## Performance Pillar

## P2 - Performance Management

## 25 May 2011 - Wednesday Afternoon Session

## Instructions to candidates

| You are allowed three hours to answer this question paper. |
| :--- |
| You are allowed 20 minutes reading time before the examination begins <br> during which you should read the question paper and, if you wish, make <br> annotations on the question paper. However, you will not be allowed, under <br> any circumstances, to open the answer book and start writing or use your <br> calculator during this reading time. |
| You are strongly advised to carefully read ALL the question requirements <br> before attempting the question concerned (that is all parts and/or sub- <br> questions). |
| ALL answers must be written in the answer book. Answers written on the <br> question paper will not be submitted for marking. |
| You should show all workings as marks are available for the method you use. |
| ALL QUESTIONS ARE COMPULSORY. |
| Section A comprises 5 questions and is on pages 2 to 6. |
| Section B comprises 2 questions and is on pages 8 to 11. |
| Maths tables and formulae are provided on pages 13 to 16. |
| The list of verbs as published in the syllabus is given for reference on page <br> 19. |
| Write your candidate number, the paper number and examination subject title <br> in the spaces provided on the front of the answer book. Also write your <br> contact ID and name in the space provided in the right hand margin and seal <br> to close. |

Tick the appropriate boxes on the front of the answer book to indicate which questions you have answered.


## [You are advised to spend no longer than 18 minutes on each question in this section.]

ANSWER ALL FIVE QUESTIONS IN THIS SECTION. EACH QUESTION IS WORTH 10 MARKS. YOU SHOULD SHOW YOUR WORKINGS AS MARKS ARE AVAILABLE FOR THE METHOD YOU USE.

## Question One

WX is reviewing the selling price of one of its products. The current selling price of the product is $\$ 25$ per unit and annual demand is forecast to be 150,000 units at this price. Market research indicates that the level of demand would be affected by any change in the selling price. Detailed analysis from this research shows that for every $\$ 1$ increase in selling price, annual demand would reduce by 25,000 units and that for every $\$ 1$ decrease in selling price, annual demand would increase by 25,000 units.
A forecast of the annual costs that would be incurred by WX in respect of this product at differing activity levels is as follows:

| Annual production (units) | 100,000 | 160,000 | 200,000 |
| :--- | ---: | ---: | ---: |
|  | $\$ 000$ | $\$ 000$ | $\$ 000$ |
| Direct materials | 200 | 320 | 400 |
| Direct labour | 600 | 960 | 1,200 |
| Overhead | 880 | 1,228 | 1,460 |

The cost behaviour patterns represented in the above forecast will apply for the whole range of output up to 300,000 units per annum of this product.

## Required:

(a)
(i) Calculate the total variable cost per unit.
(ii) Calculate the selling price of the product that will maximise the company's profits.

Note: If Price $(P)=a-b x$ then Marginal Revenue $=a-2 b x$
(b) Explain TWO reasons why the company might decide NOT to use this optimum selling price.
(Total for Question One = 10 marks)

## Question Two

PT manufactures and sells a number of products. All of its products have a life cycle of six months or less. PT uses a four stage life cycle model (Introduction; Growth; Maturity; and Decline) and measures the profits from its products at each stage of their life cycle.

PT has recently developed an innovative product. Since the product is unique it was decided that it would be launched with a market skimming pricing policy. However PT expects that other companies will try to enter the market very soon.

This product is generating significant unit profits during the Introduction stage of its life cycle. However there are concerns that the unit profits will reduce during the other stages of the product's life cycle.

## Required:

For each of the
(i) Growth; and
(ii) Maturity stages of the new product's life cycle
explain the likely changes that will occur in the unit selling prices AND in the unit production costs, compared to the preceding stage.
(Total for Question Two = 10 marks)

Section A continues on page 4

## Question Three

JYT manufactures and sells a range of products. It is not dominant in the market in which it operates and, as a result, it has to accept the market price for each of its products. The company is keen to ensure that it continues to compete and earn satisfactory profit at each stage throughout a product's life cycle.

