | 01-Jul-19 | Lower Brook | 2 | AM | BB | 100 | 7.1 | 0.01 |
| 2019 | 01-Jul-19 | Lower Brook | 2 | AM | BB | 95 | 5.2 | 0.01 |
| 2019 | 01-Jul-19 | Lower Brook | 2 | AM | BB | 84 | 4.7 | 0.01 |
| 2019 | 01-Jul-19 | Lower Brook | 2 | AM | BB | 135 | 12.9 | 0.01 |
| 2019 | 19-Sep-19 | Caroline Brook | 1 | BM | BB | 165 | 23.2 | 0.03 |
| 2019 | 19-Sep-19 | Caroline Brook | 1 | BM | BB | 127 | 10.8 | 0.02 |
| 2019 | 19-Sep-19 | Mainstem | 1 | BM | BB | 337 | 184.4 | 0.07 |
| 2019 | 19-Sep-19 | Mainstem | 1 | BM | BB | 270 | 107.5 | 0.04 |
| 2019 | 20-Sep-19 | Caroline Brook | 1 | BM | BB | 174 | 27.6 | 0.03 |
| 2019 | 20-Sep-19 | Caroline Brook | 1 | BM | BB | 164 | 22.3 | 0.01 |
| 2019 | 20-Sep-19 | Mainstem | 1 | BM | BB | 600 | 1219.8 | 0.2 |
| 2019 | 20-Sep-19 | Mainstem | 1 | BM | BB | 658 | 1357.4 | 0.14 |
| 2019 | 21-Sep-19 | Caroline Brook | 1 | BM | BB | 168 | 29.7 | 0.03 |
| 2019 | 21-Sep-19 | Caroline Brook | 1 | BM | BB | 168 | 30.7 | 0.02 |
| 2019 | 21-Sep-19 | Caroline Brook | 1 | BM | BB | 110 | 8.1 | 0.01 |
| 2019 | 21-Sep-19 | Caroline Brook | 1 | BM | BB | 94 | 4.3 | 0.03 |
| 2019 | 21-Sep-19 | Caroline Brook | 1 | BM | BB | 180 | 27.6 | 0.01 |
| 2019 | 21-Sep-19 | Caroline Brook | 1 | BM | BB | 152 | 18.5 | 0.01 |
| 2019 | 21-Sep-19 | Mainstem | 1 | BM | BB | 309 | 160.6 | 0.06 |
| 2019 | 21-Sep-19 | Mainstem | 1 | BM | BB | 618 | 1301.9 | 0.11 |
| 2019 | 22-Sep-19 | Caroline Brook | 1 | BM | BB | 153 | 23 | 0.04 |
| 2019 | 22-Sep-19 | Caroline Brook | 1 | BM | BB | 257 | 105.6 | 0.08 |
| 2019 | 22-Sep-19 | Caroline Brook | 1 | BM | BB | 231 | 64.7 | 0.02 |
| 2019 | 22-Sep-19 | Caroline Brook | 1 | BM | BB | 221 | 60.3 | 0.03 |
| 2019 | 22-Sep-19 | Caroline Brook | 1 | BM | BB | 180 | 31.1 | 0.02 |
| 2019 | 23-Sep-19 | Caroline Brook | 1 | BM | BB | 112 | 8 | 0.03 |
| 2019 | 23-Sep-19 | Mainstem | 1 | BM | BB | 443 | 500.2 | 0.11 |
| 2019 | 23-Sep-19 | Mainstem | 1 | BM | BB | 123 | 9.4 | 0.01 |
| 2019 | 24-Sep-19 | Caroline Brook | 1 | BM | BB | 117 | 8.3 | 0.01 |
| 2019 | 24-Sep-19 | Caroline Brook | 1 | BM | BB | 134 | 13.5 | 0.02 |
| 2019 | 28-Sep-19 | Caroline Brook | 1 | BM | BB | 108 | 7.4 | 0.03 |
| 2019 | 30-Sep-19 | McKenzie River | 1 | BM | BB | 138 | 16 | 0.04 |
| 2019 | 01-Oct-19 | Tomas Brook | 2 | AM | BB | 145 | 14.4 | 0.12 |

## 2019 BURBOT THg DATA (mg THg/kg ww fish)

**Summary Statistics (Excel)**

| | |
|---|---|
| **N** | 37 |
| **min** | 0.01 |
| **max** | 0.20 |
| **arithmean** | 0.04 |
| **median** | 0.03 |
| **# nd** | 5 |
| **freq. nd (%)** | 13.5135 |

**Correlation Coefficient (length vs THg)**

0.78126

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2024-10-08 3:02:56 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 37 | 0 | 0.01 | 0.2 | 0.04297 | 0.02765 | 0.04545 | 0.00747 | 0.02965 | 1.83529 | 1.0577 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1 | 50%ile(Q2 | 75%ile(Q3 | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 37 | 0 | 0.01 | 0.01 | 0.01 | 0.03 | 0.04 | 0.068 | 0.114 | 0.124 | 0.1784 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 2024-10-08 3:03:57 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 37 |
| Number of Distinct Observations | 11 |
| Minimum | 0.01 |
| Maximum | 0.2 |
| Mean of Raw Data | 0.04297 |
| Standard Deviation of Raw Data | 0.04545 |
| Khat | 1.27485 |
| Theta hat | 0.03371 |
| Kstar | 1.1895 |
| Theta star | 0.03613 |
| Mean of Log Transformed Data | -3.58812 |
| Standard Deviation of Log Transformed Data | 0.92286 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.85414 |
| Shapiro Wilk Test Statistic | 0.73369 |
| Shapiro Wilk Critical (0.0500000) Value | 0.936 |
| Approximate Shapiro Wilk P Value | 4.33E-08 |
| Lilliefors Test Statistic | 0.28801 |
| Lilliefors Critical (0.0500000) Value | 0.1436 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.97468 |
| A-D Test Statistic | 1.89394 |
| A-D Critical (0.0500000) Value | 0.77106 |
| K-S Test Statistic | 0.20636 |
| K-S Critical(0.0500000) Value | 0.14841 |

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.94807 |
| Shapiro Wilk Test Statistic | 0.87855 |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 2024-10-08 3:05:20 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 37 | Number of Distinct Observations | 11 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.04297 |
| Maximum | 0.2 | Median | 0.03 |
| SD | 0.04545 | Std. Error of Mean | 0.00747 |
| Coefficient of Variation | 1.0577 | Skewness | 1.83529 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.73369 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.814 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.28801 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.1677 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.05559 | 95% Adjusted-CLT UCL (Chen-1995) | 0.05767 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.05596 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 1.89394 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.77106 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.20636 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.14841 | Data Not Gamma Distributed at 5% Significance Level | |

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.27485 | k star (bias corrected MLE) | 1.1895 |
| Theta hat (MLE) | 0.03371 | Theta star (bias corrected MLE) | 0.03613 |
| nu hat (MLE) | 94.3389 | nu star (bias corrected) | 88.0231 |
| MLE Mean (bias corrected) | 0.04297 | MLE Sd (bias corrected) | 0.0394 |
| | | Approximate Chi Square Value (0.05) | 67.3935 |
| Adjusted Level of Significance | 0.0431 | Adjusted Chi Square Value | 66.6099 |

| | |
|---|---|
| Shapiro Wilk Critical (0.0500000) Value | 0.936 |
| Approximate Shapiro Wilk P Value | 5.54E-04 |
| Lilliefors Test Statistic | 0.18911 |
| Lilliefors Critical (0.0500000) Value | 0.1436 |

Data not Lognormal at (0.0500000) Significance Level

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.05613 | 95% Adjusted Gamma UCL | 0.05679 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.87855 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.946 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.18911 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.132 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -3.58812 |
| Maximum of Logged Data | -1.60944 | SD of logged Data | 0.92286 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.06032 | 90% Chebyshev (MVUE) UCL | 0.0633 |
| 95% Chebyshev (MVUE) UCL | 0.07311 | 97.5% Chebyshev (MVUE) UCL | 0.08672 |
| 99% Chebyshev (MVUE) UCL | 0.11344 | | |

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | | |
|---|---|---|---|---|
| | | | | Selected UCL is arithmetic mean of non-parametric UCL estimates, where alpha=0.05: |
| 95% CLT UCL | 0.05526 | 95% BCA Bootstrap UCL | 0.05811 | |
| 95% Standard Bootstrap UCL | 0.05499 | 95% Bootstrap-t UCL | 0.05954 | 0.05958 |
| 95% Hall's Bootstrap UCL | 0.05823 | 95% Percentile Bootstrap UCL | 0.05541 | |
| 90% Chebyshev(Mean, Sd) UCL | 0.06539 | 95% Chebyshev(Mean, Sd) UCL | 0.07554 | |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.08964 | 99% Chebyshev(Mean, Sd) UCL | 0.11732 | |

Suggested UCL to Use

95% Student's-t UCL 0.05559 (rejected as data distribution is non-parametric and student's-t ucl assumes normality)

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| year | date | location | section | area | species | length | weight | thg |
|---|---|---|---|---|---|---|---|---|
| 2023 | 2023-10-09 | Edwards Brook | 2 | AM | BB | 770 | 2900 | 0.19 |
| 2023 | 2023-10-10 | Gull Lake | 2 | AM | BB | 710 | 2040 | 0.21 |
| 2023 | 2023-10-20 | Gull Lake | 2 | AM | BB | 660 | 2000.6 | 0.35 |
| 2023 | 2023-10-20 | Gull Lake | 2 | AM | BB | 560 | 1161.3 | 0.13 |
| 2023 | 2023-10-20 | Gull Lake | 2 | AM | BB | 600 | 1368.7 | 0.26 |
| 2023 | 2023-10-22 | Pinus Res | 2 | AM | BB | 760 | 2300 | 0.26 |
| 2023 | 2023-10-22 | Pinus Res | 2 | AM | BB | 700 | 1893.4 | 0.28 |
| 2023 | 2023-10-22 | Pinus Res | 2 | AM | BB | 620 | 1287.4 | 0.2 |
| 2023 | 2023-10-22 | Pinus Res | 2 | AM | BB | 620 | 1610.2 | 0.22 |
| 2023 | 2023-10-22 | Pinus Res | 2 | AM | BB | 720 | 2204 | 0.21 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BB | 220 | 65.5 | 0.02 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BB | 290 | 142 | 0.03 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BB | 260 | 111.6 | 0.03 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BB | 270 | 132 | 0.04 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BB | 230 | 57.3 | 0.04 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BB | 200 | 51.7 | 0.01 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BB | 250 | 99.1 | 0.02 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BB | 230 | 76.6 | 0.01 |
| 2023 | 2023-09-26 | Mainstem | 1 | BM | BB | 330 | 231.1 | 0.11 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BB | 350 | 282.7 | 0.08 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BB | 290 | 139.6 | 0.07 |
| 2023 | 2023-09-26 | Caroline Brook | 1 | BM | BB | 260 | 93.7 | 0.1 |
| 2023 | 2023-09-28 | Mainstem | 1 | BM | BB | 341 | 188 | 0.39 |
| 2023 | 2023-09-28 | Caroline Brook | 1 | BM | BB | 220 | 58.7 | 0.04 |
| 2023 | 2023-09-28 | Caroline Brook | 1 | BM | BB | 472 | 464.8 | 0.14 |
| 2023 | 2023-09-28 | Caroline Brook | 1 | BM | BB | 340 | 273.3 | 0.14 |
| 2023 | 2023-09-28 | Caroline Brook | 1 | BM | BB | 246 | 76.6 | 0.03 |
| 2023 | 2023-09-28 | Caroline Brook | 1 | BM | BB | 232 | 63.1 | 0.02 |
| 2023 | 2023-09-28 | Caroline Brook | 1 | BM | BB | 242 | 80.1 | 0.06 |
| 2023 | 2023-09-28 | Caroline Brook | 1 | BM | BB | 216 | 48.9 | 0.03 |
| 2023 | 2023-10-03 | Mackenzie River | 1 | BM | BB | 260 | 105.4 | 0.1 |
| 2023 | 2023-10-03 | Mackenzie River | 1 | BM | BB | 288 | 81.2 | 0.08 |
| 2023 | 2023-10-04 | Mainstem | 1 | BM | BB | 255 | 81 | 0.06 |
| 2023 | 2023-10-04 | Mackenzie River | 1 | BM | BB | 235 | 69.8 | 0.03 |
| 2023 | 2023-10-04 | Mackenzie River | 1 | BM | BB | 110 | 7.5 | 0.04 |
| 2023 | 2023-10-05 | Mackenzie River | 1 | BM | BB | 460 | 671.1 | 0.15 |
| 2023 | 2023-10-05 | Mainstem | 1 | BM | BB | 290 | 120.1 | 0.12 |
| 2023 | 2023-10-05 | Mackenzie River | 1 | BM | BB | 210 | 60.3 | 0.06 |
| 2023 | 2023-10-06 | Mainstem | 1 | BM | BB | 280 | 121.7 | 0.08 |
| 2023 | 2023-10-06 | Mainstem | 1 | BM | BB | 255 | 90.9 | 0.04 |
| 2023 | 2023-10-20 | | 2 | AM | BB | 930 | 3669 | 0.47 |
| 2023 | 2023-10-21 | | 2 | AM | BB | 830 | 2004 | 0.74 |

## 2023 BURBOT THg DATA (mg THg/kg ww fish)

Summary Statistics (Excel)

| | |
|---|---|
| N | 42 |
| min | 0.01 |
| max | 0.74 |
| arithmean | 0.14 |
| median | 0.08 |
| # nd | 0 |
| freq. nd (%) | 0 |

Correlation Coefficient (length vs THg)
0.804611

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/25/2024 5:22:48 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 42 | 0 | 0.01 | 0.74 | 0.135476 | 0.082138 | 0.145873 | 0.022509 | 0.074129 | 2.248108 | 1.076745 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 42 | 0 | 0.021 | 0.03 | 0.04 | 0.08 | 0.1975 | 0.21 | 0.278 | 0.388 | 0.6293 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/25/2024 5:23:52 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| Raw Statistics | |
|---|---|
| Number of Valid Observations | 42 |
| Number of Distinct Observations | 23 |
| Minimum | 0.01 |
| Maximum | 0.74 |
| Mean of Raw Data | 0.135476 |
| Standard Deviation of Raw Data | 0.145873 |
| Khat | 1.136919 |
| Theta hat | 0.119161 |
| Kstar | 1.071584 |
| Theta star | 0.126426 |
| Mean of Log Transformed Data | -2.49935 |
| Standard Deviation of Log Transformed Data | 1.048569 |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/25/2024 5:25:01 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 42 | Number of Distinct Observations | 23 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.135476 |
| Maximum | 0.74 | Median | 0.08 |
| SD | 0.145873 | Std. Error of Mean | 0.022509 |
| Coefficient of Variation | 1.076745 | Skewness | 2.248108 |

Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.739621 | Shapiro Wilk GOF Test |
| 1% Shapiro Wilk Critical Value | 0.922 | Data Not Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.194847 | Lilliefors GOF Test |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.868101 |
| Shapiro Wilk Test Statistic | 0.739621 |
| Shapiro Wilk Critical (0.0500000) Value | 0.942 |
| Approximate Shapiro Wilk P Value | 3.27E-08 |
| Lilliefors Test Statistic | 0.194847 |
| Lilliefors Critical (0.0500000) Value | 0.1353 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.988768 |
| A-D Test Statistic | 0.527078 |
| A-D Critical (0.0500000) Value | 0.774878 |
| K-S Test Statistic | 0.129262 |
| K-S Critical(0.0500000) Value | 0.140045 |

Data appear Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.992778 |
| Shapiro Wilk Test Statistic | 0.925126 |
| Shapiro Wilk Critical (0.0500000) Value | 0.942 |
| Approximate Shapiro Wilk P Value | 0.592172 |
| Lilliefors Test Statistic | 0.110848 |
| Lilliefors Critical (0.0500000) Value | 0.1353 |

Data appear Approximate_Lognormal at (0.0500000) Significance Level

| | | | |
|---|---|---|---|
| 1% Lilliefors Critical Value | 0.1573 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.173356 | 95% Adjusted-CLT UCL (Chen-1995) | 0.180843 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.174657 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.527078 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.774878 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.129262 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.140045 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.136919 | k star (bias corrected MLE) | 1.071584 |
| Theta hat (MLE) | 0.119161 | Theta star (bias corrected MLE) | 0.126426 |
| nu hat (MLE) | 95.50119 | nu star (bias corrected) | 90.01301 |
| MLE Mean (bias corrected) | 0.135476 | MLE Sd (bias corrected) | 0.130873 |
| | | Approximate Chi Square Value (0.05) | 69.13746 |
| Adjusted Level of Significance | 0.044286 | Adjusted Chi Square Value | 68.48631 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.176382 | 95% Adjusted Gamma UCL | 0.178059 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.925126 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.951 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.110848 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1244 | Data appear Lognormal at 10% Significance Level | |

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -2.49935 |
| Maximum of Logged Data | -0.30111 | SD of logged Data | 1.048569 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.211228 | 90% Chebyshev (MVUE) UCL | 0.219616 |
| 95% Chebyshev (MVUE) UCL | 0.255873 | 97.5% Chebyshev (MVUE) UCL | 0.306198 |
| 99% Chebyshev (MVUE) UCL | 0.40505 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.1725 | 95% BCA Bootstrap UCL | 0.182857 |
| 95% Standard Bootstrap UCL | 0.172916 | 95% Bootstrap-t UCL | 0.187888 |
| 95% Hall's Bootstrap UCL | 0.196057 | 95% Percentile Bootstrap UCL | 0.175 |
| 90% Chebyshev(Mean, Sd) UCL | 0.203002 | 95% Chebyshev(Mean, Sd) UCL | 0.23359 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.276043 | 99% Chebyshev(Mean, Sd) UCL | 0.359435 |

Suggested UCL to Use

95% Adjusted Gamma UCL 0.178059

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

## ALL SEALS

| Sample Year | species | sample area | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age | Age Estimate | life_stage | # non-pups |
|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | Ringed Seal | LM | 24.9 | 70 | 0.07 | 0.42 | 0 | | Pup | 13 |
| 2017 | Ringed Seal | LM | 27.2 | 72 | 0.03 | 0.22 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 27.2 | 86 | 0.02 | 0.08 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 90.7 | 117 | 0.11 | 10.6 | 3 | | Non Pup | |
| 2017 | Ringed Seal | LM | 54.4 | 110 | 0.1 | 11.1 | 6 | | Non Pup | |
| 2017 | Ringed Seal | LM | 90.7 | 124 | 0.16 | 20.2 | 6 | | Non Pup | |
| 2017 | Ringed Seal | LM | 54.4 | 105 | 0.13 | 0.12 | 3 | | Non Pup | |
| 2017 | Ringed Seal | LM | 29.5 | 82 | 0.05 | 0.28 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 22.7 | 68 | 0.04 | 0.36 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 99.8 | 128 | 0.47 | 25.4 | 3 | | Non Pup | |
| 2017 | Ringed Seal | LM | 113.4 | 123 | 0.15 | 3.27 | 3 | | Non Pup | |
| 2017 | Ringed Seal | LM | 113.4 | 128 | 0.21 | 88.1 | 15 | | Non Pup | |
| 2017 | Ringed Seal | LM | 27.2 | 80 | 0.06 | 0.33 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 68 | 103 | 0.13 | 10.6 | 4 | | Non Pup | |
| 2017 | Ringed Seal | LM | 113.4 | 130 | 0.25 | 12.8 | 4 | | Non Pup | |
| 2017 | Ringed Seal | LM | 18.1 | 68 | 0.03 | 0.22 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 36.3 | 96 | 0.09 | 0.42 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 18.1 | 70 | 0.09 | 0.76 | | | Non Pup | |
| 2017 | Ringed Seal | LM | 11.3 | 60 | 0.11 | 0.39 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 22.7 | 72 | 0.04 | 0.29 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 27.2 | 70 | 0.05 | 0.57 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 22.7 | 66 | 0.03 | 0.24 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 90.7 | 118 | 0.19 | 18.4 | 5 | | Non Pup | |
| 2017 | Ringed Seal | LM | 15.9 | 62 | 0.07 | 0.36 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 20.4 | 68 | 0.04 | 0.37 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 90.7 | 116 | 0.17 | 45.7 | 32 | | Non Pup | |
| 2017 | Ringed Seal | LM | 90.7 | 118 | 0.69 | 150 | 3 | | Non Pup | |
| 2017 | Ringed Seal | LM | 27.2 | 80 | 0.04 | 0.29 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 22.7 | 76 | 0.06 | 0.29 | 0 | | Pup | |
| 2017 | Ringed Seal | LM | 27.2 | 80 | 0.06 | 0.5 | 0 | | Pup | |

## NON-PUPS (estimated age range: 3 to 32 years)

| Sample Year | species | sample area | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age | Age Estimate | life_stage |
|---|---|---|---|---|---|---|---|---|---|
| 2017 | Ringed Seal | LM | 90.7 | 117 | 0.11 | 10.6 | 3 | | Non Pup |
| 2017 | Ringed Seal | LM | 54.4 | 110 | 0.1 | 11.1 | 6 | | Non Pup |
| 2017 | Ringed Seal | LM | 90.7 | 124 | 0.16 | 20.2 | 6 | | Non Pup |
| 2017 | Ringed Seal | LM | 54.4 | 105 | 0.13 | 0.12 | 3 | | Non Pup |
| 2017 | Ringed Seal | LM | 99.8 | 128 | 0.47 | 25.4 | 3 | | Non Pup |
| 2017 | Ringed Seal | LM | 113.4 | 123 | 0.15 | 3.27 | 3 | | Non Pup |
| 2017 | Ringed Seal | LM | 113.4 | 128 | 0.21 | 88.1 | 15 | | Non Pup |
| 2017 | Ringed Seal | LM | 68 | 103 | 0.13 | 10.6 | 4 | | Non Pup |
| 2017 | Ringed Seal | LM | 113.4 | 130 | 0.25 | 12.8 | 4 | | Non Pup |
| 2017 | Ringed Seal | LM | 18.1 | 70 | 0.09 | 0.76 | | | Non Pup |
| 2017 | Ringed Seal | LM | 90.7 | 118 | 0.19 | 18.4 | 5 | | Non Pup |
| 2017 | Ringed Seal | LM | 90.7 | 116 | 0.17 | 45.7 | 32 | | Non Pup |
| 2017 | Ringed Seal | LM | 90.7 | 118 | 0.69 | 150 | 3 | | Non Pup |

## PUPS (<1 year)

| Sample Year | species | sample area | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age | Age Estimate | life_stage |
|---|---|---|---|---|---|---|---|---|---|
| 2017 | Ringed Seal | LM | 24.9 | 70 | 0.07 | 0.42 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 27.2 | 72 | 0.03 | 0.22 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 27.2 | 86 | 0.02 | 0.08 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 29.5 | 82 | 0.05 | 0.28 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 22.7 | 68 | 0.04 | 0.36 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 27.2 | 80 | 0.06 | 0.33 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 18.1 | 68 | 0.03 | 0.22 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 36.3 | 96 | 0.09 | 0.42 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 11.3 | 60 | 0.11 | 0.39 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 22.7 | 72 | 0.04 | 0.29 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 27.2 | 70 | 0.05 | 0.57 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 22.7 | 66 | 0.03 | 0.24 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 15.9 | 62 | 0.07 | 0.36 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 20.4 | 68 | 0.04 | 0.37 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 27.2 | 80 | 0.04 | 0.29 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 22.7 | 76 | 0.06 | 0.29 | 0 | | Pup |
| 2017 | Ringed Seal | LM | 27.2 | 80 | 0.06 | 0.5 | 0 | | Pup |

## THg Statistics - Non-pups

Meat (Muscle) THg

| | |
|---|---|
| N | 13 |
| min | 0.09 |
| max | 0.69 |
| arithmean | 0.21923077 |
| median | 0.16 |
| #nd | 0 |
| Freq nd | 0% |

| | |
|---|---|
| length vs THg (muscle) | |
| 0.364203574 | |
| | |
| length vs THg (liver) | |
| 0.291191264 | |

Liver THg

| | |
|---|---|
| N | 13 |
| min | 0.12 |
| max | 150 |
| arithmean | 30.5423077 |
| median | 12.8 |
| #nd | 0 |
| Freq nd | 0% |

