1.

**Solution:**

1) Solution:

minimize $z = 3y_1 + 2y_2 + y_3$

subject to
$$-3y_1 + y_2 + y_3 \geq 1$$
$$2y_1 + y_2 - y_3 \geq 2$$
$$y_1, y_2, y_3 \geq 0$$

| $y_1$ | $y_2$ | $y_3$ | C |
|---|---|---|---|
| -3 | 1 | 1 | 1 |
| 2 | 1 | -1 | 2 |
| 3 | 2 | 1 | |

Transpose of the above matrix to convert minimize to maximize

| $x_1$ | $x_2$ | p |
|---|---|---|
| -3 | 2 | 3 |
| 1 | 1 | 2 |
| 1 | -1 | 1 |
| 1 | 2 | 1 |

$$-3x_1 + 2x_2 \leq 3$$
$$x_1 + x_2 \leq 2$$
$$x_1 - x_2 \leq 1$$
$$x_1 + 2x_2 = p$$

Final equation will be after adding slack variable

Maximize: $-x_1 - 2x_2 + p = 0$

$-3x_1 + 2x_2 + y_1 = 3$
$x_1 + x_2 + y_2 = 2$
$x_1 - x_2 + y_3 = 1$

Where $y_1, y_2, y_3$ are slack variables

| $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | P | |
|---|---|---|---|---|---|---|
| -3 | 2 | 1 | 0 | 0 | 0 | 3 |
| 1 | 1 | 0 | 1 | 0 | 0 | 2 |
| 1 | -1 | 0 | 0 | 1 | 0 | 1 |
| -1 | -2 | 0 | 0 | 0 | 1 | 0 |

↑

Smallest value in the row, check for corresponding smallest value when dividing last column with $x_2$

Choose 2 as pivot

$R_1 \to R_1/2$

| $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | P | |
|---|---|---|---|---|---|---|
| -3/2 | 1 | 1/2 | 0 | 0 | 0 | 3/2 |
| 1 | 1 | 0 | 1 | 0 | 0 | 2 |
| 1 | -1 | 0 | 0 | 1 | 0 | 1 |
| -1 | -2 | 0 | 0 | 0 | 1 | 0 |

$R_2 \to R_2 - R_1$, $R_3 \to R_3 + R_1$, $R_4 \to R_4 + 2R_1$

| $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | P | |
|---|---|---|---|---|---|---|
| $-3/2$ | 1 | $1/2$ | 0 | 0 | 0 | $3/2$ |
| $5/2$ | 0 | $-1/2$ | 1 | 0 | 0 | $1/2$ |
| $-1/2$ | 0 | $1/2$ | 0 | 1 | 0 | $5/2$ |
| $-4$ | 0 | 1 | 0 | 0 | 1 | 3 |

$R_2 \to 2/5\, R_2$

| $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | P | |
|---|---|---|---|---|---|---|
| $-3/2$ | 1 | $1/2$ | 0 | 0 | 0 | $3/2$ |
| 1 | 0 | $-1/5$ | $2/5$ | 0 | 0 | $1/5$ |
| $-1/2$ | 0 | $1/2$ | 0 | 1 | 0 | $5/2$ |
| $-4$ | 0 | 1 | 0 | 0 | 1 | 3 |

$R_1 \to R_1 + 3/2\, R_2$

$R_3 \to R_3 + R_2/2$

$R_4 \to R_4 + 4R_2$

| $x_1$ | $x_2$ | $y_1$ | $y_2$ | $y_3$ | P | |
|---|---|---|---|---|---|---|
| 0 | 1 | $1/5$ | $3/5$ | 0 | 0 | $9/5$ |
| 1 | 0 | $-1/5$ | $2/5$ | 0 | 0 | $1/5$ |
| 0 | 0 | $2/5$ | $1/5$ | 1 | 0 | $13/5$ |
| 0 | 0 | $1/5$ | $2/5$ | 0 | 1 | $19/5$ |

$x_1 = 1/5$

$x_2 = 9/5$

$P = 19/5$ (maximize)

OR

$y_1 = 1/5$

$y_2 = 9/5$

$y_3 = 0$

$z = 19/5$

2.

**Solution:**

To determine the minimal spanning tree of a graph, linear programming must be used. There should be no cycles in the "weighted, undirected graph G = (V,E), thus create a subgraph T" of G with all vertices in V and edge weights c e for each e in E. Linear programming is a mathematical model optimization approach. An objective function can be subjected to Lagrange's inequality and inequality restrictions. Convex optimization methods are useful when the goal function or constraint function is not linear but may be arbitrarily close by linear functions.

The weighted graph G is built with vertices V and edges E. The objective is to locate an acyclic subgraph T of G, such as: The rest of the text is related to the subheading T. The edge weights of T are reduced as a whole. To determine the minimal spanning tree of a graph, linear programming must be used. The following constraints must be observed when developing the code: When an edge links the vertices I and j, xij equals 1. Otherwise, xij equals 0. S is the proprietor of (S being all subsets of E).

As a result, no more than one edge may connect two sets of vertices. A linear programming formulation can be constructed if the problem is treated in this manner. The weighted, undirected graph G = (V,E) should not have any cycles, thus create a subgraph T of G that contains every vertex in V and has edge weights c e for each e in E.
Assume w(T) is defined as follows: we wish to minimise weight w (T).
The total in T equals w (T).

A linear program can be used to solve this problem:
Maximize $x_e + y_e - z_e$, where e is a T-expression. based on:
The sum of y u and x v must be less than 1 for each pair (u, v) in VxV where (u!=v).
$Z_v = 2*z_v$ for each pair (u, vi). For each pair (u, vi), there is at least one edge in G between the pair (u, vi).
In E, $x_e > 0$, $y_e > 0$, and $z_e >= 0$ or 1 for each e in E.

Linear programming is a mathematical model optimization technique in which linear relationships are used to represent the model's requirements. A subset of linear programming that deals with a specific type of problem is mathematical programming. In the form of an optimization problem, Lagrange's inequality and inequality constraints can be applied to the objective function. As a convex polytope, its feasible region can be defined as "the intersection of a finite number of half-spaces, each defined by a linear inequality."

As the polyhedron's goal function, a real-valued affine (linear) function is defined." Many individuals mix up the terms "linear programming" with "linear optimization." Convex optimization methods are useful when the goal function or constraint function is not linear but may be arbitrarily close by linear functions.

3.
**Solution:**

Let there be 'x' ads of radio, 'y' ads of print and 'z' ads of tv

Equation can be writen as

impact = (x*a + y*b + z*c)

This equation needs to be maximized

Let total budget be 'B'

Then the **total cost** for all the ads would be

$cost = (10000*x + 70000*y + 110000*z)$

which should be **less than of equal to total budget**

$(10000*x + 70000*y + 110000*z) <= B$

where B is the total budget

There is a bound to maximum number of each type of ads which gives

$x <= 25$

$y <= 7$

$z <= 15$

4)

The Linear Program would become

**MAXIMIZE**: $impact = (x*a + y*b + z*c)$

**SUBJECT TO**: $(10000*x + 70000*y + 110000*z) <= B$

**BOUNDS**:

$x <= 25$

$y <= 7$

$z <= 1$