THE HONG KONG POLYTECHNIC UNIVERSITY

HONG KONG COMMUNITY COLLEGE

Subject Title : Introduction to Management Science **Subject Code** : CCN2158

Session : Semester Two, 2015/16

Numerical Answers

Question A1

(a) X_1=0.2308, X_2=1.8462
More than one solution.

(b) $3 < C_2 \leq \infty$
The solution remains optimal as long as the objective function coefficient of X_2 is between 3 and inf. Since 5 is within this range, the optimal solution would not change.
X_1=0.2308, X_2=1.8462
Profit=\$2(0.2308)+ \$5(1.8462)
=\$9.6926

(c) Shadow price = 1

$$\begin{cases} 0.2308 + 0.1538\Delta \geq 0 \\ 1.8462 + 0.2308\Delta \geq 0 \end{cases}$$

$4.5 \leq$ Range of $S1 < \infty$

Question A2

(b) $$EOQ = \sqrt{\frac{2(5)(16000)}{0.04}}$$

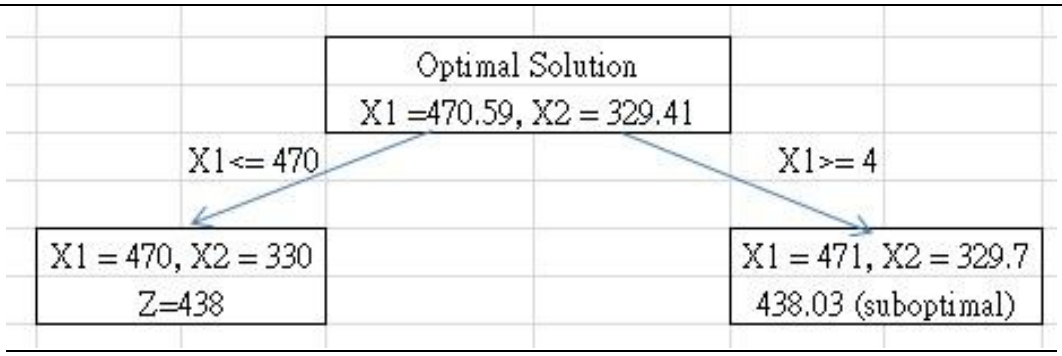
$= 2000$

Question A3

(a) Min $Z = 0.3X_1 + 0.9X_2$
subject to

$$\begin{cases} X_1 + X_2 \geq 800 \\ 0.21X_1 - 0.3X_2 \leq 0 \\ 0.03X_1 - 0.01X_2 \geq 0 \end{cases}$$

(b)



Optimal integer solution: X1 = 470; X2 = 330, Z = 438

Question A4

(a)

	Expected	Variance
A	5	4/9 = 0.444
B	7	1
C	6	1/9 = 0.111
D	9.67	1
E	5	4/9 = 0.444
F	6	4/9 = 0.444

(b) $P(X < 35)$

$= P(Z < \frac{35 - 33.67}{\sqrt{3}})$

$= P(Z < 0.77)$

$= 0.7794$

Question B1

(a) M/M/1

For $\lambda = 12, \mu = 15$

$Wq = \frac{4/5}{15(1 - 4/5)}$

$= \frac{4}{15} hr$

M/M/2

For $\lambda' = 12, \mu = 15$

$Wq' = 0.0126983 hr$

$= 0.761898 \min$

Reduction in customer waiting time = $0.266667 - 0.0126983 = 0.253968 hr = 15.2381 \min$

