**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?
3. Have a bimodal distribution? (One way to recognize a bimodal shape is a “gap” in the spacing of adjacent data values.)
4. Are skewed (i.e. not symmetric) ?
5. Have outliers on both sides of the center?



Ans:

1. Are nearly normal? : Plot C
2. Have a bimodal distribution? (One way to recognize a bimodal shape is a “gap” in the spacing of adjacent data values.) Plot B
3. Are skewed (i.e. not symmetric) ? Plot A
4. Have outliers on both sides of the center? Plot D
5. 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.

**Ans:** False. No matter the shape of the population distribution, the sampling distribution of the sample mean shall be nearly normally distributed for sufficiently large sample sizes. As long as the sample size is large enough, the manager can rely on the

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

**Ans:** False**.** The standard error of the sample mean is to be calculated as the standard deviation of the population divided by the square root of the sample size. In formula it is written as: σ/√n. In the above case, the standard deviation of the population (σ) is given as 5 lbs, and the sample size (n) is 25. Therefore, the standard error of the daily average is = 5/√25 = 5/5 = 1 lb, not 1. The statement is false because it incorrectly states the value or unit of the standard error.

1. Top of Form

Note: It is being assumed that 1 means 1 package. If the 1 means 1 lb in the above statement, then the answer shall be True.

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%

**Ans:**

mean (μ) = $50, standard deviation (σ) = $40, n=Sample size = 100

First, we need to find the standard error of the sample mean (SE):

*Std. Error* = *n/ = 40/* = 4

Calculation of z-scores corresponding to the lower and higher limits of the acceptable range:

Z-lower = (45−mean)/std. error = (45−50)/4 = −1.25

Z-higher = (55−mean)/std. error = (55−50)/4= 1.25

Finding probability that the sample mean falls outside this range using the standard normal distribution table/calculator:

*Finding P*(mean<45 or mean>55) means finding *P*(*Z*<−1.25 or *Z*>1.25)

From the standard normal distribution table or calculator, we find:

*P*(*Z*<−1.25) = 0.105

*P*(*Z*>1.25) = 1− *P*(*Z*<1.25) = 1−0.894 =0.106

Therefore, the probability that an investigation will be initiated is:

P(mean<45 or mean>55 ) = *P*(*Z*<−1.25 or *Z*>1.25)

= 0.105 +0.106 = 0.211

In percentage terms, we get approximately 21.1%.

Hence, Option D is the answer

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

previously calculated probability of the sample mean falling outside 45-55 range is approximately 21.1% with sample size of 100 transactions.

Formula to calculate required sample size n, n = (Z\*Std deviation/margin of error)2

Z = 1.96, std. deviation= 40,

margin of error= std. deviation/ = 10

= (1.96\*40/10) = 7.84

n = (1.96 \* 40/7.84)2  = 100

Hence, Sample size should be atleast 100.

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.

Ans: Options A and D are true, while option E is likely to be true subject to conditions.