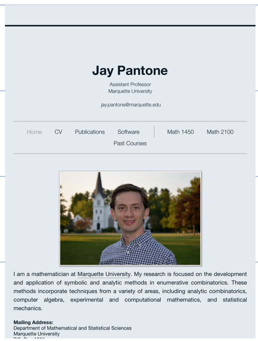
Friday, September 2 — Fall '22
Lecture #3

Announcements / Reminders

* Turn in calculus pretest
* No class on Monday (Labor Day) (still discussion on Tuesday)
* WP HW 0 due next Wed — 68/125 have already done!
* Q1 next Thurs covering 1.1 — we will finish 1.1 today
* WP HW 1 due next Fri
  * Join Wiley Plus ASAP!
    No deadline extensions, even for technical issues. (106/125 joined)
* Help Desk starts on Tuesday (hours on course website)
* If you just joined the class, see me after.

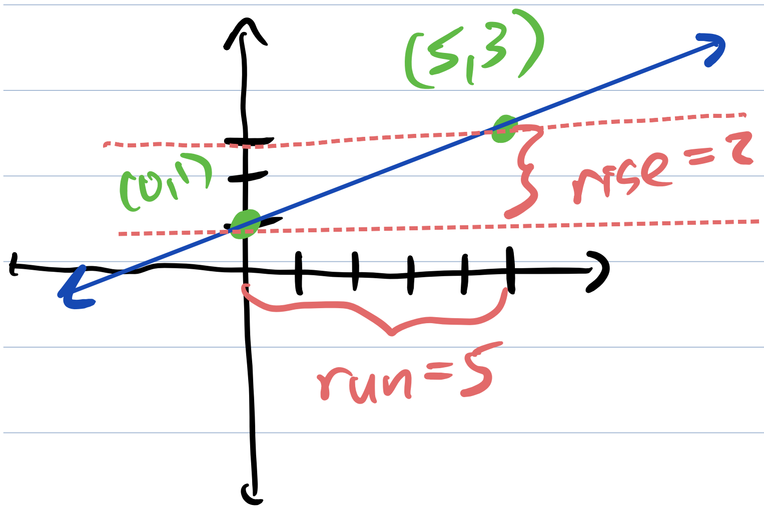


Section 1.1 - Functions and Change

Linear Functions (straight lines)

Every line has a slope - how fast it goes up or down

and a y-intercept - where it crosses the y-axis



slope $= \frac{\text{rise}}{\text{run}} = \frac{2}{5}$

y-int. $= 1$

Book definition:

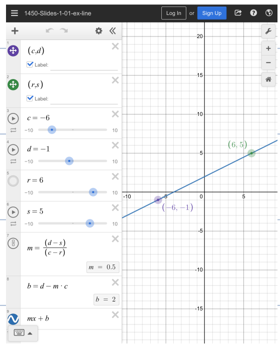
A linear function has the form

$$y = f(x) = \underbrace{b + mx}$$

$mx + b$

m is the slope

b is vertical intercept (value of y when $x = 0$)



For every topic in the course the book has more examples and more details, so it's good to read it if you need more information.

Topics in 1.1 we're skipping:
- increasing vs decreasing functions
- proportionality

Section 1.2 – Exponential Functions

Population of Burkina Faso

Year	Pop. in millions	Change in pop. (in millions)
2007	14.235	
		0.425
2008	14.660	
		0.435
2009	15.095	
		0.445
2010	15.540	
		0.455
2011	15.995	
		0.465
2012	16.460	
		0.474
2013	16.934	

$\frac{2008 \text{ pop}}{2007 \text{ pop}} \approx 1.03$ $\frac{2009}{2008} \approx 1.03$

$\frac{2010}{2009} \approx 1.029$ $\frac{2011}{2010} \approx 1.029$

If $\frac{2008}{2007} = 1 \Rightarrow$ the pop didn't change

"1.03" means the population grew 3%.

Growing at $\approx$ 3% per year.