$15.2381(2000) = 30476.204 > 20000$

Second drive- window should be installed

(b) For $\lambda = 40, \mu = 50$

$$Ls = \frac{4/5}{1-4/5}$$

$$= 4$$

Total cost per day = \$(31)(4) = \$124

For $\lambda = 40, \mu' = 66\frac{2}{3}$

$$Ls' = \frac{3/5}{1-3/5}$$

$$= \frac{3}{2}$$

Total cost per day = \$52+(31)($\frac{3}{2}$) = \$98.5

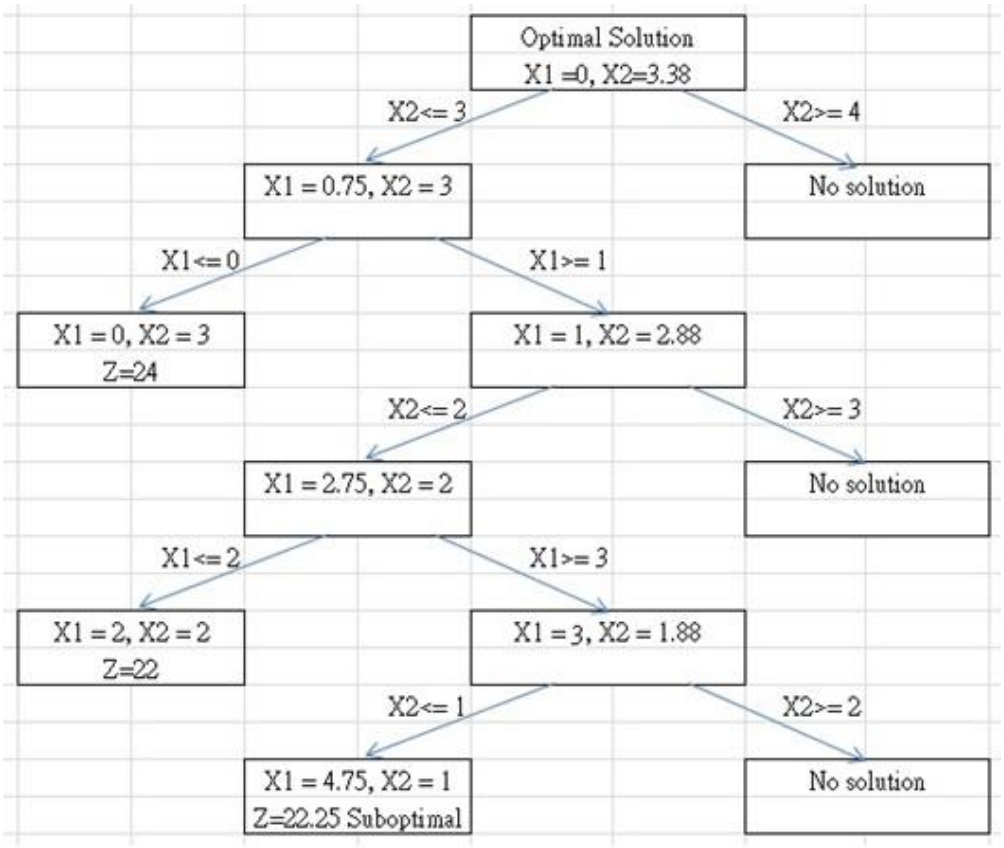
$\$98.5 < \$124$

Company should add extra employees

Question B2

(a) $3x_1 + 5x_2 \leq 75$

(b)



Optimal integer solution: X1 = 0; X2 = 3, Z = 24

Question B3

(a)

$$Q = \sqrt{\frac{2(250)(10Q)}{0.05}}$$

$$0.05Q^2 = 5000Q$$

$$Q^* = 100000$$

$$T(Q^*) = \frac{250(100000)(10)}{100000} + 250(100) + \frac{0.05(100000)}{2}$$

$$= 30000$$

$$T(Q) = \frac{250(2000)(10)}{2000} + 250(c) + \frac{0.05(2000)}{2}$$

$$= 2550 + 250c$$

Put

$$2550 + 250c \leq 30000$$

$$c \leq 109.8$$

(b)(i)

Node 1 and node 2	1 mile
Node 2 and node 5	3 miles
Node 2 and node 4	4 miles
Node 4 and node 6	3 miles
Node 1 and node 3	5 miles

(b)(ii)

Node 1 and node 2	1 mile
Node 2 and node 5	3 miles
Node 5 and node 6	2 miles
Node 6 and node 4	3 miles
Node 1 and node 3	5 miles

Question B4

(a)

	Early Start	Early Finish	Late Start	Late Finish
A	0	7	0	7
B	0	8	3	11
C	0	5	10	15
D	7	11	7	11
E	7	20	18	31
F	11	15	11	15
G	11	23	13	25
H	15	25	15	25
I	25	31	25	31
J	31	39	31	39

	Slack
A	0
B	3
C	10
D	0
E	11
F	0
G	2
H	0
I	0
J	0

Critical path = ADFHIJ

Expected project completion time = Expected duration of A + Expected duration of D + Expected duration of F + Expected duration of H + Expected duration of I+ Expected duration of J
= 39

(c) Crash A by 2 days
Crash D by 1 day
Crash F by 1 day
Crash G by 1 day
Crash H by 2 days
Crash I by 1 day
Crash J by 2 days

The shortest duration is 30 days

Critical paths:
ADGIJ
ADFHIJ