Performance Pillar

# P1 – Performance Operations

25 May 2011 – 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 7. |
| Section C 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. |

P1 – Performance Operations

SECTION A – 20 MARKS

[You are advised to spend no longer than 36 minutes on this question.]

ANSWER *ALL* EIGHT SUB-QUESTIONS IN THIS SECTION

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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 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 feature of an agreed overdraft facility?

**A** The borrower may draw funds, up to the agreed overdraft limit, as and when required.

**B** Interest is payable on the total amount of the agreed overdraft limit rather than on the amount borrowed.

**C** There is no fixed repayment date for the amount borrowed.

**D** The borrowing is repayable on demand.

***(2 marks)***

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**1.2** A marketing manager is deciding which of four potential selling prices to charge for a new product. Market conditions are uncertain and demand may be good, average or poor. The contribution that would be earned for each of the possible outcomes is shown in the payoff table below:

| **Demand level** | **Selling price** | | | |
|---|---|---|---|---|
| | **$40** | **$60** | **$80** | **$100** |
| **Good** | $50,000 | $60,000 | $40,000 | $30,000 |
| **Average** | $20,000 | $30,000 | $30,000 | $20,000 |
| **Poor** | $30,000 | $30,000 | $20,000 | $10,000 |

If the manager applies the **maximin criterion** to make decisions, which selling price would be chosen?

**A** $40

**B** $60

**C** $80

**D** $100

***(2 marks)***

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**1.3** A company is considering whether to develop and market a new product. The cost of developing the product is estimated to be $150,000. There is a 70% probability that the development will succeed and a 30% probability that the development will be unsuccessful.

If the development is successful the product will be marketed. There is a 50% chance that the marketing will be very successful and the product will make a profit of $250,000. There is a 30% chance that the marketing will be reasonably successful and the product will make a profit of $150,000 and a 20% chance that the marketing will be unsuccessful and the product will make a loss of $80,000. The profit and loss figures stated are after taking account of the development costs of $150,000.

The expected value of the decision to develop and market the product is:

**A** $154,000

**B** $4,000

**C** $107,800

**D** $62,800

***(2 marks)***

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*Section A continues on the next page*

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

A company produces three products D, E and F. The statement below shows the selling price and product costs per unit for each product, based on a traditional absorption costing system.

| | *Product D* *$* | *Product E* *$* | *Product F* *$* |
|---|---|---|---|
| Selling price per unit | 32 | 28 | 22 |
| Variable costs per unit | | | |
| Direct material | 10 | 8 | 6 |
| Direct labour | 6 | 4 | 4 |
| Variable overhead | 4 | 2 | 2 |
| Fixed cost per unit | | | |
| Fixed overhead | 9 | 6 | 6 |
| Total product cost | 29 | 20 | 18 |
| Profit per unit | 3 | 8 | 4 |
| Additional information: | | | |
| Demand per period (units) | 3,000 | 4,000 | 5,000 |
| Time in Process A (minutes) | 20 | 25 | 15 |

Each of the products is produced using Process A which has a maximum capacity of 2,500 hours per period.

**1.4** If a traditional contribution approach is used, the ranking of products, in order of priority, for the profit maximising product mix will be:

**A** D, E, F

**B** E, D, F

**C** F, D, E

**D** D, F, E

***(2 marks)***

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**1.5** If a throughput accounting approach is used, the ranking of products, in order of priority, for the profit maximising product mix will be:

**A** D, E, F

**B** E, D, F

**C** F, D, E

**D** D, F, E

***(2 marks)***

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**1.6** GS has budgeted sales for the next two years of 24,000 units per annum spread evenly throughout both years. The estimated opening inventory of finished goods at the start of the next year is 500 units but GS now wants to maintain inventory of finished goods equivalent to one month's sales.

Each unit uses 2kg of material. The estimated opening raw material inventory at the start of the next year is 300kg but GS now wants to hold sufficient raw material inventory at the end of each month to cover the following month's production.

The change in the policy for inventory holding for both raw materials and finished goods will take effect in the first month of next year and will apply for the next two years.

The budgeted material cost is $12 per kg.

*Required:*

**Calculate** the material purchases budget for the next year in $.

***(3 marks)***

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**1.7** DB's latest estimate for trade payables outstanding at the end of this year is 45 days. Estimated purchases for this year are $474,500. DB is preparing the budget for next year and estimates that purchases will increase by 10%.

The trade payables amount, in $, outstanding at the end of next year is estimated to be the same as at the end of this year.

