MONASH UNIVERSITY FOUNDATION YEAR

MUF0092 MATHEMATICS UNIT 2: CALCULUS, PROBABILITY AND STATISTICS

FORMULA SHEET

CALCULUS

$\frac{d}{dx}(x^n) = nx^{n-1}$, where n is a rational number	$\int x^n \, dx = \frac{1}{n+1} x^{n+1} + c, n \neq -1$, where n is a rational number
$\frac{d}{dx}(e^{ax}) = ae^{ax}$	$\int e^{ax} \, dx = \frac{1}{a} e^{ax} + c$
$\frac{d}{dx}(\log_e x) = \frac{1}{x}$, where $x > 0$	$\int \frac{1}{x} dx = \log_e \lvert x \rvert + c$, where $x \neq 0$
$\frac{d}{dx}(\sin ax) = a \cos ax$	$\int \sin ax \, dx = -\frac{1}{a} \cos ax + c$
$\frac{d}{dx}(\cos ax) = -a \sin ax$	$\int \cos ax \, dx = \frac{1}{a} \sin ax + c$
$\frac{d}{dx}(\tan ax) = \frac{a}{\cos^2 ax} = a \sec^2 ax$	Average Value of $f(x) = \frac{1}{b-a} \int_a^b f(x) dx$

PROBABILITY AND PROBABILITY DISTRIBUTIONS

$\Pr(A \cup B) = \Pr(A) + \Pr(B) - \Pr(A \cap B)$	${}^nP_r = \frac{n!}{(n-r)!}$
$\Pr(A \mid B) = \frac{Pr(A \cap B)}{Pr(B)}$	${}^nC_r = \frac{n!}{(n-r)!\,r!}$

PROBABILITY DISTRIBUTIONS FOR DISCRETE RANDOM VARIABLE X

$E(X) = \sum x \cdot p(x) = \sum x \cdot \Pr(X = x)$	$E(aX + b) = aE(X) + b$
$\mathrm{Var}(X) = \sum(x-\mu)^2 p(x) = \sum(x-\mu)^2 Pr(X = x) = E(X^2) - [E(X)]^2$	
$\mathrm{Var}(aX + b) = a^2 \mathrm{Var}(X)$	$\mathrm{SD}(X) = \sqrt{\mathrm{Var}(X)}$

BINOMIAL DISTRIBUTION FOR DISCRETE RANDOM VARIABLE X

$Pr(X = x) = {}^nC_x p^x (1-p)^{n-x}$	$E(X) = np$
$Var(X) = np(1-p)$	

CONTINUOUS PROBABILITY DISTRIBUTION

$Pr(a < X < b) = \int_a^b f(x)dx$	$Var(X) = \int_{-\infty}^{\infty} (x-\mu)^2 f(x)dx$
$\mu = \int_{-\infty}^{\infty} xf(x)dx$	

NORMAL DISTRIBUTION

$z = \frac{x-\mu}{\sigma}$

STATISTICS

Mean	$\bar{x} = \frac{\sum x}{n}$		
Interval for identifying outliers	$[Q_1 - 1.5 \times IQR, Q_3 + 1.5 \times IQR]$		
Population standard deviation	$\sigma_x = \sqrt{\frac{\sum(x-\bar{x})^2}{n}}$		
Sample standard deviation	$s_x = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$		
Coefficient of determination	r^2	Pearson's correlation coefficient	$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{(n-1)s_x s_y}$
Least-squares regression line	If $y = ax + b$ then, $a = r\frac{s_y}{s_x}$ and $b = \overline{y} - a\overline{x}$		
Residual = observed value - predicted value			