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TEST PAPER – 03

(Chapters Covered – Learning Curve, Business Application of Maxima & Minima, Business Forecasting Models & Introduction to Tools for Data Analytics)

STRATEGIC COST MANAGEMENT

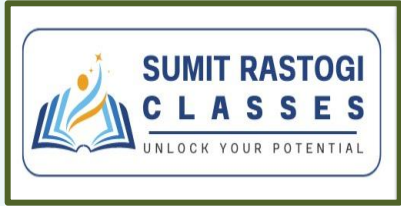
Time Allowed: 3 Hours

Full Marks: 100

**Section A contains Question Number 1. All parts of this question are compulsory.
Working notes should form part of the relevant answer.**

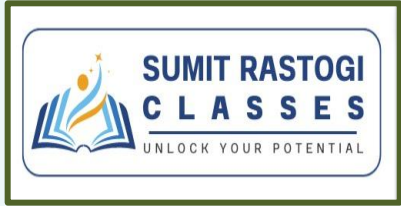
SECTION-A

- 1. Choose the correct answer from the given alternatives (you may write only the Roman number and the alphabet chosen for your answer) (2×15 = 30 Marks)**
- (i) MOB Ltd. has developed a new product and just completed the manufacture of first four units of the product. If the first unit took 4 hours to manufacture and the first 4 units together took 11.56 hours to produce, the Learning Curve (LC) rate would be:
- (a) 69.50%
 - (b) 75.00%
 - (c) 80.10%
 - (d) 85.00%
- (ii) An operation of KON Ltd. has a Learning Curve 90% and the first unit produced took 30 minutes. The labour cost is ₹120 per hour. How much should the second unit labour cost?
- (a) ₹60
 - (b) ₹54
 - (c) ₹48
 - (d) None of the above
- (iii) When 24 hours is required to produce a condenser of a particular type then the time required to produce the 16th unit with 85% Learning Curve is
- (a) Between 9 and 10 hours.
 - (b) Between 12 and 14 hours.
 - (c) Between 15 and 17 hours.
 - (d) Between 18 and 20 hours.



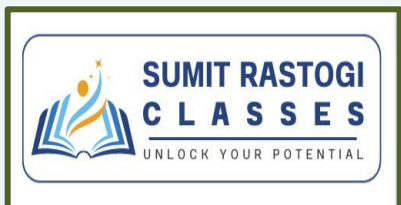
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- (iv) DOXT Ltd., a manufacturing company, is preparing a quotation for a new product-D. The time taken for the first unit is 30 hours. The company expects 85% learning curve (Index is -0.2345). The company desires that the quotation should be based on the time taken for the final output within the Learning period which is expected to end after the company has produced 200 units. What will be the time per unit of product to be used for the quotation?
[Given: $199^{-0.2345} = 0.28901$, $200^{-0.2345} = 0.28867$ and $201^{-0.2345} = 0.28834$]
- (a) 6.63 hours
(b) 10.34 hours
(c) 11.50 hours
(d) None of the above
- (v) The Cost function of TNZ PIC is given by $C = x^3 - 4x^2 + 7x$ in terms of Output x . Assess at what level of output the average cost is minimum.
- (a) 3
(b) 2
(c) 4
(d) None of the above
- (vi) In Simple Exponential Smoothing forecast to give higher weightage to recent demand information, the smoothing constant must be close to
- (a) -1
(b) 0
(c) 0.3
(d) 1
- (vii) Which of the following has no relation to Business Intelligence?
- (a) A set of business analytics solutions to retrieve, analyse and transform data into useful business sights.
(b) Visualization Tools are primarily BI Tools.
(c) ABS Glue is a tool used for the purpose of Business Intelligence.
(d) Embedded Analytics is an important part of any Business Intelligence tool.
- (viii) Which of the following is/are the financial analytics tools?
- (a) Hyper Anna
(b) Jedox
(c) NET Suite
(d) All of the above



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- (ix) Which of the following is/are not the features of Jedox tool?
- (a) Deployable in the cloud as well as on premise server or Hybrid.
 - (b) BI and Analytics platform.
 - (c) Allows users to easily create and share powerful reports within minutes.
 - (d) (b) and (c) only
- (x) Analysis of a dataset has revealed the fact that profit of a business has reduced for the financial year 2022-23. What category of data analytics it comes under?
- (a) Descriptive Analytics
 - (b) Predictive Analytics
 - (c) Diagnostic Analytics
 - (d) Prescriptive Analytics
- (xi) Which one of the following is not a Spread Sheet?
- (a) Quip
 - (b) Ms Excel
 - (c) E Views
 - (d) Google Sheets
- (xii) # Script Ends – is related to which type of Programming Language?
- (a) SPSS
 - (b) Python
 - (c) SAS
 - (d) R Programming
- (xiii) Which of the following is related to Financial Data Analytics?
- (a) Value driver analytics
 - (b) Financial ratio analytics
 - (c) Predictive sales analysis
 - (d) All of the above
- (xiv) Python can be used on Linux, Windows, Macintosh, Solaris and many more. What category of language features of Python it comes under?
- (a) Robust
 - (b) Embeddable
 - (c) High Level Language
 - (d) Platform Independent
- (xv) Which of the following is/are feature(s) of Zoho Analytics Tools?
- (a) BI and Analytics platform
 - (b) Deployable in the cloud as well as on premises server
 - (c) Both (a) and (b) of the above
 - (d) Rich Accounting Solution for small business



