Texas A & M University and U.S. Bureau of Reclamation
Hydrologic Modeling Inventory
Model Description Form

July 1999

Name of Model: Stochastic Analysis, Modeling and Simulation (SAMS)

Model Type: Stochastic and Statistical Hydrology

Model Objective(s): Perform statistical analysis on hydrologic data such as annual and monthly streamflow, estimate parameters and test a specified stochastic model, and generate synthetic stochastic traces.

Agency and Office: Colorado State University, Fort Collins, CO

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Model Structure or Mathematical Basis:

The SAMS model allows three basic options - statistical analysis (both numerical and graphical), stochastic modeling and simulation (ie generation) of data. The analysis option allows the user to review basic hydrologic data both graphically and numerically and calculates commonly used statistics such as mean, variance, skewness and correlation coefficients. The modeling option allows for fitting one of several statistical models including autoregressive moving average (ARMA), periodic autoregressive moving average (PARMA) and contemporaneous autoregressive moving average (CARMA). A number of disaggregation models including Valencia and Schaake, Mejia and Rouselle and Lane (the LAST model) are available as well. Simulation capabilities allow for generation of a large number of stochastically based hydrologic traces of any desired length. The stochastically generated traces can be graphically and numerically analyzed and compared to the historical traces.

Model Parameters:

Parameters are generally estimated within SAMS based on modeling decisions made by the user. These parameters typically include the coefficients for single site and multisite models and the coefficients for the various disaggregation schemes.

Spatial Scale Employed in the Model:

The spatial scale is flexible, but consistent with locations of gaging stations which reflect the historically observed data set.

Temporal Scale Employed in the Model:

The temporal scale can be annual and seasonal (e.g. 2, 3, 4, ... , 12 time periods or seasons). The maximum number of time periods (seasons) that are available in the current version of SAMS is 12.

Input Data Requirements:

Hydrologic data needs to be provided from all locations (sites) to be analyzed. Other input parameters simply reflect the characteristics of those input data - including length of record, grouping of stations for multisite modeling, etc.

Computer Requirements:

SAMS is operational in a PC environment using Windows 98 or Windows NT. It can also be run on Sun Workstations.

Model Output:

SAMS generates stochastic hydrology (typically streamflow and precipitation) data in numerical and graphical form. Data generated will be consistent with input data in terms of temporal and spatial distribution. Statistical properties of the generated as well as historical data are calculated and can be compared.

Parameter Estimation / Model Calibration:

Parameters for normalizing transformations are selected through a trial and error process using the graphical display capabilities to view the transformed data on a normal distribution plot and using summary tables with test statistics. Parameters for the autoregression and disaggregation models are estimated internally within the program. Calibration is done informally by comparing the various models and transformation parameters. Comparison of historical and model properties is available for some simple models.

Model Testing and Verification:

Testing and verification of SAMS results is accomplished through comparison of historically observed hydrologic data with the stochastically generated data. In general, it is best to generate a long trace or many traces of shorter lengths and compare mean, variance, skewness and correlation coefficients obtained from the stochastically generated data and the historical data. If these parameters are in close agreement, it can be safely assumed that the transformation function and parameters, and the stochastic models (e.g. autoregressive and disaggregation models) selected were adequate.

Model Sensitivity:

Hydrologic traces generated by SAMS are particularly sensitive to the selection of normalizing transformations. Random numbers selected by the user will impact the month to month and year to year data generated by the program in a specific trace, but over a long period of time in a given trace or after generation of many shorter traces, this impact becomes minimal in terms of the statistical properties of the generated data.

Model Reliability:

SAMS has undergone substantial testing by the developers, by technical experts hired by Reclamation to evaluate it and by the user community at large. A number of good suggestions have been received and incorporated and problems which were noted have been corrected. Through this formal and informal testing process, a high level of confidence has been established in the reliability of the model.

Model Application / Case Studies:

SAMS is being applied jointly with the RiverWare modeling framework for long range planning and policy studies on the Colorado River basin. This effort is being carried out jointly by Reclamation, Colorado State University and the CADSWES group at the University of Colorado. SAMS has also been used by the Bonneville Power Authority (BPA) for operational studies on the Columbia River system and by AYRES Associates for modeling and generation of the Upper Colorado River System.

Documentation:

A users manual is available on request - either through Dr. Salas at Colorado State University or through:

River Systems and Meteorology Group, Mail Code D-8510
US Bureau of Reclamation
Technical Service Center
PO Box 25007
Denver, CO 80225

Other Comments:

Users of SAMS are encouraged to contact Dr. Salas with any comments and suggestions they have for improvement of the model.