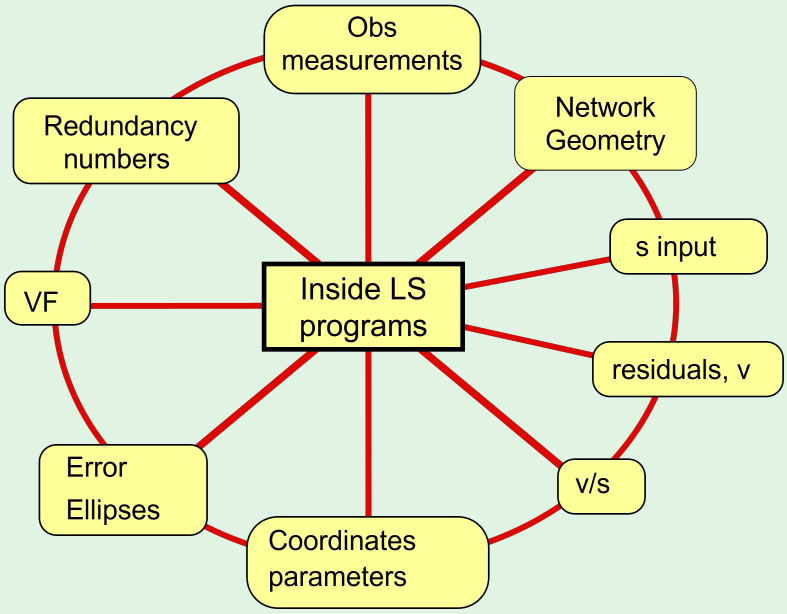
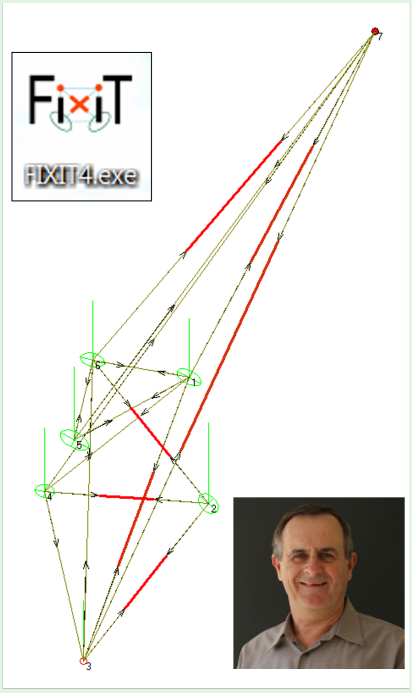
GMAT2550

Surveying Computations B

Term 3, 2022



Understand all the links



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Bruce Harvey	B.Harvey@unsw.edu.au	No appointment needed. Walk in or email.	CE 207	02 9385 4178

School Contact 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)

Course Details

Units of Credit 6

Summary of the Course

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 is inside LS programs. So the course studies both the application of software packages and the detailed calculations within such software.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Understand the basic principles of Least Squares analysis and their application to engineering surveying	PE1.1, PE1.2
2. Setup the equations within a parametric method least squares adjustment	PE1.3
3. Calculate a least squares adjustment of data step by step without using computer programs designed for Least Squares	PE1.3
4. Properly prepare data for Least Squares analysis, including a priori statistics	PE2.1
5. Professionally interpret output from Least Squares analysis software, including variance factor and outlier investigations	PE2.2, PE2.3, PE3.4
6. Design a survey network using least squares analysis, including error ellipses and redundancy number investigations	PE1.5, PE2.2, PE2.4
7. Be familiar with computer programming aspects used within LS software	PE1.2

Teaching Strategies

This course and similar previous courses have been taught by the lecturer for many years, at UNSW and elsewhere. The teaching strategies have been refined over the years based on student feedback and student performance in exams and assignments. Generally lectures are presented on each topic via PowerPoint presentations. These PowerPoint files are available in pdf format for download from the class web site. Some students have said they do not like ppt in lectures, others do. So I try not to have static slides that are read, instead I ask students questions and use computer demonstrations. I also wrote the textbook (Monograph 13) and provide additional reading material on the class Moodle site for students who prefer to learn by independent reading.

