Module 2

Balancing supply with demand

Outcomes

Upon completion of this module, students will be able to:

- *Explain* the nature of demand.
- *Understand* the strategic role of forecasting.
- *Distinguish* between qualitative and quantitative forecasting and perform basic quantitative calculations.
- *Outline* how capacity is measured and appreciate the dilemma faced by management in matching variable demand with variable capacity.
- *Calculate* various aggregate planning scenarios.
- *Identify* various strategies for balancing supply with demand.
- *Evaluate* the application of yield management.
- *Evaluate* queues and waiting lines.

Unit 3

Demand management and forecasting

Outcomes

Upon completion of this unit students will be able to:

- *Define* demand management.
- *Explain* the nature of demand.
- *Understand* the strategic role of forecasting.
- *Distinguish* between qualitative and quantitative forecasting.
- *Explain* forecast accuracy.
- *Define* forecast value added.
- *Perform* basic quantitative calculations on forecasting.
- *Define* and calculate seasonal indices.
- *Use* regression analysis to develop long-term trends.
- *Discuss* other approaches to forecasting.

Reflection 2.1

Reflection

Reflection 2.1

Excluding the changing behaviours demonstrated by the customer, what factors would influence demand?

Reflection 2.1 feedback

A number of factors influence demand such as changes in technology, competitor initiatives or pricing levels. Forecasting helps firms to focus attention on the factors that influence demand and establish a relationship between those factors and the actual demand.

Reflection 2.2

Reflection

Reflection 2.2

Think of three or four reasons why a forecast value would be inaccurate.

Reflection 2.2 feedback

Forecast inaccuracy can be attributed to the following causes:

- The forecasting model or method used may not be suitable for the demand being monitored.
- The information in the forecasting process may arrive too late to be of significant value.
- True demand is not being captured and it is being confused with sales data.
- Appropriate data is not being used. This feature develops when individuals are left to source information for themselves and then this data is consolidated in some way at an organisational level.
- Forecasts are calculated from the past data that may not hold for projected data points.

Activity 2.1

Activity

Use the data in the following table to calculate mean absolute deviation MAD.

Month	Demand *D*	Forecast *F*	Deviation (*D*-*F*)	Abs deviation |*D*-*F*|
Jan	500	550	-50	50
Feb	550	600	-50	50
Mar	420	490	-70	70
Apr	500	530	-30	30
May	610	530	80	80
Jun	600	550	50	50
Jul	680	610	70	70
Aug	670	670	0	0
Sep	720	690	30	30
Oct	750	730	20	20
Sum	**6000**	**5950**	**50**	**450**
Ave	**600**	**595**	**5**	**45**

Activity 2.1 feedback

Calculate the absolute deviation between demand values and forecast values for each month. Add them up and find the average (mean) value. This is the mean absolute deviation (MAD).

$$\text{MAD} = \frac{\sum |D - F|}{n} = \frac{450}{10} = 45$$

Thus the actual demand is, on average, 45 units from the forecast value.

Activity 2.2

Activity

Use the data in the following table to calculate bias.

Month	Demand *D*	Forecast *F*	Deviation (*D-F*)	Abs deviation |*D-F*|
Jan	500	550	-50	50
Feb	550	600	-50	50
Mar	420	490	-70	70
Apr	500	530	-30	30
May	610	530	80	80
Jun	600	550	50	50
Jul	680	610	70	70
Aug	670	670	0	0
Sep	720	690	30	30
Oct	750	730	20	20
Sum	**6000**	**5950**	**50**	**450**
Ave	**600**	**595**	**5**	**45**

Activity 2.2 feedback

Bias is found by calculating the algebraic difference between demand value and forecast value for each period. To make sure that the algebraic sign is correct, ensure you subtract forecast from demand ($D - F$). The sum of the algebraic differences is divided by the sum of the demand values and expressed as a percentage.

$$\text{bias} = \frac{\sum(D-F)\text{x}100}{\sum D}$$

$$= \frac{(6000-5950)\text{x}100}{6000}$$

$$= 0.833\%$$

Thus the forecasting model has a bias in favour of demand of 0.833 per cent.

Activity 2.3

Activity

Use the data in the following table to calculate mean absolute percentage deviation MAPD and mean absolute percentage variation MAPV.

