National Benchmark Test results and success: a longitudinal study at the University of Fort Hare

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Introduction

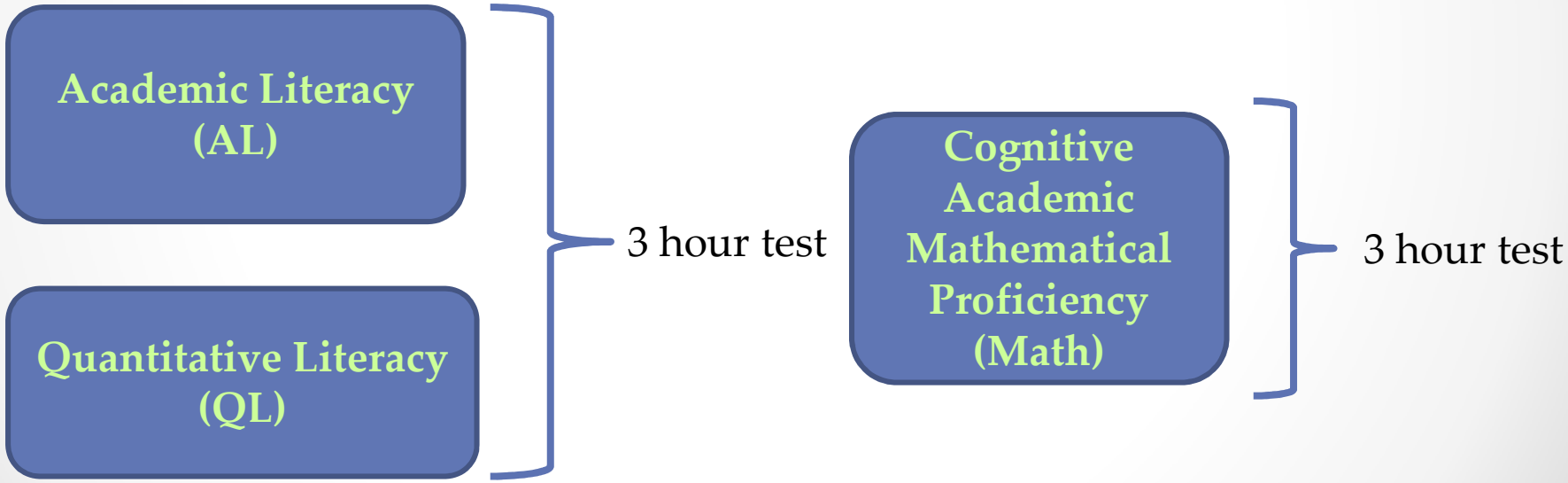
- Background to the study
- What are the NBTs?
- Study design
- Data analysis (selected results)
- Discussion
- Conclusions/Future studies

Background to the study

- Under-preparedness of school-leavers for university studies is a widely reported issue
- Foundation programmes support only 15% of the students entering university
- What is an nuanced approach to support
- How can we tell what each student needs and by when?

What are the NBTs?

- National Benchmark Tests Project
- The purpose of the NBTs
  - Prospective first-year student assessment



What are the NBTs?

Performance Levels	Academic Literacy		Quantitative Literacy		Mathematics	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
Proficient	100	65	100	66	100	62
Intermediate	64	42	65	38	61	34
Basic	41	0	37	0	33	0
Scores reported as whole number percentage						

