## EXERCISE 8: SAMPLING AND SAMPLING DISTRIBUTION

**Population distribution**: The probability distribution of the population data.

**Sampling distribution of $\bar{x}$**: The probability distribution of all the values of $\bar{x}$ calculated from all possible samples of the same size selected from a population.

**Sampling error**: The difference between the value of a sample statistic calculated from a random sample and the value of the corresponding population parameter. This type of error occurs due to chance.

**Non-sampling error**: The errors that occur during the collection, recording, and tabulation of data.

**Mean of $\bar{x}$**: The mean if the sampling distribution of $\bar{x}$, denoted by $\mu_{\bar{x}}$, is equal to the population mean, $\mu$.

**Standard deviation of $\bar{x}$**: The standard deviation of the sampling distribution of $\bar{x}$, denoted by $\sigma_{\bar{x}}$.

**Central Limit Theorem**: The theorem from which it is inferred that for a large sample size ($n \geq 30$), the shape of the sampling distribution of $\bar{x}$ is approximately normal. Also, by the same theorem, the shape of the sampling distribution binomial is approximately normal for a sample for which $np > 5 \; and \; nq > 5$.

## Exercise 8: Sampling and Sampling Distribution

1. The following data give the ages of all six members of a family.

55 53 28 25 21 15

(a) Let x denote the age of a member of this family. Write the population distribution of x.

(b) List all the possible samples of size five (without replacement) that can be selected from this population. Calculate the mean for each of these samples. Write the sampling distribution of $\bar{x}$.

(c) Calculate the mean for the population data. Select one random sample of size five and calculate the sample mean $\bar{x}$. Compute the sampling error.

2. Consider a large population with $\mu = 60$ and $\sigma = 10$. Assuming $\frac{n}{N} \leq 0.05$, find the mean and standard deviation of the sample mean, $\bar{x}$, for a sample size of

(a) 18 (b) 90

3. The mean monthly out-of-pocket cost of prescription drugs for all senior citizens in a city is $320 with a standard deviation of $72. Let $\bar{x}$ be the mean of such costs for a random sample of 25 senior citizens from this city. Find the mean and standard deviation of the sampling distribution of $\bar{x}$.

4. Explain the central limit theorem.

5. The delivery times for all food orders at a fast food restaurant during the lunch hour are normally distributed with a mean of 6.7 minutes and a standard deviation of 2.1 minutes. Let $\bar{x}$ be the mean delivery time for a random sample of 16 orders at this restaurant. Calculate the mean and the standard deviation of $\bar{x}$ and describe the shape of its sampling distribution.

6. The amounts of telephone bills for all households in a large city have a distribution that is skewed to the right with mean of $96 and a standard deviation of $27. Let $\bar{x}$ be the mean amount of the telephone bills for random sample of 90 households selected from this city. Calculate the mean and standard deviation of $\bar{x}$ and describe the shape of its sampling distribution.

7. The heights of all adults in a large city have a distribution that is skewed to the right with a mean of 68 inches and a standard deviation of 4 inches. Find the probability that the mean height of a random sample of 100 adults selected from this city would be:

(a) less than 67.8 inches

(b) between 67.5 inches and 68.7 inches

(c) within 0.6 inches of the population mean

(d) less than the population mean by 0.5 inches or more