

**Mathematical Contest in Modeling
Summaries, Pictures and Results
Simpson College
2002**



Shristi, Ellie and Donald take a break from their airline overbooking problem.

Airline Overbooking

by

Elists Banalieva, Donald Onunga and Shristi Upreti
Honorable Mention

We developed a basic model that describes the overbooking strategies of a hypothetical airline company, "Flying Colours." We put into consideration the given constraints under which we operate. We decided to use a random number generator to come up with the expected value of overbooked seats per plane, thus incorporating in our model the probability

of overbooked travelers showing up. We concluded we could overbook by 4 people from the business and coach classes.

Additionally, we segmented the market of travelers into business and coach sections in an attempt to consider the excess reservation issue in each market separately. We deemed that "Flying Colours" would profit most from its high-yield customers, the business class, whose tickets we took a

Thus, to capture the most revenues, we proceeded by proposing an optimum solution in three separate cases:

- A. Overbooked Business and Under-booked Coach Class
- B. Under-booked Business and Overbooked Coach Class
- C. Overbooked Business and Overbooked Coach Class

Lastly, we examined the strengths and weaknesses of our model. Our unique solution allows for wide applications under most conditions.

Wind and Waterspray

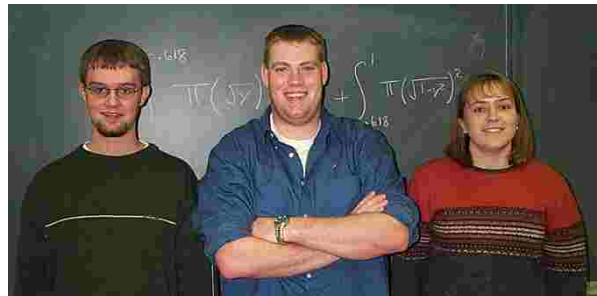
by

Ashley Bennett, Erik Jacobson and Jared Rokke
Successful Participant

The task at hand was to salvage the beautiful ornamental fountain but also to preserve the dryness of the passersby in the business plaza. The factors involved in solving this problem include several variables and equations, which describe mathematically how an animated process or algorithm could be used to adjust our elegant fountain.

Before we could begin to try to solve our problem we had to take into consideration some assumptions. Without these assumptions some of our equations and variables would not be correct. The assumptions also help to simplify the mathematics and make the problem more probable to be solved.

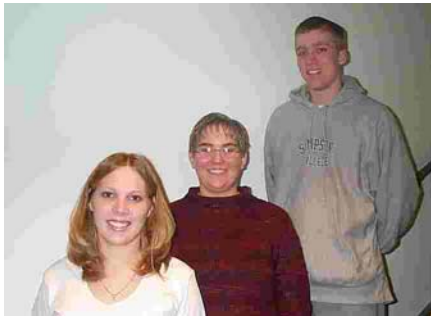
Initially we described and stated all of our variables that needed to be taken into consideration for the use of an anemometer as our independent variable. Variables other than wind speed that need to be taken into consideration were points such as distance from the fountain to the sidewalk, height of the fountain, and volume of water in the fountain.



Jared, Erik and Ashley work on a fountain design

We then applied basic physics and mathematics principles to use our variables in such a way as to describe the algorithm needed to correct the fountains volume. After coming up with these equations we then tested the model using a theoretical set of numbers. The test of this model was then used to derive the strengths, weaknesses, conclusions and some further applications for our algorithm.

We also felt it was necessary to include the basis for a possible program that uses the algorithm. This program could be used in a computer system involved in any of the applications and for an animated system to control the fountain.



Shanie, Teresa and Nick take a break from their airline overbooking problem.

Using Overbooking to Maximize Revenue

by

Nick Boyd, Shanie George and Teresa Kreykes

Successful Participant

Our task was to formulate a model that examined how different overbooking schemes affected total revenue in order to find one that maximizes revenue. We began by formulating a model to determine the number of tickets to overbook based on total capacity and a particular no show rate. This model needed to incorporate issues that have arisen since September 11th. We then recognized that total revenue is directly related to profit because

the expense of a flight is approximately constant for any number of passengers. So, maximizing profit is the same as maximizing revenue.

We set up a random number generator to experiment with no show rates since actual airline data was not available. We discovered that at any rate, the average of the number of passengers that showed up for the flight was centered on the capacity (approximately half the time we would overbook and half the time we would not fill our plane). Using a lower percentage of no show results in a fuller plane and less passengers to be bumped. We decided a better approach would be to say that no shows are non-linear and then the overbooking rate would not remain constant and would possibly pose less error.

Airlines prefer to overbook in order to maximize revenue. If they would only book each flight equal to the capacity of the airplane, the number of people who did not show up would be a loss in revenue. However, by overbooking, this no show rate is taken into account and the potential loss becomes potential revenue. Our model maximizes revenue by figuring out the optimal number of tickets to sell since revenue is generated by selling the greatest amount of tickets for a flight without having to bump passengers.

Wind and Water Spray

by

Nick Damm, Brian Mann and Joe Wilson

Successful Participant

Outdoor fountains provide a spectacular sight, but can create hazards to passersby, possibly getting them too wet on windy days. To prevent this from occurring, we have developed an algorithm that will adjust the flow of water based on current wind conditions.

Wind gusts are taken into consideration by factoring in the past five minutes of wind data from the anemometer. This allows our system to account for wind gusts before the implementation of the specific model, easing calculations.



Nick, Joe and Brian in the computer lab working on their modeling project.

In Model A, we simulated a fountain with a vertical spout. In this specific case, the calculations will be easier, and can be performed using less computing power.

Model B takes the angle of the fountain into account. This model is slightly more complex than Model A; therefore, it is included as a new model, requiring more computational power.

Model C addresses the issue of angled wind, and compensates for much of the conservativeness of previous models. A particle relative wind speed is calculated from the adjusted actual wind speed provided by the anemometer. This model is very complex, and would require a powerful computing device to calculate the required volume rate.

These models, though conservative, will allow for a more enjoyable spectacle, as they will not allow passersby to be saturated by the fountain's spray. We chose to make conservative models to provide a cushion for extreme situations, such as sudden changes in wind gusts. Though the spectacle will be limited, passersby will have a more enjoyable overall experience.