

Calculations need not be exact.

Q1-Q9: 8 points Q9-Q11(2 of 3):11 pts Q12-Q14(2 of 3):11 pts

1. An investigator has a computer file showing family incomes for 1,000 subjects in a study. These range from \$2,800 a year to \$78,600 a year. By accident, the highest income in the file gets changed to \$786,000.
 - (a) Does this affect the average? If so, in which direction?
 - (b) Does this affect the median? If so, in which direction?

2. Both of the following lists have the same average of 50. Which one has the smaller SD, and why? No computations are necessary.
 - (i) 50, 40, 60, 30, 70, 25, 75.
 - (ii) 50, 40, 60, 30, 70, 25, 75, 50, 50, 50.

3. As part of a survey, a large company asked 1000 of its employees how far they commute to work each day (round trip). The average round trip commute distance was 11.3 miles, with an SD of 16.2 miles. Would a rough sketch of the histogram for the data look like (i) or (ii) or (iii)? Or is there a mistake somewhere? Explain your answer.

4. A coin will be tossed either 2 times or 100 times. You will win \$2.00 if the number of heads is equal to the number of tails, no more and no less. Which is correct?
 - (i) 2 tosses is better. (ii) 100 tosses is better.
 - (iii) Both offer the same chance of winning.

5. In which of the following would X not have a Binomial distribution? Why?
 - a. X = number of women in McGill's graduating medical class (n=160 per year) in a randomly selected year from the last 30 years or so.
 - b. X = number of women listed in different random samples of size 20 from the 1990 directory of statisticians.
 - c. X = number of occasions, out of a randomly selected sample of 100 occasions during the year, in which you were indoors. (One might use this design to estimate what proportion of time you spend indoors)
 - d. X = number of months of the year in which it snows in Montréal.

6. On the average, hotel guests weigh about 150 pounds with an SD of 25 pounds. An engineer is designing a large elevator for a convention hotel, to lift 100 people. If he designs it to lift 15,500 pounds, the chance it will be overloaded by a random group of 100 people is closest to 0.1 of 1%, 2%, 5%, 50%, 95%, 98%, 99.9%

7. The speed of light is measured 25 times by a new procedure. The 25 measurements are recorded, and show no trend or pattern. Then the investigators work out the average and SD of the 25 numbers; the average is 299,789.2 kilometers per second and the SD is 12 kilometers per second. Find an approximate 95% confidence interval for the speed of light, showing your work.

8. True or false: "If the data do not follow the normal curve, you can't use the curve to get confidence intervals". Explain your answer.

9. In a simple random sample (n=225) of all institutions of higher learning in the U.S., the average enrollment was 3,700, with an SD of 6,000. A histogram for the enrollments was plotted and did not follow the normal curve. However, the average enrollment at all institutions in the U.S. was estimated to be around 3,700 (SE = 400). Say whether each of the following statements are true or false, and explain why.
 - (a) It is estimated that 95% of the institutions of higher learning in the U.S. enroll between 3,700-800 = 2,900 and 3,700 + 800 = 4,500 students.

- (b) An approximate 95%-confidence interval for the average enrollment of all institutions runs from 2,900 to 4,500.
- (c) If someone takes a simple random sample of 225 institutions and goes two SEs either way from the average enrollment of the 225 sample schools, there is about a 95% chance that this interval will cover the average enrollment of all schools.

10. A colony of laboratory mice consisted of several hundred animals. Their average weight was about 30 grams, with an SD of about 5 grams. As part of an experiment, graduate students were instructed to choose 25 animals haphazardly, without any definite method. The average weight of these animals turned out to be around 33 grams. Is choosing animals haphazardly the same as drawing them at random? Discuss briefly, carefully formulating the null hypothesis, and computing Z and P. (There is no need to formulate an alternative hypothesis)

11. Which of the following questions does a test of significance deal with?

- (i) Could the difference be due to chance?
- (ii) Is the difference important?
- (iii) What does the difference prove?
- (iv) Was the experiment properly designed?

12. TREATMENT OF OSTEOPOROSIS NEJM May 3 1990

ABSTRACT

- (i) "Vertebral bone mineral content increased significantly ($P < 0.01$) ..." (First sentence, 3rd paragraph of abstract) What test did they use to arrive at the P value? If you had been given just the confidence interval of 2.0 to 8.6, what could you have said about the P-value?
- (ii) The CI of 2.0 to 8.6 for the average change in the treatment group is based on a SE of 1.6; the CI of -7.3 to 1.9 is based on SE of 2.2. Using these two SE's, explain how to construct the CI of 2.4 to 13.6 for the difference between groups (second sentence of 3rd paragraph). Do not worry if your calculation does not match exactly.

13. PSEUDOHYPERKALEMIA NEJM May 3, 1990

Results

- (i) "Alone, the application of the tourniquet had no effect, whereas the addition of clenching increased potassium levels in both the patient and the controls." (first sentence) The authors used statistical tests on the data from the 4 controls. What test was appropriate?
- (ii) "Handgrip exercise also raised plasma potassium concentration in the patient (104 mmol per liter) and..." (second sentence). How would you use the first 4 measurements on just the patient (solid circles) to formally test if the increase was real? (think of Mr. W.P.!)
 - (iii) If statistical tests for the patient indicated that the effect is real, why study 4 additional subjects?

14. BRIGHT LIGHT & NIGHT WORK NEJM May 3, 1990

Results (p 1256)

Sleep-Wake Schedules:

- (i) From the SEM of 0:18 for bedtimes ($n = 5$ individuals in control studies) estimate the interindividual variation in bedtimes.
- (ii) Why would it be wrong to base the SEM on the total number of nights (7×5) rather than the total number of subjects (5)?
- (iii) What statistical test would you use to compare the average bedtimes of 00:22 and 00:04?
- (iv) Assuming we calculate rest time as waking time minus bedtime, why is it not correct to calculate $[SD(\text{rest time})]^2 = [SD(\text{waking time})]^2 + [SD(\text{bedtime})]^2$?

Circadian Phase

- (i) "In contrast, in the treatment studies, the mean final temperature nadir occurred 9.6 hours later than the mean initial temperature nadir (14.53 vs 05:19, P <0.0001)."
What test is appropriate here?
- (ii) "The mean shift in the treatment group (-9.6 hours) was significantly greater than in the control group (1.1 hours)."
What test is appropriate here?