Unit Outline

ECON6013 Resource Sector Finance
Trimester 3, 2016

Unit study package code:	ECON6013
Mode of study:	Internal
Tuition pattern summary:	Note: For any specific variations to this tuition pattern and for precise information refer to the Learning Activities section.
	Block Teaching: 8 x 6 Hours Semester
	This unit does not have a fieldwork component.
Credit Value:	25.0
Pre-requisite units:	312811 (v.0) Mineral Finance and Project Evaluation 601 or any previous version
	OR
	ECON6015 (v.0) Mineral Finance and Project Evaluation or any previous version
Co-requisite units:	Nil
Anti-requisite units:	Nil
Result type:	Grade/Mark
Approved incidental fees:	Information about approved incidental fees can be obtained from our website. Visit fees.curtin.edu.au/incidental_fees.cfm for details.

Unit coordinator:	**Title:**	Dr
	Name:	Bryan Maybee
	Phone:	+618 9266 9120
	Email:	B.Maybee@curtin.edu.au
	Location:	Building: P01 - Room: 106A
Teaching Staff:	**Name:**	Pietro Guj
	Phone:	+618 9266 2355
	Email:	pietro.guj@gsb.curtin.edu.au
	Location:	Building: P01 - Room: 407
Administrative contact:	**Name:**	Margot Stacy Javillo
	Phone:	08 9266 1205
	Email:	Margot.Javillo@curtin.edu.au
	Location:	Building: P01 - Room: 116B
Learning Management System:	Blackboard (lms.curtin.edu.au)	

Acknowledgement of Country

We respectfully acknowledge the Indigenous Elders, custodians, their descendants and kin of this land past and present.

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Perth City Campus
19 Aug 2016
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Syllabus

This unit examines finance and its application to the mineral and energy sectors. It covers feasibility studies and advanced application of risk analysis. The important incorporation of advanced financial application to mineral and energy sector planning and project development is also covered.

Introduction

This unit is delivered in an intensive format held from 10 - 19 October 2016.

Resource Sector Finance is a relatively advanced course in Business Finance as applied to mineral and petroleum asset valuations and investment decisions. As such it presupposes that participants may have already developed a degree of familiarity with fundamental accounting and business finance principles during a previous degree or from having already attended Mineral Finance and Project Evaluation.

The course commences with the construction of a Discounted Cash Flow (DCF) "base-case" model of a mining project development under assumed certainty and of an alternative acquisition option at a later stage. This exercise will both refresh the participants' knowledge of DCF analysis and create the basis for later real options modelling. It then progresses to the formulation of probabilistic models and Monte Carlo simulations, to the theory and application of decision trees and utility analysis in establishing corporate risk attitudes and of more advanced evaluation principles and methodologies such as Modern Asset Pricing (MAP) and Real Option Valuation (ROV) as applied to resources projects.

The objective of the course is to strengthen participants' project evaluation skills and to familiarise them with recent developments in risk and decision analysis, including the transfer of option valuation methodologies from the field of financial securities to investment decisions relevant to "real" assets such as mineral and petroleum projects.

While rigorous and quantitative in character, the course is not designed to turn participants into "overnight experts". It will however place future managers in the resources sector in a position to communicate with specialists in the field by becoming capable of understanding, interpreting and explaining the results of sophisticated RO analyses and evaluations to justify better informed strategic and investments decisions.

The course will also provide an ideal "springboard" for those participants who may find the subject fascinating and who, as a consequence, may wish to pursue it in further depth.

Unit Learning Outcomes

All graduates of Curtin University achieve a set of nine graduate attributes during their course of study. These tell an employer that, through your studies, you have acquired discipline knowledge and a range of other skills and attributes which employers say would be useful in a professional setting. Each unit in your course addresses the graduate attributes through a clearly identified set of learning outcomes. They form a vital part in the process referred to as assurance of learning. The learning outcomes tell you what you are expected to know, understand or be able to do in order to be successful in this unit. Each assessment for this unit is carefully designed to test your achievement of one or more of the unit learning outcomes. On successfully completing all of the assessments you will have achieved all of these learning outcomes.

