1.14 Function Model Construction

AP Precalculus

1.14 Practice

CALCULATOR ACTIVE Perform the indicated regression and answer the questions.

1. Use Quadratic Regression in the form of

$$f(x) = ax^2 + bx + c$$

x	1	2	3	4	5	6
$f(x)$	10	6	5	5.5	6	11

a. Find the value of $a, b,$ and c.

$a = 0.911 \quad b = -6.218 \quad c = 15.2$

b. Use your equation to predict $f(2.5)$.

$f(x) = 0.911x^2 - 6.218x + 15.2$

$f(2.5) = 0.911(2.5)^2 - 6.218(2.5) + 15.2$

$f(2.5) = 5.349$

---

2. Run a Quartic Regression in the form of

$$g(x) = ax^4 + bx^3 + cx^2 + dx + e$$

x	-6	-4	-2	2	4	6
$g(x)$	2700	928	80	66	500	2450

$g(x) = 1.239x^4 + 0.667x^3 + 28.646x^2 - 47.595x - 61.4$

a. Find the value of a, b, c, d and e.

$a = 1.239 \quad b = 0.667 \quad c = 28.646$

$d = -47.595 \quad e = -61.4$

b. Use your equation find average rate of change from $x = 3$ to $x = 6$.

$g(3) = 171.997$

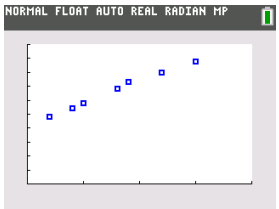
$g(6) = 2434.1$

$$\frac{g(6) - g(3)}{6 - 3} = \frac{2434.1 - 171.997}{6 - 3} = \frac{2262.103}{3} = 754.034$$

CALCULATOR ACTIVE Use regression to answer the following.

3. The data shows the salary in thousands of dollars for employees given their years experience.

Experience (years)	Salary (thousands)
2	48
4	54
5	58
8	68
9	73
12	80
15	88



a. The salary for employees can be modeled by the function S given by $S(t) = at + b$, where $S(t)$ is the salary in thousands of dollars based on years of experience t. Find the value of a and b.

$a = 3.137 \quad b = 42.349$

b. Use your equation predict the salary of an employee with 11 years experience.

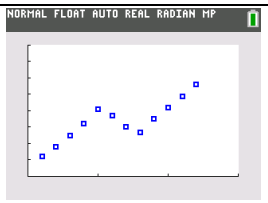
$S(t) = 3.137t + 42.349$

$S(11) = 76.856$ thousand dollar salary

---

4. The data shows poll ratings of a politician over time.

month	1	2	3	4	5	6	7	8	9	10	11	12
rating	12	18	25	32	41	37	30	27	35	42	49	56



a. The rating for a politician can be modeled by the function R given by $R(t) = at^3 + bt^2 + ct + d$, where $R(t)$ is the rating based on the month t. Find the value of a, b, c and d.

$a = 0.161 \quad b = -3.130$

$c = 19.849 \quad d = -7.364$

b. Use your equation to find the average rate of change from May to October.

$R(t) = 0.161t^3 - 3.130t^2 + 19.849t - 7.364$

$R(5) = 33.756$

$R(10) = 39.126$

$$\frac{R(5) - R(10)}{5 - 10} = \frac{33.756 - 39.126}{5 - 10} = \frac{-5.37}{-5} = 1.074$$

increase in rating every month

© The Algebros from FlippedMath.com

CALCULATOR ACTIVE Construct an inversely proportional model to answer the following.

5. The time taken for a water heater to boil water is inversely proportional to the power used in watts. It takes 2000 watts to boil water in 240 seconds. Find the time it takes when using 900 watts.

$t = \frac{k}{w}$

$240 = \frac{k}{2000} \cdot 2000$

$k = 480000$

$t = \frac{480000}{900}$

$t = 533.\overline{3}$ seconds

6. The data is inversely proportional. Find the value of a.

x	3	10	12
$f(x)$	16	4.8	a

$y = \frac{k}{x}$

$16 = \frac{k}{3} \cdot 3$

$k = 48$

$y = \frac{48}{12}$

$y = 4$

$a = 4$

7. Price is inversely proportional to time squared. If on day 2 the price is \$4, what is the price on day 4?

$p = \frac{k}{t^2}$

$4 = \frac{k}{2^2} \cdot 4$

$16 = k$

$p = \frac{16}{4^2}$

$p = 1$ dollar

8. The cost per cookie for making cookies is inversely proportional to the square root of the number of cookies made. If it costs \$2 each to make 9 cookies, how much would it cost for each cookie to make 25 cookies?

$c = \frac{k}{\sqrt{n}}$

$2 = \frac{k}{\sqrt{9}} \cdot 3$

$6 = k$

$c = \frac{6}{\sqrt{25}} = \frac{6}{5}$

$c = 1.20$ dollars

CALCULATOR ACTIVE Use the piecewise function to answer the following.

