FACULTY:	Faculty of Engineering and Built Environment.
DEPARTMENT:	**QUALITY AND OPERATIONS MANAGEMENT**
CAMPUS:	DFC
MODULE:	OPT33B3/BPI33B3 OPERATIONS MANAGEMENT TECHNIQUES 3B
SEMESTER:	SECOND
EXAM:	November 2019

DATE: 16 November 2019 **SESSION:** 12:30- 15:30

ASSESSOR(S): Ms. N.E NWOBODO-ANYADIEGWU
Ms. A.K LUMBWE

MODERATOR: PROF. O SAMUEL

DURATION: 3 Hours **MARKS:** 100

NUMBER OF PAGES: 7 PAGES

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 are 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 **[25]**

1.1. Discuss the **main** disadvantages of simulation (8)

1.2. What is the difference between Dynamic Programming and Linear Programming? (4)

1.3. What is the difference between natural and controllable causes? Provide 2 examples for each. (5)

1.4. Discuss the four categories of cost associated with quality (8)

QUESTION 2 **[20]**

You are going to help a friend who is working in a garage, where he repair car brakes. You have observed the following pattern in 7 repairs he did during a day:

Repair number	Minute pr. repair	No. of trips to toolbox
1	50	5
2	34	2
3	43	4
4	56	6
5	38	4
6	49	5
7	36	3

2.1. Construct a scatter diagram based upon the observed data. (20)

QUESTION 3 **[20]**

Khumalo has been hand-painting wooden Christmas ornaments for several years. Recently, she has hired some friends to help her increase the volume of her business. In checking the quality of the work, she notices that some slight blemishes occasionally are apparent. A sample of 10 pieces of work resulted in the following number of blemishes on each piece: 4, 1, 2, 0, 0, 1, 2, 0, 0, and 0.

3.1. Construct the upper and lower control limits chart for the number of blemishes on each piece. (20)

QUESTION 4 **[35]**

Dr. Kabelo practices dentistry in Soweto. Kabelo does his best to schedule appointments so that patients do not have to wait beyond their appointment time. His November 11, 2019 schedule is shown in the following table:

Schedule appointment and time		Expected time needed
Nkosi	9:30 A.M.	15
Lerato	9:45 A.M.	20
Kamo	10:15 A.M.	15
Mabasa	10:30 A.M.	10
Matamba	10:45 A.M.	30
Ndlovu	11:15 A.M.	15
Mulongo	11:30 A.M.	20
Mabuza	11:45 A.M.	15

Unfortunately, not every patient arrives exactly on schedule, and expected times to examine patients are just that—expected. Some examinations take longer than expected, and some take less time.

Kabelo's experience dictates the following:

(a) 20% of the patients will be 20 minutes early.
(b) 10% of the patients will be 10 minutes early.
(c) 40% of the patients will be on time.
(d) 25% of the patients will be 10 minutes late.
(e) 5% of the patients will be 20 minutes late.

He further estimates that

(a) 15% of the time he will finish in 20% less time than expected.
(b) 50% of the time he will finish in the expected time.
(c) 25% of the time he will finish in 20% more time than expected.
(d) 10% of the time he will finish in 40% more time than expected.

Dr. Kabelo has to leave at 12:15 P.M. on November 11 to catch a flight to a dental convention in Cape Town. Assuming that he is ready to start his workday at 9:30 A.M. and that patients are treated in order of their scheduled exam (even if one late patient arrives after an early one).

4.1. Will he be able to make the flight? Comment on this simulation. (35)

Random numbers have been provided. Therefore, use the following information to conduct the simulation.

Appointment	RN	Arrival time	Time doctor is free	RN	Exam time required	Time exam ends	Number of mins patient exam
Nkosi	69			37			
Lerato	84			77			
Kamo	12			13			
Mabasa	94			10			
Matamba	51			02			
Ndlovu	36			18			
Mulongo	17			31			
Mabuza	02			19			

END OF EXAMINATION

TOTAL MARKS **[100]**

ANNEXURES

$\text{Upper control limit (UCL)} = \overline{\overline{x}} + z\sigma_{\overline{x}}$
Upper limit for an $\overline{x}$-chart using standard deviations.

$\text{Lower control limit (UCL)} = \overline{\overline{x}} - z\sigma_{\overline{x}}$
Lower control limit for an $\overline{x}$-chart using standard deviations.

$\text{UCL}_{\overline{x}} = \overline{\overline{x}} + A_2\overline{R}$
Upper control limit for an $\overline{x}$-chart using tabled values and ranges.

$\text{LCL}_{\overline{x}} = \overline{\overline{x}} - A_2\overline{R}$
Lower control limit for an $\overline{x}$-chart using tabled values and ranges.

$\text{UCL}_R = D_4\overline{R}$
Upper control limit for a range chart.

$\text{LCL}_R = D_3\overline{R}$
Lower control limit for a range chart.

$\text{UCL}_p = \overline{p} + z\sigma_p$
Upper control unit for a p-chart.

$\text{LCL}_p = \overline{p} - z\sigma_p$
Lower control limit for a p-chart.

$\hat{\sigma}_p = \sqrt{\dfrac{\overline{p}(1 - \overline{p})}{n}}$
Estimated standard deviation of a binomial distribution.

$\overline{c} \pm 3\sqrt{\overline{c}}$
Upper and lower limits for a c-chart.

RANDOM NUMBER TABLE

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

Factors for Computing Control Chart Limits

SAMPLE SIZE, n	MEAN FACTOR, A_2	UPPER RANGE, D_4	LOWER RANGE, D_3
2	1.880	3.268	0
3	1.023	2.574	0
4	0.729	2.282	0
5	0.577	2.114	0
6	0.483	2.004	0
7	0.419	1.924	0.076
8	0.373	1.864	0.136
9	0.337	1.816	0.184
10	0.308	1.777	0.223
12	0.266	1.716	0.284
14	0.235	1.671	0.329
16	0.212	1.636	0.364
18	0.194	1.608	0.392
20	0.180	1.586	0.414
25	0.153	1.541	0.459