1. The Central Limit Theorem provides us with important information about the sampling distribution of the mean. [3 pts]

a. its mean (μ_M) will be	μ
b. its standard deviation (σ_M) will be	$\sigma / \sqrt{n}$
c. its shape will be normal if	n => infinity

2. Provide a brief answer to each of the following questions. (No real computation necessary) [12 pts]

Question	Answer
a. Suppose that you are dealing with an effect size (e.g., *d*) that is considered to be small. If you were interested in testing such an effect (e.g., using a *t*-test), what might you do to ensure that you found a significant effect (i.e., were able to reject H_0)?	Increase Power (often by increasing *n*)
b. If you reject H_0, what is the probability of making a Type II error?	0, impossible
c. What is another name for the standard deviation of the sampling distribution of the mean?	Standard error
d. What is the typical probability of making a Type I Error (α)?	.05
e. Suppose that a sample standard deviation (*s*) is 10. Next, suppose that you add 5 to every score in the sample. What would the standard deviation of the sample now be?	10, unchanged
f. Suppose that a sample standard deviation (*s*) is 10. Next, suppose that you convert every score in the sample to a *z*-score. What would the standard deviation of this distribution now be?	1
g. $\Sigma(X - \mu) =$	0
h. Suppose that you are computing a *t*-test with $t_{Crit} = 1.96$. What can you tell me about that *t*-distribution?	Normal, because *n* large
i. In a negatively skewed distribution, which is larger, the median or the mean?	median
j. Suppose that the mean of a sample of $n = 25$ is $M = 5$. Generally speaking, if you add another score (new $n = 26$), the *SS* of the sample would increase. However, there is one score you could add to the sample without increasing its *SS*. What is that score?	The mean (5)
k. Researchers typically hope to achieve power of roughly .80. Essentially, in so doing, what Type II error rate are they saying that they are willing to tolerate?	.20
l. When might the median be a better measure of central tendency than the mean?	Dist is skewed

3. Answer the following questions assuming that they are dealing with a population of IQ scores, which are normally distributed with $\mu = 100$ and $\sigma = 15$.

a. What is the probability that a person has an IQ score between 120 and 140? [3 pts]

$z = \frac{120-100}{15} = 1.33$ **so *p* in body = .9082;** $z = \frac{140-100}{15} = 2.67$ **so *p* in body = .9962**

.9962-.9082 = .088

b. What is the probability that a person has an IQ score between 90 and 115? [3 pts]

$z = \frac{90-100}{15} = -.67$ **so *p* from Col. D is .2486;** $z = \frac{115-100}{15} = 1.0$ **so p from Col. D is .3413**

.2486 + .3413 = .5899

c. What IQ scores would be achieved by the lower 75% of the population? [3 pts]

.75 in Col. B (Body) yields a *z* = .675; $.675 = \frac{X-100}{15}$ $X = 110.125$

d. What IQ scores would be achieved by the upper 5% of the population? [3 pts]

.05 in Col. C (Tail) yields a *z* = 1.645; $1.645 = \frac{X-100}{15}$ $X = 124.675$

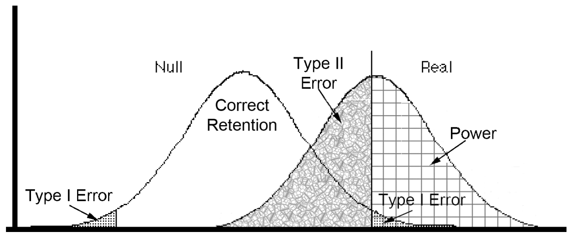
e. What is the probability that a sample of *n* = 25 would yield a mean (*M*) IQ of 103 or less from this population? [4 pts]

Because you're now in the sampling distribution of the mean, the standard error would be $\sigma_{\bar{X}} = 15/\sqrt{25} = 3$**. Thus,** $z = \frac{103-100}{3} = 1$**. Looking up Col. B (Body) for *z* = 1 yields .8413.**

f. For samples of *n* = 100, what mean IQ scores would comprise the middle 90% of the sampling distribution of the mean? [4 pts]

Because you're now in the sampling distribution of the mean, the standard error would be $\sigma_{\bar{X}} = 15/\sqrt{100} = 1.5$**. The z-scores that cut off the upper and lower .05 of the distribution would be ±1.645:** $1.645 = \frac{X-100}{1.5}$ $X = 102.47$ and $-1.645 = \frac{X-100}{1.5}$ $X = 97.53$.

