Are NSC Subjects Becoming Less Difficult? Evidence-Based Analytical Hierarchy Process

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Presentation outline

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Introduction: Umalusi legislative mandate

Council for Quality Assurance in General and Further Education and Training, derives its mandate from the:

National Qualification Framework (NQF) Act (no. 67 of 2008) as amended

- Research to enhance the quality and standards of curricula and assessments.
- Advise the Ministers on issues relating to the sub-framework.

General and Further Education and Training Quality Assurance (GENFETQA) Act (No. 58 of 2001) as amended

- Quality assurance of assessments at the exit point of qualifications under the General and Further Education and Training Qualifications Sub-framework.
- Certifies learner achievement at the exit points.

Introduction: Umalusi mandate - standardisation

Section 17A (5) of GENFETQA Act: "The Council may adjust raw marks during the standardisation process."

What is standardisation?

- Statistical process used to adjust raw scores to account for variations in difficulty across different exam papers, years, etc.
- Also called awarding, grade boundaries adjustment, scaling and equating, and standard setting in various countries.

Introduction

Standardisation tools	
Qualitative inputs (e.g. reports)	**Quantitative inputs (e.g. booklets)**
Reports from external moderators and internal moderators	Raw mark distributions and graphical representations
Reports from marking verifiers and chief markers	Historical average (norms); outliers
Post Exam Analysis: Subject experts	Percentage mark distributions
Evidence-Based Report (EBR)	Subjects Pair Analysis (SPA); **Eigenvalues**

Background

Statistical methods analysing subject difficulty:

-Classical Test Theory **(CTT)**

-Item Response Theory **(IRT)**

-Regression Analysis **(RA)**

-Historical Exam Data Analysis **(HEDA)**

-Subject Pairs Ana **(SPA)**

-Analytic Hierarchy Process **(AHP)**

(Jolliffe,

SPA as a tool to determine the subjects' difficulty.

This is where the anchor subject is compared to the mean of other related subjects.

The SPA considers only those who have written a particular pair of subjects (Coe et al., 2008).

Comparing Mathematics with numerical subjects

Sciences or Accounting ensures a fair evaluation based on similar cognitive demands, particularly

attempting to make adjustment decisions (LI & Zhou, 2021).

SPA extend to AHP,

built to generate eigenvalues.

Eigenvalues are used as a statistical analysis for objectively ranking subject difficulty (Mappe & Wongthong ham, 2014).

The incorporation of igenvalues nforms ision- and lity during the standardisatio n process.

They can be analysed in three ways:

1. Ranking of subjects' difficulty per year.

ect iculty er time.

3. Subjects' rankings over time.

Eigenvalue analysis supports other statistical tools, such as the use of norm-referencing methods.

Literature review

- Subject difficulty refers to how challenging a subject is, impacting curriculum development, resource allocation, intervention strategies, and adjustment decisions (Boudah, 2019).

- In education, subject difficulty is compared against other subjects, and against itself over the years.

- The difficulty of subjects is determined by internal factors such as learner potential and knowledge, and external factors such as the social environment, curriculum, resources, teaching methods, cognitive demands, question papers, etc (Inayati et al., 2018).

- Generally, studies reported that Mathematics and Physical Sciences are the most difficult subjects (Anyagh et al., 2018; Maipare, 2016), whereas languages in the National Senior Certificate (NSC) have high pass rates (above 90%), perceived as less difficult (DBE, 2021).

- Understanding subject difficulty leads to better educational policies, improved teaching, standard setting, and greater educational success (Smith, 2020).

Problem statement

- There are ongoing debates about whether NSC subjects are becoming less difficult, often based on the traditional analyses of pass percentages.
- Concerns over possible declining subject difficulty in the NSC suggest challenges in maintaining academic standards and qualification credibility.
- By employing the Analytical Hierarchy Process (AHP), a statistical framework which generates eigenvalues allows tracking of the relative difficulty of subjects over time.
- However, the adoption of eigenvalues remains underutilised by assessment bodies(examination boards) to assess subjects' difficulty.
- Umalusi had to address the concern of whether the NSC subjects are becoming less difficult over time using eigenvalue analysis.

