REVISION SHEET – STATISTICS 1 (Edx)

CORRELATION AND REGRESSION

The main ideas are:

- Scatter Diagrams and Lines of Best Fit
- Pearson's Product Moment Correlation
- The Least Squares Regression Line

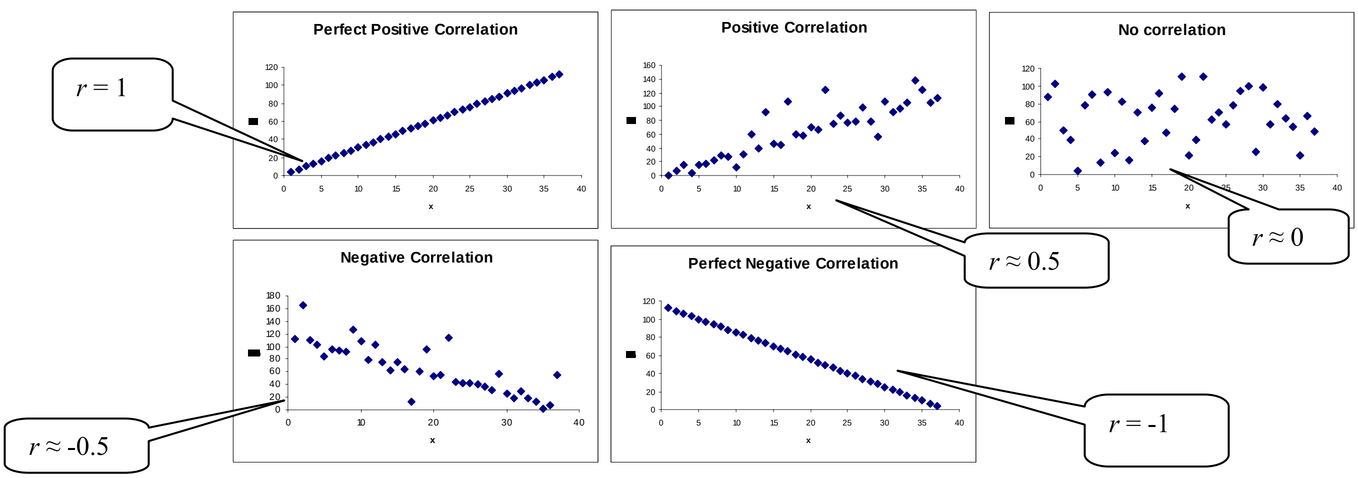
Before the exam you should know:

- Know when to use Pearson's product moment correlation coefficient
- How to use summary statistics such as $\sum x, \sum x^2, \sum y, \sum y^2, \sum xy$ to calculate S_{xx}, S_{yy}, S_{xy}.
- Know how to recognise when a 1 or 2-tail test is required.
- What is meant by a residue and the "least squares" regression line.

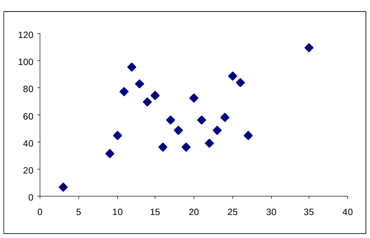
Scatter Diagrams

With Bivariate Data we are usually trying to investigate whether there is a correlation between the two underlying variable, usually called *x* and *y*.

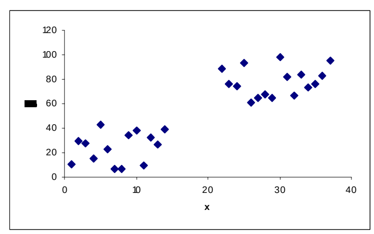
Pearson's product moment correlation coefficient, *r*, is a number between -1 and +1 which can be calculated as a measure of the correlation in a population of bivariate data.



Beware of diagrams which appear to indicate a linear correlation but in fact to not:



Here two outliers give the impression that there is a linear relationship where in fact there is no correlation.



Here there are 2 distinct groups, neither of which have a correlation.

