Sheet1

Pb1

John must work at least 20 hours a week to supplement his income while attending school. He has the opportunity to work in two retail stores. In store 1, he can work between 5 and 12 hours a week, and in store 2 he is allowed between 6 and 10 hours. Both stores pay the same hourly wage. In deciding how many hours to work in each store, John wants to base his decision on work stress. Based on interviews with present employees, John estimates that, on an ascending scale of 1 to 10, the stress factors are 8 and 6 at stores 1 and 2, respectively. Because stress mounts by the hour, he assumes that the total stress for each store at the end of the week is proportional to the number of hours he works in the store. How many hours should John work in each store?

Pb2

Jack is an aspiring freshman at Ulern University. He realizes that "all work and no play make Jack a dull boy." As a result, Jack wants to apportion his available time of about 10 hours a day between work and play. He estimates that play is twice as much fun as work. He also wants to study at least as much as he plays. However, Jack realizes that if he is going to get all his homework assignments done, he cannot play more than 4 hours a day. How should Jack allocate his time to maximize his pleasure from both work and play?

Pb3

Wild West produces two types of cowboy hats. A type 1 hat requires twice as much labor time as a type 2. If the all available labor time is dedicated to Type 2 alone, the company can produce a total of 400 Type 2 hats a day. The respective market limits for the two types are 150 and 200 hats per day. The profit is $8 per Type 1 hat and $5 per Type 2 hat. Determine the number of hats of each type that would maximize profit.

Pb4

Show & Sell can advertise its products on local radio and television (TV). The advertising budget is limited to $10,000 a month. Each minute of radio advertising costs $15 and each minute of TV commercials $300. Show & Sell likes to advertise on radio at least twice as much as on TV. In the meantime, it is not practical to use more than 400 minutes of radio advertising a month. From past experience, advertising on TV is estimated to be 25 times as effective as on radio. Determine the optimum allocation of the budget to radio and TV advertising.

Pb5

A Financial Problem: Suppose that the financial advisor of a university's endowment fund must invest exactly 100,000 in two types of securities: bond AAA, paying a dividend of 7%, and stock BB, paying a dividend of 9%. The advisor has been told that no more than 30,000 can be invested in stock BB, while the amount invested in bond AAA must at least twice the amount invested in stock BB. How much should be invested in each security to maximize the University's return?

Pb6

Fay Klein had developed two types of handcrafted, adult games that she sells to department stores throughout the country. Although the demand for these games exceeds her capacity to produce them, Ms. Klein continues to work alone and to limit her workweek to 50 h. Game I takes 3.5 h to produce and brings a profit of $28, while game II requires 4 h to complete and brings a profit of $31. How many games of each type should Ms. Klein produce weekly if her objective is to maximize total profit?

Pb7

An individual wishes to invest $5000 over the next year in two types of investment: Investment A yields 5% and investment B yields 8%. Market research recommends an allocation of at least 25% in A and at most 50% in B. Moreover, investment in A should be at least half the investment in B. How should the fund be allocated to the two investments?

Pb8

Day Trader wants to invest a sum of money that would generate an annual yield of at least $10,000. Two stock groups are available: blue chips and high tech, with average annual yields of 10% and 25%, respectively. Though high-tech stocks provide higher yield, they are more risky, and Trader wants to limit the amount invested in these stocks to no more than 60% of the total investment. What is the minimum amount Trader should invest in each stock group to accomplish the investment goal?

Pb9

A furniture maker has 6 units of wood and 28 h of free time, in which he will make decorative screens. Two models have sold well in the past, so he will restrict himself to those two. He estimates that model I requires 2 units of wood and 7 h of time, while model II requires 1 unit of wood and 8 h of time. The prices of the models are $120 and $80, respectively. How many screens of each model should the furniture maker assemble if he wishes to maximize his sales revenue?

Pb10

ChemLabs uses raw materials *I* and *II* to produce two domestic cleaning solutions, *A* and *B*. The daily availabilities of raw materials *I* and *II* are 150 and 145 units, respectively. One unit of solution *A* consumes .5 unit of raw material *I* and .6 unit of raw material *II*, and one unit of solution *B* uses .5 unit of raw material *I* and .4 unit of raw material *II*. The profits per unit of solutions *A* and *B* are $8 and $10, respectively. The daily demand for solution *A* lies between 30 and 150 units, and that for solution *B* between 40 and 200 units. Find the optimal production amounts of *A* and *B*.

Pb11

A company produces two products, *A* and *B*. The sales volume for *A* is at least 80% of the total sales of both *A* and *B*. However, the company cannot sell more than 100 units of *A* per day. Both products use one raw material, of which the maximum daily availability is 240 lb. The usage rates of the raw material are 2 lb per unit of *A* and 4 lb per unit of *B*. The profit units for *A* and *B* are $20 and $50, respectively. Determine the optimal product mix for the company.

Pb12

The Diet Problem: A nutritionist is planning a menu consisting of two main foods   A and B. Each ounce of A contains 2 units of fat, 1 unit of carbohydrates, and 4   units of protein. Each ounce of B contains 3 units of fat, 3 unit of carbohydrates, and 3 units of protein. The nutritionist wants the meal to provide at least 18 units of fat, 12 unit of carbohydrates, and 24 units of protein. If an ounce of A costs 20 cents and an ounce of B costs 25 cents, how many ounces of each food should be served to minimize the cost of the meal yet satisfy the nutritionist's requirements?

