

# Grade 10 Mathematics Lesson Plan

## Median (Grouped)

<b>Strand:</b>	<b>Statistics and Probability</b>
<b>Sub-Strand:</b>	Grouped Data
<b>Specific Learning Outcome:</b>	Determine mean, mode and median of grouped and ungrouped data
<b>Duration:</b>	40 minutes
<b>Key Inquiry Questions:</b>	What is statistics? How do we represent data? How do we use statistics in day to day life?
<b>Learning Resources:</b>	CBC Grade 10 textbooks, calculators, chart paper, markers

### Phase 1: Problem-Solving and Discovery (15 minutes)

#### Anchor Activity 3.1.9: Pocket Money Median

**Objective:** Students work in groups to discover cumulative frequency and identify the median class for grouped data.

Work in groups to analyze the following scenario:

Using the pocket money data provided below:

Pocket Money (Ksh)	Frequency
100–199	8
200–299	15
300–399	22
400–499	20
500–599	10

Tasks:

- 1. Construct a Cumulative Frequency (CF) column for this data. (Hint: CF is the running total of frequencies)
- 2. Identify the class interval where the middle student lies.

Discussion prompts for teachers:

- How many students are there in total?
- Which student is in the middle position? (Hint:  $\text{Total} \div 2$ )

- How can we find which interval contains that middle student?
- What is cumulative frequency and how does it help us?

## Phase 2: Structured Instruction (10 minutes)

### Key Takeaway 3.1.51: Calculating Median

For grouped frequency data, we use interpolation to estimate the median using the following formula:

$$\text{Median} = L + ((n/2 - CF) / F) \times C$$

Where:

- L = Lower boundary of the median class
- n = Sum of all frequencies ( $\Sigma f$ )
- CF = Cumulative frequency before the median class
- F = Frequency of the median class itself
- C = Class width

### Step-by-Step Process

1. Step 1: Add a Cumulative Frequency (CF) column to the frequency table (running total)
2. Step 2: Find  $n/2$  (half of total observations, where  $n = \Sigma f$ )
3. Step 3: Identify the median class (first interval where  $CF \geq n/2$ )
4. Step 4: Identify the values: L (lower boundary), CF (before median class), F (frequency of median class), C (class width)
5. Step 5: Apply the formula:  $\text{Median} = L + ((n/2 - CF) / F) \times C$
6. Step 6: Interpret the result (half the data is below, half above)

### Important Notes

- Cumulative Frequency (CF) is the running total - always increases or stays the same
- Last CF should equal n (total observations) - use this to verify
- The median class is where the middle observation falls
- The formula estimates where in the median class the median lies
- The median is an ESTIMATE, not an exact value (we assume even distribution within class)

## Phase 3: Practice and Application (15 minutes)

### Worked Example 3.1.52 (Race Times)

Problem: The data below represents the times (in seconds) recorded in the heats of a 100 m race. The data has been grouped into intervals of width 0.5 seconds. Estimate the median time based on the frequency table below.

Class Interval	Frequency
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11.5 - 11.9	2
12.0 - 12.4	4
12.5 - 12.9	5
13.0 - 13.4	4
13.5 - 13.9	5
14.0 - 14.4	6
14.5 - 14.9	5
15.0 - 15.4	4
15.5 - 15.9	1

**Solution:**

Step 1: Add Cumulative Frequency column

Class Interval	f	CF
11.5–11.9	2	2
12.0–12.4	4	6
12.5–12.9	5	11
13.0–13.4	4	15
13.5–13.9	5	20
14.0–14.4	6	26
14.5–14.9	5	31
15.0–15.4	4	35
15.5–15.9	1	36

Step 2: Find  $n/2$

$n = 36$  (total observations),  $n/2 = 36/2 = 18$

Step 3: Identify median class

Look for first  $CF \geq 18$ . CF of 13.5–13.9 is 20 (first one  $\geq 18$ )

**Median class: 13.5–13.9**

Step 4: Identify formula values

- $L = 13.5$  (lower boundary of median class)
- $n = 36$ ,  $n/2 = 18$
- $CF = 15$  (cumulative frequency before median class)
- $F = 5$  (frequency of median class 13.5–13.9)
- $C = 0.5$  (class width)

Step 5: Apply formula

Median =  $L + ((n/2 - CF) / F) \times C$

$$\text{Median} = 13.5 + ((18 - 15) / 5) \times 0.5$$

$$\text{Median} = 13.5 + (3/5) \times 0.5$$

$$\text{Median} = 13.5 + 0.6 \times 0.5$$

$$\text{Median} = 13.5 + 0.3$$

$$\text{Median} = 13.8 \text{ seconds}$$

**Therefore, the estimated median race time is 13.8 seconds.**

#### Phase 4: Assessment (5 minutes)

##### Exit Ticket

1. A group of 40 athletes recorded their finishing times (in minutes) during a practice run at Karura Forest.

Time (min)	Frequency
120 - 129	4
130 - 139	12
140 - 149	15
150 - 159	9

Calculate the median finishing time.

2. A county hospital in Machakos surveyed the waiting time (in minutes) for 60 patients at the outpatient department.

Time (min)	No. of Patients
0 - 19	10
20 - 39	25
40 - 59	15
60 - 79	10

Estimate the median waiting time for a patient.

#### Differentiation Strategies

##### For Struggling Learners:

- Provide pre-filled CF columns to focus on formula application.
- Use smaller datasets (4-5 intervals) to build confidence.

- Provide step-by-step worksheets with spaces for each value (L, CF, F, C).
- Use visual number lines to show where median class is located.
- Work in pairs with peer support.
- Provide formula cards with clear labels for each variable.
- Practice identifying  $n/2$  and median class before applying formula.

#### For Advanced Students:

- Explore datasets with more intervals (10-12 classes).
- Compare median from grouped data vs ungrouped data to see estimation error.
- Investigate how changing class width affects the median estimate.
- Calculate mean, median, and mode for the same grouped dataset and compare.
- Research real-world applications: census data, health statistics, economic indicators.
- Create their own grouped datasets from real data and calculate median.

#### Extension Activity: Understanding the Median Formula

Scenario: Explore what each part of the median formula represents.

Use the pocket money data from the anchor activity:

Median class: 300–399 (contains the 37.5th student)

Tasks:

1. Calculate  $n/2$ . What does this number represent?
2. Find CF (cumulative frequency before median class). How many students are below the median class?
3. Calculate  $(n/2 - CF)$ . What does this tell us?
4. Find F (frequency of median class). How many students are in the median class?
5. Calculate  $(n/2 - CF) / F$ . What fraction of the median class do we need to go through?
6. Multiply by C (class width). Why do we do this final step?
7. Add to L (lower boundary). What is the final median estimate?

Expected Findings:

- $n/2 = 37.5$  represents the middle position (between 37th and 38th student)
- $CF = 23$  means 23 students are below the median class
- $(n/2 - CF) = 14.5$  means we need to go 14.5 students into the median class
- $F = 22$  means there are 22 students in the median class
- $(n/2 - CF) / F = 14.5/22 \approx 0.66$  means we go about 66% through the class
- Multiply by  $C = 100$  converts the fraction to actual Ksh value
- Add to  $L = 300$  gives starting point, final median  $\approx 366$  Ksh
- The formula systematically locates where the middle value lies within the median class