Master of Science
Statistics & Mathematics

Academic Session 2015/2016

School of Mathematical Sciences
CONTENTS

Academic Calendar 2015/2016 iii
Important Dates for Full Time Candidates: Dissertation Courses MAT510/20 and MST566/20 iv
Important Dates for Part Time Candidates : Dissertation Courses MAT510/20 and MST566/20 v

MASTER IN STATISTICS

OBJECTIVES 1

PROGRAM STRUCTURE

COURSES

SYNOPSIS OF STATISTICS COURSES 2

1.0 MST561/4 : Statistical Inference (Pentaabiran Statistik) 2
2.0 MST562/4 : Stochastic Processes (Proses Stokastik) 3
3.0 MST564/4 : Statistical Reliability (Kebolehkepercayaan Statistik) 4
4.0 MST65/4 : Linear Models (Model Linear) 5
5.0 MST566/20 : Dissertation (Disertasi) 6
6.0 MST567/4 : Categorical Data Analysis (Analisis Data Berkategori) 7

LIST OF DISSERTATION SUPERVISORS (MST566/20) 8

MASTER IN MATHEMATICS 10

SYNOPSIS OF MATHEMATICS COURSES 11

1.0 MAT510/20 : Dissertation (Disertasi) 11
2.0 MAT514/4 : Mathematical Modelling (Pemodelan Matematik) 11
3.0 MAT515/4 : Computational Mathematics (Matematik Pengiraan) 12
4.0 MAT516/4 : Curve and Surface Methods for CAGD (Kaedah Lengkung dan Permukaan untuk RGBK) 15
5.0 MAT517/4 : Computational Linear Algebra (Aljabar Linear Pengiraan) 15
6.0 MAT518/4 : Numerical Methods For Differential Equation (Kaedah Berangka untuk Persamaan Pembezaan) 17

LIST OF DISSERTATION SUPERVISORS (MAT510) 18

GUIDELINES FOR PREPARATION OF PROJECT 21

APPENDICES

- Appendix A : Harvard System 30
- Appendix B : Dissertation Supervisor Confirmation Form 32
- Appendix C : Dissertation Re-Submission Form 33
- Appendix D : Dissertation Re-Submission Form for Examination 35
- Appendix E : Final Dissertation Submission Form 37
# ACADEMIC CALENDAR - ACADEMIC SESSION 2015/2016

**FOR ALL SCHOOLS (EXCEPT THE SCHOOL OF MEDICAL SCIENCES AND SCHOOL OF DENTAL SCIENCES)**

*Registration for New Students / Orientation Week 1-6 September 2015

<table>
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<tr>
<th>SEM</th>
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<td>Mid Semester Break</td>
<td>Monday, 09.11.2015 - Sunday, 15.11.2015</td>
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<td>Mid Semester Break (4 Week)</td>
<td>Monday, 18.01.2016 - Sunday, 24.01.2016</td>
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<td>Examinations (3 Week)</td>
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<td>Long Vacation/ Industrial Training/ KSCP (10 Week)</td>
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<td>07.07.2016, Thursday &amp; 08.07.2016, Friday - Eid-ul fitr</td>
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*KSCP
IMPORTANT DATES FOR FULL TIME CANDIDATES
DISSERTATION COURSES MAT510/20 AND MST566/20

ACADEMIC SESSION 2015/2016

Candidates submit the supervisor confirmation form to the General Office, School of Mathematical Sciences on or before **18 December 2015**

Candidates register 2nd Semester course, Academic Session **2015/2016**
* Candidates are required to have accumulated **12 units**

Deadline for candidates to submit 4 copies (soft cover) for examination on or before **43rd week** of Academic Calendar Academic Session **2015/2016**

Seminar & Viva voce will be held on **45th – 47th week** of Academic Calendar – Academic Session **2015/2016**
IMPORTANT DATES FOR PART TIME CANDIDATES
DISSERTATION COURSES MAT510/20 AND MST566/20
(for 2015/2016 intake)

ACADEMIC SESSION 2015/2016

Candidates submit the supervisor confirmation form
to the General Office, School of Mathematical Sciences
on or before 31 Julai 2015

Candidates register Semester I course, Academic Session
2015/2016
* Candidates are required to have accumulated 12 units

Deadline for candidates to submit 4 copies (soft
cover) for examination on or before 43rd week of
Academic Calender Academic Session 2015/2016

Seminar & Viva voice will be held on 45th – 47th
week of Academic Calendar – Academic Session
2015/2016

Submission date of supervisor confirmation form for part-time students
for intake Academic Session 2015/2016 is on or before 17 June 2016.
MASTERS IN STATISTICS

A. OBJECTIVE

The objective of the program is to produce experts in the field of statistics who are able to undertake research and development activities in addition to the teaching of statistics at the postgraduate level.

B. PROGRAM STRUCTURE

Students are required to obtain at least a B grade for the 20 units taught courses, pass the dissertation course and achieve a CGPA of at least 3.0.

C. COURSES

MST561/4 : Statistical Inference (Pentaabiran Statistik)
MST562/4 : Stochastic Processes (Proses Stokastik)
MST564/4 : Statistical Reliability (Kebolehpercayaan Statistik)
MST565/4 : Linear Models (Model Linear)
MST566/20 : Dissertation (Disertasi)
MST567/4 : Categorical Data Analysis (Analisis Data Berkategori)

For full time students, the minimum period given to complete the program is 12 months with a maximum period of 24 months. For part time students, the minimum period is 24 months and a maximum of 48 months.

Full time students have to register MST561/4, MST562/4, MST564/4 and MST567/4 in the first semester, and MST565/4 and MST566/20 in the second semester. Part time students are encouraged to seek the advice of the Deputy Dean (Research) concerning course registration.
SYNOPSIS OF STATISTICS COURSES

1.0 MST561/4 Statistical Inference (Pentaabiran Statistik)

Aim
To introduce the students to basic statistical theory at an advanced level.

