Tom Scarberry

Module 2 – The LP Model Assignment

Question 1:

Decision Variables:

# of Collegiate backpacks to produce weekly – x_1

# of Mini backpacks to produce weekly – x_2

Objective function:

Maximize $Z = 32 x_1 + 24 x_2$

Constraints:

$3x_1 + 2x_2 \leq 5{,}000$ (nylon sq ft for each product for total weekly supply of 5,000 sq ft)

$x_1 \leq 1{,}000$ (max demand of Collegiate backpacks per week is 1,000 units)

$x_1 \geq 0$ (cannot have negative units)

$x_2 \leq 1{,}200$ (max demand of Mini backpacks per week is 1,200 units)

$x_2 \geq 0$ (cannot have negative units)

$45x_1 + 40x_2 \leq 84{,}000$ (labor minutes for each product and total labor minutes per week is 84,000 minutes)

Notes:

Labor minutes = 35 people * 40 hours / person * 60 min / hour = 84,000 minutes

Mathematical Formulation:

Maximize $Z = 32 x_1 + 24 x_2$

$3x_1 + 2x_2 \leq 5000$

$45x_1 + 40x_2 \leq 84{,}000$

$x_1 \leq 1000$

$x_2 \leq 1200$

$x_1 \geq 0$

$x_2 \geq 0$

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Question 2:

Decision Variables:

# of small products to produce daily at plant 1 – x_{11}

# of medium products to produce daily at plant 1 – x_{21}

# of large products to produce daily at plant 1 – x_{31}

# of small products to produce daily at plant 2 – x_{12}

# of medium products to produce daily at plant 2 – x_{22}

# of large products to produce daily at plant 2 – x_{32}

# of small products to produce daily at plant 3 – x_{13}

# of medium products to produce daily at plant 3 – x_{23}

# of large products to produce daily at plant 3 – x_{33}

Objective function for linear programming model:

Maximize $Z = 300 x_{11} + 360 x_{21} + 420 x_{31} + 300 x_{12} + 360 x_{22} + 420 x_{32} + 300 x_{13} + 360 x_{23} + 420 x_{33}$

Constraints for linear programming model:

$x_{11} + x_{21} + x_{31} \leq 750$ (excess capacity for plant 1 is 750 for all products)

$X_{12} + x_{22} + x_{32} \leq 900$ (excess capacity for plant 2 is 900 for all products)

$x_{13} + x_{23} + x_{33} \leq 450$ (excess capacity for plant 3 is 450 for all products)

$x_{11} + x_{12} + x_{13} \leq 750$ (max demand of small products per day is 750 units)

$x_{21} + x_{22} + x_{23} \leq 1{,}200$ (max demand of medium products per day is 1,200 units)

$x_{31} + x_{32} + x_{33} \leq 900$ (max demand of large products per day is 900 units)

$12x_{11} + 15x_{21} + 20x_{31} \leq 13{,}000$ (excess space for holding products at plant 1 is 13,000 units)

$12x_{12} + 15x_{22} + 20x_{32} \leq 12{,}000$ (excess space for holding products at plant 2 is 12,000 units)

$12x_{13} + 15x_{23} + 20x_{33} \leq 5{,}000$ (excess space for holding products at plant 3 is 5,000 units)

$(x_{11} + x_{21} + x_{31}) / 750 = (x_{12} + x_{22} + x_{32}) / 900 = (x_{13} + x_{23} + x_{33}) / 450$ (equal percentage of the capacity of each plant to be used for labor equality)

$X_{11} \geq 0, X_{12} \geq 0, X_{13} \geq 0, X_{21} \geq 0, X_{22} \geq 0, X_{23} \geq 0, X_{31} \geq 0, X_{32} \geq 0, X_{33} \geq 0$ (cannot have negative products produced)