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SECTION-B

2. (a) The Sales of ZINC in a plant of KHT Ltd. for the years 2014 to 2022 are given below:

Year	2014	2016	2018	2020	2022
Sales of ZINC (in Million ₹)	36	42	46	54	32

Required:

- (i) Using the method of least squares, analyse a straight-line trend value.
(ii) Assess the sale (in Million ₹) of ZINC for the year 2019 and 2025. **(7 Marks)**

2. (b) On the basis of the quarterly sales (in ₹ Lakh) of commodity cumin of BOXIN Ltd., for the year 2020-2024, the following calculations were made.

Trend: $Y = 25 + 0.6t$

With Origin: 1st quarter of 2020; and Scale 1 unit of t = One quarter, where y = Quarterly sales, t = Time units.

Seasonal Variations:

Quarter	I	II	III	IV
Seasonal Index	90	95	105	110

Required:

Using the multiplicative model of the time series, estimate the sales for each of four quarters of 2024. **(7 Marks)**

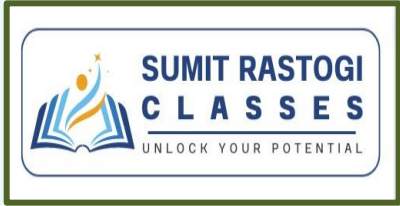
3. (a) TONIB Ltd., dealing in logistics business, has a business wing, named Ship Unloading. During the year 2023 and 2024 they have the following quarterly figures (in tonnage) of material unloading from ships:

Year	2023				2024			
Quarter	I	II	III	IV	I	II	III	IV
Material Unloading	200	188	179	195	210	225	200	202

(Use a Smoothing Co-efficient of 0.1)

Required:

If the forecast for the first quarter of 2023 is 195 tons, Assess the forecast figure for the first quarter (1) of 2025. (Using Exponential Smoothing) **(7 marks)**



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3. (b) The production of TURMERIC Powder by SONT Ltd., for the years 2022, 2023 and 2024 are given below:

Years	2022	2023	2024
Months	(Production in Thousand Tonnes)		
January	15	23	25
February	16	22	25
March	18	28	35
April	18	27	36
May	23	31	36
June	23	28	30
July	20	22	30
August	28	28	34
September	29	32	38
October	33	37	47
November	33	34	41
December	38	44	53

Required:

Assess the Seasonal Indices (monthly) for January to December by Trend Ratio Method assuming a linear trend for the data. **(7 marks)**

4. (a) The total cost function of a firm $C = (x^3/3) - 5x^2 + 28x + 10$,
 Where C is total cost and 'x' is the output. A GST @₹2 per unit of output is imposed and the producer adds it to his cost. If the demand function is given by $D = 2530 - 5x$ where ₹D is the price per unit of output.

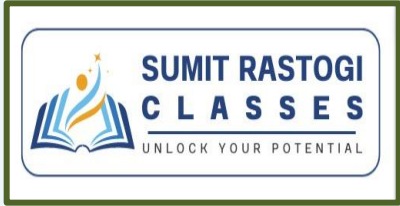
Required:

Evaluate the profit maximizing output and the price at the level. **(7 marks)**

4. (b) ZOXIN Ltd., a manufacturing company is planning to market a new model of a doll. Rather than setting the selling price of the doll based only on production cost estimation, management polls the retailers of the doll to see how many dolls they will buy for various prices. From this survey, it is determined that the unit demand function is $x = 1,500 - 75p$, and the cost function is given by $C = 4x + 1,400$, for the doll, where p is the price per unit and x is the number of units demanded.

Required:

- Evaluate how many number of dolls are sold to the retailers to maximize the profit of the company.
 - Identify the price the company should charge to retailers in order to obtain maximum profit.
 - Assess the maximum profit available to ZOXIN Ltd.
- (7 marks)**



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5. (a) ZUZOO Ltd., a Mobile manufacturer produces x sets per week at total cost of $x^2 + 78x + 300$. ZUZOO Ltd. is a monopolist and demand function for the product is $x = (600 - P)/8$ when price in rupees is P per set.

Required:

- (i) Analyze the Optimal (Profit maximizing) production per week.
- (ii) Assess the monopoly price per week.
- (iii) Assess the Total Cost and Profit at the optimal production.

(7 marks)

5. (b) ROLEX Ltd, a monopolist can effectively segment the market into two Sub-markets with the demand functions, $P_1 = 400 - 2Q_1$ and $P_2 = 300 - 2Q_2$ where $Q = Q_1 + Q_2 =$ Total production of two Sub-markets. Total Cost Function of two Sub-markets are given as $C = 3,000 + 60Q$.

Required:

If price discrimination is allowed, assess the maximum possible profit that can be earned by the Monopolist (ROLEX Ltd.) from two Sub-markets.