### Non-pups - THg in Muscle (Meat)

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/28/2024 3:00:26 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 13 | 0 | 0.09 | 0.69 | 0.2192308 | 0.1808148 | 0.1722141 | 0.0477636 | 0.074129 | 2.1764217 | 0.7855379 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 13 | 0 | 0.102 | 0.118 | 0.13 | 0.16 | 0.21 | 0.234 | 0.426 | 0.558 | 0.6636 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 2/28/2024 3:05:47 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 13 |
| Number of Distinct Observations | 12 |
| Minimum | 0.09 |
| Maximum | 0.69 |
| Mean of Raw Data | 0.2192308 |
| Standard Deviation of Raw Data | 0.1722141 |
| Khat | 2.7506537 |
| Theta hat | 0.0797013 |
| Kstar | 2.1671695 |
| Theta star | 0.10116 |
| Mean of Log Transformed Data | -1.710282 |
| Standard Deviation of Log Transformed Data | 0.5910293 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.8288812 |
| Shapiro Wilk Test Statistic | 0.7015075 |
| Shapiro Wilk Critical (0.0500000) Value | 0.866 |
| Approximate Shapiro Wilk P Value | 3.04E-04 |
| Lilliefors Test Statistic | 0.2906041 |
| Lilliefors Critical (0.0500000) Value | 0.2337 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9335653 |
| A-D Test Statistic | 0.8971517 |
| A-D Critical (0.0500000) Value | 0.7401574 |
| K-S Test Statistic | 0.2166165 |
| K-S Critical(0.0500000) Value | 0.2385217 |
| Data follow Appr. Gamma Distribution at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.943998 |
| Shapiro Wilk Test Statistic | 0.8927351 |
| Shapiro Wilk Critical (0.0500000) Value | 0.866 |

## THg Statistics - All seals combined

Meat (Muscle) THg

| | |
|---|---|
| N | 30 |
| min | 0.02 |
| max | 0.69 |
| arithmean | 0.124667 |
| median | 0.08 |
| #nd | 0 |
| Freq nd | 0% |

| | |
|---|---|
| length vs THg (muscle) | |
| 0.636728 | |
| | |
| length vs THg (liver) | |
| 0.522878 | |

Liver THg

| | |
|---|---|
| N | 30 |
| min | 0.08 |
| max | 150 |
| arithmean | 13.42267 |
| median | 0.42 |
| #nd | 0 |
| Freq nd | 0% |

### All Seals - THg in Muscle (Meat)

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/28/2024 11:20:48 AM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 30 | 0 | 0.02 | 0.69 | 0.124667 | 0.085133 | 0.140166 | 0.025591 | 0.059303 | 2.907257 | 1.124324 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 30 | 0 | 0.03 | 0.04 | 0.0425 | 0.08 | 0.145 | 0.162 | 0.214 | 0.371 | 0.6262 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 2/28/2024 11:22:18 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 30 |
| Number of Distinct Observations | 18 |
| Minimum | 0.02 |
| Maximum | 0.69 |
| Mean of Raw Data | 0.124667 |
| Standard Deviation of Raw Data | 0.140166 |
| Khat | 1.45504 |
| Theta hat | 0.085679 |
| Kstar | 1.331759 |
| Theta star | 0.093611 |
| Mean of Log Transformed Data | -2.46354 |
| Standard Deviation of Log Transformed Data | 0.836473 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.796951 |
| Shapiro Wilk Test Statistic | 0.655337 |
| Shapiro Wilk Critical (0.0500000) Value | 0.927 |
| Approximate Shapiro Wilk P Value | 3.84E-08 |
| Lilliefors Test Statistic | 0.227612 |
| Lilliefors Critical (0.0500000) Value | 0.159 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.94039 |
| A-D Test Statistic | 0.874169 |
| A-D Critical (0.0500000) Value | 0.76415 |
| K-S Test Statistic | 0.135094 |
| K-S Critical(0.0500000) Value | 0.163043 |
| Data follow Appr. Gamma Distribution at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.984234 |
| Shapiro Wilk Test Statistic | 0.966916 |
| Shapiro Wilk Critical (0.0500000) Value | 0.927 |
| Approximate Shapiro Wilk P Value | 0.506565 |
| Lilliefors Test Statistic | 0.095457 |
| Lilliefors Critical (0.0500000) Value | 0.159 |
| Data appear Lognormal at (0.0500000) Significance Level | |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 2/28/2024 11:25:21 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 30 | Number of Distinct Observations | 18 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.02 | Mean | 0.124667 |
| Maximum | 0.69 | Median | 0.08 |
| SD | 0.140166 | Std. Error of Mean | 0.025591 |
| Coefficient of Variation | 1.124324 | Skewness | 2.907257 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.655337 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.9 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.227612 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.1848 | Data Not Normal at 1% Significance Level | |
| Data Not Normal at 1% Significance Level | | | |

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.168148 | 95% Adjusted-CLT UCL (Chen-1995) | 0.181273 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.170412 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.874169 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.76415 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.135094 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.163043 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data follow Appr. Gamma Distribution at 5% Significance Level | | | |

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.45504 | k star (bias corrected MLE) | 1.331759 |
| Theta hat (MLE) | 0.085679 | Theta star (bias corrected MLE) | 0.093611 |
| nu hat (MLE) | 87.30242 | nu star (bias corrected) | 79.90551 |
| MLE Mean (bias corrected) | 0.124667 | MLE Sd (bias corrected) | 0.108028 |
| | | Approximate Chi Square Value (0.05) | 60.30933 |
| Adjusted Level of Significance | 0.041 | Adjusted Chi Square Value | 59.32768 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.165174 | 95% Adjusted Gamma UCL | 0.167907 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.966916 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.939 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.095457 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.146 | Data appear Lognormal at 10% Significance Level | |
| Data appear Lognormal at 10% Significance Level | | | |

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -3.91202 | Mean of logged Data | -2.46354 |
| Maximum of Logged Data | -0.37106 | SD of logged Data | 0.836473 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.17215 | 90% Chebyshev (MVUE) UCL | 0.179522 |
| 95% Chebyshev (MVUE) UCL | 0.206953 | 97.5% Chebyshev (MVUE) UCL | 0.245027 |
| 99% Chebyshev (MVUE) UCL | 0.319816 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

### All Seals - THg in Liver

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/28/2024 12:39:54 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 30 | 0 | 0.08 | 150 | 13.42267 | 1.437463 | 31.54742 | 5.759745 | 0.296516 | 3.478648 | 2.350309 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 30 | 0 | 0.22 | 0.288 | 0.29 | 0.42 | 10.975 | 13.92 | 27.43 | 69.02 | 132.049 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 2/28/2024 12:41:16 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 30 |
| Number of Distinct Observations | 24 |
| Minimum | 0.08 |
| Maximum | 150 |
| Mean of Raw Data | 13.42267 |
| Standard Deviation of Raw Data | 31.54742 |
| Khat | 0.30743 |
| Theta hat | 43.66095 |
| Kstar | 0.298909 |
| Theta star | 44.90555 |
| Mean of Log Transformed Data | 0.36288 |
| Standard Deviation of Log Transformed Data | 2.196608 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.679281 |
| Shapiro Wilk Test Statistic | 0.485371 |
| Shapiro Wilk Critical (0.0500000) Value | 0.927 |
| Approximate Shapiro Wilk P Value | 6.66E-11 |
| Lilliefors Test Statistic | 0.33617 |
| Lilliefors Critical (0.0500000) Value | 0.159 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.973817 |
| A-D Test Statistic | 2.90511 |
| A-D Critical (0.0500000) Value | 0.852141 |
| K-S Test Statistic | 0.313529 |
| K-S Critical(0.0500000) Value | 0.173455 |
| Data not Gamma Distributed at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.925646 |
| Shapiro Wilk Test Statistic | 0.845205 |
| Shapiro Wilk Critical (0.0500000) Value | 0.927 |
| Approximate Shapiro Wilk P Value | 3.43E-04 |
| Lilliefors Test Statistic | 0.26316 |
| Lilliefors Critical (0.0500000) Value | 0.159 |
| Data not Lognormal at (0.0500000) Significance Level | |

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 2/28/2024 12:42:14 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operation | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 30 | Number of Distinct Observations | 24 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.08 | Mean | 13.42267 |
| Maximum | 150 | Median | 0.42 |
| SD | 31.54742 | Std. Error of Mean | 5.759745 |
| Coefficient of Variation | 2.350309 | Skewness | 3.478648 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.485371 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.9 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.33617 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.1848 | Data Not Normal at 1% Significance Level | |
| Data Not Normal at 1% Significance Level | | | |

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 23.2092 | 95% Adjusted-CLT UCL (Chen-1995) | 26.80531 |
| | | 95% Modified-t UCL (Johnson-1978) | 23.81888 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 2.90511 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.852141 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.313529 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.173455 | Data Not Gamma Distributed at 5% Significance Level | |
| Data Not Gamma Distributed at 5% Significance Level | | | |

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 0.30743 | k star (bias corrected MLE) | 0.298909 |
| Theta hat (MLE) | 43.66095 | Theta star (bias corrected MLE) | 44.90555 |
| nu hat (MLE) | 18.44578 | nu star (bias corrected) | 17.93453 |
| MLE Mean (bias corrected) | 13.42267 | MLE Sd (bias corrected) | 24.55101 |
| | | Approximate Chi Square Value (0.05) | 9.343569 |
| Adjusted Level of Significance | 0.041 | Adjusted Chi Square Value | 8.986081 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 25.76416 | 95% Adjusted Gamma UCL | 26.78912 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.845205 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.939 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.26316 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.146 | Data Not Lognormal at 10% Significance Level | |
| Data Not Lognormal at 10% Significance Level | | | |

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.52573 | Mean of logged Data | 0.36288 |
| Maximum of Logged Data | 5.010635 | SD of logged Data | 2.196608 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 90.82446 | 90% Chebyshev (MVUE) UCL | 33.66741 |
| 95% Chebyshev (MVUE) UCL | 43.13892 | 97.5% Chebyshev (MVUE) UCL | 56.28501 |

| | |
|---|---|
| Approximate Shapiro Wilk P Value | 0.1025052 |
| Lilliefors Test Statistic | 0.169297 |
| Lilliefors Critical (0.0500000) Value | 0.2337 |

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/28/2024 3:06:49 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 13 | Number of Distinct Observations | 12 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.09 | Mean | 0.2192308 |
| Maximum | 0.69 | Median | 0.16 |
| SD | 0.1722141 | Std. Error of Mean | 0.0477636 |
| Coefficient of Variation | 0.7855379 | Skewness | 2.1764217 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.7015075 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.814 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.2906041 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2714 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.3043592 | 95% Adjusted-CLT UCL (Chen-1995) | 0.3286018 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.3091645 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.8971517 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7401574 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.2166165 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.2385217 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.7506537 | k star (bias corrected MLE) | 2.1671695 |
| Theta hat (MLE) | 0.0797013 | Theta star (bias corrected MLE) | 0.10116 |
| nu hat (MLE) | 71.516995 | nu star (bias corrected) | 56.346406 |
| MLE Mean (bias corrected) | 0.2192308 | MLE Sd (bias corrected) | 0.1489207 |
| | | Approximate Chi Square Value (0.05) | 40.093752 |
| Adjusted Level of Significance | 0.03009 | Adjusted Chi Square Value | 38.146583 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.3080995 | 95% Adjusted Gamma UCL | 0.3238263 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.8927351 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.889 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.169297 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.2147 | Data appear Lognormal at 10% Significance Level | |

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.407946 | Mean of logged Data | -1.710282 |
| Maximum of Logged Data | -0.371064 | SD of logged Data | 0.5910293 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.314655 | 90% Chebyshev (MVUE) UCL | 0.3199962 |
| 95% Chebyshev (MVUE) UCL | 0.3688859 | 97.5% Chebyshev (MVUE) UCL | 0.4367429 |
| 99% Chebyshev (MVUE) UCL | 0.5700349 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.2977949 | 95% BCA Bootstrap UCL | 0.3230769 |
| 95% Standard Bootstrap UCL | 0.2941704 | 95% Bootstrap-t UCL | 0.4857217 |
| 95% Hall's Bootstrap UCL | 0.7149468 | 95% Percentile Bootstrap UCL | 0.3007692 |
| 90% Chebyshev(Mean, Sd) UCL | 0.3625216 | 95% Chebyshev(Mean, Sd) UCL | 0.4274275 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.5175143 | 99% Chebyshev(Mean, Sd) UCL | 0.6944725 |

Suggested UCL to Use

| | |
|---|---|
| 95% Adjusted Gamma UCL | 0.3238263 |

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Non-pups - THg in Liver

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/28/2024 3:10:34 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 13 | 0 | 0.12 | 150 | 30.542308 | 10.798402 | 42.951612 | 11.912634 | 14.128984 | 2.227445 | 1.4062988 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 13 | 0 | 1.262 | 6.202 | 10.6 | 12.8 | 25.4 | 37.58 | 79.62 | 112.86 | 142.572 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/28/2024 4:14:36 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 13 |
| Number of Distinct Observations | 12 |
| Minimum | 0.12 |
| Maximum | 150 |
| Mean of Raw Data | 30.542308 |
| Standard Deviation of Raw Data | 42.951612 |
| Khat | 0.5950086 |
| Theta hat | 51.330868 |
| Kstar | 0.508981 |
| Theta star | 60.006777 |
| Mean of Log Transformed Data | 2.3793982 |
| Standard Deviation of Log Transformed Data | 1.9053882 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.8212927 |
| Shapiro Wilk Test Statistic | 0.6897433 |
| Shapiro Wilk Critical (0.0500000) Value | 0.866 |
| Approximate Shapiro Wilk P Value | 2.21E-04 |
| Lilliefors Test Statistic | 0.3168796 |
| Lilliefors Critical (0.0500000) Value | 0.2337 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9865464 |
| A-D Test Statistic | 0.3131172 |
| A-D Critical (0.0500000) Value | 0.7824861 |
| K-S Test Statistic | 0.1755925 |
| K-S Critical(0.0500000) Value | 0.2483127 |

Data appear Gamma Distributed at (0.0500000) Significance Level

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.16676 | 95% BCA Bootstrap UCL | 0.189333 |
| 95% Standard Bootstrap UCL | 0.166731 | 95% Bootstrap-t UCL | 0.211293 |
| 95% Hall's Bootstrap UCL | 0.378867 | 95% Percentile Bootstrap UCL | 0.17 |
| 90% Chebyshev(Mean, Sd) UCL | 0.201439 | 95% Chebyshev(Mean, Sd) UCL | 0.236214 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.28448 | 99% Chebyshev(Mean, Sd) UCL | 0.37929 |

Suggested UCL to Use

| | |
|---|---|
| 95% Adjusted Gamma UCL | 0.167907 |

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| | |
|---|---|
| 99% Chebyshev (MVUE) UCL | 82.10795 |

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 22.8966 | 95% BCA Bootstrap UCL | 27.23733 |
| 95% Standard Bootstrap UCL | 22.75007 | 95% Bootstrap-t UCL | 39.01227 |
| 95% Hall's Bootstrap UCL | 60.54156 | 95% Percentile Bootstrap UCL | 23.422 |
| 90% Chebyshev(Mean, Sd) UCL | 30.7019 | 95% Chebyshev(Mean, Sd) UCL | 38.52881 |
| 97.5% Chebyshev(Mean, Sd) UCL | 49.39226 | 99% Chebyshev(Mean, Sd) UCL | 70.7314 |

Suggested UCL to Use

| | |
|---|---|
| 95% Student's-t UCL | 23.2092 |

rejected as data distribution is non-parametric

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

average of non-parametric UCLs at 5% significance level was selected
33.48409

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9463893 |
| Shapiro Wilk Test Statistic | 0.9067528 |
| Shapiro Wilk Critical (0.0500000) Value | 0.866 |
| Approximate Shapiro Wilk P Value | 0.1356237 |
| Lilliefors Test Statistic | 0.2653481 |
| Lilliefors Critical (0.0500000) Value | 0.2337 |

Data appear Approximate_Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/28/2024 4:15:32 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 13 | Number of Distinct Observations | 12 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.12 | Mean | 30.542308 |
| Maximum | 150 | Median | 12.8 |
| SD | 42.951612 | Std. Error of Mean | 11.912634 |
| Coefficient of Variation | 1.4062988 | Skewness | 2.227445 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.6897433 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.814 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.3168796 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2714 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 51.774047 | 95% Adjusted-CLT UCL (Chen-1995) | 58.000485 |
| | | 95% Modified-t UCL (Johnson-1978) | 53.000616 |

Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.3131172 | Anderson-Darling Gamma GOF Test |
| 5% A-D Critical Value | 0.7824861 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.1755925 | Kolmogorov-Smirnov Gamma GOF Test |
| 5% K-S Critical Value | 0.2483127 | Detected data appear Gamma Distributed at 5% Significance Level |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 0.5950086 | k star (bias corrected MLE) | 0.508981 |
| Theta hat (MLE) | 51.330868 | Theta star (bias corrected MLE) | 60.006777 |
| nu hat (MLE) | 15.470224 | nu star (bias corrected) | 13.233505 |
| MLE Mean (bias corrected) | 30.542308 | MLE Sd (bias corrected) | 42.810576 |
| | | Approximate Chi Square Value (0.05) | 6.0500546 |
| Adjusted Level of Significance | 0.03009 | Adjusted Chi Square Value | 5.3728461 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 66.806305 | 95% Adjusted Gamma UCL | 75.226758 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9067528 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.889 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.2653481 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.2147 | Data Not Lognormal at 10% Significance Level | |

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.120264 | Mean of logged Data | 2.3793982 |
| Maximum of Logged Data | 5.0106353 | SD of logged Data | 1.9053882 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 819.64485 | 90% Chebyshev (MVUE) UCL | 135.88908 |
| 95% Chebyshev (MVUE) UCL | 175.15285 | 97.5% Chebyshev (MVUE) UCL | 229.64944 |
| 99% Chebyshev (MVUE) UCL | 336.69743 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 50.136847 | 95% BCA Bootstrap UCL | 57.713077 |
| 95% Standard Bootstrap UCL | 49.195713 | 95% Bootstrap-t UCL | 99.225338 |
| 95% Hall's Bootstrap UCL | 143.48036 | 95% Percentile Bootstrap UCL | 50.038462 |
| 90% Chebyshev(Mean, Sd) UCL | 66.280209 | 95% Chebyshev(Mean, Sd) UCL | 82.468275 |
| 97.5% Chebyshev(Mean, Sd) UCL | 104.93668 | 99% Chebyshev(Mean, Sd) UCL | 149.07152 |

Suggested UCL to Use

| | |
|---|---|
| 95% Adjusted Gamma UCL | 75.226758 |

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

## THg Statistics - Pups

| Meat (Muscle) THg | | | Liver THg | |
|---|---|---|---|---|
| N | 17 | length vs THg (muscle) | N | 17 |
| min | 0.02 | -0.02773751 | min | 0.08 |
| max | 0.11 | | max | 0.57 |
| arithmean | 0.05235294 | length vs THg (liver) | arithmean | 0.33117647 |
| median | 0.05 | -0.11671261 | median | 0.33 |
| #nd | 0 | | #nd | 0 |
| Freq nd | 0% | | Freq nd | 0% |

Pups - THg in Muscle (Meat)

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/29/2024 10:05:54 AM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 17 | 0 | 0.02 | 0.11 | 0.0523529 | 0.0478556 | 0.0233263 | 0.0056575 | 0.0148258 | 1.0175255 | 0.4455591 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 17 | 0 | 0.03 | 0.032 | 0.04 | 0.05 | 0.06 | 0.068 | 0.078 | 0.094 | 0.1068 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 2/29/2024 10:06:46 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 17 |
| Number of Distinct Observations | 8 |
| Minimum | 0.02 |
| Maximum | 0.11 |
| Mean of Raw Data | 0.0523529 |
| Standard Deviation of Raw Data | 0.0233263 |
| Khat | 5.7281867 |
| Theta hat | 0.0091395 |
| Kstar | 4.7565459 |
| Theta star | 0.0110065 |

| | |
|---|---|
| Mean of Log Transformed Data | -3.039567 |
| Standard Deviation of Log Transformed Data | 0.4389072 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.957479 |
| Shapiro Wilk Test Statistic | 0.9208572 |
| Shapiro Wilk Critical (0.0500000) Value | 0.892 |
| Approximate Shapiro Wilk P Value | 0.1511968 |
| Lilliefors Test Statistic | 0.1723834 |
| Lilliefors Critical (0.0500000) Value | 0.2071 |

Data appear Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9872457 |
| A-D Test Statistic | 0.2864705 |
| A-D Critical (0.0500000) Value | 0.7411495 |
| K-S Test Statistic | 0.1527588 |
| K-S Critical(0.0500000) Value | 0.209612 |

Data appear Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9870009 |
| Shapiro Wilk Test Statistic | 0.9758691 |
| Shapiro Wilk Critical (0.0500000) Value | 0.892 |
| Approximate Shapiro Wilk P Value | 0.8891817 |
| Lilliefors Test Statistic | 0.1291477 |
| Lilliefors Critical (0.0500000) Value | 0.2071 |

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/29/2024 10:07:58 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 17 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.02 | Mean | 0.0523529 |
| Maximum | 0.11 | Median | 0.05 |
| SD | 0.0233263 | Std. Error of Mean | 0.0056575 |
| Coefficient of Variation | 0.4455591 | Skewness | 1.0175255 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9208572 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.851 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.1723834 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2408 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.0622302 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0631505 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0624629 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.2864705 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7411495 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.1527588 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.209612 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 5.7281867 | k star (bias corrected MLE) | 4.7565459 |
| Theta hat (MLE) | 0.0091395 | Theta star (bias corrected MLE) | 0.0110065 |
| nu hat (MLE) | 194.75835 | nu star (bias corrected) | 161.72256 |
| MLE Mean (bias corrected) | 0.0523529 | MLE Sd (bias corrected) | 0.0240046 |
| | | Approximate Chi Square Value (0.05) | 133.32043 |
| Adjusted Level of Significance | 0.03461 | Adjusted Chi Square Value | 130.61943 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.063506 | 95% Adjusted Gamma UCL | 0.0648192 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9758691 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.91 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.1291477 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1902 | Data appear Lognormal at 10% Significance Level | |

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -3.912023 | Mean of logged Data | -3.039567 |
| Maximum of Logged Data | -2.207275 | SD of logged Data | 0.4389072 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.0654582 | 90% Chebyshev (MVUE) UCL | 0.0695325 |
| 95% Chebyshev (MVUE) UCL | 0.0773052 | 97.5% Chebyshev (MVUE) UCL | 0.0880933 |
| 99% Chebyshev (MVUE) UCL | 0.1092846 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.0616586 | 95% BCA Bootstrap UCL | 0.0635294 |
| 95% Standard Bootstrap UCL | 0.0613272 | 95% Bootstrap-t UCL | 0.06492 |
| 95% Hall's Bootstrap UCL | 0.0664894 | 95% Percentile Bootstrap UCL | 0.0617647 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0693253 | 95% Chebyshev(Mean, Sd) UCL | 0.0770133 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0876838 | 99% Chebyshev(Mean, Sd) UCL | 0.108644 |

Suggested UCL to Use

| | |
|---|---|
| 95% Student's-t UCL | 0.0622302 |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Pups - Thg in Liver

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/29/2024 10:16:21 AM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 17 | 0 | 0.08 | 0.57 | 0.3311765 | 0.3075358 | 0.1150479 | 0.0279032 | 0.0889548 | 0.0208636 | 0.3473917 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 17 | 0 | 0.22 | 0.248 | 0.28 | 0.33 | 0.39 | 0.414 | 0.452 | 0.514 | 0.5588 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/29/2024 10:17:33 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 17 |
| Number of Distinct Observations | 12 |
| Minimum | 0.08 |
| Maximum | 0.57 |
| Mean of Raw Data | 0.3311765 |
| Standard Deviation of Raw Data | 0.1150479 |
| Khat | 6.9137182 |
| Theta hat | 0.0479014 |

| | |
|---|---|
| Kstar | 5.732866 |
| Theta star | 0.057768 |
| Mean of Log Transformed Data | -1.179164 |
| Standard Deviation of Log Transformed Data | 0.4383705 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9823675 |
| Shapiro Wilk Test Statistic | 0.9770654 |
| Shapiro Wilk Critical (0.0500000) Value | 0.892 |
| Approximate Shapiro Wilk P Value | 0.8612028 |
| Lilliefors Test Statistic | 0.1103818 |
| Lilliefors Critical (0.0500000) Value | 0.2071 |

Data appear Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.974828 |
| A-D Test Statistic | 0.4468632 |
| A-D Critical (0.0500000) Value | 0.7404975 |
| K-S Test Statistic | 0.146605 |
| K-S Critical(0.0500000) Value | 0.20942 |

Data appear Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9118147 |
| Shapiro Wilk Test Statistic | 0.8542619 |
| Shapiro Wilk Critical (0.0500000) Value | 0.892 |
| Approximate Shapiro Wilk P Value | 0.0092526 |
| Lilliefors Test Statistic | 0.1799877 |
| Lilliefors Critical (0.0500000) Value | 0.2071 |