Your course has been designed so that on graduating we can say you will have achieved all of Curtin's Graduate Attributes through the assurance of learning process in each unit.

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	On successful completion of this unit students can:	Graduate Attributes addressed
1	Analyse financial activity associated with mineral and energy resource projects	☑ 💡 👥
2	Understand the fundamental concepts of risk management in a financial context and their application to optimise investment decisions through real options valuation	💡 💬
3	Interpret and assess international commodity market implications in financial analysis models	▶ 💡
4	Explain the forces behind risk analysis and its application	💡 🔍
5	Conduct project evaluation and feasibility analysis	☑ 💡 🖱

Curtin's Graduate Attributes

☑	Apply discipline knowledge	💡	Thinking skills (use analytical skills to solve problems)	🔍	Information skills (confidence to investigate new ideas)
💬	Communication skills	🖱	Technology skills	🧠	Learning how to learn (apply principles learnt to new situations) (confidence to tackle unfamiliar problems)
▶	International perspective (value the perspectives of others)	🌐	Cultural understanding (value the perspectives of others)	👥	Professional Skills (work independently and as a team) (plan own work)

Find out more about Curtin's Graduate attributes at the Office of Teaching & Learning website: ctl.curtin.edu.au

Learning Activities

The course will progress from a review of conventional financial modelling of mining projects using Discounted Cash Flow (DCF) analysis under assumed certainty (as already covered in Mineral Finance and Project Evaluation) to:

- Identification and quantification of risk using sensitivity and scenario analyses, to the formulation of probabilistic models suitable for use in a Monte Carlo simulation, which will be carried out using a user-friendly risk-analysis software package.
- The limitations of investment choices using risk-neutral expected value criteria, prevailing attitudes to risk and the use of utility or preference theory to assess the degree of risk-aversion and the pricing of risky assets, such as exploration or mining projects, based on certainty equivalent.
- Construction and analysis of decision trees as an aid to both risk-neutral and risk-averse investment choices.
- Familiarisation with option pricing principles and methodologies for the evaluation of financial securities as a preliminary to their application and adaptation to modelling and valuation of "real" assets such as mineral and petroleum projects. It will be shown how these methodologies can help in overcoming the bias introduced by the application in DCF analysis of a single, time-and-risk-adjusted discount rate to both the very risky revenue and less risky expenditure and by its use in comparing the present value of different projects with markedly different risk characteristics and/or operational leverage.
- "Modern Asset Pricing" (MAP) and "Real Option Valuations" (ROV) which recognise the value created by inherent or planned managerial flexibility allowing the choice of alternative courses of action at crucial stages during the life of a project as new information progressively dispels uncertainty and risk. The static and deterministic nature of DCF analysis fails to capture this "option" value. It will be shown how neglecting option value can be a very significant omission particularly in the case of mining projects, which display very high volatility in the determinants of their net cash flows (e.g. prices) which may lead to punitive risk-adjusted discount rates and consequently to marginal or even negative NPVs. As a result, for a more accurate net asset valuation, ROV should be assessed and added to the project DCF/NPV and the NPV investment criteria modified accordingly.
- Consideration of various methods of valuing RO including:
  - Closed-form equations, such as the Black and Scholes formula. These are accurate and easy to use with financial securities and oversimplified real options, but unsuitable for use in more complex real options models.

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- The powerful replicating portfolio method based on the no-arbitrage principle and stochastic techniques to forecast forward commodities prices, and other key volatile inputs. This method, sometimes referred to as Modern Asset Pricing or MAP, allows the construction of project models that separate and handle more realistically the inherently higher-risk components of the revenue function of mineral and petroleum projects as compared to their cost function.
- The more versatile binomial lattice method using either "risk-free" probabilities or "state prices". The accuracy and ease of use of this methodology has been enhanced in recent years by the computational power of modern PCs and of specialised risk-analysis software.
- The modifications necessary to enable the use of decision trees for real option valuations.
- How the often counter-intuitive nature of ROV results may also create not only potential risk of significant error in their interpretation but also unsurmountable challenges in communicating them effectively to decision-makers.

