# CIMA

Performance Pillar

## P2 – Performance Management

## 23 May 2012 - 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** during which you should read the question paper and, if you wish, make annotations on the question paper. However, you will **not** be allowed, **under any circumstances**, to open the answer book and start writing or use your calculator during this reading time.

You are strongly advised to carefully read ALL the question requirements before attempting the question concerned (that is all parts and/or subquestions).

ALL answers must be written in the answer book. Answers written on the 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 19.

Write your candidate number, the paper number and examination subject title in the spaces provided on the front of the answer book. Also write your contact ID and name in the space provided in the right hand margin and seal to close.

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

Performance Management I

TURN OVER

SECTION A - 50 MARKS

[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**

A company is developing a new product. During its expected life it is expected that 8,000 units of the product will be sold for \$90 per unit.

The direct material and other non-labour related costs will be \$45 per unit throughout the life of the product.

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 four batches produced. Thereafter the labour cost will remain at the same cost per batch as the 4<sup>th</sup> batch. The direct labour cost of the first batch of 1,000 units is expected to be \$40,000 and a 90% learning effect is expected to occur.

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

Requir	ed:
(a)	
(i)	Calculate the average direct labour cost per batch of the first four batches.
	(2 marks)
(ii)	Calculate the direct labour cost of the 4 <sup>th</sup> batch.
	(2 marks)
(iii)	Calculate the contribution earned from the product over its lifetime.
	(2 marks)
Note	The learning index for a 90% learning curve = -0.152
Due t learn	to the low lifetime product volume of 8,000 units the company now believes that ing may continue throughout its entire product life.
(b)	<b>Calculate</b> the rate of learning required (to the nearest whole percentage) to achieve a lifetime product contribution target of \$150,000, assuming that a constant rate of learning applies throughout the product's life.
	(4 marks)
	(Total for Question One = 10 marks)

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#### **Question Two**

A small town with a population of 35,000 has a community library. The nearest alternative library is 15 miles away. A further 20,000 people live within a ten mile radius of the town. Of these, 5,000 people live nearer to the alternative library.

The library has 25,000 registered users and on average each of the registered users borrows two books and one DVD every week. The library has 125,000 books and 50,000 DVDs on its inventory lists, though this is constantly changing as old items are removed and new items are added.

The library offers a variety of types of book and DVD in order to attract interest from a large range of potential users, and for some of the more popular items it has more than one copy.

The library does not charge a fee to its users; it is funded by donations and by government. However it does need to measure its performance and is considering the use of a Balanced Scorecard.

Requi	red:
(a)	<b>Explain</b> the key features of the Balanced Scorecard approach to performance measurement.
	(4 marks)
(b)	<b>State</b> TWO perspectives of the Balanced Scorecard and for EACH of these, <b>recommend</b> with reasons, ONE performance measure that could be used to measure the performance of the library. <i>(6 marks)</i>
	(Total for Question Two = 10 marks)

## Section A continues on the next page

### **Question Three**

A company has prepared the following summary from its functional budgets for the year ended 30th September 2013.

Sales (100,000 units)	\$000	<i>\$000</i> 1,500
Opening inventory (zero units)	nil	
Production costs (115,000 units): Direct materials Direct labour Variable overhead Fixed overhead	460 575 115 <u>230</u>	
	1,380	
Closing inventory (15,000 units)	<u>180</u>	
Cost of Sales		<u>1,200</u>
Gross Profit		300
Other overhead costs		<u>200</u>
Net Profit		<u>100</u>

The directors of the company have now met to review the above statement. They have decided to revise the budget as follows:

- Due to competition, reduce the selling price by \$5 per unit and despite the reduction in selling price the demand for the product will reduce to 90,000 units.
- Increase some of the unit production costs: direct labour by 10% and variable overhead by 5%. No change is expected to any other costs.
- Reduce production to 100,000 units.

Requi	red:
(a)	<b>Prepare</b> a summary statement (in the same format as that shown above) which clearly shows the effect of all of the changes proposed by the directors of the company. <i>(6 marks)</i>
(b)	Discuss the motivational factors in involving functional managers in the setting of functional budgets. (4 marks) (Total for Question Three = 10 marks)

#### **Question Four**

A company has predicted its sales demand for each of the four quarters of 2013 as follows:

Quarter	1	2	3	4
Sales volume (units)	100,000	110,000	190,000	140,000

The company has a normal production capacity of 135,000 units per quarter without needing to utilise any overtime working. However the capacity can be increased by up to 40% by working overtime.

