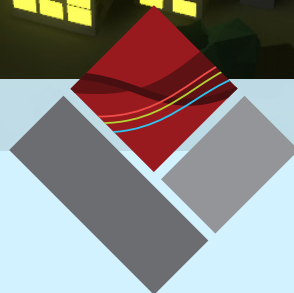




# DEADLY DISTRIBUTION

INSTRUCTOR'S GUIDE



VIRTUAL LEARNING  
EXPERIENCES

**The K20 Center** for Educational and Community Renewal is a statewide education research and development center which promotes innovative learning through school-university-community collaborations. Our mission is to cultivate a collaborative network engaged in research and outreach that creates and sustains innovation and transformation through leadership development, shared learning, and authentic technology integration.

The K20 Center's **Virtual Learning Experiences (VLE)** development team is tasked with creating game-based learning experiences to be used in undergraduate courses at the University of Oklahoma. The experiences are designed and developed by a small team working with volunteer university professors.

The purpose of this guide is to support the effective integration of Deadly Distribution into your classroom teaching. This guide provides an overview of the game's narrative, mechanics, and missions.

# TABLE OF CONTENTS

## **4 About the Game**

4 Purpose & Game Narrative

## **5 Playing the Game**

5 Data Collection

6 User Interface

## **9 Missions**

## **11 Contacts & References**

# ABOUT THE GAME

## PURPOSE

Deadly Distribution is based on actual models used in epidemiology and authentic statistical analysis. By playing through this game, the student is getting experience using statistics to solve a problem. This experience is invaluable in helping students connect the abstract concepts learned in statistics class through application.

The instruction contained in Deadly Distribution focuses on basic statistical principals, paying close attention to the concepts of *sampling distribution*, the *Central Limit Theorem*, and *confidence intervals*. Research has shown that students have difficulty understanding these concepts (Hagtvedt, Jones & Jones, 2007). This may be due to performance anxiety and a failure of the instruction to develop subject knowledge in context to real-world applications.

Deadly Distribution is designed to provide students with the opportunity to explore and learn these concepts in a low-stress environment where the information is delivered within the context of a real world situation. This allows the students to build a better understanding of the connection between the statistical concepts and their application.

## GAME NARRATIVE

A pandemic threatens the lives of the people of the peaceful nation of Kalgana. Several new and deadly diseases have been discovered spreading quickly amongst the populace, and as the nation's Regional Director for Disease Control, the student has been put in charge of monitoring the situation and managing how treatments are distributed.

