Optimization of Timetable Management System.

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The project helped us in gaining new knowledge about various problems by involving us in related research. Working on this project made us realize how small problems that we overlook could involve a lot of research and could be quite tedious.

Problem Definition:-

- Following would be take care to automate the timetable management system.
- Manage multiple class schedules for different time periods and avoid conflicts
- Provide role-based access to authorized users
- Configure and customize a timetable which help students to plan study, reduce tardiness and submit assignments on time.
- Filter schedules based on course paper, room, faculty, session & topic.
- Add topics to the scheduled classes
- Cancel a scheduled class
- Send automatic notifications to users based on scheduled/rescheduled classes or events
- Create custom user groups and assign students to the scheduled classes
- Swap a faculty and reschedule the class
- View past, current and upcoming schedules
- Save time and money in room allocation and utilization

Introduction

A general educational timetabling problem is a problem in which we assign a set of events(for eg. classes) into available time slots and lecture halls subject to some constraints. Optimization comes into the picture when we need to make optimal use of all the available resources considering the cost management too.

So, the class timetabling problem is a complex problem that we as students overlook. Looking at and solving this problem from the university's point of view makes it look tiresome and tedious.

Most of the college administrative work has been computerized, but course timetable is still mostly done manually using hit and trial method due to its difficulties. The manual lecture timetable scheduling demands considerable time and effort.

This system is mainly focused on two models.

Model 1 is working on customizing a timetable that helps students to plan study, reduce tardiness and submit assignments on time also managing the scheduled and canceled classes.

How are we optimizing?

Considering the stress, we have minimized the objective function which equals the number of class hours in a week. Minimizing this, we have taken care of the stress on faculty too. Apart from stress, we have taken care of the minimum no of lectures required for the completion of a subject in a semester. On a particular day, we have also introduced breaks to reduce stress and only 2 extra classes (of any subject) can be scheduled.

Model 2 is working on resource and cost management by scheduling which Lecture hall is to be used for a particular batch.

How are we optimizing?

We have calculated the cost of using a small LT and a large LT for a single class adding the faculty's salary as well. Taking inputs of x1 small Lecture halls and x2 large Lecture halls, we have defined the objective function to be minimized subject to constraints like the limited number of Lecture halls.

MODEL 1 Optimization of stress on students due to classes

5.1 Problem Definition:-

This model is used to optimize the stress on the students, so as to ensure timely submission of assignments by the students and also to increase their efficiency of learning, also this model aims at optimizing the stress on faculty and provides them flexible working hours so that they can give their 100% towards the learning of their students, the model also takes into consideration the rescheduling(extra class or cancelling the scheduled one) of class by the faculty minimizing the stress on both the student and faculty.

5.2 Assumptions:-

- There are 2 branches.
- There are 4 teachers per branch.
- Cancelled class for this week can be compensated next week only.
- A teacher can only take 6 classes per week.
- Saturday and Sunday are weekly off and no other holidays.
- All faculties can take extra classes.
- On odd days we have each class of 1 hour.
- On even days we have each class of 1.5 hours.
- On odd days we have scheduled classes of faculty 1 and faculty 3 only.
- On even days we have schedules classes of faculty 2 and faculty 4 only.
- Reschedulings can be done on all working days of the week.
- Each subject should be taught for at least 3 hours per week.
- Small LT's are available for maximum 15 classes per week.
- Large LT's are available for maximum 19 classes per week.

5.3 FORMULATION:-

Let us look for an application that assigns least teaching hours per week for students. The user is then required to confirm whether he is cancelling some of his class for this week or want to take some extra class.

Let the courses for CSE branch be A.P., M3, OTA, PTS with the following credits:

1) A.P. - 3 Credits

2) M3 - 3 Credits

3) OTA - 3 Credits

4) PTS - 4 Credits

Let the courses for CCE branch be A.P., M-3, DCS, S&S with the following credits:

1) A.P.- 3 Credits

2) M3 - 3 Credits

3) DCS - 3 Credits

4) S&S - 4 Credits

5.4 Objective Function:-

$$Z = x_1 + (1.5)x_2 + x_3 + (1.5)x_4 + x_5 + (1.5)x_6 + x_7 + (1.5)x_8$$

Where,

1) X_1 is number of classes in a week for A.P.
2) X_2 is number of classes in a week for OTA/DCS.
3) X_3 is number of classes in a week for M3.
4) X_4 is number of classes in a week for PTS/S&S.
5) X_5 is extra classes in a week of A.P.
6) X_6 is extra classes in a week of OTA/DCS.
7) X_7 is extra classes in a week of M3.
8) X_8 is extra classes in a week PTS/S&S.

