**INTRODUCTION TO BUSINESS STATISTICS**

**SECTION A (60 MARKS)**

**QUESTION 1**

a) (i) A time series is historical data described over a period of time. Example: Customer account credits analysed by quarter for the past 4 years

(ii) (I) increase in reservations due to an uncommon hot summer – Irregular variation. **A1**

(II) increase in reservations in the run up to Christmas and New Year festivities Seasonal variation, **A1**

**b)** Expected profit = E[P] =  = , **M1**

= , **M1**

= K 11 million, **A1**

c) (i) Binomial conditions:

- there is a fixed number of trials, **A1**

- there are two possible outcomes called success and failure. **A1**

**-** the probability of success (or failure) is constant at each and every trial. **A1**

(Also the trials are independent)

(ii) Let X be the numbers of defects. Then **, M1**

Then P(at least 4 defects)

= , **M1**

= 

= ,**M2, A1**

**(TOTAL: 15 MARKS)**

**QUESTION 2**

a) The normal distribution may be used:

(i) in calculating probabilities

(ii) in significance tests. **A2**

b) Let X be the number of ATMs that require to be serviced per day. Then . **M1**

Then (i) , **M1, A1**

(ii) P(at most 3)= **M1**

= , **M2, A1**

(c)  and ample proportion is , **M1**

Then the 98% CI is , **M1** (finding 2.33)

, **M2**

i.e. , **M1, A1**

**(TOTAL: 15 MARKS)**

**QUESTION 3**

a) (i) Independent events are events in which the occurrence of one does not affect the probability of occurrence of the other event while mutually exclusive events are events that have nothing in common. **A2**

(ii) If events A and B were mutually exclusive, the P(A or B) = P(A) + P(B) since . **A2**

**b)** (i) Let B, K and T be events that posting was done by Bwamuswe, Katete and Tivine respectively.

Let E be the event that a transaction has a posting error.

Since total number of entries made = 3000 + 2500+4500 = 10000, **M1**

then

P(B)=0.3, P(K)=0.25 and P(T)=0.45. **M1**

Tree diagram (or contingency table): **M2**

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P(posting error) = P(E) = , **M1**

= , **M1, A1**

1. If found to have errors, probability it was posted by staff Katete

= , **M2**

=**, M1, A1**

**(TOTAL: 15 MARKS)**

**QUESTION 4**

(a) (i) Compound interest is the practice of calculating interest periodically and adding it to the existing principal before each subsequent interest calculation is made. On the other hand simple interest is interest that is computed on the original lump sum only for each period over the duration of an investment or a loan. **A2**

(ii) P = K150000,  and A = K180,500, **M1**

Then Interest I = K180,500 – K150,000 = K30,500, **M1**

But since , then , **M1, A1**

1. Let M be number of customers that use this particular ATM

Then 

P(probability that between 5,500 and 7,000 customers use this ATM in a week)

= 

= , **M1**

= , **M1**

= (0.9868 -0.5) + (0.8665 – 0.5) = 0.8533, **M1, A1**

(ii) Let  be the value to be exceeded. Then

, **M1**

 **M1**

We require that, **M1**

i.e.  customers, **M1, A1**

**(TOTAL: 15 MARKS)**

**QUESTION 5**

1. Linear constraints represent limited resources under which optimality is to be achieved. They give a limit to how much resources may be used. **A2**

(b) Let , ,  be number of radios shipped from Mwimba to Ndodo, Ngala and Mbeza respectively.

Similarly, , ,  be number of radios shipped from Phale to Ndodo, Ngala and Mbeza respectively.

And , ,  be number of radios shipped from to Jali to Ndodo, Ngala and Mbeza, respectively. **M1**

Hence the LP model is:

Minimise **, A1**

subject t: 









, **A5**

where , for all .

(c) Accounting Rate of Return (ARR) = :

(i) Investment A: Average annual return = , **M1**

Hence ARR= ,  **A1**

Investment B: Average annual return = , **M1**

Hence ARR= ,  **A1**

(ii) Recommend Investment A on account of ARR being higher than in the second investment. **A2**

**(TOTAL: 15 MARKS)**

**SECTION B (40 MARKS)**

**QUESTION 6**

(a) Plot

KEY: 1,2,3,4, 5….on the horizontal axis represent quarters 1, 2, 3,4 for years 2007 to 2010.

