

## Statistics Competency Exam Fall 2019 Part II

Name \_\_\_\_\_

R and/or Minitab along with a calculator may be used for this entire section. Once you have completed this section, e-mail Part II to Dr. Price at [pricejr@etsu.edu](mailto:pricejr@etsu.edu), Dr. Lewis at [lewiscn2@etsu.edu](mailto:lewiscn2@etsu.edu), and Dr. Hendrickson at [hendricksonj@etsu.edu](mailto:hendricksonj@etsu.edu). Please make sure you e-mail it to all three professors.

**The data labeled Fall14 (that I have emailed you) is needed to answer all questions.**

**A total of 1220 students responded to the class survey. The data for 1184 students were recorded in Fall14.csv. The data in the csv file is based on a student survey that asked the following questions:**

- **GENDER:** Are you male or female? (Male, Female)
- **CHILDREN:** What do you think is the ideal number of children for a family to have?
- **MARRIED:** What is your opinion about a married person having sexual relations with someone other than the marriage partner? (Always wrong, Almost always wrong, Wrong only sometimes, Not wrong at all)
- **SEX:** There's been a lot of discussion about the way morals and attitudes about sex are changing in this country. What is your opinion about two people having sexual relations before marriage? (Always wrong, Almost always wrong, Wrong only sometimes, Not wrong at all)
- **PARTY:** What political party do you identify with? (Democratic, Republican, Independent, Other)
- **INCOME\_TAX:** Should Tennessee implement a state income tax? (Yes, No)
- **SPANKING:** Do you strongly agree, agree, disagree, or strongly disagree that it is sometimes necessary to discipline a child with a good, hand spanking? (Strongly agree, Agree, Disagree, Strongly disagree)
- **DEATH\_PENALTY:** Do you favor or oppose the death penalty for persons convicted of murder? (Favor, Oppose)
- **TV:** How many hours do you personally watch television including Netflix, Hulu Plus, Amazon Prime, etc... in a day?
- **DEVICES:** How many devices do you have that will allow you watch a TV show or movie (live, streaming, pre-recorded, online)?
- **PREPARING:** How many hours per 7-day week do you spend preparing for class (studying, reading, writing, doing homework or lab work, analyzing data, rehearsing, and other academic activities)?
- **SLEEP:** Usually, how many hours sleep do you get a night?
- **SHOES:** How many pairs of shoes do you own?

**Two questions were taken from a previously conducted survey. A total of 791 students responded to this survey. The data for those 791 students were also recorded in Fall14.csv. Below are the two questions taken from that survey.**

- **SHOE\_SIZE:** What is your U.S. shoe size?
  - **HEIGHT:** What is your height in inches?
1. **PREPARING:** Question 11 from the survey asked students, "How many hours per 7-day week do you spend preparing for class (studying, reading, writing, doing homework or lab work, analyzing data, rehearsing, and other academic activities)?"
- (A) Create an appropriate display for this variable and insert it here.
  - (B) Describe the shape of the distribution.
  - (C) Calculate numerical measures appropriate for the shape of the distribution to describe the center and spread of **PREPARING**.
    - i. Which statistic will you use to describe the center of the distribution?
    - ii. What is the value of that statistic?
    - iii. Which statistic(s) will you use to describe the spread of the distribution?
    - iv. What is(are) the value(s) of that(those) statistic(s)?
  - (D) Are there any outliers in this distribution? Justify your answer using the IQR rule or an appropriate plot.

