

Power, precision, and sample-size analysis

- How many subjects are needed for a test to achieve the desired power or for a confidence interval (CI) to achieve the desired width?
- Or what is the minimum effect size that can be detected for a given number of subjects and power?
- What about the minimum CI width?

Stata's **power** and **ciwidth** commands can answer these questions and more.

▪ Hypothesis tests

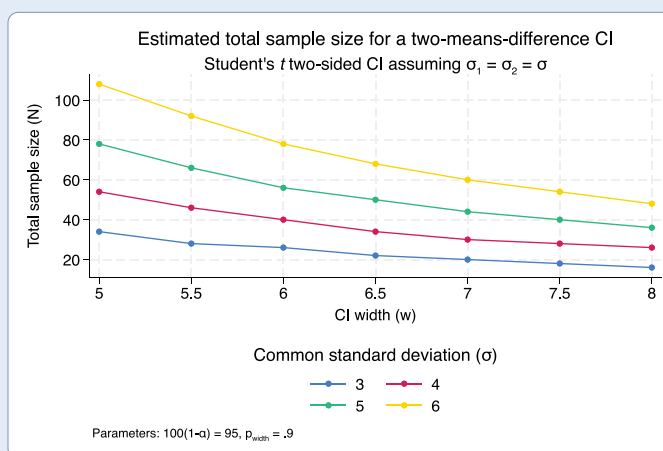
- Classic comparison of means, proportions, and more
- ANOVA models
- Linear regression
- Contingency tables
- Survival analysis
- Cluster randomized designs (CRDs)

▪ Confidence intervals

- One mean
- One variance
- Two independent means
- Two paired means

▪ Add your own methods

▪ Automatic and customizable tables and graphs



Power and sample size for tests

power provides power and sample-size analysis for hypothesis tests. Compute power, sample size, effect size, and more.

For instance, compute the total sample size required to detect an experimental-group mean of 600 given a control-group mean of 520 with a common standard deviation of 135; assume a two-sided 5% level test, a power of 80%, and equally-sized groups (the defaults).

```
. power twomeans 520 600, sd(135)

Performing iteration ...

Estimated sample sizes for a two-sample means test
t test assuming sd1 = sd2 = sd
H0: m2 = m1 versus Ha: m2 != m1

Study parameters:

    alpha =    0.0500
    power =    0.8000
    delta =   80.0000
    m1 =   520.0000
    m2 =   600.0000
    sd =   135.0000

Estimated sample sizes:

      N =      92
N per group =    46
```

Precision and sample size for CIs

ciwidth provides precision and sample-size analysis for CIs. You can compute probability of CI width, sample size, and CI width. Enter any two and get the third.

Compute the total sample size required for a two-sided 95% CI (the default) for the difference between two means with a common standard deviation of 6 to have a width no larger than 5 with a probability of 90%.

```
. ciwidth twomeans, width(5) probwidth(.9) sd(6)

Performing iteration ...

Estimated sample sizes for a two-means-difference CI
Student's t two-sided CI assuming sd1 = sd2 = sd

Study parameters:

    level =    95.00
Pr_width =    0.9000
    width =    5.0000
    sd =    6.0000

Estimated sample sizes:

      N =    108
N per group =    54
```

With both commands, you can specify single values or, to compare multiple scenarios, ranges of values of study parameters. You can also easily add your own methods and perform analyses using point and click (see the last page).

Classic hypothesis tests

Command	Description
<code>power onemean</code>	One-sample mean test
<code>power oneproportion</code>	One-sample proportion test
<code>power onecorrelation</code>	One-sample correlation test
<code>power onevariance</code>	One-sample variance test
<code>power twomeans</code>	Two-sample means test
<code>power twoproportions</code>	Two-sample proportions test
<code>power twocorrelations</code>	Two-sample correlations test
<code>power twovariances</code>	Two-sample variances test
<code>power pairedmeans</code>	Paired-means test
<code>power pairedproportions</code>	Paired-proportions test (McNemar's test)

