Instructions: This assessment provides students with an opportunity to study a real world geographic phenomenon through the application of the scientific method. Remember that the scientific method includes the following steps: observation, hypothesis formulation, selection of methods of analysis, data collection, analysis – hypothesis testing, hypothesis acceptance or rejection, and finally, reporting of results.

1. The first step of utilizing the scientific method includes observation.

Let’s say that you have visited the Sierra Nevada mountain range along the California/Nevada border. During your visit, you notice that the western slope appears to have more lush vegetation than the eastern slope and are curious as to why. Our experience lets us know that vegetation requires moisture in order to survive, and that more lush vegetation is found where precipitation occurs in abundance.

Question: Based on your observations of the spatial variation of vegetation on opposite sides of the slopes of the Sierra Nevada’s, could it be that the western slopes are perhaps rainier than the eastern slopes?

2. Step two involves formulating a hypothesis, which is essentially an “educated guess” or explanation as to what has caused a particular pattern. Given our initial observation, we suggest that there is a relationship between slope orientation and precipitation. A hypothesis is stated clearly and concisely so that it can be tested through data collection and analysis. When constructing a hypothesis, a scientist will actually formulate two hypotheses connected to their problem. The null hypothesis is a statement of no relationship, which is the hypothesis that we will ultimately reject or not reject. For example, a null hypothesis ($H_0$) about El Nino’s relationship on precipitation patterns in Peru might look like this:

$$H_0: \text{There is no relationship between El Nino events and higher than normal precipitation patterns in Peru.}$$

The alternative hypothesis (Ha) is a statement of relationship. The alternative hypothesis to the above statement would be:

$$H_a: \text{There is a relationship between slope orientation and precipitation.}$$
Question: With this in mind, what would a null and alternative hypothesis based on your observations of the spatial variations in vegetation patterns on the western and eastern slopes of the Sierra Nevada's look like?

3. The next step involves selecting an **appropriate method of analysis** to test our hypothesis. While there are a variety of potential quantitative or qualitative methods to test our hypothesis, one particularly effective method for testing this hypothesis could involve the calculation of the average precipitation for the western and eastern slopes and apply a difference of means test, also known as a t-test.

4. In order to test our hypothesis, we must collect a sample of data. For most cases, a sample set of 30 will suffice/ Primary data can be collected in the field and analyzed, but since we are not able to visit the field site at this time, we will rely on secondary data that has already been published for testing our hypothesis. To provide an idea of how this process works, we will take a small portion of the data sets. Check out the following data and answer the question that follows.

**Annual Precipitation for Truckee**, (years on record: 106); Latitude = 39 deg N

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<th>JAN</th>
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<tr>
<td><strong>IN</strong></td>
<td>30.2</td>
<td>5.8</td>
<td>4.3</td>
<td>2.0</td>
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<td>0.4</td>
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**Annual Precipitation for Reno**, (years on record: 50); Latitude = 39 deg N

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<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.8</td>
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Data Source: weatherbase.com

Distance between Truckee and Reno: 25 miles (data source: www.indo.com/distance/)

Question: Based on these data tables, which one of these cities do you suppose is located on the western slopes of the Sierra Nevada mountain range and which one rests on the eastern slopes of the range?

Question: Now look up the precipitation data for a couple of points a little further south, but situated at similar latitudes – Tahoe City and Carson City. Start by identifying their respective latitudes, then record their precipitation statistics (found on the secondary source weatherbase.com). Analyze the precipitation statistics – based on your review of these, which city do you believe is located on the western slopes of the Sierra Nevada range and which city is on the eastern slopes? Then, using the indo.com/distance website, identify the distance these two communities are apart in terms of miles.
5. The next step in the scientific method involves **testing the hypothesis**. In geography, we often begin our analysis using some technique to visualize the spatial pattern of precipitation. See the map below for an example of this in the Sierra Nevada region and answer the following question.

![Map of Oct-Mar Precipitation](image)

**Question:** Check the region along the California-Nevada border between 30 and 40 degrees North latitude. What colors/precipitation ranges do you notice on the Nevada side of the border and what colors/precipitation ranges do you notice on the California side of the border in this latitudinal zone? (Map Source: eng.ucmerced.edu)

Another method for testing the hypothesis can be to develop a graph of precipitation with the y-axis scaled for precipitation and x-axis for distance between locations along a transect. Statistics describing the data are usually calculated and the mean or average of each data set (west side and east side of the mountains) are determined. Finally the hypothesis is tested using the difference of means test, but we will save that calculation process for an upper division geography course.

6. One of the last steps after the testing of the hypothesis is to **either accept or reject our null hypothesis**. In reality, we can’t necessarily prove our hypothesis correct – rather, we can only disprove it based on our analysis. That is, we reject the null hypothesis that there is no difference in precipitation based on the data that we have collected. If new data or better data collection techniques are available in the future, they may lead us to conclude that we cannot reject our null hypothesis. Hence it is hard to prove a hypothesis is correct as new information and understanding may present itself in the future.

**Question:** While we don’t necessarily have a complete data set in this case, review the null hypothesis you created after step 2 in our journey. Then review the statistics provided on Truckee and Reno along with the statistics you assembled on Tahoe City and Carson City. Finally, review the map data on precipitation along the California/Nevada border under step 5. After reviewing this sample set of statistical and
spatial data, do you feel that you should reject or not reject the null hypothesis you developed? Why or why not?

7. The last step in the scientific method process involves reporting results. This provides others with an opportunity to review our work and test our hypothesis under different circumstances. If our null hypothesis is rejected we can turn to our alternative hypothesis or restate the null hypothesis in a different way.

Question: With this final step in mind, if you were to write a brief one paragraph summary of this exercise reporting your results based on the hypothesis you formulated.