

**CORK INSTITUTE OF TECHNOLOGY  
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

**Semester 2 Examinations 2017/18**

**Module Title:     Biostatistics and Probability**

**Module Code:**       **STAT6013**

**School:**            School of Science

**Programme Title:**   Bachelor of Science in Herbal Science  
                          Bachelor of Science in Nutrition and Health Science  
                          Bachelor of Science in Pharmaceutical Biotechnology  
                          Bachelor of Science in Applied Biosciences and Biotechnology  
                          Bachelor of Science in Food and Health Science  
                          Common Entry Biological Sciences  
                          Higher Certificate in Science in Applied Biosciences

**Programme Code:**   CR\_SFSTE\_7                    CR\_SCEBS\_8  
                          CR\_SHERB\_8                 CR\_SBIOS\_6  
                          CR\_SNHSC\_8                 CR\_SPHBI\_8  
  CR\_SBIBI\_7

**External Examiner(s):**   **Prof. Michael Wallace**  
**Internal Examiner(s):**   **Dr. Conor Lynch, Dr. Noreen Quinn,**  
                                  **Dr. Mark Hartnett, Ms. Jackie English**

**Instructions:**        **Answer ALL Questions.**

**Duration:**        **2 HOURS**

**Sitting:**         Autumn 2018

**Requirements for this examination:**

**Note to Candidates:** Please check the Programme Title and the Module Title to ensure that you are attempting the correct examination.  
If in doubt please contact an Invigilator.

**Question 1**

a) The probabilities that an adult man has high blood pressure and/or high cholesterol are shown in the table.

		Blood Pressure	
		High	OK
Cholesterol	High	0.31	0.21
	OK	0.16	0.32

- i) What is the probability that a man has both conditions?
- ii) What's the probability that he has high blood pressure?
- iii) What is the probability that a man with high blood pressure has high cholesterol?
- iv) What's the probability that a man has high blood pressure if it's known that he has high cholesterol?

[9 marks]

b) Durations of surgeries (in hours) for 13 patients receiving artificial hearts are shown here. Create a stem and leaf plot of these data. Describe the distribution. Are there any outliers?

7.0   6.5   3.5   2.8   2.5   2.6   2.4   2.1   1.8   2.3   3.1   3.0   2.5

[8 marks]

c) The recorded net weekly profit (in €1000s) for the sample of high street stores are as follows: 21.1, 18.5, 24.3, 22.9, 16.1, 28.5.

- i) Calculate the mean weekly profit.
- ii) Calculate the standard deviation.

[8 marks]

**Question 2**

(a) Using Stem-and-Leaf plot below calculate the Mean, Median and Mode of the data set.

[6 marks]

```

3 | 5 6 7 8
4 | 0 0 1 2 3
5 | 5 5 5 6 7 8 9
    
```

(b) The times recorded, to the nearest second, for a particular experiment were 93, 65, 85, 90 and 78 respectively. Calculate the mean and the mean deviation of the test times. [4 marks]

(c) Using the table below, calculate the variance and standard deviation. [6 marks]

x	3	4	5	6	7
f	2	10	26	9	3

(d) Using Pearson's Coefficient Method #1 or Method#2, calculate the skewness for a data set with the following characteristics:

- Mean = 70.5.
  - Median = 80.
  - Mode = 85.
  - Standard deviation = 19.33.
- [4 marks]

(e) Using an example, state why you should be careful over which method you use to calculate the skewness of a data set. [2 marks]

(f) Using an appropriate labelled diagram, comment on your answer in part (d). [3 marks]

### Question 3

(a) Two dice are rolled and their sum is recorded.

- List all possible outcomes.
  - Calculate the probability of rolling a sum of 4.
  - Calculate the probability of rolling a sum of at most 10.
- [8 marks]

(b) A game in a casino involves rolling a dice twice

If you get equal scores on the dice you win €20.

If you roll a four on only one of the dice you win €12.