Month	Demand D	Forecast F	Abs deviation $\lvert D-F \rvert$	$\Sigma D/n$	Abs variance $\lvert D-(\Sigma D/n) \rvert$
Jan	500	550	50	600	100
Feb	550	600	50	600	50
Mar	420	490	70	600	180
Apr	500	530	30	600	100
May	610	530	80	600	10
Jun	600	550	50	600	0
Jul	680	610	70	600	80
Aug	670	670	0	600	70
Sep	720	690	30	600	120
Oct	750	730	20	600	150
Sum	**6000**	**5950**	**450**		**860**
Average	**600**	**595**	**45**		**86**

Activity 2.3 feedback

MAPD is the mean of the absolute deviation between actual demand value and forecast value divided by the mean of the demand values expressed as a percentage. In this formula description, both numerator and denominator calculate average values using the number of observations. In the formula, the number of observations, *n*, could appear in numerator and denominator and cancels each other out.

$$\text{MAPD} = \frac{\sum |D-F| \text{ x } 100}{\sum D} = \frac{450 \text{ x } 100}{6000} = 7.5\%$$

Mean absolute percentage variation (MAPV) is the average of the absolute deviation between actual demand value and mean demand value divided by the mean demand expressed as a percentage.

$$\text{MAPV} = \frac{\sum \left| D - \frac{\sum D}{n} \right| \text{ x } 100}{\sum D} = \frac{860 \text{x} 100}{6000} = 14.33\%$$

Thus the mean absolute deviation is 7.5 per cent of the mean demand (MAPD) and the variability of demand (MAPV) is 14.33 per cent.

Activity 2.4

Activity

Calculate the forecast for month six using a three-month simple moving average given historical demand for months one to five as follows: 120, 130, 110, 135, and 145.

Activity 2.4 feedback

In this example $n = 3$ and $t = 6$.

$$n = 3,\ t = 6$$

$$F_t = \frac{\text{sum of actual demand values for the chosen number of periods}}{\text{chosen number of periods}}$$

$$= \frac{D_{t-n} + \ldots\ldots + D_{t-2} + D_{t-1}}{n}$$

$$= \frac{D_3 + D_4 + D_5}{3}$$

$$= \frac{110 + 135 + 145}{3}$$

$$= 130$$

Thus, the forecast for month six using a three-month simple moving average is 130.

Activity 2.5

Activity

Calculate the forecast for month six using a five-month simple moving average given historical demand for months one to five as follows: 120, 130, 110, 135, and 145.

Activity 2.5 feedback

In this example $n = 5$ and $t = 6$.

$$n = 5,\ t = 6$$

$$F_t = \frac{\text{sum of actual demand values for chosen number of periods}}{\text{chosen number of periods}}$$

$$= \frac{D_{t-n} + \ldots\ldots + D_{t-2} + D_{t-1}}{n}$$

$$= \frac{D_1 + D_2 + D_3 + D_4 + D_5}{5}$$

$$= \frac{120 + 130 + 110 + 135 + 145}{5}$$

$$= 128$$

Thus, the forecast for month six using a five-month simple moving average is 128.

Activity 2.6

Activity

Calculate the forecast for month six using a three-month weighted moving average given historical demand for months one to five as follows: 120, 130, 110, 135, and 145. Apply weights of 0.2, 0.3 and 0.5. (In other words, apply weights of 20 per cent, 30 per cent and 50 per cent.)

Activity 2.6 feedback

In this example $n = 3$, $t = 6$.

$$n = 3,\ t = 6,\ \ w_3 = 0.2, w_4 = 0.3,\ \ w_5 = 0.5,\ \text{sum of the weights} = 1$$

$$F_t = \frac{\text{sum of (each period's demand value x each period's weight)}}{\text{sum of the weights}}$$

$$F_t = \frac{D_{t-n}w_{t-n} + ... + D_{t-2}w_{t-2} + D_{t-1}w_{t-1}}{w_{t-n} + ... + w_{t-2} + w_{t-1}}$$

$$F_6 = (D_3 \text{ x } W_3) + (D_4 \text{ x } W_4) + (D_5 \text{ x } W_5)$$

$$F_6 = (110 \text{ x } 0.2) + (135 \text{ x } 0.3) + (145 \text{ x } 0.5)$$

$$= 135$$

In this example, the sum of the weights adds up to 1. Thus, the forecast for month six using a three-month weighted moving average is 135 units

Activity 2.7

Activity

Calculate the forecast for month six using exponential smoothing given historical demand for months one to five as follows: 120, 130, 110, 135, and 145. Use an alpha factor α equal to 0.2 and you are given a forecast for month five equal to 130.

