1. Suppose you wish to test H0: μ =50 versus HA: μ ≠ 50. The sample size is 17 and the value of the *t* - statistic is 2.82. The *p-value* of the test is:
2. Between 0.05 and 0.10
3. Between 0.025 and 0.05
4. Between 0.005 and 0.01
5. **Between 0.01 and 0.02**

Answer: (D) From the t-table with 16 degrees of freedom, the probability in the right tail is between 0.005 and 0.01. Since we have a 2-tailed test, we have to double this probability to get the p-value.

1. We draw a large number of simple random samples of size 35 from a large population and use this information to find the sampling distribution of mean value. The resulting sampling distribution has a kurtosis of 5. This implies that:
2. We can conduct hypothesis testing on the mean value using the current sample of size 35.
3. **In order to do hypothesis testing on the mean value, we must use a sample of size greater than 35.**
4. It will not be possible to do hypothesis testing on the mean value with a sample of any size.
5. Since we are using simple random sampling, the kurtosis cannot be 5.

Answer: (B) We expect the sampling distribution to be approximately normal if the sample size was large enough. Choosing samples of size 35 resulted in a sampling distribution that has higher kurtosis than what we expect. So, if one wants to do hypothesis testing on the mean value, for which CLT needs to applicable, we must use a sample of size greater than 35.

A private equity firm is considering purchasing a chain of retail clothing stores. Preliminary to the purchase, it has obtained data on the level of sales at 64 retail outlets of the chain. The data gives the sales in dollars per square foot per year. In order for the acquisition to be profitable, the stores must produce sales in excess of $380 per square foot annually.



1. If the company performs a break-even analysis of these data with α = 0.025, then it should conclude that the acquisition
2. Is definitely going to be profitable.
3. Has proven its profitability beyond reasonable doubt.
4. **Has not proven its profitability**.
5. Could be profitable if we are willing to increase the significance level of the test to 5%

Answer: (C) Let μ denote the average store profitability per sq ft after acquisition. Then, we can form the hypotheses as follows. H0: μ ≤ 380 and Ha: μ > 380. Note that from the sample of 64 stores we have =401.56 and s = 126.67. Thus, t-value is given by (401.56-380)/(126.67/√64)=1.36. From the t-table, it is clear that the p-value corresponding to this t-value is between 5% and 10%. But at α = 2.5%, we cannot reject the null hypothesis and hence conclude that the acquisition has not proven its profitability.

(Q5-Q6) The owner of a Pizza delivery restaurant is concerned about meeting the delivery time target of 30 minutes. He has kept close track of the delivery times over a very long period and has found that they follow a normal distribution with mean of 25 minutes and standard deviationof 5 minutes.

1. On a particular day, he delivers 36 pizzas, of which 9 pizzas are delivered in more than 30 minutes. Which is the smallest level of significance at which the evidence is strong enough to believe that the process has changed?
2. 1%
3. 5%
4. 10%
5. **15%**

Answer: (D) Note that our ultimate interest is testing a hypothesis on the population proportion (i.e., proportion of pizzas that take more than 30 minutes to deliver). So the first task is to calculate the population proportion of pizzas that take more than 30 minutes under the normal process.

Let X be the random variable denoting the delivery time. Then, we know that X ~ N(25,52). Then, using the usual normal distribution calculation P(X>30) = P(Z>1)=0.16. Thus, π = 0.16.

Now the relevant pair of hypotheses is as follows:

H0: π = 0.16 and Ha: π≠0.16.

Next, we know that the evidence is of the form p = 9/36 = 0.25. Then, given that this is a two-sided test, the p-value associated with this evidence is Pr(P>0.25) + Pr(P<0.07).

To calculate this, we note that P ~ N(0.16, 0.16\*0.84/36). Through the normal distributioncalculations, we can find this probability to be 0.14. Then, we can reject the null hypothesis if α = 0.15. Thus, the last alternative is correct.

1. Revisit the evidence described in Q5. Suppose the owner wanted to check if the pizza delivery process has become slower. Which is the smallest level of significance at which the evidence is strong enough to believe that the process has slowed down?
   1. 1%
   2. 5%
   3. **10%**
   4. 15%

Answer: (C) Note that now the hypotheses are as follows: H0: π ≥ 0.16 and Ha: π < 0.16. Because, this is a single-tailed test, p-value = 0.07. Then, we can reject the null hypothesis at α=0.10.

(Q7-Q8) A dean of college of business in the Midwest claims that he can correctly identify whether a student is finance major or a music industry management major by the way the student dresses. Suppose in actuality that he can correctly identify finance major 84% of the time, while 16% of the time he mistakenly identifies music industry management major as finance major. Presented with one student and asked to identify the major of this student (who is either a finance or music industry management major), the dean considers this to be a hypothesis test with the null hypothesis being that the student is finance major and the alternative that the student is a music industry management major.

1. Which of the following statements illustrates a Type I error?
   1. **Saying that the student is music industry management major when in fact the student is finance major**.
   2. Saying that the student is finance major when in fact the student is finance major.
   3. Saying that the student is finance major when in fact the student is music industry management major
   4. Saying that the student is music industry management major when in fact the student is music industry management major.

Answer (A) Type I error occurs when the null hypothesis (H0) is true, but is rejected. Here null hypothesis is that the student is finance major. When this hypothesis is true (student is actually a finance major), but is rejected to say that student is music industry management major, a Type I error occurs.

1. Which of the following statements illustrates a Type II error?
2. Saying that the student is music industry management major when in fact the student is finance major.
3. Saying that the student is finance major when in fact the student is finance major.
4. **Saying that the student is finance major when in fact the student is music industry management major**.
5. Saying that the student is music industry management major when in fact the student is music industry management major.

