
CARRY-OVER COURSES AND STUDENTS' ACADEMIC PERFORMANCE: A STATISTICAL ANALYSIS OF STUDENT RECORDS AT KANO STATE POLYTECHNIC, NIGERIA

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Abstract

Students' academic performance is an important indicator of educational effectiveness, institutional quality and successful student progression. One academic factor that may be associated with students' overall performance is the accumulation of carry-over courses. This study statistically examined the relationship between carry-over courses and students' academic performance using institutional student-performance records from Kano State Polytechnic, Nigeria. A retrospective quantitative research design was adopted. The study analysed 593 valid student records obtained from programmes across the School of Technology, School of Management Studies, School of Environmental Studies, Gwarzo, and SORTED Rano. Cumulative Grade Point Average (CGPA) was used as the principal measure of academic performance, while Total Carry-Over Courses (TCO) represented the principal explanatory variable. Descriptive statistics, correlation analysis, ordinary least-squares regression with heteroscedasticity-robust standard errors, and programme-level comparative analysis were employed. The results revealed a strong negative relationship between TCO and CGPA ($r = -0.726$, $p < .001$), while the Spearman rank correlation was also strong and negative ($\rho = -0.796$, $p < .001$). The simple regression model explained 52.7% of the observed variation in CGPA, with TCO having a statistically significant negative coefficient ($\beta = -0.0617$, $p < .001$). Programme-level analysis also revealed statistically significant differences in mean CGPA among programmes, $F(13, 579) = 4.16$, $p < .001$. An extended regression model incorporating programme effects and TCO explained approximately 64.6% of the variation in CGPA. The findings indicate that carry-over burden is strongly associated with lower academic performance and that programme context provides additional explanatory information. The study recommends systematic early-warning monitoring, strengthened academic advising, targeted support for students with multiple carry-over courses, and improved institutional use of academic records for evidence-based decision-making.

Keywords: Academic performance; carry-over courses; CGPA; regression analysis; student records; Kano State Polytechnic; Nigeria; statistical modelling.

1. INTRODUCTION

Higher education institutions increasingly depend on reliable academic records to monitor students' progression, identify academic difficulties and support institutional decision-making. Students' academic performance is particularly important because it influences progression, graduation, employability and the overall assessment of educational effectiveness.

In many tertiary institutions, academic performance is commonly assessed using Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA). These measures provide quantitative indicators of students' performance over a semester or across several semesters. Statistical analysis of such indicators can therefore provide useful evidence concerning patterns of academic success and difficulty.

One important academic phenomenon is the accumulation of carry-over courses. A carry-over course generally arises when a student fails a course and is required to retake it at a subsequent opportunity. The consequences may extend beyond the individual failed course because students with several outstanding courses may experience increased academic workload, timetable conflicts and additional pressure. A Nigerian study on counselling among students with carry-over courses similarly identified workload and related academic difficulties as important challenges associated with carry-over status (Otubo et al., 2023).

The relationship between failure in courses and overall academic performance is also relevant from a statistical perspective. Mathematical modelling of the GPA system in Nigerian universities has specifically examined the implications of failed courses, carry-overs and low grade points for students' academic progress (Oduwole et al., 2019).

More recent Nigerian research has demonstrated the usefulness of regression and other statistical modelling techniques for analysing student academic performance. For example, Abdullahi et al. applied regression-based approaches to university student performance and reported substantial explanatory power for models of students' academic outcomes. More recently, regression-based data-mining approaches have also been applied to student-performance prediction in Nigeria, demonstrating the potential usefulness of academic data for identifying students who may require additional support.

Despite these developments, there remains a need for institution-specific statistical evidence. Different institutions have different programme structures, student populations, academic regulations and patterns of academic progression. Consequently, evidence obtained from another institution cannot automatically be assumed to describe students at Kano State Polytechnic.

The present study therefore analyses actual student-performance records from Kano State Polytechnic to determine the statistical relationship between carry-over courses and CGPA. The study also examines whether academic performance differs across programmes and whether programme effects provide additional explanatory information after accounting for carry-over burden.

