

Objective 1 - Identify Type of Model

Note: There are no textbook or videos directly to this section. If you want to review a certain type of model, you will need to go back to that Module.

We summarize the types of models we've looked at below.

Linear Model:

- Used when we have a *constant* variation between two quantities.
- $y = mx + b$. Can be multiple lines added together.
- Phrases to look for: constant, steadily increasing/decreasing, adding/subtracting $[/, /,]$ every $[/, /,]$.

Direct Variation:

- Used when we have a *direct* variation between two quantities (as one quantity increases, the other increases).
- $y = kx^n$. Joint variation may have more than one variable (like $y = kx^n z^m$).
- Phrases to look for: vary directly, directly proportional, "as one increases, so does the other".

Inverse Variation:

- Used when we have an *indirect* variation between two quantities (as one quantity increases, the other decreases).
- $y = \frac{k}{x^n}$. Combined with joint variation, there may be more than one variable (like $PV = nRT$).
- Phrases to look for: vary indirectly, indirectly proportional, "as one increases, the other decreases".

Logarithmic Model:

- Used when we have a **rapid** early growth, then slower growth later.
- $y = \log(kx)$. Remember that $\ln(x) = \log_e(x)$.

Learning outcomes:
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- Phrases to look for: rapid early growth/decay, no bound on growth/decay.

Exponential Model:

- Used when we have a slow initial growth, then *rapid* growth later.
- $y = a^{kx}$. Common bases are 2, 3, and e .
- Phrases to look for: rapid late growth/decay, bounds on growth/decay.

Determine the type of model that would be most appropriate for each situation below. Answers will be either:

- Linear
- Direct
- Indirect
- Logarithmic
- Exponential
- General (if we are going to use the general form of a particular function)

Question 1 Your bank offers a savings account that will increase your total balance by 0.2% annually. You want to decide how much to initially deposit and if the initial deposit makes a big difference in the long run. S

Exponential

Question 2 A ball is dropped from the top of Century Tower. The ball steadily picks up speed before hitting the ground. You want to figure out what the ball's height is at a certain time.

Direct

Question 3 Chemists commonly create a solution by mixing two products of differing concentrations together. For example, a chemist could have large amounts of a 10% acid solution and a 30% acid solution, but need a 10 liter 15% solution.

Linear

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Question 4 *Kepler's Third Law: The square of the time, T , required for a planet to orbit the Sun is directly proportional to the cube of the mean distance, a , that the planet is from the Sun.*

Direct

Question 5 *The rate of vibration of a string under constant tension, r , varies inversely with the length of the string, l .*

Indirect

Question 6 *A population of bacteria doubles every hour.*

Exponential

Question 7 *Radiocarbon dating is used to calculate the approximate date a plant or animal died by noting the percentage of carbon-14, r in the object. The age of the object t , in years, is directly proportional to the natural log of the percentage of carbon-14, r in the object.*

Logarithmic

Question 8 *The weight of an object above the surface of Earth varies inversely with the square of the distance from the center of Earth.*

Indirect

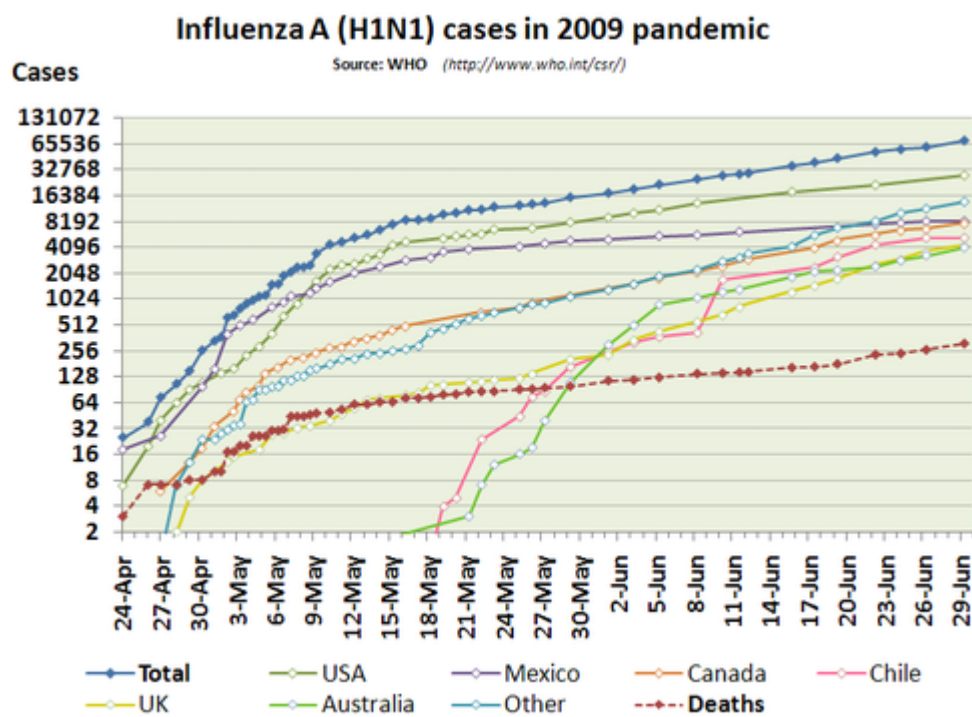
Question 9 *The kinetic energy K of a moving object varies jointly with its mass m and the square of its velocity v .*