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



5. You should recognize the SPSS output below from our last lab. Interpret the results as completely as you can. That is, what is the score of interest, what would H_0 and H_1 be, what is the *t*-test and what decision and conclusion would you reach? [5 pts]

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
MPH 00-10	10	152.48520	9.071285	2.868592

One-Sample Test

	Test Value = 160					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
MPH 00-10	-2.620	9	.028	-7.514800	-14.00401	-1.02559

The score of interest would be MPH for winners of the Indy 500 from 2000-2010. You hypothesize H_0 $\mu = 160$ (from Test Value = 160), so H_1: $\mu \neq 160$. Though you could construct the *t*-test from the information given, there's no reason to do so, because you know *t* = -2.620. Nonetheless, $t = \frac{152.48520 - 160}{2.868592}$. You would reject H0, because the probability of getting the sample mean (152.485) from a population with $\mu = 160$ is below .05 (actually .028, see Sig.). You might conclude that the sample of winning MPH would have a mean that is more likely sampled from a population with $\mu < 160$.

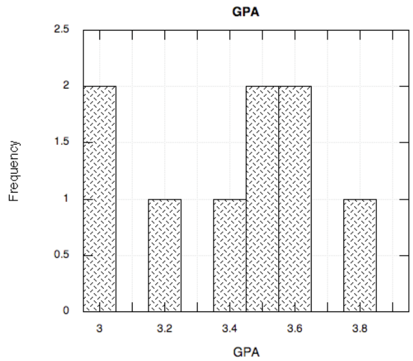
6. Below is another SPSS output. Using the information in the output table, test H_0: $\mu = 9$. [10 pts]

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
QuizScore	26	5.00	10.00	8.7308	1.53773
Valid N (listwise)	26				

First of all, it's important to recognize that the Quiz Scores are reasonably a sample, so your test of H_0 would involve a *t*-test. With 26 scores, *df* = 25, so $t_{Crit}(25) = 2.060$. $s_{\bar{X}} = \frac{1.53773}{\sqrt{26}}$ and $t = \frac{8.7308 - 9}{.30} = -.89$. The decision would be to retain H_0, because $t_{Obtained} < t_{Critical}$. I would conclude that the sample could have come from a population with $\mu = 9$.

7a. Below is a sample of GPAs. ***Estimate*** μ, σ^2, and σ of the population from which the sample was drawn. [10 pts]



Notice, first of all, that you're dealing with a sample, so you cannot compute parameters, but only estimate them. Thus…

$$\overline{X} = M = \hat{\mu} = \frac{\sum X}{n} = \frac{30.6}{9} = 3.4$$

$$SS = \sum X^2 - \frac{\left(\sum X\right)^2}{n} = 104.66 - 104.04 = .62$$

$$s^2 = \hat{\sigma}^2 = \frac{SS}{n-1} = \frac{.62}{8} = .0775$$

$$s = \hat{\sigma} = \sqrt{s^2} = \sqrt{.0775} = .278$$

7b. Given the above data, could you compute a *z*-score to test H_0: $\mu = 3.2$? Why or why not? [2 pts]

No, Because σ is not known (only estimated…so a *t*-test is in order).

8. If you were interested in estimating σ^2 for some (typically large) population, what would you do? [3 pts]

To estimate the population variance (σ^2), you would first draw a sample (random sampling?) from the population and then compute s^2 to estimate σ^2.