Activity 2.7 feedback

$$t = 6, F_5 = 130, D_5 = 145, \alpha = 0.2$$

$$F_t = F_{t-1} + \alpha(D_{t-1} - F_{t-1})$$

$$= 130 + 0.2 \times (145 - 130)$$

$$= 133$$

Thus, the forecast for month six using exponential smoothing with α equal to 0.2 is 133.

Activity 2.8

Month	Demand	x	y	xy	x^2
January	115	1	115	115	1
February	123	2	123	246	4
March	132	3	132	396	9
April	130	4	130	520	16
May	140	5	140	700	25
June	150	6	150	900	36
Sum		**21**	**790**	**2877**	**91**
Average		**3.5**	**131.6667**		

Activity

Given the six months sales data in the following table, develop a trend line using least squares regression analysis. Use the trend line to forecast the next three months.

Activity 2.8 feedback

The data as supplied has demand data for six months. The monthly demand is the independent variable and is assigned to the *x*-axis. The months in the *x*-axis are numbered 1 to 6. The *y*-axis is for the dependent variable and this is the observed demand.

In order to calculate *a, b* and the trend line, the values for *xy* and *x2* are required as shown in the table above.

$$n = 6, \sum xy = 2877, \sum x = 21, \sum y = 790, \sum x^2 = 91$$

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

$$= \frac{6\text{x}2877 - 21\text{x}790}{6\text{x}91 - 21^2}$$

$$= 6.4$$

$$n = 6, \sum xy = 2877, \sum x = 21, \sum y = 790, \sum x^2 = 91$$

$$a = \frac{\sum y}{n} - b\frac{\sum x}{n}$$

$$= 131.67 - 6.4\text{x}3.5$$

$$= 109.27$$

$\hat{y} = 109.27 + 6.4x$ trend line equation

By using Excel the calculations can be automated. The Excel software requires the data analysis add-in and the calculation is initiated using the Data menu followed by Data Analysis and then Regression. For the Input Y Range select the column of ***y***-values and for the Input X Range select the column of ***x***-values. The output report contains more data than is immediately required and the pertinent values are shown below.

SUMMARY OUTPUT	
	Coefficients
Intercept	109.27
x	6.4

Substituting x=7, x=8 and x=9 into the trend line equation provides the forecast values as shown below.

Month	***x***	**Forecast**
July	7	154
August	8	160
September	9	167

Activity 2.9

Activity

Using the observed demand data for two years is shown in the following table; perform a regression analysis on deseasonalised demand to forecast demand for the winter season in year three.

Year	Season	Observed demand
1	autumn	205
	winter	140
	spring	375
	summer	570
2	autumn	475
	winter	270
	spring	685
	summer	960
Sum of demand		3680
Average demand		460

Activity 2.9 feedback

Start by calculating the seasonal indices for autumn, winter, spring and summer.

The period average demand for autumn is (205 + 475) / 2 = 340

The period average demand for winter is (140 + 270) / 2 = 205

The period average demand for spring is (375 + 685) / 2 = 530

The period average demand for summer is (570 + 960) /2 = 765

The average demand for all periods can be calculated as 3680/8 and is given as 460.

$$\text{seasonal index} = \frac{\text{period average demand}}{\text{average demand for all periods}}$$

$$\text{seasonal index for autumn} = \frac{340}{460} = \mathbf{0.7391}$$

$$\text{seasonal index for winter} = \frac{205}{460} = \mathbf{0.4457}$$

$$\text{seasonal index for spring} = \frac{530}{460} = \mathbf{1.1522}$$

$$\text{seasonal index for summer} = \frac{765}{460} = \mathbf{1.6630}$$

Calculate the deseasonalised demand for each season by dividing the observed demand by the seasonal index for that period as shown in the following table. Then calculate the extended fields for xy and x^2 as shown in the following table.

