Tutorial: Hypothesis testing in Stata

In adults over 15 years of age, a resting heart rate around 80bpm is usually considered average. Using a subset of the Framingham cohort, we are going to attempt to make inference about heart rate among "healthy young" adults.

Specifically, we restrict our analysis to adults with the following characteristics at baseline: non-smoker, younger than 40, BMI less than 25, diastolic blood pressure less than 80, and systolic blood pressure less than 120. There are 61 participants who meet our criteria. We hypothesize that heart rate at the follow up exam in 1962 would be lower than 80bpm, the resting heart rate for adults with average health.

We are making the somewhat strong assumption that these Framingham participants are generalizable to the broader population of healthy young adults (this assumption is necessary if we want to make inference about heart rate in healthy young adults.) Use the dataset on this webpage to answer the following questions:

1. Make a histogram of heart rate at exam 2. Is the normality assumption reasonable?

```
histogram heartrte2
histogram heartrte2 if heartrte2 < 200
```

2. You are interested in whether the mean heart rate at exam 2 among healthy young adults is equal to 80bpm. Perform a hypothesis test at the $\alpha = 0.05$ level.

   (a) What test are you using?
   One-sample t-test

   (b) State your null and alternative hypothesis.

   $$H_0 : \mu = 80, H_A : \mu \neq 80$$

   (c) Perform the hypothesis test.

   Hypothesis testing in Stata: To examine options for t-tests in Stata, type `db ttest`.

   Or, using the dropdown menu, explore the options in
   Summaries, tables, and tests/Classical tests of hypothesis/.

```
. ttest heartrte2 == 80

One-sample t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
heartr~2 |      61    76.55738    2.800032    21.86895    70.95648    82.15827
------------------------------------------------------------------------------
    mean = mean(heartrte2)                                        t =  -1.2295
```

```
Ho: mean = 80                                 degrees of freedom =       60

    Ha: mean < 80               Ha: mean != 80                 Ha: mean > 80
 Pr(T < t) = 0.1118         Pr(|T| > |t|) = 0.2237          Pr(T > t) = 0.8882

. ttesti 61 76.557 21.869 80

One-sample t test
------------------------------------------------------------------------------
         |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       x |      61      76.557    2.800039      21.869    70.95609    82.15791
------------------------------------------------------------------------------
    mean = mean(x)                                                t =  -1.2296
Ho: mean = 80                                 degrees of freedom =       60

    Ha: mean < 80               Ha: mean != 80                 Ha: mean > 80
 Pr(T < t) = 0.1118         Pr(|T| > |t|) = 0.2236          Pr(T > t) = 0.8882
```

What are:

i. your test statistic, t = -1.22
ii. the distribution of your test statistic under the null hypothesis $t \sim t_{60}$
iii. the p-value, 0.2236
iv. your decision, and Fail to reject the null hypothesis.
v. your interpretation? We do not have enough evidence to suggest that the heart rate is different from 80 in healthy young adults at follow up.

3. As a diligent statistician, you decide to investigate the issue of the outlier in your dataset. List the information for the outlier.

```
. list if heartrte2 > 200
```

4. Repeat the hypothesis test, excluding this observation. What do you find?

```
. ttest heartrte2 == 80 if heartrte2 < 200
```

5. As the statistician, what results should you present in your analysis?