Who Gets The Project They Deserve?

Elizabeth Sharer
Hari K Rajagopalan
Francis Marion University

The Applied Engineering Technology Department in the College of Engineering at the University of North Carolina at Charlotte had a problem. At the beginning of each Spring and Fall semester all the graduating senior, from all of the engineering disciplines are required to complete a group projects which requires the knowledge and expertise from multiple engineering disciplines. The problem was that at the time each student was given a list of proposed projects and then asked to choose three projects from the list of projects, ranking them from first choice, second choice, to third choice. A senior design committee was convened at the beginning of every semester (Spring and Fall) and the "horse trading" would begin. There were projects that had higher priorities, such as those that were funded through government grants or private industry initiatives, than other projects. Other than each student's top three choices for projects, which were essentially reviewed manually, no other information was taken into consideration with regard to the student placement in a given project. Therefore, the senior design committee spent an inordinate amount of time at the beginning of each semester (Spring and Fall) to assign various students to various projects one at a time, by hand.

INTRODUCTION

"It is that time again," thought Dr. Deborah Sharer with some apprehension. It was the beginning of the semester and The Applied Engineering Technology Department in the College of Engineering at the University of North Carolina at Charlotte had a problem. Every semester the graduating seniors in the College of Engineering had to complete a group project. Each student was given a list of projects and asked to rank three projects in order of preference. Projects were rated according to their importance also. Projects funded by governmental or non-governmental agencies had a higher rating than projects which were not funded. Each project had a minimum and maximum number of students who were could be assigned to the project.

To assist in the assignment process, it was decide that each student's GPA would also be included in the assignment decision. The student's project choices were weighted and multiplied by each student's GPA. The idea being that a student's GPA could be used as a proxy for each student's proficiency and, therefore, those student's with the highest GPAs had worked hard, had shown some proficiency, and should have been rewarded for their efforts. Students with higher GPA were more likely to get their first preference than students with lower GPA if there was a tie.

To handle this problem, a senior design committee was usually convened at the start of every semester and a lot of time was spent on manually assigning students to projects. Dr. Sharer thought to herself, "This semester was going to be particularly hard." There were 67 students and 24 projects this semester, and as the program grew the number of students and projects also grew.

Dr. Sharer wondered if there was not an easier way to assign students to projects without these long meetings to manually assign students and to avoid inevitable mistakes. In the past a lot slipups had been made because of the huge number of students/projects combinations. Students with better GPAs were not getting the projects with higher preferences.

It was also extremely difficult to start the assignment problem on a blank slate. Committee members often expressed a wish that they had a starting point where all students would be assigned a project based on some objective criteria, but no such system was being employed. What was worse was that the whole assignment process took a very long time to complete. One objective was to take all the objective criteria into consideration by creating a software program that would assign students to projects in an objective manner and ultimately greatly reduce the time expended by the committee members. Once an objective student to project assignment was completed, the committee could modify the assignments using subjective criteria if they wished.

After lamenting her woes to her sister, also Dr. Sharer, her sister posited that the student/project assignment problem was simply a complex combinatorial problem which could be solved in a number of different ways in order to produce an objective student/project assignment, which could be modified after the fact if desired. She suggested that the problem be solved by using Linear Programming and offered to do a good pilot test in her class this semester.

For this pilot test, students would be asked to consider this problem with respect to assigning only one type of student to a given project. This was a simplification of the original problem where there were many different types of students (i.e., engineering majors) needed for each project.

Dr. Sharer established the following data parameters:

1. The different projects had been weighted according to their importance, with a larger weight signifying higher priority
2. The minimum and maximum number of students required for each project had been set
3. Each student's GPA had been recorded.
4. Students had submitted their top three project choices, each weighted according to the student's choice. For example, a student's first choice was weighted higher than their second choice, and their second choice was weighted higher than their third choice.
5. All students should be assigned to exactly one project.

This resulted in two tables.

1. Table 1 (following page) contained the data about each student, their corresponding GPA, their major, and their project choices ranked from first to third.
2. Table 2 (following table 1) contained the pertinent project information (i.e., each project's sponsor, the importance of the project, which was indicated by the weight attributed to each project, and the minimum and maximum staffing needs for each project, which was the minimum and maximum number of each major needed to complete the project).

"It's not a perfect model," Dr. Sharer told her sister. "For example, inevitably, there are times when some projects might be partially staffed; meaning that the minimum number of students needed has not been met."

Her sister countered, "In these cases, the committee would still need to re-evaluate the project and the students assigned to see if the project can be completed with the reduced staffing. Or the committee could choose to move students from partially staffed projects to other projects, perhaps those projects that have met or exceeded their minimum staffing needs, but not exceeded their maximum staffing needs. In rare occasions the committee might choose to increase the maximum staffing needs of a given project."