## Required:

Explain how JYT could use Target Costing AND Kaizen Costing to improve its future performance.

Your answer should include an explanation of the differences between Target Costing and Kaizen Costing.
(Total for Question Three = 10 marks)

## Question Four

A company produces and sells DVD players and Blu-ray players.
Extracts from the budget for April are shown in the following table:

|  | Sales <br> (players) | Selling price <br> (per player) | Standard cost <br> (per player) |
| :--- | :---: | :---: | :---: |
| DVD | 3,000 | $\$ 75$ | $\$ 50$ |
| Blu-ray | 1,000 | $\$ 200$ | $\$ 105$ |

The Managing Director has sent you a copy of an e-mail she received from the Sales Manager. The content of the e-mail was as follows:

We have had an excellent month. There was an adverse sales price variance on the DVDs of $\$ 18,000$ but I compensated for that by raising the price of Blu-ray players. Unit sales of DVD players were as expected but sales of the Blu-rays were exceptional and gave a total sales volume profit variance of \$19,000. I think I deserve a bonus!

The Managing Director has asked for your opinion on these figures. You obtained the following information:

Actual results for April were:

|  | Sales <br> (players) | Selling price <br> (per player) |
| :--- | :---: | :---: |
| DVD | 3,000 | $\$ 69$ |
| Blu-ray | 1,200 | $\$ 215$ |

The total market demand for DVD players was as budgeted but as a result of distributors reducing the price of Blu-ray discs the total market for Blu-ray players grew by $50 \%$ in April. The company had sufficient capacity to meet the revised market demand for 1,500 units of its Blu-ray players and therefore maintained its market share.

## Required:

(a) Calculate the following operational variances based on the revised market details:
(i) The total sales mix profit margin variance
(2 marks)
(ii) The total sales volume profit variance
(2 marks)
(b) Explain, using the above scenario, the importance of calculating planning and operational variances for responsibility centres.
(6 marks)
(Total for Question Four = 10 marks)

## TURN OVER

## Question Five

SFG is a national hotel group that operates more than 100 hotels. The performance of the manager of each hotel is evaluated using financial measures.

Many of the hotel's managers are not happy. They believe that there can be conflict between good performance and achieving short-term profits. They are also unhappy that their profit reports include a share of head office costs and other costs that they cannot control.

## Required:

(a) Explain why non-financial performance measures are important in the service sector
(b) Recommend, with reasons, TWO non-financial performance measures that SFG could use to evaluate the performance of the hotel managers.
(c) Explain why, and how, non-controllable costs should be shown on the profit reports.
(4 marks)
(Total for Question Five = 10 marks)

## End of Section A

Section B starts on page 8

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SECTION B - 50 MARKS
[You are advised to spend no longer than 45 minutes on each question in this section.]

## ANSWER BOTH QUESTIONS IN THIS SECTION. EACH QUESTION IS WORTH 25 MARKS. YOU SHOULD SHOW YOUR WORKINGS AS MARKS ARE AVAILABLE FOR THE METHOD YOU USE.

## Question Six

The management of a hotel is planning for the next year. The hotel has 100 bedrooms. The price of a room night includes breakfast for the guests. Other services (a snack service and a bar and restaurant) are available but are not included in the price of the room night. These additional services are provided to hotel guests only.

For planning purposes the hotel divides the year (based on 360 days) into three seasons: peak, mid and low.
Details of the hotel and its services and forecasts for the next year are given below.

## 1. Seasons, room charges, room occupancy, guests per room and room revenue

 The hotel charges a price per room per night (including breakfast) irrespective of the number of guests per room. The price charged is different in each of the seasons.| Season | Peak | Mid | Low |
| :--- | :---: | :---: | :---: |
| Number of days | 90 | 120 | 150 |
| Price charged per room per night (\$) | 100.00 | 80.00 | 55.00 |
| Hotel room occupancy \% | 95 | 75 | 50 |
| Average number of guests per room | 1.8 | 1.5 | 1.2 |
| Total room revenue (\$) | 855,000 | 720,000 | 412,500 |

## 2. Guest related costs

The hotel incurs some costs, including providing breakfast, that are directly related to the number of guests in the hotel. These are $\$ 12$ per guest per night in all seasons.

