

Selecting Journals of University Library to Stop Subscription by OR/MS Approach

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Abstract We present an OR/MS approach we adopted to stop some of the academic journals subscribed by Nanzan University Library. The problem is formulated as the knapsack problem and solved by the EXCEL Solver. We also show how we implement our solution in our university.

1 Introduction

In Japan, almost all the private universities are faced with financial problems because the applicants are decreasing every year. It is because the population of age eighteen is shrinking and there is no hope that the younger population would increase in twenty years in Japan.

Nanzan University, a middle sized private Catholic university in Nagoya, adopted Operations Research methods to improve their daily operations in 2004. The first project was to reduce the cost of its school bus system. OR professors had engaged in the project and succeeded to reduce the budget of the school buses.

The OR professors' activity in Nanzan University is recognized for the distinguished outcomes and received the Franz Edelman Finalist Award in 2005 from INFORMS (the Institute for Operations Research and the Management Sciences) [2]. After the success of the school bus project, Nanzan University formed an OR team called Project N in 2005. N is the initial of Nanzan University. The authors are members of the team.

The problem of stopping some academic journals subscribed in the library was the first challenge of Project N. While the budget of the library was limited, publishers raised the price of the journals every year. The Nanzan University librarians were in serious troubles, and they asked Project N to find a solution of the problem. They also sent a manager to Project N to work with the OR professors. The third author of this paper is the manager.

In 2004, the headquarters of Nanzan University asked the library to reduce the budget up to five percent. The librarians had tried to stop several of the subscribed journals

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by themselves, but they failed. The way they adopted in 2004 was roughly outlined as follows:

They sent questionnaires to all the faculty members in Nanzan University. The questionnaires were asking them to mark the priority of the journals in three levels listed in the questionnaires for their research. They expected that if the faculty members assigned low priority to several journals which are expensive, they could stop them. However, the faculty members did not act like their expectation.

In 2005, the headquarters asked the library to reduce the budget up to five percent again. The librarian fell into the serious dilemma. They had no way except they resort to a different approach to their problem.

In the following sections, we show how we succeeded to stop several academic journals in Nanzan University and as a result to reduce the budget. In section 2, we show our new framework of selecting journals. In section 3, we explain an OR technique we adopted. In section 4, we show the outcomes of our method. In section 4, we spend words for the actual, sometimes political, issues for our activities. We conclude our paper by summarizing our experience.

2 An OR/MS framework to select journals to stop

Project N proposed a new framework of the problem in 2005. The framework is as follows:

1. list up only costly journals,
2. provide a hundred points to each faculty member,
3. each faculty member distribute the points to the journals listed up according to his priority of research,
4. select journals to stop according to the total points assigned and the price by an OR method.

The details of the framework are as follows:

The librarian listed all of the titles in their questionnaires in 2004. The number of journals subscribed by the library is about three thousand and four hundred. The list was too long for the faculty members to check whether the journals are important or not for their research. As a result, they marked all of the journals as they had high priority for their research, or they just ignored the list. The latter faculty members claimed after the questionnaires were gathered and the librarians made the list of journals to stop. The professors have power for the academic activity and the librarians had to modify the list. This was a reason the librarians failed.

We made a list of only nine percent of the journals which spent fifty percent of the budget. We focused on the costly journals as candidates of the journals to stop. It should reduce the time for the faculty members to scan the list, and we could ask them to distribute the points according to the true priority for them.

Providing a hundred points equally to every faculty member is to attain the fairness among faculty members. Several professors claimed that they need expensive journals for their research while the other professors didn't. So far, it was approved by the faculties because the need for the research was considered as a sacred. By providing equal points

to every professor, we tried to treat the needs of journals for each faculty members fairly. It was a strong reasoning to persuade the faculty members who were suspicious of our framework.