Learn more at
stata.com/power-and-sample-size

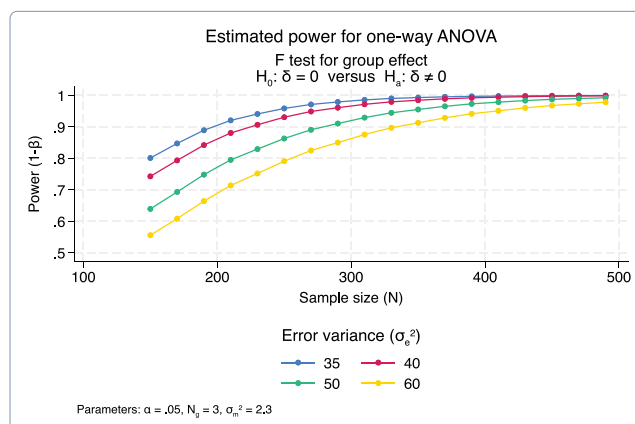
ANOVA models

power oneway estimates sample size, power, and effect size for a one-way ANOVA model. Choose the overall F test of the equality of group means or a test of a mean contrast. Specify either group means or their variability.

power twoway estimates sample size and power for a two-way fixed-effects ANOVA model. Choose the overall F test of the main effect of a row factor, a column factor, or a row-by-column interaction. Specify either cell means or the variance explained by the tested effect.

power repeated estimates sample size, power, and effect size for one-way and two-way fixed-effects ANOVA models with repeated measures. Choose the overall F test of a between-subjects factor, a within-subject factor, or a between-within factor interaction. Specify either cell means or the variance explained by the tested effect.

• `power oneway, ngroups(3) n(150(20)500)`
`varmeans(2.3) varerror(35 40 50 60) graph`



Learn more at
stata.com/power-anova-models

Confidence intervals

Sample size for CI for one mean

• `ciwidth onemean, width(1) probwidth(0.9)`

Sample size for CI for one variance

• `ciwidth onevariance 4, width(2) probwidth(0.9)`

Sample size for CI for one standard deviation

• `ciwidth onevariance 2, sd width(1) probwidth(0.9)`

Width of CI comparing two means from independent samples

• `ciwidth twomeans, n1(30) n2(50) probwidth(0.9)`

Probability of width for CI comparing two means from paired samples

• `ciwidth pairedmeans, width(1) n(15) corr(0.7)`

Learn more at
stata.com/sample-size-for-confidence-intervals

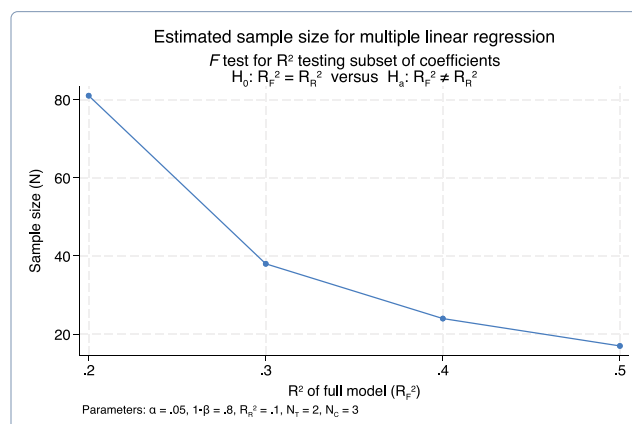
Linear regression

power oneslope performs power and sample-size analysis for a slope test in a simple linear regression. It computes the sample size, power, or target slope given the other two values and other study parameters.

power pcorr performs power and sample-size analysis for a partial-correlation test in a multiple linear regression. The command computes the sample size, power, or target squared partial-correlation coefficient given the other two values and other study parameters.

power rsquared performs power and sample-size analysis for the coefficient-of-determination (R^2) test in a multiple linear regression. Test the significance of all the coefficients or a subset of them. In both cases, the command computes the sample size, power, or target R^2 given the other two values and other study parameters.

