More Accurately Analyze Complex Relationships

Make your analysis more accurate and reach more dependable conclusions with statistics designed to fit the inherent characteristics of data describing complex relationships. SPSS Advanced Models provides a powerful set of sophisticated univariate and multivariate analytical techniques for real-world problems, such as:

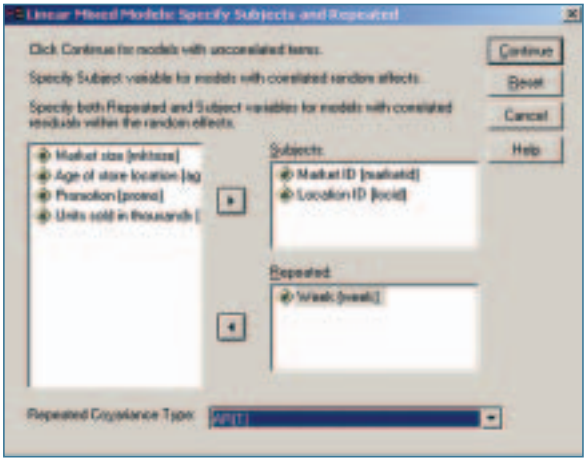
- Medical research—Analyze patient survival rates
- Manufacturing—Assess production processes
- Pharmaceutical—Report test results to the FDA
- Market research—Determine product interest levels

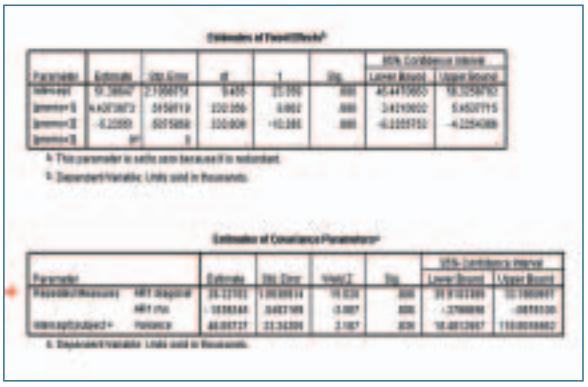
Build flexible models

The general linear model (GLM) procedure gives you more flexibility in describing the relationship between a dependent variable and a set of independent variables. Models include linear regression, ANOVA, ANCOVA, MANOVA, and MANCOVA. GLM also includes capabilities for repeated measures, mixed models, post hoc tests and post hoc tests for repeated measures, four types of sums of squares, and pairwise comparisons of expected marginal means, as well as the sophisticated handling of missing cells, and the option to save design matrices and effect files.

Get more accurate predictive models when working with nested-structure data

The linear mixed models procedure expands the general linear model used in the GLM procedure so that you can analyze data that exhibit correlation and non-constant variability. For example, work with data in which consumers are nested within households to improve the accuracy of your models. The linear mixed models procedure enables you to model not only means, but also variances and covariances in your data. This procedure's flexibility enables you to formulate a wide variety of models. Work with repeated measure designs, including incomplete repeated measurements in which the number of observations varies across subjects. You can also formulate a wide variety of models, including fixed effects ANOVA model, randomized complete blocks design, split-plot design, purely random effects model, random coefficient model, multilevel analysis, unconditional linear growth model, linear growth model with a person-level covariate, repeated measures analysis, and repeated measures analysis with time-dependent covariates.





In this example, a fast food chain uses linear mixed models to choose the best promotion for a new menu item. The chain uses data from a study in which it tested the item in several randomly selected markets, using a different promotion at each location. The estimates of the fixed effects suggest that the first promotion is the best, because it's associated with higher sales than the other promotions. The estimates for the covariance parameters show that both of the residual covariance parameters are statistically significant. The negative AR(1) Rho suggests that high sales one week are associated with lower sales the next.

Easily model your ranked outcomes

Use the poLytomous universal model (PLUM) procedure to predict ordinal outcomes with more than two categories. For example, determine what predicts customer interest level (low, medium, or high) in a product.

Break down variance into components

The variance component estimation procedure provides a number of methods to estimate the variance component for each random effect in a mixed model. Follow up your GLM analysis, which gives you correct effects tests, with variance component estimation analysis to estimate variance of random factors.

