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The Viability and Sustainability of the BSc Maths and Statistics Programme of the ZOU, Midlands Region: A Time Series Analysis Model

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Abstract **– This study used mathematical models of time series analyses and questionnaires and interviews to investigate the viability and sustainability of the BSc Mathematics and Statistics (BSMS) programme at Zimbabwe Open University (ZOU) in the Midlands Region. In particular it also explored the trends in the turn-out, drop-out and pass rates of BSMS programme from 2007 to 2015. A mixed methods approach was used to collect and analyze data. Seventeen questionnaires were completed by students in different intakes in 2007 and 13 more students from various intakes in 2014 completed the same questionnaire. Informal interviews were carried out with ten students and five part-time tutors in 2014 and historical records on the studentship in the Midlands Region were collected from the regional archives. The statistical package SPSS 16.0 was used to analyze the data and records, which revealed that there was a low turn-out rate, high drop-out rate and a medium to low pass rate in the BSMS programme. From the informal interviews and questionnaires students expressed dissatisfaction with the quality of some of the modules and how the programme was generally being run. Part time tutors pointed out administrative and financial issues as factors affecting the viability of the programme. They offered suggestions to upgrade the programme to an Honours degree level by incorporating attachment and modules on Computer Applications and Research Methods. An analysis of the coursework marks at the Region showed that most students were doing very well in their courses but examination grades showed otherwise. Since examinations are marked at National Center and not in the regions, students were not happy on how queries on their examination grades were being handled. It is recommended that the resource materials need to be reviewed, new course modules and alternative delivery modes be put in place to improve the viability and sustainability of the programme.**

Keywords **– Drop-Out Rate, Pass Rate, Time Series Analysis Models, Turn-Out Rate, Viability, Sustainability, BSMS Programme.**

INTRODUCTION

The BSc Mathematics and Statistics Programme (BSMS) of the Zimbabwe Open University (ZOU) started in July 1999 in all ZOU's ten geographical regions when the university became fully fledged through an Act of Parliament in March 1999 [14], [13]. First year students were enrolled once a year but since 2010 they were enrolled twice, i.e., during Semester I (January to June) and Semester 2 (July to December). ZOU's vision is to become a world class open and distance learning university and the mission statement is that "ZOU exists to empower people through life-long learning thereby enabling them to realize their full potential in an affordable and flexible manner while executing their endeavours" [13] (p. 5). Some of its core values are dedication to the highest levels of excellence, creation of an innovative culture and delighting stakeholders. In the year 2000 it was observed that the first and second intakes totalled around 120 in the Midlands Region. This figure seemed to be dwindling as there were observed variations in the turn-out, drop-out and pass rates in the Midlands Region over the years 2000 to 2005. In the years 2007 to 2015 actual statistics on the studentship in the Midlands Region were captured by the researcher. It also seemed that views of the students and the general public towards the programme were becoming more and more negative. Maybe ZOU was not fulfilling its mission and core values. However, through exposure to Time Series Analysis in the modules BSTD 102 (Applied Statistics) and BSTD 304 (Time Series Analysis), tutors and their students could further pursue its applications especially those of mathematical modelling and forecasting using real life examples. It is therefore of mathematical and educational interest to explore the viability and sustainability of the BSMS programme using mathematical models such as time series analysis.

Statement of the problem

ZOU has often received negative sentiments from the press and the general public about the quality and accreditation of some of its programmes. For example, Zimbabwe Council for Higher Education (ZIMCHE) once suspended the BSc Counselling programme [5] and later lifted the suspension [6] while the Public Service Commission did not recognise ZOU's Diploma in Education (Primary) [10]. There have also been unconfirmed reports and threats that the BSMS programme is not viable and sustainable and that its lecturers or tutors might lose their jobs if enrolment does not increase.

Purpose of the study

The purpose of the study was to investigate the viability and sustainability of the BSc Mathematics and Statistics (BSMS) programme at ZOU Midlands Region using time series analyses plots and forecasts as mathematical models. The study also explored the viability and sustainability of BSMS programme using data captured from students' questionnaires and from informal interviews with some of the students and part time tutors.

Objectives of the study

(i) To study and model the trends in the turn-out, drop-out and graduation/pass rates of BSMS programme since 2007 to 2015 in the Midlands Region of ZOU.

(ii) To investigate the reasons for the specific trends in the turn-out, drop-out and graduation/pass rates in (i)

(iii) To explore the adequacy of resource materials in relation to the programme.

(iv) To recommend how the programme can be made viable and sustainable.

Hypotheses

1. H_0: The first year enrolment rate for ZOU BSMS programme is not declining.

   H_1: The first year enrolment rate for ZOU BSMS programme is declining.

2. H_0: The ZOU student drop-out rate is low and negligible.

   H_1: There is a high student drop-out rate (>10%) in BSMS programme at ZOU.

3.H_0: The ZOU student graduation rate in BSMS programme is not low.

   H_1: There is a low (<10%) student graduation rate in BSMS programme at ZOU.

4. H_0: The ZOU BSMS programme is viable.

   H_1: The ZOU BSMS programme is not viable.

5.H_0: The ZOU BSMS programme is sustainable.

   H_1: The ZOU BSMS programme is not sustainable.

[The null hypotheses are to be rejected or confirmed basing on the time series analysis trends and forecasts and also on questionnaire and interview data provided by the respondents and interviewees].

Definition of terms

1. Mathematical modelling

In this paper a model is defined as a simplified version or description of a real-world object or even an invisible or theoretical situation. Mathematical models can be physical representations of mathematical concepts (either in the form of diagrams, pictures or sculptures) or can be equations or formulas which are mathematical representation of reality [4]. The Consortium for Mathematics and its Applications [11], (p. viii) defines mathematical modelling as the use of mathematics to understand a situation in the real world and to use it to take action or even to predict the future.... This study used mathematical models of time series analysis to explore the sustainability of the BSMS programme. Questionnaire and interview data were used to predict the viability of the programme.

