Comparing Two Race Cars
Racer Lab 1

Introduction

In this lab, you will be playing an online racing game. **Your goal is to determine whether the Bayes car or the Gauss car is faster.** Each car you select can be raced multiple times on a track and the time to complete each race will be recorded. After you race the cars, the data will be available for you to analyze.

To play *Racer,* go to the following URL: https://stat2games.sites.grinnell.edu.

- Click on the **Racer** tab, then click **Play Racer** (Note: *This site may take a few minutes to load.*)

Your instructor will give you a **Group ID,** which will be identical for every person in the class.
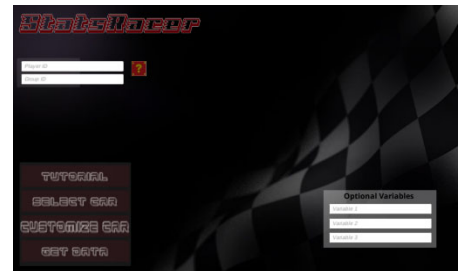
1. Record your Group ID below.

    Group ID: _____

Input a **Player ID**. This will be on the internet, so you probably *do not want to use a name that will identify you.*

2. Record your Player ID:

    Player ID: _____

3. Click on the **Tutorial** button and complete the tutorial

Task #1: Designing an Experiment

<u>Individual/Small Group Work</u>: Work with your nearest neighbor, and **design an experiment** that outlines the data collection strategy that you will implement to determine **whether the Bayes car or the Gauss car is faster on the oval track**. Each person in your class will play the game to collect this data. Your data collection strategy should allow you to conduct a hypothesis test.

State the null and alternative hypotheses, in words or symbols? Before stating the hypothesis think carefully how you plan to analyze the data that will be collected.

What is the explanatory variable?

What is the response variable?

What are the units for the data?

What data specifically needs to be recorded with each race?

What is the sample size?

<u>Confounding Variable Information</u>: In order to evaluate whether the car speeds are truly different, we should take into account possible **confounding variables** (variables that the researcher did not include in the study but that might be connected to both the independent variable and the dependent variable). For example, some race tracks are longer than others. We want to hold the track constant for everyone in your experiment to ensure that the type of track does not bias our results. Are there any other potential confounding variables that might get in the way of determining which car is faster?

<u>As a class</u>, decide on the exact protocol (instructions) for the experiment to generate the data. You need clear instructions so you can run the experiment the same every time. Write down the final instructions to collect data for this study. Specifically discuss how you will control for the potential confounding variables. If collecting data outside of class, clearly identify the timeframe for collecting data.

Task #2: Collect the data

Go to the web site https://stat2games.sites.grinnell.edu/ and select the **Racer** tab. *Ensure that you have the correct* **Player ID:** _____ **Group ID**: _____.

- **Follow the protocol decided upon for the class.**
- Click the **Select Car** button on the main menu.
- Use the **pull down menu on the top right to select a car**. Then select **Next**.
- Use the **red arrows** to select the **Oval Track**. Select the **Race** button.
- Use the arrow keys to race the car.

Record your own results:

1st Race: Car Type _____   Finishing Time _____

2nd Race: Car Type _____   Finishing Time _____

Calculate the difference in times: Bayes Time – Gauss Time: _____

Task #3: Examine and Analyze the Data

You can find the racer data at http://shiny.grinnell.edu/Racer_t-tests/.
Select the following options to help you compare the finish times of the Bayes and Gauss cars:
- Group ID [Find your Group ID]
- Level: **Choose Car**
- Player ID: **All**
- Track: **Oval**
- X Axis: **Body**
- Y Variable: **Finish Time** (or whatever variable you selected as your response variable)

Data Visualizations:

Does this graph evidence that a particular car is faster than the others? Briefly explain any patterns that you see. Sketch the most useful graph here.

Change the X Variable: **Order.** This is the order in which each car was raced for each player. If you see any patterns in this graph, describe the patterns, and explain why you think the pattern exists.

Change the X Variable: **PlayerID.** Do you see clear differences between players? How does this affect your analysis?

Were there any outliers or unusual observations in this data? Did some games take an unusually long time to complete? Should the outliers be removed or kept within the dataset? Why?

Examine the data. Were there any people who did not play the game the correct number of times? Can their data be included? Were there people who played the game using the same car? What do you do with their data? **Decide as a class, with your teacher taking notes, which data to use and what variable you will analyze.**

Explain whether you should use a two-sample t-test or a paired t-test for this experiment.

What is the final sample size available for your class' matched pairs data?

If you end up with a small sample size, it is particularly important to remember what assumptions are required to conduct a paired t-test?

How can you check that assumption using your calculator or computer?

What should you do if the needed assumption is not met?

Data Analysis:

If the data collections was conducted properly, you can use the app, http://shiny.grinnell.edu/Racer_t-tests/ to analyze your data. However, if you data was not properly collected, your instructor will provide a cleaned dataset for you. Use the data to conduct a test and make a decision about if there is a difference in the population average finishing time of the Bayes and Gauss cars.

Provide the test statistic and corresponding p-value:

Give the 95% confidence interval:

What conclusions can you draw about this experiment? Clearly state your **overall** recommendation to someone wanting to win a race on the oval track.

To receive credit for this lab, you must complete the evaluation at:
https://grinnell.co1.qualtrics.com/jfe/form/SV_0p4Cz8T1dveoAdf.