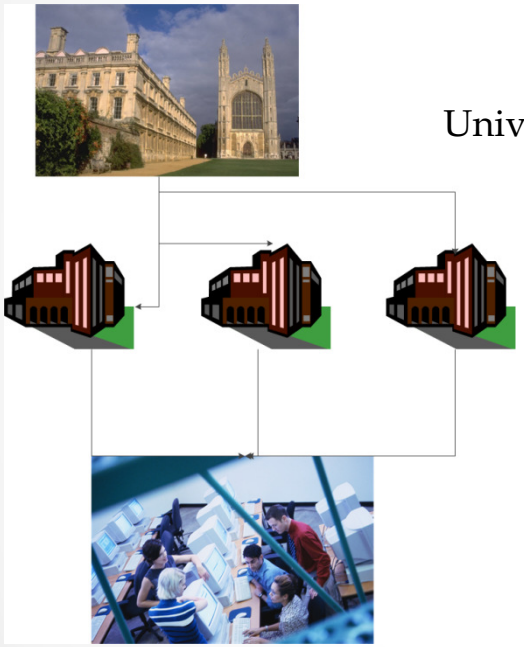
NBT Benchmarks for Degree Study

NBT Proficiency category	Score Continuum	Institutional recommendations
	100%	
Proficient		Performance in domain areas suggests that academic performance will not be adversely affected. If admitted, students should be placed on regular programmes of study.
Intermediate		Challenges in domain areas identified such that it is predicted that academic progress will be affected. If admitted, students' educational needs should be met in a way deemed appropriate by the institution (e.g. extended or augmented programmes or FET colleges. Institutions registering students performing at this level should provide such support.
Basic		Serious learning challenges identified: it is predicted that students will not cope with degree level study without extensive and long-term support, perhaps provided through bridging programmes or FET colleges. Institutions registering students performing at this level would need to provide such support.
	0%	

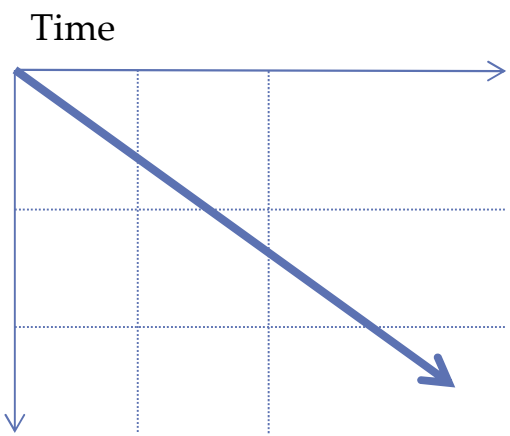
***Source Higher Education South Africa website**

Study design

Cohort selection
(stratified random sampling)



Cohort analysis



Cohort success
Mixed effects regression model linkage to National Benchmark Test results

$$\mathbf{Y}=h(\mathbf{X}\boldsymbol{\alpha}+\mathbf{Z}\mathbf{b})+\boldsymbol{\varepsilon}$$

Cohort Selection

Sampling design

Study population (1016 students and 5337 courses)

Sampling frame (student register of NBT writers)

Sampling method (proportional stratified random sample)

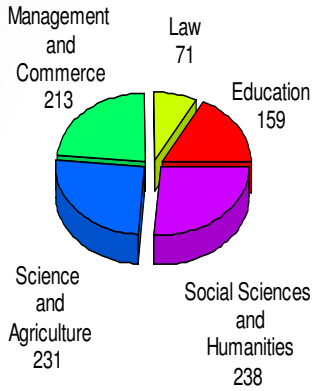
Stratum (campus by faculty)

Sampling unit (student)

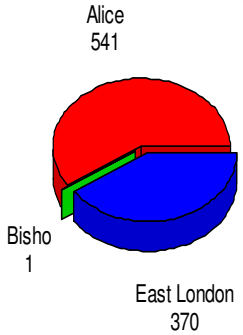
Analysis unit (registration record)

