UNIVERSITI TUNKU ABDUL RAHMAN

ACADEMIC YEAR 2019/2020

JANUARY 2020 TRIMESTER

FINAL ASSESSMENT

ANSWER SCRIPT

Candidate is required to fill in ALL the information below:

Name : (as stated in Student Identity Card)	Ngu Yi Hui		
Faculty /Institute/ Centre:	FSc	Programme :	Statistical Computing And Operations Research
Index No. (in numbers) :	A00082DBSCF	Index No. (in words) :	A Zero Zero Zero Eight Two DBSCF
Course Code :	UDPS2273	Course Description :	Network Modeling And Integer Programming
Submission Date :	4th MAY 2020	Time :	0900am - 1130am

QUESTION NUMBER	**FOR EXAMINER'S USE ONLY**	
	MARKS	
	Internal	**External**
Q1		
Q2		
Q3		
Q4		
TOTAL MARKS		

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DECLARATION STATEMENT

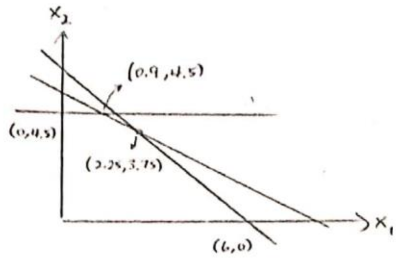
I, Ngu Yi Hui (Name), Student ID No. 18ADB01438, hereby solemnly and fully declare and confirm that during my programme of study at Universiti Tunku Abdul Rahman, I shall abide and comply with all the rules, regulations and lawful instructions of Universiti Tunku Abdul Rahman and endeavour at all times to uphold the good name of the University.

I hereby declare that my submission for this Final Assessment is based on my original work, not plagiarised from any source(s) except for citations and quotations which have been duly acknowledged. I am fully aware that students who are suspected of violating this pledge are liable to be referred to the Examination Disciplinary Committee of the University.

Programme:	SCOR
(Digital) Signature:	HUI
Student's I.C / Passport No.:	991110-14-6378
Index No:	A00082DBSCF
Date of Submission:	4th MAY 2020

Q1.

(a)

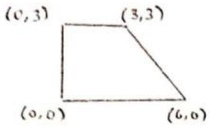


Subproblem 1

$x_1 = 2.25$, $x_2 = 3.75$

$z = 15.75$

$x_2 \leq 3$ → Subproblem 2; $x_2 \geq 4$ → Subproblem 3



Subproblem 2

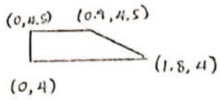
$x_1 = 3$, $x_2 = 3$

$z = 15$

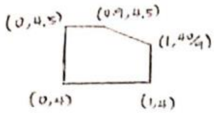
Subproblem 3

$x_1 = 1.8$, $x_2 = 4$

$z = 15.6$



$x_1 \leq 1$ → Subproblem 4; $x_1 \geq 2$ → Subproblem 5



Subproblem 4

$x_1 = 1$, $x_2 = \frac{40}{9}$

$z = \frac{46}{3}$

Subproblem 5

Infeasible

$x_2 \leq 4$ → Subproblem 6; $x_2 \geq 5$ → Subproblem 7

Subproblem 6

$x_1 = 1$, $x_2 = 4$

$z = 14$

Subproblem 7

Infeasible

$\therefore$ Optimal Solution :

$x_1 = 3$, $x_2 = 3$, $z = 15$

Q1.

(b) The strategy of divide and conquer means that the initial question is breaking down and divided into subproblems, then after obtaining the solutions for the subproblems, we gathered the solutions and combined them to get the optimal solution.

For Brench-and-Bound Algorithm, we first obtain the initial solution for the question as the answer for subproblem 1.

For example,

Max $z = x_1 + x_2$

st. $x_1 + x_2 \leq 3$

$2x_1 + x_2 \leq 4.5$

$x_1, x_2 \geq 0$ and integer.

Subproblem 1

$x_1 = 1.5,\ x_2 = 1.5$

$z = 3$

$x_1 \leq 1$ → Subproblem 2

$x_1 \geq 2$ → Subproblem 3

Subproblem 2

$x_1 = 1, x_2 = 2$

$z = 3$

Subproblem 3

$x_1 = 2,\ x_2 = 0.5$

$z = 2.5$

Subproblem 3 will continue its breakdown.

At last we gather all the solutions for subproblems, then we get the final solution for the question, which is the solution for subproblem 2, $x_1 = 1,\ x_2 = 2,\ z = 3$.

Q2.

(a)

	2	3	4	5
1	350*	600	700	–
2		600*	700	–
3			700*	850
4				850*

∴ Shortest Route : 1 - 3 - 5

Shipping Cost = $850

(b) (i) PERT

(ii) ① The duration for waiting traffic in peak hour.

② The duration for waiting traffic in normal hour.

③ The duration for waiting traffic in non-peak hour.

(iii) To ensure the smoothness of the traffic, in this case. The process of the activity will be efficient, and it will help to cut down the costs.

(c) Dijkstra's Algorithm is to find the shortest path, while Ford - Fulkerson Method is to find the maximum flow.

The statement is false.

Q3.

