Math 425 - Homework 3

Due Monday 03/04

Email work to `mccomic@mcs.anl.gov`

Note: These problem numbers may be different than in your version of the text.

1. *Problem 7.13:* A normally distributed population has a mean of $\mu = 80$ and a standard deviation of $\sigma = 20$. Calculate the z-score for each of the following samples and determine if that sample has a typical mean or an extreme mean: **a)** $n = 4$ and $\bar{X} = 90$, **b)** $n = 25$ and $\bar{X} = 84$, **c)** $n = 100$ and $\bar{X} = 84$.

2. *Problem 7.22:* Jurors are randomly selected with $\mu = 39.7$ and $\sigma = 12.4$. A statistician randomly selects a $n = 16$ sample from current jurors and finds their average age to be $\bar{X} = 48.9$. How likely is it that a random sample of that size would have that at least that average age?

3. *Problem 8.6:* A sample of $n = 25$ students participate in a skills training program. The general population of students score along the distribution $N(150, 25)$ on a skills exam, without the training program; the sample of students had an average score of $\bar{X} = 158$. **a)** Identify the independent and dependent variables in this study. **b)** Assuming a two-tailed test, state the hypotheses H_0 and H_1. **d)** Sketch the appropriate distribution of sample means, identify the mean and SD of that distribution, and shade the rejection region for $\alpha = .05$. **e)** Calculated the test-statistic (z-score) for the sample. **f)** Determine if you can reject H_0.

4. *Problem 8.9:* A self-esteem program has $n = 16$ participants drawn from a population whose self-esteem *scores* are normally distributed with $\mu = 40$ and $\sigma = 8$. **a)** If the researcher obtains a sample mean of $\bar{X} = 42$, is this enough evidence to conclude an $\alpha = .05$ significant effect for a two-tailed test? **b)** If the sample mean is $\bar{X} = 44$ do you see an $\alpha = .05$ significant effect with a two-tailed test?

5. *Problem 8.23:* Researchers want to test a drug on individuals who have blood pressure issues. For the population, average scores are normally distributed with $\mu = 160$ and $\sigma = 20$. The researcher uses a sample of $n = 25$ and wants to test for significance at the $\alpha = .05$ level with a two-tailed test. **a)** What is the power of the test if the medication causes a 5 point reduction? **b)** What is the power of the test if the medication causes a 10 point reduction?

6. *Problem 9.11:* A random sample of $n = 16$ individuals is selected from a population with $\mu = 70$. After a treatment, the sample mean is found to be $\bar{X} = 76$ with $SS = 960$. **a)** What is the difference between the sample and population means, the numerator of the t-statistic? **b)** How much difference will occur by chance, as determined by the standard error, the denominator of the t-statistic? **c)** Using the first two results, compute the t-statistic and determine if the treatment has an $\alpha = .05$ significant effect with a two-tailed test.

7. *Problem 9.18:* Research has shown that a sample of $n = 25$ children who attended day care had an average score of $\bar{X} = 27$ with $SS = 1536$ on the `MIKE` test. It is known that the population of young children have an average score of $\mu = 21$ on the `MIKE` (that's out of 100 ... it's a very difficult test). Is this sample data enough to conclude with $\alpha = .01$ that children in day care are better on the `MIKE` than the rest of the population?

8. Explain how the power of a t-test is influenced by each of the following, assuming other factors are held constant: **a)** Increasing the α level from .01 to .05, **b)** Changing from a two-tailed test to a one-tailed test, **c)** Doubling the number of participants in your sample.