Cohort Properties

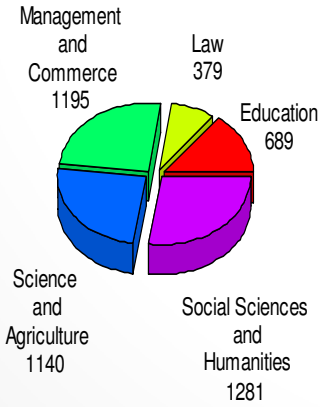
Student sample by Faculty



Student sample by Campus



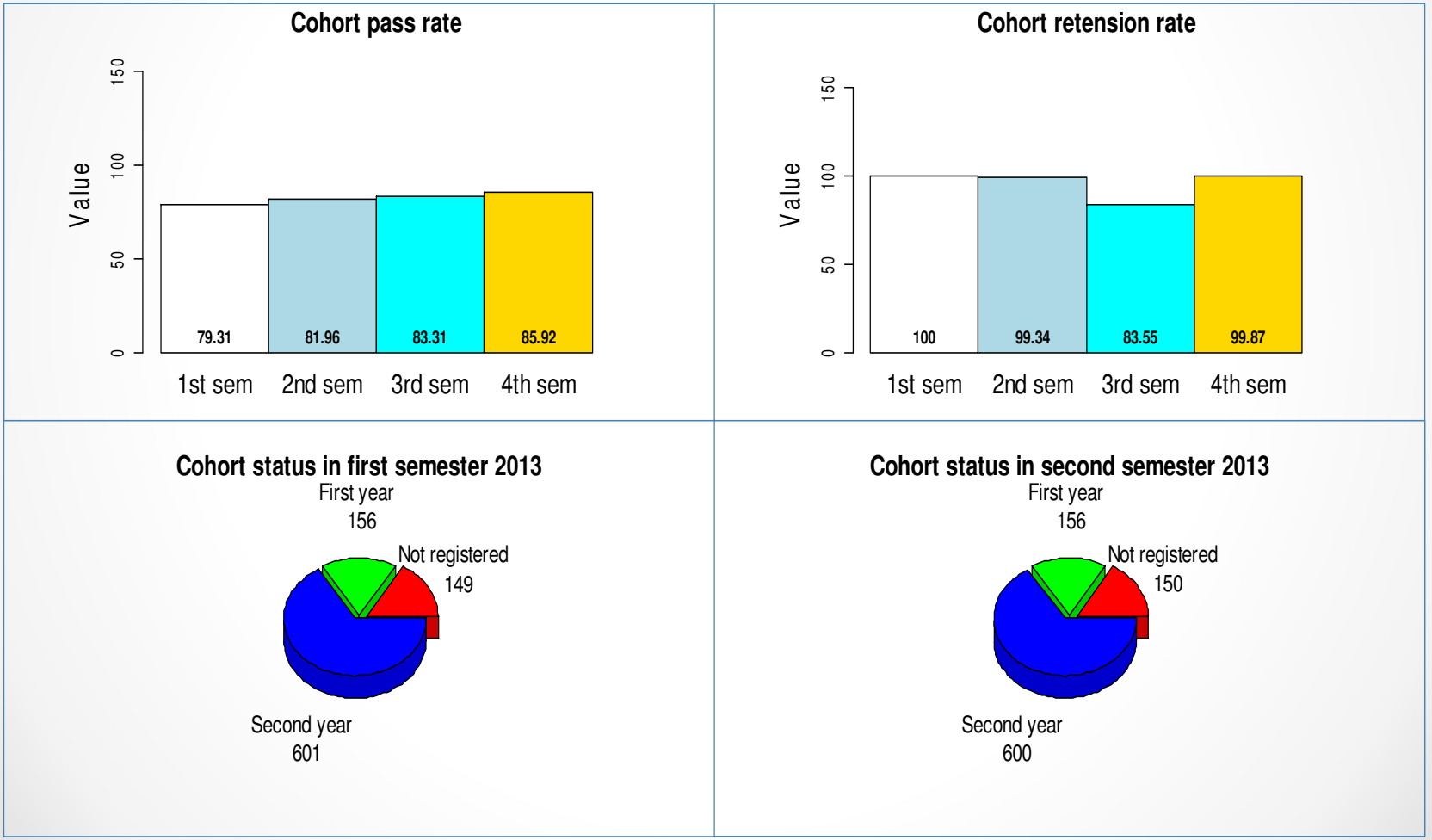
Cohort Courses by Faculty



Cohort Courses by Campus

Cohort analysis

2012-2013 Yearly progression rate of 65.90 %



Model Fitting

- $\mathrm{E}[\mathrm{y}_{\mathrm{i}j}|\mathbf{u}_{\mathbf{i}}] = \mathrm{h}\left(\mathrm{X}_{\mathrm{i}j}\boldsymbol{\beta} + \mathrm{Z}_{\mathrm{ij}}\mathbf{u}_{\mathbf{i}}\right)$, j=1,…, n_{i} and $1 = 1, \ldots, \mathrm{m}.$

- y_{ij} ith unit response at time j
- $\boldsymbol{\beta}$ (p× 1) vector of unknown fixed effect parameters
- X_{ij} (p × 1) design vector for fixed effects
- Z_{ij} (q × 1) design vector for random effects
- h(.) known differentiable link function
- $\mathbf{u}_{\mathbf{i}}$ (q× 1) vector of ith subject unobservable random effects
- $\mathbf{u}_{\mathbf{i}} \overset{i.i.d}{\sim} \mathcal{N}_i(\mathbf{0}, \mathbf{G})$
- $\mathbf{G}$ random effect variance covariance matrix
- $\mathcal{N}_i$ known distribution

