UNIVERSITY OF JOHANNESBURG

FACULTY OF ENGINEERING AND BUILT ENVIRONMENT

DECEMBER 2015 EXAMINATION

DEPARTMENT	**QUALITY AND OPERATIONS MANAGEMENT**
PROGRAMME	NATIONAL DIPLOMA OPERATIONS MANAGEMENT
SUBJECT	OPERATIONS MANAGEMENT TECHNIQUES 3
CODE	BPI33B3
DATE	: SUMMER SSA EXAMINATION 2015 10 DECEMBER 2015
DURATION	(X-PAPER) 08:00 – 11:00
WEIGHT	50:50
TOTAL MARKS	100

EXAMINER	MS E NWOBODO-ANYADIEGWU
EXTERNAL MODERATOR	MR S. FORE
NUMBER OF PAGES	6 PAGES
REQUIREMENT	CALCULATOR

INSTRUCTIONS TO CANDIDATES:

- Answer ALL questions.
- This is a closed book assessment.
- Question paper must be handed in.
- Leave margins and spaces between the questions.
- Unless otherwise indicated, express your answers correct to two (2) decimal places.
- Show all your calculations.
- Where appropriate, indicate the units of your answer. (e.g. Hour, R)
- 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 examination.

SECTION A [85]

Question 1 – Statistical Process Control [15]

For the past two months, Suzan Shader has been concerned about machine number 5 at the West Factory. To make sure that the machine is operating correctly, samples are taken, and the average and range for each sample is computed. Each sample consists of 12 items produced from the machine. Recently, 12 samples were taken, and for each, the sample range and average were computed. The sample range and sample average were 1.1 and 46 for the first sample, 1.31 and 45 for the second sample, 0.91 and 46 for the third sample, and 1.1 and 47 for the fourth sample. After the fourth sample, the sample averages increased.

For the fifth sample, the range was 1.21, and the average was 48; for sample number 6, it was 0.82 and 47; for sample number 7, it was 0.86 and 50; and for the eighth sample, it was 1.11 and 49. After the eighth sample, the sample average continued to increase, never getting below 50. For sample number 9, the range and average were 1.12 and 51; for sample number 10, they were 0.99 and 52; for sample number 11, they were 0.86 and 50; and for sample number 12, they were 1.2 and 52. Although Suzan's boss wasn't overly concerned about the process, Suzan was. During installation, the supplier set a value of 47 for the process average with an average range of 1.0. It was Suzan's feeling that something was definitely wrong with machine number 5.

Do you agree? Justify your answer and show all necessary analysis. What is your recommendation?

Sample Number	Sample Range	Sample Mean
1	1.10	46
2	1.31	45
3	0.91	46
4	1.10	47
5	1.21	48
6	0.82	47
7	0.86	50
8	1.11	49
9	1.12	51
10	0.99	52
11	0.86	50
12	1.20	52

Question 2 (Simulation Model) **[40]**

2.1 (32)

The lunch counter at Emily restaurant has difficulty handling the lunch business. Currently, there is only one cashier in a single-channel, single-phase system. The restaurant has collected information on the interarrival time, and service time distributions from past lunch hours. They are represented in the tables below.

Use the following two-digit random numbers given below to simulate 10 customers through the checkout system. What is the average time in line, and average time in system? (Set first arrival time to the interarrival time generated by first random number.) See Annexure 3

Interarrival time (minutes)	Probability
1	.20
2	.20
3	.30
4	.20
5	.10

Service time (minutes)	Probability
1	.20
2	.30
3	.30
4	.20

Random numbers for interarrival times: 32, 73, 41, 38, 73, 01, 09, 64, 34, 55
Random numbers of service times: 84, 55, 25, 71, 34, 57, 50, 44, 95, 64

2.2 A manager Using simulation, must execute a series of steps; enumerate these steps and discuss the link between the various steps where applicable. ((8)

Question 3 (Dynamic Programming) **[20]**

3.1 What are the four steps in dynamic programming? (8)

3.2 What are the four elements defining each stage in a dynamic programming problem? (4)

3.3 Identify two types of problems that can be solved by dynamic programming. (4)

3.4 Discuss, briefly, the role of the transformation function. (2)

3.5 What are the major difference between Dynamic Programming and linear? (2)

Question 4 Quality tools – C Chart **[10]**

4.1 A random sample of 100 Modern Art dining room tables that came off OK Furniture's production line is examined. Careful inspection reveals a total of 2,000 blemishes. What are the 99.7% upper and lower control limits for the number of blemishes? If one table had 39 blemishes, should any special action be taken? Why? (8)

4.2 What is the likelihood of a false signal for this control chart? (2)

SECTION B **[15]**

Answer True or False

1. In statistical process control, the range often substitutes for the standard deviation.

2. If the process average is in control, then the process range must also be in control.

3. A process range chart illustrates the amount of variation within the samples.

4. Mean charts and range charts complement one another, one detecting shifts in process average, the other detecting shifts in process dispersion.

5. X-bar charts are used when we are sampling attributes.

6. To measure the voltage of batteries, one would sample by attributes.

7. A p-chart is appropriate to plot the number of typographic errors per page of text.

8. A c-chart is appropriate to plot the number of flaws in a bolt of fabric.

9. The x-bar chart, like the c-chart, is based on the exponential distribution.

10. A process that is in statistical control will always yield products that meet their design specifications.

11. The higher the process capability ratio, the greater the likelihood that process will be within design specifications.

12. The C_{pk} index measures the difference between desired and actual dimensions of goods or services produced.

13. When a sample measurement falls inside the control limits, it means that each unit manufactured is good enough to sell.

14. Values above the upper control limits always imply that the product's quality is exceeding expectations.

15. Responsiveness is a determinant of service quality that involves having the customer's best interests at heart.

TOTAL MARKS **[100]**

END

Annexure 1: Formula Sheet

$$UCL_x = \bar{\bar{X}} + A_2 * \bar{R} \qquad UCL_x = \bar{\bar{X}} - A_2 * \bar{R}$$

$$UCL_R = D4 * \bar{R} \quad \text{and} \quad LCL_R = D3 * \bar{R}$$

$$UCL_P = \bar{p} + Z\sqrt{\frac{\bar{p}(1-\bar{p})}{n}} \qquad LCL_P = \bar{p} - Z\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

$$UCL_{\bar{x}} = \bar{\bar{x}} + z\left(\frac{\sigma_x}{\sqrt{n}}\right) \qquad LCL_{\bar{x}} = \bar{\bar{x}} - z\left(\frac{\sigma_x}{\sqrt{n}}\right)$$

ANNEXURE 2

Sample size, n Mean FactorA_2 UPPER RANGE D_4 LOWER RANGE D_3

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

ANNEXURE 3

Customer number	RN	Inter arrival time	Arrival time	Service begins	RN	Service time	Service ends	Time in line	Time in System
1	32	2	2	2	84	4	6	0	4