PARAMETRIC and NON-PARAMETRIC TESTS

In the literal meaning of the terms, a **parametric** statistical **test** is one that makes assumptions about the parameters (defining properties) of the population distribution(s) from which one's data are drawn, while a non-**parametric test** is one that makes no such assumptions.

PARAMETRIC TESTS: Most of the statistical tests we perform are based on a set of assumptions. When these assumptions are violated the results of the analysis can be misleading or completely erroneous.

Typical assumptions are:

- **Normality**: Data have a normal distribution (or at least is symmetric)
- **Homogeneity of variances**: Data from multiple groups have the same variance
- **Linearity**: Data have a linear relationship
- **Independence**: Data are independent

We explore in detail what it means for data to be *normally distributed in Normal Distribution*, but in general it means that the graph of the data has the *shape of a bell curve*. Such data is symmetric around its mean and has kurtosis equal to zero. In Testing for Normality and Symmetry we provide tests to determine whether data meet this assumption.

Some tests (e.g. ANOVA) require that the groups of data being studied have the same variance. In Homogeneity of Variances we provide some tests for determining whether groups of data have the same variance.

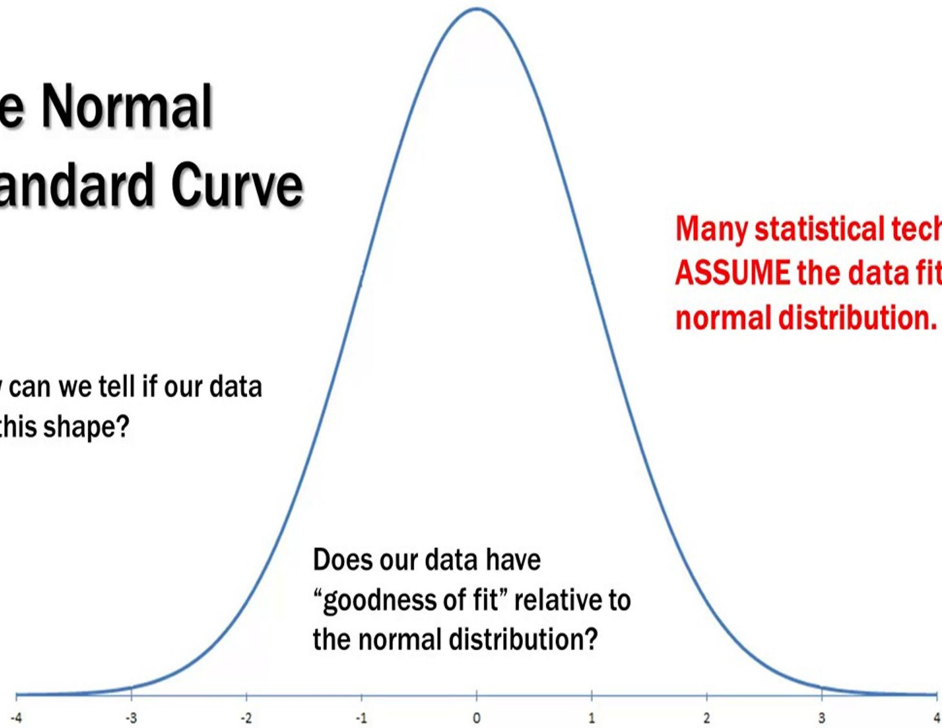
Some tests (e.g. Regression) require that there be a linear correlation between the dependent and independent variables. Generally linearity can be tested graphically using scatter diagrams or via other techniques explored in Correlation, Regression and Multiple Regression.

The Normal Standard Curve

Many statistical techniques ASSUME the data fits a normal distribution.

How can we tell if our data fits this shape?

