Power and Sample Size Calculation in Stata 13

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CVER
Short Stata seminar series
4 November 2013

Sample Size Calculation

Factors playing into choice of sample size:

- cost(s) per experimental unit (possibly at multiple levels),
- logistics for study management, e.g. duration,
- predetermined protocols (e.g. laboratory protocols),
- general statistical (or common sense) considerations:
  - size should be sufficient to detect ($\sim$ statistical significance) effects of interest,
  - avoid "waste" of experimental units,
  - reduce sensitivity to errors (by taking replications).

Why a statistical sample size calculation?

- perhaps a pretense of objectivity,
- often expected/required for grant proposals and publication.

Statistical Methods for Sample Size Calculation

Two major statistical approaches:

- from desired precision (standard error, size of CI) on selected estimate (typically involving mean(s) or proportion(s)),
- from desired power of test for effect/hypothesis of interest (if primary purpose of study can be reduced to a single test).

	Target for choice of sample size	
Calculation	Precision	Power
Manual (formulae)	+	not recommended
Software	limited (not Stata)	Stata 13 (and others)#
Simulation*	+	+

\# focus of this presentation

* see VER2 (Section 2.11.8), Feiveson (2002) paper, or
`http://www.stata.com/support/faqs/statistics/power-by-simulation/`

Stata 13 Development: the Power Command

- unifies several commands which are no longer supported,

Model/Method	Stata 12	Stata 13
means & proportions:		
1-sample, 2-sample indep.	`sampsi`, `sampncti`	`power`
survival analysis	`stpower`	`stpower`
2×2-table/χ^2-tests	`chi2power`	`power`
variances & correlations	n/a	`power`
paired proportions	n/a	`power`
one-way ANOVA	`fpower` (add-on)	`fpower` (add-on)

- includes a slick graphical interface to select methods and settings, and to customize output (including tables and graphs),
- expands range of methods available only somewhat; no multivariable models (case-control/cohort/cross-sectional studies promoted but no specific coverage of these),
- includes massive documentation (270 page manual) and video (pretty non-informative).

Some Details about Power Command

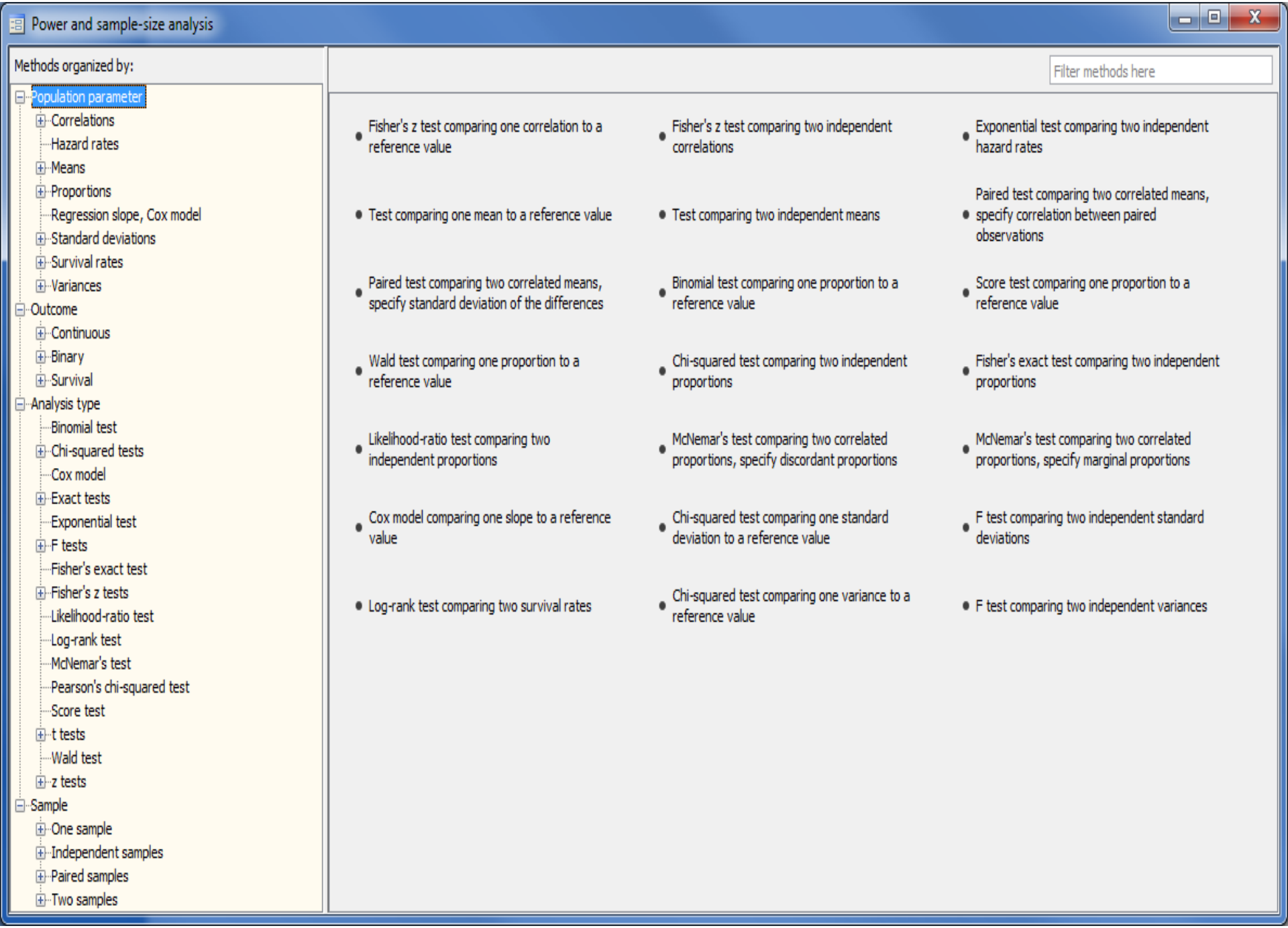
Useful new features (most of them similar to Minitab interface. . .):