***Breslow and Clayton (1993) and McCulloch and Searle (2001)**

Model Fitting

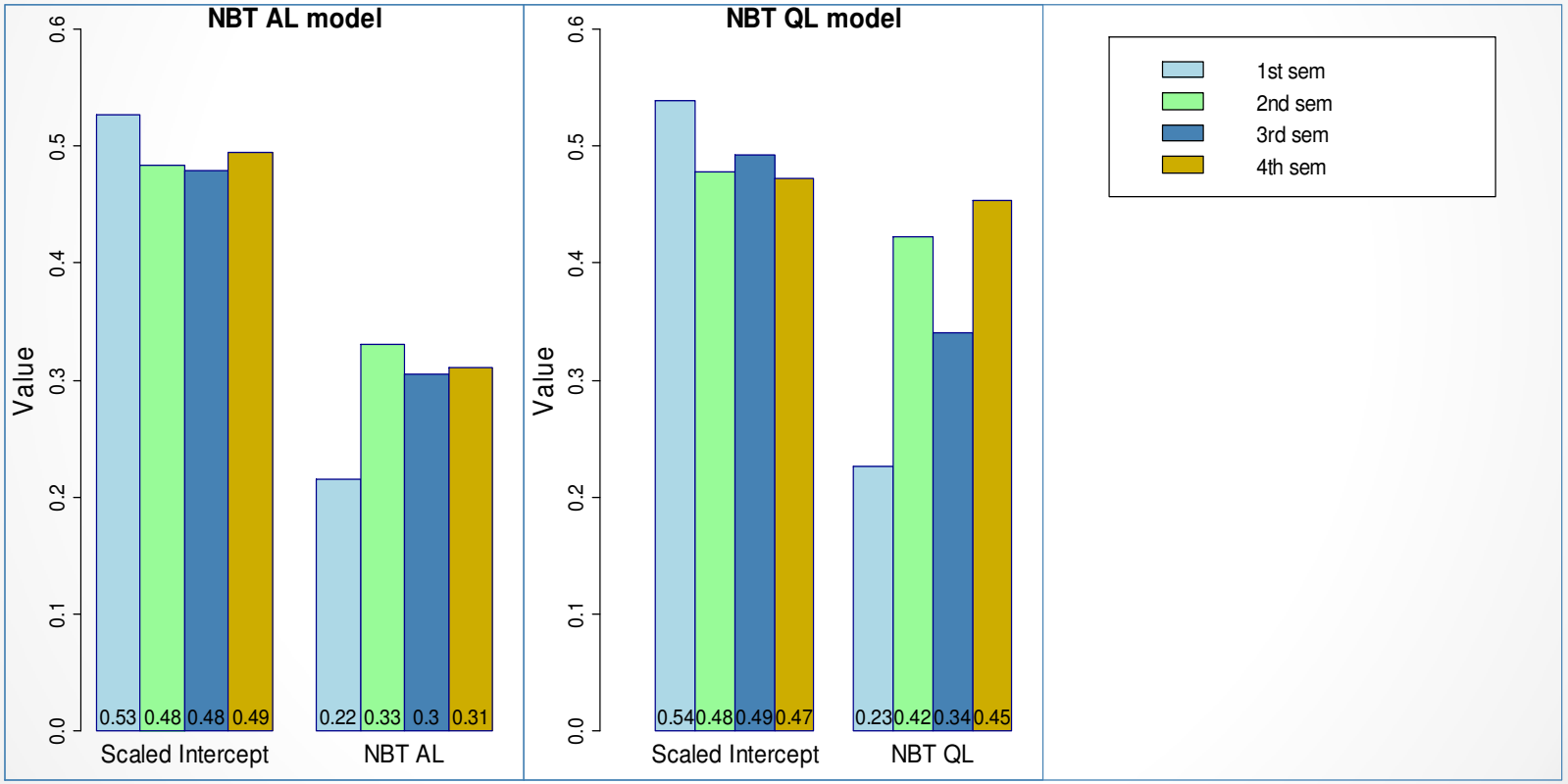
- $\mathrm{Y_i} = \mathrm{X_i}\boldsymbol{\beta} + \mathrm{Z_i}\mathbf{u_i} + \mathbf{e_i}, \mathrm{i} = 1, \ldots\ldots, \mathrm{m}.$

