UNIVERSITY
OF
JOHANNESBURG

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT
NOVEMBER EXAMINATION

DEPARTMENT OF QUALITY AND OPERATIONS MANAGEMENT

PROGRAMME	:	**BACCALALAUREUS TECHNOLOGIAE OPERATIONS MANAGEMENT**
SUBJECT	:	**OPERATIONS MANAGEMENT TECHNIQUES IV**
CODE	:	**BPI44B4**
DATE	:	**21ᵀᴴ NOVEMBER 2017**
DURATION	:	**3 HOURS**
TIME	:	**(12:30 – 15:30)**
TOTAL MARKS	:	**100** **WEIGHT** : **50**

EXAMINER(S) : **MRS E.N ANYADIEGWU**

(EXTERNAL) MODERATOR(S): **MR G.S.NHLABATHI**

NUMBER OF PAGES : **7 PAGES (Including Appendix A, B & C)**

INSTRUCTIONS TO CANDIDATES:
- Answer ALL questions.
- This is a closed book assessment.
- Leave margins and spaces between the questions.
- Show all your calculations.
- Unless otherwise indicated, express your answers correct to two (2) decimal places.
- Where appropriate, indicate the units of your answer. (e.g. Hour, R)
- Number your answers clearly.
- Write neatly and legibly
- NOTE: Marks will be awarded for theoretical knowledge, application of the theory and use of relevant examples.
- The general University of Johannesburg policies, procedures and rules pertaining to written assessments apply to this assessment.

QUESTION 1 [20]

The Olando East professional basketball team just missed making the playoffs last season and believes it needs to sign only one very good free agent to make the playoffs next season. The team is considering four players: Seithati Seloana, Rebone Moatwana, Sethu Benu, and Ify Siaga. Each player differs according to position, ability, and attractiveness to fans. The payoffs (in R1,000,000s) to the team for each player, based on the contract, profits from attendance, and team product sales for several different season outcomes, are provided in the following table:

Season Outcome

Player	Loser	Competitive	Makes Playoffs
Seithati	R 3.2	R1.3	4.4
Rebone	5.1	1.8	6.3
Sethu	2.7	0.7	5.8
Ify	6.3	1.6	9.6

1.1 Determine the best decision, using the following decision criteria. (20)
   a. Maximax
   b. Maximin
   c. Hurwicz (a = .60)
   d. Equal likelihood

QUESTION 2 [20]

During registration at University of Johannesburg every semester, students in the faculty of Engineering must have their courses approved by the faculty adviser. It takes the adviser an average of 2 minutes to approve each schedule, and students arrive at the adviser's office at the rate of 28 per hour.

2.1. What is the average number of students waiting and being served? (2)

2.2. What is the average number of students waiting in line behind the person being served? (2)

2.3. On average, how much time will a student spend until he/she asses the faculty adviser's office? (2)

2.4. What proportion of the time is the officer busy? (2)

2.5 What is the probability there are 2 or less than 2 students in the system? (2)

2.6. The dean of the faculty has received a number of complaints from students about the length of time they must wait to have their schedules approved. The dean feels that waiting 10.00 minutes to get a schedule approved is not unreasonable. Each assistant the dean assigns to the adviser's office will reduce the average time required to approve a schedule by 0.25 minute, down to a minimum time of 1.00 minute to approve a schedule. How many assistants should the dean assign to the adviser? Justify your answer. (8)

2.6 Why do waiting lines form at a service facility even though there may be more than enough service capacity to meet normal demand in the long run? (2)

QUESTION 3 [15]

The manager of Randburg Video Store in sells videocassette recorders at discount prices. If the store does not have a video recorder in stock when a customer wants to buy one, it will lose the sale because the customer will purchase a recorder from one of the many local competitors. The problem is that the cost of renting warehouse space to keep enough recorders in inventory to meet all demand is excessively high. The manager has determined that if 90% of customer demand for recorders can be met, then the combined cost of lost sales and inventory will be minimized. The manager has estimated that monthly demand for recorders is normally distributed, with a mean of 180 recorders and a standard deviation of 60.

