Cindy Phillips June 2024

Week 6 Data Driven Assignment:
Modeling the initial phase of disease spread using COVID data

Assignment:
Data can be used to engage students and bridge their classroom investigations to research done beyond the classroom. Data-driven decision making and student-centered investigations are highly valued by The Next Generation Science Standards and Common Core State Standards. Data-driven classroom activities are key to integrated STEM.
1. Select a data source on which to focus this assignment. Your instructors provide many examples in the live sessions, discussions and resource page for this course. You may use one that you find outside this course as well.
2. Components of the assignment: a) Data source: provide a title for the data and the SPECIFIC link for access. b) Lesson Enhancement: Describe how the data enhances a topic that you currently teach or plan to teach. Include a 1 paragraph statement about your personal feelings regarding using data. c) Interdisciplinary context: How can the data be used to create interdisciplinary lessons, discussions or activities in your classroom. How can you connect to multiple content areas?

Note to reader:
Since this is exactly what I am trying to do on my sabbatical, I decided to use this assignment as an opportunity to work on a full unit on Exponential Curves for Algebra 1, with extensions to Algebra 2 and Calculus.

Because of this, there is a lot of “extra” that is not part of the assignment.

Please consider “Lesson 4” as my assignment submission which starts on page 15.

This, in its entirety, is a work in progress, but consider this submission “finished enough.”

Cindy Phillips

Data Driven Lesson Plans: Modeling Initial Stages of Disease Spread

Audience: Algebra 1 or Pre-Algebra, introduction to exponential growth
Prior knowledge: How to determine an average rate of change, the units of measure of average rates of change, and a full understanding of linear equations.
Extensions: Algebra 1 through Calculus

Reference

- Based on article on curve fitting to COVID data https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7328553/
- NYS COVID raw data for this activity: https://coronavirus.health.ny.gov/cases-age
- More data as extension opportunity, from World Health Organization https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200615-covid-19-sitrep-147.pdf?sfvrsn=2497a605_2
- More data, as extension opportunity, from Google https://health.google.com/covid-19/open-data/

Table of contents

Lesson 1: Simulation of Disease spread and making predictions about the model

Lesson Goal: Create a disease-spread simulation and make predictions about the graph of the outcome. At the end of the lesson, students will revisit their predictions and make changes based on the simulation.

Subject: Algebra 1 ***Materials Needed:*** Graphing calculator and index cards

Learning Objectives: Students will make predictions about disease spread, participate in a simulation on disease spread, look at the data, revisit their predictions and make changes based on the simulation.

Standards:

Insert more standards here

AI-S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

Teaching goal(s) for the Lesson (what you want students to know and understand):

Math-specific goals

- Understand why we might need to pretend there are twice as many people in the class as there actually are
- Understand that growth curves don't have to be lines, and that this particular curve increases in two different ways through the simulation.

Other goals

- Students will start to make predictions and connections between this simulation and how it can be applied in real life situations

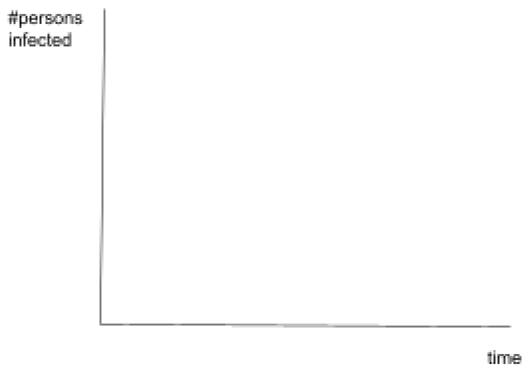
Identify Barriers to Learning for Students:

Introduction (**Warm up motivation)**
Ask for a volunteer of someone who wants to go on some "exotic" trip somewhere. Ask them where they want to go.

Use that student and their chosen trip to say that this person went on this exotic trip and came back with some communicable, rare disease that is airborne. Name it after the student, for added drama :) (Elicit understanding of the phrases "communicable" and "airborne," by asking the students if they think they understand what that means based on context clues, and if not, write these phrases on the board for them to see.)

Let's say * is spreading this disease to whomever they interact with, and that it is impossible for that person to get the same disease twice, but that every person they interact with also gets the disease and can spread it as well. Assume there are 30 students in the class, what would the graph of persons infected over time look like? Make a prediction!**

Give each student an index card, a dry-erase board, or use an online sharing platform to draw:



Implementation/Structure/Activity:

Making Predictions:

Collect cards and show what students think, and/or ask for volunteers to explain their reasoning. Do not indicate who is correct or not! Ask students if they have changed their minds based on seeing other graphs.

Simulation:

Use a random number generator to simulate the disease spread. This will only work with a critical mass of students, so perhaps if you don't have a good 25 students in class make a few fake student "guests" to take part. You can simply double the number of students in the class by giving each student a "date" to the class.

Give each student and their "date" if necessary a number. This number does not need to be random at all, except that the original student infected should be #1.

Use your graphing calculator to randomly generate integers between 1 and the total number of students (real and fake) there are in the class. The number of integers you generate should be the same as the current number of "infected" students.

Example: at t=0, the number of students infected is that one volunteer. Have the calculator generate ONE random integer that will represent who, at the end of this time period, is now infected.

Assume there are 50 total students in the class, real and not.

