Math 247: Test 1 (Take Home)   Name: **KEY**
(20 points)

Score: _____ /20   ***Due date:*** *Tuesday, 9/10/2019*

- *I encourage you to work with other people in the class but your final work must be your own. Be sure that all answers are written in your own words; i.e., do not write verbatim the same answer as another student.*
- *Scoring will be based on organization of your work, accuracy, and thoughtful, well-written answers.*
- *Use complete sentences in your answers!*

A student gathered data from 43 people, asking each to give the number of hours they sleep per night (on average), the number of hours they exercise per week, and how happy they are on a scale of 1 to 5, where 1 = Very Unhappy, 2 = Somewhat Unhappy, 3 = Neutral, 4 = Somewhat Happy, 5 = Very Happy.

The data is on www.wrightmath.info , Math 247, StatCrunch.

Research question: Is sleep or exercise a better predictor of happiness?

Part 1: Explore the association between sleep and happiness.
1. Use StatCrunch to perform a Simple Linear Regression on the sleep/happiness data. Use Sleep as the explanatory variable (independent) and Happiness as the predicted variable (dependent).

   Print out the the graph and the linear regression output and include them in your response paper.

2. Describe the scatterplot including Shape, Scatter, Trend, Strength, and potential Outliers.

   Non-linear ex:

   - Shape: No discernible curve to the points so we can say the shape is linear
   - Scatter: There is a lot of scatter!
   - Trend: The points have an upward trend, so positive.
   - Strength: The upward trend looks weak. (the line isn't sloped strongly upward)
   - Outliers: The points (4,3) and (5,1) seem somewhat atypical which makes sense since getting 4 or 5 hours of sleep on average is very unusual.

3. What is the correlation coefficient for Sleep and Happiness? ___ $r = .338$ ___

   What does this tell you about the association between Sleep and Happiness?
   Since r is closer to zero than to one, we can see that the association between Sleep and Happiness is weak but Sleep is still a factor, since r is not zero.

   Does this mean that more sleep <u>causes</u> people generally to be happier? Explain why or why not.

   This is an observational study so we can NOT conclude that there is any cause-and-effect relationship! Also, the results apply only to this group since the data doesn't come from a random sample from the population. Correlation is not causation!

4. What is the equation of the regression line? Write the equation using x and $\hat{y}$ and also using the words "Sleep" and "Happiness". → Happy

$$\widehat{Happy} = 1.436 + .323 * Sleep$$

$$\hat{y} = 1.436 + .323X$$

$\hat{y}$ = predicted Happiness

x = hours of sleep

Use the equation to predict the happiness level of someone who gets 7.5 hours of sleep, on average. Show work! Mark this point on the scatter plot.

$$X = 7.5$$
$$\hat{y} = 1.436 + .323(7.5)$$
$$= 3.859 \text{ or } 3.9$$

According to the model, we predict that people who got 7.5 hours of sleep will have, on average, a happiness level of about 3.9.

5. What is the slope of the regression line and what does it mean in terms of Sleep and Happiness? Be specific in your answer and use units!

Slope = .323

For every extra hour of sleep, happiness level increased by .323 units, in this sample group. Note that since the slope is <u>not</u> zero, we can see there is <u>some</u> link between sleep and happiness for this group.

Part 2: Explore the association between exercise and happiness and compare.

1. Use StatCrunch to perform a Simple Linear Regression on the exercise/happiness data. Use Exercise as the explanatory variable (independent) and Happiness as the predicted variable (dependent).

Print out the graph and the linear regression output and include them in your response paper.

2. What is the correlation coefficient for Exercise and Happiness? $r = .149$

① Compare the correlation between Sleep and Happiness vs. Exercise and Happiness. ② Which variable, Sleep or Exercise, is a better predictor of Happiness? How can you tell?

① Since the correlation value is closer to zero for Exercise and Happiness, we can see that Exercise is even more weakly linked to Happiness ② than Sleep is, so Sleep is a better predictor of Happiness than Exercise is. (Looking at the graphs we see the slope is bigger (steeper line) for Sleep and Happiness, indicating a stronger trend.)

3. What is the slope of the regression line for Exercise and Happiness?

$m = .023$ (Note how "flat" the regression line is – it's close to horizontal!)

Since the slope is very close to ____0____, we can see that there isn't a significant link between Exercise and Happiness for the people in this study.

4. What is the equation of the regression line? Write the equation using x and $\hat{y}$ and also using the words "Exercise" and "~~Happiness~~". → Happy

$$\widehat{Happy} = 3.423 + .023 * Exercise$$

$$\hat{y} = 3.423 + .023\,x$$

$x =$ hours of Exercise (per week)

$\hat{y} =$ predicted Happiness level.

Use the equation to predict the happiness level of someone who gets 0 hours, 10 hours, and 20 hours of exercise, on average.   Show work! Mark these points on the scatter plot.

x	$\hat{y}$
0	3.423
10	3.653
20	3.883

$x = 0$ $\hat{y} = 3.423 + .023(0)$
$= 3.423$

$x = 10$ $\hat{y} = 3.423 + .023(10)$
$= 3.653$

$x = 20$ $\hat{y} = 3.423 + .023(20)$
$= 3.883$

Was there much difference in the happiness values you found for 0, 10, and 20 hours of exercise? ___No___
Explain how this relates to the slope of the regression line.

