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UnCensor© v4.0

By

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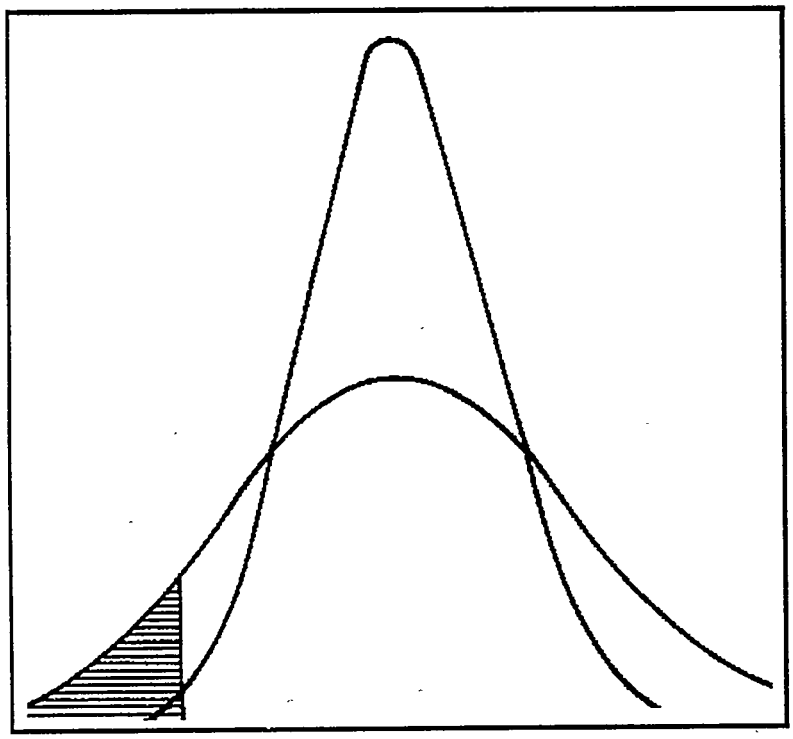

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Aiken, South Carolina

UNCENSOR° VERSION 4.0

DISTRIBUTION

UnCensor° is a public domain program that you may obtain from

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Code was developed by K. Dawn Greene under the direction of Dr. Michael C. Newman. K. Dawn Greene can also be contacted through the above address.

Please supply a 3.5 or a 5.25 inch diskette to receive the files.

The program has been reviewed by numerous individuals for errors or annoyances. If you feel that it should be modified or corrected, please contact Mike Newman. Your input will allow this tool to become more useful with time. We suggest that you do not distribute the program to another individual unless s/he registers as a user with us because we plan to send updates and modifications to each user as suggestions are incorporated into the code. We would also be delighted to receive any revisions to the program that you have made. Your contribution will be identified and acknowledged in a list of contributors appended to this document.

ACKNOWLEDGMENTS

Brian B. Looney contributed the original code for the Regression Order Statistics method. Charles Segal also contributed to the initial code.

DISCLAIMER

DISCLAIMER

No warranty is implied or expressed regarding the use of this program. We are not responsible for support or use of this software. Under no circumstances will the authors or the University of Georgia be liable for incidental or consequential damages arising from the use or the inability to use the software, even if the authors or the University of Georgia have been advised of the possibility of such damages, or for any claim by any other party.

OVERVIEW

UnCensor° is a program that estimates the mean, standard deviation, variance, and the confidence interval on the mean of left censored data sets. At present, the program can provide estimates for normal and two-parameter lognormal data sets (see flow diagram on page 16. Large (N>20) and small (N≤20) data sets can be handled. UnCensor° provides estimates by the application of several statistical methods. At present, these methods include the following. The explanations are taken from the appendix of the companion paper for this program (Newman et al. 1989 and Newman 1995.)

METHODS

The menu lists eight methods:

MLE	This is the iterative maximum likelihood method of Cohen (1950, 1959) as described below. It does not correct for the significant bias in MLE procedures for data sets with small numbers of observations (approxiately N<20).
Iterative	This is the iterative method of Gleit (1985).
Regression	This is the regression method described below in the section, REGRESSION ORDER STATISTICS METHOD.
Bias Corrected	This is the MLE technique of Cohen (1950, 1959) with a bias correction. The bias correction is important with sample numbers below approximately 20. This designation of <20 as "small" is somewhat arbitrary. However, this suggestion is based on Cohen's recommendations.
One-Step	This is the restricted (or Schneider one-step) MLE described below.

Helsel's Robust — This is Helsel's method as described below.

Winsorization — This is the Winsorization method as described below.

EPA Delta Log — This is the EPA Delta Lognormal statistical method (D-Log).

If one selects the log option in the Options menu, the transformation bias correction described below is performed on the results of the selected method. This bias is not pertinent to Helsel's robust method or to the EPA Delta Log method and, therefore, is not implemented with these methods.

MAXIMUM LIKELIHOOD METHOD (ALSO MLE OF BIAS CORRECTED METHOD)

The maximum likelihood methods are based on the statistical properties of the noncensored portion of the data, adjusted for the theoretical effects caused by the defined intensity of censoring.

The maximum likelihood estimators of a Type I censored normal distribution were derived by Cohen (1950, 1959). The MLEs of the mean and standard deviation are those values that solve the system of equations:

$$\hat{\mu} = \bar{x} - \hat{\sigma}\left[\frac{k}{n-k}\right]\left[\frac{f(\varepsilon)}{F(\varepsilon)}\right] \qquad (1)$$

$$\hat{\sigma}^2 = \frac{S^2 + (\bar{x} - \hat{\mu}^2)}{1 + \varepsilon\left(\frac{k}{n-k}\right)\left(\frac{f(\varepsilon)}{F(\varepsilon)}\right)} \qquad (2)$$

where n = the total number of observations,
k = the number of observations below the detection limit (DL),
f(x) = the distribution function for the normal distribution,
F(x) = the cumulative distribution function for the normal distribution,
$\bar{x}$ = the mean of all values above the DL,
S = the population standard deviation of all values above the DL,
and
$\varepsilon = (DL - \hat{\mu})/\hat{\sigma}$.

This system has no closed-form solution and must be solved iteratively. Starting with suitable values of $\hat{\mu}$ and $\hat{\sigma}$, such as $\bar{x}$ and S, ε is computed using the

definition above, and Equations (1) and (2) are used to compute new estimates of $\hat{\mu}$ and $\hat{\sigma}$, respectively. This process is iterated until the change in the estimates is less than some predetermined criterion.

Explicit solutions to the MLE equations can be obtained by imposing a small restriction (Persson and Rootzen 1977). The number of observations with values below the DL has a binomial distribution with parameters, n and F(ϵ) (see definitions above). Using the properties of the binomial distribution, a natural estimate of F(ϵ) is k/n, hence ϵ can be estimated by $\hat{\epsilon} = F^{-1}(k/n)$.

The restriction to the MLEs is the replacement of ϵ in Equations (1) and (2) with $\hat{\epsilon}$. These restricted equations can be solved explicitly to give the following (Persson and Rootzen 1977):

$$\hat{\mu}_{RML} = \bar{x} - a\sigma^* \qquad (3)$$

$$\hat{\sigma}_{RML} = S^2 - (a\hat{\epsilon} - a^2)(\sigma^*)^2 \qquad (4)$$

where $a = F(\hat{\epsilon})(n/k)$,

$F(x)$ = normal probability density function, and

$\sigma^* = 1/2[C + (C^2 + 4S^2 + 4(\bar{x} - DL)^2)^{1/2}]$,

$C = \hat{\epsilon}(\bar{x} - DL)$,

$\hat{\epsilon}$ = defined above.

Both the iterative MLEs and the restricted (Schneider one-step) MLEs are biased, but they have lower mean-squared errors than other, unbiased estimators. The low mean-squared error makes these estimators attractive to a statistician, but many users prefer unbiased estimators. The bias in the MLEs can be reduced by finding an equation to approximate the bias and using it to compute a corrected estimate. Bias approximations of Type II censored normal samples have been derived in Saw (1961), Schneider (1986), and Schneider and Weissfeld (1986). The bias corrected MLEs are given by the following:

$$\hat{\mu}_{BC} = \hat{\mu} - \frac{\hat{\sigma}}{n+1} B(\hat{\mu}, n, k) \qquad (5)$$

$$\hat{\sigma}_{BC}=\hat{\sigma}-\frac{\hat{\sigma}}{n+1}B(\hat{\sigma},n,k) \qquad (6)$$

where the bias in the mean ($B(\hat{\mu}, n, k)$ is approximately

$$-e^{[2.692-5.439[\frac{n-k}{n-2k+1}]]} \qquad (7)$$

and $B(\hat{\sigma}, n, k)$ is approximately

$$-[0.312+0.859[\frac{n-k}{n+1}]]^{-2} \qquad (8)$$

These expressions for the approximate bias were obtained by Schneider (1986) by least-squares fitting of Saw's tables (1961).

Although derived for Type II censoring, these bias corrections should also reduce the bias of Type I censored samples. As the bias increases as the number of observations decreases, the bias correction is particularly important for samples with small numbers of observations, i.e., less than 10 to 20 observations.

References

Cohen, A.J., Jr. 1950. Estimating the mean and variance of normal populations from singly truncated and doubly truncated samples. Annals of Mathematical Statistics 21: 557-569.

Cohen, A.J., Jr. 1959. Simplified estimators for the normal distribution when samples are singly censored or truncated. Technometrics 1(3):217-237.

Newman, M.C. 1995. Quantitative methods in aquatic ecotoxicology. Lewis/CRC Press, Chelsea, MI, 406 pp.

Newman, M.C., P.M. Dixon, B.B. Looney, and J.E. Pinder, III. 1989. Estimating mean and variance for environmental samples with below detection limit observations. Water Resources Bull. 25(4): 905-916.

Persson, T. and H. Rootzen. 1977. Simple and highly efficient estimators for a type I censored normal sample. Biometrika 64: 123-128.

Saw, J.G. 1961. The bias of the maximum likelihood estimates of location and scale parameters given a Type II censored normal sample. Biometrika 48: 448-451.

Schneider, H. 1986. Truncated and censored samples from normal populations. Marcel Dekker, New York, 273 pp.

Schneider, H. and L. Weissfeld. 1986. Inference based on Type II censored samples. Biometrics 42: 531-536.

ITERATIVE ORDER STATISTICS METHOD

Gleit, A. 1985. Estimation for small normal data sets with detection limits. Environ. Sci. & Technol. 19:1201-1206.

REGRESSION ORDER STATISTICS METHOD

A variety of order statistics methods are available for data sets censored at the DL. While all of these methods are similar, we demonstrate a regression on expected order statistics (ROS) methods because it is conceptually straightforward, general in nature, and essentially the same as recommended by Gleit (1985) in his simulation study. Observations are ranked from smallest to largest with values below the DL treated as the smallest values. Let

X_i = the ith ranked observation,
X_1 = the smallest value,
X_{k+1} = the smallest detectable value, and
X_n = the largest value.

If the observations comprising the sample are randomly drawn from the population, the ordered data values would divide the underlying probability density function into equal areas. Thus, an estimated plotting position on an appropriate coordinate system can be calculated for each point such that the noncensored portion of the data will fall on a straight line. Specifically, we calculate $A_i = F^{-1}[(i-3/8)/(n + 1/4)]$ where $F^{-1}[x]$ is the inverse cumulative normal distriution function (Blom 1958, Mandel 1964, Press et al. 1986). Consider only the n-k points above the DL and regress X_i on A_i to estimate a and b in the equation,

$$X_i = a + bA_i + e_i \quad (9)$$

The mean of the noncensored distribution is estimated by a and the standard deviation is estimated by b.

References

Blom, G. 1958. Statistical estimates and transformed beta variables. John Wiley and Sons, Inc., New York, 176 pp.

Mandel, J. 1964. The statistical analysis of experimental data. Interscience Publishers, New York, 410 pp.

Press, W.H., B.P. Flannery, S.A. Teukolsky and W.T. Vetterling. 1986. Numerical recipes: The art of scientific computing, Cambridge University Press, Cambridge, 818 pp.

HELSEL'S ROBUST METHOD

Helsel (1990) recommends a modified probability plotting method as the most robust method. It is the most robust of the methods, that he examined, to errors in assuming a specific underlying distribution. Helsel's approach fits a regression line to the log transformed observation values above the DL and their corresponding z scores. Next, the regression is used to predict "fill in" values for the below DL observations. All values including the predicted "fill in" values are then backtransformed to arithmetic units. The mean and standard deviation are estimated using the data set that now includes "fill in" values for the censored observations.

Helsel (1990)uses the Van der Waerden estimate of the normal score in his presentation.

$$z = \Phi^{-1}\left(\frac{r}{n+1}\right) \quad (10)$$

In UnCensor° V3.0 and V4.0, the theoretically preferred Blom estimate is used.

$$z = \Phi^{-1}\frac{(i-\frac{3}{8})}{(n+\frac{1}{4})} \qquad (11)$$

Note to user: We have found that the Blom estimate is the best estimate. However, if you prefer the Van der Waerden estimate there are a few simple steps you can follow to implement the Van der Waerden estimate. First, in Turbo Pascal version 5.5, edit Robustu.pas, procedure Score. Remove the remark brackets {} from around the Van der Waerden estimate and place them around the Blom estimate. Save Robustu.pas, load uc4.pas, and recompile.

References

Blom, G. 1958. Statistical estimates and transformed beta variables. John Wiley and Sons, Inc., New York, 176 pp.

Gilliom, R.J. and D.R. Helsel. 1986. Estimation of distributional parameters for censored trace level water quality data 1. Estimation techniques. Water Resources Res. 22(2): 135-146.

Helsel, D.R. 1990. Less than obvious. Statistical treatment of data below the detection limit. Environ. Sci. Technol. 24(12): 1766-1774.

Helsel, D.R. and R.J. Gilliom. 1986. Estimation of distributional parameters for censored trace level water quality data 2. Verification and applications. Water Resources Res. 22(2): 147-155.

WINSORIZATION METHOD

Gilbert (1987) suggests a winsorized estimation for the mean and standard deviation for censored data sets if the data is assumed to be distributed symmetrically. All values below the detection limit are replaced by the smallest value equal to or above the detection limit. Unlike other methods, this method replaces the same number of largest values with the next smallest value. The mean is estimated by using the simple arithmetic mean for the modified data set. The standard deviation is estimated by using an estimation of the winsorized standard deviation.

$$s_w = \frac{s(n-1)}{v-1} \qquad (12)$$

where s = standard deviation of the modified data sets
n = total sample size
v = number of values not modified

References

Gilbert, R.O. 1987. Statistical methods for environmental pollution monitoring. Van Nostrand Reinhold, New York, 140, 177, 180-181 pp.

Newman, M.C. 1995. Quantitative methods in aquatic ecotoxicology. CRC/Lewis, Boca Raton, 24-26 pp.

EPA DELTA LOGNORMAL STATISTICS METHOD

The US EPA recommends the EPA Delta Lognormal statistic technique for regulatory use. This method assumes a lognormal distribution.

$$\hat{\mu} = \delta D + (1-\delta) e^{\mu + 0.5\sigma^2} \qquad (13)$$

$$\hat{\sigma}^2 = (1-\delta) e^{2\mu + \sigma^2} [e^{\sigma^2} - (1-\delta)] D (D - 2e^{\mu + 0.5\sigma^2}) \qquad (14)$$

where k = total sample size
D = detection limit
r = number below detection limit
k - r = number above detection limit

$y_i = \ln(x_i)$ $\quad r = 1 \le i \le k, r < k$

$\mu = \sum(y_i) / (k - r)$ $\quad r = 1 \le i \le k, r < k$

$\sigma^2 = \sum(y_i - \mu)^2 / (k - r - 1)$ $\quad r = 1 \le i \le k, r < k$

$\delta = r / k$

Note: User is urged to read Hinton (Environ. Sci. Technol. 1993, 27: 2247-2249) before using this method.

References

Kahn, H.D. and M.B. Rubin. 1989. Use of statistical methods in industrial water pollution control regulations in the United States. Environ. Monitoring and Assessment 12: 129-148.

US EPA. 1991. Technical support document for water quality-based toxic control. EPA/505/2-90-001, March 1991, NTIS, Springfield, VA. See Appendix E, E-10-E-12 pp.

US EPA. 1991. Estimating the mean of data sets that include measurement below the limit of detection. NCASI Technical Bulletin No. 621 (December 1991) 36-37pp.

