


RESEARCH ARTICLE	 Statistical Modeling and Analysis of Online Examinations: Assessing the Prevalence of Cheating
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Abstract In this paper, the authors build a model that predicts the grade point from a collection of independent variables including student characteristics and exam marks achieved in four marketing management courses using data from four courses. The data from four courses in marketing management, for an off-line class in a master's in business management program taught in 2019 and the same set of four courses in marketing management taught to an on-line class in 2020 was taken. Although the number of students enrolled was almost equal, and the courses, despite being offered a year apart, were nearly comparable in structure and content, the teaching and assessment for 2019 was conducted offline, whereas it was conducted online in 2020. In the set of four courses offered in 2019 using the offline mode, the exam was proctored and offline but for the same courses offered in 2020, the final exam was also proctored but online. The authors predicted that if exams were taken without any misconduct, the prediction model would have the same explanatory power for all exams, and that if there was malpractice, the explanatory power would be lower. Their findings show that the two datasets are similar; there are variations in the independent variables that statistically and significantly predicted the Grade Point Average (GPA). The R-squared statistic suggests that the model for prediction is strong. Hence there is reason to believe that malpractice was taking place when the examinations were online, in spite of it being proctored. The goal of this paper is to provide teachers with practical ideas for administering proctored tests in their online courses.	
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Introduction

It is a general belief among academicians that the misconduct and malpractice in examinations is growing exponentially [1]. With the growth in information technology and its gadgets, students are becoming distorted geniuses, and are finding innovative ways to cheat in the examinations [2]. Literature indicates that academic dishonesty is a menace to handle and malpractice during online assessments, tracking them and dealing with the same is not easy [3]. Existing literature also indicates that academic dishonesty is more widespread when the courses are delivered and evaluation is taken using the online mode [4].

With the covid19 pandemic many universities have been forced to conduct sessions and examinations online. The main aspect of online examinations and online class is the ambiguity of mapping and monitoring the student's environment with a 360-degree view [5]. It is impossible to know if there are others standing behind the screen and are prompting or if it is a group work that is adopted while attempting the exam, or if there are social media channels and groups where the answers are being discussed [6]. It's also impossible to tell if an assignment or an online exam was completed by an individual or a group of people working together. The authors of this study provide the results of an experiment in which identical tests were given off-line in a proctored environment and online in a proctored context [7]. The aspects which were constant were the instructor who taught the courses, the textbook and the slide deck used for the courses and the approximate level of difficulty. The goal of this article is to provide teachers with practical ideas for administering proctored tests in their online courses [8].

Review of Literature

There is existing literature that gives information about the efficacy of online teaching and online evaluation. Literature indicates divergent views about online assessment. One view point from the literature indicates that online proctored examination is better than online non-proctored examination due the ease of cheating that is possible in a non-proctored online examination [9]. Also when students are located at different geographical locations, proctored examinations can be trusted when they are conducted at proctored testing locations [10]. Another view that is given by the literature is that when the questions are randomized, and if the database from which the questions are drawn is large, if the complexity of the questions is high which can enable the exam to be an open book examination, then the chance of cheating is low for both proctored and non-proctored online examinations [11]. There is extensive literature on cheating in examinations, the determinants and behavioural aspects related to cheating in examinations [12]. Limited literature is available for comparing the chance to cheat and the cheating behaviour between online and offline examinations

Very limited literature is available on cheating in online classes and online examination [13]. According to certain research, the likelihood of cheating in exams is higher in the online mode than in the offline one. A few others argue that there is equal probability of cheating in both online and offline examination [14]

The goal of this study was to add to the current literature on cheating in marketing management examinations and provide beneficial tactics to instructors as they give proctored assessments in their online courses, due to the paucity of information on the subject [15].

Research Methodology

For this study, the authors gathered data from four marketing management courses taught in an off-line master's in business administration programme in 2019, as well as the identical set of four marketing management courses offered in an on-line master's in business administration programme in 2020 [16]. The number of student enrolment was 200 for the courses offered in 2019 and in 2020. The courses offered were identical in structure and content but the teaching and evaluation for 2019 was offline and in 2020 it was online [17]. In set of four courses offered in 2019 using the offline mode, The exam was likewise proctored and offline, however the final exam was also proctored and online for the same courses offered in 2020 [18]. The students were in the age group of 21 years to 25 years.

Both male and female students were present in all the courses which were offered in 2019 and 2020. The representation of females was 40%. The four examinations were conducted in marketing for 100 marks and the duration of each exam was for 120 minutes. The grade point average (GPA) for every student was calculated based on the norms set by the institution [19]. When the examinations were conducted offline in 2019 and online on 2020, the exam started at exactly the same time for all the test takers. In the offline mode, blank sheets of papers, and calculators were allowed and the norm was same for the online mode as well. Discussion with peers or copying from text or other reference material exam was not permitted in both the offline and online mode [20]. Use of mobile phone and other electronic communication, was also not allowed. In both offline and online mode, the proctors gave information about academic dishonesty and its impact on the student.

Data Analysis

The table 1.1 give the descriptive statistics of the students who took the exam in 2019 and 2020. The descriptive statistics indicate that there is less standard deviation in the exam scores for the online mode. The standard deviation for age and work experience is almost similar. In the online exam option, the average GPA is also higher. The significance (two-tailed) of the paired t test plainly shows that there is a significant difference in exam scores. (Exam1, Exam2, Exam3, Exam4) and there is significant difference in the GPA between 2019 and 2020.

There is no significant difference in age and work experience of students between 2019 and 2020.