3.1 Determine the number of recorders the manager should order each month to meet 90% of customer demand (5)

3.2 What is the probability of producing less than 250 records each month? What is the implication? (5)

3.3 What is the probability It will produce between between 200 and 250 minutes? P($200 \leq x \leq 250$) (5)

NOTE
1) Use **Appendix A** - the Normal Distribution Table.
2) Correct all probability value to 4 decimal places.
3) For each questions above, determine:
a) The probability corresponding to the Z value Calculated (Area from the normal distribution Table)
b) <u>Area required</u> and <u>Shade</u> only the area under normal distribution curve required

Please draw rough normal distribution curve to show your understanding.

Use formulae; z = x - μ/σ   *See table at the back of Question paper.*

QUESTION 4 **[25]**

The Evco Plastic Company produces a product in a process consisting of operations of five machines. The probability distribution of the number of machines that will break down in a week follows:

Machine Breakdowns per Week	Probability
0	.10
1	.10
2	.20
3	.25
4	.30
5	.05
	1.00

4.1 Simulate the machine breakdowns per week for 20 weeks. (20)

4.2 Compute the average number of machines that will break down per week. (2)

4.3 Provide three advantages of simulation (3)

QUESTION 5 **[20]**

Ms Alice Lumbwe has invested in an Old mutual unit trust fund. Now she is considering liquidating and investing in another fund. She would like to forecast the price of the Old mutual unit trust for the next month before making a decision. She has collected the following data on the average price of the fund during the past 10 months.

Month	Fund Price
1	37
2	40
3	41
4	37
5	45
6	50
7	43

8	47
9	56
10	52

5.1   Using a 5-month average, forecast the fund prices through to month 11   (6)

5.2   Using a three month weighted average with the most recent month weighted 0.7, the next most recent month weighted 0.20, and the third month weighted 0.10, forecast the fund prices through to month 11.   (8)

5.3   Calculate the Mean Average Deviation (MAD) for each approach   (4)

5.4   Which one is more accurate and why.   (2)

END OF PAPER

TOTAL MARKS   **[100]**

Appendix C: Queuing Formulae

Single-Server Waiting Line System

$$P_0 = \left(1 - \frac{\lambda}{\mu}\right) \qquad P_n = \left(\frac{\lambda}{\mu}\right)^n \cdot P_0 = \left(\frac{\lambda}{\mu}\right)^n\left(1 - \frac{\lambda}{\mu}\right) \qquad L = \frac{\lambda}{\mu - \lambda} \qquad L_q = \frac{\lambda^2}{\mu(\mu - \lambda)}$$

$$W = \frac{1}{\mu - \lambda} = \frac{L}{\lambda} \qquad W_q = \frac{\lambda}{\mu(\mu - \lambda)} \qquad U = \frac{\lambda}{\mu} \qquad I = 1 - U = 1 - \frac{\lambda}{\mu}$$

Single-Server Waiting Line System Undefined and Constant Service Times

$$P_0 = 1 - \frac{\lambda}{\mu} \qquad L_q = \frac{\lambda^2 \sigma^2 + (\lambda/\mu)^2}{2(1 - \lambda/\mu)} \qquad L = L_q + \frac{\lambda}{\mu}$$

$$W_q = \frac{L_q}{\lambda} \qquad W = W_q + \frac{1}{\mu} \qquad U = \frac{\lambda}{\mu}$$
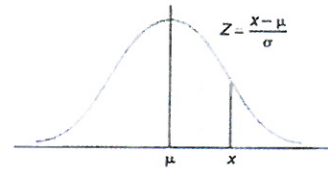
Appendix A