## 3. Room related costs

The hotel incurs some costs that are directly related to the number of rooms occupied. These include cleaning and laundry costs of $\$ 5$ per occupied room per night regardless of season. There are also power and lighting costs of $\$ 3$ in the peak season, $\$ 4$ in the mid season and $\$ 6$ in the low season per occupied room per night.

## 4. Hot snacks

The hotel offers a 24 hour hot snacks service to the guests. Past records show that this service has been used by $30 \%$ of its guests in the mid and low seasons but only $10 \%$ in the peak season. It is forecast that the average spend per guest per night will be $\$ 10$. The hotel earns a 30\% gross contribution from this income.

The hotel employs a cook on a salary of $\$ 20,000$ per year to provide this service. All of the costs for the hot snacks service, except for the cook's salary, are variable. The cook could be made redundant with no redundancy costs.

## 5. Restaurant \& Bar

Past records show that the usage of the restaurant and bar is seasonal. The restaurant and bar are particularly popular with the hotel's business guests. The forecast usage is shown below.

| Season | Daily demand |
| :--- | :--- |
| Peak | $30 \%$ of hotel guests spend an average of $\$ 15$ each |
| Mid | $50 \%$ of hotel guests spend an average of $\$ 20$ each |
| Low | $70 \%$ of hotel guests spend an average of $\$ 30$ each |

The hotel earns a 25\% gross contribution from this income and employs two chefs on a combined salary of $\$ 54,000$ per year to provide this facility. All of the costs in the restaurant and bar, except for the salaries of the chefs, are variable.

The two chefs could be made redundant with no redundancy costs.

## 6. General hotel costs.

These include the costs of reception staff, the heating and lighting of the common areas and other facility related costs. The forecast costs for next year are:

| Peak season | $\$ 300,000$ |
| :--- | :--- |
| Mid season | $\$ 400,000$ |
| Low season | $\$ 500,000$ |

These costs could be reduced by 75\% if the hotel were to close temporarily for one or more seasons of the year.

There are also some costs that are incurred by the hotel and can only be avoided by its permanent closure. These are estimated to $\$ 200,000$ for next year.

## Required:

(a) Prepare, in an appropriate format, a columnar statement that will help the managers of the hotel to plan for next year. Your statement should show the hotel's activities by season and in total.
(18 marks)
(b)
(i) Identify, based on your statement, the actions that the managers could take to maximise the profit of the hotel for next year.
(3 marks)
(ii) Explain TWO factors that the managers should consider before implementing the actions you identified in (b)(i).
(Total for Question Six = 25 marks)

Section B continues on page 10

## Question Seven

The DE Company has two divisions. The following statement shows the performance of each division for the year ended 30 April 2011:

|  | $D$ | $E$ |
| :--- | :---: | :---: |
|  | $\$ 000$ | $\$ 000$ |
| Sales | 500,200 | 201,600 |
| Variable cost | $\underline{380,400}$ | $\underline{140,000}$ |
| Contribution | 119,800 | $\underline{20,600}$ |
| Fixed costs | $\underline{30,000}$ | $\underline{41,600}$ |
| Operating profit | $\underline{89,800}$ |  |

Division E manufactures just one type of component. It sells the components to external customers and also to Division D. During the year to 30 April 2011, Division E operated at its full capacity of 140,000 units. The transfer of 70,000 units to Division D satisfied that division's total demand for that type of component. However the external demand was not satisfied. A further 42,000 components could have been sold to external customers by Division $E$ at the current price of $\$ 1,550$.

The current policy of the DE Company is that internal sales should be transferred at their opportunity cost. Consequently during the year, some components were transferred to Division D at the market price and some were transferred at variable cost.

