# Session Guide: Average Income vs Income of Average Kenyan

## Session Outline

### Description

This session will present the idea of Mean and Median in the context of skewed data with outliers. It is presented as a creative investigation in which learners should be able to conclude that in certain types of data the mean and the median can be rather different while both measuring averages. It is presented through the comparison between average income and income of the average person, which tends to present skewness to the left (i.e. there are more people with smaller income than larger income worldwide) and contains outliers (i.e. there are a very small number of people with very large incomes). It includes a component of graphical representation of data, its analysis and the calculation of an estimated mean, before reaching the intended conclusions and trying to identify other cases that follow the same trend.

### Session Objectives

The objectives of this session are to:

- To reflect on a current situation and be able to generate data that represents it.
- To be able to represent data graphically.
- To analyse graphical representations of data.
- To make conclusions about data.
- Te identify other areas where the conclusion could be replicated.

### Expected Outcomes

By the end of the session learners will have:

- Come up with a data set.
- Displayed their data set graphically.
- Estimated the median value from the graph.
- Estimated the mean value from the data.
- Compared the results and found reasons for their difference.
- Identified other contexts in which similar results could apply.

## Areas involved

- Mathematics and Financial literacy
    - Ratios and proportions
    - Self-discovery
- Life skills
    - Choosing subjects and careers
    - Daily living skills

# Activity: Creating the data

## Objectives

- To reflect and raise awareness of the income distribution in Kenya.

## Expected Outcomes

Learners will have created and agreed on a dataset for distribution of monthly income in Kenya.

## Teaching Instructions

Explain that for this session a set of 100 Kenyans will be considered and how this is supposed to be representative of the actual population. Lead a discussion on income distribution in Kenya. Learners will have to estimate how many of the 100 people have a monthly income within the intervals suggested in the following table:

| Monthly Income (KES) | Number of People |
|---|---|
| Less than 10,000 | |
| Between 10,000 and 20,000 | |
| Between 20,000 and 30,000 | |
| Between 30,000 and 40,000 | |
| Between 40,000 and 50,000 | |
| Between 50,000 and 60,000 | |
| Between 60,000 and 70,000 | |

| | |
|---|---|
| Between 70,000 and 80,000 | |
| Between 80,000 and 90,000 | |
| Between 90,000 and 100,000 | |
| Between 100,000 and 500,000 | |
| More than 500,000 | |

You can let the group decide what the distribution should look like while ensuring that it is skewed to the left and has some outliers on the right (i.e. the first 4 or fewer intervals should collectively have about 50 out of the 100, i.e. the median should be at most in the 5th backet, and there should be no more than one or two people in the 'More than 500,000' bracket). Individual learners can have their own data if there is disagreement within the group.

## Suggested Guidelines

- Make sure you don't automatically correct learners if their distributions are not as expected. Instead ask them to justify by suggesting who could be in each interval and asking them to estimate how many out of the 100 could fit into each category.
- You can discuss the idea of an outlier by pointing out that very few people will be in the last interval.

## Student Instructions

Imagine that there are 100 people that represent the population in Kenya. Think about the different income people might have and complete the following table, distributing the 100 people into each category (called class interval) according to their monthly income:

| Monthly Income (KES) | Number of People |
|---|---|
| Less than 10,000 | |
| Between 10,000 and 20,000 | |
| Between 20,000 and 30,000 | |
| Between 30,000 and 40,000 | |
| Between 40,000 and 50,000 | |
| Between 50,000 and 60,000 | |
| Between 60,000 and 70,000 | |

| | |
|---|---|
| Between 70,000 and 80,000 | |
| Between 80,000 and 90,000 | |
| Between 90,000 and 100,000 | |
| Between 100,000 and 500,000 | |
| More than 500,000 | |

# Activity: Displaying the Data

## Objectives

To be able to display data in a form of their choice.

## Expected Outcomes

Learners will have produced one or more charts or diagrams to display their data.

## Teaching Instructions

Mention the importance of displaying data in order to be able to visualise it and be able to make conclusions about it. Learners should find a way to display their data in a form of their choice, either using a graph they know about or by creating their own method to graphically display the data. Tell learners to keep in mind and decide why their graph is a good representation of the data.
After students have their graphs or diagrams, lead a discussion where learners demonstrate what they have done. They should explain how they produced their graphs and why they believe they are a good representation of the data.
Complete the discussion by asking learners to try to make conclusions from their graphs. Is there anything that the graph is telling you?

## Suggested Guidelines

- Note that whatever choice of graph learners make it should clearly demonstrate the left skew and the outliers.
- If learners are not sure about what type of graph to use encourage them to pick the one they think will best help visualise the data.

