## Performance Pillar <br> P1 - Performance Operations

## 23 November 2011 - Wednesday Morning Session

## Instructions to candidates


[You are advised to spend no longer than 36 minutes on this question.]
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 A decision maker who makes decisions using the maximin criterion would be classified as:

A Risk averse
B Risk seeking
C Risk neutral
D Risk spreading
1.2 A flexible budget is a budget that is

A set prior to the control period and not subsequently changed in response to changes in activity, costs or revenues

B continuously updated by adding a further accounting period when the earliest accounting period has expired

C changed in response to changes in the level of activity
D changed in response to changes in costs
1.3 NG is deciding which of four potential venues should be used to stage an entertainment event. Demand for the event may be low, medium or high depending on weather conditions on the day. The management accountant has estimated the contribution that would be earned for each of the possible outcomes and has produced the following regret matrix:

## Regret Matrix

| Venue | Ayefield <br> $\$$ | Beefield <br> $\$$ | Ceefield <br> $\$$ | Deefield <br> $\$$ |
| :--- | :---: | :---: | :---: | :---: |
| Demand |  |  |  |  |
| Low | 0 | 200,000 | 300,000 | 450,000 |
| Medium | 330,000 | 110,000 | 0 | 150,000 |
| High | 810,000 | 590,000 | 480,000 | 0 |

If the company applies the minimax regret criterion the venue chosen would be
A Ayefield
B Beefield
C Ceefield
D Deefield

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

JD is a retailer of storage boxes. Annual demand is 39,000 units spread evenly throughout the year. Ordering costs are $\$ 100$ per order and the cost of holding one storage box in inventory for one year is $\$ 1.60$. It takes two weeks for an order to be delivered to JD's premises.
1.4 The economic order quantity (EOQ) for the storage boxes is

A 1,746 units
B 2,208 units
C 2,793 units
D 1,248 units
1.5 The re-order level that would ensure that JD never runs out of inventory of storage boxes is

A 1,560 units
B 4,416 units
C 3,492 units
D $\quad 1,500$ units
1.6 TM's customers all pay their invoices at the end of an agreed 30 day credit period. In an attempt to improve cash flow, TM is considering offering all customers a 2.0\% discount for payment within 7 days.

## Required:

Calculate, to the nearest 0.1\%, the effective annual interest rate to TM of offering the discount. You should assume a 365 day year and use a compound interest methodology.
(3 marks)
1.7 PJ is considering building a warehouse on a piece of land which will be leased at an annual cost of $\$ 4,000$ in perpetuity. The lease payments will be made annually in advance.

PJ has a cost of capital of $12 \%$ per annum.

## Required:

Calculate the present value of the lease payments.
1.8 A company has budgeted to produce 5,000 units of Product B per month. The opening and closing inventories of Product B for next month are budgeted to be 400 units and 900 units respectively. The budgeted selling price and variable production costs per unit for Product B are as follows:

|  | \$ per unit |
| :--- | :---: |
| Selling price | 20.00 |
| Direct costs | 6.00 |
| Variable production overhead costs | 3.50 |

Total budgeted fixed production overheads are $\$ 29,500$ per month.
The company absorbs fixed production overheads on the basis of the budgeted number of units produced. The budgeted profit for Product $B$ for next month, using absorption costing, is $\$ 20,700$.

## Required:

(i) Prepare a marginal costing statement which shows the budgeted profit for Product B for next month.
(ii) Explain, using appropriate calculations, why there is a difference between the profit figures for the month using marginal costing and using absorption costing.
(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. 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.

## Question Two

(a) CH is a building supplies company that sells products to trade and private customers.