Each faculty member could distribute his points to the journals according to his research needs. He might divide the points into arbitrary portions. For example, he could give fifty points to journal A, thirty points to journal B and twenty points to Journal C. We also encouraged the collaboration of the process of distributing points among the faculty members of the same research field. For example, five OR professors could collaborate each other and distribute one hundred twenty five points to each of Operations Research, Management Sciences, Journal of the Operations Research Society of Japan, European Journal of Operational Research.

After we gathered the points for each journal listed, we solved the problem. The problem is to select journals which are stopped for subscription. The formulation was to minimize the points of the journals to stop under the condition of the given budget to be reduced. The problem was formulated as the knapsack problem. We used EXCEL solver to obtain the solutions. The formulation was very simple. The third author, who is not a specialist of OR but a librarian, made the EXCEL sheet to solve the problem, and ran the solver to obtain the solution.

3 Problem formulation

As we mentioned in the previous section, the problem was formulated as the knapsack problem. Before describing the formulation, we list up the parameters we used for the formulation.

n : number of journals listed,

p_i : points given to journal i , $i=1, \dots, n$,

c_i : price of journal i ,

C : the budget to be reduced.

The variables we have to decide are

x_i : 0-1 variables, if $x_i = 1$, journal i should be stopped. If $x_i = 0$, otherwise.

Using these notations, the problem is formulated as follows:

$$\begin{aligned}
 \text{[P]} \quad & \text{Minimize} && \sum_{i=1}^n p_i x_i \\
 & \text{s. t.} && \sum_{i=1}^n c_i x_i \geq C \\
 & && x_i \in \{0, 1\}, i = 1, \dots, n
 \end{aligned}$$

[P] is easily converted to the knapsack problem if we introduce $x_i' = 1 - x_i$, and $C' = M - C$, where $M = \sum_{i=1}^n c_i$.

$$\begin{aligned}
 \text{[P']} \quad & \text{Maximize} && \sum_{i=1}^n p_i x_i' \\
 & \text{s. t.} && \sum_{i=1}^n c_i x_i' \leq C'
 \end{aligned}$$

$$x'_i \in \{0, 1\}, i = 1, \dots, n$$

We adopted [P] for our formulation because it is easy to understand for librarians and faculty members who were not familiar with OR. The two formulations are the same.

4 Results

Nanzan University Library has two branches in two campuses respectively. The two campuses are called Nanzan Nagoya campus and Nanzan Seto campus. There are five faculties, Literature, Foreign Language, Economics, Business Administration, and Law in Nagoya campus. There are two faculties, Policy Studies and Information Engineering & Mathematical Sciences in Seto campus. We call the library in Seto campus as Seto library, and the library in Nagoya campus as Nagoya library from now on.

Table 1: A part of the Excel sheet to obtain the solutions

No. of Journals	points	price(yen) per year	x_i
1	143	1,170,634	1
2	117	792,121	1
3	103	633,697	1
4	172	441,846	1
5	224	392,504	0
6	172	372,339	0
7	185	307,668	0
8	132	302,960	1
9	159	284,716	0
10	203	260,042	0
11	162	257,528	0
12	114	247,883	0
13	162	239,990	0
14	247	228,809	0

Table 2: Reduced budget and the total points

reduced budget (yen)	goal of the reduction of the budget (yen)	total points
3,341,258	3,000,000	667

We first applied our framework to Seto library. There were two reasons to start our new framework in Seto library first. First, Seto library is smaller than Nagoya library. Second, the faculty members in Seto may understand easily because there are many faculty members of quantitative sciences such as OR, Statistics, Computer Sciences. Actually, when we explained our framework at the faculty meetings and they agreed after short questions and answers period.

Seto library subscribed five hundred and fifty titles of journals. The budget to subscribe the journals was about twenty million yen (a hundred and ninety thousand dollars at the current rate) per year. Our goal was to reduce the budget by fifteen percent. It is three million yen (twenty eight thousand dollars).

