NATIONAL UNIVERSITY OF SINGAPORE

BT1101 – INTRODUCTION TO BUSINESS ANALYTICS

(Semester 1: AY2018/19)

Time Allowed: 2 Hours

INSTRUCTIONS TO STUDENTS

1. Please write your Student Number only. Do not write your name.
2. This assessment paper contains **TWENTY** Multiple Choice Questions and **FOUR** Structured Questions, and comprises **Nineteen** printed pages including the cover page. The total mark is 90.
3. Students are required to answer **ALL** questions. Students should use the **OCR Form** for Multiple Choice Questions, and write the answers for each Structured Question in the space provided below each question.
4. This is a **CLOSED BOOK** assessment. Students are allowed to bring only a single sheet of A4 help-sheet for reference.
5. Students are provided with statistical tables for reference.
6. Students are permitted to use approved non-programmable electronic calculators only.

STUDENT NO: _____

This portion is for examiner's use only

Section B	Marks	Remarks
Question 1		
Question 2		
Question 3		
Question 4		
Total		

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Section B: Structured Questions (Total 70 marks, marks as indicated for each question)

Question 1 (20 marks)

Teo's, a soft drink company, is monitoring the sales performance of a new flavour. The amount of packs sold for the last 10 weeks from a random provision store is given below:

Week	Packs Sold
1	13
2	17
3	32
4	33
5	31
6	33
7	36
8	36
9	37
10	39

1a) Develop a simple moving average table, determine the value of k observations by using Root Mean Square Error (RMSE), and forecast the sale for Week 11.

(10 marks)

1b) Develop an exponential smoothing table, determine the value of the smoothing constant (0.2, 0.4, 0.6, 0.8) by using Mean Square Error (MSE), and forecast the sale for Week 11.

(10 marks)

Question 2 (15marks):

Fly-By-Night Security is a company that manufactures drones with build-in cameras for night surveillance. There are 3 types of drones, namely Stealth, Standard, and Lightweight. A Stealth drone has 3 cameras and 2 motors. A Standard drone has 2 cameras, 2 LED bulbs and 1 motor. A Lightweight drone has 1 camera, 4 LED bulbs and 1 motor. All the drones run on 2 batteries. A total of 16 boxes of LED bulbs, each box containing 25 LED bulbs; 21 packs of batteries, each pack containing a dozen batteries; 20 boxes of cameras, each box containing 10 cameras; and 18 crates of motor, each crate containing 50 motors, are available. Given the resources, how many of each drone can be produced if the goal is to maximize the number of drones?

(15 marks)

Question 3 (10 marks)

3a) Using an example, describe the difference between an analytics strategy that is value-driven versus technology-driven. Explain which type of strategy would generate more sustainable benefits for an organization.

(5 marks)

3b) Compare between a prediction interval and a confidence interval. Give an example to explain when it is appropriate to use each of them.

(5 marks)

Question 4 (25 marks):

A large bank has compiled data on about 70 former employees at one of its call centers. The first 10 records of the data is shown in Figure 4-1 below. In order to gather some insights on these employees, Jason, the director of Human Resources performed some descriptive analytics on the data. Figures XXX-xxx show the R scripts he ran and the results obtained.

Fig 4-1

	Gender	Starting Age	Prior Call Center Experience	College Degree	Length of Service (years)
1	0	18	0	0	7.0219178
2	1	18	1	0	3.4657534
3	0	19	0	0	2.0739726
4	0	19	0	0	1.7753425
5	0	19	0	0	4.4246575
6	0	19	0	0	3.2931507
7	0	19	1	0	3.0493151
8	1	19	1	0	0.4876712
9	1	19	1	0	0.6054795
10	1	19	0	0	3.1205479

Gender: M=1; F=0

Yes=1; No=0 for both Prior Call Center Experience and College Degree.

Fig 4-2

```
> ccd <-Call_Center_Data
> summary(ccd)
   Gender          Starting Age   Prior Call Center Experience College Degree
Length:70          Min.   :18.00  Length:70                    Length:70
Class :character   1st Qu.:21.00  Class :character             Class :character
Mode  :character   Median :26.00  Mode  :character             Mode  :character
                   Mean   :27.84
                   3rd Qu.:32.00
                   Max.   :50.00
Length of Service (years)
Min.   :0.3205
1st Qu.:1.1123
Median :1.7767
Mean   :1.8942
3rd Qu.:2.1897
Max.   :7.0219
```

