A data-driven comparison of students' performance in asynchronous online versus in-person sections of an introductory graduate statistics course

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Abstract

Many institutions of higher learning have depended on their online programs to survive. In 2006 The Sloan Survey of Online Learning documented the growth of online education and showed that nearly 6 in 10 chief academic officers agree that e-learning is "critical to the long-term strategy of their institution" [1]. The COVID-19 pandemic energized that wave as all educational institutions sent students home and converted their instruction mode to online. The gain in momentum has sustained mainly because of the flexibility of time and space that online education affords students and faculty. Seventy one percent of students surveyed in 2021 reported they would continue at least some form of online learning even post-pandemic [2]. The popularity of online degree programs promises to continue in the future. While the climate is getting back to pre-Pandemic norms, many universities are experimenting in the fully online space. For example, some have started offering mini online sessions in between typical semesters, such as early in January while students are still away from the university before the start of spring semester. However online teaching, particularly teaching quantitative subjects can be challenging. Of course, there are teaching strategies and technology resources that can be employed to provide online students with the same experiences as are available to their in-person counterparts. Ultimately, though, the faculty must ensure students enrolled in online courses have the same learning outcomes as in-person students.

This study explores data from all 55 online and in-person sections of an introductory statistics course taught in a 4-year period for a total of 724 students. To determine performance differences in the two instruction modes we explored grades on homework, take-home midterm exams, and proctored final exams. We also tested differences in the overall course average between online and in-person sections. In all cases we found no statistically significant differences between instruction modes. The only analysis that revealed statistically significant differences were paired t-tests that compared each student's grades on the take-home midterm and proctored final. However, despite statistically significant findings, we recommend caution against assuming academic dishonesty. This is due to several accommodations that made testing conditions laxer and more flexible during the take-home midterm, which were not afforded to students in the proctored final.

Introduction

Distance education offers flexible time and venue for education as students can choose the time and place to study while they meet their class requirements and deadlines. This mode of study helps students by saving on time, transportation, and residence expenses since they don't need to travel to, and potentially relocate to live near their campus. Online study promotes technology skills as well, and it enables working professionals to continue their jobs and maintain their standard of living while pursuing their educational goals remotely. On the other hand, students must be self-disciplined as there is no schedule other than potential synchronous sessions with their peers or professors. Other advantages of in-person education are developing a sense of

community and extracurricular activities which are somewhat more difficult to achieve in distance education, especially at the undergraduate level. In this work, we use the terms “online” and “distance” interchangeably. Similarly, “in-person” and “on-campus” are interchangeable.

Literature Review

A survey of college instructors and administrators involved in online teaching showed the popularity of online learning, rise of blended learning, and growing share of the women among online instructors [3]. Respondents expected growth of online and blended learning. Student success factors in online learning were associated with training to self-regulate, better measurement of student readiness, better evaluation of achievements, and course management system. Another study on a graduate-level introductory biostatistics course compared online versus traditional in-person classroom learning environments [4]. This study found online class students’ quiz scores to be only 2.5% lower than those in the traditional classroom but the final exam average 0.9% higher. The study concluded that student performance was comparable in both modes of instruction.

A summary of studies that compared outcomes between online and in-person statistics courses [5] found that student achievement in online classes is on par with in-person class. However, overall student satisfaction was higher in in-person classes. A study of the quality and extent of online education in the United States [6] found that 40.7% of schools offering online courses believe that students are more satisfied with online classes compared to traditional classes, and only 3.1% of the schools disagreed with that statement. Medium and large schools reported higher satisfaction and the small schools the lowest. The same study found that 53.6% of schools believe online education is critical to their future. Most academic leaders in this study believed that online learning is equal or even superior to in-person instruction.

Another comparison of online and in-person [7] concluded that students appreciated online learning for its clear and coherent structure of the material, supporting self-regulated learning, and distributing information. Preference of in-person classes was due to providing a shared understanding and interpersonal relations established. A study of learning preferences during the COVID-19 pandemic [8] found student preferences for online courses to be based on the course subject, perceived to be easier, as well as providing higher flexibility, comfort, and convenience. In contrast, more difficult subjects, and those in the student’s major discipline of study are preferred to be taken in-person.

