

Scheduling of a Heterogeneous Library Staff
Using Task Assignment

OR

Work Distribution for a Heterogeneous Library
Staff Using Optimization Methods

OR

Work Distribution of a Heterogeneous Library
Staff - A Personnel Task Scheduling Problem

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Problem formulation and approach

The problem we will be studying concerns assigning a set of tasks, occurring at fixed times throughout the work day, to a fixed work force of library staff. A feasible schedule would be a schedule where all tasks are fully staffed. The generated schedule should also be robust, so that there will be as many stand-in staff at each task as possible.

The Personnel Task Scheduling Problem (PTSP) has a definition very similar to our problem and probably what it would be categorized as. However, a significant hindrance is the lack of literature on the subject. A close relative to PTSP called Shift minimization personnel task scheduling problem (SMPTSP) is a more well-researched area. Our mathematical model and literature study will thus, to a large extent, focus on this problem.

The problem at hand requires a solution to an integer linear task assignment problem with a heterogeneous work force. Papers like Loucks and Jacobs, 1991 focused on a similar problem with a slight difference; in their problem the demand for staff increases as the workload grows at different times of the day. Their approach is to, at a certain hour, assign tasks one at the time to workers based on their qualifications and availability. This, however, does not have to be considered in our case since the demand of personnel is fixed in time. Another difference is that their problem involves shift scheduling, while ours does not as the shifts for the library staff are predetermined.

To solve the problem, our current approach is to initially create a basic schedule in AMPL using only CPLEX and constraint programming. Thereafter it will be reworked and re-optimized based on feedback from the library staff. The process will continue until a schedule which satisfies the demands of the staff is created. After generating schedules using the mathematical model, a heuristical method will be implemented and used to resolve the problem. This makes it possible to remove the use of CPLEX. The reason for this is because it is expensive for a library to purchase such a software. The current programming environment under consideration is Microsoft Visual Basic, since the staff is already familiar with Microsoft Excel. The heuristical approach will be chosen after consulting the existing literature. We may also develop a more complex model to solve the problem and a simple user interface depending on the time available.

Planned references

Roberts and Escudero, 1983a, 1983b; Loucks and Jacobs, 1991; Tsang and Voudouris, 1997; Duffuaa and Al-Sultan, 1999; Ernst et al., 2004; Eiselt and Marianov, 2006; Mohan, 2008; Choi, Hwang and Park, 2009; Hojati and Patil, 2010; Krishnamoorthy et al., 2011; Akbari, Zandieh, Dorri, 2012; Smet et al., 2014; Baatar et al., 2015;

Milestones

The master thesis is scheduled to continue until the end of the semester, which occurs at June 6th. Completions of the report will be done during the summer and might continue into the autumn. The oral presentation is currently set for week 23. Regarding the half-time check, our recommendation would be right after Easter, around week 14.

Time plan

In table 1 below the planned workflow is presented with estimation of time duration for each activity. Observe that these are only preliminary and can come to vary a bit.

Table 1: Time plan for activities. Half time evaluation and thesis presentation weeks in orange. Blue for work schedule, red for thesis schedule and green for presentation schedule.

Week/Activity	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)
3	Blue				Red							
4	Blue				Red							
5	Blue				Red							
6	Blue	Blue			Red	Red	Red					
7		Blue			Red	Red	Red					
8		Blue			Red	Red	Red					
9		Blue	Blue			Red	Red	Red				
10			Blue				Red	Red				
11			Blue				Red	Red				
12			Blue				Red	Red				
13												
14	Orange	Orange	Orange	Blue	Orange	Orange	Orange		Orange	Orange	Orange	Orange
15				Blue				Red	Red	Red		
16				Blue					Red	Red		
17				Blue					Red	Red		
18									Red	Red		
19									Red	Red		
20										Red		
21										Red	Red	
22											Red	Green
23	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Red	Green

The letters represent the following activities:

- (A) Study of Literature
- (B) Develop: Mathematical model
- (C) Develop: Heuristic
- (D) Develop: Another model/heuristic
- (E) Write Chapter 1: Introduction (background, method etc)
- (F) Write Chapter 2: Related work
- (G) Write Chapter 3: Mathematical model
- (H) Write Chapter 4: Heuristic (Visual Basic)
- (I) Write Chapter 5: Another model
- (J) Write Chapter 6: Computational results

(K) Write Chapter 7 and 8: Discussion/Summary and Conclusion

(L) Thesis Presentation and Preparation