Fig 4-3

```
> describe(ccd)
                              vars  n  mean   sd median trimmed  mad   min   max range
Gender*                          1 70  0.47 0.50   0.00    0.46 0.00  0.00  1.00   1.0
Starting Age                     2 70 27.84 8.01  26.00   26.95 8.15 18.00 50.00  32.0
Prior Call Center Experience*    3 70  0.39 0.49   0.00    0.36 0.00  0.00  1.00   1.0
College Degree*                  4 70  0.31 0.47   0.00    0.27 0.00  0.00  1.00   1.0
Length of Service (years)        5 70  1.89 1.10   1.78    1.79 0.91  0.32  7.02   6.7
                              skew kurtosis   se
Gender*                       0.11    -2.02 0.06
Starting Age                  0.82    -0.21 0.96
Prior Call Center Experience* 0.46    -1.81 0.06
College Degree*               0.78    -1.41 0.06
Length of Service (years)     1.63     5.08 0.13
```

Fig 4-4

```
> describeBy(ccd$`Length of Service (years)`,group=ccd$Gender)

 Descriptive statistics by group
group: 0
   vars  n mean   sd median trimmed  mad  min  max range skew kurtosis   se
X1    1 37 2.01 1.28   1.94    1.86 1.04 0.32 7.02   6.7 1.71     4.31 0.21
------------------------------------------------------------------------
group: 1
   vars  n mean   sd median trimmed  mad  min  max range skew kurtosis   se
X1    1 33 1.76 0.86   1.75    1.72 0.87 0.37 3.53  3.16 0.41     -0.7 0.15
> describeBy(ccd$`Length of Service (years)`,group=ccd$`Prior Call Center Experience`)

 Descriptive statistics by group
group: 0
   vars  n mean  sd median trimmed  mad  min  max range skew kurtosis   se
X1    1 43 1.99 1.2   1.78    1.83 0.77 0.32 7.02   6.7  1.9     5.11 0.18
------------------------------------------------------------------------
group: 1
   vars  n mean   sd median trimmed  mad  min  max range skew kurtosis   se
X1    1 27 1.75 0.91   1.88    1.73 1.31 0.35 3.47  3.12 0.07    -1.24 0.17
```

Fig 4-5

```
> describeBy(ccd$`Length of Service (years)`,group=list(ccd$Gender,ccd$`College Degree`,ccd$`Prior Call
Center Experience`))

 Descriptive statistics by group
: 0
: 0
: 0
   vars  n mean   sd median trimmed  mad  min  max range skew kurtosis   se
X1    1 15 2.44 1.71   1.95    2.25 1.38 0.32 7.02   6.7 1.18     0.88 0.44
------------------------------------------------------------------------
: 1
: 0
: 0
   vars  n mean   sd median trimmed  mad  min  max range skew kurtosis   se
X1    1 13 2.06 0.88   2.04    2.03 1.12 0.96 3.53  2.57 0.26    -1.48 0.25
------------------------------------------------------------------------
: 0
: 1
: 0
   vars n mean   sd median trimmed  mad  min  max range skew kurtosis   se
X1    1 7 1.62 0.43   1.64    1.62 0.57 1.05 2.15   1.1 0.01    -1.89 0.16
------------------------------------------------------------------------
: 1
: 1
: 0
   vars n mean   sd median trimmed  mad  min  max range  skew kurtosis   se
X1    1 8 1.33 0.52   1.36    1.33 0.35 0.37 2.16  1.79 -0.25    -0.68 0.18
------------------------------------------------------------------------
: 0
: 0
: 1
   vars  n mean   sd median trimmed  mad  min  max range skew kurtosis   se
X1    1 11 1.91 0.93   2.15    1.93 1.29 0.57 3.05  2.48 -0.1    -1.77 0.28
------------------------------------------------------------------------
: 1
: 0
: 1
   vars n mean   sd median trimmed  mad  min  max range skew kurtosis   se
X1    1 9 1.63 1.07   1.75    1.63 1.65 0.49 3.47  2.98 0.38    -1.48 0.36
------------------------------------------------------------------------
: 0
: 1
: 1
   vars n mean   sd median trimmed  mad  min  max range  skew kurtosis   se
X1    1 4 1.38 0.86   1.52    1.38 0.85 0.35 2.13  1.78 -0.17    -2.24 0.43
------------------------------------------------------------------------
: 1
: 1
: 1
   vars n mean   sd median trimmed  mad  min  max range  skew kurtosis   se
X1    1 3 1.99 0.24   2.12    1.99 0.01 1.71 2.13  0.42 -0.38    -2.33 0.14
```

Fig 4-6

```
> corr.test(ccd$`Starting Age`,ccd$`Length of Service (years)`)
Call:corr.test(x = ccd$`Starting Age`, y = ccd$`Length of Service (years)`)
Correlation matrix
[1] -0.61
Sample Size
[1] 70
Probability values  adjusted for multiple tests.
[1] 0
```