(7 marks)

6. (a) SUTON Ltd. (SL) a manufacturing company can sell 'X' items of a product ($X \geq 0$) at a price of $(3X^2 - 3X + 656)$ each, the total cost $C(X)$ of producing 'X' items is, $X^3 + 60X^2 + 8X$, (X being the output)

Required:

- (i) Analyze the number of items SUTON Ltd., should sell to make maximum profit.
- (ii) Analyze and assess the maximum profit SUTON Ltd., can earn from the product.

(7 Marks)

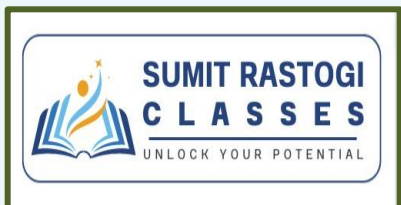
6. (b) A Company has just completed the manufacture of 40 units of a new product. The manufacturing costs (₹) are:

Direct Material	2,00,000
Direct Labour: 8000 hours at ₹20 per hour	1,60,000
Variable Overheads	80,000
Special Tools (re-usable)	10,000
Fixed Overhead apportioned	1,00,000
Total	₹5,50,000

The Company policy is to add a profit of 12% on selling price.

The Company received another order for 120 units of this product for which the company quoted, based on its policy on absorption cost basis, a price of ₹15,625 per unit. The customer struck the order to ₹11,000 per unit. The company is short of work and so is **keen** to take up more orders but it is reluctant to accept this order at the quoted price because it is against the policy to accept any price below its cost. The Company experiences a learning curve of 90%.

- (i) Compute the gain or loss arising from acceptance of the order of ₹11,000 per unit.
- (ii) Advice whether the company should accept this order for 120 units or not. **(7 marks)**



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7. (a) A Firm received an order to make and supply eight units of standard product which involves intricate labour operations. The first unit was made in 10 hours. It is understood that this type of operations is subject to 80% learning rate. The workers are getting a wages rate of ₹12 per hour.

- (i) What is the total time and labour cost required to execute the above order?
- (ii) If a repeat order of 24 units is also received from the same customer, what is the labour cost necessary for the second order? **(7 marks)**

7. (b) GANGOTRI Ltd. is developing a new product. During its expected life, 16,000 units of the product will be sold for ₹102 per unit. Production will be in batches of 1,000 units throughout the life of the product. The direct labour cost is expected to reduce due to the effects of learning for the first eight batches, produced. Thereafter, the direct labour cost will remain constant at the same cost per batch as in the 8th batch.

The direct labour cost of the first batch of 1,000 units is expected to be ₹55,000 and a 90% learning effect is expected to occur. The direct material and other non-labour related variable costs will be ₹50 per unit throughout the life of the product.

There are no fixed costs that are specific to the product.

[Given: The learning index for a 90% learning curve = - 0.152; $8^{-0.152} = 0.729$; $7^{-0.152} = 0.744$, $9^{-0.152} = 0.716$ and $4\sqrt{0.4532} = 0.8205$, $4\sqrt{0.3773} = 0.7837$, $4\sqrt{0.2636} = 0.7166$]

Required:

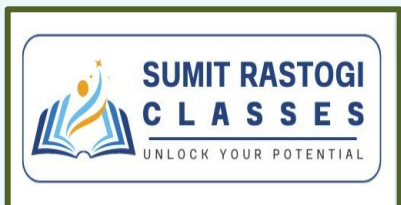
- (i) Calculate the expected direct labour cost of the 8th batch.
- (ii) Assess the expected contribution to be earned from the product over its lifetime.
- (iii) Infer the rate of learning required to achieve a lifetime product contribution of ₹6,00,000, assuming that a constant rate of learning applies throughout the product's life. **(7 marks)**

8. (a) Heavy India Shipbuilders produce a special type of boat to be used by a shipping company. A 90% Learning Curve is expected to apply to production of this type of boat. It is agreed that boats will be supplied at variable cost plus 20%. The variable cost of the first boat to be produced has been estimated as follows:

	₹
Materials	8,000
Labour (1000 hrs. @₹4 per hour)	4,000
Variable Overhead (200% of direct labour)	8,000

Order will be for a minimum of 2 boats.

- (i) Find the average selling price per boat if the order is for 4 boats and 8 boats.
- (ii) Also ascertain the separate selling price for 3rd and 4th boats. **(7 marks)**



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8. (b) Gamma Electronics which has just developed 100 units of a new type of fire alarm has been asked to quote for a prospective contract. The customer requires separate price quotations for each of the following possible orders:

Order	Number of Fire-Alarm
First	60
Second	40

The firm has incurred the following costs per unit for the first 100 units, which it has just developed:

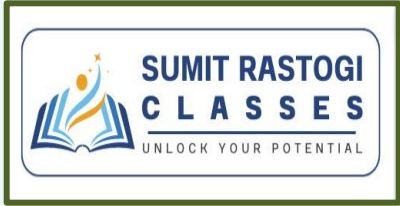
Direct Materials	₹500
Direct Labour:	
Department A (Highly automatic)	20 hours @ ₹10 per hour
Department B (Skilled Labour)	40 hours @ ₹15 per hour
Variable Overheads absorbed	20% of Direct Labour
Fixed Overheads Absorbed:	
Department A	₹8 per hour
Department B	₹5 per hour

