Lab #3
Regression, and Normal Probabilities

1. The NIH (National Institute of Health) is studying the relationship between the number of cigarettes smoked per day and the birth weight of babies born to mothers who smoke cigarettes. A sample of six is selected and is listed below

# cigarettes per day	22	13	29	11	25	6
Birth weight	6.1	7.9	5.8	7.4	6.3	8.2

   a. What is the regression equation predicting birth weight from number of cigarettes smoked per day? Recall to do a regression in Minitab you choose **Stat > Regression > Regression…**
   a. Make a scatter plot of this data and plot the regression equation onto the scatter plot.
   b. What is the value of the coefficient of determination? What percentage of the variation of birth weight is explained by the number of cigarettes per day?
   c. How much does the birth weight change if one more cigarette is smoked per day?
   d. What is the correlation coefficient between birth weight and number of cigarettes smoked per day? Calculate the correlation from the coefficient of determination.
   e. What birth weight would we predict for some one smoking ten cigarettes per day? What birth weight would we predict for a mother smoking 40 cigarettes per day?

You can use MINITAB to determine probabilities from a Normal distribution with mean 123 and standard deviation 45; in other words $X \sim N(123, 45)$. To find the probability $P(x < 156)$, choose **Calc > Probability Distributions > Normal…** In the window that appears select the bullet for **Cumulative Probability**; make sure the mean is 123 and the standard deviation is 45. Next, select the bullet for **Input Constant** and type 156. Click the **OK** button to see

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Normal with mean = 123 and standard deviation = 45
  x  P( X <= x )
156     0.768322
```

2. Assume that the random variable $X \sim N(0.987, 0.65)$. Find the probabilities:

   a. $P(X < 0.43)$
   b. $P(X > 1.23)$
   c. $P(0.67 < X < 0.89)$

You can use MINITAB to determine scores from a Normal distribution with mean 123 and standard deviation 45. For example, find the value C so that $P(x < C) = 0.95$, choose **Calc > Probability Distributions > Normal...** In the window that appears, select the bullet for **Inverse Cumulative Probability** and make sure the mean is 0.987 and the standard deviation is 0.65. Select the bullet for **Input Constant** and type *0.95* into the box. Click the **OK** button and see

```
Normal with mean = 123 and standard deviation = 45
P( X <= x )       x
       0.95  197.018
```

3. Assume that the random variable $X \sim N(54, 3)$.

   a. What is the value of C so that $P(X < C) = 0.9082$
   b. What is the value of C so that $P(X > C) = 0.0375$
   c. If $P(0 < X < a) = 0.3212$, what is the value of a?

d. What is the value of C so that $P(-C < X < C) = 0.8414$
e. What is the value of C so that $P(-C < X < C) = 0.7777$

4. Calculate the following:

   a. $X \sim N(246, 80)$, what is $P(X < 357)$?
   b. What is 99^{th} quantile of the distribution $X \sim N(246, 80)$?
   c. $X \sim N(333, 44)$, what is $P(X > 357)$?
   d. $X \sim N(333, 44)$, what is $P(246 < X < 321)$
   e. What is the 90th percentile of the distribution $X \sim N(500, 66)$?

5. The distribution of actual weights of 8 oz. Chocolate bars produced by a certain machine are normal with a mean of 8.1 ounces and a standard deviation of 0.1 ounces. What is the proportion of chocolate bars made by this machine weigh between 8.2 and 8.3 ounces?

6. Choose a household at random from Bakersfield and let the random variable X be the number of persons living in the household. If we ignore the few households with more than seven inhabitants, the probability distribution of X is as follows:

x	1	2	3	4	5	6	7
P(x)	0.25	?	0.17	0.15	0.07	0.03	0.01

   a. What is $P(X = 2)$?
   b. What is $P(X \neq 1)$?
   c. What is $P(2 < X \leq 4)$?

7. The scores on a university exam are normally distributed with a mean of 62 and a standard deviation of 11. If the top 15% of students are given A's, what is the lowest mark that a student can have and still be awarded an A?

8. According to Opinion Research Corporation, the length of time spent in the shower by men follows a normal probability distribution with a mean of 11.4 min and a standard deviation of 1.8 minutes.

   a. What is $P(x < 10)$?
   b. What is probability that the shower lasts at least 15 minutes?
   c. What is the number of minutes of the 10% fastest showers?

9. According to the College Board, the scores on the SAT Math exam have a normal distribution with a mean of 500 and a standard deviation of 100.

   a. What is $P(x < 450)$?
   b. What is the percentile for a student who scores 600 on exam?
   c. What score would the student have to make to be in the top 1%?