Research objective

- To evaluate whether the NSC subjects are becoming less difficult over time.

Significance

- The study provides insight into an additional statistical tool, eigenvalue analysis, used during the standardisation process to evaluate subjects' difficulty over time to inform decision–making and accountability.

- The study contributes to the ongoing debate about the difficulty of the NSC subjects.

Methodology

Quantitative descriptive trend analysis

Sampling: Purposive

Sample size: 135 observations (2014 -2024)

Population: NSC subjects

Targeted population: 12 high-enrolment NSC subjects

Dependent variable: Eigenvalues

Independent variables: NSC subjects

Sampled subjects

- Accounting
- Afrikaans Home Language (HL)
- Business Studies
- Economics
- English First Additional (FAL) Language
- English Home Language (HL)
- Geography
- History
- Life Sciences
- Mathematics Literacy
- Mathematics
- Physical Sciences

Data collection

SPA files were collected from Umalusi's mainframe system for the Department of Basic Education (DBE).

Eigenvalues were generated from AHP using R Studio following:

Step 1: **Pair comparison ratio**

Step 2: **Construction of pair comparison matrix**

Step 3: **Calculating eigenvector (subject difficulty weights)**

Step 4: **Approximating the eigenvector using AHP DOT product**

Step 5: **Computing the raw difficulty vector (Row sums**)

Step 6: **Normalising the difficulty vector (final AHP weights)** (Coe et al., 2008).

Data analysis

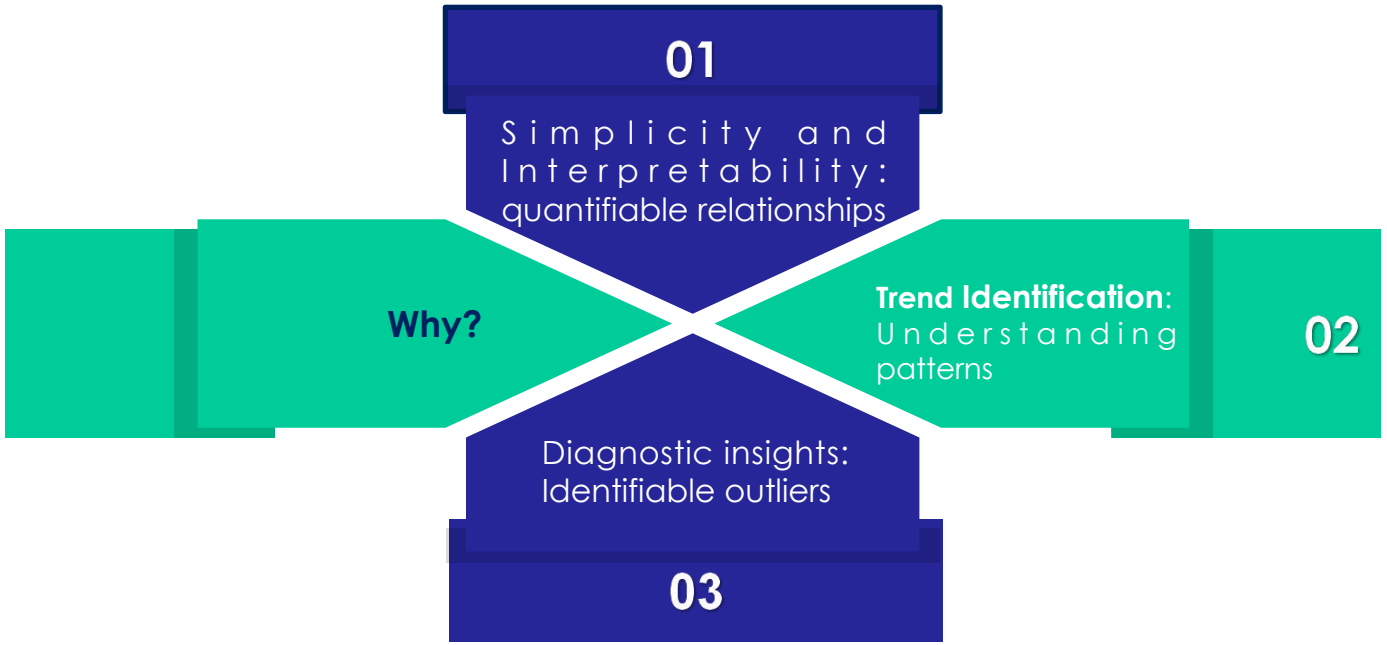
- Eigenvalues trend analysis
- Linear regression trendlines.

