

**SECTION A [30 MARKS]**  
**ANSWER ALL QUESTIONS**

**Question 1**

[30]

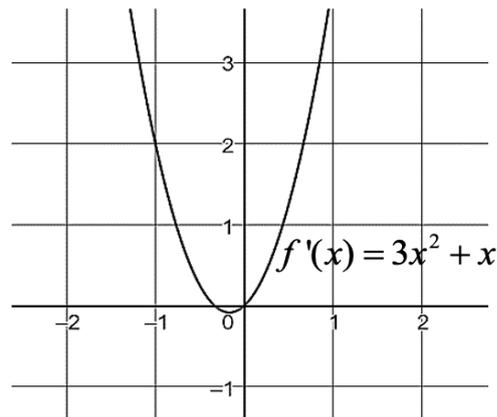
For each question, there are four alternatives: A, B, C and D. Choose the correct alternative and circle it. Do not circle more than ONE alternative. If there are more than ONE choices circled, NO score will be awarded.

i) The insurance scheme where a certain amount is paid until a child completes class XII is

- A Annuity contingent.
- B Annuity perpetual.
- C Annuity deferred.
- D Annuity certain.

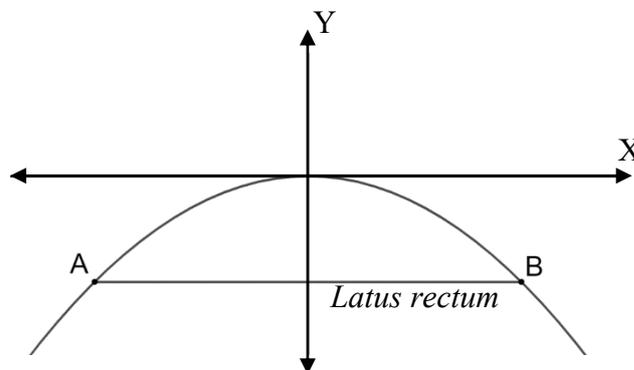
ii) The derivative of a function is shown in the figure. Find its function.

- A  $f(x) = 6x + 1 + c$
- B  $f(x) = x^3 + x^2 + c$
- C  $f(x) = 3x^3 + x^2 + c$
- D  $f(x) = x^3 + \frac{x^2}{2} + c$



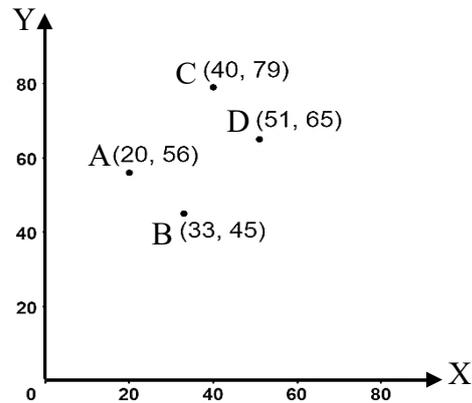
iii) The equation of the conic section given in the figure is  $-x^2 = 2y$ . Calculate the length AB.

- A 2 units
- B 4 units
- C 6 units
- D 8 units



- iv) The graph depicts the comparison of the Internal Energy Sale in million Ngultrums of Kurichhu Hydro Project and Tala Hydro Project for the year 2012 to 2015. Compute the correlation between the two hydro projects.

- A      -0.46  
 B      -0.04  
 C      0.46  
 D      0.48

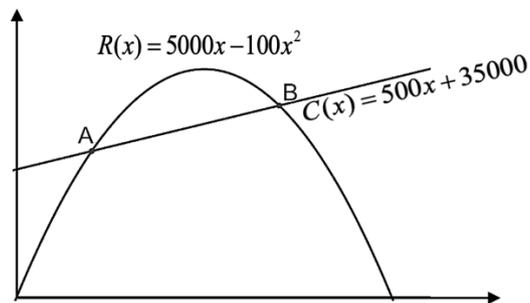


- v) If the co-factor  $(a_{32})$  of the matrix  $\begin{bmatrix} x & 0 & 2 \\ 3 & -5 & 4 \\ 1 & 5 & 1 \end{bmatrix}$  is 10, evaluate the value of  $x$ .

