QMM_ASSIGNMENT1

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```
knitr::opts_chunk$set(echo = TRUE, comment = NA)
```

Question 1

1. Clearly Define the Decision Variables

Let us consider Collegiate and Mini as Back Savers company's decision variables C= Collegiate M= Mini

- C: Number of Collegiate backpacks to produce per week.
- M: Number of Mini backpacks to produce per week.

2. What is the Objective Function?

Objective : Management wishes to know what quantity of each type of backpack to produce per week to get the maximum profit

Maximize the total profit (Z):

$$Z = 32C + 24M$$

3. What are the Constraints?
4. Material Constraint:

$$3C + 2M \leq 5000$$

2. Sales Constraints:

$$C \leq 1000$$

$$M \leq 1200$$

3. Labor Constraint:

$$45C + 40M \leq 35 \times 40 \times 60$$

4. Non-negativitM Constraints:

$$C \geq 0$$

$$M \geq 0$$

Solution using

```r
library(lpSolve)

# Define the objective function coefficients
obj_coef <- c(32, 24)

# Define the matrix of constraint coefficients
mat_coef <- matrix(c(3, 2, 1, 0, 0, 1, 45, 40), ncol = 2, byrow = TRUE)

# Define the right-hand side of constraints
rhs <- c(5000, 1000, 1200, 35 * 40 * 60)

# Define the constraint types (<=)
con_types <- rep("<=", length(rhs))

# Solve the linear programming problem
lp_result <- lp("max", obj_coef, mat_coef, con_types, rhs)

# Print the solution
cat("Collegiate backpacks to produce per week:", lp_result$solution[1], "\n")
```

```
Collegiate backpacks to produce per week: 1000
```

```r
cat("Mini backpacks to produce per week:", lp_result$solution[2], "\n")
```

```
Mini backpacks to produce per week: 975
```

```r
cat("Maximum profit per week:", lp_result$objval, "\n")
```

```
Maximum profit per week: 55400
```

Question 2

1. Define the decision variables

Decision Variables are the number of units of the new product, regardless its size that should be produced on each plant to maximize the weigelt corporation's profit.

Let's define the decision variables: - C_1: The number of large-sized units produced at Plant 1. - C_2: The number of medium-sized units produced at Plant 2. - C_3: The number of small-sized units produced at Plant 3.

Objective Function

MaCimize the total profit (Z):

$$Z = 420C_1 + 360C_2 + 300C_3$$

Constraints

1. CapacitM Constraints:
   - Plant 1 can produce up to 750 units per daM.
   - Plant 2 can produce up to 900 units per daM.
   - Plant 3 can produce up to 450 units per daM.

$$C_1 \leq 750$$
$$C_2 \leq 900$$
$$C_3 \leq 450$$

2. Storage Space Constraints:
   - Plant 1 has 13,000 square feet of in-process storage space.
   - Plant 2 has 12,000 square feet of in-process storage space.
   - Plant 3 has 5,000 square feet of in-process storage space.
   - Each unit of the large, medium, and small sizes produced per daM requires 20, 15, and 12 square feet, respectivelM.

$$20C_1 + 15C_2 + 12C_3 \leq 13,000$$
$$20C_1 + 15C_2 + 12C_3 \leq 12,000$$
$$20C_1 + 15C_2 + 12C_3 \leq 5,000$$

3. Sales Forecasts:
   - Sales forecasts indicate that if available, 900, 1,200, and 750 units of the large, medium, and small sizes, would be sold per daM.

$$C_1 \leq 900$$
$$C_2 \leq 1200$$
$$C_3 \leq 750$$

4. Non-negativitM Constraints:

$$C_1 \geq 0$$
$$C_2 \geq 0$$
$$C_3 \geq 0$$

5. Percentage constraint -

Assume,

A1 = LC1 + MC1 + SC1

A2 = LC2 + MC2 + SC2

A3 = LC3 + MC3 + SC3

$$(A1/750) * 100$$
$$(A2/900) * 100$$
$$(A3/450) * 100$$

Non-negativity of decision variables -

$$(LC1, MC1, SC1, LC2, MC2, SC2, LC3, MC3 \;\; and \;\; SC3) \geq 0$$