GENERAL MATHEMATICS (MTG315123)

INFORMATION SHEET

Bivariate data analysis

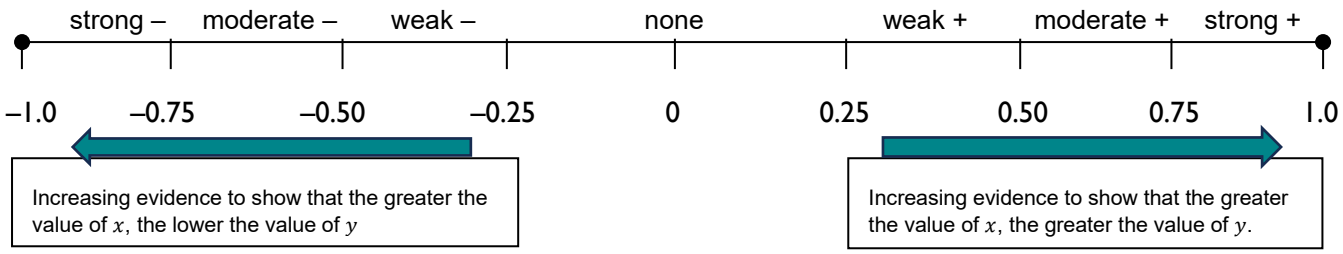
Linear Functions

$y = ax + b$ $\quad a = \frac{y_2 - y_1}{x_2 - x_1}$ $\quad y - y_1 = a(x - x_1)$

Linear Regression

$a = \frac{n\Sigma xy - \Sigma x \Sigma y}{n\Sigma x^2 - (\Sigma x)^2}$ $\quad b = \frac{\Sigma y - a\Sigma x}{n}$

Correlation coefficient (r)



Coefficient of determination (r^2) – % of the variation in 'y' that can be associated with the variation in 'x'

Residuals Residual = actual data value – modelled value

Time Series Analysis

Seasonally adjusted data

1. Find average for each cycle
2. Divide actual data by cycle averages
3. Calculate seasonal indices
4. Deseasonalise the data:

$$\text{deseasonalised data} = \frac{\text{actual data}}{\text{seasonal index}}$$

Growth and decay in sequences

Arithmetic Sequences

$a,\ a+d,\ a+2d,\ldots..,\ a+(n-1)d$ Where $t_n = a+(n-1)d$

Arithmetic Series

$a+(a+d)+(a+2d)+\ldots..+(a+(n-1)d)$ $S_n = \frac{n}{2}(a+l)$ or $S_n = \frac{n}{2}(2a+(n-1)d)$

Geometric Sequences

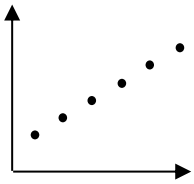
$a, ar, ar^2, \ldots\ldots, ar^{n-2}, ar^{n-1}$ Where $t_n = ar^{n-1}$

Geometric Series

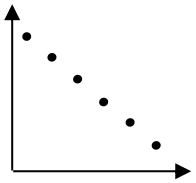
$a + ar + ar^2 + \ldots\ldots + ar^{n-1}$ $S_n = \frac{a(1-r^n)}{1-r}$ $S_\infty = \frac{a}{1-r}$

Arithmetic Sequence Graphs

Linear growth and decay



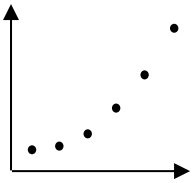
$d > 0$



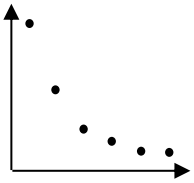
$d < 0$

Geometric Sequence Graphs

Exponential growth and decay

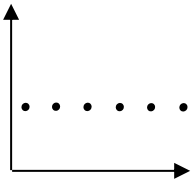


$r > 1$



$0 < r < 1$

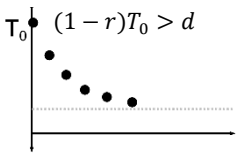
Steady State



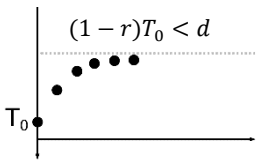
$r = 1$ & $d = 0$

First order difference (recurrence) equations

$t_{n+1} = rt_n + d,$ where t_1 or t_0 is given or $t_{n+1} = at_n + b$



Asymptote for both at $\frac{d}{1-r}$



Finance

Compound interest: $FV = PV(1+i)^n$

Straight line depreciation: $V = -Dn + C$

Reducing value depreciation: $V = C(1-i)^n$

Effective interest: $E = (1+i)^n - 1$

Annuities in advance/Sinking funds: $F = \frac{R(1+i)[(1+i)^n - 1]}{i}$ OR $t_{n+1} = r(t_n + d) \quad t_0 = 0$

