Interim Deliverable 1
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DSO 570

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Opportunity for Improvement:

Each semester the academic scheduling team of University of Southern California aims to improve inefficiencies in the process of course registration. The Marshall School of Business at the University of Southern California is attempting to keen on their weaknesses and measure and optimize their performance and methodology of managing this process. Currently, the process is extremely manual and time consuming due to the demand of each stakeholder. Those stakeholders include students, professors, departments, program directors, finance and administration team, and upper USC leadership and management, who all hold specific needs and demands of the registration team. The aim of deliverable one was to identify an inefficiency in the registration process using data that the scheduling team provided us, create and compute an insightful metric, then analyze that metric in the context of how it could be improved.

A specific opportunity for improvement that our team found was the utilization of each classroom based on the registered students to each course being taught in that specific classroom. Before each semester, Shannon Faris and Hal Warning (the academic scheduling team) assign each department a list of allocations (that include classrooms and time slots) based on the predicted number of students that will register for each course. However, sometimes very popular courses are held in smaller classrooms (creating for a tight fit). The opposite is true as well, a classroom with few registered students are sometimes assigned a larger room. Our team wanted to look at how often either one of these situations are true, and for our “goodness” measure, we chose utilization rate. This utilization rate will explore the “goodness” or efficiency of the process and to measure the magnitude of this issue. Through the exploration of the data, we were able to define, measure and evaluate a metric involving this process of room assignment using Python as our primary tool.

Inefficiency Identification:

Our metric represents efficiency of room utilization. We calculated utilization rate for each room by calculating the ratio for the number of registered students divided by capacity of each room. The closer the utilization rate is to 1.0, the better optimized the room to its capacity. Our analysis indicates that there are a number of rooms falling short of the ratio of 1.0. This represents inefficiency of room utilization. The inefficiency indicates the assignment of classes with smaller number of registered students to the bigger classrooms which may cause students to miss the opportunity to register for a class due to capacity limit and USC to increase the number of students registered for classes to the level where its revenue is maximized. However, we have assumed that Marshall stipulates a number of rules to achieve an certain faculty to students ratio for each class, therefore, we shall refrain classes with higher utilization rate from assigning to the bigger classrooms where more students can register. Instead, we have separated into two groups by comparing each room utilization rate to the overall average utilization rate for all the rooms. The average utilization rate is 73.55%. The first group consists of the lower utilization group whose room utilization rate is less than 73.55% and the second group is the higher utilization group whose room utilization is more than 73.55%. We believe that the first group with a lower utilization rate has a significant room for improvement.

Metric:

First, we used the two datasets:“Marshall_Room_Capacity_Chart.csv” and “Marshall_Course_Enrollment_1516_1517.csv”. Second, we used the second dataset and group by “First Room” and filtered the dataset by focusing on only 2016 Fall term. Third, we joined the two datasets. Fourth, we created a column for utilization rate for each room. We calculated utilization rate for each room by calculating the ratio for the number of registered students divided by capacity of each room. The aforementioned procedure results in calculating the utilization of each classroom based on the registered students to each course being taught in that specific classroom in 2016 Fall term. Our metric represents efficiency of room utilization. The closer the utilization rate is to 1.0, the better optimized the room to its capacity. Finally, we compute the overall average utilization rate for the benchmark by taking the average number of the utilization rates for each room. The benchmark serves as a basis for determining which rooms to be optimized.

Appropriateness of Metric:

Our metric satisfies CASE.

Computable: The metric needs two kinds of data, which are the number of students who registered the course and the capacity of each room. Since each course was arranged to a specific room, we can connect the number of students with the room where they have the class. Those data are available for us, so the metric is computable.

Actionable: Room arrangements is within the power of academic scheduling team, so the metric is actionable for the team to reduce inefficiency of room utilization.

Simple: The idea of the metric is easy to understand and interpret. It measures the efficiency of room utilization. For example, if one room has 200 seats and the students enrolled is only 50, then the room utilization rate is 25%, which might be inefficient.

Enlightening: We compare the average utilization rate for each room instead of just looking at the average number of enrolled students for each room, because the average utilization rate is comparable for each room while the average number of enrolled students are not comparable for different rooms. Room with lower average number of students may not be less efficient, but room with lower average utilization rate is less efficient.