BIAS CORRECTION OF ESTIMATES FROM LOG TRANSFORMED DATA (ACTIVATED BY THE "LOGNORMAL" LOG OPTION FOR ALL METHODS WITH THE EXCEPTION OF HELSEL'S ROBUST METHOD AND EPA DELTA LOGNORMAL METHOD)

Mean and variance estimators for Type I censored, 2-parameter, log-normally distributed variables were obtained by using the above methods on log-transformed data. The resulting estimates were used in the following equations as described in Gilbert and Kinnison (1981):

$$\hat{\mu} = e^{\hat{\mu}_l} \Psi_n\left(\frac{\hat{\sigma}_l^2}{2}\right) \qquad (15)$$

$$\hat{\sigma}^2 = e^{2\hat{\mu}_l}\left[\Psi_n(2\hat{\sigma}_l^2) - \Psi_n\left[\frac{n-2}{n-1}\hat{\sigma}_l^2\right]\right] \qquad (16)$$

where $\hat{\mu}_1$ = the estimate of the mean for the log-transformed data,

$\hat{\sigma}_1$ = the estimate of the standard deviation for the log-transformed data,

$\Psi_n(t)$ = a value obtained from Table A2 of Aitchison and Brown (1957).

Ψ is estimated in UnCensor° as an expansion of an equation in Finney (1941). The expansion is to the 10th power of t as explained in Finney (1941).

It is important to realize that a simple, back-transformation of mean and variance estimates from censored, log-transformed data will produce biased estimators of the arithmetic mean and variance of log-normally distributed data. The reader is referred to Chapter 5 of Aitchison and Brown (1957) for further discussion of this point.

References

Aitchison, J. and J.A.C. Brown. 1957. The Lognormal Distribution with Special Reference to Its Use in Economics. Cambridge Press, New York.

Gilbert, R.O. and R.R. Kinnison. 1981. Statistical methods for estimaing the mean and variance from radionuclide data sets containing negative, unreported or less-than values. Health Physics 40: 377-390.

CALCULATION OF 95% CONFIDENCE INTERVALS BY UnCensor° FOR POPULATION MEAN:

If the data are censored, determining a confidence interval for the population mean is not straightforward. A confidence interval for means from UnCensored normal distributions is usually found using a t-distribution. This procedure assumes that the estimated mean and variance are independent. This assumption is usually not met when the data are censored.

UnCensor° implements four confidence interval methods by Tiku (Schneider 1986), Helsel (1990), Dixon and Tukey (1968), and US EPA (1991) . The Tiku procedure is based on theoretical approximations developed for normal distributions. These approximations are better at large sample sizes. The Helsel procedure is based on simulations of the bias and variability of means estimated from a variety of censored distributions. Calculating the Helsel interval requires estimating values from the tables given by Helsel. These tables are limited in the sample sizes that they cover. Our implementation of the Helsel procedure is conservative, especially at large sample sizes.

References

Gilbert, R.O. 1987. Statistical methods for environmental pollution monitoring. Van Nostrand Reinhold, New York, 140, 177, 180-181 pp.

Helsel, D.R. 1990. Less than obvious. Statistical treatment of data below the

detection limit. Environ. Sci. Technol. 24912): 1766-1774.

Schneider, H. 1986. Truncated and censored samples from normal populations. Marcel Dekker, New York, 273 pp.

US EPA. 1991. Technical support document for water quality-based toxic control. EPA/505/2-90-001, March 1991, NTIS, Springfield, VA. See Appendix E, E-10-E-12 pp.

HARDWARE REQUIREMENTS

UnCensor° requires an IBM-PC or close compatible with at least 256K of RAM and a single floppy disk drive. It will check for and make use of a math coprocessor if it is available.

USING UnCensor°

To invoke UnCensor° from DOS, type UC4 and press the RETURN key.

To invoke UnCensor° from Windows 3.1 Program Manager, click on Run under the File category and run UC4.

The UnCensor° V4.0 screen will appear when the program is ready to run. Note that the message below the author list gives the result of the programs search for a math coprocessor. Press the RETURN key to get to the UnCensor° main menu. (A math coprocessor is recommended. Without a coprocessor, the present program sometimes will fail for certain routines. You will get the following error message, "run time error at _____.")

UnCensor° uses a Pop Down Window Interface or PDWI. You can invoke a function in one of two ways:

1. Use the cursor keys to move the "cursor" over the subject of choice, and then press the RETURN key.

2. Press the key which corresponds to the first letter of the menu choice.

To exit from a function, you just press the escape (Esc) key. Help is available for all functions. Just press the F1 key for help.

The PDWI has 4 main windows: FILE, EDIT, OPTIONS, and METHOD. Let's discuss each window.

FILE

If FILE is highlighted and selected (Press RETURN when the FILE category is highlighted), you will be presented with three functions. They allow you to manipulate files and quit to DOS. The function are defined as follows:

Load	Selection of this function allows you to load a raw data file (ASCII) into the program. Remember that the data file can have no more than 1000 observations.
Save	Selection of this function allows you to save a file.
Quit	This function allows you to quit to DOS.

EDIT

If EDIT is highlighted and selected, you can view the data or sort the data. If you've loaded the program, you can view it by selecting View. Note that, when the data was loaded, the natural logarithm was estimated for each observation. This was done to facilitate the use of the lognormal options later. Next, sort the data by selecting the Sort function. This is necessary for some of the methods.

OPTIONS

There are four OPTION functions available: Log Option, Source Data Option, Debug Output Option, and Printer Port Option.

Log Option	You can use the log transform option for lognormal data sets or normal option for normal data sets. The default is Normal (Normal Distribution). (In the actual program code, the default is "False.")
Source Data	This option allows you to select the mode of data entry. You may enter a raw data set (RAW DATA) of no more than 1000 observations. This data set is entered through the FILE (Load) window of the main PDWI of this program. The file should be an ASCII file. The file name should be of the form,

XXXX.dat. Use a small "d" for "dat, not a capital "D".

RAW DATA: The Summary Data Option window appears with a message inside it informing you that you can select this option by pressing the RETURN key. Pressing the Esc(ape) key will return you to the options window and keep you in the RAW DATA mode.

SUMMARY DATA: The Raw Data Option window appears with a message inside it informing you that you can select this option by pressing the RETURN key. Pressing the Esc(ape) key will return you to the options window and keep you in the SUMMARY DATA mode.

The default Source Data are SUMMARY DATA unless RAW DATA are loaded at the beginning.

Debug Option

You can select a simple summary of estimates for your output or a detailed listing of output from various steps involved in the estimation process. The detailed output is designed to allow the user to check each step of the calculations when a problem is suspected. Select the debug option if you want screens of detailed information.

The default Debug Option is Summary Screen. (In the actual program code, default is "FALSE.")

Printer Option

You can print screens to a printer on a parallel port or on a serial port. The F9 key is used to print a screen. When you have a screen of results in front of you, press F9 to send it to the printer.

The default is parallel port.

Note that your printer must be ON, ONLINE, and contain paper. If not, you will get an error message and you will be returned to DOS.

METHOD

Once you've selected your choice for data entry, highlight the METHOD category. You have eight methods available to you (see flow diagram on page 16 for selection of the best method for your needs). You must first decide if you are

working with a normal, lognormal or another distribution. If you are not working with a normal or 2-parameter, lognormal distribution, you should quit this program and decide if you should be using the program at all, or if you should use Helsel's Robust Method. If you are working with a normal distribution, be certain that the normal mode is selected in the Options (Log Options) window. If you are working with a 2-parameter, lognormal distribution then make certain that the log mode is selected in the Options window. If you are unsure of the underlying distribution, the most robust method available is Helsel's method. Please refer to the original manuscripts for the behavior of these methods. The original manuscripts are listed on the previous pages. They are also discussed in Newman et al. (1989) and Newman (1995).

EDITING FUNCTIONS

When entering strings or values, such as file names or data, some crude but effective editing functions are available. Editing keys that are available include:

Key	Function.
Backspace	Delete the previous character, or, if at the beginning of a line, move the cursor to the previous line.
Esc	Exit from current function.

DATA ENTRY

Data may be entered in two ways: using a data file of observations or summary statistics.

First, a data set may be entered with values below the detection limit denoted in the data set as some value(s) below the detection limit. For example, all values below the detection limit of 12.0 are entered as 11.9. In the raw data mode, a data set containing up to 1000 observations can be handled by all methods.

Second, the summary data may be entered instead of the entire data set. Slightly different summary data will be asked for in various routines. Depending on the method used, the user may enter such summary statistics as the mean of the above detection limit values (in log units if you are using the Log Option), variance of the above detection limit values (in log units if you are using the Log Option), the detection limit (arithmetic units always) , etc. The iterative methods may ask for an initial "seed" for some values. Best estimates of the mean and

variance of the censored data set for the first iteration are often the mean and variance of the observations above the detection limit.

LIMITS

Currently the data load function is limited to 1000 data values. This allows plenty of free memory for an exit to DOS. This free memory allows you to edit your data using your text editor/word processor rather than forcing an edit function on you.

Unfortunately, the DOS exit function cannot find command.com unless command.com is in your current directory. Also, it does not work properly with the MKSToolkit Korn Shell.

For the Maximum Likelihood and the Bias Corrected routines, the lookup tables from Cohen limited the intensity of censoring to less than 50% of the total sample size. This was done under the assumption that a data set with more than 50% of the values below the detection limit is such a compromised data set that the application of these methods is an excessive approach. Likely, if the intensity of censoring is greater than 50%, you do not know the parent distribution. In this case, you should not use the MLE methods. Instead, use Helsel's method which is more robust.

The other methods will function for data sets with more than 50% censoring. Also, if the number of above detection limit observations is less than or equal to 2, the program will not allow you to generate estimates. If the user finds these restrictions too limiting, s/he may want to modify the program using the references mentioned in the previous pages. We encourage your opinions regarding this decision. A sufficient number of contrary opinions will prompt us to modify the program as suggested.

MISCELLANEOUS FUNCTION KEYS

There are a few more points that you should know before you begin using UnCensor©. They involve the following function keys.

F1 — This key is used to invoke help screens for specific windows or functions. Each help screen provides information pertinent to the portion of the program presently being used. (If you've entered into the program beyond the main categories, you may need to go back to the general help window for the categories, "File, Edit, Options, or Method." However, first

you have to get back to one of these categories prior to pressing F1. To do this, simply use the left arrow key to get back to the File category, then press the Esc key to get up to the main categories. Now you can select the main category of interest and press F1.)

Alt-x — Pressing the x key while holding down the Alt key gets you out of the program.

F9 — This key sends a screen of output to the printer.

F10 — This key gives the program status and then dumps you out of the program.

TEST DATA SETS

Six data sets are included for testing the program behavior. They are the following: Alk.dat, Nsmall.dat, Nlarge.dat, PO4.dat, Lnsmall.dat, and Lnlarge.dat.

Alk.dat is a total alkalinity data set that, when tested, fits a normal distribution adequately. It has a sample size of 135. Nsmall.dat and Nlarge.dat are samples derived by computer for a normal distribution with a mean and standard deviation similar to Alk.dat. Nsmall.dat has 20 observations and Nlarge has 200 observations.

PO4.dat is an ortho-phosphate data set that, when tested, fits a log normal distribution. It has 38 observations. Lnsmall.dat (n=20) and Lnlarge.dat (n=200) are simulated data from a log normal distribution with a mean and standard deviation similar to PO4.dat.

Below are tables of values one should expect for these six data sets with (20%) and without censoring. If you suspect a problem with the program, these data sets and the associated tables can be used to check for errors.

There are four other data sets that may catch the user's eye, Test.dat, Hes.dat, Winsor.dat, and Epa.dat. Test.dat is the default data file. It is the same as nsmall.dat. Hes.dat, Winsor.dat, and Epa.dat were used during incorporation of Helsel's robust technique, Winsorization method, and EPA Delta Log method, respectively. Hes.dat is the data set used in Helsel's original paper (1990). These vaules are listed in the appendix example of the paper. You may wish to use it to compare UnCensor©'s performance against Helsel's discussion. Keep in mind the modification mentioned previously on Helsel's method. Winsor.dat is the data set used in Newman (1995) and Epa.dat is used in US EPA (1991).

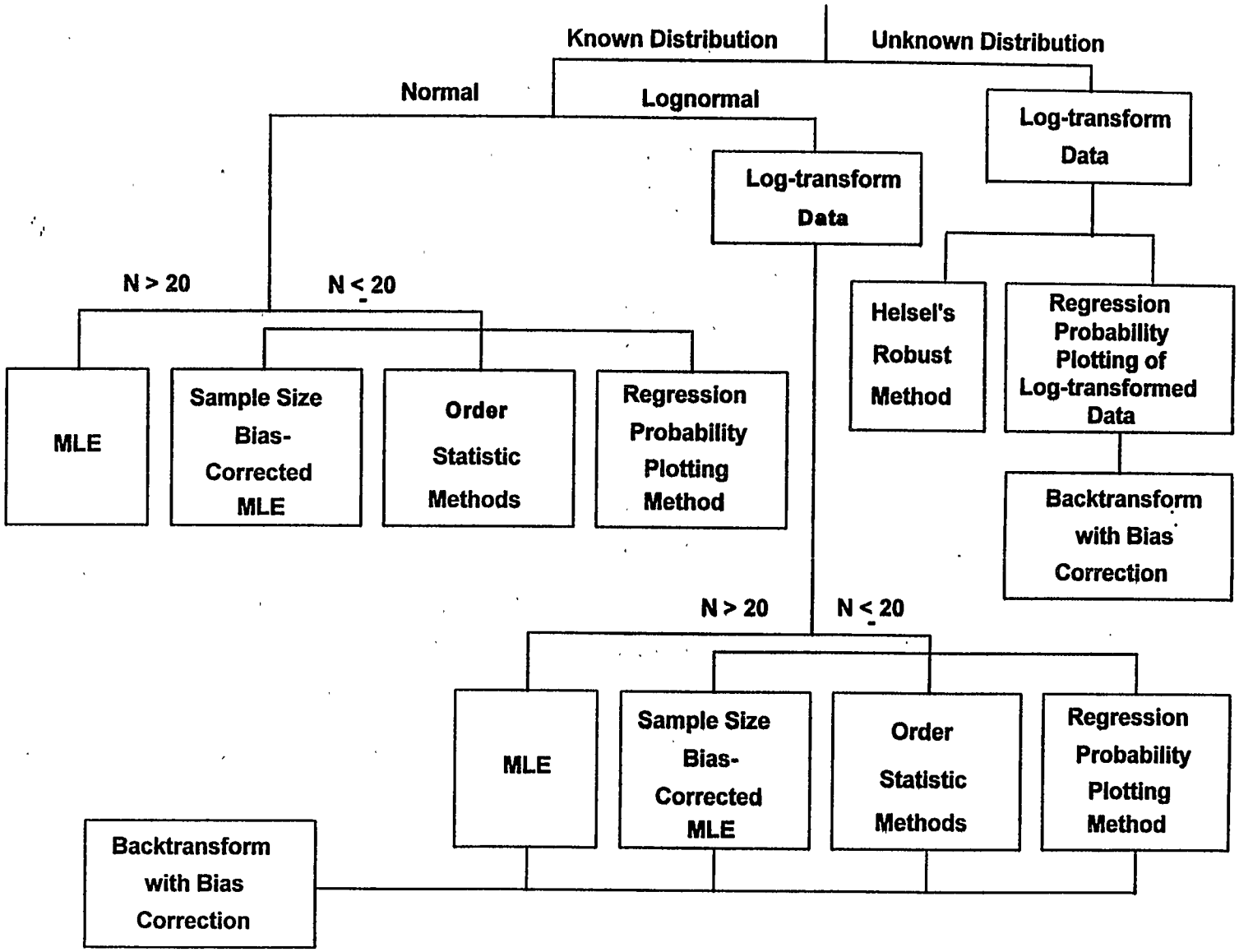

Known Distribution
Unknown Distribution
Normal
Lognormal
Log-transform Data
Log-transform Data
N > 20
N < 20
MLE
Sample Size Bias-Corrected MLE
Order Statistic Methods
Regression Probability Plotting Method
Helsel's Robust Method
Regression Probability Plotting of Log-transformed Data
Backtransform with Bias Correction
N > 20
N < 20
MLE
Sample Size Bias-Corrected MLE
Order Statistic Methods
Regression Probability Plotting Method
Backtransform with Bias Correction