2. Time Series Modeler

A time series is "a set of observations obtained by measuring a single variable regularly over a period of time" [7] (p. 1). The Time Series (Expert) Modeler in SPSS 16.0 is a statistical procedure which creates models for time series and produces forecasts. It assumes that the dependent and independent variables are time series numeric data [7]. Since this study used empirical mathematical models which are based on examination of numeric data [8], statistical methods like those used in SPSS's Time Series Modeler were found to be suitable.

3. Viability

The term viability is defined in this paper as being synonymous to employability, usefulness or applicability.

4. Sustainability

Dictionary.com [2] defines sustainability as the ability to be supported, upheld or confirmed. If something is sustainable, then it is bound to have 'life' and to continue. This study used student turn-out rates, drop-out rates, pass rates/graduation rates as indicators of the sustainability of the BSMS programme at ZOU. Since no statistics for the actual number of students who had passed each module in a given semester could be obtained, the pass rate was approximated by the 'graduation rate.'

5. BSMS Programme

The BSMS programme at ZOU is a rigorous one with a total of 32 courses (modules) of which 16 are in Mathematics and the other 16 in Statistics. The entry requirements are a minimum of five 'O' level passes of grade C or better inclusive of English Language and Mathematics. Post 'O' level qualifications such as 'A' level, diploma or mathematics-related technical or teaching experience are added advantages. The degree can be attained in a minimum of 4 years and a maximum of 8 years through flexible open and distance learning. A student can graduate after passing at least 14 Mathematics and at least 14 Statistics courses. Currently there are no courses on offer for Research Methods or Computer Applications or requirements for Attachment during the course of study as is done in other universities.

II. MATERIALS AND METHODS

The students' questionnaire had 13 questions. Questions 1 to 5 asked for bio data of the respondents, questions 6 to 10 asked about the adequacy of the programme in terms of resources and challenges they were facing, while Question 11 asked students whether they believed there was a low pass rate, high drop-out rate and low turn-out rate in the ZOU BSMS programme. Questions 12 and 13 asked what could be done to make mathematics and statistics interesting, applicable and manageable and to provide any further suggestions on the topic. Interview questions were similar to those in the questionnaires but were asked in random order and sometimes in mother tongue. Ten students and five tutors were purposively selected during the second semester of 2014 and subjected to an informal interview to relax their tensions and yet were thoroughly probed so that they could freely give required and correct information. Seventeen questionnaires were completed by students who had been selected by convenience sampling from different intakes in 2007 and 13 more students conveniently sampled from various intakes in 2014 completed the same questionnaire. Historical records on the studentship in the Midlands Region were collected from the regional archives. The statistical package SPSS 16.0 was used to analyze the data and records. The study was carried out at the ZOU in the Midlands Region, Zimbabwe.

Limitations

ZOU comprises of ten geographical regions spread out in the provinces of Zimbabwe and one Virtual Region which operates from the National Centre in Harare. The study was carried out in only one of the ten geographical ZOU regions in the country and there was lack of sponsorship, time and resources to collect and compare data from other regions. It was found out later that some pieces of the data could only be accessed from the ZOU National Centre in Harare. Hence due to communication and logistical problems the timetable had to be readjusted and objectives had to be rephrased. Thus results of this study cannot be generalised to the other regions and the time series modelling does not explain and explore fully the viability and sustainability of the BSMS programme. One limitation of models is that they should not be taken to be the reality [12]. Hence questionnaire and interview methods had to be used to verify the quantitative results. Despite these limitations ZOU faculty and department responsible for BSMS programme could use the information for programme planning, development and marketing purposes.

III. Results and Discussion

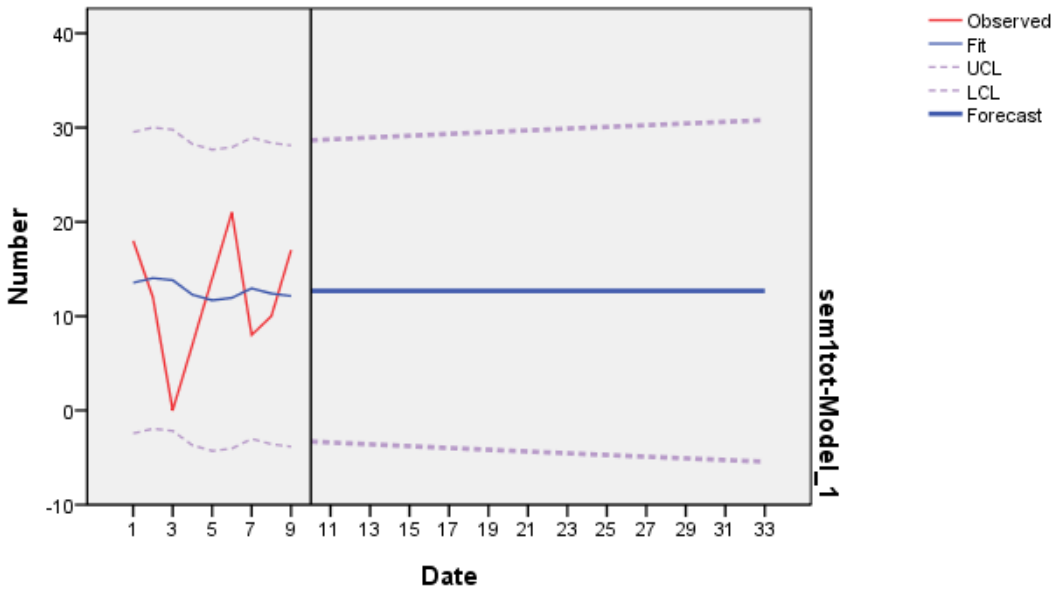
Quantitative Data of BSMS studentship at ZOU-Midlands is presented, analysed and discussed first followed by questionnaire data and last but not least interview data.

