

# How can I use Stata to conduct a one-way ANOVA power analysis?

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## RECOMMENDED CITATION

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Stata is a statistical software commonly used for data analysis and modeling. One of its powerful features is the ability to conduct a one-way ANOVA power analysis. This process allows researchers to determine the appropriate sample size for a study in order to achieve a desired level of statistical power. By using Stata's built-in commands, users can input the necessary information such as effect size, significance level, and desired power, and the software will generate the sample size needed to detect the specified effect with the desired level of confidence. This allows researchers to plan their studies more effectively and ensure that their findings are reliable and meaningful.

## One-way Anova Power Analysis | Stata Data Analysis Examples

### Introduction

Power analysis is the name given to the process for determining the sample size for a research study. The technical definition of power is that it is the probability of detecting a "true" effect when it exists. Many students think that there is a simple formula for determining sample size for every research situation. However, the reality is that there are many research situations that are so complex that they almost defy rational power analysis. In most cases, power analysis involves a number of simplifying assumptions, in order to make the problem tractable, and running the

**analyses numerous times with different variations to cover all of the contingencies.**

**In this unit we will try to illustrate the power analysis process using a simple four group design.**

### **Description of the Experiment**

**We wish to conduct a study in the area of mathematics education involving different teaching methods to improve standardized math scores in local classrooms. The study will include four different teaching methods and use fourth grade students who are randomly sampled from a large urban school district and are then random assigned to the four different teaching methods.**

**Here are the four different teaching methods which will be examined: 1) The traditional teaching method where the classroom teacher explains the concepts and assigns homework problems from the textbook; 2) the intensive practice**

method, in which students fill out additional work sheets both before and after school; 3) the computer assisted method, in which students learn math concepts and skills from using various computer based math learning programs; and, 4) the peer assistance learning method, which pairs each fourth grader with a fifth grader who helps them learn the concepts followed by the student teaching the same material to another student in their group.

Students will stay in their math learning groups for an entire academic year. At the end of the Spring semester all students will take the Multiple Math Proficiency Inventory (MMPI). This standardized test has a mean for fourth graders of 550 with a standard deviation of 80.

The experiment is designed so that each of the four groups will have the same sample size. One of the important questions we need to answer in designing the study is,

## how many students will be needed in each group?

### The Power Analysis

In order to answer this question, we will need to make some assumptions and some educated guesses about the data.

First, we will assume that the standard deviation for each of the four groups will be equal and will be equal to the national value of 80.

Further, we expect, because of prior research, that the traditional teaching group (Group 1)

will have the lowest mean score and that the peer assistance group (Group 4) will have the highest mean score on the MMPI. In fact, we expect that Group 1 will have a mean of 550

and that Group 4 will have mean that is greater by 1.2 standard deviations, i.e., the mean

will equal at least 646. For the sake of simplicity, we will assume that the means of the

other two groups will be equal to the grand mean.

We will make use of the Stata program `power` to do the power

analysis. The `power` command needs the following

information in order to do

the power analysis: 1) the keyword oneway 2)the number means of the groups, and 3) variance within each of the groups. The default alpha level is 0.05.

power oneway 550 598 598 646, varerror(6400 6400 6400 6400)

Performing iteration ...

Estimated sample size for one-way ANOVA

F test for group effect

H0: delta = 0 versus Ha: delta != 0

```

+-----+
-----+
| alpha power N N_per_group delta N_g m1 m2 m3 m4
Var_m Var_e |
|-----|
-----|
| .05 .8 68 17 .4243 4 550 598 598 646 1152 6400 |
| .05 .8 68 17 .4243 4 550 598 598 646 1152 6400 |
| .05 .8 68 17 .4243 4 550 598 598 646 1152 6400 |
| .05 .8 68 17 .4243 4 550 598 598 646 1152 6400 |
+-----+

```

-----+

The table above shows that we can achieve a power of 0.8 with 17 students per group. While 17 students per group sound like a fine number of subjects if everything works out as planned, we should consider what would occur if things do not work out as planned. Let's say that the treatment effect is not a large 1.2 but a more modest .75.

```
power oneway 550 580 580 610, varerror(6400 6400 6400 6400)
```

Performing iteration ...

Estimated sample size for one-way ANOVA

F test for group effect

H0: delta = 0 versus Ha: delta != 0

+-----

-----+

alpha	power	N	N_per_group	delta	N_g	m1	m2	m3	m4
Var_m	Var_e								

|-----

```

-----|
| .05 .8 160 40 .2652 4 550 580 580 610 450 6400 |
| .05 .8 160 40 .2652 4 550 580 580 610 450 6400 |
| .05 .8 160 40 .2652 4 550 580 580 610 450 6400 |
| .05 .8 160 40 .2652 4 550 580 580 610 450 6400 |
+-----+
-----+

```

Now, it looks like we will need 40 students per group to achieve a power of 0.8. The effect size of 0.75 is considered moderate. Finally, just to be safe, we should see what sample size would be needed if there was a small effect size of, say, 0.25.

```
power oneway 550 560 560 570, varerror(6400 6400 6400 6400)
```

Performing iteration ...

**Estimated sample size for one-way ANOVA**

**F test for group effect**

**H0:  $\delta = 0$  versus Ha:  $\delta \neq 0$**

```

+-----+

```

```

-----+
| alpha power N N_per_group delta N_g m1 m2 m3 m4
| Var_m Var_e |
|-----|
|-----|
| .05 .8 1,400 350 .08839 4 550 560 560 570 50 6400 |
| .05 .8 1,400 350 .08839 4 550 560 560 570 50 6400 |
| .05 .8 1,400 350 .08839 4 550 560 560 570 50 6400 |
| .05 .8 1,400 350 .08839 4 550 560 560 570 50 6400 |
+-----+
-----+

```

This output indicates that an N of about 350 per group is needed to obtain a power of 0.8 when the effect size is 0.25.

Here are the sample sizes per group that we have come up with in our power analysis:

17 (best case scenario), 40 (medium effect size), and 350 (almost the worst case scenario). Even though we expect a large effect, we will shoot for a sample size of between 40 and 50. For one thing, it is all that our research budget will allow and the school district won't allow us to use

**more than 200 students total.**

**See Also**

**Cohen, J. 1988. Statistical Power Analysis for the Behavioral Sciences, Second Edition. Mahwah, NJ: Lawrence Erlbaum Associates.**

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