

Q1), Q2), Q3) .Rmd File

4) Formulate the dual of the above problem and solve it. Does the solution agree with what you observed for the primal problem?

Primal L.P

Max : $420X_1L + 420X_2L + 420X_3L + 360X_1M + 360X_2M + 360X_3M + 300X_1S + 300X_2S + 300X_3S$

$$\begin{aligned} X_1L + X_1M + X_1S &\leq 750 & \text{----- (y1)} \\ X_2L + X_2M + X_2S &\leq 900 & \text{----- (y2)} \\ X_3L + X_3M + X_3S &\leq 450 & \text{----- (y3)} \\ 20X_1L + 15X_1M + 12X_1S &\leq 13000 & \text{----- (y4)} \\ 20X_2L + 15X_2M + 12X_2S &\leq 12000 & \text{----- (y5)} \\ 20X_3L + 15X_3M + 12X_3S &\leq 5000 & \text{----- (y6)} \\ X_1L + X_2L + X_3L &\leq 900 & \text{----- (y7)} \\ X_1M + X_2M + X_3M &\leq 1200 & \text{----- (y8)} \\ X_1S + X_2S + X_3S &\leq 750 & \text{----- (y9)} \\ 900X_1L + 900X_1M + 900X_1S - 750X_2L - 750X_2M - 750X_2S &= 0 & \text{----- (y10)} \\ 450X_2L + 450X_2M + 450X_2S - 900X_3L - 900X_3M - 900X_3S &= 0 & \text{----- (y11)} \\ 450X_1L + 450X_1M + 450X_1S - 750X_3L - 750X_3M - 750X_3S &= 0 & \text{----- (y12)} \\ X_1L, X_1M, X_1S, X_2L, X_2M, X_2S, X_3L, X_3M, X_3S &\geq 0 \end{aligned}$$

Dual L.P

Min: $750y_1 + 900y_2 + 450y_3 + 13000y_4 + 12000y_5 + 5000y_6 + 900y_7 + 1200y_8 + 750y_9 + 0y_{10} + 0y_{11} + 0y_{12};$

Constraints:

$$\begin{aligned} y_1 + 20y_4 + y_7 + 900y_{10} + 450y_{12} &\geq 420; & y_2 \\ +20y_5 + y_7 - 750y_{10} + 450y_{11} &\geq 420; & y_3 \\ +20y_6 + y_7 - 900y_{11} - 750y_{12} &\geq 420; \end{aligned}$$

$$\begin{aligned} y_1 + 15y_4 + y_8 + 900y_{10} + 450y_{12} &\geq 360; & y_2 \\ +15y_5 + y_8 - 750y_{10} + 450y_{11} &\geq 360; & y_3 \\ +15y_6 + y_8 - 900y_{11} - 750y_{12} &\geq 360; \end{aligned}$$

$$\begin{aligned} y_1 + 12y_4 + y_9 + 900y_{10} + 450y_{12} &\geq 300; & y_2 \\ +12y_5 + y_9 - 750y_{10} + 450y_{11} &\geq 300; & y_3 \end{aligned}$$

$$+12 y_6 + y_9 - 900 y_{11} - 750 y_{12} \geq 300;$$

$$y_1, y_2, y_3, y_4, y_5, y_6, y_7, y_8, y_9 \geq 0$$

y_{10}, y_{11}, y_{12} unrestricted

After solving it, the solution agrees with the Primal Problem. (Refer .Rmd File)