Performance Based Group Allotment for Optimum Distribution

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Abstract - The present work deals with the development of a new method to optimize student groups allotment to different faculty members of a department satisfying individual students along with project guides. The method involves distribution of projects in a class of 51 students divided as a group of three each among 14 departmental faculties. Students are categorised into three Range-lists based on their Cumulative Grade Point Average (CGPA) performance. A matrix table has been developed in the form of rows and columns for uniformity of distribution among students as well as among the faculties based upon frequencies of faculty preferences. Thus the method serves as a multipurpose and effective tool to check anomalies and achieve allotment optimally.

Keywords – CGPA, matrix table, anomaly, allotment, frequency

I. INTRODUCTION

Group allotment has always been a crucial and critical part in most industrial and academic organizations. Formation of groups is necessitated when the numbers of students/workers are large. Most academic and industrial projects are carried out by a team and a uniform and unbiased distribution is always a necessity for achievement of high performance in any job. There has always been some sort of dissatisfaction observed from the students/workers side and also from those who are supervisors/guides/in-charges. The problems that arise in any allotment are either the student/worker is not satisfied to work under a said faculty/supervisor or a supervisor is reluctant to take a particular student/worker to work under them. So most of the times the students or the workers form a group of their own choice while a large number are left without a choice or a choice that will only produce a lesser grade work. Performance is related to the satisfaction of proper allotment where we may find a mixed category of performers. Group formation should be based on valid criterion and without adversely affecting the output on the part of real workers and also the supervisors or in general those who are in charge of a particular project.

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II. METHODOLOGY

First a list has been prepared seeking the CGPA of individual students which are appropriately arranged either in ascending or descending order of respective values. The 51 students were designated as A_1, A_2, A_3, A_4……, A_{50}, A_{51} whereas there are fourteen faculty supervisors namely B_1, B_2, B_3, B_4,….,B_{13}, B_{14}. A list of three columns is prepared citing three different ranges (X_1-X_2=Y_1), (X_3-X_4=Y_2) and (X_5-X_6=Y_3) for CGPA listing. The groups are identified as I, II, III…,XVII (seventeen groups in total) consisting of three candidates per group. The serial numbers of students are not consecutive but are of a mixed type due to the reason that some students may opt out of a given programme after admission or may join a different discipline leaving their original roll nos. in the roll sheet.

A. *Group Formation*

The following conditions are laid during group formation by the individual groups.

a. Only one student is to be selected from each list Y_1, Y_2, Y_3.
b. Each group is to contain only three students.
c. No two students are from same list out of Y_1, Y_2, Y_3.

So, altogether there are 17 groups of three students each.

B. Supervisor Choice

Each of the 17 groups has 14 open choices to select a supervisor/guide according to their preferences. The following rules are framed while choosing a particular faculty by the individual groups.

a. Each group has to choose all the 14 available choices in order of their preferences.
b. No group will choose the same faculty more than once in any subsequent choices.
c. Each group put their most preferred faculty as their first choice and the remaining preferences in subsequent orders as 2^{nd} , 3^{rd}, 4^{th}, ….14^{th}.
d. No group is allowed to put more than one choice in a given preference number.

C. Rule for Supervisors'

The following conditions are laid for the supervisors while dealing with the individual groups.

a. No supervisor can have more than two project groups each.
b. Supervisors will be at liberty to choose the limited groups when preferences to them exceed the given limit.
c. Supervisors can select only one group when preferences to them are two or more due to other valid reasons.
d. Supervisors can choose extra student to his/her allotted group when total number of students are uneven i.e when the preassumption of equal number of students per group does not satisfy.

III.TABLES

Tables are constructed to ensure error free group distribution to all the faculty members of the concerned department. The number of tables can be either large or small depending on the manner in which various choices are placed, total faculty members, total number of student and other issues.

The groups gave their preferences of project guides under variable conditions. Various causes may be inferred for selecting a particular faculty viz. how frequently they are in touch with a given faculty for different academic cum extracurricular activities. Some faculties may not even be taking any courses for few semesters so probability of not preferring such faculty becomes high. Supervisors may receive high preferences if they have higher academic achievements or experience in their area of study. Students very often also seem to consider the grades obtain under a certain faculty with the help of information of senior students, way of dealing with students on being approached for certain issues, students –faculty attitude for one another and so on.

