Aalto University
MS-E2177 Seminar on Case Studies in Operations Research

Optimizing the Planning of Floorball Match Schedules in Finland

Project Plan

Petteri Koskiahde (Project leader)
Santra Uusitalo
Ilmari Saarinen
Antti Ahvenjärvi
Pihla Lindholm

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1 Background

Our client is the Finnish Floorball Federation (in Finnish, Salibandyliitto), the official floorball governing body and organization in Finland. The Finnish Floorball Federation is responsible for running the series of different age groups and regions in Finland, among other things such as other floorball related events and the official training of floorball coaches and referees in Finland.

Most games in the floorball series the Finnish Floorball Federation hosts are played in minitournament format. Scheduling a series in the minitournament format involves selecting an organizing club and location for each minitournament in addition to scheduling the matches inside each minitournament. Currently, scheduling of each series is done by hand, which takes a considerable amount of time and resources. The aim of this project is to develop a minitournament scheduling model, which would be used to optimize tournament locations as well as the individual games and game order in the minitournaments. The objective of the optimization is to minimize travelled distance of the teams, while taking into consideration equality and equity in the distance travelled between the teams.

Previously, the Finnish Floorball Federation has had two bachelor's theses done on floorball tournament scheduling with a slightly narrower scope than our project [4, 7]. Both of the bachelor's theses focus on a single type of series, whereas our aim is to create a more comprehensive model that can be used to plan matches in any region or age category. The theses share the same goal as this project of minimizing travel distance but do not investigate equality as a central concern. The bachelor's theses offer promising results, as in the solution schedule the overall travel distance was decreased in both theses while keeping within the tournament scheduling constraints.

Other literature on the subject suggests that sports scheduling, in general, is considered an NP-hard problem, with significant computational complexity [6]. The problems similar to ours are often solved using linear programming methods, and some with using combinatorial optimization techniques [8, 6, 2, 3]. The minitournament location optimization shares similarities with facility location optimization problems [1, 5], which are common objectives in cases of healthcare, transport and the trade sector.

This project has considerable potential for the Finnish Floorball Federation as well as the floorball community in Finland. The impact of a well working scheduling model would be felt by players, guardians, and team personnel as well as the employees tasked with scheduling the tournaments. Shorter and more equal travel distances of the minitournaments would make floorball more accessible and attractive for people in general and would offer environmental benefits as well. A scheduling model would also save the time of manual scheduling, and allow workers of the Finnish Floorball Federation more time and energy to concentrate on other important matters. Additionally, the scheduling model could be adapted and shared with other sports associations, and could in that way benefit an even larger group of people.

2 Objectives

Our main objective is to form a model that constructs optimal timetables for floorball series. The model should choose tournament cities so that the distances traveled can be minimized equally between the participating teams. In addition, the minitournaments should be scheduled so that the time spent by the teams in the tournament, as well as all excess gaps in the hall reservations, are minimized. Our goal is to make a generalist model that could take into account the individual needs of different series. Still, we recognize that there are many different restrictions and needs between the series, so all of the restrictions or series may not be included in the model.

In addition to formalizing the model, it could be beneficial to create a final product that the Finnish Floorball Federation could directly use to form the timetables. The product should be simple and straightforward to use.

Our final objective is to provide documentation and instructions to support our work. The additional instructions enable efficient use of the model. In addition, the documentation helps to understand the logic behind the model and the basis on which it forms the schedules. If we find a well-performing model suitable for our problem, the documentation would also make it easier to modify the model to possibly be used in other sports that are facing similar scheduling problems.

3 Tasks

This project can be divided into six main tasks, which are literature review and background studying, brainstorming model ideas, implementing the model, validating the model results, documenting the model, and writing project reports. Additionally, if time permits, we will create a user interface for our optimization tool.

All team members participate in the literature review and the background study. This involves reading related and relevant articles and contacting people who have experience in the field of sports scheduling. Based on our findings, we will develop some ideas for the model implementation. After that, we divide our team into three groups. Each group tries to create an initial version of their model. Then, we compare the initial models and continue working with the most promising ones.

The model implementation is done in smaller parts. First, a simple model is created, and it is gradually improved, e.g., by adding constraints and improving the objective function of the optimization formulation. After we are satisfied with the model, we validate the model results and benchmark the performance against manually made timetables. Also, we create documentation and model instructions for the users. For this part, we will decide on who will be focusing on validation and benchmarking and who will be focusing on documentation and user instructions. This decision will be made by mutual understanding, and all team members' strengths and timetables will also be considered. Finally, if we are on schedule, we will create a user interface for our scheduling tool. At the end of the project, each member will write a part of the project report depending on their previous tasks.

4 Schedule

The project schedule is presented in Figure 1. The tasks marked with blue are mandatory tasks and the tasks marked with red are optional tasks that are considered if we have time.

5 Resources

Our group consists of five M.Sc. students majoring in Systems and Operations Research. We utilize our skills obtained through the studies to solve this project. Within the scope of the course, we have a total of 729 hours available among the team members for the use of this project.

Previous studies in the field of sport scheduling and the two bachelor's theses written on this topic provide us with some insight to our problem. From these scientific papers, we can see how similar problems have been solved and obtain some ideas for our own model. These research papers are available to us through the databases for which Aalto University offers licenses.

The Finnish Floorball Federation has also provided us with background material. We have written documents that specify the various requirements considering the tournament schedules. Additionally, we have a few examples of previous timetables for actual series. With the information on these examples we can test our model's performance and compare the results obtained with these real schedules made by the professionals.

