Exam 1 PS 217, Spring 2011

1. Answer the following questions assuming that they are dealing with a population of IQ scores, which are normally distributed with μ = 100 and σ = 15.

a. What is the probability that a person has an IQ score between 120 and 130? [3 pts]

$z = \frac{120-100}{15} = 1.33$, which yields a probability of .0918 in Column D

$z = \frac{130-100}{15} = 2$, which yields a probability of .0228 in Column C

.0918 - .0228 = .0690

b. What is the probability that a person has an IQ score between 95 and 110? [3 pts]

$z = \frac{95-100}{15} = -.33$, which yields a probability of .3707 in Column C

$z = \frac{110-100}{15} = .67$, which yields a probability of .2514 in Column C

1.0 – (.3707 + .2514) = .3779

c. What IQ scores would be achieved by the upper 85% of the population? [3 pts]

Looking up .85 in Column B (or .15 in Column C), I'd obtain *z* = -1.035.

$-1.035 = \frac{X-100}{15}$, so *X* = 84.48

d. What IQ scores would be achieved by the lower 10% of the population? [3 pts]

Looking up .10 in Column C, I'd obtain *z* = -1.28.

$-1.28 = \frac{X-100}{15}$, so *X* = 80.8

e. What is the probability that a sample of *n* = 25 would yield a mean (*M*) IQ of 102 or more from this population? [4 pts]

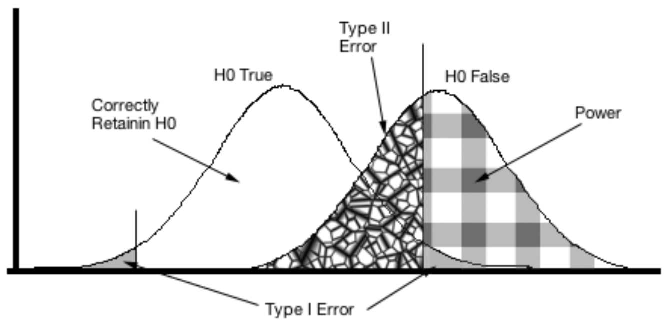
$z = \frac{102-100}{15/\sqrt{25}} = .67$, which yields a probability of .2514 in Column C.

f. For samples of n = 100, what mean IQ scores would comprise the middle 95% of the sampling distribution of the mean? [4 pts]

Looking up .025 in Column C, I'd obtain $z = \pm 1.96$.

$$\mathbf{1.96 = \frac{\bar{X}-100}{15/\sqrt{100}} = 102.94 \text{ and } -1.96 = \frac{\bar{X}-100}{15/\sqrt{100}} = 97.06}$$

2. On the curves seen below, *clearly* label the areas that represent Type I Errors, Type II Errors, Power, and Correct "Retention." [5 pts]



3. In this semester's PS 306 first lab, we collected data from a sample of students, including GPA. Tell me as much as you can about the SPSS analysis of the data seen below, including the interpretation/conclusion. [5 pts]

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
GPA	42	3.4393	.34419	.05311

One-Sample Test

	Test Value = 3.3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
GPA	2.623	41	.012	.13929	.0320	.2465

H_0: μ = 3.3 and H_1: $\mu \neq$ 3.3 [see Test Value]

t_{Obt} = 2.623

Decision: Reject H_0, because p = .012 (< .05)

The sample was likely drawn from a population with μ > 3.3

4. In a prior year's lab, we also obtained GPA data. Using the output below, test H_0: μ = 3.3. [10 pts]

Descriptive Statistics

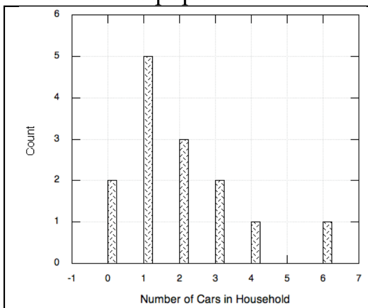
	N	Minimum	Maximum	Mean	Std. Deviation
gpa	47	2.80	3.90	3.3748	.29606
Valid N (listwise)	47				