Year	Season	Observed demand	x	Seasonal index	Deseasonalised demand y	xy	x^2
1	autumn	205	1	0.7391	277.3644	277.3644	1
	winter	140	2	0.4457	314.1126	628.2252	4
	spring	375	3	1.1522	325.4643	976.3929	9
	summer	570	4	1.6630	342.7541	1371.0164	16
2	autumn	475	5	0.7391	642.6735	3213.3675	25
	winter	270	6	0.4457	605.7886	3634.7316	36
	spring	685	7	1.1522	594.5148	4161.6036	49
	summer	960	8	1.6630	577.2700	4618.1600	64
		3680	36	8	3679.9423	18880.8616	204

$$n = 8,\ \sum xy = 18880.8616,\ \sum x = 36,\ \sum y = 3679.9423,\ \sum x^2 = 204$$

$$b = \frac{n\sum xy - (\sum x \sum y)}{n\sum x^2 - (\sum x)^2}$$
$$= \frac{8 \text{ x } 18880.8616 - 36 \text{ x } 3679.9423}{8 \text{ x } 204 - 36^2}$$
$$= 55.2648$$

$$a = \frac{\sum y}{n} - b\frac{\sum x}{n}$$
$$= 460 - 55.2648 \text{ x } 4.5$$
$$= 211.308 \qquad \therefore \hat{y} = 211.308 + 55.2648x$$

Now calculate b, a and the best estimate of $\hat{y} = a + bx$.

Thus the trend line for deseasonalised data is $\hat{y}$ = a + bx = 211.308 + 55.2648x.

Now substitute $\boldsymbol{x}$ = 10 corresponding to winter in the third year to get the deseasonalised value for that period.

when $x = 10$, the deseasonalised value for winter in the third year is

$$\hat{y} = 211.308 + 55.2648x$$
$$= 211.308 + 55.2648 \times 10$$
$$= 763.956$$

By using a program such as Excel, the calculations to get the regression line can be automated. The Excel software requires the data analysis add-in and the calculation is initiated using the Data menu followed by Data Analysis and then Regression.

For the Input Y Range select the column of y-values and for the Input X Range select the column of x-values. The output report contains more data than is immediately required and the pertinent values are shown in the following table.

SUMMARY OUTPUT	
	Coefficients
Intercept	211.308
x	55.2648

The deseasonalised forecast for winter in the third year is:

$$\hat{y} = 211.308 + 55.2648x = 763.956$$

Now multiply by the deseasonalised forecast by the seasonal index to calculate the seasonalised forecast for winter in the third year:

763.956 x 0.4457 = 340.4952 = 340 (0 dp)

Activity 2.10

Activity

Work through the following questions. You may need to go back and re-read the unit to help you.

1. Describe the four components of demand.
2. Explain the difference between qualitative and quantitative forecasting.
3. Describe the strategic importance of forecasting.
4. Describe the use of MAPD and MAPV.
5. Explain how forecasting performance might be measured.
6. Explain the expression, “Forecasting is about understanding variation”.
7. What is the difference between seasonal variation and cyclical variation?
8. Discuss seasonal variation of demand and how an organisation can respond.
9. Explain how the seasonal index is calculated.
10. What strategies are used by airlines, hotels and rental car companies to influence demand?

Activity 2.10 feedback

All answers are in the learning material.

Unit 4

Capacity planning and management

Outcomes

Upon completion of this unit students will be able to:

- *Outline* how capacity is measured and appreciate the dilemma faced by management in matching variable demand with variable capacity.
- *Calculate* various aggregate planning scenarios.
- *Discuss* the strategic planning process.
- *Identify* various strategies for balancing supply with demand.
- *Evaluate* the application of yield management.
- *Discuss* flexibility.
- *Appreciate* the customers psychology in relation to queuing.
- *Discuss* queues and waiting lines.

Reflection 2.3

Reflection

Imagine you are about to launch a new venture. It may be a factory, a restaurant, a medical centre, a retail store, a transport company, a school or a hospital (to name a few examples).

All production and service organisations usually occupy one or more facilities at one or more locations. For this new venture, the following strategic decisions need to be resolved:

1. Where will each facility be located?
2. How large, or small, will each facility need to be?
3. What process technology will be installed at each location?
4. Will the physical size of the facility be sufficient in the short term, medium term and long term?
5. When should capacity increments be installed?
6. What happens if the available capacity is too much?
7. What happens if it is too small?