We find the present study to be quite unique due to the large dataset and controlled approach in course design and delivery, and student assessments. These factors make the comparison of performance in online versus in-person sections meaningful and informative.

About the Course

The course under study is an introductory graduate statistics course which does not have a prerequisite but is acceptable as a prerequisite for courses in programs such as Business and STEM. Underprepared or students deficient in the subject of probability and statistics are the primary students who enroll. They come from diverse backgrounds, and some have little to no

preparedness in statistics; hence, this is a challenging course to teach, particularly online. A typical student is of non-traditional age, married with children, full-time employed, and generally has one or more people reporting to them in their workplace. Students have the option of enrolling in online sections or an in-person section that is offered in the evenings. Online sections are offered asynchronously, 100% via a Learning Management System (LMS). In-person sections are offered one evening per week in 3.5-hour sessions. Every semester the in-person sections have a corresponding course shell in the LMS, populated with the same content and assignments as the online sections. Duration of all sections of the course is 12 weeks.

Due to high enrollment, several sections are offered each semester, generally one in-person and multiple online, which is strictly a function of demand. Some are taught by full-time faculty and others by adjuncts with regular teaching assignments for this course. To ensure achievement of learning objectives, the design, delivery, and administration of the course is tightly structured with consistency and uniformity in assignments and assessments. For that reason, a full-time faculty acts as Course Coordinator (also referred to as Lead Faculty) to facilitate collaboration amongst all faculty. Each semester the coordinator revises the Master course in the LMS, which includes these activities: updates the syllabus, revises auto-graded homework, generates new Excel data for case analysis, sets new due dates, and coordinates team-writing of the exams.

Course assignments are comprised of a) discussion/participation, b) weekly auto-graded homework, c) team cases, d) take-at-home midterm exam (also referred to as exam 1), and e) proctored final exam (also referred to as exam 2). These assignments are explained below.

Attendance/Participation

The in-person sections of the course are offered weekly in the evenings. Students' attendance in class is monitored and recorded by faculty but class discussion/participation is not tracked nor graded. Online sections have a graded discussion requirement. Faculty of online sections track, and grade student participation based on quality and quantity of their interaction in course discussion area. The online discussion grade is subject to variation in instructor's assessment and expectations across faculty; hence it will be excluded from analysis in this study with the goal to objectively decipher differences in performance of online versus in-person sections.

Weekly homework

Each week students in all sections must complete an objective-form homework that is multiple choice in format. Weekly homework includes both concept questions and problems. Homework is created in the LMS Master Course by the Course Coordinator and questions are drawn randomly from the publisher-provided test bank that accompanies the textbook. Homework is accessible to students throughout the week in the LMS to students and it is due on Sunday of each week. Since homework is objective in format and consistently copied from the Master course into sections, we will use homework in our comparative analysis.

Cases

Cases are completed in teams. They are developed around different themes with which everyone identifies such as sales, baseball, and weather. Cases are written by the Course Coordinator and used on a rotating basis each semester. Every theme has multiple cases related to it, centered around major course topics (descriptive statistics and summaries, inferential statistics, regression

analysis and time series forecasting). New data for a theme and its cases is generated randomly in Excel within set parameters for each variable, using macros and random number generator. Each semester the Course Coordinator changes the theme and the data for its associated cases to minimize the likelihood of academic dishonesty. The database for each case is large enough to make analysis impossible without Excel. While a theme and its cases may appear to be the same as those used in a previous semester, data is different and requires students to produce original work. Case questions are open-ended and require student teams to identify and use appropriate statistical tools to analyze and answer questions. This leads to some level of subjectivity in grading across all faculty. Additionally, because cases are done in teams it is difficult to decipher the contribution of each member; hence case grades will be excluded from analysis in this study.

Take-at-Home Midterm (Exam 1)

To ensure consistency in coverage of course material, and to minimize "teaching to the test", all exams are team-written by the faculty who teach a section of the course in that term, either in-person or online. Students in all sections take the same midterm exam which is a take-at-home, open-book, and open-notes assessment that is not proctored. Students may use instructional videos and other course resources. The exam is objective in format and modeled after the multiple-choice homework. It includes a few concept questions and several problems, including word problems and some that resemble the cases with large scale data sets that require the use of Excel. Four or five answer options are provided for each problem and students must choose the best (closest) answer. Detailed rounding instructions are provided for each problem. This exam is not timed. Students have 3 days to complete the exam from when they gain access until it is due.

