T-tests, P-values, Type I and Type II errors

1. Doing a T-test and finding a p-value.
   Before doing a T-test, you must first define the null hypothesis. If, for example, you want to see if the average annual number of days missed from work by an illegal drug user is a certain value, say 10, then your null hypothesis is as follows:
   \[ H_0 : \mu = 10 \]
   Of course, your alternative hypothesis is:
   \[ H_A : \mu \neq 10 \]
   To do the test, first go through the steps that give you the histogram and quantiles. In this window, click the red triangle next to the variable name and choose “Test Mean”. In the resulting window, type in the value of the mean you want to test in the space next to “Specify Hypothesized Mean”. In the above example, you would type in “10”. For now, leave the other spaces blank. Click OK.
   In the same window as your histogram, look for the section labeled “Test Mean=value”. (You might have to scroll right or down to see it.) The first four numbers are values you already know. The first number under “T-test” is the test statistic, the same number you would get by hand if you used the following formula:
   \[ t_s = \frac{\overline{Y} - \mu_0}{SE} \]
   The number beneath this is your p-value, although it is labeled “Prob<|t|”. The other two values are p-values for one-sided tests. We will cover one-sided tests in lecture soon.
   To see a graphical representation of the p-value, click the red triangle below these values and choose “PValue animation”. We’ll play with this feature in class.

2. Finding the probabilities of a Type I and Type II error, and power.
   Remember, the \( \alpha \)-level you choose determines the probability of a Type I error. To find \( \beta \), the probability of a Type II error, click on the red triangle beneath the p-values and choose Power Animation. The resulting screen will give you the values of \( \beta \) and the power of the test, along with a graphical representation of \( \beta \).