## Required:

(a) Prepare an analysis of the sales made by Division E that shows clearly, in units and in \$, the internal and external sales made during the year.
(3 marks)
(b) Discuss the effect of possible changes in external demand on the profits of Division E, assuming the current transfer pricing policy continues.
(6 marks)

Division $E$ is considering investing in new equipment which would reduce its unit variable costs by $20 \%$ and increase its capacity by $10 \%$ for each of the next five years. The capital cost of the investment is $\$ 120 \mathrm{~m}$ and the equipment would have no value after five years. The DE company and its divisional managers evaluate investments using net present value (NPV) with an 8\% cost of capital.

External annual demand for the next five years will continue to be 112,000 components at $\$ 1,550$ each but the DE Company will insist that the internal annual demand for 70,000 components must be satisfied.

## Required:

(c) Assuming that the current transfer pricing policy continues:
(i) Evaluate the investment from the perspective of the manager of Division E.
(ii) Evaluate the investment from the perspective of the DE Company.

Note: Ignore inflation and taxation.
(d) Explain TWO factors that should be considered when designing divisional performance measures.
(6 marks)
(Total for Question Seven = 25 marks)

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## PRESENT VALUE TABLE

Present value of 1 unit of currency, that is $(1+r)^{-n}$ where $r=$ interest rate; $n=$ number of periods until payment or receipt.

| Periods | Interest rates (r) |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ( $n$ ) | 1\% | 2\% | 3\% | 4\% | 5\% | 6\% | 7\% | 8\% | 9\% | 10\% |
| 1 | 0.990 | 0.980 | 0.971 | 0.962 | 0.952 | 0.943 | 0.935 | 0.926 | 0.917 | 0.909 |
| 2 | 0.980 | 0.961 | 0.943 | 0.925 | 0.907 | 0.890 | 0.873 | 0.857 | 0.842 | 0.826 |
| 3 | 0.971 | 0.942 | 0.915 | 0.889 | 0.864 | 0.840 | 0.816 | 0.794 | 0.772 | 0.751 |
| 4 | 0.961 | 0.924 | 0.888 | 0.855 | 0.823 | 0.792 | 0.763 | 0.735 | 0.708 | 0.683 |
| 5 | 0.951 | 0.906 | 0.863 | 0.822 | 0.784 | 0.747 | 0.713 | 0.681 | 0.650 | 0.621 |
| 6 | 0.942 | 0.888 | 0.837 | 0.790 | 0.746 | 0705 | 0.666 | 0.630 | 0.596 | 0.564 |
| 7 | 0.933 | 0.871 | 0.813 | 0.760 | 0.711 | 0.665 | 0.623 | 0.583 | 0.547 | 0.513 |
| 8 | 0.923 | 0.853 | 0.789 | 0.731 | 0.677 | 0.627 | 0.582 | 0.540 | 0.502 | 0.467 |
| 9 | 0.914 | 0.837 | 0.766 | 0.703 | 0.645 | 0.592 | 0.544 | 0.500 | 0.460 | 0.424 |
| 10 | 0.905 | 0.820 | 0.744 | 0.676 | 0.614 | 0.558 | 0.508 | 0.463 | 0.422 | 0.386 |
| 11 | 0.896 | 0.804 | 0.722 | 0.650 | 0.585 | 0.527 | 0.475 | 0.429 | 0.388 | 0.350 |
| 12 | 0.887 | 0.788 | 0.701 | 0.625 | 0.557 | 0.497 | 0.444 | 0.397 | 0.356 | 0.319 |
| 13 | 0.879 | 0.773 | 0.681 | 0.601 | 0.530 | 0.469 | 0.415 | 0.368 | 0.326 | 0.290 |
| 14 | 0.870 | 0.758 | 0.661 | 0.577 | 0.505 | 0.442 | 0.388 | 0.340 | 0.299 | 0.263 |
| 15 | 0.861 | 0.743 | 0.642 | 0.555 | 0.481 | 0.417 | 0.362 | 0.315 | 0.275 | 0.239 |
| 16 | 0.853 | 0.728 | 0.623 | 0.534 | 0.458 | 0.394 | 0.339 | 0.292 | 0.252 | 0.218 |
| 17 | 0.844 | 0.714 | 0.605 | 0.513 | 0.436 | 0.371 | 0.317 | 0.270 | 0.231 | 0.198 |
| 18 | 0.836 | 0.700 | 0.587 | 0.494 | 0.416 | 0.350 | 0.296 | 0.250 | 0.212 | 0.180 |
| 19 | 0.828 | 0.686 | 0.570 | 0.475 | 0.396 | 0.331 | 0.277 | 0.232 | 0.194 | 0.164 |
| 20 | 0.820 | 0.673 | 0.554 | 0.456 | 0.377 | 0.312 | 0.258 | 0.215 | 0.178 | 0.149 |


