



Management Accounting Pillar

Managerial Level Paper

## P2 – Management Accounting - Decision Management

24 May 2006 – Wednesday Morning 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 sub-questions). The requirements for the questions in Sections B and C are contained in a dotted box.

Answer the ONE compulsory question in Section A. This is comprised of eight sub-questions and is on pages 2 to 5.

Answer ALL THREE compulsory questions in Section B on pages 6 to 8.

Answer TWO of the three questions in Section C on pages 10 to 15.

Maths Tables and Formulae are provided on pages 17 to 19. These pages are detachable for ease of reference.

Write your full examination number, paper number and the examination subject title in the spaces provided on the front of the examination 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.

# P2 – Decision Management

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SECTION A – 20 MARKS

[the indicative time for answering this section is 36 minutes]

ANSWER ALL EIGHT SUB-QUESTIONS

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*Instructions for answering Section A:*

The answers to the eight sub-questions in Section A should ALL be written in your answer book.

Your answers should be clearly numbered with the sub-question number and then ruled off, so that the markers know which sub-question you are answering. **For multiple choice questions, you need only write the sub-question number and the letter of the answer option you have chosen.** You do not need to start a new page for each sub-question.

For sub-questions **1.6**, **1.7**, and **1.8** you should show your workings as marks are available for the method you use to answer these sub-questions.

**Question One**

- 1.1** X plc intends to use relevant costs as the basis of the selling price for a special order: the printing of a brochure. The brochure requires a particular type of paper that is not regularly used by X plc although a limited amount is in X plc's inventory which was left over from a previous job. The cost when X plc bought this paper last year was \$15 per ream and there are 100 reams in inventory. The brochure requires 250 reams. The current market price of the paper is \$26 per ream, and the resale value of the paper in inventory is \$10 per ream.

The relevant cost of the paper to be used in printing the brochure is

- A** \$2,500
- B** \$4,900
- C** \$5,400
- D** \$6,500

*(2 marks)*

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*Section A continues on the opposite page*

**1.2** A farmer grows potatoes for sale to wholesalers and to individual customers. The farmer currently digs up the potatoes and sells them in 20kg sacks. He is considering a decision to make a change to this current approach. He thinks that washing the potatoes and packaging them in 2kg cartons might be more attractive to some of his individual customers. Which of the following is relevant to his decision?

- (i) the sales value of the dug potatoes
- (ii) the cost per kg of growing the potatoes
- (iii) the cost of washing and packaging the potatoes
- (iv) the sales value of the washed and packaged potatoes

- A** (ii), (iii) and (iv) only
- B** (i), (ii) and (iii) only
- C** (i), (ii) and (iv) only
- D** (i), (iii) and (iv) only

*(2 marks)*

**1.3** A company makes and sells three products, R, S, and T. Extracts from the weekly profit statements are as follows:

	<i>R</i>	<i>S</i>	<i>T</i>	<i>Total</i>
	\$	\$	\$	\$
Sales	10,000	15,000	20,000	45,000
Variable cost of sales	4,000	9,000	10,000	23,000
Fixed costs*	3,000	3,000	3,000	9,000
Profit	3,000	3,000	7,000	13,000

\* general fixed costs absorbed using a unit absorption rate

If the sales revenue mix of products produced and sold were to be changed to: R 20%, S 50%, T 30% then the new average contribution to sales ratio

- A** would be higher.
- B** would be lower.
- C** would remain unchanged.
- D** cannot be determined without more information.

*(2 marks)*

*Section A continues on the next page*

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- 1.4** Z Limited is a hotel that serves cakes and gateaux in its coffee shop. An analysis of its internal costs has revealed that the variable cost of preparing its own gateaux is £5.50 per gateau compared to the price of £8.00 per gateau that would be charged by an external bakery. Z Limited employs a chef to prepare the gateaux at a salary of £1,000 per month. This chef is not able to carry out any other work in the hotel and is the only employee capable of preparing the gateaux.

Calculate the minimum monthly number of sales of gateaux at which it is worthwhile preparing the gateaux in the hotel.

*(2 marks)*

*The following data are to be used when answering questions 1.5 to 1.7*

M plc is evaluating three possible investment projects and uses a 10% discount rate to determine their net present values.

<i>Investment</i>	<i>A</i>	<i>B</i>	<i>C</i>
	<i>£000</i>	<i>£000</i>	<i>£000</i>
Initial Investment	400	450	350
Incremental cashflows			
Year 1	100	130	50
Year 2	120	130	110
Year 3	140	130	130
Year 4	120	130	150
Year 5*	100	150	100
Net present value	39	55	48

\*includes £20,000 residual value for each investment project.