Iteration 1: Type **MATH RAND RANDINT (1, 50, 1)**. The first number indicates the starting integer, the second number represents the ending integer (50 total students) and the third number indicates how many random numbers betwee 1 and 50 will be generated. This will generate a list containing one number. That new number is now infected and is going to possibly infect others at the new round. It is possible that it will generate the number "1" which would indicate that the original infected person has not passed on the virus… they have passed it back on to themselves. Assume that #1 has infected person #5, real or fake.

Iteration 2:Type **MATH RAND RANDINT (1, 50, 2).** We are still working with students numbered 1-50, and 2 people are infecting and therefore 2 numbers in a list will be generated. Count by a show of hands how many total students are now infected. Important note: the random numer generator does not have a memory of who was previously infected! So although it is highly probable that there will be a total number of 4 people infected, that will not always be the case because the random number generator might "choose" to infect the same people again! This is what makes the activity fun for the kids… sometimes it takes many iterations to get all the student infected!

Make a table of values on the board: Ask for a student volunteer to be responsible for the table of values. This is a great opportunity to involve a student who is less confident mathematically or with English, as they can participate and be an important part of the lesson without actually having to verbally contribute to what is happening.

Iteration	Total number of infected
0	1
1	2
2	4
3	7
etc	

About halfway through the experiment, ask the students to revisit their original predictions and perhaps ask for new predictions.

Continue the experiment, and have a prize for the "last person standing," even if it's just bragging rights. 🙂

Note to teacher: the actual model here is a logistical model and is differential equation (calculus) based. The logistical model for disease spread starts off as exponential grown and at some *point, changes into logarithmic growth until the whole population is infected. The point at which the curve changes from exponential to logarithmic is called the "point of inflection" and theoretically happens when half of the population is infected. This lesson is given as an introduction of exponential curves (Algebra 1) with extensions into logarithmic curves (Algebra 2) and onward to differential equations (Calculus.)*

Graph the data with the students in whatever mode you think is useful for the level (by hand, using TI software, etc) and discuss the outcome.

Students should see that the graph goes up differently than a line, but also changes in the middle of the simulation.

Assessment (formative):
Reflection (exit ticket or verbal/online share-out)

- Did this match what you originally thought?
- Why do you think the curve looks the way it does?
- Do you think this curve would model all diseases that spread like this?

Lesson 2: Beginning Analysis of COVID data from multiple countries

Lesson Goal: Students will use graphical data to begin to analyze COVID data from multiple countries.

Subject: Algebra 1

Materials Needed: Graphing calculator and computer/internet connection

Standards:

- AI-N.Q.1 Select quantities and use units as a way to: i) interpret and guide the solution of multi-step problems; ii) choose and interpret units consistently in formulas; and iii) choose and interpret the scale and the origin in graphs and data displays.
- AI-F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). (Shared standard with Algebra II)
- AI-S.ID.6 Represent bivariate data on a scatter plot, and describe how the variables' values are related.

Learning Objectives/Teaching goal(s) for the Lesson (what you want students to know and understand):

Math-specific goals

- Students begin to analyze myriad graphs of COVID data by creating tables of values from graphs and looking at the average rates of change over different time periods
- Students will understand that when analyzing data, there are some common practices that are acceptable for doing so (ie: scaling axes by thousands or by "number of months since…" instead of labeling the date on an axis)
- Students will compare and contrast different graphs

Other goals

- Students will develop an understanding and appreciation for how scientists needed to analyze real-time data to inform policymakers on how to keep the public safe.
- Students will discuss limitations in not having access to actual data
- Language and literacy goals for analysis and reporting

Identify Barriers to Learning for Students: You may wish to give a trigger warning, as some students may have lost family members or suffered particularly hard times during COVID.

Introduction/Implementation/Structure/Activity:
See student handout on following pages.

- Intro of what the role of scientist was during the pandemic
- Analysis of sample graph for initial understanding of data
- “Grab” data from sample graph
- Analyze growth based on average rates of change
- Compare and contrast different graphs from different countries experiencing the same phenomena

Assessment: Student selected analysis at the end of the activity, rubric to follow

Name ______________________________ Date _________ Lesson #________

Student Worksheet: Beginning Data Analysis of COVID data

Lesson Goal: Students will use graphical data to begin to analyze COVID data from multiple countries.

Introduction: The COVID pandemic was a worldwide event that affected everyone in the planet, and teams of scientists and policymakers were tasked at how .

The way that scientists were able to study how the disease was moving through countries and communities was by studying data trends and making predictions as to what was going to happen in the future. This is how scientists were able to let everyone know when it was “safe” to return to “normal” activities.

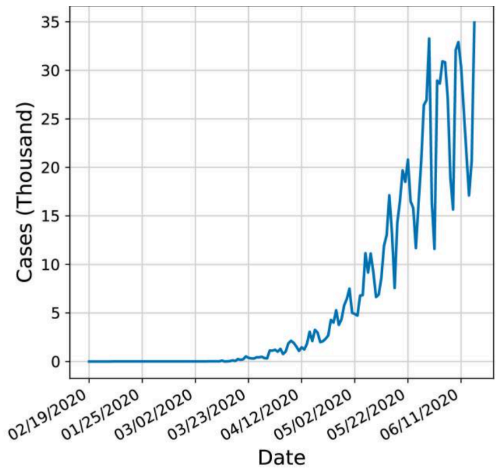
Scientists and mathematicians have a great wealth of knowledge and information to try to select the best “model” to “fit” the data. **A mathematical model is an equation that “best fits” the trend of the data**, as data is never “perfectly” linear or “perfectly” anything.