*Required:*

**Calculate** the budgeted trade payable days at the end of next year.

***(3 marks)***

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**1.8** A company is considering whether to invest in a new project. The probability distribution of the net present value of the project is as follows:

| *Net present value* | *Probability* |
|---|---|
| $2,800 | 0.25 |
| $3,900 | 0.40 |
| $4,900 | 0.35 |

*Required:*

**Calculate** the expected value of the net present value of the project and its standard deviation.

***(4 marks)***

**Note:**

SD = $\sqrt{\Sigma(x - \bar{x})^2 P}$

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***(Total for Section A = 20 marks)***

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*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. Section B begins on page 6*

SECTION B – 30 MARKS

[You are advised to spend no longer than 9 minutes on each sub-question in this section.]

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

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**Question Two**

*(a)* "Different budgets should be used for different purposes. The budget used for planning purposes should be different from the budget used to set performance targets."

*Required:*

**Explain** the above statement and the conflicts that may arise when a single budget is used for both purposes.

***(5 marks)***

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*(b)* A company has to decide which of three mutually exclusive projects to invest in during the next year. The directors believe that the success of the projects will vary depending on consumer demand. There is a 20% chance that consumer demand will be above average; a 45% chance that consumer demand will be average and a 35% chance that consumer demand will be below average.

The net present value for each of the possible outcomes is as follows:

| **Consumer demand** | **Project A** | **Project B** | **Project C** |
|---|---|---|---|
| | **$000s** | **$000s** | **$000s** |
| **Above average** | 400 | 300 | 800 |
| **Average** | 500 | 400 | 600 |
| **Below average** | 700 | 600 | 300 |

A market research company believes it can provide perfect information on potential consumer demand in this market.

*Required:*

**Calculate**, on the basis of expected value, the maximum amount that should be paid for the information from the market research company.

***(5 marks)***

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*(c)* TS operates a fleet of vehicles and is considering whether to replace the vehicles on a 1, 2 or 3 year cycle.

Each vehicle costs $25,000. The operating costs per vehicle for each year and the resale value at the end of each year are as follows:

| | *Year 1* | *Year 2* | *Year 3* |
|---|---|---|---|
| | *$* | *$* | *$* |
| Operating costs | 5,000 | 8,000 | 11,000 |
| Resale value | 18,000 | 15,000 | 5,000 |

The cost of capital is 6% per annum.

*Required:*

**Calculate** the optimum replacement cycle for the vehicles. You should assume that the initial investment is incurred at the beginning of year 1 and that all other cash flows arise at the end of the year.

***(5 marks)***

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*(d)* **Discuss** the advantages AND disadvantages of factoring as a method of managing trade receivables.

***(5 marks)***

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*(e)* **Describe** the following methods of export financing:

(i) Bills of exchange
(ii) Forfaiting
(iii) Documentary credits

***(5 marks)***

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*(f)* A bond has a coupon rate of 6% and will repay its nominal value of $100 when it matures after four years.

The bond will be purchased today for $103 ex-interest and held until maturity.

*Required:*

**Calculate**, to 0.01%, the yield to maturity for the bond based on today's purchase price.

***(5 marks)***

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***(Total for Section B = 30 marks)***

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TURN OVER

SECTION C – 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.

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## Question Three

A company produces trays of pre-prepared meals that are sold to restaurants and food retailers. Three varieties of meals are sold: economy, premium and deluxe.

**Extracts from the budget for last year are given below:**

| | ***Economy*** | ***Premium*** | ***Deluxe*** |
|---|---|---|---|
| Sales quantity (trays) | 180,000 | 360,000 | 260,000 |
| Selling price per tray | $2.80 | $3.20 | $4.49 |
| Total sales revenue | $504,000 | $1,152,000 | $1,167,400 |
| Direct material cost per tray | $1.00 | $1.60 | $2.20 |
| Total direct material cost | $180,000 | $576,000 | $572,000 |
| Direct labour cost per tray | $0.50 | $0.50 | $0.50 |
| Total direct labour cost | $90,000 | $180,000 | $130,000 |

Overhead costs for the budget were estimated using the high-low method based on the total overhead costs for three previous years.

| Output | 720,000 trays | 680,000 trays | 840,000 trays |
|---|---|---|---|
| Total overheads | $1,016,000 | $992,000 | $1,096,000 |