Linear Growth (lines) - changes by a constant amount (additive factor)

Ex: 2, 6, 10, 14, 18, 22, ... +4

Exponential Growth - changes by a constant percentage (multiplicative factor)

Ex: 2, 8, 32, 128, 512, ... ×4

Back to Burkina Faso

How can we devise a function that models this data?

Call $P(t)$ the population t years after 2007, in millions.

$P(0) = 14.235$

$P(1) = 14.660 \approx 14.235 \cdot 1.03$

$P(2) = 15.095 \approx 14.660 \cdot 1.03$

$\approx 14.235 \cdot 1.03^2$

$P(3) = 15.540 \approx 14.235 \cdot 1.03^3$

$P(t) \approx 14.235 \cdot 1.03^t$

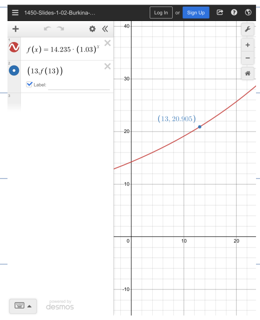
What does this predict about 2022?

$P(\cancel{2022})$

$P(15) \approx 14.235 \cdot 1.03^{15} \approx 22.178m$

Actual $= 22.130m$

$P(t) = 14.235 \cdot (1.03)^t$



Exponential Growth:

$$P(t) = \underbrace{14.235}_{\text{starting value (y-intercept)}} \cdot \overbrace{\underbrace{(1.03)}_{\text{growth rate}}}^{\text{base}} {}^{t}$$

starting value

(y-intercept)

growth rate

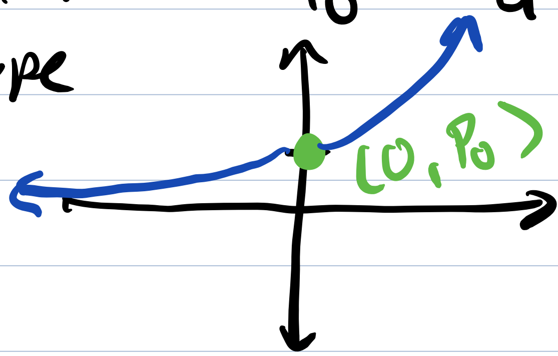
(book says "0.03" is the growth rate, either way is fine for me)

independent variable

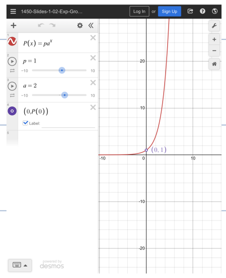
The general form for exponential growth is

$$P(t) = P_0 \cdot a^t$$

General Shape



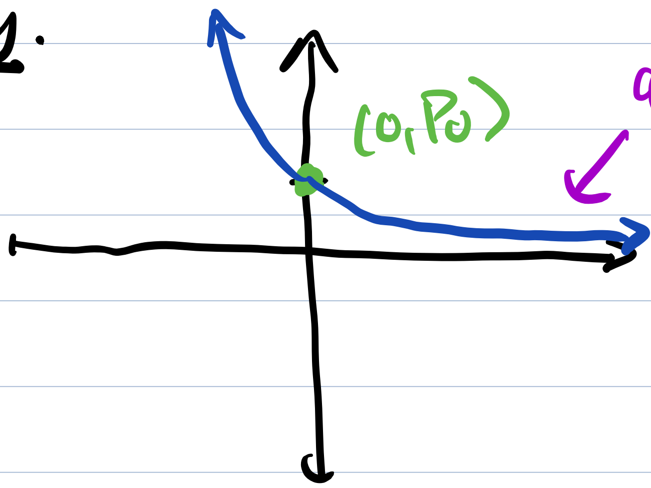
$$P(0) = P_0 \cdot a^0$$
$$= P_0 \cdot 1$$
$$= P_0$$



For exponential growth we need $P_0 > 0$ and $a > 1$.

Exponential Decay $\quad P(t) = P_0 \cdot a^t$

When $0 < a < 1$ we get exponential __decay__.



approaches 0 but never hits it

"asymptote"