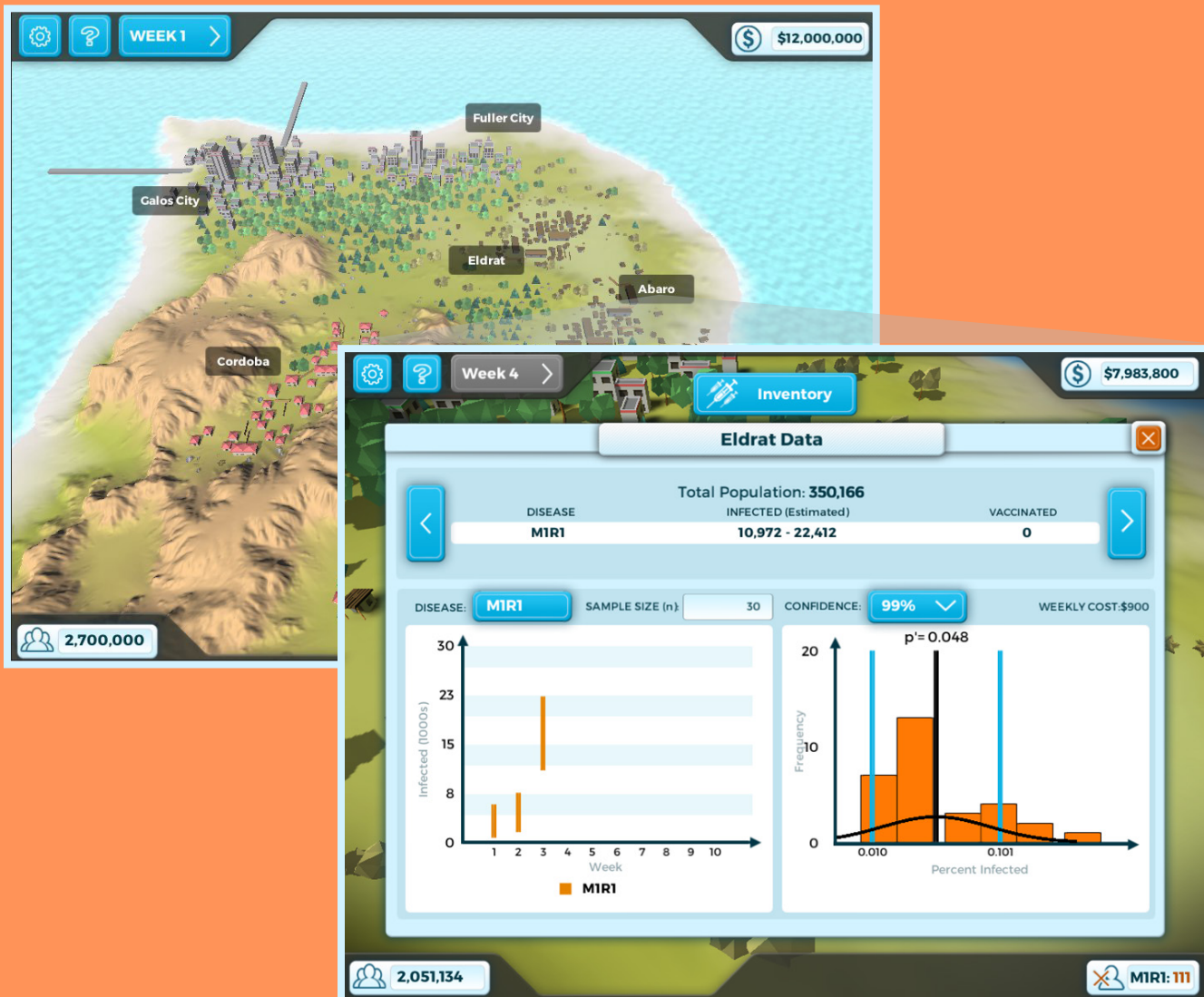
Students will have the opportunity to establish population studies to identify and track the infected, distribute medication and vaccines to combat the diseases, and if all else fails, quarantine a region to prevent the diseases from spreading. Using their understanding of statistical concepts, students will analyze the data provided by their studies to determine which treatments to use and when to seal off regions to prevent outbreaks.

# PLAYING THE GAME

## DATA COLLECTION

The primary gameplay revolves around setting up population studies and then interpreting the data to track a disease. The student can set a sample size and confidence interval, which will then result in data being collected and presented on the following week (in game time). This data is displayed both as a histogram and as week-by-week trend data that shows the estimated number of infected found through the study and any treatments the student may have used. Between these two graphs, the student can judge how fast the disease is spreading and how well their treatments are affecting it, eventually using that knowledge to eradicate diseases in each region.

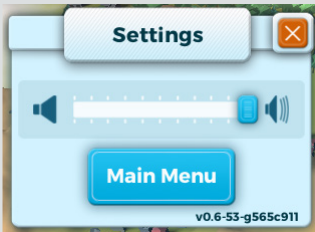
Students should be encouraged to use all of the statistical tools at their disposal. Altering sample size can adjust the cost versus accuracy of the study. Tracking the history of the disease and monitoring the mean estimated infected can help students predict possible outbreaks (where diseases spread to different regions). Observing the histogram will allow students to better understand how sample size and confidence interact with variance of a sample.



# USER INTERFACE

## Settings Menu

The Settings Menu contains the game's volume control and allows the student to return to the main menu at any time.