Scientists and mathematicians use real-life, real-time data and use appropriate mathematical modeling techniques to make important predictions for the future. Then policy makers and the use that information to address the public on what is happening and what they should do to stay safe and healthy.

(Side note: It takes a lot of experience and knowledge to understand what model is appropriate for data, and sometimes all of the evidence points to a certain model, but then the data-crunchers realize that maybe another model is better. Whenever new information is presented, data scientists have to revisit what they originally thought and make changes. When scientists “change their minds,” it is because new data might indicate that their previous models don’t tell the whole story.)

We are going to look at some patterns in actual data to see how we can model the spread of the diseases like scientists did during COVID.

Number of Daily confirmed cases of COVID (Brazil)



Understanding the Graph

1. Look at the y-axis scaling. According to the graph, if you see a y-axis value of 15, what does that "15" actually represent?

2. Look at the x-axis scaling? What discrepancy do you see?

3. According to a google search, the initial case of COVID was officially reported on 25 February 2020, in São Paulo. Does the graph reflect that? How can you tell?

Data source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7328553/

Analyzing the Data

4. Make an approximate table of values, stopping at 6/11/2020. This table won't be "perfect," but that's OK for this activity.

# of days from March 23, 2020	**Approximate number of cases, in thousands**
0 (March 23)	**1**

5. Find the **average rates of change for each time interval**. Remember that the average rate of change is the change in y divided by the change in x.

6. In what units would the average rate of change be measured?

7. Do the average rates of change going from one time interval to the next seem to be approximately the same each time? Or does the average rate of change seem to be changing by a lot?

Analysis: Select two countries from figure 5 in the article https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7328553/ and compare the graphs. Make a full discussion as to the similarities and differences between the two graphs. You may choose to make a table of values like we did in class, or not. In your analysis, you may want to address:

- Which countries did you choose to compare and why?
- Between what two months does the change seem the greatest?
- Which country seems to have been affected earlier?
- Which country seems to be affected "worse" and what do you mean by "worse"?
- Based on your personal experience with the pandemic, why do you think the curves are increasing at an increasing rate, versus increasing at a constant rate?

(Grading Rubric to be determined)

Lesson 3: Exponential versus Linear Growth

Lesson Goal: Students will be able to develop, write, and interpret models for exponential growth using the equation $y = a * b^x$ and/or $y = a(1 + r)^x$ and compare/contrast those equations with linear models.

Subject: Algebra 1

Materials Needed: Graphing calculator and computer/internet connection

Learning Objectives: Students will be able to develop, write, and interpret models for exponential growth using the equation $y = a * b^x$ and/or $y = a(1 + r)^x$ on different applicable situations: simple interest, value appreciation, etc.

Standards:

- AI-A.SSE.1b Interpret expressions by viewing one or more of their parts as a single entity. e.g., Interpret P(1 + r)n as the product of P and a factor not depending on P.
- AI-A.CED.1 Create equations and inequalities in one variable to represent a real-world context. (Shared standard with Algebra II)
- AI-A.CED.2 Create equations and linear inequalities in two variables to represent a real-world context.
- AI-F.BF.1 Write a function that describes a relationship between two quantities. ★ (Shared standard with Algebra II)
- AI-F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.
- AI-F.LE.1a Justify that a function is linear because it grows by equal differences over equal intervals, and that a function is exponential because it grows by equal factors over equal intervals.
- AI-F.LE.1c Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another, and therefore can be modeled exponentially.
- AI-F.LE.2 Construct a linear or exponential function symbolically given: i) a graph; ii) a description of the relationship; iii) two input-output pairs (include reading these from a table). (Shared standard with Algebra II)
- AI-F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

Teaching goal(s) for the Lesson (what you want students to know and understand):

Math-specific goals	**Other goals**
• Students will be able to develop, write, and interpret models for exponential growth using the equation $y = a * b^x$ and/or $y = a(1 + r)^x$ and compare/contrast those equations with linear models.	•

Identify Barriers to Learning for Students: Students may need a review on linear models y=ax+b

Introduction/Implementation:
Use simplified situations to illustrate basic principles of exponential growth functions
Lead the students to see that the equation that models this would be $y = a * b^x$, where a is the y-intercept, b is the growth factor, and lead them to see that this growth factor can also be represented by 1 + r, where r is the percentage rate of growth over a specified time period.

This will require a comparison of a 2-step method for finding a new value in a sequence that grows exponentially, i.e. multiplying a value by .03 and then adding to the original value or multiplying by 1.03 by getting the value in one step.

Structure/Activity:
Direct instruction and word problems as needed, either from Deltamath, text, online, testing platform.

Assessment:
as needed, either from Deltamath, text, online, testing platform.

Name ______________________________ Date _________ Lesson #________

Student Worksheet: Exponential versus Linear Growth

Lesson Goal: Students will write and interpret models for exponential growth, and compare/contrast those equations with linear models.