Product Moment Correlation

Pearson's product Moment Correlation Coefficient:

$$S_{xy} = \sum (x-\bar{x})(y-\bar{y}) = \sum xy - n\bar{x}\bar{y}$$

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{\sum (x-\bar{x})^2 \sum (y-\bar{y})^2}} \quad \text{where : } S_{xx} = \sum (x-\bar{x})^2 = \sum x^2 - n\bar{x}^2$$

$$S_{yy} = \sum (y-\bar{y})^2 = \sum_{i=1}^{n} y^2 - n\bar{y}^2$$

A value of +1 means perfect positive correlation, a value close to 0 means no correlation and a value of -1 means perfect negative correlation. The closer the value of r is to +1 or -1, the stronger the correlation.

Example

A 'games' commentator wants to see if there is any correlation between ability at chess and at bridge.

A random sample of eight people, who play both chess and bridge, were chosen and their grades in chess and bridge were as follows:

Player	A	B	C	D	E	F	G	H
Chess grade x	160	187	129	162	149	151	189	158
Bridge grade y	75	100	75	85	80	70	95	80

Using a calculator:

$n = 8$, $\Sigma x = 1285$, $\Sigma y = 660$, $\Sigma x^2 = 209141$, $\Sigma y^2 = 55200$, $\Sigma xy = 107230$ $\bar{x} = 160.625$, $\bar{y} = 82.5$

$$r = \frac{107230 - 8\times 160.625\times 82.5}{\sqrt{(209141 - 8\times 160.625^2)(55200 - 8\times 82.5^2)}} = 0.850 \text{ (3 s.f.)}$$

Rank Correlation

The Least Squares Regression Line

This is a line of best fit which produces the least possible value of the sum of the squares of the residuals (the vertical distance between the point and the line of best fit).

It is given by: $y - \bar{y} = \frac{S_{xy}}{S_{xx}}(x - \bar{x})$ Alternatively, $y = a + bx$ where, $b = \frac{S_{xy}}{S_{xx}}, a = \bar{y} - b\bar{x}$

Predicted values

For any pair of values (x, y), the *predicted value* of y is given by $\hat{y}$ **= *a* + *bx*.**

If the regression line is a good fit to the data, the equation may be used to predict y values for x values within the given domain, i.e. *interpolation*.

It is unwise to use the equation for predictions if the regression line is *not* a good fit for any part of the domain (set of x values) or the x value is outside the given domain, i.e. the equation is used for *extrapolation*.

The corresponding residual $= \boldsymbol{\varepsilon} = \boldsymbol{y} - \hat{y} = \boldsymbol{y - (a + bx)}$

The sum of the residuals = $\Sigma\varepsilon = 0$

The least squares regression line minimises the sum of the squares of the residuals, $\Sigma\varepsilon^2$.

Acknowledgement: Some material on these pages was originally created by Bob Francis and we acknowledge his permission to reproduce such material in this revision sheet.

REVISION SHEET – STATISTICS 1 (Edx)

DISCRETE RANDOM VARIABLES

The main ideas are:
- Discrete random variables
- Expectation (mean) of a discrete random variable
- Variance of a discrete random variable

Before the exam you should know:

- Discrete random variables are used to create mathematical models to describe and explain data you might find in the real world.
- You must understand the notation that is used.
- You must know that a discrete random variable X takes values $r_1, r_2, r_3, r_4, \ldots, r_n$ with corresponding probabilities: $p_1, p_2, p_3, p_4, \ldots, p_n$.
- Remember that the sum of these probabilities will be 1 so $p_1 + p_2 + p_3 + p_4, \ldots + p_n = \Sigma P(X=r_k) = 1$.
- You should understand that the expectation (mean) of a discrete random variable is defined by