Answer (C) Type II error occurs when the null hypothesis is false, but is erroneously not rejected. Here,null hypothesis is that the student is finance major. When this hypothesis is false (student is actually a music industry management major), but is not rejected to say that student is a finance major, a Type II error occurs.

1. The MOST APPROPRIATEsummary for management of the output indicates that the process
2. Is under control on Day 30 and an investigation, if conducted thoroughly, will reveal no problems
3. Can be deemed to be running normal throughout this period of 30 days
4. **Might be actually running normal on Day 6 and even an exhaustive, error-free investigation might not lead to the identification of any systematic cause**
5. Has a greater mean duration than that assumed by the management

Answer: (C) On Day 6, there is a suspicion that the process performance is not “as usual”. However, there is still a chance that we might commit a Type-I error after investigation. Note that option (A) is not correct because there can be a Type II error, and so the process may not be under control on Day 30 even though the sample mean is within control limits and if an investigation is conducted, might reveal some problems.

(Q9 – Q12) A firm that processes insurance claims monitors the length of time its agents spend to process each claim. The claims concern storm damages to homes. Homeowners call the firm, are connected to an agent, and the agent handles the administrative details. Based on prior experience, management believes that these calls require, on average, 20 minutes to resolve. Occasionally, some calls are considerably longer, or shorter. As a result the standard deviation is about 15 minutes. To monitor the process, 16 calls are randomly selected from phone records every day and their mean duration is recorded and charted as shown below. The process is deemed to be “running normal” if the daily mean duration falls between 12.50 and 27.50 (called upper and lower control limits).



1. If the system is operating in the fashion expected by management, the probability that the above chart signals a problem on a randomly chosen day is
2. 0.025
3. **0.05**
4. 0.01
5. 0.0027

Answer: (B) First, we calculate the probability that the chart does not signal a problem, i.e., a randomly chosen sample mean lies between the control limits or P(12.5 ≤  ≤ 27.5). To calculate this, note that H0:μ=20. Hence, according to central limit theorem,  ~ N(20,15/√16). Thus, P(12.5 ≤  ≤ 27.5) = P(2≤ Z ≤ 2) ≈ 0.95. Thus, the probability of the chart signaling a problem = 1 – 0.95 = 0.05.

1. A training program of agents reduced the standard deviation of the call duration by half. Then, which of the following statements is most likely to be true?
2. **Everything else remaining the same, the process will be deemed as running normal more often than before**.
3. There will be less Type II errors now
4. The standard error of the mean will be higher than before.
5. There will be more Type-I errors now.

Answer: (A) The standard error of the mean will be half of what it was before. In otherwords, the sample mean distribution will be tighter and hence the probability of thesample mean going beyond the limits (which are unchanged) will be lower than before.

1. If the number of calls monitored each day is doubled (from 16 to 32), then the distance between the control limits in the chart would
2. become twice as large as shown
3. become half the size shown
4. **become 71% of the size shown**
5. remain the same as shown

Answer: (C) The width of the control bands is given by 2zσ/√n. Thus doubling the sample size (n), will make the width 1/√2 times the original width, which is roughly 71%.

1. We have created a 95% confidence interval for µ with the result (10, 15). What conclusion will we make if we test: µ = 16 versus *HA*: µ ≠ 16 at α = .05?
   1. **Reject the null hypothesis**
   2. Accept the null hypothesis
   3. Fail to reject the null hypothesis.
   4. Reject the alternative hypothesis.

Answer: (A) As the 16 is outside the 95% confidence interval, so at α = .05, we will be able to reject as p will be less than 5% in this case.

Alternatively, given the confidence interval, we can calculate = 12.5 and ±t\*s/√n = ±2.5. Now, consider the hypothesis testing. Let t’ be the t-value associated with the evidence of =12.5. Then, ±t’\*s/√n = ±3.5. Thus, the resulting value of t’ will de definitely greater than the value of t in the confidence interval calculation. Consequently, p-value calculated will be smaller than 1-0.95 = 0.05. Thus, we can reject the null hypothesis at 5% level.

1. A bottling plant fills a beverage in glass bottles. The weight of the beverage is normally distributed with mean 12 oz and standard deviation 0.15 oz. Sometimes, the bottling process goes out of order and the mean weight reduces to below 12 oz. The manager of the plant thinks that he can find outwhen this happens by doing a hypothesis test on the weight of a randomly selected bottle. However, his assistant, who has recently graduated with an MBA degree points out that it is better to select a simple random sample of 50 bottles and then do a hypothesis test usingthe sample mean. Which of the following is the MOST APPROPRIATE statement in this situation? The acceptable level of Type I error is 5%.
2. The threshold weight below which the null hypothesis that the process is working as designed is rejected, will be larger in the case of a single bottle than in the case of the sample of 50 bottles.
3. The assistant’s advice should be taken as it is not possible to do hypothesis testing on the weight of a single bottle
4. **Both the methods proposed by the manager and his assistant will work in determining when the manufacturing process goes out of order**
5. The method proposed by the assistant will work provided the sample size is increased to 100 to ensure that CLT can safely be taken to be applicable

Answer (C) This is because the distribution of weights of individual bottles as well as the distribution of the average weights of samples of 50 bottles is a normal distribution. Note that since the weight of bottles is normal, the average weight is also normal irrespective of the sample size. In (A), the threshold weight of the bottle will be lower than the average weight of the sample of 50 bottles. This is because the mean of both distributions is the same, while the std. dev. of the individual weight is higher.