There wasn't much change in predicted happiness level for the different Exercise hours because the slope of the regression line is very small (close to zero). Again, this emphasizes that there is a pretty weak (negligible) link between Exercise and Happiness for this group of people.
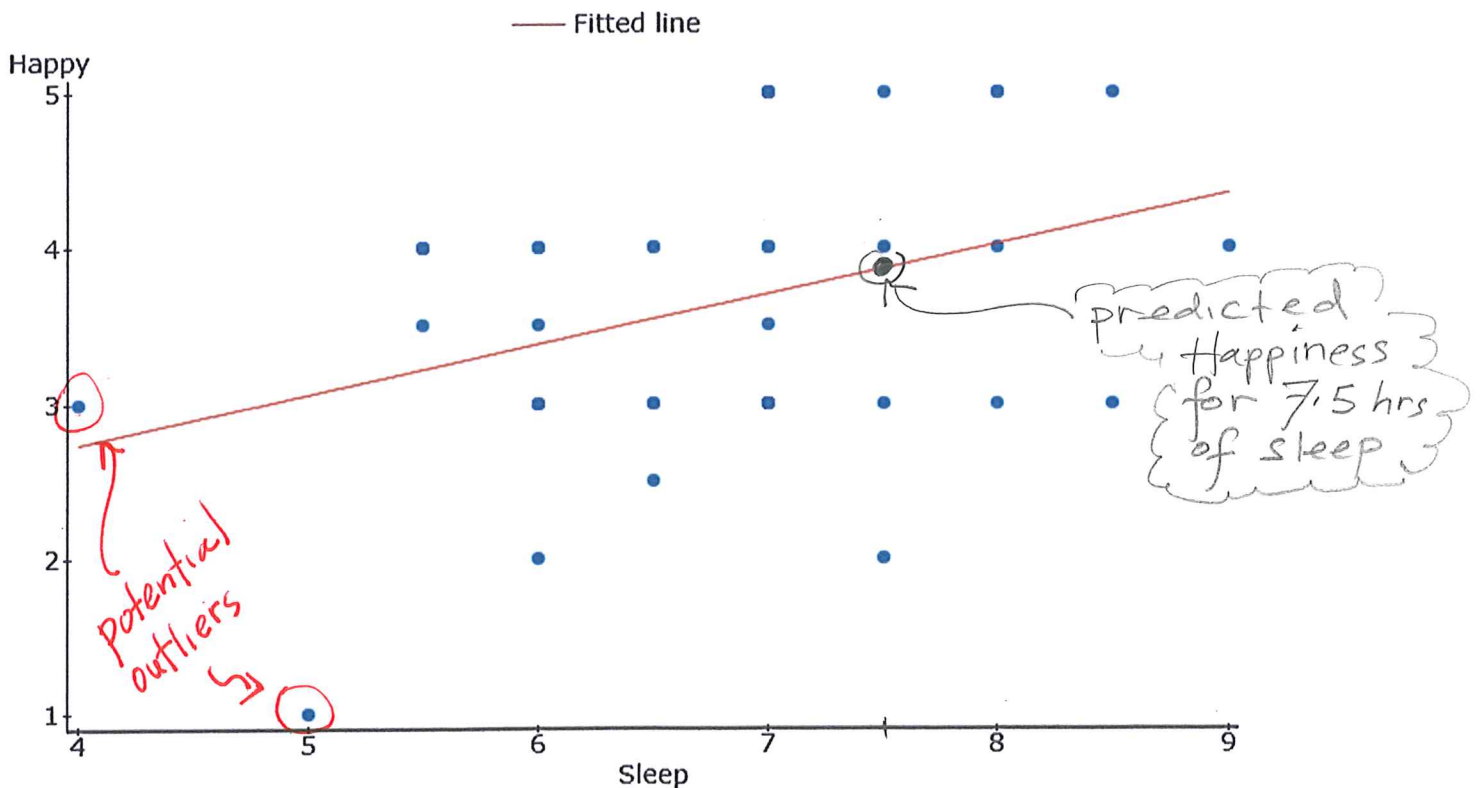
Simple linear regression results:

Dependent Variable: Happy
Independent Variable: Sleep
Happy = 1.4363484 + 0.32328308 Sleep
Sample size: 43
R (correlation coefficient) = 0.33825102
R-sq = 0.11441376
Estimate of error standard deviation: 0.90652738

Parameter estimates:

Parameter	Estimate	Std. Err.	Alternative	DF	T-Stat	P-value
Intercept	1.4363484	0.96220323	$\neq 0$	41	1.4927703	0.1432
Slope	0.32328308	0.14046475	$\neq 0$	41	2.3015246	0.0265

Analysis of variance table for regression model:

Source	DF	SS	MS	F-stat	P-value
Model	1	4.3530443	4.3530443	5.2970154	0.0265
Error	41	33.693467	0.82179189		
Total	42	38.046512			

predicted Happiness for 7.5 hrs of sleep

Potential outliers

Simple linear regression results:

Dependent Variable: Happy
Independent Variable: Exercise
Happy = 3.4283881 + 0.022547474 Exercise
Sample size: 43
R (correlation coefficient) = 0.1492375
R-sq = 0.022271832
Estimate of error standard deviation: 0.952521

Parameter estimates:

Parameter	Estimate	Std. Err.	Alternative	DF	T-Stat	P-value
Intercept	3.4283881	0.25243446	$\neq 0$	41	13.581299	<0.0001
Slope	0.022547474	0.023331199	$\neq 0$	41	0.96640872	0.3395

Analysis of variance table for regression model:

Source	DF	SS	MS	F-stat	P-value
Model	1	0.84736553	0.84736553	0.93394581	0.3395
Error	41	37.199146	0.90729625		
Total	42	38.046512			

Predicted Happiness Levels for 0, 10, 20 hours of Exercise