Reflection 2.3 feedback

All of these questions have a major bearing on the success, or otherwise, of the organisation. If you are capable of getting it right, you will find yourself in an enviable position of being able to capitalise on every opportunity that comes your way (assuming you want to take it) and thus maximise revenues and profits. If you get it wrong, you may find yourself searching for additional capacity at a premium price or being left with excess capacity that you are unable to sell.

Reflection 2.4

Reflection

For the most part, the production planner is given a sales forecast and has to use a pure strategy or a combination of strategies.

Think of three or four capacity or supply planning decisions that the production planner could use to increase/decrease the available capacity.

Reflection 2.4 feedback

- Hiring additional staff and making staff redundant.
- Working variable days a week.
- Working overtime.
- Varying the level of inventory.
- Varying the number of orders in the backlog.
- Varying the length of the queue of customers.
- Using subcontractors to supply additional capacity.
- Outsourcing parts of the business to free up resources.
- Adding or removing temporary capacity.
- Adding or removing permanent capacity.

These are reactive measures and the controllability of these factors depends on union agreements, employment contracts, employment legislation, short-term constraints on physical capacity levels, customer requirements and preferences and the amount of money that can be tied up in inventories.

Activity 2.11

Activity

The data in the following table represents the demand forecast for 12 months commencing January for an organisation.

Month	Demand forecast
Jan	4400
Feb	3200
Mar	4000
Apr	5400
May	6600
Jun	5000
Jul	4000
Aug	3000
Sep	4800
Oct	6400
Nov	7000
Dec	6200
	60000

The organisation currently employs 25 employees. For planning purposes, each employee is capable of making 200 units a month. The cost of hiring additional staff is $600 per employee and the cost of making an employee redundant is $300. A storage charge of $1 per unit is made for inventory on hand at the end of each month. This is to cover the cost of warehousing.

(Please note that the dollar amounts are nominal for planning purposes and no attempt has been made to quantify the actual costs in this example.)

Plan 1: Develop a production plan using a level production strategy.

Plan 2: Develop a production plan using a chase capacity strategy.

Plan 3: Develop a production plan using six months at 4800 and six months at 5200.

Activity 2.11 feedback

Plan 1: Develop a production plan using a level production strategy.

Start this plan by calculating the level production rate. The annual demand is 60,000 and there are 12 monthly periods so that makes 5000 units per month.

In January, the beginning inventory is zero, the production is 5000 and demand is 4400, therefore the ending inventory is 600 units.

In February, the beginning inventory (following on from January) is 600, the production is 5000 and demand is 3200, therefore the ending inventory is 2400 units.

In March, the beginning inventory (following on from February) is 2400, the production is 5000 and demand is 4000, therefore the ending inventory is 3400 units.

Continue like this for the rest of the year.

Month	Beginning inventory on hand	Production	Demand forecast	Ending inventory on hand	Number of employees	New staff	Redundant staff
Jan	0	5000	4400	600	25		
Feb	600	5000	3200	2400	25		
Mar	2400	5000	4000	3400	25		
Apr	3400	5000	5400	3000	25		
May	3000	5000	6600	1400	25		
Jun	1400	5000	5000	1400	25		
Jul	1400	5000	4000	2400	25		
Aug	2400	5000	3000	4400	25		
Sep	4400	5000	4800	4600	25		
Oct	4600	5000	6400	3200	25		
Nov	3200	5000	7000	1200	25		
Dec	1200	5000	6200	0	25		
		60000	**60000**	**28000**			

The inventory storage cost is $28,000, the cost of employing new staff is zero, and the cost of terminating staff is zero to give a total cost for this plan of $28,000.

Plan 2: Develop a production plan using a chase capacity strategy.

In this plan the production rate varies to match the demand pattern and the number of employees is increased or decreased to match the production rate.

In January, the demand forecast is 4400, so production is set to match that rate. Beginning inventory on hand is zero, production matches demand forecast, so the ending inventory on hand is zero. To produce 4400 we need 22 staff (200 units per employee per

month) so three employees are made redundant. Their employment contract would specify the temporary nature of their employment.