Table 1. Normal Distribution with No Censoring

Data Set	Method	Mean	Standard Deviation	95% Confidence Interval of Mean
Alk.dat (n=135)	Iterative Maximum Likelihood	18.265	3.832	17.614 - 18.916
	Gleit's Iterative	18.265	3.832	-
	Regression	18.265	3.834	17.992 - 18.536
	Bias Corrected MLE	18.267	3.862	17.611 - 18.923
	One-Step MLE	18.265	3.832	17.614 - 18.916
	Helsel's Robust	18.265	3.832	12.425 - 28.031
	Winsorization	18.265	3.832	17.613 - 18.917
	EPA Delta Log	18.307	4.311	1.000 - 20.204
Nlarge.dat (n=200)	Iterative Maximum Likelihood	18.783	3.964	18.231 - 19.335
	Gleit's Iterative	18.783	3.964	-
	Regression	18.783	3.979	18.593 - 18.972
	Bias Corrected MLE	18.784	3.985	18.229 - 19.339
	One-Step MLE	18.783	3.964	18.231 - 19.335
	Helsel's Robust	18.783	3.964	12.751 - 28.900
	Winsorization	18.783	3.964	18.230 - 19.336
	EPA Delta Log	18.815	4.362	1.000 - 20.704
Nsmall.dat (n=20)	Iterative Maximum Likelihood	18.951	4.042	17.088 - 20.814
	Gleit's Iterative	18.951	4.042	-
	Regression	18.951	4.136	16.910 - 20.895
	Bias Corrected MLE	18.967	4.247	17.009 - 20.924
	One-Step MLE	18.951	4.042	17.088 - 20.814
	Helsel's Robust	18.951	4.042	12.816 - 29.298
	Winsorization	18.951	4.042	17.059 - 20.843
	EPA Delta Log	18.993	4.342	1.000 - 20.846

Table 2. Normal Distribution with Approximately 20% Censoring

Data Set	Method	Mean	Standard Deviation	95% Confidence Interval of Mean
Alk.dat	Iterative Maximum Likelihood	18.269	3.804	17.636 - 18.899
(n=135)	Gleit's Iterative	*	*	*
(DL=15.67)	Regression	18.387	3.657	17.916 - 18.852
	Bias Corrected MLE	18.269	3.831	17.631 - 18.903
	One-Step MLE	18.283	3.769	17.656 - 18.907
	Helsel's Robust	18.270	2.604	17.832 - 20.858
	Winsorization	18.427	4.849	17.593 - 19.261
	EPA Delta Log	18.859	2.977	15.67 - 20.592
Nlarge.dat	Iterative Maximum Likelihood	18.839	3.871	18.310 - 19.366
(n=200)	Gleit's Iterative	*	*	*
(DL=15.40)	Regression	18.916	3.778	18.620 - 19.210
	Bias Corrected MLE	18.840	3.891	18.307 - 19.369
	One-Step MLE	18.849	3.842	18.323 - 19.372
	Helsel's Robust	19.666	2.829	18.198 - 21.286
	Winsorization	18.868	4.297	18.266 - 19.469
	EPA Delta Log	19.263	3.194	15.400 - 20.209
Nsmall.dat	Iterative Maximum Likelihood	18.939	4.088	17.069 - 20.793
(n=20)	Gleit's Iterative	*	*	*
(DL=15.00)	Regression	19.188	3.850	15.948 - 22.186
	Bias Corrected MLE	18.943	4.279	16.985 - 20.883
	One-Step MLE	18.964	4.007	17.131 - 20.781
	Helsel's Robust	19.874	2.859	17.702 - 22.392
	Winsorization	19.226	4.563	16.980 - 21.471
	EPA Delta Log	19.385	3.406	15.000 - 21.209

* - No convergence with accuracy = 0.00500

Table 3. Log Normal Distribution with No Censoring

Data Set	Method	Mean	Standard Deviation	95% Confidence Interval of Mean (Log)
P04.dat (n=38)	Iterative Maximum Likelihood	146.206	43.974	4.846 - 5.039
	Gleit's Iterative	146.206	43.974	-
	Regression	146.246	44.130	4.627 - 5.163
	Bias Corrected MLE	146.634	45.359	4.844 - 5.042
	One-Step MLE	146.206	43.974	4.846 - 5.039
	Helsel's Robust	146.553	47.868	82.602 - 287.753†
	Winsorization	146.206	43.974	4.845 - 5.040
	EPA Delta Log	146.381	44.223	1.000 - 171.703†
Lnlarge.dat (n=200)	Iterative Maximum Likelihood	156.211	66.750	4.910 - 5.025
	Gleit's Iterative	156.211	66.750	-
	Regression	154.535	61.301	4.921 - 5.012
	Bias Corrected MLE	156.373	67.208	4.910 - 5.025
	One-Step MLE	156.211	66.750	4.910 - 5.025
	Helsel's Robust	153.691	49.211	87.480 - 297.697†
	Winsorization	156.211	66.750	4.910 - 5.025
	EPA Delta Log	156.282	66.895	1.000 - 212.512†
Lnsmall.dat (n=20)	Iterative Maximum Likelihood	157.116	58.824	4.824 - 5.162
	Gleit's Iterative	157.116	58.824	-
	Regression	157.080	58.699	4.301 - 5.388
	Bias Corrected MLE	158.382	62.440	4.817 - 5.172
	One-Step MLE	157.116	58.824	4.824 - 5.162
	Helsel's Robust	156.293	50.627	88.456 - 305.130†
	Winsorization	157.116	58.824	4.822 - 5.165
	EPA Delta Log	157.674	59.777	1.000 - 201.514†

†Arithmetic

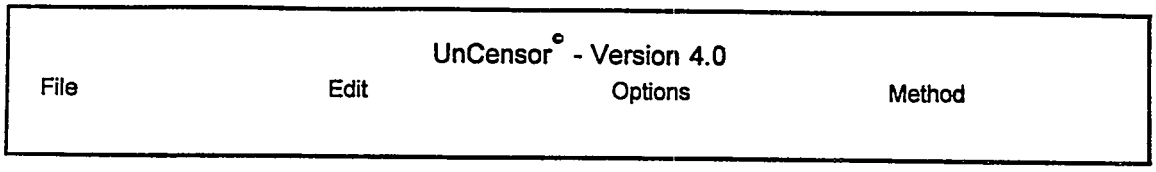
Table 4. Log Normal Distribution with Approximately 20% Censoring

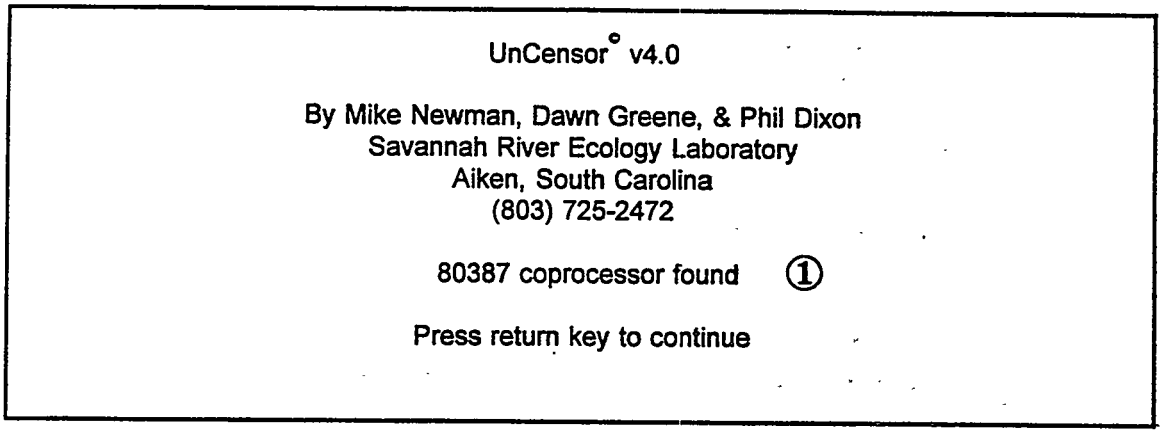
Data Set	Method	Mean	Standard Deviation	95% Confidence Interval of Mean (Log)
P04.dat	Iterative Maximum Likelihood	144.367	49.236	4.812 - 5.023
(n=38)	Gleit's Iterative	*	*	*
(DL=105)	Regression	144.752	49.972	4.404 - 5.241
	Bias Corrected MLE	144.782	50.685	4.809 - 5.026
	One-Step MLE	144.383	49.325	4.811 - 5.024
	Helsel's Robust	151.100	43.861	132.072 - 173.765†
	Winsorization	145.598	53.894	4.796 - 5.039
	EPA Delta Log	147.998	42.771	105.000 - 178.348†
Lnlarge.dat	Iterative Maximum Likelihood	156.909	47.540	4.971 -5.053
(n=200)	Gleit's Iterative	*	*	*
(DL=111.8)	Regression	158.758	43.027	4.955 - 5.102
	Bias Corrected MLE	156.979	47.807	4.971 - 5.053
	One-Step MLE	156.912	46.295	4.974 - 5.054
	Helsel's Robust	164.776	34.924	144.027 - 189.438†
	Winsorization	161.142	58.751	4.971 - 5.070
	EPA Delta Log	159.713	39.799	111.800 - 184.703†

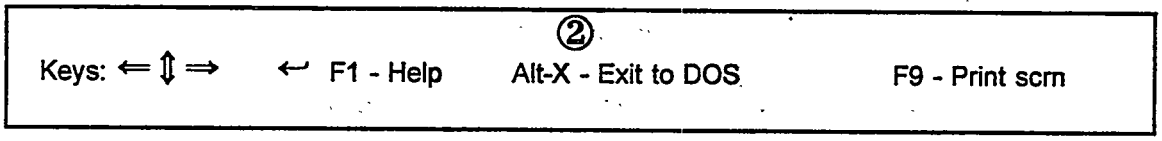
* - No convergence with accuracy = 0.00500
†Arithmetic

APPENDIX: SCREENS AND EXPLANATIONS

IA. MAIN SCREEN



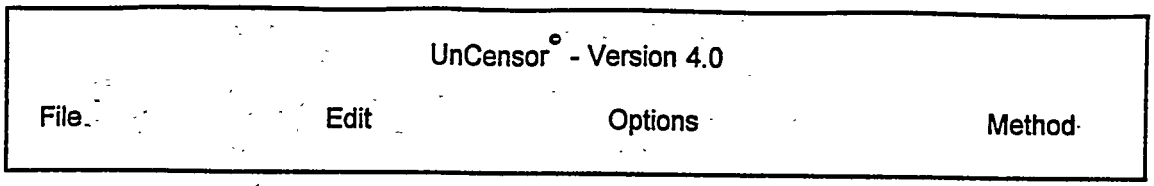


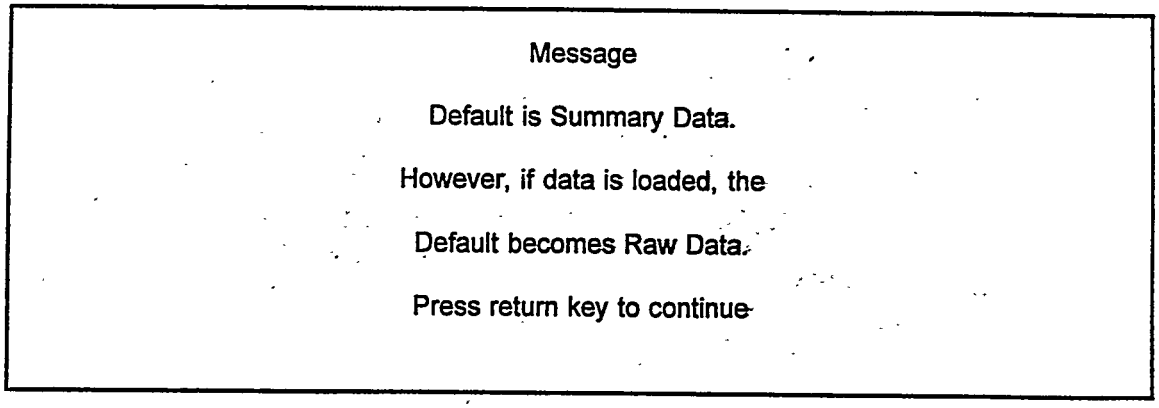


EXPLANATION

1. The result of the search for a math coprocessor will be displayed after the program is loaded.

2. These function and cursor reminders will be displayed at the bottom of pertinent screens. The arrow keys allow movement between choices. The RETURN key allows selection choice. F1 will produce a help screen for the highlighted category/function. F9 will print the screen. Alt-x will exit to DOS.

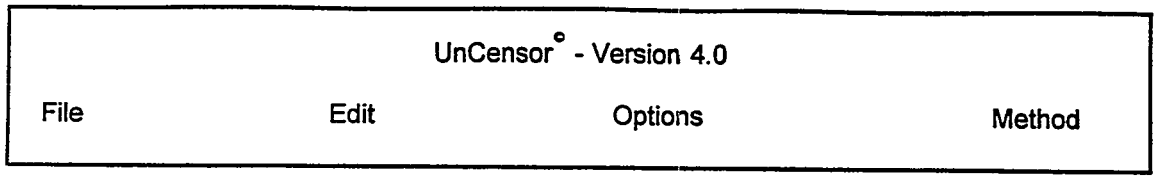


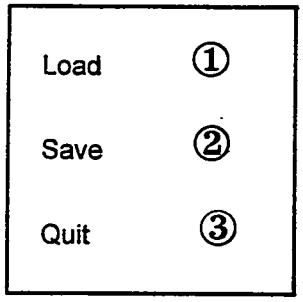


EXPLANATION

This message window clearly states that the default for the source data is summary data until raw data is loaded.

IB. FILE CATEGORY



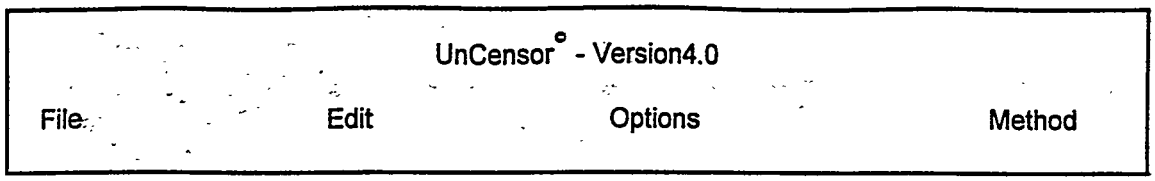


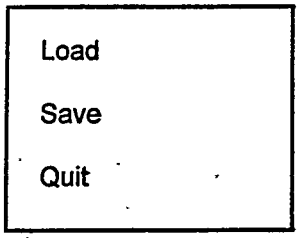
EXPLANATION

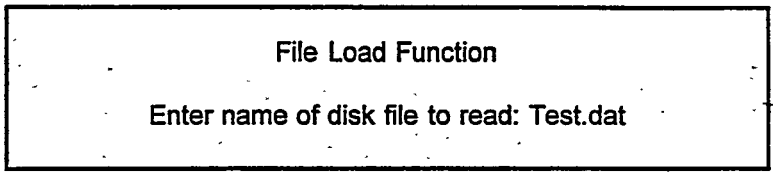
1. Selection of this function allows you to load a data file into the program. You will be asked to specify the file name after you select this function.

2. Selection of this function allows you to save a file.

3. Allows you to quit the program and return to DOS. If you select this function you will be asked if you want to return to DOS prior to actually leaving the program.



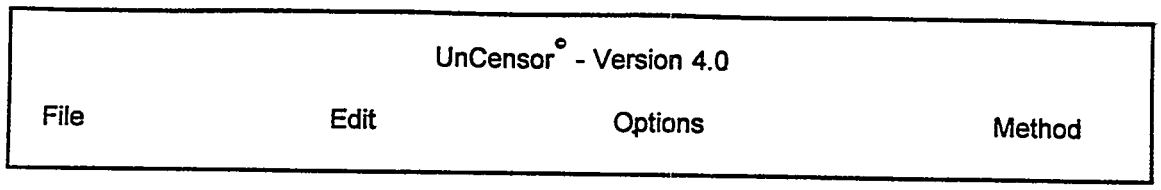


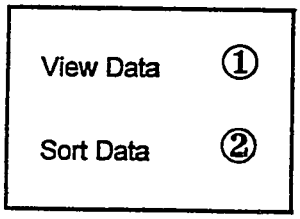


EXPLANATION

When loading a file, be sure to type the filename correctly and use the ".dat" extension. Note that you must use a lower case "d."

IC. EDIT CATEGORY





EXPLANATION

1. Allows you to view data already loaded into the program.The untransformed data (RData.Raw[x]) as well as the natural log of the data (RData.NLT[x]) will be shown. See the next two screens for an example.

2. Allows you to sort the data set for examination. Prior to use, each method will sort the data set if it is not already sorted.

