AMJAD KHAN 09-09-25 BSE 4A/4B

OPERATIONS RESEARCH.

Assignment No. 1.

Study the following problems carefully, analyze and translate them mathematically so as to obtain mathematical models therefrom by introducing variables appropriately. [illegible] at this stage!

1. A PRODUCTION PROBLEM.

A small manufacturer of photographic products prepares two types of film developers each day: Find and Extra Fine, using solutions A and B as the raw materials. Suppose that each quart of Fine contains 2 ounces of solution A and 1 ounce of solution B, while each quart of Extra Fine contains 1 ounce of solution A and 2 ounces of solution B. Suppose also that profit on each quart of Fine is 8 cents and that it is 10 cents on each quart of Extra Fine. If the firm has 50 ounces of solution A and 70 ounces of solution B available each day, how many quarts of Fine and how many quarts of Extra Fine should be made each day to maximize the profit assuming that the shop can sell all that is made?

2. THE POLLUTION PROBLEM.

A manufacture of a certain chemical product has two plants where product is made. Plant X can make at most 30 tons/week and Plant Y can make at most 40 tons/week. The manufacturer wants to make at least 50 tons/week. The amount of particulate matter found weekly in the atmosphere over a nearby town is measured and found to be 20 lbs for each tons of the product made by plant X and 30 lbs for each ton of the product made by plant Y. How many tons of the chemical product should be made weekly at each plant is order to minimize the total amount of particulate in the atmosphere?

3. THE DIET PROBLEM.

A nutritionist is planning to prepare a menu that includes foods A and B as its main staple diet. Suppose that each ounce of food A contains 2 units of protein, 1 unit of iron and 1 unit of thiamine; each ounce of food B contains a unit of protein, 1 unit of iron and 3 units of thiamine. Suppose that each ounce of food A costs 30 cents, while each ounce of food B costs 40 cents. The nutritionist wants the meal to provide at least 12 units of protein, at least 9 units of iron and at least 15 units of thiamine. How many ounces of each of the foods should be used to minimize the cost of the meal?

A television producer designs program based on a comedian and time for commercials. The advertiser insists on at least 2 minutes of advertising time, the station insists on no more than 4 minutes of advertising time and the comedian insists on at least 24 minutes of the comedy program. Also, the total time allotted for the advertising and comedy portions of the program cannot exceed 30 minutes. If it has been determined that each minute of advertising (very creative) attracts 40,000 viewers and each minute of comedy program attracts 45,000 viewers, how should the time be divided between advertising and programming to maximize the number of viewer-minutes?

The Proteins Diet Club serves a luncheon consisting of two dishes A and B. Supercalc that each unit of A has 1 gram of fat, 1 gram of carbohydrate and 4 grams proteins, whereas each unit of B has 2 grams of fat, 1 gram of carbohydrate and 6 grams of protein. If the dietitian planning the luncheon wants to provide no more than 10 grams of fat or more than 7 grams of carbohydrate, how many units of A and how many units of B should be served to maximize the amount of proteins consumed?

A small generator burns two types of fuel: low sulfur (L) and high sulfur (H) to produce electricity. For each hour of use, each gallon of L emits 3 units of sulfur dioxide, generates 4 kilowatts and costs 60 cents, while each gallon of H emits 5 units of sulfur dixoide, generates 4 kilowatts and costs 50 cents. The environment protection agency insists that the maximum amount of sulfur dioxide that may be emitted per hour is 15 units. Suppose that at least 16 kilowatts must be generated per hour. How many gallons of L and how many gallons of H should be used hourly to minimize the cost of the fuel used?

7. In designing a new transportation system, a company is considering two types of buses, types A and B. A type A bus can carry 40 passengers and requires 2 mechanics for serving, a type B bus can carry 60 passengers and requires 3 mechanics for servicing. Suppose that the company must transport at least 300 people daily and that insurance rules for the size of garage allow no more than 12 mechanics on the payroll. If each type A bus costs $ 20,000 and each type B bus costs $ 25,000, how many buses of each type should be bought to minimize the cost?

8. An animal feed producer mixes two types of grain: A and B. Each unit of grain A contains 2 grams of fat, 1 gram of proteins and 80 calories. Each unit of grain B contains 3 grams of fat, 3 grams of proteins and 60 calories. Suppose that the producer wants each unit of the final product to yield at least 18 grams of fat, at least

12 grams of proteins and at least 480 calories. If each unit of A costs 10 cents and each unit B costs 12 cents, how many units of each type of grain should be producer use to minimize the cost?

9. A steel producer makes two types of steel: regular and special. A ton of regular steel requires 2 hours in the open-hearth furnace and 5 hours in the soaking pit; a tone of special steel requires 2 hours in the open-hearth furnace and 3 hours in the soaking pit. The open-hearth furnace is available 8 hours per day and the soaking pit is available 15 hours per day. The profit on a ton of regular steel is $ 120 and it is $ 100 on a ton of special steel. Determine how many tons of each type of steel should be made to maximize the profit?

10. A trash-removal company carries industrial waste in sealed containers in its fleet of trucks. Suppose that each container from the Smith Corporation weighs 6 pounds and is 3 cubic feet in volume, while each container from the Johnson Corporation weighs 12 pounds and is 1 cubic foot in volume. The company charges the Smith Corporation 30 cents for each container carried on a trip and 60 cents for each container from the Johnson Corporation. If a truck cannot carry more than 18,000 pounds or more than 1,800 cubic feet in volume, how many containers from each customer should the company carry in a truck on each trip to maximize the revenue per truck load?

11. A trust fund is planning to invest up to $ 6,000 in two types of bonds: A and B. Bond A is safer than bond B and carries a dividend of 8 percent and bond B carries a dividend of 10 percent. Suppose that the fund's rules state that no more than $ 4,000 may be invested in bond B, while at least $ 1,500 must be invested in bond A. How much should be invested in each type of bonds to maximize the funds return?

12. Solve Exercise 11 if the fund has the following additional rule: "The amount invested in bond B cannot exceed one half the amount invested in bond A".

[redacted] Due date is 6-3-2022