Math 1530 Competence Exam 2015

Name _____

This exam has 3 parts:

1. Twenty multiple choice questions. There are five possible responses to each of the following multiple choice questions. There is only one "BEST" answer. Be sure to read all possible choices before selecting your answer. You can use a calculator but a calculator manual cannot be used. Each question is worth 2 points: 40 points total in this section.
2. Seven open ended questions in which you need to perform calculations and interpret the results. Each question is worth six points: 42 points total in this section.
3. One data analysis part to be worked with the computer (you will be allowed to work with the computer after you turn in the first two parts of the exam). This part is worth 20 points.

Tables for the Normal, t-Student and Binomial distributions will be provided.
You will have 3 hours to answer this exam
You can take a 10 minute break when you finish parts 1 & 2 before working with the computer
This is a closed book exam.

You might write on this exam but please record your answers to the multiple choice questions in the scantron. After you finish the multiple choice questions, turn in the scantron and proceed to write your answers to the open ended questions in the space provided.

1. Which of these questions from the Spring 2015 MATH1530 class survey produced variables that are quantitative?
   i. In a typical day, about how many times do you wash your hands?
   ii. Should law enforcement officers be required to wear a camera on their uniform while on duty (Yes or No)?
   iii. What is your current weight in pounds?
   iv. Do you have good reason to think you have ever been in contact with a sexual predator over the internet (Yes or No)?
   v. How safe would you feel if a nuclear energy plant were built near where you live (Extremely safe, Very safe, Moderately safe, Slightly safe, Not at all safe)?

   (A) i, iii. (B) ii, iii. (C) i, iv, v. (D) ii. (E) iii.

Use the following for the next 2 questions. The Spring 2015 MATH1530 survey asked "How much money did you spend on your last clothing purchase?" The descriptive statistics below summarize the student responses by gender of the clothing purchase.

Descriptive Statistics: PURCHASE

Variable	GENDER	N	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Clothing Purchase	Female	464	65.50	5.59	120.49	0.00	20.00	34.50	75.00	2000.00
	Male	347	67.72	4.97	92.51	0.00	20.00	40.00	75.00	850.00

2. Based on these statistics, what would you surmise about the shape of the distribution for the females?
   (A) The distribution is skewed right with possible outlier(s). (C) The distribution is bell-shaped.
   (B) The distribution is skewed left with possible outlier(s). (D) The distribution is fairly uniform.
   (E) The distribution is both left and right skewed.

3. Approximately how many students spent between $20 and $75 on their last clothing purchase?
   (A) 406 (B) 50 (C) 232 (D) 55 (E) 110

4. Asking students about the quality of food available in the cafeteria as they leave is an example of a _____.
   (A) convenience sample (C) stratified random sample (E) matched pairs design
   (B) simple random sample (D) cluster sample

5. The Spring 2015 MATH1530 class survey asked "About how much time per week (on average) do you devote to physical fitness?" The table represents the responses of 811 students.

Time spent on physical fitness	Between 0 and 2 hours	Between 2 and 5 hours	Between 5 and 9 hours	Between 9 and 15 hours	Over 15 hours
Number of Students	242	248	159	103	59

Estimate the median time spent on physical fitness per week for these 811 students.

(A) Between 2 and 5 hours (B) 406 (C) 248 (D) Between 5 and 9 hours (E) 159

6. Which of the following is NOT a proper use of correlation?

(A) The correlation between job status and salary is 0.89 dollars.

(B) The correlation between years of experience and salary is 0.67.

(C) The correlation between weight and waist circumference is 0.35.

(D) The correlation between years of education and salary is 0.67.

(E) The correlation between salary and years of education is 0.67.

7. For the Spring 2015 MATH1530 survey data, the correlation between height (inches) and weight (pounds) is 0.48. This is based on 811 student responses. If we converted inches to centimeters and pounds to kilograms, what would be the correlation? (Note: 1 inch = 2.54 centimeters and 1 pound = 0.453592 kilograms)

(A) 0.48

(B) $0.48/(2.54 \times .453592) = 0.42$

(C) $0.48 \times 2.54 \times .453592 = 0.55$

(D) 0.48 centimeters per kilograms

(E) Cannot be determined without converting all English unit measurements (in & lb) to Metric units (cm & kg).

8. A recent study found that the following behaviors–smoking, drinking too much alcohol, not exercising, and not eating enough fruits and veggies–can reduce your lifespan (on average). Whether moderation of these behaviors will extend life is not clear. Suppose that the added life expectancy from moderation of these behaviors is just 3 months. A statistical test is more likely to find a significant increase in mean life if

(A) it is based on a very large random sample.