Learning Resources
Other resources

The material covered in this course will be largely covered by Prof. Guj's:

- Presentation slides and
- Guj P., 2013. "Mineral Project Evaluation - Dealing with Uncertainty and Risk", Chapter 10, in AusIMM Monograph 29, Mineral Economics (2nd edition), Philip Maxwell and Pietro Guj editors.

In addition, the following text are highly recommended but not compulsory:

Benninga, S. 2008. *Financial Modelling*. 3rd ed. Cambridge MA: The MIT Press

Copeland T. and V. Antikarov. 2003. *Real options: a practitioner's guide*. New York: Texere

References and Relevant Publications

Borison A., 2005 – Real Options Analysis: Where are the Emperor's clothes? – Journal of applied corporate finance, v.17, n. 2, pp. 17-31

Brandao L.E., Dyer J.S. and Hahn W.J., 2005 – Using binomial decision trees to solve real-option valuation problems – Decision Analysis, Vol.2, N. 2, June 2005, pp. 69-88

Baker, M.P., E.S. Mayfield and J.E. Parson. 1998. Alternative models of uncertain commodity prices for use with modern Asset pricing methods. The Energy Journal 19 (1): 115-148

Blais, V., R. Poulin and M. Samis. 2002. Using real options to incorporate price risk into the valuation of a multi-mineral mine - AusIMM, Spectrum Series. *Orebody Modelling and Strategic Mine Planning* 14

Claeys, J. and Walkup, G. – 1999 – Discovering real options in oilfields exploration and development – SPE Hydrocarbon Economics and Evaluation Symposium, Dallas, TX, Society of Petroleum Engineers

Copeland, T.E. and Keenan, P.T. – 1998 – How much is flexibility worth? – The McKinsey Quarterly 1998, Number 2

Diaz, M. – 2002 – Stochastic processes with focus in petroleum applications – www.puc-rio.br/marco.ind/stocast.html

Dixit, A.K. and Pindyck, R.S., 1994 – Investment under uncertainty – Princeton University Press, Princeton, New Jersey.

Dixit, A.K. and Pindyck, R.S. - 1995 – The option approach to capital investment – Harvard Business Review, May-June 1995

Faiz, S. – 2001 – Real option applications: from success in asset valuation to challenges for an enterprisewide approach – Society of Petroleum Engineers – pp. 42-48

Guj P., 2011, A practical real option methodology for the evaluation of farm-in/out joint venture agreements in mineral exploration, Resources Policy 36 (2011) 80–90

Guj P. and Garzon R., 2007 – Modern asset pricing: a valuable real option complement to discounted cash flow modelling of mining projects – Proceedings of the AuIMM's "Project Evaluation 2007" Conference, Melbourne.

Jacoby, H. and Laughton, D. – 1992 – Project evaluation: a practical asset pricing method – The Energy Journal v.13 –

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pp. 19-47

Laughton, D.G. –1998 – The potential for use of the Modern Asset Pricing methods for upstream petroleum project evaluation: Introductory remarks – The Energy Journal, v.19 (1) – pp. 1-11

Laughton, D.G. – 1998 – The management of flexibility in the upstream petroleum industry – The Energy Journal v.19 (1) – pp. 83-114

Lesley, K.J. and Michaels, M.P. – 1997 – The real power of real options – The McKinsey Quarterly 1997, Number 3

Monkhouse, P.H.L., and Yeates, G. – Beyond naïve optimisation – 2002 - AusIMM, Spectrum Series Volume 14, Orebody Modelling and Strategic Mine Planning

Newendorp, P.D. and Schuyler, J. – 2000 – Decision analysis for petroleum Exploration – Planning Press, Aurora, Co. ISBN 0 9664401 1 0

Salahor, G – 1998 – Implications of output price risk and operating leverage for the evaluation of petroleum development projects – The Energy Journal v.19 (1) – pp. 13-46

Samis, M., Laughton, D. and Poulin, R. – 2002 – An example of using real options to model a mine expansion decision at a multi-zone deposit – Application of Computer and Operation Research in the Mineral industry, Phoenix, AZ

