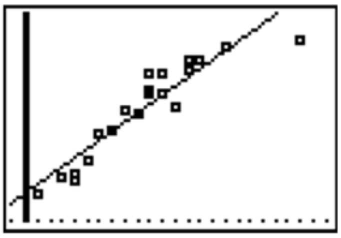
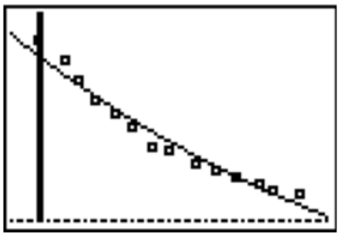
Algebra 2 Common Core Regents Review Statistical Analysis using Regression

Often times in science, a mathematical relationship between two variables is desired for predictive purposes. In the real world, the relationship between two variables is not always a perfect one, thus we often look for the "best" line or curve that can fit the data.

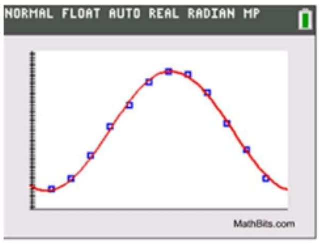
A.



B.



C.



The examples above represent a few of the different types of regression models. Could you name the type of regression each example above represents?

A. Linear B. Exponential C. Sinusoidal

The use of a model to predict outputs when the input is within the range of the known data is called Interpolation. Interpolation tends to be fairly accurate.

The use of a model to predict outputs when the input is outside the range of the known input data is called Extraplation. Models are most helpful when they can be used to extrapolate, but they tend to be less accurate.

Heavier cars typically get worse gas mileage (their miles per gallon) than lighter cars. The table below gives the weight versus highway gas mileage for seven vehicles.

L_1	x Vehicle Weight (thousands of pounds)	2.5	2.9	3.1	3.0	4.2	6.6	3.4
L_2	y Gas Mileage (miles per gallon)	34	36	31	29	23	12	26

(a) Determine the line of best fit linear equation, in $y = ax + b$ form, for this data set. Round all coefficients to the nearest tenth.

Stat - Calc - 4: Lin Reg

$y = -5.5x + 47.6$

(b) Using your model from part (a), determine the gas mileage, to the nearest mile per gallon, for a vehicle that weighs 3500 pounds.

y

$x = 3.5$

$y = -5.5x + 47.6$

$y = -5.5(3.5) + 47.6 = 28.35$

28 mph

(c) Is the prediction you made in (b) an example of interpolation or extrapolation? Explain.

(d) What is the value of the correlation coefficient to the nearest *hundredth*? Why is it negative?

$r = -.95$

b/c the slope is (−).

As wt ↑, gas mileage ↓

The population of Jamestown has been recorded for selected years since 2000. The table below gives these populations.

x	2	4	5	7	9
Year	2002	2004	2005	2007	2009
Population	5564	6121	6300	6812	7422

(a) Using your calculator, determine a best fit exponential equation, of the form $y = ab^x$, where x represents the number of years since 2000 and y represents the population. Round a to the nearest integer and b to the nearest thousandth.

Stat − Calc − 0: ExpReg

$y = 5158(1.041)^x$

(b) By what percent does your exponential model predict the population is increasing per year? Explain.

Base $= 1.041 = 1 + r$

$.041 = r$

4.1% increase

(c) Algebraically, determine the number of years, to the nearest year, for the population to reach 20,000.

$$\frac{20{,}000}{5158} = \frac{5158(1.041)^x}{5158}$$

$$\frac{20{,}000}{5158} = 1.041^x$$

$$\frac{\log\left(\frac{20{,}000}{5158}\right)}{\log 1.041} = \frac{x \log 1.041}{\log 1.041}$$

$x = 33.7 \approx 34$ years

Sinusoidal, or trigonometric, regression is much more complicated than either linear or exponential. It should be used in situations that appear periodic in nature.

The soil's temperature beneath the ground varies in a periodic manner. A temperature probe was left 3 feet underground and recorded the temperature as a function of the number of days since January 1st ($x = 0$). The temperatures for 14 days throughout the year are shown below.

Day	5	36	57	94	127	153	192
Temp (^{0}F)	41	37	36	40	48	64	68
Day	226	241	262	289	305	337	356
Temp (^{0}F)	66	61	58	49	44	42	40

(a) Find a best fit sinusoidal function for this data set in the form $y = a \sin(bx + c) + d$. Round all parameters to the nearest *hundredth*.

(b) Based on the model from (a) what are the highest and lowest temperatures reached in the soil?

(c) What is the average soil temperature?

Source for questions: www.emathinstruction.com

Review Topics for Regents Review #1

- Quadratic Formula
- Complex Numbers
- Parabolas
- Systems of Equations
- Substitution

Quadratic Formula

$X = \dfrac{-b \pm \sqrt{b^2-4ac}}{2a}$ *On your reference sheet

When entering the Quadratic Formula into your calculator, remember that you have the Alpha y= command to plug in the whole equation at once to evaluate. This command will only work for real answers and not for imaginary answers.

store

Example: The solutions to the equation $-\frac{1}{2}x^2 = -6x + 20$ are

$0 = \frac{1}{2}x^2 - 6x + 20$

$a = .5 \quad b = -6 \quad c = 20$

1. $-6 \pm 2i$
2. $-6 \pm 2\sqrt{19}$
3. $6 \pm 2i$
4. $6 \pm 2\sqrt{19}$

$x = \dfrac{6 \pm \sqrt{36 - 4(.5)(20)}}{\cancel{2(.5)}\ 1}$

$x = 6 \pm \sqrt{-4}$

$i\cancel{\sqrt{4}}\ 2$

Complex Numbers

Please refer to Section 1 in the Algebra 2 Common Core Review Packet 2019. Remember, your calculator will do the powers of i through i^6.

i^2=______

i^{35}=______

Remember that complex numbers travel in pairs. They are called conjugates. For example, if one root of an equation is 2+i the other root is ___________________.