- choice between calculation of power, sample size or effect size,
- use of "numlist" (value list) – allows to include many calculations with a single command),
- tabulation of results (customizable),
- graphical representation of results (customizable),
- comprehensive menu interface.

Basics of command syntax:

power method . . . , power(numlist) options
power method . . . , n(numlist) options
power method . . . , n(numlist) power(numlist) options

for computation of sample size, power, and effect size, respectively.


Power and sample-size analysis
Methods organized by:
Population parameter
Correlations
Hazard rates
Means
Proportions
Regression slope, Cox model
Standard deviations
Survival rates
Variances
Outcome
Continuous
Binary
Survival
Analysis type
Binomial test
Chi-squared tests
Cox model
Exact tests
Exponential test
F tests
Fisher's exact test
Fisher's z tests
Likelihood-ratio test
Log-rank test
McNemar's test
Pearson's chi-squared test
Score test
t tests
Wald test
z tests
Sample
One sample
Independent samples
Paired samples
Two samples
Filter methods here
Fisher's z test comparing one correlation to a reference value
Fisher's z test comparing two independent correlations
Exponential test comparing two independent hazard rates
Test comparing one mean to a reference value
Test comparing two independent means
Paired test comparing two correlated means, specify correlation between paired observations
Paired test comparing two correlated means, specify standard deviation of the differences
Binomial test comparing one proportion to a reference value
Score test comparing one proportion to a reference value
Wald test comparing one proportion to a reference value
Chi-squared test comparing two independent proportions
Fisher's exact test comparing two independent proportions
Likelihood-ratio test comparing two independent proportions
McNemar's test comparing two correlated proportions, specify discordant proportions
McNemar's test comparing two correlated proportions, specify marginal proportions
Cox model comparing one slope to a reference value
Chi-squared test comparing one standard deviation to a reference value
F test comparing two independent standard deviations
Log-rank test comparing two survival rates
Chi-squared test comparing one variance to a reference value
F test comparing two independent variances

A Demonstration Example (VER 2.5)

Context: vaccine to reduce the risk of respiratory disease in feedlot steers from (current) 15% to 10%.

Settings for power calculation:

- desired power $= \mathbf{0.8}$ (or 80%),
- two-sided alternative hypothesis, significance level 0.05,
- methods: Pearson χ^2-test (or likelihood-ratio χ^2-test),

$\Rightarrow$ required total sample size (both groups): $n = \mathbf{1372}$ (or $n = \mathbf{1366}$).

Variable settings:

- one-sided alternative hypothesis,
- desired power (e.g. $\mathbf{0.70, 0.75, 0.80, 0.85, 0.90} = \mathbf{0.7(0.1)0.9}$),
- compute power for sample sizes (e.g. $n = \mathbf{800(100)1400}$),
- compute effect sizes for each of those combinations.

Summary Remarks

The new Stata 13 command power and the interface for power analysis facilitate the exploration of the impact (in terms of power) of a range of simple experimental designs, and thereby helps us

- in choosing a sensible sample size,
- in formulating a formal justification for sample size,
- in checking other people's claims about sample size.

The implementation:

- is a vast improvement over Stata 12 in terms of user-friendliness,
- still has a fairly narrow scope (mostly one- and two-sample),
- at times uses large-sample approximations (correlations, McNemar's test),

$\Rightarrow$ caution is (as always) needed, and other implementations or approaches (precision-based sample size calculation, simulation methods) may be required for specific situations.