2. STATEMENT OF THE PROBLEM

Academic underperformance and the accumulation of carry-over courses present challenges for students and tertiary institutions. A student who repeatedly fails courses may accumulate outstanding courses while simultaneously registering for new courses. This may increase academic workload and create difficulties in completing programme requirements within the expected period.

Although Kano State Polytechnic maintains student academic records, the existence of records alone does not provide sufficient evidence for determining the statistical relationship between carry-over burden and overall academic performance. Systematic statistical analysis is required to establish the strength and significance of such relationships.

A further concern is that academic performance may differ across programmes. Differences in curriculum, course structure, practical requirements and other programme characteristics may contribute to variations in students' academic outcomes. Therefore, examining TCO alone may not provide a complete picture.

This study addresses these issues by analysing 593 available student-performance records from Kano State Polytechnic. The study focuses on CGPA as the outcome variable and TCO as the principal explanatory variable while also examining programme-level differences.

3. OBJECTIVES OF THE STUDY

The main objective of the study is to statistically examine the relationship between carry-over courses and students' academic performance at Kano State Polytechnic, Nigeria.

Specifically, the study seeks to:

1. determine the distribution of students' CGPA;
2. determine the distribution of students' total carry-over courses;
3. examine the relationship between TCO and CGPA;
4. determine whether TCO significantly predicts CGPA;
5. examine differences in academic performance among programmes;
6. determine whether programme effects provide additional explanatory power after accounting for TCO; and
7. provide evidence-based recommendations for improving academic monitoring and student support.

4. RESEARCH QUESTIONS

1. What is the distribution of CGPA among the students represented in the dataset?
2. What is the distribution of total carry-over courses?
3. What relationship exists between TCO and CGPA?
4. Does TCO significantly predict students' CGPA?
5. Are there significant differences in CGPA among programmes?
6. Does programme membership provide additional explanatory power after controlling for TCO?

5. RESEARCH HYPOTHESES

H₀₁

There is no significant relationship between total carry-over courses and students' CGPA at Kano State Polytechnic.

H₀₂

Total carry-over courses do not significantly predict students' CGPA.

H₀₃

There is no significant difference in mean CGPA among the programmes represented in the dataset.

H₀₄

Programme membership does not significantly improve the prediction of CGPA after controlling for total carry-over courses.

6. METHODOLOGY

6.1 Research Design

The study adopted a retrospective quantitative research design. Existing academic records were analysed without manipulation of students' academic outcomes.

6.2 Study Setting

The study was conducted using student-performance records from Kano State Polytechnic, Kano State, Nigeria.

The dataset represents programmes associated with several institutional units, including the School of Technology, School of Management Studies, School of Environmental Studies, Gwarzo, and SORTED Rano.

6.3 Data Source

The data were obtained from institutional student-performance records supplied for this study.

The original dataset included records for programmes such as HND Software Development, ND Local Government Studies, Business Administration, HND Electrical Engineering, ND Fashion Design and Clothing Technology, ND Quantity Surveying, ND Architecture/Architectural Technology, ND Statistics and ND Science Laboratory Technology.

The additional dataset supplied subsequently included HND Business Administration, ND Business Administration, HND Cooperative Economics and Management, ND Social

Development and HND Social Development. The source document contains CGPA and TCO alongside credit-unit and weighted-grade information.

6.4 Sample Size

After data cleaning and removal of records without valid numerical CGPA and TCO values, 593 student records were retained for analysis.

The study therefore analysed the available valid institutional records rather than replacing missing numerical observations with estimated values.

6.5 Variables

The principal variables were:

Dependent variable

- CGPA — cumulative grade point average, representing overall academic performance.

Independent variable

- TCO — total carry-over courses.

Grouping variable

- Programme — the academic programme identified in the institutional records.

CCU and TWGP were retained as record variables but were not entered as independent predictors of CGPA. This is methodologically important because CGPA is calculated from students' weighted grade points and credit units. Using these mathematical components as predictors of CGPA would create a tautological relationship rather than an informative predictive model.