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

Another important aspect is that the main software used in this course has been written by the lecturer specifically for students in this course. This software is also used in industry by our graduates and others.

Suggested Learning Methods:

Students are encouraged to ask questions and participate in class discussions during lectures, tutorials and labs. Read the text and lecture slides. Attempt the tutorial questions and worked examples yourself. Get feedback: Ask the lecturer for help and help each other. After the mid-session tests visit me individually for feedback. AND after the end of the course you are welcome to see me and get feedback on your final exams and assignments and to collect any of your remaining submissions.

I encourage attendance in class and participation because I think it is better for your education than just reading the PowerPoint. You will also notice that I say more in class than what is written on PowerPoint slides. I do not like lectures that read the screen to you. So for example their might be a graphic chart, plan, map or photograph or table of numbers on the screen and we talk about it. If you want to learn by reading then that is what my textbook (monograph) is for, because the lecture PowerPoint are missing some information.

Assessment

Last year's mid term and final exam papers will be supplied on Moodle for students to study.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Mid Term Test 1	20%	06/10/2022 03:00 PM	1, 2, 3, 4, 5, 6, 7
2. Mid Term Test 2	25%	03/11/2022 03:00 PM	1, 2, 3, 4, 5, 6, 7
3. Final Exam	40%	Not Applicable	1, 2, 3, 4, 5, 6, 7
4. Computer Lab exercises	15%	Not Applicable	1, 2, 3, 4, 5, 6, 7

Assessment 1: Mid Term Test 1

Due date: 06/10/2022 03:00 PM
Marks returned: Prior to census date

Test in computer lab, using special software

Assessment criteria

Test in computer lab, using special software, in week 4. All students test are marked by the course coordinator / lecturer.
Students visit lecturer's office for individual feedback after their test is marked. This will continue while the class remains small. If campus is in lockdown this will be done online.

Assessment 2: Mid Term Test 2

Due date: 03/11/2022 03:00 PM
Marks returned: Within 2 weeks. Usually much sooner.

Test in computer lab, using special software

Assessment criteria

Test in computer lab, using special software, in week 8. All student's tests are marked by the course convenor / lecturer.
Students visit lecturer's office for individual feedback after their test is marked. This will continue while the class remains small. If campus is in lockdown this will be done online.

Assessment 3: Final Exam

Marks returned: Via the UNSW formal course results

Final exam is in a computer lab using supplied software. Some questions involve analysing real survey data sets that include challenging data analysis aspects. Typically one of the questions involves many hundreds of observations.

Assessment criteria

All exams are marked by the course coordinator / lecturer.

Assessment 4: Computer Lab exercises

Marks returned: Moodle quizzes give marks and feedback directly upon submission.

An important element of the teaching is the computer lab classes where students are encouraged to work on problems in class with direct assistance from the lecturer. Lab exercises are set for each week. Moodle Quizzes will be used to describe the tasks and manage students' progress. The small class sizes currently in this course make it possible to follow the following strategies. The work will be audited in the student' presence by viewing the students' notes or computer screens and immediate feedback will be given. There is no need to rewrite the work or to submit formal well written reports. Generally the work will not be collected or be examined in detail unless a student has had difficulties getting correct or good quality output. Generally, lab marks will be assigned using a mastery scheme, i.e. if the work is acceptable it will get full marks if it is not acceptable it will get zero marks, students can resubmit in this case. There will also be a time limit for lab work submissions; the deadlines are given in the settings for each quiz.