Normal and Chi-Square Tables

$$Z = \frac{X - \mu}{\sigma}$$

Table A.1
The normal table
Normal curve areas

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

803

APPENDIX B TABLE OF RANDOM NUMBERS

Table 14.3

Random number table

39 65 76 45 45	19 90 69 64 61	20 26 36 31 62	58 24 97 14 97	95 06 70 99 00
73 71 23 70 90	65 97 60 12 11	31 56 34 19 19	47 83 75 51 33	30 62 38 20 46
72 18 47 33 84	51 67 47 97 19	98 40 07 17 66	23 05 09 51 80	59 78 11 52 49
75 12 25 69 17	17 95 21 78 58	24 33 45 77 48	69 81 84 09 29	93 22 70 45 80
37 17 79 88 74	63 52 06 34 30	01 31 60 10 27	35 07 79 71 53	28 99 52 01 41
02 48 08 16 94	85 53 83 29 95	56 27 09 24 43	21 78 55 09 82	72 61 88 73 61
87 89 15 70 07	37 79 49 12 38	48 13 93 55 96	41 92 45 71 51	09 18 25 58 94
98 18 71 70 15	89 09 39 59 24	00 06 41 41 20	14 36 59 25 47	54 45 17 24 89
10 83 58 07 04	76 62 16 48 68	58 76 17 14 86	59 53 11 52 21	66 04 18 72 87
47 08 56 37 31	71 82 13 50 41	27 55 10 24 92	28 04 67 53 44	95 23 00 84 47
93 90 31 03 07	34 18 04 52 35	74 13 39 35 22	68 95 23 92 35	36 63 70 35 33
21 05 11 47 99	11 20 99 45 18	76 51 94 84 86	13 79 93 37 55	98 16 04 41 67
95 89 94 06 97	27 37 83 28 71	79 57 95 13 91	09 61 87 25 21	56 20 11 32 44
97 18 31 55 73	10 65 81 92 59	77 31 61 95 46	20 44 90 32 64	26 99 76 75 63
69 08 88 86 13	59 71 74 17 32	48 38 75 93 29	73 37 32 04 05	60 82 29 20 25
41 26 10 25 03	87 63 93 95 17	81 83 83 04 49	77 45 85 50 51	79 88 01 97 30
91 47 14 63 62	08 61 74 51 69	92 79 43 89 79	29 18 94 51 23	14 85 11 47 23
80 94 54 18 47	08 52 85 08 40	48 40 35 94 22	72 65 71 08 86	50 03 42 99 36
67 06 77 63 99	89 85 84 46 06	64 71 06 21 66	89 37 20 70 01	61 65 70 22 12
59 72 24 13 75	42 29 72 23 19	06 94 76 10 08	81 30 15 39 14	81 33 17 16 33
63 62 06 34 41	79 53 36 02 95	94 61 09 43 62	20 21 14 68 86	84 95 48 46 45
78 47 23 53 90	79 93 96 38 63	34 85 52 05 09	85 43 01 72 73	14 93 87 81 40
87 68 62 15 43	97 48 72 66 48	53 16 71 13 81	59 97 50 99 52	24 62 20 42 31
47 60 92 10 77	26 97 05 73 51	88 46 38 03 58	72 68 49 29 31	75 70 16 08 24
56 88 87 59 41	06 87 37 78 48	65 88 69 58 39	88 02 84 27 83	85 81 56 39 38
22 17 68 65 84	87 02 22 57 51	68 69 80 95 44	11 29 01 95 80	49 34 35 36 47
19 36 27 59 46	39 77 32 77 09	79 57 92 36 59	89 74 39 82 15	08 58 94 34 74
16 77 23 02 77	28 06 24 25 93	22 45 44 84 11	87 80 61 65 31	09 71 91 74 25
78 43 76 71 61	97 67 63 99 61	30 45 67 93 82	59 73 19 85 23	53 33 65 97 21
03 28 28 26 08	69 30 16 09 05	53 58 47 70 93	66 56 45 65 79	45 56 20 19 47
04 31 17 21 56	33 73 99 19 87	26 72 39 27 67	53 77 57 68 93	60 61 97 22 61
61 06 98 03 91	87 14 77 43 96	43 00 65 98 50	45 60 33 01 07	98 99 46 50 47
23 68 35 26 00	99 53 93 61 28	52 70 05 48 34	56 65 05 61 86	90 92 10 70 80
15 39 25 70 99	93 86 52 77 65	15 33 59 05 28	22 87 26 07 47	86 96 98 29 06
58 71 96 30 24	18 46 23 34 27	85 13 99 24 44	49 18 09 79 49	74 16 32 23 02
93 22 53 64 39	07 10 63 76 35	87 03 04 79 88	08 13 13 85 51	55 34 57 72 69
78 76 58 54 74	92 38 70 96 92	52 06 79 79 45	82 63 18 27 44	69 66 92 19 09
61 81 31 96 82	00 57 25 60 59	46 72 60 18 77	55 66 12 62 11	08 99 55 64 57
42 88 07 10 05	24 98 65 63 21	47 21 61 88 32	27 80 30 21 60	10 92 35 36 12
77 94 30 05 39	28 10 99 00 27	12 73 73 99 12	49 99 57 94 82	96 88 57 17 91