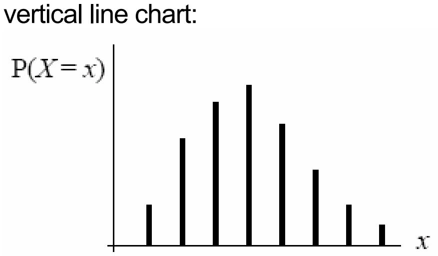
$$E(X) = \mu = \Sigma r P(X=r_k)$$

- You should understand that the variance of a discrete random variable is defined by:

$$\text{Var}(X) = \sigma^2 = E(X-\mu)^2 = \Sigma(r-\mu)^2 P(X=r)$$

$$\text{Var}(X) = \sigma^2 = E(X^2) - [E(X)]^2$$

Discrete random variables with probabilities $p_1, p_2, p_3, p_4, \ldots, p_n$ can be Illustrated using a vertical line chart:



Notation

- A discrete random variable is usually denoted by a capital letter (X, Y etc).
- Particular values of the variable are denoted by small letters (r, x etc)
- $P(X=r_1)$ means the probability that the discrete random variable X takes the value r_1
- $\Sigma P(X=r_k)$ means the sum of the probabilities for all values of r, in other words $\Sigma P(X=r_k) = 1$

Example: A child throws two fair dice and adds the numbers on the faces. Find the probability that
(i) P(X=4) (the probability that the total is 4)
(ii) P(X<7) (the probability that the total is less than 7)

Answer:

(i) $P(X=4) = \frac{3}{36} = \frac{1}{12}$ (ii) $P(X<7) = \frac{15}{36} = \frac{5}{12}$

Example: X is a discrete random variable given by $P(X = r) = \frac{k}{r}$ for $r = 1, 2, 3, 4$ Find the value of k and illustrate the distribution.

Answer:

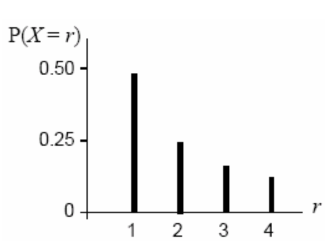
To find the value of k, use $\Sigma P(X = x_i) = 1$

$\Sigma P(X = x_i) = \frac{k}{1} + \frac{k}{2} + \frac{k}{3} + \frac{k}{4} = 1$

$\Rightarrow \frac{25}{12}k = 1$

$\Rightarrow k = \frac{12}{25} = \mathbf{0.48}$

Illustrate with a vertical line chart:



Example

Calculate the expectation and variance of the distribution

Answer:

Expectation is
$E(X) = \mu$
$= \Sigma r P(X = r) = 1\times0.48 + 2\times0.24 + 3\times0.16 + 4\times0.12$
$= \mathbf{1.92}$

$E(X^2) = \Sigma r^2 P(X = r)$
$= 1^2\times0.48 + 2^2\times0.24 + 3^2\times0.16 + 4^2\times0.12$
$= 4.5$

Variance is $\text{Var}(X) = E(X^2) - [E(X)]^2$
$= 4.5 - 1.92^2 = \mathbf{0.8136}$

Using tables:

For a small set of values it is often convenient to list the probabilities for each value in a table

r_i	r_1	r_2	r_3	….	r_{n-1}	r_n
$P(X = r_i)$	p_1	p_2	p_3	….	p_{n-1}	p_n

Using formulae:

Sometimes it is possible to define the probability function as a formula, as a function of r, $P(X = r) = f(r)$

Calculating probabilities:

Sometimes you need to be able to calculate the probability of some compound event, given the values from the table *or* function.

Explanation of probabilities:

Often you need to explain how the probability $P(X = r_k)$, for some value of k, is derived from first principles.