Budget data for each of the six months to March are given below:

|  | Oct | Nov | Dec | Jan | Feb | March |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: |
|  | $\$ 000$ | $\$ 000$ | $\$ 000$ | $\$ 000$ | $\$ 000$ | $\$ 000$ |
| Credit sales | 250 | 250 | 250 | 260 | 260 | 280 |
| Cash sales | 60 | 60 | 65 | 75 | 80 | 90 |
| Credit purchases | 170 | 180 | 180 | 200 | 200 | 200 |
| Other operating costs | 90 | 90 | 90 | 122 | 123 | 123 |
| (excluding depreciation) |  |  |  |  |  |  |

$80 \%$ of the value of credit sales is received in the month after sale, $10 \%$ two months after sale and $8 \%$ three months after sale. The balance is written off as a bad debt.
$75 \%$ of the value of credit purchases is paid in the month after purchase and the remaining $25 \%$ is paid two months after purchase.

All other operating costs are paid in the month they are incurred.
CH has placed an order for four new forklift trucks that will cost $\$ 25,000$ each. The scheduled payment date is in February.

The cash balance at 1 January is estimated to be $\$ 15,000$.

## Required:

Prepare a cash budget for each of the THREE months of January, February and March.
(b) GT is considering building a restaurant in a new retail park.

It can build either a small restaurant or a large restaurant. Since there are strict local planning regulations, once GT has committed to the size of restaurant it cannot be extended later.

Past experience suggests that there is a $60 \%$ chance that demand will be high and a $40 \%$ chance that demand will be low. Estimates of the net present values of the future cash flows for GT associated with each size of restaurant are as follows:

|  | Demand |  |
| :---: | :---: | :---: |
| Size of restaurant | Low | High |
|  | $\$$ | $\$$ |
| Small | 800,000 | $1,200,000$ |
| Large | $(1,000,000)$ | $2,000,000$ |

## Required:

(i) Demonstrate, using a decision tree, which course of action GT should pursue.
(ii) GT could commission a market research survey that will give an accurate prediction of the level of demand.

## Required:

Calculate the maximum price that GT should pay for the market research survey.
(2 marks)
(Total for sub-question (b) = 5 marks)
(c) Discuss TWO sources of information that a company could use when setting credit limits for customers.
(5 marks)
(d) Explain THREE benefits that a company could gain from using environmental costing.
(e) A company is planning to launch a new product. The price at which it can sell the product will be determined by the number of other entrants into the market. The possible selling prices and variable costs and their respective associated probabilities are as follows:

| Selling price per unit |  | Variable cost per unit |  |
| :---: | :---: | :---: | :---: |
| $\$$ | Probability | $\$$ | Probability |
| 80 | 0.25 | 40 | 0.20 |
| 100 | 0.30 | 60 | 0.55 |
| 120 | 0.45 | 80 | 0.25 |

Selling price and variable cost per unit are independent of each other.

## Required:

(i) Calculate the probability of the contribution being greater than $\$ 39$ per unit.
(ii) Calculate the expected value of the contribution per unit.
(Total for sub-question (e) = 5 marks)
(f) Explain THREE benefits that organisations gain from using budgetary planning and control systems.
(Total for Section B = 30 marks)

## End of section B. Section $C$ begins on page 10

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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.

## Question Three

TP makes wedding cakes that are sold to specialist retail outlets which decorate the cakes according to the customers' specific requirements. The standard cost per unit of its most popular cake is as follows:

## \$

Direct material:

| Ingredient A | 4 kg at $\$ 25$ per kg | 100 |
| :--- | :--- | ---: |
| Ingredient B | 3 kg at $\$ 22$ per kg | 66 |
| Ingredient C | 2 kg at $\$ 11.50$ per kg | 23 |
| Direct labour | 3 hours at $\$ 12$ per hour | 36 |
| Variable overhead | 3 hours at $\$ 8$ per hour | $\underline{24}$ |
| Standard cost |  | $\underline{\underline{249}}$ |

The budgeted production for the period was 10,000 units.

## Actual results for the period were as follows:

Production (units) 9,000 \$
Direct material: Ingredient A
$35,000 \mathrm{~kg}$
910,000
Ingredient B
$28,000 \mathrm{~kg}$
630,000
Ingredient C
$27,000 \mathrm{~kg}$
296,000
Direct labour
30,000 hours
385,000
Variable overhead
230,000

The general market prices at the time of purchase for Ingredient A and Ingredient B were $\$ 23$ per kg and $\$ 20$ per kg respectively.