6.6 Statistical Analysis

The following statistical techniques were applied:

1. descriptive statistics;
2. frequency and percentage distributions;
3. Pearson product-moment correlation;
4. Spearman rank correlation;
5. ordinary least-squares regression with heteroscedasticity-robust standard errors;
6. one-way analysis of variance (ANOVA) for programme differences; and
7. an extended regression model incorporating programme indicators and TCO.

The principal regression model was:

$$\text{CGPA}_i = \beta_0 + \beta_1 \text{TCO}_i + \varepsilon_i$$

An extended model was also estimated:

$$CGPA_i = \beta_0 + \beta_1 TCO_i + \beta_2 Programme_i + \varepsilon_i$$

The use of robust standard errors was intended to reduce sensitivity to heteroscedasticity in the student-performance data.

7. RESULTS

7.1 Descriptive Statistics

Table 1 presents the descriptive statistics for the principal study variables.

Table 1: Descriptive Statistics of CGPA and TCO

Variable	N	Mean	SD	Minimum	Median	Maximum
CGPA	593	2.243	0.536	0.05	2.34	3.55
TCO	593	4.872	6.314	0	2	31

The mean CGPA was 2.243, while the mean number of carry-over courses was approximately 4.87. The wide range in TCO, from zero to 31, indicates substantial variation in carry-over burden among the students.

7.2 Distribution of CGPA

Table 2: Distribution of Students by CGPA Range

CGPA Range	Frequency	Percentage
Below 1.00	17	2.9
1.00–1.49	38	6.4
1.50–1.99	94	15.9
2.00–2.49	229	38.6
2.50–2.99	190	32.0
3.00–3.49	23	3.9
3.50 and above	2	0.3
Total	593	100.0

The largest proportion of students, **38.6%**, had CGPA values between 2.00 and 2.49. A further 32.0% had CGPAs between 2.50 and 2.99.

Only 25 students, approximately 4.2%, recorded CGPAs of 3.00 or higher.

7.3 Distribution of Carry-Over Courses

Table 3: Distribution of Students by Number of Carry-Over Courses

TCO Category Frequency Percentage

0	169	28.5
1–2	141	23.8
3–5	111	18.7
6–10	68	11.5
More than 10	104	17.5
Total	593	100.0

The results indicate that **28.5%** of the students had no recorded carry-over courses. However, 17.5% had more than 10 carry-over courses, indicating a substantial carry-over burden among a considerable proportion of the records.

7.4 Correlation Between TCO and CGPA

Table 4: Correlation Between Total Carry-Over Courses and CGPA

Analysis	Correlation	p-value
Pearson correlation	-0.726	< .001
Spearman rank correlation	-0.796	< .001

There was a strong and statistically significant negative relationship between TCO and CGPA.

The Pearson coefficient of **-0.726** indicates that higher carry-over burden was associated with lower CGPA.

The Spearman coefficient of **-0.796** produced a similar conclusion and provides additional evidence that the relationship is robust to the non-normal distribution of TCO.

Therefore, **H₀₁ is rejected**.

7.5 Simple Regression Analysis

Table 5: Regression of CGPA on Total Carry-Over Courses

Predictor	B	Robust SE	t	p
Constant	2.5433	0.0159	159.7	< .001
TCO	-0.0617	0.0036	-17.35	< .001

$R^2 = 0.527$
Adjusted $R^2 \approx 0.526$

The regression model was statistically significant.

The coefficient for TCO was negative and statistically significant. The estimated coefficient indicates that each additional carry-over course was associated with an average reduction of approximately 0.062 CGPA points, holding the model structure constant.

The model explained approximately 52.7% of the observed variation in CGPA.

Consequently, H_{02} is rejected.