- Calculate the expected value of the player's winnings.
  - What would be a suitable amount
- [8 marks]

(c) A multiple choice exam was given to students in CIT doing a business course. The exam consisted of 7 questions. There are 4 choices for each question with 1 correct answer and 3 incorrect answers. Calculate the probability:

- (i) All 7 are correct?
- (ii) At least 5 are correct?
- (iii) Exactly 5 are correct?
- (iv) Less than 4 correct?

[9 marks]

#### Question 4

The following data was obtained in a calibration experiment.

Concentration(ppm)	5	10	15	20	30	40
Absorbance	6.8	10.3	14.1	17.9	23.5	31.1

For this data set:

$$\sum x = 120; \sum y = 103.7; \sum xy = 2655.5; \sum x^2 = 3250; \sum y^2 = 2191.01$$

- (i) Plot a scatter diagram of the data. [6 marks]
- (ii) Use the least squares method to find the regression equation of absorbance on concentration. [6 marks]
- (iii) Plot this line on the scatter diagram in part (i) of this question. [4 marks]
- (iv) Calculate the value of the correlation coefficient and comment on its nature and degree. [6 marks]
- (v) Predict the absorbance if the concentration is 25ppm? [3 marks]

## Formulae

1.  $\mu = \frac{\sum_{i=1}^n x_i}{n}$  or  $\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$

2. Mean  $\bar{x} = \frac{\sum fx}{\sum f}$

3. Mean Deviation =  $\frac{\sum |x - \bar{x}|}{n}$

4. Population Standard Deviation  $\sigma = \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}}$  or  $\sigma = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$

or  $\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^n (x_i - \mu)^2}$

5. Sample Standard Deviation  $s = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2}$

6. Variance:

$$\sigma^2 = \frac{\sum_{i=1}^n (x - \mu)^2}{n}$$

7. Median =  $L_M + C_M \left( \frac{\frac{1}{2}N - F_{M-1}}{f_M} \right)$  or Median =  $\frac{\frac{n}{2} - cf}{f}(w) + L_m$

$$8. \text{ Mode} = L_M + C_M \left( \frac{f_M - f_{M-1}}{2f_M - (f_{M-1} + f_{M+1})} \right) \text{ or } \text{ Mode} = L + \left( \frac{D_1}{D_1 + D_2} \right) C$$

$$\text{or } \text{ Mode} = \frac{f_m - f_{m-1}}{(f_m - f_{m-1}) - (f_m - f_{m+1})} (w) + L$$

$$9. \text{ Coefficient of Variation} = \frac{s}{x}$$

$$10. \text{ Pearson's Coefficient of Skewness} = \frac{\text{Mean-Mode}}{\text{Standard Deviation}} \text{ or}$$

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

11. Expected Value :

$$E(x) = \sum_{i=1}^n x_i P(x_i)$$

$$12. \text{ Conditional Probability: } P(A \setminus B) = \frac{P(A, B)}{P(B)} \text{ or } P(A \setminus B) = \frac{P(A \text{ And } B)}{P(B)}$$

$$13. \text{ Binomial Distribution : } P(r, n) = C(n, r) p^r q^{(n-r)} \text{ or}$$

$$P(r, n) = {}^n C_r p^r q^{n-r}$$

14. Normal Probability Distribution Formula:

$$Z = \frac{x - \mu}{\sigma} \text{ or } Z = \frac{x - \bar{x}}{s}$$

15. Regression and Correlation:

$$y = ax + b$$

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

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

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





## Standard Normal Probabilities

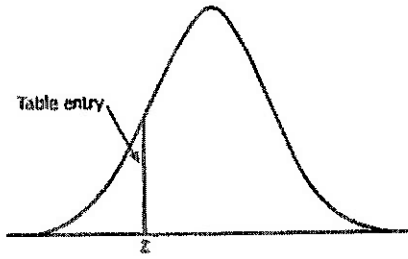


Table entry for  $z$  is the area under the standard normal curve to the left of  $z$ .

$z$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
-3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
-3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
-3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
-3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
-2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
-2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
-2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
-2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
-2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
-2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
-2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
-2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
-2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
-2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
-1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
-1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
-1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
-1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
-1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
-1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
-1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
-1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
-1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
-1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
-0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
-0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
-0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
-0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
-0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
-0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
-0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
-0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
-0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
-0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641