Data appear Approximate_Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/29/2024 10:18:23 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 17 | Number of Distinct Observations | 12 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.08 | Mean | 0.3311765 |
| Maximum | 0.57 | Median | 0.33 |
| SD | 0.1150479 | Std. Error of Mean | 0.0279032 |
| Coefficient of Variation | 0.3473917 | Skewness | 0.0208636 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9770654 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.851 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.1103818 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2408 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.3798923 | 95% Adjusted-CLT UCL (Chen-1995) | 0.3772241 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.3799158 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.4468632 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7404975 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.146605 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.20942 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 6.9137182 | k star (bias corrected MLE) | 5.732866 |
| Theta hat (MLE) | 0.0479014 | Theta star (bias corrected MLE) | 0.057768 |
| nu hat (MLE) | 235.06642 | nu star (bias corrected) | 194.91744 |
| MLE Mean (bias corrected) | 0.3311765 | MLE Sd (bias corrected) | 0.1383164 |
| | | Approximate Chi Square Value (0.05) | 163.61718 |
| Adjusted Level of Significance | 0.03461 | Adjusted Chi Square Value | 160.61358 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.3945311 | 95% Adjusted Gamma UCL | 0.4019092 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.8542619 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.91 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.1799877 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1902 | Data appear Lognormal at 10% Significance Level | |

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.525729 | Mean of logged Data | -1.179164 |
| Maximum of Logged Data | -0.562119 | SD of logged Data | 0.4383705 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.4204225 | 90% Chebyshev (MVUE) UCL | 0.4465993 |
| 95% Chebyshev (MVUE) UCL | 0.4964741 | 97.5% Chebyshev (MVUE) UCL | 0.5656983 |
| 99% Chebyshev (MVUE) UCL | 0.701676 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.3770732 | 95% BCA Bootstrap UCL | 0.3764706 |
| 95% Standard Bootstrap UCL | 0.3756738 | 95% Bootstrap-t UCL | 0.3831357 |
| 95% Hall's Bootstrap UCL | 0.3853667 | 95% Percentile Bootstrap UCL | 0.3752941 |
| 90% Chebyshev(Mean, Sd) UCL | 0.4148861 | 95% Chebyshev(Mean, Sd) UCL | 0.4528038 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.5054321 | 99% Chebyshev(Mean, Sd) UCL | 0.6088101 |

Suggested UCL to Use

| | |
|---|---|
| 95% Student's-t UCL | 0.3798923 |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

## ALL SEALS

| Sample Year | species | sample area | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age | Age Estimate | life_stage | # non-pups |
|---|---|---|---|---|---|---|---|---|---|---|
| 2018 | Ringed Seal | LM | 54.5 | 104 | 0.11 | 8.15 | 4 | Non Pup | | 16 |
| 2018 | Ringed Seal | LM | 22.7 | 68 | 0.05 | 0.14 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 27.3 | 72 | 0.05 | 0.11 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 68.2 | 115 | 0.13 | 35.2 | 5 | Non Pup | | |
| 2018 | Ringed Seal | LM | 90.9 | 134 | 0.12 | 5.81 | 8 | Non Pup | | |
| 2018 | Ringed Seal | LM | 18.2 | 66 | 0.05 | 0.15 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 27.3 | 78 | 0.05 | 0.1 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 27.3 | 80 | 0.05 | 0.16 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 22.7 | 74 | 0.05 | 0.14 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 22.7 | 76 | 0.05 | 0.2 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 31.8 | 80 | 0.05 | 0.08 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 22.7 | 68 | 0.05 | 0.17 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 27.3 | 72 | 0.05 | 0.16 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 22.7 | 68 | 0.05 | 0.18 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 22.7 | 66 | 0.05 | 0.14 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 45.5 | 105 | 0.15 | 8.59 | 4 | Non Pup | | |
| 2018 | Ringed Seal | LM | 18.2 | 64 | 0.05 | 0.44 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 45.5 | 108 | 0.11 | 7.8 | 4 | Non Pup | | |
| 2018 | Ringed Seal | LM | 45.5 | 112 | 0.14 | 7.19 | 5 | Non Pup | | |
| 2018 | Ringed Seal | LM | 68.2 | 124 | 0.22 | 10.4 | 6 | Non Pup | | |
| 2018 | Ringed Seal | LM | 40.9 | 100 | 0.56 | 27.2 | 3 | Non Pup | | |
| 2018 | Ringed Seal | LM | 22.7 | 88 | 0.05 | 0.16 | 2 | Non Pup | | |
| 2018 | Ringed Seal | LM | 81.8 | 140 | 0.41 | 21.6 | 9 | Non Pup | | |
| 2018 | Ringed Seal | LM | 68.2 | 137 | 0.23 | 22.1 | 9 | Non Pup | | |
| 2018 | Ringed Seal | LM | 90.9 | 162 | 0.05 | 15 | 14 | Non Pup | | |
| 2018 | Ringed Seal | LM | 63.6 | 138 | 0.17 | 9.53 | 9 | Non Pup | | |
| 2018 | Ringed Seal | LM | 59.1 | 128 | 0.08 | 10.7 | 7 | Non Pup | | |
| 2018 | Ringed Seal | LM | 31.8 | 78 | 0.05 | 0.41 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 45.5 | 110 | 0.13 | 8.97 | 4 | Non Pup | | |
| 2018 | Ringed Seal | LM | 22.7 | 65 | 0.05 | 0.36 | 0 | Pup | | |
| 2018 | Ringed Seal | LM | 45.5 | 124 | 0.11 | 6.9 | 6 | Non Pup | | |

## NON-PUPS (estimated age range: 2 to 14 years)

| Sample Year | species | sample area | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age | Age Estimate | life_stage |
|---|---|---|---|---|---|---|---|---|---|
| 2018 | Ringed Seal | LM | 54.5 | 104 | 0.11 | 8.15 | 4 | Non Pup | |
| 2018 | Ringed Seal | LM | 68.2 | 115 | 0.13 | 35.2 | 5 | Non Pup | |
| 2018 | Ringed Seal | LM | 90.9 | 134 | 0.12 | 5.81 | 8 | Non Pup | |
| 2018 | Ringed Seal | LM | 45.5 | 105 | 0.15 | 8.59 | 4 | Non Pup | |
| 2018 | Ringed Seal | LM | 45.5 | 108 | 0.11 | 7.8 | 4 | Non Pup | |
| 2018 | Ringed Seal | LM | 45.5 | 112 | 0.14 | 7.19 | 5 | Non Pup | |
| 2018 | Ringed Seal | LM | 68.2 | 124 | 0.22 | 10.4 | 6 | Non Pup | |
| 2018 | Ringed Seal | LM | 40.9 | 100 | 0.56 | 27.2 | 3 | Non Pup | |
| 2018 | Ringed Seal | LM | 22.7 | 88 | 0.05 | 0.16 | 2 | Non Pup | |
| 2018 | Ringed Seal | LM | 81.8 | 140 | 0.41 | 21.6 | 9 | Non Pup | |
| 2018 | Ringed Seal | LM | 68.2 | 137 | 0.23 | 22.1 | 9 | Non Pup | |
| 2018 | Ringed Seal | LM | 90.9 | 162 | 0.05 | 15 | 14 | Non Pup | |
| 2018 | Ringed Seal | LM | 63.6 | 138 | 0.17 | 9.53 | 9 | Non Pup | |
| 2018 | Ringed Seal | LM | 59.1 | 128 | 0.08 | 10.7 | 7 | Non Pup | |
| 2018 | Ringed Seal | LM | 45.5 | 110 | 0.13 | 8.97 | 4 | Non Pup | |
| 2018 | Ringed Seal | LM | 45.5 | 124 | 0.11 | 6.9 | 6 | Non Pup | |

## PUPS (<1 year)

| Sample Year | species | sample area | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age | Age Estimate | life_stage |
|---|---|---|---|---|---|---|---|---|---|
| 2018 | Ringed Seal | LM | 22.7 | 68 | 0.05 | 0.14 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 27.3 | 72 | 0.05 | 0.11 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 18.2 | 66 | 0.05 | 0.15 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 27.3 | 78 | 0.05 | 0.1 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 27.3 | 80 | 0.05 | 0.16 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 22.7 | 74 | 0.05 | 0.14 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 22.7 | 76 | 0.05 | 0.2 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 31.8 | 80 | 0.05 | 0.08 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 22.7 | 68 | 0.05 | 0.17 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 27.3 | 72 | 0.05 | 0.16 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 22.7 | 68 | 0.05 | 0.18 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 22.7 | 66 | 0.05 | 0.14 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 18.2 | 64 | 0.05 | 0.44 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 31.8 | 78 | 0.05 | 0.41 | 0 | Pup | |
| 2018 | Ringed Seal | LM | 22.7 | 65 | 0.05 | 0.36 | 0 | Pup | |

## THg Statistics - Non-pups

Meat (Muscle) THg

| | |
|---|---|
| N | 16 |
| min | 0.05 |
| max | 0.56 |
| arithmean | 0.173125 |
| median | 0.13 |
| #nd | 2 |
| Freq nd | 13% |

length vs THg (muscle): -0.04881529

length vs THg (liver): 0.195842135

Liver THg

| | |
|---|---|
| N | 16 |
| min | 0.16 |
| max | 35.2 |
| arithmean | 12.83125 |
| median | 9.25 |
| #nd | 0 |
| Freq nd | 0% |

Non-pups - THg in Muscle (Meat)

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/5/2024 2:52:12 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 16 | 0 | 0.05 | 0.56 | 0.173125 | 0.140242 | 0.1342495 | 0.0335624 | 0.0444774 | 2.072879 | 0.775448 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2 | 75%ile(Q3 | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 16 | 0 | 0.065 | 0.11 | 0.11 | 0.13 | 0.1825 | 0.22 | 0.32 | 0.4475 | 0.5375 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/5/2024 2:59:02 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 16 |
| Number of Distinct Observations | 12 |
| Minimum | 0.05 |
| Maximum | 0.56 |
| Mean of Raw Data | 0.173125 |
| Standard Deviation of Raw Data | 0.1342495 |
| Khat | 2.5279058 |
| Theta hat | 0.0684855 |
| Kstar | 2.0955901 |
| Theta star | 0.082614 |
| Mean of Log Transformed Data | -1.964383 |
| Standard Deviation of Log Transformed Data | 0.6435407 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.856247 |
| Shapiro Wilk Test Statistic | 0.7468109 |
| Shapiro Wilk Critical (0.0500000) Value | 0.887 |
| Approximate Shapiro Wilk P Value | 3.49E-04 |
| Lilliefors Test Statistic | 0.2592856 |
| Lilliefors Critical (0.0500000) Value | 0.2128 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9493766 |
| A-D Test Statistic | 0.7014047 |
| A-D Critical (0.0500000) Value | 0.7471284 |
| K-S Test Statistic | 0.1911234 |
| K-S Critical(0.0500000) Value | 0.2172312 |
| Data appear Gamma Distributed at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9685949 |
| Shapiro Wilk Test Statistic | 0.940924 |

## THg Statistics - All seals combined

Meat (Muscle) THg

| | |
|---|---|
| N | 31 |
| min | 0.05 |
| max | 0.56 |
| arithmean | 0.113548 |
| median | 0.05 |
| #nd | 15 |
| Freq nd | 48% |

length vs THg (muscle): 0.461502 (likely not meaningful given all pups <RDL)

length vs THg (liver): 0.680115

All Seals - THg in Muscle (Meat)

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/29/2024 3:02:44 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 31 | 0 | 0.05 | 0.56 | 0.113548 | 0.085143 | 0.113682 | 0.020418 | 0 | 2.757083 | 1.001179 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1 | 50%ile(Q2 | 75%ile(Q3 | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 31 | 0 | 0.05 | 0.05 | 0.05 | 0.05 | 0.13 | 0.14 | 0.22 | 0.32 | 0.515 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 2/29/2024 3:04:11 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 31 |
| Number of Distinct Observations | 12 |
| Minimum | 0.05 |
| Maximum | 0.56 |
| Mean of Raw Data | 0.113548 |
| Standard Deviation of Raw Data | 0.113682 |
| Khat | 1.886328 |
| Theta hat | 0.060196 |
| Kstar | 1.725286 |
| Theta star | 0.065814 |
| Mean of Log Transformed Data | -2.46342 |
| Standard Deviation of Log Transformed Data | 0.693953 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.775582 |
| Shapiro Wilk Test Statistic | 0.617692 |
| Shapiro Wilk Critical (0.0500000) Value | 0.929 |
| Approximate Shapiro Wilk P Value | 4.67E-09 |
| Lilliefors Test Statistic | 0.288081 |
| Lilliefors Critical (0.0500000) Value | 0.1559 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.922458 |
| A-D Test Statistic | 3.051816 |
| A-D Critical (0.0500000) Value | 0.759861 |
| K-S Test Statistic | 0.316846 |
| K-S Critical(0.0500000) Value | 0.160014 |
| Data not Gamma Distributed at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.882525 |
| Shapiro Wilk Test Statistic | 0.77143 |
| Shapiro Wilk Critical (0.0500000) Value | 0.929 |
| Approximate Shapiro Wilk P Value | 4.92E-06 |
| Lilliefors Test Statistic | 0.326867 |
| Lilliefors Critical (0.0500000) Value | 0.1559 |
| Data not Lognormal at (0.0500000) Significance Level | |

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/29/2024 3:11:39 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operation | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 31 | Number of Distinct Observations | 12 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.05 | Mean | 0.113548 |
| Maximum | 0.56 | Median | 0.05 |
| SD | 0.113682 | Std. Error of Mean | 0.020418 |
| Coefficient of Variation | 1.001179 | Skewness | 2.757083 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.617692 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.902 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.288081 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.182 | Data Not Normal at 1% Significance Level | |
| Data Not Normal at 1% Significance Level | | | |

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.148203 | 95% Adjusted-CLT UCL (Chen-1995) | 0.157936 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.149888 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 3.051816 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.759861 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.316846 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.160014 | Data Not Gamma Distributed at 5% Significance Level | |
| Data Not Gamma Distributed at 5% Significance Level | | | |

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.886328 | k star (bias corrected MLE) | 1.725286 |
| Theta hat (MLE) | 0.060196 | Theta star (bias corrected MLE) | 0.065814 |
| nu hat (MLE) | 116.9524 | nu star (bias corrected) | 106.9677 |
| MLE Mean (bias corrected) | 0.113548 | MLE Sd (bias corrected) | 0.086447 |
| | | Approximate Chi Square Value (0.05) | 84.09868 |
| Adjusted Level of Significance | 0.0413 | Adjusted Chi Square Value | 82.97202 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.144426 | 95% Adjusted Gamma UCL | 0.146387 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.77143 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.94 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.326867 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1432 | Data Not Lognormal at 10% Significance Level | |
| Data Not Lognormal at 10% Significance Level | | | |

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.99573 | Mean of logged Data | -2.46342 |
| Maximum of Logged Data | -0.57982 | SD of logged Data | 0.693953 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.141273 | 90% Chebyshev (MVUE) UCL | 0.150691 |

Liver THg

| | |
|---|---|
| N | 31 |
| min | 0.08 |
| max | 35.2 |
| arithmean | 6.717419 |
| median | 0.44 |
| #nd | 0 |
| Freq nd | 0% |

All Seals - THg in Liver

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/29/2024 5:05:54 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 31 | 0 | 0.08 | 35.2 | 6.717419 | 1.324338 | 9.108308 | 1.635901 | 0.533729 | 1.646451 | 1.355924 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1 | 50%ile(Q2 | 75%ile(Q3 | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 31 | 0 | 0.14 | 0.15 | 0.16 | 0.44 | 9.25 | 10.4 | 21.6 | 24.65 | 32.8 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 2/29/2024 5:06:47 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 31 |
| Number of Distinct Observations | 27 |
| Minimum | 0.08 |
| Maximum | 35.2 |
| Mean of Raw Data | 6.717419 |
| Standard Deviation of Raw Data | 9.108308 |
| Khat | 0.404516 |
| Theta hat | 16.60608 |
| Kstar | 0.386874 |
| Theta star | 17.36331 |
| Mean of Log Transformed Data | 0.280912 |
| Standard Deviation of Log Transformed Data | 2.202071 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.866467 |
| Shapiro Wilk Test Statistic | 0.75112 |
| Shapiro Wilk Critical (0.0500000) Value | 0.929 |
| Approximate Shapiro Wilk P Value | 1.78E-06 |
| Lilliefors Test Statistic | 0.270779 |
| Lilliefors Critical (0.0500000) Value | 0.1559 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.972805 |
| A-D Test Statistic | 2.226028 |
| A-D Critical (0.0500000) Value | 0.831043 |
| K-S Test Statistic | 0.258547 |
| K-S Critical(0.0500000) Value | 0.168867 |
| Data not Gamma Distributed at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.914412 |
| Shapiro Wilk Test Statistic | 0.813041 |
| Shapiro Wilk Critical (0.0500000) Value | 0.929 |
| Approximate Shapiro Wilk P Value | 4.43E-05 |
| Lilliefors Test Statistic | 0.232917 |
| Lilliefors Critical (0.0500000) Value | 0.1559 |
| Data not Lognormal at (0.0500000) Significance Level | |

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 2/29/2024 5:07:38 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operation | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 31 | Number of Distinct Observations | 27 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.08 | Mean | 6.717419 |
| Maximum | 35.2 | Median | 0.44 |
| SD | 9.108308 | Std. Error of Mean | 1.635901 |
| Coefficient of Variation | 1.355924 | Skewness | 1.646451 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.75112 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.902 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.270779 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.182 | Data Not Normal at 1% Significance Level | |
| Data Not Normal at 1% Significance Level | | | |

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 9.493969 | 95% Adjusted-CLT UCL (Chen-1995) | 9.925135 |
| | | 95% Modified-t UCL (Johnson-1978) | 9.574595 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 2.226028 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.831043 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.258547 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.168867 | Data Not Gamma Distributed at 5% Significance Level | |
| Data Not Gamma Distributed at 5% Significance Level | | | |

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 0.404516 | k star (bias corrected MLE) | 0.386874 |
| Theta hat (MLE) | 16.60608 | Theta star (bias corrected MLE) | 17.36331 |
| nu hat (MLE) | 25.07997 | nu star (bias corrected) | 23.98621 |
| MLE Mean (bias corrected) | 6.717419 | MLE Sd (bias corrected) | 10.79984 |
| | | Approximate Chi Square Value (0.05) | 13.83816 |
| Adjusted Level of Significance | 0.0413 | Adjusted Chi Square Value | 13.40918 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 11.64356 | 95% Adjusted Gamma UCL | 12.01606 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.813041 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.94 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.232917 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1432 | Data Not Lognormal at 10% Significance Level | |
| Data Not Lognormal at 10% Significance Level | | | |

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.52573 | Mean of logged Data | 0.280912 |
| Maximum of Logged Data | 3.561046 | SD of logged Data | 2.202071 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 78.44996 | 90% Chebyshev (MVUE) UCL | 31.41048 |

| | |
|---|---|
| Shapiro Wilk Critical (0.0500000) Value | 0.887 |
| Approximate Shapiro Wilk P Value | 0.3445803 |
| Lilliefors Test Statistic | 0.165427 |
| Lilliefors Critical (0.0500000) Value | 0.2128 |

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/5/2024 3:04:19 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 16 | Number of Distinct Observations | 12 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.05 | Mean | 0.173125 |
| Maximum | 0.56 | Median | 0.13 |
| SD | 0.1342495 | Std. Error of Mean | 0.033562 |
| Coefficient of Variation | 0.7754481 | Skewness | 2.072879 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.7468109 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.844 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.2592856 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2477 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.2319615 | 95% Adjusted-CLT UCL (Chen-1995) | 0.246915 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.23486 |

Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.7014047 | Anderson-Darling Gamma GOF Test |
| 5% A-D Critical Value | 0.7471284 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.1911234 | Kolmogorov-Smirnov Gamma GOF Test |
| 5% K-S Critical Value | 0.2172312 | Detected data appear Gamma Distributed at 5% Significance Level |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.5279058 | k star (bias corrected MLE) | 2.09559 |
| Theta hat (MLE) | 0.0684855 | Theta star (bias corrected MLE) | 0.082614 |
| nu hat (MLE) | 80.892984 | nu star (bias corrected) | 67.05888 |
| MLE Mean (bias corrected) | 0.173125 | MLE Sd (bias corrected) | 0.119593 |
| | | Approximate Chi Square Value (0.05) | 49.21279 |
| Adjusted Level of Significance | 0.03348 | Adjusted Chi Square Value | 47.47473 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.2359055 | 95% Adjusted Gamma UCL | 0.244542 |

Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.940924 | Shapiro Wilk Lognormal GOF Test |
| 10% Shapiro Wilk Critical Value | 0.906 | Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.165427 | Lilliefors Lognormal GOF Test |
| 10% Lilliefors Critical Value | 0.1956 | Data appear Lognormal at 10% Significance Level |

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.995732 | Mean of logged Data | -1.96438 |
| Maximum of Logged Data | -0.579818 | SD of logged Data | 0.643541 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.2490941 | 90% Chebyshev (MVUE) UCL | 0.255995 |
| 95% Chebyshev (MVUE) UCL | 0.2949821 | 97.5% Chebyshev (MVUE) UCL | 0.349095 |
| 99% Chebyshev (MVUE) UCL | 0.4553905 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.2283302 | 95% BCA Bootstrap UCL | 0.24375 |
| 95% Standard Bootstrap UCL | 0.2260641 | 95% Bootstrap-t UCL | 0.305233 |
| 95% Hall's Bootstrap UCL | 0.5365256 | 95% Percentile Bootstrap UCL | 0.229375 |
| 90% Chebyshev(Mean, Sd) UCL | 0.2738121 | 95% Chebyshev(Mean, Sd) UCL | 0.31942 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.3827219 | 99% Chebyshev(Mean, Sd) UCL | 0.507066 |

Suggested UCL to Use

| | |
|---|---|
| 95% Adjusted Gamma UCL | 0.2445421 |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Non-pups - THg in Liver

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/5/2024 3:16:43 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 16 | 0 | 0.16 | 35.2 | 12.83125 | 8.932375 | 9.1384338 | 2.2846084 | 3.2690882 | 1.242663 | 0.712201 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2 | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 16 | 0 | 6.355 | 7.19 | 7.6475 | 9.25 | 16.65 | 21.6 | 24.65 | 29.2 | 34 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/5/2024 3:17:39 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 16 |
| Number of Distinct Observations | 16 |
| Minimum | 0.16 |
| Maximum | 35.2 |
| Mean of Raw Data | 12.83125 |
| Standard Deviation of Raw Data | 9.1384338 |
| Khat | 1.5257285 |
| Theta hat | 8.4099168 |
| Ktstar | 1.2813211 |
| Theta star | 10.014079 |
| Mean of Log Transformed Data | 2.1896823 |
| Standard Deviation of Log Transformed Data | 1.1987562 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9220906 |
| Shapiro Wilk Test Statistic | 0.8586306 |
| Shapiro Wilk Critical (0.0500000) Value | 0.887 |
| Approximate Shapiro Wilk P Value | 0.0163671 |
| Lilliefors Test Statistic | 0.2797041 |
| Lilliefors Critical (0.0500000) Value | 0.2128 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9790559 |
| A-D Test Statistic | 0.8623563 |
| A-D Critical (0.0500000) Value | 0.7544631 |
| K-S Test Statistic | 0.2188839 |

| | | | |
|---|---|---|---|
| 95% Chebyshev (MVUE) UCL | 0.170342 | 97.5% Chebyshev (MVUE) UCL | 0.197618 |
| 99% Chebyshev (MVUE) UCL | 0.251196 | | |

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | | selected average of non-parametric UCLs at 5% |
|---|---|---|---|---|
| 95% CLT UCL | 0.147133 | 95% BCA Bootstrap UCL | 0.157097 | signifance level |
| 95% Standard Bootstrap UCL | 0.146486 | 95% Bootstrap-t UCL | 0.180344 | 0.184094 |
| 95% Hall's Bootstrap UCL | 0.307311 | 95% Percentile Bootstrap UCL | 0.147742 | |
| 90% Chebyshev(Mean, Sd) UCL | 0.174802 | 95% Chebyshev(Mean, Sd) UCL | 0.202548 | |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.241058 | 99% Chebyshev(Mean, Sd) UCL | 0.316704 | |

Suggested UCL to Use

| | | |
|---|---|---|
| 95% Student's-t UCL | 0.148203 | rejected as data distribution is non-parametric |

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| | | | |
|---|---|---|---|
| 95% Chebyshev (MVUE) UCL | 40.22529 | 97.5% Chebyshev (MVUE) UCL | 52.4599 |
| 99% Chebyshev (MVUE) UCL | 76.49242 | | |

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | | selected average of non-parametric UCLs at 5% |
|---|---|---|---|---|
| 95% CLT UCL | 9.408236 | 95% BCA Bootstrap UCL | 9.843871 | signifance level |
| 95% Standard Bootstrap UCL | 9.341073 | 95% Bootstrap-t UCL | 10.16089 | 10.30075 |
| 95% Hall's Bootstrap UCL | 10.03042 | 95% Percentile Bootstrap UCL | 9.472581 | |
| 90% Chebyshev(Mean, Sd) UCL | 11.62512 | 95% Chebyshev(Mean, Sd) UCL | 13.84814 | |
| 97.5% Chebyshev(Mean, Sd) UCL | 16.93361 | 99% Chebyshev(Mean, Sd) UCL | 22.99442 | |