## HELP

Statistics Concepts

Game Concepts

### Random Sampling

Random sampling is concerned with the random selection of a subset of individuals within a statistical population. Thus allowing for a smaller subset of samples to represent a larger total population for statistical inference.

### Sample Size

The sample size ( $n$ ) is one of the most important elements in any study in which the goal is to make inferences about a total population. The larger the sample size the more accurate the data.

### Sample Distribution

Any sample drawn from a population is really only one from a huge variety of possible samples. The set of all mean value of possible samples is the Sample Distribution. This acts to simplify the numbers so that we can make statistical inferences from them.

### Sample Mean

The Sample Mean ( $\bar{x}$ ) is an arithmetic mean of all samples pulled from a given

## Help Menu

The Help Menu supplies gameplay concepts such as budget information and win conditions. The Help Menu supplies important information about how the game works and the statistics concepts the game is designed to teach.

## Next Week Button

The game tracks time in weeks. Each week, diseases will spread, new study data will become available, and new treatments will arrive. Once the student has accomplished all of the actions they intended to take, click the "Next Week" button to move forward.



## Budget

The budget total will be displayed in the upper right corner of the screen and students will begin each mission with a set amount. Treatments, Quarantines, and Studies all subtract from the starting budget. If the budget reaches zero before eradicating the disease, students will fail the mission.

## Population

Population totals for all regions are displayed on the lower left corner of the screen.

## Deaths

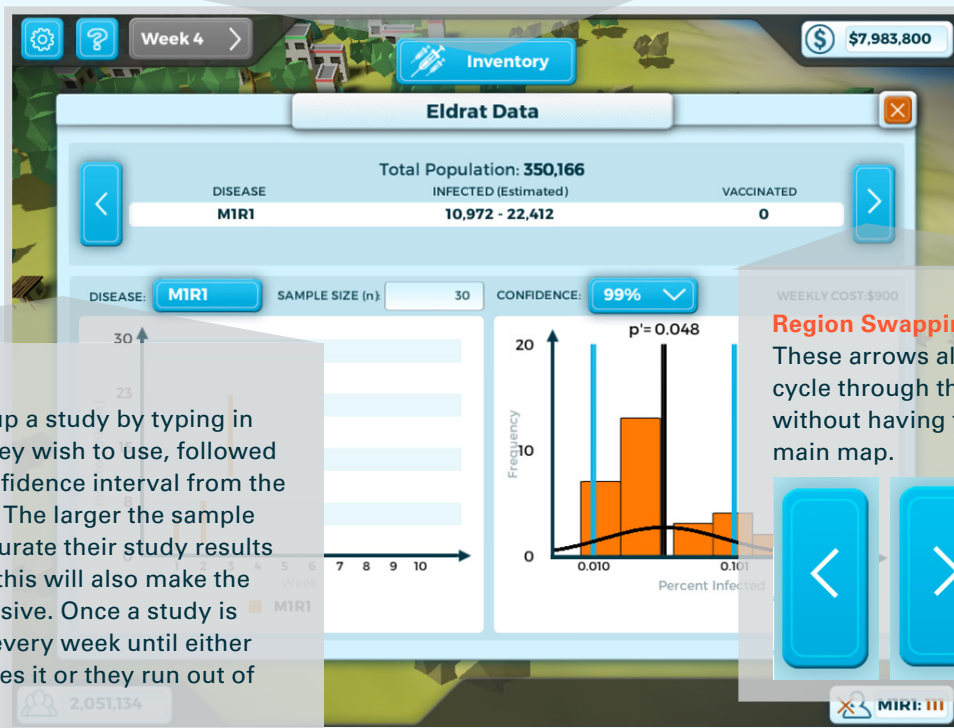
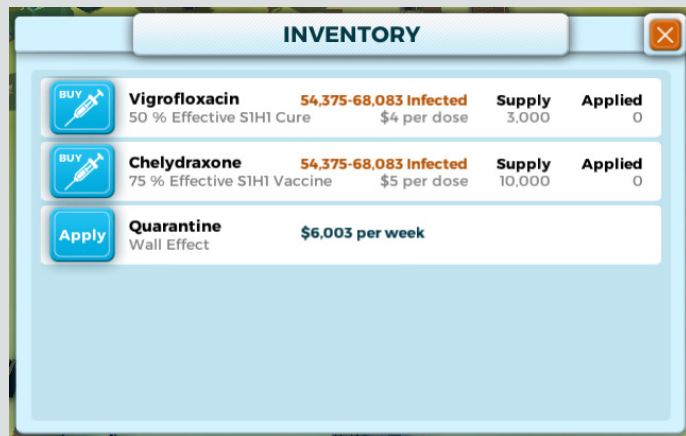
Nationwide death totals attributed to each disease are displayed in the lower right corner of the screen.

