Overview

SAS/STAT 15.1 introduces three new procedures as well as adding new features and options to many existing procedures. This release is available with Base SAS® 9.4M6.

Bayesian Generalized Linear Mixed Models

The BGLIMM procedure is a sampling-based procedure that you use to obtain Bayesian inference for generalized linear mixed models (GLMMs). PROC BGLIMM allows you to build models for hierarchical nested or non-nested multilevel random effects and repeated measures data such as shown in the graph to the right. It supports missing completely at random (MCAR) and missing at random (MAR) approaches in modeling missing data.

The Bayesian approach to GLMMs estimates the joint posterior disruption of all parameters in a model, including all fixed- and random-effect parameters. The Monte Carlo method numerically integrates out the random effects and propagates the uncertainties to the marginal posterior of the fixed-effects parameters. PROC BGLIMM uses efficient Markov chain Monte Carlo (MCMC) sampling tools to estimate the posterior marginal distributions and use them for further inference.

PROC BGLIMM offers you many features including:

- syntax similar to other SAS/STAT regression procedures
- parallelized efficient sampling algorithms for fast performance.
- the ability to specify link functions and distributions for the response variable
- a RANDOM statement and a REPEATED statement
- a suite of covariance structures for random effects and residuals
- built-in prior distributions for regression coefficients and covariance parameters
- the ability to output posterior samples to a data set for further inferences

PROC BGLIMM is multithreaded and uses the ODS Graphics to create graphs as part of its output.

Graphical Causal Models for Guiding Causal Inference

The CAUSALGRAPH procedure examines the structure of graphical causal models and suggests statistical strategies that enable you to compute unbiased estimates of causal effects. With PROC CAUSALGRAPH, you can obtain a valid adjustment set that can remove noncausal influences.

You use PROC CAUSALGRAPH to define graphical causal models in the form of directed acyclic graphs (DAGs). PROC CAUSALGRAPH lets you explore formal properties of a causal graph, enabling you to take the following actions:

- list or test adjustment sets that can be used to remove or block noncausal associations between the treatment and outcome variables
- list or test sets of variables that can be used as instruments to estimate a causal effect
- clarify causal and noncausal (associative) paths between the treatment and outcome variables
- enumerate conditional independence assumptions encoded in a causal model

PROC CAUSALGRAPH analyzes multiple causal models simultaneously to obtain common identification criteria. The identification results from PROC CAUSALGRAPH enable you to devise sound statistical strategies to estimate causal effects in confounding situations.
Restricted Mean Survival Time

Classical hazard-based methods can be inappropriate or inefficient when the proportional hazards assumption is violated. You can use the RMSTREG procedure or the LIFETEST procedure to perform survival analysis when your data have nonproportional hazards (see graph). These procedures analyze the restricted mean survival time (RMST), the expected value of the time-to-event variable up to a prespecified time horizon.

You use the RMSTREG procedure to fit linear and log-linear models to the RMST. This procedure enables you to:
- choose a specific time horizon for analysis
- specify classification and interaction effects
- fit models by using pseudo-value regression or inverse probability censoring weighting techniques
- perform hypothesis tests for model effects
- make inferences on covariate-adjusted RMST differences or ratios

You can use the RMST option in the LIFETEST procedure to perform nonparametric analysis of the RMST. PROC LIFETEST enables you to estimate the RMST at times of interest and make appropriate group comparisons by performing multiple comparisons.

Other Enhancements

Other enhancements include the following:
- In the ANOVA procedure, you can specify the EFFECTSIZE option in the MODEL statement to add measures of effect size to each analysis-of-variance table.
- The ICPHREG procedure fits the semiparametric proportional hazards model to interval-censored data.
- The CAUSALMED procedure enables you to input observational weights in the WEIGHT statement and to input the standard deviations of continuous variables in the STD statement.
- The FMM procedure supports random starting values for maximum likelihood estimation.
- The FREQ and SURVEYFREQ procedures offer the SENSPEC option in the TABLES statement to provide estimates and confidence limits for sensitivity, specificity, positive predictive value, and negative predictive value.

- The QUANTREG procedure enables you to perform observationwise conditional distribution analysis as shown in the graph below.
- The MCMC and NLMIXED procedures support a steady state option for one-, two-, and three-compartment models.
- The PHREG procedure fits the semiparametric proportional hazards model to interval-censored data.
- The PSMATCH procedure provides a PSWEIGHT statement to compute weights for observations on the basis of propensity scores.
- The SURVEYFREQ, SURVEYLOGISTIC, SURVEYMEANS, and SURVEYREG procedures provide two methods of computing the deviations for the replication variance estimation method.
- The TTEST procedure produces graphs of bootstrap distributions and confidence intervals.

For More Information

For complete information about all SAS/STAT releases, see the documentation available at support.sas.com/statistics.