Question 1

Find the quantity $t_{n-1,\alpha/2}t_{n-1,\alpha/2}$ when $\alpha=0.05\alpha=0.05$ and $n=22n=22$. Use Appendix D, Table D.2 or R. Round your answer to two decimal places.

We need to find the $100-(95/2)=97.5100-(95/2)=97.5$ percentile of the t distribution with $n-1n-1$ degrees of freedom. This can be read from the table by searching the degrees of freedom (22-1=21) from the rows and $\alpha/2=0.05/2=0.025\alpha/2=0.05/2=0.025$ from the columns. We see that this quantity is approximately 2.080. Alternatively we can use R command qt(0.975,df=21) or qt(0.025,df=21,lower.tail=FALSE).

The correct answer is: 2.08

Question 2

Find the quantity $z_{\alpha/2}z_{\alpha/2}$ when $\alpha=0.1\alpha=0.1$. Use a table or R. Round your answer to two decimal places.

We need to find the $100-(90/2)=95100-(90/2)=95$ percentile of the standard normal distribution. This can be found from the table or by using R command qnorm(0.95) or qnorm(0.05, lower.tail=FALSE). We see that this quantity is approximately 1.64.

The correct answer is: 1.645

Question 3

We want to calculate the 99 percent confidence interval estimate for the mean parameter of the normal distribution when the variance parameter is unknown. We need to find the quantity

Select one:

a. $t_{n-1,0.01}t_{n-1,0.01}$
b. $t_{n-1,0.005}t_{n-1,0.005}$
c. $z_{0.01}z_{0.01}$
d. $z_{0.005}z_{0.005}$

Since the variance parameter is unknown, we need to use t confidence interval. Since we want to calculate the two-sided confidence interval (not the lower or the upper confidence bound), we need to leave $\alpha/2=0.01/2=0.005\alpha/2=0.01/2=0.005$ of probability to the tails of the distribution. So we need the quantity $t_{n-1,0.005}t_{n-1,0.005}$.

The correct answer is: $t_{n-1,0.005}t_{n-1,0.005}$

Question 4

We want to find the 95 percent confidence interval estimate for the mean parameter of the normal distribution when the variance parameter is known. We need to find the quantity

Select one:

a. $z_{0.025}z_{0.025}$
b. $z_{0.05}z_{0.05}$
c. $t_{n-1,0.025}t_{n-1,0.025}$
d. $t_{n-1,0.05}t_{n-1,0.05}$

Since the variance parameter is known, we can use z confidence interval. Since we want to calculate the two-sided confidence interval (not the lower or the upper confidence bound), we need to leave α/2=0.05/2=0.025α/2=0.05/2=0.025 of probability to the tails of the distribution. So we need to find the quantity z0.025z0.025.

The correct answer is: z0.025z0.025

Information

In the following questions we assume that a sample has been drawn from a normal distribution. We want to test the null hypothesis that the mean of the distribution is equal to 70. The alternative hypothesis is that the mean of the distribution is not equal to 70. The significance level is 5 percent. The sample mean of the observations is 68.22 and the sample standard deviation of the observations is 1.71.

Question 5

The test is a

Select one:

a. one-sided t test

b. two-sided z test

c. two-sided t test

d. one-sided z test

Since the alternative hypothesis is that the mean is not equal to 70 (greater than or less than 70), the test has to be two-sided. Since the sample standard deviation has been calculated and there is no mention of known standard deviation, the test has to be t test.

The correct answer is: two-sided t test

Question 6

What is µ0µ0 in this?

Select one:

a. 70

b. µ0µ0 can't be determined

c. 0.05

d. 68.22

The quantity µ0µ0 is the specified value of the population mean according to the null hypothesis. So µ0µ0 is equal to 70.

The correct answer is: 70

Question 7

What kind of values of the test statistic are critical to the null hypothesis in this situation?

Select one:

a. Small values of the test statistic

b. Both small and large values of the test statistic

c. Large values of the test statistic

Since this is a two-sided test, the values of the test statistic that differ a lot from $\mu_0\mu_0$ are critical to the null hypothesis. This means large **absolute values** that is both small and large values of the test statistic.

The correct answer is: Both small and large values of the test statistic

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Question 8

Which one of the following is correct?

Select one:

a. $S=1.71S=1.71$
b. $\sigma=1.71\sigma=1.71$

SS is the sample standard deviation and $\sigma\sigma$ is the population standard deviation. We were told that the sample standard deviation was 1.71.

The correct answer is: $S=1.71S=1.71$

In the remaining questions we have a following story:

Historical data indicate that men's average score in the Cooper 12 minute run test is 2650 meters in a certain age group. A PE teacher claims that the result is outdated and the results have got worse. The teacher is going to measure the Cooper test result of 100 men from this age group. After measuring the teacher found that the sample mean of the results was 2544 meters and the sample standard deviation was 348 meters.

Question 9

The null hypothesis in this situation is that

Select one:

a. the average result of the age group is 2650 meters

b. the average result of the age group is at most 2650 meters

c. the average result of the age group is at least 2650 meters

The teacher claims that the results have got worse and he/she wants to use statistical hypothesis testing to support his/her claim. If the teacher wants to "prove" the claim by the data, the opposite of the claim (the null hypothesis) has to be rejected by the data. Therefore the null hypothesis has to be that the average result is at least 2650 meters.

The correct answer is: the average result of the age group is at least 2650 meters

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Question 10

The teacher obtains a p value of 0.001. How is the p value interpreted? Select two correct answers.

Select one or more:

a. Only one per mille of the Cooper test results of the population are consistent with the null hypothesis.

b. If the null hypothesis was true, the probability of observing as extreme or more extreme result as observed is only one per mille.

c. The probability that the null hypothesis is true is only one per mille.

d. The teacher can reject the null hypothesis even at very low significance levels (e.g. at 1 percent level of significance). Hence the risk of rejecting a true null hypothesis is very small (less than one percent).

The pp value is the probability that data as unsupportive of the null hypothesis as those observed will occur when the null hypothesis is true. Since a value of 0.001 was obtained, it means that the probability of observing as extreme (or even more extreme) result as observed in the sample is only 1 per mille if the null hypothesis was true (if the average result was at least 2650 meters). Since the p value is less than 1 percent, the teacher can reject the null hypothesis at the 1 percent level of significance which means that the probability of type I error is at most 0.01.

The remaining two answers are incorrect and do not meet the definition of the p value.

The correct answers are: If the null hypothesis was true, the probability of observing as extreme or more extreme result as observed is only one per mille., The teacher can reject the null hypothesis even at very low significance levels (e.g. at 1 percent level of significance). Hence the risk of rejecting a true null hypothesis is very small (less than one percent).

Question 11

What are the assumptions of this test?

Select one:

a. The sample is from any distribution whose mean and variance are unknown.

b. The sample is from a normal distribution (the results are normally distributed in the population).

c. The sample is from a t distribution (the results are t distributed in the population)

In t test we assume that the sample is from a normal distribution (with unknown mean and unknown variance).

The correct answer is: The sample is from a normal distribution (the results are normally distributed in the population).