

# Production & Operations Management

## Graphical Linear Programming Lecture Example

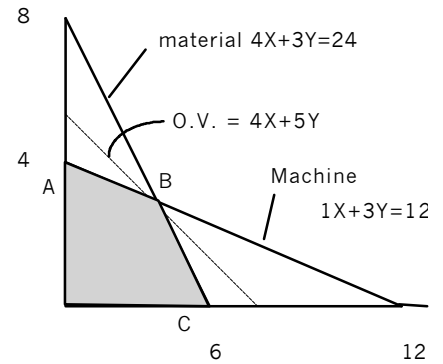
**Objective Function:**  $\text{MAX } 4X + 5Y$

**Subject to:**

**Constraints:**

**Machine time:**  $1X + 3Y \leq 12$

**Material:**  $4X + 3Y \leq 24$



**Ranges of Optimality on Objective Function (cost/profit) Coefficients,  $4X + 5Y$ :**

Effect of changing the Coefficient of Y on the Objective (Profit) function Value						
Corner	Product mix	$4X + 2Y$	$4X + 3Y$	$4X + 5Y$	$4X + 12Y$	$4X + 13Y$
A	$Y = 4; X = 0$	8	12	20	48	52
B	$Y = 8/3; X = 4$	21.33	24	29.33	48	50.67
C	$Y = 0; X = 6$	24	24	24	24	24

C optimal    Degenerate    B optimal    Degenerate    A optimal

**MAX profit:**  
B is the  
**Optimal solution:**  
 $X = 4; Y = 8/3$   
**O.V. = \$29.33**

**Range of Optimality for corner B, coefficient of Y:**  
Lower limit = \$3      Upper Limit = \$12

*Similar Analysis shows Range of Optimality on Coefficient of X at corner B:*

**Range of Optimality for corner B, coefficient of X:**  
Lower limit = \$1.67,      Upper Limit = \$6.67

Outside these limits of profit per unit, the optimal production plan changes to another corner. Within these ranges of optimality, the total profit may change, but the optimal production plan stays the same as the corner B solution.

**Shadow price for material:**  
new O.V. = \$30.11  
old O.V. = \$29.33  
increase = \$0.78  
**Range of Validity:**  
 $12 < \text{material} < 48$

**Shadow price for machine time:**  
new O.V. = \$30.22  
old O.V. = \$29.33  
increase = \$0.89  
**Range of Validity:**  
 $6 < \text{machine time} < 24$

The shadow price is the value of relaxing or tightening a constraint. The incremental change becomes something different outside the range of validity.