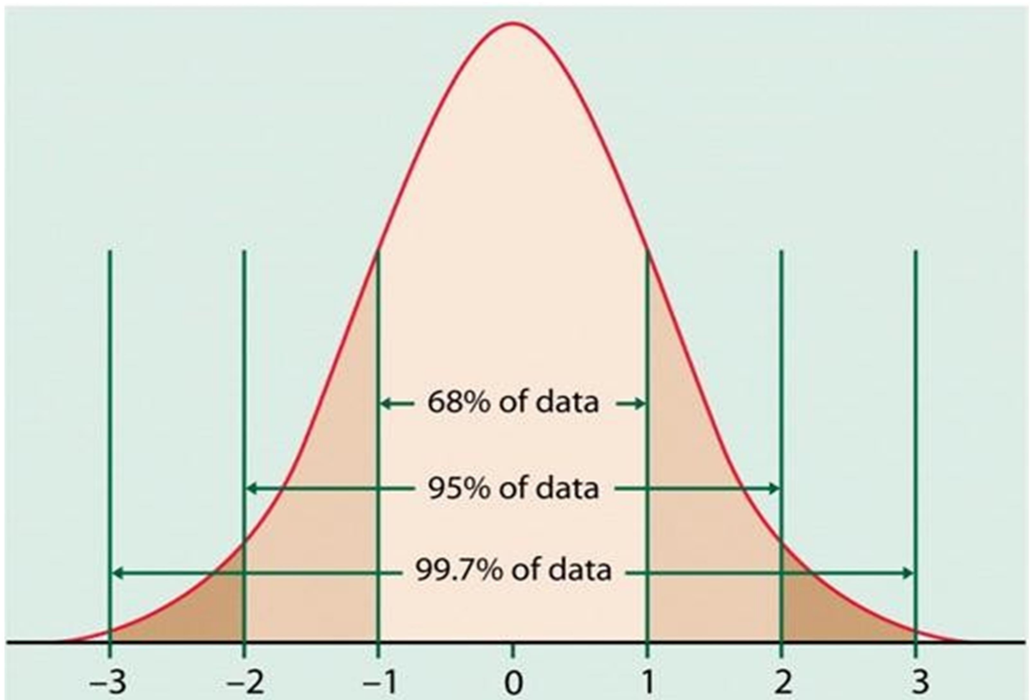
Does our data have "goodness of fit" relative to the normal distribution?

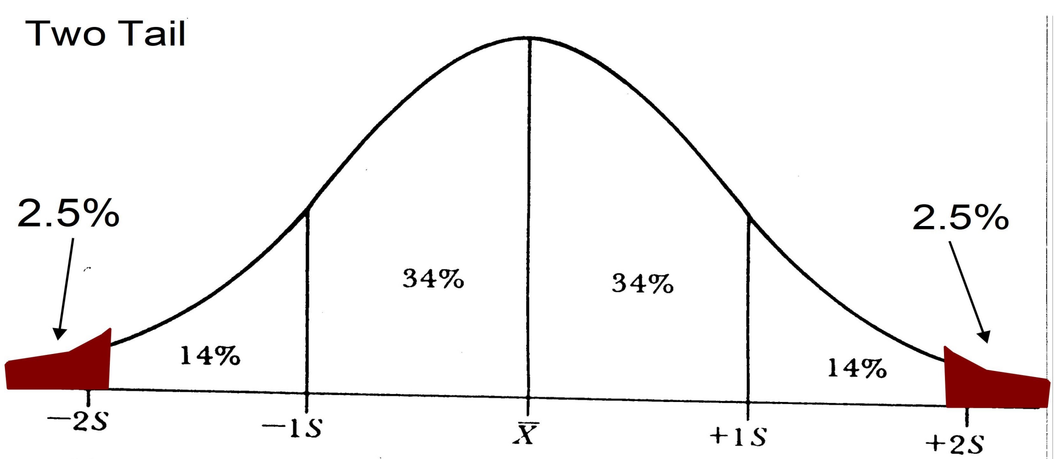


- *Many statistical methods require that the numeric variables we are working with have an approximate **normal distribution**.*

- *Standardized normal distribution with empirical rule percentages.*

- *For example, t-tests, F-tests, and regression analyses all require in some sense that the numeric variables are approximately normally distributed.*





5% region of rejection of null hypothesis
Non directional

<u>t – test</u>

Introduction:

- The t-test is a basic test that is limited to two groups. For multiple groups, you would have to compare each pair of groups. For example with three groups there would be three tests (AB, AC, BC) whilst with seven groups there would be need of 21 tests.
- The basic principle is to test the null hypothesis that means of the two groups are equal.

