Exercises:

Supplementary Problems.

Exercise 1:

Determine the duals of the given programs.

Minimize: Z=$12x_1 + 26x_2 + 80x_3$

Subject to the constraints:

$$2x_1 + 6x_2 + 5x_3 \geq 4$$

$$4x_1 + 2x_2 + x_3 \geq 10$$

$$x_1 + x_2 + 2x_3 \geq 6$$

with: all variables nonnegative

Exercise 2:

Determine the duals of the given programs.

Maximize: Z=$4x_1 + 5x_2 + 7x_3$

Subject to the constraints:

$$x_1 + x_2 + x_3 \leq 10$$

$$4x_1 - x_2 + 2x_3 \geq 15$$

$$-x_1 + 4x_2 + 7x_3 \geq 35$$

with: all variables nonnegative

Exercise 3:

Determine the duals of the given programs.

Maximize: Z=$51x_1 + 52x_2 - 53x_3$

Subject to the constraints:

$$11x_1 + 12x_2 + 13x_3 \leq 10$$

$$21x_1 + 22x_2 + 23x_3 \leq 20$$

with: all variables nonnegative

Exercise 4:

Determine the duals of the given programs.

Minimize: Z = $5x_1$ - $6x_2$ + $4x_3$

Subject to the constraints:

$$3x_1 + 4x_2 + 6x_3 \geq 9$$

$$x_1 + 3x_2 + 2x_3 \geq 5$$

$$7x_1 - 4x_2 - x_3 \geq 10$$

$$x_1 - 2x_2 + 4x_3 \geq 4$$

$$2x_1 + 5x_2 - 3x_3 = 3$$

with: all variables nonnegative

Exercise 5:

A company wishes to get at least 160 million 'audience exposures' the number of times one of the advertisements is seen or heard by a person. Because of the nature of the product the company wants at least 60 million of these exposures to involve persons with family income of over Rs 10,000 a month and at least 80 million of the exposures to involve persons between 18 and 40 years of age.

The relevant information pertaining to the two advertising media under consideration-magazine and television is given below:

	Magazine	**Television**
Cost per advertisement (Rs thousand)	40	200
Audience per advertisements (million)	4	40
Audience per advertisement with monthly income over Rs 10000 (million)	3	10
Audience (per advertisement) in the age group 18-40 (million)	8	10

The company wishes to determine the number of advertisements to be released each in magazine and television so as to keep the advertisement expenditure to the minimum. Formulate it as a linear programming problem. Write 'dual' of this problem. ***Solve the DUAL problem to find the minimum*** expenditure and its allocation among the two media.

Exercise 6:

A firm produces three types of biscuits: A, B and C. It packs them in assortment of two sizes I and II. Size I contains 20 biscuits of type A, 50 biscuits of type B and 10 biscuits of type C. The Size II contains 10 biscuits of type A, 80 biscuits of type B and 60 biscuits of type C. A buyer intends to buy 120 biscuits of type A, 740 biscuits of type B and 240 biscuits of type C.

Determine the least number of packets he should buy. ***Write the associated Dual. Use simplex method to solve dual and read solution of the Primal.***

Exercise 7:

A diet is to contain at least 20 ounces of protein and 15 ounces of carbohydrates. There are three foods: A, B and C available in the market, costing Rs 2, Rs 1 and Rs 3 per unit respectively. Each unit of A contains 2 ounces of protein and 4 ounces of carbohydrates. Each unit of B contains 3 ounces of protein and 2 ounces of carbohydrates. Each unit of C contains 4 ounces of protein and 2 ounces of carbohydrates.

I. Formulate LPP so as to minimize the cost of diet.
II. Find its dual.
III. Solve the dual by simplex method and from the dual solution read the solution to the primal problem.

Exercise 8:

Determine the duals of the given programs.

Minimize: Z = $3x_1 + 2x_2 + x_3 + 2x_4 + 3x_5$

Subject to the constraints:

$$2x_1 + 5x_2 + x_4 + x_5 \geq 6$$
$$4x_2 - 2x_3 + 2x_4 + 3x_5 \geq 5$$
$$x_1 - 6x_2 + 3x_3 + 7x_4 + 3x_5 \leq 7$$

with: all variables are nonnegative

Exercise 9:

Use the results of Exercise 8 to verify the complementary slackness principle.

Exercise 10:

Use the simplex or two-phase method to solve the following problems.

Minimize: Z = $x_1 + 2x_2$

Subject to the constraints:

$$x_1 + 3x_2 \geq 11$$
$$2x_1 + x_1 \geq 9$$

with: $x_1 \; and \; x_2$ nonnegative