Table 1 Showing BSMS Studentship from 2007 to 2015

Year		2007	2008	2009	2010	2011	2012	2013	2014	2015
Semester 1	Total	18	12	#	7	14	21	8	10	17
	New	4	7	#	3	8	9	3	1	6
	Drop	#	13	#	3	2	5	6	0	3
	Grad	0	0	0	0	0	0	0	0	0
Semester II	Total	#	#	7	8	17	11	9	14	#
	New	#	#	2	2	11	1	2	4	#
	Drop	#	#	7	1	8	11	1	0	#
	Grad	5	0	5	0	2	1	0	1	#

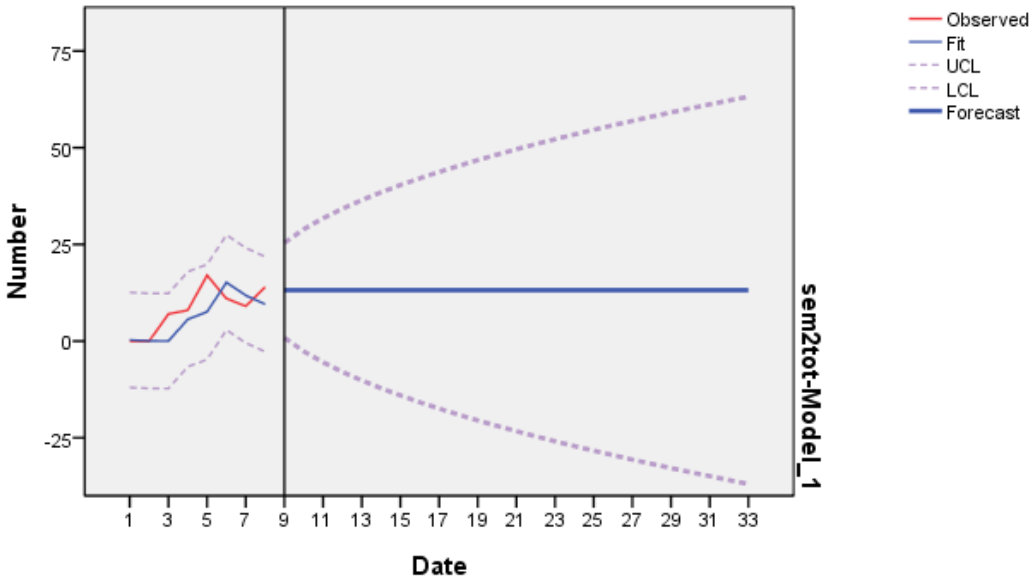
Key: Semester I=January to June, Semester II= July to December, Total=Total for all intakes, New =First Years, Drop=dropped, Grad= Graduated, # means no figures were available.

In Table 1 there were no drop-out figures for Semester 1 of 2007 since this was the base year for the study (i.e. the reference point or initial period of data collection). The absence of enrolment figures for some semesters in 2007 to 2009 could be explained by the fact that ZOU was not enrolling students for BSMS programme every semester or twice a year as became the case from 2010 to 2015. The write up of this study was done in the first semester of 2015 and this explains the absence of data for Semester II of 2015. SPSS 16.0 was used to analyse data and find models for the First Year enrolment, total enrolment and drop-out rates. The SPSS Expert Modeler was preferred because, "it automatically identifies and estimates the best-fitting ARIMA or exponential smoothing model for one or more dependent variable series, thus eliminating the need to identify an appropriate model through trial and error" [7] (p. 3). The results are shown in the following time series plots:



Plot 1: Semester 1 Totals modelled by Expert Modeler

Plot 1 shows Semester 1 total enrolment figures which fluctuated up and down between 0 and 21. The forecast shows that total enrolment will likely remain between 15 and 20 with a possible upper confidence limit (UCL) of 28.65 and lower confidence limit (LCL) of -3.3. However, the 'Fit' curve looks like it is somehow steadily decreasing. The forecasted Semester 1 total was 12.68. Stationary R square value was 0.337. This value "provides an estimate of the proportion of the total variation in the series that is explained by the model and is preferable to ordinary *R*-squared when there is a trend or seasonal pattern" (IBM Corporation 2012, p. 67), as was the case in this study.



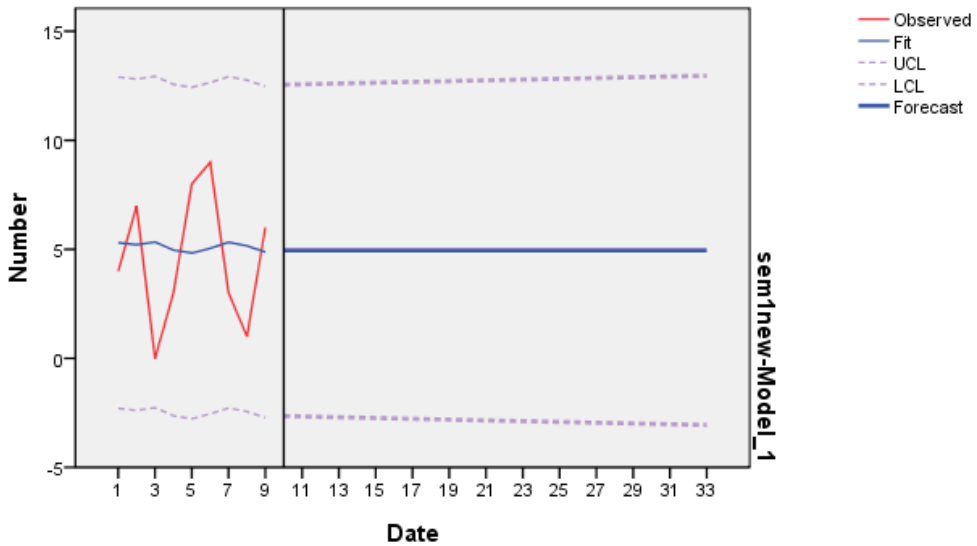
Plot 2: Semester 2 Totals modelled by Expert Modeler