5.5 Constraints:-

1) $x_1 + x_3 + x_5 + x_7 <= 15$, availability of large LT's.
2) $x_2 + x_4 + x_6 + x_8 <= 19$, availability of small LT's.
3) $x_1 + x_5 <= 6$, Upper bound for classes.
4) $x_2 + x_6 <= 6$, Upper bound for classes.
5) $x_3 + x_7 <= 6$,
6) $x_4 + x_8 <= 6$,
7) $x_1 >= 3$, Lower bound for teaching classes.
8) $x_3 >= 3$, Lower bound for teaching classes.
9) $x_2 >= 2$, Lower bound for teaching classes.
10) $x_4 >= 2$, Lower bound for teaching classes.
11) $x_5, x_6, x_7, x_8 >= 0$, lower bound for extra classes.
12) $X_1, x_2, x_3, x_4, x_4, x_5, x_6, x_7, x_8$ are all integers.

5.6 Executive summary:-

This model is used for optimising weekly class time table for two different branches each with 4 different subjects along with minimising the stress on students . Students are having regular classes. Students are having classes of only two subjects a day with sufficient amount of breaks between their continuous classes to help them absorb the content efficiently. Number of teaching hours per subject per week are constraint to some minimum number in order to move course towards completion with time. This model also helps faculty to reschedule their classes under which they can either cancel their class or can take extra class but either one is only possible for a particular week. It is generating a weekly timetable according to the optimised number of classes after considering all the cancelled and extra classes for each subject in a particular branch.In order to minimise the stress

on faculty too, number of classes in a week per faculty is also limited and also they are provided with classes on alternate days.

5.7 Screenshots:-

```
>> Stressmanagement
Enter the branch
"CSE"
Faculty 1:
If you want to reschedule your classes enter 1 else 0
1
Enter 1 if you want to cancel the scheduled class and 2 if you want to take extra class
2
2
Faculty 2:
If you want to reschedule your classes enter 1 else 0
1
Enter 1 if you want to cancel the scheduled class and 2 if you want to take extra class
2
1
Faculty 3:
If you want to reschedule your classes enter 1 else 0
1
Enter 1 if you want to cancel the scheduled class and 2 if you want to take extra class
2
1
Faculty 4:
If you want to reschedule your classes enter 1 else 0
1
Enter 1 if you want to cancel the scheduled class and 2 if you want to take extra class
2
2

MONDAY:
AP(8:00-9:00)| M3(9:00-10:00)| BREAK| Ex-AP(11:00-12:00)| Ex-M3(12:00-1:00)|
TUESDAY:
OTA(8:00-9:30)| BREAK| PTS(10:00-11:30)| BREAK| Ex-OTA(12:00-1:30)| BREAK| Ex-PTS(2:00-3:30)|
WEDNESDAY:
AP(8:00-9:00)| M3(9:00-10:00)| BREAK| Ex-AP(11:00-12:00)|
THURSDAY:
OTA(8:00-9:30)| BREAK| PTS(10:00-11:30)| BREAK| Ex-PTS(12:00-1:30)|
FRIDAY:
AP(8:00-9:00)| M3(9:00-10:00)|
```

```
>> Stressmanagement
Enter the branch
"CCE"
Faculty 1:
If you want to reschedule your classes enter 1 else 0
1
Enter 1 if you want to cancel the scheduled class and 2 if you want to take extra class
2
2
Faculty 2:
If you want to reschedule your classes enter 1 else 0
1
Enter 1 if you want to cancel the scheduled class and 2 if you want to take extra class
2
2
Faculty 3:
If you want to reschedule your classes enter 1 else 0
1
Enter 1 if you want to cancel the scheduled class and 2 if you want to take extra class
2
1
Faculty 4:
If you want to reschedule your classes enter 1 else 0
1
Enter 1 if you want to cancel the scheduled class and 2 if you want to take extra class
1
2
MONDAY:
AP(8:00-9:00)| M3(9:00-10:00)| BREAK| Ex-AP(11:00-12:00)| Ex-M3(12:00-1:00)|
TUESDAY:
DCS(8:00-9:30)| BREAK| S&S(10:00-11:30)| BREAK| Ex-S&S(12:00-1:30)|
WEDNESDAY:
AP(8:00-9:00)| M3(9:00-10:00)| BREAK| Ex-AP(11:00-12:00)|
THURSDAY:
DCS(8:00-9:30)| BREAK| Ex-S&S(10:00-11:30)|
FRIDAY:
AP(8:00-9:00)| M3(9:00-10:00)|
```

MODEL 2 Optimization of cost in room allocation and utilization

6.1 PROBLEM DEFINITION:-

This model is used for optimising the utilization of different types of lecture hall available in the institute for two different branches of different branch strength in order to optimize the power consumption of different appliances in each lecture theatre and the expense of having a faculty in each lecture theatre and hence minimizing the cost of successful conduction of classes for both the batches.

The model is designed considering environmental issues as ,When there is less power consumption, we reduce the amount of pollutants released by power plants. It also helps in the conservation of the earth's natural resources and protect our ecosystem. By taking these steps we are contributing to a healthier and greener Mother Earth.

