Meister Final Exam - Quantitative Management Modeling

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What factors affect the success of groups? Define three factors, e.g., GPA, gender, etc., that you feel affect the contributions that students make towards project success.

1. Class GPA

2. Class Attendance (0-10 days of class missed total, more than 10 results in a failure)

3. Class Year (Since this is primarily a Junior and Senior level course we only need two #'s. Junior = 0, Senior = 1)

How do the above factors combine to define success? For example, is a person with high GPA the same as one with a more relevant background? Decide on how each of the factors contribute toward your definition of success.

1. Class GPA: For obvious reasons if you have a higher GPA you are more likely to be a better student in comparison to someone with a lower GPA.

2. Class Attendance: In this case, the higher the number would be the worse off a student will be in the course. If you miss too many classes you are likely to have missed important learning materials.

3. Class Year: Not every student from every year can take the same class. This is why I simply used Junior and Senior level students in my problem. While it does not make a huge difference, I believe having one extra year of schooling could provide for a more knowledgeable student.

How will you collect data for these factors? For this assignment, randomly generate sensible data for each of the above three defined factors.

I used the round function to automatically generate random samples for each of my requests. I used completely random numbers in the first GPA problem as this does not necessarily need to be a rounded number. I then made the following two whole numbers since you cannot miss part of a class or be between a Junior and Senior.

What are your decision variables?

1. Number of students

2. Number of students per group

What is your objective function?

Unknown - will determine later in the problem...

What are your constraints?

$$S1G1 + S2G1 + S3G1 + S4G1 + S5G1 + S6G1 + S7G1 + S8G1 + S9G1 + S10G1 + S11G1 + S12G1 = 3$$
$$S1G2 + S2G2 + S3G2 + S4G2 + S5G2 + S6G2 + S7G2 + S8G2 + S9G2 + S10G2 + S11G2 + S12G2 = 3$$
$$S1G3 + S2G3 + S3G3 + S4G3 + S5G3 + S6G3 + S7G3 + S8G3 + S9G3 + S10G3 + S11G3 + S12G3 = 3$$
$$S1G4 + S2G4 + S3G4 + S4G4 + S5G4 + S6G4 + S7G4 + S8G4 + S9G4 + S10G4 + S11G4 + S12G4 = 3$$
$$S1G1 + S1G2 + S1G3 + S1G4 = 1$$
$$S2G1 + S2G2 + S2G3 + S2G4 = 1$$
$$S3G1 + S3G2 + S3G3 + S3G4 = 1$$
$$S4G1 + S4G2 + S4G3 + S4G4 = 1$$
$$S5G1 + S5G2 + S5G3 + S5G4 = 1$$
$$S6G1 + S6G2 + S6G3 + S6G4 = 1$$
$$S7G1 + S7G2 + S7G3 + S7G4 = 1$$
$$S8G1 + S8G2 + S8G3 + S8G4 = 1$$
$$S9G1 + S9G2 + S9G3 + S9G4 = 1$$
$$S10G1 + S10G2 + S10G3 + S10G4 = 1$$
$$S11G1 + S11G2 + S11G3 + S11G4 = 1$$
$$S12G1 + S12G2 + S12G3 + S12G4 = 1$$
$$(S1G1 + S1G2 + S1G3 + S1G4) + (S2G1 + S2G2 + S2G3 + S2G4) + (S3G1 + S3G2 + S3G3 + S3G4) + (S4G1 + S4G2 + S4G3 + S4G4) + (S5G1 + S5G2 + S5G3 + S5G4) + (S6G1 + S6G2 + S6G3 + S6G4) + (S7G1 + S7G2 + S7G3 + S7G4) + (S8G1 + S8G2 + S8G3 + S8G4) + (S9G1 + S9G2 + S9G3 + S9G4) + (S10G1 + S10G2 + S10G3 + S10G4) + (S11G1 + S11G2 + S11G3 + S11G4) + (S12G1 + S12G2 + S12G3 + S12G4) = 12$$

```
round(runif(12, min = 0, max = 4), 2)
```

```
##  [1] 3.18 3.66 2.59 3.86 0.87 1.59 0.23 3.71 1.51 1.61 1.56 2.56
```