Required:

Calculate the price per unit for each of the two orders, assuming the firm uses a markup of 25% on total costs and allows for an 80% learning curve. Extract from 80% Learning Curve table is given below:

X	1.0	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
Y (%)	100.0	91.7	89.5	87.6	86.1	84.4	83	81.5	80.0

X represents the cumulative total volume produced to date expressed as a multiple of the initial production of 100 units and Y is the Learning Curve factor for a given X Value, expressed as a % of the cost of initial 100 units. (7 marks)



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ANSWERS OF TEST PAPER – 03

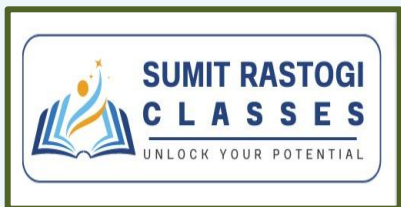
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STRATEGIC COST MANAGEMENT

SECTION-A

ANS.1

- (i) (d) 85.00%**
- (ii) (c) ₹48**
- (iii) (b) Between 12 and 14 hours**
- (iv) (a) 6.63 hours**
- (v) (b) 2**
- (vi) (d) 1**
- (vii) (c) ABS Glue is a tool used for the purpose of Business Intelligence.**
- (viii) (d) All of the above**
- (ix) (d) (b) and (c) only**
- (x) (a) Descriptive Analytics**
- (xi) (c) E Views**
- (xii) (b) Python**
- (xiii) (d) All of the above**
- (xiv) (b) Embeddable**
- (xv) (c) Both (a) & (b) of the above**



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SECTION-B

ANS. 2 (a)

(i) Calculations for fitting Straight Line Trend:

Year	Y Sales (₹ in Million)	x	x ²	xy
2014	36	-4	16	-144
2016	42	-2	4	-84
2018	46	0	0	0
2020	54	2	4	108
2022	32	4	16	128
Total	210	0	40	8

Let the best fit trend line be $y = a + bx$

Normal Equations are $\sum y = an + b\sum x$ and

$\sum xy = a\sum x + b\sum x^2$

Putting the values in Equation 1, we get,

$$210 = 5a + 0b$$

$$a = 42$$

Putting the values in Equation 2, we get,

$$8 = 0a + 40b$$

$$b = 0.2$$

So, the required straight-line trend is $y = 42 + 0.2x$

(ii) For 2019, $x = 1$ and for 2025, $x = 7$

So, Sales for 2019 = $42 + 0.2(1) = \text{₹}42.20 \text{ Million}$

For 2025 Sales = $42 + 0.2(7) = \text{₹}43.40 \text{ Million}$

ANS. 2 (b)

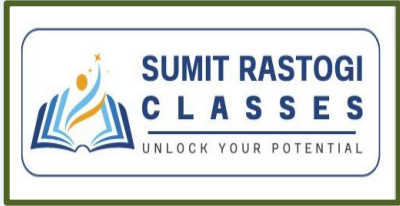
Since, in the Trend equation: $Y = 25 + 0.6t$

1st Quarter of 2020 is origin, we have $t = 0$ for 1st Quarter. Further, since time unit is one Quarter, we have $t = 1, 2$ and 3 for 2nd, 3rd, 4th Quarters respectively of the year 2020.

Hence, the value of t for 1st, 2nd, 3rd and 4th Quarters of 2024 are 16, 17, 18 and 19 respectively. The estimated quarterly Sales for the year 2024 are obtained in the following table.

Quarterly Sales for the Year 2024

2024 Quarter	t	Total Value (T)	Seasonal Effects (S) Seasonal Index $\div 100$	Expected Sales (₹ in Lakh) (T $\times$ S)
I	16	34.6	0.90	31.14
II	17	35.2	0.95	33.44
III	18	35.8	1.05	37.59
IV	19	36.4	1.10	40.04

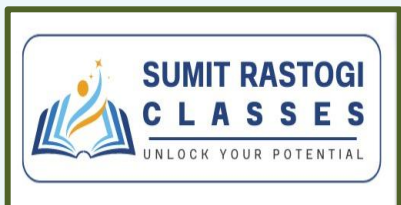


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ANS. 3 (a)

Quarters	Material (Tons) Previous Quarter (y_t)	Old Forecast (u_{t-1})	Forecast Error ($e_t = y_t - u_{t-1}$)	Correction Alpha (αe_t)	New Forecast $u_t = u_{t-1} + \alpha e_t$
2023					
II	200	195	5	0.50	195.50
III	188	195.50	-7.50	-0.75	194.75
IV	179	194.75	-15.75	-1.58	193.17
2024					
I	195	193.17	1.83	0.18	193.35
II	210	193.35	16.65	1.67	195.02
III	225	195.02	29.98	3.00	198.02
IV	200	198.02	1.98	0.20	198.22
2025					
I	202	198.22	3.78	0.38	198.60

Forecast figure for the first Quarter of 2025 will be **198.60**.