Analytical tools:

R Studio Programme

Analytical framework

Process of establishing trendline (linear regression: $y = mx + c$)

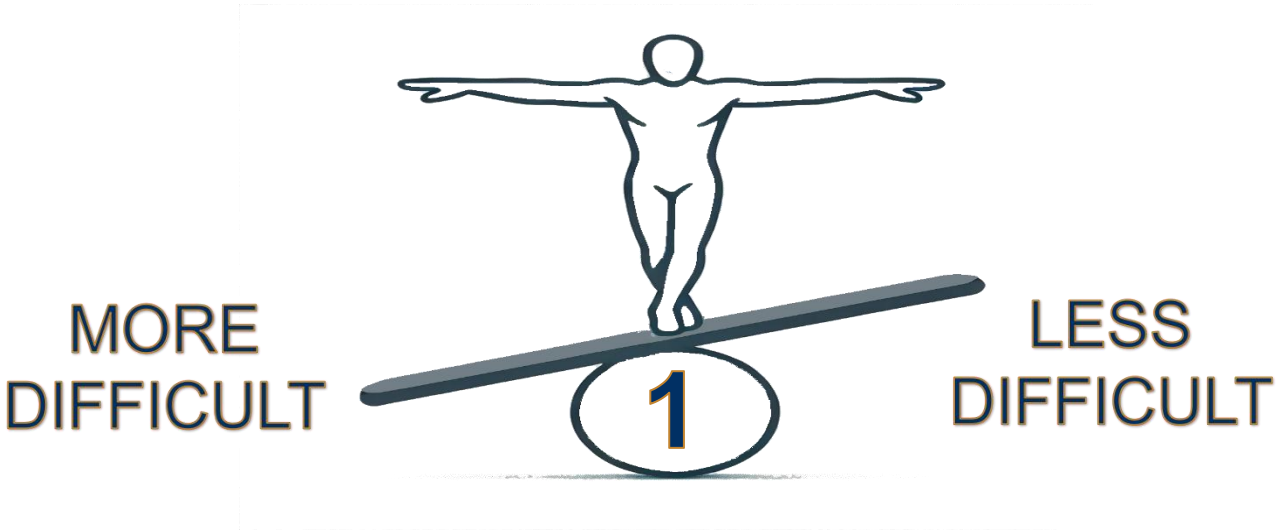


Where:

- y = dependent variable (response variable)
- x = independent variable (predictor variable)
- m = slope of the line

Analytical interpretation

Application of AHP
End-product: Eigenvalues
Thomas L. Satty (1970;1980; 1982)