Example:

The discrete random variable X has the distribution shown in the table

r	0	1	2	3
$P(X = r)$	0.15	0.2	0.35	0.3

(i) Find $E(X)$.
(ii) Find $E(X^2)$.
(iii) Find Var(X) using (*a*) $E(X^2) - \mu^2$ and (*b*) $E(X - \mu)^2$.
(iv) Hence calculate the standard deviation.

r	0	1	2	3	totals
$P(X = r)$	0.15	0.2	0.35	0.3	**1**
$rP(X = r)$	0	0.2	0.7	0.9	**1.8**
$r^2P(X = r)$	0	0.2	1.4	2.7	**4.3**
$(r - \mu)^2$	3.24	0.64	0.04	1.44	**5.36**
$(r-\mu)^2P(X=r)$	0.486	0.128	0.014	0.432	**1.06**

This is the expectation (μ)

This is $E(X^2)$

This is Var(X) = $\Sigma(r-\mu)^2P(X=r)$

(i) $E(X) = \mu = \Sigma r\,P(X = r) = 0\times0.15 + 1\times0.2 + 2\times0.35 + 3\times0.3$
$= 0 + 0.2 + 0.7 + 0.9$
$= \mathbf{1.8}$

(ii) $E(X^2) = \Sigma r^2\,P(X = r) = 0^2\text{x}0.15 + 1^2\text{x}0.2 + 2^2\text{x}0.35 + 3^2\text{x}0.3$
$= 0 + 0.2 + 1.4 + 2.7$
$= \mathbf{4.3}$

Notice that the two methods give the same result since the formulae are just rearrangements of each other.

(iii) (a) $\text{Var}(X) = E(X^2) - \mu^2 = 4.3 - 1.8^2 = \mathbf{1.06}$

(b) $\text{Var}(X) = E(X - \mu)^2 = 0.15(0\text{-}1.8)^2 + 0.2(1\text{-}1.8)^2 + 0.35(2\text{-}1.8)^2 + 0.3(3\text{-}1.8)^2$
$= 0.486 + 0.128 + 0.014 + 0.432$
$\mathbf{= 1.06}$

(iv) $s = \sqrt{1.06} = 1.02956 = \mathbf{1.030}$ (3d.p.)

standard deviation (s) is the square root of the variance

REVISION SHEET – STATISTICS 1 (Edx)

EXPLORING DATA

The main ideas are:

- Types of data
- Stem and leaf
- Measures of central tendency
- Measures of spread
- Coding

Before the exam you should know:

- And be able to identify whether the data is categorical, discrete or continuous.
- How to describe the shape of a distribution, say whether it is skewed positively or negatively and be able to identify any outliers.
- And be able to draw an ordered stem and leaf and a back to back stem and leaf diagram.
- And be able to calculate and comment on the mean, mode, median and mid-range.
- And be able to calculate the range, variance and standard deviation of the data.

Types of data

Categorical data or qualitative data are data that are listed by their properties e.g. colours of cars.

Numerical or quantitative data

Discrete data are data that can only take particular numerical values. e.g. shoe sizes.

Continuous data are data that can take any value. It is often gathered by measuring e.g. length, temperature.

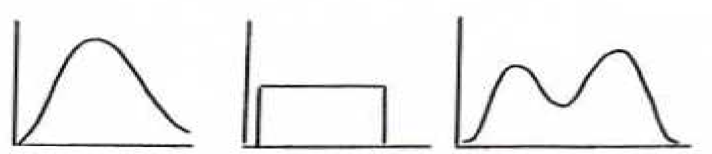
Frequency Distributions

Frequency distributions: data are presented in tables which summarise the data. This allows you to get an idea of the shape of the distribution.

Grouped discrete data can be treated as if it were continuous, e.g. distribution of marks in a test.

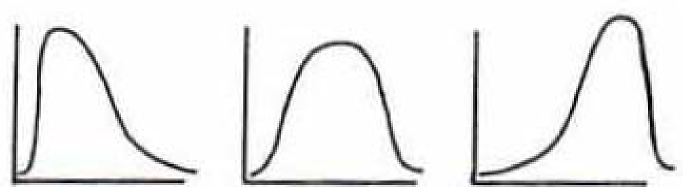
Shapes of distributions

Symmetrical (Unimodal) **Uniform** **Bimodal** *bimodal does not mean that the peaks have to be the same height*



Skew

Positive Skew **Symmetrical** **Negative Skew**



Stem and leaf diagrams

A concise way of displaying discrete or continuous data (measured to a given accuracy) whilst retaining the original information. Data usually sorted in ascending order and can be used to find the mode, median and quartiles. You are likely to be asked to comment on the shape of the distribution.

