Exponential Models $y = ab^x$

Fit an exponential curve to the data.

X	1	3	4	5
y	3.00	6.75	10.13	15.19

$y = 1.9998 \cdot (1.5)^x$

The average price of an adult ticket to the movies in the United States has increased,

a. Use the movie price data to plot y versus year x. Represent the years 1948, 1958,... as x = 0, 10,

b. linear or exponential? x

y = .37(1.06)^x c. write the equation.

$8.81 d. price of a movie ticket in 2000?

$16.22 e. price of a movie ticket in 2010?

X = year	Y = price
1948	$0.36
1958	$0.68
1967	$1.22
1978	$2.34
1988	$4.11

2. A study of nutrition in developing counties collected data from the Egyptian village of Nahya. Here are the mean weights for 170 infants in Nahya who were weighed each month during their first year of life.

Age (in months)	1	2	3	4	5	6	7	8	9	10	11	12
Mean Wt. (kg)	4.3	5.1	5.7	6.3	6.8	7.1	7.2	7.2	7.2	7.2	7.5	7.8

a. Find the correlation coefficient for each type of equation. (linear, exponential) round to 4 places

.9065 , .8804

linear b. Which equation best fits the data?

3. Brian wanted to determine the relationship that might exist between speed and miles per gallon of an automobile. Let x be the average speed of a car on the highway measured in miles per hour and let Y represent the miles per gallon of the automobile. The following data are collected.

X	50	55	55	60	60	62	65	65
Y	28	26	25	22	20	20	17	15

Linear (Look at exponential)

a) Plot the data. Find the regression equation and correlation coefficient (r).

b) Interpret what the slope means. you lose .83 of gas mileage for every 1 mph

c) Predict the miles per gallon of a car traveling 61 miles per hour. 19.97

d) Predict the speed of a car that gets 24 miles per gallon. 56.13

4. A doctor wished to determine whether a relationship exists between the height of a female and weight. She obtained the heights and weights of 10 females aged 18-24. Let height be the independent variable, measured in inches, and weight be the dependent variable, Y, measured in pounds.

X	60	61	62	62	64	65	65	67	68	68
y	105	110	115	120	120	125	130	135	135	145

a) Plot the data. Find the regression equation and correlation coefficient (r). $y = 4.13x - 140.95$

b) Interpret what the slope means. go up 4 lbs every 1 inch.

c) Predict the weight of a female aged 18 to 24 whose height is 66 inches. 131.43

d) Predict the height of a female whose weight is 122 pounds. 63.72

5. Suppose you are studying frogs that live in a nearby wetland area. The data below was collected by a local conservation organization. They indicate the number of frogs estimated to be living in the wetland area over a 5-year period. .

a. Write the exponential equation to model this data. $y = 120.36(.84)^x$ year 0 ←

b. What will the population be in 8 years? 36.28

c. What will be the population in 2020? 10.76

Year	Estimated Population
2006	120
2007	101
2008	86
2009	72
2010	60

AFM Unit 9 Day 2 HW Exponential Regression Worksheet

1. Fit an exponential curve for each set of data. Find the correlation coefficient.

a.

x	1	3	4	5
y	3.00	6.75	10.13	15.19

$y = 1.999(1.5)^x$ $r = .999999$

b.

x	2	2.5	4	5.5
y	3.63	3.81	4.39	5.07

$y = 3(1.1)^x$ $r = .99999$

2. Each year after he bought his new car, Mr. Brown kept track of the market value of the car.

x = year after purchase	1	2	3	4	5	6
y = market value (in dollars)	12,000	9600	7700	6200	4900	3900

a. Fit an exponential curve to the data. $y = 15066.88(.7989)^x$
b. What is the correlation coefficient? .99992
c. Based on the correlation coefficient, is the model a good fit to the data yes
d. Predict the value of the car when it is 10 years old. 1,597.64
e. Estimate the amount that Mr. Brown paid for the car. $15066.88

3. A cup of hot tea just poured at 158°F slowly cools over time t (in minutes) and its temperature T is recorded.

t	0	10	30	50	70	90	110	120	125	130
T	158	132.8	105.8	92.3	84.2	79.2	76.1	75	74.7	74.5

a. Fit an exponential curve to the data. $y = 134.18(.9948)^x$
b. What is the correlation coefficient? -.9395
c. Based on the correlation coefficient, is the model a good fit to the data? yes
d. What will the temperature of the tea be after 60 minutes? 98.59
e. What will the temperature of the tea be after 150 minutes? 62.1
f. Estimate the room temperature. 74 degrees

4. Each student in a typing class is tested at various times in the course and the average number of errors for the class is recorded.