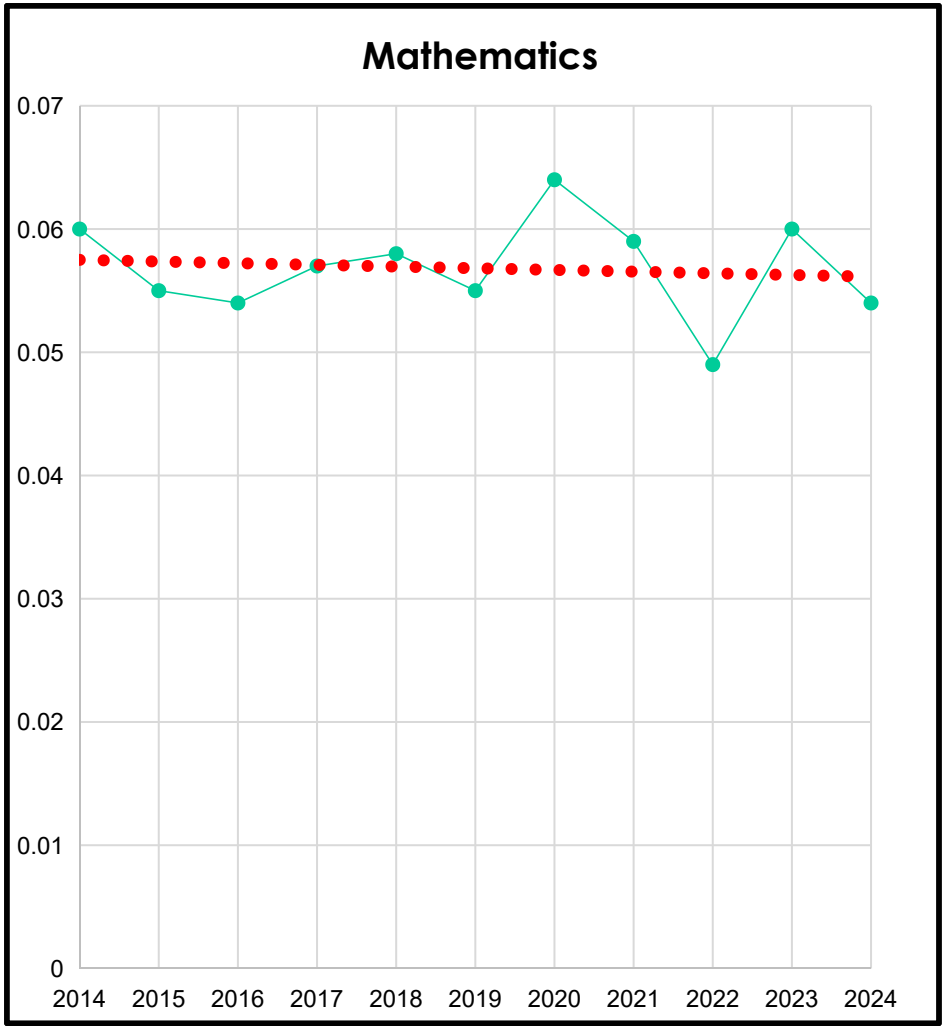


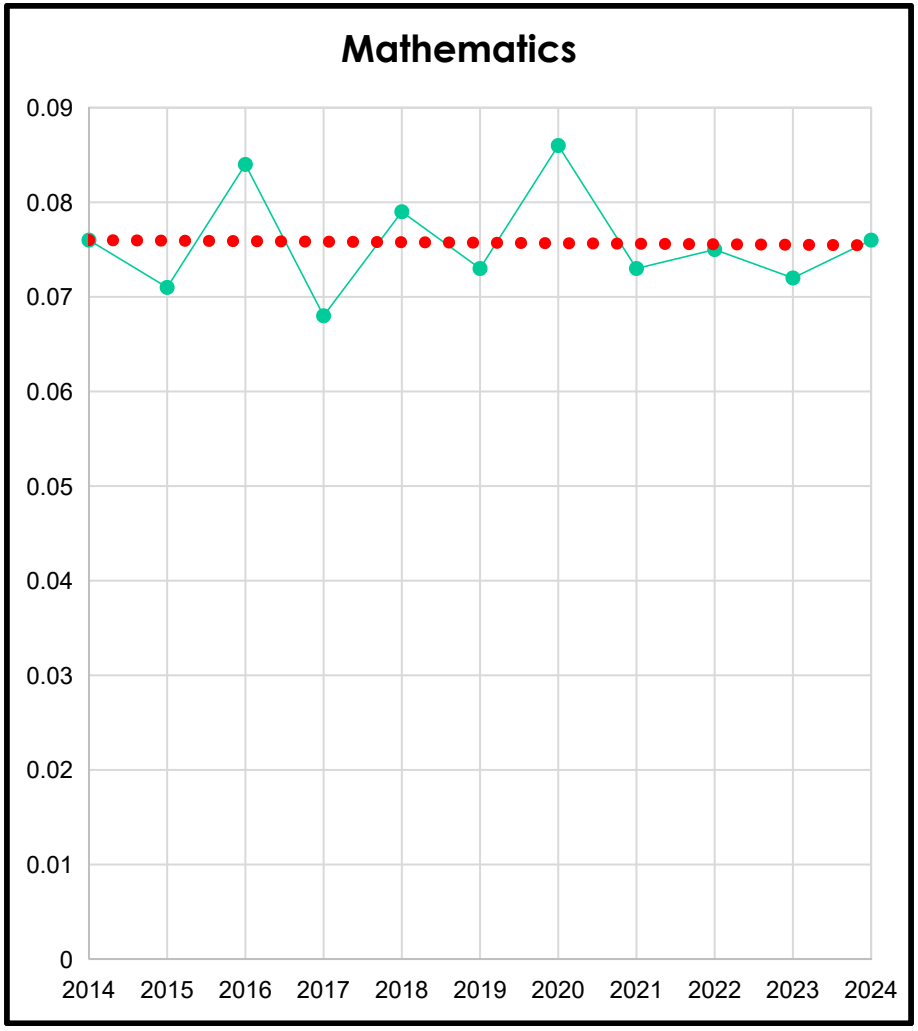
- **Principle 1**: The decrease in eigenvalues, the more the subject becomes more difficult.
- **Principle 2:** An increase in eigenvalues, the more the subject becomes less difficult.

