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Chapter 12

LINEAR PROGRAMMING

SUMMARY

- A linear programming problem is one that is concerned with finding the optimal value (maximum or minimum) of a linear function of several variables (called objective function) subject to the conditions that the variables are non-negative and satisfy a set of linear inequalities (called linear constraints). Variables are sometimes called decision variables and are non-negative.
- A few important linear programming problems are:
  - **(i)** Diet problems
  - **(ii)** Manufacturing problems
  - **(iii)** Transportation problems
- **Feasible region:**

  The common region determined by all the constraints including non-negative constraints of a L.P.P is called the feasible region (or) solution region. Feasible region is always a convex set. Feasible region may be bounded (or) unbounded.
- **Feasible solution**

  The set of points , whose co-ordinates satisfy the constraints and non-negativity of a linear programming problem, is said to be the feasible solution
- **Infeasible region**

  The region other than the feasible region is called Infeasible region of the L.P.P

- Any point in the feasible region that gives the optimal value (maximum or minimum) of the objective function is called an optimal solution.
- The following Theorems are fundamental in solving linear programming problems:

Theorem-1:

Let R be the feasible region(convex polygon) for a linear programming problem and Let $z = ax + by$ be the objective function. When z has an optimal value (maximum or minimum), where the variables x and y are subject to constraints described by linear inequalities this optimal value must occur at a corner point(vertex) of the feasible region

Theorem-2 :

Let R be the feasible region for a linear programming problem, and let $z = ax + by$ be the objective function. If R is bounded, then the objective function z has both a maximum and a minimum value on R and each of these occurs at a Corner point(vertex) of R.

- If the feasible region is unbounded, then a maximum or a minimum may not exist. However, if it exists, it must occur at a corner point of R.

- **Method To Solve Linear Programming Problem**

Corner Point Method:

1. Find the feasible region of the linear programming problem and determine its Corner point (vertices)

2. Evaluate the objective function $z = ax + by$ at each corner point. Let M and m respectively

denotes the largest and smallest values at these point.

3. When the feasible region is bounded, M and m are the maximum and minimum values of Z.

4. In case, the feasible region is unbounded , then

   (a) M is the maximum value Z if open half plane determined by $ax+by>M$ has no point in common with the feasible region. Otherwise, Z has no, maximum value

   (b) M is the minimum value of Z if open half plane determined by $ax+by<M$ has no point in common with the feasible region. Otherwise, Z has no minimum value.

- If two corner points of the feasible region are both optimal solution of the same type i.e. both produce the same maximum (or) minimum, then any points is also an optimal solution of the same type.