

Instructions: This exam is a tool to help me (and you) assess how well you are learning the course material. As such, you should report enough written detail for me to understand how you are thinking about each problem. (100 points total)

1. About 45% of all current UPS students are male. Consider a SRS of 12 UPS students.
 - (a) What is the probability that there are exactly two males in the sample? (5 points)
 - (b) What is the probability that there are 9 or more males in the sample? (5 points)

2. Problem 5.11 from the homework uses the binomial distribution $B(509, 0.116)$ as the distribution of number of home runs a certain baseball player will hit in 509 attempts. This binomial distribution can be approximated by a normal distribution.
 - (a) Show that the conditions for using a normal distribution to approximate a binomial distribution hold in for this situation. (4 points)
 - (b) Sketch the relevant normal distribution for this situation. Mark relevant values on the horizontal scale. (6 points)
 - (c) According to this model, what is the probability that the baseball player will hit 70 or more home runs in 509 attempts? (4 points)

3. Birth weights of babies in the United States have a distribution that is approximately normal with a mean of 3,400 grams and a standard deviation of 570 grams.
 - (a) Sketch this normal distribution. Mark relevant values on the horizontal scale. (2 points)
 - (b) Now consider simple random samples of 100 babies in the United States. For each SRS, birth weights can be measured and a sample mean can be computed. Determine the mean and standard deviation for the distribution of sample means. (6 points)
 - (c) Sketch the distribution of sample means for SRSs of size 100. Mark relevant values on the horizontal scale. (3 points)
 - (d) On your sketch for (c), shade the region that corresponds to the probability of getting a SRS of size 100 with a sample mean less than 3350 grams. (3 points)
 - (e) Determine the probability of getting a SRS of size 100 with a sample mean less than 3350 grams. (4 points)

4. A sociologist is studying volunteer work among students at liberal arts colleges. In particular, the sociologist wants to know how many hours per week college students spend in volunteer work in the local community during the academic year. The sociologist surveys a simple random sample of 550 college students and finds that the mean amount of volunteer work per academic year is 35.2 hours. The standard deviation for this sample is 7.4 hours. Since the sample is relatively large, assume that this sample standard deviation is a good estimate of the population standard deviation. Determine a 95% confidence interval for the mean amount of volunteer work per academic year for college students. (12 points)

5. The New York Times and ABC News each do a poll on the same day and each uses a sample of size 1200. Each poll surveys adults living in the U.S. and each includes the question “Do you approve of the job Congress is doing?” The proportion who respond yes is called the *approval rating for Congress*. The NY Times reports an approval rating of 32% with a 3% margin of error. ABC News reports an approval rating of 28% with a 3% margin of error. Both polls use the same confidence level.

(a) Are these two polls consistent with each other? Explain how you reach your conclusion.

(4 points)

(b) Suppose 80 polls asking this same question were conducted all on the same day and each used a sample of size 1200. Each reports a value for the approval rating with a margin of error. All use the same confidence level of 95%. About how many of the polls would you expect to produce a confidence interval that does not contain the true approval rating for all U.S. adults? Explain how you reach your conclusion.

(4 points)

(c) Another organization conducts a poll with the same question using a sample of size 2000. How would margin of error for this poll compare with the margin of error for the two polls described above?

(4 points)

6. SAT Math (SATM) scores for college-bound high school seniors are approximately normal with a mean of 515 and a standard deviation of 114. You suspect that UPS student have a higher mean SATM score than the national mean so you plan to get SATM scores from a sample of UPS students.

(a) Set up appropriate null and alternative hypothesis for this situation.

(4 points)

(b) You get SATM scores from a SRS of 20 UPS students and find the mean for this sample is 576. Carry out a significance test on your hypothesis in (a) using this sample mean. You can assume that the distribution of SATM scores for all UPS students is the same as the national standard deviation of 114.

(10 points)

(c) You want to report on your results in a brief *Trail* article. Write a one-sentence conclusion appropriate for a general audience of *Trail* readers.

(4 points)

7. When asked to explain the meaning of “statistically significant at the $\alpha = 0.05$ level”, a student says “This means there is only probability of 0.05 that the null hypothesis is true.” This statement is flawed. Write a brief explanation to correct the student.

(8 points)

8. A standard short-term memory test involves showing each subject a list of words for a brief time and then counting the number of words the subject can correctly recall. A researcher is studying the question of whether current college students are worse at short-term memorization than college students were 30 years ago. Data from 30 years ago shows the mean number of words correctly recalled by college students was 6.21. Let μ be the mean number of words correctly recalled by current college students. The researcher forms the hypotheses

$$H_0 : \mu = 6.21$$

$$H_a : \mu < 6.21$$

The researcher administers the word recall test to 10,000 current college students. Using the sample mean for this data, the researcher calculates a P-value of 0.00023. The researcher also computes a 99% confidence interval of [6.195, 6.205]. The researcher summarizes these results, by writing “There is a significant difference between the two groups, but this difference is not important.” Explain why this summary is consistent with the results and does not contradict itself.

(8 points)