Suggested UCL to Use

| | |
|---|---|
| 95% Student's-t UCL | 9.493969 |

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| | |
|---|---|
| K-S Critical(0.0500000) Value | 0.218847 |

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.8156619 |
| Shapiro Wilk Test Statistic | 0.6970178 |
| Shapiro Wilk Critical (0.0500000) Value | 0.887 |
| Approximate Shapiro Wilk P Value | 6.53E-05 |
| Lilliefors Test Statistic | 0.2973761 |
| Lilliefors Critical (0.0500000) Value | 0.2128 |

Data not Lognormal at (0.0500000) Significance Level

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/5/2024 3:19:02 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 16 | Number of Distinct Observations | 16 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.16 | Mean | 12.83125 |
| Maximum | 35.2 | Median | 9.25 |
| SD | 9.1384338 | Std. Error of Mean | 2.284608 |
| Coefficient of Variation | 0.7122014 | Skewness | 1.242663 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.8586306 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.844 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.2797041 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2477 | Data Not Normal at 1% Significance Level | |

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 16.836284 | 95% Adjusted-CLT UCL (Chen-1995) | 17.34747 |
| | | 95% Modified-t UCL (Johnson-1978) | 16.95458 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.8623563 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7544631 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.2188839 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.218847 | Data Not Gamma Distributed at 5% Significance Level | |

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.5257285 | k star (bias corrected MLE) | 1.281321 |
| Theta hat (MLE) | 8.4099168 | Theta star (bias corrected MLE) | 10.01408 |
| nu hat (MLE) | 48.823313 | nu star (bias corrected) | 41.00228 |
| MLE Mean (bias corrected) | 12.83125 | MLE Sd (bias corrected) | 11.33548 |
| | | Approximate Chi Square Value (0.05) | 27.32748 |
| Adjusted Level of Significance | 0.03348 | Adjusted Chi Square Value | 26.05995 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 19.252063 | 95% Adjusted Gamma UCL | 20.18847 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.6970178 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.906 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.2973761 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1956 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -1.832581 | Mean of logged Data | 2.189682 |
| Maximum of Logged Data | 3.5610461 | SD of logged Data | 1.198756 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 46.698169 | 90% Chebyshev (MVUE) UCL | 34.37829 |
| 95% Chebyshev (MVUE) UCL | 42.206597 | 97.5% Chebyshev (MVUE) UCL | 53.07198 |
| 99% Chebyshev (MVUE) UCL | 74.414921 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 16.589096 | 95% BCA Bootstrap UCL | 17.39188 |
| 95% Standard Bootstrap UCL | 16.473732 | 95% Bootstrap-t UCL | 18.18367 |
| 95% Hall's Bootstrap UCL | 17.567938 | 95% Percentile Bootstrap UCL | 16.59938 |
| 90% Chebyshev(Mean, Sd) UCL | 19.685075 | 95% Chebyshev(Mean, Sd) UCL | 22.78963 |
| 97.5% Chebyshev(Mean, Sd) UCL | 27.098625 | 99% Chebyshev(Mean, Sd) UCL | 35.56282 |

Suggested UCL to Use

| | |
|---|---|
| 95% Student's-t UCL | 16.836284 |

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

## THg Statistics - Pups

| Meat (Muscle) THg | | | Liver THg | |
|---|---|---|---|---|
| N | 15 | length vs THg (muscle) | N | 15 |
| min | 0.05 | NA | min | 0.08 |
| max | 0.05 | | max | 0.44 |
| arithmean | 0.05 | length vs THg (liver) | arithmean | 0.196 |
| median | 0.05 | -0.30177775 | median | 0.16 |
| #nd | 15 | | #nd | 0 |
| Freq nd | 100% | | Freq nd | 0% |

Pups - THg in Muscle (Meat)

All samples <0.05 mg/kg ww. Thus, EPC = RDL = 0.05 mg/kg ww.

Pups - THg in Liver

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/5/2024 3:45:50 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 15 | 0 | 0.08 | 0.44 | 0.196 | 0.172888 | 0.1125547 | 0.0290615 | 0.0296516 | 1.440221 | 0.574259 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2 | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 15 | 0 | 0.104 | 0.134 | 0.14 | 0.16 | 0.19 | 0.232 | 0.39 | 0.419 | 0.4358 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/5/2024 3:46:42 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 15 |

| | |
|---|---|
| Number of Distinct Observations | 12 |
| Minimum | 0.08 |
| Maximum | 0.44 |
| Mean of Raw Data | 0.196 |
| Standard Deviation of Raw Data | 0.1125547 |
| Khat | 4.1444214 |
| Theta hat | 0.0472925 |
| Kstar | 3.3599816 |
| Theta star | 0.0583337 |
| Mean of Log Transformed Data | -1.755109 |
| Standard Deviation of Log Transformed Data | 0.4959201 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.8796281 |
| Shapiro Wilk Test Statistic | 0.7719348 |
| Shapiro Wilk Critical (0.0500000) Value | 0.881 |
| Approximate Shapiro Wilk P Value | 0.0013755 |
| Lilliefors Test Statistic | 0.2898538 |
| Lilliefors Critical (0.0500000) Value | 0.2196 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.935675 |
| A-D Test Statistic | 1.0029006 |
| A-D Critical (0.0500000) Value | 0.7398163 |
| K-S Test Statistic | 0.2354292 |
| K-S Critical(0.0500000) Value | 0.2224821 |

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9506128 |
| Shapiro Wilk Test Statistic | 0.9007729 |
| Shapiro Wilk Critical (0.0500000) Value | 0.881 |
| Approximate Shapiro Wilk P Value | 0.1037032 |
| Lilliefors Test Statistic | 0.2009413 |
| Lilliefors Critical (0.0500000) Value | 0.2196 |

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/5/2024 3:47:46 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 15 | Number of Distinct Observations | 12 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.08 | Mean | 0.196 |
| Maximum | 0.44 | Median | 0.16 |
| SD | 0.1125547 | Std. Error of Mean | 0.029062 |
| Coefficient of Variation | 0.5742589 | Skewness | 1.440221 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.7719348 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.835 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.2898538 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2545 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.2471863 | 95% Adjusted-CLT UCL (Chen-1995) | 0.255349 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.248988 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 1.0029006 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7398163 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.2354292 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.2224821 | Data Not Gamma Distributed at 5% Significance Level | |

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 4.1444214 | k star (bias corrected MLE) | 3.359982 |
| Theta hat (MLE) | 0.0472925 | Theta star (bias corrected MLE) | 0.058334 |
| nu hat (MLE) | 124.33264 | nu star (bias corrected) | 100.7995 |
| MLE Mean (bias corrected) | 0.196 | MLE Sd (bias corrected) | 0.106927 |
| | | Approximate Chi Square Value (0.05) | 78.63592 |
| Adjusted Level of Significance | 0.03235 | Adjusted Chi Square Value | 76.22813 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.2512426 | 95% Adjusted Gamma UCL | 0.259179 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9007729 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.901 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.2009413 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.2016 | Data appear Lognormal at 10% Significance Level | |

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.525729 | Mean of logged Data | -1.75511 |
| Maximum of Logged Data | -0.820981 | SD of logged Data | 0.49592 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.2570141 | 90% Chebyshev (MVUE) UCL | 0.270382 |
| 95% Chebyshev (MVUE) UCL | 0.3050907 | 97.5% Chebyshev (MVUE) UCL | 0.353265 |
| 99% Chebyshev (MVUE) UCL | 0.4478931 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.2438019 | 95% BCA Bootstrap UCL | 0.254 |
| 95% Standard Bootstrap UCL | 0.2422355 | 95% Bootstrap-t UCL | 0.26646 |
| 95% Hall's Bootstrap UCL | 0.2460716 | 95% Percentile Bootstrap UCL | 0.244667 |
| 90% Chebyshev(Mean, Sd) UCL | 0.2831845 | 95% Chebyshev(Mean, Sd) UCL | 0.322676 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.3774891 | 99% Chebyshev(Mean, Sd) UCL | 0.485158 |

Suggested UCL to Use

| | |
|---|---|
| 95% H-UCL | 0.2570141 |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

## ALL SEALS

| Sample Year | species | sample area | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age | Age Estimate | life_stage | # non-pups |
|---|---|---|---|---|---|---|---|---|---|---|
| 2019 | Ringed Seal | LM | 27.2 | 74 | 0.03 | 0.1 | | 0 | Pup | 12 |
| 2019 | Ringed Seal | LM | 22.7 | 65 | 0.1 | 0.38 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 27.2 | 80 | 0.03 | 0.28 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 24.9 | 76 | 0.01 | 0.17 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 27.2 | 78 | 0.04 | | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 22.7 | 68 | 0.02 | 0.17 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 27.2 | 77 | 0.01 | 0.1 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 22.7 | 62 | 0.02 | 0.3 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 40.8 | 120 | 0.28 | 13.7 | | 1 | Non Pup | |
| 2019 | Ringed Seal | LM | 36.3 | 100 | 0.1 | 14.4 | | 1 | Non Pup | |
| 2019 | Ringed Seal | LM | 45.4 | 120 | 0.21 | 10.8 | | 1 | Non Pup | |
| 2019 | Ringed Seal | LM | 45.4 | 110 | 1.16 | 9.53 | | 1 | Non Pup | |
| 2019 | Ringed Seal | LM | 113.4 | 138 | 0.14 | 4.8 | | 1 | Non Pup | |
| 2019 | Ringed Seal | LM | 27.2 | 84 | 0.03 | 0.27 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 68 | 120 | 0.15 | 8.03 | | 1 | Non Pup | |
| 2019 | Ringed Seal | LM | 68 | 120 | 0.11 | 28.9 | | 1 | Non Pup | |
| 2019 | Ringed Seal | LM | 15.9 | 60 | 0.09 | 0.59 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 22.7 | 70 | 0.01 | 0.32 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 22.7 | 65 | 0.04 | 0.26 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 18.1 | 60 | 0.04 | 0.21 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 27.2 | 73 | 0.04 | 0.2 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 18.1 | 64 | 0.04 | 0.12 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 68 | 125 | 0.12 | 15.9 | | 1 | Non Pup | |
| 2019 | Ringed Seal | LM | 31.7 | 84 | 0.03 | 0.22 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 22.7 | 66 | 0.06 | 0.14 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 36.3 | 90 | 0.03 | 0.28 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 18.1 | 65 | 0.01 | 0.07 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 90.7 | 125 | 0.08 | 15 | | 1 | Non Pup | |
| 2019 | Ringed Seal | LM | 18.1 | 60 | 0.05 | 0.2 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 27.2 | 68 | 0.03 | 0.5 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 22.7 | 64 | 0.05 | 0.55 | | 0 | Pup | |
| 2019 | Ringed Seal | LM | 45.4 | 126 | 0.41 | 0.33 | | 1 | Non Pup | |
| 2019 | Ringed Seal | LM | 45.4 | 120 | 0.21 | 38.6 | | 1 | Non Pup | |
| 2019 | Ringed Seal | LM | 54.4 | 116 | 2.68 | 0.18 | | 1 | Non Pup | |

## NON-PUPS (estimated age range: ~1 year)

| Sample Year | species | sample area | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age | Age Estimate | life_stage |
|---|---|---|---|---|---|---|---|---|---|
| 2019 | Ringed Seal | LM | 40.8 | 120 | 0.28 | 13.7 | | 1 | Non Pup |
| 2019 | Ringed Seal | LM | 36.3 | 100 | 0.1 | 14.4 | | 1 | Non Pup |
| 2019 | Ringed Seal | LM | 45.4 | 120 | 0.21 | 10.8 | | 1 | Non Pup |
| 2019 | Ringed Seal | LM | 45.4 | 110 | 1.16 | 9.53 | | 1 | Non Pup |
| 2019 | Ringed Seal | LM | 113.4 | 138 | 0.14 | 4.8 | | 1 | Non Pup |
| 2019 | Ringed Seal | LM | 68 | 120 | 0.15 | 8.03 | | 1 | Non Pup |
| 2019 | Ringed Seal | LM | 68 | 120 | 0.11 | 28.9 | | 1 | Non Pup |
| 2019 | Ringed Seal | LM | 68 | 125 | 0.12 | 15.9 | | 1 | Non Pup |
| 2019 | Ringed Seal | LM | 90.7 | 125 | 0.08 | 15 | | 1 | Non Pup |
| 2019 | Ringed Seal | LM | 45.4 | 126 | 0.41 | 0.33 | | 1 | Non Pup |
| 2019 | Ringed Seal | LM | 45.4 | 120 | 0.21 | 38.6 | | 1 | Non Pup |
| 2019 | Ringed Seal | LM | 54.4 | 116 | 2.68 | 0.18 | | 1 | Non Pup |

## PUPS (<1 year)

| Sample Year | species | sample area | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age | Age Estimate | life_stage |
|---|---|---|---|---|---|---|---|---|---|
| 2019 | Ringed Seal | LM | 27.2 | 74 | 0.03 | 0.1 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 22.7 | 65 | 0.1 | 0.38 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 27.2 | 80 | 0.03 | 0.28 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 24.9 | 76 | 0.01 | 0.17 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 27.2 | 78 | 0.04 | | | 0 | Pup |
| 2019 | Ringed Seal | LM | 22.7 | 68 | 0.02 | 0.17 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 27.2 | 77 | 0.01 | 0.1 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 22.7 | 62 | 0.02 | 0.3 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 27.2 | 84 | 0.03 | 0.27 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 15.9 | 60 | 0.09 | 0.59 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 22.7 | 70 | 0.01 | 0.32 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 22.7 | 65 | 0.04 | 0.26 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 18.1 | 60 | 0.04 | 0.21 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 27.2 | 73 | 0.04 | 0.2 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 18.1 | 64 | 0.04 | 0.12 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 31.7 | 84 | 0.03 | 0.22 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 22.7 | 66 | 0.06 | 0.14 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 36.3 | 90 | 0.03 | 0.28 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 18.1 | 65 | 0.01 | 0.07 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 18.1 | 60 | 0.05 | 0.2 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 27.2 | 68 | 0.03 | 0.5 | | 0 | Pup |
| 2019 | Ringed Seal | LM | 22.7 | 64 | 0.05 | 0.55 | | 0 | Pup |

## THg Statistics - Non-pups

| Meat (Muscle) THg | | | | Liver THg | |
|---|---|---|---|---|---|
| N | 12 | length vs THg (muscle) | | N | 12 |
| min | 0.08 | -0.24035609 | | min | 0.18 |
| max | 2.68 | | | max | 38.6 |
| arithmean | 0.4708333 | length vs THg (liver) | | arithmean | 13.3475 |
| median | 0.18 | -0.12598808 | | median | 12.25 |
| #nd | 0 | | | #nd | 0 |
| Freq nd | 0% | | | Freq nd | 0% |

Non-pups - THg in Muscle (Meat)

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/6/2024 4:50:36 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 12 | 0 | 0.08 | 2.68 | 0.4708333 | 0.239096 | 0.7560358 | 0.2182487 | 0.1111935 | 2.725417 | 1.60574 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 12 | 0 | 0.101 | 0.112 | 0.1175 | 0.18 | 0.3125 | 0.384 | 1.085 | 1.844 | 2.5128 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/6/2024 4:51:50 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| Raw Statistics | |
|---|---|
| Number of Valid Observations | 12 |
| Number of Distinct Observations | 11 |
| Minimum | 0.08 |
| Maximum | 2.68 |
| Mean of Raw Data | 0.4708333 |
| Standard Deviation of Raw Data | 0.7560358 |
| Khat | 0.8667923 |
| Theta hat | 0.5431905 |
| Kstar | 0.7056498 |
| Theta star | 0.6672337 |
| Mean of Log Transformed Data | -1.438892 |
| Standard Deviation of Log Transformed Data | 1.0541912 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.7340308 |
| Shapiro Wilk Test Statistic | 0.5621367 |
| Shapiro Wilk Critical (0.0500000) Value | 0.859 |
| Approximate Shapiro Wilk P Value | 1.24E-05 |
| Lilliefors Test Statistic | 0.365399 |
| Lilliefors Critical (0.0500000) Value | 0.2426 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9360682 |
| A-D Test Statistic | 1.3129304 |
| A-D Critical (0.0500000) Value | 0.7614609 |
| K-S Test Statistic | 0.2785279 |
| K-S Critical(0.0500000) Value | 0.2536608 |

## THg Statistics - All seals combined

| Meat (Muscle) THg | | | |
|---|---|---|---|
| N | 34 | length vs THg (muscle) | |
| min | 0.01 | 0.358909 | |
| max | 2.68 | | |
| arithmean | 0.19 | length vs THg (liver) | |
| median | 0.045 | 0.639793 | |
| #nd | 0 | | |
| Freq nd | 0% | | |

All Seals - THg in Muscle (Meat)

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/6/2024 10:49:37 AM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 34 | 0 | 0.01 | 2.68 | 0.19 | 0.062875 | 0.484974 | 0.083172 | 0.05189 | 4.593938 | 2.552496 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1 | 50%ile(Q2 | 75%ile(Q3 | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 34 | 0 | 0.013 | 0.03 | 0.03 | 0.045 | 0.1175 | 0.144 | 0.259 | 0.6725 | 2.1784 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/6/2024 10:50:41 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| Raw Statistics | |
|---|---|
| Number of Valid Observations | 34 |
| Number of Distinct Observations | 18 |
| Minimum | 0.01 |
| Maximum | 2.68 |
| Mean of Raw Data | 0.19 |
| Standard Deviation of Raw Data | 0.484974 |
| Khat | 0.563909 |
| Theta hat | 0.336934 |
| Kstar | 0.533761 |
| Theta star | 0.355965 |
| Mean of Log Transformed Data | -2.76661 |
| Standard Deviation of Log Transformed Data | 1.285565 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.589368 |
| Shapiro Wilk Test Statistic | 0.380804 |
| Shapiro Wilk Critical (0.0500000) Value | 0.933 |
| Approximate Shapiro Wilk P Value | 5.66E-14 |
| Lilliefors Test Statistic | 0.365906 |
| Lilliefors Critical (0.0500000) Value | 0.1497 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.864142 |
| A-D Test Statistic | 2.868356 |
| A-D Critical (0.0500000) Value | 0.805507 |
| K-S Test Statistic | 0.211883 |
| K-S Critical(0.0500000) Value | 0.158871 |
| Data not Gamma Distributed at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.964191 |
| Shapiro Wilk Test Statistic | 0.92973 |
| Shapiro Wilk Critical (0.0500000) Value | 0.933 |
| Approximate Shapiro Wilk P Value | 0.036992 |
| Lilliefors Test Statistic | 0.137509 |
| Lilliefors Critical (0.0500000) Value | 0.1497 |
| Data appear Approximate_Lognormal at (0.0500000) Significance Level | |

UCL Statistics for Uncensored Full Data Sets

| User Selected Options | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/6/2024 10:51:39 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operation | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 34 | Number of Distinct Observations | 18 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.19 |
| Maximum | 2.68 | Median | 0.045 |
| SD | 0.484974 | Std. Error of Mean | 0.083172 |
| Coefficient of Variation | 2.552496 | Skewness | 4.593938 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.380804 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.908 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.365906 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.1747 | Data Not Normal at 1% Significance Level | |
| Data Not Normal at 1% Significance Level | | | |

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.330758 | 95% Adjusted-CLT UCL (Chen-1995) | 0.396824 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.341679 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 2.868356 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.805507 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.211883 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.158871 | Data Not Gamma Distributed at 5% Significance Level | |
| Data Not Gamma Distributed at 5% Significance Level | | | |

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 0.563909 | k star (bias corrected MLE) | 0.533761 |
| Theta hat (MLE) | 0.336934 | Theta star (bias corrected MLE) | 0.355965 |
| nu hat (MLE) | 38.34584 | nu star (bias corrected) | 36.29572 |
| MLE Mean (bias corrected) | 0.19 | MLE Sd (bias corrected) | 0.260064 |
| | | Approximate Chi Square Value (0.05) | 23.50687 |
| Adjusted Level of Significance | 0.0422 | Adjusted Chi Square Value | 22.99706 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.293369 | 95% Adjusted Gamma UCL | 0.299873 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.92973 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.943 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.137509 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1373 | Data Not Lognormal at 10% Significance Level | |
| Data Not Lognormal at 10% Significance Level | | | |

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -2.76661 |
| Maximum of Logged Data | 0.985817 | SD of logged Data | 1.285565 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.269921 | 90% Chebyshev (MVUE) UCL | 0.249774 |
| 95% Chebyshev (MVUE) UCL | 0.300496 | 97.5% Chebyshev (MVUE) UCL | 0.370895 |
| 99% Chebyshev (MVUE) UCL | 0.509181 | | |

Nonparametric Distribution Free UCL Statistics

| Liver THg | |
|---|---|
| N | 33 |
| min | 0.07 |
| max | 38.6 |
| arithmean | 5.018182 |
| median | 0.3 |
| #nd | 0 |
| Freq nd | 0% |

All Seals - THg in Liver

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/6/2024 3:53:16 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 33 | 0 | 0.07 | 38.6 | 5.018182 | 0.778048 | 9.124086 | 1.5883 | 0.266864 | 2.324755 | 1.818206 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1 | 50%ile(Q2 | 75%ile(Q3 | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 33 | 0 | 0.124 | 0.174 | 0.2 | 0.3 | 8.03 | 10.292 | 14.88 | 21.1 | 35.496 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/6/2024 3:54:37 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| Raw Statistics | |
|---|---|
| Number of Valid Observations | 33 |
| Number of Distinct Observations | 29 |
| Minimum | 0.07 |
| Maximum | 38.6 |
| Mean of Raw Data | 5.018182 |
| Standard Deviation of Raw Data | 9.124086 |
| Khat | 0.35922 |
| Theta hat | 13.96968 |
| Kstar | 0.346765 |
| Theta star | 14.47141 |
| Mean of Log Transformed Data | -0.25097 |
| Standard Deviation of Log Transformed Data | 1.992517 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.775854 |
| Shapiro Wilk Test Statistic | 0.613247 |
| Shapiro Wilk Critical (0.0500000) Value | 0.931 |
| Approximate Shapiro Wilk P Value | 1.11E-09 |
| Lilliefors Test Statistic | 0.383248 |
| Lilliefors Critical (0.0500000) Value | 0.1518 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.981987 |
| A-D Test Statistic | 3.654039 |
| A-D Critical (0.0500000) Value | 0.842247 |
| K-S Test Statistic | 0.340534 |
| K-S Critical(0.0500000) Value | 0.164972 |
| Data not Gamma Distributed at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.910539 |
| Shapiro Wilk Test Statistic | 0.812672 |
| Shapiro Wilk Critical (0.0500000) Value | 0.931 |
| Approximate Shapiro Wilk P Value | 2.27E-05 |
| Lilliefors Test Statistic | 0.252186 |
| Lilliefors Critical (0.0500000) Value | 0.1518 |
| Data not Lognormal at (0.0500000) Significance Level | |

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

UCL Statistics for Uncensored Full Data Sets

| User Selected Options | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/6/2024 3:56:01 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operation | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 33 | Number of Distinct Observations | 29 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.07 | Mean | 5.018182 |
| Maximum | 38.6 | Median | 0.3 |
| SD | 9.124086 | Std. Error of Mean | 1.5883 |
| Coefficient of Variation | 1.818206 | Skewness | 2.324755 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.613247 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.906 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.383248 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.177 | Data Not Normal at 1% Significance Level | |
| Data Not Normal at 1% Significance Level | | | |

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 7.708584 | 95% Adjusted-CLT UCL (Chen-1995) | 8.317506 |
| | | 95% Modified-t UCL (Johnson-1978) | 7.815712 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 3.654039 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.842247 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.340534 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.164972 | Data Not Gamma Distributed at 5% Significance Level | |
| Data Not Gamma Distributed at 5% Significance Level | | | |

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 0.35922 | k star (bias corrected MLE) | 0.346765 |
| Theta hat (MLE) | 13.96968 | Theta star (bias corrected MLE) | 14.47141 |
| nu hat (MLE) | 23.70849 | nu star (bias corrected) | 22.8865 |
| MLE Mean (bias corrected) | 5.018182 | MLE Sd (bias corrected) | 8.521747 |
| | | Approximate Chi Square Value (0.05) | 13.00508 |
| Adjusted Level of Significance | 0.0419 | Adjusted Chi Square Value | 12.62097 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 8.831063 | 95% Adjusted Gamma UCL | 9.099824 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.812672 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.942 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.252186 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1392 | Data Not Lognormal at 10% Significance Level | |
| Data Not Lognormal at 10% Significance Level | | | |

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.65926 | Mean of logged Data | -0.25097 |
| Maximum of Logged Data | 3.653252 | SD of logged Data | 1.992517 |

