

## NR140 Group Work z-tests

On blackboard you have the global land and sea temperature anomalies from 1880 to 2016 as recorded by NASA (Source: NASA Goddard Institute for Space Studies, "Global Temperature Anomalies in 0.01 C" at **Global-mean monthly, seasonal, and annual means**, 1880-present, updated through most recent month) <https://data.giss.nasa.gov/gistemp/>

Typically, NASA climatologists use 1981-2010 as a **baseline climate "population"**. We have a column that labels each year as either "historical (pre 1981)", "baseline population (1981-2010)" or "Anthropocene (2011 on)".

Our task will be to **compare the mean Historical and Anthropocene Annual climate anomalies to this Baseline "population" annual anomaly using a one-sample z-test.**

I will get you started with information for some of the steps we need to consider when conducting an inferential test. Your job is to complete the rest of these steps (specifically answer the questions in red below).

**Let's start in JMP** so we can run our normality tests the easy way but keep in mind that you can run a one sample z-test in excel using the =ztest(array, pop\_mean, pop\_stdev) function.

*Note that we will be using the **Annual Anom J-D** data column (although climate data for all of the individual months and seasons is also included).*

Start with a comparison of **historical** era anomalies to the **baseline population** following our steps for any inferential test:

1. State the null hypotheses:  
H0a: **There is no difference between the mean of historical era annual anomalies and the baseline population mean.**
2. Set alpha level for the test  
**P<0.05**
3. Choose the appropriate test  
We are **comparing a sample mean (historical era) to a specified population (baseline population) mean.** This should be a one **sample z-test** as long as data is normally distributed.

4. Let's check for normality
  - a. Run a goodness of fit test on the **annual anom J-D** data column for the historical era (since this is the sample we want to test against the population, the sample is what we must test for normality)...so be sure to ANALYZE > DISTRIBUTION **by the era** categories.
  - b. **Report the p-value for the goodness of fit test for the historical data only**
  - c. **Is your historical annual anom normally distributed?**
5. Calculate the test statistic (in this case the one sample z-test). In order to run a one sample z-test in JMP we first need to know the **mean of the sample** we want to test and the **mean and standard deviation of the population** we are testing our sample against. Since all of our data is stacked in one column, we will need to separate our eras using the By Box in the Analyze > Distribution window.
  - a. Report the **mean of the baseline population** era annual anom J-D. This will be your hypothesized population mean that you test.
  - b. Report the **standard deviation** of the baseline population era annual anom J-D. This will be your hypothesized population standard deviation that you test
  - c. From the "TEST MEAN" window of the **historical era sample** that you want to compare to this baseline population, **report the obtained (calculated) z-test statistic.**
6. Compare and conclude: because JMP bypasses looking up a critical value and instead just gives you the actual p-value associated with the obtained test statistic we can just report and make conclusions from the reported p-value
  - a. Assuming that we were conducting a **non-directional (2-tailed test)** **report the correct p-value associated with this test.**
  - b. **Is there a significant difference between the historical sample annual anom and the baseline population?**
  - c. Describe any differences you find based on the statistical output in JMP (i.e. **which is higher or lower?**).
7. **Summarize: Write a concise on paragraph summary of this analysis.** Remember that any summary should include the following:
  - a. Statement of the research hypothesis or study objectives
  - b. Statement of the statistical results (including type of test and correct shorthand:  $z(n) =$  obtained value,  $p = 0.xxx$ )
  - c. Description of any differences along with any interpretation of why these results make sense (or don't make sense).
  - d. Implications or bigger picture that relates back to the study objectives?

Your final task is to repeat this whole process but this time comparing the few years we have in the “Anthropocene” era to the baseline population mean.

**Specifically, test to see if the Anthropocene Era has been significantly higher than the baseline population of climate anomalies.**

*To give you some perspective on why we would ask such a question: if we find that our recent Anthropocene era climate differs significantly from the baseline climate (our hypothesized population mean), it infers that our recent climate comes from a different population (i.e. the nature of climate itself has changed significantly and the climate we live in now does not come from the same population of temperatures that we consider our baseline “normal”. It would mean we are in a new Era of climate conditions.*

I won’t walk you through this step by step, but let you walk through the analysis on your own, ending by summarizing it all in a concise, clear paragraph.

*(keep in mind that you run the test mean analysis from within the distribution details of the SAMPLE population you are testing....and you enter the hypothesized population parameters)*

8. Summarize: **Write a concise on paragraph summary of the Anthropocene sample mean comparison to the baseline population.**