Homework - Week 8

- **4.17 (a-b)** Write the null and alternative hypotheses in words and then symbols for each of the following situations.

  (a) New York is known as "the city that never sleeps". A random sample of 25 New Yorkers were asked how much sleep they get per night. Do these data provide convincing evidence that New Yorkers on average sleep less than 8 hours a night?

  Null hypothesis: New Yorkers sleep 8 hours a night on average
  Alternative hypothesis: New Yorkers sleep less than 8 hours a night on average
  $\boldsymbol{H_0 : \mu = 8}$
  $\boldsymbol{H_a : \mu < 8}$

  (b) Employers at a firm are worried about the effect of March Madness, a basketball championship held each spring in the US, on employee productivity. They estimate that on a regular business day employees spend on average 15 minutes of company time checking personal email, making personal phone calls, etc. They also collect data on how much company time employees spend on such non- business activities during March Madness. They want to determine if these data provide convincing evidence that employee productivity decreases during March Madness.

  Null hypothesis: Employees spend 15 minutes per day on personal matters, on average
  Alternative hypothesis: Employees spend more than 15 minutes per day on personal matters, on average
  $\boldsymbol{H_0 : \mu = 15}$
  $\boldsymbol{H_a : \mu > 15}$

- **4.18 (a-b)** Write the null and alternative hypotheses in words and using symbols for each of the following situations.

  (a) Since 2008, chain restaurants in California have been required to display calorie counts of each menu item. Prior to menus displaying calorie counts, the average calorie intake of diners at a restaurant was 1100 calories. After calorie counts started to be displayed on menus, a nutritionist collected data on the number of calories consumed at this restaurant from a random sample of diners. Do these data provide convincing evidence of a difference in the average calorie intake of a diners at this restaurant?

  Null hypothesis: Diners consume 1100 calories on average
  Alternative hypothesis: Diners consume an amount different than 1100 calories on average
  $\boldsymbol{H_0 : \mu = 1100}$

$\boldsymbol{H_a : \mu \neq 1100}$

(b) Based on the performance of those who took the GRE exam between July 1, 2004 and June 30, 2007, the average Verbal Reasoning score was calculated to be 462. In 2011 the average verbal score was slightly higher. Do these data provide convincing evidence that the average GRE Verbal Reasoning score has changed since 2004?

Null hypothesis: The average GRE Verbal Reasoning score is 462
Alternative hypothesis: The average GRE Verbal Reasoning score is not 462
$\boldsymbol{H_0 : \mu = 462}$
$\boldsymbol{H_a : \mu \neq 462}$

- **4.19** A study suggests that the average college student spends 10 hours per week communicating with others online. You believe that this is an underestimate and decide to collect your own sample for a hypothesis test. You randomly sample 60 students from your dorm and find that on average they spent 13.5 hours a week communicating with others online. A friend of yours, who offers to help you with the hypothesis test, comes up with the following set of hypotheses. Indicate any errors you see.

$$H_0 : \bar{x} < 10 \; hours$$
$$H_A : \bar{x} > 13.5 \; hours$$

  - **Hypotheses are statements about population parameters. The symbol μ should be used instead of $\bar{x}$.**
  - **The null hypothesis should always be an equality statement, i.e $\bar{x} = 10$.**

- **4.20** Exercise 4.16 presents the results of a 2006 - 2010 survey showing that the average age of women at first marriage is 23.44. Suppose a social scientist believes that this value has increased in 2012, but she would also be interested if she found a decrease. Below is how she set up her hypotheses. Indicate any errors you see.

$$H_0 : \bar{x} = 23.44 \; years \; old$$
$$H_A : \bar{x} > 23.44 \; years \; old$$

  - **Hypotheses are statements about population parameters. The symbol μ should be used instead of $\bar{x}$.**
  - **Because the researcher is interested in increases or decreases, the alternative hypothesis should be $\bar{x} \neq 23.44$.**

- **4.21 (a-c)** Exercise 4.13 provides a 95% confidence interval for the mean waiting time at an emergency room (ER) of (128 minutes, 147 minutes). Answer the following questions based on this interval.

  (a) A local newspaper claims that the average waiting time at this ER exceeds 3 hours. Is this claim supported by the confidence interval? Explain your reasoning.

  No. 3 hours (180 minutes) is not in the reported confidence interval. Thus, there is no evidence that the true population mean is 3 hours.

  (b) The Dean of Medicine at this hospital claims the average wait time is 2.2 hours. Is this claim supported by the confidence interval? Explain your reasoning.

  Maybe. 2.2 hours (132 minutes) is within the confidence interval, so there is not evidence that the claim is wrong. However, confidence intervals do not provide evidence for a particular value over another that is also in the interval.

  (c) Without actually calculating the interval, determine if the claim of the Dean from part (b) would be supported based on a 99% confidence interval?

  Yes. A 99% confidence interval will be wider than a 95% confidence interval. Thus, a value that is within a 95% CI will also be in a 99% CI.

- For the following scenarios, give the required sample size.

  (a) A university wants to know how much time their students are spending on homework each week to within plus or minus 15 minutes (0.25 hours) with 95% confidence. Previous studies have suggested the standard deviation for weekly study times is about 3 hours.

  $$n = \left(\frac{z_\alpha \times \sigma}{ME}\right)^2 = \left(\frac{1.96 \times 3}{0.25}\right)^2 = 553.1904 \rightarrow 554$$

  (b) The university would also like to know what proportion of their students utilize university resources, like tutoring help, to within 3.5% with 99% confidence. Previous years found about 35% of students used available resources, but the university thinks that has increased recently.

  $$n = \left(\frac{z_\alpha \times \sqrt{pq}}{ME}\right)^2 = \left(\frac{2.58 \times \sqrt{0.35 \times 0.65}}{0.035}\right)^2 = 1236.189 \rightarrow 1237$$

(c) The student association at the university would like to know what proportion of professors offer extra credit in their classes. They plan to gather a random sample of syllabuses and see which mention extra credit. They have no reasonable estimate as to what that proportion might be. They want an estimate within 5% at a 90% confidence level.

$$\boldsymbol{n = \left(\frac{z_\alpha \times \sqrt{pq}}{ME}\right)^2 = \left(\frac{1.645 \times \sqrt{0.5 \times 0.5}}{0.05}\right)^2 = 270.6025 \rightarrow 271}$$

(d) The university bookstore would like to know how much the average student spends on textbooks each semester to within \$10 (plus or minus) with 95% confidence. From experience, they think that a standard deviation of \$30 is a reasonable estimate.

$$\boldsymbol{n = \left(\frac{z_\alpha \times \sigma}{ME}\right)^2 = \left(\frac{1.96 \times 30}{10}\right)^2 = 34.5744 \rightarrow 35}$$

All submitted files should be PDFs.