Assuming Lognormal Distribution

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9219814 |
| Shapiro Wilk Test Statistic | 0.8525326 |
| Shapiro Wilk Critical (0.0500000) Value | 0.859 |
| Approximate Shapiro Wilk P Value | 0.0368335 |
| Lilliefors Test Statistic | 0.2156469 |
| Lilliefors Critical (0.0500000) Value | 0.2426 |

Data appear Approximate_Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/6/2024 4:53:00 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 12 | Number of Distinct Observations | 11 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.08 | Mean | 0.470833 |
| Maximum | 2.68 | Median | 0.18 |
| SD | 0.7560358 | Std. Error of Mean | 0.218249 |
| Coefficient of Variation | 1.6057398 | Skewness | 2.725417 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.5621367 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.805 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.365399 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2812 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.8627829 | 95% Adjusted-CLT UCL (Chen-1995) | 1.013295 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.891401 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 1.3129304 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7614609 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.2785279 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.2536608 | Data Not Gamma Distributed at 5% Significance Level | |

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 0.8667923 | k star (bias corrected MLE) | 0.70565 |
| Theta hat (MLE) | 0.5431905 | Theta star (bias corrected MLE) | 0.667234 |
| nu hat (MLE) | 20.803016 | nu star (bias corrected) | 16.9356 |
| MLE Mean (bias corrected) | 0.4708333 | MLE Sd (bias corrected) | 0.560496 |
| | | Approximate Chi Square Value (0.05) | 8.626227 |
| Adjusted Level of Significance | 0.02896 | Adjusted Chi Square Value | 7.736813 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.924372 | 95% Adjusted Gamma UCL | 1.030637 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.8525326 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.883 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.2156469 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.2228 | Data appear Lognormal at 10% Significance Level | |

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.525729 | Mean of logged Data | -1.43089 |
| Maximum of Logged Data | 0.9858168 | SD of logged Data | 1.054191 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 1.0862653 | 90% Chebyshev (MVUE) UCL | 0.77364 |
| 95% Chebyshev (MVUE) UCL | 0.9471098 | 97.5% Chebyshev (MVUE) UCL | 1.187879 |
| 99% Chebyshev (MVUE) UCL | 1.6608222 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.8298206 | 95% BCA Bootstrap UCL | 1.045833 |
| 95% Standard Bootstrap UCL | 0.8148448 | 95% Bootstrap-t UCL | 3.062047 |
| 95% Hall's Bootstrap UCL | 2.476522 | 95% Percentile Bootstrap UCL | 0.831667 |
| 90% Chebyshev(Mean, Sd) UCL | 1.1255796 | 95% Chebyshev(Mean, Sd) UCL | 1.422158 |
| 97.5% Chebyshev(Mean, Sd) UCL | 1.8337963 | 99% Chebyshev(Mean, Sd) UCL | 2.642381 |

Suggested UCL to Use

| | |
|---|---|
| 95% H-UCL | 1.0862653 |

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Non-pups - THg in Liver

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/6/2024 4:56:59 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 12 | 0 | 0.18 | 38.6 | 13.3475 | 6.934679 | 11.099894 | 3.2042633 | 5.8339511 | 1.160755 | 0.831608 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2 | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 12 | 0 | 0.777 | 5.446 | 7.2225 | 12.25 | 15.225 | 15.72 | 27.6 | 33.265 | 37.533 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/6/2024 4:58:19 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 12 |
| Number of Distinct Observations | 12 |
| Minimum | 0.18 |
| Maximum | 38.6 |
| Mean of Raw Data | 13.3475 |
| Standard Deviation of Raw Data | 11.099894 |
| Khat | 0.8936071 |
| Theta hat | 14.936654 |
| Kstar | 0.7257609 |
| Theta star | 18.391043 |
| Mean of Log Transformed Data | 1.9365348 |
| Standard Deviation of Log Transformed Data | 1.6603736 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9421866 |
| Shapiro Wilk Test Statistic | 0.8926435 |
| Shapiro Wilk Critical (0.0500000) Value | 0.859 |
| Approximate Shapiro Wilk P Value | 0.1133298 |
| Lilliefors Test Statistic | 0.2423959 |
| Lilliefors Critical (0.0500000) Value | 0.2426 |

Data appear Normal at (0.0500000) Significance Level

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.326806 | 95% BCA Bootstrap UCL | 0.424118 selected ucl is average of |
| 95% Standard Bootstrap UCL | 0.320945 | 95% Bootstrap-t UCL | 0.811769 non-parametric ucl's at 5% |
| 95% Hall's Bootstrap UCL | 0.860896 | 95% Percentile Bootstrap UCL | 0.335882 significance level |
| 90% Chebyshev(Mean, Sd) UCL | 0.439517 | 95% Chebyshev(Mean, Sd) UCL | 0.55254 0.518993771 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.709411 | 99% Chebyshev(Mean, Sd) UCL | 1.017555 |

Suggested UCL to Use

| | |
|---|---|
| 95% Student's-t UCL | 0.330758 |

rejected as data distribution appears non-parametric

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| | | | |
|---|---|---|---|
| 95% H-UCL | 21.89739 | 90% Chebyshev (MVUE) UCL | 11.73345 |
| 95% Chebyshev (MVUE) UCL | 14.85346 | 97.5% Chebyshev (MVUE) UCL | 19.18391 |
| 99% Chebyshev (MVUE) UCL | 27.69025 | | |

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 7.630702 | 95% BCA Bootstrap UCL | 8.139697 selected ucl is average of |
| 95% Standard Bootstrap UCL | 7.605756 | 95% Bootstrap-t UCL | 9.437938 non-parametric ucl's at 5% |
| 95% Hall's Bootstrap UCL | 9.733976 | 95% Percentile Bootstrap UCL | 7.660909 significance level |
| 90% Chebyshev(Mean, Sd) UCL | 9.78308 | 95% Chebyshev(Mean, Sd) UCL | 11.94142 8.878628 |
| 97.5% Chebyshev(Mean, Sd) UCL | 14.93711 | 99% Chebyshev(Mean, Sd) UCL | 20.82156 |

Suggested UCL to Use

| | |
|---|---|
| 95% Student's-t UCL | 7.708584 |

rejected as data distribution is non-parametric

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9702618 |
| A-D Test Statistic | 0.6861325 |
| A-D Critical (0.0500000) Value | 0.7605106 |
| K-S Test Statistic | 0.2201498 |
| K-S Critical(0.0500000) Value | 0.2533969 |

Data appear Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.8782108 |
| Shapiro Wilk Test Statistic | 0.7761811 |
| Shapiro Wilk Critical (0.0500000) Value | 0.859 |
| Approximate Shapiro Wilk P Value | 0.0037207 |
| Lilliefors Test Statistic | 0.2851902 |
| Lilliefors Critical (0.0500000) Value | 0.2426 |

Data not Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/6/2024 4:59:17 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 12 | Number of Distinct Observations | 12 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.18 | Mean | 13.3475 |
| Maximum | 38.6 | Median | 12.25 |
| SD | 11.099894 | Std. Error of Mean | 3.204263 |
| Coefficient of Variation | 0.8316084 | Skewness | 1.160755 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.8926435 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.805 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.2423959 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2812 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 19.101988 | 95% Adjusted-CLT UCL (Chen-1995) | 19.7653 |
| | | 95% Modified-t UCL (Johnson-1978) | 19.28094 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.6861325 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7605106 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.2201498 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.2533969 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 0.8936071 | k star (bias corrected MLE) | 0.725761 |
| Theta hat (MLE) | 14.936654 | Theta star (bias corrected MLE) | 18.39104 |
| nu hat (MLE) | 21.446571 | nu star (bias corrected) | 17.41826 |
| MLE Mean (bias corrected) | 13.3475 | MLE Sd (bias corrected) | 15.66762 |
| | | Approximate Chi Square Value (0.05) | 8.971804 |
| Adjusted Level of Significance | 0.02896 | Adjusted Chi Square Value | 8.062084 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 25.913434 | 95% Adjusted Gamma UCL | 28.83749 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.7761811 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.883 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.2851902 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.2228 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -1.714798 | Mean of logged Data | 1.936535 |
| Maximum of Logged Data | 3.6532523 | SD of logged Data | 1.660374 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 228.88167 | 90% Chebyshev (MVUE) UCL | 57.10212 |
| 95% Chebyshev (MVUE) UCL | 72.92421 | 97.5% Chebyshev (MVUE) UCL | 94.88466 |
| 99% Chebyshev (MVUE) UCL | 138.02172 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 18.618044 | 95% BCA Bootstrap UCL | 19.4075 |
| 95% Standard Bootstrap UCL | 18.361944 | 95% Bootstrap-t UCL | 21.62859 |
| 95% Hall's Bootstrap UCL | 34.702124 | 95% Percentile Bootstrap UCL | 18.8275 |
| 90% Chebyshev(Mean, Sd) UCL | 22.96029 | 95% Chebyshev(Mean, Sd) UCL | 27.31456 |
| 97.5% Chebyshev(Mean, Sd) UCL | 33.358118 | 99% Chebyshev(Mean, Sd) UCL | 45.22952 |

Suggested UCL to Use

| | |
|---|---|
| 95% Student's-t UCL | 19.101988 |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

## THg Statistics - Pups

Meat (Muscle) THg

| | |
|---|---|
| N | 22 |
| min | 0.01 |
| max | 0.1 |
| arithmean | 0.0368182 |
| median | 0.03 |
| #nd | 0 |
| Freq nd | 0% |

length vs THg (muscle)

| |
|---|
| -0.38318807 |

length vs THg (liver)

| |
|---|
| -0.20410319 |

Liver THg

| | |
|---|---|
| N | 21 |
| min | 0.07 |
| max | 0.59 |
| arithmean | 0.258571 |
| median | 0.22 |
| #nd | 0 |
| Freq nd | 0% |

Pups - THg in Muscle (Meat)

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/7/2024 10:50:36 AM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 22 | 0 | 0.01 | 0.1 | 0.0368182 | 0.030343 | 0.0233781 | 0.0049842 | 0.0148258 | 1.358061 | 0.634962 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2 | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 22 | 0 | 0.01 | 0.02 | 0.0225 | 0.03 | 0.04 | 0.048 | 0.059 | 0.0885 | 0.0979 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/7/2024 10:51:23 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 22 |
| Number of Distinct Observations | 8 |
| Minimum | 0.01 |
| Maximum | 0.1 |
| Mean of Raw Data | 0.0368182 |
| Standard Deviation of Raw Data | 0.0233781 |
| Khat | 2.7404046 |

| | |
|---|---|
| Theta hat | 0.0134353 |
| Kstar | 2.3970161 |
| Theta star | 0.01536 |
| Mean of Log Transformed Data | -3.495175 |
| Standard Deviation of Log Transformed Data | 0.6628363 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9244848 |
| Shapiro Wilk Test Statistic | 0.8561754 |
| Shapiro Wilk Critical (0.0500000) Value | 0.911 |
| Approximate Shapiro Wilk P Value | 0.0034077 |
| Lilliefors Test Statistic | 0.2185975 |
| Lilliefors Critical (0.0500000) Value | 0.184 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.971846 |
| A-D Test Statistic | 0.640713 |
| A-D Critical (0.0500000) Value | 0.7511645 |
| K-S Test Statistic | 0.178766 |
| K-S Critical(0.0500000) Value | 0.1870037 |

Data appear Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9597844 |
| Shapiro Wilk Test Statistic | 0.9129779 |
| Shapiro Wilk Critical (0.0500000) Value | 0.911 |
| Approximate Shapiro Wilk P Value | 0.05169 |
| Lilliefors Test Statistic | 0.2204223 |
| Lilliefors Critical (0.0500000) Value | 0.184 |

Data appear Approximate_Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/7/2024 10:56:08 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 22 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.036818 |
| Maximum | 0.1 | Median | 0.03 |
| SD | 0.0233781 | Std. Error of Mean | 0.004984 |
| Coefficient of Variation | 0.6349615 | Skewness | 1.358061 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.8561754 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.878 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.2185975 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2141 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.0453948 | 95% Adjusted-CLT UCL (Chen-1995) | 0.046559 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.045635 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.640713 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7511645 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.178766 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.1870037 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.7404046 | k star (bias corrected MLE) | 2.397016 |
| Theta hat (MLE) | 0.0134353 | Theta star (bias corrected MLE) | 0.01536 |
| nu hat (MLE) | 120.5778 | nu star (bias corrected) | 105.4687 |
| MLE Mean (bias corrected) | 0.0368182 | MLE Sd (bias corrected) | 0.023781 |
| | | Approximate Chi Square Value (0.05) | 82.7692 |
| Adjusted Level of Significance | 0.0386 | Adjusted Chi Square Value | 81.26883 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0469156 | 95% Adjusted Gamma UCL | 0.047782 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9129779 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.926 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.2204223 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.169 | Data Not Lognormal at 10% Significance Level | |

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -3.49518 |
| Maximum of Logged Data | -2.302585 | SD of logged Data | 0.662836 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.0516727 | 90% Chebyshev (MVUE) UCL | 0.054208 |
| 95% Chebyshev (MVUE) UCL | 0.0618434 | 97.5% Chebyshev (MVUE) UCL | 0.072441 |
| 99% Chebyshev (MVUE) UCL | 0.0932569 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.0450165 | 95% BCA Bootstrap UCL | 0.046364 |
| 95% Standard Bootstrap UCL | 0.0448386 | 95% Bootstrap-t UCL | 0.048033 |
| 95% Hall's Bootstrap UCL | 0.051884 | 95% Percentile Bootstrap UCL | 0.045 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0517709 | 95% Chebyshev(Mean, Sd) UCL | 0.058544 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0679447 | 99% Chebyshev(Mean, Sd) UCL | 0.086411 |

Suggested UCL to Use

| | |
|---|---|
| 95% Adjusted Gamma UCL | 0.0477817 |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Pups - THg in Liver

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/8/2024 10:59:53 AM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 21 | 0 | 0.07 | 0.59 | 0.2585714 | 0.222914 | 0.1448891 | 0.0316174 | 0.1186064 | 1.024225 | 0.560345 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2 | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 21 | 0 | 0.1 | 0.14 | 0.17 | 0.22 | 0.3 | 0.32 | 0.5 | 0.55 | 0.582 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/8/2024 11:00:45 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 21 |
| Number of Distinct Observations | 17 |
| Minimum | 0.07 |
| Maximum | 0.59 |
| Mean of Raw Data | 0.2585714 |

| | |
|---|---|
| Standard Deviation of Raw Data | 0.1448891 |
| Khat | 3.5275997 |
| Theta hat | 0.0732995 |
| Kstar | 3.0554029 |
| Theta star | 0.0846276 |
| Mean of Log Transformed Data | -1.500968 |
| Standard Deviation of Log Transformed Data | 0.5693959 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9529752 |
| Shapiro Wilk Test Statistic | 0.9034191 |
| Shapiro Wilk Critical (0.0500000) Value | 0.908 |
| Approximate Shapiro Wilk P Value | 0.037779 |
| Lilliefors Test Statistic | 0.155498 |
| Lilliefors Critical (0.0500000) Value | 0.1881 |

Data appear Approximate Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.984732 |
| A-D Test Statistic | 0.2279984 |
| A-D Critical (0.0500000) Value | 0.7483015 |
| K-S Test Statistic | 0.0869787 |
| K-S Critical(0.0500000) Value | 0.1905918 |

Data appear Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9913093 |
| Shapiro Wilk Test Statistic | 0.9777129 |
| Shapiro Wilk Critical (0.0500000) Value | 0.908 |
| Approximate Shapiro Wilk P Value | 0.8714709 |
| Lilliefors Test Statistic | 0.091125 |
| Lilliefors Critical (0.0500000) Value | 0.1881 |

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/8/2024 11:01:46 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 21 | Number of Distinct Observations | 17 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.07 | Mean | 0.258571 |
| Maximum | 0.59 | Median | 0.22 |
| SD | 0.1448891 | Std. Error of Mean | 0.031617 |
| Coefficient of Variation | 0.5603447 | Skewness | 1.024225 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9034191 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.873 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.155498 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.219 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.3131025 | 95% Adjusted-CLT UCL (Chen-1995) | 0.318128 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.31428 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.2279984 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7483015 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.0869787 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.1905918 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 3.5275997 | k star (bias corrected MLE) | 3.055403 |
| Theta hat (MLE) | 0.0732995 | Theta star (bias corrected MLE) | 0.084628 |
| nu hat (MLE) | 148.15919 | nu star (bias corrected) | 128.3269 |
| MLE Mean (bias corrected) | 0.2585714 | MLE Sd (bias corrected) | 0.147927 |
| | | Approximate Chi Square Value (0.05) | 103.1607 |
| Adjusted Level of Significance | 0.0383 | Adjusted Chi Square Value | 101.4283 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.3216504 | 95% Adjusted Gamma UCL | 0.327144 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9777129 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.923 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.091125 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1726 | Data appear Lognormal at 10% Significance Level | |

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.65926 | Mean of logged Data | -1.50097 |
| Maximum of Logged Data | -0.527633 | SD of logged Data | 0.569396 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.3405134 | 90% Chebyshev (MVUE) UCL | 0.361348 |
| 95% Chebyshev (MVUE) UCL | 0.4073228 | 97.5% Chebyshev (MVUE) UCL | 0.471134 |
| 99% Chebyshev (MVUE) UCL | 0.5964785 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.3105774 | 95% BCA Bootstrap UCL | 0.312381 |
| 95% Standard Bootstrap UCL | 0.3081398 | 95% Bootstrap-t UCL | 0.324331 |
| 95% Hall's Bootstrap UCL | 0.3206207 | 95% Percentile Bootstrap UCL | 0.307143 |
| 90% Chebyshev(Mean, Sd) UCL | 0.3534236 | 95% Chebyshev(Mean, Sd) UCL | 0.396389 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.456022 | 99% Chebyshev(Mean, Sd) UCL | 0.573161 |

Suggested UCL to Use

| | |
|---|---|
| 95% Student's-t UCL | 0.3131025 |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

## ALL SEALS

| Sample Year | species | sample area | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age | Age Estimate | life_stage | # non-pups |
|---|---|---|---|---|---|---|---|---|---|---|
| 2020 | Ringed Seal | LM | 27.2 | 80 | 0.01 | 0.14 | | 0 | Pup | 10 |
| 2020 | Ringed Seal | LM | 27.2 | 76 | 0.02 | 0.11 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 18.1 | 68 | 0.04 | 0.29 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 22.7 | 78 | 0.01 | 0.36 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 27.2 | 82 | 0.02 | 0.24 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 90.7 | 126 | 0.28 | 10.8 | | 1 | Non Pup | |
| 2020 | Ringed Seal | LM | 18.1 | 70 | 0.03 | 0.31 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 45.4 | 104 | 0.04 | 2.54 | | 1 | Non Pup | |
| 2020 | Ringed Seal | LM | 13.6 | 54 | 0.01 | 0.41 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 45.4 | 100 | 0.3 | 29.4 | | 1 | Non Pup | |
| 2020 | Ringed Seal | LM | 27.2 | 80 | 0.02 | 0.09 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 27.2 | 78 | 0.19 | 0.8 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 27.2 | 76 | 0.03 | 0.14 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 27.2 | 80 | 0.07 | 0.35 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 22.7 | 76 | 0.04 | 0.42 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 18.1 | 74 | 0.03 | 0.14 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 24 | 99 | 0.1 | 3.25 | | 1 | Non Pup | |
| 2020 | Ringed Seal | LM | 38.6 | 108 | 0.12 | 3.99 | | 1 | Non Pup | |
| 2020 | Ringed Seal | LM | 90.7 | 141 | 0.56 | 4.33 | | 1 | Non Pup | |
| 2020 | Ringed Seal | LM | 22.7 | 83 | 0.07 | 1.23 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 30.8 | 90 | 0.08 | 0.68 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 86.2 | 131 | 0.36 | 24 | | 1 | Non Pup | |
| 2020 | Ringed Seal | LM | 21.8 | 79 | 0.03 | 0.23 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 31.8 | 85 | 0.19 | 0.8 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 36.3 | 109 | 0.1 | 4.76 | | 1 | Non Pup | |
| 2020 | Ringed Seal | LM | 81.6 | 115 | 0.19 | 5.59 | | 1 | Non Pup | |
| 2020 | Ringed Seal | LM | 27.2 | 76 | 0.04 | 0.28 | | 0 | Pup | |
| 2020 | Ringed Seal | LM | 68 | 110 | 0.21 | 7.35 | | 1 | Non Pup | |
| 2020 | Ringed Seal | LM | 27.2 | 78 | 0.07 | 0.41 | | 0 | Pup | |

**note: one seal had no THg data for either muscle or liver, but was measured for weight and length; this seal is excluded

## NON-PUPS (estimated age range: ~1 year)

| Sample Year | species | sample area | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age | Age Estimate | life_stage |
|---|---|---|---|---|---|---|---|---|---|
| 2020 | Ringed Seal | LM | 90.7 | 126 | 0.28 | 10.8 | | 1 | Non Pup |
| 2020 | Ringed Seal | LM | 45.4 | 104 | 0.04 | 2.54 | | 1 | Non Pup |
| 2020 | Ringed Seal | LM | 45.4 | 100 | 0.3 | 29.4 | | 1 | Non Pup |
| 2020 | Ringed Seal | LM | 24 | 99 | 0.1 | 3.25 | | 1 | Non Pup |
| 2020 | Ringed Seal | LM | 38.6 | 108 | 0.12 | 3.99 | | 1 | Non Pup |
| 2020 | Ringed Seal | LM | 90.7 | 141 | 0.56 | 4.33 | | 1 | Non Pup |
| 2020 | Ringed Seal | LM | 86.2 | 131 | 0.36 | 24 | | 1 | Non Pup |
| 2020 | Ringed Seal | LM | 36.3 | 109 | 0.1 | 4.76 | | 1 | Non Pup |
| 2020 | Ringed Seal | LM | 81.6 | 115 | 0.19 | 5.59 | | 1 | Non Pup |
| 2020 | Ringed Seal | LM | 68 | 110 | 0.21 | 7.35 | | 1 | Non Pup |

## PUPS (<1 year)

| Sample Year | species | sample area | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age | Age Estimate | life_stage |
|---|---|---|---|---|---|---|---|---|---|
| 2020 | Ringed Seal | LM | 27.2 | 80 | 0.01 | 0.14 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 27.2 | 76 | 0.02 | 0.11 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 18.1 | 68 | 0.04 | 0.29 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 22.7 | 78 | 0.01 | 0.36 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 27.2 | 82 | 0.02 | 0.24 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 18.1 | 70 | 0.03 | 0.31 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 13.6 | 54 | 0.01 | 0.41 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 27.2 | 80 | 0.02 | 0.09 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 27.2 | 78 | 0.19 | 0.8 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 27.2 | 76 | 0.03 | 0.14 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 27.2 | 80 | 0.07 | 0.35 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 22.7 | 76 | 0.04 | 0.42 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 18.1 | 74 | 0.03 | 0.14 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 22.7 | 83 | 0.07 | 1.23 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 30.8 | 90 | 0.08 | 0.68 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 21.8 | 79 | 0.03 | 0.23 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 31.8 | 85 | 0.19 | 0.8 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 27.2 | 76 | 0.04 | 0.28 | | 0 | Pup |
| 2020 | Ringed Seal | LM | 27.2 | 78 | 0.07 | 0.41 | | 0 | Pup |

## THg Statistics - Non-pups

| Meat (Muscle) THg | | | Liver THg | |
|---|---|---|---|---|
| N | 10 | length vs THg (muscle) | N | 10 |
| min | 0.04 | 0.81616239 | min | 2.54 |
| max | 0.56 | | max | 29.4 |
| arithmean | 0.226 | length vs THg (liver) | arithmean | 9.601 |
| median | 0.2 | 0.05783592 | median | 5.175 |
| #nd | 0 | | #nd | 0 |
| Freq nd | 0% | | Freq nd | 0% |

Non-pups - THg in Muscle (Meat)