Description
This course will cover basic statistical theory at an advanced level. Point estimation theory, interval estimation theory, Bayesian procedures and hypothesis testing theory will be done at a theoretical level.

Syllabus


Interval Estimation: Confidence Intervals for Small and Large Samples. Methods of Constructing Confidence Interval.

Hypothesis Testing: Type I & Type II errors, non-randomized test, randomized test critical region, critical function, power of a test, power function, Most Powerful Test, Uniformly Most Powerful Test, Unbiased Test, Invariant Test, Likelihood Ratio Test. Generalized Likelihood Ratio Test.

Skills and Knowledge Acquired
At the end of the course the students will have a better appreciation of statistical theory. They will see that many of the statistical procedures that are taught at an elementary level are actually optimal.

References
2.0 MST562/4 Stochastic Processes (Proses Stokastik)

Aim

To introduce the students to basic stochastic processes.

Description

This course will cover stochastic processes. Students will be exposed to Markov processes and its applications. Poisson processes, branching processes, birth and death processes will be discussed. Applications to Queuing Theory will be given.

Syllabus


Skills and Knowledge Acquired

At the end of the course, the students will have a better appreciation of stochastic processes. They will be able to identify many of the phenomena that occur as random processes and apply the tools taught to these problems.

References

3.0 MST564/4 Statistical Reliability (*Kebolehkepercayaan Statistik*)

**Aim**

To introduce the models and statistical methods for survival data analysis, both in biomedical and reliability research.

**Description**

This course introduces the basic and most commonly used statistical methods of analyzing lifetime data. Both parametric and nonparametric models and procedures are included with applications in various fields, especially in the biomedical sciences and reliability engineering. This course also considers system lifetimes and system structure.

**Syllabus**

Introduction to reliability/survival concepts, examples of reliability data and the different types of censoring.

Lifetime Distribution: survivor/reliability function, hazard function and cumulative hazard function, mean lifetime and residual lifetime (MTTF/MTBF), distribution classes (IFR and DFR), likelihood function construction under different types of censoring.

Parametric Lifetime Models: exponential distribution, Weibull distribution, lognormal distribution, extreme value distribution and other distributions such as the gamma, logistic and the loglogistic distribution.

Estimation of survival function and other related functions, estimation from censored data (Kaplan-Meier) and the confidence interval, tests on survival function.

Probability plotting: linearizing the exponential, Weibull and other distributions, graphical goodness-of-fit.

Parametric Estimation of Models: for complete and censored data; exponential, Weibull and other models, planning life tests, estimation and test procedures under different types of censoring.

Regression Models: accelerated lifetime model and the proportional hazards model.

System Reliability: structure functions, block diagram, minimal path and cut sets, reliability functions.

Repairable Systems: point processes and availability.

Industrial visit or industrial talk will be one of the component in this course focusing on the application of statistical reliability in industry and real life situation.

**Skills and Knowledge Acquired**

The students should be able to handle the appropriate method to analyse survival data using statistical packages.
References


4.0 MST565/4 Linear Models (*Model Linear*)

Aim

To introduce the basic theory of linear models to the students with applications to analysis of variance models and linear regression analysis.

Description

Basic theory of Linear Models will be developed. Applications to ANOVA and Regression models will be discussed. This course will cover various types of Linear Models along with corresponding estimation procedures and testing of hypotheses. Statistical software packages will be used in this course.

Syllabus

Introduction to Linear Models: Simple Linear Regression Model, Multiple Linear Regression Model, Analysis of Variance Models.


Quadratic Forms and Their Distributions: Sums of Squares, Mean and Variance of Quadratic Forms, Distribution of Quadratic Forms, Independence of Linear Forms and Quadratic Forms

Simple Linear Regression: The Model, Estimation of Parameters, Hypothesis Test and Confidence Interval for Parameters, Coefficient of Determination.


Tests of Hypotheses for Multiple Regression Parameters: Test of Overall Regression, Test on a Subset of Parameters, The General Linear Hypothesis Tests, Testing One or Several Parameters,

Model Validation and Diagnostics: Residuals, The Hat Matrix, Outliers, Influential Observations and Leverages.


Skills and Knowledge Acquired

At the end of the course, the students will be able to use the knowledge acquired to solve statistical problems related to a wide range of linear models in various fields of applications.


References


5.0 MST566/20 Dissertation (Disertasi)

All students are required to submit the Dissertation Supervisor Confirmation Form (APPENDIX B) no later than week 10 of the first semester of the academic session (November). For all students, a minimum of 12 units have to be accumulated before they are allowed to register for this course in the month of February (during the second semester registration). There will be an interim viva/presentation around the 4th week of the second semester consisting of the background study, objectives and methodology to determine the direction of the research.

Full time and part time students are required to submit their dissertation (after confirmation by their respective supervisors) no later than a date that will be determined in June 2014. Within 1 – 2 weeks after this date, there will be a seminar presentation (30 mins) and finally the viva. The viva will begin with a short oral presentation by the student regarding his/her achievements followed by a question and answer session.

Details are available in the GUIDE FOR DISSERTATION PREPARATION.

The above-mentioned dates are subjected to changes and further information on this matter will be displayed on the School of Mathematical Sciences notice board from time to time.
6.0 MST567/4 Categorical Data Analysis (*Analisis Data Berkategori*)

**Aim**

To expose students the proper method of analyzing categorical data, interpreting parameters in the model and checking adequacy of models using statistical packages such as SPSS and SAS.

