Features of LOADEST
January 2005

This document briefly outlines the basic features of LOADEST, a new software package that combines two previously undocumented packages, LOADEST2 (by C. Crawford) and ESTIMATOR (by T. Cohn). In the outline below, each feature of LOADEST is compared to the features present in the earlier packages.

I. Model Formulation

A. Data Variables

New Package: Explanatory variables may be formulated based on streamflow, decimal time, and additional data variables defined by the user (e.g. specific conductivity, turbidity, etc.).

Old Packages: Explanatory variables may be formulated based on streamflow and decimal time.

B. Development of User-Defined Models

New Package: Allows for the development of user-defined models, where each explanatory variable is based on a data variable (streamflow, decimal time, or additional user-defined variable) and a transformation (log, square, etc.) of that variable.

Old Packages: ESTIMATOR requires the user to define the model based on a set of predefined explanatory variables. While similar to the new package, it is somewhat less flexible. LOADEST2 requires the user to select one of its predefined models — no user defined models are allowed.

C. Predefined Models

New Package: In lieu of a user-defined model, the user may select one of the eleven predefined models. The predefined models include the 10 models that are available in LOADEST2 and the '7-parameter model' described by Cohn et al. [1992, WRR 28(9)].

Old Packages: LOADEST2 allows the user to select one of the ten predefined models. No predefined models are available in ESTIMATOR.

II. Model Calibration

A. Regression Methods

New Package: Regression coefficients for the formulated regression model are developed using Adjusted Maximum Likelihood (AMLE), Maximum Likelihood (MLE), and least absolute deviation (LAD) methods.

Old Packages: Regression coefficients in ESTIMATOR are developed by AMLE. Regression coefficients in LOADEST2 are developed by MLE, LAD, and the linear attribution method (LAM).

B. Concentration Regression

New Package: A concentration regression that corresponds to the specified loading model is provided.

Old Packages: A concentration regression is provided by ESTIMATOR, but not by LOADEST2.

C. Regression Diagnostics - Model Coefficients

New Package: Regression diagnostics provided include the coefficient's standard deviation, t-ratio, and P-value. A cross-correlation matrix for the explanatory variables is also provided.

Old Packages: The features described above are included in ESTIMATOR. LOADEST2 includes the coefficient's standard deviation.

D. Regression Diagnostics - Model Selection

New Package: Regression diagnostics provided include the r-squared, the Akaike Information Criterion (AIC), the Schwarz Posterior Probability Criterion (SPPC).

Old Packages: ESTIMATOR calculates r-squared. LOADEST2 calculates AIC and SPPC.

E. Regression Diagnostics - Residuals

New Package: Regression diagnostics provided include the Probability Plot Correlation Coefficient (PPCC), the Turnbull-Weiss statistic, the serial correlation coefficient, and the residual variance.

Old Packages: ESTIMATOR includes the PPCC, the serial correlation coefficient, and the residual standard deviation. LOADEST2 includes the Turnbull-Weiss statistic and the residual variance.

F. Centering

New Package: Streamflow and decimal time are 'centered' as described in Cohn et al. [1992, WRR 28(9)].

Old Packages: Streamflow and decimal time are centered in ESTIMATOR. Within LOADEST2, streamflow and decimal time are adjusted using the median of ln(Q) and the beginning year, respectively.

G. Residual Output

New Package: A residual output file is included for each constituent.

Old Packages: A residual output file is provided by ESTIMATOR. Residuals are not output by LOADEST2.

H. Automated Model Selection

New Package: Users may select the automated model selection option; under this option, the 'best' regression model is chosen from the set of predefined models based on the AIC statistic.

Old Packages: LOADEST2 uses the model selection option described above. ESTIMATOR does not provide an automated means of model selection.

III. Load Estimation

A. Estimation Methods

New Package: Load estimates based on the calibrated regression model are developed using Adjusted Maximum Likelihood (AMLE), Maximum Likelihood (MLE), and least absolute deviation (LAD) methods.

Old Packages: Load estimates in ESTIMATOR are developed by AMLE. Load estimates in LOADEST2 are developed by MLE, LAM, and LAD.

B. Seasonal Loads

New Package: Mean load estimates are calculated for any number of user-defined seasons.

Old Packages: Mean load estimates for 4 predefined seasons are calculated by LOADEST2. Seasonal output is not provided by ESTIMATOR.

C. Monthly Loads

New Package: Mean load estimates for each month are calculated.

Old Packages: ESTIMATOR calculates the mean load for each month. Monthly output is not provided by LOADEST2.

D. Errors

New Package: The standard error, standard error of prediction, and 95% confidence intervals are provided for each load estimate.

Old Packages: ESTIMATOR provides the error quantities described above. LOADEST2 provides the standard error.

E. Concentration

New Package: Concentration estimates with 95% confidence intervals may be calculated — see Application 6 in the documentation.

Old Packages: Neither ESTIMATOR or LOADEST2 provide this functionality.

IV. Misc.

A. Multiple Constituents

New Package: Load estimates for multiple constituents may be obtained.

Old Packages: LOADEST2 allows for multiple constituents, ESTIMATOR does not.

B. Units

New Package: Constituent concentrations may be in terms of mg/L and μg/L. Loads may be output in kg/d, g/d, pounds/d, and tons/day.

Old Packages: less flexible than described above.

C. Hardware Platforms and Operating Systems

New Package: Executable versions of the program are available for Linux, Sun Solaris, and ahem, Windows.

Old Packages: ???

D. Documentation

New Package:

> Runkel, R.L., Crawford, C.G., and Cohn, T.A., 2004, Load Estimator (LOADEST): A FORTRAN Program for Estimating Constituent Loads in Streams and Rivers: U.S. Geological Survey Techniques and Methods Book 4, Chapter A5, 69 p.

Old Packages: no citable documentation exists.