Linear Programming Practice Problems (Formulation, not solving)

1. A company produces two lines of its product, the Super and the Regular. Unit resource requirements for production are shown in the table. There are 1600 hours of assembly worker hours available per week, 700 hours of paint time, and 300 hours of inspection time. It is projected that regular customers will demand at least 80 units of the Super and the company policy dictates that it produce at least twice as many units of Regular as Super. Formulate an LP model that will determine the optimal product mix on a weekly basis.



2. An oil company must decide how to allocate its budget from windfall profits. The government grants certain tax breaks if the company invests funds in research concerned with energy conservation. However, the government stipulates that at least 60% of the funds must be funneled into research for automobile efficiency. The company has a $1 million budget for energy research and development this year; the research proposal data are shown in the table. Assuming the company wants to maximize return on its investments and receive the government tax break, how should the budget be allocated? Formulate an LP model.



3. Pirate Furniture Company (PFC) operates two manufacturing plants that produce three products: loft beds, futon frames, and desks. Each product’s resource requirements are given in the accompanying table. Based on the existing facilities and the current workforce, Plant 1 has 480 hours of assembly time per month and 640 hours of finishing time per month. The corresponding figures for Plant 2 are: 540 hours of assembly time and 680 hours of finishing time. PFC’s lumber source can provide a combined total of at most 5000 board feet of lumber per month.

The Accounting Department has determined that each loft bed, futon frame, and desk contribute $90, $110, and $45 to profit, respectively. Forecasting indicates that the minimum monthly demand for desks is 120, which must be met. Additionally, based on past experience, management has specified that the **total number of loft beds produced by PFC should not exceed 15% of the total number of items produced.** Assuming that PFC can sell all it can manufacture, clearly identify the decision variables and formulate a linear program to maximize profit.

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| --- | --- | --- | --- |
| Product | Wood (board feet) | Assembly Time (hours) | Finishing Time (hours) |
| Loft beds | 12 | 1.3 | 1.9 |
| Futon frames | 9 | 1.1 | 2.1 |
| Desks | 5 | 0.8 | 1.7 |

Indexed Sets

i = product type, (i=1 for loft beds, i=2 for futon frames, i=3 for desks)

j = plant (j = 1 for plant 1 and j = 2 for plant 2)

Decision variables

Xij = the amount of product i manufactured in j plant

Objective:

Max profit = 90(X11+X12) + 110(X21+X22) + 45(X31+X32)

Constraints:

1.3X11 + 1.1X21 + 0.8X31 <= 480 (assembly time at plant 1)

1.3X12 + 1.1X22 + 0.8X32 <= 540 (assembly time at plant 2)

1.9X11 + 2.1X21 + 1.7X31 <= 640 (finishing time at plant 1)

1.9X12 + 2.1X22 + 1.7X32 <= 680 (finishing time at plant 2)

12(X11+X12) + 9(X21+X22) = 5(x31+X32) <=5000 (lumber constraint)

(X11+X12) <= (15% constraint)

Xij >=0 for all i, j (Non-negativity)