GENERAL MATHEMATICS

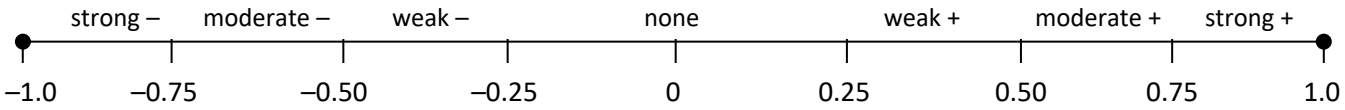
COURSE CODE: MTG315120

BIVARIATE DATA ANALYSIS

Linear Functions

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

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:

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

OFFICE OF TASMANIAN ASSESSMENT, STANDARDS & CERTIFICATION

GROWTH & DECAY IN SEQUENCES

Arithmetic Sequences

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

Arithmetic Series

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

Geometric Sequences

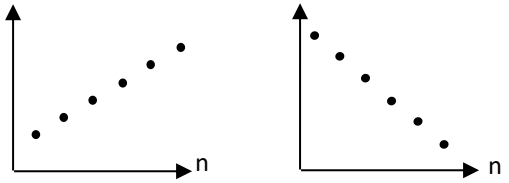
$a,\ ar,\ ar^2,.....,ar^{n-2},ar^{n-1}$ Where $t_n = ar^{n-1}$

Geometric Series

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

Arithmetic Sequence Graphs

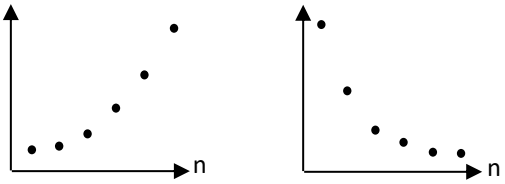
Linear growth and decay



$d>0$ $d<0$

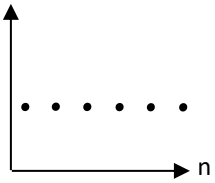
Geometric Sequence Graphs

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 $t_{n+1} = at_n + b$

Annuities in arrears: $t_{n+1} = rt_n - d \quad t_0 = a$ Annuities in advance: $t_{n+1} = r(t_n + d) \quad t_0 = 0$

FINANCE

Simple interest: $I = PRT$

Compound interest $A = P(1+i)^n$

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

Reducing Balance depreciation: $A = P(1-i)^n$

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

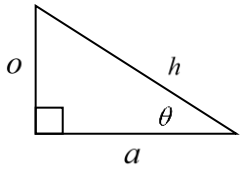
Annuities in advance/Sinking funds: $F = \frac{R(1+i)[(1+i)^n - 1]}{i}$ OR $t_{n+1} = r(t_n + d) \quad t_0 = 0$

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



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

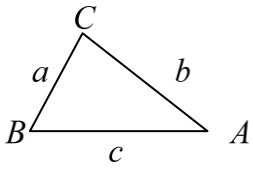
Non-Right-Angle Trigonometry

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

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

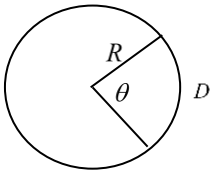
$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}, \text{ where } s = \frac{a+b+c}{2}$$

Bearings -'true' 215°T or 'reduced' S35°W

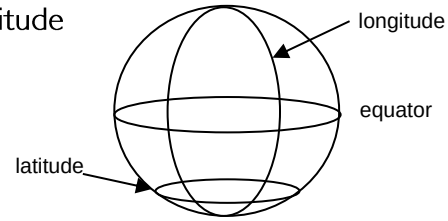
Earth Geometry

Radius of the Earth = 6 371 km

Arc length



Latitude & Longitude



	kilometres	nautical miles (n miles)	
Great circle	$D = \frac{2\pi R\theta}{360}$	$D = 60\theta$	
Small circle	$D = \frac{2\pi R\theta\cos\alpha}{360}$	$D = 60\theta\cos\alpha$	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

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

GRAPHS & NETWORKS

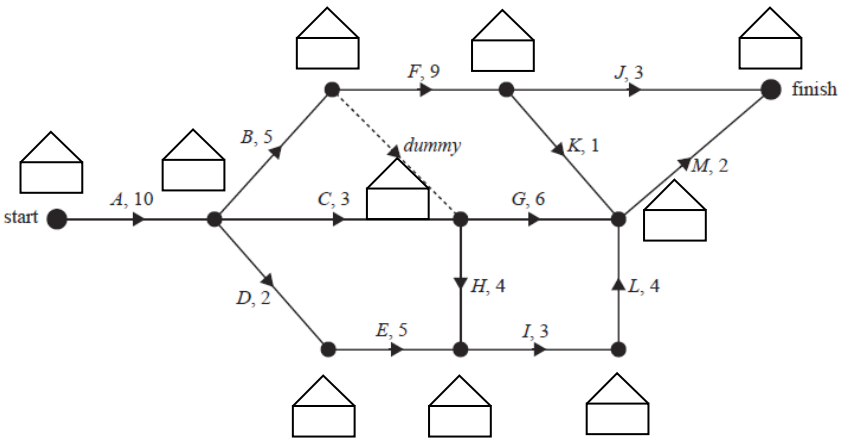
Euler's formula

$V + F - E = 2$

Critical path analysis

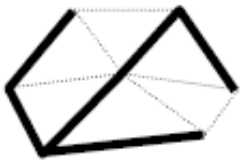
Critical path: longest path from start to finish
Earliest start time (EST)
Latest finish time (LFT)
Latest start time (LST): = LFT – activity duration

Float time = time available – activity duration
= (LFT – activity duration) – EST
= LST – EST



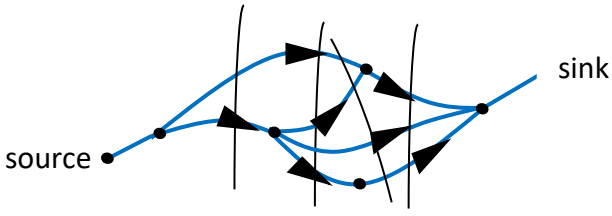
Spanning Trees

Prim's Algorithm: Start with any vertex then to shortest edge…..



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