| Periods |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | :---: | :---: |
| $(n)$ | Interest rates $(r)$ |  |  |  |  |  |  |  |  |  |  |  |
|  | $11 \%$ | $12 \%$ | $13 \%$ | $14 \%$ | $15 \%$ | $16 \%$ | $17 \%$ | $18 \%$ | $19 \%$ | $20 \%$ |  |  |
| 1 | 0.901 | 0.893 | 0.885 | 0.877 | 0.870 | 0.862 | 0.855 | 0.847 | 0.840 | 0.833 |  |  |
| 2 | 0.812 | 0.797 | 0.783 | 0.769 | 0.756 | 0.743 | 0.731 | 0.718 | 0.706 | 0.694 |  |  |
| 3 | 0.731 | 0.712 | 0.693 | 0.675 | 0.658 | 0.641 | 0.624 | 0.609 | 0.593 | 0.579 |  |  |
| 4 | 0.659 | 0.636 | 0.613 | 0.592 | 0.572 | 0.552 | 0.534 | 0.516 | 0.499 | 0.482 |  |  |
| 5 | 0.593 | 0.567 | 0.543 | 0.519 | 0.497 | 0.476 | 0.456 | 0.437 | 0.419 | 0.402 |  |  |
| 6 | 0.535 | 0.507 | 0.480 | 0.456 | 0.432 | 0.410 | 0.390 | 0.370 | 0.352 | 0.335 |  |  |
| 7 | 0.482 | 0.452 | 0.425 | 0.400 | 0.376 | 0.354 | 0.333 | 0.314 | 0.296 | 0.279 |  |  |
| 8 | 0.434 | 0.404 | 0.376 | 0.351 | 0.327 | 0.305 | 0.285 | 0.266 | 0.249 | 0.233 |  |  |
| 9 | 0.391 | 0.361 | 0.333 | 0.308 | 0.284 | 0.263 | 0.243 | 0.225 | 0.209 | 0.194 |  |  |
| 10 | 0.352 | 0.322 | 0.295 | 0.270 | 0.247 | 0.227 | 0.208 | 0.191 | 0.176 | 0.162 |  |  |
| 11 | 0.317 | 0.287 | 0.261 | 0.237 | 0.215 | 0.195 | 0.178 | 0.162 | 0.148 | 0.135 |  |  |
| 12 | 0.286 | 0.257 | 0.231 | 0.208 | 0.187 | 0.168 | 0.152 | 0.137 | 0.124 | 0.112 |  |  |
| 13 | 0.258 | 0.229 | 0.204 | 0.182 | 0.163 | 0.145 | 0.130 | 0.116 | 0.104 | 0.093 |  |  |
| 14 | 0.232 | 0.205 | 0.181 | 0.160 | 0.141 | 0.125 | 0.111 | 0.099 | 0.088 | 0.078 |  |  |
| 15 | 0.209 | 0.183 | 0.160 | 0.140 | 0.123 | 0.108 | 0.095 | 0.084 | 0.079 | 0.065 |  |  |
| 16 | 0.188 | 0.163 | 0.141 | 0.123 | 0.107 | 0.093 | 0.081 | 0.071 | 0.062 | 0.054 |  |  |
| 17 | 0.170 | 0.146 | 0.125 | 0.108 | 0.093 | 0.080 | 0.069 | 0.060 | 0.052 | 0.045 |  |  |
| 18 | 0.153 | 0.130 | 0.111 | 0.095 | 0.081 | 0.069 | 0.059 | 0.051 | 0.044 | 0.038 |  |  |
| 19 | 0.138 | 0.116 | 0.098 | 0.083 | 0.070 | 0.060 | 0.051 | 0.043 | 0.037 | 0.031 |  |  |
| 20 | 0.124 | 0.104 | 0.087 | 0.073 | 0.061 | 0.051 | 0.043 | 0.037 | 0.031 | 0.026 |  |  |

