10.5 HW Key

For Exercises 1–3, complete Parts (a), (b), and (c).

a. Identify each relationship as linear growth, exponential growth, or neither. Explain your answer.

b. If the growth is linear or exponential, write an equation that models the pattern.

c. Check your function with a graphing calculator to see if your model fits the given data.

1.

x	y
0	2
1	77
2	302
3	677
4	1,202

① Neither:
→ not linear because rate of change is not constant
→ not exponential because successive quotients are not constant

2.

x	y
0	2
1	10
2	50
3	250
4	1,250

$\frac{10}{2}=5$, $\frac{50}{10}=5$, $\frac{250}{50}=5$

② Exponential, because successive quotients always $=5$

$y=a\cdot b^x$

$y=2(5)^x$

3.

x	y
0	2
1	302
2	602
3	902
4	1,202

+1, +1, +1; +300, +300, +300

③ Linear, because rate of change is always 300.

$y=mx+b$

$y=300x+2$

4. The table shows how the population of the state of Washington changed from the year 1950 to 2000.

Census Year	Decade Number	Population
1950	0	2,378,963
1960	1	2,853,214
1970	2	3,409,169
1980	3	4,132,156
1990	4	4,866,692
2000	5	5,894,121

$\frac{2,853,214}{2,378,963} \approx 1.20$, ≈ 1.19, ≈ 1.21, ≈ 1.18, ≈ 1.21

a. Explain what type of function fits the data. The successive quotients are almost constant at 1.20, so an exponential function should fit the data

b. Write a function that closely models the data.

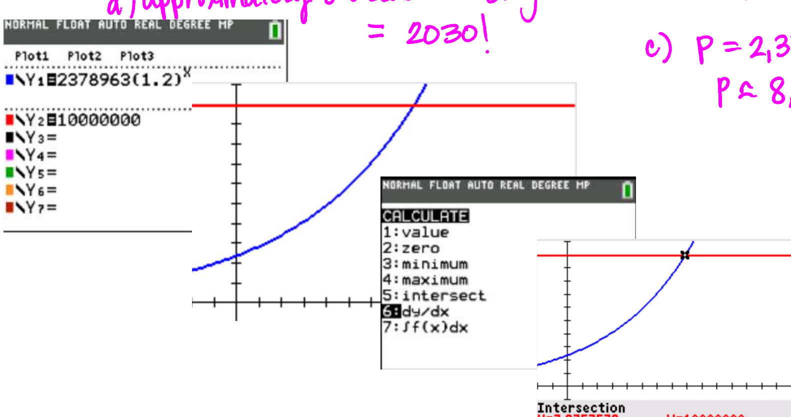
c. If your model continues to hold into the future, what will the population of Washington be in 2020?

d. Graph your function and use it to predict when Washington's population will be 10,000,000.

b) $P=2{,}378{,}963(1.20)^t$
where $P=$ population and
$t=$ time (in decades) since 1950

c) $P=2{,}378{,}963(1.20)^7$
$P\approx 8{,}524{,}254$

d) approximately 8 decades = 80 years = 2030!



5. According to the U.S. Census Bureau, in 2000 there were 50,454 *centenarians* in the United States. A centenarian is a person at least 100 years old. Suppose that a researcher continued to collect data through 2009.

Year	Year Number	Number of Centenarians
2000	0	50,454
2001	1	53,986
2002	2	57,765
2003	3	61,808
2004	4	66,135
2005	5	70,764
2006	6	75,718
2007	7	81,018
2008	8	86,689
2009	9	92,758

1.07
1.07
1.07
1.07
1.07
⋮

a. Explain what type of function fits the data. The successive quotients of the # of centenarians is constant so an exponential function should fit the data
b. Write a function that closely models the data.
c. If the model continues to hold into the future, how many centenarians will there be in 2017?
d. Graph your function and use it to predict when the number of centenarians will reach 1,000,000.

b) $C = 50{,}454(1.07)^t$ where $C = \#$ of centenarians and $t =$ time in years since 2000

c) $C = 50{,}454(1.07)^{17}$
$C \approx 159375$ centenarians

d) sometime during the 44th year, so 2044

6. Wildlife scientists use mathematical models to predict animal populations. The data in the table show the growth of the buffalo population in a national park.

Year	Population
2005	125
2006	160
2007	205
2008	260
2009	335

a. Find the growth rate each year, as a percent of increase from the previous year's population. Round to the nearest percent.

	Year	Population	Percent of Increase
0	2005	125	—
1	2006	160	28%
2	2007	205	28%
3	2008	260	27%
4	2009	335	29%

$\frac{160-125}{125}$ .28
.28125
.268
.288

b. Write an equation that models the buffalo population as a function of time. (Use $t = 0$ to represent the year 2005.)
c. Use a calculator to verify your model using the data from 2005 to 2009. How well does your model fit the data?
d. Use your function to predict how many buffalo will be in the park in 2015. $t = 10$

b) $P = 125(1+.28)^t$ or $P = 125(1.28)^t$

c) The function fits the data very well!

d) $P = 125(1.28)^{10}$
$P \approx 1476$ buffalo in 2015

7. The 2010 Census found that the population of the United States on April 1, 2010 was about 309 million. This figure represented an increase of about 28 million from the 2000 census figure. This is an annual percent of increase of about 0.95%.
a. Find a model that could be used to predict the population of the United States after the year 2010. Assume a constant growth rate.
b. At the same rate of increase, what would be the population of the United States on April 1, 2013?
c. Write your answer to Part (b) in scientific notation.
d. From 1990 to 2000, the U.S. population grew at a rate of 1.25% per year. If this rate is used to answer Part (b), what effect would it have on the population estimate for 2013?

$t=0$

	t	P (in mil)
2010	0	309
11	1	
12	2	
13	3	

a) $P = 309(1+.0095)^t$ or $P = 309(1.0095)^t$

b) $P = 309(1.0095)^3 \approx 318$ so 318 millions

c) 3.18×10^8

d) $P = 309(1.0125)^3 \approx 321$ so 321 million
A difference of 3 million people ← woah!!!