Evaluating Student Performance in Statistics Using SAS/ETS Procedures

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Abstract

This paper intends to study the semester trend of students' performance in Statistics beyond the first exam. It addresses the question of whether the final exam scores, which represent the semester performance, tend to decline, remain at the same level, or improve during the semester.

The study also considers the influence of gender in students' performance in terms of the three variables of declining, remaining the same or improving in relation to the first exam.

A cursory view of the data used in this study shows that 70% of students' grades falls below or remains the same as the first exam grade. In other words, the probability that a Statistics student improves his grade beyond the first exam is only 30%.

The use of multiple regression procedure and relative frequency confirms the earlier presumption. The Pearson Correlation Coefficients and t tests of hypotheses suggest a strong relationship between the first grade and the final semester grade in undergraduate Statistics courses. The influence of gender on the grade variables turned out to be insignificant.

Introduction

In recent years institutions of higher learning have taken serious steps to improve students' capability in qualitative analysis and research.

A number of departments in the College of Liberal Arts and Business Administration at LMU have already included a senior research or thesis course in their core requirements. Students in such courses can learn how to apply Business and Economics concepts in real-life situations and acquire a cutting edge in competitive career opportunities.

Successful completion of a senior research course entails a solid foundation of Basic Statistics. This study casts light on the long-run student performance in basic statistics and tries to establish a pattern for diagnostic purposes. Information obtained from the results of this study can serve as bases to determine why one group regresses and one group makes continuous progress, while another carries the same grade levels throughout the course.

Since Statistics is not a favorite course and students often fear quantitative subjects, the instructor must use a type of teaching methodology that would make the course both interesting and motivating. One suggestion is to show the practical application of each statistical concept and assign pertinent case problems as a follow-up procedure in the course.

Statistical Methodology

A multiple linear regression equation used in this study may be expressed as:

$$Y_i = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \mu_i,$$

where Y_i represents the final semester grade as a dependent variable and X_1 and X_2 are gender and first exam grades, respectively, as independent variables and μ is error term or residual.

The intention is to determine the impact of gender and first exam on the final grades. In addition, the information drawn from the SAS solution of the multiple regression models is used to test a series of null hypotheses about the overall

relationship between independent and dependent variables specified here. A summary table of the Pearson Correlation Coefficients is developed to show the strength of the relationships between these variables:

r = 1 denotes perfect relationship and
r = 0 shows no relationship at all.

Data

The data used for the analysis came from a systematic collection of student grades in both introductory and intermediate Statistics for a period of fifteen years. The number of students in the survey totaled 1128. Each student took 5 exams during a semester: four midterms and one final. Final semester grades were obtained by averaging all five exams. The variables selected from the data comprised the first exam score (x_1), gender (x_2), and the final semester grade (y). Y, the dependent variable, was grouped into three categories in relation to the first exam: decline, same, and improved scores.

Arrangement of the data in such a fashion was intended to determine the effect of gender and the impact of the first exam grade on students' semester performance. This study holds such exogenous factors-such as students' semester course loads, the onset of personal problems, engagement in income-earning employment, and the like-constant. The authors contend that the inclusion of such factors does not alter the results of this study.

Findings

As expected, gender had not played a significant role in the direction and trend of the grades toward the final exam scores. In other words, male and female students behaved similarly in establishing their semester grade earning patterns.

Summary tables of analysis of variance below indicates that all t values on the relationships between the first and the final exam grades for the three categories are significant. The correlation coefficients tabulated in the Pearson Correlation Coefficients confirm the strength of the relationships.

The REG Procedure
incdec = d
Dependent Variable: final

Analysis of Variance

Source	DF	SS	MS	F Value
Model	2	48467	24234	355.86
Error	449	30577	68.1	
Total	451	79044		

Root MSE 8.25224 R-Square 0.6132
CV 10.66540

Parameter Estimates

Variable	DF	Parameter Est.	t Value
Intercept	1	-6.92696	2.16
first	1	0.94540	26.68
gender	1	1.03405	1.31

The REG Procedure
Incdec = s
Dependent Variable: final

Analysis of Variance

Source	DF	SS	MS	F Value
Model	2	27034	13517	1635
Error	286	2215.6	8.3	
Total	270	29249		

Root MSE 2.87524 R-Square 0.9243
Coeff. Var. 3.34934

Parameter Estimates

Variable	DF	Parameter Est.	t Value
Intercept	1	7.30036	5.19
first	1	0.90861	57.07
gender	1	0.00454	0.9897

The REG Procedure
incdec = i
Dependent Variable: final

Analysis of Variance

Source	DF	SS	MS	F Value
Model	2	23143	11572	259.94
Error	373	16605	44.52	
Total	375	39748		