It is current company policy to manufacture units using a constant level production system. This means that although the opening and closing levels of inventory for the year are zero units there are increases and decreases in the quarterly inventory levels. On this basis the selling price, variable production costs and contribution for 2013 are expected to be as follows:

Selling price		\$ per unit 90.00
Direct materials Direct labour Variable production overhead	30.00 35.00	75.00
Contribution	10.00	<u>15.00</u>

However, any overtime working will increase the unit direct labour cost by 50% and the unit variable production overhead cost by 30% for those units produced during overtime working.

In addition, the company incurs a storage cost of \$4 per unit per quarter for each item that is held in inventory. These costs are not included in the production costs above.

The company is considering whether it should change to a just-in-time (JIT) production system, but is concerned that due to the fluctuating levels of its sales demand this may not be financially beneficial. If the company did change to a JIT production system:

- No inventory would be held.
- There would be no change in the behaviour of variable production costs.

 	Requir	red:	     
             	(a)	<b>Calculate</b> the cost of holding inventory (based on average inventory levels in each of the quarters) for each of the quarters and the year in total under the current production system. Assume that sales occur evenly during each quarter. <i>(4 marks)</i>	
1	(b)	Calculate the financial impact of changing to a JIT production system.	i
		(6 marks)	י ו ו
     		(Total for Question Four = 10 marks)	ו ו וו

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### **Question Five**

A company uses "total cost plus" pricing. Recent results show that profits are falling and that the company is losing market share in what is becoming a very competitive market.

<i>(a)</i> Exp	blain TWO disadvantages of "total cost plus" pricing. (4 marks)
(b) Exp	blain how target costing could be of benefit to the company.
	(6 marks)
	(Total for Question Five = 10 marks)

(Total for Section A = 50 marks)

End of Section A Section B starts on page 8

**TURN OVER** 

## 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**

WRX manufactures three products using different quantities of the same resources. Details of these products are as follows:

Product	W	R	Х
	\$/unit	\$/unit	\$/unit
Market selling price	90	126	150
Direct labour (\$7/hour)	14	28	35
Material A (\$3/kg)	15	12	21
Material B (\$6/kg)	24	36	30
Variable overhead (\$4/hour)	8	16	20
Fixed overhead	<u>12</u>	_7	12
	73	<u>99</u>	<u>118</u>
Profit	17	27	32

The management of WRX has predicted the demand for these products for July as follows:

Product W	500 units
Product R	800 units
Product X	1,600 units

These demand estimates do NOT include an order from a major customer to supply 400 units per month of each of the three products, at a discount of \$10 per unit from the market selling price.

During July the management of WRX anticipate that there will be a shortage of material B, and that only 17,500 kgs will be available.

It is not possible for WRX to hold inventory of any raw materials, work in progress or finished products.