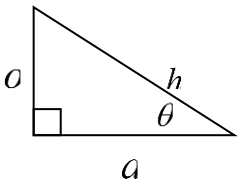
Present value of an annuity: $PV = \frac{FV}{(1+i)^n}$

Annuities in arrears/Reducible balance: $P = \frac{R[1-(1+i)^{-n}]}{i}$ OR $t_{n+1} = rt_n - d \quad t_0 = a$

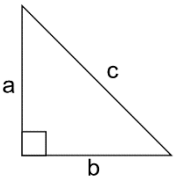
Perpetuities: $P = \frac{R}{i}$

Trigonometry

Right-Angle Trigonometry



$$\sin\theta = \frac{o}{h} \quad \cos\theta = \frac{a}{h} \quad \tan\theta = \frac{o}{a}$$



Pythagoras theorem

$a^2 + b^2 = c^2$

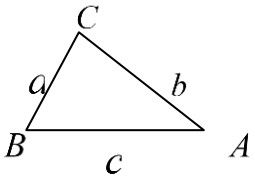
Non-Right-Angle Trigonometry

Sine Rule

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Cosine Rule

$$a^2 = b^2 + c^2 - 2bc\cos A \quad \cos A = \frac{b^2 + c^2 - a^2}{2bc}$$



Area of a triangle

Area $= \frac{1}{2}ab\sin C$

Area $= \sqrt{s(s-a)(s-b)(s-c)}$,

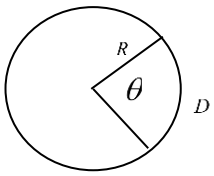
where $s = \frac{a+b+c}{2}$

Bearings - 'true' $215°\text{T}$ or 'reduced' $\text{S}35°\text{W}$

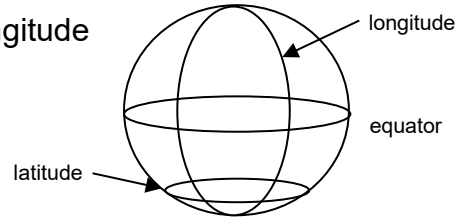
Earth Geometry

Radius of the Earth = 6 371 km

Arc length



Latitude & Longitude



kilometres

Great circle $D = \frac{2\pi R\theta}{360}$

Small circle $D = \frac{2\pi R\theta\cos\alpha}{360}$ where α = latitude

Angular Separation on Great Circles

$$\cos\theta = \sin(\text{latP}).\sin(\text{latQ}) + \cos(\text{latP}).\cos(\text{latQ}).\cos(\text{longitudinal difference})$$

Standard Time Zones

$$= \text{UTC} \pm \frac{\text{longitude °E / °W}}{15} \text{ hours}$$ (round to nearest hour)

Australian Time Zones

WST = UTC + 8 hours (Western Standard Time)

CST = UTC + 9.5 hours (Central Standard Time)

EST = UTC + 10 hours (Eastern Standard Time)

Estimated Time of Arrival (ETA)

ETA = depart time + travel time ± standard time difference $\text{speed} = \frac{\text{distance}}{\text{time}}$ v

Graphs & Networks

Euler's formula

$V + F - E = 2$

Critical path analysis

Critical path: longest path from start to finish

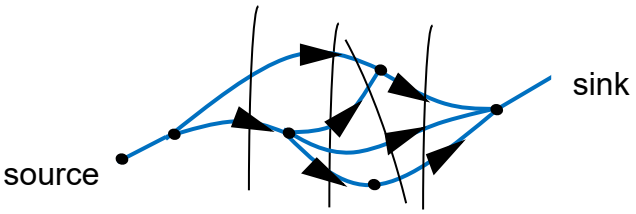
Float time = time available – activity duration

= (LFT – activity duration) – EST

= LST – EST

Network Flow

'minimum cut' = 'maximum flow'



Hungarian Algorithm

1. Row reduction
2. Column reduction
3. Hungarian algorithm
   - Select smallest uncovered number.
   - Add that number to numbers that are crossed twice.
   - Subtract that number from any uncovered number.
4. Assignment.