Advance Engineering Mathematics(AEM)

Branch :Information Technology, Sem:IIIrd

Dr. Kashish Parwani
Associate Professor, Dept. of Mathematics
JECRC, Sitapura Jaipur

Vision of the Institute

To become a renowned centre of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities

Mission of the Institute

- Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.
- Identify, based on informed perception of Indian, regional and global needs, the areas of focus and provide platform to gain knowledge and solutions.
- Offer opportunities for interaction between academia and industry.
- Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders may emerge.

Course Outcomes

- **CO2:** To learn the formulation of different mathematical problems into optimization problems.
- **CO3:** Apply the principles of optimization using differential calculus.
- **CO4:** To understand the concepts of Linear Programming
- **CO1:** To learn the concepts and principles of Random variables and Probability distribution.

Duality Theory

- The notion of duality within linear programming asserts that every linear program has associated with it a related linear program called its **dual**. The original problem in relation to its dual is termed the **primal**.

- it is the **relationship** between the primal and its dual, both on a mathematical and economic level, that is truly the essence of duality theory.

Q1. Write the dual of the problem

Max $z_P=2x_1+4x_2$

S.to $2x_1+3x_2\leq 48$

$x_1+3x_2\leq 42$

$x_1+x_2\leq 21$

$x_1,x_2\geq 0$

Solution : It is a maximization problem with all constraints having ≤sign.

Max $z_P=2x_1+4x_2$

s.to $2x_1+3x_2\leq 48$ w_1

$x_1+3x_2\leq 42$ w_2

$x_1+x_2\leq 21$ w_3

$x_1,x_2\geq 0$

The dual is

Min $z_D=48w_1+42w_2+21w_3$

s.to $2w_1+w_2+w_3\geq 2$

$3w_1+3w_2+w_3\geq 4$

$w_1,w_2,w_3\geq 0$

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Q2. Write the dual of the problem

Max $z=x_1+2x_2-x_3$

s.to $2x_1+3x_2+4x_3 \leq 5$

$2x_1-2x_2 \leq 6$

$3x_1-3x_3 \geq 4$

$x_1,x_2,x_3 \geq 0$

Solution: The above problem is

$$
\begin{array}{lll}
\text{Max} & z_p = x_1 + 2x_2 - x_3 & \\
\text{s.to} & 2x_1 + 3x_2 + 4x_3 \le 5 & w_1 \\
 & 2x_1 - 2x_2 \le 6 & w_2 \\
 & -3x_1 + 3x_3 \le -4 & w_3 \\
 & x_1, x_2, x_3 \ge 0 &
\end{array}
$$

Dual:

$$
\begin{array}{ll}
\text{Min} & z_D = 5w_1 + 6w_2 - 4w_3 \\
\text{s.to} & 2w_1 + 2w_2 - 3w_3 \ge 1 \\
 & 3w_1 - 2w_2 \ge 2 \\
 & 4w_1 + 3w_3 \ge -1 \\
 & w_1, w_2, w_3 \ge 0
\end{array}
$$

Q3. Write the dual of the problem

Max $z_p = x_1 + 3x_2$

s.to $3x_1 + 2x_2 \le 6$

$3x_1 + x_2 = 4$

$x_1, x_2 \ge 0$

Solution: Given problem can be written as s

Max $z_p = x_1 + 3x_2$

s.to $3x_1 + 2x_2 \leq 6$ w_1

$3x_1 + x_2 \leq 4$ w_2

$-3x_1 - x_2 \leq -4$ w_3

$x_1, x_2 \geq 0$

Dual:

Min $z_D = 6w_1 + 4w_2 - 4w_3$

s.to $3w_1 + 3w_2 \quad -3w_3 \geq 1$

$2w_1 + w_2 - w_3 \quad \geq 3$

$w_1, w_2, w_3 \quad \geq 0$

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Dual:

Min $\quad z_D = 6w_1 + 4w_2 - 4w_3$

s.to $\quad 3w_1 + 3w_2 \quad -3w_3 \geq 1$

$2w_1 + 3w_2 - w_3 \geq 3$

$w_1, w_2, w_3 \geq 0$

Replace $(w_2 - w_3)$ by w'_2

Min. $\quad z_D = 6w_1 + 4w'_2$

s.to $\quad 3w_1 + 3w_2 \geq 1$

$2w_1 + w_2 \geq 3$

$w_1 \geq 0$ and w'_2 unrestricted is sign

Q4. Min $z_p = x_1 - 3x_2 - 2x_3$

s.to $-3x_1 + x_2 - 2x_3 \geq -7$ w_1

$-2x_1 - 4x_2 \geq 12$ w_2

$-4x_1 + 3w_2 + 8x_3 = 10$ w_3

$x_1, x_2 \geq 0, x_3$ unrestricted

MaX $z_D = -7w_1 + 12w_2 + 10w_3$

s.to $-3w_1 - 2w_2 - 4w_3 \leq 1$

$w_1 - 4w_2 + 3w_3 \leq -3$

$-2w_1 \quad + 8w_3 = -2,$

$w_1, w_2, w_3 \geq 0$ unrestricted

Thank You