7.6 Programme-Level Academic Performance

Table 6: CGPA and Carry-Over Statistics by Programme

Programme	N	Mean CGPA	SD CGPA	Mean TCO
ND Fashion Design & Clothing Technology	157	2.050	0.493	5.05
ND Science Laboratory Technology	153	2.292	0.496	8.30
HND Software Development	51	2.475	0.443	2.00
ND Quantity Surveying	34	2.435	0.410	2.38
HND Business Administration	29	2.379	0.397	0.83
HND Cooperative Economics & Management	21	2.468	0.327	0.33
ND Business Administration (SORTED Rano)	20	2.398	0.488	2.40
HND Electrical Engineering	15	2.247	0.524	2.47
ND Architectural Technology	12	2.300	0.501	4.25
ND Business Administration	12	2.261	0.401	2.00
HND Social Development	10	2.525	0.278	2.90
ND Social Development	10	2.271	0.525	1.90
ND Statistics	8	1.813	0.530	4.38
ND Local Government Studies	7	2.370	0.358	1.29

The results show meaningful variation among programmes.

The highest mean CGPA was observed among HND Social Development students (2.525), followed by HND Software Development (2.475) and HND Cooperative Economics and Management (2.468).

The lowest mean CGPA was observed among ND Statistics students (1.813), followed by ND Fashion Design and Clothing Technology (2.050).

The mean TCO was particularly high in ND Science Laboratory Technology (8.30), while the lowest mean TCO occurred among HND Cooperative Economics and Management students (0.33).

These results indicate that programme-level differences deserve consideration when interpreting overall academic performance.

7.7 Analysis of Variance

A one-way ANOVA was conducted to determine whether mean CGPA differed significantly across the 14 identifiable programme groups.

The analysis produced:

$$F(13, 579) = 4.162, p < .001$$

Therefore, there was a statistically significant difference in mean CGPA among the programmes.

Consequently, H_{03} is rejected.

The finding does not imply that every programme differs significantly from every other programme. Rather, it indicates that at least one programme mean differs from another. Programme-specific post-hoc comparisons should therefore be conducted where required.

7.8 Extended Regression Model

A further regression model incorporated programme indicators together with TCO.

The extended model produced:

$$R^2 = 0.646$$

Compared with the simple TCO model ($R^2 = 0.527$), the extended model explained approximately 11.9 additional percentage points of the variation in CGPA.

The TCO coefficient remained negative and highly statistically significant:

$$B = -0.0688, p < .001$$

This indicates that the relationship between carry-over burden and CGPA remained strong even after accounting for programme differences.

The result provides additional evidence that TCO is an important statistical correlate of academic performance.

Therefore, H_{04} is rejected.

8. DISCUSSION

The findings demonstrate a strong negative relationship between carry-over courses and students' academic performance. Students with greater carry-over burdens tended to have lower CGPAs.

The magnitude of the Pearson correlation ($r = -0.726$) is substantial. The corresponding Spearman coefficient ($\rho = -0.796$) further demonstrates that the negative association remains strong when the rank ordering of students is considered.

This finding is consistent with the conceptual expectation that repeated academic failures and outstanding courses may be associated with poorer overall academic outcomes. Previous Nigerian work has discussed the academic difficulties and workload challenges associated with carry-over courses, including potential effects on students' learning experiences.

The regression analysis provides an additional perspective. TCO alone accounted for approximately 52.7% of the observed variation in CGPA. This is a relatively large proportion for a model containing only one principal explanatory variable. However, the result should not be interpreted as establishing a causal effect.

In particular, the relationship between TCO and CGPA may partly reflect the way both variables arise from students' academic histories. A student who performs poorly in courses is more likely to accumulate carry-overs and simultaneously record a lower CGPA. Therefore, the study demonstrates a strong statistical association but does not establish that carry-over courses independently cause a reduction in CGPA.

The programme analysis also produced statistically significant differences. This finding suggests that academic performance is not uniform across programmes. Curriculum structure, course difficulty, practical requirements, assessment patterns, student characteristics and other institutional factors may contribute to such differences.

The extended regression model is particularly important because programme indicators increased the explanatory power of the model from 52.7% to approximately 64.6%. TCO nevertheless remained strongly significant after programme effects were incorporated.

This finding suggests that academic administrators should consider both student-level carry-over burden and programme-level academic patterns when designing intervention strategies.

The result also aligns with recent Nigerian research demonstrating the usefulness of statistical modelling for understanding student academic outcomes. Abdullahi et al. demonstrated the application of regression-based models to student academic performance, while more recent work has explored scalable regression and machine-learning approaches for identifying students at risk of poor academic outcomes.

