EXPECTED OUTCOME-BASED DELIVERY AND ASSESSMENT OF STATISTICS COURSES FOR GRADUATE STUDENTS IN A NIGERIAN UNIVERSITY

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INTRODUCTION

Statistics, an applied branch of Mathematics, is perhaps the most challenging study area to graduate students in the fields of Agriculture. Two Statistics courses are compulsory for graduate students in the Department of Crop Production and Protection (CPP), Obafemi Awolowo University (OAU), Ile-Ife, Nigeria: CPP 613 *Statistical Methods*, followed by CPP 614 *Design and Analysis of Experiments*, offered during the Harmattan and Rain Semester, respectively. Because most students performed poorly in the course exams, the *expected outcome-based delivery and assessment* approach was used for the course in the last four academic years. The expected outcome is the student's ability to skillfully demonstrate or apply the knowledge gained in both courses by accurate statistical analysis of data from experiments and correct interpretation of the outputs from the analysis. The objective of this study was to evaluate the actual outcomes of CPP 613 and 614 offered for four academic years.

METHODOLOGY

CPP 613 covered frequency distribution, measures of central tendency, dispersion, skewness and kurtosis, probability, the normal distribution and test of hypothesis, Chi square, introduction to analysis of variance (ANOVA), and simple linear correlation and regression. CPP 614 involved separation of means, multiple comparisons, linear contrasts, ANOVA with fixed, random or mixed models, experimental designs, multiple regression, matrices and its application to regression analysis, covariance, and transformations. The courses involved manual and computer software approaches to lectures; weekly assignments quizzes and mid-semester exam for continuous assessment; a 3-hr comprehensive final examination (venue exam) and the students taking home the same question paper and submitting their answers 0800 hrs the following morning (take-home exam). Scores of 80 and 50 students were analyzed for the two courses, respectively.

RESULTS AND DISCUSSION

Students' performance was higher in the take-home compared to the venue exam, with a larger variance in venue relative to the take-home exam in both courses (Table 1).

Table 1. Summary statistics for venue and take-home exams of CPP 613 and CPP 614 taught during four academic years at Obafemi Awolowo University, Nigeria.

Statistic, %	CPP 613 (n = 80)		CPP 614 (n = 50)	
	Venue	Take-home	Venue	Take-home
Minimum	4.00	29.00	5.00	41.00
Maximum	74.00	86.00	6.40	84.00
Mean	31.70	58.30	33.70	67.90
Standard error of mean (SEM)	1.76	1.33	2.07	1.32
Median	32.00	58.50	35.00	68.00
Mode	41.00	53.00	15.00	68.00
Variance	248.70	141.60	209.30	85.30
Coefficient of variation (CV)	49.75	20.41	42.93	13.60

Take-home exam reduced the proportion of students scoring F-grade from 82.5% (66 out of 80 students) to 13.8% (11 of 80 students) in CPP 613 and from 72% (36 of 50 students) to 2% (1 of 50 students) in CPP 614 (Table 2).

Table 2. Number of students scoring certain grades in venue exam and number scoring the grade in take-home exams of CPP 613 and CPP 614 taught during four academic years at Obafemi Awolowo University, Nigeria.

CPP 613 Venue	CPP 613 Take-home					Venue Total
	A	B+	B	C	F	
A	0	1	0	0	0	1
B+	2	0	1	0	0	3
B	2	3	2	0	0	7
C	1	2	0	0	0	3
F	4	20	27	4	11	66
Take-home Total	9	26	30	4	11	80

CPP 614 Venue	CPP 614 Take-home					Venue Total
	A	B+	B	C	F	
A	0	0	0	0	0	0
B+	2	0	0	0	0	2
B	4	1	0	0	0	5
C	4	2	1	0	0	7
F	11	21	1	2	1	36
Take-home Total	21	24	2	2	1	50

