MINE3220
RESOURCE ESTIMATION

COURSE OUTLINE

SEMESTER 1, 2014    Version 1.3
Course Title: MINE3220 Resource Estimation

Semester Offered: Semester 1

Level: Undergraduate

Number of Units/Credits: 6 UOC

Course Convenor: Wendy Timms, Rm 162, 1st Floor Old Main Building
e-mail: w.timms@unsw.edu.au  (MINE3220 in email subject line please!)

Contact Hours per Week:

Four contact hours to be utilised for Project Based Learning with lecture support.

Contact times are scheduled for

- Monday 1 pm – 3 pm: OldMain 145
- Wednesday 11 am – 1 pm: OldMain 149

For up to date information on lectures and tutorials, see the Course Calendar in Moodle.

Learning & Teaching Management System (LTMS): The Learning & Teaching
Management System (LTMS) used with this course is Moodle which can be accessed at
https://moodle.telt.unsw.edu.au.

Support material for this course including, copies of lecture notes, recommended readings,
assignments and results for assignments etc. whenever available can be found in LTMS.

It is important that students regularly check LTMS for changes in calendar events and for
email messages. It is strongly recommended that students use the mail redirection facility to
forward LTMS emails to their usual email address.

Assessment

Assessments will take the form of three quizzes, group projects with individual contributions
and a final exam.

All assessments are due at 9 am EST on Mondays.
All assessment are to be submitted electronically via Moodle.
IMPORTANT NOTES:
- Course completion requires all assessment items be completed otherwise a student can be awarded a grade of Unsatisfactory Fail.
- Students must attend at least 80% of course lectures/tutorials in order for their mark in the formal exam to be counted towards their overall course mark.

Course Description


Assumed Background

This course assumes the student has a basic knowledge of mining, geology and statistics.
This course covers the following topics:

- Data collection, compositing and resource model
- Principles of resource and reserve estimation
- Resource estimation techniques
- Orebody and Block modelling
- JORC Code
- Mine planning process
- Roles of feasibility studies
- Fundamental financial concepts for mining operations
- Mining business framework
AIMS, LEARNING OUTCOMES & GRADUATE ATTRIBUTES

Course Aims

The aim of this course is to introduce students to the principles of resource and reserve estimation for metalliferous and coal deposits, as well as the fundamental concepts of mine planning process.

Learning Outcomes

Resource estimation is intended to enable students to:
- Appreciate the mine planning process and the impact of the economic environment on mining
- Appreciate the role of feasibility studies in mine planning
- Create coal and metalliferous resource models from exploration datasets using appropriate software tools and various estimation techniques
- Evaluate the merits and drawbacks of various estimation methods relevant to specific mineral deposit types
- Report resources and reserves using the JORC code
- Demonstrate an appreciation of the time value of money, discount rates, commodity markets, the required rate of return to equity
- Explain the unique characteristics of mining and their implications for mine economics

Graduate Attributes

This course will contribute to the development of the following graduate attributes:
- Appropriate technical knowledge
- Having advanced problem solving, analysis and synthesis skills with the ability to cope with ambiguity and geological uncertainty
- Being able to think and work individually and in teams
- Awareness of opportunities to add value through engineering and the need for continuous improvement
- Being able to work and communicate effectively across discipline boundaries
RECOMMENDED TEXTS AND RESOURCES

Recommended Texts
- SME Mining Engineers Handbook, 1992. USA
- Course reader (available on Moodle)
- Lecture slides and supporting readings (available on Moodle)

Reference Texts
- Reference texts are listed in the course reader at the end of each section.

Software Tools
- Surfer 8
- Microsoft Excel
- Geostatistics for Windows / Vulcan / Datamine

Other Resources
Other material that should be referred to in conjunction with this Course Outline includes:
Course Reader and Lecture Presentations will be available in Moodle on a weekly basis.

Online Resources
Many of the above reference books are available in the institution libraries.

In addition to the above texts, a number of selected readings are available to students in Moodle. These readings are either extracts/chapters from books, conference papers or articles from journals.

