CIMA

Performance Pillar

P1 – Performance Operations

26 May 2010 – 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, highlight and/or make notes 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).
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 8 sub-questions and is on pages 2 to 5.
Section B comprises 6 sub-questions and is on pages 6 to 8.
Section C comprises 2 questions and is on pages 10 to 13.
Maths tables and Formulae are provided on pages 15 to 18.
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.

P1 – Performance Operations

TURN OVER

[Note: The indicative time for answering this section is 36 minutes]

ANSWER *ALL* EIGHT SUB-QUESTIONS IN THIS SECTION

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 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** to **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 Which of the following is **not** a symptom of overtrading?

A Increasing levels of inventory

B Increasing levels of trade receivables

C Increasing levels of current liabilities

D Increasing levels of long term borrowings

(2 marks)

1.2 The following information has been calculated for a business:

Trade receivable collection period   54 days
Raw material inventory turnover period   46 days
Work in progress inventory turnover period 32 days
Trade payables payment period   67 days
Finished goods inventory turnover period   43 days

The length of the working capital cycle is:

A 134 days

B 156 days

C 108 days

D 150 days

(2 marks)

1.3 A project with an initial outlay of $250,000 has a net present value of $46,000 when discounted at the cost of capital of 8%. The present value of the receipts from sales is $520,000.

The sensitivity of the investment decision to changes in the initial outlay is:

A 18·4%

B $204,000

C $270,000

D 8·8%

(2 marks)

Section A continues on the next page

The following data are given for sub-questions 1.4 and 1.5 below

The owner of a van selling hot take-away food has to decide how many burgers to purchase for sale at a forthcoming outdoor concert. The number of burgers sold will depend on the weather conditions and any unsold burgers will be thrown away at the end of the day.

The table below details the profit that would be earned for each possible outcome:

Weather	Number of burgers purchased			
	1,000	*2,000*	*3,000*	*4,000*
Bad	$1,000	$0	($1,000)	($3,000)
Average	$3,000	$6,000	$7,000	$6,000
Good	$3,000	$6,000	$9,000	$12,000

1.4   If the van owner applies the maximin rule he will purchase:

A   1,000 burgers

B   2,000 burgers

C   3,000 burgers

D   4,000 burgers

(2 marks)

1.5   If the van owner applies the minimax regret rule he will purchase:

A   1,000 burgers

B   2,000 burgers

C   3,000 burgers

D   4,000 burgers

(2 marks)

1.6   JB is concerned about the increasing level of trade receivables and is considering various options to encourage customers to pay earlier. The company offers a 30 day payment term but customers are taking on average 65 days to pay.

One option being considered is to offer an early settlement discount of 2·5% for customers paying within 15 days.

Calculate, to the nearest 0·1%, the effective annual interest rate to JB of offering this discount if all customers pay within 15 days. You should assume a 365 day year and use compound interest methodology.

(3 marks)

1.7 A company is considering investing in a new project. The following table shows the project's estimated cash inflows and cash outflows, together with their associated probabilities. The cash inflows and cash outflows are totally independent.

Cash Inflows		Cash Outflows	
$	Probability	$	Probability
120,000	0·30	50,000	0·25
140,000	0·45	60,000	0·35
160,000	0·25	70,000	0·40

Calculate the probability of net cash flows being $90,000 or greater.

(3 marks)

1.8 A $1,000 bond has a coupon rate of 8% and will repay its nominal value when it matures in four years' time.

The bond will be purchased today for $900 ex interest and held until maturity.

Calculate, to the nearest 0·01%, the yield to maturity for the bond based on today's purchase price.

(4 marks)

(Total for Section A = 20 marks)

Reminder

All answers to Section A must be written in your answer book.

Answers to Section A written on the question paper will **not** be submitted for marking.

End of Section A

TURN OVER

SECTION B – 30 MARKS

[Note: The indicative time for answering this section is 54 minutes]

ANSWER ALL SIX SUB-QUESTIONS. YOU SHOULD SHOW YOUR
WORKINGS AS MARKS ARE AVAILABLE FOR THE METHOD YOU USE.

Question Two

(a)   The trade receivable ledger account for customer J from 1 January to 30 April 2010
shows the following:

		Debit	Credit	Balance
		$	$	$
01-Jan-2010	Balance b/fwd			125
10-Jan-2010	Invoice No. 234	181		306
12-Jan-2010	Invoice No. 263	92		398
18-Jan-2010	Invoice No. 297	287		685
23-Jan-2010	Receipt No. 85 (Balance b/fwd + Inv No. 263)		217	468
09-Feb-2010	Invoice No. 328	294		762
13-Feb-2010	Credit Note No.167 (Inv No. 234)		63	699
05-Mar-2010	Invoice No. 365	135		834
15-Mar-2010	Invoice No. 379	232		1066
18-Mar-2010	Receipt No. 102 (Inv No. 297)		287	779
25-Mar-2010	Invoice No. 391	71		850
01-Apr-2010	Receipt No. 126 (Inv No. 328)		294	556
24-Apr-2010	Invoice No. 438	145		701

(i)   Prepare an age analysis of trade receivables, for customer J, at 30 April 2010 showing
the outstanding balance analysed by month.