UnCensor° - Version 4.0

File Edit Options Method

Raw Data View Window

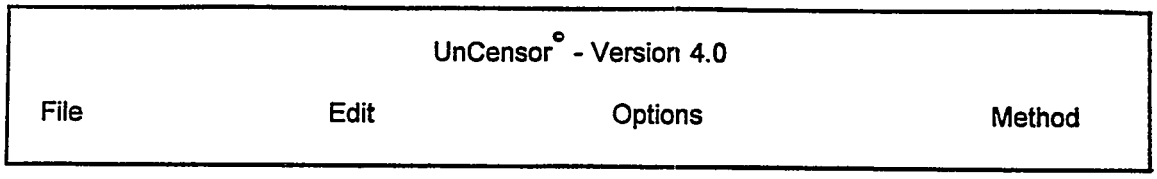
RData.Raw[1] =	26.1265	RData.NLT[1] =	3.2630
RData.Raw[2] =	22.4160	RData.NLT[2] =	3.1098
RData.Raw[3] =	18.5813	RData.NLT[3] =	2.9222
RData.Raw[4] =	23.1612	RData.NLT[4] =	3.1425
RData.Raw[5] =	13.5671	RData.NLT[5] =	2.6076
RData.Raw[6] =	19.5622	RData.NLT[6] =	2.9736
RData.Raw[7] =	13.2064	RData.NLT[7] =	2.5807
RData.Raw[8] =	12.4233	RData.NLT[8] =	2.5196
RData.Raw[9] =	16.5052	RData.NLT[9] =	2.8037
RData.Raw[10] =	15.9442	RData.NLT[10] =	2.7691
RData.Raw[11] =	19.4429	RData.NLT[11] =	2.9675
RData.Raw[12] =	12.3335	RData.NLT[12] =	2.5123
RData.Raw[13] =	24.0045	RData.NLT[13] =	3.1782
RData.Raw[14] =	17.6204	RData.NLT[14] =	2.8691
RData.Raw[15] =	20.1751	RData.NLT[15] =	3.0044
RData.Raw[16] =	23.1236	RData.NLT[16] =	3.1409
RData.Raw[17] =	21.1060	RData.NLT[17] =	3.0496
RData.Raw[18] =	17.5478	RData.NLT[18] =	2.8649
RData.Raw[19] =	19.8332	RData.NLT[19] =	2.9874
RData.Raw[20] =	22.3369	RData.NLT[20] =	3.1062

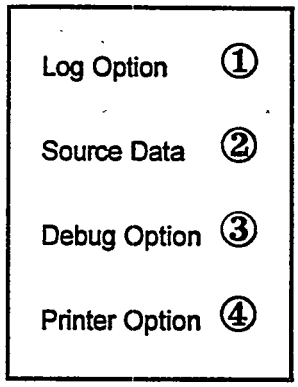
Press return key to continue

Raw Data View Window

RData.Raw[18] =	17.5478	RData.NLT[18] =	2.8649
RData.Raw[19] =	19.8332	RData.NLT[19] =	2.9874
RData.Raw[20] =	22.3369	RData.NLT[20] =	3.1062

ID. OPTIONS CATEGORY





EXPLANATION

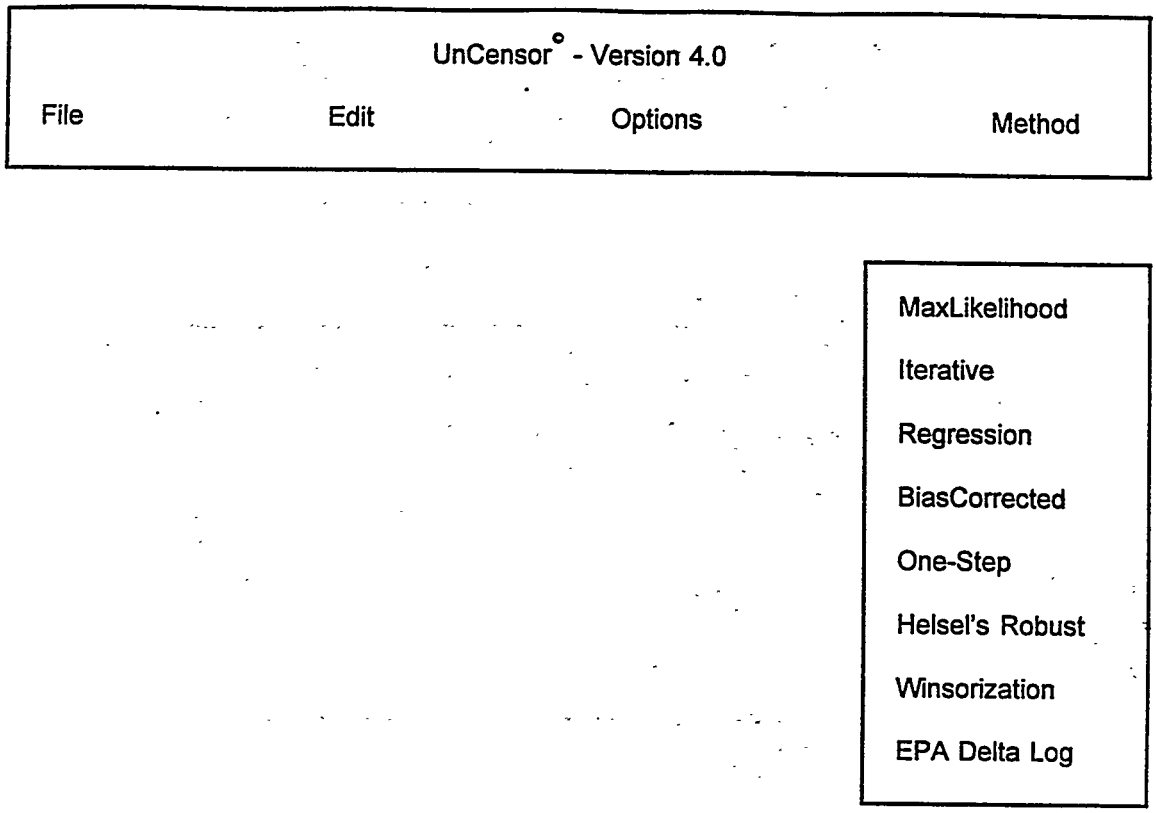
1. Select lognormal if you believe that your data best fit a two parameter lognormal distribution. Select normal if the data set is normally distributed.

2. You may use a raw data set or a summary data set for these statistical methods. See page 11 of this manual for further explanaion.

3. You may get a simple screen with your original (censored) data summary statistics plus the estimated mean and variance or you may select the debug option that gives you many of the intermediate values used in the calculations.

4. Allows you to print with a parallel port or a serial port.

IE. METHOD CATEGORY



EXPLANATION

Please refer to the companion manuscript for explanations of these methods. Do not use these methods without understanding their limitations.

Note that the authors have had a problem with convergence with the Iterative Order method. We believe the code is correct.

IIA. INPUT - RAW DATA

UnCensor° - Version 4.0

File Edit Options Method

① Data Entry

Enter Detection Limit: [-10000.00000 .. 10000.00000]: 70.00000 ②

EXPLANATION

1. This screen will be shown for the following methods:
   - Maximum Likelihood
   - Regression Order Statistic
   - Bias Corrected
   - Schneider One-Step
   - Helsel's Robust
   - Winsorization
   - EPA Delta Log

   It will be different for Iterative Order Statistic (see next page).

2. Simply enter the detection limit. Note that the range of values for this entry is given in brackets, i.e. [- 10000.00000 .. 10000.00000]. You may enter any number between these limits. The number may have 5 places to the right of the decimal.

   NOTE: With the log option, you do not have to enter the log of the detection limit. The program will take the untransformed detection limit and transform it for you.

UnCensor© - Version 4.0

File Edit Options Method

Iterative Order Statistics Data Entry

Enter Detection Limit: [-10000.00000 .. 10000.00000]: 70.00000 ①

Enter seed for MuStar: [-10000.00000 .. 10000.00000]: -0.25000 ②

Enter seed for SigmaStar: [-500.00000 .. 500.00000]: 1.00000 ③

Enter accuracy: [-10000.00000 .. 10000.00000]: 0.00500 ④

Enter MaxIterations: [1.00000 .. 10000.00000]: 40.00000 ⑤

EXPLANATION

1. See previous page. Note that the range of acceptable values for this and all other variables are shown in the brackets [ ].

2. This is an iterative technique that requires an initial seed or guess for the mean (MuStar or μ Start). Usually, the mean of the "above detection limit values" is a good MuStar. If you don't have it, you may estimate it.

3. You need to provide an initial guess for the standard deviation (SigmaStar or σ Start). The standard deviation of the "above detection limit values" is a good SigmaStar. The better your guess, the easier it is for the program to reach convergence.

4. When the iterations are performed, the new estimates of mean and variance will be compared to the estimates from the previous iteration. If they are "sufficiently close," convergence is reached and the results are presented. The accuracy requested by this line is your desired maximum difference between the values from the two consecutive iterations.

5. The computer will do the computations for a maximum of 10,000 iterations. Specify the maximum number of iterations.

NOTE: With the log option, you do not have to enter the log of the detection limit. The program will take the untransformed detection limit and transform it for you.

IIB. INPUT - SUMMARY DATA

UnCensor© - Version 4.0

File Edit Options Method

Maximum Likelihood Data Entry ①

Enter Detection Limit: [-10000.00000 .. 10000.00000]: 70.00000 ②

Enter Mean: [-10000.00000 .. 10000.00000]: 80.65400 ③

Enter Variance: [-250000.00000 .. 250000.00000]: 31.73488 ④

Enter Num Samp Below Det Limit: [0.00000 .. 1000.00000]: 20.00000 ⑤

Enter Total Number of Samples: [0.00000 .. 1000.00000]: 20.00000 ⑥

EXPLANATION

1. This screen will be shown for the following methods:
   - Maximum Liklihood
   - Bias-Corrected
   - Schneider One-Step
   - EPA Delta Log

   It will be different for Iterative Order Statistic (see next page). Remember, only raw data entry may be used for Regression Order Statistics, Helsel's Robust Method and for the Winsorization Method. You will get an error message on the screen if you ask for a summary data entry screen for either method.

2. Enter the detection limit. If you are in the log option, enter the nontransformed detection limit. The program will transform it for you.

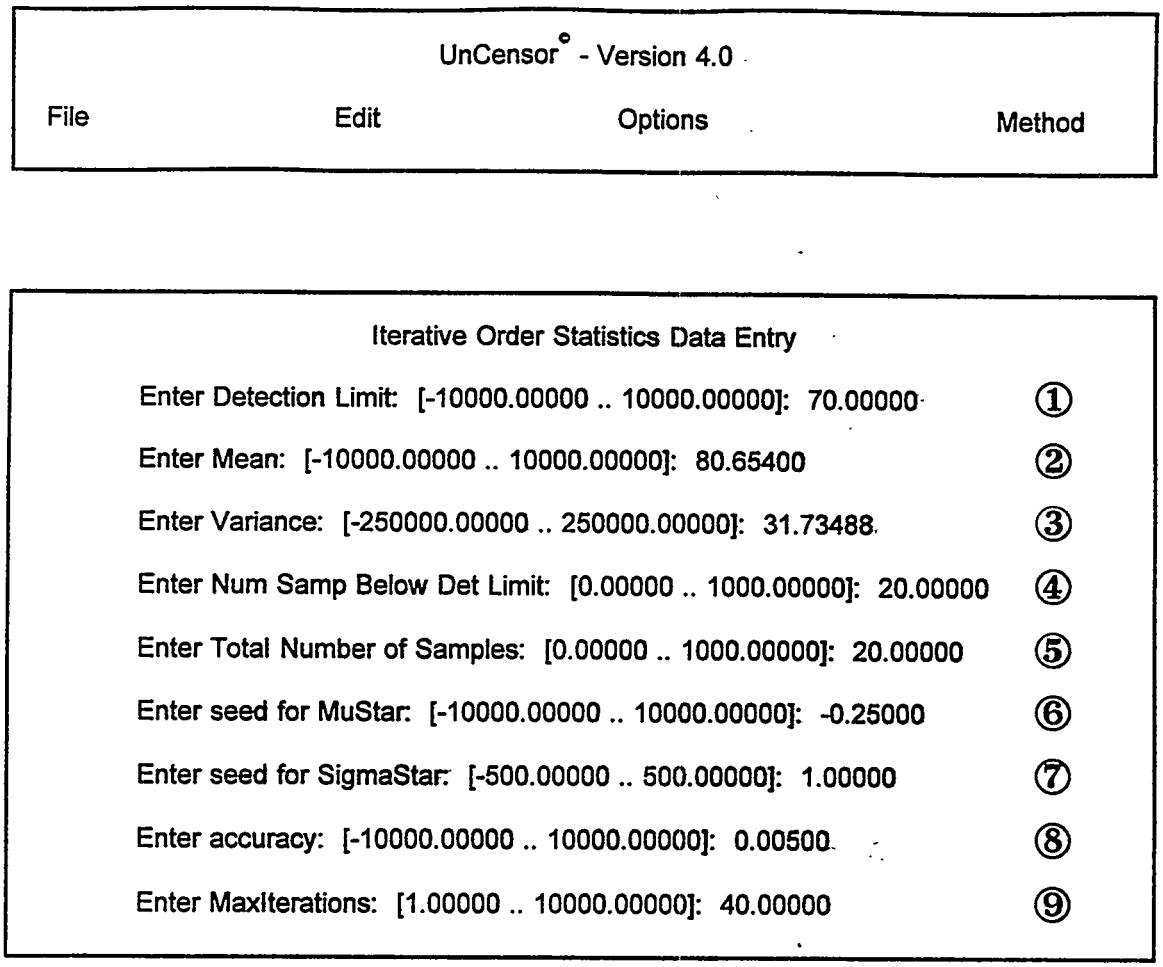
3. Enter the mean of the observations that are above the detection limit (of the transformed observations if you are in the log normal).

4. Enter the variance of the observations that are above the detection limit (of the transformed observations if you are in the log normal).

5. Enter the number of observations that were at or below the detection limit.

6. Enter the total number of observations in the data set.

NOTE: With the log option, you do not have to enter the log of the detection limit. The program will take the untransformed detection limit and transform it for you.



EXPLANATION

1. Enter the detection limit. If you are using the log option, enter the nontransformed detection limit. The program will transform it for you.

2.- 3. Enter the mean and the variance of the observations above the detection limit. If you are using the log option, i.e. the data set is described best by a two-parameter lognormal distribution, enter the mean and the variance of the transformed data.

4. Enter the number of observations that were at or below the detection limit.

5. Enter the total number of observations in the data set.

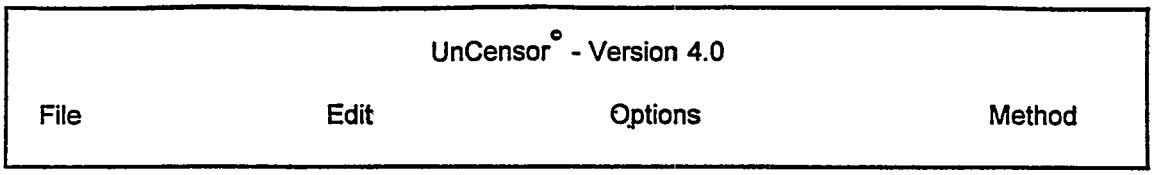
6. - 7. Enter your initial estimates of the data set's mean and standard deviation. The best initial values are often the mean and the standard deviation of the observations above the detection limit.

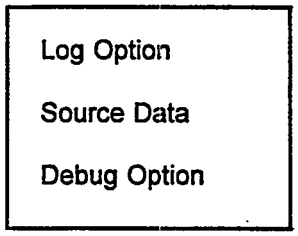
8. When the iterations are performed, the new estimates of the mean and variance will be compared to the estimates from the previous iteration. The program will end the iterations and converge if the differences between the estimates are less than a specific value. Enter this value or "accuracy" here.

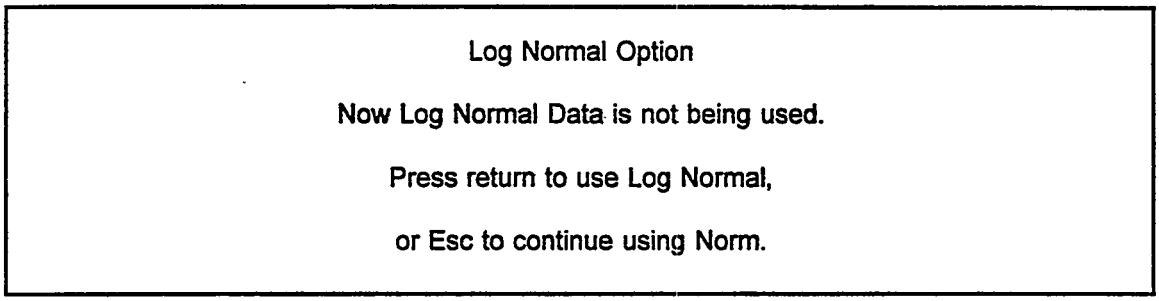
9. The program will perform the iterations until convergence is reached, or for a maximum number of iterations that you specify here.