Plot 2 shows a somewhat increasing trend for Semester 2 totals between periods (Date) 1 and 9. Expert Modeler gave a LCL of 0.85 and UCL of 25.42. The forecasted Semester 2 total was 13.14 ≈ 14 students. However, stationary R square was negative (-0.125) meaning that this model was worse than the baseline model although it could still be considered to be a significant (t=2.143, α=0.069) predictor of Semester 2 totals. Comparison with totals for 1999 to 2006 as indicated in Table 2 below shows that on the whole Semester 1 and 2 totals for 2007 to 2015 had declined.

Table 2: Enrolment for BSMS 2000-2006

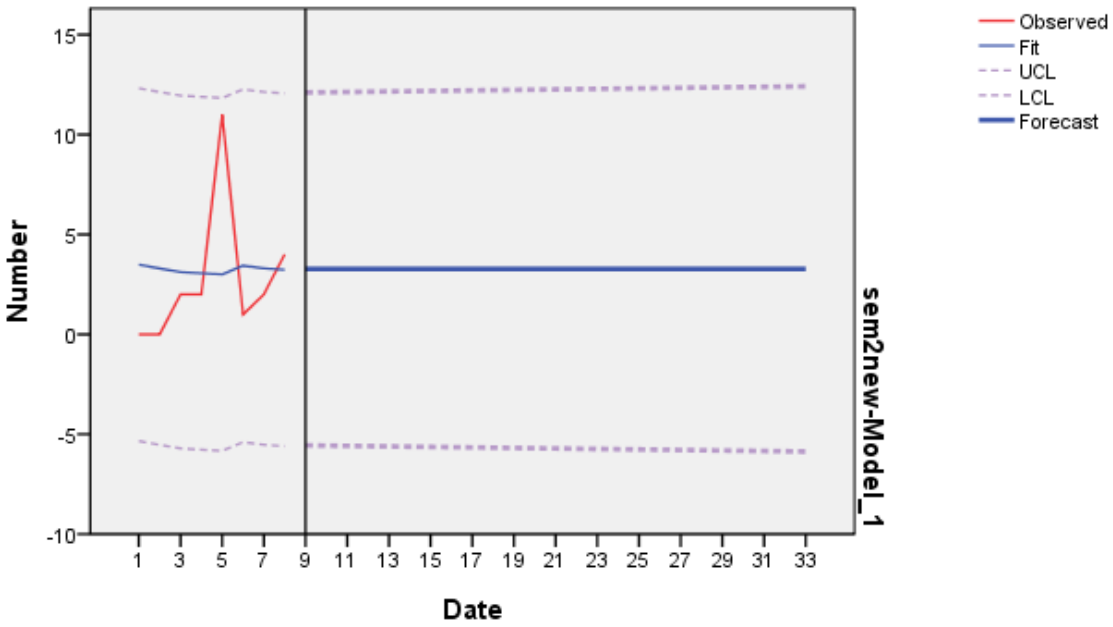
2000	2001	2002	2003	2004	2005	2006
Intake 2	Intake 3	Intake 4	Intake 5	Intake 6	Intake 7	Intake 8
75	67	13	10	22	22	Sem 1: 12, Sem 2: 5

Source: ZOU Midlands Region Archives



Plot 3: Semester 1 New modelled by Expert Modeler

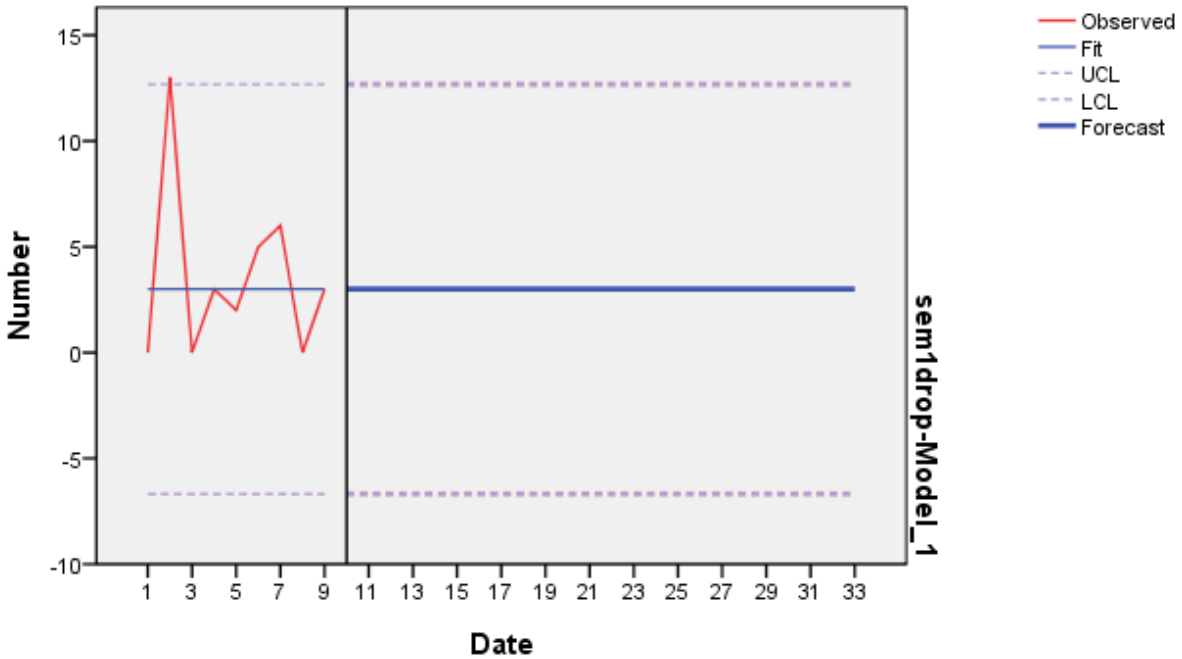
Plot 3 shows an up and down fluctuating scenario for Semester 1 enrolment for first year (New) students. The UCL was 12.55 and LCL was -2.65. However the 'Fit' curve shows a smoothed pattern close to 5 but looking like being on the decline while the 'Forecast' value was 4.95. Stationary R square was 0.459 thus explaining about 45% of the variance in the dependent variable as accounted for by the model.



