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Student Behavior in Selecting an Exam Time in a Computer-Based Testing Facility

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Abstract

A Computer-Based Testing Facility (CBTF) can provide students flexibility regarding when they take exams. By analyzing the data from the service that students used to schedule their exams, we can learn about student preferences and behaviors regarding their exam times. This paper explores the exam times that students choose, when students make and change their reservations, and the correlation between when students choose to take exams and their exam performance.

Among our results, we find that students prefer to take exams in late afternoon/early evening towards the end of the exam period. In addition, we find that students frequently re-schedule when they take exams; 42% of reservations are later canceled/rescheduled. Finally, we find that there is a correlation between how early in the exam period a student takes an exam and their score on the exam.

1 Introduction

In large classes, running exams can be a logistical nightmare, which leads most faculty to run only a few exams during the whole semester. Studies have universally found, however, that the majority of students prefer more frequent, smaller exams[1,2,3]. In general, studies also find that more frequent, smaller exams leads to higher scores[1,2].

In order to reduce the overhead of testing and increase its learning potential for students, we have set up a computer-based testing facility (CBTF), which allows students to complete exams in a secure manner, at a time convenient to the student, and with little effort on the part of faculty and course staff. We describe the CBTF in detail in Section 2.

With traditional testing mechanisms, faculty alone decide what day and time exams will be held. As such, there is little data about student preferences about exam dates and times. The CBTF allows students to select an exam time within a range of days, providing students the flexibility to choose to take the exam when it is convenient for them. By observing the students' interactions with the scheduler, we can begin to learn about student preferences and behaviors with regards to choice in their exam times. In Section 3, we explore both the times at which students choose to take exams as well as the process that arrived at that choice. Finally, in Section 4, we consider how a student's choice of exam time relates to their ability to master the material.

Figure 1: Computer-Based Testing Facility (CBTF) during an exam.

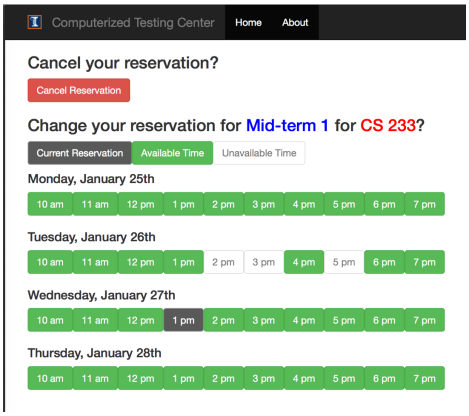


Figure 2: The student exam sign-up interface for the CBTF.

2 The Computer-based Testing Facility (CBTF)

The focus of this paper is the prototype computer-based testing facility that was initially set up over the summer of 2014[6] at the University of Illinois at Urbana-Champaign. The CBTF is housed in a converted computer lab, central in the engineering campus. Shown in Figure 1, this testing lab provides 49 seats for students, along with another 4 seats in a reduced distraction environment for students registered with our disability resource center. Each of the computers is outfitted with a privacy screen that prevents test takers from reading off the screens of neighboring computers and the networking and filesystem are strictly controlled[6].

In Fall 2015, 8 large enrollment courses, spanning three departments (Computer Science, Electrical and Computer Engineering, and Mechanical Engineering) used the CBTF. During this semester, the CBTF was used by over 3,000 unique students with more than 20,000 exams taken. To accommodate this utilization (typically between one to two thousand exams per week), the facility was open/proctored 10–12 hours a day, 7 days a week. In addition, during finals week, a second 40-seat computer lab was temporarily converted to a testing lab to provide additional capacity. We employed 7 part-time proctors to operate the space.

Courses typically assign a 3-to-5 day period for the students to take an exam. Generally, the exam periods of exams from different classes overlap each other and the CBTF is running a number of distinct exams concurrently. Students reserve a time of their convenience from an online reservation system. Sign-ups for exams typically begin 2 weeks before the exam period begins, and the service now sends periodic reminders to students when they have exams available for which they haven't made a reservation. We schedule exam periods so that the CBTF doesn't need to run at more than 85% capacity on any given day, to provide students many potential exam times to choose from, and to be able to tolerate any operational problems. At their scheduled exam time, students have their identity checked by a proctor and are randomly assigned to a computer (to deter coordinated cheating).