Cumulative present value of 1 unit of currency per annum, Receivable or Payable at the end of each year for $n$ years $\frac{1-(1+r)^{-n}}{r}$

| Periods | Interest rates (r) |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ( $n$ ) | 1\% | 2\% | 3\% | 4\% | 5\% | 6\% | 7\% | 8\% | 9\% | 10\% |
| 1 | 0.990 | 0.980 | 0.971 | 0.962 | 0.952 | 0.943 | 0.935 | 0.926 | 0.917 | 0.909 |
| 2 | 1.970 | 1.942 | 1.913 | 1.886 | 1.859 | 1.833 | 1.808 | 1.783 | 1.759 | 1.736 |
| 3 | 2.941 | 2.884 | 2.829 | 2.775 | 2.723 | 2.673 | 2.624 | 2.577 | 2.531 | 2.487 |
| 4 | 3.902 | 3.808 | 3.717 | 3.630 | 3.546 | 3.465 | 3.387 | 3.312 | 3.240 | 3.170 |
| 5 | 4.853 | 4.713 | 4.580 | 4.452 | 4.329 | 4.212 | 4.100 | 3.993 | 3.890 | 3.791 |
| 6 | 5.795 | 5.601 | 5.417 | 5.242 | 5.076 | 4.917 | 4.767 | 4.623 | 4.486 | 4.355 |
| 7 | 6.728 | 6.472 | 6.230 | 6.002 | 5.786 | 5.582 | 5.389 | 5.206 | 5.033 | 4.868 |
| 8 | 7.652 | 7.325 | 7.020 | 6.733 | 6.463 | 6.210 | 5.971 | 5.747 | 5.535 | 5.335 |
| 9 | 8.566 | 8.162 | 7.786 | 7.435 | 7.108 | 6.802 | 6.515 | 6.247 | 5.995 | 5.759 |
| 10 | 9.471 | 8.983 | 8.530 | 8.111 | 7.722 | 7.360 | 7.024 | 6.710 | 6.418 | 6.145 |
| 11 | 10.368 | 9.787 | 9.253 | 8.760 | 8.306 | 7.887 | 7.499 | 7.139 | 6.805 | 6.495 |
| 12 | 11.255 | 10.575 | 9.954 | 9.385 | 8.863 | 8.384 | 7.943 | 7.536 | 7.161 | 6.814 |
| 13 | 12.134 | 11.348 | 10.635 | 9.986 | 9.394 | 8.853 | 8.358 | 7.904 | 7.487 | 7.103 |
| 14 | 13.004 | 12.106 | 11.296 | 10.563 | 9.899 | 9.295 | 8.745 | 8.244 | 7.786 | 7.367 |
| 15 | 13.865 | 12.849 | 11.938 | 11.118 | 10.380 | 9.712 | 9.108 | 8.559 | 8.061 | 7.606 |
| 16 | 14.718 | 13.578 | 12.561 | 11.652 | 10.838 | 10.106 | 9.447 | 8.851 | 8.313 | 7.824 |
| 17 | 15.562 | 14.292 | 13.166 | 12.166 | 11.274 | 10.477 | 9.763 | 9.122 | 8.544 | 8.022 |
| 18 | 16.398 | 14.992 | 13.754 | 12.659 | 11.690 | 10.828 | 10.059 | 9.372 | 8.756 | 8.201 |
| 19 | 17.226 | 15.679 | 14.324 | 13.134 | 12.085 | 11.158 | 10.336 | 9.604 | 8.950 | 8.365 |
| 20 | 18.046 | 16.351 | 14.878 | 13.590 | 12.462 | 11.470 | 10.594 | 9.818 | 9.129 | 8.514 |