In February, the demand forecast is 3200, so production is set to match that rate. Beginning inventory on hand is zero, production matches demand forecast, so the ending inventory on hand is zero. To produce 3200 we need 16 staff (200 units per employee per month) so six employees are made redundant.

In March, the demand forecast is 4000, so production is set to match that rate. Beginning inventory on hand is zero, production matches demand forecast, so the ending inventory on hand is zero. To produce 4000 we need 20 staff (200 units per employee per month) so four employees are hired.

The remaining months are calculated in a similar fashion.

Month	Beginning inventory on hand	Production	Demand forecast	Ending inventory on hand	Number of employees	New staff	Redundant staff
Jan	0	4400	4400	0	22		3
Feb	0	3200	3200	0	16		6
Mar	0	4000	4000	0	20	4	
Apr	0	5400	5400	0	27	7	
May	0	6600	6600	0	33	6	
Jun	0	5000	5000	0	25		8
Jul	0	4000	4000	0	20		5
Aug	0	3000	3000	0	15		5
Sep	0	4800	4800	0	24	9	
Oct	0	6400	6400	0	32	8	
Nov	0	7000	7000	0	35	3	
Dec	0	6200	6200	0	31		4
		60000	60000	0		37	31

The inventory storage cost is zero, the cost of employing new staff is $22,200, the cost of terminating staff is $9,300 to give a total cost for this plan of $31,500.

Plan 3: Develop a production plan using six months at 4800 and six months at 5200.

The calculations for this strategy follow the same pattern as plan 1 and 2 except that the production rate is set at 4800 for the first six months and then increases to 5200 for the rest of the year. This represents a starting position in trying to optimise the plan. The number of employees is increased or decreased to match the production rate.

Month	Beginning inventory on hand	Production	Demand forecast	Ending inventory on hand	Number of employees	New employees	Redundant employees
Jan	0	4800	4400	400	24		1
Feb	400	4800	3200	2000	24		
Mar	2000	4800	4000	2800	24		
Apr	2800	4800	5400	2200	24		
May	2200	4800	6600	400	24		
Jun	400	4800	5000	200	24		
Jul	200	5200	4000	1400	26	2	
Aug	1400	5200	3000	3600	26		
Sep	3600	5200	4800	4000	26		
Oct	4000	5200	6400	2800	26		
Nov	2800	5200	7000	1000	26		
Dec	1000	5200	6200	0	26		
		60000	60000	20800		2	1

The inventory storage cost is $20,800, the cost of employing new staff is $1,200, the cost of terminating staff is $300 to give a total cost for this plan of $22,300.

Activity 2.12

Activity

When you are waiting in a queue, it often feels like you are waiting for a very long time. Make a list of possible reasons why a customer perceives the wait time is longer than it actually is.

Activity 2.12 feedback

Johnson and Clark identified that the customer often perceives that the time in the queue is longer than it really is. They observed the following:

- Unoccupied time feels longer than occupied time.
- Pre-process waits feel longer than in-process waits.
- Anxiety makes the wait seem longer.
- Uncertain waits are longer than known, finite waits.
- Unexplained waits seem longer than explained waits.
- Unfair waits are longer than equitable waits.
- The more valuable the service, the longer the customer waits.
- Solo waiting feels longer than group waiting.
- Uncomfortable waits feel longer than comfortable waits.
- New or infrequent users feel they wait longer

Activity 2.13

Activity

1. What does the term “capacity” mean?
2. How does capacity differ from capability?
3. Why is capacity management strategically important?
4. The management of capacity for services is more difficult than for manufacturing. Why?
5. Describe the capacity considerations for a hospital and identify how this is different from a manufacturing unit.
6. What are the possible consequences of demand rate being different from design capacity rate?
7. What is yield management?
8. What industries use yield management and why?
9. Describe three strategies for expanding capacity.

Activity 2.13 feedback

All answers are in the learning material.

Assignment 1

Assignment

There are three questions in this assignment.

Question 1 40 marks

a. Lowering prices can increase demand for products or services, but it also reduces profit margins if the product or service cannot be produced at lower cost. Briefly discuss how an operations manager should approach his or her job when **competing on cost**.

b. Quality is a dimension of a product or service that is defined by the customer. Today, more than ever, quality has important market implications. Briefly discuss how an operations manager should approach his or her job when **competing on quality**.

c. As the saying goes, "time is money." Some companies do business at "Internet speed", while others thrive on consistently meeting delivery promises. Briefly discuss how an operations manager should approach his or her job when **competing on time**.

d. Flexibility is a characteristic of a firm's operations that enables it to react to customer needs quickly and efficiently. Some firms give top priority to flexibility. Briefly discuss how an operations manager should approach his or her job when **competing on flexibility**.

