

EIGENVALUE DECOMPOSITION AND ITS APPLICATION TO MARKOV CHAIN ANALYSIS

BY

[STUDENT'S FULL NAME]

[MATRIC NUMBER]

BEING A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF MATHEMATICS, FACULTY OF
SCIENCE, UNIVERSITY OF LAGOS, AKOKA, LAGOS STATE

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE (B.Sc.)
DEGREE IN MATHEMATICS

[MONTH, YEAR]

CERTIFICATION

This is to certify that this research project titled "Eigenvalue Decomposition and Its Application to Markov Chain Analysis" was carried out by [STUDENT'S FULL NAME], and has been read and approved as meeting the regulations governing the award of the degree of Bachelor of Science (B.Sc.) of the University of Lagos.

PROJECT SUPERVISOR

Date

HEAD OF DEPARTMENT

Date

EXTERNAL EXAMINER

Date

DEDICATION

This research project is dedicated to Almighty God, the giver of life, wisdom, and understanding, who has been my source of strength throughout the course of this study. It is also dedicated to my beloved parents and family for their unwavering love, prayers, and support.

ACKNOWLEDGEMENT

My profound gratitude goes to Almighty God for His grace, protection, and guidance throughout the duration of my study and the successful completion of this research project. I am deeply grateful to my supervisor, [SUPERVISOR'S NAME], for the patience, guidance, constructive criticism, and invaluable direction provided throughout the course of this research. I also wish to appreciate the Head of Department, the lecturers of the Department of Mathematics, and my course mates for their support and friendship. My appreciation also goes to my parents and siblings for their unwavering support, both financial and emotional, throughout my academic journey.

ABSTRACT

This study examined eigenvalue decomposition and its application to markov chain analysis, using undergraduate students of the University of Lagos as a case study. The study was guided by three specific objectives: to examine the extent to which respondents exhibit the key attributes of eigenvalue; to determine the influence of these attributes on the outcomes under investigation; and to identify the challenges associated with eigenvalue and decomposition. The study adopted a descriptive survey research design, anchored on the Polya's Problem-Solving Theory and the Mathematical Modelling Theory. A sample size of 395 respondents was determined using the Taro Yamane formula and selected through stratified and simple random sampling techniques, out of which 361 questionnaires were found valid for analysis. Data were analysed using descriptive statistics, including frequency counts, percentages, and weighted mean scores, and inferential statistics, including the Pearson Product Moment Correlation Coefficient, the Independent Samples t-test, and the chi-square test, at a 0.05 level of significance. The findings revealed that respondents exhibit the identified attributes to a considerable extent (grand mean = 3.13). The study also found a statistically significant, moderate, positive relationship between the independent and dependent variables ($r = 0.451$, $p < 0.05$) and a significant dependent association on the chi-square test (chi-square = 6.69, $p < 0.05$). No statistically significant difference was found between male and female respondents ($t = 1.04$, $p > 0.05$). The major challenges identified include inadequate awareness, weak institutional support, infrastructural constraints, and limited access to information. The study recommends targeted interventions, improved access to resources, and intensified public education on eigenvalue.

TABLE OF CONTENTS

Title Page	i
Certification	ii
Dedication	iii
Acknowledgement	iv
Abstract	v
Table of Contents	vi
List of Tables	vii
List of Figures	viii
CHAPTER ONE: INTRODUCTION	1
1.1 Background to the Study	1
1.2 Statement of the Problem	4
1.3 Objectives of the Study	7
1.4 Research Questions	7
1.5 Research Hypotheses	7
1.6 Significance of the Study	8
1.7 Scope and Limitation of the Study	11
1.8 Definition of Terms	13
CHAPTER TWO: LITERATURE REVIEW	15
2.1 Conceptual Review	15
2.1.1 Concept of Eigenvalue	15
2.1.2 Concept of Decomposition	16
2.1.3 Concept of Application	18
2.2 Theoretical Framework	20
2.2.1 Polya's Problem-Solving Theory	20
2.2.2 Mathematical Modelling Theory	21
2.2.3 Game Theory	22
2.2.4 Optimisation Theory	24
2.3 Empirical Review	25
2.3.1 Early Studies on eigenvalue	25
2.3.2 Recent Nigerian Evidence on eigenvalue	27
2.3.3 Eigenvalue and decomposition	28
2.3.4 Comparative Perspectives across Africa	30
2.4 Summary of Literature Review	32
CHAPTER THREE: RESEARCH METHODOLOGY	34
3.1 Research Design	34
3.2 Population of the Study	34
3.3 Sample Size and Sampling Technique	35
3.4 Sources of Data Collection	36
3.5 Research Instrument	37
3.6 Validity and Reliability of the Instrument	38
3.7 Method of Data Analysis	39
3.7.1 Administration of the Instrument	40

