

DEPARTMENT OF STATISTICS AND OPERATIONS RESEARCH

BSc (Honours) Degree in Operations Research & Statistics: Part I  
 BSc (Honours) Degree in Business Analytics: Part I

SORS1102: OPERATIONS MANAGEMENT

DECEMBER 2024 EXAMINATION

Time : 3 hours

Candidates should attempt **ALL** questions from **Section A** (40 marks) and **ANY THREE** questions from **Section B** (20 marks each).

**SECTION A**

**ANSWER ALL QUESTIONS IN THIS SECTION [40 MARKS]**

**A1.** (a) Differentiate between the following:

- (i) Production and operations management, [2]
- (ii) Order qualifiers and order winners, [2]
- (iii) Design capacity and effective capacity, [2]
- (iv) A city hotel and a safari lodge based on the 4Vs typology of operations, [2]
- (v) Walter Shewhart and Taiichi Ohno's perspectives on quality management. [2]

**A2.** Complete the following table:

Table 1: Types of processing

	Job	Project	Batch Production	Mass Production	Continuous Production
Type of product					
Type of customer					
Product demand					
Demand volume					
Examples					

[10]

**A3.** Twenty samples of  $n = 200$  were taken by a quality assurance officer at a workstation in a production process. The number of defective items in each sample were recorded as follows:

Table 2: Samples

SAMPLE	NUMBER OF DEFECTIVES	P	SAMPLE	NUMBER OF DEFECTIVES	p
1	12	0.060	11	16	0.080
2	18	0.090	12	14	0.070
3	10	0.050	13	12	0.060
4	14	0.070	14	16	0.080
5	16	0.080	15	18	0.090
6	19	0.095	16	20	0.100
7	17	0.085	17	18	0.090
8	12	0.060	18	20	0.100
9	11	0.055	19	21	0.105
10	14	0.070	20	22	0.110

(a) Construct a p-chart for this process using  $3\sigma$  limits and indicate if the production process was out of control. [4,1]

(b) Use pattern tests to determine if any non-random patterns exist. [5]

**A4.** A solar panel system is assembled using three components, as shown in the accompanying product structure tree. The company that makes the solar panel system wants to ship 100 units at the beginning of day 4, 150 units at the beginning of day 5, and 200 units at the beginning of day 7. Receipts of 100 panel frames are scheduled at the beginning of day 2. There are 120 mounting hardware kits on hand, and 60 solar cells on hand. Lead times (in days) for all items are shown in the following table.

Table 3: Lead times in days

Quantity	Lead Time
1-200	1
201-550	2
551-999	3

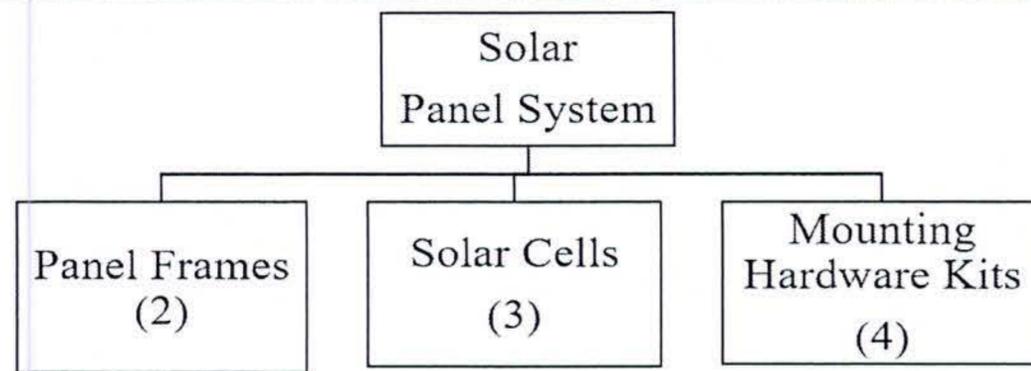


Figure 1: Product Structure Tree

(a) Prepare a material requirements plan using lot-for-lot ordering.

[10]

**SECTION B****ANSWER THREE QUESTIONS FROM THIS SECTION [60 MARKS]**

- B5.** (a) Briefly explain the five (5) elements of a product using practical examples. [5]
- (b) Using a diagram, examine the implications of the bell shaped new product diffusion curve for production and operations managers? [15]
- B6.** (a) Explain any five (5) factors that influence location decisions for business organisations. [10]
- (b) A baking company currently has 4 retail locations as follows. To reduce cost management wants to build a central stores repository. Table 4 shows the different locations:

Table 4: Locations

STORE	X CO-ORDINATE	Y CO-ORDINATE	QTY OF PRD SOLD (KGS)
Gwanda	125	100	1250
Mutare	250	75	3000
Bulawayo	450	300	2750
Harare	200	350	1500

- (i) Where should this store be located in terms of the x and y coordinates? [8]
- (ii) Draw a grid map to position these stores and the new location. [2]

- B7.** (a) The following data are monthly sales of jeans at a local department store. The operations manager would like to forecast sales of jeans for the next month, July.

Table 5: Sales Data

Month	Sales
January	45
February	30
March	40
April	50
May	55
June	47

- (i) Forecast sales of jeans for February through July using exponential smoothing ( $\alpha = 0.2$ ). [6]
- (ii) Compute mean absolute deviation (MAD), the mean squared error (MSE), and the mean absolute percent error (MAPE) showing actual and forecasted numbers of accounts serviced. [3, 3, 3].
- (b) A company offers ID theft protection using leads obtained from client banks. Three employees work 40 hours a week on the leads, at a pay rate of \$25 per hour per employee. Each employee identifies an average of 3,000 potential leads a week from a list of 5,000. An average of 4 percent actually sign up for the service, paying a one-time fee of \$70. Material costs are \$1,000 per week, and overhead costs are \$9,000 per week. Calculate the multifactor productivity for this operation in fees generated per dollar of input. [5]

- B8.** (a) At an executive meeting, the accountant of your organisation has distributed the previous month's income statement as a basis for a cost-volume analysis exercise. Table 6 presents the income statement:

Table 6: Income Statement

Revenue	\$1000000
Variable Costs	(\$600000)
Contribution Margin	\$400000
Fixed Costs	(\$260000)
Profit before taxes	\$140000
Taxes (25% of profit before taxes)	(\$35000)
Profit after taxes	<u>\$105000</u>

During the meeting, the various officers of the company made the following reports:

- The marketing director indicated that due to a competitor leaving the market, the company could raise the unit selling price on all products by 20% without affecting demand.
- The operations director indicated that due to recent advances in technology, the company's unit variable costs could be reduced by 20%.
- The accountant distributed a new tax bill, just signed into law that will increase the company's tax rate to 30% of profit before taxes.

**Required:**

- (i) What is the company's current break even revenue? (Ignore all the changes announced at the meeting.) [4]
- (ii) Ignoring the other two changes, what effect would raising the unit selling price by 20% have on break-even revenue? [3]
- (iii) Ignoring the other two changes, what effect would decreasing the unit variable cost by 20% have on the break-even revenue? [3]
- (iv) Suppose all the changes announced at the meeting do take place, what will your company's profit after taxes be next month? (Support your answer with a revised pro-forma income statement based on the format in Table 6) [5]
- (b) Explain the strategies for managing capacity on the demand side versus the supply side in Zimbabwe's manufacturing sector. [5]

**END OF QUESTION PAPER**