### Region Data Panel

The Region Data Panel updates each week with new data about the region. You can access the Region Data Panel by clicking on any region of the map. This panel contains the most important tools in the game. It is here that the student sets up their studies and views the results of those studies. Studies must be set up for each disease and each region independently.

#### Inventory

The inventory lists all treatments that are currently available for use. Inventory is accessed by clicking the "Inventory" button at the top of the Region Data Panel.

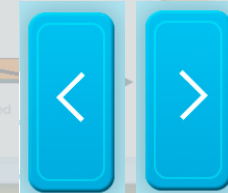


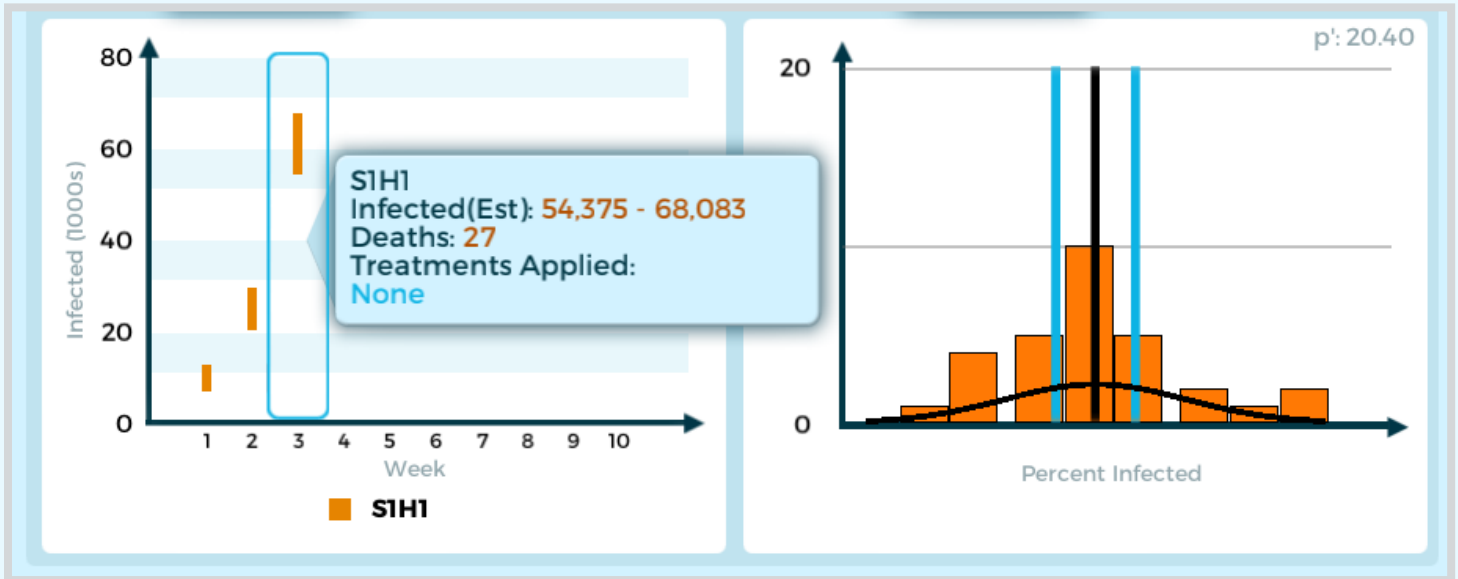
#### Study Setup

The student sets up a study by typing in the sample size they wish to use, followed by choosing a confidence interval from the drop down menu. The larger the sample size, the more accurate their study results will be. However, this will also make the study more expensive. Once a study is set up, it will run every week until either the student changes it or they run out of money.