- A      -4  
 B      -1  
 C      1  
 D      4

- vi) The total cost and the total revenue graphs are given in the figure. From the figure, find the points A and B.

- A       $x = -10, x = -35$   
 B       $x = -10, x = 35$   
 C       $x = 10, x = 35$   
 D       $x = 10, x = -35$

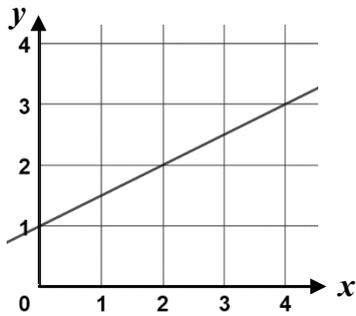


- vii) If a line has the direction angles  $\beta = 60^\circ$  and  $\gamma = 30^\circ$ , find the angle  $\alpha$ .
- A       $30^\circ$   
 B       $45^\circ$   
 C       $60^\circ$   
 D       $90^\circ$

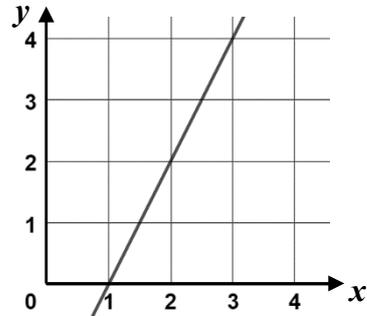
viii) The table given shows the sales of two different types of commodities.

$x$	2	3	4	5
$y$	2	4	6	8

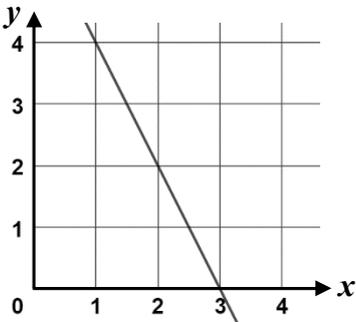
Which of the following graphs represents the regression line of ' $x$  on  $y$ ' for the above data?



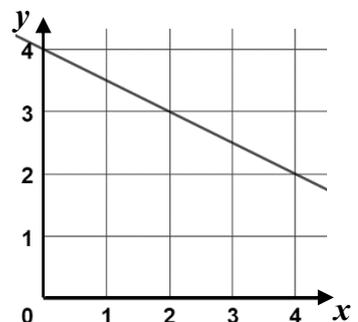
I



II



III



IV

- A I
- B II
- C III
- D IV

ix) A calculator is marked at Nu 1,250 with successive discounts of 20% and 10%. An additional discount of 5% is allowed during the payment. Find the selling price of the calculator.

- A Nu 855
- B Nu 831
- C Nu 812
- D Nu 790

x) Evaluate the differential coefficient of  $y^2 = 4ax + y$  at  $a = 2$  and  $y = 1$ .

A 8

B  $\frac{1}{8}$

C  $-\frac{1}{6}$

D -6

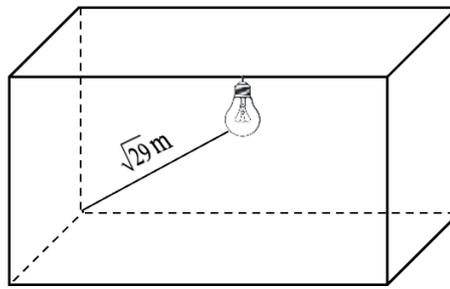
xi) The light bulb shown in the diagram is anchored 2 m away from the left wall and 3 m away from the front wall. How high is the bulb from the floor if the distance from the corner to the light bulb is  $\sqrt{29}$  m.

A 16.0 m

B 6.5 m

C 4.3 m

D 4.0 m



xii) A student takes an International English Language Testing System (IELTS) examination. He estimates his chance of passing in listening at  $\frac{4}{5}$ , writing at  $\frac{3}{4}$  and speaking at  $\frac{2}{3}$ . To qualify, he must pass in at least two areas. What is the probability that he qualifies?