Our contacts at the Finnish Floorball Federation are Ari Vehniäinen and Mervi Kilpikoski. They have shared the background data with us and answer questions regarding the needs of the client. Our professor, Ahti Salo, gives us feedback and helps us with possible problems with the course. We are also exploring the possibility of benchmarking how the floorball series scheduling problems are solved elsewhere,

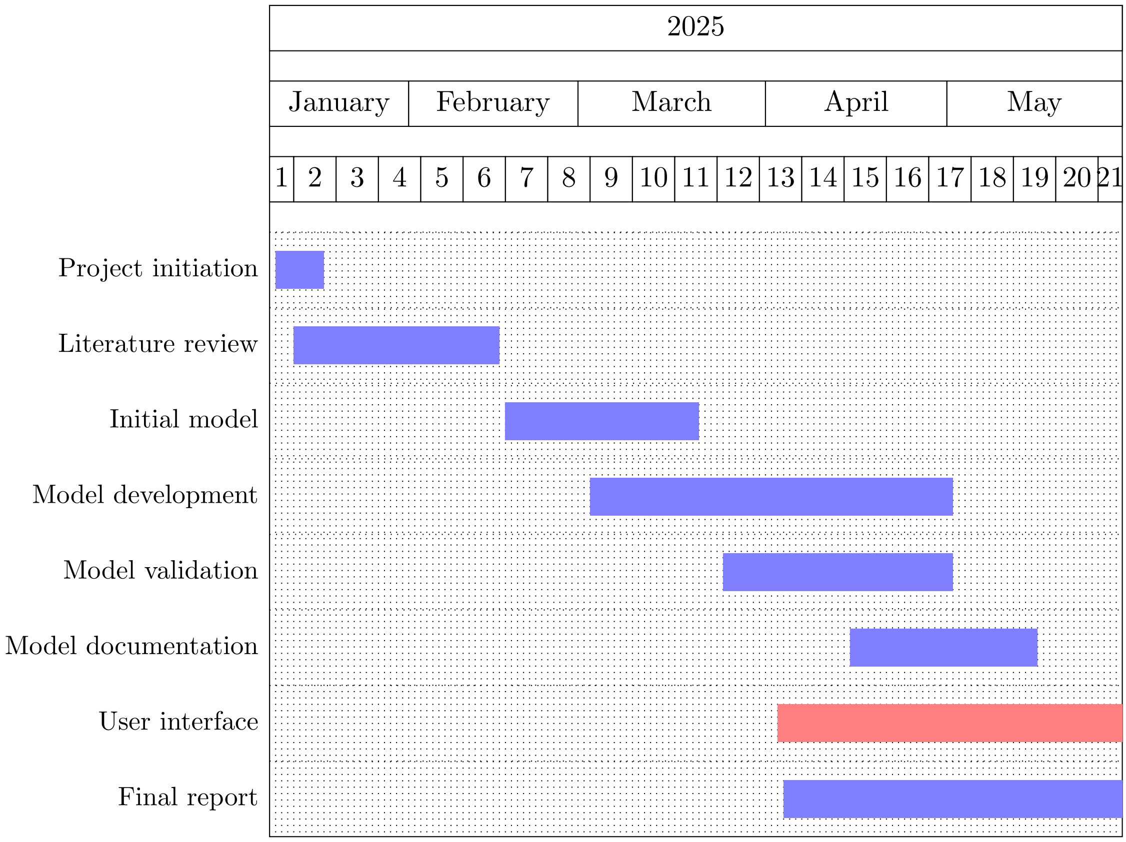

Figure 1: Project schedule

for example in Sweden. In addition, we have conducted a meeting with Cimmo Nurmi who has previously made a similar model for scheduling icehockey series.

Finally, we have to consider the resources of the Finnish Floorball Federation since they are the ones that will be using the final model. Thus, we should prioritize using cost-efficient platforms and creating thorough instructions and documentation.

6 Risks

The risks relating to the project are listed in Table 1. The scale for the probabilities is {Low, Medium, High}, where "Low" means a probability that the scenario is very unlikely to occur during the project, "Medium" means a probability that the scenario might occur, but it is still more likely that it does not occur, and "High" means that there is a greater likelihood of the scenario occurring than not during the project.

Scenario	Probability	Consequences	Mitigation actions
Risks relating to the model			
Too large space for feasible solutions; too many inefficient solution decisions.	Medium	Model becomes inefficient.	Considering solution times, when making decisions regarding the model.
Model provides practically unoptimal solutions.	Medium	The model is not usable in practice.	Active discussion of the model requirements within the team and with the client.
All constraints cannot be included in the general model.	High	Model cannot be used for every age group and series.	As many series are considered as possible. Considering features that are present in most of the series.
Risks relating to teamwork			
Inefficient scheduling of the project (e.g. Too much time is allocated for considering different models); uneven shared workload between team members.	Medium	Decreased quality of deliverables and model. Some team members might be overloaded.	Project manager focuses on scheduling and sharing tasks evenly. Also, team members contribute to efficiency by being active.

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Scenario	Probability	Consequences	Mitigation actions
Schedules do not hold; workload stacks up to the end of the course.	Medium	There is no time left for validating the model or producing a practical tool for the client's need.	Project manager makes sure that this is not the situation. Everyone's responsibility is to finish tasks before the deadlines.
For some reason, someone is not able to deliver effort.	Low	Other team members need to work more; overloaded team.	Open communication within the project team. Also, checkups every now and then.
Risks relating to communicating and working with the client			
Final model does not match client needs.	Medium	The client cannot utilize the model.	Everyone focuses on the client's needs. Open communication with the client.
The client is not committed to the project.	Low	The project stays on hold or proceeding is very limited.	Active communication with the client.
Model and the corresponding tool are so complicated that the client does not have the ability to use them.	High	The client cannot utilize the model and needs to acquire resources to use it.	Focusing on building the model on cost efficient platform. Creating instructions and focusing on documentation.

Table 1: Risk scenarios for the project

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