| Periods |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $(n)$ | Interest rates $(r)$ |  |  |  |  |  |  |  |  |  |  |
|  | $11 \%$ | $12 \%$ | $13 \%$ | $14 \%$ | $15 \%$ | $16 \%$ | $17 \%$ | $18 \%$ | $19 \%$ | $20 \%$ |  |
| 1 | 0.901 | 0.893 | 0.885 | 0.877 | 0.870 | 0.862 | 0.855 | 0.847 | 0.840 | 0.833 |  |
| 2 | 1.713 | 1.690 | 1.668 | 1.647 | 1.626 | 1.605 | 1.585 | 1.566 | 1.547 | 1.528 |  |
| 3 | 2.444 | 2.402 | 2.361 | 2.322 | 2.283 | 2.246 | 2.210 | 2.174 | 2.140 | 2.106 |  |
| 4 | 3.102 | 3.037 | 2.974 | 2.914 | 2.855 | 2.798 | 2.743 | 2.690 | 2.639 | 2.589 |  |
| 5 | 3.696 | 3.605 | 3.517 | 3.433 | 3.352 | 3.274 | 3.199 | 3.127 | 3.058 | 2.991 |  |
| 6 | 4.231 | 4.111 | 3.998 | 3.889 | 3.784 | 3.685 | 3.589 | 3.498 | 3.410 | 3.326 |  |
| 7 | 4.712 | 4.564 | 4.423 | 4.288 | 4.160 | 4.039 | 3.922 | 3.812 | 3.706 | 3.605 |  |
| 8 | 5.146 | 4.968 | 4.799 | 4.639 | 4.487 | 4.344 | 4.207 | 4.078 | 3.954 | 3.837 |  |
| 9 | 5.537 | 5.328 | 5.132 | 4.946 | 4.772 | 4.607 | 4.451 | 4.303 | 4.163 | 4.031 |  |
| 10 | 5.889 | 5.650 | 5.426 | 5.216 | 5.019 | 4.833 | 4.659 | 4.494 | 4.339 | 4.192 |  |
| 11 | 6.207 | 5.938 | 5.687 | 5.453 | 5.234 | 5.029 | 4.836 | 4.656 | 4.486 | 4.327 |  |
| 12 | 6.492 | 6.194 | 5.918 | 5.660 | 5.421 | 5.197 | 4.988 | 7.793 | 4.611 | 4.439 |  |
| 13 | 6.750 | 6.424 | 6.122 | 5.842 | 5.583 | 5.342 | 5.118 | 4.910 | 4.715 | 4.533 |  |
| 14 | 6.982 | 6.628 | 6.302 | 6.002 | 5.724 | 5.468 | 5.229 | 5.008 | 4.802 | 4.611 |  |
| 15 | 7.191 | 6.811 | 6.462 | 6.142 | 5.847 | 5.575 | 5.324 | 5.092 | 4.876 | 4.675 |  |
| 16 | 7.379 | 6.974 | 6.604 | 6.265 | 5.954 | 5.668 | 5.405 | 5.162 | 4.938 | 4.730 |  |
| 17 | 7.549 | 7.120 | 6.729 | 6.373 | 6.047 | 5.749 | 5.475 | 5.222 | 4.990 | 4.775 |  |
| 18 | 7.702 | 7.250 | 6.840 | 6.467 | 6.128 | 5.818 | 5.534 | 5.273 | 5.033 | 4.812 |  |
| 19 | 7.839 | 7.366 | 6.938 | 6.550 | 6.198 | 5.877 | 5.584 | 5.316 | 5.070 | 4.843 |  |
| 20 | 7.963 | 7.469 | 7.025 | 6.623 | 6.259 | 5.929 | 5.628 | 5.353 | 5.101 | 4.870 |  |

## PROBABILITY

$A \cup B=\boldsymbol{A}$ or $\boldsymbol{B} . \quad A \cap B=\boldsymbol{A}$ and $\boldsymbol{B}$ (overlap).
$P(B \mid A)=$ probability of $B$, given $A$.