Team-writing of the exam is coordinated by the Course Coordinator who assigns course topics and "nearly" equal number of questions to each faculty. The coordinator assigns due dates for writing and sharing questions and for evaluating questions written by others. Once the exam is written, every faculty must solve the entire exam and provide comments and suggestions for improving it, such as: difficulty/ease of questions, fairness of questions, ambiguity, need for clarification in instructions, mistakes in the answer options provided, and the like. The Course Coordinator consolidates input, finalizes the exam, and shares it with faculty to upload to their own LMS course shell prior to the student access date. The due date for students to submit their answers is three days from when they gain access to the midterm exam. Students complete the exam from within the LMS quiz function which has auto-grading capability like the homework.

Proctored Final (Exam 2)

The team writing process for the final (exam 2) is identical to the midterm, but the final is cumulative in content with 30% of points allotted to content from the first half of the course, and 70% over new content since the midterm. The final is proctored, and all students may use their book, notes, and a calculator. Use of Excel is not allowed during the proctored final exam.

In-person students take the final exam in the regularly scheduled evening class period and the instructor proctors the exam in a 3-hour window. However, the logistics of the final exam proctoring for online sections is somewhat different and is managed by the testing center. Early each term the student identifies a proctoring center in the city of their residence and provides details about it to the testing center who vets the authenticity of the proctoring center. Later in the term when team writing of the final exam is over, the Course Coordinator sends the exam to

the testing center who distributes it to proctoring locations. Those centers print and administer the test to online students using a picture ID for identity verification. The proctors fax the summary sheets of answers to the testing center, and later mail the exams to the testing center, who distributes the summaries and the exams to each faculty.

Since the goal of this study is to compare two modes of instruction, assignments that have any level of subjectivity in grading are excluded from this study. Those are:

- Discussion activity: Only graded for online sections and grading could be subjective.
- Case studies: Done in teams; individual contribution not discernible; graded subjectively.

Instruction

The course content is the same for both modes of delivery. Course Coordinator designed and developed course modules for asynchronous online delivery. Learning material for each module include textbook and required readings, several previously-recorded instructional videos for each module accessible through the LMS, critical thinking activities that would be discussed by students in the course discussion area, solutions to end-of-chapter problems for practice problem-solving, asynchronous Q/A with instructor and peers in Discussion Board, other related resources such as tutorials on features and functionalities of Excel, and valuable recordings, websites, or publications related to the topic for each module.

Asynchronous discussion is a key feature of this course. In each module, students are expected to read the assigned pages, watch the instructional videos, practice problem solving, and post questions to the discussion area to fully learn the material before attempting homework, cases, or exams. Questions in the Discussion Board are answered quickly by the instructor or by students who know the answer. Answers are provided in various forms such as typed text, picture of a manual process showing solution steps, short video clips created with the intent to answer a specific question; these videos could show keystrokes on a calculator emulator, or Excel solution to a problem, or screen capture of writing with a stylus on a tablet. Students also post to the discussion board their thoughts and perspectives, such as how the material is or could be used in their work, an epiphany in their learning that might help others, or examples of how the subject is used in everyday life.

In-person classes are taught using traditional methods, mainly with instructor lectures. Since class is offered once per week in the evenings, instructors are encouraged to use active learning strategies such as “think, pair, share”, and small group discussions and activities during class. Those enrolled in in-person sections have access to an LMS course that is copied from the Master course. So, they can access all resources and recordings provided to the online sections.

Other than discussion activity which is graded in online sections and not graded in the in-person sections, all other assignments and assessments are identical for both delivery modes. Comments made in the course evaluations of in-person sections suggest that some students may watch the instructional videos prepared for online students. However, we do not have the ability to track that information to know who and how often in-person students use resources provided for online students. Hence, our assumption is that in-person students rely on class attendance to learn and engage with the material.

Data collection

Data was tracked from 55 online and in-person sections during four years of instruction, including summer classes. Sections were taught by different instructors; however, the exams were team-developed to maintain consistency across all sections. This helps to avoid teaching to the test, reduces variance in grading by maintaining an objective (multiple-choice) format, and uses similar testing criteria and parameters.