NOTE: With the log option, you do not have to enter the log of the detection limit. The program will take the untransformed detection limit and transform it for you.

IIIA. OPTIONS - LOG OPTION

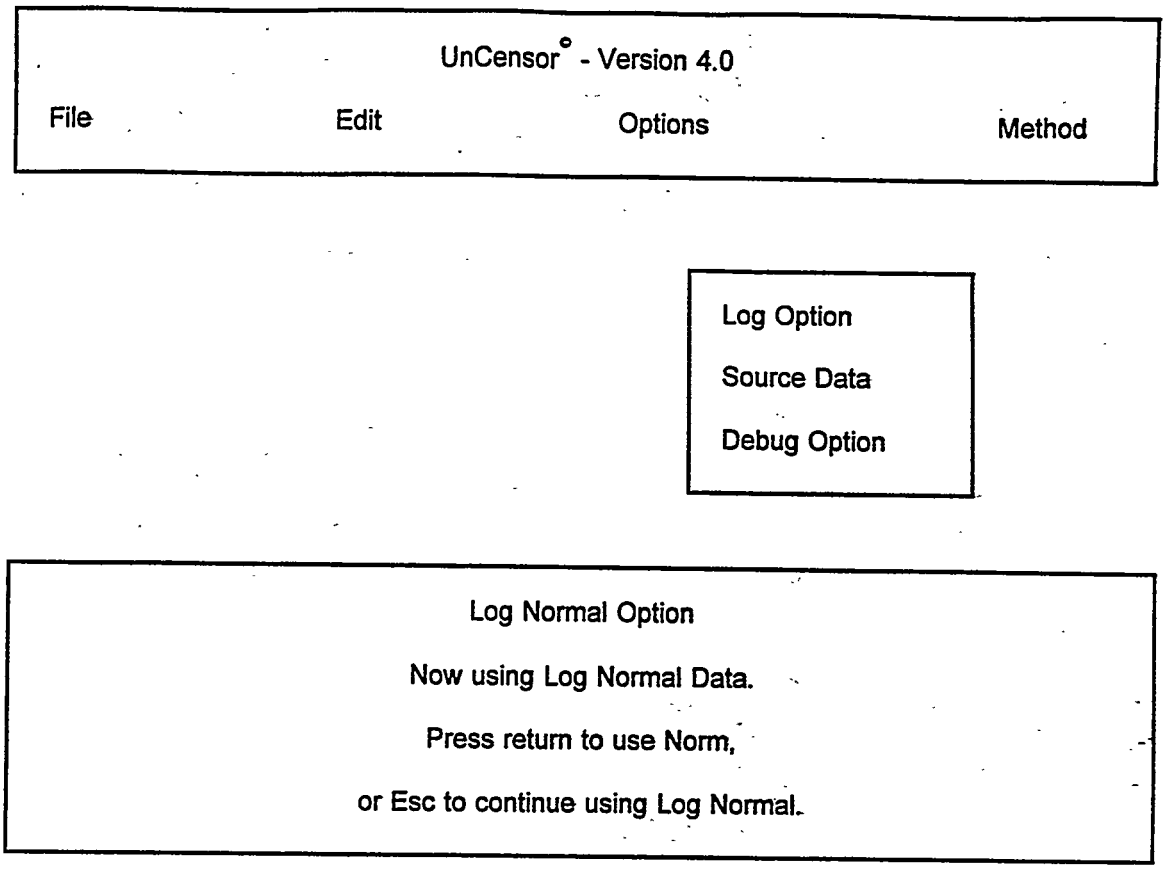






EXPLANATION

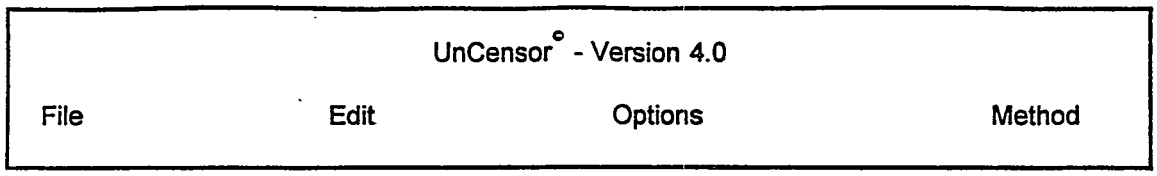
The distribution default (Log Option) is the normal distribution. Selection of Log Option gives you this screen when the program is in the Normal distribution mode. If you want to use the Log Normal distribution, press the RETURN key. If you want to continue using the Normal distribution, press the Esc key.

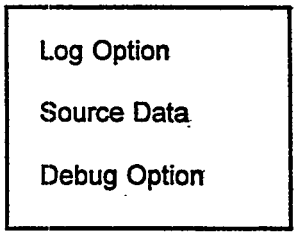


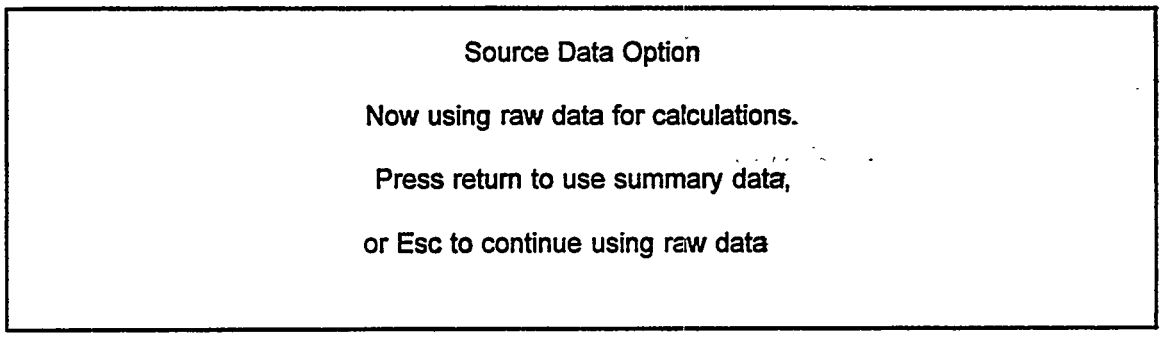
EXPLANATION

If you are using the program in the Log Normal distribution mode, the selection of Log Option will give you this screen. If you want to use the Normal distribution, press the RETURN key. If you want to continue using the Log Normal distribution, press the Esc key.

IIIB. OPTIONS - SOURCE DATA

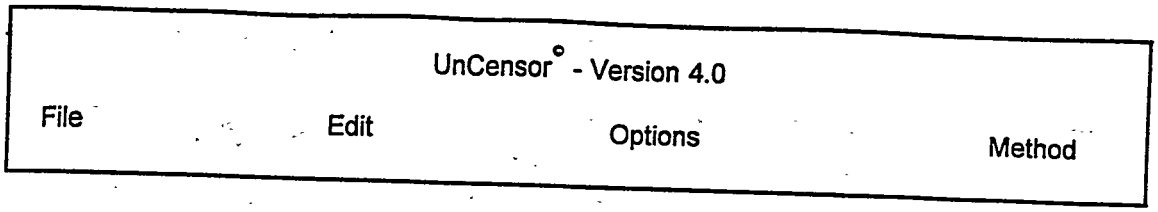


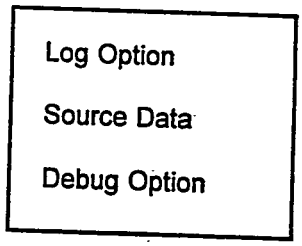


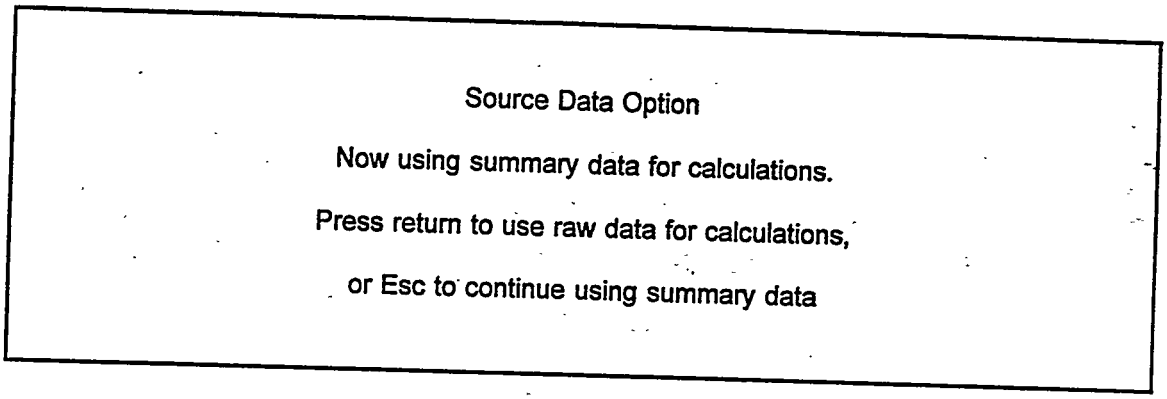


EXPLANATION

The Source Data default is the Summary Data Entry; however, if Raw Data is loaded at the beginning of the program then the default will became Raw Data Entry. Selection of Source Data Option will give you this screen if Raw Data Entry is being used. If you want to use Summary Data Entry, press the RETURN key. If you want to continue using Raw Data Entry, press the Esc key.



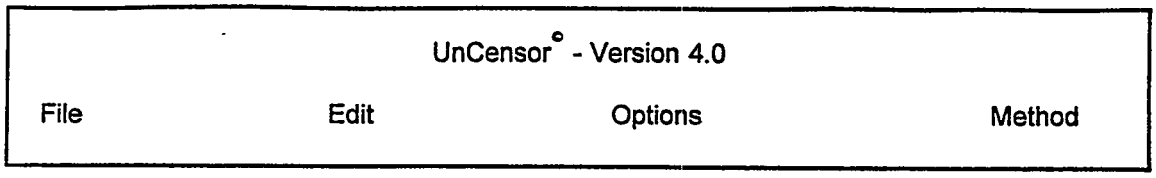


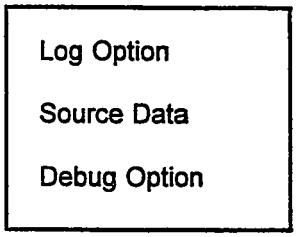


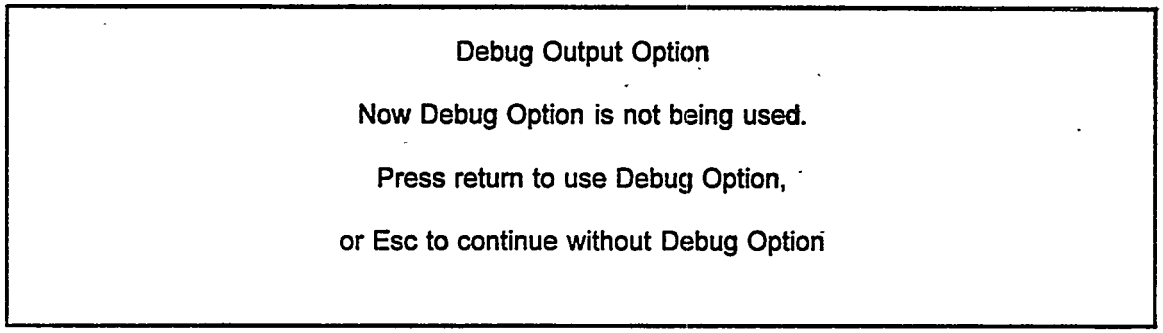
EXPLANATION

The Source Data default is the Summary Data Entry; however, if Raw Data is loaded at the beginning of the program then the default will become Raw Data Entry. Selection of Source Data Option will give you this screen if Summary Data Entry is being used. If you want to use Raw Data Entry, press the RETURN key. If you want to continue using the Summary Data Entry, press the Esc key.

IIIC. OPTIONS - DEBUG OPTION

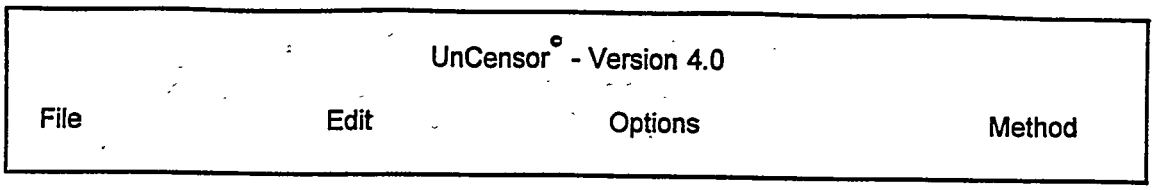


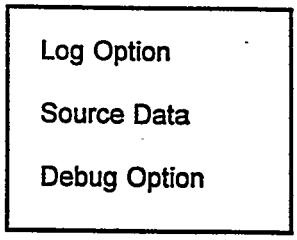


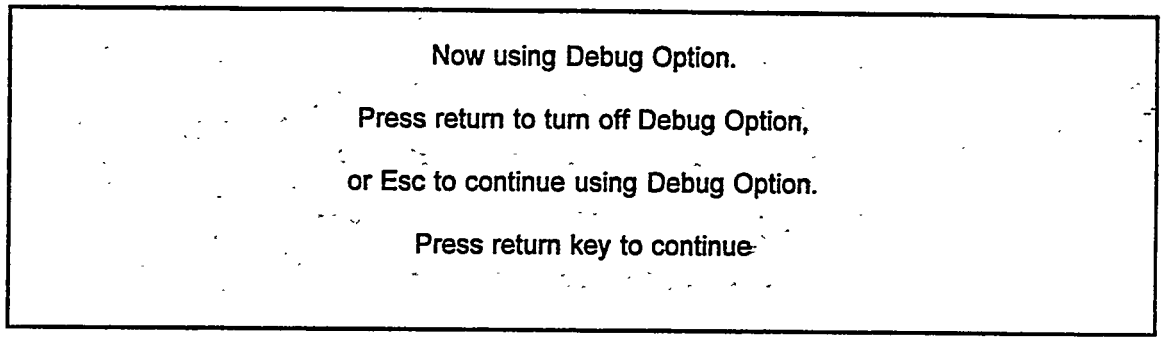


EXPLANATION

The Debug Option default is OFF. Selection of Debug Option will give you this screen when Debug Output is OFF. If you want the Debug Output screens, press the RETURN key. If you want to continue with the Summary Output screens, press the Esc key.



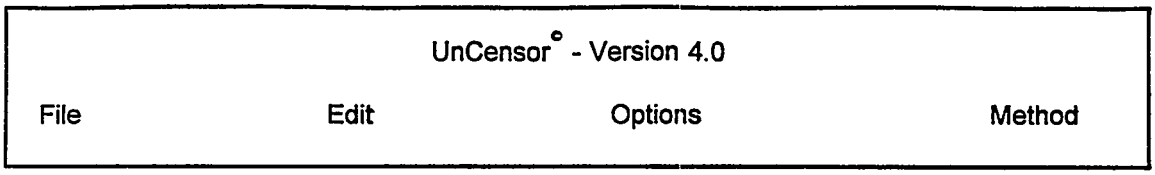


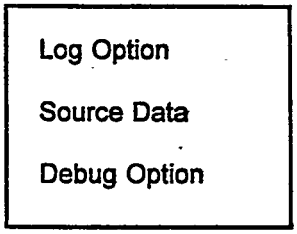


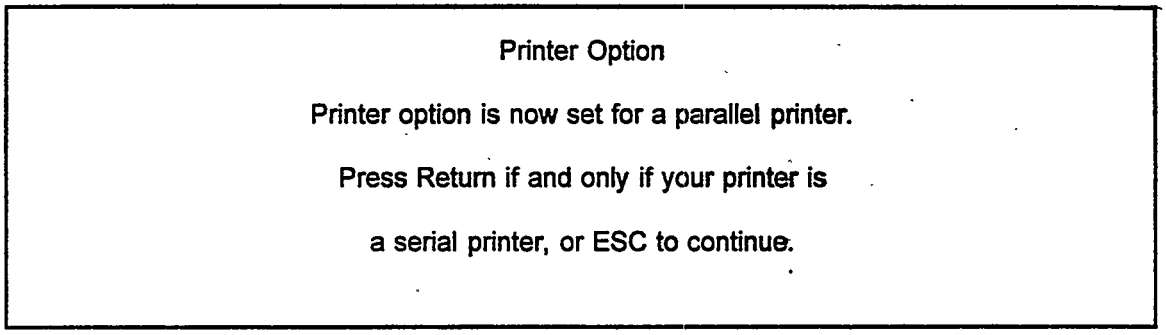
EXPLANATION

Selection of Debug Option will give you this screen when Debug Output is ON. If you want the Summary Output screens only, press RETURN key. If you want to continue with the Debug Output Screens, press the Esc key.