Selected readings as well as other supporting material (e.g. course outline and lecture notes will be made available on Moodle, the Learning & Teaching Management System (LTMS) accessed on-line at http://elearning.mea.edu.au/)
# Learning Activities and Methods

## Learning Activities Summary (Draft) – MINE3220 for 2014

<table>
<thead>
<tr>
<th>WEEK</th>
<th>DATE 2014</th>
<th>CONTENT</th>
<th>TASKS</th>
</tr>
</thead>
</table>
| 1A   | 3 March    | Course Organisation, Introduction (WT, FRN) and Mine Planning Process (SS) | • Course outline, learning outcomes and assessment,  
• Course content, weekly schedules,  
• Expectation, “rules”, teaching and learning strategy.  
• Project criteria; Data gathering, data analysis, design; Equipment selection, scheduling; Valuation, Mine Plan; Mining method selection |
| 1B   | 5 March    | Mining Business Framework (SS) | • Economic factors – interest, inflation, etc.  
• Commodity prices, supply demand  
• Mineral marketing  
• Value adding, concentrates |
| 2A   | 10 March   | Role of Feasibility Studies (SS) | • Purpose of a feasibility study  
• Types of feasibility studies  
• Structure of a feasibility study |
| 2B   | 12 March   | Geology, Data Collection and Sampling Theory (WT) | • Geology of ore bodies and sedimentary structures  
• Data collection  
• Sampling theory |
| 3A   | 17 March   | Data Compositing (SS & external TBC) | • Review of the principles and practice of compositing drill hole analytical data.  
• Coal washability.  
• Project 1 begins – Coal Resource Estimation  
• Surfer Training @ Comp Lab |
| 3B   | 19 March   | JORC Code (WT) | • Resource estimates and other technical inputs, resources and reserves at the feasibility study stage, the JORC code, resources and reserves during mining, grade control in practice. |
| 4A   | 24 March   | Quiz 1 (6%) | • Quiz 1 on Mine Planning, Process, Mining Business Framework, Role of Feasibility Studies, Data Collection, Sampling, Compositing, Coal Washability and JORC |
| 4B   | 26 March   | Resource Estimation Techniques/Geostatistical Estimation (SS & FRN) | • Traditional Resource Estimation Techniques (polygon, triangulation, IDS, etc.)  
• Geostatistics |
| 5A   | 31 March   | Guest presentation – JORC applications to coal resources | • A guest presentation from industry. Attendance is compulsory to pass the course. |
| 5B   | 2 April    | Tutorials on estimation techniques (FRN) | Tutorials |
| 6A   | 7 April    | NO CLASS | • Due to Software training at this week  
• Project 1 due at 9 am Monday 14th April |
| 6B   | 10-11 April ALL DAY | Software Training (Vulcan) | • Vulcan Software Training - Orebody Modelling. Attendance is compulsory to pass the course.  
• 2 days for each half of group, 9 am to 5pm.  
• Group A - 8 & 9th April, Group B - 10 &11th April. |
| 7A   | 26 April   | Orebody modelling, global resource-reserve estimation, Grade Tonnage Curve (WT) | • Introduction to orebody modelling in the context of resource estimation  
• Project 2 begins - Block Model |
| 7B   | 30 April   | Quiz 2 (7%) WT | • Quiz 2 on Estimation Techniques, Geostatistics and Block Modelling |
| 8A   | 5 May      | Kriging tutorial (FRN) | Tutorials |
| 8B   | 7 May      | Progress Review for the project (WT) | |
| 9A   | 12 May     | Financial Concepts and Time Value of Money (SS) | • Time value of money  
• Net present value  
• Other decision analysis techniques  
• Undiscounted evaluation tools  
• DCF techniques |
| 9B   | 14 May     | Mining Economics (SS) | • Demand and supply  
• Basic concepts of mine optimisation |
| 10A  | 19 May     | Cost Estimation and Benchmarking (SS) | • Capital and Operating Cost Estimation |
| 10B  | 21 May     | CASE STUDY - NPM (external TBC) | • Guest presenter from North Parkes Mine TBC. Attendance is compulsory to pass the course. |
| 11A  | 26 May     | Group Project 2 Interviews from 9 AM to 12 Noon 10 min for each group @ Comp Lab Room 49 (WT) | |
| 11B  | 28 May     | Tutorials on Mining Economics (FG) | Project 2 due @ 9 am Monday 2nd June |
Assessment of Learning Outcomes