## Rules of Addition

If $A$ and $B$ are mutually exclusive:
If $A$ and $B$ are not mutually exclusive:

$$
\begin{aligned}
& P(A \cup B)=P(A)+P(B) \\
& P(A \cup B)=P(A)+P(B)-P(A \cap B)
\end{aligned}
$$

## Rules of Multiplication

If $A$ and $B$ are independent:

$$
\begin{aligned}
& P(A \cap B)=P(A) * P(B) \\
& P(A \cap B)=P(A) * P(B \mid A)
\end{aligned}
$$

If $A$ and $B$ are not independent:
$E(X)=\sum$ (probability * payoff)

## DESCRIPTIVE STATISTICS

Arithmetic Mean

$$
\bar{x}=\frac{\sum x}{n} \quad \bar{x}=\frac{\sum f x}{\sum f} \quad \text { (frequency distribution) }
$$

Standard Deviation

$$
S D=\sqrt{\frac{\sum(x-\bar{x})^{2}}{n}} \quad S D=\sqrt{\frac{\sum \mathrm{fx}^{2}-\overline{x^{2}}}{\sum \mathrm{f}}} \text { (frequency distribution) }
$$

## INDEX NUMBERS

Price relative $=100 * P_{1} / P_{0} \quad$ Quantity relative $=100 * Q_{1} / Q_{0}$
Price: $\quad \frac{\sum w *\left(\frac{P_{1}}{P_{0}}\right)}{\sum w} \times 100$
Quantity: $\quad \frac{\sum w *\left(\frac{Q_{1}}{Q_{0}}\right)}{\sum w} \times 100$

## TIME SERIES

Additive Model

$$
\text { Series }=\text { Trend }+ \text { Seasonal + Random }
$$

Multiplicative Model

$$
\text { Series }=\text { Trend * Seasonal * Random }
$$

## FINANCIAL MATHEMATICS

## Compound Interest (Values and Sums)

Future Value $S$, of a sum of $X$, invested for $n$ periods, compounded at $r \%$ interest

$$
S=X[1+r]^{n}
$$

## Annuity

Present value of an annuity of $£ 1$ per annum receivable or payable for $n$ years, commencing in one year, discounted at $r \%$ per annum:

$$
\mathrm{PV}=\frac{1}{r}\left[1-\frac{1}{[1+r]^{n}}\right]
$$

## Perpetuity

Present value of $£ 1$ per annum, payable or receivable in perpetuity, commencing in one year, discounted at $r \%$ per annum:

$$
\mathrm{PV}=\frac{1}{r}
$$

## LEARNING CURVE

$$
Y_{x}=a x^{b}
$$

where:
$Y_{X}=$ the cumulative average time per unit to produce $X$ units;
$a=$ the time required to produce the first unit of output;
$X=$ the cumulative number of units;
$b=$ the index of learning.
The exponent $b$ is defined as the log of the learning curve improvement rate divided by $\log 2$.

## INVENTORY MANAGEMENT

Economic Order Quantity

$$
\mathrm{EOQ}=\sqrt{\frac{2 \mathrm{C}_{0} \mathrm{D}}{\mathrm{C}_{\mathrm{h}}}}
$$

where: $\mathrm{C}_{0}=$ cost of placing an order
$C_{h}=$ cost of holding one unit in inventory for one year
D $\quad=\quad$ annual demand

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## LIST OF VERBS USED IN THE QUESTION REQUIREMENTS

A list of the learning objectives and verbs that appear in the syllabus and in the question requirements for each question in this paper.

It is important that you answer the question according to the definition of the verb.

| LEARNING OBJECTIVE | VERBS USED | DEFINITION |
| :--- | :--- | :--- |
| Level $\mathbf{1}$ - KNOWLEDGE <br> What you are expected to know. | Make a list of |  |
|  | List | Express, fully or clearly, the details/facts of |
| Level 2 - COMPREHENSION | Give the exact meaning of |  |

## Performance Pillar

## Management Level Paper

P2 - Performance Management

## May 2011

## Wednesday Afternoon Session