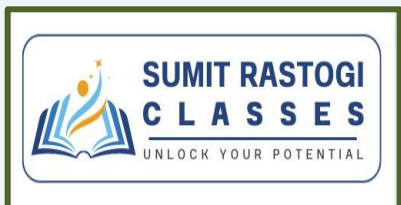


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ANS. 3 (b)

Calculation for fitting Straight Line Trend:

Year	Y production (in thousand tonnes)	t	t ²	Yt	Trend Values	Trend Ratio = Y × 100/Trend Values
2022						
January	15	1	1	15	19.2027	78.11
February	16	2	4	32	19.8197	80.73
March	18	3	9	54	20.4367	88.08
April	18	4	16	72	21.0537	85.50
May	23	5	25	115	21.6707	106.13
June	23	6	36	138	22.2877	103.20
July	20	7	49	140	22.9047	87.32
August	28	8	64	224	23.5217	119.04
September	29	9	81	261	24.1387	120.14
October	33	10	100	330	24.7557	133.30
November	33	11	121	363	25.3727	130.06
December	38	12	144	456	25.9897	146.21
2023						
January	23	13	169	299	26.6067	86.44
February	22	14	196	308	27.2237	80.81
March	28	15	225	420	27.8407	100.57
April	27	16	256	432	28.4577	94.88
May	31	17	289	527	29.0747	106.62
June	28	18	324	504	29.6917	94.30
July	22	19	361	418	30.3087	72.59
August	28	20	400	560	30.9257	90.54
September	32	21	441	672	31.5427	101.45
October	37	22	484	814	32.1597	115.05
November	34	23	529	782	32.7767	103.73
December	44	24	576	1056	33.3937	131.76
2024						
January	25	25	625	625	34.0107	73.51
February	25	26	676	650	34.6277	72.20
March	35	27	729	945	35.2447	99.31
April	36	28	784	1008	35.8617	100.39
May	36	29	841	1044	36.4787	98.69
June	30	30	900	900	37.0957	80.87
July	30	31	961	930	37.7127	79.55
August	34	32	1024	1088	38.3297	88.70
September	38	33	1089	1254	38.9467	97.57
October	47	34	1156	1598	39.5637	118.80
November	41	35	1225	1435	40.1807	102.04
December	53	36	1296	1908	40.7977	129.91
Total	1,080	666	16,206	22,377		



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Let the best fit trend line by $y = a + bt$

Normal Equations are $\sum y = an + b\sum t$

(1)

and $\sum yt = a\sum t + b\sum t^2$

(2)

Putting the values in Equation (1) we get,

$$1,080 = 36a + 666b$$

Putting the values in Equation (2) we get,

$$22,377 = 666a + 16,206b$$

Solving both the equations we get,

$$2,397 = 3885b$$

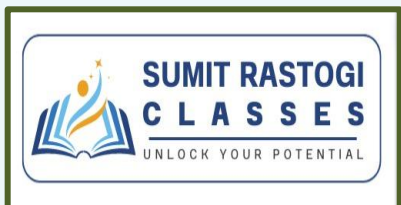
$$b = 0.6170$$

$$a = 18.5857$$

So, the required straight-line trend is $y = 18.5857 + 0.6170t$

Months	Trend Value			Average	Seasonal Indices
	2022	2023	2024		
January	78.11	86.44	73.51	79.35	79.40
February	80.73	80.81	72.20	77.91	77.95
March	88.08	100.57	99.31	95.98	96.04
April	85.50	94.88	100.39	93.59	93.64
May	106.13	106.62	98.69	103.81	103.87
June	103.20	94.30	80.87	92.79	92.84
July	87.32	72.59	79.55	79.82	79.86
August	119.04	90.54	88.70	99.43	99.48
September	120.14	101.45	97.57	106.39	106.44
October	133.30	115.05	118.80	122.38	122.44
November	130.06	103.73	102.04	111.94	112.00
December	146.21	131.76	129.91	135.96	136.03
Total				1199.36	

$$\text{Seasonal Indices} = \text{Average} \times 12 \times 100 / 1,199.36$$



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ANS. 4 (a)

$$\text{Revised } C = x^3 - 5x^2 + 28x + 10 + 2x$$

$$= x^3/3 - 5x^2 + 30x + 10$$

$$\text{Revenue} = (D)(x)$$

$$= (2,530 - 5x)(x)$$

$$= 2,530x - 5x^2$$

$$\text{Profit} = \text{Revenue} - \text{Cost}$$

$$P = (2,530x - 5x^2) - (x^3/3 - 5x^2 + 30x + 10)$$

$$= 2,530 - 5x^2 - x^3/3 + 5x^2 - 30x - 10$$

$$= 2,500x - x^3/3 - 10$$

For Profit to be maximum its 1st derivative should be zero.

$$dp/dx = 2,500 - 3x^2/3 = 0$$

$$2,500 = x^2$$

$$x = 50 \text{ units}$$

Maximum profit is at 50 units

$$\text{Price} = 2,530 - 5(50) = \text{₹}2,280$$

$$\text{Maximum Profit} = 2,500(50) - (50)^3/3 - 10$$

$$= \text{₹}83,323$$

ANS. 4 (b)