**M2** (Labelled axes and scaling), **A2** (Plotting points accurately and joining them)

b) Trend values – moving averages method

Quarter 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4

Y: 20 10 4 11 33 17 9 18 45 23 11 25 60 46 13 29

M. Total 45 58 65 70 77 89 95 97 104 119 126 128 132 **M2**

M. average 11.25 14,5 16.25 17.5 19.25 22.25 23.75 24.25 26 29.75 31.25 32 33 **M2**

M.A. Centering (t): 12.875 15.375 16.875 18.375 20.75 23 24 25.125 27.875 30.625 31.75 32.5

**M2** (Trend values)

y/t: 0.31 0.72 1.96 0.93 0.43 0.78 1.875 0.92 0.39 1.89 0.92 **M1**

c) Seasonal factors:

y/t table Quarter

Year 1 2 3 4

2007 ---- ---- 0.31 0.72

2008 1.96 0.93 0.43 0.78

2009 1.875 0.92 0.39 0.82

2010 1.89 0.92 ---- ----

Average 1.91 0.92 0.38 0.77 sum = 3.98, **M2**

Adjustment 1.005 1.005 1.005 1.005 (4/3.98=1.005), **M1**

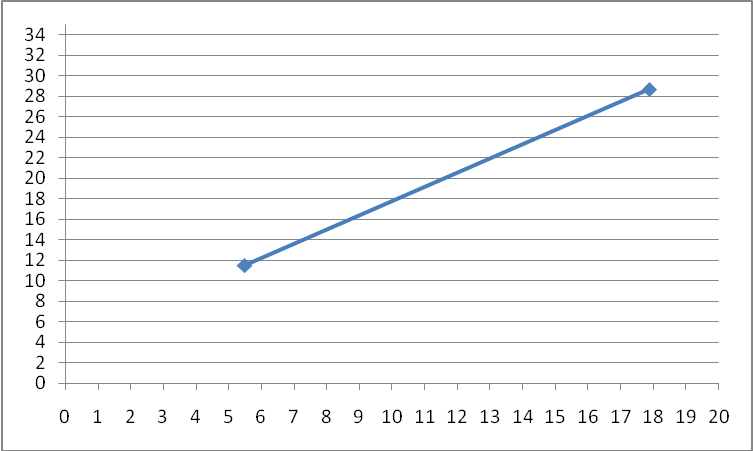
Adjusted s values 1.920 0.925 0.382 0.774 Sum = 4.001, **A1**

d) Forecasting:

Estimating trend values using semi-averages method:

Lower group averages: 

Upper group averages: **M1**

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**M1**(st.line)

From the st. line graph: trend value for 2011, Qrtr 1 is when x =17. Then t = 27

trend value for 2011, Qrtr 2 is when x =18. Then t = 28, **M1**

Hence forecast values: 2011, Qrtr 1, , **A1**

2011, Qrtr 2, to the nearest whole number, **A1**

**(TOTAL: 20 MARKS)**

**QUESTION 7**

a) Interest is paid as an incentive to sacrifice an amount of money now to have it back in the future. **A2**

b) (i) Laspeyres quantity index = 

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  | 240 | 200 | 264 |
|  | 1173 | 1265 | 1275 |
|  | 1428 | 1071 | 1428 |
|  | 646 | 532 | 680 |
| Sum | 3487 | 3068 | 3647 |

**M1 M1 M1** (for products), **M1** (for summing)

Hence Laspeyres quantity index = , **M1, A1**

(ii) Paasche price index = , **M1, A1**

c) Calculation of present values:

|  |  |  |  |
| --- | --- | --- | --- |
| Year | Net Cash flow | PV Discount rate 10% | PV Discount rate 15% |
| 0  1  2  3  4  5 | 200,000  50,000  55,000  65,000  75,000  75,000 | -200,000  45454.55  45454.55  48835.46  51226.01  46569.1 | -200,000  43480  41586  42738  42885  37290 |
| Total | - | 37539.66 | 7979 |