A  $\frac{13}{60}$

B  $\frac{13}{30}$

C  $\frac{2}{5}$

D  $\frac{4}{5}$

xiii) Suppose you purchase a plot of land which is worth Nu 1 million, paying 50% in cash and agreeing to pay the remaining amount on instalment basis half-yearly for five years. If the land owner charges an interest rate of 10% p.a., find the amount of each instalment.

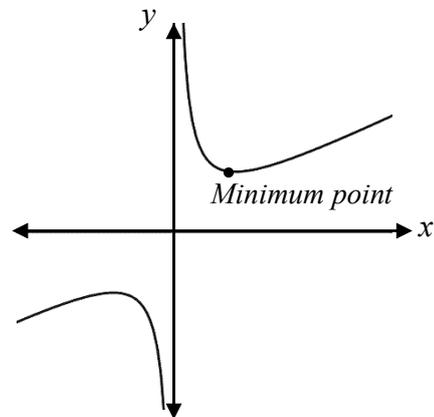
- A Nu 39,751.90
- B Nu 61,668.85
- C Nu 64,752.29
- D Nu 81,372.69

xiv) In a bookshelf, 3 books of English, 3 books of Dzongkha and 4 books of science are to be arranged in such a way that the books of the same subject are to be kept together. Find in how many ways this can be done?

- A 288
- B 864
- C 1728
- D 5184

xv) The equation of the given curve is  $y = \frac{x}{2} + \frac{2}{x}$ . Find the coordinates of the point indicated.

- A (3, 2)
- B (3, 3)
- C (2, 2)
- D (2, 3)



**SECTION B [70 MARKS]**  
**ATTEMPT ANY TEN QUESTIONS**

**Question 2**

- a) Pema bought 3 notebooks and 2 scrapbooks, and paid Nu 260. You purchased 2 notebooks and 3 scrapbooks, and paid Nu 240. Find the price of each item using Martin's rule.

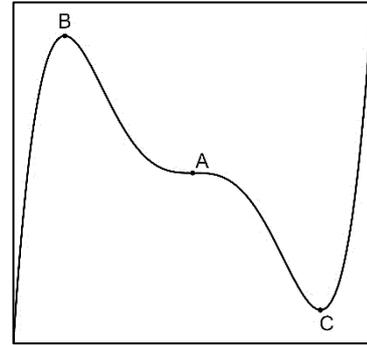
**[3]**

--	--

b) Identify and find the coordinates of the points A, B and C of the given curve

$$f(x) = \frac{1}{5}x^5 - 3x^3 + 1.$$

[4]

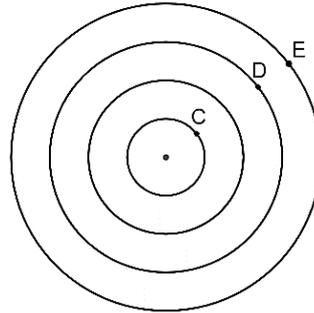


--	--

**Question 3**

- a) The points  $C(9, 8, -10)$ ,  $D(x, y, z)$  and  $E(3, 2, -4)$  are in a straight line as shown in the diagram. Find the coordinates of the point D.

[3]



--	--

- b) The table shows the marks of Continuous Assessment (CA) and Written Examination (WE) obtained by eight students.

<b>CA</b>	19	18	19	17	20	18	20	17
<b>WE</b>	70	75	68	80	70	78	69	85

[4]

Evaluate the correlation coefficient and interpret the result.

--	--

**Question 4**

a) Differentiate  $(2x+1)\sqrt{x}$  with respect to  $x$ .

**[3]**

--	--

- b) The total cost per semester to study in Norbuling Rigter College is shown below. You are planning to study in the college after class XII as a boarder by saving Nu 8,000 per month in a bank that pays an interest rate of 7.5% p.a., How many years would it take to accumulate the amount that would cover the cost for six semesters?