(3 marks)

(ii)   State two benefits of preparing an age analysis of trade receivables.

(2 marks)
(Total for sub-question (a) = 5 marks)

(b)   A company, which uses the EOQ inventory management model, purchases 64,000
units of raw materials per year. The purchase price of the raw material is $10 per unit.
The cost of holding one unit in inventory is $1·20 per year. The cost of reordering and
taking delivery is $150 per order regardless of the size of the order.

Assuming that usage is predictable and spread evenly throughout the year and that
ordering and delivery are simultaneous, calculate for the raw material:

(i)   The total annual cost of holding and ordering inventory.

(3 marks)

Past experience has shown that the supplier of the raw material can be unreliable and
that the delivery period can be between one week and three weeks. If the company
wants to hold enough raw material to ensure that it never runs out, calculate for the raw
material:

(ii)   The lowest inventory level at which raw material should be reordered.

(2 marks)
(Total for sub-question (b) = 5 marks)

The following scenario is given for sub-questions (c) and (d)

A medium-sized manufacturing company, which operates in the electronics industry, has employed a firm of consultants to carry out a review of the company's planning and control systems. The company presently uses a traditional incremental budgeting system and the inventory management system is based on economic order quantities (EOQ) and reorder levels. The company's normal production patterns have changed significantly over the previous few years as a result of increasing demand for customised products. This has resulted in shorter production runs and difficulties with production and resource planning.

The consultants have recommended the implementation of activity based budgeting and a manufacturing resource planning system to improve planning and resource management.

(c) Explain how a manufacturing resource planning system would improve the planning of purchases and production for the company.

(5 marks)

(d) Explain the benefits for the company that could occur following the introduction of an activity based budgeting system.

(5 marks)

(e) The production budgets for quarters 1 and 2 for a manufacturing company are as follows:

	Quarter 1	*Quarter 2*
Production (Units)	15,000	20,000
Budgeted production costs	*$*	*$*
Direct materials	180,000	240,000
Production labour	155,000	195,000
Production overheads	210,000	240,000

The cost structure, which is expected to continue unchanged in quarter 3, is as follows:

- (ii) The variable cost elements are linear and vary in direct proportion to volume.
- (iii) There is a bulk purchase discount of 5% on materials if orders exceed $250,000 per quarter. The discount will apply to the purchase of all materials in that quarter.
- (iv) The company operates a JIT system for material purchases.
- (v) Fixed production overheads will increase by $20,000 per quarter at production output levels in excess of 22,000 units in a quarter.

The budgeted production volume for quarter 3 is 23,000 units.

Prepare the production cost budget for quarter 3.

(5 marks)

Section B continues on the next page

(f) An events management company is trying to decide whether or not to advertise an outdoor concert. The sale of tickets is dependent on the weather. If the weather is poor it is expected that 5,000 tickets will be sold without advertising. There is a 70% chance that the weather will be poor. If the weather is good it is expected that 10,000 tickets will be sold without advertising. There is a 30% chance that the weather will be good.

If the concert is advertised and the weather is poor, there is a 60% chance that the advertising will stimulate further demand and ticket sales will increase to 7,000. If the weather is good there is a 25% chance the advertising will stimulate demand and ticket sales will increase to 13,000.

The profit expected, before deducting the cost of advertising, at different levels of ticket sales are as follows:

Number of tickets sold	Profit $
5,000	(20,000)
6,000	(5,000)
7,000	35,000
8,000	55,000
9,000	70,000
10,000	90,000
11,000	115,000
12,000	130,000
13,000	150,000

The cost of advertising the concert will be $15,000.

Required:

Demonstrate, using a decision tree, whether the concert should be advertised.

(5 marks)

(Total for Section B = 30 marks)

End of Section B

Section C begins on page 10

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SECTION C – 50 MARKS

[Note: The indicative time for answering this section is 90 minutes]

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 Three

A company manufactures a range of industrial cleaning products from its automated factory in
Western Europe. The company has recently introduced a just-in-time system for raw material
purchases.

The company uses a standard absorption costing system for planning and control purposes
although this system is now under review.

The following budget data relate to the production of one of its major products CP1 for April.
The product is manufactured by mixing two raw materials ETH1 and RXY2.

Standard cost per kg of Product CP1

	Quantity	Cost/kg	Cost
Raw material input			
ETH1	0·30kg	$18·00	$5·40
RXY2	0·70kg	$6·00	$4·20
Raw material cost per kg of input			$9·60
Yield			96%
Raw materials cost per kg of output			$10·00
Fixed production overheads per kg of output			$4·00
Total standard cost per kg of output			$14·00

Budget data for product CP1 for the period is detailed below:-

- Sales - 72,000kg
- Production - 70,000kg
- Opening inventory - 2,000kg of CP1 (valued at $28,000)
- Selling price per kg - $20·00
- Fixed production overheads - $280,000

The fixed production overhead absorption rate is based on the budgeted number of kilograms
produced.