Relative to venue exam, distribution of student scores improved positively in take-home exam, with larger number of students scoring high marks (Fig. 1).
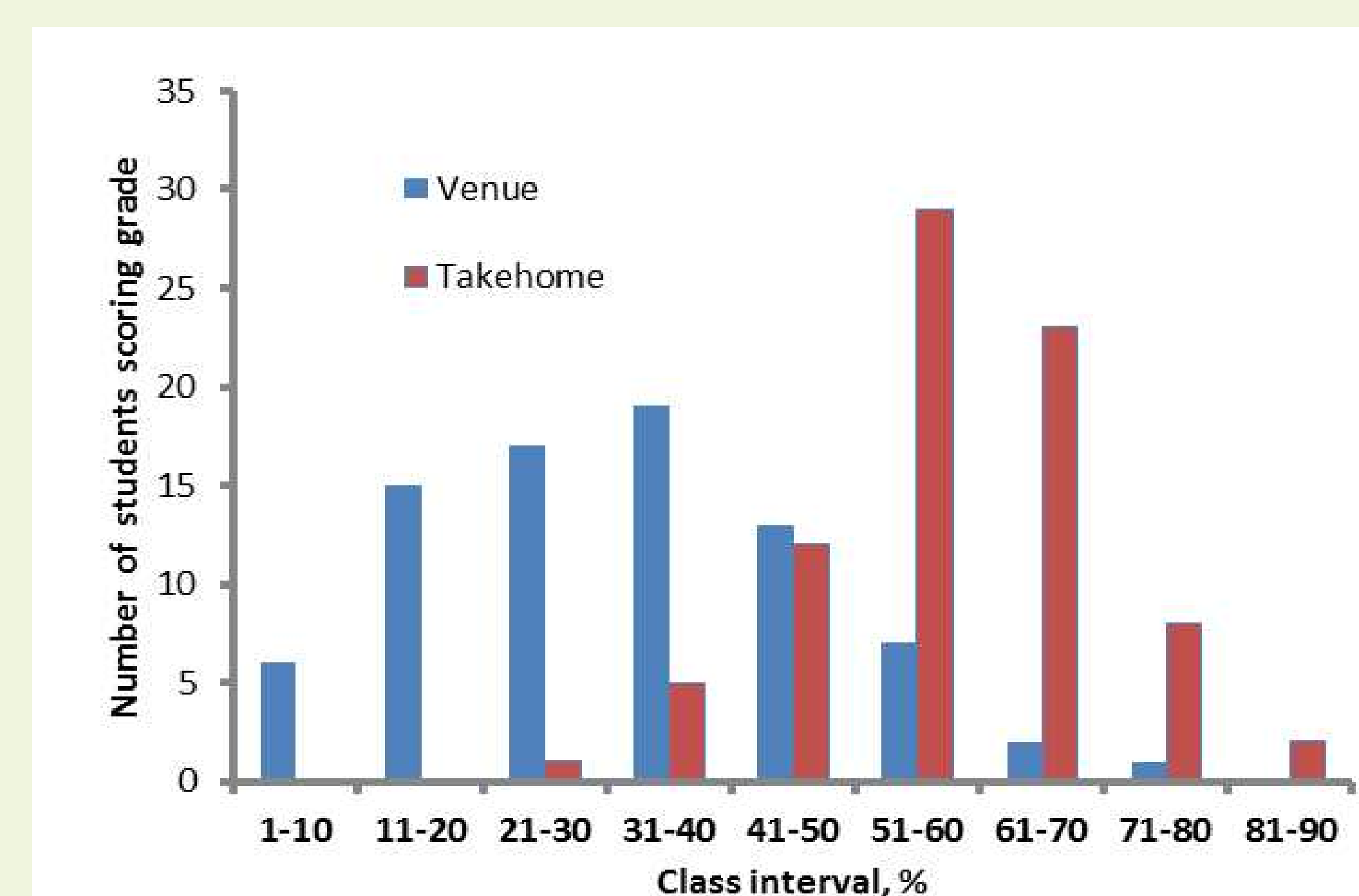

Fig. 1. Frequency distribution of student scores in venue and take-home exams of CPP 613 taught in four academic years at Obafemi Awolowo University, Nigeria.

Performance in take-home exam was greatly (>75%) independent of the venue exam score (Fig. 2), although the higher the score in the venue exam, the lower the gain in the take-home exam score (Fig. 3).