The numbers collected from this sample are as follows (different each time):
These are the class GPAs for each student
[1] 1.89 2.45 3.81 2.48 3.18 3.67 2.43 2.79 2.27 1.76 2.92 2.35

```
round(runif(12, min = 0, max = 10), 0)
```

```
##  [1] 1 1 6 7 8 8 9 3 7 6 0 6
```

The numbers collected from this sample are as follows (different each time):
This is the classes missed for each student
[1] 10 6 6 10 1 1 3 6 10 7 1 1

```
round(runif(12, min = 0, max = 1), 0)
```

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

The numbers collected from this sample are as follows (different each time):
This is the Class year, Junior or Senior
[1] 0 1 1 0 1 0 1 0 0 0 0 1

Student 1: 1.89 GPA, 10 Classes Missed, Year = Junior
Student 2: 2.45 GPA, 6 Classes Missed, Year = Senior
Student 3: 3.81 GPA, 6 Classes Missed, Year = Senior
Student 4: 2.48 GPA, 10 Classes Missed, Year = Junior
Student 5: 3.18 GPA, 1 Class Missed, Year = Senior
Student 6: 3.67 GPA, 1 Class Missed, Year = Junior
Student 7: 2.43 GPA, 3 Classes Missed, Year = Senior
Student 8: 2.79 GPA, 6 Classes Missed, Year = Junior
Student 9: 2.27 GPA, 10 Classes Missed, Year = Junior
Student 10: 1.76 GPA, 7 Classes Missed, Year = Junior
Student 11: 2.92 GPA, 1 Class Missed, Year = Junior
Student 12: 2.35 GPA, 1 Class Missed, Year = Senior

I am going to multiple (2 classes per week X 16 weeks in a semester)
(32 Classes total - Classes Missed) / 32 =
Student 1: 22/32 = .6875 Total Class Attendence
Student 2: 26/32 = .8125 Total Class Attendence
Student 3: 26/32 = .8125 Total Class Attendence
Student 4: 22/32 = .6875 Total Class Attendence
Student 5: 31/32 = .9688 Total Class Attendence
Student 6: 31/32 = .9688 Total Class Attendence
Student 7: 29/32 = .9063 Total Class Attendence
Student 8: 26/32 = .8125 Total Class Attendence
Student 9: 22/32 = .6875 Total Class Attendence
Student 10: 25/32 = .7813 Total Class Attendence
Student 11: 31/32 = .9688 Total Class Attendence
Student 12: 31/32 = .9688 Total Class Attendence

Find Total Student Average Scores by doing the following:
Average = (.8592+1.4210+1.8742+1.0558+1.7163+1.5463+1.4454+1.1592+.9858+.8471+1.2963+1.4396)/12

```
Average <- 1.304
```

We are now looking to see what students are above or below the average class values:

```
S1 <- .8592
S1 <- S1 - Average
S1
```

```
## [1] -0.4448
```

(1.89+.6875+0)/3 = Student 1 Average score

```
S2 <- 1.4210
S2 <- S2 - Average
S2
```

```
## [1] 0.117
```

(2.45+.8125+1)/3 = Student 2 Average score

```
S3 <- 1.8742
S3 <- S3 - Average
S3
```

```
## [1] 0.5702
```

(3.81+.8125+1)/3 = Student 3 Average score

```
S4 <- 1.0558
S4 <- S4 - Average
S4
```

```
## [1] -0.2482
```

(2.48+.6875+0)/3 = Student 4 Average score

```
S5 <- 1.7163
S5 <- S5 - Average
S5
```

```
## [1] 0.4123
```

(3.18+.9688+1)/3 = Student 5 Average score

```
S6 <- 1.5463
S6 <- S6 - Average
S6
```

```
## [1] 0.2423
```

(3.67+.9688+0)/3 = Student 6 Average score

```
S7 <- 1.4454
S7 <- S7 - Average
S7
```

```
## [1] 0.1414
```

(2.43+.9063+1)/3 = Student 7 Average score

```
S8 <- 1.1592
S8 <- S8 - Average
S8
```

```
## [1] -0.1448
```

(2.79+.8125+0)/3 = Student 8 Average score

```
S9 <- .9858
S9 <- S9 - Average
S9
```

```
## [1] -0.3182
```