(i) **Cost** = $4x + 1,400$

Demand Function

$$x = 1,500 - 75p$$

$$75p = 1,500 - x$$

$$p = 20 - x/75$$

$$\text{Revenue} = (p)(x)$$

$$= [20 - x/75](x)$$

$$= 20x - x^2/75$$

$$\text{Profit} = \text{Revenue} - \text{Cost}$$

$$= [20x - x^2/75] - [4x + 1,400]$$

$$= 16x - x^2/75 - 1,400$$

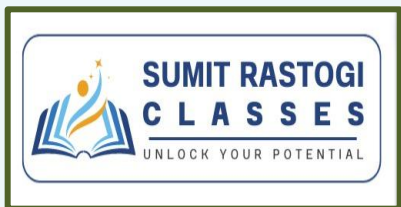
For Profit to be maximum its 1st derivative should be zero.

$$dp/dx = 16 - (2/75)x = 0$$

$$(2/75)x = 16$$

$$x = 16 \times 75/2 = 600 \text{ units}$$

Maximum profit is at 600 units.



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(ii) Price = $20 - x/75$
 $= 20 - 600/75$
 $= 20 - 8 = \text{₹}12$

(iii) Maximum Profit = $16x - x^2/75 - 1,400$
 $= 16(600) - (1/75)(600)^2 - 1,400$
 $= \text{₹}3,400$

ANS. 5 (a)

(i) Demand Function

$$x = (600 - P)/8$$
$$8x = 600 - P$$
$$P = 600 - 8x$$

Revenue = (D)(x)

$$= (600 - 8x)(x)$$
$$= 600x - 8x^2$$

Profit = Revenue - Cost

$$P = (600x - 8x^2) - (x^2 + 78x + 300)$$
$$= 600x - 8x^2 - x^2 - 78x - 300$$
$$= 522x - 9x^2 - 300$$

For Profit to be maximum its 1st derivative should be zero.

$$dp/dx = 522 - 18x = 0$$
$$18x = 522$$

$$x = 29 \text{ sets}$$

Optimal Production = 29 sets

(ii) Monopoly Price = $600 - 8x$

$$= 600 - 8(29) = \text{₹}368$$

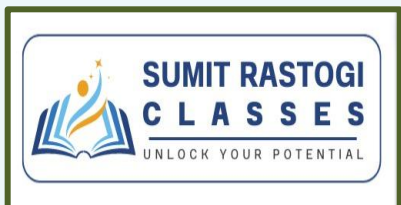
(iii) Total Cost = $x^2 + 78x + 300$

$$= (29)^2 + 78(29) + 300$$
$$= \text{₹}3,403$$

Total Revenue = $600x - 8x^2$

$$= 600(29) - 8(29)^2$$
$$= \text{₹}10,672$$

$$\text{Profit} = 10,672 - 3,403 = \text{₹}7,269$$



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ANS. 5 (b)

MC Function = 1st Derivative of Total Cost

$$dC/dQ \text{ (MC)} = 60$$

Total Revenue = Quantity $\times$ Price

$$TR_1 = Q_1 (400 - 2Q_1)$$

$$= 400Q_1 - 2Q_1^2$$

$$MR_1 = d(TR_1)/dQ_1 = 400 - 4Q_1$$

$$TR_2 = Q_2 (300 - 2Q_2)$$

$$= 300Q_2 - 2Q_2^2$$

$$MR_2 = d(TR_2)/dQ_2 = 300 - 4Q_2$$

For Maximum profit MR = MC

$$MR_1 = MC$$

$$400 - 4Q_1 = 60$$

$$4Q_1 = 340$$

$$Q_1 = 85$$

$$TR_1 = 400(85) - 2(85)^2 = ₹19,550$$

$$MR_2 = MC$$

$$300 - 4Q_2 = 60$$

$$4Q_2 = 240$$

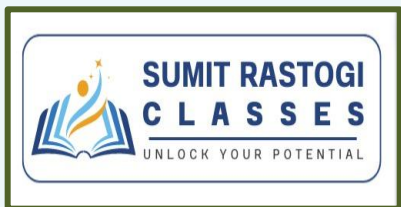
$$Q_2 = 60$$

$$TR_2 = 300(60) - 2(60)^2 = ₹10,800$$

$$\text{Total Revenue} = 19,550 + 10,880 = ₹30,350$$

$$\text{Total Cost} = 3,000 + 60(85 + 60) = ₹11,700$$

$$\text{Profit} = 30,350 - 11,700 = ₹18,650$$



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ANS. 6 (a)

(i) Total Cost $C(x) = x^3 + 60x^2 + 8x$

Total Revenue $R(x) = (3x^2 - 3x + 656)x$
 $= 3x^3 - 3x^2 + 656x$

Profit $(P) = (3x^2 - 3x^2 + 656x) - (x^3 + 60x^2 + 8x)$
 $= 3x^3 - x^3 - 3x^2 - 60x^2 + 656x - 8x$
 $= 2x^3 - 63x^2 + 648x$

For Maximization of Profit.