**Actual results for last year were as follows:**

| | ***Economy*** | ***Premium*** | ***Deluxe*** |
|---|---|---|---|
| Sales quantity (trays) | 186,000 | 396,000 | 278,000 |
| Selling price per tray | $2.82 | $3.21 | $4.50 |
| Total sales revenue | $524,520 | $1,271,160 | $1,251,000 |
| Direct material cost per tray | $1.10 | $1.50 | $2.10 |
| Total direct material cost | $204,600 | $594,000 | $583,800 |
| Direct labour cost per tray | $0.52 | $0.54 | $0.48 |
| Total direct labour cost | $96,720 | $213,840 | $133,440 |
| Variable overhead per tray | $0.64 | $0.66 | $0.63 |
| Total variable overheads | $119,040 | $261,360 | $175,140 |
| Actual fixed overheads: $546,000 | | | |

The company operates a just-in-time system for purchasing and production and does not hold any inventory.

Ignore inflation.

*Required:*

*(a)* **Calculate,** for the original budget, the budgeted fixed overhead costs, the budgeted variable overhead cost per tray and the budgeted total overheads costs.

***(3 marks)***

*(b)* **Prepare**, for last year, a budget control statement on a marginal cost basis for the Premium product.

The statement should show the original budget, the flexed budget and the total budget variances for sales revenue and each cost element.

***(5 marks)***

*(c)* **Discuss** the benefits of flexible budgeting for planning and control purposes.

You should use the figures calculated in *(b)* above to illustrate your answer.

***(6 marks)***

*(d)* The company has previously calculated only a sales volume variance but has now decided that valuable management information will be provided by further analysis of this variance.

(i) **Calculate** the sales quantity contribution variance.

***(3 marks)***

(ii) **Calculate** the sales mix contribution variance.

***(3 marks)***

*(e)* **Explain** why the analysis of the sales volume variance into the sales quantity and sales mix variances will provide valuable management information.

Your answer should refer to the figures calculated in *(d)* above.

***(5 marks)***

***(Total for Question Three = 25 marks)***

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*Section C continues on the next page*

## Question Four

A company is considering the launch of a new 5G mobile phone. Experience from the sale of previous models has shown that the expected life of the new model is four years and life cycle sales will total 25,000,000 units. Sales volumes over the life cycle of the product will follow the pattern shown below.

| | |
|---|---|
| Year 1 | 20% |
| Year 2 | 40% |
| Year 3 | 30% |
| Year 4 | 10% |

The company's research and development division, which has an annual budget of $35,000,000, has developed a prototype of the 5G phone. A further investment of $600,000,000 in a new manufacturing facility will be required at the start of year 1 to put the new model into production. It is expected that the new manufacturing facility will have a residual value of $100,000,000 at the end of four years.

The new model is to be marketed initially at a premium price of $300 per unit. The price will remain at $300 for the first year after which prices will be reduced by 20% per annum.

The 5G model will be produced exclusively in the new manufacturing facility. The total fixed manufacturing costs will be $300,000,000 per year excluding depreciation. It is also anticipated that a further $150,000,000 will be spent in each of years 1 and 2 and $100,000,000 in year 3, on further development and marketing of the new model. The variable cost per unit will be $125 and this is expected to remain the same throughout the life of the model.

It is estimated that the launch of the new model will result in a reduction in sales of the current 4G model of 2,000,000 units in the first year after which there will no longer be a market for the 4G model. It was never anticipated that there would be a market for the 4G model after this period. The contribution per unit of the 4G model is $100.

The company's financial director has provided the following taxation information:

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

The 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 project.

Workings should be shown in $millions.

***(12 marks)***

*(b)*

(i) **Calculate** the internal rate of return (IRR) of the project.

(ii) **Calculate** the discounted payback period of the project.

***(5 marks)***

*(c)* **Discuss** the reasons why a company may want to calculate the IRR and discounted payback period of a project even though NPV is the theoretically superior method of investment appraisal.

***(4 marks)***

*(d)* **Explain** the benefits to a company of carrying out a post-completion audit of a project.

***(4 marks)***

***Total for Question Four = 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 13 to 16*

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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

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

Standard Deviation

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

**INDEX NUMBERS**

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

Price: $$\frac{\sum \text{w} * \left(\frac{\text{P}_1}{\text{P}_\text{o}}\right)}{\sum \text{w}} \text{x}\, 100$$

Quantity: $$\frac{\sum w * \left(\frac{Q_1}{Q_o}\right)}{\sum w} \text{x}\, 100$$

**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

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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 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 2011*

# *Wednesday Morning Session*