Hypothesis Testing

Math 122 - Introduction to Statistics and Probability

Types of Claims we will test.

One Proportion

More than one quarter of students on campus attend Chapel at least once a week.

Requirement: : $np \geq 5$ and $n(1-p) \geq 5$
Calculator: onepropz

One Mean

Students on campus on average attend chapel at least two times per week.

Requirement: : Population normal or sample large ($n > 30$)
Calculator: ttest

Two Proportions

The proportion of females on campus who attend chapel at least twice each week is larger than the proportion of males who attend chapel at least twice per week.

Requirement: : Independent samples, at least 5 successes and 5 failures in each sample.
Calculator: twopropz

Two Independent Means

Males on campus on average spend more time per week in the weight room than females.

Requirement: : Independent samples which are either both large or both normally distributed.
Calculator: twomeant

Matched Pairs

The fall track program improves athletes' 30m times.

Requirement: : Samples are large or the differences are normally distributed.
Calculator: matchedpairs

Linear Correlation

There is a linear correlation between the number of hours slept the night before an exam and the grade a student receives on the exam.

Requirement: : Scatterplot confirms that points approximate a linear pattern, and outliers must be removed.
Calculator: correlation

Goodness of Fit

About one half of our students are education majors. About one quarter are business majors, and about one quarter are something else.

Requirement: : The expected frequency of each category is at least 5.
Calculator: chi2GOF

Contingency Table

Whether or not a student attends chapel regularly is independent of that student's major.

Requirement: : Each expected frequency is at least 5.
Calculator: contingency

ANOVA

Students in theology, music, and mathematics have the same average GPA.

Requirement: : Populations are approximately normal, and samples are independent.
Calculator: ANOVA

Outline

1. Parameters.
2. Symbolic Claim.
3. Null Hypothesis H_0.
4. Alternative Hypothesis H_1.
5. Significance level α.
6. Distribution/Test Statistic
7. P-value
8. Formal Conclusion.
9. Final Conclusion.

Formal Conclusion

1. If $P < \alpha$, then the observations are not consistent with H_0.
   REJECT H_0 (support H_1).
2. If $P > \alpha$, the observations are consistent with H_0.
   FAIL TO REJECT H_0 (do not support H_1).

Final Conclusion

1. If your claim is H_0, your conclusion will be one of these
   - There is enough sample evidence to reject the claim.
   - There is NOT enough sample evidence to reject the claim.
2. If your claim is H_1, then your conclusion will be one of these
   - There is enough sample evidence to support the claim.
   - There is NOT enough sample evidence to support the claim.

Proportion Examples

Gender Selection

Among 726 babies born to couples using the XSORT method in an attempt to have a baby girl, 668 of the babies were girls (and the others were boys).

Use these results with a significance level of $\alpha = 5\%$ to test the claim:

"More babies born to couples with the XSORT method are female than are male."

Gender Prediction

104 pregnant women were asked to predict the gender of their child. Of these, 57 guessed correctly.

Use these results with a significance level of $\alpha = 5\%$ to test the claim:

"The success rate of women guessing the gender of their children is 50%."

Tamiflu

Among 724 patients given Tamiflu in a clinical trial, 72 experienced nausea.

Use a significance level of 0.03 to test the claim:

"The rate of nausea in patients using Tamiflu is greater than the 6% rate experienced by flu patients given a placebo."

Mean Examples

Weights of Men

A random sample of 40 men has an average weight of 172.55lb with standard deviation of 26 lb,

use these results to test the claim:

"Men have an average weight greater than 166.3 lb (which is the mean weight reported by the National Transportation and Safety Board)."

Use a 0.05 significance level.

Heights of Super Models

A random sample of super models had these heights (in inches)

66 69 69 72 72 70 71 68

Use this data to test the claim:

"Super Models have an average height which is different from the average adult female height of 63.6 in."

Use a 0.01 significance level.

Weight Watchers

When 40 people used the Weight Watchers diet for one year, their average weight loss was 3.0 lb with a standard deviation of 4.9 lb. Use a 0.01 significance level to test the claim:

"People on this diet lose on average more than 0 lb."

M&Ms

A simple random sample of 19 green M&Ms has a mean weight of 0.8635 g and a standard deviation of of 0.0565 g.

Use a 0.05 significance level to test the claim:

"Green M&Ms weigh the same as other M&Ms."

According to the manufacturer, the average weight of all M&Ms is 0.8535 g.