**Description**

Introduction to the analysis of discrete data, fitting log-linear models; linear logistic regression models; goodness of fit tests; residual analysis; applications with the use of statistical packages.

**Syllabus**


Three-way contingency tables, marginal and conditional independence; Simpson’s paradox; Common odds ratio estimate in stratified 2x2 tables; Measures of association in IxJ tables. Log-linear model: representation, interpretation. Fitting log-linear model: likelihood method; test of goodness of fit. Model building strategies, models for ordinal data, test of conditional independence based on models.


Logistic regression model for binary outcome: model interpretation; parameter estimation and inference. Goodness of fit and residual analysis. Logistic regression for case-control design; matched case-control design and conditional logistic regression.


**Skills and Knowledge Acquired**

After following the course, students should be able to handle the appropriate method to analyse categorical data and to interpret the results.

**References**

**LIST OF DISSERTATION SUPERVISORS (MST566/20)**

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<th>BIL.</th>
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<tbody>
<tr>
<td>1.</td>
<td>ADAM BAHARUM BSc, MSc W. MICHIGAN</td>
<td>Mathematical Programming, Inventory Control, Reliability and Maintenance Modelling</td>
<td>Room No. : 121 <a href="mailto:adam@usm.my">adam@usm.my</a> Ext. No. : 3942</td>
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<td>2.</td>
<td>ADLI MUSTAFA BSc, MSc W. MICHIGAN PhD NUS</td>
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<td>Room No : 136 <a href="mailto:adli.mustafa@usm.my">adli.mustafa@usm.my</a> Ext. No. : 3968</td>
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<td>3.</td>
<td>FAM PEI SHAN BSc, MSc, PhD UM</td>
<td>Categorical Data Analysis</td>
<td>Room No. : 09 (Kabin B) <a href="mailto:fpeishan@usm.my">fpeishan@usm.my</a> Ext. No. : 5908</td>
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<td>4.</td>
<td>JOSHUA IGNATIUS BSc, MSc, PhD USM</td>
<td>Business Research Methods, Structural Equations Modeling, Supply Chain Analysis, Industrial Engineering Optimization Processes</td>
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<td>5.</td>
<td>HUSNA HASAN BSc IOWA MSc W. MICHIGAN PhD USM</td>
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<td>6.</td>
<td>LOW HENG CHIN BSc, PhD LIVERPOOL</td>
<td>Statistical Theory, Practical Applications of Statistics</td>
<td>Room No. : 037 <a href="mailto:hclow@usm.my">hclow@usm.my</a> Ext. No. : 3641</td>
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<td>7.</td>
<td>MICHAEL KHOO BOON CHONG B.App.Sc, PhD USM</td>
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<td>Room No. : 120 <a href="mailto:mkbc@usm.my">mkbc@usm.my</a> Ext. No. : 3941</td>
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<td>8.</td>
<td>MOHD TAHIR ISMAIL B.App.Sc, MSc USM PhD UKM</td>
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<td>Room No. : 131 <a href="mailto:m.tahir@usm.my">m.tahir@usm.my</a> Ext. No. : 2071</td>
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<td>NORHASHIDAH AWANG</td>
<td>Spatial Statistics</td>
<td>Room No. : 041 <a href="mailto:shidah@usm.my">shidah@usm.my</a> Ext. No. : 4774</td>
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<td>NORLIDA MOHD. NOOR</td>
<td>Applied Statistics</td>
<td>Room No. : 039 <a href="mailto:norlida@usm.my">norlida@usm.my</a> Ext. No. : 3958</td>
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<td>Ijazah Kepujian ITM</td>
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<td>NUZLINDA ABDUL RAHMAN</td>
<td>Spatial Statistics</td>
<td>Room No : 126 <a href="mailto:nuzlinda@usm.my">nuzlinda@usm.my</a> Ext No : 4781</td>
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<td>ONG HONG CHOON</td>
<td>Neural Networks, Data Mining</td>
<td>Room No : 019 <a href="mailto:hcong@usm.my">hcong@usm.my</a> Ext No : 4763</td>
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<td>ROSMANJAWATI ABD. RAHMAN</td>
<td>Applied Statistics</td>
<td>Room No : 119 <a href="mailto:rosmanjawati@usm.my">rosmanjawati@usm.my</a> Ext No : 4778</td>
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<td>SEK SIOK KUN</td>
<td>Econometrics</td>
<td>Room No : 113 <a href="mailto:sksek@usm.my">sksek@usm.my</a> Ext No : 5338</td>
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<td>SHAMSUL RIJAL MUHAMMAD SABRI</td>
<td>Applied Statistics</td>
<td>Room No : 115 <a href="mailto:rija@usm.my">rija@usm.my</a> Ext No : 3964</td>
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<td>B.Sc. UTM M.Sc. Tech., PhD UNSW</td>
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<td>MSc SHEFFIELD</td>
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</tr>
<tr>
<td></td>
<td>BSc, MSc W. MICHIGAN</td>
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</tr>
</tbody>
</table>
MASTER IN MATHEMATICS

A. OBJECTIVE

The objective of the program is to produce experts in the field of Computational and Applied Mathematics who are able to undertake research and development activities in addition to teaching of Computational and Applied Mathematics at the postgraduate level.

B. PROGRAMME STRUCTURE

Students are required to obtain at least a B grade for the 20 units taught courses, pass the dissertation course and achieve a CGPA of at least 3.0.

