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CIT Semester 1 Examinations 2018/19

Note to Candidates:	Check the <u>Programme Title</u> and the <u>Module Description</u> to ensure that you have received the correct examination. If in doubt please contact an Invigilator.
Module Title:	Statistical Calculations
Module Code:	STAT6006
Programme Title(s):	BSc Analytel & Pharma Chem Y2 BSc Hons Analytel Chmstry QA Y2 BSc Hons Env Sci & Sus Tech Y2
Block Code(s):	SCHEM_7_Y2 SCHQA_8_Y2 SESST_8_Y2
External Examiner(s):	Dr. Katarina Domijan
Internal Examiner(s):	Dr. Justin Mc Guinness, Mrs. Patricia Cogan
Instructions:	Answer all three questions. Each question carries equal marks. All work must be shown and written in the answer booklet. Please do not write in red pen.
Duration:	2 Hours
Required Items:	Calculator

Question 1

(a) State whether the following are types of discrete, continuous, nominal or ordinal data:

- (i) The length of time each student spent in lab in Semester 1.
- (ii) The number of labs completed by each student in Semester 1.
- (iii) The colour pen(s) each student used to write up their lab reports.

[1.5 marks]

(b) Given the mean for the following frequency table is 6.625, calculate the value of x .

Data	Frequency
5	7
6	10
7	x
8	9

[2 marks]

(c) A company is testing thermometers from various hospitals and doctors surgeries to determine if they are calibrated correctly. The number of thermometers tested from each location depends on the number of thermometers initially at that location. The table below gives a summary of the results.

Number of Thermometers Tested	Frequency
0 but less than 10	27
10 but less than 20	30
20 but less than 50	15
50 but less than 80	33
80 but less than 90	27
90 but less than 100	18

- (i) Estimate the mean and standard deviation for the Number of Thermometers Tested. Round your answer to one decimal place.

[6 marks]

Question 1 continued ...

- (c)
- (ii) Represent the data in a histogram using the graph paper provided in the centre of the exam booklet. **[4 marks]**
- (iii) Use the histogram to estimate the modal Number of Thermometers Tested. **[1.5 marks]**
- (iv) Using the appropriate formula and the frequency table above, estimate the median Number of Thermometers Tested. Round your answer to one decimal place. **[3 marks]**
- (v) Compare your answers for mean, median and mode and comment on the results. In your comment, give one example of how the organisation of this data could be improved. **[2 marks]**

Question 2

- (a) An electric fire was switched on in a cold room and the temperature was taken in 5 minute intervals. The temperatures are recorded in the table below.

Time in Minutes Electric Fire is on, x	0	5	10	15	20	25	30	35	40
Temperature of Room ($^{\circ}\text{C}$), y	0.4	1.2	2.7	5.1	8.0	10.3	11.7	12.8	14.1

- (i) Using the graph paper in the centre of the exam booklet, plot the data on a scatter diagram.

[4 marks]

- (ii) Calculate the least squares line of regression and round the values of a and b to three decimal places. Plot the regression line on your scatter diagram from part (i).

[8 marks]

- (iii) Using your least squares line of regression equation from part (ii), predict the temperature 60 minutes and 80 minutes after switching the fire on. Why would these predictions be treated cautiously?

[3 marks]

- (b) Two judges ranked the texture of scones in a national competition. The judge's rankings are recorded in the table below.

Score	A	B	C	D	E	F	G	H	I	J
Judge 1	1	2	3	4	5	6	7	8	9	10
Judge 2	1	2	5	6	7	8	10	4	3	9

Calculate the Spearman's rank correlation coefficient between the rankings for Judge 1 and Judge 2. What conclusion can you draw from your calculation?

[5 marks]

Question 3

The table below shows the sales of antidepressants (€000,000s) for a pharmaceutical company:

Sales (€000,000s)				
	Winter	Spring	Summer	Autumn
2013	9.5	5.3	4.7	8.6
2014	9.8	6.1	4.9	9.2
2015	10	6.3	5.5	9.7
2016	10.4	6.8	6	9.8

- (a) Comment on the overall trend in the data and the seasonal trend in the data. [1 mark]
- (b) Using the graph paper provided, plot the data on a time series graph to illustrate the fluctuations in the data. [4 marks]
- (c) Calculate the four quarter centred moving averages for the data and plot them on your graph from part (b). [7 marks]
- (d) Using a multiplicative model, determine seasonal index values for the data. Keep a minimum of six decimal places in your calculations. [6 marks]
- (e) The trend in the data can be depicted by the linear equation:
$$y = 6.99 + 0.080x$$
where x units corresponds to 1 quarter and $x = 1$ gives Winter in 2013. Use the linear trend equation and the seasonal index to forecast figures for the Spring of 2017. [2 marks]

Statistical Formulae

Descriptive Statistics

$$\bar{x} = \frac{\sum fx}{\sum f}$$

$$s = \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}} \quad \text{or} \quad s = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

$$\text{Median} = L_M + C_M \left(\frac{\frac{1}{2}N - F_{M-1}}{f_M} \right)$$

$$\text{Mode} = L_M + C_M \left(\frac{f_M - f_{M-1}}{2f_M - (f_{M-1} + f_{M+1})} \right)$$

$$\text{Coefficient of Variation} = \frac{s}{\bar{x}} \times 100\%$$

$$\text{Coefficient of Skewness} = \frac{3(\text{Mean} - \text{Median})}{\text{Standard Deviation}}$$

Regression and Correlation

$$y = a + bx$$

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$$

$$a = \frac{\sum y - b \sum x}{n}$$

$$\text{Coefficient of Correlation} = r = \frac{n \sum xy - \sum x \sum y}{\sqrt{n \sum x^2 - (\sum x)^2} \cdot \sqrt{n \sum y^2 - (\sum y)^2}}$$

$$\text{Spearman's Coefficient of Rank Correlation: } R_S = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$