IIID. OPTIONS - PRINTER OPTION

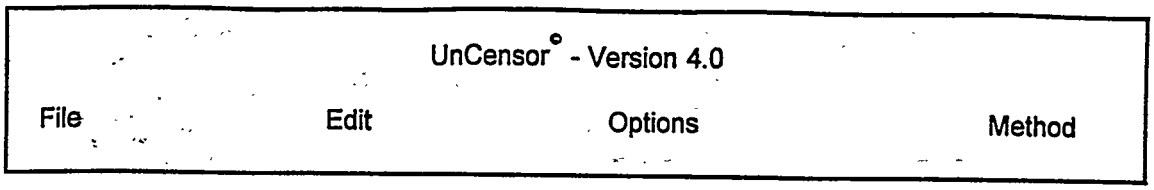


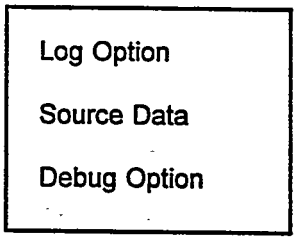


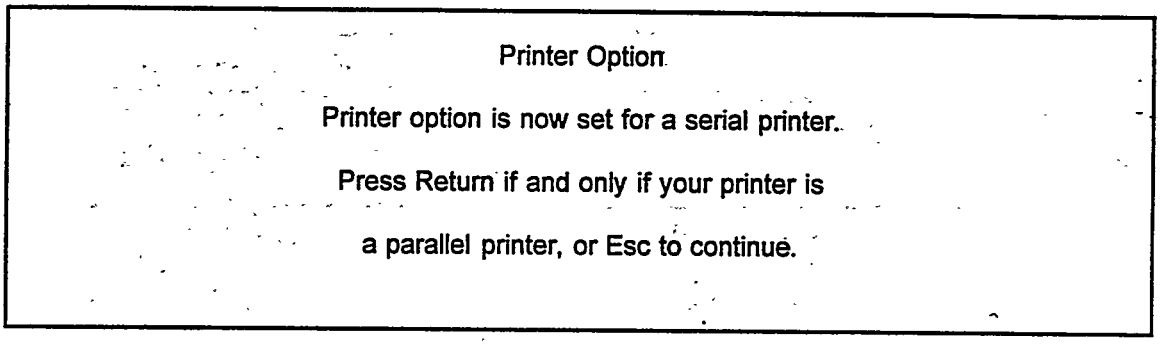


EXPLANATION

The Printer Port default is Parallel. Selection of Printer Option will give you this screen when the Printer Port is set to a Parallel Printer. If your printer is a Serial Printer, press the RETURN key. If your printer is a Parallel Printer, press the Esc key.



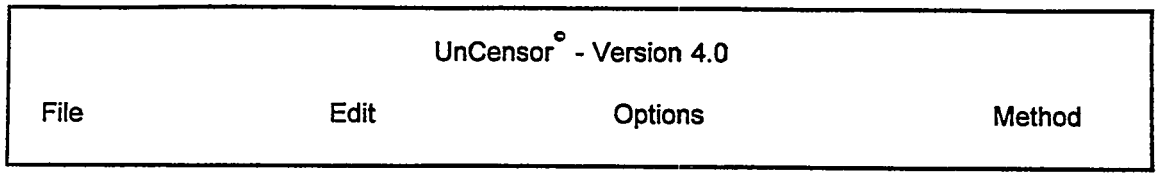


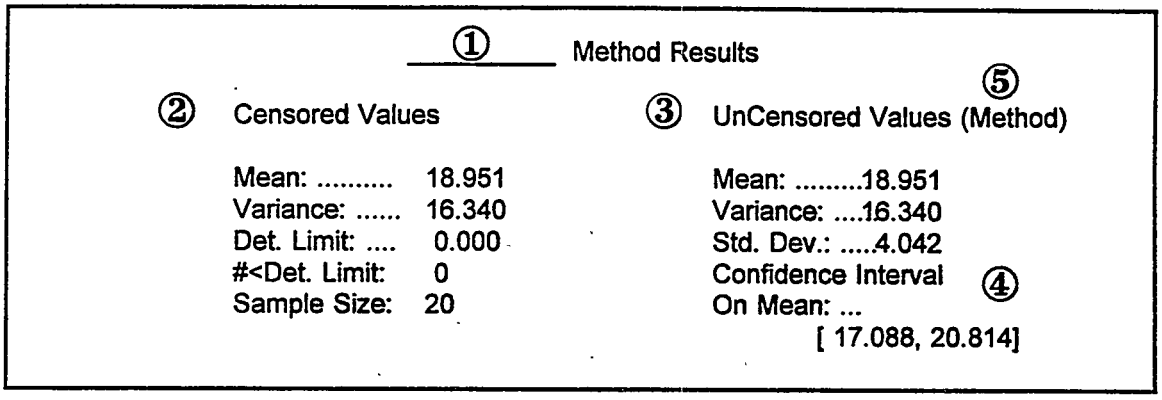


EXPLANATION

Selection of Printer Option will give you this screen when the Printer Port is set to Serial. If your printer is a Parallel Printer, press the RETURN key. If your printer is a Serial Printer, press the Esc key.

IVA. OUTPUT SCREENS - NORMAL DISTRIBUTION WITHOUT DEBUG OPTION





EXPLANATION

1. This window will be displayed for the following methods:
   - Maximum Likelihood
   - Regression Order Statistic
   - Bias Corrected
   - Schneider One-Step
   - Winsorization

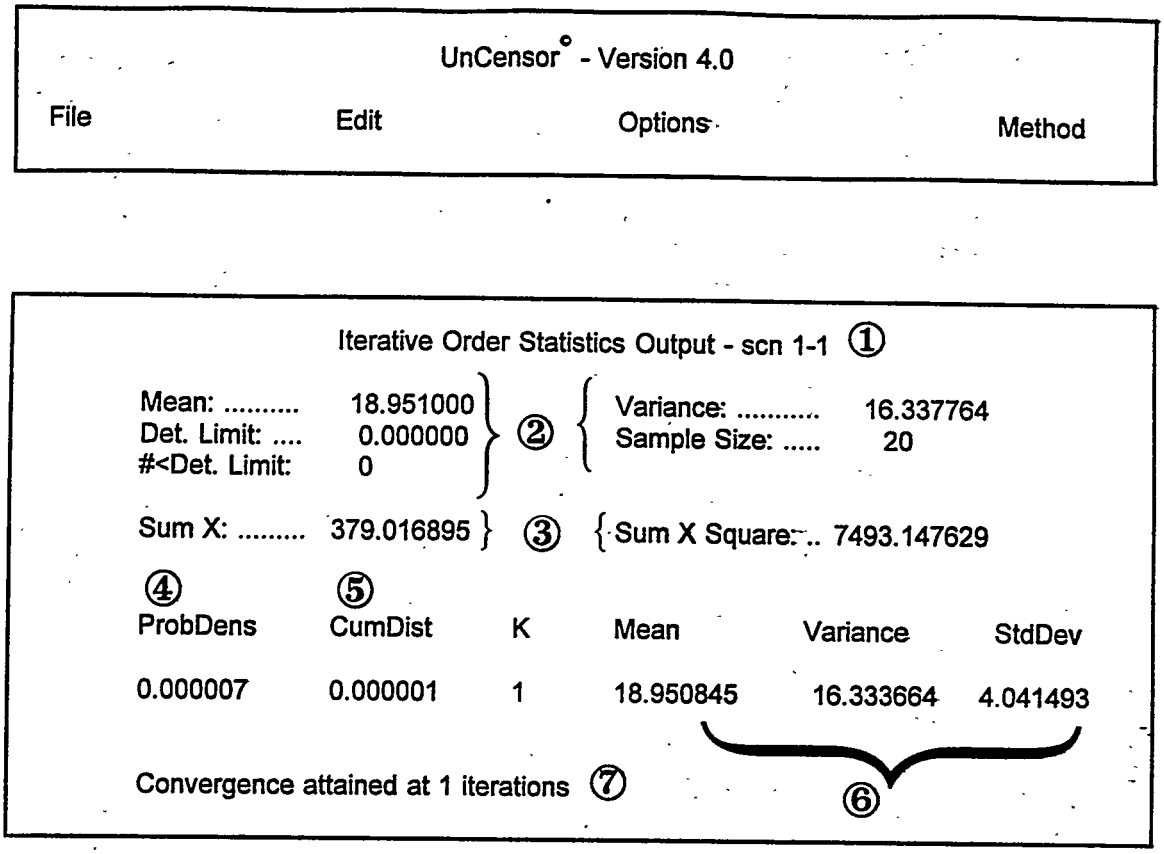
   A different set of screens will be used to output results from the Iterative Order Statistic (page) and from Helsel's Robust (page) methods.

2. The initial mean, variance of the observations above the detection limit, number of observations below the detection limit, and total number of observations are displayed here.

3. The estimates of mean, variance, and standard deviation derived from the input data by the specified method are presented here.

4. The 95% confidence interval calculated on the estimated mean is displayed here.

5. The label showing how calculations were performed.



EXPLANATION

1. The Iterative Order Statistic method will produce one screen, as indicated here. This screen is also produced for the Iterative Order Statistic method using the normal and debug options.

2. These are the values entered originally as the mean and variance of the observations above the detection limit, the detection limit, and the number of observations below the detection limit.

3. The sum of the observation values and the sum of the squares of the observation values.

4. The estimated normal distribution function. (Please see Gleit 1985 Env. Sci. Technol. 19:1201-1206 for specific details.)

5. The cumulative normal distribution function. (Please see Gleit 1985 for specific details.)

6. The number of iterations performed and the associated results. The last iteration resulted in convergence; therefore, use the associated estimates as the final method estimates.

7. Convergence or nonconvergence during the specified iterations is reported here. If

convergence is not reached, you can simply go through the input menu again. The final iteration estimates will be used as the default input values. By choosing the "default" values, you can send the program through more iterations. You could also change the values to see if you can approach convergence sooner in this manner.

Please note that the authors have found it difficult to obtain convergence of data sets with high levels of censoring.

UnCensor° - Version 4.0

File Edit Options Method

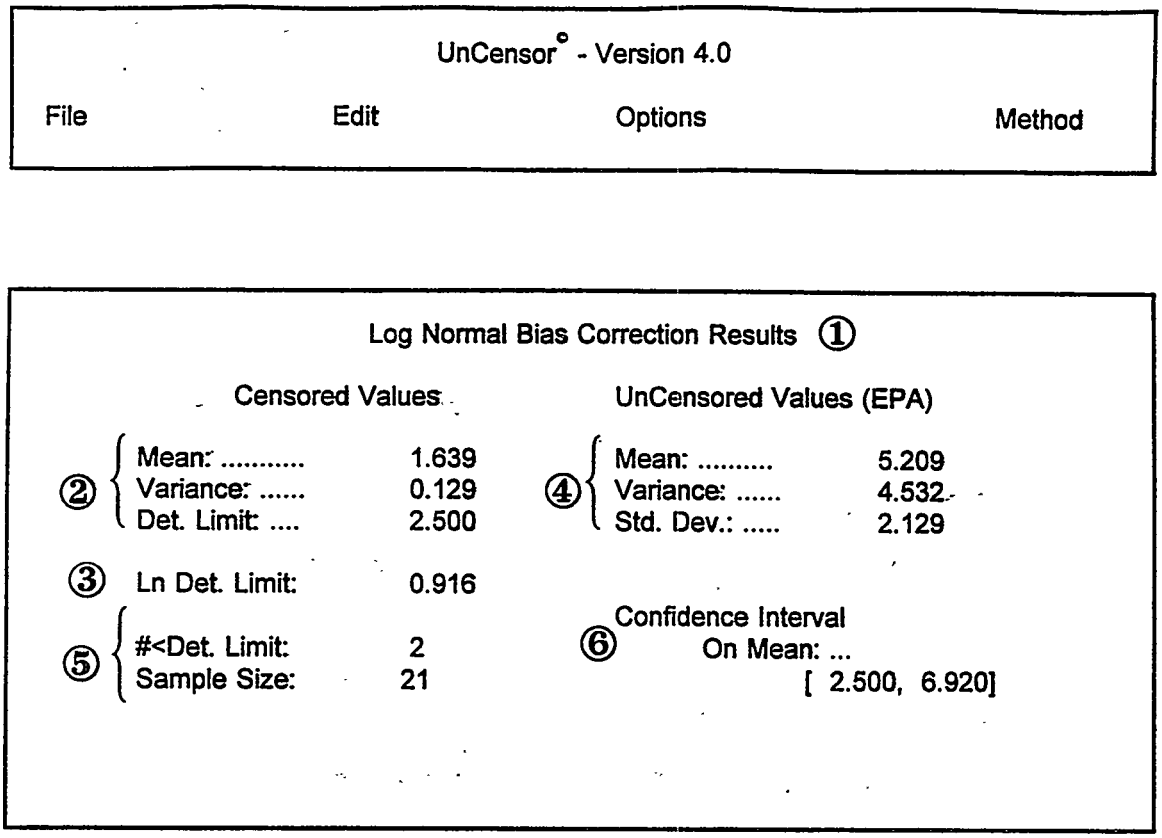
Robust Method Results

Censored Values		UnCensored Values (Robust)	
Mean:	18.951	Mean:	18.951
Variance:	16.340	Variance:	16.340
Det. Limit: ...	0.000	Std. Dev.:	4.042
#<Det. Limit:	0	Confidence Interval	
Sample Size:	20	On Mean: ...	
		[12.816, 29.298]	
r squared: ...	0.947		
Intercept:	2.919		
Slope:	0.228		

EXPLANATION

See page 46 for detailed explanation. This screen is also produced by Helsel's Robust Method using the lognormal distribution and debug options.

These are the regression results produced by the Robust method. Helsel's Robust displays the r^2, intercept, and slope used in producing values for the below detection limit observations.



EXPLANATION

1. This screen will be displayed for the EPA Delta Log method. This screen is also produced by EPA Delta Log method using the lognormal distribution and debug option.

2. These are the original mean, variance (of the log transformed data above the detection limit), and the detection limit. Note that you enter the detection limit, not the log transformed detection limit.

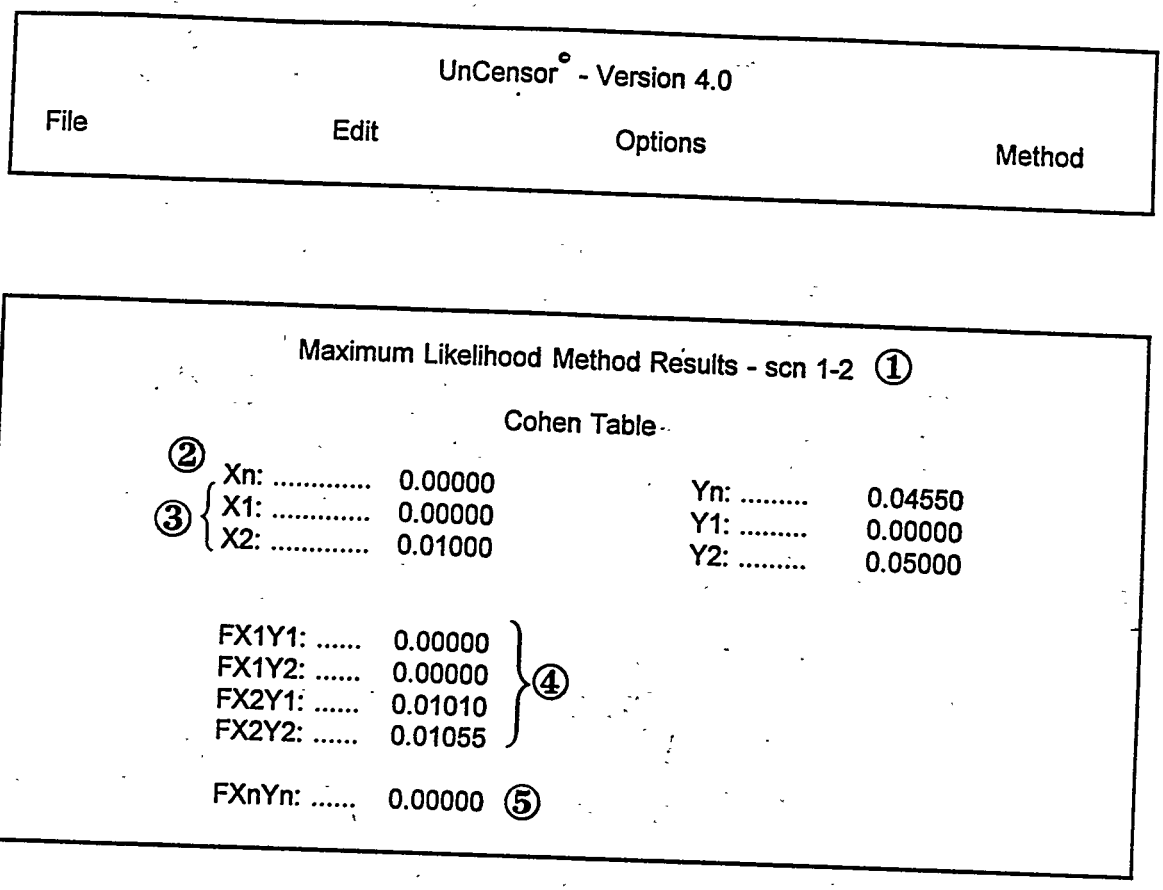
3. The log transformation of the detection limit.