$dp/dx = 0$ and $d^2p/dx^2 = \text{Negative} < 0$

Derivative w.r.to x

$dp/dx = d/dx (2x^3 - 63x^2 + 648x)$

$\therefore 6x^2 - 126x + 648 = 0$

Or, $x^2 - 21x + 108 = 0$

Or, $x(x - 9) - 12(x - 9) = 0$

$(x - 12)(x - 9) = 0$

i.e. $x = 12$ or 9

Again,

$d^2p/dx^2 = 12x - 126$, at $x = 9$

$d^2p/dx^2 = 108 - 126 = -18 < 0$ (Negative)

Therefore, P is maximum at $x = 9$

at $x = 12$, $d^2p/dx^2 = 144 - 126 = 18 > 0$ (Positive)

P is minimum at $x = 12$

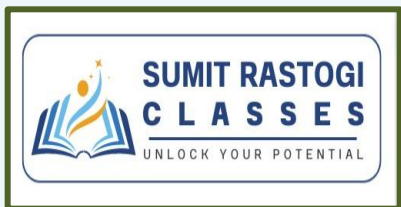
Hence, the SUTON Ltd., should sell 9 items to make Maximum Profit.

(ii) Profit $(P) = 2x^3 - 63x^2 + 648x$

$= 2(9)^3 - 63(9)^2 + 648(9)$ at $x = 9$

$= 7290 - 63 \times 81 = 2187$ (Rs.)

The maximum profit SUTON Ltd., can earn from the product is ₹2187.



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ANS. 6 (b)

Cost Sheet for order of 120 units:

Particulars	Computation	₹
Direct Material	$\text{₹}2,00,000 \div 40 = \text{₹}5,000 \times 120 \text{ units}$	6,00,000
Direct Labour	$17,920 \text{ hours} \times \text{₹}20 \text{ per hour}$	3,58,400
Variable Overheads	$17,920 \text{ hours} \times \text{₹}10 \text{ per hour}$	1,79,200
Special Tools (Re-usable)	Hence, Relevant Cost is Nil	-
Fixed Overheads	Idle Capacity Not Relevant	-
Total Cost		11,37,600
Cost/Unit	$\text{₹}11,37,600 \div 120$	9,480
Price offered		11,000
Hence, Profit per unit		1,520
Total Profit from 120 units		1,82,400

Decision: The Order should be accepted.

Working Notes:

1. Computation of selling price of First order for 40 units:

a. Total Costs (As given)	₹5,50,000
b. Number of units	40 units
c. Average cost per unit	₹13,750
d. Since profit is 12% on price, it is 12/88 on cost ($12/88 \times 13,500$)	₹1,875
e. Price quoted (Cost + Profit)	₹15,625

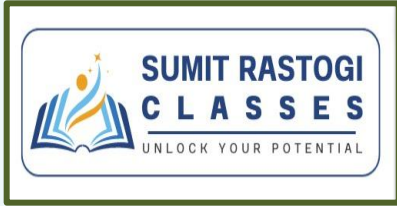
2. Computation of Time required for 120 units:

No. of Units	Time Required per Unit	Total Time Required	Cumulative Time
40	$8,000 \text{ hrs.} \div 40 \text{ units} = 200 \text{ hrs.}$	8,000 hrs. (given)	8,000 hrs.
80	$200 \times 90\% = 180 \text{ hrs.}$	80 units $\times$ 180 hrs. per unit	14,400 hrs.
160	$180 \times 90\% = 162 \text{ hrs.}$	160 units $\times$ 162 hrs. per unit	25,920 hrs.

Time required for 120 units

= Cumulative time required for 160 units – Time required for first 40 units

= 25,920 – 8,000 = 17,920 Hours



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ANS. 7 (a)

80% Learning Curve results are given below:

Production (Units)	Cumulative Average Time (Hours)	Total Time (Hours)
1	10	10
2	8	16
4	6.4	25.6
8	5.12	40.96
16	4.096	65.54
32	3.2768	104.86

- (i) Labour Time required for first eight units = 40.96 hours
 Labour Cost required for 8 units = 40.96 hours $\times$ ₹12/hr. = **₹491.52**
- (ii) Labour time for 32 units = 104.86 hours
 Labour time for first eight units = 40.96 hours
 Labour time required for 2nd order for 24 units = 63.90 hours
 Labour Cost for 24 units = 63.90 hours $\times$ ₹12/hr. = **₹766.80**

ANS. 7 (b)

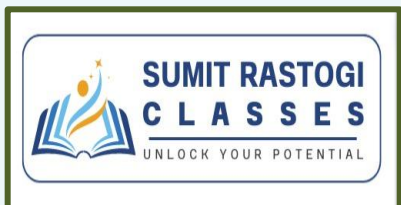
- (i) **Total direct labour cost for the 8 batches** = $ax^b = 55,000 \times 8^{-0.152} \times 8$
 $= 55,000 \times 0.729 \times 8 = ₹3,20,760$
Total Direct Labour Cost for 7 batches = $55,000 \times 7^{-0.152} \times 7$
 $= 55,000 \times 0.744 \times 7 = ₹2,86,440$
Expected Direct Labour cost for the 8th batch = $3,20,760 - 2,86,440 = ₹34,320$

(ii) **Statement of Contribution:**

Particulars	Amount (₹)
Sales (16,000 $\times$ 102)	16,32,000
Less: Variable Costs (16,000 $\times$ 50)	8,00,000
Less: Labour Cost:	
First 8 batches	3,20,760
Next 8 batches (34,320 $\times$ 8)	2,74,560
Contribution	2,36,680

(iii)

