

## Tangrams: One Sample Hypothesis Test

### Background

Tangrams is an ancient Chinese puzzle where players arrange geometrically shaped pieces into a particular design by flipping, rotating, and moving them. The online Tangrams game allows students the opportunity to design many versions of the original game. You can go to the Tangrams website and leave all the variables blank when you are simply trying out the game. However, if you want to find your completion time in the database of results, a specific course (Group Name) will be needed. In this activity you play the role of a statistician as you design a study, collect data, and then analyze and interpret the results.

Play the Tangrams game one time using the following settings:

Go to the web site <https://stat2games.sites.grinnell.edu/> and select the Tangrams tab.

a. Enter Player information

- **Player ID:** Use a secret name, any combination of letters and numbers with no spaces. Do not use your name or a term that will identify you.
- **Group ID:** *(given by your instructor)*

[select **PLAY**]

b. Select Puzzle Type: *(given by your instructor)*

c. Time Limit: **No Limit**

d. Select: **Display Timer**

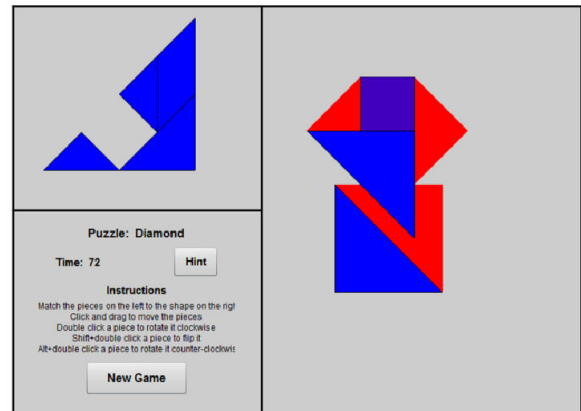
e. Select: **Hints Enabled**

[select **START**]

### Conduct a hypothesis test about students in our course

(e.g. on average can students complete a particular puzzle in less than \_\_\_ seconds?)

1. State the null and alternative hypotheses corresponding to the objective of this study.



2. All students in the class should play the game. Each student will be considered a subject in this study. In this test, we are simply conducting a test on game completion time. However, we want to make the conditions as similar as possible for all subjects. Determine the settings for each of the following variables on the Tangram Game:

Select Puzzle Type:

Time Limit:

Display Timer:

Hints Enabled:

3. List any other conditions that should be controlled during this study. After the settings/conditions have been defined, each student should play the game one time.

4. Why is it important to attempt to ensure that all subjects play the game under the same conditions?

5. After all students complete the game, go to <http://shiny.grinnell.edu/tangrams/> to view all data from our study (use same Group ID as above). Copy and paste the data into Minitab, Excel, or other statistical software package.

Create a graph of your data. Identify any outliers or skewness shown in the plot. Identify any potential errors in the data (use the Player ID to identify specific data). Correct or delete the erroneous data. Briefly explain any changes you made to the data set and describe why you made these changes.

6. Use appropriate statistical techniques to calculate a p-value for your study.

7. What assumptions need to be checked before we can conclude the analysis in Question 6) is appropriate? For example, did keeping or removing the outliers influence the results? If some of the students used hints and others did not, are the results biased?

8. State your conclusions *in context*. For example, explain whether we can use this data to conclude that our results hold for all students at our school. In addition, if the model assumptions were not perfectly met, explain how your results might be influenced.

9. Create a 95% confidence interval for the mean, use the form  $(a, b)$  where  $a$  represents the lower bound and  $b$  represents the upper bound.

10. Identify which of the following statements are proper interpretations of a confidence interval. If a statement is not correct, explain why.

\_\_\_ We are 95% confident that the true average time it takes students to complete the Tangrams game is in the interval  $(a, b)$ .

\_\_\_ We are 95% certain that each student takes approximately  $a$  to  $b$  seconds to complete the Tangrams game.

\_\_\_ We expect 95% of the students to have completion times between  $a$  and  $b$  seconds.

\_\_\_ We expect about 95% of all possible sample means from this population to be between  $a$  and  $b$  seconds.