Apply more sophisticated models

Use SPSS Advanced Models when your data don't conform to the assumptions required by more simple techniques. SPSS Advanced Models has loglinear and hierarchical loglinear analysis for modeling multiway tables of count data. The general loglinear analysis procedure helps you analyze the frequency counts of observations falling into each cross-classification category in a crosstabulation or contingency table. You can select up to 10 factors to define the cells of a table. Model information and goodness-of-fit statistics are automatically displayed. Display a variety of statistics and plots, or save residuals and predicted values in the working data file.

Analyze event history and duration data

You can examine lifetime or duration data to understand terminal events, such as part failure, death, or survival. SPSS Advanced Models includes Kaplan-Meier and Cox regression, state-of-the-art survival procedures. Use Kaplan-Meier estimations to gauge the length of time to an event; use Cox regression to perform proportional hazard regression with time-to-response or duration response as the dependent variable. These procedures, along with life tables analysis, provide a flexible and comprehensive set of techniques for working with your survival data.

Features

Procedures

MIXED

Fits a variety of linear mixed models. Linear mixed models expand the general linear model used in the GLM procedure so that data can exhibit correlation and non-constant variability

- Fit the following models:
  - Fixed effects ANOVA model, randomized complete blocks design, split-plot design, purely random effects model, random coefficient model, multilevel analysis, unconditional linear growth model, linear growth model with person-level covariate, repeated measures analysis, and repeated measures analysis with time-dependent covariate
- Opt to apply frequency weights
- Use one of six covariance structures offered: First-Order autoregressive, compound asymmetry, Huynh-Feldt, identity, unstructured, and variance components
- Select from eleven non-spatial covariance types: First-order ante-dependence, heterogeneous, first-order autoregressive, ARMA (1,1), heterogeneous compound symmetry, compound symmetry with correlation parameterization, diagonal, first-order factor analytic, Toeplitz, heterogeneous Toeplitz, and unstructured correlations
- Choose from the following CRITERIA to control the iterative algorithm used in estimation and to specify numerical tolerance for checking singularity: Confidence interval level, log-likelihood function convergence criterion, maximum number of iterations, parameter estimates convergence criterion (absolute and relative), maximum step-halving allowed, apply scoring algorithm, and value used as tolerance in checking singularity
- Specify the fixed effects in the mixed model: No intercept, type I sum of squares, and type III sum of squares
- Specify the random effects: Identify the subjects and covariance structure (first-order autoregressive, compound symmetry, Huynh-Feldt, identity, and unstructured variance components)
- Depending on the covariance type specified, random effects specified in one RANDOM subcommand may be correlated
- Use one of two estimation methods: Maximum likelihood and restricted maximum likelihood

- Missing values: Exclude both user-missing and system-missing values; treat user-missing values as valid
- Select from a variety of print options: Asymptotic correlation matrix of the fixed-effects parameter estimates, asymptotic covariance matrix of the fixed-effects parameter estimates, case processing summary, descriptive statistics, estimated covariance matrix of random effects, iteration history, estimable functions, estimated covariance matrix of residual, solution for fixed-effects and random-effects parameters, and tests for covariance parameters
- Opt to apply regression weights
- Use the REPEATED subcommand to specify the residual covariance matrix in the mixed effects model: Identify the subjects and covariance structure (first-order autoregressive, compound symmetry, Huynh-Feldt, identity, unstructured, and variance components)
- Save fixed predicted values, predicted values, and residuals
- Use the TEST subcommand to customize hypotheses tests by directly specifying null hypotheses as linear combinations of parameters
  - Supply divisor for coefficients of random effects
- Save standard error of prediction
- Means subcommand for fixed effects, which displays the dependent variable's estimated marginal means in the cells and its standard errors for the specified factors