How does disease spread (grow)?
Recall: In a **linear growth situation,** we say that the graph is **INCREASING** (going up as we read from left to right) at a **CONSTANT** rate. This means that as the x-value increases by 1, the y-value will increase by **ADDING** the (approximate) same amount each time.

Here are some more graphs from other countries, and one that represents the global number of cases. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7328553/figure/fig0007/

Although there is great variability between the countries, the graphs are increasing in vaguely the same manner.

In a linear growth curve, to get to the “next” number in the table (if the x-values are increasing by 1), you are adding the same number every time.

In an exponential growth curve, to get to the “next” number in the table, what do you think you are doing to get to the next number every time? And what kind of number makes numbers bigger when you are multiplying?

A simple, practical example:
You get an apartment that costs $1600 per month, but that every year, the monthly rent increases by 4%. Make a table of values for how much the rent will be for each year in 10 years. Round to the nearest cent.

# of years after the first	Rent per month
0	$1200

What number do you have to multiply the first y-value by to get the second y-value?

**** Insert standard lesson, word problems, assessment on exponential growth**

Lesson 4: Modeling the initial phase of disease spread using COVID data

Lesson Goal: Students will choose a data set of COVID disease spread, create and interpret a model in the form $y = a * b^x$ that approximately models a phase of exponential growth.

Subject: Algebra 1 (adaptable to Algebra 2 up to calculus)

Materials Needed: Graphing calculators, computers with internet connection, microsoft excel or google sheets

Learning Objectives: Create a disease-spread simulation and make predictions about the graph of the outcome. At the end of the lesson, students will revisit their predictions and make changes based on the simulation.

Standards:

- AI-F.IF.4 For a function that models a relationship between two quantities: i) interpret key features of graphs and tables in terms of the quantities; and ii) sketch graphs showing key features given a verbal description of the relationship. (Shared standard with Algebra II)
- AI-F.IF.6 Calculate and interpret the average rate of change of a function over a specified interval. (Shared standard with Algebra II)
- AI-F.IF.7 Graph functions and show key features of the graph by hand and by using technology where appropriate. ★ (Shared standard with Algebra II)
- AI-F.IF.7a Graph linear, quadratic, and exponential functions and show key features
- AI-F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context. (Shared standard with Algebra II)
- AI-S.ID.6a Fit a function to real-world data; use functions fitted to data to solve problems in the context of the data. (Shared standard with Algebra II)

Teaching goal(s) for the Lesson (what you want students to know and understand):

Math-specific goals	**Other goals**
Students should be able to:	Students should be able to:
• Use appropriate technology to aggregate data and choose an appropriate subset of data that can be modeled by an exponential growth function	• Read and interpret written instructions • Work in groups to make decisions • Work with data in Microsoft Excel or Google sheets

- Use data and technology to create an exponential model for the self-selected data
- Interpret the constants a and b in the equation $y = a * b^x$ and rates of change in the context of COVID disease data

Identify Barriers to Learning for Students: Technology skills will need to be developed. This will take quite a bit of time and depending on the technology used (I used Microsoft Excel and TI calculators) sub-lessons on the use of technology will need to be developed. Therefore, depending on what level of class this is given to, and depending on the amount of flexibility to develop these technology goals, this lesson could take a day or up to a week to gain proficiency in the technology usage.

Students will probably have difficulty with the concept of average rate of change and the units used on those rates.

Students will first be introduced to appropriate methods of data grouping and possibly will not understand why these conventions of data grouping are acceptable and mathematically valid.

Introduction:
Activity and motivation starts in prior lessons with a simulation of disease spread in the class, and looking at different graphs of COVID spread in myriad countries (cultural relevance!) based on an article written by scientists about how they actually modeled disease spread:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7328553/

Implementation:
Students will be placed in groups of 3 or 4 according to teacher preference and student needs to work on this activity. Students will be given an assignment packet with instructions, a recording sheet, a grading rubric, and individual support as necessary as they work through the assignment.

Opportunities for extensions and extra research will be provided as necessary.

Structure/Activity:
Worksheet on following pages.
- Activity 1 (whole class)
- Activity 2 (small group)
- Small group presentations

***the teacher has to decide how the students will find a suitable exponential fitting situation. They can do it directly from excel if the school has a regression option added to it (it is not standard.) They can input the data into DESMOS and do what they did before, or you can choose to teach them how to perform an exponential regression on a TI calculator.**

Assessment:
Recording sheet with rubric for group report and student presentations.

Reference

Based on article on curve fitting to COVID data
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7328553/

NYS COVID raw data for this activity: https://coronavirus.health.ny.gov/cases-age

More data as extension opportunity, from World Health Organization
https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200615-covid-19-sitrep-147.pdf?sfvrsn=2497a605_2

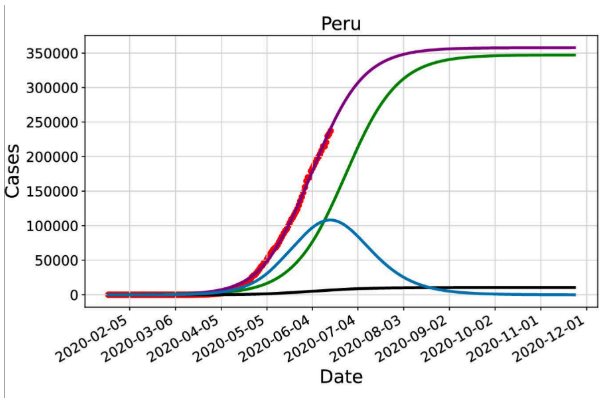
More data, as extension opportunity, Google
https://health.google.com/covid-19/open-data/

Name ____________________________ Date _________

Student Worksheet: Modeling the initial phase of disease spread using COVID data

Lesson Goal: Students will choose a data set of COVID disease spread, create and interpret a model in the form $y = a * b^x$ that approximately models a phase of exponential growth.

