**Math 243**

**Common Midterm/Final Exam Problems**

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**Inference problem:**

In a 1998 study for Consumer Reports (March 1998), 1000 fresh, whole broiler chickens were purchased at grocery stores in 36 cities across the U.S. over a five-week period. The shoppers packed the birds in coolers and shipped them overnight to the lab. There, tests were conducted to determine the presence of Salmonella and Campylobacter, another chicken-related bug. The results of the study for Salmonella are contained below.

|  |  |  |  |
| --- | --- | --- | --- |
| Brand | Present | Absent | Total |
| A | 8 | 192 | 200 |
| B | 17 | 183 | 200 |
| C | 27 | 173 | 200 |
| D | 14 | 186 | 200 |
| E | 20 | 180 | 200 |
| Total | 86 | 914 | 1000 |

Assuming that the chickens represent a random sample from each of the brands included in the study, use the information in the table to test whether Brand B has a higher incidence of Salmonella than Brand D:

a) State your hypotheses:

b) Find the appropriate test statistic and the corresponding *P*-value:

c) State your conclusion (using a significance level of 0.05), in terms of this problem.

**Normal Distribution problem:**

The National Assessment of Educational Progress (NAEP) is a nationwide assessment of students’ proficiency in nine subjects, including science. In 2000, the science scores for female students had a mean of 146 with a standard deviation of 35. Assume that these scores were normally distributed. Draw a sketch of this distribution below and label the mean and multiples of standard deviations on the axis.

Suppose a female student is chosen at random. What is the probability that this student’s score is below 200? Shade in the appropriate area associated with this probability on your sketch above. Write what you entered in your calculator below.

Entered in calculator: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*P*(*x* < 200) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Round to 2 decimal places.)

Assuming all scores are whole numbers, what score would a student need to achieve to be in the top 5%? Draw a new sketch below, labeling the mean, and shade in and label the appropriate area for this question. Label this cut-off with an “x” on the sketch. Write what you entered in your calculator and your answer in the indicated spaces.

Entered in calculator: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

A student would need to achieve a score above \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to be in the top 5%.

**Descriptive Statistics problem:**

The data in the table below are from observations taken on Roman coins dating from the first three centuries AD. Historians believe that different mints might reveal themselves in different trace element profiles in the coins; these coins are known to have been minted in Rome. The technique of Atomic Absorption Spectrometry was used to estimate the % by weight of various elements in these coins; the % by weight that is gold is presented here.

1. Calculate these numerical summaries and label each with the correct notation, where appropriate:

The mean: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The standard deviation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The median: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The interquartile range:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Construct a histogram on your calculator. Judging from the histogram, would you say this distribution is skewed right, skewed left, or approximately symmetric?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What information from part (a) supports your answer for part (b)? Be specific.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |
| --- |
| **Roman Mint:**  **Gold Content**  **(% by weight)** |
| 0.22 |
| 0.24 |
| 0.20 |
| 0.24 |
| 0.21 |
| 0.23 |
| 0.18 |
| 0.15 |
| 0.17 |
| 0.17 |
| 0.38 |
| 0.38 |
| 0.43 |
| 0.36 |
| 0.32 |
| 0.42 |
| 0.47 |
| 0.52 |
| 0.28 |

**Numerical Summary (Boxplot) Problem:**

The boxplots show prices of used cars (in thousands of dollars) advertised for sale at three different car dealers.

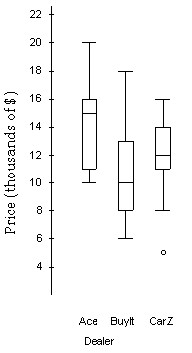
a. Which dealer offers the cheapest car offered, and at what price?

b. Which dealer has the lowest median price, and how much is it?

c. Which dealer has the smallest price range, and what is it?

d. Which dealer’s prices have the smallest IQR, and what is it?

e. Which dealer generally sells cars cheapest? Explain.



**Paired Data (or “matched pairs”) versus Two Sample Test (for population mean) problem:**

Are scores higher on the second test? The table below gives a sample of scores on the first two tests in an introductory statistics course. We are interested in testing whether scores are significantly higher on the second test than on the first test. Assume scores on each test are normally distributed.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| First Test | 72 | 95 | 56 | 87 | 80 | 98 | 74 | 85 | 77 | 62 |
| Second Test | 78 | 96 | 72 | 89 | 80 | 95 | 86 | 87 | 82 | 75 |

a) Assume that the scores from the first test come from a random sample of 10 students in the course, and the scores on the second test come from a different, independently chosen random sample of 10 students in the course. Do these samples provide good evidence that the mean grade on the second test is higher that the mean score on the first test? Be sure to state your hypotheses, give the value of the test statistic and the P-value, and state your conclusion in a complete sentence.   
  
  
  
  
  
  
  
  
  
  
  
  
b) Suppose you find out that the samples are not independent – in fact, the grades recorded for the first test and the second test are from the same 10 students in the same order. (For example, the first student got a 72 on the first test and a 78 on the second test.) Do these samples provide good evidence that the average student will score higher on the second test than on the first test? Again, state your hypotheses, give the value of the test statistic and P-value, and state your conclusion in a complete sentence. (*Hint:* you will need to do some subtracting before you run the test.)