6.2 ASSUMPTIONS:-

1. There are two branches in LNMIIT namely, CSE and CCE.
2. Number of students in CSE branch is 200.
3. Number of students in CCE branch is 150.

   Note: Our model can optimize the cost and utilization of LTs for any number of students in both the branches.

4. There are two types of Lecture theatre namely
   - Small LT with capacity of 50 students at a time.
   - Large LT with capacity of 120 students at a time.
5. Our campus has 8 small LTs and 4 large LTs.
6. Small LT has 2 Air conditioners of load capacity 1 ton each and Large LT has 3 Air conditioners of load capacity 2 ton each.
7. Small LT has 4 fans and Large LT has 9 fans.
8. Small LT has 7 tube lights. and Large LT has 11 tubelights.
9. Every LT has a projector.

10. The power consumption of 1 ton AC is 980 units.
11. The power consumption of 2 ton AC is 1800 units.
12. The power consumption of fan is 25 units.
13. The power consumption of tube light is 3 units.
14. The power consumption of projector is 350 units.
15. Cost of 1 unit is Rs.10
16. The Salary of each faculty is Rs. 50,000 per week.

LT	**Small**	**Large**
AC (1 ton)	2	0
AC (2 ton)	0	3
Fan	4	9
Tubelight	7	11
Projector	1	1

Appliances	**Power Consumption (in Units)**
AC (1 ton)	980
AC (2 ton)	1800
Fan	25
Tubelight	3
Projector	350

6.3 FORMULATION:-

1. **x1** = no. of small LTs required to accommodate the students per week.
2. **x2** = no. of large LTs required to accommodate the students per week.
3. For each Small LT we have the Power consumption as follows:

   2 * 980 + 4 * 25 +7 * 3 + 1 * 350 = 2431 unit

4. For each Large LT we have the Power consumption as follows:

   3 * 1800 + 9 * 25 + 11 * 3 + 1 * 350 = 6008 unit

5. Hence the cost of operation of small LT is Rs.24310 per week.
6. Hence the cost of operation of large LT is Rs.60080 per week.
7. Also, in each lecture hall will have one faculty teaching the students, so the expense will be 50,000 per week(Salary).
8. So, total expense for successful conduction of classes will be,

   Small LT will be 24,310+50,000=74310.

   Large LT will be 60,080+50,000=110080.

9. Our Objective function will be the cost of operation of small LTs and large LTs.

   Min Z = 74310 * x1 + 110080 * x2

10. Subjected to constraints

    x1 <= 8,

    x2 <= 4,

    (As the institute has 8 small and 4 large LTs)

11. For CSE students, we have constraints

    x1 * 50 + x2 * 120 >= 200,

12. For CCE students, we have constraints

    x1 * 50 + x2 * 120 >= 160,

Explanation: As small LT has a capacity of 50 and large LT has a capacity of 120. The total students in CSE and CCE students are 200 and 160 respectively.

6.4 Executive summary:-

This model is used for optimising the use of small and large lecture hall available in the institute.The model optimizes the power consumption by minimizing the operational cost for successful conduction of classes for two different branches having different sizes. The model has been designed considering the expense of having faculty in every lecture hall. It minimizes the cost and hence

```
>> Costoptimization
Please enter the branch
"CSE"
Enter the number of students in cse branch
210

The required number of lecture halls are as follows-:
Small lecture halls: 0
Big lecture halls: 2
Optimal  cost is 220160.000000

>> Costoptimization
Please enter the branch
"CCE"
Enter the number of students in cce branch
160

Heuristics:         Found 1 solution using rounding.
                    Upper bound is 220160.000000.
                    Relative gap is 18.57%.

Cut Generation:     Applied 1 Gomory cut.
                    Lower bound is 179280.000000.
                    Relative gap is 18.57%.

Heuristics:         Found 1 solution using total rounding.
                    Upper bound is 184390.000000.
                    Relative gap is 2.77%.

The required number of lecture halls are as follows-:
Small lecture halls: 1.000000e+00
Big lecture halls: 1
Optimal  cost is 184390.000000
```

Conclusion

The intention of the project to generate a suitable time table satisfying the constraints along with the optimization of various factors is satisfied. We have designed this project, keeping in mind the required number of lectures needed to complete a course as well as the upper bound condition so that it does not turn out to be a burden for students. This project also helps in minimizing electricity consumption and hence the cost, by choosing between small or large lecture halls depending upon the batch strength. Faculty also need to have flexible and suitable working hours so that they can give valuable inputs to the students. We have organized this time table minimizing the stress faced by faculty also. Consequently, we were able to rectify assignment burdens on students. There can be situations like when a faculty member is unable to deliver his/her class on any of the working days. In such situations, an extra class for the same can be scheduled next week. Combinedly, we were able to design a MATLAB project for course timetabling problem.