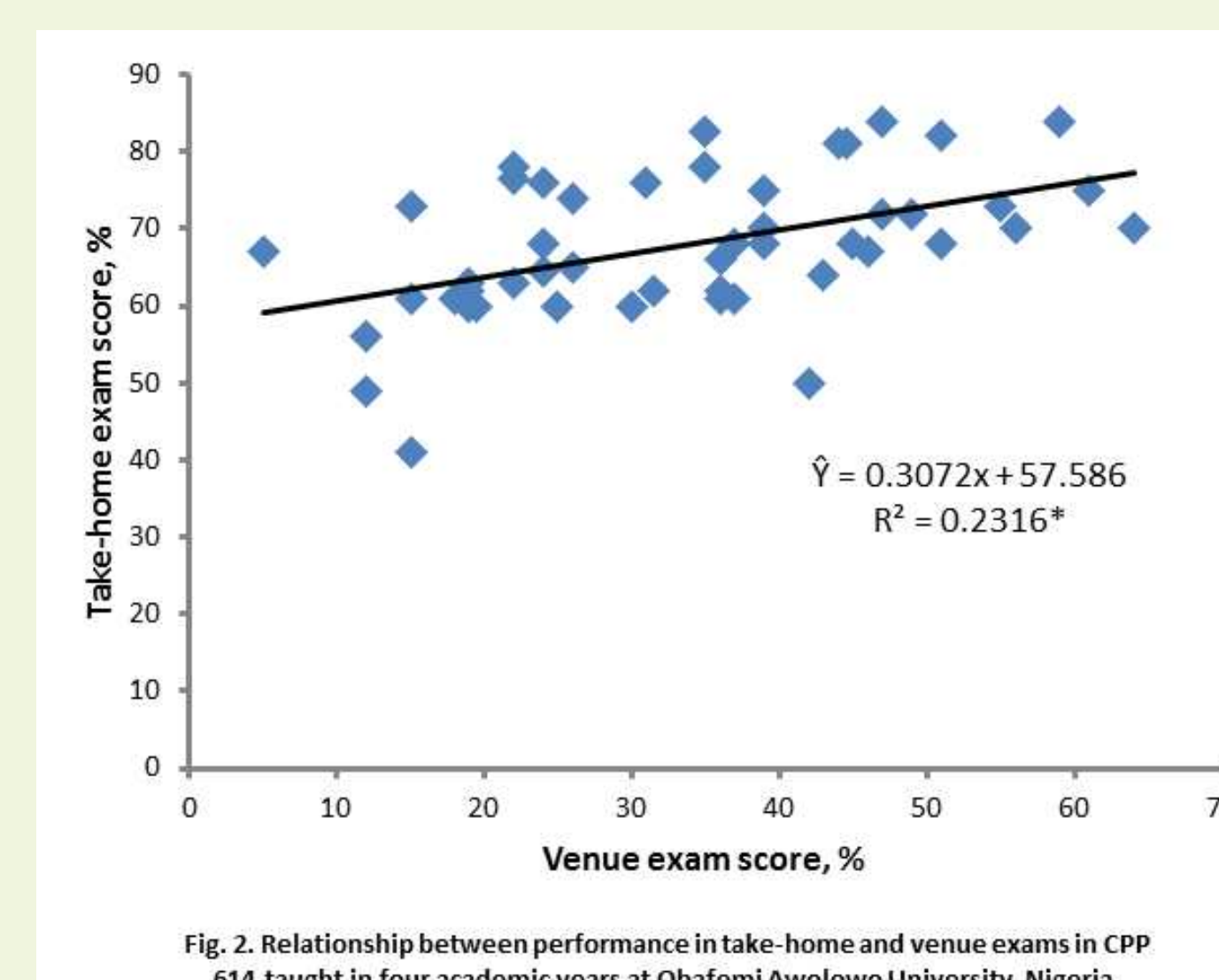$\hat{Y} = 0.3072x + 57.586$
$R^2 = 0.2316*$

Fig. 2. Relationship between performance in take-home and venue exams in CPP 614 taught in four academic years at Obafemi Awolowo University, Nigeria.