(B) it is based on a very small random sample.

(C) The size of the sample doesn't have any effect on the significant of the test.

(D) it is of practical significance.

(E) the p-value is large.

9. A radio show conducts a phone-in survey each morning. Listeners are asked to call in with a response to the question of the day. One morning in 2011, listeners were asked if they supported or opposed term limits for members of Congress. Remarkably, 88% of listeners that called in favored term limits. We may safely conclude that

(A) nothing, except that a great majority of those with strong enough feelings on the issue to call in are in favor of congressional term limits. We cannot generalize any of this survey's results to any larger population.

(B) it is unlikely that if all Americans were asked their opinion, the results would differ from that obtained in the poll.

(C) there is strong evidence that the majority of Americans believe that there should be congressional term limits.

(D) there is overwhelming approval for congressional term limits among Americans generally.

(E) there is overwhelming approval for congressional term limits among all people living in the listening area of the radio station.

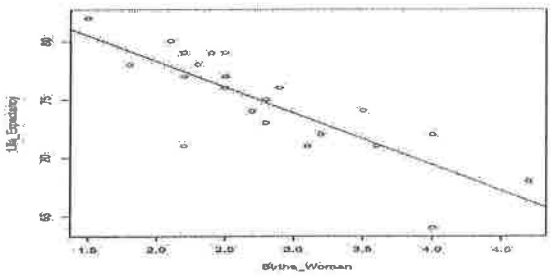
10. A sample of households in a community is selected at random from the telephone directory. In this community, 4% of households have no telephone, 10% have only cell phones, and another 25% have unlisted telephone numbers. The sample will certainly suffer from

    (A) undercoverage bias. (C) interviewer bias. (E) response bias.

    (B) question wording bias. (D) nonresponse bias.

Use the following for the next 3 questions. Data from the World Bank for 25 Western Hemisphere countries were collected to examine the association between female life expectancy and the average number of children women give birth to. The observations and the least-squares regression line appear in the scatterplot. The correlation between the two variables is $r = -0.815$ and the least-squares regression equation is

$$Life\ Expectancy = 87.2 - 4.4 \times Births\ per\ Woman.$$



11. Which is the most appropriate interpretation of the slope?

    (A) For each additional child a female has the life expectancy will decrease by 4.4 years on the average.

    (B) For each additional child a female has the estimated life expectancy is 87.2 years on the average.

    (C) For each additional year a female lives the average number of children women give birth to decreases by 4.4.

    (D) The average number of births is decreasing by 4.4 years.

    (E) For each additional child a female has the life expectancy will increase by 4.4 years on the average.

12. According to the least-squares regression equation, what is the predicted female life expectancy for a woman that has 3 children?

    (A) 74 yrs. (B) 71 yrs. (C) 82.8 yrs. (D) 60 yrs. (E) $(-.815)^2 = 66.4$ yrs.

13. If government leaders wanted to increase life expectancy, in their country, should they encourage women to have fewer children?

    (A) No, while there is an association, there is no reason to expect causality. There may be lurking variables.

    (B) Yes, females will have shorter life expectancies by having more children.

    (C) Yes, for each additional child a female will live 4.4 years less.

    (D) No, the graph indicates more births means longer lives.

    (E) No, all the points are not exactly on the line.

14. A simple random sample of size n requires that

    (A) every set of n individuals in the population has an equal chance of being selected.

    (B) the population be unbiased.

    (C) the distribution or original data be approximately normal.

    (D) the population size is large.

    (E) sample size is large.

15. At a local health club, a researcher samples 75 people whose primary exercise is cardiovascular and 75 people whose primary exercise is strength training. The researcher's objective is to assess the effect of type of exercise on cholesterol. Each subject reported to a clinic to have his or her cholesterol measured. The subjects were unaware of the purpose of the study, and the technician measuring the cholesterol was not aware of the subjects' type of exercise. This is

    (A) an observational study.
    (B) an experiment, but not a double-blind experiment.
    (C) a double-blind experiment.
    (D) a matched pairs experiment.
    (E) a simple random sample.

16. You read online that the chance of winning the Powerball lottery is one in 175 million. This means

    (A) if billions of Powerball lottery tickets are purchased, the fraction of them that are winning tickets will be very close to one in 175 million.
    (B) if 175 million lottery tickets are sold, exactly one of them will be the winning ticket.
    (C) if 175 million lottery tickets are sold, at least one of them will be the winning ticket.
    (D) if someone wins the lottery, at least 175 million tickets must have been sold.
    (E) none of the above.