Plot 4: Semester 2 New modelled by Expert Modeler

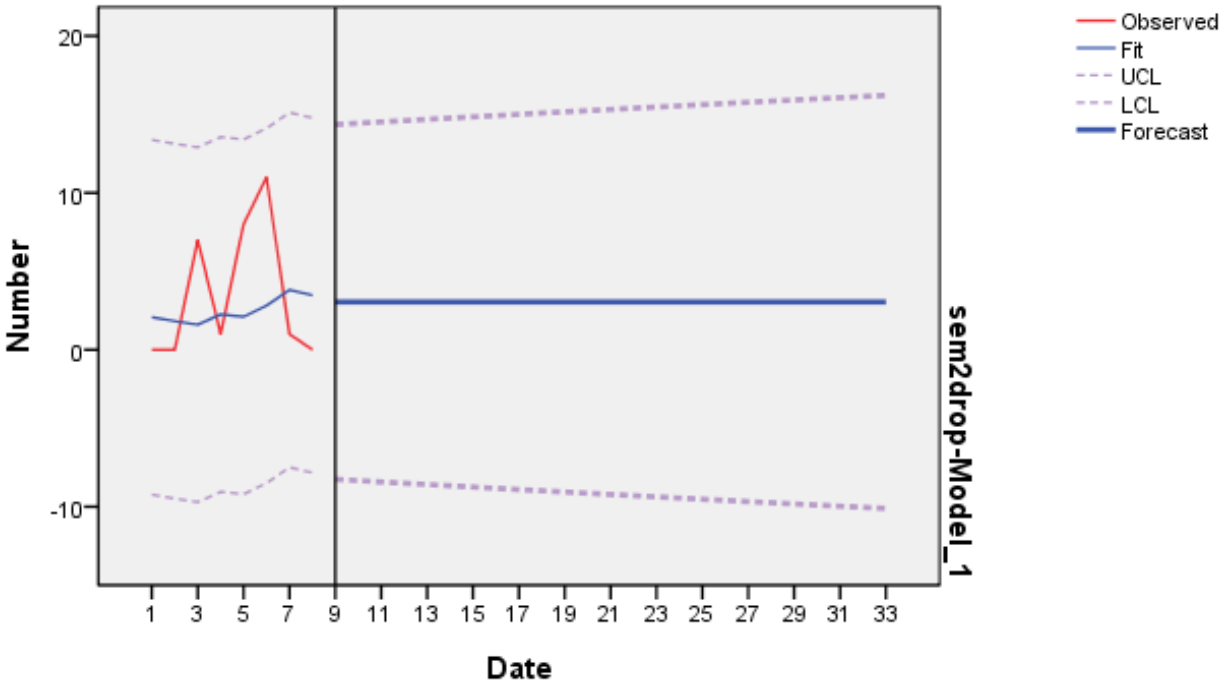
Plot 4 depicts an increase in the first year enrolment figures for Semester 2 with a peak of more than 10 students during period 5 (year 2011). However the figures declined thereafter to below 5. The UCL was 12.11 and LCL was -5.56. The 'Fit' curve shows a somewhat constant or declining trend. The forecasted figure was 3.27. Stationary R square was 0.545 showing that 54.5% of the variability in the Semester 2 enrolment for first year students was explained by the model.

The forecasted 'total' and 'new' figures gave estimated enrolment rates of 39.03% for Semester 1 and 24.88% for Semester 2 which seemed to be low and on the decline. Combining this observation with the analyses given in Plots 3 and 4, $1H_0$ is rejected and hence it is concluded that the first year enrolment rate for BSMS programme is declining.



