UNSW Course Outline

GMAT2550 Surveying Computations B - 2024

Published on the 26 Aug 2024

General Course Information

Course Code : GMAT2550
Year : 2024
Term : Term 3
Teaching Period : T3
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Civil and Environmental Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Least Squares measurement adjustment principles and concepts, with particular reference to surveying observations of distance, height difference, angular directions, GPS solutions. Determining input into, and analysing output from, typical Least Squares adjustment software.

Inside Least Squares: Modelling observations, observation equations, parametric method, condition and combined methods, linearisation of equations, derivation of Least Squares algorithm, methods of forming normal equations. Variance-covariance matrices, measurement uncertainty, and error ellipses, and in particular the application of statistics and error analysis in surveying. Worked examples and case studies from various areas of cadastral and engineering surveys. Calibration of EDM instruments.

Course Aims

This course aims to introduce students to the analysis of surveying observations primarily by the least squares method and associated statistical analysis. One part of the course is applied LS, that is, how to use LS programs. The other part of the course is the theoretical aspects of LS and what's inside LS programs. So the course studies both the application of software packages and the detailed calculations within such software.

Relationship to Other Courses

Pre-requsites: GMAT1110; GMAT2500; GMAT2700

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Apply the basic principles of Least Squares analysis
CLO2 : Setup the equations within a parametric method least squares adjustment
CLO3 : Calculate a least squares adjustment of data step by step without using computer programs designed for Least Squares
CLO4 : Prepare data for Least Squares analysis, including a priori statistics
CLO5 : Interpret output from Least Squares analysis software, including variance factor and outlier investigations
CLO6 : Design a survey network using least squares analysis, including error ellipses and redundancy number investigations
CLO7 : Describe computer programming aspects used within LS software

Course Learning Outcomes	Assessment Item
CLO1 : Apply the basic principles of Least Squares analysis	• Quizzes • Class Discussion Presentations • Case Study Report • Final Exam
CLO2 : Setup the equations within a parametric method least squares adjustment	• Quizzes • Class Discussion Presentations • Case Study Report • Final Exam
CLO3 : Calculate a least squares adjustment of data step by step without using computer programs designed for Least Squares	• Quizzes • Class Discussion Presentations • Case Study Report • Final Exam
CLO4 : Prepare data for Least Squares analysis, including a priori statistics	• Quizzes • Class Discussion Presentations • Case Study Report • Final Exam
CLO5 : Interpret output from Least Squares analysis software, including variance factor and outlier investigations	• Quizzes • Class Discussion Presentations • Case Study Report • Final Exam
CLO6 : Design a survey network using least squares analysis, including error ellipses and redundancy number investigations	• Quizzes • Class Discussion Presentations • Case Study Report • Final Exam
CLO7 : Describe computer programming aspects used within LS software	• Quizzes • Class Discussion Presentations • Case Study Report • Final Exam

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

Like other UG courses in the School, workshops for this course are compulsory (students are required to attend minimum 80%). If any student has difficulties to meet this attendance requirement, contact the course coordinator for alternative arrangements to cover the classes missed.

Other Professional Outcomes

Suggested Learning Methods Towards the Outcomes

The recommended textbooks and background reading materials are available on the class web site for students who prefer to learn by independent reading.

An important element of the teaching is the case studies and workshop classes where students are encouraged to work on assignments and workshop problems with direct assistance from the lecturer. The small class sizes currently in this course make it possible to follow these strategies.

Students are encouraged to ask questions and participate in class discussions during lectures and workshops. Read the text and lecture slides. Attempt the workshop questions and worked examples yourself. Get feedback: Ask the lecturer for help and help each other.

Attendance in class and participation in discussions are important because there are more details to learn and reflect upon in classes and workshops than just reading the PowerPoint slides.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Quizzes Assessment Format: Individual	30%	Start Date: Not Applicable Due Date: Quizzes will be scheduled Mondays in Weeks 3, 7 and 9.
Class Discussion Presentations Assessment Format: Individual	15%	Start Date: Not Applicable Due Date: Tuesdays in Weeks 4 and 9
Case Study Report Assessment Format: Individual	15%	Start Date: Not Applicable Due Date: Friday, Week 9
Final Exam Assessment Format: Individual	40%	Start Date: Not Applicable Due Date: Exam time to be scheduled.

Assessment Details

Quizzes

Assessment Overview

3 x 30-minute quizzes throughout the term. Marks will be returned in the following week.