Answer to Assignment Question 1

a. Competing on cost 10 marks

An organisation may elect to compete purely on the basis of cost. It could achieve this by lowering prices to increase demand for products and services. However, this approach also reduces profit margins if the product or service cannot be produced at a lower cost.

Cost advantage can be gained by adopting lean thinking and cutting the cost of non-value-adding activities in the value chain. This may require additional investment in automation, a streamlining of

procedures, additional training and development, and usually results in a narrower range of products or services.

A “no frills” airline competes on the basis of cost by reducing fares for the base service — travel with no checked bags, no free food and receive just music entertainment. A customer can obtain a very cheap fare if the travel portion is all they want. If, however, the customer wants more than that they can pay extra for checked bags, food and drinks and video on demand.

Guide to marker: Look for what the operations manager should do when competing on cost.

Some students may suggest the manager should buy the cheapest, but this is not necessarily competing on cost. When competing on cost the firm delivers exactly what the customer wants (no more than the minimum requirement) and the process for delivery aims to eliminate unnecessary cost elements. Therefore the manager should implement lean thinking ideas.

b. Competing on quality 10 marks

An organisation may elect to compete purely on the basis of quality. Two aspects of quality have to be considered: high performance design which includes superior features, close tolerances, and greater durability, and consistent quality which measures the frequency with which the product meets design specifications.

Customers want products that consistently conform to the specifications they contracted for, have come to expect, or saw advertised. An organisation can achieve product differentiation by developing expertise in product quality and process quality. The aim is to provide superior performance products that meet the specifications and are reliable.

Car companies such as Toyota and BMW compete on the basis of quality since the concepts of quality feature at the top of their priority lists. Note that both these companies will argue that they compete on other issues and not solely on quality.

Guide to marker: Look for what the operations manager should do when competing on quality. This means the manager should ensure that the product design includes all features required by the customer and the production process is close to error-free.

c. Competing on time 10 marks

An organisation may elect to compete purely on the basis of time. This involves a short delivery time which is the elapsed time between receiving a customer’s order and filling it. Firms can shorten delivery lead times by storing inventory or having excess capacity. It also involves on-time delivery which measures the

frequency with which delivery-time promises are met. Organisations measure on-time delivery as the percentage of orders shipped when promised.

On-time delivery requires the product or service to be delivered at the first customer-requested delivery time. Firms may convince themselves they are meeting delivery promises by shipping goods out the door on or before the delivery promise date and time. However, the customer does not see it this way. Customers want the product or service and they will measure on-time delivery as being the actual time the product is delivered to their location.

International courier companies use parcel tracking technology to identify the exact location of all their deliveries and they promise delivery on time. Their technology reduces the chance of losing a parcel or misdirecting it.

Another aspect of competing on the basis of time is product development speed which measures how quickly a new product is introduced. This includes the elapsed time from idea generation through to final design and production. Getting a new product to market first gives a firm an edge on the competition and this is difficult to overtake in a rapidly changing business environment.

Guide to marker: Look for what the operations manager should do when competing on time. This means that the manager is improving processes to reduce lead times, delivery times and new product development times.

d. Competing on flexibility 10 marks

An organisation may elect to compete purely on the basis of flexibility. Flexibility allows a firm to change volumes quickly or change products quickly to suit customer requirements. This is also referred to as customisation, which is the ability to accommodate the unique needs of each customer and changing product designs. Products are tailored to individual preferences. Customisation implies the operating system must be flexible to handle specific customer needs and changes in designs. Volume flexibility is the ability to accelerate the production rate quickly to handle large fluctuations in demand. The time between peaks may be years as in the construction industry, months as with a ski resort, or hours as with a postal sorting firm.

Dell computers are a good example of competing on flexibility. At the time a customer places an order for a Dell computer the actual computer does not physically exist. Dell has the manufacturing capability to assemble exactly what the customer wants and ship it to them within a few days. They facilitate this flexibility by pricing the configurations in favour of the components they can deliver. If a component (memory, hard drive or screen) is in short supply they will offer that component at a higher price and customers will be

encouraged to choose another component at a lower price and the alternative may be at a higher specification, which is even better.