TABLE 1

Group No.	Roll Nos.	SUPERVISOR PREFERENCES													
		1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	6^{th}	7^{th}	8th	9^{th}	10^{th}	11^{th}	12^{th}	13^{th}	14^{th}
I.	A_{12}, A_{17}, A_{67}	B_{10}	B_4	B_8	B_5	B_3	B_7	B_9	B_{11}	B_{12}	B_{14}	B_{13}	B_6	B_1	B_2
II.	A_{19}, A_{54}, A_{65}	B_{10}	B_4	B_5	B_3	B_7	B_8	B_9	B_{11}	B_{13}	B_{12}	B_6	B_{14}	B_1	B_2
III.	A_{28}, A_{49}, A_{51}	B_7	B_5	B_9	B_4	B_3	B_{11}	B_2	B_8	B_{10}	B_{14}	B_{12}	B_{13}	B_6	B_1
IV.	A_{27}, A_{31}, A_{43}	B_5	B_7	B_{10}	B_3	B_9	B_{11}	B_8	B_4	B_2	B_6	B_1	B_{12}	B_{14}	B_{13}
V.	A_{18}, A_{20} ,A_{63}	B_4	B_5	B_7	B_9	B_1	B_2	B_{10}	B_6	B_8	B_3	B_{11}	B_{12}	B_{13}	B_{14}
VI.	A_1, ,A_5, A_{14}	B_8	B_5	B_1	B_4	B_{10}	B_3	B_7	B_2	B_9	B_{11}	B_{12}	B_{13}	B_6	B_{14}
VII.	A_{10}, A_{32}, A_{60}	B_3	B_5	B_{10}	B_8	B_{14}	B_{12}	B_{13}	B_7	B_9	B_1	B_{11}	B_2	B_4	B_6
VIII.	A_{30}, A_{34}, A_{58}	B_7	B_5	B_8	B_{10}	B_9	B_3	B_4	B_1	B_{12}	B_2	B_{11}	B_6	B_{14}	B_{13}
IX.	A_{13}, A_{26}, A_{42}	B_{11}	B_5	B_3	B_4	B_7	B_1	B_8	B_{10}	B_9	B_{12}	B_{13}	B_{14}	B_6	B_2
X.	A_1, A_{35}, A_{66}	B_5	B_{11}	B_{10}	B_3	B_7	B_2	B_1	B_4	B_6	B_8	B_{13}	B_{14}	B_{12}	B_9
XI.	A_{45}, A_{61}, A_{62}	B_8	B_5	B_7	B_3	B_4	B_{10}	B_9	B_2	B_6	B_1	B_{12}	B_{11}	B_{13}	B_{14}
XII.	A_{38}, A_{39}, A_{59}	B_{10}	B_5	B_1	B_3	B_7	B_8	B_4	B_2	B_6	B_9	B_{11}	B_{12}	B_{14}	B_{13}
XIII.	A_{33}, A_{40}, A_{48}	B_7	B_9	B_5	B_3	B_8	B_{10}	B_{11}	B_4	B_6	B_1	B_2	B_{12}	B_{13}	B_{14}
XIV.	A_{44}, A_{53}, A_{55}	B_1	B_7	B_{11}	B_4	B_5	B_9	B_{10}	B_3	B_6	B_{12}	B_{13}	B_8	B_2	B_{14}
XV.	A_{22}, A_{50}, A_{46}	B_1	B_7	B_{10}	B_3	B_5	B_4	B_2	B_8	B_9	B_{11}	B_6	B_{14}	B_{12}	B_{13}
XVI.	A_4, A_{23}, A_{64}	B_3	B_2	B_5	B_7	B_{12}	B_8	B_{11}	B_{13}	B_{10}	B_1	B_4	B_9	B_{14}	B_6
XVII.	A_{47}, A_{56}, A_{57}	B_1	B_5	B_4	B_3	B_{10}	B_7	B_9	B_{14}	B_{11}	B_6	B_8	B_{12}	B_2	B_{13}