C. COURSES

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>MAT510/20</td>
<td>Dissertation (Disertasi)</td>
</tr>
<tr>
<td>MAT514/4</td>
<td>Mathematical Modelling (Pemodelan Matematik)</td>
</tr>
<tr>
<td>MAT515/4</td>
<td>Computational Mathematics (Matematik Pengiraan)</td>
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<tr>
<td>MAT516/4</td>
<td>Curve and Surface for CAGD</td>
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<td>(Kaedah Lengkung dan Permukaan untuk RGBK)</td>
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<tr>
<td>MAT517/4</td>
<td>Computational Linear Algebra</td>
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<td></td>
<td>(Aljabar Linear Pengiraan)</td>
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<tr>
<td>MAT518/4</td>
<td>Numerical Methods For Differential Equation</td>
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<td></td>
<td>(Kaedah Berangka untuk Persamaan Pembezaan)</td>
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</tbody>
</table>

For full time students, the minimum period given to complete the program is 12 months with a maximum period of 24 months. For part time students, the minimum period is 24 months and a maximum of 48 months.

Full time students have to register MAT514/4, MAT515/4, MAT517/4 and MAT518/4 in the first semester, and MAT516/4 and MAT510/20 in the second semester. Part time students are encouraged to seek the advice of the Deputy Dean (Research) concerning course registration.
SYNOPSIS OF MATHEMATICS COURSES

1.0 MAT510/20 Dissertation (Disertasi)

All students are required to submit the Dissertation Supervisor Confirmation Form (APPENDIX B) no later than week 10 of the first semester of the academic session (November). For all students, a minimum of 12 units have to be accumulated before they are allowed to register for this course in the month of February (during the second semester registration). There will be an interim viva/presentation around the 4th week of the second semester consisting of the background study, objectives and methodology to determine the direction of the research.

Full time and part time students are required to submit their dissertation (after confirmation by their respective supervisors) no later than a date that will be determined in June 2014. Within 1 – 2 weeks after this date, there will be a seminar presentation (30 mins) and finally the viva. The viva will begin with a short oral presentation by the student regarding his/her achievements followed by a question and answer session.

Details are available in the GUIDE FOR DISSERTATION PREPARATION.

The above-mentioned dates are subjected to changes and further information on this matter will be displayed on the School of Mathematical Sciences notice board from time to time.

2.0 MAT514/4 Mathematical Modelling (Pemodelan Matematik)

Aim

The aim of this course is to equip students with the techniques and skills for developing and interpreting mathematical models.

Description

This course will concentrate on development and interpretation of mathematical models in the physical and life sciences.

Syllabus

This course will concentrate on some the following topics:

2. Ecological models.
3. Fluid flow and water resources modelling.
4. Environmental Modelling.
5. Convective heat and mass transfer.

The topics may also be adjusted from time to time by the lecturer.
Skills and Knowledge Acquired

At the end of the course, students will have acquired the skills for developing and interpreting mathematical models.

References


3.0 MAT515/4 Computational Mathematics (*Matematik Pengiraan*)

**Aim**

To introduce the student to the use of mathematical software (*Mathematica*) as an investigative tool in the field of scientific computing, with special emphasis being put on experimental techniques involving graphical and numerical displays.

**Description**

The course is split into two distinct but related parts: the lectures on numerical analysis topics and the practical laboratory sessions. The scientific computing topics listed below are intended to introduce the student to important areas of the subject.

The laboratory sessions have the important function of allowing the student to experiment with and investigate mathematical problems. Some of the laboratory time is taken up with the investigation of techniques and problems arising from the lectures. Emphasis will be on built in functions of the software, together with their strengths and weaknesses.
Syllabus

Introduction to Mathematica

1. *Mathematica* syntax
2. List, vectors and matrices
3. Procedural programming
4. Functional programming
5. Rule-based programming
6. Recursion
7. Visualisation and graphics

Numerical Analysis Topics

1. Basic concepts
2. System of linear and nonlinear equations
3. Polynomials approximation
4. Numerical Integration and Differentiation
5. IVP and BVP for Ordinary Differentiation Equations
6. Fast Fourier Transform
7. Random Numbers and Stochastic Simulation
8. Advanced topics

Skills and Knowledge Acquired

To be able to use mathematical software, not just for mathematics, but as a general investigative tool in many areas of applicable mathematics, such as that found in industries.

References

4.0 MAT516/4 Curve and Surface Methods for CAGD  
(Kaedah Lengkung dan Permukaan untuk RGBK)

Aim

To provide the basic theoretical concepts underlying curve and surface design in CAGD.

Description

This course introduces theory and methods for the approximation and representation of curves and surfaces that arise when these objects are processed by a computer.

Syllabus

Basic concepts of vector geometry and differential geometry. Polynomial interpolation including Lagrange form, Newtons form, Aitken’s algorithm and Hermite form. Concepts of Bezier curves with Bernstein polynomials basis. Curves evaluation with de Casteljau algorithm. Derivatives of Bezier curves, degree elevation and reduction. Continuity issues of composite curves focused on parametric and geometric continuity. Different representation of spline curves and surfaces such as piecewise Bezier form, piecewise Hermite form and B-Spline. B-Spline evaluation using subdivision method and de Boor Cox algorithm. Rational Bezier and B-Spline curves and surfaces. Representation of conic segments by rational curves. Coons patches and Triangular Bezier patches. Shape preserving splines, focussing on positivity (or non positivity) and monotonocity.

Skills and Knowledge Acquired

At the end of the course, students would have acquired the fundamental theory and knowledge of methods for the design of curves and surfaces.

References

5.0 MAT517/4 Computational Linear Algebra  
(Aljabar Linear Pengiraan)

**Aim**

The course deals with computational methods in solving linear algebra problems. In particular, it evolves around the following aspects:

i) the fundamental & numerical properties;  
ii) algorithm development;  
iii) factorization techniques;  
iv) conditioning and stability.

**Description**

The course is divided into four parts to reflect different aspects of the course:

**PART 1 (PRELIMINARIES)**

- Numerical Computations, Floating Point Operations, Round-off error, absolute error, relative error;  
- Some MATLAB examples;  
- Revision of important linear algebra concepts;  
- Algorithm, efficiency, stability, conditioning;  
- Perturbation analysis of the linear system problem.

