

**Mathematical Contest in Modeling
Summaries, Pictures and Results
Simpson College
2006**

Love and Loss in Wheelchair Service

by

Shikha Basnet, Maya Hristakeva and Max Schlatter
Meritorious

Developing a cost effective wheelchair service system for Epsilon Airlines has consisted of two parts: a scheduling algorithm that determines internal airport operations and a budget analysis that maximizes overall benefit for Epsilon airlines.

The wheelchair scheduling system determines where the escorts and wheelchairs should be and how they should move throughout each day. We used various data structures to represent the components of the system such as a weighted graph to represent the airport structure, priority queues to simulate the arrival time and requests of each flight, and others. Representing the system's components in this way allows the algorithm to be applied to any type of airport under high and low traffic loads. Planning and processing stages for each request are then represented by the algorithm. The planning stage will scan the queue of requests to check for periods during which many requests will have to be serviced and will plan accordingly. The processing stage actually schedules wheelchairs and escorts to service the incoming requests for assistance. Requests are processed as far in advance as possible. While processing the algorithm considers the closest wheelchair storage location, the wheelchairs that are currently in motion and do not have a request assigned to them, and the wheelchairs that are currently in use but will be freed by the time the next request needs to be serviced. Upon testing, the algorithm would provide outputs such as number of wheelchairs, average delay time, number of requests, and average number of flights. .

Using these outputs, our cost/benefit analysis model uses the derivative of a negative exponential probability function to calculate the present cost and benefit estimates. These estimates are then used to predict the effects of present decisions on the future using concepts such as the opportunity cost of delay, the elasticity of delay time, and the multiplier effect. Opportunity cost of delay estimates missed benefits from flight delays while

elasticity of delay measures the sensitivity of future ticket sales to delay time. The multiplier effect tells us net gain due to a change in delay time. Combining these concepts with cost constants determined by Epsilon's decisions about its wheelchair system gives us a way to adjust the system in order to meet any cost or benefit goals Epsilon may have.

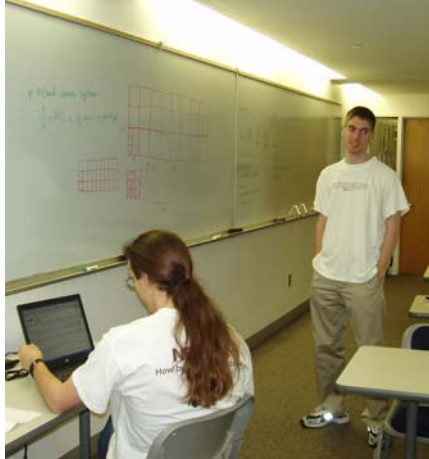
In order to best represent every possible case, our model is universal to all airports, traffic loads, and industry trends, an appropriate parameter given the depth and scope of the problem presented by Epsilon Airlines.



Max and Shikha discuss their model for wheelchair allocation.



Maya works to translate the ideas generated by the team into words.



Tim and Patrick consider irrigation configurations ...

“Hand Moved” Pipe Irrigation System

by

Patrick Carlson, Tim Fairfield and Joan Ritho

Honorable Mention

With agriculture being one of the major cornerstones of human existence, its efficiency is very important. Irrigation is one of the major aspects of agriculture and it is necessary to conserve time and energy in the process. There are a wide variety of techniques that can be used to irrigate a field. The "hand move" irrigation system is more flexible, cheaper, and easier to maintain than other systems. The one major flaw is that it requires a great deal of time and effort to move and set up the equipment. Our two different models that we have come up with will help assuage the problem.

For the basis of both models we set up a general design for placing each of the nozzles so that the entire field would be covered.

Using a free version of GEUP, a geometry modeling program, we mapped our general design. The nozzle radii were set to be the main variables being tested. Using the model helped us visualize what an increase in the radius would do to the required minimum number of nozzles and the area covered by each circle.

We used the simulated field to show how the real field would be irrigated at different times and sections. Model one dealt with knowing the amount of water that would be dispersed onto the field and then using this information to calculate the time spent on each circle. We determined the time and the frequency required to irrigate the whole field. The model was time conserving and adhered well to the limits set, like the amount of water in the soil per hour.

Based on the geometric design of the model, only 8.32% of the water sprayed on the field will be lost.

Model two focused on the amount of water distributed to each circle. The amount of water flowing through the nozzle is the key to the success of the model. At any flow rate that sprays more than 0.375 cm per hour on a circle, the model falls apart. Since the model is based on the maximum flow rate allowable, anything greater causes the maximum of 0.75 cm per hour to be broken. While the maximum value for the water sprayed cannot be greater, it can be smaller. If the value of water per circle decreases, the amount of time it will take to water the field will increase.



...while Joan works on the physics of water droplets.



Joe, Dillon and Prabal contemplate the irrigation problem.

Irrigated Fields

by

Joe Edgington, Dillon McKelvey and Prabal Thapa
Successful Participant

The problem at hand was that of devising an irrigation system that would most efficiently water a field with dimensions 80 meters by 30 meters. We were given certain specifications that the system had to have, and build our system to meet these specifications.

A system was devised in which a field could be watered according to the specifications. An efficient protocol

for watering was also made. This model can be used over many different sized fields and with many different types of pressure and water. The major problem of the model is the failure to manipulate the data. The general idea of the model works but the exact time could not be found due to the inability to manipulate the data. However, after researching sprinkler heads it was found that the pressures at which our system works would destroy even the strongest of sprinkler heads. We did find very useful data which shows the wetted diameter of different sprinklers, with relation to the pressure available. Our research is realistic and can be used for real life situation and with some proper testing it can be used for any different climate.

It can be adjusted very easily so that the field receives a lot more water or lot less just by reducing the amount of times the sprinkler system is rotated around the field.