Assignment 1A: Regression

Answer the following problems from your Lippman/Rasmussen textbook with as much detail, explanation, and work that is appropriate.

1. A regression was run to determine if there is a relationship between the diameter of a tree (x, in inches) and the tree's age (y, in years). The results of the regression are given below. Use this to predict the age of a tree with diameter 10 inches.

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y=ax+b
a=6.301
b=-1.044
r²=0.940
r=-0.970
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   With the equation of a line $y = ax + b$ we are given $a = 6.301$ and $b = -1.044$, let our regression line be, $y = 6.301x - 1.044$. Since our correlation coefficient is close to negative one ($r = -0.970$) we know that the regression line will be a relatively good fit for the data and thus will give us a good prediction. Since x is the diameter of a tree in inches *and y is the trees age in years we can plug in* 10 *for x in our equation to get the predicted age of a tree with that diameter. That is,*

   $$y = 6.301(10) - 1.044 = \frac{30983}{500} \approx 61.966.$$

   A tree with a diameter of 10 inches is predicted to be approximately 62 years old.

2. The US census tracks the percentage of persons 25 years or older who are college graduates. The data for several years is given below.

Year	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008
Percent Graduates	21.3	21.4	22.2	23.6	24.4	25.6	26.7	27.7	28	29.4

   a. Find a linear regression model equation for the data.
      $y = 0.476x - 926.6, r=.99$
   b. Find a quadratic regression model equation for the data.
      $y = .002x^2 - 7.853x + 7398.318,\ R^2 = .99$
   c. Determine if the trend appears linear or quadratic. *Explain.*
      The quadratic model has $R^2 = .99$, and the linear model has $r = .99$. So, this doesn't help us decide. Since the quadratic model is not substantially different, the linear model is the best to choose.
   d. Using the linear model, determine in what year will the percentage exceed 35%?
      For the linear model, it will reach 35% in the year 2020
      For the quadratic model, it will reach 35% in the year 2018

3. The US import of wine (in hectoliters) for several years is given below.

Year	1992	1994	1996	1998	2000	2002	2004	2006	2008	2009
Imports	2665	2688	3565	4129	4584	5655	6549	7950	8487	9462

a. Determine if the trend appears linear. If so, what is the regression equation

y = 409.5x - 813800   R² = 0.9699
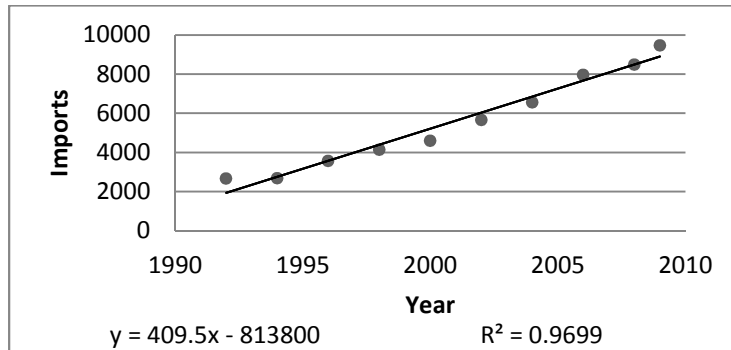
From graphing the data one can see that it is relatively linear. Finding the equation for the regression line with a computer we can calculate what year (if the trend continues) the amount of imports will exceed $12,000$ hectoliters. That is $y = 409.5x - 813,800$ with x equal to the year and y equal to the amount of wine in hectoliters that is imported into the US.

b. If so and the trend continues, in what year will imports exceed 12,000 hectoliters?

We can plug $y = 12,000$ and solve for x with algebra. With algebra let, $12,000 = 409.5x - 813800$, adding $813,800$ to each side we have, $825,800 = 409.5x$. Then by dividing both sides by 409.5 we arrive at $x = \frac{1651600}{819} \approx 2017.$ And so we can conclude that if the trend continues we will exceed $12,000$ hectoliters by the year 2017.

4. Find the quadratic regression model for this data and use it to find the maximum height.

Time (sec)	2	3	4	5	6	7	8
Height (m)	5	7.5	8.2	9	8.5	7.8	6.1

(5.206, 8.915)
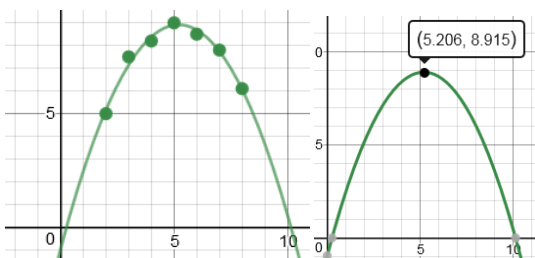
Regression model: $y = -0.36429x^2 + 3.7929x - 0.95714$

Maximum height will be approximately 8.915 m. The object will reach max height at 5.2 seconds.

When a projectile is launched, it's height s at time t can be found using the function $s(t) = s_0 + v_0 t - \frac{1}{2} g t^2$ and use the gravitation constant $g = 32 \, ft/sec$. Use this equation and graph to answer the next couple questions.
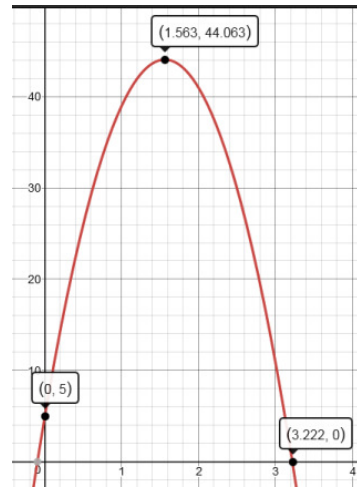
5. A ball is thrown such that $s_0 = 5$ feet off of the ground. The ball has an initial velocity of $v_0 = 50$ ft/sec at the moment it is thrown.
   a. Write the height function for the ball.

$$s(t) = 5 + 50t - 16t^2$$

   b. Sketch the graph of the projectile function.
      Identify and label the coordinates of the maximum point.

   The maximum is at $(1.563, 44.063)$

   a. Describe what does the y-coordinate of the maximum represent?

   The maximum height is 44.063 ft.

   b. Use your calculator to approximate when the ball will hit the ground to the nearest tenth of a second.

   It will hit the ground at 3.2 seconds because this is the x-intercept.