

Hypothesis Testing Cheat Sheet

Key Concepts

- ◇ Hypothesis testing uses statistical tests to determine if a hypothesis is true.
- ◇ **The null hypothesis, H_0** , is the statement that there **IS NO** statistically significant difference or relationship between variables.
- ◇ Any differences observed are due to chance. It is a statement of “no effect” or “no difference.” It is the hypothesis to disprove, reject or nullify.
- ◇ **The alternative hypothesis, H_1 or H_a** , describes what you are speculating upon regarding the outcome of an experiment.
- ◇ The alternative hypothesis states that there **IS** a statistically significant difference or relationship between variables.
- ◇ For example, we test whether a new drug increases weight loss by $> 20\%$.
null hypothesis (H_0): $p \leq 20\%$. alternative hypothesis (H_1): $p > 20\%$

Hypothesis Testing Is Not Just for Researchers

Hypothesis testing can be used in businesses to identify differences between machines, formulas, raw materials, medications, etc. Without such testing, employees may change a product or process causing more variation. Hypothesis tests enable data driven decisions.

Three Hypothesis Testing Methods

1. **Classical:** Compare a test statistic to a critical value.
2. **p value:** Probability of a test statistic being contrary to the null hypothesis.
3. **Confidence Interval:** Is the test statistic between or outside of the confidence interval.

Type I and Type II Errors

Type I error - Reject a null hypothesis that is true (Producer’s Risk)

Type II error - Not reject a null hypothesis that is false (Consumer’s Risk)

How to Conduct a Hypothesis Test

Steps to Follow

1. Define the null and alternative hypothesis.
2. Conduct the test.
3. Using data from the test:
 - Calculate the test statistic (i.e. F) and the critical value (i.e. F crit).
 - Calculate a p value and compare it to a significance level (α) or confidence level ($1-\alpha$). For example, if the significance level = 5%, then the confidence level = 95%.
4. Interpret the results to accept or reject the null hypothesis.

Interpreting the Results

Test Method	Compare	Result
Classical	test statistic $>$ critical value (i.e. $F > F \text{ crit}$)	Reject the null hypothesis
Classical	test statistic $<$ critical value (i.e. $F < F \text{ crit}$)	Cannot reject the null hypothesis
p value	p value $<$ α	Reject the null hypothesis
p value	p value $>$ α	Cannot reject the null hypothesis

Translating Stat Speak to English

Null Hypothesis: means or variances are **not significantly different**.

Reject the Null Hypothesis

$$p \text{ value} < \alpha$$

Means are not the same or
Variances are not the same

Means are different
Variances are different

Cannot Reject the Null Hypothesis

$$p \text{ value} > \alpha$$

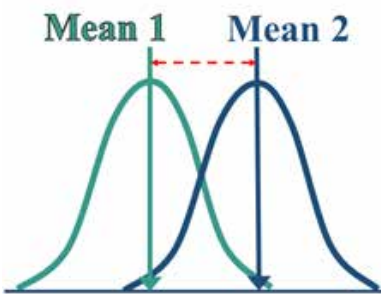
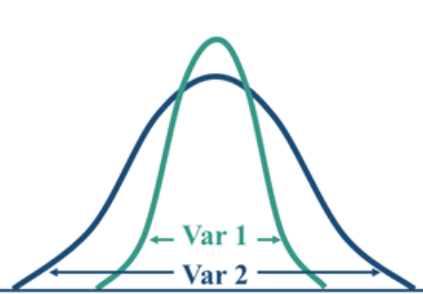

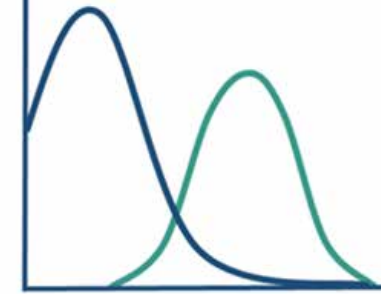
Means are not significantly different
Variances are not significantly different

Means are the same or
Variances are the same



Hypothesis Testing Cheat Sheet

Examples of Statistical Tests included in QI Macros for Excel

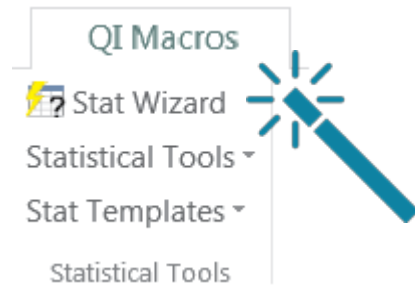
Test of Means	Test of Variances	Test of Relationships	And More
			
ANOVA t tests z test	f test Levenes test	Chi-square Descriptive Statistics Multiple Regression Analysis	AQL Sampling Tables Normality Test Sample Size Calculator

Advantages of Using QI Macros

- Just select your data and then the test you want from QI Macros menu.
- Performs all of the calculations and interprets the results for you. (i.e. Reject null hypothesis because $p < \alpha$, means are different)
- Draws a box plot or other chart to better explain the results.
- Compatible with PC and Mac. Excel 2010-2019 and Office 365.
- Reduce risk of manual calculations or your own Excel formulas.
- Save Time!

Not Sure Which Statistical Test to Run?

QI Macros Stat Wizard will analyze your data and run the correct tests for you.



Example of QI Macros Results