Root MSE 6.67206 R-Square 0.5823
Coeff. Var. 8.15729

Parameter Estimates

Variable	DF	Parameter Est.	t Value
Intercept	1	42.238	23.86
first	1	0.54597	22.12
gender	1	2.06369	2.98

The CORR Procedure
Incdec = d
Pearson Correlation Coefficients,
N = 452
Prob > |r| under H0: Rho=0

	first	final	gender
first	1.00000	0.782 <.0001	0.04689 0.3199
final	0.7821 <.0001	1.00000	0.00181 0.9694
gender	-0.04689 0.3199	0.0018 0.9694	1.00000

The CORR Procedure
Incdec = s

Pearson Correlation Coefficients
N = 452
Prob > |r| under H0: Rho=0

	first	final	gender
first	1.00000	0.96138 <.0001	0.06339 0.2984
final	0.9613 <.0001	1.00000	0.06073 0.3193
gender	-0.06339 0.3193	-0.06073	1.00000

The CORR Procedure
Incdec = i

Pearson Correlation Coefficients,
N = 376
Prob > |r| under H0: R

	first	final	gender
first	1.00000	0.7565 <.0001	0.1131 0.0283
final	0.7565	1.0000	0.1847
gender	0.1131 0.0283	0.1847 0.0003	1.0000

A further summary of findings under the t and r-values provides clear evidence that at the .05 significance level all the null hypotheses of no relationship between the three groups of the final and the first exam grades can strongly be rejected. The same results are shown in bar graphs presented on the last page.

Table I t values
(t = 2 at the .05 Significance Level)

Final Grade	Gender	First Exam
y (Declined)	1.31	26.7
y (Same)	0.01	57.1
y (Improved)	2.98	22.1

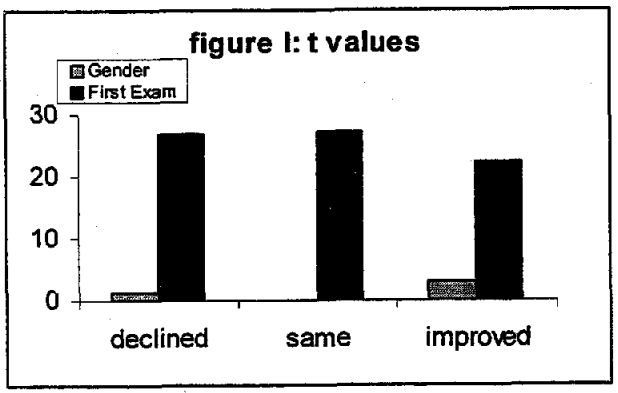
Table II: r Values

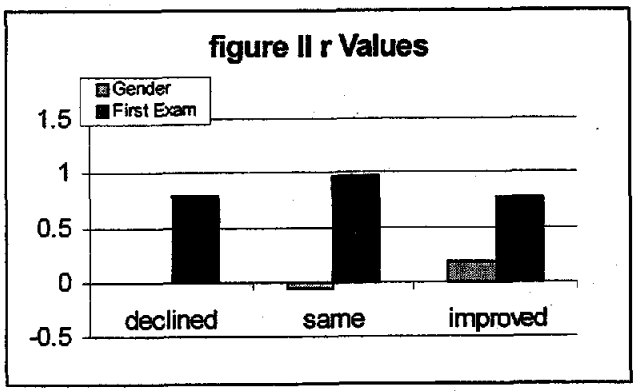
(r = 1 for Perfect Relationship between y and Independent Variables)

Final Grade	Gender	First Exam
y (Declined)	0.002	0.78
y (same)	-0.61	0.96
y (improved)	0.185	0.76

Conclusion

The results of this study suggest that the first exam grade on Statistics cannot in general predict the final semester grade. Looking at the three final exam categories of declined, remained the same, and improved, one notes that the impact of the first exam had played a significant role in placing the students in one of the three categories, depending on the caliber, math background and personal attributes of students themselves.





An analysis of the performance of male and female rendered no significant difference; in other words, gender played no role in the direction of the students' performance. In general, after the first Statistics exam, thirty percent of a total number of 1,128 students steadily declined, forty percent stayed the same, and thirty percent improved. No explanation for consistency of grades was given here. The grades could have been all at failing level or A level. By the same token, improvement could have been from failing to a passing grade, or from a high B to an A grade.

An important information drawn from this study is the negative influence of the first exam on the course of study during the entire semester. To save students from a steady decline, which necessarily is an indication of a decline in learning, a different teaching methodology that enhances student motivation needs to be devised. Strengthening students' backgrounds through tutoring services, and assigning real-life cases, may very well contribute to the enhancement of students' grades that otherwise would be declining.

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