

QMM-Final

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2022-12-09

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I. Introduction to the Problem and Objective

The objective is to form four groups of 12 students in order to optimize each group's chances of success on a class.

Factors Three factors may impact group project success. These are the elements: 1- Student's current GPA 2- The student's appropriate years of professional experience. 3- The student's course-related abilities.

These characteristics were chosen based on previous data analysis of students enrolled in this or comparable courses across the United States. This study found that the three variables mentioned above had a substantial impact on student success in these courses. Based on the analysis, + The course relevant 50% + The experience 30% + The GPA 20% were weighted the student was awarded a score based on the weightage.

Data Collection

Data from students was acquired from a variety of sources. GPA was obtained from the university database, and students were requested to take a survey in order to collect data on their experience, course-related abilities, skills, etc., so that it could be easily analyzed and scored.

**** Years of Relevant Work Experience (1-4)** 1. if the student experience ranges from 0-2 years 2. if the student experience ranges from 2-4 years 3. if the student experience ranges from 4-6 years 4. if the student experience is more than 6 years

**** Course-Related Skills (1-4)** There are 8 skills required for the project that were identified by the professor 1. if the student has 0-2 skills 2. if the student has 2-5 skills 3. if the student has 5-7 skills 4. if the student has all skills needed .

Here is an overview of the student dataset:

```
set.seed(123)
#importing Data set and converting
getwd()
```

```
## [1] "/Users/avinashravipudi/Documents/QMM-FINAL"
```

```
sd <- read_excel("Sd.xlsx")
sd
```

```
## # A tibble: 12 x 5
##   Student GPA 'Years of experience' 'project related skills' score
##   <dbl> <dbl> <dbl> <dbl> <dbl>
## 1      1      3      2      1  42.5
## 2      2     3.5      1      3  62.5
## 3      3     2.5      3      3  72.5
## 4      4      4      3      4  92.5
## 5      5      3      4      2   70
## 6      6     3.8      2      4   84
## 7      7     2.4      1      4  69.5
## 8      8     3.3      2      3   69
## 9      9     3.8      3      1  61.5
## 10     10     2.6      2      2   53
## 11     11      4      3      3   80
## 12     12     3.6      3      2  65.5
```

II. Problem Formulation

Using integer programming, we will define, create, and solve a mathematical optimization model.

1. Decision Variables

Each of the 12 students assigned to each of the four groups is represented by a decision variable. x_{ij} , where i represents the student number and j represents the student group number

$$x_{11}, x_{12}, x_{13}, \dots, x_{ij}, \quad \text{where } i = 1, 2, 3, \dots, 12 \text{ and } j = 1, 2, 3, 4$$

2. Objective Function

The function's goal is to optimize the success of each group. let: $x_{ij} = 1$ if the student i belongs to group j , and 0 if not.

$$\text{maximize : } 42.5 \sum_{j=1}^4 x_{i1} + 62.5 \sum_{j=1}^4 x_{i2} + 72.5 \sum_{j=1}^4 x_{i3} + 94.5 \sum_{j=1}^4 x_{i4} + 70 \sum_{j=1}^4 x_{i5} + 84 \sum_{j=1}^4 x_{i6} + 69.5 \sum_{j=1}^4 x_{i7} + 69 \sum_{j=1}^4 x_{i8} + 61.5 \sum_{j=1}^4 x_{i9} + 5$$

3. Constraints

For this problem, three types of constraints were identified: 1- There are only four groups, each with three members. 2- Each person can only be a part of one group. 3- There are integer constraints.

III. R Code

```
set.seed(123)
#Import lp file
lp <- read.lp("group.lp")
lp
```

```
## Model name:
## a linear program with 48 decision variables and 28 constraints
```

```
#Optimal solution found
solve(lp)
```

```
## [1] 0
```

```
#get objective function, which is the maximum total score a group can have = 849.5
get.objective(lp)
```

```
## [1] 267
```

```
#get each student membership
Groups <- get.variables(lp)
Groups
```

```
## [1] 0 0 1 0 0 1 0 0 0 0 1 0 0 1 0 0 0 0 0 1 0 0 0 1 1 0 0 0 1 0 0 0 0 1 0 0 0 0
## [39] 0 1 0 0 1 0 1 0 0 0
```

```
df <- as.data.frame(matrix(Groups, nrow = 12, ncol= 4)) %>%
  rename(Group1= V1, Group2=V2, Group3=V3, Group4=V4)
df
```

```
##      Group1 Group2 Group3 Group4
## 1         0      0      1      0
## 2         0      1      0      0
## 3         1      0      0      0
## 4         0      0      0      1
## 5         0      0      1      0
## 6         1      0      0      0
## 7         0      0      0      1
## 8         0      1      0      0
## 9         0      0      0      1
## 10        0      0      1      0
## 11        1      0      0      0
## 12        0      1      0      0
```

```
Group_number <- c(4,3,2,1,3,1,1,2,4,4,2,3)

results <- cbind(sd , Group_number)
results
```

```
##      Student GPA Years of experience project related skills score Group_number
## 1         1 3.0                2                1 42.5                4
## 2         2 3.5                1                3 62.5                3
## 3         3 2.5                3                3 72.5                2
## 4         4 4.0                3                4 92.5                1
## 5         5 3.0                4                2 70.0                3
## 6         6 3.8                2                4 84.0                1
## 7         7 2.4                1                4 69.5                1
## 8         8 3.3                2                3 69.0                2
## 9         9 3.8                3                1 61.5                4
## 10        10 2.6               2                2 53.0                4
## 11        11 4.0                3                3 80.0                2
## 12        12 3.6                3                2 65.5                3
```

IV. Model Results

The integer model was able to determine the best solution to maximize group success. The project groups should be divided as follows:

Group 1 has student number 4,6,7

Group 2: students number 3,8,11

Group 3:students number 2,5,12

Group 4: students number 1,9,10

##References

1.<https://www.tandfonline.com/doi/full/10.1080/01605682.2018.1500429>