Plot 5: Semester 1 Drop-out modelled by Expert Modeler

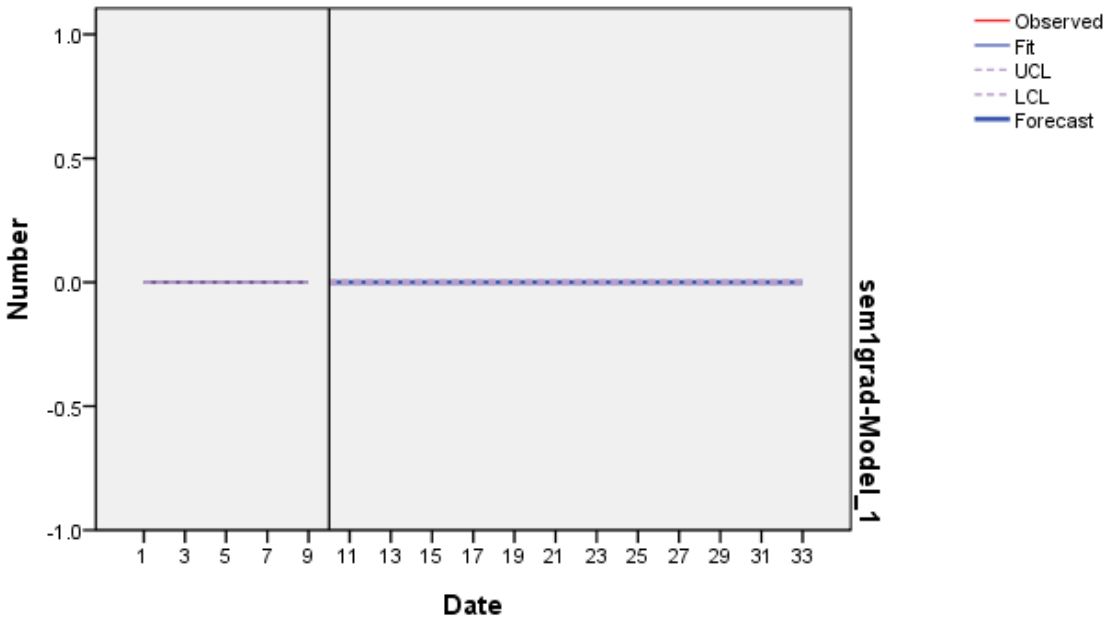
Plot 5 gives a picture of the student drop-out rate. The observed values show an up and down fluctuating pattern while the 'Fit' curve shows a constant drop-out figure of 3 students which coincides with the forecasted figure. The UCL for the drop-out figures was 12.68 and LCL was -6.68. The stationary R square was 0.672 accounting for 67.2% of the variance in the stationary part of the model as compared to the simple mean model.



Plot 6: Semester 2 Drop-out modelled by Expert Modeler

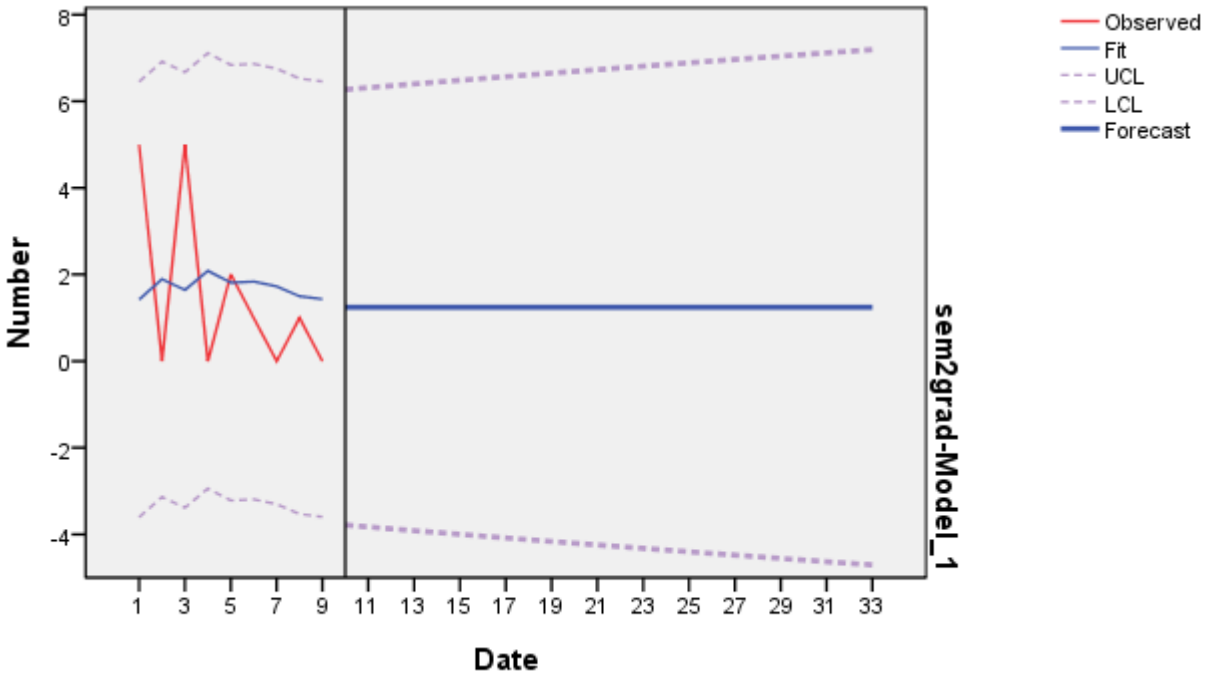
The observed values for Semester 2 drop-out figures in Plot 6 show an up and down fluctuating pattern while the 'Fit' curve appears to show a steadily increasing trend. The UCL was 14.36 and the LCL was -8.25 while the forecasted value was 3.05. The model produced a stationary R square value of 0.362.

The forecasted 'total' and 'drop-out' figures give estimated drop-out rates of 23.65% for Semester 1 and 23.21% for Semester 2. These results and the analysis given for Plot 6 lead to the rejection of $2H_0$ and therefore it is concluded that there is a high student drop-out rate (>10%) in BSMS programme at ZOU.



Plot 7: Semester 1 Graduates modelled by Expert Modeler

Plot 7 shows that no students graduated during Semester 1. This is explained by the fact that at ZOU graduation takes place at National Centre in Harare. The ceremony is carried out during the second semester in the month of November or December of each year.



