

MAT 222 (Spring 2017) HW Problems (for chapters 6, 7, and 8)

Chapter 6

From the Textbook:

Section 6.1	6.12, 6.27, 6.28, 6.30, 6.36
Section 6.2	6.52, 6.53, 6.54, 6.58, 6.59, 6.70, 6.71, 6.73, 6.75
Section 6.4	6.118, 6.119

Additional Problems:

1. A machine is used to fill soda bottles. The amount of soda dispensed into each bottle varies slightly and is known to have a normal distribution with population standard deviation $\sigma = 2.62$ ml. A random sample of 25 bottles filled by the machine is taken and the amount of soda filled in each bottle was measured. From this sample data, the sample mean was calculated to be 591.2 ml.
 - a. Find the 90% confidence interval for the population mean amount of soda filled by the machine.
 - b. Find the 98% confidence interval for the population mean amount of soda filled by the machine.
2. A firm that administers flexible spending plans would like to estimate the population mean of the unused yearly dollars within \$0.30 with 99% confidence. The standard deviation of the unused yearly dollars is known to be \$2.4. What should be the number of flexible spending plan members that the firm should sample?
3. The level of calcium in the blood of healthy young adults follows a normal distribution with mean $\mu = 10$ milligrams per deciliter and standard deviation $\sigma = 0.5$. A clinic measures the blood calcium of 27 healthy pregnant young women at their first visit for prenatal care. The mean of these 27 measurements is $\bar{x} = 9.8$. Is this evidence that the mean calcium level in the population of healthy pregnant young women is less than 10?
 - a. Set up the null and alternative hypotheses that you will be testing regarding the above question.
 - b. Assuming that the distribution of calcium level measurements for pregnant young women is a normal distribution with $\sigma = 0.5$, find the value of the test statistic and compute the P-value.
 - c. Is this statistically significant (circle your answers)
at the 5% level? (Yes, No); at the 1% level? (Yes, No)
 - d. At the 5% level of significance, state your conclusion in words.
4. A car brand XYZ states on their stickers and their advertisements that the highway MPG is 27. A consumer watchdog group believes that XYZ is overstating the highway MPG.
 - a. If μ denotes the average highway MPG for all XYZ cars, state the null and alternate hypotheses for this scenario in terms of μ .
 - b. From a simple random sample of 140 cars of the brand XYZ, sample average highway MPG was computed to be 25.9. Assuming the population standard deviation is $\sigma = 7$, compute the test statistic and the p-value.
 - c. State the decisions at significance levels $\alpha=10\%$, $\alpha=5\%$, and $\alpha=1\%$.
5. A machine is used to fill soda bottles. The amount of soda dispensed into each bottle varies slightly and is known to have a normal distribution with population standard deviation $\sigma = 2.62$ ml. A random sample of 25 bottles filled by the machine is taken and the amount of soda filled in each bottle was measured. From this sample data, the sample mean was calculated to be 591.2 ml.
 - a. Consider the hypotheses $H_0 : \mu = 592.4$ and $H_a : \mu < 592.4$. Compute the test statistic z and the p-value.
 - b. State the decisions at significance levels $\alpha=10\%$, $\alpha=5\%$, and $\alpha=1\%$.
6. Consider the test $H_0: \mu = 450$ against the alternative hypothesis $H_a: \mu > 450$ at the $\alpha = 1\%$ level of significance. Assume that the population standard deviation is $\sigma = 100$ and a simple random sample of size 500 is to be taken.
 - a. Calculate the critical value. For what values of the sample mean will H_0 be rejected?
 - b. Calculate $P(\text{Type II Error})$ and the power at the particular alternative value $\mu = 460$.

Chapter 7

From the Textbook (problems marked with * are recommended to be done with MINITAB):

Section 7.1	7.17, 7.20, 7.21, 7.22, 7.23, 7.24, 7.30*, 7.31*, 7.32, 7.35
Section 7.2	7.63, 7.64, 7.67, 7.74, 7.80, 7.84, 7.85*
Section 7.3	7.102, 7.103, 7.107*, 7.109

Additional Problems:

- A machine is used to make a particular type of HDMI cord. The length of each cord made varies slightly and is known to have a normal distribution. A random sample of 25 cords made by the machine is taken and the exact length of each cord in the sample was measured. From this sample data, the sample mean was calculated to be 591.2 mm with a sample standard deviation 2.62 mm.
 - Find a 95% confidence interval for the population mean cord length made by the machine.
 - Consider the hypotheses $H_0 : \mu = 592.4$ and $H_a : \mu < 592.4$. Compute the t-statistic and the p-value.
 - State the decisions at significance levels $\alpha=10\%$, $\alpha=5\%$, and $\alpha=1\%$.
- A faster loan processing time produces higher productivity and greater customer satisfaction. A financial services institution wants to determine if their mean loan processing time is less than a competitor's claim of 6 hours. A financial analyst randomly selects 7 loan applications and manually calculates the time between loan initiation and when the customer receives the institution's decision. From the sample data, the sample mean of the loan processing time was 5.079 hours with a sample standard deviation of 1.319 hours. Assume that the loan processing times follow a normal distribution.
 - Compute the test statistic and the p-value that can be used to determine if their mean loan processing time is less than a competitor's claim of 6 hours.
 - State the decisions at significance levels $\alpha=10\%$, $\alpha=5\%$, and $\alpha=1\%$.
 - Find a 95% confidence interval for the population mean loan processing time.
- An inspector wants to compare the bolts produced by company A and company B, based on the length of the bolts. A random sample of 16 bolts by company A yields a sample mean of 4.488 and a sample standard deviation of 0.035 inches. Random sample of size 10 from company B yields a sample mean of 4.512 inches and a sample standard deviation of 0.029 inches. Assume the population standard deviations are equal.
 - Consider testing the research hypothesis that the population mean length of the bolts from company A is *smaller* than the population mean length of the bolts from company B. Calculate the appropriate test statistic, specify the degrees of freedom of the test statistic, and find the p-value.
 - State the conclusions at significance levels 1%, 5%, and 10%.
 - Consider instead testing the research hypothesis that the mean lengths of the bolts from company A and company B are *different*. Find the p-value. State the conclusions at significance levels 1%, 5%, and 10%.
 - Provide a 95% confidence interval for the difference in the population mean lengths.
- Repeat the previous problem assuming that the population standard deviations are not equal.
- Using the data from problem 3, test whether or not the population standard deviations are equal.
- Sample standard deviation from a random sample of size 7 was computed to be 4.876. From another independent random sample of size 13, sample standard deviation was computed to be 2.371.
 - Consider the hypotheses $H_0: \sigma_1 = \sigma_2$ against $H_a: \sigma_1 \neq \sigma_2$. Find the appropriate test statistic for this hypothesis testing scenario, specify the numerator and denominator degrees of freedom of the test statistic, and find the p-value. Work must be shown by providing the bracketing critical values from the table and the corresponding upper tail probabilities.
 - State the conclusions at significance levels 1%, 5%, and 10%.

Chapter 8

From the Textbook (problems marked with * are recommended to be done with MINITAB):

Section 8.1 8.15, 8.18, 8.19, 8.20, 8.37, 8.39

Section 8.2 8.60, 8.61, 8.62, 8.63, 8.64, 8.69, 8.71

Additional Problems:

1. A software developer is interested in analyzing the population proportion of doctors that use a certain medical software.
 - a. How many observations (what sample size) should be taken to estimate, at 99% confidence level, the population proportion within $\pm 5\%$ if no prior estimate is available?
Note: Here desired margin of error is at most ± 0.05 (i.e., $\pm 5\%$ expressed in decimal form).
 - b. A random sample of 190 doctors was collected. 85 doctors out of the sample reported using the specific software.
 - c. Find a 90% confidence interval for the proportion of doctors that use that particular software.
2. Delivery department of a manufacturing company A&B uses a company CDE for its shipping needs. CDE advertises that they deliver shipments on schedule (on or before the scheduled delivery date) 85% of the time. If the on time delivery rate of CDE is less than 85%, A&B will have to consider other shippers or alternative options. A&B collects a random sample of size 625 from their shipments across a year and finds that 515 shipments were delivered on time. Let p denote the population proportion on time delivery rate of CDE.
 - a. State the appropriate null and alternate hypotheses to test (in terms of p)
 - b. Find the appropriate test statistic and the p -value.
 - c. Is there significant evidence at level 1% to believe that the on time delivery of CDE is less than 85%?
YES NO (circle the correct option)
 - d. Is there significant evidence at level 5% to believe that the on time delivery of CDE is less than 85%?
YES NO (circle the correct option)
 - e. In order to explore their options, another random sample of 625 shipments across a year were sent via a different shipping carrier FGH. 530 of those shipments were delivered on time. Is the performance of FGH significantly better than that of CDE? Calculate the appropriate test statistic to answer this question and find the p -value. State whether the performance of FGH significantly better than that of CDE at significance level 5%.
3. Using the data from the previous question, answer the following:
 - a. Find the 95% confidence interval for the CDE's on time delivery rate (i.e., the population proportion of time packages delivered by CDE before the scheduled delivery date).
 - b. Find the 95% confidence interval for the FGH's on time delivery rate (i.e., the population proportion of time packages delivered by FGH before the scheduled delivery date).
 - c. Find the 95% confidence interval for the difference between CDE's on time delivery rate and FGH's on time delivery rate.