#### Region Swapping Arrows

These arrows allow the student to cycle through the nation's regions without having to return to the main map.





### Trend Graph

This graph displays the week-by-week history of the samples the student has taken. The vertical bars represent the range of samples. The length of the bars is dependent upon the standard deviation of the student's study. The actual number of infected is likely to be somewhere within this range, based on the confidence interval the student selects. More detailed information will appear by hovering over a data point on the graph.

### Histogram

The histogram acts as a snapshot of the student's sample for each week.

Hovering over the histogram provides more detailed information. Students can use the histogram to help gauge the accuracy of their studies and to help predict the occurrence of outbreaks.





## MISSIONS

Deadly Distribution is divided into four missions. Each mission has a single end goal: to contain and eradicate the diseases spreading across the country. Students will use estimation and random sampling to locate and track the diseases occurring in each mission and then use their understanding of sampling distribution to judge how best to treat the diseases. When a student successfully completes a mission it will unlock the next one, each becoming progressively more difficult and requiring the student to use all the skills and techniques they learned in the previous missions to complete those that follow.



### MISSION 1

The Republic of Kalgana has become a hot bed for new and deadly diseases in recent years. Right now, we are tracking a disease that has appeared in one of the poorer southern provinces. The disease has been given the designation "S1H1". It is spreading quickly amongst the populace, and we fear it will soon pass into the adjoining provinces.

As Regional Director for Disease Control, your job will be to track, contain, and eradicate this disease before it can overtake the entire region. It will take a week or so for the first batch of treatments to get to you, but we do have some tools ready for you to begin studying and tracking the disease.

This mission is relatively simple and acts as an introduction to the gameplay mechanics and the concepts the game is designed to teach. Only four of the nation's regions are used, and only a single disease is present.



### MISSION 2

You did a good job dealing with the spread of that last disease; however it looks like a new disease designated "S1H2" has managed to spread into an adjoining province. This one is proving significantly more deadly and appears to be spreading faster.

The disease is still susceptible to the treatments we have on hand so we are shipping a batch out to you as fast as possible. With some research, we should have some more effective treatments ready in a few weeks. Keep your eyes on the data and I'm sure you'll have no problem dealing with this situation. This second scenario adds a fifth region and uses a more lethal disease which will spread much more rapidly. It also adds a limited supply of more effective treatments for the student to use and experiment with.



### MISSION 3

You've handled diseases in the southern provinces admirably, but now we have reports that a new disease, designated "M1R1," has appeared in several regions across the nation. The disease does not appear to be spreading very quickly, but it is extremely lethal.

With the disease appearing in so many regions simultaneously, you will have to keep a closer eye on things and use the data to prioritize your actions. As always, your resources are limited so you will need to make every treatment count. Good Luck!

This mission forces the student to deal with two regions all infected simultaneously from the start of the mission. As a result they have to pay closer attention to the data to make best use of their limited resources.



### MISSION 4

The entire Republic of Kalgana is on alert as more cases of infection have been detected spreading across the nation. All seven of the nation's provinces are in danger. Despite your best efforts a new deadly disease with a high rate of infection has appeared.

This fourth and final mission covers all seven regions of the nation of Kalgana and contains an extremely fast spreading disease that also has a high death rate.

# CONTACTS

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## REFERENCES

Hagtvedt, R., Jones, G. T., & Jones, K. (2007). Pedagogical simulation of sampling distributions and the Central Limit Theorem. *Teaching Statistics*, 29(3), 94-97.



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