Background: We have seen that the initial phase of disease spread is **exponential**. We are going to use data to model the exponential phase of the disease spread.



Here is the data for Peru. The data starts off growing exponentially (increasing at an increasing rate), and then continues to grow logarithmically (increasing at a decreasing rate). Using the an approximate value for “Approximate number of COVID cases,” transfer the data into the table, stopping at the approximate location where exponential growth changes to logarithmic growth. (This point is called a **point of inflection**.)

Source of data: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7328553/

Activity 1: Using DESMOS to model data

Exponential curves cannot have a y-intercept of 0, so we have to pick a data point to start with where the y-value is not 0.

Also, it is easiest to represent the x-values (date) with smaller numbers as they are easier to work with. This is a completely appropriate method of working with data! An easy way to do this is to let x= “Number of months after January 2020” and y= "Approximate number of COVID cases” because there was no way to grab the actual data from the website.

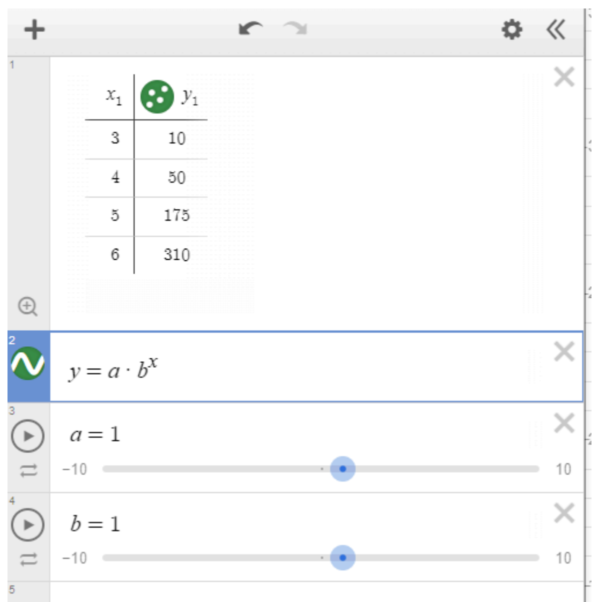
If we grab an approximate sample of data from the PURPLE curve, we get the table here:

Number of months after January 2020	Approximate number of COVID cases
0 (1/20)	0
1 (2/20)	0
2 (3/20)	0
3 (4/20)	10,000
4 (5/20)	50,000
5 (6/20)	175,000
6 (7/20)	310,000

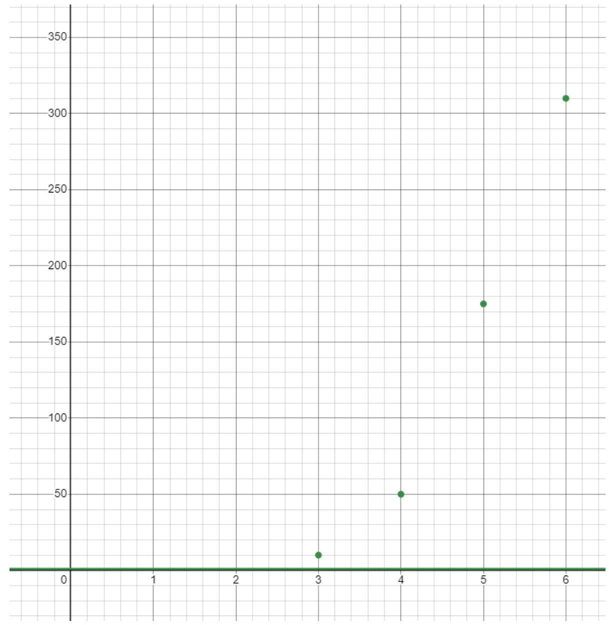
So we will ignore the first few rows of the table and for simplicity, we can make a graph where the y-values represent the approximate number of COVID cases IN THOUSANDS. This is also an acceptable way to manage data.