We pooled the results into two groups, in-person and online learning modes and measured the average performance of each group to compare the effectiveness of the two modes of instruction. Exhibit 1 shows the number of sections for each modality in various years and terms. In total, this study included 45 online sections and 10 in-person sections of the course which represent population data, *not sample data*.

Exhibit 1: Number of online and in-person sections of the course

	Fall		***Winter***		***Spring***		***Summer***	
	Online	**In-Person**	**Online**	**In-Person**	**Online**	**In-Person**	**Online**	**In-Person**
2008	4	1	1					
2009	3	1	2		4	1	2	
2010	3	1	5	1	4	2	3	1
2011	4		3		5	2	2	

Data Cleaning and Adjustments

After compiling the grades for all 55 sections, we dropped records with missing data, mostly due to students withdrawing from the course. Those who withdrew were excluded from analysis because one of the goals of this study is to compare performance on the final exam as well as overall course performance (i.e., course GPA). So, we looked at those who finished the course.

After trimming the data, we had a total of 724 student records: 536 online and 188 in-person. The maximum number of sections offered in a semester during the 4-year period were five online and two in-person. The variables of interest were averages of homework scores, midterm exams, and final exams. Homework assignments in this course weighed 20%, midterm exam 25%, and final exam 30%. The balance of 25% was for discussion and cases that were excluded from this study. Therefore, we adjusted the grade scale to 100% for the three assignment types included in this study (i.e., homework, midterm exam, final exam). Hence, after adjustment, when computing course average for the purpose of this study, the weights are homework 26.7%, midterm exam 33.3%, and final exam 40%, for a total of 100%.

Analysis and Findings

In this section we present the various tests performed to look for differences between performance of online and in-person sections.

Homework assignment scores

Both online and in-person students submit 10 homework assignments. Each is multiple-choice and graded out of 30 points. These assignments are identical for all sections. We averaged homework scores for each student. The first hypothesis compares the mean homework grades between the two groups:

H_0: Mean online class homework score = Mean in-person homework score
H_1: Mean online class homework score ≠ Mean in-person class homework score

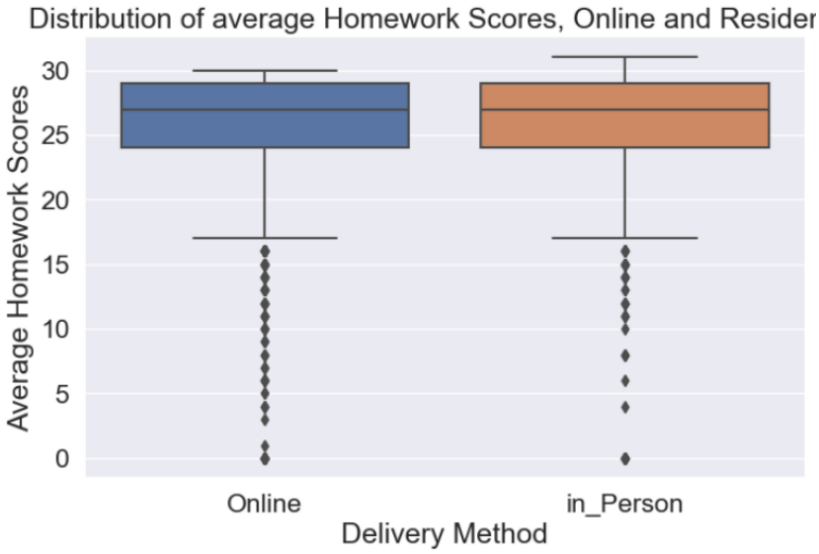
With the population homework data for both online and in-person classes in hand and known variances (18.998 for online and 22.142 for in-person), test of homoscedasticity does not find statistically significant difference between the variances of these groups (Levene's test p-value = 0.069). The z-test of two means is used to determine the statistical significance of differences among the means of homework scores between online and in-person classes. See Exhibit 2 for results. With a p-value of 0.11 for the two-tailed z-test we fail to reject the null hypothesis of this test, hence concluding there is no significant difference among the mean of homework assignment scores between the online and residential sections.

Exhibit 2: z-test of means of homework scores for online and in-person sections.

