# 4.1 Data summaries, histograms and interpretation

Name: _____ Class: _____ Date: _____ **Total: 13 marks**

**KEY WORDS** frequency density

## Objective

Data summaries, histograms and interpretation. Original classroom practice for IB SL; not an official IB paper.

## 1 Key knowledge and worked examples

### ■ Can one average tell the whole story?

- Two groups have the same median but different spread. One summary cannot describe both location and consistency.
- This lesson studies **frequency density** : Frequency divided by class width, used as histogram height.

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### ■ The method

- Compare an appropriate average and spread in context.
- A histogram uses area for frequency, so height=frequency/class width.
- Grouped estimates assume representative values within intervals.

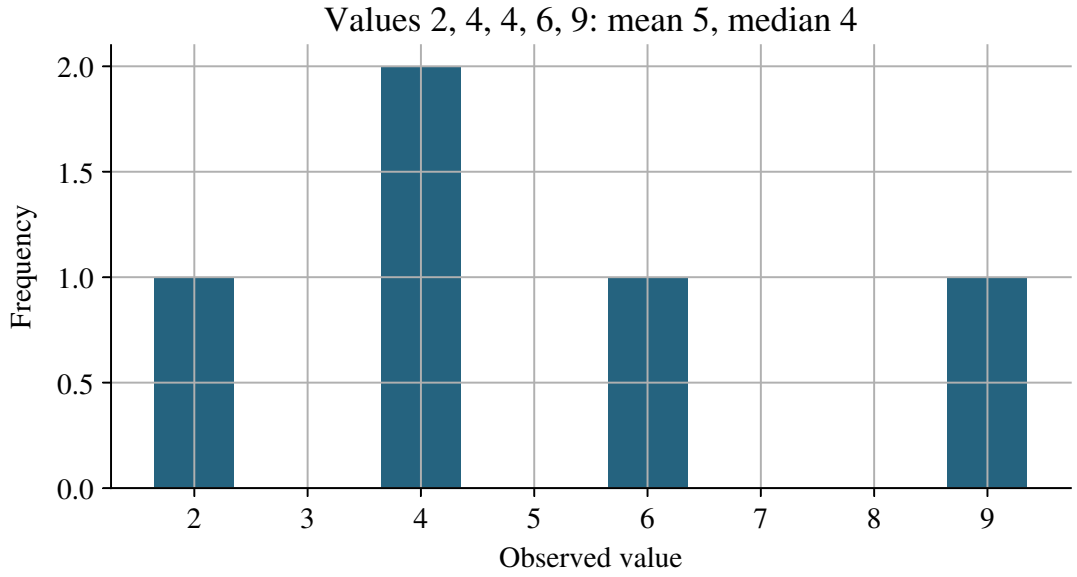
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### ■ A worked case

$$\overline{x} = \frac{\sum x_i}{n}, \qquad \text{density} = \frac{\text{frequency}}{\text{class width}}$$

**Example:**

A class from 10 to 20 with frequency 30 has density 30/10=3. A class from 20 to 40 with frequency 20 has density 20/20=1. Its wider bar must not be mistaken for a larger density. For values 2,4,4,6,9, the median is 4 and mean is 5.




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## Where it goes wrong

- The tallest histogram bar need not contain the most observations.
- A grouped mean is an estimate.
- Correlation does not prove causation, and extrapolation extends beyond the observed range.

**Not true:** A histogram bar's height always equals its frequency, even with unequal class widths. With unequal class widths the height is frequency density; frequency is the area of the bar.

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## Applying it

- Choose a display that fits the data type.
- Give both a numerical comparison and what it means for the population; do not infer more precision than the sample supports.

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## In your course

- Analysis and Approaches SL, the course first assessed in 2021.
- Paper 1 is non-calculator: keep fractions, surds and $\pi$ exact and show each step. On calculator papers, still write the expression before its value.

**Key:**

- **Frequency density**: Frequency divided by class width, used as histogram height.
- Compare an appropriate average and spread in context.
- Watch for: the tallest histogram bar need not contain the most observations.

■ **Write from a mean of 6**

- A class has frequency 24 and width 6. The data values 3, 5, 5, 8 and 9 are a separate list.
- Find the frequency density and the mean. Histogram height is density when widths differ.

## 2 Practice

**2.1** Find the density for frequency 30 and class width 10. Show the relation, substitution and units. [2]

**2.2** Find the mean of 2,4,4,6,9. Show the relation, substitution and units. [2]

**2.3** Find the median of 2,4,4,6,9. Show the relation, substitution and units. [2]

**2.4** Decide whether this claim is true and justify: Frequency density means Frequency divided by class width, used as histogram height. [2]

**2.5** In a histogram with unequal class widths, which bar contains the most observations? Choose one answer.

- **A** The one with the largest AREA, not necessarily the tallest
- **B** Always the tallest bar, because height shows how many observations it holds
- **C** Always the widest bar, because a wider class must contain more values [1]

## 3 Exam-style questions

**3.1** Classes 0–10 and 10–30 have frequencies 20 and 30. Find histogram densities and compare bar heights with frequencies; can the exact mean be recovered? [4]

## Solutions

**2.1** Density=frequency/class width=30/10=3.

**2.2** The total is 25 across five observations: mean=25/5=5.

**2.3** The sorted list is 2,4,4,6,9. Its third observation is 4.

**2.4** True. True: Frequency divided by class width, used as histogram height.

**2.5 A** Histogram area equals frequency. A wide bar of low density can hold more observations than a narrow tall bar; height alone shows density, not frequency.

**3.1** Densities 2 and 1.5, so the higher bar has fewer observations. Areas represent frequency. Only a grouped midpoint estimate, not the exact mean, follows without raw values; state the endpoint convention.