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>Assessment Methods</th>
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<tbody>
<tr>
<td>• Appreciate the mine planning process and the impact of the economic environment on mining</td>
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<tr>
<td>• Appreciate the role of feasibility studies in mine planning</td>
<td>• Quiz 1</td>
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<td>• Final exam</td>
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<tr>
<td>• Create coal and metalliferous resource models from exploration datasets using appropriate software tools and various estimation techniques</td>
<td>• Assignment</td>
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<td>• Group project</td>
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<td>• Final exam</td>
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<tr>
<td>• Appreciate the merits and drawbacks of various estimation methods relevant to specific mineral deposit types.</td>
<td>• Quiz 2</td>
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<td>• Group project</td>
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<td>• Final exam</td>
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<tr>
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<td>• Quiz 1</td>
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<td></td>
<td>• Quiz 2</td>
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<tr>
<td></td>
<td>• Assignment</td>
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<td></td>
<td>• Final exam</td>
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<tr>
<td>• Demonstrate an appreciation of the time value of money, discount rates, commodity markets, the required rate of return to equity</td>
<td>• Quiz 3</td>
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<td>• Final exam</td>
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<tr>
<td>• Explain the unique characteristics of mining and their implications for mine economics</td>
<td>• Quiz 3</td>
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<td>• Final exam</td>
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Teaching & Learning Methods

This course uses a number of different teaching and learning approaches including:

- Lectures
- Tutorials
- Software applications
- Self-directed activities

*Project-based learning*

This course utilises project-based learning methods. Students will be given two projects that will require group co-ordination and individual contributions. Students are required to share the project workload, and have weekly meetings and discussions.

*Tutorials*

Project work will be supported with tutorials as needed. The content of these are aligned with the projects to help students.

*Quizzes*

Three quizzes will be conducted in a controlled environment. The course lecturer will give the details.

*Group Projects*

Two group projects will be conducted in this course. Four or five students will form groups in GP1 and two students will form groups in GP2.

*Final Exam*
ASSESSMENT

Assessment Summary

<table>
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<tr>
<th>Assessment</th>
<th>Start</th>
<th>Due</th>
<th>Weighting</th>
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</thead>
<tbody>
<tr>
<td>Quiz 1</td>
<td>Week 4A</td>
<td>Week 4A</td>
<td>6%</td>
</tr>
<tr>
<td>Group Project 1</td>
<td>Week 3A</td>
<td>Week 5B</td>
<td>20%</td>
</tr>
<tr>
<td>Quiz 2</td>
<td>Week 7B</td>
<td>Week 7B</td>
<td>7%</td>
</tr>
<tr>
<td>Group Project 2</td>
<td>Week 7A</td>
<td>Week 11A</td>
<td>20%</td>
</tr>
<tr>
<td>Quiz 3</td>
<td>Week 12A</td>
<td>Week 12A</td>
<td>7%</td>
</tr>
<tr>
<td>Final Exam</td>
<td></td>
<td>Exam Period</td>
<td>40%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

- Only electronic copies will be evaluated.
- See the section on Group Work - Peer Assessment in the section on University Policies for further details on the requirements and process of peer assessment in-group project work.