Example

Average daily temperatures in 16 cities are recorded in January and July. The results are

January: 2, 18, 3, 6, -3, 23, -5, 17, 14, 29, 28, -1, 2, -9, 28, 19

July: 21, 2, 16, 25, 5, 25, 19, 24, 28, -1, 8, -4, 18, 13, 14, 21

Draw a back to back stem and leaf diagram and comment on the shape of the distributions.

Answer

Jan		July
9 5 3 1	**-0**	1 4
6 3 2 2	**0**	2 5 8
9 8 7 4	**10**	3 4 6 8 9
9 8 8 3	**20**	1 1 4 5 5 8

The January data is uniform but the July data has a negative skew

Note. Histograms, stem and leaf diagrams and box plots will not be the direct focus of examination questions.

Central Tendency (averages)

Mean: $\bar{x} = \frac{\Sigma x}{n}$ (raw data) $\bar{x} = \frac{\Sigma xf}{\Sigma f}$ (grouped data)

Median: mid-value when the data are placed in rank order

Mode: most common item or class with the highest frequency

Mid-range: (minimum + maximum) value ÷ 2

Outliers

These are pieces of data which are at least two standard deviations from the mean

i.e. beyond $\bar{x} \pm 2s$

Dispersion (spread)

Range: maximum value – minimum value

Sum of squares:

$S_{xx} = \Sigma(x-\bar{x})^2 \equiv \Sigma x^2 - n\bar{x}^2$ (raw data)

$S_{xx} = \Sigma(x-\bar{x})^2 f \equiv \Sigma x^2 f - n\bar{x}^2$ (frequency dist.)

Mean square deviation: msd $= \frac{S_{xx}}{n}$

Root mean squared deviation: $rmsd = \sqrt{\frac{S_{xx}}{n}}$

Variance: $s^2 = \frac{S_{xx}}{n-1}$ **Standard deviation**: $s = \sqrt{\frac{S_{xx}}{n-1}}$

Example: Heights measured to nearest cm:

159, 160, 161, 166, 166, 166, 169, 173, 173, 174, 177, 177, 177, 178, 180, 181, 182, 182, 185, 196.

Modes = 166 and 177 (i.e. data set is *bimodal*), **Midrange** = (159 +196) ÷ 2 = 177.5 , **Median** = (174 + 177) ÷ 2 = 175.5

Mean: $\bar{x} = \frac{\Sigma x}{n} = \frac{3472}{20}$ = 174.1

Range = 196 – 159 = 37

Sum of squares: $S_{xx} = \Sigma x^2 - n\bar{x}^2$ = 607886 – 20 × 174.1^2 = 1669.8

Root mean square deviation: rmsd $= \sqrt{\frac{S_{xx}}{n}} = \sqrt{\frac{1669.8}{20}}$ = 9.14 (3 s.f.) **Standard deviation:** $s = \sqrt{\frac{S_{xx}}{n-1}} = \sqrt{\frac{1669.8}{19}}$ = 9.37 (3 s.f.)

Outliers (a): 174.1 ± 2 × 9.37 = 155.36 *or* 192.84 - *the value* 196 *lies beyond these limits*, *so one outlier*

Example

A survey was carried out to find how much time it took a group of pupils to complete their homework. The results are shown in the table below. Calculate an estimate for the mean and standard deviation of the data.

