



School of Business

DSO 570: GROUP 6

SCHEDULING OPTIMIZATION INTERIM DELIVERABLE

Group Members:

Feng, Xiaoxuan

Fu, Yu-Ellie

Liu, Qiao

Sung, David

Zhou, Fang

EXECUTIVE SUMMARY

This report provides an analysis of Marshall's course schedule data for 2016-2017 and evaluates a possible success metric for optimization. The goal of this initial investigation is to determine an area of improvement for the Administration Office and find a suitable way of measuring positive outcomes. Methods of analyses include table aggregation and data manipulation, leading to the computable, actionable, simple, and enlightening measurement of a Capacity Ratio - a more detailed description of this ratio is found in the Goodness Metric section of this report.

An initial application of the Capacity Ratio on Marshall's course data is then explored in the Analysis of Data Utilizing Metric section of this report. In short, the measurement indicated suboptimal utilizations of classroom capacities. In addition, splitting the data by terms, we notice a cyclical trend where summer terms have less capacity wastage than other terms.

Finally, conclusions and next steps are presented in the last section of this report for subsequent project phases.

DESCRIPTION OF CURRENT PROCESS

The current process of scheduling is segmented into two phases that are centered on Shannon's team and the department coordinators. After allocating each department coordinator a set of classroom time slots, the department coordinator will schedule the courses with instructor inputs. The department coordinators will then work with Shannon and Hal to schedule the remaining courses. This is largely an iterative process that requires significant repeated communication between Shannon's team and the department coordinators. Aside from the set phases, there is little systematic processes in place to create the finalized schedule.

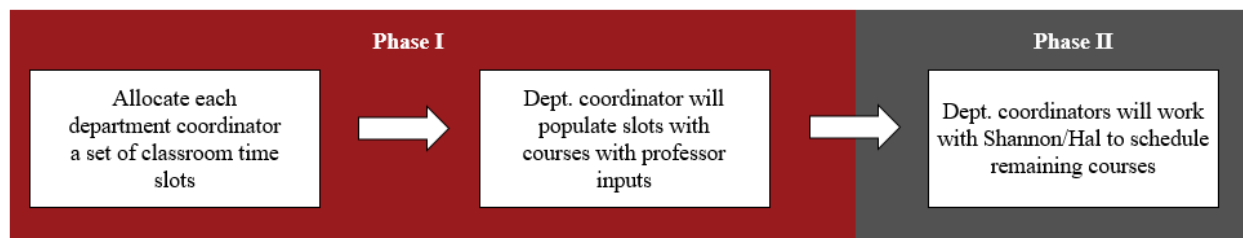


Figure 1. Description of Current Process

BIGGEST OPPORTUNITIES FOR IMPROVEMENT

In analyzing the current course schedule, we found that classroom assignment for courses can be handled in a systematic way resulting in a more efficient outcome.

This task occurs in both Phase I and II. As deadlines arrive, it becomes increasingly harder to accommodate all classroom times and sizes. The ideal assignment of classrooms is for the actual number of enrolled students to be equal to the capacity of the classroom. However, it is often the case that the number of enrolled students exceed or is below the classroom capacity. This can cause issues in student scheduling and capacity wastage.

We believe there is room for improvement in better utilizing classroom capacities. Through analyzing the current scheduling data and optimizing the classroom assignment procedures, we expect to see an increase in the classroom utilization rate.

GOODNESS METRIC

The metric we will use to determine the goodness of the utilization rate of classrooms is a Capacity Ratio. It is defined as student registered count divided by the room capacity.

$$\text{Capacity Ratio} = \frac{\sum \text{Reg Count}}{\sum \text{Size}}$$

This metric is defined based on the following assumptions:

- Number of registered students will not be changed during the semester. In other words, we assume the students who registered the class at the beginning of the semester will not drop the class after the semester begins. In addition, we assume no student will add courses after the semester begins.
- No auditors for the courses. There are some courses are very popular among students so that they may attend the class without any registration. In our assumption, we filtered out these special cases.
- Special classroom courses will not be included. These may include online, international, and office courses

The Capacity Ratio is an appropriate metric because it is computable, actionable, simple, and enlightening.

Computable: The ratio can be calculated immediately under the assumptions mentioned above. It is the division between Reg Count in Course Enrollment table and Size in the Capacity Chart.

Actionable: Since the metric is indicative of resource utilization, with better planning, it is an actionable metric that can drive more purposeful classroom assignment.

Simple: The meaning of Capacity Ratio is very clear and simple. It is a measurement of the efficiency of classrooms utilization.

Enlightening: Capacity Ratio is related to the “goodness” of schedule directly. A good course schedule system should be able to assign classrooms efficiently and wisely, which can be explained by the Capacity Ratio. A value of 1 indicates that the classroom is being perfectly utilized. Values below 1 indicate wastage, and values above 1 indicate a need for a larger classroom.

ANALYSIS OF DATA UTILIZING METRIC

To compute the metric for the previous two academic years, the Course Enrollment and Capacity Chart tables were joined.