9.

$$f(x) = \begin{cases} 9x - x^2, & -2 \le x \le 3 \\ 2x - 17, & 3 < x < 10 \\ 5, & 10 \le x \le 12 \end{cases}$$

a. Find $f(1)$.

$f(1) = 9(1) - (1)^2 = 8$

b. Find $f(10)$.

$f(10) = 5$

10. A rental car costs \$20 to rent plus 70 cents every mile driven for the first 100 miles. Miles driven over 100 only cost 40 cents.

$$C(m) = \begin{cases} 20 + 0.7m, & 0 \le m \le 100 \\ 0.4(m - 100) + 90, & m > 100 \end{cases}$$

a. Find $C(128)$.

$C(128) = 0.4(128 - 100) + 90 = 101.2$

b. How many miles did a customer drive that spent 24 dollars on their rental car?

$24 = 20 + 0.7m$

$m = 5.714$ miles

OR $24 = 0.4(m - 100) + 90$

$m = -165$ miles

Can't be negative

© The Algebros from FlippedMath.com

1.14 Function Model Construction

Test Prep

Multiple Choice – Calculator Active

11. The table below shows the average price of a movie ticket during certain years.

year	2012	2015	2018	2019	2020	2022
price	7.96	8.17	8.97	9.11	9.16	10.12

A linear regression is used to construct a function model P that models the price over the given years. If $t = 1$ corresponds to 2012, $t = 4$ corresponds to 2015, and this pattern continues, which of the following defines function P?

(A) $P(t) = 0.206x + 7.541$

(B) $P(t) = 0.397x + 7.524$

(C) $P(t) = 0.206x + 7.747$

(D) $P(t) = 0.206x - 407.07$

---

12. The weight of an object is inversely proportional to the square of the distance between an object and the center of the earth. This relationship is modeled by the function W, where $W(d) = \frac{2.944 \times 10^9}{d^2}$ for distance, d, measured in feet, and weight where $W(d)$ measured in pounds. What is the average rate of change, in pounds per foot, if the distance between an object and the center of the earth is increased from 8500 feet to 9500 feet?

(A) 2944

(B) 8.127

(C) -123.047

(D) -0.00817

$W(8500) = 40.747$

$W(9500) = 32.62$

$\frac{32.62 - 40.747}{9500 - 8500}$

---

13. A membership to World Fitness costs \$75 per month and includes 10 free fitness classes. Any fitness classes attended after the first 10 free fitness classes cost \$5 each. Function C is used to model the cost of a monthly membership to World Fitness where n is the number of fitness classes taken and $C(n)$ is the cost in dollars. Which of the following defines C ?

(A) $C(n) = \begin{cases} 75, & 0 \le n \le 10 \\ 5n + 75, & n > 10 \end{cases}$

(B) $C(n) = \begin{cases} 75, & 0 \le n \le 10 \\ 5(n - 10) + 75, & n > 10 \end{cases}$

(C) $C(n) = \begin{cases} 75, & 0 \le n \le 10 \\ 10(n - 5) + 75, & n > 10 \end{cases}$

(D) $C(n) = 5n + 75$

© The Algebros from FlippedMath.com

FREE RESPONSE PREP – Calculator Active

You will need regression for FRQ #2 part A. Try some!!

14. The table shows the height of a ball thrown straight up in the air. The height of the ball can be modeled by the quadratic function *h* given by $h(t) = at^2 + bt + c$ where *h(t)* is the height of the ball *t* seconds after the ball is thrown.

***time* (*seconds*)**	0	2	3	4	7	8
***heigth* (*meters*)**	5	24	29	33	29	22

(A)

(i) Use the given data to write three equations that can be used to find the values for constants *a, b,* and *c* as decimal approximations.

Pick any three points from the table to set up your equations! I just picked the first 3 points.

$$5 = a(0)^2 + b(0) + c$$

$$24 = a(2)^2 + b(2) + c$$

$$29 = a(3)^2 + b(3) + c$$

(ii) Find the values of *a, b,* and *c* as decimal approximations.

$$a = -1.203 \qquad b = 11.793 \qquad c = 4.972$$

---

15. A water tank is being filled in a way that causes the rate of filling to increase over time. When the filling begins, the tank contains 40 liters of water. After 2 minutes, the tank contains 70 liters of water. After 4 minutes, the tank contains 115 liters of water. The volume of water in the tank can be modeled by the quadratic function V given by $V(t) = at^2 + bt + c$ where $V(t)$ is the volume of the water in the tank *t* minutes after the tanks starts being filled.

(A)

(i) Use the given data to write three equations that can be used to find the values for constants *a, b,* and *c* as decimal approximations.

Use the three points given in the prompt! $(0,40)$ and $(2,70)$ and $(4,115)$

$$40 = a(0)^2 + b(0) + c$$

$$70 = a(2)^2 + b(2) + c$$

$$115 = a(4)^2 + b(4) + c$$

(ii) Find the values of *a, b* and *c* as decimal approximations.

$$a = 1.875 \qquad b = 11.25 \qquad c = 40$$

© The Algebros from FlippedMath.com