Eigenvalues (2014 – 2024)

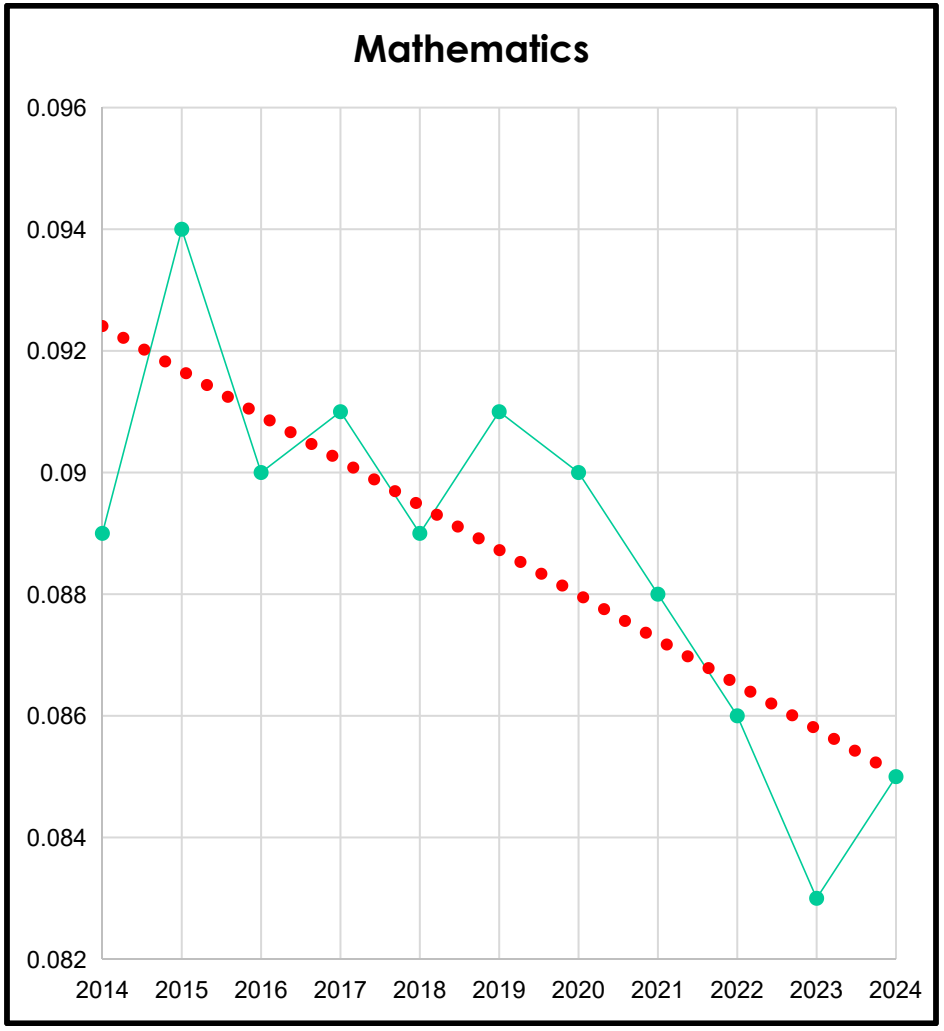
Subjects	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Mathematics	0.060	0.055	0.054	0.057	0.058	0.055	0.064	0.059	0.049	0.060	0.054
Physical Sciences	0.061	0.060	0.065	0.065	0.068	0.068	0.068	0.064	0.067	0.065	0.061
Life Sciences	0.080	0.080	0.077	0.079	0.076	0.069	0.074	0.076	0.067	0.072	0.082
Accounting	0.076	0.071	0.084	0.068	0.079	0.073	0.086	0.073	0.075	0.072	0.076
Economics	0.080	0.082	0.083	0.083	0.078	0.074	0.077	0.071	0.085	0.084	0.080
Geography	0.090	0.088	0.078	0.071	0.072	0.082	0.079	0.077	0.089	0.085	0.085
Business Studies	0.073	0.080	0.077	0.079	0.073	0.083	0.090	0.094	0.090	0.097	0.096
Mathematical Literacy	0.079	0.076	0.077	0.090	0.095	0.094	0.091	0.091	0.091	0.087	0.091
English Home Language	0.089	0.094	0.090	0.091	0.089	0.091	0.090	0.088	0.086	0.083	0.085
Afrikaans Home Language	0.098	0.098	0.102	0.097	0.097	0.093	0.093	0.098	0.099	0.103	0.103
History	0.108	0.104	0.103	0.111	0.113	0.108	0.095	0.101	0.098	0.093	0.095
English First Additional Language	0.106	0.111	0.109	0.110	0.103	0.109	0.093	0.109	0.104	0.099	0.094