Fig 4-7

```
> hist(ccd$`Starting Age`)
> hist(ccd$`Length of Service (years)`)
```

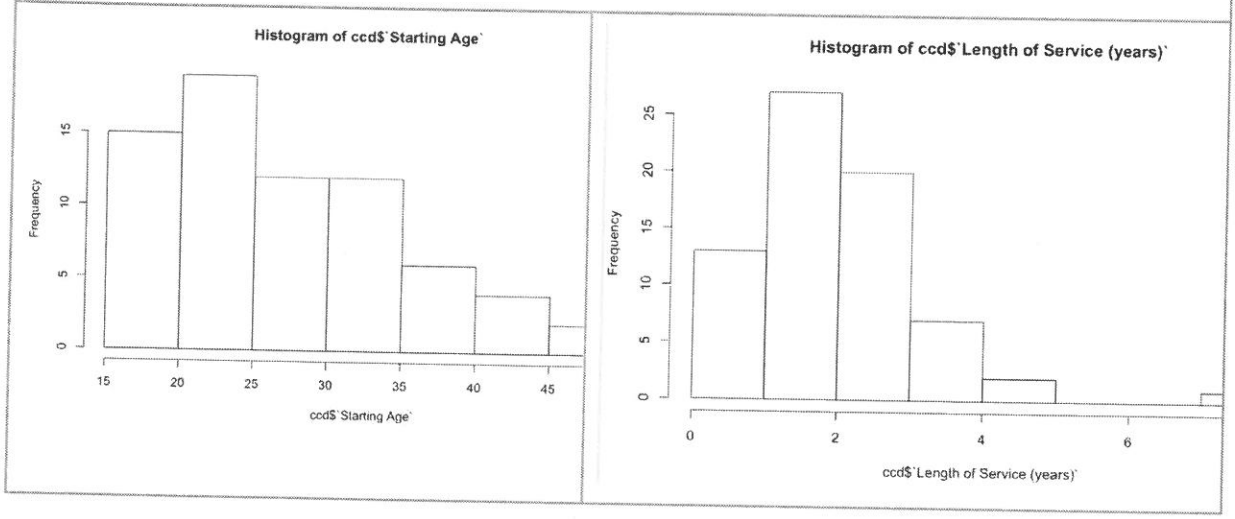

Fig 4-8

```
> shapiro.test(ccd$`Starting Age`)

        Shapiro-Wilk normality test

data:  ccd$`Starting Age`
W = 0.91319, p-value = 0.0001341

> shapiro.test(ccd$`Length of Service (years)`)

        Shapiro-Wilk normality test

data:  ccd$`Length of Service (years)`
W = 0.88607, p-value = 1.14e-05
```

Fig 4-9

```
> t.test(ccd$`Length of Service (years)`~ccd$Gender)

        Welch Two Sample t-test

data:  ccd$`Length of Service (years)` by ccd$Gender
t = 0.98044, df = 63.407, p-value = 0.3306
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.2619426  0.7666759
sample estimates:
mean in group 0 mean in group 1
       2.013180        1.760814

> t.test(ccd$`Length of Service (years)`~ccd$`Prior Call Center Experience`)

        Welch Two Sample t-test

data:  ccd$`Length of Service (years)` by ccd$`Prior Call Center Experience`
t = 0.94713, df = 65.631, p-value = 0.347
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.2658865  0.7457232
sample estimates:
mean in group 0 mean in group 1
       1.986747        1.746829

> t.test(ccd$`Length of Service (years)`~ccd$`College Degree`)

        Welch Two Sample t-test

data:  ccd$`Length of Service (years)` by ccd$`College Degree`
t = 2.5204, df = 67.994, p-value = 0.01407
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 0.1127033 0.9695092
sample estimates:
mean in group 0 mean in group 1
       2.064269        1.523163
```

4a) Describe what type of data (e.g. nominal, ordinal, ratio, etc.) each of the variable in the data set is.

(2 marks)

4b) Is the average length of service higher for males or females? How much higher and is this difference significant?

(4 marks)

4c) What is the statistical analyses that was conducted in Fig 4-6? Explain what the result shows about the data.

(4 marks)

4d) Construct a contingency table for average length of service (years) by gender, college degree and prior center experience.

(5 marks)

4e) What is the 95% confidence interval for mean length of service (years) of employees without prior call center experience [round off final answer to 2 decimal places]? (3 marks) Explain what the confidence interval obtained tell us about the true population parameter. (2marks)

(5 marks)

4f) Jason wanted to know if the average length of service (years) is the same for employees with and without college degree. Set up the hypotheses that he should test. (2 marks) Making reference to the descriptive analytics he conducted, what would be the conclusion for his hypotheses test? (3 marks)

(5 marks)

- END OF PAPER -