Plot 8: Semester 2 Graduates modelled by Expert Modeler

The observed values in Plot 8 for Semester 2 graduates show an up and down pattern with an overall declining trend. The 'Fit' curve also shows a somewhat decreasing pattern. The UCL was 6.27 and LCL was -3.78. The forecasted value for the number of graduating students in Semester 2 was 1.24. The stationary R square value was 0.684 implying that about 68% of the variance in the dependent variable was accounted for by the model. The forecasted 'total' and 'graduate' figures gave an estimated graduation rate of 9.4% for Semester 2. Thus the third hypothesis ($3H_0$) is rejected and it is concluded that there is a low (<10%) student graduation rate in BSMS programme at ZOU. However, the pattern of graduates has been: 5 for 2007-2008/2009, 4 for 2007-2014, while one who enrolled in 2010 is expected to graduate in November/December 2015.

IV. Questionnaire Data Analysis

Table 3: Demographic Data of the Respondents for Questions 1-5 (% in brackets)

Gender	Occupation	Age in yrs	Intakes	Qualification
Male 23 (66.7)	Teacher 19 (63.34)	21-25: 3 (10)	6-9: 16 (53.3)	'O' level 2 (6.7)
Female 7 (23.3)	Technician 3 (10)	26-30: 6 (20)	12-22: 14 (46.7)	'A' level 13 (43.3)
Total 30 (100)	Train driver 1(3.33)	31-35: 9 (30)	Total 30 (100)	Diploma 12 (40)
	Parks Ranger 1(3.33)	36-40: 7 (23.3)		'A' level & Diploma 2 (6.7)
	Met Officer 1(3.33)	41-45: 2 (6.7)		CE 1(3.3)
	Draughtsman 1(3.33)	46-50: 3 (10)		Total 30 (100)
	Unemployed 4 (13.34)	Total 30 (100)		
	Total 30 (100)			

Key: 'O' level = Ordinary level, 'A' level = Advanced level, CE= Certificate in Education.

Table 3 shows that most of the students who enrolled for BSMS were male (67.3%) which confirms the widely held belief that mathematics is a male domain. Since ZOU is an open and distance learning (ODL) institution, its openness and flexibility allows both employed and unemployed people to enrol in any suitable programme. Table 3 shows that most of the BSMS students were teachers (63.34%) followed by unemployed (13.34%) and other students employed in other careers (23.32%) which might be directly or not directly related to mathematics and statistics. Most of the students were in the age group 31-40 years (53.3%) with an average age of 34.3 years. Thus the majority of the students in BSMS programme are relatively mature. Two students had the minimum entry qualification (at least five 'O' levels including English and Mathematics only) while the rest had post 'O' level

qualifications.

For Questions 6-9, the majority of students (96.7%) strongly believed their qualifications to be adequate for the programme while one (3.3%) was undecided. Of the students 13 (43.3%) indicated that they were finding modules to be difficult, 11 (36.7%) indicated modules were not difficult while 4 (13.3%) were undecided and 2 (6.7%) did not respond. Although some students indicated that the modules were difficult the majority (80%) were however satisfied with the program in which they had enrolled. Those who were not satisfied with the programme (Question 9) cited the following challenges: printing errors in the modules, insufficient information and unclear examples in the modules, inadequate study and reading materials in the library, less time for face to face tutorials, assignments and tests solutions taking too much time to arrive from National Centre, getting insufficient help from tutors, pressure of duties and marriage problems.

When asked whether they believed there was a low turn-out rate, high drop-out rate and low pass rate in BSMS programme (Questions 10-12), the students responded as indicated in Table 4.

Table 4: Responses to turn-out, drop-out and pass rates in BSMS programme (%)

	Low turn-out rate	High drop-out rate	Low pass rate
Yes	28 (93.3)	24 (80)	18 (60)
No	2 (6.7)	5 (16.7)	9 (30)
Undecided	0 (0)	1 (3.3)	3 (10)
Total	30 (100)	30 (100)	30 (100)

The results in Table 4 indicate that most students believed there was a low turn-out rate, high drop-out rate and low pass rate in BSMS programme. The low turn-out and high drop-out rates seem to be confirmed by the studentship figures in Table 1 while the actual pass rate could not be confirmed since it was not mandatory for students to avail their results slips to their tutors. Lists of graduating students were usually prepared from the Academic Registry at National Centre which had the data base of all students including their examination and coursework profiles. The researcher could only get the numbers of graduating students in BSMS programme at regional level.

Question 13 asked respondents what could be done to make mathematics and statistics interesting, applicable and manageable and to provide any further comments and suggestions on the topic. The responses were that ZOU should lower the fees and put in place a student friendly fees payment plan, provide adequate learning resources, introduce internet and e-learning platform or online class, review BSMS modules, increase tutorial time, introduce practical statistical and mathematical computer packages apart from just theorising them and integrate study and work through field-work or attachment. These suggestions could be considered as possible solutions to the challenges mentioned in Question 9.

V. Interview Data Analysis

Separate interviews carried out with ten students (randomly selected from those who had completed the questionnaire) and five part time tutors produced the following opinions, views, challenges and suggestions pertaining to the viability and sustainability of the BSMS programme:

Summary of Students' Voices

- There are a lot of errors on examination papers eg BSTD 204, BSTD 203 and BMTD 302. There are no maths and statistics past examination papers on the ZOU website unlike for similar programs in other universities.

- Most of the BSMS courses do not have workbooks.

- Some modules have weak development of concepts and do not have clearly worked out examples. Some modules lack real life applications and have too many referrals.

- The library does not have enough mathematics and statistics text books and the few available ones are outdated. We are not allowed to borrow books two weeks before the examinations. The librarians do not follow the library time table.

- Group discussions are not viable because of few numbers.

- There are no computer courses for BSMS program.

- There are few tutorial sessions for a challenging programme like BSc Mathematics and Statistics and we need more of weekend schools. There are too many required courses for one to complete the degree and yet BSMS is a general degree.

