

## LINEAR PROGRAMMING LAB ACTIVITY

1. Consider a small manufacturer making two products P1 and P2. Two resources R1 and R2 are required to make these products. Each unit of product P1 requires 1 unit of R1 and 3 units of R2. Each unit of product P2 requires 1 unit of R1 and 2 units of R2. The manufacturer has 5 units of R1 and 12 of R2 available. The manufacturer also make a profit of Rs 6 per unit of product P1 sold and Rs 5 per unit of product P2 Sold.

2. Blue Ridge Hot Tubs manufactures and sells two models of hot tubs: the Aqua-Spa and the Hydro-Lux. Howie Jones, the owner and manager of the company, needs to decide how many of each type of hot tub to produce during his next production cycle. Howie buys prefabricated fiberglass hot tub shells from a local supplier and adds the pump and tubing to the shells to create his hot tubs. (This supplier has the capacity to deliver as many hot tub shells as Howie needs.)

Howie installs the same type of pump into both hot tubs. He will have only 200 pumps available during his next production cycle. From a manufacturing standpoint, the main difference between the two models of hot tubs is the amount of tubing and labour required. Each Aqua-Spa requires 9 hours of labour and 12 feet of tubing. Each Hydro-Lux requires 6 hours of labour and 16 feet of tubing.

Howie expects to have 1,566 production labour hours and 2,880 feet of tubing available during the next production cycle. Howie earns a profit of \$350 on each Aqua-Spa he sells and \$300 on each Hydro-Lux he sells. He is confident that he can sell all the hot tubs he produces. The question is, how many Aqua-Spas and Hydro- Luxes should Howie produce if he wants to maximize his profits during the next production cycle.

3. Consider the following product mix example (Hadley, 1962). A shop that has three machines, A, B, and C, turns out four different products. Each product must be processed on each of the three machines (for example, lathes, drills, and milling machines). The following table shows the number of hours required by each Product on each machine:

Product				
Machine	1	2	3	4
A	1.5	1	2.4	1
B	1	5	1	3.5
C	1.5	3	3.5	1

The weekly time available on each of the machines is 2,000, 8,000, and 5,000 hours, respectively. The products contribute 5.24, 7.30, 8.34, and 4.18 to profit, respectively. What mixture of products can be manufactured to maximize profit?

### Capital budget allocation

4. In his position as vice president of research and development (R&D) for CRT Technologies, Mark Schwartz is responsible for evaluating and choosing which R&D projects to support. The company received 18 R&D proposals from its scientists and engineers and identified six projects as being consistent with the company's mission.

However, the company does not have the funds available to undertake all six projects. Mark must determine which of the projects to select. The funding requirements for each project are summarized in the following table along with the NPV the company expects each project to generate.

Project	Expected NPV (in \$1,000s)	Capital (in \$1,000s) Required in				
		Year 1	Year 2	Year 3	Year 4	Year 5
1	\$141	\$ 75	\$25	\$20	\$15	\$10
2	\$187	\$ 90	\$35	\$ 0	\$ 0	\$30
3	\$121	\$ 60	\$15	\$15	\$15	\$15
4	\$ 83	\$ 30	\$20	\$10	\$ 5	\$ 5
5	\$265	\$100	\$25	\$20	\$20	\$20
6	\$127	\$ 50	\$20	\$10	\$30	\$40

The company currently has \$250,000 available to invest in new projects. It has budgeted \$75,000 for continued support for these projects in year 2 and \$50,000 per year for years 3, 4, and 5. Surplus funds in any year are re- appropriated for other uses within the company and may not be carried over to future years.

### Assignment problem

5. Air-Express is an express shipping service that guarantees overnight delivery of packages anywhere in the continental United States. The company has various operations centers, called hubs, at airports in major cities across the country.

Packages are received at hubs from other locations and then shipped to intermediate hubs or to their final destinations. The manager of the Air-Express hub in Baltimore, Maryland, is concerned about labor costs at the hub and is interested in determining the most effective way to schedule workers. The hub operates seven days a week, and the number of packages it handles each day varies from one day to the next. Using historical data on the average number of packages received each day, the manager estimates the number of workers needed to handle the packages as:

<b>Day of Week</b>	<b>Workers Required</b>
Sunday	18
Monday	27
Tuesday	22
Wednesday	26
Thursday	25
Friday	21
Saturday	19

The package handlers working for Air-Express are unionized and are guaranteed a five-day work week with two consecutive days off. The base wage for the handlers is \$655 per week. Because most workers prefer to have Saturday or Sunday off, the union has negotiated bonuses of \$25 per day for its members who work on these days. The possible shifts and salaries for package handlers are:

The manager wants to keep the total wage expense for the hub as low as possible. With this in mind, how many package handlers should be assigned to each shift if the manager wants to have a sufficient number of workers available each day?

### **Transportation Problem**

6. Tropicsun currently has 275,000 bags of citrus at Mt. Dora, 400,000 bags at Eustis, and 300,000 bags at Clermont. Tropicsun has citrus processing plants in Ocala, Orlando, and Leesburg with processing capacities to handle 200,000, 600,000, and 225,000 bags, respectively.

Tropicsun contracts with a local trucking company to transport its fruit from the groves to the processing plants. The trucking company charges a flat rate for every mile that each bushel of fruit must be transported. Each mile a bushel of fruit travels is known as a bushel-mile. The following table

summarizes the distances (in miles) between the groves and processing plants:

<b>Grove</b>	<b>Distances (in miles) Between Groves and Plants</b>		
	<b>Ocala</b>	<b>Orlando</b>	<b>Leesburg</b>
Mt. Dora	21	50	40
Eustis	35	30	22
Clermont	55	20	25