Z-test of 2 means (Known variances)	Online	In-person	p-value
Homework Average (Based on 30 points)	25.72	25.9	0.11
n	536	188	

Exhibit 3 is the distribution of average homework scores for online and in-person classes and shows a similar distribution between the two groups. Each graph shows the minimum, first quartile, median, third quartile, and the maximum values. The graphical summaries in Exhibit 3 support the findings of the inferential test and no differences between the two groups.

Exhibit 3: Boxplots of mean homework scores for online and in-person sections



Midterm exam scores
The next hypothesis relates to the mean midterm grades of the two groups.

H_0: Mean online class midterm score = Mean in-person class midterm score
H_1: Mean online class midterm score ≠ Mean in-person class midterm score

See Exhibit 4 for results. Since we have population data and variances are known, given the homoscedasticity of variances (Levene's test p-value = 0.42) a z-test of two means is used to determine the statistical significance of the differences between online and in-person sections.

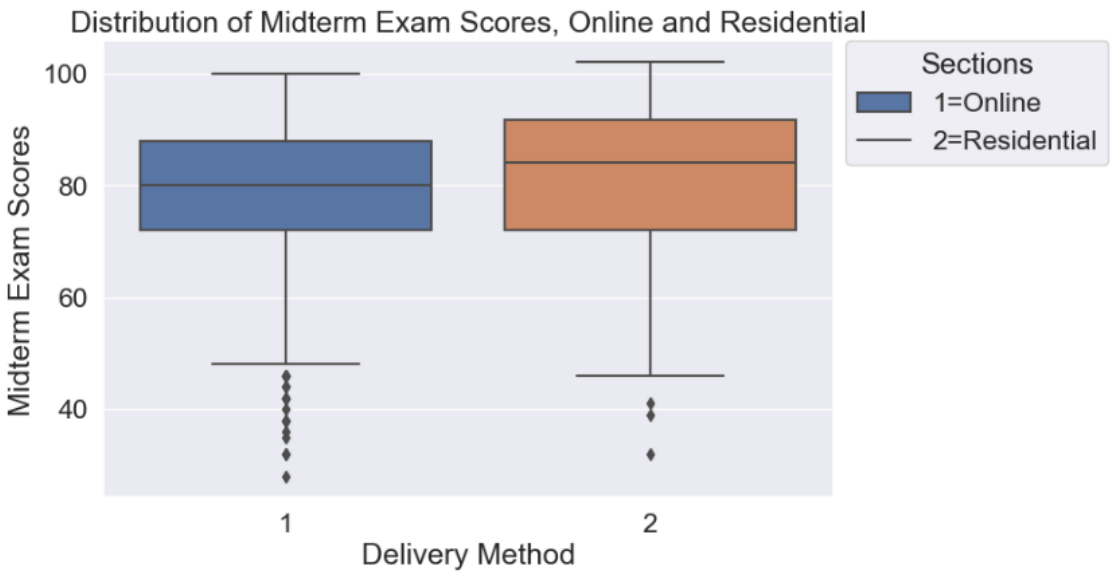
Exhibit 4: z-test of means of midterm exam for online and in-person sections.

Z-test of 2 means (Known variances)	Online	In-person	p-value
Midterm exam average (based on 100 points)	78.6	80.2	0.16
n	536	188	

A p-value of 0.16 is not indicative of a statistically significant difference between the means of the midterm exam scores for the two groups. We fail to reject the null hypothesis and conclude that online and in-person midterm exam scores are not different.

Exhibit 5 shows a similar distribution of midterm exams for online and in-person classes. The graphical summaries support the findings of the inferential test.

Exhibit 5: Boxplots of midterm exam scores for online and in-person sections



Final exam scores
The next hypothesis compares the mean final exam scores between online and in-person classes.