(a)	<b>Prepare</b> calculations to show the optimum product mix to maximise WRX's profit for July, assuming that the order with the major customer is supplied in full.
	(7 marks)
WR to be WR finar	X has now realised that the contract with the major customer does not have e met in full for any of the three products. The customer will accept whatever X is prepared to supply at the contracted prices but they will charge a ncial penalty if WRX does not supply them in full in July.
(b)	<b>Calculate</b> the lowest value of the financial penalty that the major customer would need to insert in the contract to ensure that WRX meets its order in full in July.
	(8 marks)
tean dired A de July the o requ	In of WRX, the production manager has advised that, due to holidays, the numb ct labour hours available will be reduced to a total of 9,800 hours in July. ecision has been made that WRX will fulfil its order with the major customer in f , and it has been agreed that a linear programming model will be used to deter optimum usage of the resources that will be available after setting aside those ired for the major customer's order.
tean dired A de July the o requ	That you have presented your answers to (a) and (b) above to the management of WRX, the production manager has advised that, due to holidays, the numb of labour hours available will be reduced to a total of 9,800 hours in July. ecision has been made that WRX will fulfil its order with the major customer in f , and it has been agreed that a linear programming model will be used to deter optimum usage of the resources that will be available after setting aside those nired for the major customer's order.
tean dired A de July the c requ Requi	In all you have presented your answers to (a) and (b) above to the management of WRX, the production manager has advised that, due to holidays, the number of under hours available will be reduced to a total of 9,800 hours in July. Excision has been made that WRX will fulfil its order with the major customer in f , and it has been agreed that a linear programming model will be used to detern optimum usage of the resources that will be available after setting aside those irred for the major customer's order. Identify the objective function and the constraints to be used in the linear programming model to determine the optimum usage of the remaining resources to maximise the company's profits for July.
tean dired A de July the c requ Requi	In all you have presented your answers to (a) and (b) above to the management of WRX, the production manager has advised that, due to holidays, the number of WRX, the production manager has advised that, due to holidays, the number of under the tabour hours available will be reduced to a total of 9,800 hours in July. Excision has been made that WRX will fulfil its order with the major customer in f and it has been agreed that a linear programming model will be used to detern optimum usage of the resources that will be available after setting aside those sired for the major customer's order. Identify the objective function and the constraints to be used in the linear programming model to determine the optimum usage of the remaining resources to maximise the company's profits for July. (6 marks)
tean dired A de July the requ Requi	In all you have presented your answers to (a) and (b) above to the management of WRX, the production manager has advised that, due to holidays, the number of WRX, the production manager has advised that, due to holidays, the number of wreak advised that a linear programming model will be used to detern optimum usage of the resources that will be available after setting aside those nired for the major customer's order.          Identify the objective function and the constraints to be used in the linear programming model to determine the optimum usage of the remaining resources to maximise the company's profits for July.         The optimal solution has been determined as:         W 500 units R       0 units X 880 units
tean dired A de July the o requ (i)	Identify the objective function and the constraints to be used in the linear programming model to determine the optimum usage of the resources that will be constraints to be used in the linear programming model in the linear programming model in the linear programming model to determine the optimum usage of the remaining resources to maximise the company's profits for July. (6 marks) The optimal solution has been determined as: W 500 units R 0 units X 880 units Explain which of the constraints you stated in (c)(i) are binding on the solution.
tean dired A de July the o requ (i) (ii)	In all you have presented your answers to (a) and (b) above to the management of WRX, the production manager has advised that, due to holidays, the number of WRX, the production manager has advised that, due to holidays, the number of WRX, the production manager has advised that, due to holidays, the number of WRX, the production manager has advised that, due to holidays, the number of WRX, the production manager has advised that, due to holidays, the number of WRX, the production manager has advised that, due to holidays, the number of WRX, the production manager has advised that, due to holidays, the number of labour hours available will be reduced to a total of 9,800 hours in July. Accision has been made that WRX will fulfil its order with the major customer in f, and it has been agreed that a linear programming model will be available after setting aside those between the major customer's order. Identify the objective function and the constraints to be used in the linear programming model to determine the optimum usage of the remaining resources to maximise the company's profits for July. (6 marks) The optimal solution has been determined as: W 500 units R 0 units X 880 units Explain which of the constraints you stated in (c)(i) are binding on the solution. (You are not required to draw a graph.)

Section B continues on the next page

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#### **Question Seven**

The GHYD company comprises two divisions: GH and YD.

GH manufactures components using a specialised machine. It sells the same components both externally and to YD. The variable costs of producing the component are as follows:

	\$/unit
Direct materials	25.00
Direct labour	35.00
Variable overhead	<u>10.00</u>
	70.00

GH currently sells its components to the external market for \$125 per unit.

GH also sells 4,000 components per month to YD. These are transferred at the same price as the external selling price.

YD uses two of these components in each unit of its CX product. The current selling price of the CX product is \$375 per unit and at this selling price the demand for the CX is 2,000 units per month. The variable costs of producing a unit of CX are as follows:

	\$/unit
Direct materials	35.00
Components transferred from GH @ \$125 each	250.00
Direct labour	15.00
Variable overhead	10.00

At this level of activity the total monthly contribution earned by YD from the sale of the CX product is \$130,000.

An analysis of the demand for the CX product indicates that for every \$25 increase in its selling price the monthly demand would reduce by 500 units, and that for every \$25 decrease in its selling price demand would increase by 500 units.