Time taken (hours), t	0<t≤1	1<t≤2	2<t≤3	3<t≤4	4<t≤6
Number of pupils, f	14	17	5	1	3

Answer

Time taken (hours), t	0<t≤1	1<t≤2	2<t≤3	3<t≤4	4<t≤6
Mid interval, *x*	0.5	1.5	2.5	3.5	5
Number of pupils, f	14	17	5	1	3
fx	7	25.5	12.5	3.5	15
fx^2	88.2	38.25	31.25	12.25	75

$\bar{x} = \frac{7+25.5+12.5+3.5+15}{14+17+5+1+3} = \frac{63}{40} = 1.575$

$S_{xx} = (88.2+38.25+31.25+12.25+75) - (40 \times 1.575^2) = 2.4686$

$s = \sqrt{(2.4686/39)} = 0.252$ (3dp)

Linear coding

If the data are coded as y = ax +b then the mean and standard deviation have the coding

$\bar{y} = a\bar{x} + b$ (the same coding) and $s_y = as_x$ (multiply by the multiplier of x)

Example

For two sets of data x and y it is found that they are related by the formula *y* = 5*x* – 20:

Given $\bar{x}$ = 24.8 and s_x = 7.3, find the values of $\bar{y}$ and s_y

$\bar{y}$ = (5 × 24.8) – 20 = 102

s_y = 5 × 7.3 = 36.5

REVISION SHEET – STATISTICS 1 (Edx)

NORMAL DISTRIBUTION

The main ideas are:

- Properties of the Normal Distribution
- Mean, SD and Var

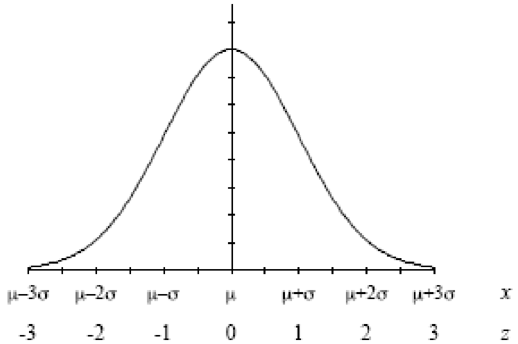
Before the exam you should know:

- All of the properties of the Normal Distribution.
- How to use the relevant tables.
- How to calculate mean, standard deviation and variance.

Definition

A continuous random variable X which is bellshaped and has mean (expectation) μ and standard deviation σ is said to follow a **Normal Distribution** with **parameters** μ and σ.

In shorthand, $\boldsymbol{X \sim N(\mu, \sigma^2)}$



This may be given in *standardised* form by using the transformation

$$z = \frac{x-\mu}{\sigma} \Rightarrow x = \sigma z + \mu \text{, where } Z \sim \mathbf{N}(0, 1)$$

Calculating Probabilities

The area to the left of the value z, representing $P(Z \le z)$, is denoted by $\Phi(z)$ and is read from tables for $z \ge 0$.

Useful techniques for $z \ge 0$:

- $P(Z > z) = 1 - P(Z \le z)$
- $P(Z > -z) = P(Z \le z)$
- $P(Z < -z) = 1 - P(Z \le z)$

The *inverse normal tables* may be used to find $z = \Phi^{-1}(p)$ for $p \ge 0.5$. For $p < 0.5$, use symmetry properties of the Normal distribution.

99.73% of values lie within 3 s.d. of the mean

Estimating μ and/or σ

Use (simultaneous) equations of the form: $x = \sigma z + \mu$ for matching (x, z) pairs – where z is given or may be deduced from $\Phi^{-1}(p)$ for given value(s) of x.

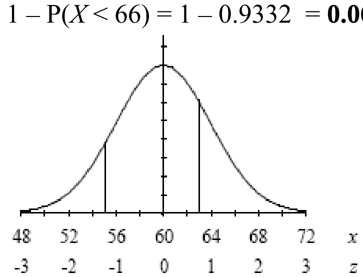
Example 1

$X \sim N(60, 16) \Rightarrow z = \frac{x-60}{4}$;

find (a) $P(X < 66)$, (b) $P(X \ge 66)$, (c) $P(55 \le X \le 63)$, (d) x_0 s.t. $P(X > x_0) = 99\%$