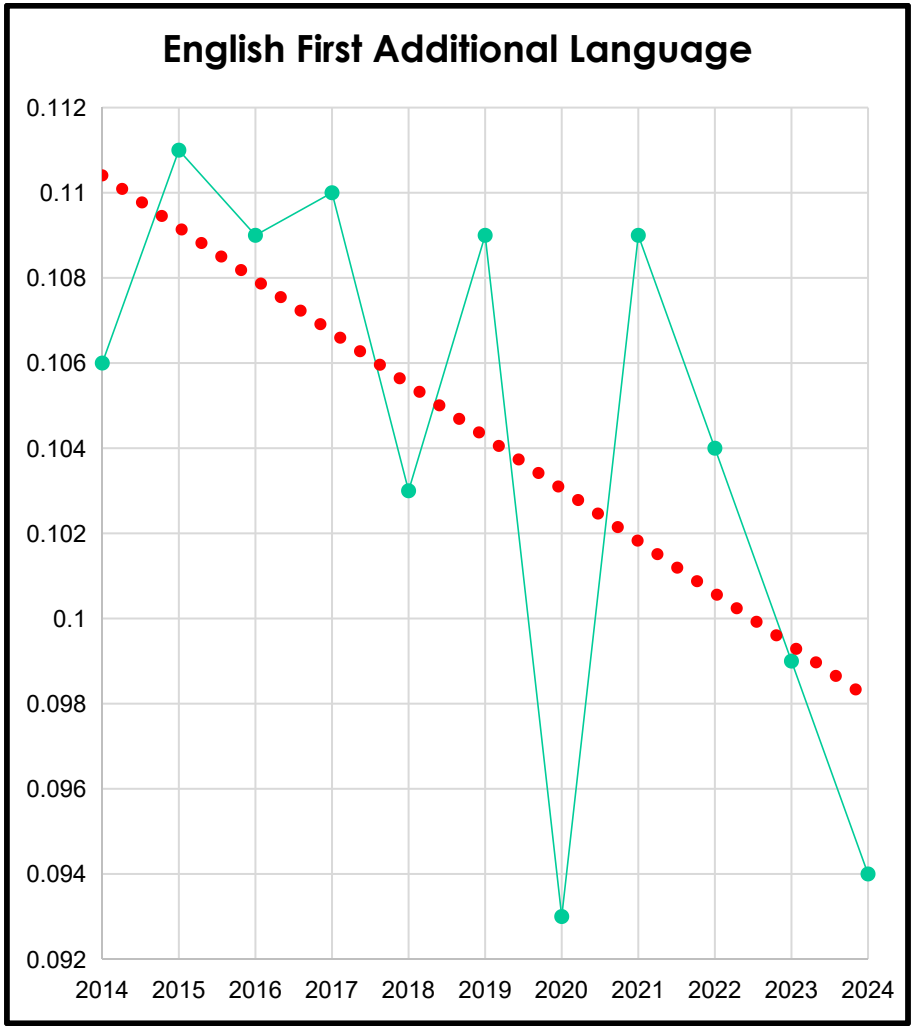
Results: Stable Slopes



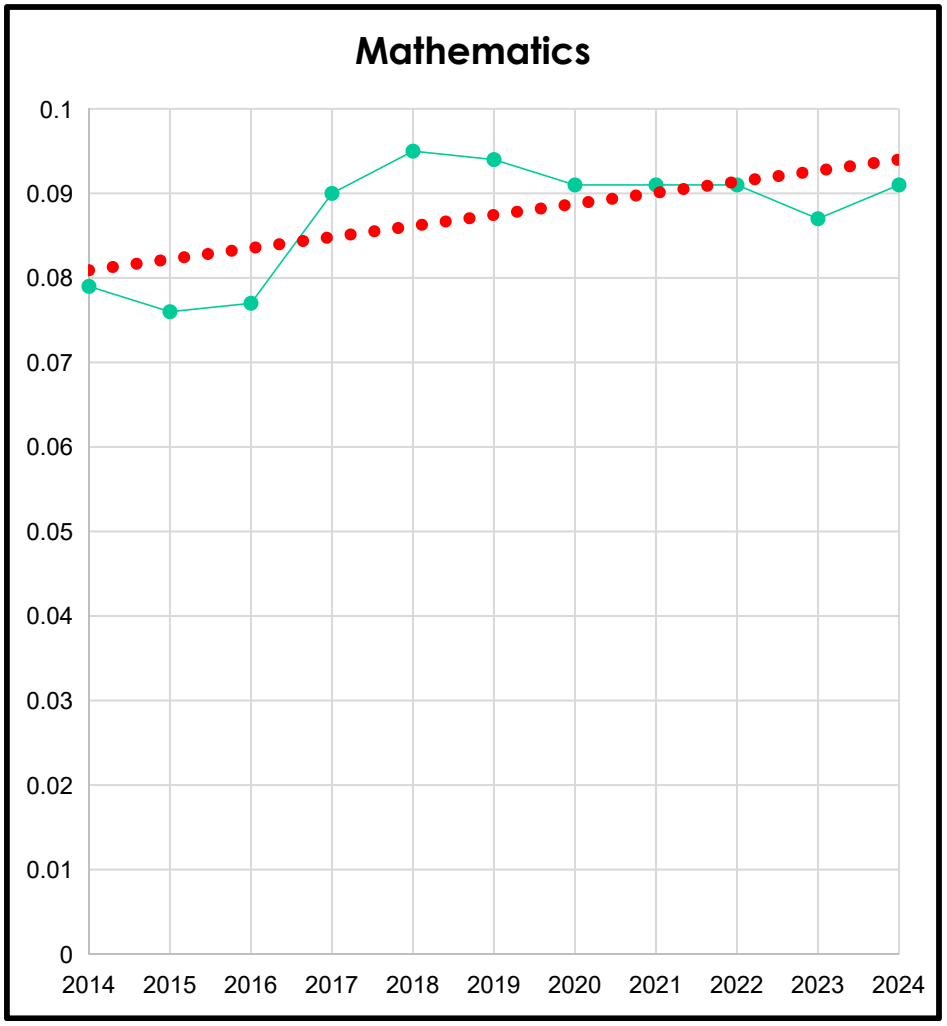


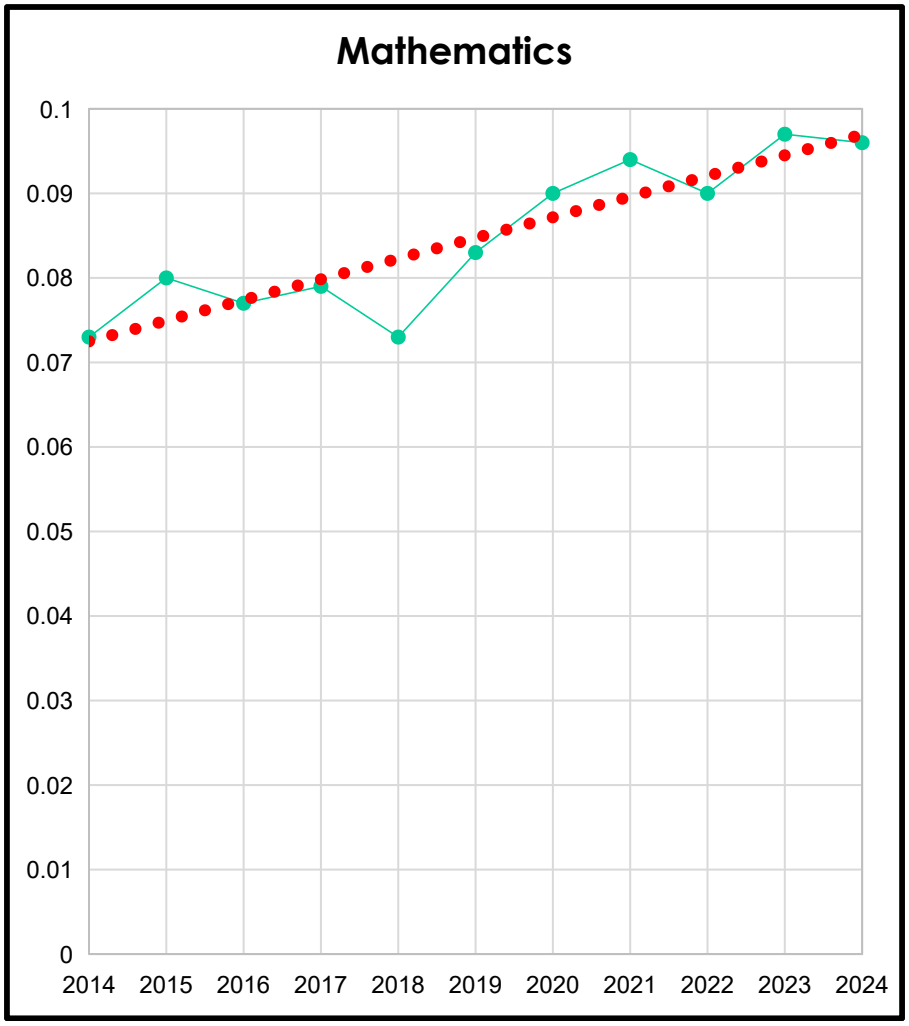
Results: Downwards slopes





Results: Upwards slopes





Discussions

Trend Category	Subject	Results	Possible Adjustments	Recommendation Action (Assessment bodies)
Stable Slope (41,67%)	Mathematics Accounting Life Sciences Economics Geography Physical Sciences	Stable difficulty (Sustained assessment standards)	More raw adjustments to maintain standards	**Can we make some improvements?** ○ Review the subject content ○ Evaluate teaching methodologies and resources
Downwards Slope (33.33%)	English HL English FAL History Afrikaans HL	More difficult	More upward adjustments to maintain standards	**Are examinations not accessible?** ○ Review the subject content ○ Evaluate teaching methodologies and resources ○ Explore the cognitive demands of examination items ○ Measure the validity and reliability of assessment instruments ○ Check the design of the question papers
Upwards Slope (25%)	Business Studies Mathematical Literacy	Less difficult	More downwards adjustments to maintain the standards	**Are examinations too easy?** ○ Review the subject content ○ Evaluate teaching methodologies and resources ○ Explore the cognitive demands of examination items ○ Measure the validity and reliability of assessment instruments ○ Check the design of the question papers

Conclusion

- The eigenvalue analysis reveals that not all NSC subjects are becoming less difficult. Instead, it shows a variety of trends in subjects' difficulty over time, suggesting differentiated standardisation approaches.

- The AHP framework enables assessment bodies to justify adjustments, promoting transparency and accountability.

Recommendations

- **For assessment bodies**: To adopt the AHP framework to analyse subjects' difficulty over time to inform decisions and accountability during the standardisation process.

- **For Umalusi**: To officially include the AHP framework as part of the standardisation policy.

THANK YOU

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