

DSO 570 Final Project: Optimizing Course Scheduling at Marshall

Interim deliverable 1 - Group 9

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Identification of the Inefficiency

The scheduling of courses and classrooms at USC Marshall is a complicated systematic procedure with lots of constraints. Under this situation, the tradeoff between requirements of different parties involved and limited resources of classrooms and the prime-time can be a conundrum.

In this stage, we choose the management team as our stakeholder. For management team, many possible notions can be used to measure goodness. And based on our analysis, the management office's goal is that every Marshall department can assign class properly where the eventual number of enrolled students for each class will be close to the targeted size of the class and classroom. In this way, figuring out how to maximize the usage of each classroom is our primary objective.

After digging deeper into our data, we found that the usage of classrooms in different departments has a rather polarized distribution. In some departments such as ACCT, their courses are with pretty low seats utilization rate which means limited large classrooms resources are not well used. However, in some other departments, their courses are with such high utilization rates that the classrooms are almost full and fail to provide students with a good learning experience. We can see that there exists severe imbalance and indicates great room to improve. As the management office of Marshall, it has to keep the balance of resource allocation between different departments and make full use of the resources.

Definition of Metric

Based on the reasons above, we pick the Marshall prime-time seats utilization rate by departments in each academic term (fall, spring, summer) as our metric, and calculate the average of the prime-time seats utilization rate of all the departments in each term to be our final number. In this way, we can quantify the average course scheduling goodness of all the departments as a whole in each semester.

The steps of building this metric is as follows:

- a. Dataset Combination

At first, we merge Marshall_Course_Enrollment_1516_1617 and Marshall_Room_Capacity_Chart datasets with room name. By doing this, we can get the information regarding term, department, time of course, room and class registration.

b. Data Screening

Then, we filter out the courses that were not held in rooms within Marshall, not belong to 7 departments of Marshall and not held within the prime-time (10:00-16:00).

c. Seats Utilization Rate Calculation

For each semester and each department, we calculate the seats utilization rate. The formula is as follows:

$$\begin{aligned} & \text{seats utilization rate by department} \\ &= \frac{\sum \text{the number of enrolled students after add - drop date}}{\sum \text{the number of seats available for each classroom}} \end{aligned}$$

This metric will get 7 numbers which represent 7 departments in each term.

d. Seats Utilization Rate Aggregation

For each semester, we calculate the average seats utilization rate of departments. The formula is as follows:

$$\text{average seats utilization rate of departments} = \frac{\sum \text{seats utilization rate by department}}{\text{the number of department for this term}}$$

Justification of Appropriateness

Our metric - each department's prime-time seats utilization rate for every academic term (fall, spring, summer) is the most appropriate one to measure "goodness" for the Marshall management team based on the criteria. First of all, the seats utilization rate is computable from the current data. We can first aggregate the total number of registered students and classroom seats available and then calculate the utilization rate for each department under the six terms. In addition, this metric is actionable. If we conducted appropriate improvements during the course scheduling process, the utilization rate will be directly affected and increase if possible. Also, it is simple to understand and interpret. Most importantly, the prime-time seats utilization rate for each department in every semester is enlightening, clearly showing whether each Marshall department efficiently uses the available space to schedule course or not.

Nevertheless, there might be questions about why not taking the average prime time seats utilization rate for every class under each department. Since our group's targeted stakeholder is the management office, we are more interested in finding an aggregate measure that can reflect how well each department utilizes the available space but not how well each course utilizes the classroom resource. The utilization rate of each class is more of each department's interest as they are trying to figure out the popularity of classes. Additional analysis can be done using the average approach to compare whether it will generate the same result as the aggregate approach.

Analysis of Available Data

As mentioned before, our goal is to calculate the prime-time seats utilization rate. By using Python, we merged datasets, filtered out records that we're interested in and analyzed our data. (Please refer to the attachment for the complete Python code.) Below are the results of our analysis:

Term	20153	20161	20162	20163	20171	20172
Department						
ACCT	0.631548	0.602936	0.312500	0.673449	0.600925	0.594203
BAEP	0.735043	0.764706	NaN	0.760417	0.748188	NaN
BUCO	0.734139	0.771654	0.342105	0.796786	0.794847	0.776316
DSO	0.807345	0.723973	0.709091	0.744275	0.792160	0.705882
FBE	0.667503	0.657227	0.747525	0.632493	0.607225	0.515625
MKT	0.767059	0.672533	0.530000	0.772083	0.663931	0.333333
MOR	0.827710	0.872753	NaN	0.851108	0.767268	NaN

Based on the statistical description of data, we found that the highest seats utilization rate is 87.28%, and the lowest utilization rate is 31.25%. So, we set the best value as 90%, the worst value as 30% and our aim as 80%. Besides, the average seats utilization rate is 70%, and if we can achieve our goal at 80%, we will have an improvement of 14%.

Apart from this, we also go deeper to group the seats utilization rate by term and department.

Registered Size Utilization				Registered Size Utilization		
Term				Department		
20153	7700	10738.0	0.717080	ACCT	9708	15503.0
				BAEP	1390	1847.0
20161	7148	10399.0	0.687374	BUCO	2226	2919.0
				DSO	5953	7776.0
20162	349	612.0	0.570261	FBE	7471	11759.0
				MKT	5914	8276.0
20163	11122	15464.0	0.719219	MOR	4829	5835.0
20171	10811	16082.0	0.672242			
20172	361	620.0	0.582258			

Table 1. Seats Utilization Rate by Term

Table 2. Seats Utilization Rate by Department

From Table 1 we can see, there's no clear improvement of seats utilization rate from fall 2015 (Term 20153) to summer 2017 (Term 20172) for the entire Marshall School of Business. The utilization rate in the fall semester (Term codes end with 3) is a little bit higher than in the spring semester (Term codes end with 1). The utilization rates in summer (Term codes end with 2) are particularly low. This might occur due to the low registered students in summer. However, since the demand for the classroom in summer is also low, the low utilization rate in summer is not the issue we concern.

The overall seats utilization rate for all Marshall controlled classrooms in the prime-time is 0.70. From Table 2 we can see, departments of ACCT, and FBE have seats utilization rate lower than the average rate of Marshall. These two departments requested for more than 10 thousand seats in two years but only have a utilization rate that slightly higher than 0.6. This might be a situation that the management team

doesn't want to see. On the other hand, there were more than 4 thousand students registered in the courses offered by the department of MOR, and the seats utilization rate of MOR is higher than 0.8! This indicates that a utilization rate of higher than 0.8 is feasible even if the number of registered students is high in that department. Therefore, we think a utilization rate of 0.8 would be a reasonable goal.

Low seats utilization rate might be due to the over-requesting of the classroom size. If we can set a rule of penalty for those departments that often over request (e.g., assign a smaller room to the department no matter how large they requested), each department will better estimate the size of classrooms they need. In this way, we can achieve our goal of a seats utilization rate higher than 0.8 and better allocate our resources of classrooms in the prime-time.