Particulars	Amount (₹)
Sales (16,000 $\times$ 102)	16,32,000
Less: Desired Contribution	6,00,000
Less: Variable Costs (16,000 $\times$ 50)	8,00,000
Required Direct Labour Costs	2,32,000



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Total Direct Labour for 16 batches = $55,000 \times 16^b \times 16$

$2,32,000 = 8,80,000 \times 16^b$

$16^b = 0.2636$

$(2^4)^b = 0.2636$

$2^b = 4\sqrt{0.2636}$

$2^b = 0.7166$

$b \log 2 = \log 0.7166$

$b = \log 0.7166 / \log 2$

Therefore, learning rate = $0.7166 = 71.66\%$

ANS. 8 (a)

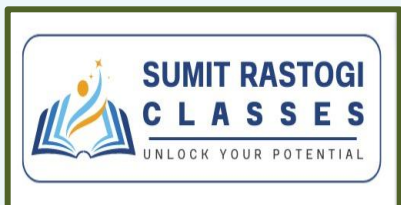
No. of Boats	Average Time	Total Time
1	1,000	
2	$1,000 \times 90\% = 900$	1,800
4	$900 \times 90\% = 810$	3,240
8	$810 \times 90\% = 729$	5,832

(i) Statement of Selling Price of 4 Boats and 8 Boats

Particulars	4 Boats	8 Boats
Materials	$8,000 \times 4 = 32,000$	$8,000 \times 8 = 64,000$
Labour	$3,240 \times 4 = 12,960$	$5,832 \times 4 = 23,328$
Variable Overheads	$12,960 \times 200\% = 25,960$	$23,328 \times 200\% = 46,656$
Total Cost	70,880	1,33,984
Profit 20%	14,176	26,797
Selling Price	85,056	1,60,781
Selling Price Per Boat	$85,056/4 = ₹21,164$	₹20,097.63

(ii) Statement of Selling Price for 3rd and 4th Boats:

Particulars	Amount (₹)
Materials	$8,000 \times 2 = 16,000$
Labour	$(3,240 - 1,800) \times 4 = 5,760$
Variable Overheads	$5,760 \times 200\% = 11,520$
Total Cost	33,280
Profit 20%	6,656
Selling Price	39,936
Selling Price Per Boat	$39,936/2 = ₹19,968$



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ANS. 8 (b)

Since, Department A is highly automatic there is no learning effect in respect of Machine operations. Hence, learning effect is applicable for Department B only where skilled labour is involved.

Computation of Selling Price Per Unit for Order of 60 Units

Particulars	Computation	Amount (₹)
Direct Materials	60×500	30,000
Direct Labour:		
Department A	$60 \times 20 \text{ hours} \times ₹10$	12,000
Department B (W.N.)	$1,510.40 \times ₹15$	22,656
Variable OH	$(12,000 + 22,656) \times 20\%$	6,931.20
Fixed OH Absorbed:		
Department A	$60 \times 20 \text{ hours} \times ₹8$	9,600
Department B	$1,510.40 \times ₹5$	7,552
Total Cost		88,739.20
Add: Profit	$88,739.20 \times 25\%$	22,184.20
Total Sales		1,10,924
Selling Price Per Unit	1,10,924/60	1,848.73

Working Note:

100 units have been already produced, so order of 60 units will make the cumulative units as 160.

So, the x factor = $160/100 = 1.6$ and y factor is 86.1% i.e., the learning effect is 86.1%.

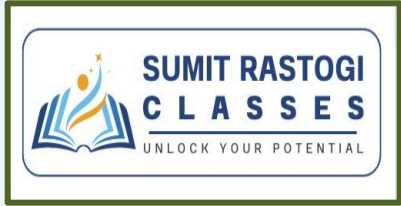
Now total time taken for 100 units = $40 \times 100 = 4,000$ hours

Total time taken for 160 units = $40 \times 86.1\% \times 160 = 5,510.40$ hours

So, Time for 60 units = $5,510.40 - 4,000 = 1,510.40$ hours

Computation of Selling Price per unit for order of 40 Units

Particulars	Computation	Amount (₹)
Direct Materials	40×500	20,000
Direct Labour:		
Department A	$40 \times 20 \text{ hours} \times ₹10$	8,000
Department B (W.N.)	$889.60 \times ₹15$	13,344
Variable OH	$(8,000 + 13,344) \times 20\%$	4,268.80
Fixed OH Absorbed:		
Department A	$40 \times 20 \text{ hours} \times ₹8$	6,400
Department B	$889.60 \times ₹5$	4,448
Total Cost		56,460.80
Add: Profit	$56,460.80 \times 25\%$	14,115.20
Total Sales		70,756
Selling Price Per Unit	70,756/40	1,764.40



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Working Note:

160 units would have been already produced, before this order of 40 units. So cumulative units will be 200.

So, the x factor = $200/100 = 2.0$ and y factor is 80.0% i.e., the learning effect is 80.0%.

Total time taken for 160 units = 5,510.40 hours

Total time taken for 200 units = $40 \times 80.0\% \times 200 = 6,400$ hours

So, Time for 40 units = $6,400 - 5,510.40 = \mathbf{889.60 \text{ hours}}$