• `power rsquared 0.1 (0.2(0.1)0.5), ntested(2)`
`ncontrol(3) graph`



Learn more at
stata.com/power-linear-regression

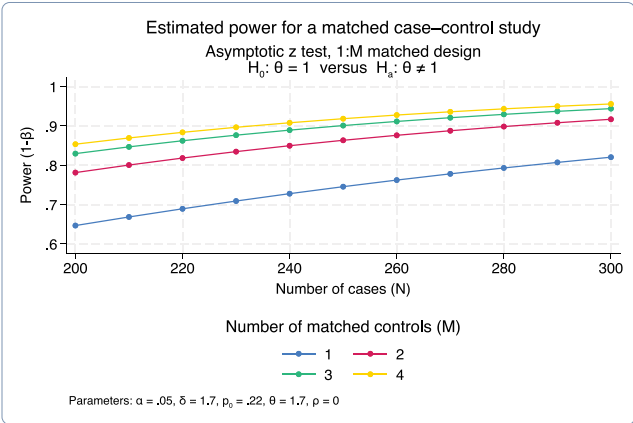
Contingency tables

power cmh performs power and sample-size analysis for a Cochran–Mantel–Haenszel test of association in stratified 2×2 tables.

power trend performs power and sample-size analysis for a Cochran–Armitage test of a linear trend in a probability of response in J×2 tables.

power mcc performs power and sample-size analysis for a test of association between a risk factor and a disease in 1:M matched case–control studies.

```
. power mcc 0.22, oratio(1.7) n(200(10)300)
m(1 2 3 4) graph
```



Learn more at stata.com/power-contingency-tables

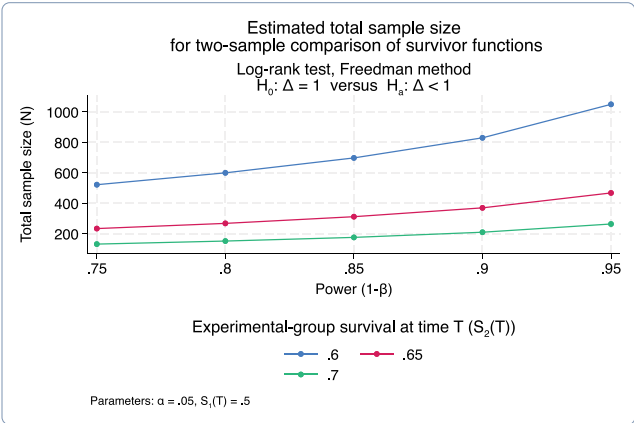
Survival analysis

power cox estimates sample size, power, and effect size for survival analysis using Cox proportional hazards models with possibly multiple covariates.

power exponential estimates sample size and power for survival analysis comparing two exponential survivor functions using the Wald hazards-difference test.

power logrank estimates sample size, power, and effect size for survival analysis comparing survivor functions in two groups using the log-rank test.

```
. power logrank 0.5 (0.6 0.65 0.7),
power(0.75(0.05)0.95) onesided graph
```



Learn more at stata.com/power-survival-analysis

Cluster randomized designs

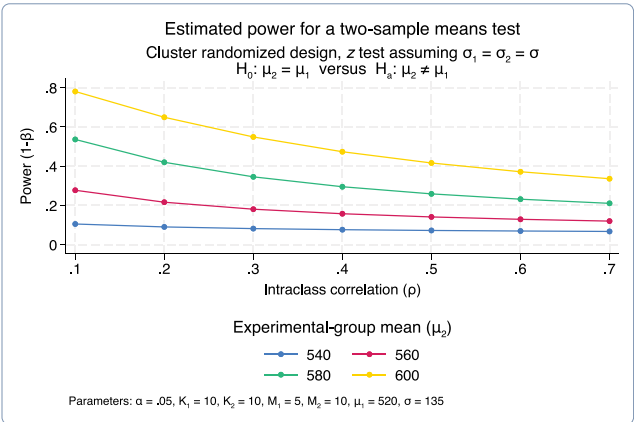
In the presence of clustering, observations within the same cluster are correlated. In a cluster randomized design (CRD), groups of subjects (clusters) are randomized instead of individual subjects, which leads to clustering of subjects. With clustered data, the sample size is determined by the number of clusters and the cluster size.

Five of **power**'s methods support CRDs or clustered data when you specify the **cluster** option or other CRD-specific options.