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/11/2024 1:09:17 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 10 | 0 | 0.04 | 0.56 | 0.226 | 0.178278 | 0.1552918 | 0.0491076 | 0.148258 | 1.058875 | 0.687132 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2 | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 10 | 0 | 0.094 | 0.1 | 0.105 | 0.2 | 0.295 | 0.312 | 0.38 | 0.47 | 0.542 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/11/2024 1:10:01 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| | |
|---|---|
| Raw Statistics | |
| Number of Valid Observations | 10 |
| Number of Distinct Observations | 9 |
| Minimum | 0.04 |
| Maximum | 0.56 |
| Mean of Raw Data | 0.226 |
| Standard Deviation of Raw Data | 0.1552918 |
| Khat | 2.2606333 |
| Theta hat | 0.099972 |
| Kstar | 1.6491099 |
| Theta star | 0.1370436 |
| Mean of Log Transformed Data | -1.72441 |
| Standard Deviation of Log Transformed Data | 0.7723119 |
| Normal GOF Test Results | |
| Correlation Coefficient R | 0.9572477 |
| Shapiro Wilk Test Statistic | 0.9214166 |
| Shapiro Wilk Critical (0.0500000) Value | 0.842 |
| Approximate Shapiro Wilk P Value | 0.3294622 |
| Lilliefors Test Statistic | 0.1525657 |
| Lilliefors Critical (0.0500000) Value | 0.2616 |
| Data appear Normal at (0.0500000) Significance Level | |
| Gamma GOF Test Results | |
| Correlation Coefficient R | 0.9932623 |
| A-D Test Statistic | 0.1779446 |
| A-D Critical (0.0500000) Value | 0.7346938 |
| K-S Test Statistic | 0.1350197 |
| K-S Critical(0.0500000) Value | 0.2694555 |
| Data appear Gamma Distributed at (0.0500000) Significance Level | |
| Lognormal GOF Test Results | |
| Correlation Coefficient R | 0.9813199 |
| Shapiro Wilk Test Statistic | 0.9675437 |
| Shapiro Wilk Critical (0.0500000) Value | 0.842 |
| Approximate Shapiro Wilk P Value | 0.8296672 |
| Lilliefors Test Statistic | 0.1328563 |

## THg Statistics - All seals combined

| Meat (Muscle) THg | | | Liver THg | |
|---|---|---|---|---|
| N | 29 | length vs THg (muscle) | N | 29 |
| min | 0.01 | 0.821422 | min | 0.09 |
| max | 0.56 | | max | 29.4 |
| arithmean | 0.112414 | length vs THg (liver) | arithmean | 3.566897 |
| median | 0.07 | 0.581749 | median | 0.42 |
| #nd | 1 | | #nd | 0 |
| Freq nd | 3% | | Freq nd | 0% |

All Seals - THg in Muscle (Meat)

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/11/2024 9:47:41 AM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 29 | 0 | 0.01 | 0.56 | 0.112414 | 0.062719 | 0.128804 | 0.023918 | 0.074129 | 1.954278 | 1.1458 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1 | 50%ile(Q2 | 75%ile(Q3 | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 29 | 0 | 0.018 | 0.026 | 0.03 | 0.07 | 0.19 | 0.19 | 0.284 | 0.336 | 0.504 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/11/2024 9:48:42 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| | |
|---|---|
| Raw Statistics | |
| Number of Valid Observations | 29 |
| Number of Distinct Observations | 14 |
| Minimum | 0.01 |
| Maximum | 0.56 |
| Mean of Raw Data | 0.112414 |
| Standard Deviation of Raw Data | 0.128804 |
| Khat | 0.990331 |
| Theta hat | 0.113511 |
| Kstar | 0.910872 |
| Theta star | 0.123413 |
| Mean of Log Transformed Data | -2.76909 |
| Standard Deviation of Log Transformed Data | 1.128351 |
| Normal GOF Test Results | |
| Correlation Coefficient R | 0.867498 |
| Shapiro Wilk Test Statistic | 0.76103 |
| Shapiro Wilk Critical (0.0500000) Value | 0.926 |
| Approximate Shapiro Wilk P Value | 6.18E-06 |
| Lilliefors Test Statistic | 0.228045 |
| Lilliefors Critical (0.0500000) Value | 0.1614 |
| Data not Normal at (0.0500000) Significance Level | |
| Gamma GOF Test Results | |
| Correlation Coefficient R | 0.990765 |
| A-D Test Statistic | 0.70175 |
| A-D Critical (0.0500000) Value | 0.774529 |
| K-S Test Statistic | 0.181274 |
| K-S Critical(0.0500000) Value | 0.167529 |
| Data follow Appr. Gamma Distribution at (0.0500000) Significance Level | |
| Lognormal GOF Test Results | |
| Correlation Coefficient R | 0.986223 |
| Shapiro Wilk Test Statistic | 0.958531 |
| Shapiro Wilk Critical (0.0500000) Value | 0.926 |
| Approximate Shapiro Wilk P Value | 0.337727 |
| Lilliefors Test Statistic | 0.137674 |
| Lilliefors Critical (0.0500000) Value | 0.1614 |
| Data appear Lognormal at (0.0500000) Significance Level | |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/11/2024 9:49:36 AM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operation | 2000 |

C0

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 29 | Number of Distinct Observations | 14 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.112414 |
| Maximum | 0.56 | Median | 0.07 |
| SD | 0.128804 | Std. Error of Mean | 0.023918 |
| Coefficient of Variation | 1.1458 | Skewness | 1.954278 |

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.76103 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.898 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.228045 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.1886 | Data Not Normal at 1% Significance Level | |
| Data Not Normal at 1% Significance Level | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.153102 | 95% Adjusted-CLT UCL (Chen-1995) | 0.161031 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.154549 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.70175 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.774529 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.181274 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.167529 | Data Not Gamma Distributed at 5% Significance Level | |
| Detected data follow Appr. Gamma Distribution at 5% Significance Level | | | |

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 0.990331 | k star (bias corrected MLE) | 0.910872 |
| Theta hat (MLE) | 0.113511 | Theta star (bias corrected MLE) | 0.123413 |
| nu hat (MLE) | 57.4382 | nu star (bias corrected) | 52.83055 |
| MLE Mean (bias corrected) | 0.112414 | MLE Sd (bias corrected) | 0.117785 |
| | | Approximate Chi Square Value (0.05) | 37.13369 |
| Adjusted Level of Significance | 0.0407 | Adjusted Chi Square Value | 36.34699 |
| Assuming Gamma Distribution | | | |
| 95% Approximate Gamma UCL | 0.159933 | 95% Adjusted Gamma UCL | 0.163394 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.958531 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.937 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.137674 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1483 | Data appear Lognormal at 10% Significance Level | |
| Data appear Lognormal at 10% Significance Level | | | |
| Lognormal Statistics | | | |
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -2.76909 |
| Maximum of Logged Data | -0.57982 | SD of logged Data | 1.128351 |
| Assuming Lognormal Distribution | | | |
| 95% H-UCL | 0.207703 | 90% Chebyshev (MVUE) UCL | 0.199308 |
| 95% Chebyshev (MVUE) UCL | 0.237685 | 97.5% Chebyshev (MVUE) UCL | 0.290951 |
| 99% Chebyshev (MVUE) UCL | 0.395581 | | |
| Nonparametric Distribution Free UCL Statistics | | | |
| Data appear to follow a Discernible Distribution | | | |

All Seals - THg in Liver

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/11/2024 12:29:02 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 29 | 0 | 0.09 | 29.4 | 3.566897 | 0.893527 | 6.9491 | 1.290415 | 0.4596 | 2.925221 | 1.94822 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1 | 50%ile(Q2 | 75%ile(Q3 | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 29 | 0 | 0.14 | 0.236 | 0.28 | 0.42 | 3.99 | 4.502 | 8.04 | 18.72 | 27.888 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/11/2024 12:29:58 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| | |
|---|---|
| Raw Statistics | |
| Number of Valid Observations | 29 |
| Number of Distinct Observations | 25 |
| Minimum | 0.09 |
| Maximum | 29.4 |
| Mean of Raw Data | 3.566897 |
| Standard Deviation of Raw Data | 6.9491 |
| Khat | 0.464214 |
| Theta hat | 7.683737 |
| Kstar | 0.43918 |
| Theta star | 8.121716 |
| Mean of Log Transformed Data | -0.11258 |
| Standard Deviation of Log Transformed Data | 1.672139 |
| Normal GOF Test Results | |
| Correlation Coefficient R | 0.729797 |
| Shapiro Wilk Test Statistic | 0.547871 |
| Shapiro Wilk Critical (0.0500000) Value | 0.926 |
| Approximate Shapiro Wilk P Value | 1.13E-09 |
| Lilliefors Test Statistic | 0.308419 |
| Lilliefors Critical (0.0500000) Value | 0.1614 |
| Data not Normal at (0.0500000) Significance Level | |
| Gamma GOF Test Results | |
| Correlation Coefficient R | 0.964751 |
| A-D Test Statistic | 1.819793 |
| A-D Critical (0.0500000) Value | 0.819488 |
| K-S Test Statistic | 0.238264 |
| K-S Critical(0.0500000) Value | 0.172938 |
| Data not Gamma Distributed at (0.0500000) Significance Level | |
| Lognormal GOF Test Results | |
| Correlation Coefficient R | 0.965953 |
| Shapiro Wilk Test Statistic | 0.918912 |
| Shapiro Wilk Critical (0.0500000) Value | 0.926 |
| Approximate Shapiro Wilk P Value | 0.031761 |
| Lilliefors Test Statistic | 0.191416 |
| Lilliefors Critical (0.0500000) Value | 0.1614 |
| Data not Lognormal at (0.0500000) Significance Level | |

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/11/2024 12:31:27 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operation | 2000 |

C0

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 29 | Number of Distinct Observations | 25 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.09 | Mean | 3.566897 |
| Maximum | 29.4 | Median | 0.42 |
| SD | 6.9491 | Std. Error of Mean | 1.290415 |
| Coefficient of Variation | 1.94822 | Skewness | 2.925221 |

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.547871 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.898 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.308419 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.1886 | Data Not Normal at 1% Significance Level | |
| Data Not Normal at 1% Significance Level | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 5.762062 | 95% Adjusted-CLT UCL (Chen-1995) | 6.43842 |
| | | 95% Modified-t UCL (Johnson-1978) | 5.878888 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 1.819793 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.819488 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.238264 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.172938 | Data Not Gamma Distributed at 5% Significance Level | |
| Data Not Gamma Distributed at 5% Significance Level | | | |

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 0.464214 | k star (bias corrected MLE) | 0.43918 |
| Theta hat (MLE) | 7.683737 | Theta star (bias corrected MLE) | 8.121716 |
| nu hat (MLE) | 26.9244 | nu star (bias corrected) | 25.47245 |
| MLE Mean (bias corrected) | 3.566897 | MLE Sd (bias corrected) | 5.382315 |
| | | Approximate Chi Square Value (0.05) | 14.97375 |
| Adjusted Level of Significance | 0.0407 | Adjusted Chi Square Value | 14.49248 |
| Assuming Gamma Distribution | | | |
| 95% Approximate Gamma UCL | 6.067791 | 95% Adjusted Gamma UCL | 6.269291 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.918912 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.937 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.191416 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1483 | Data Not Lognormal at 10% Significance Level | |
| Data Not Lognormal at 10% Significance Level | | | |
| Lognormal Statistics | | | |
| Minimum of Logged Data | -2.40795 | Mean of logged Data | -0.11258 |
| Maximum of Logged Data | 3.380995 | SD of logged Data | 1.672139 |
| Assuming Lognormal Distribution | | | |
| 95% H-UCL | 10.60121 | 90% Chebyshev (MVUE) UCL | 7.178531 |
| 95% Chebyshev (MVUE) UCL | 8.952417 | 97.5% Chebyshev (MVUE) UCL | 11.4145 |

| | |
|---|---|
| Lilliefors Critical (0.0500000) Value | 0.2616 |
| Data appear Lognormal at (0.0500000) Significance Level | |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/11/2024 1:10:52 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

| | | | |
|---|---|---|---|
| General Statistics | | | |
| Total Number of Observations | 10 | Number of Distinct Observations | 9 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.04 | Mean | 0.226 |
| Maximum | 0.56 | Median | 0.2 |
| SD | 0.1552918 | Std. Error of Mean | 0.049108 |
| Coefficient of Variation | 0.687132 | Skewness | 1.058875 |
| Normal GOF Test | | | |
| Shapiro Wilk Test Statistic | 0.9214166 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.781 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.1525657 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.3037 | Data appear Normal at 1% Significance Level | |
| Data appear Normal at 1% Significance Level | | | |
| Assuming Normal Distribution | | | |
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.3160198 | 95% Adjusted-CLT UCL (Chen-1995) | 0.324345 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.31876 |
| Gamma GOF Test | | | |
| A-D Test Statistic | 0.1779446 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7346938 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.1350197 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.2694555 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data appear Gamma Distributed at 5% Significance Level | | | |
| Gamma Statistics | | | |
| k hat (MLE) | 2.2606333 | k star (bias corrected MLE) | 1.64911 |
| Theta hat (MLE) | 0.099972 | Theta star (bias corrected MLE) | 0.137044 |
| nu hat (MLE) | 45.212665 | nu star (bias corrected) | 32.9822 |
| MLE Mean (bias corrected) | 0.226 | MLE Sd (bias corrected) | 0.175988 |
| | | Approximate Chi Square Value (0.05) | 20.85248 |
| Adjusted Level of Significance | 0.0267 | Adjusted Chi Square Value | 19.19201 |
| Assuming Gamma Distribution | | | |
| 95% Approximate Gamma UCL | 0.3574625 | 95% Adjusted Gamma UCL | 0.38839 |
| Lognormal GOF Test | | | |
| Shapiro Wilk Test Statistic | 0.9675437 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.869 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.1328563 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.241 | Data appear Lognormal at 10% Significance Level | |
| Data appear Lognormal at 10% Significance Level | | | |
| Lognormal Statistics | | | |
| Minimum of Logged Data | -3.218876 | Mean of logged Data | -1.72441 |
| Maximum of Logged Data | -0.579818 | SD of logged Data | 0.772312 |
| Assuming Lognormal Distribution | | | |
| 95% H-UCL | 0.4763652 | 90% Chebyshev (MVUE) UCL | 0.407558 |
| 95% Chebyshev (MVUE) UCL | 0.4872054 | 97.5% Chebyshev (MVUE) UCL | 0.597753 |
| 99% Chebyshev (MVUE) UCL | 0.8149018 | | |
| Nonparametric Distribution Free UCL Statistics | | | |
| Data appear to follow a Discernible Distribution | | | |
| Nonparametric Distribution Free UCLs | | | |
| 95% CLT UCL | 0.3067748 | 95% BCA Bootstrap UCL | 0.319 |
| 95% Standard Bootstrap UCL | 0.3023219 | 95% Bootstrap-t UCL | 0.34275 |
| 95% Hall's Bootstrap UCL | 0.3517515 | 95% Percentile Bootstrap UCL | 0.307 |
| 90% Chebyshev(Mean, Sd) UCL | 0.3733228 | 95% Chebyshev(Mean, Sd) UCL | 0.440055 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.5326768 | 99% Chebyshev(Mean, Sd) UCL | 0.714614 |
| Suggested UCL to Use | | | |
| 95% Student's-t UCL | 0.3160198 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Non-pups - THg in Liver

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/11/2024 1:14:03 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 10 | 0 | 2.54 | 29.4 | 9.601 | 6.803723 | 9.3975132 | 2.9717546 | 3.0392884 | 1.61119 | 0.978806 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2 | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 10 | 0 | 3.179 | 3.842 | 4.075 | 5.175 | 9.9375 | 13.44 | 24.54 | 26.97 | 28.914 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/11/2024 1:15:23 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| | |
|---|---|
| Raw Statistics | |
| Number of Valid Observations | 10 |
| Number of Distinct Observations | 10 |
| Minimum | 2.54 |
| Maximum | 29.4 |
| Mean of Raw Data | 9.601 |
| Standard Deviation of Raw Data | 9.3975132 |
| Khat | 1.5981127 |
| Theta hat | 6.0077114 |
| Kstar | 1.1853456 |
| Theta star | 8.0997476 |
| Mean of Log Transformed Data | 1.91747 |
| Standard Deviation of Log Transformed Data | 0.8247812 |
| Normal GOF Test Results | |
| Correlation Coefficient R | 0.8550753 |
| Shapiro Wilk Test Statistic | 0.7310216 |
| Shapiro Wilk Critical (0.0500000) Value | 0.842 |
| Approximate Shapiro Wilk P Value | 0.0024369 |
| Lilliefors Test Statistic | 0.2946532 |
| Lilliefors Critical (0.0500000) Value | 0.2616 |
| Data not Normal at (0.0500000) Significance Level | |
| Gamma GOF Test Results | |
| Correlation Coefficient R | 0.9573366 |
| A-D Test Statistic | 0.7424338 |
| A-D Critical (0.0500000) Value | 0.7385138 |
| K-S Test Statistic | 0.2373303 |
| K-S Critical(0.0500000) Value | 0.2708629 |
| Data appear Gamma Distributed at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | | | |
|---|---|---|---|
| Nonparametric Distribution Free UCLs | | | |
| 95% CLT UCL | 0.151756 | 95% BCA Bootstrap UCL | 0.161724 |
| 95% Standard Bootstrap UCL | 0.151392 | 95% Bootstrap-t UCL | 0.166684 |
| 95% Hall's Bootstrap UCL | 0.168413 | 95% Percentile Bootstrap UCL | 0.155517 |
| 90% Chebyshev(Mean, Sd) UCL | 0.184169 | 95% Chebyshev(Mean, Sd) UCL | 0.216671 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.261783 | 99% Chebyshev(Mean, Sd) UCL | 0.350397 |
| Suggested UCL to Use | | | |
| 95% Adjusted Gamma UCL | 0.163394 | | |

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| | | | |
|---|---|---|---|
| 99% Chebyshev (MVUE) UCL | 16.25079 | | |
| Nonparametric Distribution Free UCL Statistics | | | |
| Data do not follow a Discernible Distribution | | | |
| Nonparametric Distribution Free UCLs | | | selected average of non-parametric UCLs at 5% significance level |
| 95% CLT UCL | 5.689441 | 95% BCA Bootstrap UCL | 6.753793 |
| 95% Standard Bootstrap UCL | 5.687103 | 95% Bootstrap-t UCL | 8.790609 8.154456 |
| 95% Hall's Bootstrap UCL | 15.05063 | 95% Percentile Bootstrap UCL | 5.917931 |
| 90% Chebyshev(Mean, Sd) UCL | 7.438143 | 95% Chebyshev(Mean, Sd) UCL | 9.191687 |
| 97.5% Chebyshev(Mean, Sd) UCL | 11.62554 | 99% Chebyshev(Mean, Sd) UCL | 16.40637 |
| Suggested UCL to Use | | | |
| 95% Student's-t UCL | 5.762062 | rejected as data distribution is non-parametric | |

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| | |
|---|---|
| Correlation Coefficient R | 0.9540175 |
| Shapiro Wilk Test Statistic | 0.9002975 |
| Shapiro Wilk Critical (0.0500000) Value | 0.842 |
| Approximate Shapiro Wilk P Value | 0.2555488 |
| Lilliefors Test Statistic | 0.1941501 |
| Lilliefors Critical (0.0500000) Value | 0.2616 |

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/11/2024 1:16:15 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 10 | Number of Distinct Observations | 10 |
| | | Number of Missing Observations | 0 |
| Minimum | 2.54 | Mean | 9.601 |
| Maximum | 29.4 | Median | 5.175 |
| SD | 9.3975132 | Std. Error of Mean | 2.971755 |
| Coefficient of Variation | 0.9788057 | Skewness | 1.61119 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.7310216 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.781 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.2946532 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.3037 | Data appear Normal at 1% Significance Level | |

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 15.048562 | 95% Adjusted-CLT UCL (Chen-1995) | 16.10696 |
| | | 95% Modified-t UCL (Johnson-1978) | 15.30092 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.7424338 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7385138 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.2373303 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.2708629 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.5981127 | k star (bias corrected MLE) | 1.185346 |
| Theta hat (MLE) | 6.0077114 | Theta star (bias corrected MLE) | 8.099748 |
| nu hat (MLE) | 31.962255 | nu star (bias corrected) | 23.70691 |
| MLE Mean (bias corrected) | 9.601 | MLE Sd (bias corrected) | 8.818485 |
| | | Approximate Chi Square Value (0.05) | 13.62598 |
| Adjusted Level of Significance | 0.0267 | Adjusted Chi Square Value | 12.31627 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 16.704125 | 95% Adjusted Gamma UCL | 18.48044 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9002975 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.869 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.1941501 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.241 | Data appear Lognormal at 10% Significance Level | |

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | 0.9321641 | Mean of logged Data | 1.91747 |
| Maximum of Logged Data | 3.3809947 | SD of logged Data | 0.824781 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 20.396769 | 90% Chebyshev (MVUE) UCL | 16.61848 |
| 95% Chebyshev (MVUE) UCL | 19.99393 | 97.5% Chebyshev (MVUE) UCL | 24.67893 |
| 99% Chebyshev (MVUE) UCL | 33.881697 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 14.489101 | 95% BCA Bootstrap UCL | 15.845 |
| 95% Standard Bootstrap UCL | 14.309362 | 95% Bootstrap-t UCL | 26.6394 |
| 95% Hall's Bootstrap UCL | 39.572675 | 95% Percentile Bootstrap UCL | 14.701 |
| 90% Chebyshev(Mean, Sd) UCL | 18.516264 | 95% Chebyshev(Mean, Sd) UCL | 22.55458 |
| 97.5% Chebyshev(Mean, Sd) UCL | 28.159602 | 99% Chebyshev(Mean, Sd) UCL | 39.16959 |

Suggested UCL to Use

| | | |
|---|---|---|
| 95% Student's-t UCL | 15.048562 | rejected on basis of GOF tests; data distribution is best represented as lognormal given GOF test outcomes |

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

## THg Statistics - Pups

| Meat (Muscle) THg | | | Liver THg | |
|---|---|---|---|---|
| N | 19 | length vs THg (muscle) | N | 19 |
| min | 0.01 | 0.37827931 | min | 0.09 |
| max | 0.19 | | max | 1.23 |
| arithmean | 0.0526316 | length vs THg (liver) | arithmean | 0.391053 |
| median | 0.03 | 0.30382396 | median | 0.31 |
| #nd | 1 | | #nd | 0 |
| Freq nd | 5% | | Freq nd | 0% |

Pups - THg in Muscle (Meat)

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/11/2024 2:59:05 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 19 | 0 | 0.01 | 0.19 | 0.0526316 | 0.036192 | 0.0530034 | 0.0121598 | 0.0148258 | 2.01464 | 1.007064 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2 | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 19 | 0 | 0.01 | 0.02 | 0.02 | 0.03 | 0.07 | 0.07 | 0.102 | 0.19 | 0.19 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/11/2024 2:59:55 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 19 |
| Number of Distinct Observations | 7 |
| Minimum | 0.01 |
| Maximum | 0.19 |
| Mean of Raw Data | 0.0526316 |
| Standard Deviation of Raw Data | 0.0530034 |
| Khat | 1.4797772 |
| Theta hat | 0.0355672 |
| Kstar | 1.2812159 |
| Theta star | 0.0410794 |
| Mean of Log Transformed Data | -3.318916 |
| Standard Deviation of Log Transformed Data | 0.8699705 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.8405542 |
| Shapiro Wilk Test Statistic | 0.7090007 |
| Shapiro Wilk Critical (0.0500000) Value | 0.901 |
| Approximate Shapiro Wilk P Value | 2.49E-05 |
| Lilliefors Test Statistic | 0.2783927 |
| Lilliefors Critical (0.0500000) Value | 0.1965 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9438081 |
| A-D Test Statistic | 0.7238877 |
| A-D Critical (0.0500000) Value | 0.7574371 |
| K-S Test Statistic | 0.1989412 |
| K-S Critical(0.0500000) Value | 0.2021514 |

Data appear Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9739699 |
| Shapiro Wilk Test Statistic | 0.9385436 |
| Shapiro Wilk Critical (0.0500000) Value | 0.901 |
| Approximate Shapiro Wilk P Value | 0.2734305 |
| Lilliefors Test Statistic | 0.1384359 |
| Lilliefors Critical (0.0500000) Value | 0.1965 |

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/11/2024 3:00:55 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 19 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.052632 |
| Maximum | 0.19 | Median | 0.03 |
| SD | 0.0530034 | Std. Error of Mean | 0.01216 |
| Coefficient of Variation | 1.0070639 | Skewness | 2.01464 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.7090007 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.863 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.2783927 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2285 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.0737175 | 95% Adjusted-CLT UCL (Chen-1995) | 0.078638 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.074654 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.7238877 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7574371 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.1989412 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.2021514 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.4797772 | k star (bias corrected MLE) | 1.281216 |
| Theta hat (MLE) | 0.0355672 | Theta star (bias corrected MLE) | 0.041079 |
| nu hat (MLE) | 56.231533 | nu star (bias corrected) | 48.6862 |
| MLE Mean (bias corrected) | 0.0526316 | MLE Sd (bias corrected) | 0.046498 |
| | | Approximate Chi Square Value (0.05) | 33.66902 |
| Adjusted Level of Significance | 0.03687 | Adjusted Chi Square Value | 32.57807 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0761065 | 95% Adjusted Gamma UCL | 0.078655 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9385436 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.917 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.1384359 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1803 | Data appear Lognormal at 10% Significance Level | |