GLM

- Select univariate and multivariate lack-of-fit tests
- Regression model
- Fixed-effect ANOVA, ANCOVA, MANOVA, and MANCOVA
- Random or mixed ANOVA and ANCOVA
- Repeated measures: Univariate or multivariate
- Doubly multivariate design
- Four types of sums of squares
- Full-parameterization approach to estimate parameters in the model
- General linear hypothesis testing for parameters in the model
- Write a covariance or correlation matrix of the parameter estimates in the model in a matrix data file
- Plots: Spread vs. level, residual, and profile
- Post hoc tests for observed cell means: Student-Newman-Keuls, Tukey's honestly significant difference, Tukey's *b*, Duncan's multiple comparison procedure based on the Studentized range test, Scheffé's multiple comparison *t* test, Dunnett's one-tailed *t* test (compares if the mean at any level is smaller than that of the reference category), Dunnett's two-tailed *t* test, (compares if the mean at any level is larger than that of the reference category), Bonferroni *t* test, least significant difference *t* test, Sidak *t* test, Hochberg's GT2, Gabriel's pairwise comparisons test based on the Studentized maximum modulus test, Ryan-Einot-Gabriel-Welsch's multiple stepdown procedure based on an F test, Ryan-Einot-Gabriel-Welsch's multiple stepdown procedure based on the Studentized range test, Tamhane's T2, Dunnett's T3, Games and Howell's pairwise comparisons test based on the Studentized range test, Dunnett's C, and Waller-Duncan *t* test
- User-specified error term in post hoc analysis
- Estimated population marginal means for predicted cell means
- Save variables to the active file: Unstandardized predicted values, weighted unstandardized predicted values, unstandardized residuals, weighted unstandardized residuals, deleted residuals, standardized residuals, Studentized residuals, standard errors of predicted value, Cook's distance, and uncentered leverage values
- Allows unlimited number of factors
- Fractional numbers in LMATRIX, MMATRIX, and KMATRIX subcommands
- Pairwise comparisons of expected marginal means
- Linear hypothesis testing of an effect vs. a linear combination of effects
- Option to save design matrices
- Contrasts: Deviations, simple, difference, Helmert, polynomial, repeated, and special
- Print: Descriptive statistics, tests of homogeneity of variance, parameter estimates, partial eta-squared, general estimable function table, a lack of fit test, observed power for each test, and a set of contrast coefficient (L) matrices

PLUM

PoLytomous universal model procedure to predict ordinal outcomes

- Seven options to control the iterative algorithm used for estimation, to specify numerical tolerance for checking singularity, and to customize output
- Five link functions to specify the model: Cauchit, complementary log-log, LOGIT, negative log-log, and probit
- Location subcommand to specify the location model: Intercept, main effects, interactions, nested effects, multiple-level nested effects, nesting within an interaction, interactions among nested effects, and covariates
- Missing values: Exclude both user-missing and system-missing values; treat user-missing values as valid
- Print: Cell information, asymptotic correlation matrix of parameter estimates, goodness-of-fit statistics, iteration history, kernel of the log-likelihood function, test of parallel lines assumption, parameter statistics, and model summary
- Save casewise post-estimation statistics into the active file: Expected probabilities of classifying factor/covariate patterns into response categories, response category with the maximum expected probability for factor/covariate patterns
- Customize your hypotheses tests by directly specifying null hypotheses as linear combinations of parameters using the TEST subcommand (syntax only)

VARCOMP

Variance component estimation

- Estimation methods: ANOVA MINQUE, maximum likelihood (ML), and restricted maximum likelihood (REML)
- Type 1 and Type 3 sums of squares for ANOVA method
- Choices of zero-weight or uniform-weight methods
- Choices of ML and REML calculation methods: Fisher's scoring method or Newton-Raphson method
- Save variance components estimates and covariance matrices
- Criteria specification: Iterations, convergence, and Epsilon value used as tolerance in checking singularity
- Print: Expected mean squares, iteration history, and sums of squares

SURVIVAL

Analysis of life tables

- Life tables for individual groups
- Interval variable lengths
- Plots: Cumulative survival distribution on log or linear scale, hazard function, and density function
- Comparisons of subgroups
- Include plots of the one minus survival function
- Status variables to indicate if the terminal event occurred for the observation
- Print life tables
- Calculate comparisons of the subgroups: Exact, approximate, conditional, pairwise, and compare
- Missing data options: Groupwise, listwise, and include
- Option to write survival table data records and label records files

LOGLINEAR

General models of multiway contingency tables (syntax only)