[4]

Fees per Semester		
Type	Facilities	Amount
<b>Boarder</b>	1. Tuition (also includes computer labs, library and other academic facilities relevant to the students with free on-campus internet connectivity) 2. Food 3. Room rentals	<b>Nu 84,734</b>
<b>Days Scholar</b>	1. Tuition (also includes computer labs, library and other academic facilities relevant to the students with free on-campus internet connectivity) 2. Food (Compulsory Lunch for day students)	<b>Nu 62,066</b>

Source: <https://nrc.bt/apply/fees/>

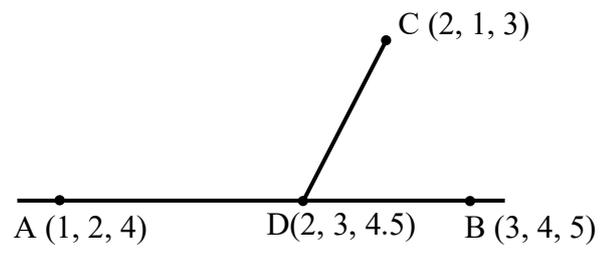
**Question 5**

- a) Two traders drew a bill amount of Nu 50,000 on 5<sup>th</sup> September, 2022 due at 6 months. The drawer discounted the bill on 17<sup>th</sup> December, 2022 at 6% p.a. from a Bill-broker. Find the amount the drawer gets from the Bill-broker. [3]

--	--

b) From the given figure, find the acute angle.

[4]



--	--

**Question 6**

a) Integrate:  $\frac{3x+5}{(3x^2+10x+2)^{2/3}}$

**[3]**

--	--

- b) The following data shows the sale of two brands of smartphones in percentage, in the United States for two years from the year 2020 to 2022.

Year	2020	2021				2022	
Brands	4 <sup>th</sup> Quarter	1 <sup>st</sup> Quarter	2 <sup>nd</sup> Quarter	3 <sup>rd</sup> Quarter	4 <sup>th</sup> Quarter	1 <sup>st</sup> Quarter	2 <sup>nd</sup> Quarter
Apple	65	55	53	47	56	50	?
Samsung	16	27	26	34	22	24	30

Use the regression analysis to predict the number of sales of apple phones in the 2<sup>nd</sup> quarter of 2022.

[4]

--	--

**Question 7**

- a) Find the coordinates of foci, vertices and eccentricity of the curve  $9x^2 - 27y^2 = -243$ . [3]

--	--

b) A group of *desuups* have set up a production plant for ground-apple juice with an initial setup cost of Nu 500,000. The additional cost for producing one litre of ground-apple juice is Nu 30, and the demand price of each litre of juice is Nu 80 in the market. During the first month, 5000 litres of juice was produced and sold.

i. Determine the cost function and the revenue function for producing and selling  $x$  units of juice. **[1]**

--	--

ii. Determine the profit function of the company. **[1]**

--	--

iii. During the first month, what profit or loss has the company incurred? [1]

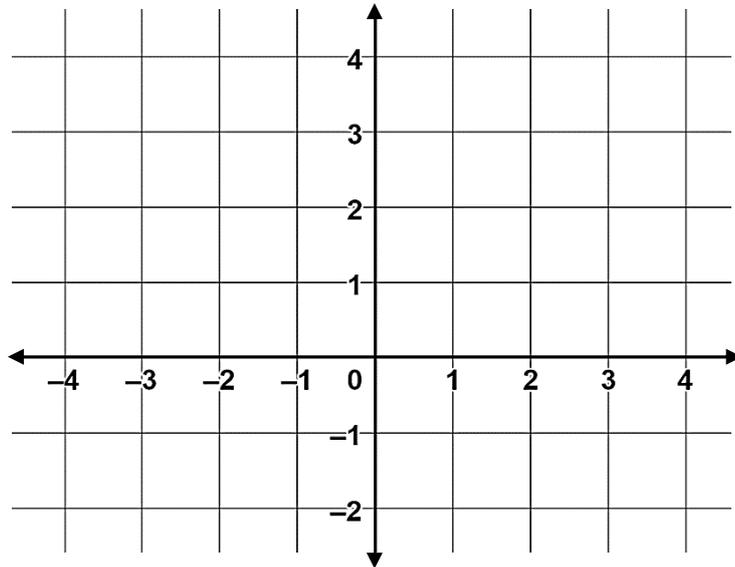
--	--

iv. If there is a loss in the first month, how many more litres of juice must be sold? [1]

--	--

**Question 8**

- a) For the equation  $y = 3x^2 + x^3$ , find the turning points and sketch the curve on the grid. [3]



--	--

b) Suppose you are asked to arrange the numbers from 1 to 9, how many numbers can be formed if:

i. all even numbers are always together?

