

Submit by 11:59 pm on Thursday August 5th.

Scan your answers to the assignment, and submit it as a single pdf file through the LMS. The printers around campus are also scanners. By submitting your work electronically, you are affirming that it is all your own work, and you will be asked to confirm this as you submit it.

You may use facts from the Readings, or derived in the Practice Classes, to answer these questions. In marking your assignment, as well as accuracy, the clarity of your communication will be considered. Use the practice class solutions for a model of the standard expected. Working must be shown to support your answers. Answer in sentences.

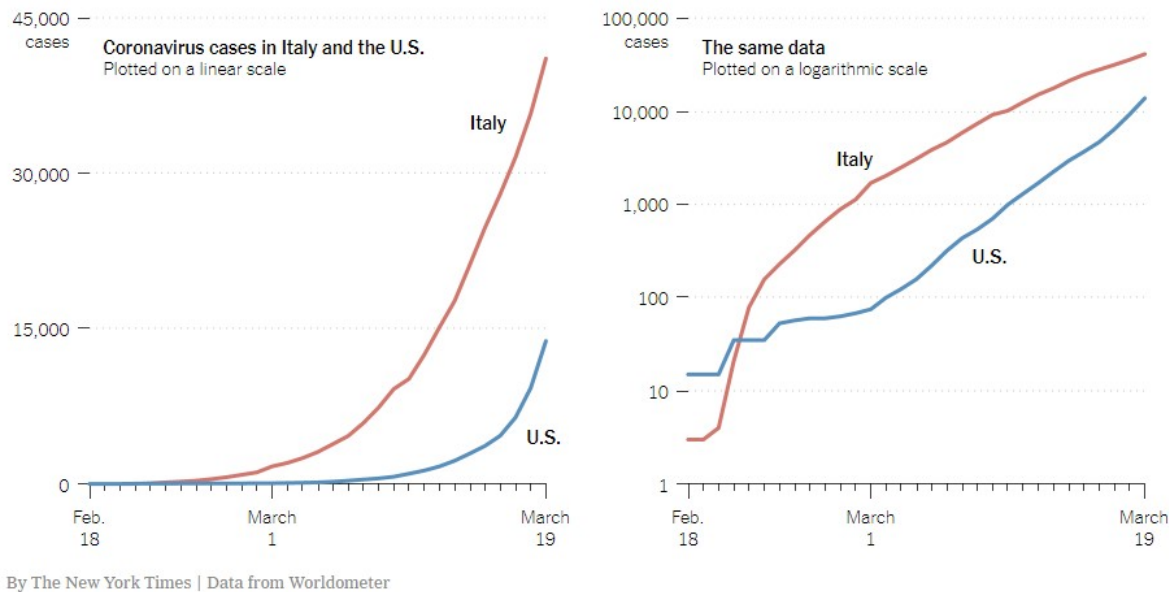
Question 1 Solve these equations for x , showing working. If the equation has no solution (there is no value of x that satisfies the equation) clearly explain why this is so.

- (a) $\log_{11}(3) \log_x(\pi^3) = \log_{11}(27^2) \log_\pi(\sqrt{\pi})$
- (b) $\log_2(6 + x - x^2) + \log_2(3 - x) + \log_2(2 + x) = 2^2$.
- (c) $4^x - 2^{x+1} + 1^{x-2} = 0$.
- (d) Show that any solution to $\log_2(x) + \log_2(3)(\ln(2)e - 1) \log_3(x) = x$ satisfies $\ln(x) = x/e$. This equation has only one solution $x = e$. Explain with a picture why this is special (think about the graphs of the functions on the left and the right hand sides).

Question 2 In this question you will take several steps to draw a complex graph starting from a simple graph. Make sure your graphs are large, typically each graph should be roughly square and at least a third of the width of the page.

- (a) Draw the graph of $y = x^2$ with x values between -1 and $+1$.
- (b) Draw the graph of $y = (x - 1)^2$ with x values between 0 and 2 . Clearly explain the link between this graph and the previous one.
- (c) Draw the graph of $y = -(x - 1)^2$ with x values between 0 and 2 . Clearly explain the link between this graph and the previous one.
- (d) Draw the graph of $y = 2 - (x - 1)^2$ with x values between 0 and 2 . Clearly explain the link between this graph and the previous one.
- (e) Draw the graph of $y = 1/(2 - (x - 1)^2)$ with x values between 0 and 2 . Clearly explain the link between this graph and the previous one.
- (f) Draw the graph of $y = 1 - 1/(2 - (x - 1)^2)$ with x values between 0 and 2 . Clearly explain the link between this graph and the previous one.
- (g) Does your final graph of $y = 1 - 1/(2 - (x - 1)^2)$ have a y value for every value of x ? If so explain why this is true (for all values of x , not just those shown on your graph). If not, explain why not. (Use 2 or 3 sentences for your explanation.)

Question 3 The following graphs are taken from an article in The New York Times in March last year.



- The graphs show the same data, but in different ways. Describe what is meant by "plotted on a linear scale" for the left graph, and "plotted on a logarithmic scale" for the right graph.
- Each graph does a better job of illustrating some aspect(s) of the data than the other graph. Point out specific features that each graph does best that show something important about the underlying data. Use dates to indicate which part of the data you mean. For full marks point out at least three different ways that one graph is better than the other. (Not three different places where you can see the same advantage.)
- What is the domain (input values) and the range (output values) of the plotted data?
- Assuming exponential growth between March 1 and March 19, deduce from the graph on the right in how many days the numbers of Coronavirus cases would increase by a factor of 10 in the U.S. and in Italy. Based on those numbers derive formulas for the growth in both countries in the mentioned period.
- Use your answer to (d) to:
 - calculate the doubling rates (number of days it takes for the number of cases to double)
 - predict the date when the number of Coronavirus cases would be equal in both countries.

Question 4

Let m and n be the last two digits of your student number that are not 0. Consider the function $f : [0, 1] \rightarrow \mathbb{R}$ given by

$$f(x) = \sqrt[n]{\exp(mx)}$$

- Write down your m and n .
- The domain of f is $[0, 1]$, i.e. $0 \leq x \leq 1$. What is the range (the outputs) of f ?
- Using a method similar to practice class 2 and the readings, find the inverse of f . I.e. find $f^{-1}(x)$.
- If you plot $f(x)$ and $f^{-1}(x)$ (e.g. using the graphing calculator at <https://www.geogebra.org/graphing>), what is the relationship between the two graphs?

- (e) Write $f(x)$ as the composition of three functions g, h and k , i.e. $f(x) = g(h(k(x)))$. Be aware of the order of g, h and k (which one is which).

Question 5 - video recording

For this question you are required to record your answer in a video. Example videos are available on the LMS to give you an idea of what your video should look like. Your task is to choose any one part of any previous question in this assignment, and explain how you think people will make mistakes in it. You might judge this on mistakes that you almost made, or did make and then noticed, or you might choose a topic that you think students have trouble with. Once you have chosen the topic and created anything written or on your computer screen you need for your explanation, structure your recording as follows:

- (a) Introduce yourself. Point the camera at yourself so you are recognisable and say hello and say your name.
- (b) Point the camera / share screen at the worked solution/error you have chosen. Clearly describe a kind of error that you think other students will make doing that problem part (due to misunderstanding an important idea, not due to making an arithmetic error). Explain what they should do instead to be correct.
- (c) Make your description clear but keep your video to less than one minute in length. Any extra will not be watched or marked.