(a) $P(X < 66) = P(Z < 1.5) = \mathbf{0.9332}$

(b) $P(X \ge 66) = 1 - P(X < 66) = 1 - 0.9332 = \mathbf{0.0668}$



(c) $P(55 \le X \le 63) = P(-1.25 \le Z \le 0.75)$
$= P(Z \le 0.75) - P(Z < -1.25)$
$= P(Z \le 0.75) - P(Z > 1.25)$
$= P(Z \le 0.75) - [1 - P(Z \le 1.25)]$
$= 0.7734 - [1 - 0.8944] = \mathbf{0.6678}$

(d) $P(Z > -2.326) = 0.99$ from tables

Since $z = \frac{x-60}{4}$, $x = 4z + 60$

$\Rightarrow x_0 = 60 + 4\times(-2.326) = \mathbf{50.7}$ (to 3 s.f.)

Example 2

For a certain type of apple, 20% have a mass greater than 130g and 30% have a mass less than 110g.

(a) Estimate μ and σ.

(b) When 5 apples are chosen at random, find the probability that all five have a mass exceeding 115g

(a) $P(Z > 0.8416) = 0.2$ $(X = 130)$
$P(Z < -0.5244) = 0.3$ $(X = 110)$

$\Rightarrow 130 = 0.8416\,\sigma + \mu$
$110 = -0.5244\,\sigma + \mu$

Solving equations simultaneously gives: $\boldsymbol{\mu} = \mathbf{117.68}$, $\boldsymbol{\sigma} = \mathbf{14.64}$

(b) $X \sim N(117.68, 14.64^2) \Rightarrow z = \frac{x-117.68}{14.64}$;

$P(X > 115)^5 = P(Z > -0.183)^5 = 0.5726^5 = \mathbf{0.0616}$ (to 3 s.f.)

Acknowledgement: Material on this page was originally created by Bob Francis and we acknowledge his permission to reproduce it here.

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PROBABILITY

The main ideas are:

- Measuring probability
- Estimating probability
- Expectation
- Combined probability
- Two trials
- Conditional probability

The experimental probability of an event is = $\frac{\text{number of successes}}{\text{number of trials}}$

If the experiment is repeated 100 times, then the *expectation* (expected frequency) is equal to $n \times P(A)$.

Before the exam you should know:

- The theoretical probability of an event A is given by

  $P(A) = \frac{n(A)}{n(\xi)}$ where A is the set of favourable outcomes

  and ξ is the set of all possible outcomes.
- The complement of A is written A' and is the set of possible outcomes not in set A. P(A') = 1 – P(A)
- For any two events A and B:
  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
  [or P(A or B) = P(A) + P(B) – P(A and B)]
- Tree diagrams are a useful way of illustrating probabilities for both independent and dependent events.
- Conditional Probability is the probability that event B occurs if event A has already happened. It is given by

  $P(B \mid A) = \frac{P(A \cap B)}{P(A)}$

The sample space for an experiment illustrates the set of all possible outcomes. Any event is a sub-set of the sample space. Probabilities can be calculated from first principles.

Example: If two fair dice are thrown and their scores added the sample space is

+	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

If event *A* is "the total is 7" then

$P(A) = \frac{6}{36} = \frac{1}{6}$

If event *B* is "the total > 8" then

$P(B) = \frac{10}{36} = \frac{5}{18}$

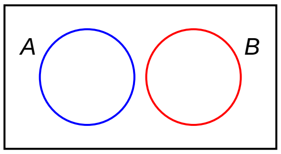
If the dice are thrown 100 times, the expectation of event B is

$100 \times P(B) = 100 \times \frac{5}{18} = 27.7778$

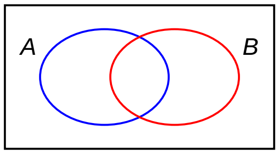
or 28 (to nearest whole number)

More than one event

Events are **mutually exclusive** if they cannot happen at the same time so P(A **and** B) = $P(A \cap B) = 0$



Addition rule for mutually exclusive events:
P(A **or** B) = $P(A \cup B) = P(A) + P(B)$



For non-mutually exclusive events
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

Example: An ordinary pack of cards is shuffled and a card chosen at random.