- Our tutors do not explain the usefulness, applicability and opportunities offered by this programme.

- I have a lot of financial constraints and ZOU should put in place a user friendly fees payment plan.

- Our fellow students lack the confidence of doing a mathematics and statistics degree through ODL. They would rather receive lectures with explanations and worked out examples rather than shallow and short tutorials.

The interviewees mentioned these issues as the reasons why there was a low turn-out and high drop-out rate in BSMS programme. They said these factors were also affecting the pass rate in BSc Mathematics and Statistics.

Summary of Part time Tutors' Voices

- There is no research methods module for BSMS programme and yet all university students should be introduced to research work.

- There is too much theorization in BSMS course and students lack hands on and practical skills.

- It is high time for ZOU as an ODL institution to have online (e-learning) classes. BSMS programme is a good one but should be upgraded to an honours programme.

The concerns and issues which were raised by the students and part time tutors were valid and credible. The researcher has often raised similar points in his monthly reports sent to the National Centre. In spite of some challenges which they mentioned, both students and tutors agreed that the BSMS programme is useful, applicable in a variety of contexts and increases promotion chances and employability status of the graduates. From these findings $4H_0$ is not rejected and it can be concluded that the BSMS programme is generally viable to some extent. It needs some review to enhance its viability.

Questionnaire and interview data and the low enrolment figures provided sufficient evidence to reject $5H_0$. Hence it can be concluded that the BSMS programme is not sustainable and might phase itself off.

VI. Discussion

Viability and sustainability factors emerging from Questionnaire and Interview Data

Time series analyses carried out on the studentship figures in BSMS programme at ZOU from 2007 to 2015 showed that the turn-out rate was low and tended to be decreasing. The drop-out rate was high and tended to be increasing. The programme seemed to enrol mostly teachers. The graduation rate was found to be less than 10% and it was forecasted that in 2015 the BSMS programme could have one or no graduating students. The low numbers do not seem to sustain the programme. Hence $5H_0$ is again rejected.

Factors that emerged from the questionnaire and interview data can be grouped into library related factors, module related factors, tutorial quality and tutorial time related factors, fees related factors and factors related to the nature, applicability and relevance of the BSMS programme itself. Prior to the year 2009 there were no internet facilities in the ZOU Midlands region and the e-learning platform is not fully functioning up to now (2015). Most students in the BSMS programme are not aware of statistical packages or the use of e-resources apart from just 'googling.'

Similar challenges encountered by students studying with ZOU in Mashonaland East Region were investigated and described by Rupande [10], most of them being missing results (48%), need to improve assignment turn-around time (75%), need to introduce e-learning (30%), need to enhance supervision and monitoring of tutorials (42%), reduction of fees (40%), need for practical skills through technical and vocational courses and hard sciences (38%) and the need to computerise the library (58%). These challenges also affect the sustainability and viability of the BSMS programme. Dholakia, King and Baraniuk [1] in trying to come up with a sustainability model for open education programmes (OEP) have identified understanding the users, revenue issues, partnerships issues and value component (staying true to vision, mission and core values) as factors that make an OEP sustainable. Ferns, Oliver, Jones and Kerr [3] identified criteria and indicators for course sustainability as course quality (value, experience, graduate destination, pass rate, retention rate) and course viability (international demand, direct application, financial profile, enrolments). In this study value of the programme, applicability of the degree, financial issues, drop-out rates (as opposite of retention rates) were used to model the viability and sustainability of the BSMS programme. In particular time series analysis models as well as findings from questionnaire and interview data provided pieces of evidence on which to gauge the viability and sustainability of the programme. Different institutions can use different criteria and indicators to assess viability and/or sustainability of their programmes but as Reed [9] (p 1) has pointed out, "There is need for a process by which at risk programmes can be systematically identified and reviewed for viability in a timely manner." ZOU can come up with its own Programme Viability and Sustainability Review Model.

VII. Conclusion

- ODL Students at ZOU lack opportunities and skills to practice hands on activities such as modelling of real life situations. The Mathematical Modelling course exists in the BSMS programme but has never been on offer and a module has never been produced for this course.
- Mathematical modelling (like time series models) can be used to explain trends and forecasts in programme enrolments, drop-out rates graduation rates and even pass rates.
- Mathematical modelling results are critical. They help institutions such as universities to have a basis on which to review, terminate, downsize, or upgrade their educational programmes in order to meet their vision, mission and priorities.
- ZOU Midlands students for BSMS programme generally do well in assignments (coursework) but examinations are marked centrally in Harare. Tutors are not privy to students' final results hence it cannot be concluded that there is a low pass-rate in the BSMS programme.
- The results of this study support the conclusions that there is a low turn-out rate, high drop-out rate and low graduation rate in BSMS programme at ZOU.
- The BSMS programme at ZOU is generally viable but there are some challenges which may affect its sustainability.

Recommendations

1. Mathematical modelling should be included as a compulsory course in BSMS programme. The Mathematics and Statistics department should find people who can write a good module and a workbook for this course.
2. ZOU departments and faculties should regularly collect and analyse statistics about student enrolments, drop-out rates, pass rates and graduation rates. Such data are useful to assess the future of their programmes.
3. There is need to review all modules in the BSMS programme, include modules on Computer Applications and Research Methods, include the component of

attachment or field work and upgrade the programme to an Honours status.

4. Tutors should be availed with their students' results in order to compute pass rates which help as sustainability checks or indicators.

5. The BSMS programme should be well supported in terms of library resources, computers and e-resources (including e-lectures and videos), more tutorial time, qualified and dedicated tutors in order to increase student enrolment, lower drop-out rates and add value to the final student-product as well as to ZOU at large.

6. ZOU should set up a programme viability and sustainability review committee at department, faculty or even senate level.

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