

## Defenders Lab 1: Comparing Two Medicines

### Introduction

In this lab, you will be playing an online videogame, **Defenders**. In this game, there is an outbreak of new viruses. Two potential medicines are currently being tested to stop the viruses from spreading. For simplicity, we will refer to them as **Med R** and **Med B**. Both have shown some evidence of success when compared against a placebo. However, neither is 100% effective and more testing is needed to determine which treatment is best. Your task is to determine the best treatment strategy to stop the spread of the viruses.

Go to the web site: <https://stat2games.sites.grinnell.edu>.

Click on the **Defenders** tab, then click **Play Defenders**

Note: **This site may take a few minutes to load.**

- Input your own **Player ID**: This will be on the web. **Do not use a player name that will identify you.** However, make sure you print your Player ID on this worksheet. Player ID \_\_\_\_\_.
- Your instructor will tell you your **Group ID** \_\_\_\_\_. **Every person in the class should have an identical Group ID.**
- Click the yellow play button:
- Click on the blue land to complete the **Tutorial**.



### TASK #1: Collecting Level 1 Information

After entering Level 1, select **Pillshooter Fast Lvl1** with **Med R** at Location 1 and **Pillshooter Fast Lvl1** with **Med B** at Location 3.

\*Pillshooter Fast Lvl1 is the upgrade of Pillshooter. The upgrade action can be completed after you choose the medicine for the turrets.

**Wave1:** Click the **Start Wave** button and record your results for **Wave 1** (the first Round) below.

**Med R Effectiveness** \_\_\_\_\_

**Med B Effectiveness** \_\_\_\_\_

**Wave2:** Using the same settings, click the **Start Wave** button and record your results after **Wave 2** below.

**Med R Effectiveness** \_\_\_\_\_

**Med B Effectiveness** \_\_\_\_\_

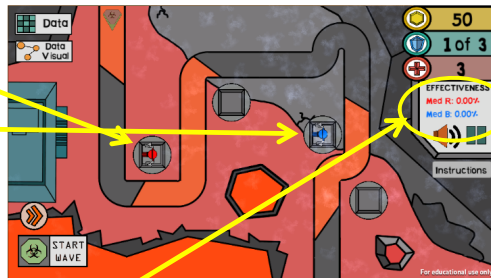
**Strategy for Wave 3:** After Wave 2, hover over the Start Wave button and you will see that there will be 5 Red and 25 Blue Enemies in Wave 3. Do not make any changes to the location or upgrades in each turret. Provide a strategy *only based upon changing the type of medicine* for **Wave 3**. Will you use Med R for both locations, Med B for both locations, or some other combination?

Location 1 Med \_\_\_\_ Location 3 Med \_\_\_\_

**Play Wave 3** and record your results:

**Remaining Funds at the end of Level 1** \_\_\_\_\_

**Med R Effectiveness** \_\_\_\_\_ **Med B Effectiveness** \_\_\_\_\_



## TASK #2: Conduct a Hypothesis Test for Level 1:

Conduct a hypothesis test to determine if there is a difference between the effectiveness of the two medicines.

**Gather Data:** There are two ways to do this

- Click the **Show Data** button and sum your results for Level 1.
- (slightly easier) Click on the **Data Visuals** button, and choose **Bar Chart** for the dropdown that currently displays "Dot Plots" and sum the total number of destroyed and shot for each medicine.

**Med R:** Destroyed \_\_\_\_\_ Shot \_\_\_\_\_      **Med B:** Destroyed \_\_\_\_\_ Shot \_\_\_\_\_  
**Med R Effectiveness = Destroyed/Shot = \_\_\_\_\_**      **Med B Effectiveness = Destroyed/Shot = \_\_\_\_\_**

Write the research question of interest. Make sure to identify whether you are testing proportions, counts or averages. State your null and alternative hypothesis:

Describe an appropriate population for this study.

What are the population parameters of interest?

Calculate the p-value from your data and state your conclusions below. After completing Level 1, can you conclude there is a difference in the effectiveness of the medicines? How confident are you in your conclusions?

**Commented [KS1]:** If students left the Level 1 page, they can still view data by selecting the See Previous Data button on the Menu page.



### TASK #3: Use data visualizations and charts to explore the data

Click on the **Data Visuals** button, and choose **Percent Destroyed** for the dropdown that currently displays “Total Shots” and check the **Show Averages** check box. Hover over each of the points representing averages on the graph and record the following:

**Med R:** Percent Red Enemy Destroyed \_\_\_\_\_ Percent Blue Enemy Destroyed \_\_\_\_\_  
**Med B:** Percent Red Enemy Destroyed \_\_\_\_\_ Percent Blue Enemy Destroyed \_\_\_\_\_

\*Note that Percent Destroyed is the same as the effectiveness of the medicine against that enemy.