H_0: Mean online class final exam score = Mean in-person class final exam score
H_1: Mean online class final exam score ≠ Mean in-person class final exam score

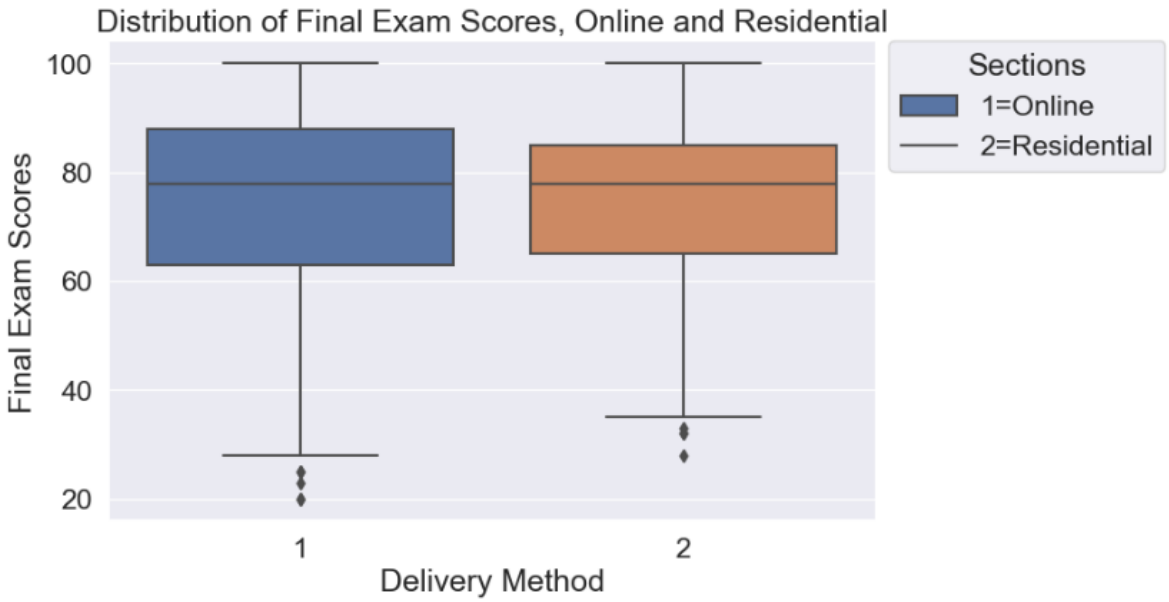
Exhibit 6 shows the results of this test. The p-value of 0.94 from a z-test of two means shows no statistically significant difference between the mean of exams for online and in-person classes. Hence, we fail to reject the null hypothesis in this case also.

Exhibit 6: Z-test of means of final exam scores for online and in-person sections.

Z-test of 2 means (Known variances)	Online	in-person	p-value
Final exam average (Based on 100 points)	73.7	73.8	0.94
n	536	188	

Exhibit 7 is the distribution of final exam scores for online and in-person groups. Again, the graphical summaries support the findings from the inferential test.

Exhibit 7: Boxplots of final exam scores for online and in-person classes



Overall course average scores

We compared the course average score of online and in-person classes to determine whether statistically significant differences exist between the overall performance of students enrolled in the two instructional modes. Conducting a test of means, our hypothesis is stated similarly to those for midterm and final exam.

H_0: Mean course average score of online class = Mean course average score of in-person class
H_1: Mean course average score of online class ≠ Mean course average score of in-person class

Please see Exhibit 8 for the results. Overall class average variances of online and in-person classes show homoscedasticity (Levene's test p-value=0.45). The p-value of 0.4 from a z-test of two means shows no statistically significant difference between the means of overall averages