**PART II (FACTORIZATION METHODS)**

- Gaussian elimination, the algorithm, pivoting strategies;  
- Gaussian elimination & matrix factorization, elementary matrices, LU Factorization, $LDL^T$ and Cholesky Factorization ($LL^T$);  
- Orthogonal Factorization Methods: Gram-Schmidt orthogonalization and QR factorization, modified Gram-Schmidt;  
- Orthogonal matrices: Orthogonal transformations, Householder matrix, Givens matrices;  
- QR factorization using Householder & Givens matrices;  
- Solution of linear system of equation using QR factorization;  
- Eigenvalue Decomposition, Singular Value Decomposition (SVD), Golub-Kahan-Reinsch algorithm.

**PART III (THE LEAST SQUARES PROBLEM)**

- Orthogonal projection and best approximation, the normal equation, pseudoinverse;  
- Computational Issues in solving the normal equation;  
- QR Method for Computing Full Rank, Overdetermined Least Squares Solution;  
- Computation of Rank Deficient, Overdetermined Least Squares Solution using SVD.
PART IV (EIGENVALUE PROBLEM)

- Computational difficulties in computing eigenvalues;
- Important definitions & theories: Similarity transformation, eigen decomposition, the Bauer-Fike theorem, Gersgorin Circle;
- Power Iteration;
- Power Method: Basic algorithm, rate of convergence and acceleration, Power method with shift;
- Deflation;
- QR Method for Symmetric Eigenvalue Problem: Special properties of the symmetric eigenvalue problem, basic QR iteration for symmetric matrices, QR algorithm using Givens matrices;
- Accelerating convergence: QR method with shift.

Skills and Knowledge Acquired

At the end of the course, students would have acquired the fundamental theory and knowledge of advanced techniques in Computational Linear Algebra.

References

1. Datta B. (2009), Numerical Linear Algebra. SIAM.
6.0 MAT518/4 Numerical Methods for Differential Equations
(Kaedah Berangka untuk Pesamaan Pembezaan)

Aim

The aim of this course is to increase students knowledge of numerical methods for the solution of differential equations.

Description

Differential equations form the basis for the mathematical modeling of various phenomena. This course will focus on the theory and implementation of numerical methods for the solution of differential equations (in particular partial differential equations).

Syllabus

Numerical methods for ordinary differential equations
- Initial value problems: one step, multi-step methods; systems; stability; stiff equations;
- Boundary value problems: shooting, finite difference, Rayleigh-Ritz methods.

Numerical methods for parabolic and hyperbolic partial differential equations
- Finite difference schemes: derivation and implementation; error analysis, stability, consistency, convergence, applications.

Finite Difference Discretization for the solution of Elliptic PDEs
Iterative Methods for Systems Arising from Elliptic PDEs
- Jacobi, Gauss-Seidel, S.O.R methods.

Convergence Properties and Rate of Convergence of Basic Iterative Methods.
Block Iterative Methods.
Other Advanced Point Iterative Methods.
- Simultaneous Displacement Method, Second Order Methods, Gradient Method Preconditioning;
- Preconditioned Conjugate Gradient Method.

Skills and Knowledge Acquired

At the end of this course, students should have the knowledge and skills to efficiently use numerical methods for solving differential equations. The students will also understand the theoretical foundations of the numerical methods discussed.

References

## LIST OF DISSERTATION SUPERVISORS (MAT510/20)

<table>
<thead>
<tr>
<th>BIL.</th>
<th>NAME</th>
<th>FIELD OF SPECIALIZATION</th>
<th>ROOM NO./ E-MAIL/ EXT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ABD. RAHNI MT. PIAH BA KNOX COLLEGE MSc USM PhD DUNDEE</td>
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<tr>
<td>5.</td>
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<tr>
<td>BIL.</td>
<td>NAME</td>
<td>FIELD OF SPECIALIZATION</td>
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Note:
The staff from the Operational Research Group of the School of Mathematical Sciences can also be contacted to obtain appropriate dissertation topics.
GUIDELINES FOR CANDIDATES OF MAT510/20 – DISSERTATION OR MST566/20 – DISSERTATION REGISTERED IN SEMESTER I (Part time Candidates) and SEMESTER II (Full time Candidates)

Introduction

The Dissertation should be completed within the stipulated time. Candidates who fail to submit their Dissertation for examination at the time set by their school will be awarded a Grade F for this course and are required to repeat the course with a new topic. This set of guidelines explains the minimum requirements that have to be fulfilled by candidates as well as the process and the aspects of examination of the Dissertation in partial fulfillment of the Master of Science (Mathematics) or Master of Science (Statistics) Degree (Mixed Mode).

Submission of Dissertation

1. Dissertations may be written either in Bahasa Malaysia or English.

2. All candidates have to submit 4 copies of their Dissertation (bound in red with soft cover) for the purpose of examination together with the Submission of Dissertation Form that has been signed and approved by the Supervisor to the Dean’s Office will be determined in June 2014. The topic of the Dissertation and its translation should be stated in the Submission of Dissertation Form (refer to Appendix B) for confirmation and approval by the Council of The School of Mathematical Sciences. The Dissertation will not be examined until the candidate fulfills all the requirements.

