

3/4 GENERAL MATHEMATICS

Types of Data

Categorical Nominal - no order
Categorical Ordinal - have order
Numerical Discrete - how many?
Numerical Continuous - how much?

Data Displays

There are many forms of ways to display data. For categorical you can use...

- frequency table
- bar chart
- segmented bar chart

And for numerical data you can use...

- frequency table
- histogram
- dot plots
- stem and leaf plots

Log Scale

A **log scale** spreads out the countries with small populations and 'pulls in' the countries with huge populations.

If $\log_{10} x = 3$ then $10^3 = x$

A **logarithmic transformation** involves changing the scale on the horizontal axis from x to $\log_{10} x$, and replacing each of the data values with its logarithm.

Measures of centre and spread

Mean 'average' - sum of all data values divided by amount of values.

Median the middle value when placed in ascending order

Mode most occurring number

Range the largest number subtract the smallest number

IQR spread of middle half of data values
 Quartile 3 - quartile 1

5 number summary

The **five number summary** includes:

- minimum (smallest number)
- quartile 1 (median of lower half)
- median
- quartile 3 (median of upper half)
- maximum (largest number)

A **boxplot** displays this.

To find outliers...

UPPER FENCE: $Q3 + 1.5 \times IQR$

LOWER FENCE: $Q1 - 1.5 \times IQR$

Normal Distribution

Standard Deviation: how much members from a group differ from the mean value

Normal Distribution: data distribution with a bell shape 68-95-99.7% rule.

For a normal distribution, approximately:

- 68% of the observations lie within one standard deviation of the mean
- 95% of the observations lie within two standard deviations of the mean
- 99.7% of the observations lie within 3 standard deviations of the mean

Standard score = $\frac{\text{actual score} - \text{mean}}{\text{standard deviation}}$

Population

Population: set of all eligible members of a group which we intend to study
Sample: a subset of the population

Bivariate Data

When investigating the association between two variables the **explanatory variable (X)** is the variable we expect to explain or predict the value of the **response variable (Y)**.

Which graph to use with **Bivariate Data**
 X is categorical and Y is categorical

- segmented bar chart
- scatterplot

X is numerical and Y is categorical

- parallel box plot/chart plot
- best fit best stem plot

Scatterplot

Things to note when interpreting:

- Direction (positive/negative/none)
- Outliers
- Form (linear or non-linear)
- Strength (strong/moderate/weak)

CC & CoD

Correlation Coefficient: measures strength of linear relationship (r), value is between -1 (strong positive) and 1 (strong negative), 0 is no relation

Coefficient of determination: degree to which one variable can be predicted from another (linearly related variable, this is the squared value of r)

Causality

- Common response (sunscreen & tanning, hot weather, temperature)
- Confounding variables (ice-cream consumption & drowning)
- Causation (divorce rate & marriage consumption)

Regression Line

The **least squares line** is the line that minimises the sum of the squares of the residuals. It is given by:

$$y = a + bx$$

b (slope)

$$\frac{r \times \text{standard deviation of } y}{\text{standard deviation of } x}$$

a (y-intercept)

mean value of $y - b \times$ mean value of x
INTERPOLATION: Predicting within the range of values (reliable)

EXTRAPOLATION: Predicting outside range of values (unreliable)

RESIDUAL PLOT: residual value (actual data value - predicted data value)

Transformations



Time Series data

Patterns in this data include:

- trends (increase/decrease)
- cycles (recurring movements)
- seasonality (related to calendar)
- structural change (sudden change)
- possible outliers (stand out)
- irregular fluctuations (random)

SEASONALITY

Can help to get rid of irregularities in data seasonally:

- mean smoothing (calculator)
- median smoothing (visual)

SEASONAL INDEX

actual figure - deseasonalised figure = seasonal index

Using a **trend line** fitted to a time series plot to make predictions about future values is known as **trend line forecasting**.

Math 4 Summary Notes

Royal Society (Great Britain)



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