Assessment Criteria

Assessment Criteria will be provided in the project documents.
Assignment Submissions

All assignments submitted for assessment in this course must be made in accordance with the School Policy on Assignment Submissions, hereafter in this subsection termed the Policy. Details of the Policy can be found in the School Policies section of the School webpage at http://www.engineering.unsw.edu.au/mining-engineering/university-policies-and-school-guidelines

Students are required to read the latest version of the Policy and be aware of the various requirements including submission requirements and academic integrity. Failure to adhere to the requirement and/or submit an assignment that is fully compliant with the Policy may result in forfeiture by the student of all marks for that assignment.

An Assignment Coversheet must be attached to each assignment submitted for assessment whether the assignment is submitted in electronic or hardcopy form. The coversheet identifies the student, assignment, course and contains a declaration of academic integrity – see later section on Academic Honesty and Plagarism. Assignments not containing a fully completed copy of the official coversheet for the assignment will be deemed non-compliant and not marked resulting in the student will be awarded zero marks for the assignment.

By default all assignments for courses in the School must be submitted as an electronic document. The submission requirements for electronic submissions are detailed in the Policy.

In the case where a hardcopy submission of an assignment has been permitted in the assignment briefing document then the submission requirements for hardcopy submissions as detailed in the Policy must be followed. The student must attach to the front of the assignment a completed and signed copy of the appropriately coloured Assignment Coversheet for the particular Course Convenor which in this case is LIGHT GREEN. A copy of the coloured Coversheet is available from the Course Convenor one week before the assignment due date.

Students are advised to retain a copy of every assignment submitted for assessment for their own record either in hardcopy or electronic form. From time to time assignments may be mislaid and a student can be asked to re-submit.

Late Submission of an Assignment

In the normal course of events late submission of an assignment will automatically result in a zero mark being awarded to the student for the assignment.

The onus is on the student to ensure each course assignment is submitted on-time during normal business hours and no later than the required time on the due date as stated in the relevant assignment briefing document.

For further details see Late Submissions in the School Policies section on the School webpage at http://www.engineering.unsw.edu.au/mining-engineering/university-policies-and-school-guidelines
See also the later section on Adverse Performance – Special Consideration.
Course Results

For details on assessment policy, assessment process and an explanation of course results, see the Assessment Policy section in the School Policies section on the School webpage at http://www.engineering.unsw.edu.au/mining-engineering/university-policies-and-school-guidelines.

In some instances a student’s final course result may be withheld and not released on the usual date. This is indicated by a course grade result of either:

- **WD** – which usually indicates that the student has not completed one or more items of assessment or there is an issue with one or more assignment; or
- **WC** – which indicates the student has applied for Special Consideration due to illness or misadventure and the course results have not been finalised.

In either event the onus is on the student to contact the Course Convenor as soon as practicable but no later than five (5) days after release of the course result. Failure to take this action will normally result in forfeiture of any additional assessment granted to the student. In which case the student may be required to re-submit an assignment or re-sit the final exam. Failure to contact the Course Convenor within the stated period may result in the student failing the course.

If contact has not been made and/or course assessment has not been finalised by commencement of the following academic semester then the grade will be automatically altered to a course grade of **NC** (course not completed) in Week 2. This will require the student to re-enrol in the course at some later time.

Adverse Performance – Special Consideration

In cases of illness or other extenuating circumstances that may have adversely impacted on a student’s performance in a course, it is recommended the student apply to Student Central for Special Consideration.

It is incumbent on the student to contact the Course Convenor immediately following lodgement and acceptance of the Special Consideration preferably in person and no later than one week from lodgement. Failure to make contact can result in forfeiture for any consideration and subsequent finalisation of the mark for the assignment and/or course.

Only following acceptance and official notification from the University, will any decision be made by the Course Convenor as to an appropriate response based the circumstances outlined by the student.

