UNIVERSITY OF ENGINEERING AND TECHNOLOGY TAXILA

Department of Industrial Engineering

Assignment # 1

Course Name: Operations Research **Course Code:** IE-313

Semester: 4th(2k13 Session)

Formulate the LP Model.

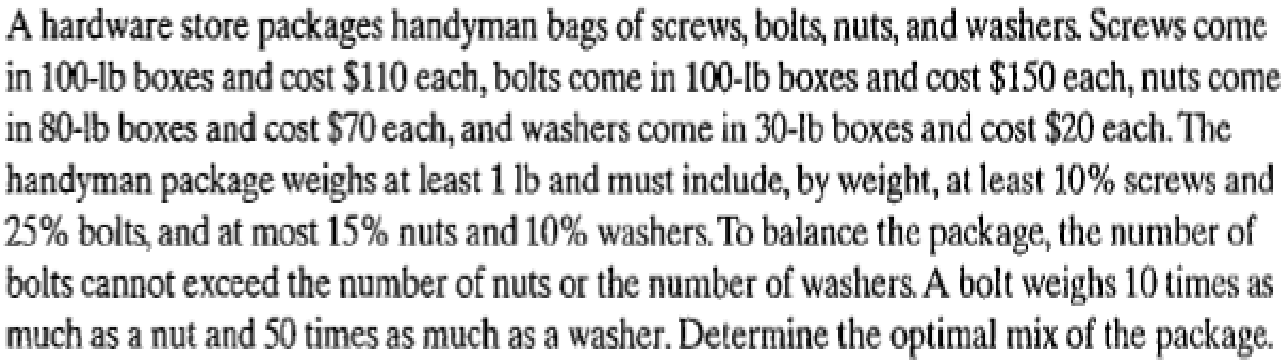
Q 1: A **100*100 m** lot is available to construct a multi-storey office building. At least 20,000m2 total floor space is needed. According to a zoning ordinance, the maximum height of the building can be only 21 m, and the area for parking outside the building must be at least 25 percent of the total floor area. It has been decided to fix the height of each story at 3.5 m. The cost of the building in millions of dollars is estimated at $0.6h + 0.001A$, where A is the cross-sectional area of the building per floor and h is the height of the building. Formulate the minimum cost design problem.

Q 2: A vegetable oil processor wishes to determine how much shortening, salad oil, and margarine to produce to optimize the use of his current oil stocks. At the current time, he has 250,000 kg of soybean oil, 110,000 kg of cottonseed oil, and 2000 kg of milk base substances. The milk base substances are required only in the production of margarine. There are certain processing losses associated with each product; 10 percent for shortening, 5 percent for salad oil, and no loss for margarine. The producer's back orders require him to produce at least 100,000 kg of shortening, 50,000 kg of salad oil, and 10,000 kg of margarine. In addition, sales forecasts indicate a strong demand for all products in the near future. The profit per kilogram and the base stock required per kilogram of each product are given in Table. Formulate the problem to maximize profit over the next production scheduling period (created by J. Liittschwager).

Table: Date for Vegetable Oil Processing

		Parts per kg of base stock requirements		
Product	*Profit per kg*	*Soybean*	*Cottonseed*	*Milk base*
Shortening	0.10	2	1	0
Salad oil	0.08	0	1	0
Margarine	0.05	3	1	1

Q # 3:



A hardware store packages handyman bags of screws, bolts, nuts, and washers. Screws come in 100-lb boxes and cost $110 each, bolts come in 100-lb boxes and cost $150 each, nuts come in 80-lb boxes and cost $70 each, and washers come in 30-lb boxes and cost $20 each. The handyman package weighs at least 1 lb and must include, by weight, at least 10% screws and 25% bolts, and at most 15% nuts and 10% washers. To balance the package, the number of bolts cannot exceed the number of nuts or the number of washers. A bolt weighs 10 times as much as a nut and 50 times as much as a washer. Determine the optimal mix of the package.

Transcribe the following problems into standard form and then solve them using the graphical method:

Q # 4: **Maximize Z =** $x_1 + 3x_2$

Subject to: $x_1 + 4x_2 >= 48$

$5x_1 + x_2 >= 50$

$x_1, x_2 >= 0$

Q # 5: **Minimize Z** $= 3x_1 + 2x_2$

Subject to: $3x_1 + 2x_2 <= 12$

$2x_1 + 3x_2 = 12$

$2x_1 + x_2 >= 8$

$x_1, x_2 >= 0$

Q # 6: **Minimize Z** $= 3x_1 + x_2$

Subject to: $2x_1 + 4x_2 <= 21$

$5x_1 + 3x_2 <= 18$

$x_1, x_2 >= 0$

Q # 7: **Minimize Z** $= 3x_1 + 6x_2$

Subject to: $-3x_1 + 3x_2 <= 2$

$4x_1 + 2x_2 <= 4$

$-x_1 + 3x_2 >= 1$

$x_1, x_2 >= 0$