Figure 2 shows a student signing up for "Mid-term 1" in the course "CS 233", and they have currently selected the time "1pm" on "Wednesday, January 27th". The green times indicate time slots that are still available (rescheduling is freely allowed before the scheduled time slot). The

white times are unavailable due to already being fully booked.

The data that is presented in this paper was collected from the scheduler web service depicted in Figure 2 for a period in the Fall 2015 semester spanning September 1st to December 12th.

The exams in the CBTF are administered via the PrairieLearn system[4], which generates a random selection of questions from a large collection of parameterized problems that together meet coverage and difficulty criteria. Students sitting next to each other will typically have different exams from different courses. Exams are typically auto-graded, so students are given their exam score as soon as they are finished (consistently and strongly popular in student feedback surveys). PrairieLearn also supports allowing students multiple attempts at each question with a partial credit schedule controlled on a per question basis.

3 Student Scheduling Behavior and Preferences

Exam scheduling is performed on a first-come, first-served basis. Last semester, we made the exams available for students to register for in two week blocks, typically at least one week before the beginning of the exam period. Each time slot is limited by the capacity of the lab; when a slot fills up, it is no longer available for scheduling. By observing the order that students select time slots, we can observe their preferences for scheduling.

3.1 Exam Time Preferences

With respect to when students want to take exams, two features are particularly prominent. First, students significantly prefer taking exams toward the end of the exam period; in Figure 3, we show the fraction of exams that are taken each day of an exam period, relative to the last day of the exam period. Roughly half of the students elect to take the exam on the last day of an exam period.

Second, students have a strong preference for later in the day. In Figure 4, we show the fraction of exams taken at each time of day. The data shows that the afternoon/evening hours have occupancies of roughly double the morning hours, but this actually under-emphasizes student preference for afternoon/evening exams, because those exams fill up and push students to take exams at less preferred times.

In our related work[5], we developed a *discrete choice* model for predicting student demand for exam times given the schedule of exams. This model is trained using the trace of student reservations considering which exam time a student chose given the exam times that were available when they scheduled their exam. One component of this model is the probability a student will select a given exam time (if available) independent of starting/end days of the exam. A plot of the relative probabilities (normalized to the highest probability) is included as Figure 5. Note that, we added service during 8pm-10pm on Monday-Friday late in the semester to add additional capacity, which explains the apparent discontinuity at 8pm (20 on the figure). In general, students prefer to take exams: 1) later in the day, 2) on Tuesdays and Thursdays (many lower level engineering and CS courses have MWF lectures), 3) before 6pm on Friday, rather than Friday night and the weekend.

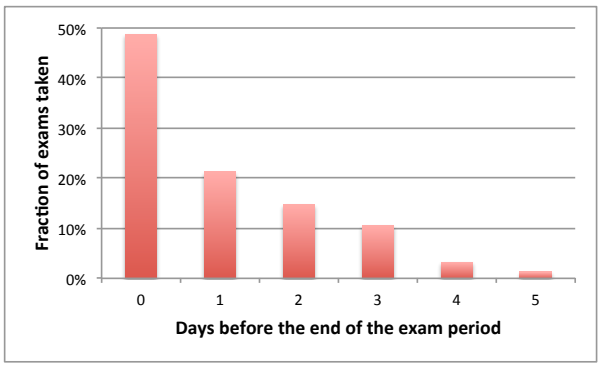


Figure 3: The relative frequency of a student choosing a time slot as a function of days remaining.

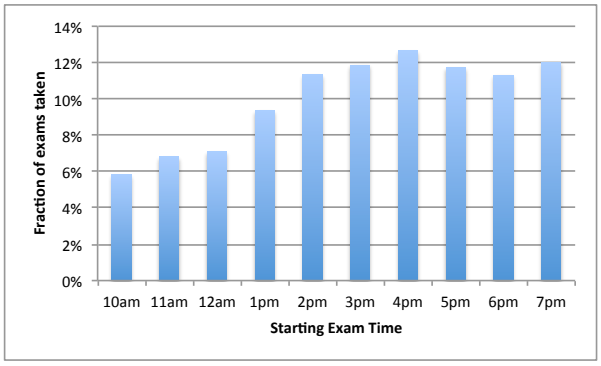


Figure 4: The relative frequency of a student choosing a time slot as a function of the exam time.

