Mat-2.4177 Seminar on Case Studies in Operational Research

Designing Layouts for Specimens in Agricultural Experiments Suffering from External Disturbances

Project Status Report

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Introduction

In this report we examine the progress made in our project so far. We have almost finished the literature review and have had an extremely promising start in MATLAB-programming. No significant changes have been made to our original research objectives. Some important decisions have been reached regarding which methods to use in designing the program, but generally they are in line with our original research plan. Naturally the resource needs and other more practical matters have been clarified during the project, and in order to accommodate them some small changes have been made to our original plan.

Changes to research objectives and limitations

At this point of the study we are still planning to pursue all the goals we set for ourselves in the beginning of the project. In order to succeed in this assignment it is important that the algorithm we develop is capable of taking into account all the factors presented in the project plan. These factors are for example: the number of treatments in the experiment, the different levels of each treatment as well as the shape of the experiment area. It is however likely that we will have to limit our research in some ways. For example, originally we intended to study whether changing the shape of the experiment area or using more replicates of the specimens could enhance the likelihood of success in the experiment. We are still going to examine these subjects, but because of our limited time, this part of the study will most likely be more of a snapshot. Our main goal is still to provide our client with the understanding and tools for better experiment design.

Progress so far and results

The goals of our project were divided into five sub-objectives: Literature survey, identification of risks, mathematical model, MATLAB-program and measurement of the quality of the layout the model gives. Below we have discussed all of these in more detail.

Literature Review: So far our literature review has shown that there is relatively little existing information relating directly to our specific problem setting. However, there are some existing general concepts we can try to utilize when developing our algorithm. So far we have studied the following experimental designs: Completely Randomized Design (CRD), Randomized Block Design (RBD) and the Latin Square Design. Each of these methods has some main principles we

could put to use in our solution. The CRD suggests that if the conditions of the experiment are known to be uniform, a completely randomized design is the most efficient. The principles of RBD and Latin Square Designs can be implemented if some known external factors cause variance to the experiment. Even though none of these design methods solves our unique problem alone, they can be helpful when trying to create the best possible designs in varying environments.

Identification of risks: Our team has examined various risks in agricultural experiment design. Some features of the risks have been found in existing literature, such as the fact that disturbances tend to affect a few large areas rather than several small ones. Other risks have been identified through discussion with the client.

Mathematical model: Our mathematical model so far consists mostly of scattered ideas from our literature review, such as the CRD, RBD and the Latin Square designs.

MATLAB: We considered the use of MATLAB the most challenging part of our study. So far our team has been mostly acquainting itself with the basics of MATLAB and the various possibilities it offers. We have however developed an initial platform for describing how various specimens are arranged within the experiment area.

Quality: We have discussed different methods for measuring of quality, and as our model advances we will be better able to assess the merits of each method.

Changes in resources

We have proceeded according to our original plan and have split our project team into two sub-groups. As the literature analysis has taken less time than anticipated, we are planning to strengthen our programming team by letting one of the literature reviewers focus on MATLAB-programming as well. It now looks likely that we will take an approach where the focus is less on risk analysis and more on making the design as robust as possible to reduce its vulnerability to disturbances.

Our original schedule has held well so far and we will continue adhering to it. An additional element not presented in the plan is the writing of the final report which will take place in the weeks 16 and 17. This part will be made easier by the fact that the literature review is almost finished and can be directly used in the final report.

Updated risk evaluation

In the research plan we identified three major risks, all of which concerned on the quality of our model. The first risk regarded the definition for layout quality. The risk was that we would not able to find a proper indicator which could be used to compare different models with each other. We have been able to develop a few alternatives to measure the quality with and so far they all seem both suitable as well as feasible. Therefore we think that the probability of this risk has decreased during our work.

The second risk concerned the MATLAB programming and the usability of our program. First, we have managed to learn the basics of MATLAB programming relatively fast and our program is performing the most basic procedures successfully. In this sense we have made progress and decreased the probability of this risk. On the other hand we still lack most of the advanced features of the program so the risk is still considerable. As the literature review is already almost complete we have designated more resources into MATLAB programming and hope to decrease the probability of this risk even further.

The third risk we identified in the research plan regarded the successful identification and modeling of external disturbances. Here we have developed a method which would allow the user to enter the form of the disturbance into the model manually. This would enable the user to customize the program according to changing situations. However, there are still some open questions about how to implement this in the program, and thus the probability of this risk has also decreased but it cannot be ignored.

In conclusion, none of the risks have been totally avoided and they are all within the realm of possibility, but we have been able to decrease their likelihood significantly. Still the most severe risk is related to our MATLAB programming skills and the functionality of the actual program. However, the good progress made so far in this area looks promising.