- 1.5** Calculate the payback period of investment A.

*(2 marks)*

- 1.6** Calculate the discounted payback period of investment B.

*(3 marks)*

- 1.7** Calculate the Internal Rate of Return (IRR) of investment C.

*(3 marks)*

*Section A continues on the opposite page*

- 1.8** A company is preparing a quotation for a new product. The time taken for the first unit of the product was 30 minutes and the company expects an 85% learning curve. The quotation is to be based on the time taken for the final unit within the learning period which is expected to end after the company has produced 200 units.

Calculate the time per unit to be used for the quotation.

*Note:* The learning index for an 85% learning curve is -0.2345

*(4 marks)*

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*(Total for Section A = 20 marks)*

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*End of Section A*

*Section B starts on the next page*

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SECTION B – 30 MARKS

[the indicative time for answering this section is 54 minutes]

ANSWER ALL THREE QUESTIONS

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**Question Two**

A manager is evaluating a three year project which has the following relevant pre-tax operating cashflows:

Year	1	2	3
	\$000	\$000	\$000
Sales	4,200	4,900	5,300
Costs	2,850	3,100	4,150

The project requires an investment of \$2m at the start of year 1 and has no residual value.

The company pays corporation tax on its net relevant operating cashflows at the rate of 20%. Corporation tax is payable in the same year as the net relevant pre-tax operating cashflows arise. There is no tax depreciation available on the investment.

The manager has discounted the net relevant post-tax operating cashflows using the company's post-tax cost of capital of 7% and this results in a post-tax net present value of the project of \$1·018m.

**Required:**

- (a) Briefly explain sensitivity analysis and how the manager may use it in the evaluation of this project.

*(4 marks)*

- (b) Calculate the sensitivity of the project to independent changes in

- (i) the selling price;
- (ii) the cost of capital.

*(6 marks)*

*(Total for Question Two = 10 marks)*

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*Section B continues on the opposite page*

### Question Three

A firm of financial advisors has established itself by providing high quality, personalised, financial strategy advice. The firm promotes itself by sponsoring local events, advertising, client newsletters, having a flexible attitude towards the times and locations of meetings with clients and seeking new and innovative ideas to discuss with its clients.

The senior manager of the firm has recently noticed that the firm's profitability has declined, with fewer clients being interested in the firm's new investment ideas. Indeed, many clients have admitted to not reading the firm's newsletters.

The senior manager seeks your help in restoring the firm's profitability to its former level and believes that the techniques of *Value Analysis* and *Functional Analysis* may be appropriate.

**Required:**

- (a) Explain the meanings of, and the differences between, Value Analysis and Functional Analysis. *(4 marks)*
- (b) Briefly explain the series of steps that you would take to implement Value Analysis for this organisation. *(6 marks)*

*(Total for Question Three = 10 marks)*

*Section B continues on the next page*

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#### **Question Four**

The Managing Director of a manufacturing company based in Eastern Europe has recently returned from a conference on modern manufacturing. One of the speakers at the conference presented a paper entitled "Compliance versus Conformance – the quality control issue". The Managing Director would like you to explain to her some of the concepts that she heard about at the conference.

*Required:*

Prepare a report, addressed to the Managing Director, that discusses quality costs and their significance for the company. Your report should include examples of the different quality costs and their classification within a manufacturing environment.

*(10 marks)*

*Note:* 2 marks are available for report format

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*(Total for Section B = 30 marks)*

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*End of Section B*

*Section C starts on page 10*



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SECTION C – 50 MARKS

[the indicative time for answering this section is 90 minutes]

ANSWER TWO QUESTIONS OUT OF THREE

**Question Five**

AVX Plc assembles circuit boards for use by high technology audio video companies. Due to the rapidly advancing technology in this field, AVX Plc is constantly being challenged to learn new techniques.

AVX Plc uses standard costing to control its costs against targets set by senior managers. The standard labour cost per batch of one particular type of circuit board (CB45) is set out below:

Direct labour - 50 hours @ £10 /hour      £  
500

The following labour efficiency variances arose during the first six months of the assembly of CB45:

<i>Month</i>	<i>Number of batches assembled and sold</i>	<i>Labour Efficiency Variance (£)</i>
November	1	Nil
December	1	170.00 Favourable
January	2	452.20 Favourable
February	4	1,089.30 Favourable
March	8	1,711.50 Favourable
April	16	3,423.00 Favourable

An investigation has confirmed that all of the costs were as expected except that there was a learning effect in respect of the direct labour that had not been anticipated when the standard cost was set.

