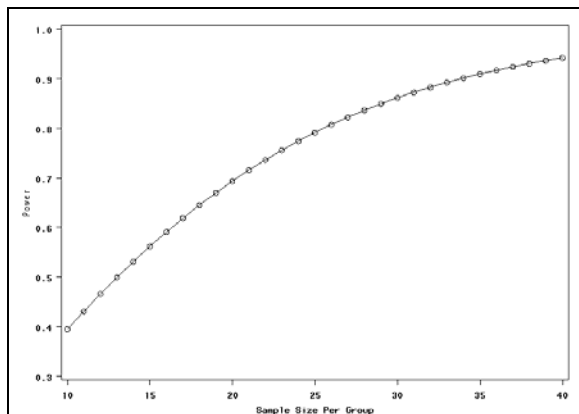


SAS/STAT Software: SAS 9.1

Power and Sample Size Computations with SAS

Overview

Statistical power analysis characterizes the ability of a study to detect a meaningful effect size—for example, the difference between two population means. It also determines the sample size required to provide a desired power for an effect of scientific interest. Proper planning reduces the risk of conducting a study that will not produce useful results and determines the most sensitive design for the resources available. Power analysis is now integral to the health and behavioral sciences, and its use is steadily increasing wherever empirical studies are performed.



SAS 9.1 brings power and sample size computations to the SAS System through both procedures and an interface. This release contains production versions of the POWER and GLMPOWER procedures, which perform prospective power and sample size computations, and PSS, a web application that provides an interface to these computations. The POWER procedure covers a variety of statistical analyses, while the GLMPOWER procedure focuses on power analysis for the linear model. The PSS Application is a point-and-click interface to common power and sample size tasks. It provides multiple input parameter options, stores results in a project format, displays power curves, and produce appropriate narratives for the results. Both the procedures and the PSS Application are included with SAS/STAT software.

Here *prospective* indicates that the analysis pertains to planning for a future study.. This is in contrast to *retrospective* analysis for a past study, which is not supported by this software.

The POWER Procedure

The POWER procedure covers a variety of statistical analyses such as *t* tests, equivalence tests, and confidence intervals for means; exact binomial, chi-square, Fisher's exact, and McNemar tests for

proportions; multiple regression and correlation; one-way analysis of variance; and rank tests for comparing survival curves.

Statistical Analysis Coverage in PROC POWER

t tests for means
equivalence tests for means
confidence intervals for means
tests of binomial proportions
multiple regression
tests of correlation and partial correlation
one-way analysis of variance
rank tests for comparing two survival curves

There are many factors involved in a power analysis, such as the research objective, design, data analysis method, power, sample size, Type I error, variability, and effect size. By performing a power analysis, you can learn about the relationships between these factors, optimizing those that are under your control and exploring the implications of those that are fixed.

The following table lists the input to the POWER procedure that include these components of study planning:

Input Components for PROC POWER

design
statistical model and test
significance level (alpha)
surmised effects and variability
power
sample size

You designate one of these components by a missing value in the input, in order to identify it as the result parameter. The procedure calculates this result value over one or more scenarios of input values for all other components. Power and sample size are the most common result values, but for some analyses the result can be something else. For example, you can solve for the sample size of a single group for a two sample *t* test.

In addition to tabular results, PROC POWER produces graphs. You can produce the most common types of plots easily with default settings and use a variety of options for more customized graphics. For example, you can specify your axis ranges, number of plotted points, mapping of graphical features (such as color, line style, symbol and panel) to analysis parameters, and legend appearance.

The GLMPOWER Procedure

The GLMPOWER procedure performs prospective analyses for linear models. The statistical analyses that are covered include Type III tests and contrasts of fixed class effects in univariate linear models, optionally with covariates. The covariates can be continuous or categorical. Tests and contrasts involving random effects are not supported.

You specify the design and the cell means using an *exemplary data set* and specify the model and contrasts using MODEL and CONTRAST statements like those in the GLM procedure. You specify the remaining parameters with the POWER statement, which is similar to analysis statements in the POWER procedure.

In addition to tabular results, PROC GLMPOWER also produces graphs that are customizable. The following table lists the input to the POWER procedure that include these components of study planning:

Input Components for PROC GLMPOWER
design (including subject profiles and their allocation weights)
statistical model
contrasts of class effects
significance level (alpha)
surmised response means for subject profiles (often called "cell means")
surmised variability
power
sample size

The following SAS statements illustrate the syntax of PROC GLMPOWER:

```
proc glmpower data=Exemplary;
  class Variety Exposure;
  model Height = Variety |
    Exposure;
  power
  stddev = 5
  ntotal = 60
  power = .;
run;
```

These statements request power for a planned data analysis is a two-way ANOVA with flower height (measured at two weeks) as the response and a model consisting of the effects of light exposure, flower variety, and their interaction. Requested is the power of each effect test using a balanced design with a total of 60 specimens (10 for each combination of exposure and variety) and $\alpha = 0.05$ for each test.

The following output shows the computed power:

Computed Power			
Index	Source	Test DF	Power
1	Variety	1	0.718
2	Exposure	2	0.957
3	Variety*Exposure	2	0.191

The Power and Sample Size Application

The Power and Sample Size Application, distributed with SAS/STAT software, is a web interface that provides access to basic power and sample size computations.

The screenshot shows a web interface for power and sample size calculations. It has two main sections: 'Alpha' and 'Means'. In the 'Alpha' section, there is a text input field containing '0.01' and a button with a plus sign. In the 'Means' section, there are two columns: 'Group 1' and 'Group 2'. Under 'Group 1', there is a text input field containing '120' and a button with a plus sign. Under 'Group 2', there is a text input field containing '132' and a button with a plus sign. At the bottom of the interface, there is a button labeled 'Select Alternate Form'.

The following table illustrates the statistical tasks for which PSS computes power and sample size.

Statistical Analysis Coverage in PSS
t-tests, confidence intervals, equivalence tests
multiple regression, correlation
linear models (ANOVA, ANCOVA, fixed-effect GLM's) with contrasts
1-proportion, 2-proportion, and McNemar tests
rank tests for survival analysis

Allowing alternate input specifications, writing narratives, and saving each analysis as a project for later retrieval makes PSS a very convenient tool for both you and your clients. PSS can be run locally on a workstation or laptop or surfaced with a browser from a server running SAS.

Obtaining SAS 9.1

SAS 9.1 is planned for availability at the end of 2003. To obtain more information, ask your organization's SAS representative to contact the SAS Customer Interaction Center at 1.800.727.0025.