$t_{Crit}(46)$ = 2.01

$$\mathbf{t = \frac{3.3748 - 3.3}{.29606/\sqrt{47}} = 1.73}$$

Decision: Retain H_0, because $|t_{Obt}| < t_{Crit}$.
Sample could have come from a population with μ = 3.3

5a. Below are data about the number of cars owned in a sample of households in Saratoga Springs. ***Estimate*** μ, σ^2, and σ of the population from which the sample was drawn. [10 pts]



$\Sigma X = 27$, $\Sigma X^2 = 87$

$$SS = \Sigma X^2 - \frac{(\Sigma X)^2}{n} = 87 - \frac{27^2}{14} = 34.929$$

$$\bar{X} = M = \hat{\mu} = 1.929$$

$$s^2 = \hat{\sigma}^2 = \frac{SS}{n-1} = \frac{34.929}{13} = 2.687$$

$$s = \hat{\sigma} = \sqrt{s^2} = \sqrt{2.687} = 1.639$$

5b. Given the above data, could you compute a *z*-score to test H_0: $\mu = 2.0$? Why or why not? [2 pts]

No, because σ is not known.

5c. What is the median of the data set? Which measure of central tendency would you prefer for this data set, the median or the mean? Why? [3 pts]

Mdn = 1.5. The data appear to be positively skewed, so the median would be a better measure of central tendency.

6. If you were interested in estimating σ^2 for some (huge) population, what procedure would you follow? [3 pts]

Draw an appropriate sample (e.g., random sampling) that is fairly large (e.g., 100) and compute the sample variance (s^2), which is an unbiased estimate of σ^2.

7. As you saw in that lab, you can use *z*-scores to determine a measure of sensitivity (d'). Suppose that on a recognition memory test, a person got 90% hits and 5% false alarms. What d' would that person receive? [5 pts]

For Hits, look up .10 in Column C, so $z = 1.28$ (actually -1.28, but ignore the sign).
For False Alarms, look up .05 in Column C, so $z = 1.64$.

Thus, d' would be 1.28 + 1.64 = 2.92 (a very high d')

8. Some semi-random questions:

a. Suppose that your population is very strangely shaped (e.g., multimodal and skewed). If you were to translate all the scores in the population to *z*-scores, what can you tell me about the transformed distribution in terms of central tendency (i.e., mean), variability (i.e., standard deviation), and shape? [2 pts]

Mean = 0, standard deviation = 1, shape = unchanged (multimodal and skewed)

b. For that same strangely shape population, what can you tell me about the shape of the sampling distribution of the mean derived from that population? [2 pts]

With small *n*, the sampling distribution of the mean would not be at all normal. However, as *n* approached infinity, the sampling distribution of the mean would become increasingly normal.

c. You have a sample of 10 scores with $M = 20$. You remove one score ($X = 10$). What is the mean of the new sample (with $n = 9$)? [1 pt]

$\overline{X} = \frac{\Sigma X}{n}$, **so** $20 = \frac{\Sigma X}{10}$ **implies that** $\Sigma X = 200$**. Removing 10 means that** $\Sigma X = 190$**. Thus, the new mean would be** $\overline{X} = \frac{190}{9} = 21.11$

d. In one distribution, with μ = 80 and σ = 10 you have a score of 85. Translate that score into an equivalent score in a distribution with μ = 300 and σ = 100. [2 pts]

First, convert the score to a *z*-score: $z = \frac{85-80}{10} = .5$**. Next, determine what that *z*-score would be in the new distribution:** $.5 = \frac{X-300}{100}$**. Thus, that score would translate into a new score of 350.**

e. You've obtained a sample mean of *M* = 80. Test the null hypothesis that the mean was obtained from the distribution with μ = 80 and σ = 10. [5 pts]

Note that you're not given sample size (*n*). However, it's clear that $z = 0$**.**

$$z = \frac{80 - 80}{10/\sqrt{n}}$$

Because $|z_{Obt}| < 1.96$**, you would retain** H_0 **and conclude that the sample could well have come from a population with μ = 80.**