Potential critiques and solutions:

Critique 1: The metric does not take professors’ preferences into consideration. For example, if a professor wants to teach only 40 students while the capacity of the room is 100, and there are 40 students enrolled, the utilization rate would be 40%. Due to the preference of professor, students cannot be added anymore, so the efficiency cannot be raised in this case.

Potential solutions: Departments can collect professors' preferences and arrange suitable rooms for them first. For example, in the case above, department can firstly arrange a room with capacity 40 or a little larger for that professor's course. Then, for professors who do not have any preferences, department or scheduling team can use our metric to arrange rooms that maximize their utilization rates. Another solution is to strengthen our metric by taking this preference into consideration. That's probably the next step we would like to take.

Critique 2: The metric is not categorized by each day of week. For example, if room A has 100% utilization rate on Mondays and Tuesdays while only has 30% utilization rate on the other days, then its average utilization rate might be around 50%. If room B has 50% utilization rate on everyday, then the average utilization rate for room B is also around 50%. But the efficiency problems of room A and B are not the same.

Potential solutions: If departments and administration team only care about the average room utilization rate in general, then we don't need to worry about each day of week. If they want to maximize room utilization rate for each day, then we would like to apply our metric for each day of week and do further analyses on that.

Analysis of Data:

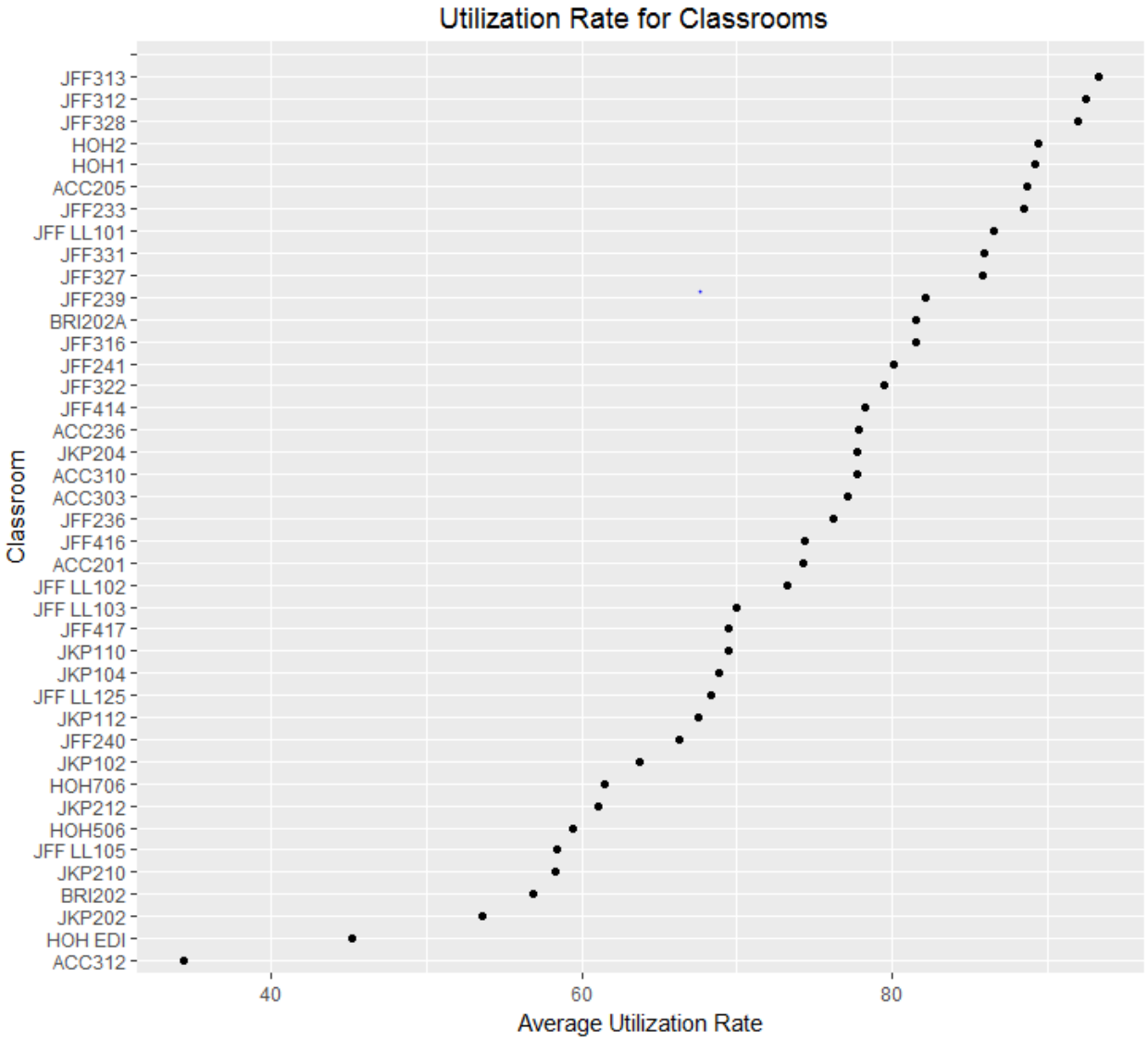
Based on the primary analysis, we define the mean of average utilization rate of all classrooms as optimization benchmark. That is, classrooms with rates above the benchmark are classified as better utilization group. Meanwhile, those with rates lower than the benchmark are classified as worse utilization group.