(a)(i) Let x_i = the duration of the activity i shorten / crashed

y_i = the earliest starting time for activity i

y_{end} = the dummy activity end

d_i = normal duration of activity i

c_i = cost of crashing of activity i

For $i \to j$, we will have the constraint

$$y_j - y_i \geq d_i - x_i$$
$$y_j \geq y_i + d_i - x_i$$

Objectives : Min $z = \sum c_i x_i$

$$= 20x_{12} + 25x_{13} + 30x_{14} + 10x_{24} + 15x_{34} + 40x_{45}$$

st:

$y_2 \geq y_1 + 9 - x_{12}$ $\quad x_{12} \leq 3$

$y_3 \geq y_1 + 8 - x_{13}$ $\quad x_{13} \leq 3$

$y_4 \geq y_1 + 15 - x_{14}$ $\quad x_{14} \leq 5$

$y_4 \geq y_2 + 5 - x_{24}$ $\quad x_{24} \leq 2$

$y_4 \geq y_3 + 10 - x_{34}$ $\quad x_{34} \leq 4$

$y_5 \geq y_4 + 2 - x_{45}$ $\quad x_{45} \leq 1$

$y_{end} \leq 15$

All variables ≥ 0

(a)(ii) From the objective, we will get the minimized cost for the shortened duration. Then, in the constraint, $y_{end} \leq 15$ means the duration is limited to 15 days. Also, the constraint $y_j \geq y_i + d_i - x_i$ shows the next activity will start after the previous activity done. Lastly, the x_i is limited to the available shorten time. This will ultimately lead us to the correct answer.

(a)(iii) The direct cost of this project, such as the salaries for the workers, the cost of the materials, and the equipment rental cost will increase, if the duration of a project is longer.

(a)(iv) The indirect cost of the project, such as depreciation, and the cost of quality cost may incur.

Q3.

(b) For each day i, $i = 1, 2, 3$

Let R_i = number of production produced in regular shift at day i

O_i = number of production produced in overtime shift at day i

S_i = number of production store in the storage at day i

Assume $S_0 = 0$, $S_3 = 0$

Objective : Min $Z = 20(R_1 + R_2 + R_3) + 25(O_1 + O_2 + O_3) + 5(S_1 + S_2)$

st. $R_1 + O_1 - S_1 = 320$

$R_2 + O_2 + S_1 - S_2 = 400$

$R_3 + O_3 + S_2 = 450$

$R_1 \leqslant 200$

$R_2 \leqslant 250$

$R_3 \leqslant 240$

$O_1 \leqslant 150$

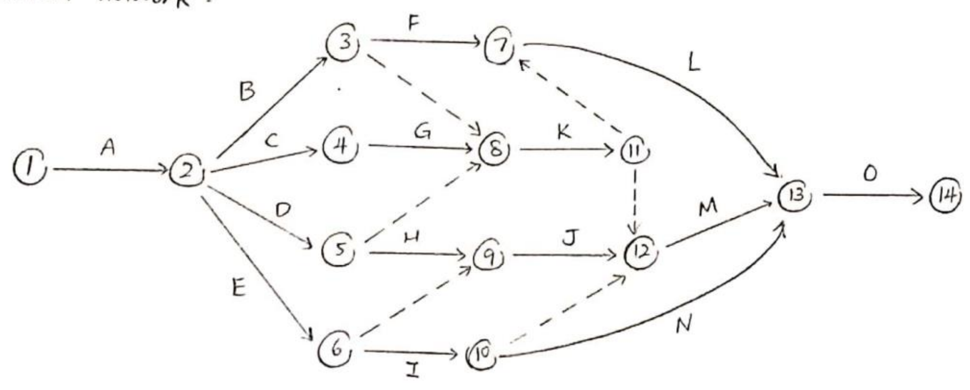
$O_2 \leqslant 160$

$O_3 \leqslant 170$

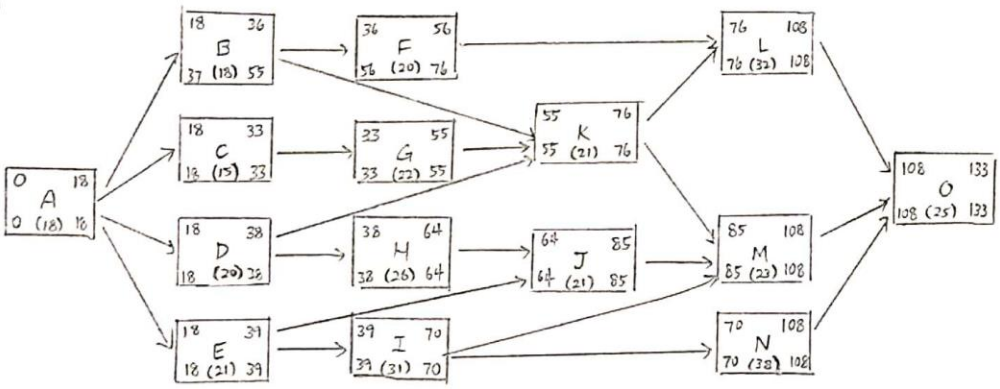
All variables $\geqslant 0$

Q4.

(a)(i) AOA network :



(a)(ii)



Critical Path :	Variance :
① A → C → G → K → L → O	134/3
② A → C → G → K → M → O	47
③ A → D → H → J → M → O	146/3
④ A → E → I → N → O	730/9

Q4.

(b) (i) Artificial arcs help construct the phase 1 for network simplex method.

(ii) Let the objective of phase 1 be minimize the cost, min z.
After performing phase 1, if we found that z is larger than 0, then we shall not continue phase 2, as the problem is unsolvable.
On the other hand, if we found that z is equal to 0, we can perform phase 2 to continue finding our optimal solution.
Additional, if we found that z is equal to 0 but artificial arcs remain in the tree solution, we should not continue performing phase 2. The question should be divided into subdivisions to continue finding the optimal solution.