Smith, J. and McCardle, K. – 1999 – Options in the real world: Lessons learned in evaluating oil and gas investments – Operations Research v.47 – pp. 1-15

Torries, T.F. – 1998 – Evaluating Mineral Projects: Applications and Misconceptions – Society for Mining, Metallurgy and Exploration, Inc. - ISBM 0-87335-159-2

Relevant web sites:

www.real-options.com

Pontificia Universidade Catolica do Rio de Janeiro: www.puc-rio.br/marco.ind/main.html

New York University: http://pages.stern.nyu.edu/~adamodar/

Arizona State University: http://www.public.asu.edu/~kirkwood/index.html

University of Texas at Austin: http://www.mccombs.utexas.edu/faculty/luiz.brandao/

To download the risk analysis software and related manuals: http://www.decisiontoolpak.com/

Assessment
Assessment schedule

	Task	Value %	Date Due	Unit Learning Outcome(s) Assessed
1	Group assignment	30 percent	**Week:** Part 1: 11th Oct, Part 2: 14th Oct **Day:** Tuesday and Friday **Time:** 08:30	1,2,3
2	Individual assignment	20 percent	**Week:** Part 1: 13th Oct, Part 2: 18th Oct **Day:** Thursday and Tuesday **Time:** 08:30	2,3,4
3	Final Examination	50 percent	**Week:** 19th Oct **Day:** Wednesday **Time:** 08:30	1,2,3,4,5

Detailed information on assessment tasks

1. This assessment will have 2 parts. Students will be given the modelling problems for afternoon and overnight

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group work, which are to be submitted/presented the following morning.

2. This assessment will be undertaken in 2 Parts. Each part will be distributed following the lecture, and is to be completed individually for submission the following morning.

3. The final examination will be held on the last day of class, and will be based on the material covered in the Intensive session.

Pass requirements

Students must attend the intensive session classes, complete all assessments, and **receive a passing grade on the combination of their individual assessment tasks (Assessment 2 and Assessment 3)** to be awarded a passing grade for this unit.

Fair assessment through moderation

Moderation describes a quality assurance process to ensure that assessments are appropriate to the learning outcomes, and that student work is evaluated consistently by assessors. Minimum standards for the moderation of assessment are described in the Assessment and Student Progression Manual, available from
policies.curtin.edu.au/policies/teachingandlearning.cfm

Late assessment policy

This ensures that the requirements for submission of assignments and other work to be assessed are fair, transparent, equitable, and that penalties are consistently applied.

1. All assessments students are required to submit will have a due date and time specified on this Unit Outline.
2. Students will be penalised by a deduction of ten percent per calendar day for a late assessment submission (eg a mark equivalent to 10% of the total allocated for the assessment will be deducted from the marked value for every day that the assessment is late). This means that an assessment worth 20 marks will have two marks deducted per calendar day late. Hence if it was handed in three calendar days late and given a mark of 16/20, the student would receive 10/20. An assessment **more than seven calendar days overdue will not be marked and will receive a mark of 0.**

Assessment extension

A student unable to complete an assessment task by/on the original published date/time (eg examinations, tests) or due date/time (eg assignments) must apply for an assessment extension using the Assessment Extension form (available from the Forms page at students.curtin.edu.au/administration/) as prescribed by the Academic Registrar. It is the responsibility of the student to demonstrate and provide evidence for exceptional circumstances beyond the student's control that prevent them from completing/submitting the assessment task.

The student will be expected to lodge the form and supporting documentation with the unit coordinator before the assessment date/time or due date/time. An application may be accepted up to five working days after the date or due date of the assessment task where the student is able to provide an acceptable explanation as to why he or she was not able to submit the application prior to the assessment date. An application for an assessment extension will not be accepted after the date of the Board of Examiners' meeting.

Deferred assessments

If your results show that you have been granted a deferred assessment you should immediately check OASIS for details.

Deferred examinations/tests will be held from 13/08/2016 to 03/12/2016 . Notification to students will be made after the Board of Examiners' meeting via the Official Communications Channel (OCC) in OASIS.