17. During World War II, the British found that the probability that a bomber was lost through enemy action on a mission over occupied Europe was 0.05. The probability that the bomber returned safely from a mission was therefore 0.95. It is reasonable to assume that missions were independent. The probability that a bomber survives mission 1 and mission 2 is

    (A) $(0.95)(0.95) = 0.9025$
    (B) $0.95 + 0.95 = 1.9$
    (C) $(0.05)(0.05) = 0.0025$
    (D) $0.05 + 0.05 = 0.10$
    (E) $(0.95)(0.95) - (0.05)(0.05) = 0.90$

18. The length of human pregnancies from conception to birth varies according to a distribution that is approximately Normal with mean 266 days and standard deviation 16 days. The distribution of the sample mean pregnancy length for 100 randomly chosen women is

    (A) approximately Normal, mean 266 days, standard deviation 1.6 days
    (B) approximately Normal, mean 266 days, standard deviation 16 days
    (C) approximately Normal, mean equal to the observed value of the sample mean, standard deviation 16 days
    (D) approximately Normal, mean 266 days, standard deviation 0.16 days
    (E) approximately Normal, mean 26.6 days, standard deviation 16 days

19. The Spring 2015 MATH1530 survey asked students "What is the lowest gas price you recall seeing at the gas station?" The price of regular gas is lower than the other grades, so if students are reporting the lowest price, we will assume it is probably for regular. AAA reports in their Daily Fuel Gauge Report that the average price of regular grade gasoline, in the state of Tennessee, was \$1.922 per gallon during the first week of February (when many of our MATH1530 students took the survey). Do students, on the average, recall seeing the lowest gas price less than the reported \$1.922 from AAA? In the sample of 789 students who responded to the question, the sample mean was $\bar{x} = \$1.771$. Regard these students as an SRS from the population of all students at ETSU. The hypotheses of interest are

    (A) $H_0 : \mu = 1.922$ vs. $H_a : \mu < 1.922$
    (B) $H_0 : \mu = 1.922$ vs. $H_a : \mu > 1.922$
    (C) $H_0 : \mu = 1.771$ vs. $H_a : \mu < 1.771$
    (D) $H_0 : \bar{x} = 1.771$ vs. $H_a : \bar{x} < 1.771$
    (E) $H_0 : \mu = 1.922$ vs. $H_a : \mu < 1.771$

20. You use software to carry out a test of significance. The program tells you that the $P-$value is $P = 0.031$. You conclude

    (A) that the probability, computed assuming that H_0 is true, that the test statistic would take a value as extreme or more extreme than that actually observed is 0.031.

    (B) that the probability, computed assuming that H_0 is true, that the test statistic would take a value as extreme or less extreme than that actually observed is 0.031.

    (C) that the probability, computed assuming that H_0 is false, that the test statistic would take a value was extreme or more extreme that that actually observed is 0.031.

    (D) that the probability that H_0 is true is 0.031.

    (E) that the probability that H_a is true is 0.031.

Section 2 of the exam. Please answer the following questions in the spaces provided

1. The following data (sorted) are the percents of residents aged 65 and older in the 50 states, according to the 2000 censuses.

5.7	8.5	9.6	9.7	9.9	10.6	11.0	11.2	11.2	11.3	11.3	11.6	11.7
11.7	12.0	12.0	12.1	12.1	12.1	12.1	12.3	12.4	12.4	12.5	12.7	12.8
12.9	13.0	13.0	13.0	13.1	13.2	13.2	13.3	13.3	13.3	13.4	13.5	13.5
13.6	13.8	14.0	14.3	14.4	14.5	14.7	14.9	15.3	15.6	17.6		

a)Prepare the stem-and-leaf display of the data.

b) Draw the boxplot.

c)Calculate the five-number summary.

d) Comment on the shape of the distribution

2. A new roller coaster at an amusement park requires individuals to be at least 50 inches tall to ride. It is estimated that the heights of 10-year-old boys are normally distributed with $\mu = 54.5$ inches and $\sigma = 4.5$ inches.
a)Sketch the distribution and shade in the area corresponding to the 10-year old boys who are tall enough to ride this coaster. Calculate the proportion of 10-year old boy who are tall enough to ride the coaster. (Show your work)

b) How tall at most are the 10-year old boys who rank in the lowest 10% of heights? (Show your work)

3. A test has 20 multiple choice questions, each one with 5 answers. A student has not studied, and decides to not even read the questions but to answer totally at random. What is the probability that he/she answers correctly half or more of the questions? _____ Explain how you calculated that answer and why you did so.

