# Understanding Parameters and Statistics

A common source of ***confusion*** in statistics lies in the vocabulary used to describe certain numbers. A frequent occurrence of this is when students see the words ***parameter*** and ***statistic***.

The ***key*** thing to know is that both parameters and statistics are just ***numbers*** that describe some ***aspect*** of a ***population*** or ***sample***.

When we refer to a ***number*** that describes a ***population***, we use the word ***parameter*** and when we refer to a ***number*** that describes a ***sample*** from a population, we use the word ***statistic***.

A ***parameter*** is a ***number*** that describes some ***characteristic*** of a ***population***. The four most commonly-used parameters are listed below:

$\mu$: Population ***mean***
$\sigma^2$: Population ***variance***
$\sigma$: Population ***standard deviation***
**p**: Population ***proportion***

A ***statistic*** is a ***number*** that describes some ***characteristic*** of a ***sample***. The four most commonly-used statistics are listed below:

$\bar{x}$: Sample ***mean***
$s^2$: Sample ***variance***
**s**: Sample ***standard deviation***
$\hat{p}$: Sample ***proportion***

If you are ***confused*** as to whether a symbol is for a population or a sample, ***ask*** yourself if it is a Greek or English letter. If it is a ***Greek*** letter, it is usually a ***parameter*** and if it is an ***English*** letter, it is usually a ***statistic***.

**Memory Tip**: To remember the difference between a parameter and a statistic, think this way. Both ***parameter*** and ***population*** start with the letter **P**. Likewise, both ***statistic*** and ***sample*** start with the letter **S**. So when you see the word parameter, think population and when you see the word statistic, think sample.

**Note:** The sample ***mean***, sample ***proportion***, sample ***variance*** and sample ***standard deviation*** are all considered to be ***good*** or ***unbiased*** estimators of a population.

This is both an ***important*** and ***powerful*** concept that forms the ***basis*** of statistics. It means that we ***do not*** need to ***sample*** every person in a population. In addition,

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# Confidence and Significance Levels and Alpha

Statistics' students are often confused by the terms confidence level, significance level and alpha. What they don't realize is that ***all three*** are ***interrelated*** and if you know ***just one*** of these numbers, you are able to figure out the other two. The following table shows the ***relationship*** between confidence and significance levels.

**Confidence Level + Significance Level = 1**

| | | | |
|---|---|---|---|
| .90 | + | .10 | = 1 |
| .95 | + | .05 | = 1 |
| .99 | + | .01 | = 1 |

The ***significance level*** (level of significance) is also called ***alpha***. It is represented by the lowercase Greek letter $\alpha$ (alpha). ***Observe*** the following relationship:

**significance level = level of significance = alpha = $\alpha$**

You can see that there is ***no difference*** between the significance level and alpha. Once you understand this relationship, statistics becomes much less daunting.

When textbooks want you to test a claim at the 95% confidence level, they are ***in-directly*** telling you that the significance level is 5%. And if the significance level is 5%, that means alpha =.05 because we ***always*** write ***alpha*** as a ***decimal***.

Likewise, if a problem says to test a claim at alpha =.01, it is indirectly telling you to test the claim at the 99% confidence level which ***implies*** a significance level of 1%.

The three most ***commonly used*** confidence levels are 90%, 95% & 99%. On ***rare*** occasion, other confidence levels are used. If ***no*** confidence level is ***given***, most textbooks want you to ***assume*** a 95% confidence level.

**Notes:** Confidence levels are used ***both*** in ***hypothesis testing*** and when we create ***confidence intervals***. In general, the ***higher*** our level of confidence, the ***wider*** our intervals will become. Likewise, the ***lower*** our level of confidence, the ***narrower*** our intervals will be.

When ***creating*** confidence intervals, books will have you find $\alpha/2$. It is important to realize that this is ***not*** a number that you ***calculate***. What you will be doing is using either the z or t-tables to ***find*** the z or t-score that ***corresponds*** to a given ***area*** under the ***curve***.

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# How to Perform a Hypothesis Test
**(Using the Traditional Method)**

1. Thoroughly ***read*** the problem and ***underline*** all of the important information. As you read, look for ***key words*** and ***phrases*** such as: ***claim***, ***greater than***, ***less than*** or ***does not equal***. If you are testing a claim about a ***mean***, see if the problem gives you the ***population*** standard deviation or ***sample*** standard deviation.

2. Write down all of the ***important*** information from the problem. Make sure to include all of the statistics from the problem as well as the ***significance level***.

3. Determine the ***null*** and ***alternative*** hypothesis and write them down. Remember that the alternative hypothesis determines if it is a one or two-tailed test. Lastly, remember that the ***null*** hypothesis ***always*** has an ***equals*** sign.

4. Determine if you will perform a ***one*** or ***two-tailed*** test. If it is a ***one-tailed*** test, decide if it is ***right-tailed*** or ***left-tailed***.

5. Draw a ***picture*** and note the following information: the ***confidence*** and ***significance*** levels, the ***accept*** null and ***reject*** null regions and the ***critical values*** that separate the two regions. (Critical values are also known as ***critical numbers***).

6. Write down the appropriate ***formula*** for calculating the ***test statistic***.

7. ***Calculate*** the value of the ***test statistic*** or calculator function and mark this number on your picture.

8. Mark on your picture which ***region*** (**accept or reject null**) your test statistic falls into and then determine if you accept or reject the null hypothesis.

9. State your ***conclusion*** using the ***exact same wording*** as found in your ***textbook*** or as provided by your ***instructor***.

**Notes**: We ***always*** test the ***null*** hypothesis. We ***never*** test the ***alternative*** hypothesis. Sometimes the claim becomes the alternative hypothesis and at other times it becomes the null hypothesis. Remember that you ***look up*** your critical values but you ***calculate*** your test statistic (**obtained value**).

This handout uses the phrase "***accept null***" instead of "***do not reject null***" or "***fail to reject null***." While this makes it easier for students to understand, it is not exactly correct. We ***haven't proven*** that the null hypothesis is ***true***, only that it is ***not false***. This is a subtle but important distinction.

This is similar to when someone is put on trial. If a jury returns a ***not guilty*** verdict, it has ***not said*** that the person is ***innocent***; only that there is ***not enough evidence*** to find him or her guilty.

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