**CBA: Practice Problem Set 2**

**Topics: Sampling Distributions and Central Limit Theorem**

1. Examine the following normal Quantile plots carefully. Which of these plots indicates that the data …
2. Are nearly normal?

**Solution: C**

1. Have a bimodal distribution? (One way to recognize a bimodal shape is a “gap” in the spacing of adjacent data values.)

**Solution: B & D**

1. Are skewed (i.e., not symmetric) ?

**Solution: A,B,D**

1. Have outliers on both sides of the center?

**Solution: A & B**



1. For each of the following statements, indicate whether it is True/False. If false, explain why.

The manager of a warehouse monitors the volume of shipments made by the delivery team. The automated tracking system tracks every package as it moves through the facility. A sample of 25 packages is selected and weighed every day. Based on current contracts with customers, the weights should have *μ* = 22 lbs. and *σ* = 5 lbs.

1. Before using a normal model for the sampling distribution of the average package weights, the manager must confirm that weights of individual packages are normally distributed.

**Solution: False**

Explanation:

As per Central Limit Theory of sample, sampling distribution of the mean will always be normally distributed, as long as sample size is large.

Here the mean for one these samples is 22lbs and standard deviation of 5lbs and so each package is having a weight varying between ±5lbs from the mean i.e., 22lbs. Hence it is invalid to take a weight of individual packages and confirm that it follows normal distribution before using a normal model for the sampling distribution.

1. The standard error of the daily average SE() = 1.

**Solution: True**

Explanation:

Standard Error (E) = σ / √ n

Standard Error (E) = 5 /√25 = 5/5 = 1

1. Auditors at a small community bank randomly sample 100 withdrawal transactions made during the week at an ATM machine located near the bank’s main branch. Over the past 2 years, the average withdrawal amount has been $50 with a standard deviation of $40. Since audit investigations are typically expensive, the auditors decide to not initiate further investigations if the mean transaction amount of the sample is between $45 and $55. What is the probability that in any given week, there will be an investigation?
2. 1.25%
3. 2.5%
4. 10.55%
5. 21.1%
6. 50%

**Solution: D. 21.1%**

n = 100

μ = 50

σ = 40

S is between 45 and 55

There is no investigation as long as the Sample mean is between 45 and 55 i.e., x̄ should be >45 and <55

Z = (x̄ – μ)/(σ/√n)

= ((45-50) or (55-50))/(40/√100)

= ±5/(40/10)

= ±5/4

= ±1.25

Z-Score for 1.25 = 0.8944

(Based on <https://mathbitsnotebook.com/Algebra2/Statistics/PositiveZScores.pdf>)

Z-Score for -1.25 = 0.1056

(Based on <https://mathbitsnotebook.com/Algebra2/Statistics/NegativeZScores.pdf>)

Probability of no investigation = Z-Score for 1.25 - Z-Score for -1.25 (the area between the two points)

= 0.8944 - 0.1056

Probability of no investigation = 0.7888

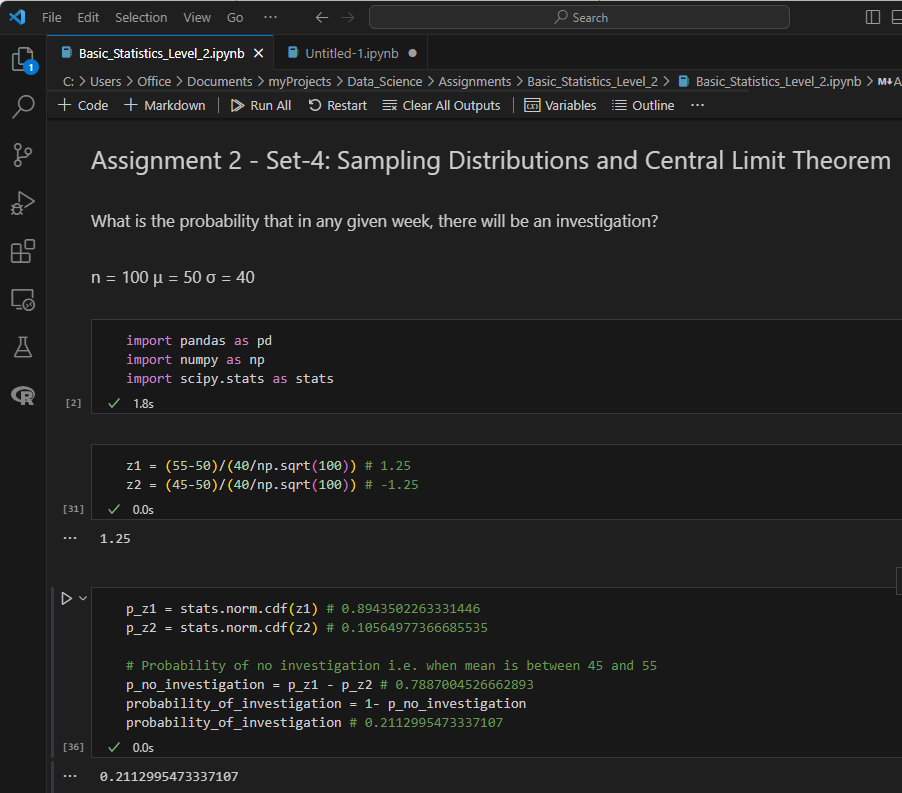
Probability of an investigation = 1- Probability of no investigation