Attendance Requirements

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

Course Schedule

Wk	**Tuesday** 10am – 12 noon Lec CE G1 & BBCU	**Thursday** 1-3 pm Lec Matt Th.C & BBCU or Lab CE201	**Thursday** 3-5pm Lab in CE201
1	Course Outline. Least Squares concepts & principles Why use LS? LS & means. Ch1	Revision matrix algebra, differentiation, Excel. Ch 1. Statistics applied to surveying problems. Ch2	LS Treasure Hunt game. Matrix algebra, differentiation, Excel. Statistics problems
2	Input to LS programs. Preprocessing obs and std devs. Ch 3.	Modelling observation equations, Parametric method. Linearisation – Partial derivatives Ch 4.	Statistics and input to LS. Data collection, Pillar trilateration or traverse
3	Derivation of LS equations. Ch 4 Least Squares step by step worked examples Ch4	Forming and solving normal equations. Ch 4. (≈ 1 hr) then lab CE201	Modelling & linearization LS software FIXIT4. Input trilateration data.
4	VCV matrices, residuals, VF. Ch4	Lab: Forming & solving normal equations in Excel. CE201	**Test 1 in CE computer lab**
5	Analysis of Output. Ch 5	Outliers. Ch 6	Analysis of Output
6	**No lecture classes**	Optional Field: EDM baseline fieldwork	
7	Redundancy. Ch 6 Survey Design. Ch 7	Survey Design. Ch 7	Analysis of Output, Outliers, Simulations
8	Lab: Outliers. Simulations. CE201	Lab: Outliers. Simulations. CE201	**Test 2 in CE computer lab**
9	EDM Calibration procedure. LS aspects of EDM calibration	Combined and condition methods. Ch8	Combined and condition methods
10	Advanced LS. Ch9. LS Essentials and Predicting results. Ch 10	Case Studies: OH, SHB, CD control surveys - examples of network analysis. Exam discussion.	Final Lab class – analysis of past papers

Chapters in the table above refer to our textbook, Monograph 13.

View class timetable

Timetable

Date	Type	Content
Week 4: 3 October - 7 October	Assessment	Mid Term Test 1
Week 8: 31 October - 4 November	Assessment	Mid Term Test 2

Resources

Recommended Resources

Lecture Material, Lab quizzes, and custom learning software for this course are available on the course website: moodle.telt.unsw.edu.au

Text Book Harvey B.R., 2016, Practical Least Squares and Statistics for Surveyors, Monograph 13, Third Edition, Available from UNSW Bookshop. ISBN 0733423396 $40.

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.

Computer software relevant to this course and available in the School's computer labs includes: FIXIT4 and MS Excel

Course Evaluation and Development

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.

Laboratory Workshop Information

CE201 computer lab will be our home.

Submission of Assessment Tasks

Please refer to the Moodle page of the course for further guidance on assessment submission.

UNSW has a standard late submission penalty of:

- 5% per day, for all assessments where a penalty applies, capped at five days (120 hours), after which a student cannot submit an assessment, and no permitted variation.

Academic Honesty and Plagiarism

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

https://student.unsw.edu.au/plagiarism

Academic Information

Final Examinations:

Final exams in T3 2022 will be held online between 25th November - 8th December 2022 inclusive, and supplementary exams between 9th - 13th January 2023 inclusive. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

ACADEMIC ADVICE

- Key Staff to Contact for Academic Advice (log in with your zID and password): https://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw
- Key UNSW Dates - eg. Census Date, exam dates, last day to drop a course without academic/financial liability etc.
- CVEN Student Intranet (log in with your zID and password): https://intranet.civeng.unsw.edu.au/student-intranet
- Student Life at CVEN, including Student Societies: https://www.unsw.edu.au/engineering/civil-and-environmental-engineering/student-life
- Special Consideration: https://student.unsw.edu.au/special-consideration
- General and Program-Specific Questions: The Nucleus: Student Hub
- Book an Academic Advising session: https://app.acuityscheduling.com/schedule.php?owner=19024765

Disclaimer

This course outline sets out 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 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 (as updated in Moodle), the description in the Course Outline/Moodle applies.

Image Credit

Cover image created by Bruce Harvey. Thank you for thoroughly reading this course outline. The first student to go to CE207 might get a small reward.

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	✓
PE2.3 Application of systematic engineering synthesis and design processes	✓
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	✓
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	
PE3.3 Creative, innovative and pro-active demeanour	
PE3.4 Professional use and management of information	✓
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	