Lab 06A

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10. Why are your number of misses not exactly what you expected and why is it that everyone has differing numbers of ‘misses’ for each set of confidence intervals?

    Since we only have a sample of 20, our estimate of the numbers of misses, we will call this value α, will vary. The larger our sample size (the number of intervals we create), the closer our number of misses will be to α for a $(1 - \alpha)$100% CI.

11. What causes a particular interval to miss?

    Each interval within a confidence level has the same length, so the only reason an interval does not cover μ is because that sample mean is too far from center, μ - it is in the α% tail of the distribution of the sample means. Your smallest and/or largest sample means should be the flagged confidence intervals.

12. What is difference between 90%, 95% and 99% confidence intervals?

    As the confidence level increases, the width of the interval increases, so more of the intervals cover the parameter (μ for this exercise).

13. What things affect the width of a confidence interval and how do they affect it?

    The confidence level, the standard deviation of the population and the sample size all affect the width of a Z confidence interval. The sample mean does NOT affect the width; it is merely the center of the interval. As the level increases, say from 90 to 95%, the width increases. As the population standard deviation increases, the width increases – since the data is more variable so is our statistic. As the sample size increases, the width of the interval decreases because the standard deviation of our statistic decreases.

14. What is the definition of a confidence interval?

    A 95% confidence interval says that 95% of all possible confidence intervals created by the method we demonstrated will include the true mean, μ. Since we cannot create ALL confidence intervals, we says we are confident that our one interval contains μ since we took a random sample and used the proper method to create the interval.

1. What is the formula for creating our Z test statistics and what does it measure?

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

It tells us how many standard deviations away our sample mean is from the hypothesized mean.

2. What is the formula for the p-value for the greater than test? the less than test? the not equal to test?

   For the greater test, p-Value = $P(Z > z)$. For the less than test, p-value = $P(Z < z)$. For the not equal to test, p-Value = $2 * P(Z > |z|)$ where $|z|$ is the absolute value of the test statistic.

3. How many Type I errors do you expect for α=10%? 5%? 1%?

   In general, we expect a Type I error to occur α% of the time since the null hypothesis is TRUE. If the null were false, we could NOT make a Type I error. Remember, there are two things needed to make a Type I error: a true H_0 AND a rejection.

4. How can we use confidence intervals to carry out a hypothesis test?

   If the hypothesized value, 30, is NOT in a confidence interval, then 30 is not a plausible value for μ so it is rejected which means that the p-Value is less than α. A confidence interval is a range of plausible values for a population parameter.

5. What is the advantage of a confidence interval over a hypothesis test?

   A confidence interval gives one an idea of 'how far off' the sample mean is from the hypothesized value. A small p-value indicates the sample mean is far from the hypothesized value, but it is possible that the standard deviation of the sample mean is quite small (maybe because the sample size is large) so the actual 'distance' between the two is not practically significant. A confidence interval gives values that are plausible for the true mean and so you can judge if there is real significance or not.

6. What can a hypothesis test ‘prove’? What can it never prove?

   If we reject the null hypothesis, then we claim that the alternative is true. We can never claim (or prove) that the null is true.

7. When do we reject the null hypothesis?

   We reject the null when the p-value is less than α and conclude the alternative is true.

8. What do we conclude when we fail to reject the null hypothesis?

   If the p-value is NOT less than α, we CANNOT reject the null and we canNOT conclude the alternative is true. We can never say the null is true.

9. What is a p-value and what does it tell us?

   A p-value is a probability so it must be between 0 and 1. It tells us how likely we are to see a statistic at least as extreme (contradictory to the null) as we got even though the null hypothesis is true. This is why the smaller the p-value the less we believe the null is true.

10. What three things affect the p-value and how?

    The distribution (type) of the test statistic tells us which curve we use, the value of the test statistic tells us where we are on the curve, and the sign of the alternative tells us which direction to ‘shade’ or which area to use for the p-value.

11. What does it mean for a hypothesis test to be statistically significant?

    A hypothesis test is statistically significant if we rejected the null hypothesis.

12. What three things affect the power of a test, and so the probability of making a Type II error and how?

    The more false the null hypothesis (the further the true mean is from the hypothesized mean), the higher the power of the test. The smaller the α-level, the probability of making a Type I error, the lower the power of the test. The larger the sample size for any given α-level, the higher the power of the test. In general, as α decreases, β increases, but they are areas of DIFFERENT curves so they are NOT complements. Power = 1 - β; they are areas of the curve centered at the true mean. α and the p-value are areas of the hypothesized curve.