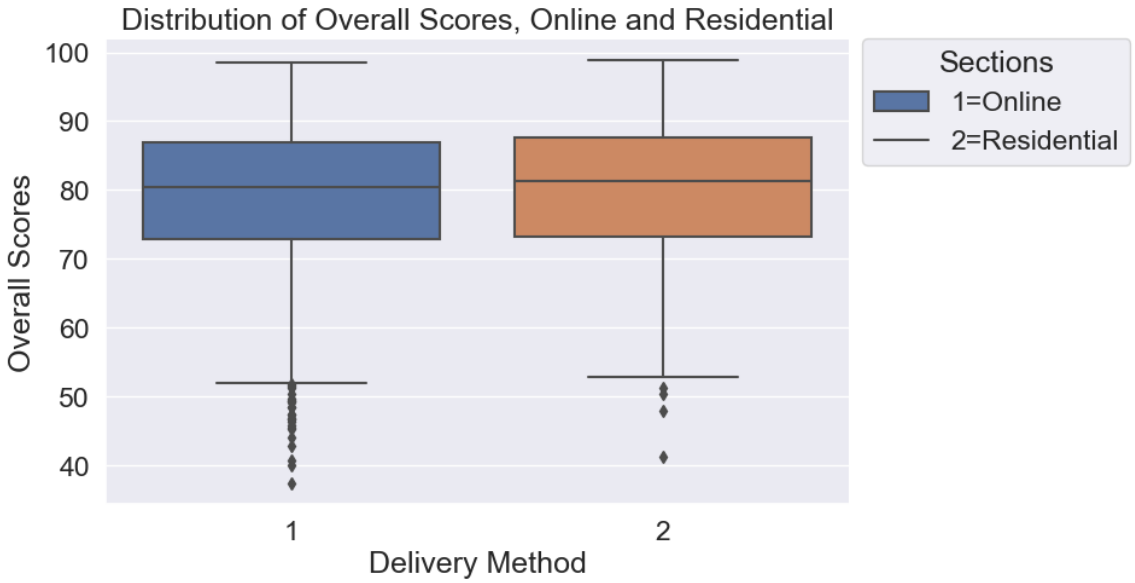
between online and in-person classes. Again, we fail to reject the null hypothesis and conclude that the overall course average of online and in-person sections is approximately the same.

Exhibit 8: Z-test of means of course average for online and in-person sections

Z-test of 2 means (Known variances)	Online	In-person	p-value
Course Average (Based on 100 points)	78.6	79.3	0.4
n	536	188	

Exhibit 9 illustrates the distribution of overall course averages for online and in-person classes. The graphical representation supports the findings of the inferential test.

Exhibit 9: Boxplot of overall course averages for online and in-person classes



Based on the analysis of data in this study as measured by homework and exam scores, and overall course average, we have concluded that there are no statistically significant differences between performance of online and in-person students.

Concerns of Academic Honesty

Since the onset of the COVID pandemic much attention has been given to academic cheating. However, academic dishonesty has been a concern for a lot longer and faculty have been warned of rampant cheating practices and strategies used by students at all levels [9]. Cheating as a subject of academic study has gained traction in the last few decades. Articles in The Chronicle of Higher Education and the like have warned of cheating practices and strategies used by students at all levels [10] [11] [12]. Many authors have investigated cheating as well as contracted cheating in both in-person and online environments [13] [14]. While Daty [15] found that online students are not more likely than in-person students to engage in academic dishonesty, a fair question to ask in the present study is whether there is any difference in the

grades of students on the take-home midterm exam versus the proctored final exam. Let us recall that in this course, midterm exam is not proctored, but all students take the final exam in a proctored setting, and in the same room as the proctor.

Comparison of midterm exam scores to final exam scores

We conducted paired t-tests and looked at each individual student's midterm vs. final exam scores. Exam scores for all online sections were examined together to compare the average midterm exam score versus the final exam score for online sections. This would indicate the magnitude of difference between the two exams and whether there is a considerable difference between the take-home and proctored exam. The same statistical test was also repeated for in-person classes. Exhibit 10 shows the results of this analysis, including the aggregate results for all 724 students in comparing midterm versus final exam scores.

The p-value of t-tests are 7.87E-17 and 2.11E-08 for online and in-person sections, respectively, indicating statistically significant differences which are 4.9 points for online and 6.4 points for in-person classes. Aggregate scores for all students (online and in-person, combined) show a difference of 5.3 points between the midterm and final exam scores.

Exhibit 10: Test of means for midterm and final exam

	Online Sections	In-person Sections	Aggregate
n	536	188	724
p-value	7.87E-17	2.11E-08	9.40E-24
Take-home Midterm	78.6	80.2	79
Proctored Final	73.7	73.8	73.7
Difference in score	4.9	6.4	5.3

Although the differences are statistically significant, for several reasons we caution against assuming foul play, and refrain from concluding that academic dishonesty was a factor in explaining the differences. We believe the 5.3-point difference can be explained by much tighter testing parameters and requirements during the final exam, as summarized in Exhibit 11.