- (E) Create a side-by-side boxplot to display **PREPARING** for the different levels of **GENDER**. Insert your graph here.
- (F) Describe the distributions of **PREPARING** for the different levels of **GENDER** and compare them.
2. **PARTY**: Question 5 from the survey asked students “What political party do you identify with? (Democratic, Republican, Independent, Other)” On October 15, 2014, Gallup polling found that 33% of Americans identified as Republican. Is the same true for the population of all U.S. college/university students?
- (A) Create an appropriate graph to display the distribution of **PARTY** and insert it here.
- (B) What is the mode of this distribution?
- (C) How many students surveyed said “Republican” was the political party they identified with?
- (D) What proportion of our sample said “Republican” was the political party they identified with?
- (E) Assume (for the purpose of this problem) that we may treat the Fall 2014 sample of Math 1530 students as a simple random sample drawn from the population of all U.S. college/university students. Calculate a 95% confidence interval for the proportion of students in the population who identify with the “Republican” party (based on our sample data). Copy and paste the output here.
- (F) Interpret the confidence interval you reported above.
- (G) What do you think? Is the percentage of Americans that identify as Republican, 33%, the same for the population of all U.S. college/university students? Explain.
3. **SHOE.SIZE and HEIGHT**: Someone’s shoe size depends on several variables and one of them could be someone’s height. Questions 14 and 15 asked students to input their U.S. shoe size (**SHOE\_SIZE**) and their height (**HEIGHT**) in inches. Assume the respondents are an SRS of all ETSU students. We are interested in studying the relationship between a student’s height and their shoe size. That is, we are interested in seeing whether knowing one’s height can explain one’s shoe size.
- (A) Create an appropriate plot to display the relationship between **SHOE\_SIZE** and **HEIGHT**. Insert the plot here.
- (B) What is the correlation between the pair of variables?
- (C) Based on the information displayed in the graph and the correlation you reported, how would you describe the association between **SHOE\_SIZE** and **HEIGHT**?
- (D) Obtain the least squares regression equation for the pair of variables. Insert it here.
- (E) Interpret the value of the slope in the least squares regression equation you found in part (c).
- (F) What percent of the variation in **SHOE\_SIZE** is accounted for by its linear relationship with **HEIGHT**?
- (G) Use the regression equation in part (c) to predict a student’s shoe size for someone that is 71 inches tall.
- (H) How well does the regression equation fit the data? Explain. Justify your answer with appropriate plot(s) and summary statistics.
4. **SHOES**: A marketing analyst for a shoe store wishes to know if males or females own more shoes, in order for the company’s advertisements to target that specific gender. After talking to the company’s current sales representatives across the US, he concludes that females own more pairs of shoes. Questions 13 from the survey asked students “How many pairs of shoes do you own?” Assume that the students who responded the survey are a SRS of all ETSU students. Is there good evidence to support the idea that female students at ETSU own more pairs of shoes, on average, than male students?
- (A) Create an appropriate graph(s) to display the distribution of number of pairs of shoes owned for each gender. Insert it here.
- (B) Calculate a 99% confidence interval for the difference in the mean number of shoes owned between male and female students. Interpret this interval.
- (C) Using  $\alpha = 0.01$ , perform an appropriate test of significance. Insert the output here.
- (D) Write the correct null and alternative hypotheses for the test.
- (E) What is the value of the test statistic?
- (F) What is the P-value for this test?

- (G) State your decision and conclusion for the test.
- (H) What assumptions are you making in order to carry out the test? Is the P-value valid in this case?

5. **MARRIED and SPANKING:** Question 3 from the survey asked students “What is your opinion about a married person having sexual relations with someone other than the marriage partner? (Always wrong, Almost always wrong, Wrong only sometimes, Not wrong at all)” and Question 7 from the survey asked students “Do you strongly agree, agree, disagree, or strongly disagree that it is sometimes necessary to discipline a child with a good, hand spanking? (Strongly agree, Agree, Disagree, Strongly disagree)” We want to check if there is a relationship between disciplinary spanking and extramarital sex. Assume the students who took the survey are from an SRS of ETSU students.

- (A) Create an appropriate graph to display the data and insert it here.
- (B) Create an appropriate two-way table to summarize the data between **MARRIED** and **SPANKING** and insert it here.
- (C) Find the probability that a randomly selected student thinks that extramarital sex is “Always wrong” and strongly agrees that it is sometimes necessary to discipline a child with a good, hand spanking.
- (D) Find the probability that a randomly selected student thinks that extramarital sex is “Always wrong”, given they strongly agree that it is sometimes necessary to discipline a child with a good, hand spanking.
- (E) Find the probability that a randomly selected student strongly disagrees that it is sometimes necessary to discipline a child with a good, hand spanking.
- (F) Carry out a test for the hypothesis that there is no relationship between **MARRIED** and **SPANKING** for ETSU students. Use a significance level of  $\alpha = 0.05$ .
  - i. State the null and alternative hypothesis.
  - ii. Perform the test and include any output here.
  - iii. Which test statistic are you using and what is its value?
  - iv. State your decision and conclusion for the test.
  - v. Examine the data. Are the conditions for inference in part (ii) violated? Explain.