**EASTERN MEDITERRANEAN UNIVERSITY**



**Department of Industrial Engineering**

**IENG212/MANE212 Modelling and Optimization**

**HOMEWORK 2 Spring 2021-22**

1. Consider the problem:

Min **cx**

*St.* **Axb**

**x0**

In each of the following case answer to these questions,

What happens to the feasible region? What happens to the optimal objective?

1. One component of the vector **b**, say *bi* is increased by one unit to *bi+1*.
2. A new constraint, *m+1* is added to the problem.
3. A new variable, *n+1* is added to the problem.
4. A constraint, say constraint *i* is deleted from the problem.
5. A variable say, *xk* is deleted from the problem.
6. Assume that the right hand side of the following constraints can take the given values and just one of them should consider in the problem. Use the binary variables to manage the situation..



1. Consider the following three constraints with variable right hand side values and assume that only two constraints from these three constraints must hold.



1. Assume that is one of constraints in our problem, how we can consider it as linear constraint using binary variables?
2. Stockco is considering four investments. Investment 1 will yield a net present value (NPV) of $16,000; investment 2, an NPV of $22,000; investment 3, an NPV of $12,000; and investment 4, an NPV of $8,000. Each investment requires a certain cash outﬂow at the present time: investment 1, $5,000; investment 2, $7,000; investment 3, $4,000; and investment 4, $3,000. Currently, $14,000 is available for investment. Formulate an IP whose solution will tell Stockco how to maximize the NPV obtained from investments 1–4.
3. Rewrite the following pure integer linear programming as a pure binary linear programming.



1. A corporation is considering four possible investment opportunities. The following table present information about the investment (in $) profits:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Project | Present Value of Expected Returns | Capital Required Year-wise by Project  Year1 Year2 Year3 | | |
| 1 | 6500 | 700 | 550 | 400 |
| 2 | 7000 | 850 | 550 | 350 |
| 3 | 2250 | 300 | 150 | 100 |
| 4 | 2500 | 350 | 200 | 170 |
| *Capital available for investment* |  | 1200 | 700 | 400 |

In addition, one or both of the projects 1 and 2 can consider but project 4 can consider if project 3 accepted. Formulate an integer programming model to determine which project should be accepted and which should be rejected to maximize the present value from accepted project.

1. Four products A, B and C produce by five machines. The technological order and time scheduling for each of machines are pointed in the following figure. The product B must delivered at *t* o’clock and product C must delivered two hours after B. Formulated the problem in a manner that products are complete in minimum time respect to above restrictions.

3

a3

1

a1

4

a4

5

a5

A:

3

b3

2

b2

4

b4

B:

5

c5

2

c2

1

c1

C:

1. A company has developed three possible new products but from these three possible new products at most two should be chosen to be produced. Each of these products can produced in either two plants of the company but just one of the two plants should be chosen to be the sole producer of the new products. The production cost per unit of each product would be essentially the same in the two plants. However, because of difference in their production facilities, the number of hours of production time needed per unit of each product might differ between the two plants. These data are given in the following table along with other relevant information. The objective is to choose the products, the plant and the production rates of the chosen products so as to maximize total profit.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Production time used for each unit produced (in hour) | | | Production time available per week |
| Product1 | Product2 | Product3 |
| Plant1 | 3 | 4 | 2 | 60 |
| Plant2 | 5 | 6 | 2 | 70 |
| Unit profit | 4 | 8 | 3 | (thousands of dollars) |
| Sale potential | 20 | 54 | 62 | (unit per week) |

1. Solve the following linear programming problem graphically when *x1* and *x2* are integer.

