UNIVERSITY OF JOHANNESBURG

FACULTY OF ENGINEERING AND BUILT ENVIRONMENT

2016 MAIN EXAMINATION

DEPARTMENT	**QUALITY AND OPERATIONS MANAGEMENT**
PROGRAM	NATIONAL DIPLOMA: MANAGEMENT SERVICES & OPERATIONS MANAGEMENT
SUBJECT	OPERATIONS MANAGEMENT TECHNIQUES 2
CODE	BPI22B2/OPT22B2
DATE	26 NOVEMBER 2016
DURATION	3 HOURS (8:30 – 11:30)
WEIGHT	50%
TOTAL MARKS	100

EXAMINER	MRS E NWOBODO-ANYADIEGWU
MODERATOR	MR S MUKWAKUNGU
NUMBER OF PAGES	11 PAGES

INSTRUCTIONS:

- Answer ALL questions.
- This is a closed book assessment.
- **Question paper must be handed in**.
- 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)
- 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.

REQUIREMENTS: **SCANNER SHEET & GRAPH PAPER – ANNEXURE 4**

SECTION A [80]

Question 1 [40]

Set up an initial simplex tableau, given the following two constraints and objective function:

Minimize $Z = 8X_1 + 6X_2$

Subject to: $2X_1 + 4X_2 \geq 8$

$3X_1 + 2X_2 \geq 6$

1.1 Formulate this problem in the standard form for a Simplex table. (2)

1.2 Solve for the optimal solution by the simplex method. (33)

1.3 What is the optimal solution? (3)

1.4 Can this problem be solved using the graphical method? Why (2)

NOTE: Leave values in the simplex table as fractions ***no decimals.***

Question 2 [26]

The Schmedley Discount Department Store has approximately 300 customers shopping in its store between 9 A.M. and 5 P.M on Saturdays. In deciding how many cash registers to keep open each Saturday, Schmedley's manager considers two factors: customer waiting time (and the associated waiting cost) and the service cost of employing additional checkout clerks. Checkout clerks paid an average of R8 per hour. When only one is on duty, the waiting time per customer is about 10 minutes (or 1/6 of an hour), when two clerks are on duty, the average checkout time is 6 minutes per person, 4minutes when three clerks are working, and 3 minutes when four clerks are on duty. Schmedley's management has conducted customer satisfaction surveys and has been able to estimate that the store suffers approximately R10 in lost sales and goodwill for every hour of customer time spent waiting in checkout lines. Using the information provided, determine the optimal number of clerks to have on duty each Saturday to minimize the store's total expected cost.

See Annexure B2.

Question 3 **[14]**

Fill in the blank space (2 Mark each)

1. In a single server queuing model it is assumed that the customers are ____________ faster than they ____________.
2. As the level of service improves, cost of providing the service ________________.
3. The ________________ is the average number of customers who can be served during a given time period.
4. The service time can most often be described by the ______________________ distribution.
5. The ____________ is the frequency at which the customers arrive at a waiting line according to a probability distribution.
6. The ______________________ is the source of the customers or objects being simulated for a queuing system.
7. The source population is considered to be either ________ in its size.

SECTION B Use the scanner sheet **[20]**

Choose the correct answer:

1. Network models such as PERT and CPM are used to
   a. Plan large and complex projects.
   b. Schedule large and complex projects
   c. Monitor large and complex projects
   d. Control large and complex projects
   e. All the above

2. The primary difference between PERT and CPM is that
   a. PERT uses one time estimates.
   b. CPM uses three time estimates.
   c. PERT has three time estimates.
   d. With CPM ,it is assumed that all activities can be performed at the same time.

3. The earliest start time for an activity is equal to
   a. The earliest start time for an activity is equal to
   b. The largest EF of the immediate predecessors
   c. The smallest EF of the immediate predecessors

d. The largest ES of the immediate predecessors
e. The smallest ES of the immediate predecessors

4. The latest finish tie for an activity is found during the backward pass through the network. The latest finish time is equal to
   a. The largest LF of the activities for which it is an immediate predecessor.
   b. The smallest LF of the activities for which it is an immediate predecessor.
   c. The largest LS of the activities for which it is an immediate predecessor.
   d. The smallest LS of the activities for which it is an immediate predecessor.

5 When PERT is used and probabilities are found ,one of the assumption made is that
   a. All activities are on critical path
   b. Activity times are independent.
   c. All activities have the same variance.
   d. The project variance is equal to the sum of the variances of all .activities in the project.
   e. All the above.

6 In PERT ,the time estimate *b* represents
   a. The most optimistic time
   b. The most likely time.
   c. The most pessimistic time.
   d. The expected time.
   e. None of the above.

7 In PERT,slack time equals
   a. ES + t.
   b. LS – ES.
   c. 0.
   d. EF – ES.
   e. None of the above.

8 The standard deviation for the PERT project is approximately
   a. The square root of the sum of the variances along the critical path.
   b. The sum of the critical path activity standard deviations.
   c. The square root of the sum of the variances of the project activities.
   d. All of the above.
   e. None of the above.

9. The critical path is the
    a. Shortest path in a network.
    b. Longest path in a network.
    c. Path with the smallest variance.
    d. Path with the largest variance
    e. None of the above.

10. If the project completion time is normally distributed and the due date for the project is greater than the expected completion time, then the probability that the project will be finished by the due date is
    a. Less than 0.50.
    b. Greater than 0.50.
    c. Equal to 0.50.
    d. Undeterminable without more information.