**Required:**

(a)

- (i) Calculate the monthly rates of learning that applied during the six months;
- (ii) Identify when the learning period ended and briefly discuss the implications of your findings for AVX Plc.

**(10 marks)**

AVX Plc initially priced each batch of CB45 circuit boards on the basis of its standard cost of £960 plus a mark up of 25%. Recently the company has noticed that, due to increasing competition, it is having difficulty maintaining its sales volume at this price.

The Finance Director has agreed that the long run unit variable cost of the CB45 circuit board is £672.72 per batch. She has suggested that the price charged should be based on an analysis of market demand. She has discovered that at a price of £1,200 the demand is 16 batches per month, for every £20 reduction in selling price there is an increase in demand of 1 batch of CB45 circuit boards, and for every £20 increase in selling price there is a reduction in demand of 1 batch.

*Required:*

- (b) Calculate the profit maximising selling price per batch using the data supplied by the Finance Director

*(8 marks)*

*Note:* If Price (P) = a-bx then Marginal Revenue (MR) = a-2bx

The Technical Director cannot understand why there is a need to change the selling price. He argues that this is a highly advanced technological product and that AVX Plc should not reduce its price as this reflects badly on the company. If anything is at fault, he argues, it is the use of Standard Costing and he has asked whether Target Costing should be used instead.

*Required:*

- (c)
- (i) Explain the difference between standard costs and target costs;
  - (ii) Explain the possible reasons why AVX Plc needs to re-consider its pricing policy now that the CB45 circuit board has been available in the market for six months.

*(7 marks)*

*(Total for Question Five = 25 marks)*

*Section C continues on the next page*

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## Question Six

A health clinic is reviewing its plans for the next three years. It is a not for profit organisation but it has a financial responsibility to manage its costs and to ensure that it provides a value for money service to its clients. The health clinic uses the net present value technique to appraise the financial viability of delivering the service, but it also considers other non-financial factors before making any final decisions.

The present facilities, which incur an annual total cost of £300,000, are only sufficient to meet a low level of service provision so the manager is considering investing in facilities to meet potential higher levels of demand. For the purpose of evaluating this decision the possible levels of demand for the health clinic's services have been simplified to high, medium or low.

The possible demand for the services in the first year and the level of demand that could follow that specific level in the next years, and their expected probabilities, are as follows:

<i>Year 1</i>	<i>Probability</i>	<i>Years 2 and 3</i>	<i>Probability</i>
Low	30%	Low	40%
		Medium	60%
		High	0%
Medium	50%	Low	30%
		Medium	40%
		High	30%
High	20%	Low	0%
		Medium	30%
		High	70%

The level of demand will be the same in years 2 and 3.

The manager is considering two alternative investments in facilities:

Facility A has the capacity to meet the low and medium levels of demand and requires an investment at the start of year 1 of £500,000. Thereafter it incurs annual fixed costs of £100,000 and annual variable costs depending on the level of operation. These annual variable costs are expected to be £150,000 at the low level of operation and £250,000 at the medium level of operation.

Facility B has the capacity to meet all levels of demand and requires an investment at the start of year 1 of £800,000. Thereafter it incurs annual fixed costs of £200,000 and annual variable costs depending on the level of operation. These annual variable costs are expected to be £100,000 at the low level of operation, £150,000 at the medium level of operation and £200,000 at the high level of operation.

Neither of these alternative investments has any residual value at the end of year 3.

If the facilities of the health clinic are insufficient to meet the level of service demand that occurs, the clinic must obtain additional facilities on a yearly contract basis at the following annual costs:

<i>Level of service provision available internally</i>	<i>Level of service provision demanded</i>	<i>Annual cost of additional facilities</i>
Low	Medium	£100,000
Low	High	£250,000
Medium	High	£150,000

These additional facilities are not under the direct control of the health clinic manager.

*Note:* All monetary values used throughout the question have been stated in terms of their present value. No further discounting is required.

*Required:*

- (a) Prepare a decision tree to illustrate the investment decision that needs to be made by the manager of the health clinic. (Numerical values are NOT required).

*(6 marks)*

- (b) Advise the manager of the health clinic which investment decision should be undertaken on financial grounds.

*(15 marks)*

- (c) Briefly discuss any non-financial factors that the manager should consider before making her final investment decision.