Note: If P = a - bx then MR = a - 2bx

(a)		
(i)	<b>Calculate</b> the selling price per unit of CX that would maximise the generated by that product <b>for the YD division</b> .	profits
	(4	FIIIdrKS
(ii)	<b>Calculate,</b> based on the selling price you calculated in (a)(i) above monthly contribution that CX would generate for:	e, the
	GHYD as a whole	
	<ul> <li>GH division</li> <li>YD division</li> </ul>	
	Note: Your answer should show three separate amounts.	6 marks
(b)	GHYD has now reviewed its transfer pricing policy and decided that transfer prices should be set so as to lead to optimal decision mak the company as a whole. Assuming that the transfer price for the component is changed to reflect this new policy:	at all ing for
(i)	<b>Calculate</b> the selling price per unit of CX that would maximise the earned by CX for the company as a whole. Note: you should as: that there is sufficient capacity within the company.	profits sume
	(4	a marks
(ii)	<b>Calculate,</b> based on the selling price you calculated in (b)(i) above monthly contribution that CX would generate for:	e, the
	GHYD as a whole	
	GH division     YD division	
	Note: Your answer should show three separate amounts.	8 marks
(c)	<b>Discuss</b> , using your answers to (a) and (b) above, the impact that alternative transfer prices have on the divisional profits of GH and on the company as a whole	YD and
	on the company as a whole.	8 marks

(Total for Section B = 50 marks)

End of question paper

Maths tables and formulae are on pages 13 to 16

## 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	t rates (r)				
( <i>n</i> )	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					Interest	t rates (r)				
( <i>n</i> )	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 TABLE