- $\mathrm{Y_i}$ $(\mathrm{n_i} \times 1)$ vector of ith unit response variables (final course marks)
- $\boldsymbol{\beta}$ $(\mathrm{p} \times 1)$ vector of fixed effect parameters
- $\mathrm{X_i}$ $(\mathrm{n_i} \times \mathrm{p})$ design matrix for fixed effects (NBT scores)
- $\mathrm{Z_i}$ $(\mathrm{n_i} \times \mathrm{q})$ design matrix for random effects
- $\mathbf{u_i}$ $(\mathrm{q} \times 1)$ vector of random effects
- $\mathbf{e_i}$ $(\mathrm{n_i} \times 1)$ vector of random (within-unit) errors
- $\mathbf{u_i} \overset{i.i.d}{\sim} \mathcal{N}_i(\mathbf{0}, \mathbf{D})$ and $\mathbf{e_i} \overset{i.i.d}{\sim} \mathcal{N}_i(\mathbf{0}, \mathbf{R_i})$
- $\mathcal{N}_i$ is the normal distribution
- h(.) is the identity function
- $\mathbf{D} = \mathbf{I}\sigma_u^2$
- $\mathbf{R_i} = \mathbf{I}\sigma_e^2$
- $\mathbf{u_i}$ and $\mathbf{e_i}$ are independent

Faculty of Social Sciences and Humanities

- $y_{ij} = \beta_0 + \ (\text{NBT AL Score})\ \boldsymbol{\beta_1} + \ u_{0i} + \ e_{ij}$, $i = 1,..,m, j = 1,..,n_i$.
- $y_{ij} = \beta_0 + \ (\text{NBT QL Score})\ \boldsymbol{\beta_1} + u_{0i} + \ e_{ij}$, $i = 1,..,m, j = 1,..,n_i$.
- Significant for all four semesters
- Scaled intercept $= \frac{\beta_0}{100}$

Faculty of Social Sciences and Humanities



Faculty of Management and Commerce

Single predictor models

- $y_{ij} = \beta_0 + (\text{NBT AL Score})\,\boldsymbol{\beta_1} + u_{0i} + e_{ij},\ i = 1,..,m, j = 1,..,n_i.$
- $y_{ij} = \beta_0 + (\text{NBT QL Score})\,\boldsymbol{\beta_1} + u_{0i} + e_{ij},\ i = 1,..,m, j = 1,..,n_i.$
- $y_{ij} = \beta_0 + (\text{NBT Math Score})\,\boldsymbol{\beta_1} + u_{0i} + e_{ij},\ i = 1,..,m, j = 1,..,n_i.$
- All models significant for first three semesters
- First model also significant for fourth semester

Faculty of Management and Commerce

Two predictor models

- $y_{ij} = \beta_0 + (\text{NBT AL Score})\boldsymbol{\beta_1} + (\text{NBT QL Score})\boldsymbol{\beta_2} + u_{0i} + e_{ij}, i = 1,.,m, j = 1,.,n_i.$
- $y_{ij} = \beta_0 + (\text{NBT AL Score})\boldsymbol{\beta_1} + (\text{NBT Math Score})\boldsymbol{\beta_2} + u_{0i} + e_{ij}, i = 1,.,m, j = 1,.,n_i.$
- $y_{ij} = \beta_0 + (\text{NBT QL Score})\,\boldsymbol{\beta_1} + (\text{NBT Math Score})\boldsymbol{\beta_2} + u_{0i} + e_{ij}, i = 1,.,m, j = 1,.,n_i.$
- Models significant only for first two semesters

