Unit 4: Nonlinear Regression
Due next Friday the 29th

1. At the end of 2005, Marissa placed $750 into a new savings account, but then made no other deposits or withdrawals. The table below shows the balance of the account at the end of each year, beginning with the initial deposit. Use **exponential regression** to write an equation to model the data, then find the year in which her balance reaches $2,000.

	Year	Balance
0	2005	$750.00
1	2006	$794.79
2	2007	$842.25
3	2008	$892.54
4	2009	$945.84

$y = 750 \cdot (1.06)^x$

$2000 = 750(1.06)^x$

$2.\overline{6} = 1.06^x$

$\frac{\log(2.\overline{6})}{\log 1.06} = \frac{x \cdot \log 1.06}{\log 1.06}$

$x = 16.83 \rightarrow 17$

$\boxed{2022}$

2. The table below shows the annual sales of a company, in thousands of dollars, in each of its first six years. Use **power regression** to write an equation to model the data, then find the sales of the company in its 10th year.

Year	Sales
1	157
2	238
3	304
4	361
5	412
6	460

$y = 157.07 \cdot (x)^{0.6}$

$y = 157.07 \cdot (10)^{0.6}$

$y = 625.31$

$\boxed{\$625.31}$

3. The table below shows average United States life expectancy, in years, since 1900. Use **logistic regression** to write an equation to model the data, then estimate the average life expectancy in 2014.

Year	Expectancy
10	50.0
20	54.1
30	59.7
40	62.9
50	68.2
60	69.7

$y = \frac{83.15}{1 + .87e^{-.03x}}$

$y = \frac{83.15}{1 + .87e^{-.03(114)}}$

$y = 80.85$

$\boxed{80.9 \text{ years}}$

4. In 1996, a group of foxes were relocated to a new wildlife preserve. The table below shows the population of foxes in years since 1996. Use **logarithmic regression** to write an equation to model the data, then determine how long it would take the population to reach 200.

Year	Population
1	87
2	116
3	131
4	145
5	154

$y = 86.83 + 41.53 \ln x$

$200 = 86.83 + 41.53 \ln x$

$113.17 = 41.53 \ln x$

$2.73 = \ln x$

$e^{2.73} = x$

$x = 15.26 \to 16$

$\boxed{\text{16 years}}$

5. The table below shows the height of a tree, in inches, during its first 6 years. Use **logistic regression** to write an equation to model the data, then determine how long it will take the tree to reach a height of 9 feet.

Year	Height
1	37.1
2	41.9
3	48.7
4	60.2
5	68.4
6	75.5

$y = \dfrac{142.88}{1 + 3.81e^{-.25x}}$

$\boxed{\text{10 years}}$

$108 = \dfrac{142.88}{1 + 3.81e^{-.25x}}$

$1 + 3.81e^{-.25x} = \dfrac{142.88}{108}$

$1 + 3.81e^{-.25x} = 1.32$

$e^{-.25x} = 0.08$

$-.25x = \ln(0.08)$

$-.25x = -2.47 \quad x = 9.87$

6. The table below shows the length of a cobra, in inches, for the first five years of its life. Determine whether a **logarithmic or exponential function** would best model the data, then determine how long it will take the cobra to reach a length of 90 inches.

Age	Length
1	16
2	34
3	53
4	65
5	71

Log: $y = 13.82 + 35.49 \ln x$

$90 = 13.82 + 35.49 \ln x$

$76.18 = 35.49 \ln x$

$2.15 = \ln x$

$e^{2.15} = x$

$x = 8.56$

$\boxed{\text{9 years}}$

7. The table below shows the number of smartphone owners, in millions, in the number of years since 2010. Determine whether an **exponential or power function** would best model the data, then determine the number of smartphone owners in 2028.

Years	Users
1	1.6
2	7.1
3	18.2
4	33.9
5	52.7
6	85.8

Power: $y = 1.58 \cdot x^{2.21}$

$y = 1.58 \cdot 18^{2.21}$

$y = 939.31$

$\boxed{\text{939.31 million}}$