TABLE 2
Preference Order

Faculty	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th
B_1	II	00	II	00	I	I	II	II	00	III	I	00	II	I
	14, 15	0	6, 12	0	5	9	10,17	8,16	0	7,11,13	4	0	1,2	3
B_2	I	00	00	00	00	II	II	III	II	I	I	I	I	III
	17	0	0	0	0	5, 10	3, 15	6,11,12	4,16	8	13	7	14	1,2,9
B_3	II	00	II	VII	II	III	00	I	00	I	00	00	00	00
	7,16	0	9,17	2,4,10, 11,12, 13,15	1,3	6,8	0	14	0	5	0	0	0	0
B_4	I	II	00	IV	I	II	II	III	00	I	00	00	I	00
	5	1,2	0	3,6,9,14	4	15,17	8,12	4,10,13	0	16	0	0	7	0
B_5	II	VIII	II	II	II	00	00	I	00	00	00	00	00	00
	4,10	3,5,6,7,8,9,11, 12	2,13	1,16	14,15	0	0	17	0	0	0	0	0	0
B_6	00	00	00	00	00	00	00	I	V	I	II	II	III	II
	0	0	0	0	0	0	0	5	10,11,12,13 ,14	4	2,15,16	1,8	3,6,9	7,17
B_7	III	III	II	I	IV	II	I	II	00	00	00	00	00	00
	3,8,13	4,14,15	5,11	17	2,9,10,12	1,16	6	7	0	0	0	0	0	0
B_8	II	I	II	I	I	II	II	II	II	I	00	I	00	00
	6,11	16	1,8	7	13	2,12	4,9	3,15	5,17	10	0	14	0	0
B_9	00	I	II	I	III	I	III	00	IV	I	00	00	00	I
	0	13	3,16	5	4,8,17	14	1,2,11	0	6,7,9,15	12	0	0	0	10
B_{10}	III	00	III	I	I	II	II	II	II	00	00	I	I	00
	1,2,12	0	4,7,10,15	8	6	11,13	5,14	9	3	0	0	17	16	0
B_{11}	I	II	I	00	00	II	I	II	00	II	III	I	00	00
	9	10,17	14	0	0	3,4	13	1,2	0	6,15	5,7,8	11	0	0
B_{12}	00	00	00	00	00	I	I	00	II	III	IV	IV	II	00
	0	0	0	0	0	7	16	0	1,8	2,9,14	3,6,11,17	4,5,12,13	10,15	0
B_{13}	00	00	00	00	00	00	0	00	I	I	IV	III	III	IV
	0	0	0	0	0	0	7	0	2	17	1,9,10,14	3,6,16	5,11,13	4,8,12,15
B_{14}	00	00	00	00	I	00	00	00	00	II	00	III	IV	VI
	0	0	0	0	7	0	0	0	0	1,3	0	2,9,10,15	4,8,12, 17	5,6,11,13,14, 16

The order of preferences for each faculty by the project groups are shown in table 2 above. For a faculty same preference may be given by any number of the formed groups under first to fourteenth choices.

D. Filling of Choices(Group Allotment)

Groups are allotted to supervisors according to the preferences of both faculties and groups keeping in view the various activities that sought load sharing by the faculties during the semester or year. In the present case all the seventeen group allotment has been completed in six number of evaluation in the form of six allotment tables. The number of allotment tables may even get reduced or increase depending upon how the choices are put by the different groups.

TABLE 3

First Choice Allotment				
Faculty	Group	Group selected by faculty	Unselected Group	Reason
B1	14,15	15	14	Other load
B2	17	17	0	none
B3	7,16	7,16	0	none
B4	5	5	0	none
B5	4,10	10	4	other load
B6	0	0	0	no choice
B7	3,8,13	3,8	13	Max. limit
B8	6,11	6,11	0	none
B9	0	0	0	no choice
B10	1,2,12	12	1,2	Other load
B11	9	9	0	none
B12	0	0	0	No choice
B13	0	0	0	No choice
B14	0	0	0	No choice

TABLE 4

Second Choice Allotment				
Faculty	Group	Group selected by faculty	Unselected Group with previous list	Reason
B1	0	0	0	No choice
B2	0	0	0	No choice
B3	0	0	0	No choice
B4	1,2	0	1,2	Other load
B5	3,5,6,7,8,9 ,11,12	0	0	other load
B6	0	0	0	no choice
B7	4,14,15	0	4,14	restricted
B8	16	0	0	No choice
B9	13	0	13	Other load
B10	0	0	0	No choice
B11	10,17	0	0	Other load
B12	0	0	0	No choice
B13	0	0	0	No choice
B14	0	0	0	No choice

The first choices are placed to the faculties. The number of choices may vary from 0 to 2 or more. Table 3 shows the group distribution and the unselected five groups 1, 2,4,13 and 14 after accommodating the other groups. The reasons for not selecting a particular group vary from one faculty to another as indicate on the extreme right column in the above table. Similar attempts are made in subsequent tables to fill the other unselected groups keeping in view that each faculty is allotted at least one project group.

Table 4 considers the second choices of different groups and matches with the first choices already filled in Table 3 and finally place the unselected groups in fourth column after comparison. It is seen that no choices are

filled in this allotment either due to lack of choices for a given faculty, unwillingness of faculty due to other load activities or reaching the maximum limit of group selection. So, the unselected groups are same in the above two allotment tables viz. 1,2,4,13,14. In other words, the second allotment table serves no use.