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

$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Periods					Interest	rates (r)				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	( <i>n</i> )	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
2       1.970       1.942       1.913       1.886       1.859       1.833       1.808       1.783       1.759         3       2.941       2.884       2.829       2.775       2.723       2.673       2.624       2.577       2.531         4       3.902       3.808       3.717       3.630       3.546       3.465       3.387       3.312       3.240         5       4.853       4.713       4.580       4.452       4.329       4.212       4.100       3.993       3.890         6       5.795       5.601       5.417       5.242       5.076       4.917       4.767       4.623       4.486         7       6.728       6.472       6.230       6.002       5.786       5.582       5.389       5.206       5.033         8       7.652       7.325       7.020       6.733       6.463       6.210       5.971       5.747       5.535         9       8.566       8.162       7.786       7.435       7.108       6.802       6.515       6.247       5.995         10       9.471       8.983       8.530       8.111       7.722       7.360       7.024       6.710       6.418	1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736
4       3.902       3.808       3.717       3.630       3.546       3.465       3.387       3.312       3.240         5       4.853       4.713       4.580       4.452       4.329       4.212       4.100       3.993       3.890         6       5.795       5.601       5.417       5.242       5.076       4.917       4.767       4.623       4.486         7       6.728       6.472       6.230       6.002       5.786       5.582       5.389       5.206       5.033         8       7.652       7.325       7.020       6.733       6.463       6.210       5.971       5.747       5.535         9       8.566       8.162       7.786       7.435       7.108       6.802       6.515       6.247       5.995         10       9.471       8.983       8.530       8.111       7.722       7.360       7.024       6.710       6.418         11       10.368       9.787       9.253       8.760       8.306       7.887       7.499       7.139       6.805         12       11.255       10.575       9.954       9.385       8.863       8.384       7.943       7.536       7.161	3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487
5       4.853       4.713       4.580       4.452       4.329       4.212       4.100       3.993       3.890         6       5.795       5.601       5.417       5.242       5.076       4.917       4.767       4.623       4.486         7       6.728       6.472       6.230       6.002       5.786       5.582       5.389       5.206       5.033         8       7.652       7.325       7.020       6.733       6.463       6.210       5.971       5.747       5.535         9       8.566       8.162       7.786       7.435       7.108       6.802       6.515       6.247       5.995         10       9.471       8.983       8.530       8.111       7.722       7.360       7.024       6.710       6.418         11       10.368       9.787       9.253       8.760       8.306       7.887       7.499       7.139       6.805         12       11.255       10.575       9.954       9.385       8.863       8.384       7.943       7.536       7.161         13       12.134       11.348       10.635       9.986       9.394       8.853       8.358       7.904       7.487	4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	6	5.795	5.601	5.417	5.242	5.076	4.917	4.767	4.623	4.486	4.355
8         7.652         7.325         7.020         6.733         6.463         6.210         5.971         5.747         5.535           9         8.566         8.162         7.786         7.435         7.108         6.802         6.515         6.247         5.995           10         9.471         8.983         8.530         8.111         7.722         7.360         7.024         6.710         6.418           11         10.368         9.787         9.253         8.760         8.306         7.887         7.499         7.139         6.805           12         11.255         10.575         9.954         9.385         8.863         8.384         7.943         7.536         7.161           13         12.134         11.348         10.635         9.986         9.394         8.853         8.358         7.904         7.487           14         13.004         12.106         11.296         10.563         9.899         9.295         8.745         8.244         7.786           15         13.865         12.849         11.938         11.118         10.380         9.712         9.108         8.559         8.061           16         14.718 <t< td=""><td>7</td><td>6.728</td><td>6.472</td><td>6.230</td><td>6.002</td><td>5.786</td><td>5.582</td><td>5.389</td><td>5.206</td><td>5.033</td><td>4.868</td></t<>	7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868
9         8.566         8.162         7.786         7.435         7.108         6.802         6.515         6.247         5.995           10         9.471         8.983         8.530         8.111         7.722         7.360         7.024         6.710         6.418           11         10.368         9.787         9.253         8.760         8.306         7.887         7.499         7.139         6.805           12         11.255         10.575         9.954         9.385         8.863         8.384         7.943         7.536         7.161           13         12.134         11.348         10.635         9.986         9.394         8.853         8.358         7.904         7.487           14         13.004         12.106         11.296         10.563         9.899         9.295         8.745         8.244         7.786           15         13.865         12.849         11.938         11.118         10.380         9.712         9.108         8.559         8.061           16         14.718         13.578         12.561         11.652         10.838         10.106         9.447         8.851         8.313           17         14.529	8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.335
10         9.471         8.983         8.530         8.111         7.722         7.360         7.024         6.710         6.418           11         10.368         9.787         9.253         8.760         8.306         7.887         7.499         7.139         6.805           12         11.255         10.575         9.954         9.385         8.863         8.384         7.943         7.536         7.161           13         12.134         11.348         10.635         9.986         9.394         8.853         8.358         7.904         7.487           14         13.004         12.106         11.296         10.563         9.899         9.295         8.745         8.244         7.786           15         13.865         12.849         11.938         11.118         10.380         9.712         9.108         8.559         8.061           16         14.718         13.578         12.661         11.652         10.838         10.106         9.447         8.851         8.313	9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.759
11         10.368         9.787         9.253         8.760         8.306         7.887         7.499         7.139         6.805           12         11.255         10.575         9.954         9.385         8.863         8.384         7.943         7.536         7.161           13         12.134         11.348         10.635         9.986         9.394         8.853         8.358         7.904         7.487           14         13.004         12.106         11.296         10.563         9.899         9.295         8.745         8.244         7.786           15         13.865         12.849         11.938         11.118         10.380         9.712         9.108         8.559         8.061           16         14.718         13.578         12.561         11.652         10.838         10.106         9.447         8.851         8.313	10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145
12         11.255         10.575         9.954         9.385         8.863         8.384         7.943         7.536         7.161           13         12.134         11.348         10.635         9.986         9.394         8.853         8.358         7.904         7.487           14         13.004         12.106         11.296         10.563         9.899         9.295         8.745         8.244         7.786           15         13.865         12.849         11.938         11.118         10.380         9.712         9.108         8.559         8.061           16         14.718         13.578         12.561         11.652         10.838         10.106         9.447         8.851         8.313	11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495
13         12.134         11.348         10.635         9.986         9.394         8.853         8.358         7.904         7.487           14         13.004         12.106         11.296         10.563         9.899         9.295         8.745         8.244         7.786           15         13.865         12.849         11.938         11.118         10.380         9.712         9.108         8.559         8.061           16         14.718         13.578         12.561         11.652         10.838         10.106         9.447         8.851         8.313           17         19.102         10.402         10.402         10.402         10.564         10.573         9.544	12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814
14         13.004         12.106         11.296         10.563         9.899         9.295         8.745         8.244         7.786           15         13.865         12.849         11.938         11.118         10.380         9.712         9.108         8.559         8.061           16         14.718         13.578         12.561         11.652         10.838         10.106         9.447         8.851         8.313           17         19.102         10.402         10.402         10.402         10.554         10.554         10.554	13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103
15         13.865         12.849         11.938         11.118         10.380         9.712         9.108         8.559         8.061           16         14.718         13.578         12.561         11.652         10.838         10.106         9.447         8.851         8.313           17         14.522         10.402         14.674         10.402         10.554         10.554	14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367
16         14.718         13.578         12.561         11.652         10.838         10.106         9.447         8.851         8.313           17         14.522         10.402         14.624         14.674         10.402         14.674	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	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	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	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	20	18.046	16.351	14.878	13.590	12.462	11.470	10.594	9.818	9.129	8.514