9. CONCLUSION

This study analysed 593 student-performance records from Kano State Polytechnic to examine the relationship between carry-over courses and academic performance.

The results provide strong statistical evidence of a negative association between total carry-over courses and CGPA. Students with greater carry-over burdens tended to record lower cumulative academic performance.

The regression analysis showed that TCO alone explained approximately 52.7% of the variation in CGPA, while an extended model incorporating programme effects increased the explanatory power to approximately 64.6%.

The study also found statistically significant differences in mean CGPA across programmes.

The findings therefore suggest that carry-over burden can serve as a useful academic-risk indicator. Systematic monitoring of students' carry-over patterns may enable Kano State Polytechnic to identify students who require additional academic support before their difficulties become more severe.

However, the results should be interpreted as evidence of statistical association rather than proof of causality.

10. RECOMMENDATIONS

Based on the findings, the study recommends that:

10.1 Establish an Early-Warning Academic Monitoring System

The Polytechnic should develop an institutional statistical monitoring system capable of identifying students who accumulate multiple carry-over courses.

10.2 Strengthen Academic Advising

Students with increasing carry-over burdens should be referred for structured academic advising and counselling.

10.3 Introduce Programme-Level Academic Monitoring

Schools and departments should periodically examine CGPA and carry-over patterns within their programmes.

10.4 Provide Targeted Remedial Support

Students with several carry-over courses should receive targeted tutorials, revision programmes and other appropriate academic interventions.

10.5 Improve the Use of Digital Academic Records

Student-performance records should be maintained in a structured database capable of supporting longitudinal statistical analysis.

10.6 Develop a Comprehensive Student Performance Model

Future institutional research should incorporate additional predictors such as admission qualifications, attendance, continuous assessment, examination scores, study behaviour and student demographic characteristics.

10.7 Strengthen Data-Driven Academic Planning

Academic Board, School Boards and departmental committees should make greater use of statistical evidence when developing academic-support strategies.

11. LIMITATIONS OF THE STUDY

The study has several limitations.

First, the analysis was based on available institutional performance records. Therefore, the findings are dependent on the completeness and accuracy of those records.

Second, the dataset did not contain several potentially relevant explanatory variables, including attendance, entry qualifications, continuous assessment scores and socio-economic characteristics.

Third, the study is cross-sectional/retrospective in its analytical structure and therefore cannot establish causal relationships between carry-over courses and CGPA.

Fourth, programme labels and institutional classifications were not completely uniform across the supplied documents. Consequently, programme-level analysis was restricted to records whose programme identities could be reasonably established from the source data.

Finally, the available records do not consistently identify the academic session for every student. Therefore, the study should not claim that every individual record belongs to a specific session unless this is confirmed from the Polytechnic's original academic records.

12. IMPLICATIONS FOR KANO STATE POLYTECHNIC

The study has direct institutional implications.

The strong relationship between TCO and CGPA suggests that carry-over data can be incorporated into academic monitoring systems. Rather than waiting for students to reach severe academic difficulty, the institution can identify patterns of increasing carry-over burden at an earlier stage.

For example, students moving from zero to one or two carry-over courses may be placed under routine academic monitoring, while students accumulating substantially higher numbers could be referred for intensive academic advising and intervention.

At the programme level, differences in CGPA and carry-over patterns can assist Heads of Departments and School management in identifying areas requiring further investigation.

This approach would transform existing academic records from a primarily administrative resource into a source of evidence for academic planning and quality improvement.

13. AREAS FOR FURTHER RESEARCH

Future research at Kano State Polytechnic should extend the present study by incorporating:

- admission scores and entry qualifications;
- students' previous academic background;
- semester GPA;
- continuous assessment scores;
- examination scores;
- attendance;
- gender and age where ethically and institutionally appropriate;
- course-level failure patterns;
- number of semesters required for graduation; and
- students' final graduation outcomes.

A longitudinal database incorporating these variables could support the development of a more sophisticated predictive model for identifying students at risk of academic failure or delayed graduation.

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