3.2 When do students make their reservations?

Students are given the freedom to make and change their reservations up to 1 hour before they take the exam, and we see the students exploiting this freedom. In particular, it is common for students to change their reservations (42% of reservations are canceled), and many reservations are made a relatively short amount of time before the exam.

We find that students make their reservations throughout the full 24-hour period, but the bulk of the reservations are made during the hours that we expect students to be awake (e.g., late morning to midnight), as shown in Figure 6. The times when reservations are deleted show an almost identical trend.

Figure 7 shows a cumulative distribution of how many days ahead students make reservations. In this plot, we distinguish reservations that were used from those that were canceled. The data point labeled '1' indicates that over 23% of exam reservations were made 24 hours or less before the selected exam period, and over 50% of reservations are made within 3 days of the exam.

From Figure 8, we can also see that reservations made long before an exam are roughly equally likely to be canceled as not. Only reservations made within 24 hours have a significantly smaller than even chance of being canceled.

Most exams are not rescheduled. As shown in Figure 9, 58% of times that a given student schedules to take an exam, they do not reschedule the appointment. When a student does reschedule, they may reschedule many times. In fact, one student rescheduled a single exam 21 times.

When rescheduling occurs, it is typically done very shortly before the exam. From Figure 10, we can see that over 55% of the time, rescheduling is performed within 24 hours of the exam time to be taken.

When students choose to reschedule, they are more likely than not to be pushing the exam out to the future, but most reschedulings change the time of the exam without changing the day. Figure 11, compares the time that was initially reserved with the time that the student finally took

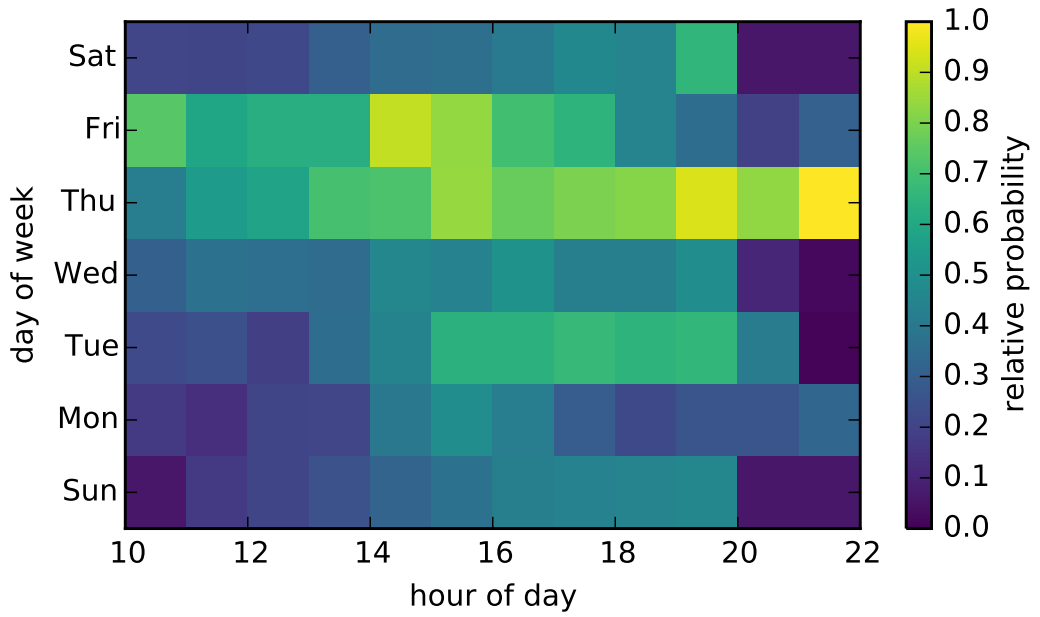


Figure 5: Probabilities that a student will select a given exam time (time and day-of-week) computed using a discrete choice model, normalized to the highest probability.

