The Center for Research and Outreach
REACH
Leveraging Evidence and Science into Practice

IT'S ALL GREEK TO ME: A PRIMER FOR UNDERSTANDING STATISTICAL LANGUAGE

A HOW-TO GUIDE

USDA

UNIVERSITY OF MINNESOTA
Driven to Discover℠

I. Introduction

Quantitative research articles often contain statistics and statistical information. To the reader unfamiliar with research statistics the numbers, acronyms, and short-hand may feel about as familiar as the Greek language. In fact, in many of these articles you may actually encounter Greek lettering! The purpose of this guide is to provide an overview of some of the more common statistical language used in research articles and explain the meaning of frequently used symbols and short hand used to explain research findings.
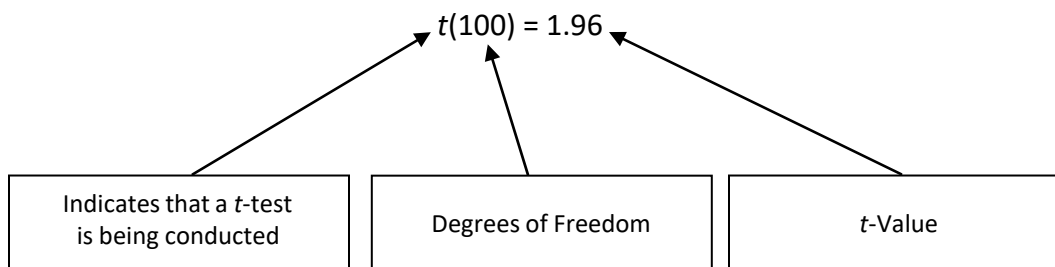
II. Common Statistical Symbols

Below is a list of the common statistical symbols and short hand frequently found in research articles, and a brief description of each:

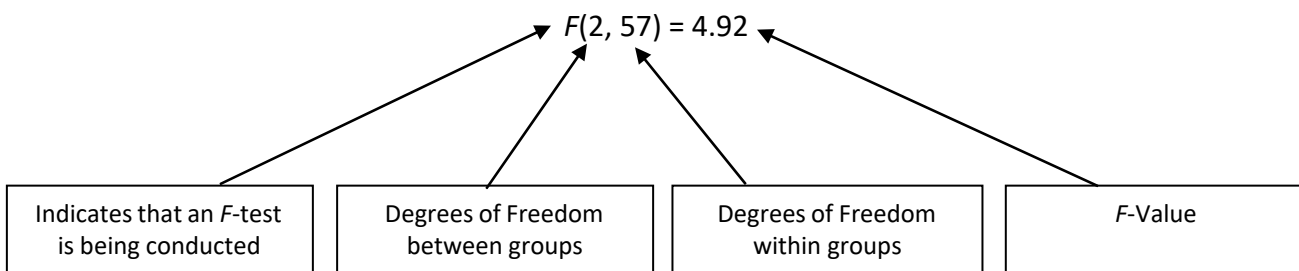| Symbol	Definition
N	This symbol is typically used as short hand for the **number of participants** in a study. It will usually appear as *N* = (number of participants). For example, if our research study included 3 participants, *N*=3.
Range	The range is the distance between the highest and lowest scores on a measure. You can calculate this by subtracting the highest score from the lowest score. For example, if a *variable*[1] has values of 1 2 3 4 5, the range for this set of numbers would be 5 minus 1, or 4. Range is also used to refer to the array of scores. In the previous set of numbers, the range could be reported as follows: *range* = 1-5.
M	This symbol is short hand for **Mean**. It reflects the average score of study participants on some measure. Often it will appear in research articles as *M* = (number). For example, if in a research article the mean is reported as *M* = 2.86, that indicates the average score for participants was 2.86 on a given scale.
SD	This is short hand for **Standard Deviation**. Standard deviation refers to the average amount that study participants' scores deviate from the mean score, or 'average'. One way to think about a standard deviation is in terms of the distribution of participants' scores. A small standard deviation indicates that, on average, participants deviate from the mean very little (e.g., they are clustered around the mean). In contrast, a large standard deviation indicates that participants' scores are spread out around the mean. Standard deviation is often reported with the mean score and may appear something like this: *M* = (number), *SD* = (number).

---

[1] A *variable* refers to something that varies. An example might be the age of the participants in a study. The participants may differ in their age and thus will vary between one another. Another example of a variable is something that is measured. For example, in a study on youth programs, instructor quality might be measured. Because some instructors are more effective than others, scores for instructor quality will vary between instructors .