Format

3. The full title of the dissertation, full name of the candidate, name of the School of Mathematical Sciences, Universiti Sains Malaysia and the year of submission of the Dissertation for examination has to be typed in capital letters of size 18 on the front cover as shown in the example below:
LONGITUDINAL DATA ANALYSIS
(Font size 18)

NORAINI BINTI ABIDIN
(Font size 18)

SCHOOL OF MATHEMATICAL SCIENCES (Font size 18)
UNIVERSITI SAHS MALAYSIA (Font size 18)

2016
4. Every Dissertation comprises four parts: Introduction, Text, Reference and Appendix. Every part has sections that have to be organized in a specific order. The heading of each section should be in capital letters, centralized without any punctuation marks and 5cm from the top of the page; the text and list begin four spaces below.

5. Only good quality plain white paper (80 g/m²) of A4 size (210 × 297 mm) should be used. Materials must be typed or printed on one side of the paper only using a ‘laser printer’. All photocopies must be clear to ensure the quality of printing. Carbon copies are not acceptable. All copies must be clean and legible. The text should be typed, double-spaced using the ‘Microsoft Word 2000/Latex’ word processor or the latest version. Candidates are encouraged to use the font, ‘Times New Roman’ and the acceptable font size for the whole Dissertation is 10-12 points. Single-spacing is recommended for long tables, long quotations, notes, footnotes, multiline captions and bibliographic entries. No crossing-out of letters or words is permitted. All sections erased must be clean. The use of transparent tape as a form of patching is not allowed.
6. The **Introduction** begins with the Title page as shown in the example below:

```plaintext
LONGITUDINAL DATA ANALYSIS
(Font size 14)

by
(Font size 12)

NORAINI BINTI ABIDIN
(Font size 14)

Dissertation submitted in partial fulfillment
of the requirements for the degree
of Master of Science in Statistics
(Font size 12/single spacing/centre)

August 2016
(Font size 14)
```
or as follows (if the dissertation is written in Bahasa Malaysia):

ANALISIS DATA LONGTITUD

oleh

NORAINI BINTI ABIDIN

Disertasi diserahkan untuk memenuhi sebahagian keperluan bagi Ijazah Sarjana Sains Statistik

Ogos 2016

7. The Introduction is made up of a number of sections such as the Acknowledgment, Table of Contents, List of Tables (if any), List of Figures (if any), List of Diagrams (if any), List of Symbols (if any), Abbreviations or Wordlist (if any) and lastly the Abstract. All pages in the Introduction are numbered using lower case Roman numerals (i, ii, iii, etc). The title page of the Dissertation is considered as page i, but the number is not printed on the page.

8. Consistency in pagination is more important than the position of the page number.
9. An Abstract in both Bahasa Malaysia and English must be provided, the former version appearing before the latter. If the dissertation is written in Bahasa Malaysia, the English version of the Abstract must have an English title and vice-versa. The Abstract is a summary of the entire Dissertation and should provide a brief exposition of the research problems and aims, approaches taken to solve the problems and a summary of findings in the context of the whole area of study. Subsequent research proposals may be incorporated. This section should be double-spaced and the length of each version should not exceed 400 words. The Abstract should be placed immediately before the First Chapter of the Dissertation.

10. The Text is made up of a number of sections. **The organisation of this section is to be determined by the student and his/her supervisor(s).** As a general guideline, the length of the text should not exceed 25,000 words. For example, the Text can start with an introduction that highlights the problem(s) under investigation by describing the status of the problem(s) conceptually and theoretically. Besides that, the candidate can state the scope and objectives of the study and outline the plan of action or research protocol based on the status of the problem(s). The literature review may be written as a separate chapter and the materials that have been quoted or extracted should be relevant to the research topic, objectives, method or the research protocol and the basic theory or the approach used. The literature review should include the latest research findings from books, journals, magazines, research reports and the latest materials from the internet/websites. The subsequent chapters or sections in the Text may include research methods, results, discussion, summary or conclusion and recommendations for future research.

11. The standard margins for the general text, tables and diagrams are as follows:

- Top : 2.5cm
- Right : 2.5cm
- Left : 3.5cm
- Bottom : 2.5cm

12. The Bibliography or Reference is the section after the Text that begins on a fresh page bearing the heading in capital letters, centralized without any punctuation marks, 5 cm from the top. The list of references begins four spaces below the heading, double-spaced between entries but single-spaced within each entry. A 3-space indentation should be used for any entry exceeding a single line. References must be presented according to the Harvard System (refer to Appendix C). If a candidate makes use of other works in his/her project, either in direct quotation or by reference, these sources must be listed in the bibliography.

13. The Appendix is a section that is separated from the preceding material by a cover sheet bearing the heading APPENDICES in capital letters (or, if there is only one, APPENDIX), centralized without any punctuation marks. This sheet is not numbered and also not included in the total number of pages. Appendices present materials that are referred to in the text. It contains supplementary illustrative material, notes on the interview/questionnaires, data or quotations too long for inclusion in the text or long explanations about a particular method/experiment. Appendices may be divided into Appendix A, Appendix B, etc., such divisions being treated as first order subdivisions. Each appendix with its title, if it has one, should be listed separately in the Table of Contents as a first order subdivision under the heading APPENDICES. Tables and figures in the Appendices must be numbered and have captions and also listed in the List of Tables and List of Figures in the Introduction.
Examination of the Dissertation

14. The Supervisor and Internal Examiner appointed by the Board of the School of Mathematical Sciences will be given a copy each of the Dissertation for examination purposes, to be completed within 3 weeks.

15. Candidates need to hold a seminar on the Dissertation that has been submitted for examination on a specific date. The seminar may include the presentation of the research background, framework, hypothesis, findings, discussions and recommendations. Each candidate is given 20 minutes for the presentation and 10 minutes for the question and answer session.

16. Candidates have to attend a viva in the presence of the Panel of Dissertation Examiners at the School of Mathematical Sciences. The viva will begin with a 5-minute oral presentation by the candidate regarding his/her dissertation.