The t-test assumes:

- A normal distribution (parametric data)
- Underlying variances are equal (if not, use welch's test)
- It is used when there is random assignment and only two sets of measurement to compare.

There are two main types of t-test:

- **Independent – measures – t- test: when samples are not matched.**
- **Match – pair – t-test: when samples appear in pairs (eg. before and after)**

- **A single – sample t-test** compares a sample against a known figure. For example when measures of a manufactured item are compared against the required standard.

APPLICATIONS:

- To compare the mean of a sample with population mean. (Simple t-test)
- To compare the mean of one sample with the independent sample. (Independent Sample t-test)
- To compare between the values (readings) of one sample but in two occasions. (Paired sample t-test)

Independent Samples t-Test (or 2-Sample t-Test)

The independent samples t-test is probably the single most widely used test in statistics. It is used to compare differences between separate groups. In Psychology, these groups are often composed by randomly assigning research participants to conditions. However, this test can also be used to explore differences in naturally occurring groups. For example, we may be interested in differences of emotional intelligence between males and females.

Any differences between groups can be explored with the independent t-test, as long as the tested members of each group are reasonably representative of the population.

There are some technical requirements as well. PRINCIPALLY, EACH VARIABLE MUST COME FROM A NORMAL (OR NEARLY NORMAL) DISTRIBUTION.

Example: Suppose we put people on 2 diets: *the pizza di*et and *the beer diet.*

Participants are randomly assigned to either 1-week of eating exclusively pizza or 1-week of exclusively drinking beer. Of course, this would be unethical, because pizza and beer should always be consumed together, but this is just an example.

At the end of the week, we measure weight gain by each participant. Which diet causes more weight gain?

In other words, the null hypothesis is: Ho: wt. gain pizza diet = wt. gain beer diet.

(The null hypothesis is the opposite of what we hope to find. In this case, our research hypothesis is that there ARE differences between the 2 diets. Therefore, our null hypothesis is that there are NO differences between these 2 diets.)

		Column 3	***Column 4***
X_1 :Pizza	**X_2 : Beer**	$(X_1 - \overline{X}_1)^2$	$(X_2 - \overline{X}_2)^2$
1	**3**	**1**	**1**
2	**4**	**0**	**0**
2	**4**	**0**	**0**
2	**4**	**0**	**0**
3	**5**	**1**	**1**
2	**4**	**0.4**	**0.4**

$$s_x^2 = \frac{\sum (X - \overline{X})^2}{n} = 0.4$$

The formula for the independent samples t-test is:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{S_{x_1}^2}{n_1 - 1} + \frac{S_{x_2}^2}{n_2 - 1}}}$$

$$t = \frac{2-4}{\sqrt{\frac{.4}{4}+\frac{.4}{4}}} \approx -4.47$$

df = $(n_1\text{-}1) + (n_2\text{-}1)$ = (5-1) + (5-1) = 8

After calculating the "t" value, we need to know if it is large enough to reject the null hypothesis. The "t" is calculated under the assumption, called the null hypothesis, *that there are no differences between the pizza and beer diet. If this were true, when we repeatedly sample 10 people from the population and put them in our 2 diets, most often we would calculate a "t" of "0."*

The calculated t-value is 4.47 (notice, I've eliminated the unnecessary "-" sign), and the degrees of freedom are 8. In the research question we did not specify which diet should cause more weight gain, therefore this t-test is a so-called "2-tailed t."

In the last step, we need to find the critical value for a 2-tailed "t" with 8 degrees of freedom. *(This is available from tables that are in the back of any Statistics textbook).*

Look in the back for **"Critical Values of the t-distribution,"** or something similar. The value you should find is: **C.V.** $_{t(8),\ 2\text{-tailed}}$ **= 2.31.**

The calculated t-value of 4.47 is larger in magnitude than the C.V. of 2.31, therefore we can reject the null hypothesis. Even for a results section of journal article, this language is a bit too formal and general. It is more important to state the research result, namely:
Participants on the Beer diet (*M* = 4.00) gained significantly more weight than those on the Pizza diet (*M* = 2.00), t (8) = 4.47, p < .05 (two-tailed).