TP operates a JIT purchasing system for ingredients and a JIT production system; therefore there was no inventory during the period.

## Required:

(a) Prepare a statement which reconciles the flexed budget material cost and the actual material cost. Your statement should include the material price planning variances, and the operational variances including material price, material mix and material yield.
(b) Discuss the usefulness of the planning and operational variances calculated in part (a) for TP's management.
(5 marks)

The budgeted selling price for the product is $\$ 400$ per unit. Budgeted sales volume for the period was 10,000 units. Actual results for the period were as follows:

| Sales volume | 9,000 units |
| :--- | :--- |
| Sales revenue | $\$ 3,456,000$ |

Required:
(c) Calculate the total sales price variance and the total sales volume contribution variance.
(d) Explain the benefits that TP should gain from operating a JIT purchasing system for materials.
(Total for Question Three $=25$ marks)

Section C continues on the next page

## Question Four

GR is an outsourcing company that provides call centre services to a range of clients. As a result of technical advances in telecommunication equipment, the company's existing telephone system is out-dated and inefficient and needs to be replaced. A technical consultant, hired at a cost of $\$ 80,000$, has prepared a report outlining two possible replacement systems. The details of each system are as follows:

|  | System 1 | System 2 |
| :--- | ---: | ---: |
|  |  |  |
| Initial investment | $\$ 600,000$ | $\$ 800,000$ |
| Estimated useful life | 3 years | 5 years |
| Residual value | $\$ 60,000$ | $\$ 50,000$ |
| Contribution per annum | $\$ 580,000$ | $\$ 600,000$ |
| Fixed maintenance costs per annum | $\$ 20,000$ | $\$ 40,000$ |
| Other fixed operating costs per annum | $\$ 360,000$ | $\$ 305,000$ |

The maintenance costs are payable annually in advance. All other cash flows apart from the initial investment should be assumed to occur at the end of each year.

Depreciation has been calculated using the straight line method and has been included in other fixed operating costs.

The company uses a cost of capital of $12 \%$ per annum to evaluate projects of this type.

Required:
(a) Prioritise the two systems using an annualised equivalent approach. You should ignore taxation and inflation. Your workings should be shown in $\$ 000$.
(b)
(i) Explain the purpose of sensitivity analysis in investment appraisal.
(4 marks)
(ii) Calculate the sensitivity of your recommendation in part (a) to changes in the contribution generated by System 1.
(4 marks)

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

- Tax depreciation: $25 \%$ of the reducing balance per annum, with a balancing adjustment in the year of disposal
- 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


## Required:

(c) Calculate, for System 2, the tax depreciation and the resulting tax cash flows for each year. Your workings should be shown in \$000.

## End of question paper <br> 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 |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $(n)$ | 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 |  |


| $\begin{gathered} \hline \text { Periods } \\ (n) \\ \hline \end{gathered}$ | 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 TABLE

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 |  |


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

## FORMULAE

## PROBABILITY

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

## Rules of Addition

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

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

## Rules of Multiplication

If $A$ and $B$ are independent::

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

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

## DESCRIPTIVE STATISTICS

Arithmetic Mean

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

Standard Deviation

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

## INDEX NUMBERS

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

## TIME SERIES

Additive Model

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

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:

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

## Perpetuity

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

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

## LEARNING CURVE

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

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

## INVENTORY MANAGEMENT

Economic Order Quantity

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

where: $\mathrm{C}_{0}=$ cost of placing an order
$\mathrm{C}_{\mathrm{h}}=$ 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 $\mathbf{1}$ - KNOWLEDGE <br> What you are expected to know. | Make a list of |  |
|  | List | Express, fully or clearly, the details/facts of |
| Level $\mathbf{2}$ - COMPREHENSION |  |  |
| What you are expected to understand. | Define |  |
|  |  | Cescribe |

## Performance Pillar

## Operational Level Paper

## P1 - Performance Operations

## November 2011

Wednesday Morning Session