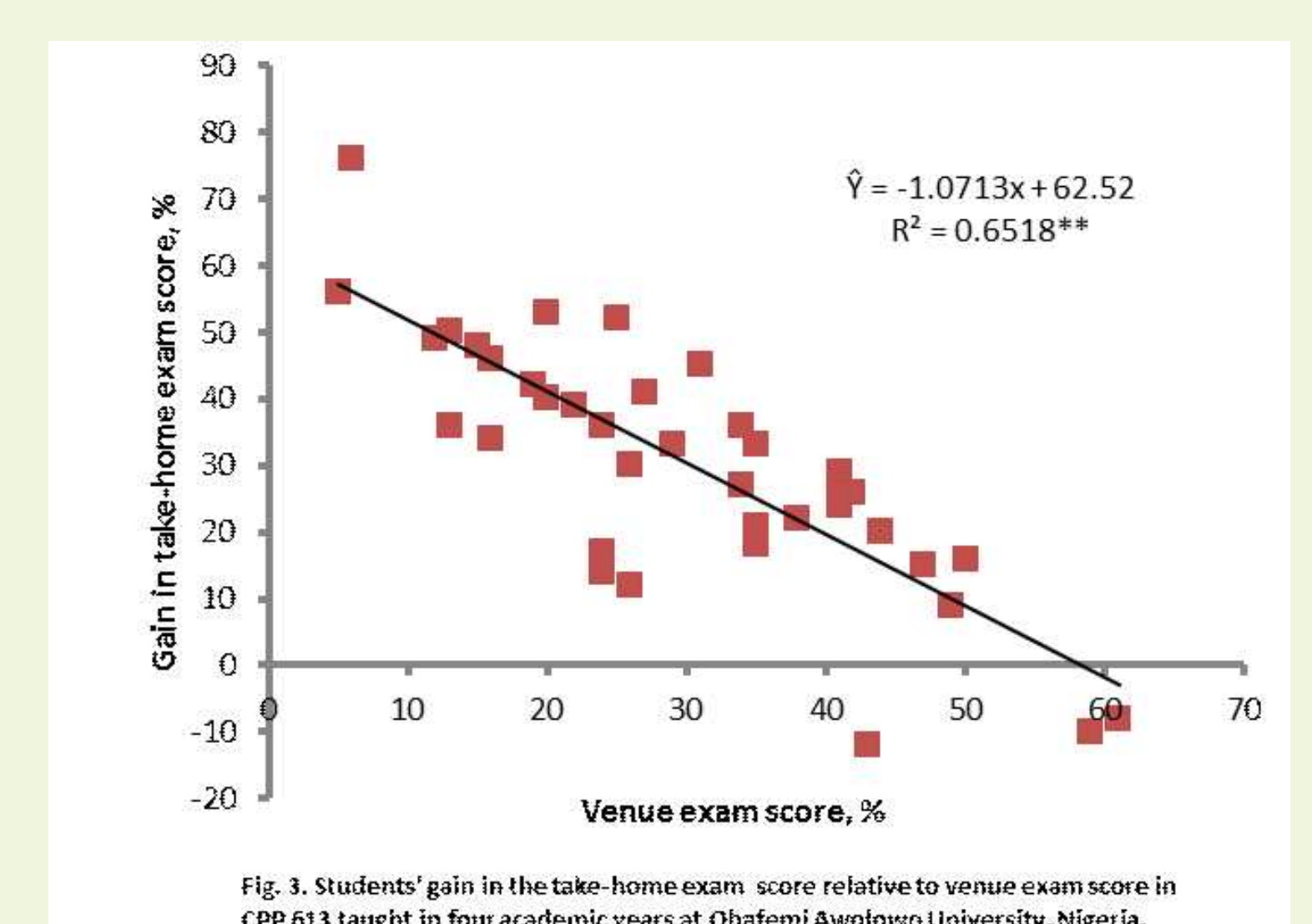$\hat{Y} = -1.0713x + 62.52$
$R^2 = 0.6518**$

Fig. 3. Students' gain in the take-home exam score relative to venue exam score in CPP 613 taught in four academic years at Obafemi Awolowo University, Nigeria.

CONCLUSION

Take-home examination was effective for attaining the expected outcome of statistics courses by low-achieving Agriculture graduate students.