[1]

--	--

ii. all even numbers are never together?

[1]

--	--

iii. no two even numbers are never together?

[1]

--	--

iv. numbers begin with an even and end with an even?

[1]

--	--

**Question 9**

a) Given that  $P(A) = \frac{1}{2}$ ,  $P(B) = \frac{1}{3}$ ,  $P(A \cap B) = \frac{1}{4}$ , find the value of:

i.  $P(A/B)$ . [1]

--	--

ii.  $P(B/A)$ . [1]

--	--

iii.  $P(A \cup B)$ . [1]

--	--

b) Evaluate:  $\int \frac{x^2 + x + 3}{(x-2)(x+1)} dx$

[4]

--	--

**Question 10**

- a) Naku is paying Nu 10,260 at the end of every month for a sum of loan taken from a bank. If the tenure of his loan is 5 years at 9% p.a., calculate the amount of loan he has taken from the bank.

**[3]**

--	--

b) Find  $\frac{dy}{dx}$  of the following:

i.  $\sqrt{\frac{1}{2}x^2 - 3x}$ .

[2]

--	--

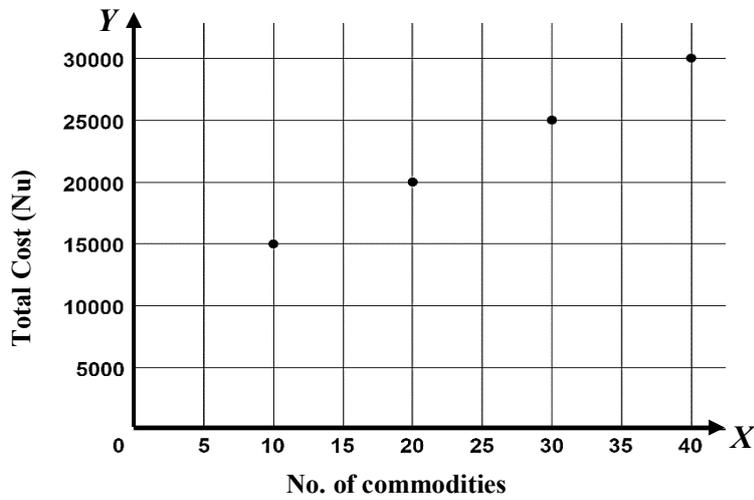
ii.  $x = t^4 - 2t$  and  $y = 4 - t^2$ .

[2]

--	--

### Question 11

- a) The following scatter plot shows the number of commodities produced and their costs incurred:



- i. Find the cost function of the commodities.

[2]

--	--

- ii. Find the marginal cost function of the commodities and interpret the result.

[2]

--	--

b) Check the given system for consistency and solve if consistent.

[4]

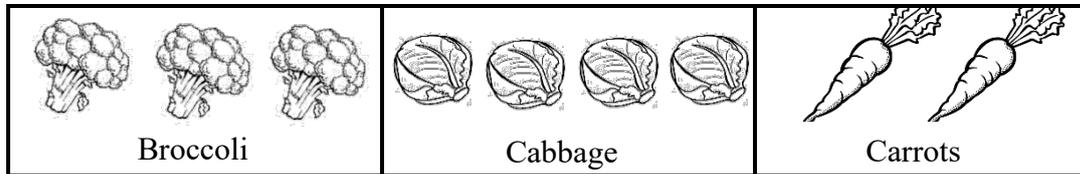
$$-2x + 3y = -7$$

$$4x - 6y = 14$$

--	--

**Question 12**

- a) Following are the types of vegetables available in a vegetable shop, and you want to buy five vegetables in total.