- Maximum likelihood estimation
- Models: Saturated, hierarchical, or non-hierarchical single degree of freedom partitions, and LOGIT models
- Observed and expected frequencies
- Raw and standardized residuals
- Parameter estimates
- Cell weight and structural zero specification
- Plots of adjusted residual vs. observed/expected counts
- Normal and detrended probability plots of adjusted residuals
- Likelihood ratio and Pearson Chi-squares
- Contrasts: Deviation, difference, Helmert, simple, repeated, polynomial, and special

HILOGLINEAR

Hierarchical loglinear models for multiway contingency tables

- Simultaneous entry and backward elimination methods
- Print: Frequencies and residuals
- Parameter estimates and partial associations for saturated models
- Criteria specification: Convergence, maximum iterations, probability of Chi-square for model, and maximum steps
- Specified cell weights and maximum order of terms
- Plots of standardized residuals vs. observed and expected counts
- Normal probability plots of standardized residuals

GENLOG

Fits loglinear and LOGIT models to count the data approach

- Fit two models: Maximum likelihood estimation under Poisson loglinear model and multinomial loglinear models
- Exponential of the Beta
- GLM approach handles “messy data”
- Cell structure specification
- Model designs are specified through GLM model syntax
- Accommodate structural zeros
- Print Chi-square goodness-of-fit statistics
- Generalized log-odds ratio facility tests whether the specific generalized log-odds ratios are equal to zero and can print confidence intervals
- Cell statistics include expected cell counts, residual, standardized, adjusted, and deviance residual
- Include generalized residuals facility
- Diagnostic plots include high-resolution scatterplots and normal probability plots of residual statistics
- Print parameter estimates, along with correlations and covariances of the estimates
- Save residuals, standardized residuals, adjusted residuals, deviance residuals, and predicted values
- Criteria specification: Confidence interval, iterations, convergence, Delta, and Epsilon values used as tolerance in checking singularity

KAPLAN-MEIER

Estimates the length of time to an event using Kaplan-Meier estimation methods

- Define factors and strata
- Plots: Cumulative hazard functions, cumulative, and log survival
- Display censored cases
- Save variables to a file: Cumulative number of events, hazard, standard error, and survival function
- Statistical display: Cumulative events and survival, mean and median survival times with standard errors, number at risk, requested percentiles, and standard error
- Tests for equality of survival distributions: Breslow, Tarone, and logrank
- Specify a trend component for factor levels having a metric
- Include plots of the one minus survival function
- Status variables to indicate if the terminal event occurred for the observation
- Specify strata (subgroups) within categories of factors
- Compare the survival distributions for different levels of the factor: Compare all factor levels in a single test, compare each pair of factors, pool the test statistic across all strata, and compare the factor levels for each stratum

COX REGRESSION

Proportional hazards with time-dependent covariates

- Contrasts: Deviations, simple, difference, Helmert, polynomial, repeated, special, and indicator
- Define strata to estimate separate baseline functions
- Methods: Backward and forward stepwise and direct entry
- Plots: Cumulative survival, hazard, and log minus log plots for each stratum
- Removal of variables: Change in likelihood ratio, conditional, and Wald
- Save variables to files: Baseline survival and hazard functions and their standard errors, cumulative hazard function, dfbeta, log minus log of survival function, residuals, and survival function
- Include plots of the one minus survival function
- Status variables to indicate if the terminal event occurred for the observation
- Specify ordinal or nominal predictors
- Print: Full regression output including overall model statistics for variables in the equation and variables not in the equation, summary information, correlation/covariance matrix of the parameter estimates for the variables in the model, baseline table, and confidence intervals for exponential of beta
- Criteria: Change in parameter estimates for terminating iteration; maximum number of iterations; percentage of change in log-likelihood ratio for terminating iteration; probability of score statistic for variable entry; and probability of Wald, LR or conditional LR statistic to remove a variable
- Specify the pattern of covariate values to be used for requested plots and coefficient tables
- Write on external SPSS data files: Coefficients in the final model and survival table

System requirements

- Software: SPSS Base 13.0
- Minimum free drive space: 2.5MB
- Other system requirements vary according to platform