In the **Data Visuals**, change **Dot Plot** to **Bar Chart** and record the following information:

Med R	Destroyed	Missed	Total Shots	Med B	Destroyed	Missed	Total Shots
Red Enemy				Red Enemy			
Blue Enemy				Blue Enemy			
Total				Total			

What information do these graphs provide? In particular, does there appear to be a pattern between the effectiveness of the medicine and the type of enemy? Knowing that a majority of Wave 3 enemies are blue, should you make any changes to your strategy? If so, what medicines will you use?

Location 1 Med \_\_\_\_ Location 3 Med \_\_\_\_ Instructor's signature \_\_\_\_\_

#### More Graphs

**Graph 1:** Go to the app that shows data for every player: [http://shiny.grinnell.edu/Defenders\\_Visualizations/](http://shiny.grinnell.edu/Defenders_Visualizations/). Create a graph (using only Level 1 data) that provides evidence that the effectiveness of the medicines depends on the type of enemy. Take a screenshot of the graph and post it below.

**Graph 2:** Create a graph (using only Level 1 data) that helps you determine whether the effectiveness of the medicines depends upon the wave. Take a screenshot of the graph, post it below, and state your conclusions.

**Graph 3:** Create a graph (using only Level 1 data) that helps you determine whether the effectiveness of the medicines depends upon the type of upgrade. Take a screenshot of the graph, post it below, and state your conclusions.

**Commented [KS2]:** If students left the Level 1 page, they can still view data by selecting the See Previous Data button on the Menu page.



**Commented [KS3]:** Students should be able to

1. Identify variables that they want to graph.
2. Identify potential graph features, such as color, shape, size, and direction (i.e. horizontal axis, vertical axis, radial axis, etc...)
3. Determine which graph features will be used to represent each variable.
4. Determine whether it is important to be able to identify each unit within the graph.
5. Discuss what the graph means (and what conclusions can be drawn).
6. After the graph is created, students should be able to identify and discuss patterns in the data. Teachers and students should discuss
  - What patterns are clear in particular graphs?
  - What patterns are missing or not very clear?
  - Would choosing a different graph feature better enable people to see a pattern?
  - Do the title, legend, and labels help the reader better identify and understand the patterns?

**Commented [KS4]:** Students can use this app or download the data and create their own graphs on different software.

- If you “download data” directly from the game, it will be raw data.
- If you download data from the app, it will be cleaned and filtered based on the variables selected.

**Commented [KS5]:** This can lead to multiple questions.

- 1) Should we create a graph with a few data points or a graph based upon a large sample size?
- 2) How many samples are needed before we feel we have “evidence”?
- 3) What is the challenge of only using data from playing the game 1 time?
- 4) Are there challenges with possible confounding variables if we use all the data in the data base?
- 5) Using only the data with our Group ID may be the best option as it has a larger sample size and also likely eliminates the impact of unknown variables.
- 6) There is more than one way to create a meaningful graph for this question.
- 7) Currently this app only creates dotplots and boxplots. Why is it helpful to overlay a boxplot on the dotplots?
- 8) Would a bar chart provide better information? Why?

**TASK #4:**

With this additional information provided from Task #3, design a strategy that you believe would give the best performance for Level 1. List the medicine type (Med R or Med B) and upgrade (Fast, Far, None) for each location you use for each wave.

Wave 1	Wave 2	Wave 3
Location ___ Med ___ Upgrade _____	Location ___ Med ___ Upgrade _____	Location ___ Med ___ Upgrade _____
Location ___ Med ___ Upgrade _____	Location ___ Med ___ Upgrade _____	Location ___ Med ___ Upgrade _____
Location ___ Med ___ Upgrade _____	Location ___ Med ___ Upgrade _____	Location ___ Med ___ Upgrade _____
Location ___ Med ___ Upgrade _____	Location ___ Med ___ Upgrade _____	Location ___ Med ___ Upgrade _____

Remaining Funds at the end of Level 1 \_\_\_\_\_ Health \_\_\_\_\_

Did your performance (total funds and health at the end of the level) improve? Describe why you believe the strategy used in Task #4 is better than (or worse) than the one used in Task #1 or Task #3.

In making a decision about which medicine to use, how valuable is a statistical test? What are potential issues with using only statistics in making such a decision? What, if any, other considerations should be used?

**Task #5:** Read the ASA's statement on statistical significance and p-values,

<https://amstat.tandfonline.com/doi/pdf/10.1080/00031305.2016.1154108?needAccess=true>. Selected one of the six principles and write one to two paragraphs discussing this principle. Then, briefly discuss how that principle applies to this Defenders activity.

**Commented [KS6]:** Share best scores in the class and ask

Discussion Questions:

- 1) What information was the most helpful in determining a winning strategy?
- 2) What additional information would be helpful in ensuring that you have a "best" strategy?
- 3) Do you believe the best score for this game is determined by luck or by understanding the patterns within the game?