Table 1.1 Descriptive Statistics

Variable	2019			2020			Paired t Test	Sig (Two Tailed)
	Mean	Standard Deviation	Number of Observations	Mean	Standard Deviation	Number of Observations		
Age	22.2	2.1	200	22.4	2.2	200	-1.31	0.16
Exam 1	75.84	8.11	200	90.81	2.31	200	-2.31	0.00
Exam 2	78.67	7.32	200	89.83	2.54	200	-1.98	0.02
Exam 3	77.66	7.65	200	89.91	2.31	200	-1.43	0.00
Exam 4	80.59	8.23	200	91.40	1.98	200	-1.54	0.01
Work Experience in Months	21.71	2.3	200	21.76	2.1	200	-2.11	0.11
GPA Out of 10	8.22	0.45	200	9.36	0.34	200	-0.92	0.00

GPA was modelled using the variables shown in table 1.2

Table 1.2 Variable Definition

Variable	Definition
Age	Age of the Student

Work Experience	Number of months of work experience prior to joining the management programme
Exam 1	Score in Exam 1
Exam 2	Score in Exam 2
Exam 3	Score in Exam 3
Exam 4	Score in Exam 4
Gender	Student's Gender (Male or Female)
GPA	Grade Point Average

For both offline and online tests, a regression model was used to develop a model for predicting examination score. The model for offline examination in 2019 was computed after regression modeling and based on the B values given in the table 1.3 the model is Predicted GPA = 2.246 + 1.145(Age) + 0.007(work Exp) + 0.031(Exam1) + 0.011(Exam2) + 0.014(Exam 3) + 0.008(Exam4) + 0.61(Gender).

When all other independent variables are maintained constant, unstandardized coefficients show how much the dependent variable fluctuates with an independent variable. The factors (age, job experience, gender, and Exam3) have all contributed significantly to the prediction (Sig. p.05) in all four tests.

The R square value of 68.6 percent, which indicates the models best fit and the amount of variation in the dependent variable that can be explained by the independent variables, is clearly seen in Table 1.4.

Table 1.3 Regression Model- Offline Exam

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Standard Error	Beta		
Constant	2.246	0.804		1.306	0.760
Age	1.145	0.033	0.251	4.454	0.000
Work Experience	0.007	0.003	0.126	2.391	0.001
Exam 1	0.031	0.005	0.344	6.025	0.073
Exam 2	0.011	0.005	0.125	2.308	0.071
Exam 3	0.014	0.003	0.277	4.979	0.000
Exam 4	0.008	0.003	0.129	2.421	0.080
Gender	0.061	0.068	0.047	0.885	0.001

Table 1.4 Model Summary-Offline Exam

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	0.697	0.686	0.618	0.44153

The model for the online exam in 2020 was created using regression modeling, and it is based on the B values in Table 1.5. $2.416 + 0.845 (\text{age}) + 0.026 (\text{work experience}) + 1.31 (\text{Exam1}) + 1.11 (\text{Exam2}) + 0.14 (\text{Exam 3}) + 0.28 (\text{Exam4}) + 1.061 (\text{Gender})$. When all other independent variables are maintained constant, unstandardized coefficients show how much the dependent variable fluctuates with an independent variable. It can be seen that all the four examination variables (Exam1, Exam2, Exam3, Exam4) have contributed significantly to the prediction (Sig. $p < .05$) and other variable like age, gender and work experience have no significant contribution. The R square value of 61.5 percent is readily seen in the model summary in Table 1.6, which illustrates the models best fit and the amount of variation in the dependent variable that can be explained by the independent variables.

Table 1.5 Regression Model-Online Exam

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Standard Error	Beta		
Constant	2.416	0.704		2.104	0.760
Age	0.845	0.013	0.531	3.234	0.081
Work Experience	0.026	0.023	0.216	1.133	0.071
Exam 1	1.31	0.015	0.484	4.178	0.001
Exam 2	1.11	0.125	0.275	1.038	0.001
Exam 3	0.14	0.061	0.715	1.382	0.000
Exam 4	0.28	0.021	0.239	2.231	0.000
Gender	1.061	0.116	0.467	0.885	0.060

Table 1.6 Model Summary – Online Exam

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	0.697	0.651	0.631	0.51513

The authors predicted that if exams were taken without any misconduct, the prediction model would have the same explanatory power for all exams, and that if there was malpractice, the explanatory power would be different. The findings show that the independent variables' explanatory power is similar across the two datasets, implying that the possibility of malpractice occurring while the exams were online, despite being proctored, cannot be ruled out.

Conclusion and Recommendation

As there is empirical evidence which indicates that malpractice cannot be ruled out when the examinations are conducted online, the authors suggest the following strategies, which can be followed by the faculty members as they administer proctored assessments in their online courses.

Strategy 1

Conducting online viva voce can help to understand if the students have grasped what is taught to them. This can be time consuming but this can significantly reduce the chance of mal practice, if the exam is conducted in the online mode.

Strategy 2

Open book examinations with plagiarism checks can help in reducing the chance of malpractice. When the questions are given which do not have one specific correct answer and when students apply what they learn and write type their answers which can be checked for plagiarism, the chance of malpractice can be reduced.

Strategy 3

Gamification of examinations can make examinations interesting and competing. There are several platforms which can be used to gamify the examination which can make it interesting and engaging for students. If examinations are gamified then the students will be playing the game with each other while they actually are being evaluated. The chance of malpractice can be highly reduced if this strategy is adopted.

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Conflict of Interest Statement

The authors declare no conflicts of interest related to this research. The views expressed are solely those of the authors and do not necessarily reflect the official policies or positions of the Symbiosis Institute of Business Management or Symbiosis International (Deemed University).

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