Direct

Question 10 *Carlos has taken an initial dose of a prescription medication orally. The medicine is absorbed rapidly by the large intestine and absorbed slowly as it is digested otherwise.*

Exponential

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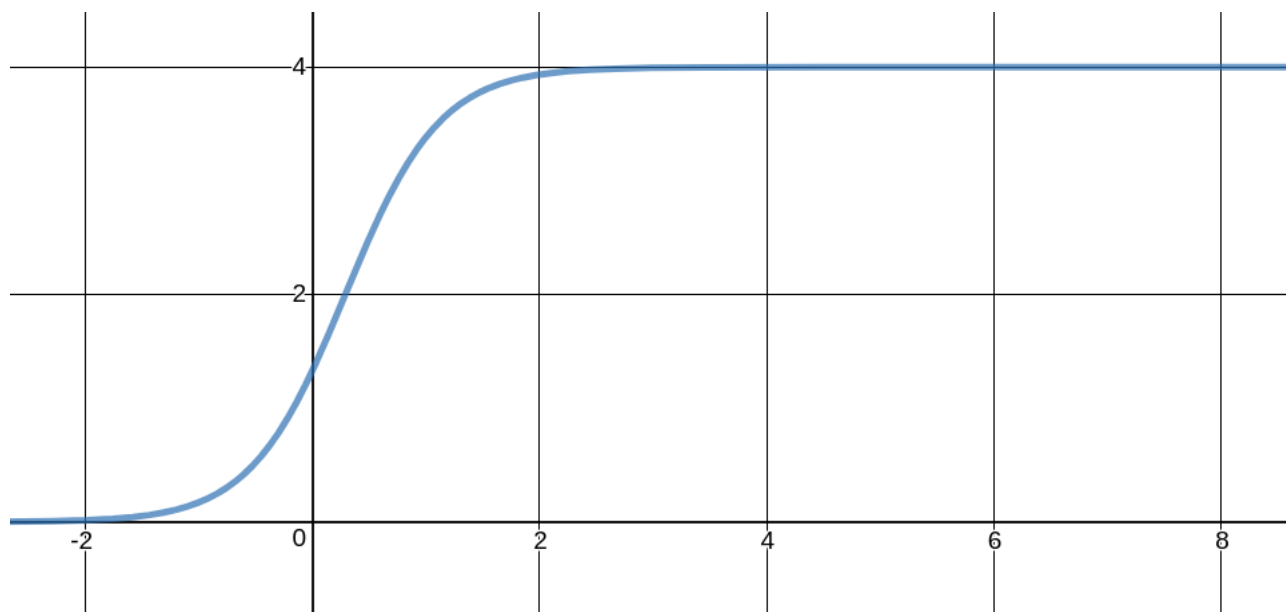


Figure 1: A sigmoidal curve.

Question 11

Question 12 A ball is dropped from the top of Century Tower. The ball steadily picks up speed before hitting the ground. You want to figure out what the ball's speed is at a certain time.

Question 13

Question 14 Kappa Delta is hosting an all-you-can-eat pancake fundraiser to support the prevention of child abuse. Adult (18+) tickets are \$10 and teen (10-17) tickets are \$5. Children under 10 are let in without a ticket. The ticket-sellers only keep track of the total number of tickets sold and total revenue, but want to know how many adult and teen tickets were sold.