(2.27+.6875+0)/3 = Student 9 Average score

```
S10 <- .8471
S10 <- S10 - Average
S10
```

```
## [1] -0.4569
```

(1.76+.7813+0)/3 = Student 10 Average score

```
S11 <- 1.2963
S11 <- S11 - Average
S11
```

```
## [1] -0.0077
```

(2.92+.9688+0)/3 = Student 11 Average score

```
S12 <- 1.4396
S12 <- S12 - Average
S12
```

```
## [1] 0.1356
```

(2.35+.9688+1)/3 = Student 12 Average score

-

Objective Function:

Min: .45 S1G1 + .45 S1G2 + .45 S1G3 + .45 S1G4 + .12 S2G1 + .12 S2G2 + .12 S2G3 + .12 S2G4 + .57 S3G1 + .57 S3G2 + .57 S3G3 + .57 S3G4 + .25 S4G1 + .25 S4G2 + .25 S4G3 + .25 S4G4 + .41 S5G1 + .41 S5G2 + .41 S5G3 + .41 S5G4 + .24 S6G1 + .24 S6G2 + .24 S6G3 + .24 S6G4 + .14 S7G1 + .14 S7G2 + .14 S7G3 + .14 S7G4 + .14 S8G1 + .14 S8G2 + .14 S8G3 + .14 S8G4 + .32 S9G1 + .32 S9G2 + .32 S9G3 + .32 S9G4 + .46 S10G1 + .46 S10G2 + .46 S10G3 + .46 S10G4 + .01 S11G1 + .01 S11G2 + .01 S11G3 + .01 S11G4 + .14 S12G1 + .14 S12G2 + .14 S12G3 + .14 S12G4

```r
lpfunction <- make.lp(0, 48)
set.objfn(lpfunction, c(.45,.45,.45,.45,.12,.12,.12,.12,.57,.57,.57,.57,.25,.25,.25,.25,.41,.41,.41,.41
```

First constraint where every group must have three total students:

```r
add.constraint(lpfunction, c(1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,
add.constraint(lpfunction, c(0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,
add.constraint(lpfunction, c(0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,
add.constraint(lpfunction, c(0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1,0,
```

Now, the constraint where every student must only be in one group. We will make 12 total constraints for this rule.

```r
add.constraint(lpfunction, c(1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
add.constraint(lpfunction, c(0,0,0,0,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
add.constraint(lpfunction, c(0,0,0,0,0,0,0,0,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
add.constraint(lpfunction, c(0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
add.constraint(lpfunction, c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
add.constraint(lpfunction, c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,
add.constraint(lpfunction, c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,0,0,0,0,0,0,0,0,0,
add.constraint(lpfunction, c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,0,0,0,0,0,
add.constraint(lpfunction, c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,0,
add.constraint(lpfunction, c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,
add.constraint(lpfunction, c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
add.constraint(lpfunction, c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
```

This constraint ensures every student is used with it equaling to 12 showing 12 students total are in the group.

```r
add.constraint(lpfunction, c(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,
```

```r
solve(lpfunction)
```

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

```r
get.objective(lpfunction)
```

```
## [1] 3.25
```

```r
get.variables(lpfunction)
```

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

Results from get.variables will help us determine what students are in each group.
1:S1G1
0:S1G2

0:S1G3
0:S1G4
0:S2G1
0:S2G2
0:S2G3
1:S2G4
1:S3G1
0:S3G2
0:S3G3
0:S3G4
0:S4G1
1:S4G2
0:S4G3
0:S4G4
0:S5G1
1:S5G2
0:S5G3
0:S5G4
0:S6G1
0:S6G
1:S6G3
0:S6G4
0:S7G1
0:S7G2
0:S7G3
1:S7G4
0:S8G1
0:S8G2
1:S8G3
0:S8G4
0:S9G1
1:S9G2
0:S9G3
0:S9G4
1:S10G1
0:S10G2
0:S10G3
0:S10G4
0:S11G1
0:S11G2
0:S11G3
1:S11G4
0:S12G1
0:S12G2
1:S12G3
0:S12G4

Final Results:
Group 1 Students: 1, 3, 10
Group 2 Students: 4, 5, 9
Group 3 Students: 6, 8, 12
Group 4 Students: 2, 7, 11