TG ACADEMIC RESOURCE SERIES

MBA QUANTITATIVE METHODS

Measures of Central Tendency
Arithmetic Mean, Median & Mode - A Worked Example

SUBJECT	Quantitative Methods / Business Statistics
LEVEL	MBA / PGDM / BBA / Undergraduate Statistics
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This sample explains how a dataset can be summarised by one representative value. It introduces the three common measures and demonstrates their calculation from a grouped frequency distribution.

A focused introduction - not a complete Business Statistics or Quantitative Methods module.

1. Learning Objectives

After studying this note, you should be able to:

- Explain the purpose of measures of central tendency.
- Distinguish arithmetic mean, median and mode.
- Calculate these measures from a grouped frequency distribution.
- Interpret the results and select a suitable measure for a business context.

2. What Is Central Tendency?

A measure of central tendency is a single value used to represent the centre or typical location of a dataset. It helps summarise a large set of observations, but it does not describe the spread or variability of the data.

3. The Three Common Measures

Arithmetic Mean

The arithmetic mean is the sum of all observations divided by the number of observations. For a frequency distribution, each value is weighted by its frequency.

Median

The median is the middle value after observations are arranged in order. It divides the ordered data into two halves. For grouped continuous data, it is estimated by interpolation within the median class.

Mode

The mode is the value that occurs most frequently. In grouped data, the class with the highest frequency is the modal class, and the mode is estimated using the frequencies of that class and its two neighbouring classes.

Choosing a measure

The mean uses all observations but can be influenced by extreme values. The median is resistant to extreme observations and is useful for skewed distributions such as income. The mode identifies the most common value or category.

4. Worked Example - Grouped Frequency Distribution

A business analyst summarises the monthly order-processing time (in minutes) for 30 transactions as follows:

Time (minutes)	Frequency (f)	Midpoint (m)	f x m	Cumulative f
0 - 10	2	5	10	2
10 - 20	5	15	75	7
20 - 30	9	25	225	16
30 - 40	8	35	280	24
40 - 50	4	45	180	28
50 - 60	2	55	110	30
Total	30	-	880	-

The class intervals are treated as continuous, non-overlapping intervals of width h = 10. The total frequency is N = 30.

5. Arithmetic Mean

For grouped data, use the class midpoint m as the representative value for each class:

$$\text{Mean} = \text{Sum}(f \times m) / \text{Sum}(f)$$

$$\text{Mean} = 880 / 30 = 29.333\ldots \text{ minutes}$$

The estimated arithmetic mean processing time is **29.33 minutes**.

Why use the midpoint?

The exact individual observations are not available in a grouped table. The midpoint is used as a representative value for each class, so the grouped-data mean is an estimate rather than necessarily the exact raw-data mean.

6. Median for Grouped Data

Step 1: Calculate N/2 = 30/2 = 15.
Step 2: Locate the first cumulative frequency that is at least 15. It is 16, so the median class is 20 - 30.
Step 3: Identify the values needed for the formula:

L = 20; cf = 7; f = 9; h = 10; N = 30
Median = L + [(N/2 - cf) / f] x h
Median = 20 + [(15 - 7) / 9] x 10 **= 20 + (8/9) x 10** **= 28.888... minutes**

Estimated median = **28.89 minutes**.

7. Mode for Grouped Data

The modal class is the class with the highest frequency. Here, the modal class is 20 - 30, with frequency 9.

Let f1 = 9 (modal class frequency), f0 = 5 (preceding class frequency), f2 = 8 (succeeding class frequency), L = 20 and h = 10.

Mode = L + [(f1 - f0) / (2f1 - f0 - f2)] x h
Mode = 20 + [(9 - 5) / (2 x 9 - 5 - 8)] x 10 **= 20 + (4/5) x 10** **= 28 minutes**

Estimated mode = **28 minutes**.

Grouped-data estimates

Median and mode are estimated from grouped intervals using interpolation-based formulas. Their values need not equal an actual observation in the original ungrouped dataset.

8. Compare the Results

Measure	Estimated value	What it represents
Mean	29.33 minutes	Average based on class midpoints and frequencies
Median	28.89 minutes	Estimated midpoint of the ordered observations
Mode	28.00 minutes	Estimated most frequent value around the modal class

Interpretation

The three values are close, indicating that they describe a similar central region for this example. The mean is slightly higher than the median and mode. The measures alone, however, are not sufficient to establish the full shape or variability of the distribution.

9. Business Applications

• Mean: average order value, production time or monthly sales.
• Median: typical salary, house price or customer waiting time when extreme values may distort the mean.
• Mode: most frequently purchased product size, most common complaint category or most popular service option.

10. Check Your Understanding

Q1. Find the mean, median and mode of: 4, 6, 6, 8, 11.

Q2. Which measure is usually more resistant to a very large outlier: mean or median?

Q3. In a grouped distribution, how is the median class identified?

Q4. What is the modal class?

Suggested Answers

A1. Mean = 35/5 = 7; median = 6; mode = 6.
A2. Median.
A3. It is the class containing the N/2-th observation, identified using cumulative frequency.
A4. The class with the highest frequency.

Where to Go Next

A complete Quantitative Methods module can continue with measures of dispersion, quartiles and percentiles, skewness, correlation, regression, probability and index numbers. Each requires its own concepts, formulas and worked problems.

In guided classes: students can practise selecting the appropriate measure, solving grouped and ungrouped numerical problems, interpreting results and explaining their business implications.

About this resource
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