11. If activity A is on critical path, then the slack for A will equal
    a. LF-EF.
    b. LS-ES.
    c. 0.
    d. All of the above.

The following Table provides information for questions 12 to 15.

Activity	Immediate Predecessor	Optimistic	Most Likely	Pessimistic	σ	σ^2
A	-	2	3	4	0.333	0.111
B	-	2	5	8	1.000	1.000
C	A	1	2	9	1.330	1.780
D	A	5	5	5	0.000	0.000
E	B, C	6	7	8	0.333	0.111
F	B	14	14	14	0.000	0.000
G	D, E	1	5	9	1.333	1.780
H	G, F	1	4	8	1.167	1.362

12. Which activities are part of the critical path?

(a) A-B-E-G-H
(b) A-C-E-G-H
(c) A-D-G-H
(d) B-F-H
(e) none of the above

13. What is the variance of the critical path?

(a) 5.222
(b) 4.364
(c) 1.362
(d) 5.144
(e) 2.362

14. If the normal distribution were used to find the probability of finishing this project in 24 weeks or fewer, what mean would be used?

(a) 20.833
(b) 22.167
(c) 23.2
(d) 20
(e) 23.2

15. If the normal distribution were used to find the probability of finishing this project in 24 weeks or fewer, what standard deviation would be used?

(a) 5.144
(b) 5.144
(c) 2.362
(d) 4.222
(e) 1.537

---

16. Which of the following is not a property of linear programs?

(a) one objective function
(b) at least two separate feasible regions
(c) alternative courses of action
(d) one or more constraints
(e) objective function and constraints are linear

17. Consider the following linear programming problem:

Maximize	$12X + 10Y$
Subject to:	$4X + 3Y \leq 480$
	$2X + 3Y \leq 360$
	all variables ≥ 0

The maximum possible value for the objective function is

(a) 360.
(b) 480.
(c) 1520.

(d) 1560.
(e) none of the above

18. Consider the following linear programming problem:

Maximize	$5X + 6Y$
Subject to:	$4X + 2Y \leq 420$
	$1X + 2Y \leq 120$
	all variables ≥ 0

Which of the following points (X,Y) is not a feasible corner point?

(a) (0,60)
(b) (105,0)
(c) (120,0)
(d) (100,10)
(e) none of the above

19. Consider the following linear programming problem:

Maximize	$5X + 6Y$
Subject to:	$4X + 2Y \leq 420$
	$1X + 2Y \leq 120$
	all variables ≥ 0

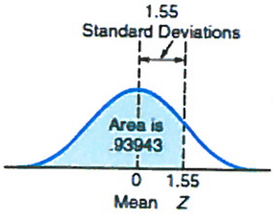
Which of the following points (X,Y) is not feasible?
(a) (50,40)
(b) (20,50)
(c) (60,30)
(d) (90,10)
(e) none of the above

20. What combination of x and y will yield the optimum for this problem?
Minimize R3x + R15y, subject to (1) $2x + 4y \leq 12$ and (2) $5x + 2y \leq 10$.
a. $x = 2, y = 0$
b. $x = 0, y = 3$
c. $x = 0, y = 0$
d. $x = 1, y = 5$
e. none of the above

TOTAL MARKS **[100]**

END OF ASSESSMENT

Appendix A: Areas Under the Standard Normal Curve



Example: To find the area under the normal curve, you must know how many standard deviations that point is to the right of the mean. Then the area under the normal curve can be read directly from the normal table. For example, the total area under the normal curve for a point that is 1.55 standard deviations to the right of the mean is .93943.

	00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
0.1	.53983	.54380	.54776	.55172	.55567	.55962	.56356	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73536	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91309	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
2.0	.97725	.97784	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
3.0	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900
3.1	.99903	.99906	.99910	.99913	.99916	.99918	.99921	.99924	.99926	.99929
3.2	.99931	.99934	.99936	.99938	.99940	.99942	.99944	.99946	.99948	.99950

ANNEXURE B: TABLE OF FORMULAES

1. *PROJECT MANAGEMENT*

$E(t) = \frac{a + 4m + b}{6}$ and Variance = $\left(\frac{b-a}{6}\right)^2$

$$Z = \frac{\text{Due date} - \text{Expected date of completion}}{\sigma_T}$$

$$\text{Project standard deviation} = \sigma_T = \sqrt{\text{Project variance}}$$

2.

Number of checkout Clerks

	1	2	3	4
Number of customers	300	300	300	300
Average waiting time per customer	hour	1/10 hour	hour	hour
Total customer waiting time	hours	hours	hours	hours
Cost per waiting hour	R10	R10	R10	R10
Total waiting cost	R	R	R	R
Checkout clerk salary per hour	R8	R8	R8	R8
Total pay of clerks for 8 hours				
Total expected cost				

3. ***QUEUING THEORY***

Average number in system, $L = \frac{\lambda}{\mu - \lambda}$

Average time in system, $W = \frac{1}{\mu - \lambda}$

Average number in queue, $L_q = \frac{\lambda^2}{\mu(\mu - \lambda)}$

Average time waiting, $W_q = \frac{\lambda}{\mu(\mu - \lambda)}$

Utilization Factor, $\rho = \frac{\lambda}{\mu}$

Percent Idle, $P_0 = 1 - \frac{\lambda}{\mu}$

Probability the number of customers is > k, $P_{n>k} = \left(\frac{\lambda}{\mu}\right)^{k+1}$