Topic Notes 8 & 9, Problem Formulation & Linear Programming
Exam Sample Questions

Question 1

What is the meaning of tractability for a mathematical model?

a) The model's ability to handle large amounts of data
b) The model's ability to produce accurate predictions
c) The model's ability to be solved or analyzed efficiently
d) The model's ability to adapt to changing conditions
e) The model's ability to produce simple and intuitive explanations.

c)

Question 2

What is meant by validity of a model?

a) The model's ability to produce consistent results over time
b) The model's ability to fit the data accurately
c) The extent to which the model is able to generalize to new situations
d) The degree to which inferences drawn from the model hold meaning for the real system
e) The model's ability to handle complex ata inputs

d)

Question 3

What is heuristic optimization?

a) A problem-solving approach that uses a set of rules or guidelines to find a solution
b) A mathematical technique for optimizing a function using derivatives
c) A search algorithm that guarantees the optimal solution
d) An approach that uses trial and error to find the best solution but is not guaranteed to yield an exact optimum
e) An optimization method that involves solving a series of linear equations

d)

Question 4

Which of the following is not a continuous variable?

a) The average 30-day rainfall in a region in centimetres.
b) Water volume in a concrete mix.
c) The result of rolling a die.
d) The temperature of a freezer.
e) They are all continuous variables

c)

Question 5

Use the following scenario for questions 5-7.

A steel mill has two production lines available to make steel for industrial use. The first production line can produce one lot of steel in t_1 hours at cost c_1, and the second requires t_2 hours and cost c_2. The plant manager wishes to find the least costly way to produce *z* lots in a total of at most *T* hours of operation (meaning that even though the lines operate in parallel, *T* is the sum of the hours the lines are operating. e.g. Both lines running for one hour each would be two total hours.) An integer number of lots x_1 will be produced on line 1, and integer number of lots x_2 will be produced on line 2.

Identify the decision variables.

a) x_1, x_2
b) t_1, t_2
c) c_1, c_2
d) x_1, x_2, t_1, t_2, c_1, c_2
e) none of the above

a)

Question 6

Identify the objective function from Question 5.

a) $\max_{x_1,x_2} \phi = c_1x_1 + c_2x_2$
b) $\max_{x_1,x_2} \phi = c^Tx$
c) $\min_{x_1,x_2} \phi = c_1x_1 + c_2x_2$
d) $\min_{x_1,x_2} \phi = c^Tx$
e) c and d

e)

Question 7

Identify the constraints from Question 5.

a) $t_1x_1 + t_2x_2 \leq T$
b) $x_1 + x_2 = z$
c) $x_1 \geq 0,\ x_2 \geq 0$
d) $x_1, x_2 \in \mathbb{Z}$
e) All of the above

e)

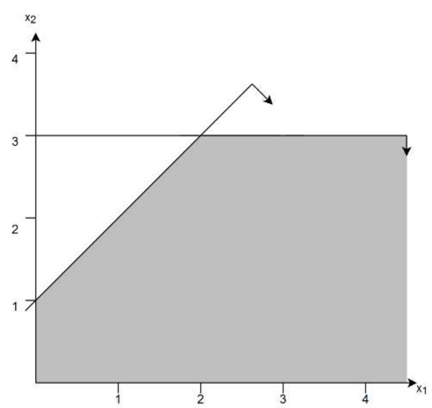
Question 8

Consider the constraints:

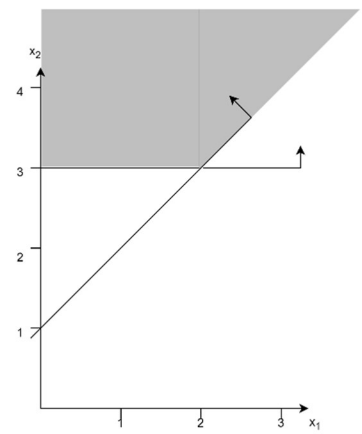
$$-x_1 + x_2 \leq 1$$
$$x_2 \leq 3$$
$$x_1, x_2 \geq 0$$

Which of the following represents the feasible space?

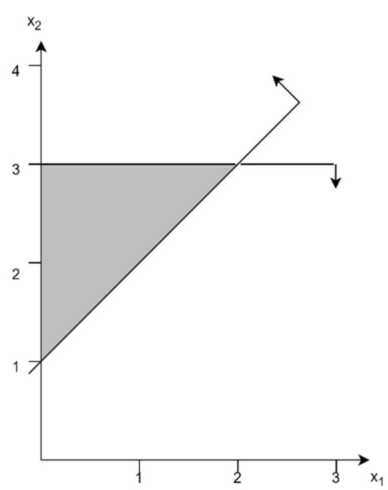
a)