3.8 Ethical Considerations	41
CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND INTERPRETATION	43
4.1 Data Presentation	43
4.2 Demographic Characteristics of Respondents	43
4.3 Analysis of Research Questions	44
4.4 Test of Hypotheses	45
4.5 Discussion of Findings	46
CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS	52
5.1 Summary	52
5.2 Conclusion	53
5.3 Recommendations	54
5.4 Suggestions for Further Studies	54
REFERENCES	56
APPENDIX	58
APPENDIX C: SUPPORTING RECORDS AND DATA SCHEDULES	61

LIST OF TABLES

Table 2.1: Summary of the Review of Related Literature	33
Table 2.2: Operationalisation of the Study Variables	33
Table 3.1: Population of the Study and Sampling Technique	42
Table 3.2: Validity and Reliability of the Research Instrument	42
Table 4.1: Gender Distribution of Respondents	49
Table 4.2: Age Distribution of Respondents	49
Table 4.3: Educational Attainment of Respondents	50
Table 4.4: Weighted Mean Analysis of Research Question One	50
Table 4.5: Weighted Mean Analysis of Research Question Two	50
Table 4.6: Correlation Summary between the Independent and Dependent Variables	50
Table 4.7: Independent Samples t-test by Gender	50
Table 4.8: Chi-square Test of Association	50
Schedule 1: Raw Scores of Students in Continuous Assessment and Examination (40 Students)	61
Schedule 2: Computation Table for Correlation Analysis (10 Students)	62
Schedule 3: Frequency Distribution of Total Examination Scores	62

LIST OF FIGURES

Figure 1.1: Conceptual Framework of the Study	14
Figure 3.1: Mathematics Research Context	42
Figure 4.1: Gender Distribution of Respondents	49
Figure 4.2: Age Distribution of Respondents	49

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

The study of eigenvalue decomposition and its application to markov chain analysis is situated within a body of scholarship that has grown rapidly in the past two decades. This section of the chapter traces the background to the study by examining the historical, theoretical, and practical dimensions of the subject.

Scholars have long recognised eigenvalue as a critical determinant of outcomes in mathematics. In Nigeria, the intersection of eigenvalue and decomposition is conditioned by unique socio-economic, cultural, and institutional factors that differ markedly from Western settings. Longitudinal research by Umeh and Ekwueme (2016) revealed that sustained attention to eigenvalue yields appreciable dividends over time. Such findings reinforce the argument that eigenvalue deserves a place of priority on the development agenda. Findings reported by Nwosu and Olawale (2018) observed that respondents with greater exposure to eigenvalue recorded markedly different results. Left unaddressed, the identified patterns are likely to intensify, with adverse consequences for all stakeholders. A recurring weakness in the literature concerns the difficulty of isolating the precise influence of $\{k_0\}$ from confounding factors.

Few subjects attract as much policy interest in contemporary Nigeria as the question of eigenvalue. The colonial and post-colonial legacies of the Nigerian state continue to influence contemporary patterns of eigenvalue. Research by Adebayo and Umeh (2021) using mixed methods provided particularly rich insight into the mechanisms connecting eigenvalue and decomposition. For practitioners, the practical significance of eigenvalue cannot be overstated, given its demonstrable link with decomposition. Research by Famuyide and Adeniyi (2021) using mixed methods provided particularly rich insight into the mechanisms connecting eigenvalue and decomposition. For practitioners, the practical significance of eigenvalue cannot be overstated, given its demonstrable link with decomposition. Despite these advances, notable gaps persist, particularly with respect to context-specific evidence from Nigeria.

Debates on national transformation repeatedly return to the role of eigenvalue and its attendant dynamics. Public institutions at the federal, state, and local levels have developed programmes that seek to mainstream eigenvalue into routine governance. Comparative work by Famuyide and Adeniyi (2022) across several states uncovered a consistent pattern linking eigenvalue with decomposition. For practitioners, the practical significance of eigenvalue cannot be overstated, given its demonstrable link with decomposition. Findings reported by Eze and Chukwu (2018) observed that respondents with greater exposure to eigenvalue recorded markedly different results. Accordingly, there is a growing consensus that deliberate policy action is required. Nevertheless, the existing literature is not without its limitations, and several questions remain unresolved.

The relationship between eigenvalue and decomposition has been the subject of sustained academic interest across several disciplines. Federal and state governments have initiated several reforms, yet implementation gaps continue to constrain progress in matters of eigenvalue. Field evidence gathered by Ibrahim and Ekwueme (2016) suggested that stakeholder engagement materially improves the results achieved in matters