Course Learning Outcomes

- CLO1 : Apply the basic principles of Least Squares analysis
- CLO2 : Setup the equations within a parametric method least squares adjustment
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- CLO4 : Prepare data for Least Squares analysis, including a priori statistics
- CLO5 : Interpret output from Least Squares analysis software, including variance factor and outlier investigations
- CLO6 : Design a survey network using least squares analysis, including error ellipses and redundancy number investigations
- CLO7 : Describe computer programming aspects used within LS software

Detailed Assessment Description

To reinforce the learning experience, a total of 3x30 minute quizzes will be given in closed book format during the classes on Mondays in Weeks 3, 7 and 9. Quizzes may include various types of questions: short answer questions, multiple choice questions and problem-solving questions. Quiz questions will be asked on the materials presented in the previous teaching and learning activities. Marks will be awarded for correct answers; partially correct answers will also be awarded with proportionally reduced marks. The detailed marking scheme will be provided to students after each quiz as part of feedback.

Assessment Length

Each quiz will take about 30 minutes.

Assessment information

Please refer to Moodle for more information.

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Class Discussion Presentations

Assessment Overview

Students will give a 5 minute presentation with 4 or 5 accompanying slides. Marks will be returned in the following week.

Course Learning Outcomes

- CLO1 : Apply the basic principles of Least Squares analysis
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Detailed Assessment Description

Students should regularly attend the lectures and participate actively in worksop class discussions. The students are invited to give two short presentations to the workshop classes in Weeks 4 and 9. These short presentations will offer the opportunities for students, a) to demonstrate and enhance their understanding of the concepts covered in the lectures; b) to establish links between the concepts and real world applications of these concepts, c) to

articulate relevant problems and issues in learning, d) to develop technical presentation skills. The detailed marking scheme will be provided together with the class presentation instructions in the week before
each presentation.

Assessment Length

5 minutes for each presentation

Submission notes

Presentation slides are submitted for feedback 2-3 days before the scheduled presentation

Assessment information

Please refer to Moodle for more information.

Assignment submission Turnitin type

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Case Study Report

Assessment Overview

Students will submit a 20-25 page case study report. Marks will be returned in 2 weeks.

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- CLO4 : Prepare data for Least Squares analysis, including a priori statistics
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- CLO6 : Design a survey network using least squares analysis, including error ellipses and redundancy number investigations
- CLO7 : Describe computer programming aspects used within LS software

Detailed Assessment Description

This exercise lets you enhance your understanding of the fundamentals of least squares estimation and statistical analysis, with raw data set(s) of your own choice. Such data sets may come from, for example, a textbook, literature provided during the class via Moodle. That lets you gain deeper insights into the calculation steps that are inside least squares computer programs.
This Assignment aims for you to:
1. Gain insight into the nature of the least squares estimation and the statistical analysis associated with the least squares estimation;
2. Enhance your understanding of the procedures to establish functional and stochastic models for use in least squares adjustment;
3. Demonstrate your understanding of quality measures behind the least squares estimation (for example, the quality measures for use in a survey network design), a) accuracy; b) reliability;
4. Train the skills of presenting the results from an investigative study.

Assessment Length

20-25 pages

Assessment information

Please refer to Moodle for more information.

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
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Final Exam

Assessment Overview

The final exam is 2-hours in length and all content in the course may be assessed.

Course Learning Outcomes

- CLO1 : Apply the basic principles of Least Squares analysis

- CLO2 : Setup the equations within a parametric method least squares adjustment
- CLO3 : Calculate a least squares adjustment of data step by step without using computer programs designed for Least Squares
- CLO4 : Prepare data for Least Squares analysis, including a priori statistics
- CLO5 : Interpret output from Least Squares analysis software, including variance factor and outlier investigations
- CLO6 : Design a survey network using least squares analysis, including error ellipses and redundancy number investigations
- CLO7 : Describe computer programming aspects used within LS software

Detailed Assessment Description

Final Exam will be of 2 hours duration. and will be held in the formal examination period, in closed book format, but the complicated formulae to be used in the exam will be provided in the examination paper. The final exam will cover all the contents in the teaching and learning activities. Past sample exam questions and answers will be provided to the class as part of revision in Week 10. The formal exam scripts will not be returned. The final mark for the course will be officially available to you via myUNSW. You may find the key dates for the UNSW exams at: https://student.unsw.edu.au/exam-dates

Assessment Length

2 hours

Assessment information

Please refer to Moodle for more information

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

Not Applicable

Generative AI is not considered to be of assistance to you in completing this assessment. If you do use generative AI in completing this assessment, you should attribute its use.
For more information on Generative AI and permitted use please see here.