Event *A* (card chosen is a picture card): $P(A) = \frac{12}{52}$

Event *B* (card chosen is a 'heart'): $P(B) = \frac{13}{52}$

Find the probability that the card is a picture card **and** a heart.

$P(A \cap B) = \frac{12}{52} \times \frac{13}{52} = \frac{3}{52}$:

Find the probability that the card is a picture card **or** a heart.

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$= \frac{12}{52} + \frac{13}{52} - \frac{3}{52} = \frac{22}{52} = \frac{11}{26}$

Tree Diagrams

Remember to multiply probabilities along the branches (*and*) and add probabilities at the ends of branches (*or*)

Independent events

P(*A* and *B*) = P($A \cap B$) = P(*A*) × P(*B*)

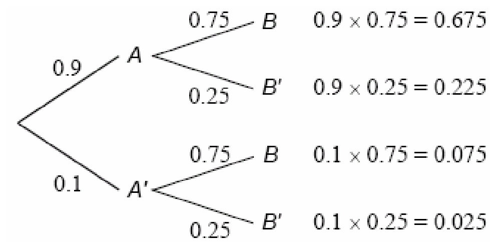
Example 1: A food manufacturer is giving away toy cars and planes in packets of cereals. The ratio of cars to planes is 9:1 and 25% of toys are red. Joe would like a car that is not red.

Construct a tree diagram and use it to calculate the probability that Joe gets what he wants.

Answer:

Event *A* (the toy is a car): P(*A*) = 0.9
Event *B* (the toy is not red): P(*B*) = 0.75

The probability of Joe getting a car that is not red is 0.675



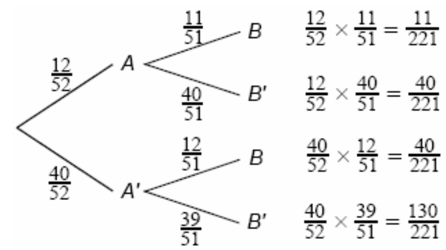
Example 2: dependent events

A pack of cards is shuffled; Liz picks two cards at random without replacement. Find the probability that both of her cards are picture cards

Answer:

Event *A* (1st card is a picture card)
Event *B* (2nd card is a picture card)

The probability of choosing two picture cards is $\frac{11}{221}$



Conditional probability

If A and B are **independent events** then the probability that event B occurs is not affected by whether or not event A has already happened. This can be seen in example 1 above. For independent events P(B/A) = P(B)

If A and B are dependent, as in example 2 above, then P(B/A) = $\frac{P(A \cap B)}{P(A)}$

so that probability of Liz picking a picture card on the second draw card given that she has already picked one picture card is given by P(B/A) = $\frac{P(A \cap B)}{P(A)} = \frac{11/221}{3/13} = \frac{11}{51}$

The multiplication law for dependent probabilities may be rearranged to give P(*A* and *B*) = P($A \cap B$) = P(*A*) × P(*B*|*A*)

Example: A survey in a particular town shows that 35% of the houses are detached, 45% are semi-detached and 20% are terraced. 30% of the detached and semi-detached properties are rented, whilst 45% of the terraced houses are rented. A property is chosen at random.

(i) Find the probability that the property is rented

(ii) Given that the property is rented, calculate the probability that it is a terraced house.

Answer

Let A be the event (the property is rented)
Let B be the event (the property is terraced)

(i) P(rented) = (0.35 X 0.3) + (0.45 X 0.3) + (0.2 X 0.45) = 0.33

The probability that a house is detached and rented | *The probability that a house is semi-detached and rented* | *The probability that a house is terraced and rented*

(ii) P(A) = 0.33 from part (i)

P(B/A) = $\frac{P(A \cap B)}{P(A)} = \frac{(0.2 \times 0.45)}{(0.33)}$ = 0.27 (2 decimal places)