T = time of testing (days)	2	10	14	21	30	45	63	70	91
Y = average number of errors	45.2	36.1	30.2	23.1	18.7	11.0	5.6	4.3	2.4

a. Fit an exponential curve to the data. $y = 48.89(.9668)^x$
b. What is the correlation coefficient? -.99906
c. Based on the correlation coefficient, is the model a good fit to the data? yes
d. What is the average number of errors for a student after 50 days? 9
e. How many days would it take a student to practice to only have 10 errors? 47

Day 3 Notes

(5, 3) & (7, 4) in standard form.

$$\frac{4-3}{7-5} = \frac{1}{2}$$

$y = \frac{1}{2}x + b$

$3 = \frac{1}{2}(5) + b$

$3 = \frac{5}{2} + b$

$b = \frac{1}{2}$

$2\left[y = \frac{1}{2}x + \frac{1}{2}\right]$

$y - y_1 = \frac{1}{2}(x - x_1)$

$y - 3 = \frac{1}{2}(x - 5)$

$y - 3 = \frac{1}{2}x - \frac{5}{2}$

$+3 \qquad +3$

$y = \frac{1}{2}x + \frac{1}{2}$

$2y = x + 1$

$-1 = x - 2y$

① A must be positive,
② x, y same side
③ NO FRACTIONS.

Write an equation perpendicular to $y = -\frac{2}{3}x + 5$ through (8, -1).

$m = \frac{3}{2}$

$y = \frac{3}{2}x + b$

$-1 = \frac{3}{2}(8) + b$

$-13 = b$

$2\left[y = \frac{3}{2}x - 13\right]$

$2y = 3x - 26$

$26 = 3x - 2y$

Parallel = Same slope
Perpendicular = opp reciprocal

AFM Unit 9 Day 3 HW Power Regression and Choosing Best Model Worksheet

Round all answers 4 places after the decimal.

1. Fit a power curve for each set of data. Find the correlation coefficient and the equation.

1a) $y = .3664 \cdot x^{3.3378}$, .9934

1b) $y = 4.0083 x^{-2.0039}$, -.9999

a.

x	2.0	3.0	5.0	6.0
y	4.0	13.5	62.5	180.0

b.

x	0.9	1.5	2.4	3.0
y	4.94	1.78	0.70	0.44

2. In 1610, Galileo discovered how the time, T, required for each of Jupiter's satellites to revolve about Jupiter is related to the average distance, a, from Jupiter.

Satellite	a (kilometers)	T (hours)
Io	422,000	42.5
Europa	671,000	85.2
Ganymede	1,072,000	171.7
Callisto	1,883,000	400.5

1.4995

$y = .000001559 x$ a. Find the power regression equation.

.9999 b. What is the correlation coefficient?

excellent c. Is the power model a good fit for the data?

3. The winning times (in seconds) for various men's races (in meters) in the 1988 Olympics are given.

x = distance (m)	100	200	400	800	1500	5000	10,000
y = time (seconds)	9.92	19.75	43.87	103.45	215.96	791.70	1641.46

1.125

$y = .054 x$ a. Find the power regression equation.

.9997 b. What is the correlation coefficient?

good c. Is the power model a good fit for the data?

128.22 secs d. What would the predicted winning time be for a 1000 meter race?

3,351.57 meters e. For the winning time to be 500 seconds, how long would the race have to be?

4. A scientist caught, measured, weighed, and then released eight Maine landlocked salmon.

x = length (in.)	5.5	10.6	15	17	19.6	22	25	28
y = weight (lb)	0.1	0.4	1.0	1.6	2.5	3.5	5.4	7.4

.9298 a. What is the correlation coefficient for a linear model for this data?

.9877 b. What is the correlation coefficient for a exponential model for this data?

.9950 c. What is the correlation coefficient for a power model for this data?

power d. Which model best fits the data?

$y = .0008386 x^{2.69}$ e. What is the best model equation?

.6703 f. Predict the weight of a salmon that is 12 inches long.

5. The table shows the average salaries (in thousands of dollars) of major league baseball players for selected years from 1967-1989.

let 1967 = 1

1976 = 10

year	1967	1976	1979	1982	1984	1986	1989
salary (in thousands)	19.0	51.5	114	242	329	413	497

.9218 a. What is the correlation coefficient for a linear model for this data?

.9841 b. What is the correlation coefficient for a exponential model for this data?

.8963 c. What is the correlation coefficient for a power model for this data?

exponential d. Which model best fits the data?

$y = 14.4759 (1.1767)^x$ e. What is the best model equation?

27.75 f. Estimate the average salary in 1970.

6. Various depths (in meters) below the water surface and corresponding water pressures (in atmospheres) at those depths are given in the table. (one atmosphere is about 14.7 lb/in.^{2})

d = depth (m)	10	20	30	40	50	60
P = pressure (atmospheres)	15.0	31.0	44.5	60.1	74.8	88.1

.9997 a. What is the correlation coefficient for a linear model for this data?

.9639 b. What is the correlation coefficient for a exponential model for this data?

.9997 c. What is the correlation coefficient for a power model for this data?

power d. Which model best fits the data?

$y = 1.5686 \cdot x^{.9868}$ e. What is the best model equation?

19.71 f. Predict the water pressure at a depth of 13 m.