Number of months after January 2020	Approximate number of COVID cases (in thousands)
3 (4/20)	10
4 (5/20)	50
5 (6/20)	175
6 (7/20)	310

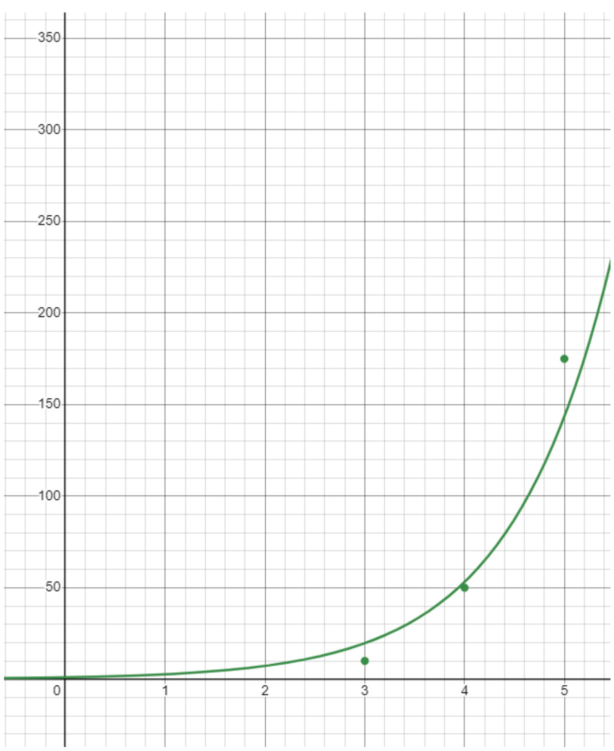
1. Go to the DESMOS graphing calculator. In the upper-left hand corner there is a "+" sign which will allow you to add things. Choose TABLE and a table will appear; enter the data above. Then go back to the + sign and choose EQUATION and type y=a*b^x. It will give you the option to "add sliders." Choose all sliders. When done it should look like this:

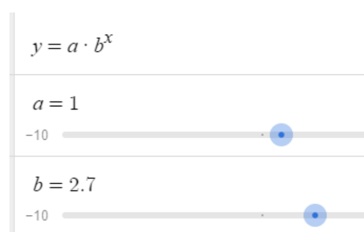


2. CHANGE THE WINDOW: Look at the table of values and decide what is a good window to see this data. Choose a window that starts at 0 for both x and y and ends close to the highest data point.For here, I would choose $0 \le x \le 10$ and $0 \le y \le 350$.



3. Change the sliders a and b until you have a curve that approximately models the trend of the data. This is not perfect by any means, but from this you can get an idea of how this modeling occurs.





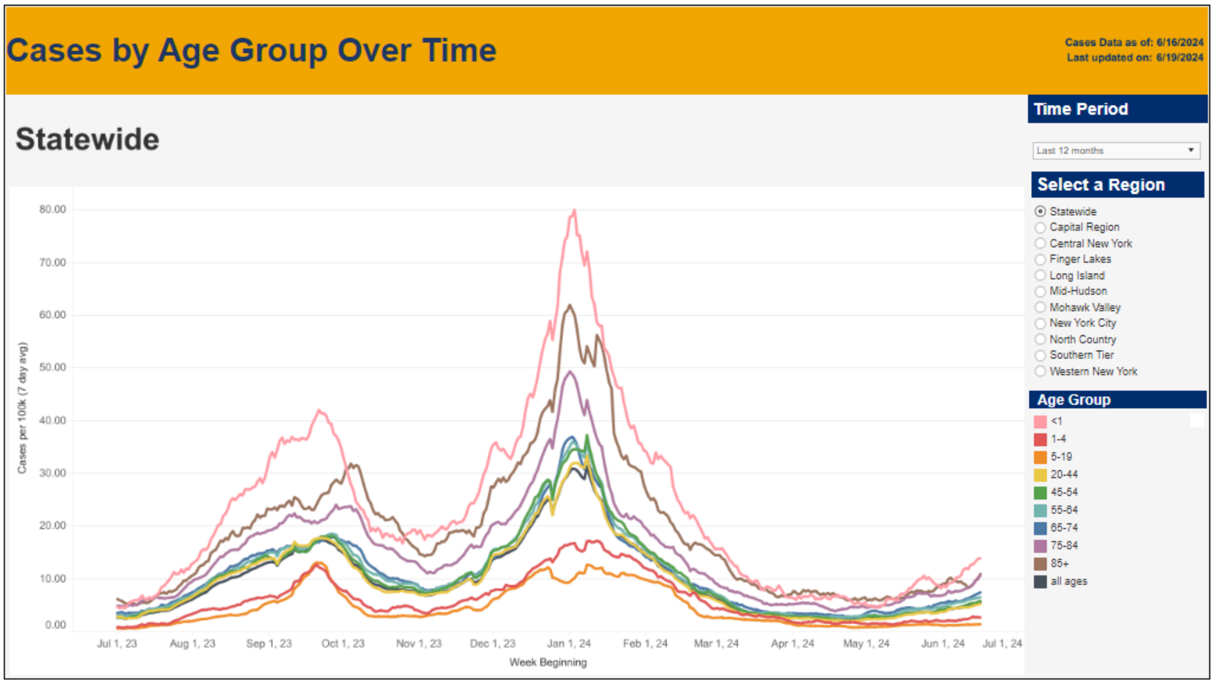
The answers to thes questions should be written on the recording sheet.

4. If the b-value is 2.7, what would be the growth rate expressed as a percent?

5. What would be the unit of measure of the growth rate?

Activity 2:
Unfortunately, we cannot access the raw data in the report where the Peru graph came from, only the graph.