- If learners can't think of any graph thy know and can't come up with any ideas feel free to suggest a few options (dot plots, bar charts, line graphs, histograms, pictograms, pie charts, box plots, cumulative frequency graphs, etc).

## Student Instructions

Representing data graphically can help you visualise it, analyse it and accurately make conclusions about it. Display your data in a graph or chart of your choice, creating your own imaginative way of displaying your data if you don't know any type of graphs. Once you are done answer the following questions:

1. Why do you think this is a good representation of the data?
2. What are the key components of your graph or chart that can allow you to make conclusions?
3. What can you conclude about the data from your graph or chart?

# Activity: The Income of the Average Kenyan

## Objectives

To understand the idea of median (without necessarily using the term) and be able to identify it from their graphs, charts or diagrams.

## Expected Outcomes

- Learners would have understood what is meant by "The Average Kenyan".
- Learners would have been able to place the average kenyan in their graphs, charts or diagrams.
- Learners would have used their graphs, charts or diagrams to estimate the income of the average kenyan.

## Teaching Instructions

Discuss what is meant by "The Average Kenyan" in the context of income. (If you order all the sample population of 100 people in increasing salaries, the average Kenyan would be the one in the middle. In this case as there are 100 people, the average Kenyans are the ones in the 49th and 50th place in this list.)
Ask learners to identify where in their graphs, charts or diagrams the average Kenyan would appear and share it with the rest of the group.
Once learners are comfortable with their placement of the average Kenyan in their graphical representation, ask them to use this to estimate what the income of the average Kenyan would

be. Discuss any differences in their answers and why they might be evident from their choice of representation.

## Student Instructions

Imagine the 100 Kenyans you have been considering as representative of the population and you put them in order of increasing income. Where in that order would “The Average Kenyan” be?
Place “The Average Kenyan” in your graphical representation of the data. Can you estimate the income of “The Average Kenyan” from your graph, chart or diagram?

# Activity: The Average Income

## Objectives

To understand the idea of mean (without necessarily using the term) and be able to estimate it from their table of values.

## Expected Outcomes

Learners would have calculated an estimated mean from their table of values.

## Teaching Instructions

Discuss what is meant by The “Average Income in Kenya”. Ask students to find an estimate for the average income in Kenya from their data. (This is done by multiplying the number of people in each interval by the midpoint of each interval, adding the results and dividing by 100, which is the total number of people. For example if there were 15 people in the “Between 10,000 and 20,000” interval, you multiply 15 by 15,000, which is 225,000. In the case of the first interval the midpoint would be 5,000, in the case of the final interval, learners would have to select a value that they would consider an average income above KES500,000.)
Compare results and ask learners to discuss why they might have different results if they used the same data.

## Suggested Guidelines

- Look out for the common mistake of dividing by the number of intervals rather than by 100 (the total of the sample population).

## Student Instructions

Find the Average Income in Kenya according to your data. You can do so by multiplying the number of people in each interval by the midpoint of each interval, adding the results and dividing by 100, which is the total number of people. For example if there were 15 people in the "Between 10,000 and 20,000" interval, you multiply 15 by 15,000, which is 225,000. In the case of the first interval the midpoint would be 5,000, in the case of the final interval, learners would have to select a value that they would consider an average income above KES500,000.

# Activity: Conclusions

## Objectives

- To distinguish between median and mean of data.
- To be aware that skew and outliers can generate differences between mean and median values.
- To understand that the median is not always representative.

## Expected Outcomes

- Learners will have distinguished between average income and the income of an average Kenyan (mean and median).
- Learners will have thought about the reasons why the difference occurs.
- Learners will have tried to find other types of data sets that could lead to similar outcomes.

## Teaching Instructions

Lead a discussion about the difference between the two estimations, that of the income of the Average Kenyan and that of the Average Income in Kenya. Ask why that difference could occur (more population earning smaller amounts, i.e. data is skewed to the left, and there are very small numbers of people earning large amounts, i.e. there are outliers).
Ask learners to try to come up with other types of data in which this could also happen and explain why (e.g. rainfall).

## Suggested Guidelines

- The key point of the last question is for learners to be able to justify why the suggested type of data could lead to different outcomes. As long as they can justify (either through the existence of skewness or through outliers or both) the answer should be correct.

## Student Instructions

Did you get similar or different answers for the income of the Average Kenyan and the Average Income in Kenya? Why do you think that is? Can you find any other types of data that could lead to similar results? Why will this happen for each case?