Periods					Interes	t rates (r)				
( <i>n</i> )	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

#### FORMULAE

#### PROBABILITY

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

#### **Rules of Addition**

If A and B are mutually exclusive:	$P(A \cup B) = P(A) + P(B)$
If A and B are not mutually exclusive:	$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

#### **Rules of Multiplication**

If A and B are independent.	$P(A \cap B) = P(A) * P(B)$
If A and B are <b>not</b> independent.	$P(A \cap B) = P(A) * P(B \mid A)$

 $E(X) = \sum$  (probability \* payoff)

#### **DESCRIPTIVE STATISTICS**

Arithmetic Mean

$$\overline{x} = \frac{\sum x}{n}$$
  $\overline{x} = \frac{\sum fx}{\sum f}$  (frequency distribution)

Standard Deviation

$$SD = \sqrt{\frac{\sum(x - \overline{x})^2}{n}}$$
  $SD = \sqrt{\frac{\sum fx^2}{\sum f} - \overline{x^2}}$  (frequency distribution)

#### **INDEX NUMBERS**

Price relative =  $100 * P_1/P_0$  Quantity relative =  $100 * Q_1/Q_0$ 

Price:

$$\frac{\sum w * \left(\frac{P_1}{P_o}\right)}{\sum w} x 100$$

Quantity:

$$\frac{\sum w * \left(\frac{Q_1}{Q_o}\right)}{\sum w} \times 100$$

TIME SERIES

Additive Model

Series = Trend + Seasonal + Random

**Multiplicative Model** 

Series = 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:

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

#### Perpetuity

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

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

#### LEARNING CURVE

$$Y_x = aX^b$$

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

 $C_{\text{o}}$ 

$$EOQ = \sqrt{\frac{2C_oD}{C_h}}$$

where:

 cost of placing an order
 cost of holding one unit in inventory for one year
 annual demand Ch D

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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 1 - KNOWLEDGE					
What you are expected to know.	List	Make a list of			
	State	Express, fully or clearly, the details/facts of			
	Define	Give the exact meaning of			
Level 2 - COMPREHENSION					
What you are expected to understand.	Describe	Communicate the key features			
	Distinguish	Highlight the differences between			
	Explain	Make clear or intelligible/State the meaning or			
		purpose of			
	Identify	Recognise, establish or select after			
		consideration			
	Illustrate	Use an example to describe or explain			
		something			
Level 3 - APPLICATION					
How you are expected to apply your knowledge.	Apply	Put to practical use			
	Calculate	Ascertain or reckon mathematically			
	Demonstrate	Prove with certainty or to exhibit by			
		practical means			
	Prepare	Make or get ready for use			
	Reconcile	Make or prove consistent/compatible			
	Solve	Find an answer to			
	Tabulate	Arrange in a table			
Level 4 - ANALYSIS					
How are you expected to analyse the detail of	Analyse	Examine in detail the structure of			
what you have learned.	Categorise	Place into a defined class or division			
	Compare and contrast	Show the similarities and/or differences			
		between			
	Construct	Build up or compile			
	Discuss	Examine in detail by argument			
	Interpret	Translate into intelligible or familiar terms			
	Prioritise	Place in order of priority or sequence for action			
	Produce	Create or bring into existence			
Level 5 - EVALUATION					
How are you expected to use your learning to	Advise	Counsel, inform or notify			
evaluate, make decisions or recommendations.	Evaluate	Appraise or assess the value of			
	Recommend	Advise on a course of action			

## Performance Pillar

## Management Level Paper

## P2 – Performance Management

## May 2012

## Wednesday Afternoon Session

May 2012

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