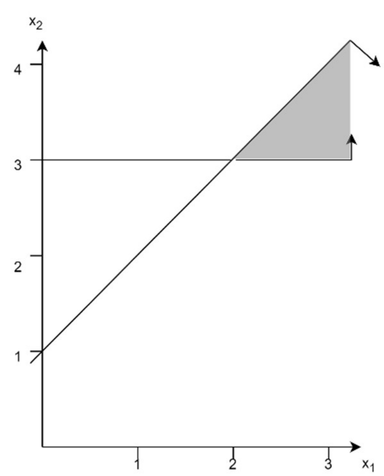
b)



c)



d)



e) none of the above

a)

Question 9

For questions 9- 12 use the constraints from Question 8 and consider the points:

$$x_1 = (2,3), x_2 = (0,3), x_3 = (2,1), x_4 = (3,3)$$

What is the correct classification for point x_1?

a) Interior Point
b) Boundary Point
c) Extreme Point
d) Infeasible Point
e) Edge Point

Question 10

What is the correct classification for point x_2?

a) Interior Point
b) Boundary Point
c) Extreme Point
d) Infeasible Point
e) Edge Point

Question 11

What is the correct classification for point x_3?

a) Interior Point
b) Boundary Point
c) Extreme Point
d) Infeasible Point
e) Edge Point

Question 12

Of the four points, which point may be a possible optimal solution?

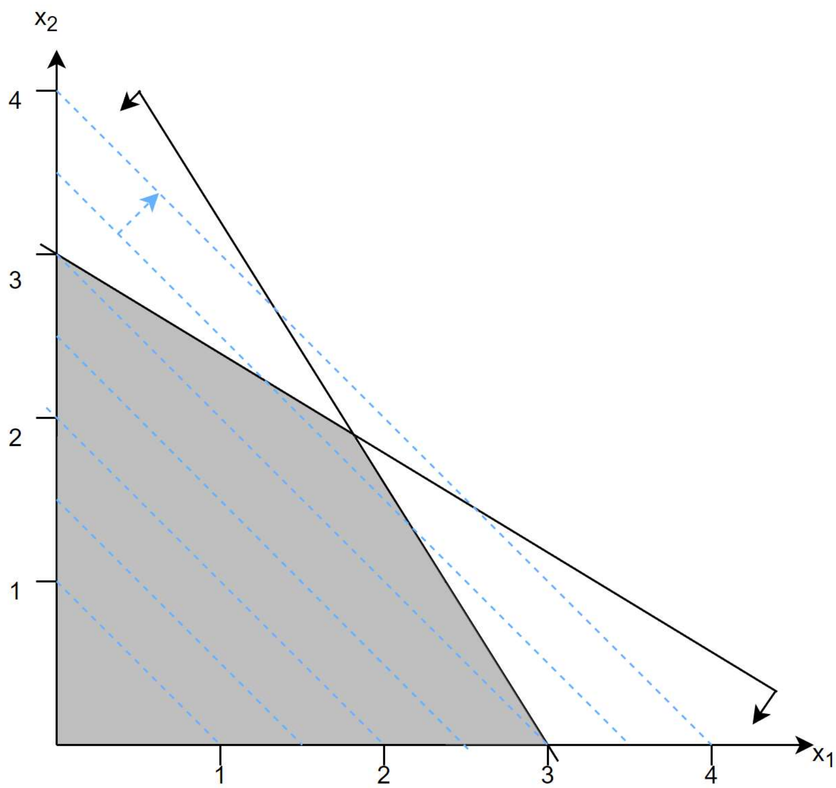
a) x_2
b) x_4
c) x_1
d) x_3
e) x_1, x_4

Question 13

Consider the linear constraints:

$$3x_1 + 5x_2 \leq 16$$
$$5x_1 + 3x_2 \leq 16$$
$$x_1, x_2 \geq 0$$

And the objective contour:



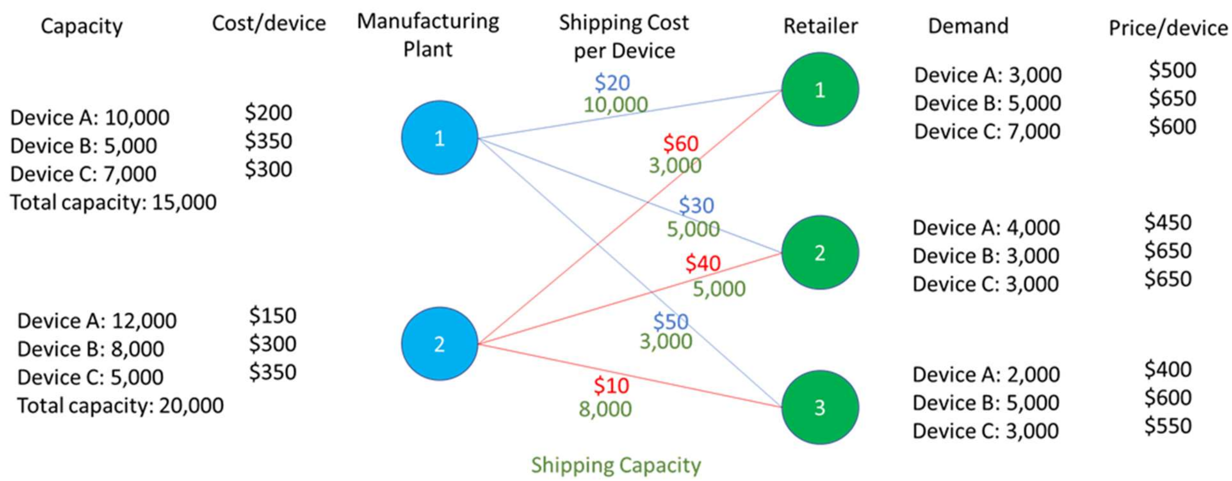
Of the following four points, x_5 through x_8, which point represents the best solution? $x_5 = (2,2), x_6 = \left(2, \frac{3}{2}\right), x_7 = (3,0), x_8 = (\frac{1}{2}, \frac{5}{2})$

