MTH 345
Exam 2, Form B
Fall 2012

Justify all answers with neat and organized work. Clearly indicate your answers. For hypothesis tests, you must use the required format. 100 points possible.

1. (12 pts.) In each of parts (a), (b), and (c), assume we want to construct a confidence interval using the given confidence level. Choose and do only one of these three choices, whichever is appropriate.
   • If the normal distribution should be used, then find the critical value $z_{\alpha/2}$.
   • If the $t$ distribution should be used, then find the critical value $t_{\alpha/2}$.
   • If neither the normal nor the $t$ distribution applies, then state this.

   (a) 99%; $n = 10$; $\sigma = 15$; population appears to be normally distributed.

   (b) 90%; $n = 6$; $\sigma$ is unknown; population appears to be normally distributed.

2. (11 pts.) As a manufacturer of golf equipment, the Spalding Corporation wants to estimate the proportion of golfers who are left-handed. (The company can use this information in planning for the number of right-handed and left-handed sets of golf clubs to make.) A previous study study suggests that 15% of golfers are left-handed. How many golfers must be surveyed if we want 98% confidence that the sample proportion has a margin of error of 2 percentage points?
3. (11 pts.) Quarters are currently minted with weights having a mean of 5.670 g and a standard deviation of 0.062 g. New equipment is being tested in an attempt to improve quality by reducing variation. A random sample of 24 quarters is obtained from those manufactured with the new equipment, and the sample has a standard deviation of 0.049 g. Use a 0.05 significance level to test the claim that quarters manufactured with the new equipment have weights with a standard deviation less than 0.062 g. (Assume that a simple random sample is selected from a normally distributed population.) Use the Traditional (i.e., Critical Value) Method.

**Hypothesis Test: Traditional Method (i.e., Critical Value Method)**

1. Original claim in symbolic form:
2. Competing idea in symbolic form:
3. $H_0$:

   $H_1$:
4. $\alpha =$
5. Formula for the test statistic:
6. Observed value of the test statistic, with calculations:

   Graph showing critical value(s) and critical region:

   Critical value(s):

7. Reject $H_0$ / Fail to reject $H_0$ (Circle one)

8. Wording of final conclusion in simple, nontechnical terms, addressing the original claim:
4. (11 pts.) The serum cholesterol levels in men aged 18 to 24 are normally distributed with a mean of 178.1 and a standard deviation of 40.7. The units are in mg/100 mL, and the data are based on the National Health Survey. A Health Maintenance Organization wants to establish a criterion for recommending dietary changes if cholesterol levels are in the top 7%. What is the cutoff for men aged 18 to 24?

5. (11 pts.) When people smoke, the nicotine they absorb is converted to cotinine, which can be measured. A sample of 32 smokers has a mean cotinine level of 172.5. Assuming that $\sigma$ is known to be 119.5, find a 99% confidence interval estimate of the mean cotinine level of all smokers.
6. (11 pts.) A study was conducted to determine whether a standard clerical test would need revision for use on video display terminals (VDTs). The VDT scores of 22 subjects have a mean of 170.2 and a standard deviation of 35.3 (based on data from “Modification of the Minnesota Clerical Test to Predict Performance on Video Display Terminals,” by Silver and Bennett, *Journal of Applied Psychology*, Vol. 72, No. 1). At the 0.05 level of significance, test the claim that the mean for all subjects taking the VDT test differs from the mean of 243.5 for the standard printed version of the test. (Assume that a simple random sample is selected from a normally distributed population.) Use the Traditional (i.e., Critical Value) Method.

**Hypothesis Test: Traditional Method (i.e., Critical Value Method)**

1. Original claim in symbolic form:

2. Competing idea in symbolic form:

3. \( H_0: \)

4. \( H_1: \)

5. \( \alpha = \)

6. Formula for the test statistic:

7. Observed value of the test statistic, with calculations:

8. Critical value(s):

9. Reject \( H_0 \) / Fail to reject \( H_0 \) (Circle one)

10. Wording of final conclusion in simple, nontechnical terms, addressing the original claim:
7. (11 pts.) In a study of store checkout scanners, 1234 items were checked and 20 of them were found to be overcharges (based on data from “UPC Scanner Pricing Systems: Are They Accurate?” by Goodstein, Journal of Marketing, Vol. 58). Use a 0.05 significance level to test the claim that with scanners, 1% of sales are overcharges. (Before scanners were used, the overcharge rate was estimated to be about 1%). Use the P-Value Method.