4. Final estimates from the specified method.

5. The number of samples below the detection limit and the total number of observations.

6. The 95% confidence interval of the estimated mean.

IVB. OUTPUT SCREENS - NORMAL DISTRIBUTION WITH DEBUG OPTION



EXPLANATION

1. There will be two screens when the normal distribution and debug options are selected. As indicated, this is the first for the Maximum Likelihood method.

2. Xn and Yn are the estimates used in Cohen's (1959) table.

3. The X1, Y1 and X2, X2 values in Cohen's table are specified. These values will be used to interpolate in this table for Xn, Yn.

4. These are the values from Cohen's table for interpolation to FXn, Yn.

5. The value FXn, Yn obtained by interpolation from Cohen's table.

UnCensor© - Version 4.0

File Edit Options Method

Maximum Likelihood Method Results - scn 2-2

Censored Values		UnCensored Values (MLE)	
Mean:	18.951	Mean:	18.951
Variance:	16.340	Variance:	16.340
Det. Limit:	0.000	Std. Dev.:	4.042
#<Det. Limit:	0	Confidence Interval	
Sample Size:	20	On Mean: ...	
		[17.088, 20.814]	

EXPLANATION

The second of two screens for Maximum Likelihood method.

See page 46 for detailed explanation.

UnCensor® - Version 4.0

File Edit Options Method

Iterative Order Statistics Output - scn 1-1

Mean:	18.910000	Variance:	16.337764
Det. Limit:	0.000000	Sample Size:	20
#<Det. Limit:	0		
Sum X:	379.016895	Sum X Square: ..	7493.147629

ProbDens	CumDist	K	Mean	Variance	StdDev
0.000007	0.000001	1	18.950845	16.333664	4.041493

Convergence attained at 1 iterations

EXPLANATION

See page 47 for detailed explanation.

UnCensor© - Version 4.0

File Edit Options Method

Maximum Likelihood Method Results - scn 1-3

Cohen Table

Xn:	0.00000	Yn:	0.04550
X1:	0.00000	Y1:	0.00000
X2:	0.01000	Y2:	0.05000

FX1Y1: ...	0.00000
FX1Y2: ...	0.00000
FX2Y1: ...	0.01010
FX2Y2: ...	0.01055
FXnYn: ..	0.00000

EXPLANATION

The first of three screens for the Bias Corrected method.

See page 51 for detailed explanation.

UnCensor® - Version 4.0

File Edit Options Method

Maximum Likelihood Method Results - scn 2-3

	Censored Values	UnCensored Values (MLE)	
Mean:	18.951	Mean:	18.951
Variance:	16.340	Variance:	16.340
Det. Limit:	0.000	Std. Dev.:	4.042
#<Det. Limit:	0		
Sample Size:	20		

EXPLANATION

The second of three screens for the Bias Corrected method.

See page 46 for detailed explanation.

UnCensor° - Version 4.0

File Edit Options Method

Bias Correction Results - scn 3-3

Censored Values		UnCensored Values(Bias)	
Mean:	18.951	Mean:	18.967
Variance:	16.340	Variance:	18.036
Det. Limit:	0.000	Std. Dev.:	4.247
#<Det. Limit:	0	Confidence Interval	
Sample Size:	20	On Mean: ...	
		[17.009, 20.924]	

EXPLANATION

The third of three screens for the Bias Corrected method.

See page 46 for detailed explanation.

UnCensor° - Version 4.0

File Edit Options Method

Helsel's Robust - scn 1-2 ①

② Sample size: ..... 20 Detection Limit: 17.000000
Below Det. Limit: . 6 Mean: 21.074096
Variance: 6.456828

③ Rank	④ z Score	⑤ Log	⑥ Obs.Vals.	⑦ Predict.NLog	⑧ Predict.Vals.
6	-0.589095	2.803673	16.505154	2.944453	19.000257
5	-0.743897	2.769093	15.944168	2.929871	18.725221
4	-0.919037	2.607648	13.567101	2.915290	18.454167
3	-1.128213	2.580698	13.206351	2.900709	18.187036
2	-1.403662	2.519573	12.423291	2.886128	17.923771
1	-1.868659	2.512318	12.333487	2.871547	17.664318

EXPLANATION

1. The first of two screens for Helsel's Robust method.
2. The initial mean, variance of the values above the detection limit, number of observations below the detection limit, and the total number of observations are displayed here.
3. The rank given to the values below the detection limit are displayed here.
4. The z score given to the values below the detection limit are displayed here.
5. The log transformation of the values for below the detection limit observations are displayed here.
6. The values for observations below the detection limit are displayed here.
7. The natural log values predicted by Helsel's Robust method are displayed here.
8. The antilog values predicted by Helsel's Robust method are displayed here.

UnCensor© - Version 4.0

File Edit Options Method

Robust Method Results - scn 2-2

Censored Values		UnCensored Values (Robust)	
Mean:	21.074	Mean: 20.250	
Variance:	6.457	Variance: 6.153	
Det. Limit:	17.000	Std. Dev.: 2.481	
#<Det. Limit:	6	Confidence Interval	
Sample Size:	20	On Mean: ...	
		[18.037, 22.815]	
r squared:	0.966		
Intercept:	2.959		
Slope:	0.173		

EXPLANATION

The second of two screens for Helsel's Robust method.

See pages 46 and 49 for detailed explanation.

UnCensor© - Version 4.0

File Edit Options Method

Winsorization - scn 1-2 ①

② Sample size: ..... 21 Detection Limit: 2.500000
Below Det. Limit: . 2 Mean: 5.119048
Variance: 4.568619

③ Rank	④ Obs.Vals	⑤ Winsor.Vals
1	1.300000	2.600000
2	2.300000	2.600000
3	2.600000	2.600000
4	3.300000	3.300000
5	3.500000	3.500000
6	3.500000	3.500000
7	3.600000	3.600000
8	4.000000	4.000000
9	4.100000	4.100000
10	4.500000	4.500000
11	5.200000	5.200000

Press return key to continue

Winsorization - scn 1-2

Rank	Obs.Vals	Winsor.Vals
12	5.600000	5.600000
13	5.700000	5.700000
14	6.100000	6.100000
15	6.500000	6.500000
16	6.500000	6.500000
17	6.900000	6.900000
18	7.100000	7.100000
19	7.700000	7.700000
20	7.900000	7.700000
21	9.900000	7.700000

Press return key to continue

EXPLANATION

1. The first of two screens for Winsorization method.

2. The initial mean, variance of the values above the detection limit, number of observations below the detection limit, and the total number of observations are displayed here.

3. The rank given to the values below the detection limit are displayed here.

4. The values for all the observations are displayed here.

5. The values for the observations in the modified data set are displayed here.

UnCensor° - Version 4.0

File Edit Options Method

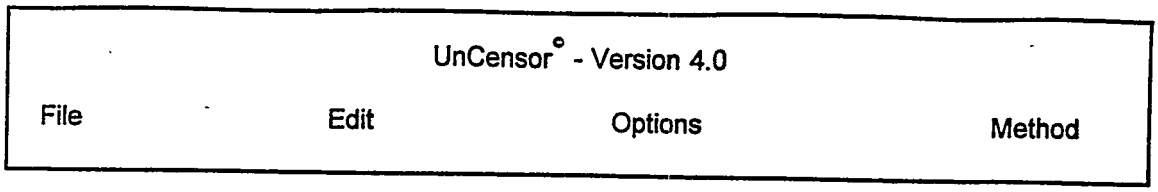
Bias Correction Results - scn 2-2

Censored Values		UnCensored Values (Winsor)	
Mean:	5.119	Mean:	5.081
Variance:	4.569	Variance:	5.018
Det. Limit:	2.500	Std. Dev.:	2.240
#<Det. Limit:	2	Confidence Interval	
Sample Size:	21	On Mean: ...	
			[4.045, 6.117]

EXPLANATION

The second of two screens for Winsorization method.

See pages 46 for detailed explanation.



Log Normal Bias Correction Results

Censored Values		UnCensored Values (EPA)	
Mean:	1.639	Mean:	5.209
Variance:	0.129	Variance:	4.532
Det. Limit:	2.500	Std. Dev.:	2.129
Ln Det. Limit:	0.916	Confidence Interval	
#<Det. Limit:	2	On Mean: ...	
Sample Size:	21	[2.500, 6.920]	

EXPLANATION

The screen for the EPA Delta Log method.

See page 46 for detailed explanation.

IVC. OUTPUT SCREENS - LOGNORMAL DISTRIBUTION WITHOUT DEBUG OPTION

UnCensor© - Version 4.0

File Edit Options Method

Log Normal Bias Correction Results ①

Censored Values		UnCensored Values (MLE)	
② Mean:	2.919	⑥ Mean:	2.919
Variance:	0.051	Variance:	0.051
Det. Limit:	1.000	Std. Dev.:	0.226
③ Ln Det. Limit:	0.000		
⑤ #<Det. Limit:	0	⑦ Confidence Interval On Mean: ...	
Sample Size:	20		[2.815, 3.023]
④ Back Transformed Values (A&B)		Back Transformed Values (A&B)	
Mean:	18.968	⑧ PhiOne:	1.024
Variance:	18.630	PhiTwo:	1.101
		PhiThree:	1.047
		⑨ Mean:	18.968
		Variance:	18.630
		Std. Dev.:	4.316

EXPLANATION

1. This screen will be displayed for the following methods:
   Maximum Likelihood
   Iterative Order Statistic
   Regression Order Statistic
   Bias Corrected
   Schneider One-Step
   Winsorization

2. These are the original mean, variance (of the log transformed data above the detection limit), and the detection limit. Note that you enter the detection limit, not the log transformed detection limit.

3. The log transformation of the detection limit.

4. The "transformation bias" corrected mean and variance (Aitchison and Brown, 1957) of observations above the detection limit.

5. The number of samples below the detection limit and the total number of observations.

6. Final estimates from the specified method.

7. The 95% confidence interval of the estimated mean.

8. The "Phis" (Ψ) used to calculate the log transformations of the estimated mean, variance, and standard deviation.

9. Final estimate from the method specified after correcting for censoring and correcting for transformation bias (Aitchison and Brown, 1957).

UnCensor° - Version 4.0

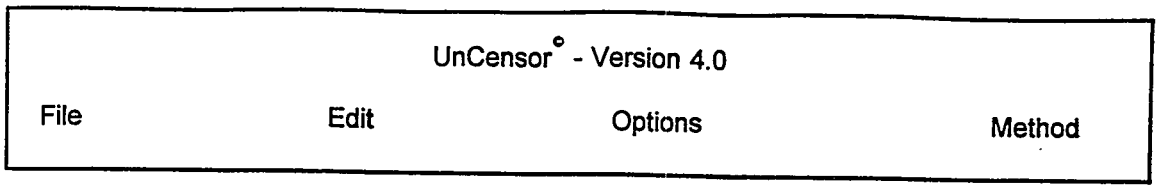
File Edit Options Method

Robust Method Results

Censored Values		UnCensored Values (Robust)	
Mean:	18.951	Mean:	18.951
Variance:	16.340	Variance:	16.340
Det. Limit: ...	0.000	Std. Dev::	4.042
#<Det. Limit:	0	Confidence Interval	
Sample Size:	20	On Mean: ...	
		[12.816, 29.298]	
r squared: ...	0.947		
Intercept:	2.919		
Slope:	0.228		

EXPLANATION

See pages 46 and 49 for detailed explanation.



Log Normal Bias Correction Results

Censored Values		UnCensored Values (EPA)	
Mean:	1.639	Mean:	5.209
Variance:	0.129	Variance:	4.532
Det. Limit:	2.500	Std. Dev.:	2.129
Ln Det. Limit:	0.916	Confidence Interval	
#<Det. Limit:	2	On Mean: ...	
Sample Size:	21		[2.500, 6.920]

EXPLANATION

The screen for the EPA Delta Log method.

See page 46 for detailed explanation.

IVD. OUTPUT SCREENS - LOGNORMAL DISTRIBUTION WITH DEBUG OPTION

UnCensor° - Version 4.0

File Edit Options Method

Log Normal Bias Correction Results - scn 1-4

Censored Values

Mean:	2.919
Variance:	0.051
Det. Limit:	1.000
Ln Det. Limit:	0.000
#<Det. Limit:	0
Sample Size:.	20

Back Transformed Values (A&B)

Mean:	18.968
Variance:	18.630

EXPLANATION

The first of four screens for Maximum Likelihood and Bias Corrected methods.

See 2-5 on page 63 for detailed explanation.

UnCensor© - Version 4.0

File Edit Options Method

Maximum Likelihood Method Results - scn 2-4

Cohen Table

Xn:	0.00000	Yn:	0.00598
X1:	0.00000	Y1:	0.00000
X2:	0.01000	Y2:	0.05000

FX1Y1: ...	0.00000
FX1Y2: ...	0.00000
FX2Y1: ...	0.01010
FX2Y2: ...	0.01055
FXnYn: ...	0.00000

EXPLANATION

The second of four screens for the Maximum Likelihood and the Bias Corrected methods.

See page 51 for detailed explanation.

UnCensor© - Version 4.0

File Edit Options Method

Maximum Likelihood Method Results - scn 3-4

Censored Values		UnCensored Values (MLE)	
Mean:	2.919	Mean:	2.919
Variance:	0.051	Variance:	0.051
Det. Limit:	1.000	Std. Dev.:	0.226
Ln Det. Limit:	0.000	Confidence Interval	
#<Det. Limit:	0	On Mean: ...	
Sample Size:	20		[2.815, 3.023]

Back Transformed Values (A&B)

Mean:	18.968
Variance:	18.630

EXPLANATION

The third of four screens for the Maximum Likelihood and the Bias Corrected methods.

See 2-7 on page 63 for detailed explanation.

UnCensor© - Version 4.0

File Edit Options Method

Log Normal Bias Correction Results - scn 4-4

Censored Values		UnCensored Values (MLE)	
Mean:	2.919	Mean:	2.919
Variance:	0.051	Variance:	0.051
Det. Limit:	1.000	Std. Dev.:	0.226
Ln Det. Limit:	0.000	Confidence Interval	
#<Det. Limit:	0	On Mean: ...	
Sample Size:	20		[2.815, 3.023]

Back Transformed Values (A&B)		Back Transformed Values (A&B)	
Mean:	18.968	PhiOne:	1.024
Variance:	18.630	PhiTwo:	1.101
		PhiThree:	1.047
		Mean:	18.968
		Variance:	18.630
		Std. Dev.:	4.316

EXPLANATION

The fourth of four screens for the Maximum Likelihood and the Bias Corrected methods.

See page 63 for detailed explanation.

UnCensor© - Version 4.0

File Edit Options Method

Log Normal Bias Correction Results - scn 1-3

Censored Values

Mean:	2.919
Variance: .....:	0.051
Det. Limit:	1.000
Ln Det. Limit:	0.000
#<Det. Limit:	0
Sample Size:	20

Back Transformed Values (A&B)

Mean:	18.968
Variance:	18.630

EXPLANATION

The first of three screens for the Iterative Order Statistic method.

See 2-5 on page 63 for detailed explanation.

UnCensor° - Version 4.0

File Edit Options Method

Log Norm Iterative Order Statistics - scn 2-3

Mean:	2.919000	Variance:	0.070756
Det. Limit:	1.000000	Ln Det. Limit:	0.000000
Sample Size:	20	#<Det. Limit:	0
Sum X:	58.372115	Sum X Square:	171.333181

ProbDens	CumDist	K	Mean	Variance	StdDev
0.000000	0.009262	1	2.918606	0.048524	0.220282
0.000000	0.468414	2	2.918606	0.050947	0.225714
0.000000	0.345276	3	2.918606	0.050947	0.225714

Convergence attained at 3 iterations

EXPLANATION

The second of three screens for the Iterative Order Statistic method.

See page 47 for detailed explanation.