We will use data from the State of New York instead:
[Cases by Age | Department of Health (ny.gov)]

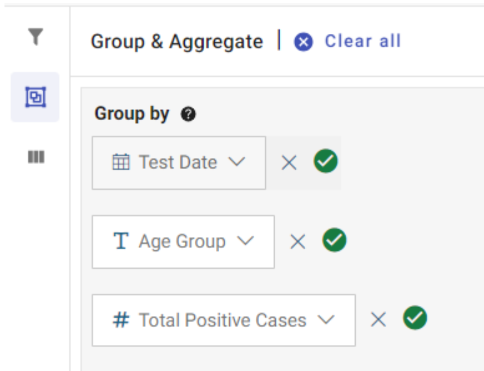


On the right, we have to make some changes.

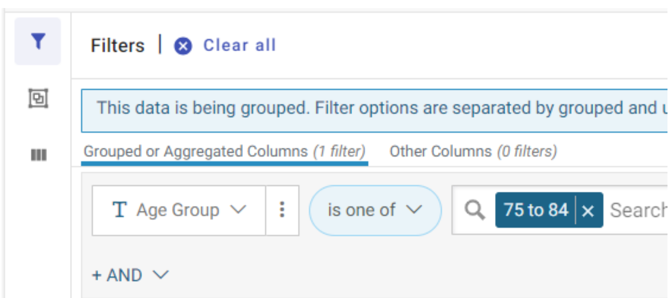
1. Under “time period” choose “last 5 years.” You can choose a region and an age group. I have chosen Age group 65-74 and New York CIty.

2. Go to DOWNLOAD TESTING DATA at the bottom.

3. A new window will come up, on the top right choose ACTIONS and QUERY DATA. At the bottom left, there are three small icons. Choose the second Icon, and where it says “group and aggregate, make it look like the following:



4. Then we will flter out all but your chosen age group. It's the top icon… select your age group.



5. Go to the top-right, choose EXPORT, and save it as a .CSV file.

Working with the data

6. Open the file in Excel. The data will arrive sorted strangely.

Test Date	Age Group	Total Positive Cases
3/18/2021	75 to 84	186
12/1/2020	75 to 84	417
10/6/2023	75 to 84	218
8/10/2022	75 to 84	373
11/5/2022	75 to 84	278
2/11/2023	75 to 84	154
1/29/2024	75 to 84	259
10/2/2021	75 to 84	109
9/9/2022	75 to 84	304
3/13/2020	75 to 84	39
7/3/2023	75 to 84	70
11/5/2020	75 to 84	179
12/21/2021	75 to 84	709

7. You can delete the column for age group, as all of them are identical and therefore unnecessary. Then select all columns and sort by test date.

	A	B	C
1	Test Date	Total Positive Cases	
2	1/1/2020	0	
3	1/2/2020	0	
4	1/3/2020	0	
5	1/4/2020	0	
6	1/5/2020	0	
7	1/6/2020	0	
8	1/7/2020	0	
9	1/8/2020	0	
10	1/9/2020	0	
11	1/10/2020	0	
12	1/11/2020	0	
13	1/12/2020	0	

This data is more meaningful if we look at the test date by week.

8. Insert three column headers. On the top of column C, type “start date” and column D, type “end date” and in column E, type “total.”

- In C1, type =A2
- In D2, type =C2+7
- In C3, type D2+1
- In D3, type =C3+7
- In E2, type =SUMIFS(B2:1500,A2:A1500,”>=”&C2,A2:A1500,”<=”&D2)
- Select cell E2, copy and paste that formula all the way down the spreadsheet.

Other example of how to use the SUMIFS command:
https://docs.google.com/spreadsheets/d/1FM8-yOGatZH_xgJr2HIv2XAWci9YGEWLxHj2cJGODBk/edit?usp=sharing

9. Select cells C3 and D3 at the same time, copy and paste that formula all the way down the spreadsheet.

SUM | `=SUMIFS(B2:B1500,A2:A1500,">="&C2,A2:A1500,"<="&D2)`

	A	B	C	D	E	F	G	H
1	Test Date	Total Positive Cases	Start Date	End Date	Count			
2	1/1/2020	0	1/1/2020	1/8/2020	D2)			
3	1/2/2020	0	1/9/2020	1/16/2020	0			
4	1/3/2020	0	1/17/2020	1/24/2020	0			
5	1/4/2020	0	1/25/2020	2/1/2020	0			
6	1/5/2020	0	2/2/2020	2/9/2020	0			
7	1/6/2020	0	2/10/2020	2/17/2020	0			
8	1/7/2020	0	2/18/2020	2/25/2020	0			
9	1/8/2020	0	2/26/2020	3/4/2020	4			
10	1/9/2020	0	3/5/2020	3/12/2020	136			

10. Insert a column before column E and call it "week number" this will make the data easier to work with. In the NEW blank cell E2, type "1." In E3, type "=E2+1". Then copy E3 and drag down the rest of the column to paste the formula. You should have something like this.