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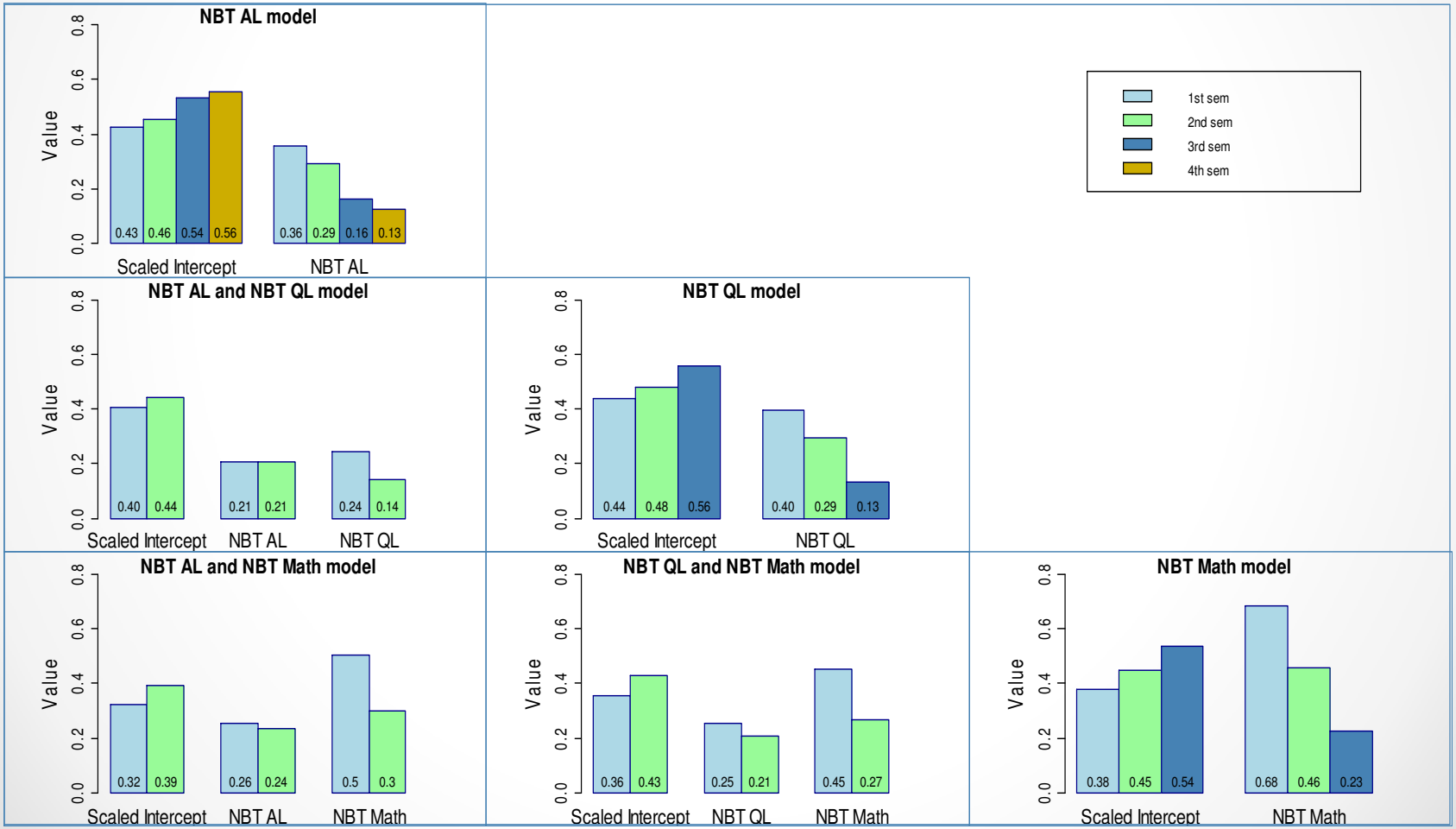

Discussion

- Differing faculty NBT - final marks relationship patterns over four semesters
- Faculty of Management and Commerce only faculty showing reduced effect after third semester
- Faculty of Science and Agriculture shows an increasing strength pattern with semester progression
- Faculty of Law, and Faculty of Social Sciences and Humanities show stable relationship patterns to NBT over all four semesters
- Progressing student cohort has higher pass rate and lower attrition rate

Conclusions / Future studies

- More detailed cohort analysis will allow for deeper exploration of NBT and student success relationship
- Study will be repeated with greater variety of success indicators and modelling
- Study will be complemented with 2013 cohort study

References

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