**Hypothesis Test: P-Value Method**

1. Original claim in symbolic form:
2. Competing idea in symbolic form:
3. \( H_0: \)
   \[ H_1: \]
4. \( \alpha = \)
5. Formula for the test statistic:
6. Observed value of the test statistic, with calculations:

   Graph showing observed value of the test statistic and P-value:

   \( P\text{-value}: \)

7. Reject \( H_0 \) / Fail to reject \( H_0 \) (Circle one)
8. Wording of final conclusion in simple, nontechnical terms, addressing the original claim:
8. (11 pts.) A study was made of seat-belt use among children who were involved in car crashes that caused them to be hospitalized. It was found that children not wearing any restraints had hospital stays with a mean of 7.37 days and a standard deviation of 0.79 days (based on data from “Morbidity Among Pediatric Motor Vehicle Crash Victims: The Effectiveness of Seat Belts,” by Osberg and Di Scala, *American Journal of Public Health*, Vol. 82, No. 3). If 40 such children are randomly selected, find the probability that their mean hospital stay is greater than 7.25 days.

9. (11 pts.) The listed values are waiting times (in minutes) of customers at the Bank of Providence, where customers may enter one of three different lines that have formed at three different teller windows. (Assume that a simple random sample is selected from a normally distributed population.) Construct a 95% confidence interval for the population standard deviation $\sigma$.

4.2 5.4 5.8 6.2 6.7 7.7 7.7 8.5 9.3 10.0
Formulas

Ch 6: Normal Distribution

\[ z = \frac{x - \bar{x}}{s} \quad \text{or} \quad \frac{x - \mu}{\sigma} \quad \text{Standard score} \]

\[ x = \mu + z \cdot \sigma \]

\[ \mu_{\bar{x}} = \mu \quad \text{Central limit theorem} \]

\[ \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \quad \text{Central limit theorem (Standard error)} \]

Ch 7: Confidence Intervals (one population)

\[ \hat{p} - E < p < \hat{p} + E \quad \text{Proportion} \]

where \( E = z_{\alpha/2} \sqrt{\frac{\hat{p}\hat{q}}{n}} \)

\[ \bar{x} - E < \mu < \bar{x} + E \quad \text{Mean} \]

where \( E = z_{\alpha/2} \frac{\sigma}{\sqrt{n}} \) (\( \sigma \) known, see flowchart)

or \( E = t_{\alpha/2} \frac{s}{\sqrt{n}} \) (\( \sigma \) unknown, see flowchart)

\[ \frac{(n-1)s^2}{\chi^2_R} < \sigma^2 < \frac{(n-1)s^2}{\chi^2_L} \quad \text{Variance} \]

\[ \sqrt{\frac{(n-1)s^2}{\chi^2_R}} < \sigma < \sqrt{\frac{(n-1)s^2}{\chi^2_L}} \quad \text{Standard Deviation} \]

Ch. 7: Sample Size Determination

\[ n = \left[ \frac{z_{\alpha/2}}{E} \right]^2 \cdot 0.25 \quad \text{Proportion} \]

\[ n = \left[ \frac{z_{\alpha/2}}{E} \right]^2 \hat{p}\hat{q} \quad \text{Proportion (\( \hat{p} \) and \( \hat{q} \) are known)} \]

\[ n = \left[ \frac{z_{\alpha/2}}{E} \right]^2 \frac{\sigma^2}{\gamma} \quad \text{Mean} \]

Ch. 8: Test Statistics (one population)

\[ z = \frac{\hat{p} - p}{\sqrt{\frac{\hat{p}\hat{q}}{n}}} \quad \text{Proportion—one population} \]

\[ z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} \quad \text{Mean—one population (\( \sigma \) known—see flowchart)} \]

\[ t = \frac{\bar{x} - \mu}{s/\sqrt{n}} \quad \text{Mean—one population (\( \sigma \) unknown—see flowchart)} \]

\[ \chi^2 = \frac{(n-1)s^2}{\sigma^2} \quad \text{Standard deviation or variance—one population} \]