- i. Find the number of ways you can buy. **[1]**

--	--

- ii. Find the number of ways you can buy if you want to have minimum of two broccolis. **[1]**

--	--

- iii. Find the number of ways you can buy if you want only two cabbages. **[1]**

--	--

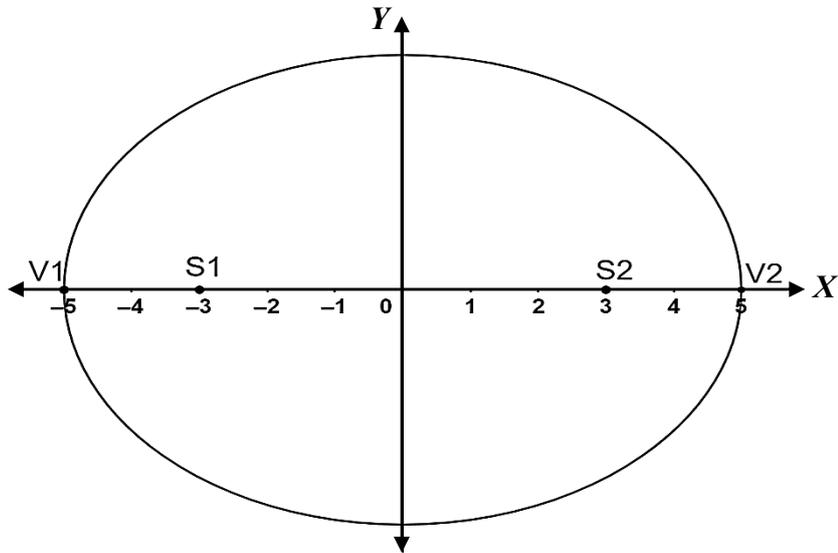
- b) The following data shows the comparison in prices of items in two different hotels. Find the Spearman's rank coefficient of correlation between the prices charged by the hotels. [4]

Items	Pork Curry	Ema Datshi	Shakam Paa	Shakam Datshi	Shamu Datshi	Sikam Paa	Chicken Curry
Hotel A	150	90	140	120	90	190	90
Hotel B	180	75	130	125	90	180	100

**Question 13**

a) Determine the equation of the conic section shown in the diagram.

[3]



--	--

b) A retailer paid Nu 50,000 for a phone. He wants to give a discount of 20% on the marked price and still wants to make a profit of 30%.

i. What price should be marked on the phone?

[2]

--	--

ii. If a customer demands a discount of 30% on the marked price, find the percent profit the retailer will get.

[2]

--	--

## FORMULAE

### Strand A: Numbers and Operations

$${}^n P_r = \frac{n!}{(n-r)!}$$

$${}^n C_r = \frac{n!}{r!(n-r)!}$$

$$C_{ij} = (-1)^{i+j} M_{ij}$$

$$AA^{-1} = A^{-1}A = I$$

$$A^{-1} = \frac{1}{\det A} \cdot \text{adj}A$$

$$A = \frac{a}{i}(1+i) \left[ (1+i)^n - 1 \right],$$

$$A = \frac{a}{i} \left[ (1+i)^n - 1 \right]$$

$$P = \frac{a}{i}(1+i) \left[ 1 - (1+i)^{-n} \right],$$

$$P = \frac{a}{i} \left[ 1 - (1+i)^{-n} \right]$$

$$\text{Present worth}(P) = \frac{A}{1+ni}$$

$$\text{True Discount}(D) = A - P = \frac{Ani}{1+ni}$$

$$\text{Banker's Discount}(B.D.) = Ani$$

$$\begin{aligned} \text{Banker's Gain}(B.G.) &= B.D. - T.D. \\ &= \frac{A(ni)^2}{1+ni} \end{aligned}$$

$$\text{D.V. of the bill} = B.V. - B.D.$$

### Strand B: Patterns and Algebra

$$a^2 - b^2 = (a+b)(a-b)$$

$$(a \pm b)^2 = a^2 \pm 2ab + b^2$$

In the quadratic equation  $ax^2 + bx + c = 0$ ,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$y = x^n, y' = nx^{n-1}$$