a) x_5
b) x_6
c) x_7
d) x_8
e) From the given information, it is impossible to tell which of the four points represents the best solution.

a)

Question 14

Consider the following scenario presented in lecture for Questions 14-17.



How many decision variables are there for this problem?

a) 12
b) 16
c) 18
d) 24
e) 30

c)

Question 15

A linear optimization was performed on the problem above and the following sensitivity report was generated by Excel Solver:

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
I2	A11 Devices Made	1000	0	280	0	0
I3	A12 Devices Made	2000	0	220	0	0
I4	A13 Devices Made	0	0	150	0	1E+30
I5	A21 Devices Made	2000	0	290	0	0
I6	A22 Devices Made	2000	0	260	0	0
I7	A23 Devices Made	2000	0	240	1E+30	0
I8	B11 Devices Made	5000	0	280	1E+30	0
I9	B12 Devices Made	0	0	270	0	0
I10	B13 Devices Made	0	0	200	0	1E+30
I11	B21 Devices Made	0	0	290	0	1E+30
I12	B22 Devices Made	3000	0	310	0	0
I13	B23 Devices Made	5000	0	290	1E+30	0
I14	C11 Devices Made	4000	0	280	0	0
I15	C12 Devices Made	3000	0	320	0	0
I16	C13 Devices Made	0	0	200	80	0
I17	C21 Devices Made	1000	0	190	0	0
I18	C22 Devices Made	0	0	260	0	1E+30
I19	C23 Devices Made	1000	0	190	0	190

What is the profit per Device A manufactured at plant 1 and shipped to retailer 3?

a) $290
b) $270
c) $200
d) $190
e) $150

e)

Question 16

The sensitivity report for the constraints is shown below:

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
B23	A Demand 1 Value	3000	100	3000	1000	2000
B24	A Demand 2 Value	4000	0	4000	1000	0
B25	A Demand 3 Value	2000	50	2000	1000	2000
B26	B Demand 1 Value	5000	50	5000	0	0
B27	B Demand 2 Value	3000	0	3000	1E+30	0
B28	B Demand 3 Value	5000	50	5000	0	0
B29	C Demand 1 Value	5000	0	7000	1E+30	2000
B30	C Demand 2 Value	3000	0	3000	1E+30	0
B31	C Demand 3 Value	1000	0	3000	1E+30	2000
B32	A Capacity 1 Value	3000	0	10000	1E+30	7000
B33	A Capacity 2 Value	6000	0	12000	1E+30	6000
B34	B Capacity 1 Value	5000	50	5000	0	0
B35	B Capacity 2 Value	8000	50	8000	0	0
B36	C Capacity 1 Value	7000	100	7000	1000	2000
B37	C Capacity 2 Value	2000	0	5000	1E+30	3000
B38	Total Capacity 1 Value	15000	100	15000	2000	0
B39	Total Capacity 2 Value	16000	0	20000	1E+30	4000
B40	Shipping Capacity 1,1 Value	10000	80	10000	0	2000
B41	Shipping Capacity 1,2 Value	5000	120	5000	0	2000
B42	Shipping Capacity 1,3 Value	0	0	3000	1E+30	3000
B43	Shipping Capacity 2,1 Value	3000	190	3000	2000	1000
B44	Shipping Capacity 2,2 Value	5000	260	5000	0	1000
B45	Shpping Capacity 2,3 Value	8000	190	8000	2000	1000

Which of the following constraint is not binding at the optimum solution?

a) Demand for Device C from Retailer 2
b) Shipping capacity from Plant 1 to Retailer 3
c) Shipping capacity from Plant 1 to Retailer 1
d) Demand for Device A from Retailer 1
e) Manufacturing Capacity of Plant 2 for Device B

b)

Question 17

What is the increase in profit if shipping capacity from plant 2 to retailer 3 is increased by 1500 units?

a) $165,000
b) $190,000
c) $250,000
d) $285,000
e) Cannot be determined since shadow price will change

d)