ExamPath

CLASS 9 MATHEMATICS · FBISE · UNIT 11 NOTES

Unit 11: Basic Statistics

Short notes on mean, median and mode, weighted and grouped mean, histograms, probability and expected frequency.

Mean, median, mode | Weighted mean | Grouped data | Probability | Expected frequency

1. Three averages
2. Median step by step
3. Which average
4. Mean tricks
5. Weighted mean
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7. Grouped mode and median
8. Graphs
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1 · AVERAGES

Mean, median and mode

Mean. sum of all values ÷ number of values. For 2, 4, 6, 8, 10 the sum is 30 and n = 5, so the mean is **6**.

Median. The middle value of the data **arranged in order**. For an odd number n of values it is the $(n+1)/2$-th value, so with 5 values it is the 3rd.

Mode. The value that occurs most often. Data may have **two modes** (2, 2, 5, 5, 9) or **none** when every value occurs once.

Mean, median and mode are measures of central tendency. The range measures spread, so it is not an average.

2 · FINDING THE MEDIAN

Order first, then find the middle

Step 1. Arrange the values in order. The median is defined for ordered data, so skipping this step gives a wrong answer.

Odd number of values. Take the single middle value.

Even number of values. Take the mean of the two middle values. For 3, 8, 5, 10: ordered it is 3, 5, 8, 10, so the median is $(5+8)/2 = $ **6.5**.

For 2, 4, 6, 10 the middle values are 4 and 6, so the median is $(4+6)/2 = $ **5**.

3 · CHOOSING AN AVERAGE

Which one tells the truth?

The mean uses **every** value, so one extreme value pulls it a lot. The median is affected much less.

Marks 40, 45, 50, 55, 100: the mean is 290 ÷ 5 = 58, pulled up by 100. The median is **50**, which represents a typical student better.

Houses at about Rs 5 million and one palace at Rs 500 million: the **median** describes a typical house.

A shoe shop deciding which size to stock most should use the **mode**, because it is the most frequently sold size.

4 · WORKING WITH THE MEAN

Sum, shifts and scaling

Sum from the mean. $\text{sum} = \text{mean} \times n$. If the mean of 10 values is 35.5, the sum is 355, not 35.5 + 10.

Missing value. The mean of 8 values is 25, so the total is 200. Seven values add to 162, so the eighth is **38**.

Add 5 to every value: the mean and the median both go up by 5. **Multiply every value by 3:** the mean becomes 3 times as large.

Add a value equal to the mean: the mean does not change. With 9 values of mean 20, adding 20 gives $(180 + 20)/10 = 20$.

5 · WEIGHTED MEAN

When values are not equally important

$$\text{Weighted mean} = \Sigma wx \div \Sigma w$$

Multiply each value x by its weight w, add, then divide by the total of the weights.

Scores 50, 70, 90 with weights 2, 3, 5: Σwx = 100 + 210 + 450 = 760 and Σw = 10, so the weighted mean is **76**.

A final exam is 70% and a quiz 30%, so use weights 70 and 30. The simple mean of the two scores would be unfair.

Combined mean. 20 students with mean 60 and 30 students with mean 70 give $(20 \times 60 + 30 \times 70)/50 = 66$, not 65.

6 · GROUPED DATA

Class marks and the mean

Class mark = (lower limit + upper limit) ÷ 2. For 20 – 30 it is 25. It represents the class because the exact values are unknown.

Class boundaries lie halfway across the gap between classes. For 30 – 39 they are 29.5 and 39.5.

$$\text{Mean} = \Sigma fx \div \Sigma f$$

Classes 10–20, 20–30, 30–40, 40–50 with frequencies 4, 6, 8, 2. Class marks: 15, 25, 35, 45. Σfx = 60 + 150 + 280 + 90 = 580 and Σf = 20, so the mean is **29**.

Values 2, 4, 6 with frequencies 3, 5, 2: Σfx = 6 + 20 + 12 = 38 and Σf = 10, so the mean is **3.8**.

7 · GROUPED MODE AND MEDIAN

Mode and median formulas

Mode = $l + (f_m - f_1)/(2f_m - f_1 - f_2) \times h$, where f_m is the modal class frequency, f_1 the frequency before it and f_2 the frequency after it.

Same classes as before: the modal class is 30–40 with l = 30, h = 10, f_m = 8, f_1 = 6, f_2 = 2. Mode = $30 + (8 - 6)/(16 - 6 - 2) \times 10 =$ **32.5**.

Median = $l + h/f \times (n/2 - C)$, where l is the lower boundary of the median class, h its size, f its frequency, $n = \Sigma f$ and C the cumulative frequency before the median class.

The median class is the class that contains the $n/2$-th value.

8 · GRAPHS

Histogram and frequency polygon

A **histogram** is a chart of adjacent rectangular bars, one for each class interval. The bars touch because the class boundaries join one class to the next.

A **frequency polygon** plots **class marks** on the x-axis and frequencies on the y-axis, then joins the points.

Do not plot class limits or boundaries for the polygon. The points are class marks.

9 · PROBABILITY

Always between 0 and 1

$$\mathrm{P(E)} = \text{favourable outcomes} \div \text{total outcomes}$$

Probability lies from **0 to 1**, ends included. An impossible event has probability 0 and a certain event has probability 1. So 1.2 or 1.5 can never be a probability.

Complement. E′ and E together make the whole sample space, so $\mathrm{P(E)} + \mathrm{P(E')} = 1$. P(E) = 0.6 and P(E′) = 0.6 cannot both be true.

A bag has 5 red, 3 green and 2 white balls. P(green) = 3/10, so P(not green) = 1 − 3/10 = **7/10**.

Letter chosen from ALLAH: L occurs 2 times among 5 letters, so P(L) = **2/5**.

10 · EXPERIMENTAL PROBABILITY

Relative and expected frequency

Relative frequency = times the event occurred ÷ total trials. It is also called experimental probability. Heads 45 times in 120 tosses gives 45/120 = **3/8**.

Expected frequency = number of trials × probability. It is a prediction, not a guarantee.

A bulb is defective with probability 0.02: in 5000 bulbs expect $5000 \times 0.02 = 100$. Rain probability 0.2 over 150 days gives **30** rainy days.

With more trials, relative frequency comes closer to the theoretical probability: 0.168 from 5000 rolls is a better estimate than 0.20 from 50.

After 7 heads in 10 tosses, the next toss is still equally likely to be heads or tails. Earlier results do not change it.

11 · COMMON MISTAKES

Five traps to avoid

Finding the median without ordering the data.

Adding instead of multiplying: sum = mean × *n*.

Wrong total in probability. With 3 red and 7 blue balls, P(red) = 3/10, not 3/7.

Using favourable ÷ total when outcomes are not equally likely. "It may rain or not" does not make P(rain) = 1/2.

Using the simple mean when weights differ.

12 · QUICK CHECK

Try these, then check your answers

Find the median of 3, 8, 5, 10.

Answer: Ordered: 3, 5, 8, 10, so (5 + 8)/2 = 6.5.

Find the class mark of 20 – 30.

Answer: (20 + 30)/2 = 25.

Find the expected number of rainy days in 150 days if P(rain) = 0.2.

Answer: 150 × 0.2 = 30.

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