U of A Students Deliver Results for Pizza Company

by Chris Neuman

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Ordering pizza for delivery is not the sort of activity on which one's mind lingers. The process is simple: pick up the phone, call the pizza store of choice, place your order with an operator, and half an hour later the pizza is delivered to your door. It sounds simple; yet, all the components of a manufacturing facility exist. Combine with the manufacturing the economics of order taking and the delivery of finished product, and it quickly becomes a much more complex process. And, as we all know, where there is process there is process improvement through OR/MS – exactly the thoughts of six University of Alberta business students.

In 1997, two groups of students approached Pizza 73, an Edmonton-based pizza chain with locations in Alberta and British Columbia. The two groups came from Distribution Management and Service Operations Management classes respectively, and were looking for term projects with real data and real consequences.

The Distribution Management group proposed to analyze the delivery areas of Pizza 73's Edmonton stores. When an order came in from the city, it would be assigned to a location based on present delivery boundaries. These boundaries had been set up through a process of negotiation, and no analytical design had been applied. In addition, the company was opening a ninth store and was looking to determine a store allocation that would give the new location a solid sales base while minimizing revenue loss from the other companies.

The students used the company's sales database and exported 12,000 records, representing two weeks of delivery sales in the city. Importing the data into MapInfo, a GIS program, they aggregated the sales into 157 census tracts and exported the aggregated sales and tract centroid coordinates. Using Microsoft Excel, the students solved an integer programming problem, minimizing total distance by assigning census tracts to stores. An additional constraint required that no location should lose more than a certain percentage of their original sales. By changing this percentage to determine distance-revenue sensitivity, the group found that for a 2% maximum reduction in per-store revenues, the company could move to a solution that was within 2% of optimality.

A modified version of the problem detailed above was used to determine the new store's zone. A "dummy" location was added and the problem solved again. In this case, the percentage loss was location-specific, so the store closest to the new location would be most affected, while other stores would be less so. The rationale for this decision lies in the method Pizza 73 used previously: when a new store was opened, the store whose existing area was took the entire loss of revenue, while neighbouring stores suffered no loss. This method allowed a fairer allocation of losses, allowed boundaries to "ripple" around the new store, and redistributed boundaries with distance criteria in mind.

The company, due to the relatively small improvement, did not improve on the original eight store boundaries. However, they were interested in the new zone creation aspect of the project. Since the students' analysis, the company has added 3 new stores, and has taken their model into account.

The second project, for the service OM course, revolved around the company's Edmonton call center. Scheduling a call center is a difficult problem that must take into account anticipated demand, required service levels, and labour cost nonlinearities that arise from regulation governing benefits and shift lengths. The company had scheduled their call center by hand, which yielded schedules that were more costly than desired. The call center was slated for upgrading, since the company was folding their Calgary order processing (previously served by a call center in Calgary) into the Edmonton center. This, and the relative high cost of commercial scheduling software, led the management at Pizza 73 to offer the project to the U of A team.

The company wanted a decision-support system that would be easy to use, would not require new hardware, would produce schedules that complied with labour laws, and would minimize cost to the company. The "easy to use" criterion was critical: the company wanted the system to be comprehensive but also comprehendible.

In consultation with the company, the students devised a system that would run within Microsoft Excel, would take one major input – management expectation of weekly sales, a number for which management had a firm grasp – and output a sequence of shifts. The actual assignment of operators to shifts was left for the call center staff to fill. In addition to the weekly sales figure, management could specify a desired service rate.

The DSS required several pieces of data that Pizza 73 did not keep. The students first analyzed historical sales information to determine the hour-by-hour, day-by-day distribution of orders. Pizza sales peak around dinnertime, with a second peak later in the evening. In addition, daily sales vary, with a peak on Friday and a low on Tuesday.

By comparing the phone switch records with the sales database, the team was able to determine how many calls resulted in actual orders, compared to those which were for information or comments. This provided a bridge between sales and calls, needed to provide accurate arrival rates. Service rates were determined by looking again at the phone switch data. The arrival and service rates were used in simple queueing calculations, to determine the minimum number of servers required to meet a management-specified level of service.

The data provided tells how many people are needed for a given time; it does not say how to arrange these needs into shifts. Microsoft's Excel Solver saved the day, allocating staffing levels to shifts so as to produce labour law-compliant, minimum cost solutions.

The staffing DSS provides is a simple and flexible tool that met Pizza 73's needs efficiently and at low cost – namely, the time it took for management to work with the group and provide the data. The weekly use of the DSS has resulted in an annual saving of approximately $5000. Its direct economic benefits are not all that the company gained, however. The DSS forced the company to look at the data it had but was not using, and has resulted in a new awareness of the power of data already in their hands. This additional data will only improve the DSS's ability to correctly predict staffing requirements, and drive costs down further.

These results – simple tools yielding tangible benefits – are reflective of what the OR/MS profession can offer the takeout and delivery fast-food industry as a whole. The emphasis on being a low-cost competitor and a leader in customer service has made quantitative analysis a prerequisite for success. In addition to the methods discussed here, industry is a prime candidate to benefit from work in daily demand forecasting, distribution network design, fleet-size and route optimization, and inventory planning, to mention but a few examples. The opportunity for scientific analysis in this field is vast; the simple action of ordering a pizza or picking up an order of fries from the local drive-through burger joint sounds easy but there are surprisingly complex systems at work.