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.60517 | Mean of logged Data | -3.31892 |
| Maximum of Logged Data | -1.660731 | SD of logged Data | 0.869971 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.0870043 | 90% Chebyshev (MVUE) UCL | 0.085163 |
| 95% Chebyshev (MVUE) UCL | 0.1004206 | 97.5% Chebyshev (MVUE) UCL | 0.121598 |
| 99% Chebyshev (MVUE) UCL | 0.1631953 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.0726327 | 95% BCA Bootstrap UCL | 0.08 |
| 95% Standard Bootstrap UCL | 0.0726256 | 95% Bootstrap-t UCL | 0.096872 |
| 95% Hall's Bootstrap UCL | 0.1624697 | 95% Percentile Bootstrap UCL | 0.073158 |
| 90% Chebyshev(Mean, Sd) UCL | 0.089111 | 95% Chebyshev(Mean, Sd) UCL | 0.105635 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.1285695 | 99% Chebyshev(Mean, Sd) UCL | 0.17362 |

Suggested UCL to Use

| | |
|---|---|
| 95% Adjusted Gamma UCL | 0.0786551 |

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Pups - THg in Liver

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/11/2024 3:05:29 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 19 | 0 | 0.09 | 1.23 | 0.3910526 | 0.306964 | 0.2946353 | 0.067594 | 0.1630838 | 1.56292 | 0.753442 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2 | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 19 | 0 | 0.134 | 0.14 | 0.185 | 0.31 | 0.415 | 0.524 | 0.8 | 0.843 | 1.1526 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 3/11/2024 3:10:06 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 19 |
| Number of Distinct Observations | 15 |
| Minimum | 0.09 |
| Maximum | 1.23 |
| Mean of Raw Data | 0.3910526 |
| Standard Deviation of Raw Data | 0.2946353 |

| | |
|---|---|
| Khat | 2.2174769 |
| Theta hat | 0.1763503 |
| Kstar | 1.9024367 |
| Theta star | 0.2055536 |
| Mean of Log Transformed Data | -1.181025 |
| Standard Deviation of Log Transformed Data | 0.7174821 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9110299 |
| Shapiro Wilk Test Statistic | 0.8356697 |
| Shapiro Wilk Critical (0.0500000) Value | 0.901 |
| Approximate Shapiro Wilk P Value | 0.0030489 |
| Lilliefors Test Statistic | 0.2503413 |
| Lilliefors Critical (0.0500000) Value | 0.1965 |

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9811846 |
| A-D Test Statistic | 0.3883175 |
| A-D Critical (0.0500000) Value | 0.7510197 |
| K-S Test Statistic | 0.1593884 |
| K-S Critical(0.0500000) Value | 0.2006495 |

Data appear Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9870087 |
| Shapiro Wilk Test Statistic | 0.9681031 |
| Shapiro Wilk Critical (0.0500000) Value | 0.901 |
| Approximate Shapiro Wilk P Value | 0.7557871 |
| Lilliefors Test Statistic | 0.12623 |
| Lilliefors Critical (0.0500000) Value | 0.1965 |

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

User Selected Options

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 3/11/2024 3:10:58 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 19 | Number of Distinct Observations | 15 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.09 | Mean | 0.391053 |
| Maximum | 1.23 | Median | 0.31 |
| SD | 0.2946353 | Std. Error of Mean | 0.067594 |
| Coefficient of Variation | 0.7534415 | Skewness | 1.56292 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.8356697 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.863 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.2503413 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.2285 | Data Not Normal at 1% Significance Level | |

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.5082649 | 95% Adjusted-CLT UCL (Chen-1995) | 0.528132 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.512304 |

Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.3883175 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.7510197 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.1593884 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.2006495 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.2174769 | k star (bias corrected MLE) | 1.902437 |
| Theta hat (MLE) | 0.1763503 | Theta star (bias corrected MLE) | 0.205554 |
| nu hat (MLE) | 84.264124 | nu star (bias corrected) | 72.2926 |
| MLE Mean (bias corrected) | 0.3910526 | MLE Sd (bias corrected) | 0.283518 |
| | | Approximate Chi Square Value (0.05) | 53.71476 |
| Adjusted Level of Significance | 0.03687 | Adjusted Chi Square Value | 52.31562 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.5263024 | 95% Adjusted Gamma UCL | 0.540378 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9681031 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.917 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.12623 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1803 | Data appear Lognormal at 10% Significance Level | |

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.407946 | Mean of logged Data | -1.18103 |
| Maximum of Logged Data | 0.2070142 | SD of logged Data | 0.717482 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.5800844 | 90% Chebyshev (MVUE) UCL | 0.596535 |
| 95% Chebyshev (MVUE) UCL | 0.6898163 | 97.5% Chebyshev (MVUE) UCL | 0.819287 |
| 99% Chebyshev (MVUE) UCL | 1.0736079 | | |

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.5022348 | 95% BCA Bootstrap UCL | 0.53 |
| 95% Standard Bootstrap UCL | 0.5011971 | 95% Bootstrap-t UCL | 0.575333 |
| 95% Hall's Bootstrap UCL | 0.5694288 | 95% Percentile Bootstrap UCL | 0.502632 |
| 90% Chebyshev(Mean, Sd) UCL | 0.5938345 | 95% Chebyshev(Mean, Sd) UCL | 0.685688 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.8131768 | 99% Chebyshev(Mean, Sd) UCL | 1.063604 |

Suggested UCL to Use

| | |
|---|---|
| 95% Adjusted Gamma UCL | 0.540378 |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| Sample Year | Sample ID | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age Estimate | Life Stage |
|---|---|---|---|---|---|---|---|
| 2023 | 2023_RS01 | 20.4 | 73 | 0.05 | 0.3 | 0 | Pup |
| 2023 | 2023_RS02 | 27.2 | 79 | 0.03 | 0.26 | 0 | Pup |
| 2023 | 2023_RS04 | 31.8 | 85 | 0.05 | 0.22 | 0 | Pup |
| 2023 | 2023_RS05 | 30.8 | 84 | 0.15 | 0.87 | 0 | Pup |
| 2023 | 2023_RS06 | 17.2 | 68 | 0.04 | 0.2 | 0 | Pup |
| 2023 | 2023_RS07 | 15.9 | 62 | 0.05 | 0.38 | 0 | Pup |
| 2023 | 2023_RS09 | 22.7 | 78 | 0.02 | 0.15 | 0 | Pup |
| 2023 | 2023_RS10 | 22.7 | 76 | 0.03 | 0.23 | 0 | Pup |
| 2023 | 2023_RS11 | 27.2 | 86 | 0.17 | 1.2 | 0 | Pup |
| 2023 | 2023_RS12 | 29.5 | 90 | 0.17 | 1.1 | 0 | Pup |
| 2023 | 2023_RS13 | 23.6 | 80 | 0.04 | 0.37 | 0 | Pup |
| 2023 | 2023_RS14 | 22.7 | 79 | 0.07 | 0.22 | 0 | Pup |
| 2023 | 2023_RS15 | 18.1 | 70 | 0.02 | 0.07 | 0 | Pup |
| 2023 | 2023_RS16 | 27.2 | 78 | 0.03 | 0.15 | 0 | Pup |
| 2023 | 2023_RS17 | 22.7 | 72 | 0.07 | 0.52 | 0 | Pup |
| 2023 | 2023_RS18 | 22.7 | 68 | 0.09 | 0.44 | 0 | Pup |
| 2023 | 2023_RS19 | 27.2 | 74 | 0.06 | 0.44 | 0 | Pup |
| 2023 | 2023_RS20 | 22.7 | 70 | 0.05 | 0.36 | 0 | Pup |
| 2023 | 2023_RS21 | 27.2 | 78 | 0.15 | 1.4 | 0 | Pup |
| 2023 | 2023_RS22 | 22.7 | 72 | 0.02 | 0.24 | 0 | Pup |
| 2023 | 2023_RS23 | 27.2 | 84 | 0.03 | 0.27 | 0 | Pup |
| 2023 | 2023_RS24 | 27.2 | 80 | 0.06 | 0.39 | 0 | Pup |
| 2023 | 2023_RS25 | 27.2 | 74 | 0.1 | 0.86 | 0 | Pup |
| 2023 | 2023_RS26 | 31.8 | 88 | 0.04 | 0.34 | 0 | Pup |
| 2023 | 2023_RS27 | 27.2 | 78 | 0.1 | 0.79 | 0 | Pup |
| 2023 | 2023_RS28 | 22.7 | 72 | 0.11 | 0.33 | 0 | Pup |
| 2023 | 2023_RS29 | 27.2 | 84 | 0.07 | 0.57 | 0 | Pup |
| 2023 | 2023_RS30 | 27.2 | 80 | 0.04 | 0.23 | 0 | Pup |

## 2023 RINGED SEAL MUSCLE THg DATA

Summary Stats - Muscle THg

| | |
|---|---|
| N | 28 |
| min | 0.02 |
| max | 0.17 |
| arithmean | 0.068214 |
| median | 0.05 |
| #nd | 0 |
| freq nd (%) | 0.00% |

Correlation Coefficient (length vs THg) 0.330436

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/26/2024 12:59:36 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.67 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 28 | 0 | 0.02 | 0.17 | 0.068214 | 0.055847 | 0.045465 | 0.008592 | 0.029652 | 1.135795 | 0.666502 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 28 | 0 | 0.027 | 0.03 | 0.0375 | 0.05 | 0.0925 | 0.1 | 0.15 | 0.163 | 0.17 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/26/2024 1:03:33 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

| Raw Statistics | |
|---|---|
| Number of Valid Observations | 28 |
| Number of Distinct Observations | 11 |
| Minimum | 0.02 |
| Maximum | 0.17 |
| Mean of Raw Data | 0.0682143 |
| Standard Deviation of Raw Data | 0.045465 |
| Khat | 2.654383 |
| Theta hat | 0.0256987 |
| Kstar | 2.3937943 |
| Theta star | 0.0284963 |
| Mean of Log Transformed Data | -2.885139 |
| Standard Deviation of Log Transformed Data | 0.6429844 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9273018 |
| Shapiro Wilk Test Statistic | 0.8469883 |
| Shapiro Wilk Critical (0.0500000) Value | 0.924 |
| Approximate Shapiro Wilk P Value | 6.06E-04 |
| Lilliefors Test Statistic | 0.1986206 |
| Lilliefors Critical (0.0500000) Value | 0.1641 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9740711 |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/26/2024 1:05:05 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 28 | Number of Distinct Observations | 11 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.02 | Mean | 0.068214 |
| Maximum | 0.17 | Median | 0.05 |
| SD | 0.045465 | Std. Error of Mean | 0.008592 |
| Coefficient of Variation | 0.666502 | Skewness | 1.135795 |

Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.846988 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.896 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.198621 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.1911 | Data Not Normal at 1% Significance Level | |
| Data Not Normal at 1% Significance Level | | | |

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.082849 | 95% Adjusted-CLT UCL (Chen-1995) | 0.084318 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.083156 |

Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.593874 | Anderson-Darling Gamma GOF Test |
| 5% A-D Critical Value | 0.755156 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.142278 | Kolmogorov-Smirnov Gamma GOF Test |
| 5% K-S Critical Value | 0.166919 | Detected data appear Gamma Distributed at 5% Significance Level |

| | |
|---|---|
| A-D Test Statistic | 0.5938742 |
| A-D Critical (0.0500000) Value | 0.7551562 |
| K-S Test Statistic | 0.142278 |
| K-S Critical(0.0500000) Value | 0.1669187 |
| Data appear Gamma Distributed at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9834381 |
| Shapiro Wilk Test Statistic | 0.9493051 |
| Shapiro Wilk Critical (0.0500000) Value | 0.924 |
| Approximate Shapiro Wilk P Value | 0.2132271 |
| Lilliefors Test Statistic | 0.1039958 |
| Lilliefors Critical (0.0500000) Value | 0.1641 |
| Data appear Lognormal at (0.0500000) Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.654383 | k star (bias corrected MLE) | 2.393794 |
| Theta hat (MLE) | 0.025699 | Theta star (bias corrected MLE) | 0.028496 |
| nu hat (MLE) | 148.6455 | nu star (bias corrected) | 134.0525 |
| MLE Mean (bias corrected) | 0.068214 | MLE Sd (bias corrected) | 0.044089 |
| | | Approximate Chi Square Value (0.05) | 108.3038 |
| Adjusted Level of Significance | 0.0404 | Adjusted Chi Square Value | 106.874 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.084432 | 95% Adjusted Gamma UCL | 0.085562 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.949305 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.936 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.103996 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1509 | Data appear Lognormal at 10% Significance Level | |
| Data appear Lognormal at 10% Significance Level | | | |

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -3.91202 | Mean of logged Data | -2.88514 |
| Maximum of Logged Data | -1.77196 | SD of logged Data | 0.642984 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.088682 | 90% Chebyshev (MVUE) UCL | 0.094583 |
| 95% Chebyshev (MVUE) UCL | 0.106591 | 97.5% Chebyshev (MVUE) UCL | 0.123257 |
| 99% Chebyshev (MVUE) UCL | 0.155994 | | |

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.082347 | 95% BCA Bootstrap UCL | 0.082857 |
| 95% Standard Bootstrap UCL | 0.082005 | 95% Bootstrap-t UCL | 0.08611 |
| 95% Hall's Bootstrap UCL | 0.084382 | 95% Percentile Bootstrap UCL | 0.0825 |
| 90% Chebyshev(Mean, Sd) UCL | 0.093991 | 95% Chebyshev(Mean, Sd) UCL | 0.105666 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.121872 | 99% Chebyshev(Mean, Sd) UCL | 0.153704 |

Suggested UCL to Use

| | |
|---|---|
| 95% Adjusted Gamma UCL | 0.085562 |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| Sample Year | Sample ID | Weight (kg) | Length (cm) | Mercury (muscle) | Mercury (liver) | Age Estimate | Life Stage |
|---|---|---|---|---|---|---|---|
| 2023 | 2023_RS01 | 20.4 | 73 | 0.05 | 0.3 | 0 | Pup |
| 2023 | 2023_RS02 | 27.2 | 79 | 0.03 | 0.26 | 0 | Pup |
| 2023 | 2023_RS04 | 31.8 | 85 | 0.05 | 0.22 | 0 | Pup |
| 2023 | 2023_RS05 | 30.8 | 84 | 0.15 | 0.87 | 0 | Pup |
| 2023 | 2023_RS06 | 17.2 | 68 | 0.04 | 0.2 | 0 | Pup |
| 2023 | 2023_RS07 | 15.9 | 62 | 0.05 | 0.38 | 0 | Pup |
| 2023 | 2023_RS09 | 22.7 | 78 | 0.02 | 0.15 | 0 | Pup |
| 2023 | 2023_RS10 | 22.7 | 76 | 0.03 | 0.23 | 0 | Pup |
| 2023 | 2023_RS11 | 27.2 | 86 | 0.17 | 1.2 | 0 | Pup |
| 2023 | 2023_RS12 | 29.5 | 90 | 0.17 | 1.1 | 0 | Pup |
| 2023 | 2023_RS13 | 23.6 | 80 | 0.04 | 0.37 | 0 | Pup |
| 2023 | 2023_RS14 | 22.7 | 79 | 0.07 | 0.22 | 0 | Pup |
| 2023 | 2023_RS15 | 18.1 | 70 | 0.02 | 0.07 | 0 | Pup |
| 2023 | 2023_RS16 | 27.2 | 78 | 0.03 | 0.15 | 0 | Pup |
| 2023 | 2023_RS17 | 22.7 | 72 | 0.07 | 0.52 | 0 | Pup |
| 2023 | 2023_RS18 | 22.7 | 68 | 0.09 | 0.44 | 0 | Pup |
| 2023 | 2023_RS19 | 27.2 | 74 | 0.06 | 0.44 | 0 | Pup |
| 2023 | 2023_RS20 | 22.7 | 70 | 0.05 | 0.36 | 0 | Pup |
| 2023 | 2023_RS21 | 27.2 | 78 | 0.15 | 1.4 | 0 | Pup |
| 2023 | 2023_RS22 | 22.7 | 72 | 0.02 | 0.24 | 0 | Pup |
| 2023 | 2023_RS23 | 27.2 | 84 | 0.03 | 0.27 | 0 | Pup |
| 2023 | 2023_RS24 | 27.2 | 80 | 0.06 | 0.39 | 0 | Pup |
| 2023 | 2023_RS25 | 27.2 | 74 | 0.1 | 0.86 | 0 | Pup |
| 2023 | 2023_RS26 | 31.8 | 88 | 0.04 | 0.34 | 0 | Pup |
| 2023 | 2023_RS27 | 27.2 | 78 | 0.1 | 0.79 | 0 | Pup |
| 2023 | 2023_RS28 | 22.7 | 72 | 0.11 | 0.33 | 0 | Pup |
| 2023 | 2023_RS29 | 27.2 | 84 | 0.07 | 0.57 | 0 | Pup |
| 2023 | 2023_RS30 | 27.2 | 80 | 0.04 | 0.23 | 0 | Pup |

## 2023 RINGED SEAL LIVER THg DATA

Summary Stats - Muscle THg

| | |
|---|---|
| N | 28 |
| min | 0.07 |
| max | 1.4 |
| arithmean | 0.460714 |
| median | 0.35 |
| #nd | 0 |
| freq nd (%) | 0.00% |

Correlation Coefficient (length vs THg)
0.339746

General Statistics on Uncensored Full Data

| | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 6/26/2024 1:25:30 PM |
| User Selected Options | |
| From File | WorkSheet.xls |
| Full Precision | ON |

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

| Variable | NumObs | # Missing | Minimum | Maximum | Mean | Geo-Mean | SD | SEM | MAD/0.675 | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 28 | 0 | 0.07 | 1.4 | 0.460714 | 0.365257 | 0.340913 | 0.064427 | 0.185323 | 1.446641 | 0.739966 |

Percentiles for Uncensored Dataset

| Variable | NumObs | # Missing | 10%ile | 20%ile | 25%ile(Q1) | 50%ile(Q2) | 75%ile(Q3) | 80%ile | 90%ile | 95%ile | 99%ile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 | 28 | 0 | 0.185 | 0.224 | 0.23 | 0.35 | 0.5325 | 0.702 | 0.939 | 1.165 | 1.346 |

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/26/2024 1:26:30 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 0.95 |

C0

Raw Statistics

| | |
|---|---|
| Number of Valid Observations | 28 |
| Number of Distinct Observations | 24 |
| Minimum | 0.07 |
| Maximum | 1.4 |
| Mean of Raw Data | 0.4607143 |
| Standard Deviation of Raw Data | 0.340913 |
| Khat | 2.3064426 |
| Theta hat | 0.199751 |
| Kstar | 2.0831333 |
| Theta star | 0.2211641 |
| Mean of Log Transformed Data | -1.007154 |
| Standard Deviation of Log Transformed Data | 0.6931202 |

Normal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9078566 |
| Shapiro Wilk Test Statistic | 0.8238388 |
| Shapiro Wilk Critical (0.0500000) Value | 0.924 |
| Approximate Shapiro Wilk P Value | 1.82E-04 |
| Lilliefors Test Statistic | 0.238511 |
| Lilliefors Critical (0.0500000) Value | 0.1641 |
| Data not Normal at (0.0500000) Significance Level | |

Gamma GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9783532 |

UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 6/26/2024 1:27:37 PM |
| From File | WorkSheet.xls |
| Full Precision | ON |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

C0

General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 28 | Number of Distinct Observations | 24 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.07 | Mean | 0.460714 |
| Maximum | 1.4 | Median | 0.35 |
| SD | 0.340913 | Std. Error of Mean | 0.064427 |
| Coefficient of Variation | 0.739966 | Skewness | 1.446641 |

Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.823839 | Shapiro Wilk GOF Test |
| 1% Shapiro Wilk Critical Value | 0.896 | Data Not Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.238511 | Lilliefors GOF Test |
| 1% Lilliefors Critical Value | 0.1911 | Data Not Normal at 1% Significance Level |
| Data Not Normal at 1% Significance Level | | |

Assuming Normal Distribution

| | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.570451 | 95% Adjusted-CLT UCL (Chen-1995) | 0.585507 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.573387 |

Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.721249 | Anderson-Darling Gamma GOF Test |
| 5% A-D Critical Value | 0.756652 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.153589 | Kolmogorov-Smirnov Gamma GOF Test |
| 5% K-S Critical Value | 0.16726 | Detected data appear Gamma Distributed at 5% Significance Level |

| | |
|---|---|
| A-D Test Statistic | 0.7212487 |
| A-D Critical (0.0500000) Value | 0.7566523 |
| K-S Test Statistic | 0.1535894 |
| K-S Critical(0.0500000) Value | 0.1672597 |
| Data appear Gamma Distributed at (0.0500000) Significance Level | |

Lognormal GOF Test Results

| | |
|---|---|
| Correlation Coefficient R | 0.9841982 |
| Shapiro Wilk Test Statistic | 0.9699388 |
| Shapiro Wilk Critical (0.0500000) Value | 0.924 |
| Approximate Shapiro Wilk P Value | 0.6084845 |
| Lilliefors Test Statistic | 0.1084036 |
| Lilliefors Critical (0.0500000) Value | 0.1641 |
| Data appear Lognormal at (0.0500000) Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.306443 | k star (bias corrected MLE) | 2.083133 |
| Theta hat (MLE) | 0.199751 | Theta star (bias corrected MLE) | 0.221164 |
| nu hat (MLE) | 129.1608 | nu star (bias corrected) | 116.6555 |
| MLE Mean (bias corrected) | 0.460714 | MLE Sd (bias corrected) | 0.319208 |
| | | Approximate Chi Square Value (0.05) | 92.71841 |
| Adjusted Level of Significance | 0.0404 | Adjusted Chi Square Value | 91.39971 |

Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.579657 | 95% Adjusted Gamma UCL | 0.58802 |

Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.969939 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.936 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.108404 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.1509 | Data appear Lognormal at 10% Significance Level | |
| Data appear Lognormal at 10% Significance Level | | | |

Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.65926 | Mean of logged Data | -1.00715 |
| Maximum of Logged Data | 0.336472 | SD of logged Data | 0.69312 |

Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 0.615817 | 90% Chebyshev (MVUE) UCL | 0.654336 |
| 95% Chebyshev (MVUE) UCL | 0.742532 | 97.5% Chebyshev (MVUE) UCL | 0.864946 |
| 99% Chebyshev (MVUE) UCL | 1.105403 | | |