For further information, see Special Consideration – Illness and Misadventure within the section on UNSW Policies on the School webpage at http://www.engineering.unsw.edu.au/mining-engineering/university-policies-and-school-guidelines

Academic Honesty and Plagiarism

The University has certain expectations in terms of academic behaviour related to study and research. This is expressed in the University Policy on Academic Misconduct. Students
should be aware of and understand this Policy. For further information, see Academic Misconduct and Plagiarism in the section on UNSW Policies at http://www.engineering.unsw.edu.au/mining-engineering/university-policies-and-school-guidelines

Plagiarism is one form of Academic Misconduct. It is the presentation of the thoughts or work of another as one’s own\(^1\). Examples include:

- direct duplication of the thoughts or work of another, including by copying work, or knowingly permitting it to be copied. This includes copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person’s assignment without appropriate acknowledgement;
- paraphrasing another person’s work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- piecing together sections of the work of others into a new whole;
- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and,
- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed\(^2\).

Submitting an assessment item that has already been submitted for academic credit elsewhere may also be considered plagiarism.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does not amount to plagiarism.

Students are reminded of their Rights and Responsibilities in respect of plagiarism, as set out in the University Undergraduate and Postgraduate Handbooks, and are encouraged to seek advice from academic staff whenever necessary to ensure they avoid plagiarism in all its forms.

The Learning Centre website is the central University on-line resource for staff and student information on plagiarism and academic honesty. It can be viewed at https://student.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are 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 items.

\(1\) Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle.

\(2\) Adapted with kind permission from the University of Melbourne.
In line with this university expectation, a student must attach to each assignment a fully completed official coversheet which contains a declaration of academic integrity. The following is an extra from an assignment coversheet.

Extract from an Assignment Coversheet

ACADEMIC REQUIREMENTS
Before submitting this assignment, students are advised to review:

- the assessment requirements contained in the briefing document for the assignment;
- the various matters related to assessment in the relevant Course Outline; and
- the Plagiarism and Academic Integrity website at <http://www.lc.unsw.edu.au/plagiarism/pintro.html> to ensure they are familiar with the requirements to provide appropriate acknowledgement of source materials.

If after reviewing this material there is any doubt about assessment requirements then in the first instance the student should consult with the Course Convenor and then if necessary with the Director – Undergraduate Studies.

While students are generally encouraged to work with other students to enhance learning, all assignments submitted for assessment by a student must be their entire own work and they may be required to explain any or all parts of the assignment to the Course Convenor or other authorised persons. Collusion is where another person(s) assists in the preparation of an assignment without the consent or knowledge of the Course Convenor.

Plagiarism and Collusion are considered as Academic Misconduct and will be dealt with according to University Policy.

STUDENT DECLARATION OF ACADEMIC INTEGRITY
I declare that:

- This assessment item is entirely my own original work, except where I have acknowledged use of source material [such as books, journal articles, other published material, the Internet, and the work of other student/s or any other person/s].
- This assessment item has not been submitted for assessment for academic credit in this, or any other course, at UNSW or elsewhere.

I understand that:

- The assessor of this assessment item may, for the purpose of assessing this item, reproduce this assessment item and provide a copy to another member of the University.
- The assessor may communicate a copy of this assessment item to a plagiarism checking service (which may then retain a copy of the assessment item on its database for the purpose of future plagiarism checking).

Continual Course Improvement

Periodically the process of course evaluation is undertaken. One aspect of this evaluation is feedback from students gathered by various means including:

- UNSW's Course and Teaching Evaluation and Improvement (CATEI) which is an anonymous, on-line survey system.

Student feedback is taken seriously, and continual improvements are made to the course based in part on such feedback.
Significant changes that are made to a course as a result of such student feedback will be communicated to students by the Course Convenor at commencement of semester when the course is next run.
Correspondence and Email Messages

University policy states that official correspondence with a student will be made using the university provided email address and that it expects students will regularly check their official university email account. The School assists in this by providing free access to computing facilities and the internet.

In line with this policy, messages will be sent to students through their LTMS account. Students can retrieve messages from the mailbox in each LTMS course account.

Administrative Matters

Students should ensure they are familiar with the various policies related to expectations of students. Links to the Policies can be found on the School web page at http://www.engineering.unsw.edu.au/mining-engineering/university-policies-and-school-guidelines

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 Equity and Diversity Unit http://www.studentequity.unsw.edu.au/

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.