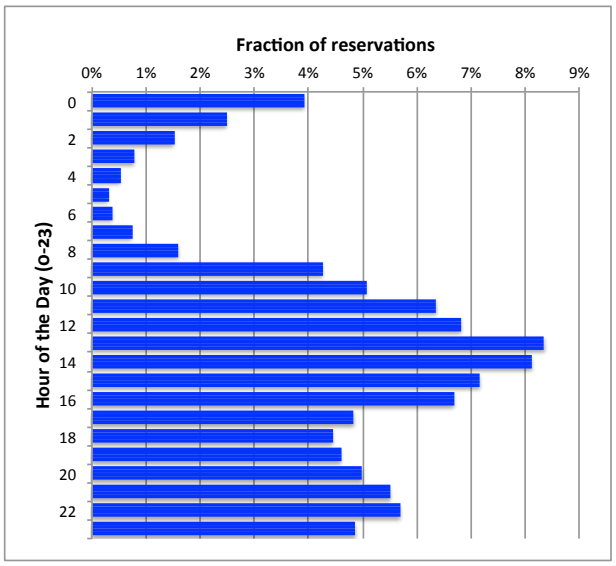
the exam. The structure in this figure results from the fact that we were offering exams at most 12 hours a day, so some differences (e.g., 12 or 36 hours) are impossible. Somewhat surprisingly, the most common rescheduling was to move an exam one hour earlier or later. Furthermore, 5% of students that rescheduled an exam ended up taking it at the same time as their original reservation.

4 Relationship between exam time and exam grade

When we started the CBTF, we were initially concerned that allowing students to take exams over a range of days would introduce significant new opportunities for academic misconduct. While we go into significant effort to randomize the problems and their parameters to provide each student with a unique exam, there was still a concern that students taking exams later in the exam period would have an advantage. According to our findings, however, there does not appear to be a significant advantage to taking an exam late in the exam period.

As shown in Figure 12, the average student grade decreases through the exam period. We see this effect both on the original offering of the exam as well as its second chance offering (where student have the opportunity to improve their score through taking a second equivalent exam the following week). In fact, the effect is even more pronounced in the second chance exam takers.

This finding is easy to explain. The strongest students are confident and are willing to take the exam early in the exam period to get it over with. Less strong students put off the exam, perhaps in hopes that additional time to study will help them do better on the exam. While the data shown is for a single exam in one class, we've observed this effect repeatedly across classes and across



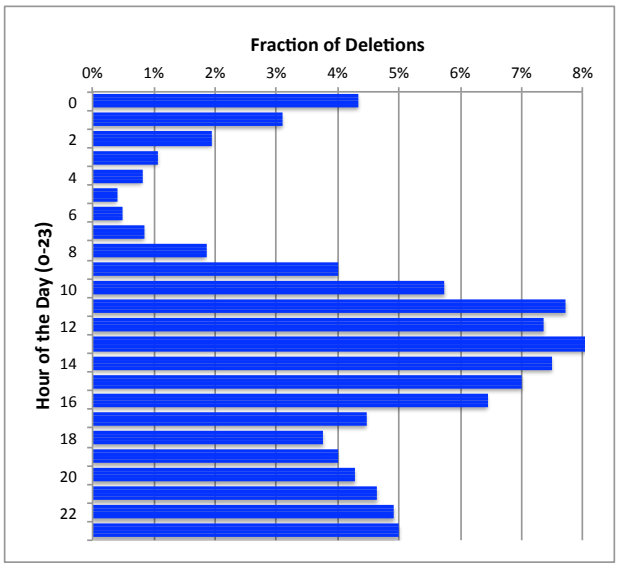


Figure 6: The time of day at which students make and delete reservations show the same trend.

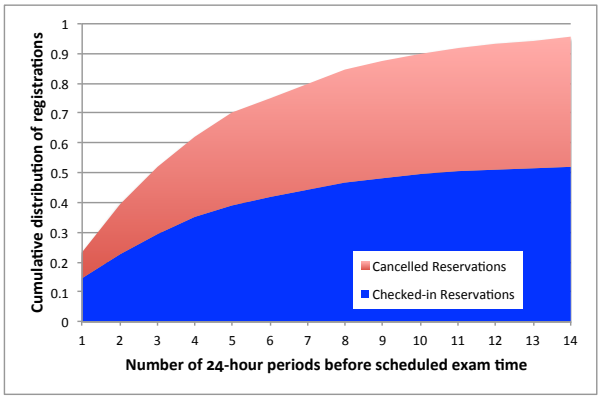


Figure 7: Cumulative distribution of the time between when a student makes a reservation and the reserved exam time (in 24-hour increments, rounded up).