Command	Description
<code>power onemean, cluster</code>	One-sample mean test in a CRD
<code>power oneproportion, cluster</code>	One-sample proportion test in a CRD
<code>power twomeans, cluster</code>	Two-sample means test in a CRD
<code>power twoproportions, cluster</code>	Two-sample proportions test in a CRD
<code>power logrank, cluster</code>	Log-rank test in a CRD

Compute the number of clusters, cluster size, power, or minimum detectable effect size given the other parameters, and adjust for unequal cluster sizes. For two-sample methods, you can also adjust for unequal numbers of clusters in the two groups.

```
. power twomeans 520 (540 560 580 600),
cluster k1(10) m1(5) m2(10) sd(135)
rho(0.1(0.1)0.7) graph(xdim(rho))
```



Learn more at stata.com/power-cluster-randomized-designs

Add your own methods

Sometimes, you may need to compute power or sample size yourself, for instance, by simulation. **power** makes it easy for you to add your own method. All you need to do is write a program that computes sample size, power, or effect size, and **power** will do the rest for you.

```
program power_cmd_myztest, rclass
    version 19.5

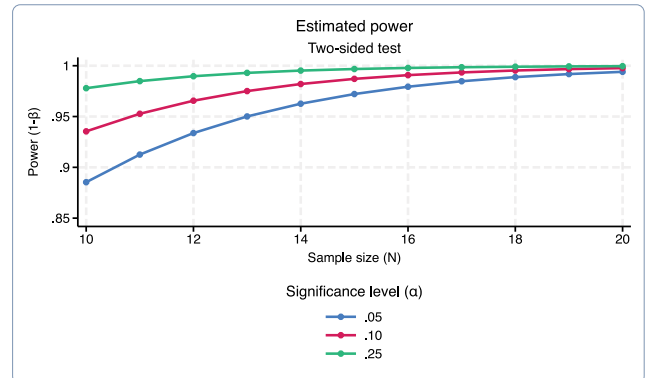
    // parse options
    syntax , n(integer) /// sample size
           STDDiff(real) /// standardized diff.
           Alpha(string) /// significance level

    // compute power
    tempname power
    scalar `power' = normal(`stddiff'*sqrt(`n') - ///
                           invnormal(1-`alpha'/2))

    // return results
    return scalar power = `power'
    return scalar N = `n'
    return scalar alpha = `alpha'
    return scalar stddiff = `stddiff'
end
```

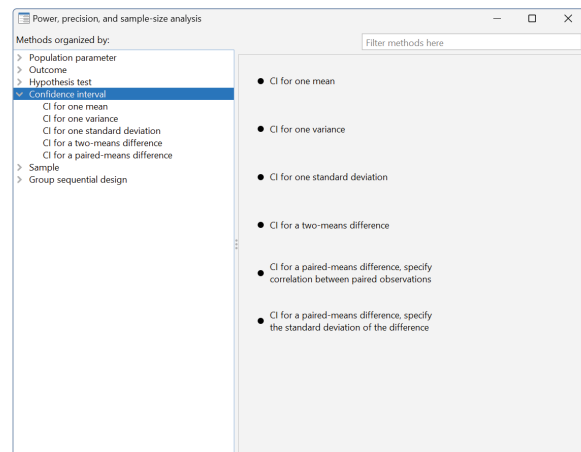
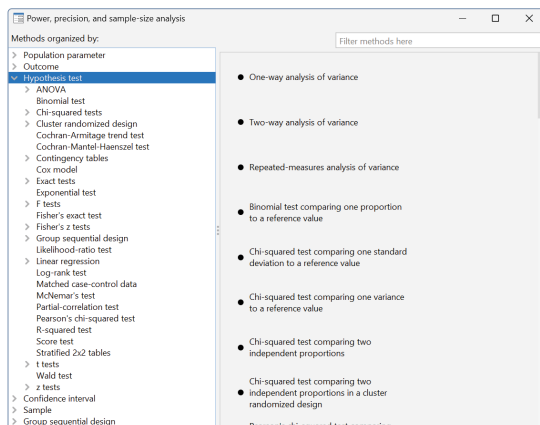
Similarly, you can add your own methods to **ciwidth**.

```
. power myztest, n(10(1)20) alpha(.05 .10 .25)
  stddiff(1) graph
```



Perform analyses using point and click

You can perform your analyses interactively by typing the commands or by using the point-and-click GUI available via the PSS Control Panel.



```
. power twomeans 520 (540 560 580 600),
  sd(135) n(50(10)100) graph
```

