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## Duality in LPP

There exists a corresponding LPP for a given LPP. This corresponding LPP is called the dual of the original LPP or the Primal.

Interesting fact: The optimal solution of the dual is also the optimal solution of the primal.

Use: If you face any difficulties while solving the primal problem, first compute the dual then try to solve the dual.

## Dual Simplex Method

1. Formulate the problem.
   a. If the objective function is of minimization type then change it into maximization type.
   b. Change all $\geq$ constraints to $\leq$ constraints by multiplying them with -1.
   c. Transform every $\leq$ constraints into an $=$ sign by adding slack variable to every constraints and assign a zero constraint coefficient in the objective function.
2. Find initial solution.
   Find the initial basic solution for all the slack variables by putting every decision variable as zero.
3. Test for optimality
   a. If all the values of $X_B \geq 0$ and $Z_j - C_j \geq 0$, then the solution is the optimal solution. Terminate the process.
   b. If any $X_B < 0$, then select the most negative $X_B$ and this row will be called the key row.
   c. Find maximum ratio: $\frac{Z_j - C_j}{\text{key row}}$ where $\text{key row} < 0$ and the column determining the max value will be the key column.
   d. Find the new solution table and repeat step 3.