= 1- 0.7888

= 0.2112 or 21.12%

So, the **correct option is D. 21.1%**

**Solving the same using Python:**



1. The auditors from the above example would like to maintain the probability of investigation to 5%. Which of the following represents the minimum number transactions that they should sample if they do not want to change the thresholds of 45 and 55? Assume that the sample statistics remain unchanged.
2. 144
3. 150
4. 196
5. 250
6. Not enough information

**Solution: D 250**

Explanation:

μ = 50 ; σ = 40

S is between 45 and 55

Probability of an investigation = 1- Probability of no investigation

0.05 = 1 - Probability of no investigation

Probability of no investigation = 0.95

In order to get 95% in the middle, we need to take 2.5% or 0.025 on either side and then get the range between.

For 97.5% i.e., 0.975, the t-value should be 1.96

(Based on <https://mathbitsnotebook.com/Algebra2/Statistics/PositiveZScores.pdf>)

t-value = (x̄ – μ)/(σ/√n)

t-value \* σ/√n = x̄ – μ

√n = t-value \* σ/( x̄ – μ)

n = (t-value \* σ/( x̄ – μ))2

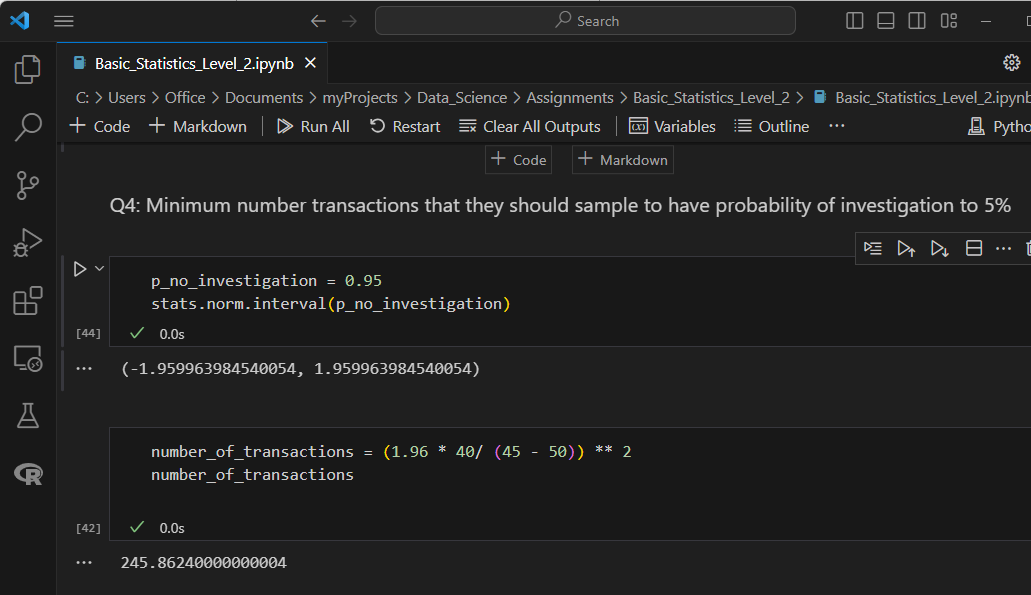
After substituting the values, we get -

n = (1.96 \* 40/ (45 50))2

n = 245.8624

**So, the correct option is D. 250**

**Solving the same using Python:**

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1. An educational startup that helps MBA aspirants write their essays is targeting individuals who have taken GMAT in 2012 and have expressed interest in applying to FT top 20 b-schools. There are 40000 such individuals with an average GMAT score of 720 and a standard deviation of 120. The scores are distributed between 650 and 790 with a very long and thin tail towards the higher end resulting in substantial skewness. Which of the following is likely to be true for randomly chosen samples of aspirants?
2. The standard deviation of the scores within any sample will be 120.
3. The standard deviation of the mean of across several samples will be 120.
4. The mean score in any sample will be 720.
5. The average of the mean across several samples will be 720.
6. The standard deviation of the mean across several samples will be 0.60

**Solution: E. The standard deviation of the mean across several samples will be 0.60**

Size of the Population(n) = 4000

Sigma (σ) = 120

Standard Error (E) = σ / √ n

= 120 / √40000

= 120/200

= 6/10

= 0.6