Table 1:
Student Information

Student #	Last Name	First Name	GPA	Major*	Preferred Project Number**		
					1st Choice	2nd Choice	3rd Choice
1	Tory	Eugene	4.0	C	15	12	3
2	South	Carol	3.9	C	5	2	17
3	Lemmon	Rose	3.9	C	12	1	20
4	Howell	David	3.8	C	17	22	9
5	Tucker	Peter	3.8	C	23	18	20
6	Jefferson	Gracie	3.6	C	17	6	15
7	Boss	Betty	3.5	C	3	21	24
8	Haufmeyer	Chris	3.5	C	15	12	20
9	Sceptic	Sharon	3.5	C	9	22	21
10	Nurmer	Nancy	3.3	C	12	6	5
11	Yates	Scott	3.0	C	12	14	24
12	Rotterman	Irene	2.9	C	13	1	7
13	Frankel	Alice	2.8	C	23	12	20
14	Greene	Kevin	2.8	C	21	13	3
15	Buck	Mitch	2.8	C	7	23	11
16	Fozzle	Marie	2.7	C	21	16	6
17	Howard	Olivia	2.7	C	21	1	22
18	Hover	Zane	2.6	C	22	5	24
19	Grover	Ken	2.5	C	22	19	23
20	Grainger	Zoe	2.4	C	24	7	6
21	Gates	Kelly	2.3	C	16	5	19
22	Zeller	Windy	2.3	C	20	22	17
23	Vale	Evelyn	2.2	C	9	20	16
24	Jones	Ralph	2.1	C	6	11	8
25	Quin	Larry	4.0	E	22	4	7
26	Olivale	Jill	3.9	E	16	10	23
27	Rain	Marty	3.9	E	1	4	18
28	Farrel	Patty	3.9	E	21	23	9
29	Black	Abby	3.8	E	24	12	8
30	Stough	Amber	3.8	E	16	11	13
31	Smith	John	3.8	E	13	8	23
32	Yarbough	Edward	3.5	E	23	10	21
33	Qaule	Lois	3.4	E	17	16	23
34	Yackle	Mark	3.4	E	15	9	3
35	Davis	Howard	3.2	E	3	19	13
36	Ransom	Richard	3.2	E	15	3	17
37	Emerson	Daphne	3.0	E	14	2	10
38	Clark	Jane	3	E	21	2	16
39	West	Joe	2.8	E	24	11	5
40	Dover	Sam	2.8	E	9	22	2
41	Emery	Mary	2.5	E	1	8	3
42	Avery	Carl	2.4	E	24	9	4
43	Joggers	John	2.2	E	3	11	8
44	Clary	Vincent	2.2	E	10	17	9

45	Utterman	Karen	2.1	E	11	12	1
46	Muller	Lacy	2.1	E	9	15	13
47	Yarsen	Kay	3.9	M	19	23	7
48	Corone	Leo	3.6	M	22	5	3
49	Wormer	Tony	3.5	M	6	18	1
50	Trane	Jack	3.4	M	9	21	8
51	Rodrick	Aaron	3.3	M	5	4	17
52	Puller	Leslie	3.1	M	9	21	8
53	Forrest	Paul	3.1	M	4	22	1
54	Powers	Greg	3.0	M	23	7	10
55	Rowel	Sally	3.0	M	16	11	12
56	Livingston	Tina	3.0	M	18	10	2
57	Klien	Florence	2.7	M	4	8	2
58	Lee	Stacy	2.7	M	14	18	10
59	Barns	Kate	2.6	M	6	22	24
60	Drey	William	2.6	M	1	23	5
61	Gravel	Helen	2.4	M	12	7	17
62	Turner	Lisa	2.4	M	14	23	11
63	Bail	Norman	2.4	M	4	23	22
64	Alba	Harold	2.3	M	23	17	18
65	Smalls	Oliver	2.2	M	21	23	22
66	Grobber	Ellie	2.1	M	1	11	7
67	Alamance	Violet	2.1	M	3	1	15

*Different Majors in Engineering: C = Civil Engineering, E = Electrical Engineering, and M = Mechanical Engineering

**1st choice has weight = 6, 2nd choice has a weight = 4, 3rd choice has a weight = 2, all other projects have the weight of 1.

Please Note: Student Information and Project Information have been masked and scrubbed to ensure confidentiality and privacy.

TABLE 2:
Project Information

Project #	Project Name	Project Sponsor	Project Weight***	Staffing Needs	
				Max	Min
1	E1	Dr. Q	240	3	0
2	A1	Dr. X	230	4	0
3	A3	Dr. P	220	3	0
4	C4	Dr. Z	210	4	0
5	E4	Dr. Y	200	3	0
6	D2	Dr. Q	190	3	0
7	D4	Dr. Q	180	3	0
8	A4	Dr. P	170	4	0
9	C2	Dr. Z	160	3	0
10	F3	Dr. R	150	3	0
11	B4	Dr. X	140	3	0
12	F4	Dr. R	130	4	0
13	E3	Dr. Y	120	3	0
14	D1	Dr. P	110	3	0
15	F1	Dr. R	100	3	0
16	B1	Dr. Y	90	4	0
17	B2	Dr. X	80	3	0
18	C1	Dr. Z	70	3	0
19	F2	Dr. R	60	3	0
20	C3	Dr. Z	50	3	0
21	E2	Dr. Y	40	4	0
22	A2	Dr. P	30	3	0
23	D3	Dr. Q	20	3	0
24	B3	Dr. X	10	3	0

***Note: The weights given to each project is subjective. The more important projects receive the highest weights; however, the range of weights is arbitrary. Therefore, the greater the range of weights, the greater the selective pressure for the higher weighed projects.

REFERENCES

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