

Data & Probability

Formulas, rules and quick reference - Primary to lower secondary

A practical reference covering data collection, tables, graphs, averages, spread, probability, sample spaces and everyday data interpretation.

1. Data Vocabulary

Data	Information collected for a purpose.
Categorical data	Data grouped by categories rather than numerical measurement.
Numerical data	Data represented by numbers.
Discrete data	Countable values, often whole numbers.
Continuous data	Measurements that can take any value within a range.
Frequency	The number of times a value or category occurs.

2. Organising Data

Frequency table	A table showing values or categories and how often they occur.
Tally	A quick counting method used to record frequency.
Total frequency	The sum of all frequencies.
Grouped data	Data collected into intervals or classes.
Class interval	A range used to group numerical data.

3. Reading Data

Title	States what the data display is about.
Labels	Identify categories, values, axes or units.
Scale	Shows the value represented by divisions on an axis.
Trend	A general pattern or direction shown by data.
Outlier	A value that is unusually far from the rest of the data.

Averages & Measures of Central Tendency

Mean, median, mode and range

4. Mean

Formula	Mean = sum of all values / number of values.
Frequency data	Mean = sum of (value x frequency) / total frequency.
Missing value	If mean and number of values are known: total = mean x number of values.
Check	The mean should usually lie between the smallest and largest values.

5. Median

Definition	Median is the middle value when data are arranged in order.
Odd number	For an odd number of values, the centre value is the median.
Even number	For an even number of values, median = average of the two middle values.

6. Mode

Definition	Mode is the value or category occurring most often.
More than one	A data set may have more than one mode.
No mode	A data set may have no value occurring more often than the others.

7. Range

Formula	Range = maximum value - minimum value.
Use	Range gives a simple measure of spread.
Effect of outlier	An extreme value can make the range much larger.

Graphs & Data Displays

Choosing and interpreting common charts

8. Bar Charts

Use	Useful for comparing separate categories.
Bars	Bars are usually separated to show distinct categories.
Scale	Choose an even and clearly labelled scale.
Frequency	Bar height represents frequency or another measured quantity.

9. Line Graphs

Use	Useful for showing change over time or another continuous variable.
Axes	Label both axes and include units.
Trend	Look for increases, decreases, peaks, dips and stable periods.

10. Pie Charts

Whole	The complete circle represents 100%.
Angle	$\text{Sector angle} = \text{category frequency} / \text{total frequency} \times 360 \text{ degrees.}$
Percentage	$\text{Sector percentage} = \text{category frequency} / \text{total frequency} \times 100\%.$
Check	All sector angles should add to 360 degrees.

11. Scatter Plots

Use	Show the relationship between two numerical variables.
Positive correlation	As one variable increases, the other tends to increase.
Negative correlation	As one variable increases, the other tends to decrease.
No clear correlation	No obvious relationship is visible.
Important	Correlation does not by itself prove causation.

Probability Basics

Measuring chance from impossible to certain

12. Probability Scale

Impossible	Probability = 0.
Unlikely	Probability is greater than 0 and less than $\frac{1}{2}$ in simple comparisons.
Even chance	Probability = $\frac{1}{2}$.
Likely	Probability is greater than $\frac{1}{2}$ and less than 1.
Certain	Probability = 1.

13. Theoretical Probability

Formula	Probability of an event = favourable outcomes / total equally likely outcomes.
Range	Probability is between 0 and 1 inclusive.
Fraction form	Probability may be written as a fraction.
Decimal form	Probability may be written as a decimal.
Percentage form	Probability may be written as a percentage.

14. Complementary Events

Formula	Probability of not A = $1 - \text{probability of A}$.
Total	An event and its complement together have probability 1.
Example structure	If $P(A) = 0.3$, then $P(\text{not A}) = 0.7$.

15. Experimental Probability

Formula	Experimental probability = number of times event occurs / number of trials.
More trials	With more trials, experimental probability may become closer to theoretical probability.
Variation	Results can vary from experiment to experiment.

Combined Events & Sample Spaces

Rules for more advanced probability questions

16. Sample Space

Definition	A sample space lists all possible outcomes of an experiment.
Simple events	Each outcome can be considered an event.
Equally likely	If outcomes are equally likely, count favourable outcomes and divide by total outcomes.

17. Mutually Exclusive Events

Meaning	Two events are mutually exclusive if they cannot happen at the same time.
Addition rule	For mutually exclusive A and B: $P(A \text{ or } B) = P(A) + P(B)$.
Check	Their combined probability cannot exceed 1.

18. Independent Events

Meaning	The outcome of one event does not affect the probability of the other.
Multiplication rule	For independent A and B: $P(A \text{ and } B) = P(A) \times P(B)$.
Repeated trials	Use the multiplication rule when the required events are independent.

19. Probability Trees

Branches	Each branch represents a possible outcome.
Path probability	Multiply probabilities along a path.
Combined event	Add probabilities of separate paths that represent the required event.
Check	Probabilities at branches from the same starting point should add to 1.

Data Interpretation & Percentage Links

Using data to compare, describe and communicate results

20. Percentage of a Group

Formula	Percentage = subgroup / total group x 100%.
Frequency to percentage	Percentage = frequency / total frequency x 100%.
Check	Category percentages should total approximately 100%, allowing for rounding.

21. Comparing Data Sets

Centre	Compare mean, median or mode.
Spread	Compare range or another appropriate measure of spread.
Shape	Look at clusters, gaps, peaks and outliers.
Context	Interpret results in relation to what the data represent.

22. Estimating from Graphs

Read scale	Check the interval represented by each grid line or division.
Approximation	If exact values are not shown, estimate carefully from the scale.
Units	Include the units when reporting a measurement.

23. Everyday Data

Shopping	Compare prices, discounts and quantities.
Sports	Analyse scores, times, averages and performance.
Weather	Compare temperature and rainfall data.
School	Study marks, attendance and survey results.
Business	Use sales, costs and customer data to identify patterns.

Quick Reference & Common Mistakes

Essential formulas and checking strategies

24. Essential Formula Box

Mean	Mean = sum of values / number of values.
Frequency mean	Mean = sum of (value x frequency) / total frequency.
Range	Range = maximum - minimum.
Pie-chart angle	Angle = frequency / total x 360 degrees.
Percentage	Percentage = part / whole x 100%.
Theoretical probability	Probability = favourable outcomes / total equally likely outcomes.
Complement	$P(\text{not } A) = 1 - P(A)$.

25. Common Mistakes to Watch

Mean	Do not forget to divide by the number of values.
Median	Arrange the data before finding the middle value.
Range	Subtract the smallest value from the largest.
Pie charts	Use 360 degrees for the full circle.
Probability	A probability cannot be below 0 or above 1.
Graph scales	Read the scale carefully before interpreting a graph.
Correlation	A relationship between variables does not automatically mean one causes the other.

26. Checking Data & Probability

Totals	Check frequencies add to the stated total.
Percentages	Check percentages add to approximately 100%.
Angles	Check pie-chart sectors add to 360 degrees.
Probability	Check all probabilities lie between 0 and 1.
Reasonableness	Ask whether the conclusion is supported by the data.

Maths Connects Us All

Data helps us understand the world, while probability helps us describe uncertainty. Together they support better decisions in everyday life, science, business and society.