PSYC 2317: Statistical Methods for Psychology

1. Suppose we are sampling from a population that is known to be normal with standard deviation $\sigma = 10$. However, the mean μ is unknown, so we'll have to estimate it.
   (a) A sample of $N = 10$ is drawn and is found to have mean $\overline{X} = 25$. Compute a 95% confidence interval for μ.
   (b) A sample of $N = 20$ is drawn and is also found to have mean $\overline{X} = 25$. Compute a 95% confidence interval for μ.
   (c) Based on your answers to (a) and (b), what happens to the width of the confidence interval as sample size increases?

2. A treatment is administered to a sample of $N = 16$ individuals. The treatment population has unknown mean, but has a known standard deviation of $\sigma = 8$. The sample mean is found to be $\overline{X} = 33$.
   (a) Compute a 95% confidence interval for μ, the mean of the treatment population.
   (b) Define $\mathcal{H}_0 : \mu = 30$ and $\mathcal{H}_1 : \mu > 30$. What is the probability of observing a sample mean $\overline{X} = 33$ or larger if $\mathcal{H}_0$ is true?
   (c) Given the results of (a) and (b), can we reject $\mathcal{H}_0$ in favor of $\mathcal{H}_1$? Why or why not?

3. A treatment is administered to a sample of $N = 25$ individuals. The treatment population has unknown mean, but has a known standard deviation of $\sigma = 5$. The sample mean is found to be $\overline{X} = 44$.
   (a) Compute a 95% confidence interval for μ, the mean of the treatment population.
   (b) Define $\mathcal{H}_0 : \mu = 40$ and $\mathcal{H}_1 : \mu > 40$. What is the probability of observing a sample mean $\overline{X} = 44$ or larger if $\mathcal{H}_0$ is true?
   (c) Given the results of (a) and (b), can we reject $\mathcal{H}_0$ in favor of $\mathcal{H}_1$? Why or why not?

4. A high school teacher has designed a new course intended to help students prepare for the mathematics section of the SAT. A sample of $N = 20$ students is recruited to take the course and, at the end of the year, each student takes the SAT. The average score for this sample is 562. For the general population, scores on the SAT are standardized to form a normal distribution with a mean of 500 and a standard deviation of 100. Can the teacher conclude that students who take the course score significantly higher than the general population? Use the tools you've learned this week to convince me of your answer.