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Chapter 11: Tests concerning proportions

Like the previous chapter, this chapter deals with **statistical hypothesis**: assertions or conjectures about a parameter (or parameters) of a population. Unlike the previous chapter, the tests in this chapter concern proportions.

For example, if you interview 859 people and 47% say they would vote democrat you could test the claim that the election is not too close too call, i.e., that the population proportion voting democrat in the actual election will be less than 0.5.

We follow the same procedure as in the previous chapter:

Procedure

To verify such an assertion statistically, one has to

1. Make a study in which a simple random sample is selected and the value in question is collected for every subject in the sample (in this case the proportion of voters which say they would vote democrat).
2. Set the **null hypothesis H_0** and the **alternative hypothesis H_A**.

In this case we could set:
H_0: p=0.5 (election too close to call)
H_A: p<0.5 (election not too close to call, republicans will win)

1. Find the sample statistics (in this case, the sample proportion, and sample size).
2. Fix a level of significance (for example $\alpha = 0.05$)
3. Determine the corresponding critical value. This value would be read from the corresponding table (z-, t- or chi-table).
4. Calculate the **test statistic** (see table).
5. Decide whether the claim is accepted or rejected.

Table for Hypothesis Tests for proportions

Hypothesis for	parameter	conditions	test statistic	critical values
Proportion	*p*	np>=5, nq>=5	$z = \frac{\hat{p}-p}{\sqrt{pq/n}}$	z-score table

Difference among proportions	p_1, p_2		$z = \frac{\frac{x_1}{n_1} - \frac{x_2}{n_2}}{\sqrt{\hat{p}\hat{q}(\frac{1}{n_1} + \frac{1}{n_2})}}$, where $\hat{p} = \frac{x_1 + x_2}{n_1 + n_2}$, $\hat{q} = 1 - \hat{p}$	z-score table

Chi-square tests

All the tests below use the Chi-square distributionchi-square distribution with the following test statistic:

$$\chi^2 = \sum \frac{(o-e)^2}{e}, \qquad (1)$$

where e stands for expected values and o stands for observed values.

For more than two proportions

The file on differences among proportions in the case that there is more than two groups is available at:

- http://statistics.wikidot.com/local--files/ch11/DifferencesAmongProportions.xls
- http://statistics.wikidot.com/local--files/ch11/ProportionForMoreThanTwoSampleEx10.xlsx

Contingency tables

The file on contingency tables for independence tests is available at: http://statistics.wikidot.com/local--files/ch11/ContingencyTableIndepencenceTest.xls

Goodness of fit

The file on goodness of fit tests is available at: http://statistics.wikidot.com/local--files/ch11/GoodnessOfFit.xls

Homework: 11.2, 11.5, 11.12, 11.20, 11.28, 11.32