TABLE 5

Third Choice Allotment				
Faculty	Group	Group selected by faculty	Unselected Group left from previous choice list	Reason
B1	6,12	0	0	Other load
B2	0	0	0	No choice
B3	9,17	0	0	restricted
B4	0	0	0	No choice
B5	2,13	0	2,13	other load
B6	0	0	0	no choice
B7	5,11	0	0	restricted
B8	1,8	0	1	restricted
B9	3,16	0	0	Other load
B10	4,7,10,15	0	4	Other load
B11	14	0	14	Other load
B12	0	0	0	No choice
B13	0	0	0	No choice
B14	0	0	0	No choice

TABLE 6

Fourth Choice allotment				
Faculty	Group	Group selected by faculty	Unselected Group taking earlier choices	Reason
B1	0	0	0	no choice
B2	0	0	0	no choice
B3	2,4,10,11, 12,13,15	0	2,4,13	Restricted
B4	3,6,9,14	0	14	Load
B5	1,16	0	1	Load
B6	0	0	0	no choice
B7	17	0	0	Restricted
B8	7	0	0	Restricted
B9	5	0	0	Load
B10	8	0	0	Other load
B11	0	0	0	no choice
B12	0	0	0	No choice
B13	0	0	0	No choice
B14	0	0	0	No choice

Table 5, 6 has no allotment due to similar reasons cited for second choice allotment in table 4 and because of allotment in the first choice itself. The column of unselected group contains only those project groups which are neither selected in the present choice nor selected in the previous allotments. Any group or groups already selected in previous allotment but has a choice in present allotment against a particular faculty cannot be allotted to any supervisor now or further down the allotment line.

TABLE 7

Fifth Choice Allotment				
Faculty	Group	Group selected by faculty	Unselected Group with previous list	Reason
B1	5	0	0	Other load
B2	0	0	0	none
B3	1,3	0	1	restricted
B4	4	0	4	load
B5	14,15	0	14	other load
B6	0	0	0	no choice
B7	2,9,10 ,12	0	2	restricted
B8	13	0	13	restricted
B9	4,8,17	4	0	load
B10	6	0	0	Other load
B11	16	0	0	load
B12	0	0	0	No choice
B13	0	0	0	No choice
B14	7	0	0	No choice

TABLE 8

Ninth Choice Allotment				
Faculty	Group	Group selected by faculty	Unselected Group with previous list	Reason
B1	0	0	0	load
B2	4,16	0	0	load
B3	0	0	0	restricted
B4	0	0	0	load
B5	0	0	0	load
B6	10,11,12, 13,14	14	13	load
B7	0	0	0	restricted
B8	5,17	0	0	restricted
B9	6,7,9,15	0	0	load
B10	3	0	0	load
B11	0	0	0	load
B12	1,8	1	0	none
B13	2	2	0	No choice
B14	0	0	0	No choice

Table 7 has one allotment of group 4 to faculty B9.Others allotments are skipped due to earlier reasons. It has been observed that continuing in this way the eighth choice table becomes unnecessary whereas groups 1,2,14 are directly allotted to respective supervisors based on choices. Group 13 and faculty B14 is left unselected. So, finally G13 is allotted to B14.

IV. RESULTS AND DISCUSSION

The above data reveals that the entire allotment though performed in nine choice based allotment tables, in actual case only three tables has been able to successfully allocate all the groups among all the faculties. The other six tables did not serve in any way in the process of allotment. The most useful table being the first table with maximum number of group allocations. The allocation justifies certain amount of uniformity keeping more

importance to the practical aspects of distribution where a number of shortcomings are considered. Students as well as faculty supervisors are given certain degree of individual liberty in choosing one another rather than exaggerating one over the other. The final allotment is given in table 9.

TABLE 9

Faculty	Group(s) Allotted	Faculty	Group(s) Allotted
B1	15	B8	6,11
B2	17	B9	4
B3	7,16	B10	12
B4	5	B11	9
B5	10	B12	1
B6	14	B13	2
B7	3,8	B14	13

Table 9 indicate the project group numbers allotted against each faculty. Three of the faculties namely B3, B7, B8 got two groups as maximum limit whereas remaining eleven are marked with only one group each.

V.CONCLUSION

The group distribution can be more conveniently performed with fewer numbers of tables by neglecting the intermediate tables that are useless but creeps in between during the allocation. More convenient algorithm can be developed to minimize the number of table iterations thereby providing a unique way of group allocation justifying the various aspects. Time saving can be much easier mainly when the allocation is sought in certain crucial moments where the only way to attain the optimization is in time minimization along with maximum satisfaction on individual student and faculty members. Similar distribution may be followed in industries and other units accordingly providing suitable training to the technicians or workers.

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