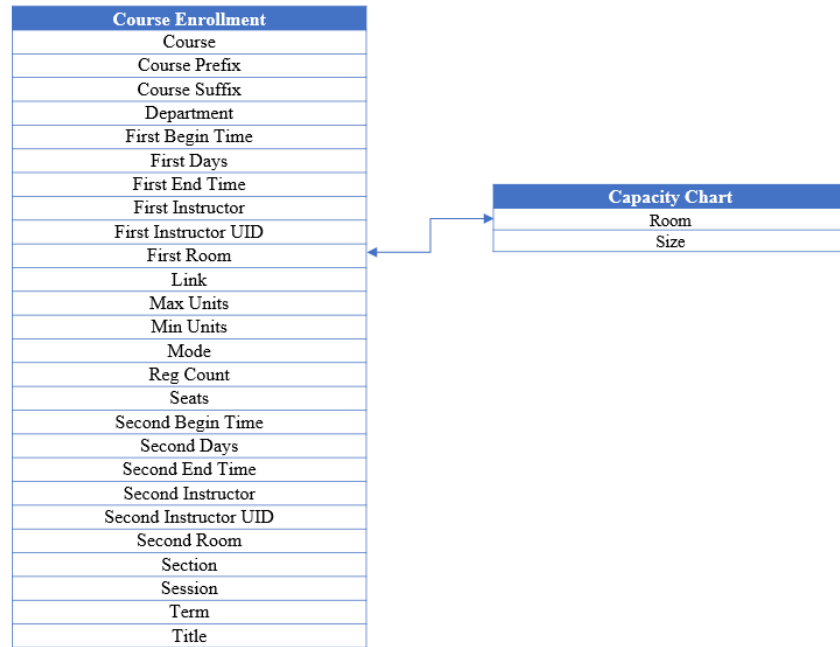


Figure 2. Table Joins

The overall Capacity Ratio across all terms is 0.682. The current value suggests capacity wastage at a rate of 0.318. When examining the trend of the Capacity Ratio across terms, a cyclical trend is apparent. The Capacity Ratio utilizes capacity best in the summer terms, followed by fall then spring.

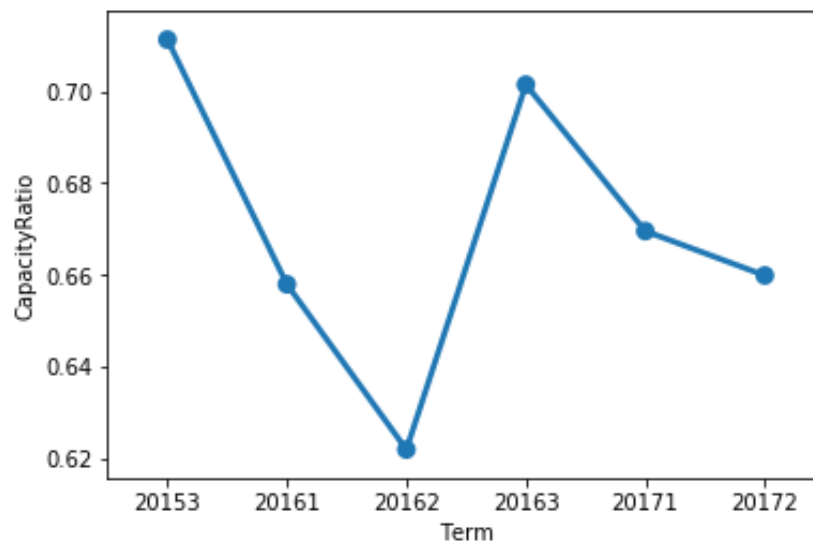


Figure 3. Capacity Ratio Trend

<i>Ratio\Term</i>	<i>20153</i>	<i>20161</i>	<i>20162</i>	<i>20163</i>	<i>20171</i>	<i>20172</i>
<i>>= 0.9 (Good)</i>	39.5%	30.0%	18.0%	34.9%	33.1%	16.1%
<i>< 0.682 (Average)</i>	34.6%	41.5%	57.4%	31.6%	35.2%	42.9%
<i>< 0.5 (Poor)</i>	17.3%	21.6%	32.8%	13.9%	18.6%	21.4%

When binning the Capacity Ratio into three different segments as shown in the summary table above, it becomes apparent that a substantial proportion of classrooms are underutilized.

The room scheduling for spring semesters (Spring 2016 and Spring 2017) perform the worst in terms of the Capacity Ratio. For Spring 2016 and Spring 2017, only 18% and 16.1% of the classes have a Capacity Ratio greater than 0.9, respectively. A considerable proportion of classes for all semester have a Capacity Ratio under the 0.682 average. Furthermore, each semester has approximately 20% of classes with a Capacity Ratio less than 0.5, which indicates mediocre performance of the classroom assignment.

Through proper analysis and optimization, this value is expected to converge towards 1 for future academic terms.

CONCLUSION AND NEXT STEPS

After exploring Marshall's course data, the greatest area of improvement was determined to be addressing the inefficiency of classroom utilization. The current assignment of classrooms is not completely consistent with the needs of departments leading to course conflicts that leave some classrooms completely vacant during the day. In addition, course to classroom matching is currently suboptimal leading to student capacity wastage in some rooms where the upper limit of the room is well above that of the actual course size.

To address this problem, a Capacity Ratio was defined and applied to the data for initial exploration of potential improvement schemes. Clear noticeability of suboptimal classroom allocation was identified along with a cyclical trend of this inefficiency across terms. Next steps would be to develop an active management decision and determine necessary input parameter variables that would allow for an optimization algorithm to be fitted. Successful implementation of the optimization would then be measured by the pre-defined Capacity Ratio on the algorithm's outputs.