Guide to marker: Look for what the operations manager should do when competing on flexibility. This means improving processes to reduce batch sizes and reducing set-up times, arranging for suppliers to deliver frequently and generally moving towards batches of one.

Question 2 30 marks

a. Provide three questions that should be considered when developing the objectives of a forecast.

b. Name three different models that could be developed and tested during the forecasting process.

c. What does "applying the model" mean?

d. Explain, using an example, the forecasting step "considering real-world constraints on the model's application".

e. Explain how one might "revise and evaluate the forecast".

f. What is the most important rule of forecasting, and what should we be trying to achieve?

Answer to Assignment Question 2

a. Provide three questions that should be considered when developing the objectives of a forecast. **6 marks**

What is the purpose of the forecast?

What variables are to be forecast?

Who will use the forecast?

What is the time frame for the forecast – long or short term?

How accurate should the forecast be?

When is the forecast needed?

b. Name three different models that could be developed and tested during the forecasting process. **6 marks**

Moving average

Weighted moving average

Exponential smoothing

Regression analysis.

c. What does "applying the model" mean? **4 marks**

After the model is tested, historical data about the problem are collected. These data are applied to the model, and the forecast is obtained. Great care should be taken so that the proper data are used and the model is applied correctly.

d. Explain, using an example, the forecasting step "considering real-world constraints on the model's application". **4 marks**

A model may predict that sales will double in the next three years. Management therefore expands the plant, but does not think about the impact this increase will have on the distribution system. What if the company cannot move the increased volume? What about raw material availability, and actions such as price-cutting by competitors.

e. Explain how one might "revise and evaluate the forecast". **4 marks**

The technical forecast should be tempered with human judgement. What relationships might have changed?

f. What is the most important rule of forecasting, and what should we be trying to achieve? **6 marks**

Forecasts are always wrong, and it is better to plan for this by having a range as a forecast, than a definitive number. This will make it easier to have contingency plans drawn up. With forecasting we are trying to minimise the size of the forecast deviation.

Question 3: 30 marks

The actual number of guests staying at an exclusive lodge has been as follows:

Quarter	Year	Actual
Summer	1	73
Autumn	1	104
Winter	1	168
Spring	1	74
Summer	2	65
Autumn	2	82
Winter	2	144
Spring	2	52
Summer	3	89
Autumn	3	146
Winter	3	205
Spring	3	98
Total		**1300**

a. Calculate seasonal indices using the above data.

b. Deseasonalise the above data, and determine the regression equation.

c. Using the regression equation determine the forecasts for year four.

Answer to Assignment Question 3

The actual number of guests staying at an exclusive lodge has been as follows:

Quarter	Year	Actual Guests	Seas. Ave	Seas. Index	Deseas. Demand		
Summer	1	73	75.6667	0.6985	104.5154		
Autumn	1	104	110.6667	1.0215	101.8072		
Winter	1	168	172.3333	1.5908	105.6093		
Spring	1	74	74.6667	0.6892	107.3661		
Summer	2	65		0.6985	93.0617		
Autumn	2	82		1.0215	80.2711		
Winter	2	144		1.5908	90.5222		
Spring	2	52		0.6892	75.4464		
Summer	3	89		0.6985	127.4229		
Autumn	3	146		1.0215	142.9217		
Winter	3	205		1.5908	128.8685		
Spring	3	98		0.6892	142.1875	**Deseas. Forecast**	**Seas. Forecast**
Total		**1300**					
				0.6985	13	130.5345	91
Total Average		108.333333		1.0215	14	133.9500	137
				1.5908	15	137.3655	219
Slope		**3.4155**		0.6892	16	140.7810	97
y-intercept		**86.133**					

a. Calculate seasonal indices using the above data. **10 marks**

0.6985

1.0215

1.5908

0.6892

b. Deseasonalise the above data, and determine the regression equation. **10 marks**

Deseasonalised data is column six above.

Y = 86.133 + 3.4155 (four decimal places)

c. Using the regression equation determine the forecasts for year four. **10 marks**

Forecast data is column eight above.