General Assessment Information

Grading Basis

Standard

Requirements to pass course

Achieve a composite mark of at least 50 out 100.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 0 : 2 September - 8 September	Homework	Reading the course outline.
Week 1 : 9 September - 15 September	Lecture	Course Outline; Fundamentals of Positioning; Introduction to Least Squares. Revision matrix algebra, differentiation; Statistics applied to surveying problems
	Workshop	LS Treasure Hunt game. Matrix algebra, differentiation, Excel/Matlab: Statistics problems. Case study on measurement errors.
Week 2 : 16 September - 22 September	Lecture	Input to LS programs. Preprocessing obs and std devs. Modelling observation equations, Parametric method. Linearisation – Partial derivatives
	Workshop	Statistics and input to LS. LS output and analysis. Data collection assigment: Pillar trilateration or traverse. Preparation for Class Discussion A
Week 3 : 23 September - 29 September	Lecture	Derivation of LS equations. Least Squares step by step worked examples. Forming and solving normal equations. Quiz 1.
	Workshop	Modelling & linearization. LS software FIXIT4. Input trilateration data. Matlab programming for LS case studies and measurement error analysis.
Week 4 : 30 September - 6 October	Lecture	Statistical analysis of LS outputs: VCV matrices, residuals, VF, outliers, systematic errors.
	Workshop	Numerical analysis of measurment errors. Class Discussions A.
Week 5 : 7 October - 13 October	Lecture	Classes are resheduled for measurement colldection for individual case studies on error analysis
	Workshop	This time slot is reshedudled for LS programming for individual case studies on error analysis
Week 6 : 14 October - 20 October	Fieldwork	Field trip work (This time slot reschduled for Pillar network data collection) - no class
Week 7 : 21 October - 27 October	Lecture	Outlier detections; Reloiability measures (MDB); Redundancy. Survey control network design; Quiz 2
	Workshop	Network adjustment and reliability analysis: worked examples
Week 8 : 28 October - 3 November	Lecture	Network design and quality analysis.
	Workshop	Simulating outliters and systematic errors. Preparation of Class Discussion B.
Week 9 : 4 November - 10 November	Lecture	EDM Calibration procedure. LS aspects of EDM calibration. Combined and condition adjustment methods. Quiz 3
	Workshop	Class Discussion B
Week 10 : 11 November - 17 November	Lecture	Advanced LS. LS essentials and predicting results. Practical control network adjustment case studies
	Workshop	Practical control network adjustment case studies. Revision and preparation for final exam.

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Resources

Prescribed Resources

The course materials will be available through “Moodle”: http://moodle.telt.unsw.edu.au/

The Power Point lecture slides are available for download as PDF files at the course website.

Electronic resources on the lecture topics are available at the course website.

The class notes, latest journal articles and references related the course topics will be referred to and/or distributed during the lectures.

Text Book Harvey B.R, 2016, Practical Least Squares and Statistics for Surveyors, Monograph 13, Third Edition, Available from UNSW Bookshop. ISBN 073342339

Software Free copies of the FIXIT4 survey network analysis program and of the LSTH game are available (via the Moodle website) for students to use in class or at home for educational purposes.

Further references are described in the text book.

Recommended Resources

Computer software relevant to this course and available in the School's computer labs includes FIXIT4, Matlab package, and MS Excel, which are available in the School's computer lab CE611/20.

Course Evaluation and Development

Students are encouraged to engage into all the teaching activities, and the feedback from students on any aspects of the course is always welcome. There will be regular chats with individual or groups of students, to deal with any potential difficulties in learning. As a small class, we have all the advantages to collect feedback and address any concerns in a timely manner.

UNSW myExperience surveys of this course and teacher are studied by the course coordinator. Students comments are much appreciated. Past feedback will be discussed in class. Students are welcome to offer informal feedback at any time during the course.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Jinling Wang		CE413	0293854203	You may contact me via Teams or email any time.	Yes	Yes

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School Contact Information

For assistance with enrolment, class registration, progression checks and other administrative matters, please see the Nucleus: Student Hub. They are located inside the Library – first right as you enter the main library entrance. You can also contact them via http://unsw.to/webforms or reserve a place in the face-to-face queue using the UniVerse app.

For course administration matters, please contact the Course Coordinator.

Questions about the this course should normally be asked during the scheduled class so that everyone can benefit from the answer and discussion.