What is the power analysis for two independent proportions?

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Power analysis for two independent proportions is a statistical tool used to determine the minimum sample size required for a study to have sufficient statistical power in detecting a significant difference between two proportions. It takes into account factors such as effect size, significance level, and desired power level to estimate the sample size needed to accurately detect a difference between the proportions of two independent groups. This analysis is crucial in research studies as it ensures that the study has enough participants to draw reliable conclusions and avoid false negative results.

Two Independent Proportions Power Analysis

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 it 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 how to do a power analysis for a test of two independent proportions, i.e.,

the response variable has two levels and the predictor variable also has two levels. Instead of analyzing these data using a test of independent proportions, we could compute a chi-square statistic in a 2×2 contingency table or run a simple logistic regression analysis. These three analyses yield the same results and would require the same sample sizes to test effects.

Description of the Experiment

It is known that a certain type of skin lesion will develop into cancer in 30% of patients if left untreated. There is a drug on the market that will reduce the probability of cancer developing by 10%. A pharmaceutical company is developing a new drug to treat skin lesions but it will only be worthwhile to do so if the new drug is 5% better than the existing drug.

The pharmaceutical company plans to do a study with patients randomly assigned to two groups, the control (untreated) group and the treatment group. The company wants to know how many subjects will be needed to test a difference in proportions of .15 with a power of .8 at alpha equal to .05.

The Power Analysis

We will make use of SPSS's power proportions independent command which can be used to determine the sample size needed for tests of two independent proportions as well as for tests of means.

```
power proportions independent
/parameters test=nondirectional significance=0.05
power=.8 nratio=1 proportions=.3 .15
method=chisq estimate=normal continuity=false
pooled=true.
```

Power Analysis - Independent Proportions

Power Analysis Table

	N1	N2	Actual Power[b]	Test Assumptions				
				Power	Risk Difference	Risk Ratio	Odds Ratio	Sig.
Test for Proportion Difference[a]	118	118	.801	.8	.150	2.000	2.429	.05

a. Two-sided test using large-sample approximation.

b. The estimation of power is based on the Pearson Chi-Square test and the unpooled standard deviation.

This is all well and good, but a two-sided test doesn't make much sense in this situation. We want to test for a drug that reduces the probability of cancer not for one that increases the probability. In this case we should be using one-tail test.

```
power proportions independent
```

/parameters test=directional significance=0.05 power=.8 nratio =1 proportions=.3 .15 method=chisq estimate=normal continuity=false pooled=true.

Power Analysis - Independent Proportions

Power Analysis Table

	N1	N2	Actual Power[b]	Test Assumptions				
				Power	Risk Difference	Risk Ratio	Odds Ratio	Sig.
Test for Proportion Difference[a]	118	118	.801	.8	.150	2.000	2.429	.05

a. Two-sided test using large-sample approximation.

b. The estimation of power is based on the Pearson Chi-Square test and the unpooled standard deviation.

This is better. The output indicates that we need to use 95 subjects in each group to find a change in probability of .15 for a power of .8 when alpha equals .05.

Just as a check let's run the analysis specifying each of the two sample sizes.

power proportions independent
/parameters test=directional significance=0.05 n=95 95 proportions=.3 .15 method=chisq estimate=normal continuity=false pooled=true.

Power Analysis - Independent Proportions

Power Analysis Table

	Power[b]	Test Assumptions					
		N1	N2	Risk Difference	Risk Ratio	Odds Ratio	Sig.
Test for Proportion Difference[a]	.801	95	95	.150	2.000	2.429	.05

a. One-sided test using large-sample approximation.

b. The estimation of power is based on the Pearson Chi-Square test and the pooled standard deviation.

Now because we believe that we know a lot about the incidence of cancer in the untreated group, we would like to make the control group half as large as the treatment group. We can easily do this by including the ratio option.

power proportions independent
/parameters test=directional significance=0.05 power=.8 nratio =2 proportions=.3 .15 method=chisq estimate=normal continuity=false pooled=true.

Power Analysis - Independent Proportions

Power Analysis Table

	N1	N2	Actual Power[b]	Test Assumptions				
				Power	Risk Difference	Risk Ratio	Odds Ratio	Sig.
Test for Proportion Difference[a]	70	139	.804	.8	.150	2.000	2.429	.05

a. One-sided test using large-sample approximation.

b. The estimation of power is based on the Pearson Chi-Square test and the pooled standard deviation.

As you can see, we will need more subjects overall than for equal sized groups, but we can have a much smaller

untreated group.

In the end, the company has decided to use 75 patients in the control group and 150 in the treatment group. Let's see what the power is.

power proportions independent
/parameters test=directional significance=0.05 n=75 150
proportions=.3 .15 method=chisq
estimate=normal continuity=false pooled=true.

Power Analysis - Independent Proportions

Power Analysis Table

	Power[b]	Test Assumptions					
		N1	N2	Risk Difference	Risk Ratio	Odds Ratio	Sig.
Test for Proportion Difference[a]	.827	75	150	.150	2.000	2.429	.05

a. One-sided test using large-sample approximation.

b. The estimation of power is based on the Pearson Chi-Square test and the pooled standard deviation.

With this unbalanced design we have an estimated power of .827 which the company deems acceptable.

References

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