Sample Midterm 3B

Instructions:

1. Questions 1 to 8 are short answer questions. Put your answer in the box.
2. Question 9 is a full-answer question. For full-answer questions, marks will be deducted for incomplete or poorly presented solutions.
3. Space will be provided for you to work out your answers on the actual midterm.

Duration: You should be able to complete this midterm within 45 minutes. If you cannot, this means that more practice is still needed.

(Set-up for Questions 1, 2, 3 and 4) As part of the interview process for a software engineer position in a large company, job applicants must write a computer program that produces the desired output. A random sample of 20 past applicants reveals that their average time to write the computer program was 30.5 minutes with a sample standard deviation of 7.2 minutes. Assume the times to write the computer program are normally distributed.

[3] **1.** Construct the *lower* bound of a 99% confidence interval for the true mean time for applicants to write the computer program.

Answer:

[3] **2.** Assume that the true standard deviation is known and as estimated above, i.e. $\sigma = 7.2$ minutes and that the observations are normally distributed. What sample size would be required so that the width of a 90% confidence interval is 1.0 minute?

Answer:

[3] **3.** The software company wishes to test the claim that the mean time to write the computer program is greater than 30 minutes. What are the null and alternative hypotheses under consideration?

Answer:

[3] **4.** The software company wishes to test the claim that the mean time to write the computer program is greater than 30 minutes. Compute the p-value of the appropriate hypothesis test within table accuracy. Assume that σ is unknown, and estimate it using the sample standard deviation.

Answer:

(Set-up for Questions 5 and 6) A chocolate company wishes to estimate the proportion of people who feel happier after eating chocolate.

[3] **5.** With no prior estimates available, determine the maximum sample size needed to estimate the true proportion of people that feel happier after eating chocolate with a margin of error of 0.03 and 92% confidence.

Answer:

[3] **6.** Suppose a random sample of 142 people are interviewed and 87 report they feel happier after eating chocolate. Construct the *upper* bound of a 95% confidence interval for the true proportion of people that feel happier after eating chocolate.

Answer:

(Set-up for Questions 7 and 8) A manager evaluates effectiveness of a major hardware upgrade by running 50 different processes before the upgrade and the same 50 processes after the upgrade. Based on these data, the average of the differences in running time, before minus after, was 1.3 minutes. The standard deviation of the fifty differences was 0.4.

[3] **7.** What is the upper bound of a 90% confidence interval for the mean difference in running time due to the hardware upgrade?

Answer:

[3] **8.** What is the p-value for the test of the null hypothesis that there is no change in the mean running time versus the alternative that there is a decrease in the running time of the process after the upgrade?

Answer:

[10] **9.** WRITTEN ANSWER QUESTION: A study was undertaken to investigate the battery life of a type of laptop. The manufacturer of the laptop claims that the battery life has a mean of more than 6 hours. Users were asked to start work on fully charged laptops until the "low battery" sign displayed. Eighteen users of this type of laptop worked an average of 5.3 hours with a sample standard deviation of 1.4 hours. Assume that observations are normally distributed. Is the data consistent with the manufacturer's claim?

a) Define the parameter(s) of interest.

b) Define the null and alternative hypotheses.

c) Define the appropriate test statistic and give its distribution assuming the null hypothesis is true.

d) What is the observed value of the test statistic?

e) Provide the p-value for the test.

f) What is the strength of evidence against the null hypothesis and what are your conclusions?

Answers:

1. lower bound = 25.894
2. n = 562
3. $H_0 : \mu = 30$, $H_1 : \mu > 30$
4. $0.30 <$ p-value < 0.40
5. n = 851
6. 0.6928
7. 1.393
8. p-value ≈ 0

9(a) the mean battery life

9(b) $H_0 : \mu = 6$ (or $\mu \geq 6$)(innocence), $H_1 : \mu < 6$.

9(c) Test statistic $\dfrac{\overline{x} - \mu}{s/\sqrt{n}}$. The distribution is $t_{(17)}$ assuming H_0.

9(d) Observed value: ≈ -2.12.

9(e) p-value $\approx .0246$ (computed using R) or .025 from the table

9(f) There is **strong** evidence against H_0.