17. The Panel of Dissertation Examiners comprises:
   a. Dean (Chairperson);
   b. Deputy Dean (Research);
   c. Supervisor;
   d. Internal Examiner;
   e. Assistant Registrar (Secretary).

   The overall Dissertation Grade is either a Grade P (PASS) or a Grade F (FAIL).

18. After the viva, all copies of the Dissertation will be returned to the candidate.

19. Candidates who are required to re-submit their Dissertations for re-examination and/or attend a viva must submit 3 copies of the amended Dissertation together with the re-submission of Dissertation Form (refer to Appendix D) filled by the candidate and approved by the Supervisor.

20. After all corrections (if any) and the decision of the Panel of Examiners are implemented, candidates who PASS should submit 3 hard cover “deposit copies” of their Dissertation bound in red buckram or rexine together with the Submission of Final Dissertation Form (refer to Appendix E). The full Dissertation title, name of candidate, name of the university and year of submission of the Dissertation should be **printed in gold, font size 18, on the cover page.** The name of the candidate, the full title (if not too long), year of submission of the Dissertation and the degree to be awarded should also be printed in gold of a suitable font size on the spine as shown below:
LONGITUDINAL DATA ANALYSIS

NORAINI BINTI ABIDIN

SCHOOL OF MATHEMATICAL SCIENCES, UNIVERSITI SAINS MALAYSIA

2016

* Dissertation front cover.
* Spine of the Dissertation.
The Harvard System

Under the Harvard System, reference is made by giving the author’s surname together with the year of publication. In the text, the year of publication appears within parenthesis after the author’s surname if it forms part of the sentence; for example, Ch’ng (1986) or Salleh and Zainuddin (1987) or where there are more than two authors, Nagendran et al. (1990). If several papers by the same author and from the same year are cited, the letters a, b, c, etc. should be placed after the year of publication; for example Karel and Labuza (1988b).

In contrast, both the author’s surname and the year of publication appear within brackets if the author’s surname does not form part of the sentence; for example: …………(Omar & Tan, 1989).

In any particular sentence, if several publications are cited, the references should be cited in chronological order. However, if several publications in the same year are cited, the references should be made in alphabetical order and with publications by a single author taking precedence over those by co-authors.

Under the heading Bibliography or Reference, all references are cited in alphabetical order. The references do not need to be numbered. References to periodicals should be listed as follows: authors’ surnames and initials (instead of first author et al.) year of publication in brackets, exact title of paper, abbreviated title of the periodical in italics (or underlined), volume number in Arabic numerals, underlined twice (or in bold print) and initial and final page numbers of the article. For example:


In the Harvard System, the titles of books are in italics (or underlined), followed by the city and publisher. For example:


Reference from edited books may be written as follows:


References from other materials are as follows:

**Web page without author**


**Web page with author**

Thesis


Proceedings/ Conference paper


Electronic journal

http://www.blackwell-synergy.com/

CD-ROM


Note:

1. There are various systems of abbreviating titles of periodicals. As a general guideline, students can adopt the system provided in the book “The World List of Scientific periodicals” or refer to their respective supervisors.

2. When listing the references, the titles of articles should be reproduced exactly as they appear in the original.

3. Consistency is the keyword in any system of referencing.
## RANCANGAN SARJANA SAINS [STATISTIK/MATEMATIK]
(Mod Campuran)

Sidang Akademik ………………

BORANG PENGESAHAN PENYELIA KURSUS DISERTASI
(Dissertation Supervisor Confirmation Form)

<table>
<thead>
<tr>
<th>Kod Kursus : MST 566/20/MAT 510/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nama Pelajar : ……………………………………………………</td>
</tr>
<tr>
<td>No. K/Pengenal : …………………………………………………</td>
</tr>
<tr>
<td>No. Matrik : …………………………………………………</td>
</tr>
<tr>
<td>Tandatangan Pelajar : ………………………………………</td>
</tr>
<tr>
<td>No. Tel : ………………………………………………… E-mail : ……………………………</td>
</tr>
<tr>
<td>Tarikh : …………………………………………………</td>
</tr>
</tbody>
</table>

| Tajuk Disertasi : …………………………………………………… |
| ………………………………………………………………… |
| ………………………………………………………………… |

Saya mengesahkan bahawa saya bersetuju untuk menyelia pelajar di atas pada

Sidang Akademik : …………………………

Nama Penyelia : ………………………………………………

Tandatangan Penyelia : …………………………………………

Tarikh : …………………………………………………………...
Kepada : Dekan
Pusat Pengajian Sains Matematik
Universiti Sains Malaysia
11800 Pulau Pinang

Nama : …………………………………………………………………………………..

Taraf Pencalonan (sila tandakan) : Sambilan/Penuh Masa

No. Matrik : …………………………………….

Alamat Terkini : ………………………………………………………………………

No. Tel. : ……………………………   E-Mel : ………………………………………

Tarikh : …………………………………………………..

Bersama-sama ini saya kemukakan 4 naskhah disertasi dalam bentuk berjilid dengan pembalut yang lembut untuk tujuan penilaian.

Tajuk Disertasi : ………………………………………………………………………

Terjemahan : ………………………………………………………………………

1. Saya ingin mengesahkan bahawa disertasi tersebut telah pun disemak oleh Penyelia saya dan komen beliau adalah seperti yang terdapat di Bahagian B borang ini.

Sekian, terima kasih.

…………………………
(Tandatangan Calon)
**BAHAGIAN B**
(untuk diisi oleh Penyelia Disertasi)

Nama Penyelia :
...........................................................................................................................................

Saya telah menyemak disertasi Encik/Puan/Cik………………………………………………………………
seorang calon Rancangan Ijazah Tinggi Sarjana Sains Matematik/Statistik.