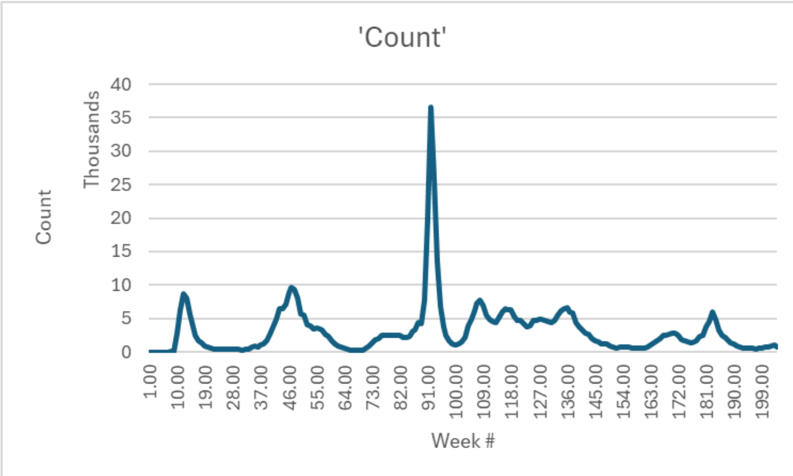
A	B	C	D	E	F
Test Date	Total Positive Cases	Start Date	End Date	Week #	Count
1/1/2020	0	1/1/2020	1/8/2020	1.00	0
1/2/2020	0	1/9/2020	1/16/2020	2.00	0
1/3/2020	0	1/17/2020	1/24/2020	3.00	0
1/4/2020	0	1/25/2020	2/1/2020	4.00	0
1/5/2020	0	2/2/2020	2/9/2020	5.00	0
1/6/2020	0	2/10/2020	2/17/2020	6.00	0
1/7/2020	0	2/18/2020	2/25/2020	7.00	0
1/8/2020	0	2/26/2020	3/4/2020	8.00	4
1/9/2020	0	3/5/2020	3/12/2020	9.00	136
1/10/2020	0	3/13/2020	3/20/2020	10.00	2825
1/11/2020	0	3/21/2020	3/28/2020	11.00	6270
1/12/2020	0	3/29/2020	4/5/2020	12.00	8668
1/13/2020	0	4/6/2020	4/13/2020	13.00	8065
1/14/2020	0	4/14/2020	4/21/2020	14.00	5617
1/15/2020	0	4/22/2020	4/29/2020	15.00	3817
1/16/2020	0	4/30/2020	5/7/2020	16.00	2503
1/17/2020	0	5/8/2020	5/15/2020	17.00	1733
1/18/2020	0	5/16/2020	5/23/2020	18.00	1352
1/19/2020	0	5/24/2020	5/31/2020	19.00	952
1/20/2020	0	6/1/2020	6/8/2020	20.00	727
1/21/2020	0	6/9/2020	6/16/2020	21.00	486

Now you can select part of columns E and F to work with the data.

Analyzing the data
Excel can analyze data for you.

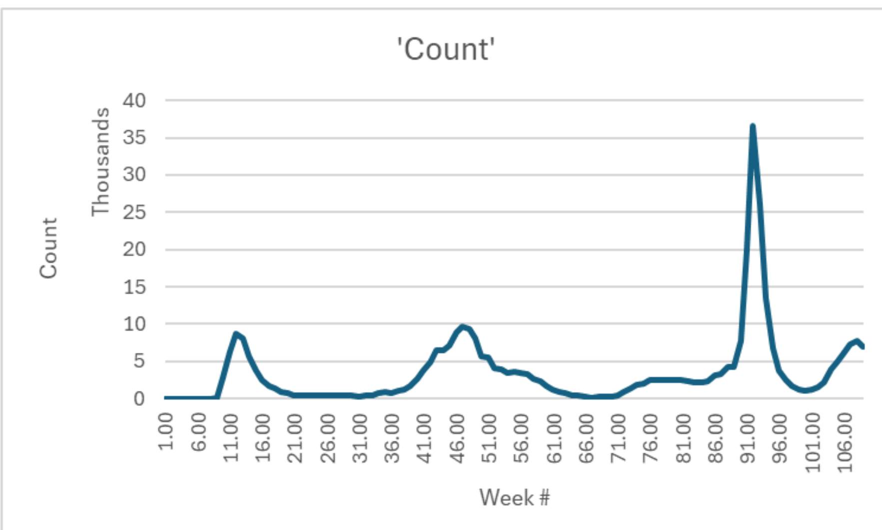
1. Select all of column E and F. Go to the top of the spreadsheet, make sure HOME is clicked, and at the far right it should say "analyze data." Click it, and it will give you options to look at the data graphically.

2. Go to "insert chart" and it will produce something like this.



The data will naturally go up and down but there should be a huge spike. This is what we are going to model.

3. Re-select a portion of the data where you can clearly see an exponential curve.



4. Your teacher will have chosen an appropriate method for you to find a curve that models an exponential spike in data. Using that method, determine an appropriate exponential model for the period of time selected.

Student Reporting Sheet

Modeling the initial phase of disease spread using COVID data

Group members ______________________________________

Activity 1: Using DESMOS to model data

1. Your answer to #4, 5:

Activity 2:

2. Explain what data set you chose and why you chose it.
3. Upload the .CSV or Excel file that you made when it was completed, or put here a shareable link so your teacher can access your data set.
4. Insert or upload all of the relevant charts for your project.
5. Explain, in words, how you found your equation $y = a * b^x$ that models the data.
6. Explain, using language as specific as possible, what the x-axis values mean and what the y-axis values mean.
7. Explain in detail, what interval of data you chose to select and why.
8. Explain, in context, what the values of a and b represent in terms of the data you chose. Be as specific as possible.

Insert Instructions for Submission here:

Grading Rubric

Modeling the initial phase of disease spread using COVID data

** should be designed according to specific alteration of activity