Exhibit 11: Different Testing parameters for midterm versus final exam

	Midterm	Final
Timed nature of exam	3 Days	3 Hours
Coverage of content	5 chapters	Cumulative; all 10 chapters
Resources allowed	Book, notes, videos, other resources	Book and notes
Technology allowed	Computer with Excel, and calculator	Only Calculator
Testing Conditions	Take at home, NOT proctored	In-person; In room with proctor

Anxiety can detrimentally impact academic performance as students panic, experience increased pulse, and draw a blank [16], [17]. Creating an environment that reduces worry and anxiety can help reduce test anxiety [18]. The take-at-home nature and duration of the midterm enables the

student to be relaxed and afford additional studying targeted at the content of the midterm exam during the 3-day testing window.
Additionally, the cumulative nature of the final exam requires students to demonstrate knowledge of all course material and to recall content from the first half of the course which may contribute to a lower grade on the final exam.

The use of Excel on the midterm enables the student to check the accuracy of their solutions for several types of problems which are not accessible to them while taking the final exam.

Finally, if cheating were a factor, one would expect midterm exam scores to be higher. We are not naive to claim no cheating occurs. However, the C range (upper 70s and a low 80) midterm scores are relatively low for a take-home exam and do not support the occurrence of prevalent cheating on the midterm. Hence, we believe that it is safe to assume academic dishonesty is not a factor of concern for this class and for this group of students.

Conclusions

Online education has a significant and growing share of higher education nationally and globally. This study compared traditional in-person and online delivery modes of education to understand differences and challenges in student performance. Our findings show that online learning can be as effective as traditional classroom, provided the proper design and media of instruction are utilized. In this course, the online student is fully supported and connected to their classmates and to the instructor. The use of pre-recorded videos provides similar learning opportunities that in-person students experience. Online students have ample opportunities to ask questions on the discussion board to seek clarification on topics they need help with. Online instructors respond to questions with text, or upload pictures of a manual solution process, or even create short video clips to answer the specific questions from the student or to demonstrate use of software. Students are encouraged to respond in the discussion area when they know the answer to a question posted by their classmates. Student-to-student interaction is high through cases assigned to teams and through graded discussion activity. Student motivation is an important factor in successful online classes. The fact that this course is graduate-level, and the audience is non-traditional students might make it ideal for effective online instruction with little to no disparities in performance between students enrolled in this course and those in an in-person environment.

Limitations

Our dataset excludes information on students who withdrew from the course. In other words, the students who persisted in the course were included in this study. We did not track the drop rates and could not compare it for each delivery mode. This could be important and relevant to exploring differences in effectiveness of the two instruction modes if withdrawal rates for online sections are higher than those for the in-person sections.

Another limitation is the unequal parameters and conditions for midterm and final exams. To determine whether performance and grades are statistically different between the take-home and the proctored exams, we must have a controlled environment with similar testing conditions. In other words, factors presented in Exhibit 11 must be levelled.

Future Studies

The students in this study were non-traditional graduate learners who are employed full-time and may have different motivations for being in school than a typical undergraduate student who is generally between the ages of 18 – 22 and a full-time student. Replicating this study for an undergraduate statistics course offered both online and in-person might generate interesting and different results.

When the effectiveness of online instruction mode is compared to in-person, the withdrawal rate becomes a relevant factor. In the future, we recommend tracking the withdrawal rates for the two instruction modes. If drop rates are not comparable, this could indicate potential problems that students may face in one instruction mode relative to the other, which could be cause for investigation.

Course design that would reduce disparity in testing parameters between the midterm and the final exam is recommended. This would enable authors to design and conduct an experiment to capture only the effect of proctored vs. un-proctored testing.

We have data on homework related to four global topics in the course (descriptive statistics, probability and inferential statistics, simple and multiple regression analysis, and applications of statistics, such as in forecasting). We could use ANOVA to explore differences in homework grades among topics to determine which of the topics, if any, presents itself as a challenge to students' learning, which could inform revision of instructional materials, and changes to pedagogical design and delivery of each topic.

A variable in our dataset is section numbers for online sections (i.e., section 1, 2, 3, etc.). During enrollment period, as an online section fills, the administrators open a new online section and the Course Coordinator assigns a faculty to it, generally an adjunct professor from the faculty pool for this course. Anecdotal evidence suggests that earlier sections outperform later sections; conventional wisdom explanation is student motivation. The untested hypothesis is that those who are motivated, eager to learn, and are better students, register early and enroll in earlier sections. It would be interesting to test that hypothesis to determine if there are indeed differences in the performance of earlier versus later online sections.

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