If  $y = u \pm v$ , then  $\frac{dy}{dx} = \frac{du}{dx} \pm \frac{dv}{dx}$

If  $y = uv$ , then  $\frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$

If  $y = \frac{u}{v}$ , then  $\frac{dy}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$

$$\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$$

$$\int x^n dx = \frac{x^{n+1}}{n+1} + c$$

$$C(x) = F + V(x), A(x) = \frac{C(x)}{x}$$

$$R(x) = p \cdot x, P(x) = R(x) - C(x)$$

$$MC = \frac{d}{dx}(C(x)), MR = \frac{d}{dx}(R(x))$$

$$C = C(x) = \int MC dx + k$$

$$R = R(x) = \int MR dx + k$$

**Strand C: Measurement  
&  
Strand D: Geometry**

$$SP = ePM$$

$$\Rightarrow \sqrt{(x-\alpha)^2 + (y-\beta)^2} = \left| \frac{ax+by+c}{\sqrt{a^2+b^2}} \right|$$

$$D = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2 + (z_2-z_1)^2}$$

$$(x, y, z) = \left( \frac{m_1x_2 + m_2x_1}{m_1 + m_2}, \frac{m_1y_2 + m_2y_1}{m_1 + m_2}, \frac{m_1z_2 + m_2z_1}{m_1 + m_2} \right)$$

$$a_1x + b_1y + c_1z = 0 \text{ and } a_2x + b_2y + c_2z = 0$$

$$\frac{x}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{z}{a_1b_2 - a_2b_1}$$

Conditions of perpendicularity and parallelism:

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}, \frac{l_1}{l_2} = \frac{m_1}{m_2} = \frac{n_1}{n_2}$$

$$a_1a_2 + b_1b_2 + c_1c_2 = 0, \quad l_1l_2 + m_1m_2 + n_1n_2 = 0$$

$$l = \frac{a}{\sqrt{a^2 + b^2 + c^2}}$$

$$m = \frac{b}{\sqrt{a^2 + b^2 + c^2}}$$

$$n = \frac{c}{\sqrt{a^2 + b^2 + c^2}}$$

Angles between two lines:

$$\cos \theta = \pm \frac{a_1a_2 + b_1b_2 + c_1c_2}{\sqrt{a_1^2 + b_1^2 + c_1^2} \sqrt{a_2^2 + b_2^2 + c_2^2}}$$

$$\cos \theta = l_1l_2 + m_1m_2 + n_1n_2$$

**Strand E: Data Management &  
Probability**

$$\bar{X} = \frac{\sum fx}{\sum f} \text{ or } \bar{X} = \frac{\sum x}{n}$$

$$r = \frac{n \sum xy - \sum x \sum y}{\sqrt{n \sum x^2 - (\sum x)^2} \sqrt{n \sum y^2 - (\sum y)^2}}$$

$$r = \frac{\sum (x-\bar{x})(y-\bar{y})}{n \sigma_x \sigma_y}$$

$$r = 1 - \frac{6 \sum D^2}{n(n^2 - 1)}$$

$$\text{Correction factor} = \frac{1}{12}(m^3 - m)$$

$$r = \pm \sqrt{b_{xy} \cdot b_{yx}}$$

$$b_{yx} = r \frac{\sigma_y}{\sigma_x} = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$$

$$b_{xy} = r \frac{\sigma_x}{\sigma_y} = \frac{n \sum xy - \sum x \sum y}{n \sum y^2 - (\sum y)^2}$$

$$y - \bar{y} = \frac{\text{cov}(x, y)}{\sigma_x^2} (x - \bar{x}) = r \frac{\sigma_y}{\sigma_x} (x - \bar{x})$$

$$x - \bar{x} = \frac{\text{cov}(x, y)}{\sigma_x^2} (y - \bar{y}) = r \frac{\sigma_x}{\sigma_y} (y - \bar{y})$$

$$b_{xy} = r \frac{\sigma_x}{\sigma_y}, \quad b_{yx} = r \frac{\sigma_y}{\sigma_x}$$

$$y - \bar{y} = b_{yx} (x - \bar{x})$$

$$x - \bar{x} = b_{xy} (y - \bar{y})$$

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

$$P(A) + P(\bar{A}) = 1$$

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

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

## **Rough Work**

## Rough Work

## **Rough Work**