Symbol	Definition
t	The symbol *t* typically refers to a **t-test**. A '*t*-test' is used to statistically compare two mean scores to determine if there are differences between the means. A *t*-test might be conducted to test for differences between two groups, for example comparing boys and girls, or to test for differences between pre-test and post-test scores for individuals (see *Understanding t-Tests: A How-To Guide* for more information).
	A t-test contains two parts, the degrees of freedom and the *t*-value. When you see a reference to a *t*-test in an articles, it indicates the researchers are making comparisons between two means. An example of how a *t*-test is reported is shown below:

$$t(100) = 1.96$$

Indicates that a *t*-test is being conducted	Degrees of Freedom	*t*-Value

Symbol	Definition
F	When you see '*F*' in a research article, this indicates that the authors are conducting an analysis called Analysis of Variance (ANOVA). Like the '*t*-test', the *F*-test is used when comparing means, though most often the *F* is used when **more than two** means (or groups) are being compared. The *F* statistic is interpreted the same way as a *t*-statistic; it typically tests for a difference between three or more means. The *F* statistic has four parts: (1) the *F* which indicates than an ANOVA is being conducted, (2) the degrees of freedom between groups, (3) the degrees of freedom within groups, and (4) the *F*-value. When you see this symbol, it indicates that three or more groups are being compared. For more detailed information on ANOVA see *Understanding ANOVA: A How-To Guide*. Below is an example of how an *F* statistic might be reported in a research article:

$$F(2, 57) = 4.92$$

Indicates that an *F*-test is being conducted	Degrees of Freedom between groups	Degrees of Freedom within groups	*F*-Value

Symbol	Definition
r	This symbol is short hand for the statistical coefficient known as the **Pearson Correlation Coefficient**. It indicates the *degree of association* between two variables. Consider two variables, one called 'X' and one called 'Y.' If 'Y' increases at a similar rate as 'X,' these two variables would be described as 'positively correlated.' Alternatively if Y decreases as X increases, then the two variables are negatively correlated. Coefficient '*r*' can range between -1 and +1, and the direction (+ or -) of the coefficient tells you if the correlation is positive or negative. In the social sciences, a value of ±.10 is considered small, ±.20 is considered medium, and ±.30 is considered large[1]. See *Understand- ing Correlation: A How-To Guide* for more detailed information about correlation.
β	The technical definition of this symbol is a **standardized regression coefficient**, though it is often referred to as a **beta-weight**. When you see this symbol, the researchers are typically conducting a regression analysis. Regression is a type of correlational statistic that researchers use when they want to estimate the correlation between more than two variables. Regression is covered in more detail in *Understanding Regression Analysis: A How-To Guide*.
p	This symbol stands for a ***p*-value**. The *p*-value indicates whether an effect is larger than would be expected by chance alone. For example, suppose you saw a correlation that has a value of .34 (*r* = .34). While the size of the correlation tells you about the strength of the association between two variables, the question remains, is the size of the association larger than would be expected by chance alone? The *p*-value provides this information. The *p*-value has come to be a very important statistic in the social sciences and can be found in conjunction with most other statistics. The *p*-value is based on the probability that a given effect is larger than would be expected by chance, so small *p*-values are desirable. In most research, a standard *p* cut-off-value of .05 is used. This number indicates that if you were to run the analysis on different samples 100 times, the association would occur by chance only 5 out of those 100 times. When *p*-values are at or below .05, the effect is considered **statistically significant**. When effects are statistically significant they are generally accepted as real effects that are not due to chance. *p*-values are reported with a range of statistics including the *r*, *t*, *β*, and *F*.

III. Summary

In this How-To Guide we have reviewed some of the common statistical symbols found in quantitative research articles. This guide is intended to familiarize readers of research with these symbols and provide information about what each of the symbols mean. For more detailed information about this topic, interested readers are encouraged to explore our other guides on specific statistics. These include guides on the correlation, regression, *t*-test, and ANOVA.

---

[1] Funder, D. C., & Ozer, D. J. (2019). Evaluating effect size in psychological research: Sense and nonsense. *Advances in Methods and Practices in Psychological Science, 2*(2), 156-168. doi: 10.1177/2515245919847202

Developed by
The Arizona Center for Research and Outreach (AZ REACH)

Lynne M. Borden, Principal Investigator
Gabriel Schlomer, Ph.D. (Primary Author)