Pb13

. 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 servicing, a type B bus can carry 60 passengers and requires 3 mechanics for servicing. Suppose the company must transport at least 300 people daily and that insurance rules for the size of the 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?

Pb14

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 ton 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 42$ and it is 50$ on a ton of regular steel. Determine how many tons of each type of steel should be made to maximize the profit.

Pb15

A Blending Problem: A manufacturer of artificial sweetener blends 14 kilograms of saccharin and 18 kilograms of dextrose to prepare two new products: Sweet and Low-Sugar. Each kilogram of Sweet contains 0.4 kilograms of dextrose and 0.2 kilograms of saccharin, while each kilogram of Low-Sugar contains 0.3 kilograms of dextrose and 0.4 kilograms of saccharin. If the profit on each kilogram of Sweet is 20 cents and the profit on each kilogram of Low-Sugar is 30 cents, how many kilograms of each product should be made to maximize the profit?

Pb16

A small generator burns 2 types of fuel law 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 kw and costs 60 cents, while each gallon of (H) emits 5 units of sulfur dioxide, generates 4 kw and costs 50 cents. The environmental protection agency insists that the max amount of sulfur dioxide that can be emitted per hours is 15 units, suppose that at least 16 kw must be generated per hour. How many gallons of L and H should be used hourly to minimize the cost of the fuel?

Pb17

A truth fund is planning to invest up to 6000 $ in 2 types of bonds A and B, bond A is safer than bond B, and carries a dividend of 8% and B carries a dividend of 10%, suppose that the fund's rules state that no more than 4000$ may be invested in bond B, while at least 1500$ must be invested in bond A. How much should be invested in each type of bonds to maximize the fund's return?

Pb18

OilCo is building a refinery to produce four products: diesel, gasoline, lubricants, and jet fuel. The minimum demand (in bbl/day) for each of these products is 14,000, 30,000, 10,000, and 8,000, respectively. Iran and Dubai are under contract to ship crude to OilCo. Because of the production quotas specified by OPEC (Organization of Petroleum Exporting Countries) the new refinery can receive at least 40% of its crude from Iran and the remaining amount from Dubai. OilCo predicts that the demand and crude oil quotas will remain steady over the next ten years.

The specifications of the two crude oils lead to different product mixes: One barrel of Iran crude yields .2 bbl of diesel, .25 bbl of gasoline, .1 bbl of lubricant, and .15 bbl of jet fuel. The corresponding yields from Dubai crude are .1, .6, .15, and .1, respectively. OilCo needs to determine the minimum capacity of the refinery (in bbl/ day).

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Pb19

A small manufacturer employs 5 skilled men and 10 semi-skilled men and makes an article in two qualities, a deluxe model and an ordinary model. The making of a deluxe model requires 2 hours work by a skilled man and 2 hours work by a semi-skilled man. The ordinary model requires 1 hour work by a skilled man and 3 hours work by a semi-skilled man. By union rules no man can work more than 8 hours per day. The manufacturer's clear profit of the deluxe model is Rs. 10 and of the ordinary model is Rs. 8. Formulate the model of the problem.

Pb20

Old hens can be bought for Rs. 2 each but young ones cost Rs. 5 each. The old hens lay 3 eggs per week and young ones 5 eggs per week, each egg being worth 30 paise. A hen costs Re. 1 per week to feed. If a person has only Rs. 80 to spend on the hens, how many of each kind should he buy to give a profit of more than Rs. 6 per week assuming that he cannot house more than 20 hens?

Pb21

The manager of an oil refinery has to decide upon the optimal mix of two possible blending processes, of which the inputs and outputs per production run are as follows:

Table 2.16

	Input		Output	
Process	Crude A	Crude B	Gasoline X	Gasoline Y
1	5	3	5	8
2	4	5	4	4

The maximum amounts available of crude A and B are 200 units and 150 units respectively. Market requirements show that at least 100 units of gasoline X and 80 units of gasoline Y must be produced. The profits per production run from process 1 and process 2 are Rs. 3 and Rs. 4 respectively. Formulate the problem as linear programming problem.

Pb22

A plant manufactures washing machines and dryers. The major manufacturing departments are the stamping deptt., motor and transmission deptt. and assembly deptt. The first two departments produce parts for both the products while the assembly lines are different for the two products. The monthly deptt. capacities are

Stamping deptt.	: 1,000 washers or 1,000 dryers
Motor and transmission deptt.	: 1,600 washers or 7,000 dryers
Washer assembly line	: 9,000 washers only
Dryer assembly line	: 5,000 dryers only

Profits per piece of washers and dryers are Rs. 270 and Rs. 300 respectively. Formulate the L.P. model.

Pb23

A company that operates 10 hours a day manufactures two products on three sequential processes. The following table summarizes the data of the problem:

	Minutes per unit			
Product	Process 1	Process 2	Process 3	Unit profit
1	10	6	8	$2
2	5	20	10	$3

Determine the optimal mix of the two products.