1. Saya ingin mengesahkan bahawa saya berpuashati dengan kemajuan yang dicapai oleh calon tersebut dan dilihat dari segi kualiti dan mutu bahasa, saya tiada halangan disertasi tersebut diserahkan untuk tujuan penilaian.

........................................................................................................................................
(Tandatangan Penyelia)  (Tarikh)

........................................................................................................................................

**BAHAGIAN C**
(untuk diisi oleh Timbalan Dekan [Penyelidikan] )

Saya ingin mengesahkan perakuan yang dibuat oleh Penyelia Disertasi calon ini seperti yang tercatat di Bahagian B di atas.

........................................................................................................................................
(Tandatangan Timbalan Dekan (Penyelidikan))  (Tarikh)
PUSAT PENGAJIAN SAINS MATEMATIK
SCHOOL OF MATHEMATICAL SCIENCE

BORANG PENYERAHAN SEMULA
DISERTASI UNTUK PEMERIKSAAN
Dissertation Re-Submission Form for Examination

BAHAGIAN A
(Untuk diisi oleh calon)

Kepada: Dekan
Pusat Pengajian Sains Matematik
Universiti Sains Malaysia
11800 Pulau Pinang

Nama: __________________________________________________________________________
Alamat(terkini): ________________________________________________________________
Tel.Rumah : _____________________________     Tel. Pejabat : ________________________
E-Mel:_____________________________________  Tarikh :   ___________________________

Bersama-sama ini saya kemukakan disertasi dalam bentuk berjilid untuk penyerahan dan pemeriksaan
semula :

Tiga (3) naskhah Disertasi Ijazah Sarjana Sains [Matematik/Statistik] dengan pembalut lembut
(berwarna merah) :

_________________________________________________________________________________
_________________________________________________________________________________

Terjemahan :

_________________________________________________________________________________
_________________________________________________________________________________

1. Saya ingin mengesahkan bahawa semua pindaan/pembetulan telah dilaksanakan disertasi tersebut
dan telahpun disemak oleh penyelia saya komentari beliau adalah seperti yang terdapat pada Bahagian B
borang ini.

Sekian, terima kasih.

…………………………….
(Tandatangan Calon)
**BAHAGIAN B**  
*(Untuk diisi oleh Penyelia Utama)*

Nama Penyelia: ________________________________

**Pusat Pengajian**

Saya telah menyemak semua pembetulan/pindaan yang dibuat oleh Encik/Puan/Cik ..............................................................dalam disertasinya yang diserahkan semula untuk pemeriksaan sebagaimana yang disetujui oleh Jemaah Pemeriksaan Disertasi.

1. Saya ingin mengesahkan bahawa saya berpuas hati dengan pembetulan/pindaan yang dibuat oleh calon dan tiada halangan disertasi tersebut diserahkan untuk pemeriksaan semula.

Sekian, terima kasih.

........................................................................................................
(Tandatangan Penyelia)   (Tarikh)

**BAHAGIAN C**  
*(Untuk diisi oleh Timbalan Dekan [Penyelidikan]*)

Saya ingin mengesahkan perakuan yang dibuat oleh penyelia disertasi calon ini seperti yang tercatat di Bahagian B di atas:-

........................................................................................................
(Tandatangan Timbalan Dekan)   (Tarikh)  
[Penyelidikan]
APPENDIX E

PUSAT PENGAJIAN SAINS MATHEMATIK
SCHOOL OF MATHEMATICAL SCIENCES

BORANG PENYERAHAN DISERTASI MUTAKHIR
(TIGA (3) NASKHAKH)
((Final Dissertation Submission Form)

BAHAGIAN A
(Untuk diisi oleh calon)

Nama :………………………………………………………………………………………………..

Bidang Pengajian : Sarjana Sains Statistik/Matematik (tandakan yang berkenaan)

Alamat (terkini) :…………………………………………………………………………………….
………………………………………………………………………………………………………

No. Tel. :………………………. E-Mel : ………………………..

Tarikh :………………………………

Bersama-sama dengan ini saya kemukakan :-

i) Tiga (3) naskhah berjilid dengan pembalut khas dan satu (1) cakera padat disertasi Ijazah
Sarjana Sains [Matematik/Statistik] bertajuk :-
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

Terjemahan :-
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

ii) Saya ingin mengesahkan bahawa disertasi tersebut telahpun disemak oleh Penyelia Utama saya
dan Dekan Pusat Pengajian, komen mereka adalah seperti yang terdapat pada Bahagian B dan C borang
ini.

Sekian, terima kasih.

……………………………
(Tandatangan Calon)
BAHAGIAN B
(Untuk diisi oleh Penyelia Utama)

Nama Penyelia : ............................................................
Pusat Pengajian ............................................................

Saya telah menyemak semua pembetulan/pindaan yang dilaksanakan oleh Encik/Puan/Cik ........................................... mengenai disertasinya sebagaimana yang dipersetujui oleh Jemaah Pemeriksaan Disertasi.

1. Saya ingin mengesahkan bahawa saya berpuas hati dengan pembetulan/pindaan yang dilaksanakan oleh calon.

Sekian, terima kasih.

............................................................  ............................................................
(Tandatangan Penyelia)                  (Tarikh)

BAHAGIAN C
(Untuk diisi oleh Dekan Pusat Pengajian)

Saya, ............................................................ Dekan Pusat Pengajian Sains Matematik ingin :-

(i)  Mengesahkan perakuan yang dibuat oleh Penyelia Calon ;

(ii) Mengesahkan bahawa saya berpuas hati dengan pembetulan/pindaan yang dilaksanakan oleh calon sebagaimana yang dipersetujui oleh Jemaah Pemeriksaan Disertasi.

............................................................  ............................................................
(Tandatangan Dekan)                  (Tarikh)