**M1**, **M1**, **M1, M1**

Then IRR = 

= . **M2**

Conclusion: Since the cost of capital = 10% < 17.45%, then the firm should buy the machine. **M1**, **A1**

(**TOTAL: 20 MARKS**)

**QUESTION 8**

a) Four major steps in hypothesis testing:

(i) Formulating the null and alternative hypotheses

(ii) Choosing and applying an appropriate test statistic

(iii) Using an appropriate significance level to come up with a decision rule

(iv) Making a conclusion based on parts (i) and (iii). **A4**

b) Appraisal methods:

(i) Net Present Value method – involves calculating the present values of all cash flows associated with a project using a given cost of capital (interest rate). When the sum of present values, known as Net Present Value, is positive then project is worthwhile. **A2**

Advantage – it takes into account the time value of money. **A1**

Disadvantage – it is difficult to identify an appropriate discount rate. **A1**

(ii) Payback period method – This involves finding the length of time that it takes for a project to recoup its initial cost out of the cash receipts that it generates. The shorter the period the more desirable the investment is. **A2**

Advantage – it is simple and straightforward. **A1**

Disadvantage – it does not take into account the time value of money. **A1**

**(Candidates may present Accounting Rate of Return and Internal Rate of Return)**

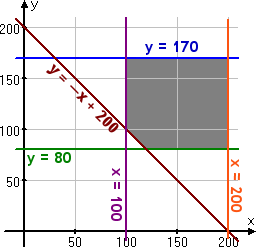
c) Let *x* be the number of scientific calculators produced and *y* number of graphing calculators produced

Then we need to solve

Maximise *P* = –800*x* + 1200*y*

 subject to:   
 100 < *x* < 200   
 80 <  *y* < 170   
 *y* > –*x* + 200, **M2**

Using graphical solution:



**M2**

Checking the vertices of the feasible (shaded) region:

1. (100, 170): 
2. (200, 170): 
3. (200, 80): 
4. (120, 80): 
5. (100, 100): , **M2**

Since the vertex (100,170) results in the highest profit, then 100scientific calculators and 170 graphing calculators should be produced to maximize profit. **M1**, **A1**

**(TOTAL: 20 MARKS)**

**QUESTION 9**

a) The two errors are Type I and Type II errors. Type I error is committed when is rejected when true while type II error is an error that is made when is accepted when false. **A4**

b) Hypotheses: , , **M1**

Test Statistic: Since n = 45 is large, use the normal distribution.

Hence , **M2**

Decision Rule: At 5% level of significance, reject if z > 1.96 or z < -1.96. **M1**

Conclusion: Since z = -2.3479 < -1.96,  has to be rejected i.e. there is significant evidence that to suggest that the average salary is different from K15,000. **M1**, **A1**

(c) (i) Hypotheses: : Difference in opinion is independent of age

: Difference in opinion depends on age, **M1**

Test Statistic: 

Expected frequencies (in brackets) calculated: **M2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Age in years** | **Opinion** | | | |
| **Very unfair** | **Fair** | **Don’t Care** | **No opinion** |
| 20 but less than 30  30 but less than 40  40 and older | 100(121)  300(270)  20(29) | 200(184)  400(412)  40(44) | 50(42)  80(93)  15(10) | 30(33)  70(74)  15(8) |

Then  , **M2**

, **M1**

Decision Rule: At 5%, reject  if , **M2**

Conclusion: Since , reject  i.e. difference in opinion is not independent of age. **A1**

(ii) Type I may have been made. **A1**

**(TOTAL: 20 MARKS)**

**10.** a) Importance of index numbers:

* 1. measuring relative changes prices or quantities of items
  2. may be used in salary negotiations
  3. used in calculating the real values of commodities, **A3**

b) A 95% CI is , **M1**

So the width is , **M2**

Since width is 20,000, then , **M1**

 or , **M1, A1**

(c) Let and  be mean time required for form completing and verification processes respectively. Then

(i) , **M1**

But  , **M1**

where  and , **M2**

Thus , **M1, A1**

(ii) . But , **M1**,

where  and , **M2**

Thus

, **M1, A1**

**(TOTAL: 20 MARKS)**