We made a list of journals which were comparatively expensive. The number of the journals on the list was sixty. The total budget to subscribe the journals on the list was about twelve million yen. It was about sixty percent of the budget of subscription of journals in Seto library.

We distributed the questionnaire of the list of journals. We also showed whether the journal had alternatives to the subscription in the questionnaire. The alternatives were, for example, that faculty members who need the journal could read the journal on the WEB site which the publisher opened, or they could go to the nearby library which subscribed the journal. This information might help the faculty members to distribute their points to the journals.

Forty eight percent of the faculty members in Seto campus replied to the questionnaire. We thought that forty eight percent was a good number because a number of teaching stuffs are included in our faculty members. Also, the number is larger than the ratio, which is thirty three percent, by which faculty members replied to the questionnaire in 2004.

We made a sheet of EXCEL and solve [P] by the solver. Table 1 is a part of the sheet for Seto library. The CPU time to obtain the solutions was very short. It is less than one second. So, we solved the problem many times with various C . We could obtain kinds of solutions for various C . It was because we recognized the fact that it should be better for us not to decide the journals to stop immediately, but to show candidate journals to the faculty members. The faculties then could decide which journals should be stopped from the candidates as the final decision. This made them have a chance that they could consider the journals to stop again. Actually, we presented the solution of three million and fifty hundred thousand yen for the reduction to the faculty members. It included seven journals. They picked up six of them to stop from 2006. As a result, we succeeded to reduce the budget more than our goal (Table 2).

We proposed our framework to the faculty members in Nagoya campus at the beginning of 2006 fiscal year. We thought that it should be easily done, because of our experience in Seto. However, there was a strong reaction from the faculties in Nagoya campus contrary to our expectation. Many faculty members were concerned about stopping journals. It was because the fields of faculty members in Nagoya campus were mainly qualitative ones such as literature, law, or languages. They were very concerned about that the journals which were important for their research activities would be stopped by a very strange way which they could not understand.

We attended meetings of Nagoya library where the representatives of each faculty attended. We explained many times about our framework and also the librarians showed the financial situation of the library. Several months later, our framework was approved by the faculties and we started the process.

We modified our framework according to the suggestions presented at the library meetings. First, we removed the journals which are very important for faculty members from the candidates even if the journals were expensive and the number of the faculty

members who needed it was small. Second, we decided to present the solution of more than three times of our goal of the budget reduction. For Example, if our goal is six million yen, we presented of the solution of more than twenty million yen. It made the faculty members decide the journals to stop for themselves. Third, we changed the goal itself. Our first goal of the budget reduction was fifteen percent from the original budget. We used this in Seto, but we lowered the goal up to ten percent in Nagoya.

We listed up hundred sixty journals from two thousand eight hundred fifty journals in Nagoya library. The sum of prices of subscription of the journals listed up was sixty percent of the total budget for the subscription of academic journals in Nagoya library. It was about sixty million yen. We set our goal of budget reduction as six million yen.

We distributed the questionnaires to ask the faculty members to distribute their provided points with the list. Fifty percent of the faculty members replied to the questionnaire and distributed the points to the listed journals. We obtained the solution of twenty one million yen for budget reduction as C in [P]. The library showed the solution to the faculty members at the faculty meetings. After two months, Nagoya library finally decided the journals to stop from 2007 fiscal year.

5 Conclusions

We presented a case study of applications of an OR methodology to the library management. As the library management has been a field of OR/MS from the frontier book of Morse [1], our study is also an example of the library management. In our case, we spent more time for persuading the faculty members who are suspicious to our framework than for modeling or for computation of solving the problem. In the service industries where they treat human activities, application of OR is usually like this. According to our experience, OR specialists who are engaged in the project should propose not only the solution of the problem, but also the materials for persuading people who are against the solution. Solving the problem is not enough. The most important and time consuming part of the project is persuading people to accept the OR approach.

References

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