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

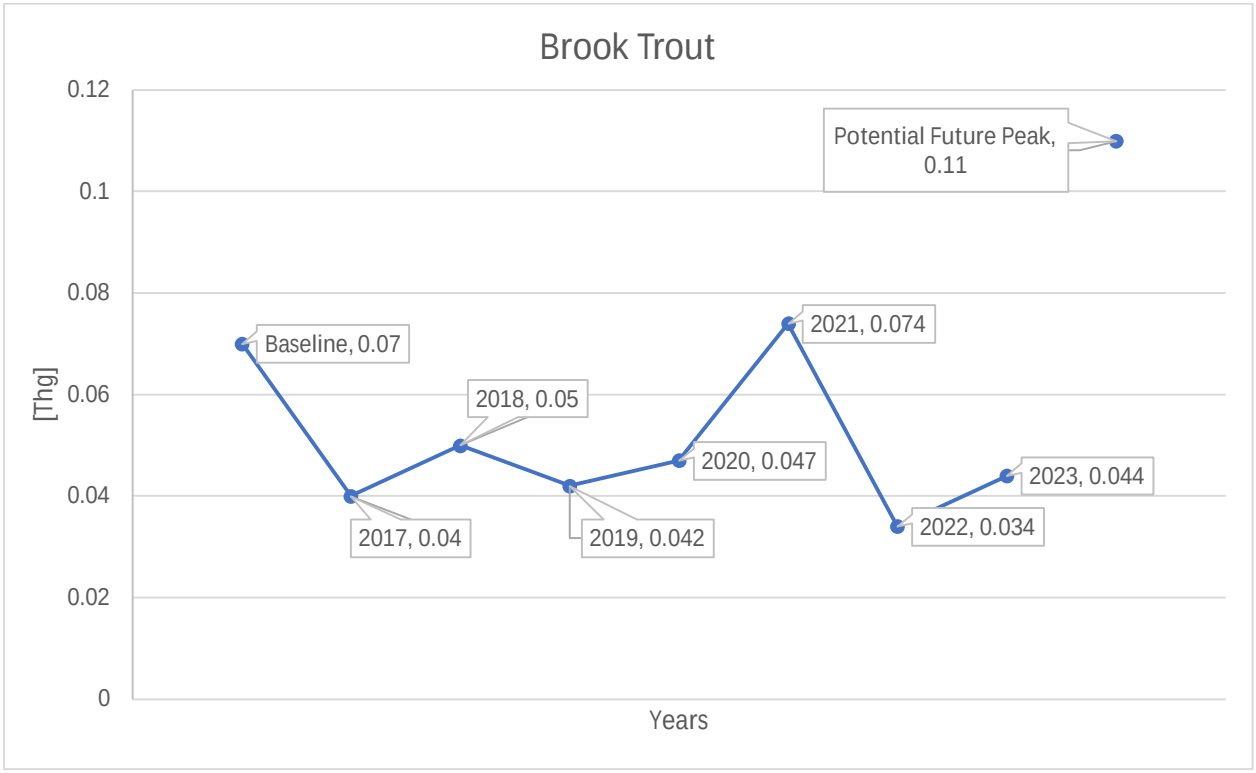
Nonparametric Distribution Free UCLs

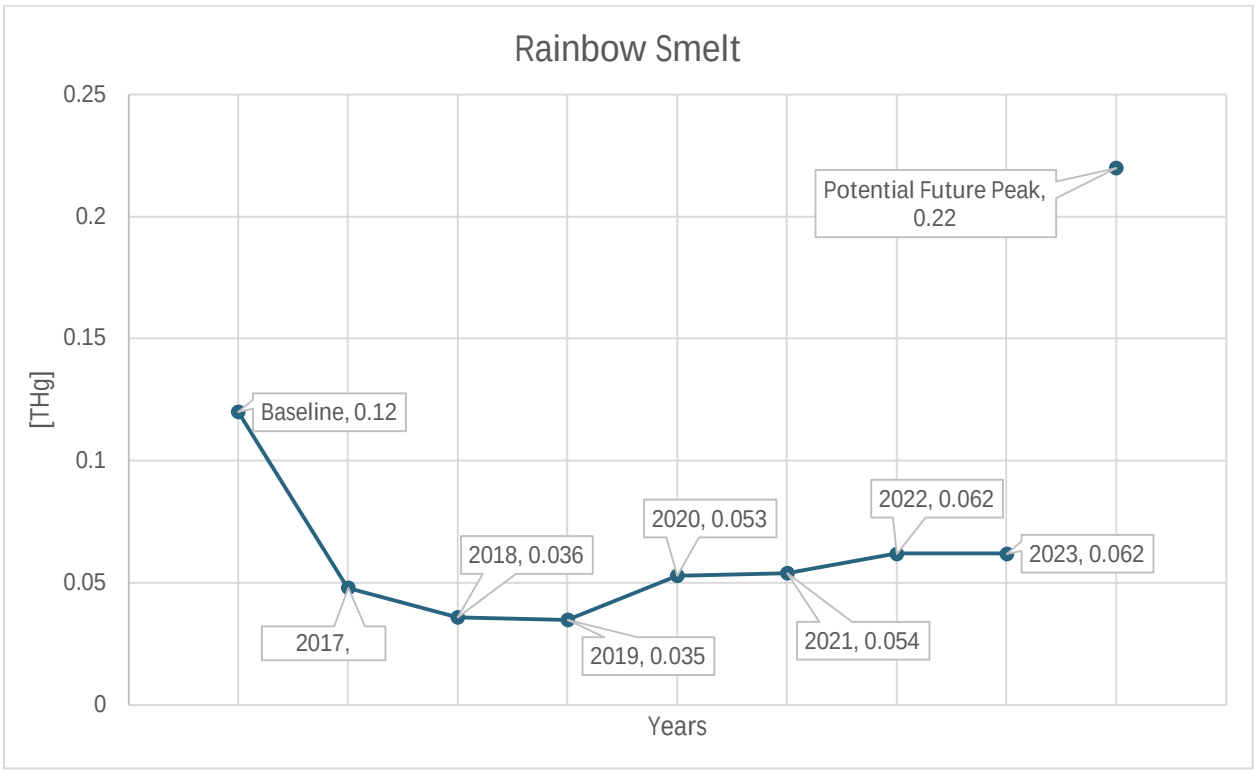
| | | | |
|---|---|---|---|
| 95% CLT UCL | 0.566687 | 95% BCA Bootstrap UCL | 0.576429 |
| 95% Standard Bootstrap UCL | 0.563945 | 95% Bootstrap-t UCL | 0.596153 |
| 95% Hall's Bootstrap UCL | 0.580147 | 95% Percentile Bootstrap UCL | 0.566786 |
| 90% Chebyshev(Mean, Sd) UCL | 0.653994 | 95% Chebyshev(Mean, Sd) UCL | 0.741543 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.863058 | 99% Chebyshev(Mean, Sd) UCL | 1.10175 |

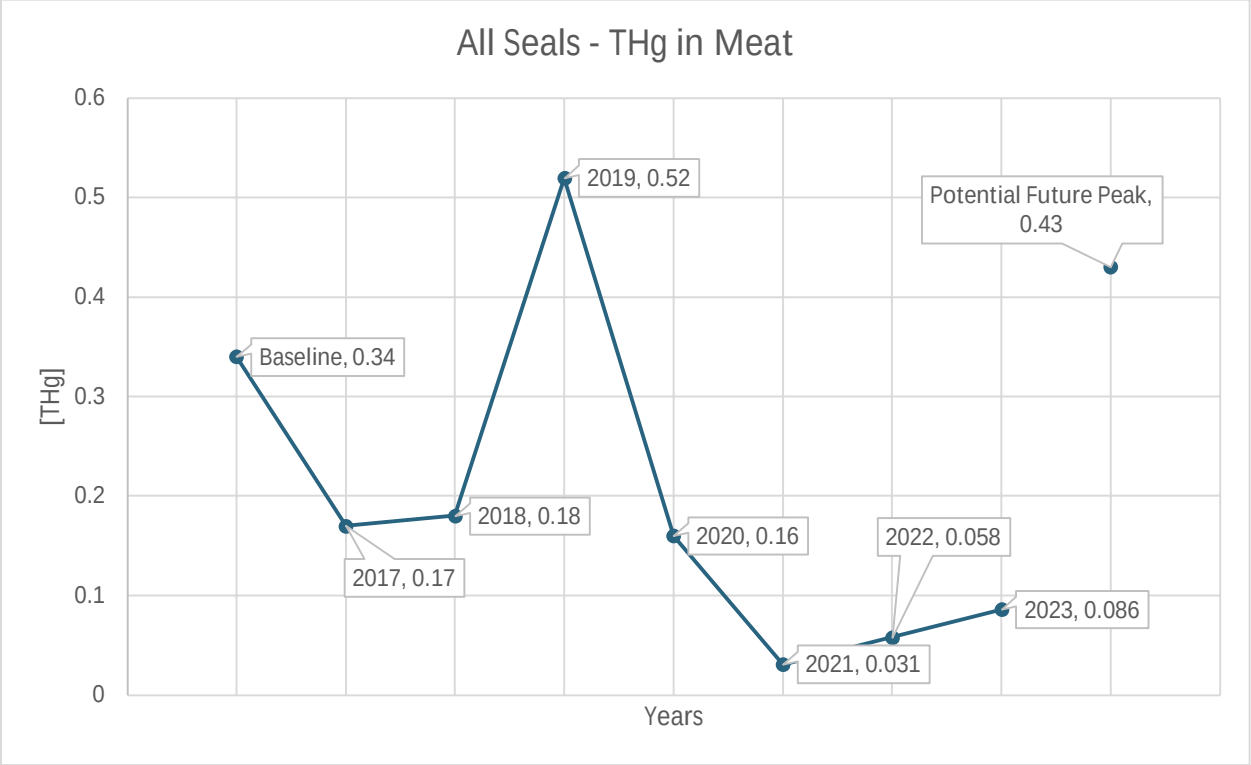
Suggested UCL to Use
95% Adjusted Gamma UCL 0.58802

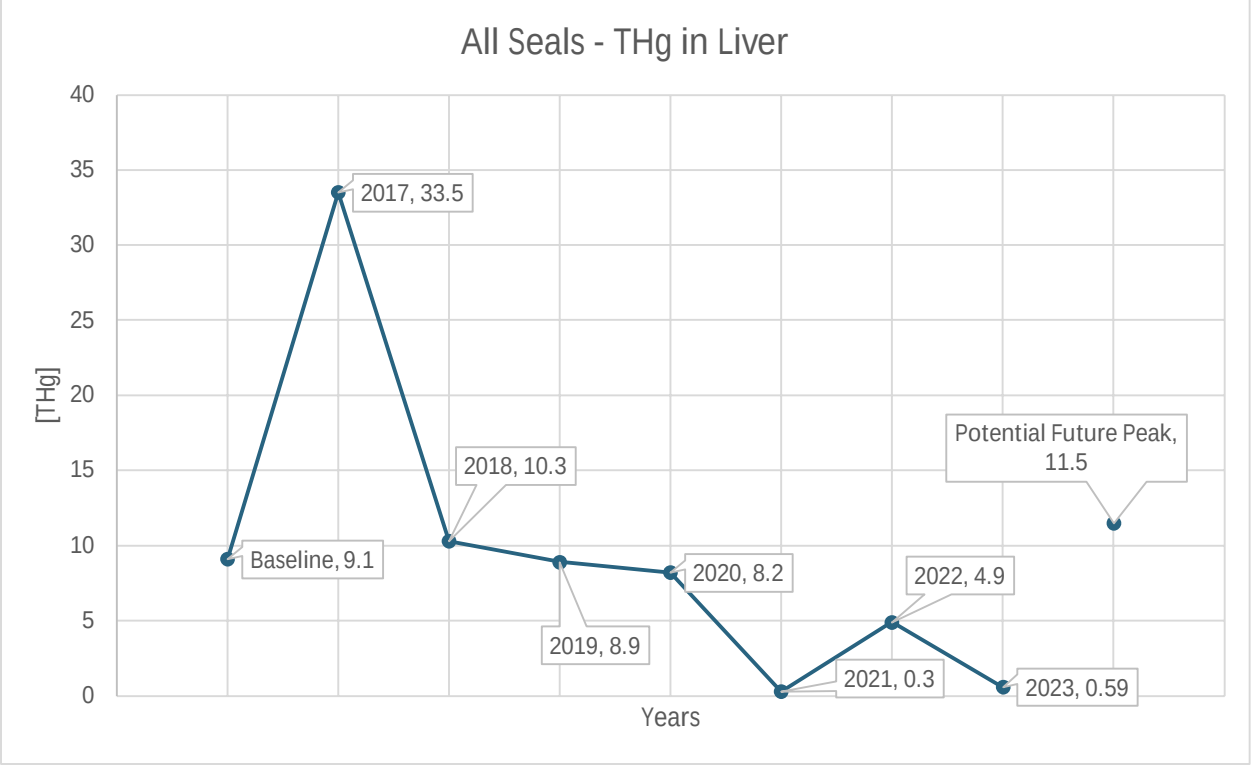
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

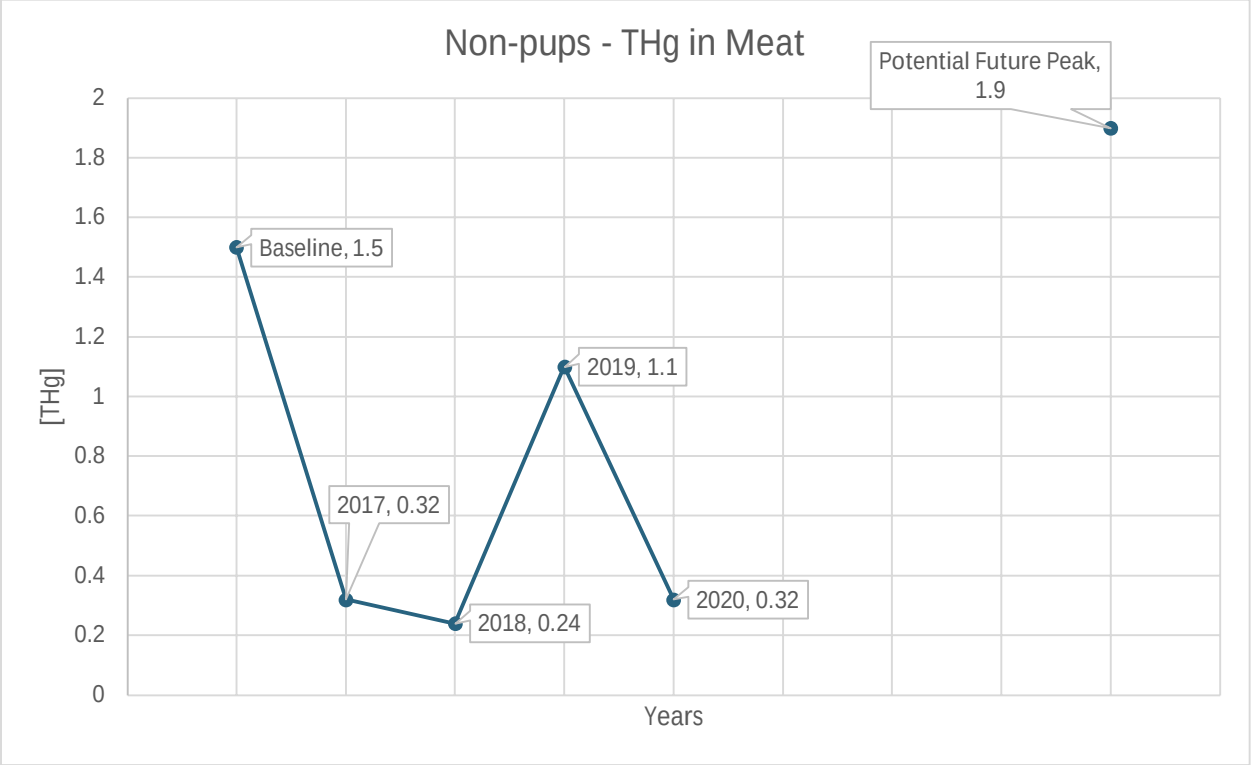
# Attachment B: Graphs of THg Exposure Point Concentrations – Baseline to 2023, and Future Predicted Peak (Brook Trout, Rainbow Smelt, Ringed Seal)

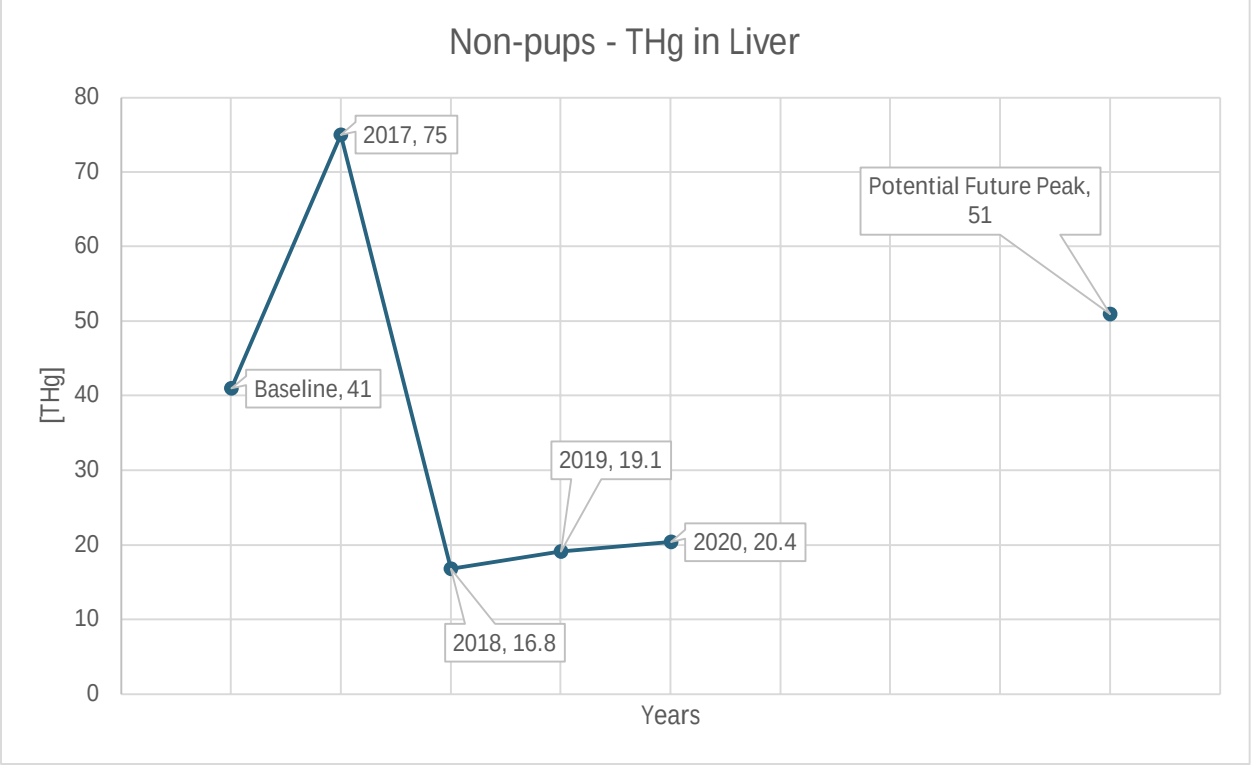

Brook Trout
0.12
0.1
0.08
0.06
0.04
0.02
0
[Thg]
Years
Potential Future Peak, 0.11
Baseline, 0.07
2018, 0.05
2021, 0.074
2020, 0.047
2023, 0.044
2017, 0.04
2019, 0.042
2022, 0.034

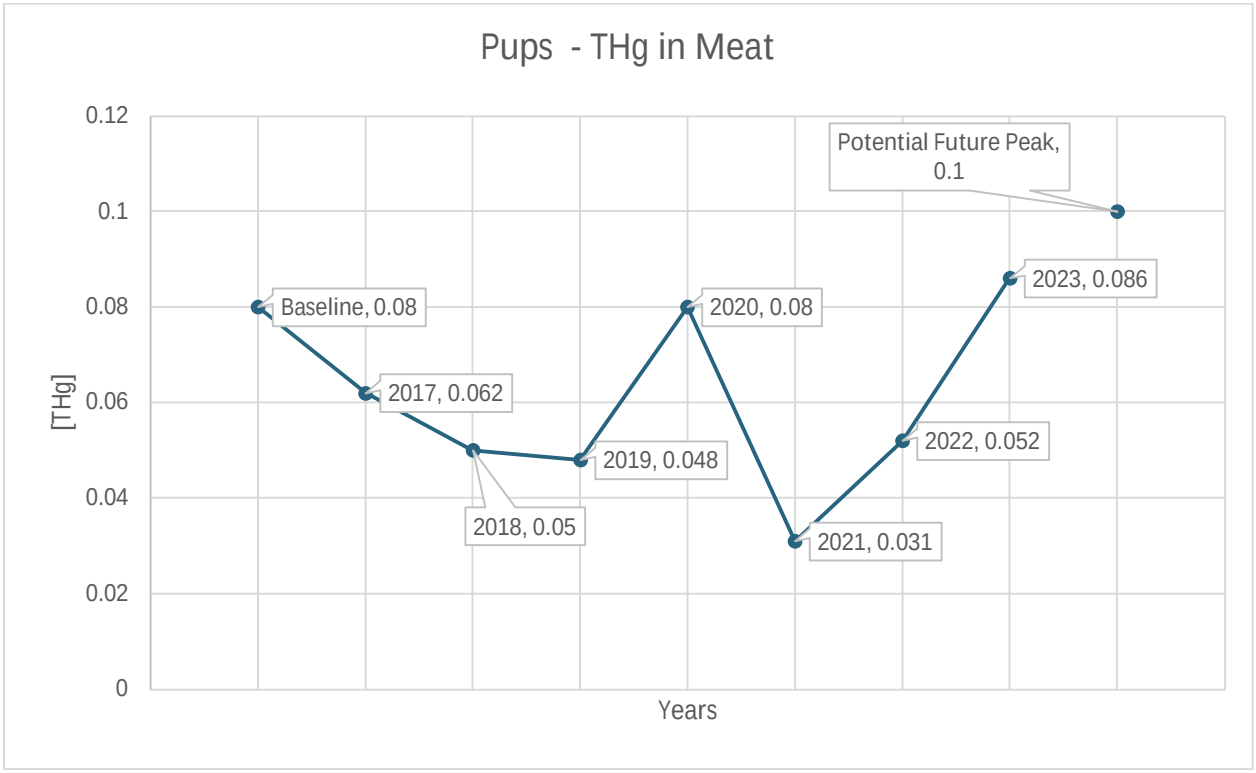

Rainbow Smelt
0.25
0.2
0.15
0.1
0.05
0
[THg]
Years
Potential Future Peak, 0.22
Baseline, 0.12
2018, 0.036
2020, 0.053
2022, 0.062
2023, 0.062
2017,
2019, 0.035
2021, 0.054

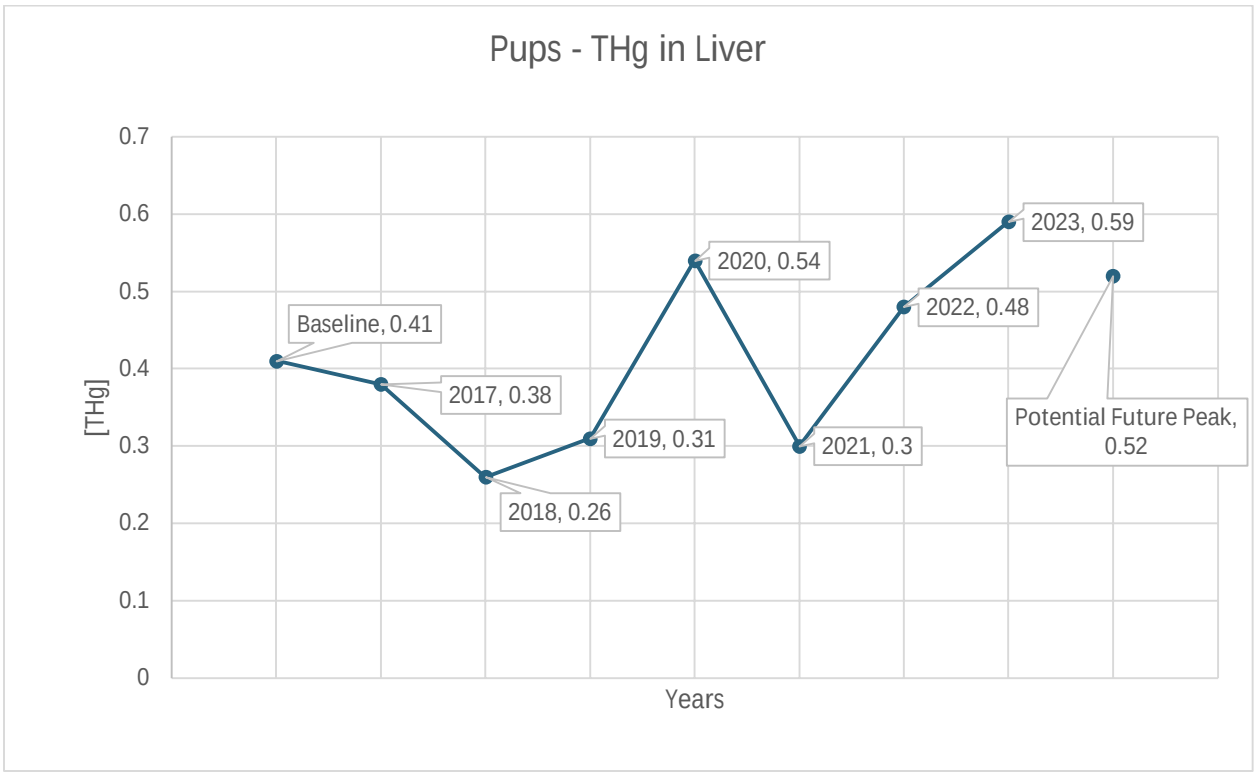

All Seals - THg in Meat
[THg]
Years
0.6
0.5
0.4
0.3
0.2
0.1
0
Baseline, 0.34
2017, 0.17
2018, 0.18
2019, 0.52
2020, 0.16
2021, 0.031
2022, 0.058
2023, 0.086
Potential Future Peak, 0.43


All Seals - THg in Liver
[THg]
Years
40
35
30
25
20
15
10
5
0
Baseline, 9.1
2017, 33.5
2018, 10.3
2019, 8.9
2020, 8.2
2021, 0.3
2022, 4.9
2023, 0.59
Potential Future Peak, 11.5


Non-pups - THg in Meat
Potential Future Peak, 1.9
Baseline, 1.5
2019, 1.1
2017, 0.32
2020, 0.32
2018, 0.24
[THg]
Years
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2


Non-pups - THg in Liver
Potential Future Peak, 51
2017, 75
Baseline, 41
2019, 19.1
2020, 20.4
2018, 16.8
[THg]
Years
0
10
20
30
40
50
60
70
80


Pups - THg in Meat
0.12
0.1
0.08
0.06
0.04
0.02
0
[THg]
Years
Baseline, 0.08
2017, 0.062
2018, 0.05
2019, 0.048
2020, 0.08
2021, 0.031
2022, 0.052
2023, 0.086
Potential Future Peak, 0.1


Pups - THg in Liver
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
[THg]
Years
Baseline, 0.41
2017, 0.38
2018, 0.26
2019, 0.31
2020, 0.54
2021, 0.3
2022, 0.48
2023, 0.59
Potential Future Peak, 0.52