*(4 marks)*

*(Total for Question Six = 25 marks)*

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*Section C continues on the next page*

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## Question Seven

GHK manufactures four products from different combinations of the same direct materials and direct labour. An extract from the flexible budgets for next quarter for each of these products is as follows:

Product	G		H		J		K	
	3,000	5,000	3,000	5,000	3,000	5,000	3,000	5,000
Units								
Revenue	\$000 30	\$000 50	\$000 60	\$000 100	\$000 45	\$000 75	\$000 90	\$000 150
Direct Material A (note 1)	9	15	12	20	4.5	7.5	18	30
Direct Material B (note 2)	6	10	6	10	13.5	22.5	36	60
Direct labour (note 3)	6	10	24	40	22.5	37.5	9	15
Overhead (note 4)	6	8	13	19	11	17	11	17

### Notes

- 1 Material A was purchased some time ago at a cost of \$5 per kg. There are 5,000 kgs in inventory. The costs shown in the flexible budget are based on this historical cost. The material is in regular use and currently has a replacement cost of \$7 per kg.
- 2 Material B is purchased as required; its expected cost is \$10 per kg. The costs shown in the flexible budget are based on this expected cost.
- 3 Direct labour costs are based on an hourly rate of \$10 per hour. Employees work the number of hours necessary to meet production requirements.
- 4 Overhead costs of each product include a specific fixed cost of \$1,000 per quarter which would be avoided if the product was to be discontinued. Other fixed overhead costs are apportioned between the products but are not affected by the mix of products manufactured.

GHK has been advised by the only supplier of material B that the quantity of material B that will be available during the next quarter will be limited to 5,000 kgs. Accordingly the company is being forced to reconsider its production plan for the next quarter. GHK has already entered into contracts to supply one of its major customers with the following:

500 units of product G  
1,600 units of product H  
800 units of product J  
400 units of product K

Apart from this, the demand expected from other customers is expected to be

3,600 units of product G  
3,000 units of product H  
3,000 units of product J  
4,000 units of product K

The major customer will not accept partial delivery of the contract and if the contract with this major customer is not completed in full, then GHK will have to pay a financial penalty of \$5,000.

**Required:**

- (a) For each of the four products, calculate the relevant contribution per \$ of material B for the next quarter.  
*(6 marks)*
- (b) It has been determined that the optimum production plan based on the data above is to produce 4,100 units of product G, 4600 units of product H, 800 units of product J, and 2,417 units of product K. Determine the amount of financial penalty at which GHK would be indifferent between meeting the contract or paying the penalty.  
*(5 marks)*
- (c) Calculate the relevant contribution to sales ratios for each of the four products.  
*(2 marks)*
- (d) Assuming that the limiting factor restrictions no longer apply, prepare a sketch of a multi product profit volume chart by ranking the products according to your contribution to sales ratio calculations based on total market demand. Your sketch should plot the products using the highest contribution to sales ratio first.  
*(6 marks)*
- (e) Explain briefly, stating any relevant assumptions and limitations, how the multi product profit volume chart that you prepared in (d) above may be used by the manager of GHK to understand the relationships between costs, volume and profit within the business.  
*(6 marks)*

*(Total for Question Seven = 25 marks)*

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*(Total for Section C = 50 marks)*

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*End of question paper*

*Maths Tables and Formulae are on pages 17 to 19*

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## PRESENT VALUE TABLE

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

Periods ( $n$ )	Interest rates ( $r$ )									
	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	0.705	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 per annum, Receivable or Payable at the end of each year for  $n$  years  $\frac{1-(1+r)^{-n}}{r}$

Periods ( $n$ )	Interest rates ( $r$ )									
	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	4.793	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

### **Time series**

Additive model:

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

Multiplicative model:

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

### **Regression analysis**

The linear regression equation of  $Y$  on  $X$  is given by:

$$Y = a + bX \quad \text{or} \quad Y - \bar{Y} = b(X - \bar{X}),$$

where:

$$b = \frac{\text{Covariance}(XY)}{\text{Variance}(X)} = \frac{n \sum XY - (\sum X)(\sum Y)}{n \sum X^2 - (\sum X)^2}$$

and  
or solve

$$a = \bar{Y} - b\bar{X}$$

$$\sum Y = na + b \sum X$$

$$\sum XY = a \sum X + b \sum X^2$$

Exponential

$$Y = ab^x$$

Geometric

$$Y = aX^b$$

### **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.

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# *Management Accounting Pillar*

## *Managerial Level*

### *P2 – Management Accounting – Decision Management*

*May 2006*

*Wednesday Morning Session*