4. What is the average age of an undergraduate at ETSU? The 2014 ETSU Fact Book reports the average age of an undergraduate at ETSU is 23.1. Somebody questions if that is true and suggests that maybe students are younger on average.
   a) Write the null and alternative hypotheses.

   b) We select a random sample of 800 students and ask them "What is your age?". The mean age of the students in the sample is 21.293 and the standard deviation is 5.72. Perform a test to check if the results from the sample constitute evidence against what is stated in the ETSU Fact Book. Show your work and state clearly your conclusion.

   c) Calculate and interpret a 95% two-sided confidence interval for the mean age of the population of ETSU students.

5. A letter to the editor in a local newspaper claims that 3/4 students support the idea of officers wearing a camera in their uniform. The Spring 2015 MATH1530 survey asked students "Should law enforcement officers be required to wear a camera on their uniform while on duty?" In the sample of 811 students who responded to this question, 640 said "YES."

   a)The sample proportion $\hat{p}$ of students who responded "YES" is _____.

   b)Assume that the students who answered the survey can be considered a random sample of the population of ETSU students. Calculate a 95%confidence interval for the proportion in the population and interpret it.

   c)Based on the confidence interval, what is your opinion about the statement done in the letter to the editor?

   d) Assume you are planning a survey on the topic in another college, how many students would you include in the sample if you wanted the margin of error to be 3% and you don't really have an idea of what proportion of students in that college would agree with the police wearing a camera.

6. A survey directed toward college students asked "How many articles of clothing are you wearing right now?" A distribution of proportions for the number of articles of clothing is displayed below.

Number of clothing articles	0	1	2	3	4	5	6	7	8	9	10	11
Proportions	0.022	0.016	0.059	0.118	0.171	0.232	0.210	0.107	0.037	0.017	0.009	0.001

a) If we randomly select a student who responded to this survey, what is probability that random student will be wearing at most 1 article of clothing?

b) What is the number of pieces of cloth that the students in this population wear on average when the temperature is about the temperature when the survey was conducted? **(Show your work)**

7. The MATH1530 survey asked students "How safe would you feel if a nuclear energy plant were built near where you live?" The table below displays the counts for males and females.

Nuclear safe	**Female**	**Male**	**Total**
Extremely safe	10	27	37
Very safe	26	43	69
Moderately safe	132	107	239
Slightly safe	114	75	189
Not at all safe	182	95	277
Total	464	347	811

a)What percent of the students feel extremely safe if a nuclear energy plant were built near them?

b) What percent of males feel extremely safe if a nuclear energy plant were built near them?

c) How would you to find out if how safe a person feels is independent of gender?

d) How many males would you have expected to feel extremely safe if feeling safe was independent of gender?

TURN IN YOUR ANSWERS BEFORE WORKING ON THE NEXT SECTION WITH THE COMPUTER

Part 3 of the exam

Turn on the computer now. You are expected to use statistical software (Minitab or R) to solve this part. You will prepare a Word document with your analysis inserting the computer output you get (including graphs), interpretations, answers to the questions etc. and upload it to.....

You can use either the data file Default-1000.mtw or Default-1000.txt. Those data files contain the values of four variables for a random sample of 1000 individuals from the records of a credit card company. The variables are:

- default (YES= client has not paid, NO= client is paying his/her debt)
- student (YES= client is a student, N0= client is not a student)
- balance (the amount of money person has as debt in the credit card)
- income (annual income in $)

The purpose of this data analysis is to understand which characteristics of the individuals are associated to paying or not paying the debt. We will organize the analysis by asking very specific questions.

1. Is there a strong relationship between income and balance? Obtain a plot and calculate an statistic to answer this question. Interpret the results.
2. Is there a difference in mean income between those who default and those who don't? Obtain a plot and perform a test of hypothesis to answer this questions.
3. Is there a difference in the mean balance between those who default and those who don't? Obtain a plot and perform a test of hypothesis to answer this question. Interpret the results.
4. Get a histogram and perform a test for normality for each of the variables balance and income. Based on this, do you have any concerns about the test you applied in questions 1 and 2?
5. Is defaulting independent of being a student when we consider all the individuals in the sample? Produce a table, a plot and perform a test to answer this question.
6. Produce a scatterplot with balance in the Y axis and income in the X axis, using different symbols for the individuals according to their student status (YES,NO) AND their default status (YES,NO). Where in the plot are the students located with respect to income? Where in the plot are the students who default their credit card located with respect to balance? Where in the plot are the non-students located with respect to income? Where in the plot are the non-students who default their credit card located with respect to balance? Do you perceive any difference between students and non-students who default the payment with regard to their balance?
7. Write a paragraph summarizing your findings.