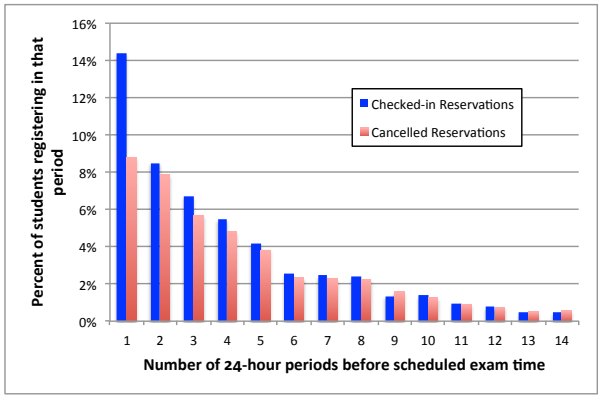


Figure 8: Time between when a student makes a reservation and the reserved exam time (in 24-hour increments, rounded up).

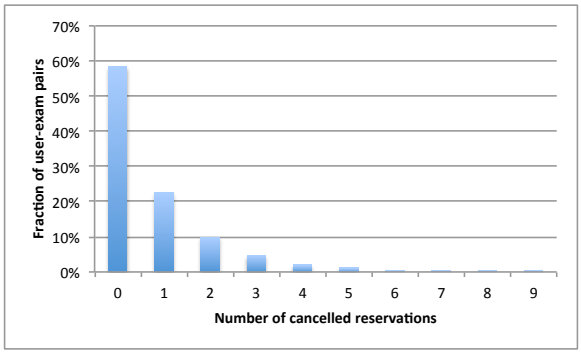


Figure 9: The distribution of number of times a rescheduling occurs for a given student-exam pair.

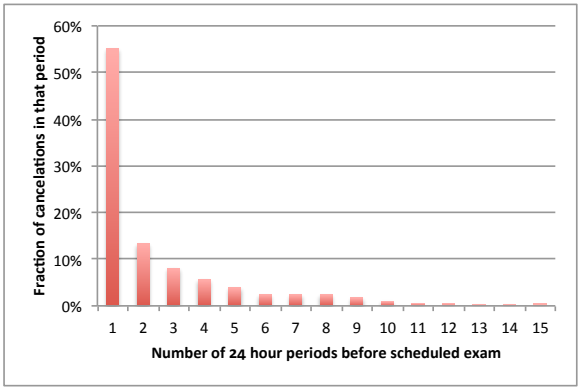


Figure 10: When a student re-schedules an exam, how long before the scheduled time does the rescheduling occur.