Actual data for product CP1 for the period was as follows:

- Sales - 71,000kg
- Production - 69,000kg
- Selling price per kg - $20·30
- Fixed production overheads incurred - $278,000
- Cost per kg of ETH1 - $18·10
- Cost per kg of RXY2 - $5·80
- Input of ETH1 - 22,100kg
- Input of RXY2 – 47,900kg

Required:

(a) Produce a statement that reconciles the budgeted and actual profit for CP1 for April showing the variances in as much detail as possible.

(19 marks)

(b) Discuss three reasons why the use of a standard costing system is considered inappropriate in a company that operates in an advanced manufacturing technology environment.

(6 marks)

(Total for Question Three= 25 marks)

Section C continues on the next page

Question Four

A small regional airport is modernising its facilities in anticipation of significant growth in the number of passengers using the airport. It is expected that the number of passengers will increase by 10% per annum as a result of a "low cost" airline opening new routes to and from the airport.

At present, the airport has only one food outlet selling sandwiches and other cold food and drinks. To improve the facilities available to customers, the management of the airport is considering opening a restaurant selling a range of hot food and drinks. The cost of fitting out the new restaurant, which will have to be fully refurbished after four years, is estimated to be $350,000. These assets are expected to have a residual value of $30,000 at the end of four years.

A firm of consultants carried out an extensive study in relation to this project at a cost of $30,000. The key findings from their report, regarding expected revenue and contribution from the restaurant, are as follows:

- Average revenue: $9·00 per customer
- Average variable cost: $5·00 per customer
- Demand in year 1: 500 customers per day

Future demand for the restaurant is expected to rise in line with passenger numbers.

The airport operates for 360 days per year.

Other relevant information from the consultants' report is listed below:

1. Staffing of the new restaurant:

- Number of employees (Years 1 and 2): 4
- Numbers employees (Years 3 and 4): 5
- Average salary per employee: $20,000 per annum

2. Overheads

- The annual budgeted fixed overhead of the airport which will be apportioned to the restaurant is $80,000.
- The annual overheads apportioned to the cold food outlet will be $30,000.
- The airport's overheads are expected to increase by the following annual amounts as a direct result of the opening of the restaurant:

    - Electricity: $40,000
    - Advertising: $20,000
    - Audit: $10,000

3. Cold food outlet

The average contribution from the sale of cold food is $2·50 per customer. If the restaurant is not opened it is expected that the cold food outlet will sell to 1,200 customers per day in the coming year and in subsequent years the customer numbers will rise in line with passenger numbers.

If the restaurant is opened, the consultants expect sales from the existing cold food outlet to initially reduce by 40% in year 1 and then to increase in line with passenger numbers.

The airport's Financial Director has provided the following taxation information:

- Tax depreciation: 25% reducing balance per annum.
- The first year's tax depreciation allowance is used against the first year's net cash inflows.
- Taxation rate: 30% of taxable profits. Half of the tax is payable in the year in which it arises, the balance is paid the following year.
- Any taxable losses resulting from this investment can be set against profits made by the airport company's other business activities since the airport company is profitable.

The airport company uses a post-tax cost of capital of 8% per annum to evaluate projects of this type. Ignore inflation.

Required:

   (a)   Calculate the net present value (NPV) of the restaurant project.

(16 marks)

(b)   The Managing Director of a company has been presented with the details of three potential investment projects. He has very little experience of project appraisal and has asked you for help.

The project details are given below:-

	Project A	Project B	Project C
Expected NPV	$150,000	$180,000	$180,000
Standard Deviation of Expected NPV	$10,000	$50,000	$30,000
IRR	12%	12%	10%

The three projects will require the same level of initial investment. The projects are mutually exclusive and therefore the Managing Director can only choose one of them.

Required:

Interpret the information for the Managing Director (your answer should include an explanation of the factors he should consider when deciding which project to undertake).

(9 marks)

(Total for Question Four = 25 marks)

(Total for Section C = 50 marks)

End of question paper
Maths tables and formulae are on pages 15 to 18

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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	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	Interest rates (r)									
(n)	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	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	Interest rates (r)									
(n)	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 **not** *independent*: $P(A \cap B) = P(A) * P(B \mid A)$

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

DESCRIPTIVE STATISTICS

Arithmetic Mean

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

Standard Deviation

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

INDEX NUMBERS

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

Price: $$\frac{\sum w * \left(\frac{P_1}{P_o}\right)}{\sum w} \times 100$$

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:

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

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

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

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

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

where: C_o =   cost of placing an order
           C_h =   cost of holding one unit in inventory for one year
           D =   annual demand

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 what you have learned.	Analyse	Examine in detail the structure of
	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 evaluate, make decisions or recommendations.	Advise	Counsel, inform or notify
	Evaluate	Appraise or assess the value of
	Recommend	Advise on a course of action

Performance Pillar

Operational Level Paper

P1 – Performance Operations

May 2010

Wednesday Morning Session