UnCensor© - Version 4.0

File Edit Options Method

Log Normal Bias Correction Results - scn 3-3

Censored Values		UnCensored Values (Iter.)	
Mean:	2.919	Mean:	2.919
Variance:	0.051	Variance:	0.051
Det. Limit:	1.000	Std. Dev.:	0.226
Ln Det. Limit:	0.000	No Confidence Interval Available	
#<Det. Limit:	0		
Sample Size:	20		

Back Transformed Values (A&B)		Back Transformed Values (A&B)	
Mean:	18.968	PhiOne:	1.024
Variance:	18.630	PhiTwo:	1.101
		PhiThree:	1.047
		Mean:	18.968
		Variance:	18.630
		Std. Dev.:	4.316

EXPLANATION

The third of three screens for the Iterative Order Statistic method.

See page 63 for detailed explanation.

UnCensor° - Version 4.0

File Edit Options Method

Log Normal Bias Correction Results - scn 1-3

Censored Values

Mean:	2.919
Variance:	0.051
Det. Limit:	1.000
Ln Det. Limit:	0.000
#<Det. Limit:	0
Sample Size:	20

Back Transformed Values (A&B)

Mean:	18.968
Variance:	18.630

EXPLANATION

The first of three screens for the Regression Order Statistic method.

See 2-5 on page 63 for detailed explanation.

UnCensor° - Version 4.0

File Edit Options Method

Log Normal Regression Method - scn 2-3

Censored Values		UnCensored Values (Regress)	
Mean:	2.919	Mean:	2.919
Variance:	0.051	Variance:	0.052
Det. Limit:	1.000	Std. Dev.:	0.228
Ln Det. Limit:	0.000	Confidence Interval	
#<Det. Limit:	0	On Mean: ...	
Sample Size:	20		[2.383, 3.125]

Back Transformed Values (A&B)

Mean:	18.968
Variance:	18.630

EXPLANATION

The second of three screens for the Regression Order Statistic method.

See 2-7 on page 63 for detailed explanation.

UnCensor© - Version 4.0

File Edit Options Method

Log Normal Bias Correction Results - scn 3-3

Censored Values		UnCensored Values (Regress)	
Mean:	2.919	Mean:	2.919
Variance:	0.051	Variance:	0.052
Det. Limit:	1.000	Std. Dev.:	0.228
Ln Det. Limit:	0.000	Confidence Interval	
#<Det. Limit:	0	On Mean: ...	
Sample Size:	20		[2.383, 3.125]

Back Transformed Values (A&B)		Back Transformed Values (A&B)	
Mean:	18.968	PhiOne:	1.025
Variance:	18.630	PhiTwo:	1.103
		PhiThree:	1.048
		Mean:	18.978
		Variance:	19.030
		Std. Dev.:	4.362

EXPLANATION

The third of three screens for the Regression Order Statistic method.

See page 63 for detailed explanation.

UnCensor© - Version 4.0

File Edit Options Method

Log Normal Bias Correction Results - scn 1-2

Censored Values

Mean:	2.919
Variance:	0.051
Det. Limit:	1.000
Ln Det. Limit:	0.000
#<Det. Limit:	0
Sample Size:	20

Back Transformed Values (A&B)

Mean:	18.968
Variance:	18.630

EXPLANATION

The first of two screens for the Schneider One-Step.

See 2-5 on page 63 for detailed explanation.

UnCensor© - Version 4.0

File Edit Options Method

Log Normal Bias Correction Results - scn 2-2

Censored Values		UnCensored Values (OneStep)	
Mean:	2.919	Mean:	2.919
Variance:	0.051	Variance:	0.051
Det. Limit:	1.000	Std. Dev.:	0.226
Ln Det. Limit:	0.000	Confidence Interval	
#<Det. Limit:	0	On Mean: ...	
Sample Size:	20		[2.815, 3.023]

Back Transformed Values (A&B)		Back Transformed Values (A&B)	
Mean:	18.968	PhiOne:	1.024
Variance:	18.630	PhiTwo:	1.101
		PhiThree:	1.047
		Mean:	18.968
		Variance:	18.630
		Std. Dev.:	4.316

EXPLANATION

The second of two screens for the Schneider One-Step method.

See page 63 for detailed explanation.

UnCensor© - Version 4.0

File Edit Options Method

Helsel's Robust - scn 1-2

Sample size:	20	Detection Limit:	17.000000
Below Det. Limit: .	6	Mean:	21.074096
Variance:	6.456828		

Rank	z Score	Log	Obs.Vals.	Predict.NLog	Predict.Vals.
6	-0.589095	2.803673	16.505154	2.944453	19.000257
5	-0.743897	2.769093	15.944168	2.929871	18.725221
4	-0.919037	2.607648	13.567101	2.915290	18.454167
3	-1.128213	2.580698	13.206351	2.900709	18.187036
2	-1.403662	2.519573	12.423291	2.886128	17.923771
1	-1.868659	2.512318	12.333487	2.871547	17.664318

EXPLANATION

See page 57 for detailed explanation.

UnCensor° - Version 4.0

File Edit Options Method

Robust Method Results - scn 2-2

Censored Values		UnCensored Values (Robust)	
Mean:	21.074	Mean:	20.250
Variance:	6.457	Variance:	6.153
Det. Limit:	17.000	Std. Dev.:	2.481
#<Det. Limit:	6	Confidence Interval	
Sample Size:	20	On Mean: ...	
		[18.037, 22.815]	
r squared:	0.966		
Intercept:	2.959		
Slope:	0.173		

EXPLANATION

See pages 46 and 49 for detailed explanation.

UnCensor® - Version 4.0

File Edit Options Method

Log Normal Bias Correction Results - scn 1-3

Censored Values

Mean:	1.535
Variance:	0.232
Det. Limit:	2.500
Ln Det. Limit:	0.916
#<Det. Limit:	2
Sample Size:	21

Back Transformed Values (A&B)

Mean:	5.182
Variance:	6.725

EXPLANATION

The first of three screens for the Winsorization.

See 2-5 on page 63 for detailed explanation.

UnCensor° - Version 4.0

File Edit Options Method

Winsorization - scn 2-3 ①

② Sample size: ..... 21 Detection Limit: 0.916291
Below Det. Limit: . 2 Mean: 1.535300
Variance: 0.232013

③ Rank	④ Log	⑤ Obs.Vals.	⑥ Winsor.NLog	⑦ Winsor.Vals.
1	0.262364	1.300000	0.955511	2.600000
2	0.832909	2.300000	0.955511	2.600000
3	0.955511	2.600000	0.955511	2.600000
4	1.193922	3.300000	1.193922	3.300000
5	1.252763	3.500000	1.252763	3.500000
6	1.252763	3.500000	1.252763	3.500000
7	1.280934	3.600000	1.280934	3.600000
8	1.386294	4.000000	1.386294	4.000000
9	1.410987	4.100000	1.410987	4.100000
10	1.504077	4.500000	1.504077	4.500000
11	1.648659	5.200000	1.648659	5.200000

Press return key to continue

Winsorization - scn 2-3

Rank	Log	Obs.Vals.	Winsor.NLog	Winsor.Vals.
12	1.722767	5.600000	1.722767	5.600000
13	1.740466	5.700000	1.740466	5.700000
14	1.808289	6.100000	1.808289	6.100000
15	1.824549	6.200000	1.824549	6.200000
16	1.871802	6.500000	1.871802	6.500000
17	1.931521	6.900000	1.931521	6.900000
18	1.960095	7.100000	1.960095	7.100000
19	2.041220	7.700000	2.041220	7.700000
20	2.066863	7.900000	2.041220	7.700000
21	2.292535	9.900000	2.041220	7.700000

Press return key to continue

EXPLANATION

1. The second of three screens for Winsorization method.
2. The initial mean, variance of the values above the detection limit, number of observations below the detection limit, and the total number of observations are displayed here.
3. The rank given to the values for all the observations are displayed here.
4. The log transformation of the values for the observations are displayed here.
5. The values for observations are displayed here.
6. The natural log values of the modified data set are displayed here.
7. The antilog values of the modified data set are displayed here.

UnCensor© - Version 4.0

File Edit Options Method

Log Normal Bias Correction Results - scn 3-3

Censored Values		UnCensored Values (Winsor)	
Mean:	1.535	Mean:	1.561
Variance:	0.232	Variance:	0.222
Det. Limit:	2.500	Std. Dev.:	0.471
Ln Det. Limit:	0.916	Confidence Interval	
#<Det. Limit:	2	On Mean: ...	
Sample Size:	21		[1.343, 1.779]

Back Transformed Values (A&B)		Back Transformed Values (A&B)	
Mean:	5.182	PhiOne:	1.111
Variance:	6.725	PhiTwo:	1.515
		PhiThree:	1.220
		Mean:	5.292
		Variance:	6.685
		Std. Dev.:	2.586

EXPLANATION

The third of three screens for the Winsorization method.

See page 63 for detailed explanation.

UnCensor® - Version 4.0

File Edit Options Method

Log Normal Bias Correction Results

Censored Values		UnCensored Values (EPA)	
Mean:	1.639	Mean:	5.209
Variance:	0.129	Variance:	4.532
Det. Limit:	2.500	Std. Dev.:	2.129
Ln Det. Limit:	0.916	Confidence Interval	
#<Det. Limit:	2	On Mean: ...	
Sample Size:	21		[2.500, 6.920]

EXPLANATION:

The screen for the EPA Delta Log method.

See page 46 for detailed explanation.

VA. MAIN CATEGORIES - HELP SCREENS

FILE HELP WINDOW

Within the "file" portion of the menu, there are three functions as indicated. These functions allow you to load ASCII data files, save data files, or quit the program.

EDIT HELP WINDOW

Once you have loaded a data file (File-Load function), you may view the data file or sort the data file using the appropriate function in the EDIT menu.

OPTIONS HELP WINDOW

You may select four options with this program. One allows you to use raw data or summary data as input. Another allows you to select a simple output screen or an output screen with the many intermediate results of the various calculations. The debug option screen will be helpful if you suspect a program bug. The options also allow you to select untransformed data (raw or summary) or log transformed data (raw or summary). Obviously, when the data set is described by a lognormal distribution, you will select the log option. Finally, the printer option allows you to print results on a printer connected via a parallel or serial port.

METHOD HELP WINDOW

There are eight methods in this program. All may be used for log-normal or normal data sets. Three (Regression, Helsel's Robust, and Winsorization) will not accept summary data. Three are maximum likelihood methods. One corrects for small sample size bias and one corrects for a bias produced during imposition of a restriction on the MLE procedure. The iterative order statistic and regression order statistic ("probability plotting") methods have less small sample size bias than the MLE procedures. The EPA Delta Log method is the method recommended in certain US EPA documents.
NOTE: We recommend that you do not use these techniques until you have read the companion manuscript and the indicated references.

VB. FILE CATEGORIES - HELP SCREENS

FILE - LOAD HELP WINDOW

With this function, you can load an ASCII file into the program. These raw data will then be used in subsequent calculations. Values below the detection limit should be entered as the detection limit. The natural log will be calculated for each data observation as it is loaded. For this reason, it is important that you DO NOT have observations with values equal to zero.
REMEMBER: If you use raw data from a file, be certain that you select the RAW DATA option in OPTIONS-SOURCE DATA.

FILE-SAVE HELP WINDOW

With this function, you can save a file for later use. The file name should conform to standard DOS restrictions, i.e. XXXX.dat with no more than eight characters in the filename (XXXX).
NOTE: The .dat extension should not have a capital "D".

FILE-QUIT HELP WINDOW

With this function, you may exit UnCensor and return to DOS. The program will ask you to confirm your desire to exit to DOS before it actually exits.

VC. EDIT CATEGORIES - HELP SCREENS

EDIT-VIEW DATA HELP WINDOW

Once you have loaded the raw data file, you can view it with this function. The raw data observations (RData.Raw[x]) and natural log-transformed data observations (RData.NLT[x]) will be displayed.

EDIT-SORT DATA HELP WINDOW

For many of the statistical procedures, the data observations must be sorted from smallest to largest. We have programmed the procedures such that you should sort the observations after loading them. It is a good practice to view the data after sorting to insure that the sort was done.

VD. OPTIONS CATEGORIES - HELP SCREENS

OPTIONS-LOGNORMAL OPTION HELP WINDOW

This option allows you to select the untransformed data or the log transformed data if you are using the raw data input mode. It also allows selection of appropriate screens and equations when the summary data input mode is selected.

Essentially, you would select the lognormal option for two parameter lognormal data or normal option for normal data.

Note: Carefully read the screens to select the proper mode.

OPTIONS-SOURCE DATA HELP WINDOW

This option allows you to input summary data or raw data. The windows for this option are confusing and should be read carefully. Within the window, you will see indicated the option that is presently selected. If you haven't loaded any raw data into the program, you can't select the raw data option. Press return to change to the other option as indicated on the screen. If you wish to keep the selected data type, press ESC.

OPTIONS-DEBUG OPTION HELP WINDOW

This option allows you to get a simplified output screen or an extensive output screen. The extensive output screen may be helpful in debugging as it provides many "internal" or "intermediate" values used in the calculations.

Note: Carefully read the screens to select the debug or normal output mode.

OPTIONS-PRINTER OPTION HELP WINDOW

This option allows you to output a screen of data to a printer connected via a parallel or serial port.
Note: Carefully read the screens to select the correct mode of output. Note: To print the screen later, use the F-9 key. CAUTION: PRINTER MUST BE ON AND ONLINE.

VE. METHOD CATEGORY - HELP SCREENS

METHOD-MAXIMUM LIKELIHOOD HELP WINDOW

Reference: Cohen,A.J. 1959. Simplified estimators for the normal distribution when samples are singly censored or truncated. Technometrics 1(3):217-237. Please refer to the original article for specific details. Note: This method is especially biased for small sizes (N less than twenty observations). Bias Corrected is this method followed by small sample size bias correction. If you have a small sample and want to use a maximum likelihood method, you can use Bias Corrected.

METHOD-ITERATIVE ORDER STATISTICS HELP WINDOW

Reference: Gleit, A. 1985. Estimation for small data sets with detection limits. Environmental Science & Technology 19:1201-06. This procedure (Gleit's "fill-in with expected values") allows one to estimate means and variances for large or small sample numbers. Please refer to the original article for specific details.

METHOD-REGRESSION ORDER STATISTICS HELP WINDOW

Reference: Companion manuscript for this program. (Newman et al. 1989. Wat. Res. Bull. 25(4):905). This procedure will only accept raw data sets. Essentially, this method is similar to probability plotting but uses least-squares regression methods. The mean and the standard deviation are estimated from the intercept and slope of the regression equation, respectively.

METHOD-MAXIMUM LIKELIHOOD WITH BIAS CORRECTION HELP WINDOW

Reference: Schneider, H. and Weissfield, L. 1986. Estimation in linear models with censored data. Biometrika 73:741-745. This procedure uses the Max Likelihood procedure, but then uses a small sample size bias correction. The procedure should be used when sample size is small ($n \leq 10$ to 20) and one wants to use a maximum likelihood estimator.

METHOD-SCHNEIDER ONE-STEP MAXIMUM LIKELIHOOD HELP WINDOW

Reference: Schneider, H. 1986. Truncated and censored samples from normal populations. Marcel Dekker, New York. This restricted, one-step method has a correction for minimizing the bias associated with the restriction outlined in the companion manuscript.

METHOD-HELSEL'S ROBUST HELP WINDOW

Reference: Gilliom, R. and Helsel, D. 1986, Water Resources Research, 22(2):135-146. This procedure will only accept raw data sets. This method uses the Blom estimate to get a normal z score for the samples above the detection limit. The slope, intercept, and r are estimated from the least-square regression equation. New values, for those below the detection limit, are predicted using the slope and the intercept. The new observation values are substituted in the list, and the mean, variance, and standard deviation are calculated.

METHOD-WINSORIZATION HELP WINDOW

Reference: Gilbert, R.O. 1987, Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, New York. ISBN 0-442-23050-8 (pgs 140, 177, 180-181).
Newman, M.C. 1995, Quantitative Methods in Aquatic Ecotoxicology. CRC/Lewis, Boca Raton. ISBN 0.87371-622-1 (pgs 24-26).
This procedure will only accept raw data sets. It assumes a symetrical distribution (normal distribution of arithmetic or log transformed values). Note that, unlike the other techniques, this method discards values for observations above the detection limit.

METHOD-EPA DELTA LOG HELP WINDOW

Reference: US EPA, 1991, Technical Support Document for Water Quality-Based Toxic Control. EPA/505/2-90-001, March 1991, NTIS, Springfield, VA. See Appendix E, (pgs E-10 - E-12).
This procedure has been recommended in the above technical report. Although advocated by the EPA for regulatory use, this method has no advantage over the other methods in this program and emerges from difficult to obtain sources. The user is urged to read Hinton (Environ. Sci. Technol. 1993, 27:2247-2249) prior to its use.