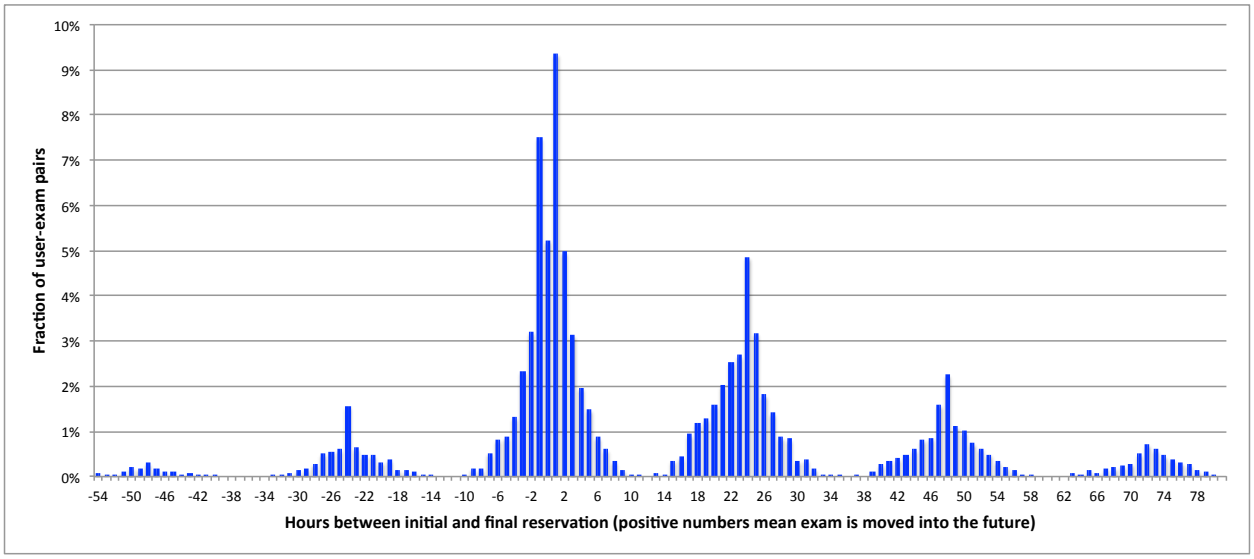


Figure 11: When a student changes their reservation, how does the time when they take an exam differ from their initial reservation. Shifting the exam by only a few hours is most common, but clear peaks can be seen at -1 day, the same day, +1 day, and +2 days.

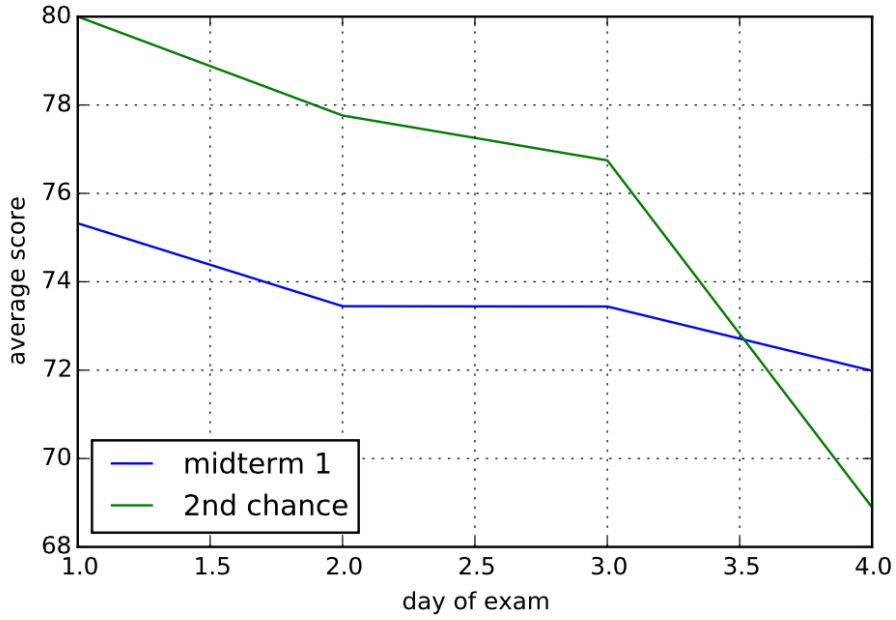


Figure 12: As we progress through an exam period, the average student grade decreases.

semesters.

While this does not refute the idea that students taking the exam later in the exam period aren't getting an unfair advantage, it does suggest that any advantage they are getting is smaller than the self-selection effect of who chooses to take the exam when.

Conclusion

Our experiences with the Computer-Based Testing Facility have been overwhelmingly positive. This Spring (2016) semester, we've increased the number of courses in the CBTF, with many of the classes that used it last Fall returning to use it again. In this paper, we are hoping to share our findings resulting from the operation of the CBTF to share insight both on student behavior as well as to facilitate others in replicating CBTFs at their own institutions.

This paper has characterized some student behaviors regarding how they make reservations for exam times in a context where they are given the freedom to choose from a wide array of potential exam times. These findings demonstrate that students will exploit the flexiblity provided by an automated scheduling tool. We view this as a positive, because in contrast with a traditional testing environment, dealing with exam time conflicts and short-term student illness can be handled without faculty/course-staff intervention. We are, however, disappointed by students' perclivity towards procrastination, especially by the weakest students. We feel that an interesting avenue for future work would be to use students' choice of reservations as one factor to drive interventions for students that might be falling behind.

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