Exponential Regression

Vocabulary

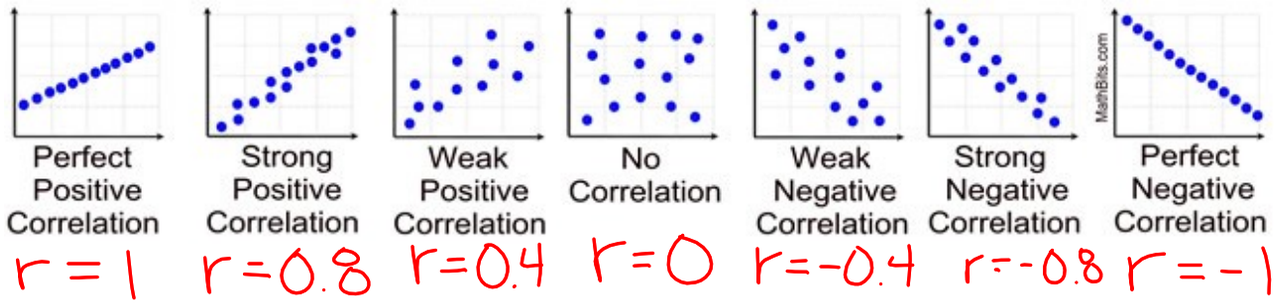
Correlation Coefficient – A number between -1 and +1 that is calculated to determine the linear dependence of two variables.

Regression—finding an equation for the graph of best fit. The shape of the graph can be linear, quadratic, exponential, etc. depending on the data.

Interpolation—using a line of best fit to estimate a value that is inside/within the data.

Extrapolation—using a line of best fit to estimate a value that is outside/beyond the data.

- Correlation is measured by the correlation coefficient, r.
- r (not r^2) is a number between -1 and 1.
- There are 4 traits to correlation:
  - Form (linear vs. exp.)
  - Direction (pos. or neg.)
  - Strength (strong, moderate, weak, no corr.)
  - Outliers



Size of correlation coefficient	General Interpretation
.8 - 1.0	Very Strong
.6 - .8	Strong
.4 - .6	Moderate
.2 - .4	Weak
.0 - .2	Very Weak or no relationship

How to perform an exponential regression in a TI-84

Click STAT, and under EDIT choose Edit. A blank table should appear. Under L_1 you are going to list the trial number and under L_2 list the Number of M&Ms.

(ONLY IF YOUR ALREADY HAVE DATA IN THE LISTS: To clear the lists before you begin, highlight the list name all the way at the top and press CLEAR—not delete—and ENTER.)

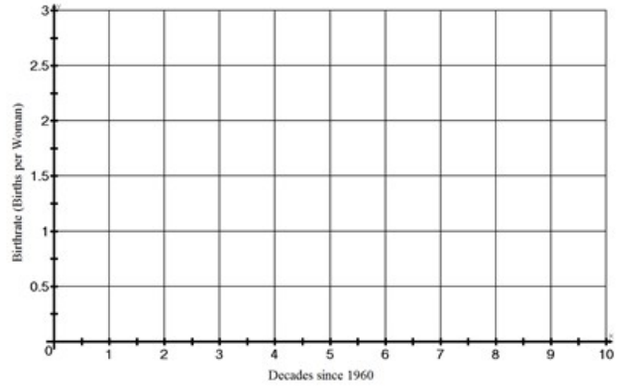
Now you need to find the "curve of best fit". This will make an equation that *best models* your data. Go to your home screen (2^{nd} QUIT), click STAT, scroll right to CALC, select ExpReg, press ENTER.

Write the exponential regression equation to three decimal places.

$$y = \underset{a}{\_\_\_\_\_} * \left(\underset{b}{\_\_\_\_\_}\right)^{x}$$

Year (t)	1960 X=0	1970 X=1	1980 X=2	1990 X=3	2000 X=4	2010 X=5
Birthrate (births per woman)	2.37	2.03	1.44	1.45	1.38	1.39

a) Plot the points to make a scatter plot.
For x, use the number of decades since 1960.
Example: 2000 is 4 decades from 1960, so x = 4.



b) Find an equation of the exponential line of best fit for the data.
Once again, use the number of decades since 1960 for your x-values.

y = $2.151(0.897)^x$; r = _____

c) Graph the line of best fit on the graph.

d) What does the y-intercept mean in context? Does it make sense?
2.151 births/woman in 1960

e) What does base mean in context?
Birthrate dec. by 10.3% per decade

f) How would you describe the correlation between the two variables?
negative and very strong

g) What was the expected birthrate 5 decades after 1960? What year is that? (2010)

$y = 2.151(0.897)^5 = 1.249$ births/woman

Interpolation or extrapolation?

h) What was the expected birthrate 10 decades after 1960? What year is that? 2060

$y = 2.151(0.897)^{10} = 0.725$ b/w

Interpolation or extrapolation?

i) How many decades after 1960 would you expect to have a birthrate of 1 birth per woman? What year is that? $1 = 2.151(.897)^x$ 2030

$x = \log_{.897}\left(\frac{1}{2.151}\right) = 7.05$ dec.

70.46 years

j) If this trend line were true farther into the past, what would you expect the birthrate in Germany was in 1800? $x = -16$

Data Analysis Project

From population growth to Carbon-14 dating, there are many topics from finance, biology, environmental science, etc. that are best modeled as exponential functions. In this project, you are choosing a topic that could be modeled exponentially and analyzing a set of data using an exponential regression. You are then comparing the validity of the exponential regression to a linear regression to decide which model would be better.

Parts of the Project

1. Complete the M&M Task with AT LEAST 100 M&Ms. Answer all questions accurately. (25 points)

2. Choose a topic/data set from the shared document. (5 points)

3. Create a google document in which you write your own set of questions to analyze the data. Answer the questions showing all work that leads to your answer. (85 points)

4. Turn in the M&M task in person and submit the data analysis by sharing it with your teacher's MAGNET ACCOUNT. (10 points)

Expectations

This should be one complete word document. Word has formatting options so you shouldn't have to use carets (^) for exponents or strange formats for subscripts. Your name or names and a title should be on the first page and the website for the data should be cited at the end.

This is a math project so all calculations that you would put in a calculator or steps to solve should be shown in your work. This is a data project so your data and how you manipulated the values as inputs or outputs (for instance, changing x-values based on a year) should be clearly included in a table in your document. Your table needs at least 10 data points - the more, the better. Use 3 decimal places for all calculations before rounding to reasonable numbers for your topic.