The best possible utilization rate is 100%, and the worst possible utilization rate is 0%. Our final goal is to get solutions to help maximize the utilization rate of each classroom. The main focus for this stage is to boost the utilization rate of worse utilization group at least to benchmark and maintain the present utilization level of better utilization group.

Conclusion:

According to the analysis, the benchmark utilization rate is 73.54995%. 23 classrooms are in better utilization group, while 18 classrooms are in worse utilization group awaiting improvement as shown in the graph below. Best utilized room is JFF 313 (93.3%); worst utilized room is ACC 312 (34.29%).

For classroom in worse utilization group, we recommend to boost the utilization rate. Possible solution including: better allocation of courses according to the room capacity and enrollment rate of students, better courses design to increase student enrollment rate, and better management of course capacities based on room capacities. Further detailed optimization strategies will be presented in future report.


Utilization Rate for Classrooms
Classroom
JFF313
JFF312
JFF328
HOH2
HOH1
ACC205
JFF233
JFF LL101
JFF331
JFF327
JFF239
BRI202A
JFF316
JFF241
JFF322
JFF414
ACC236
JKP204
ACC310
ACC303
JFF236
JFF416
ACC201
JFF LL102
JFF LL103
JFF417
JKP110
JKP104
JFF LL125
JKP112
JFF240
JKP102
HOH706
JKP212
HOH506
JFF LL105
JKP210
BRI202
JKP202
HOH EDI
ACC312
40
60
80
Average Utilization Rate

Python Code:

In [16]:
```
import pandas as pd
from pandas import DataFrame
import numpy as np
import scipy.stats as sps
import matplotlib.pyplot as plt


courses = pd.read_excel('/Users/roselynbyrd/Desktop/DSO570 Final Project/courses.xlsx')
capacity = pd.read_excel('/Users/roselynbyrd/Desktop/DSO570 Final Project/capacity.xlsx')
#Filter by Term
c2 = courses[courses['Term'] == 20163]

c2 = c2.rename(columns={'First Room': 'Room'})
#Merging Data Sets
merged_inner = pd.merge(left=c2,right=capacity, left_on='Room', right_on='Room')

m0 = merged_inner.rename(columns={'Reg Count': 'Reg'})
#Creating Metric

m1 = m0.assign (Utilization_Rate = (m0.Reg/ m0.Size)*100)
#Finding Avg Mean UR For each Room
URatio = m1.groupby('Room', as_index=False).agg({"Utilization_Rate": "mean"})

URatio
```

Out[16]:

	Room	Utilization_Rate
0	ACC201	74.218750
1	ACC205	88.715278
2	ACC236	77.867746
3	ACC303	77.173913
4	ACC310	77.777778
5	ACC312	34.285714
6	BRI202	56.878307
7	BRI202A	81.535948
8	HOH EDI	45.156353
9	HOH1	89.165629
10	HOH2	89.383562