Supplementary assessments

Supplementary assessments are not available in this unit.

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Reasonable adjustments for students with disabilities/health circumstances likely to impact on studies

A Curtin Access Plan (CAP) is a document that outlines the type and level of support required by a student with a disability or health condition to have equitable access to their studies at Curtin. This support can include alternative exam or test arrangements, study materials in accessible formats, access to Curtin's facilities and services or other support as discussed with an advisor from Disability Services (disability.curtin.edu.au). Documentation is required from your treating Health Professional to confirm your health circumstances.

If you think you may be eligible for a CAP, please contact Disability Services. If you already have a CAP please provide it to the Unit Coordinator at the beginning of each semester.

Referencing style

The referencing style for this unit is Chicago.

More information can be found on this style from the Library web site:
http://libguides.library.curtin.edu.au/referencing.

Copyright

© Curtin University. The course material for this unit is provided to you for your own research and study only. It is subject to copyright. It is a copyright infringement to make this material available on third party websites.

Academic Integrity (including plagiarism and cheating)

Any conduct by a student that is dishonest or unfair in connection with any academic work is considered to be academic misconduct. Plagiarism and cheating are serious offences that will be investigated and may result in penalties such as reduced or zero grades, annulled units or even termination from the course.

Plagiarism occurs when work or property of another person is presented as one's own, without appropriate acknowledgement or referencing. Submitting work which has been produced by someone else (e.g. allowing or contracting another person to do the work for which you claim authorship) is also plagiarism. Submitted work is subjected to a plagiarism detection process, which may include the use of text matching systems or interviews with students to determine authorship.

Cheating includes (but is not limited to) asking or paying someone to complete an assessment task for you or any use of unauthorised materials or assistance during an examination or test.

From Semester 1, 2016, all incoming coursework students are required to complete Curtin's Academic Integrity Program (AIP). If a student does not pass the program by the end of their first study period of enrolment at Curtin, their marks will be withheld until they pass. More information about the AIP can be found at:
https://academicintegrity.curtin.edu.au/students/AIP.cfm

Refer to the Academic Integrity tab in Blackboard or academicintegrity.curtin.edu.au for more information, including student guidelines for avoiding plagiarism.

Information and Communications Technology (ICT) Expectations

Curtin students are expected to have reliable internet access in order to connect to OASIS email and learning systems such as Blackboard and Library Services.

You may also require a computer or mobile device for preparing and submitting your work.

For general ICT assistance, in the first instance please contact OASIS Student Support:
oasisapps.curtin.edu.au/help/general/support.cfm

For specific assistance with any of the items listed below, please contact The Learning Centre:
life.curtin.edu.au/learning-support/learning_centre.htm

- Using Blackboard, the I Drive and Back-Up files
- Introduction to PowerPoint, Word and Excel

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Additional information

Online Supplementation of this unit

This unit is supplemented in Blackboard, a web-based learning environment that is to be used in conjunction with face to face delivery of the unit. If you are new to online environment, we encourage you to look at the CBS Online section of the website at http://business.curtin.edu.au/schools/cgsb/current_students/studying_online/index.cfm

This website provides useful information about Blackboard. Should you require assistance of any kind, please make sure you direct your queries to the appropriate area in order to get the result you need quickly. For content-related issues, contact your Lecturer. For technical issues relating to your online unit, please fill in the online help form available from the above website.

Access to your online unit on Blackboard will become available once the study period has started. It is recommended that you access your online Blackboard unit through OASIS, your student portal at Curtin. You will find the Blackboard option located under the '*My Studies'* tab.
You can also use the direct link: http://www.lms.curtin.edu.au/ . Should you choose to use this link, you will need to use your login and password which are exactly the same as for OASIS.
If you have not activated your OASIS logon, please go to http://www.oasis.curtin.edu.au and follow the prompts. If you are a new student, please note that to activate OASIS logon you have to know your student number, which is to be found on your letter of offer.

Scheduled CITS outages

Scheduled Maintenance occurs when Curtin Information Technology Services (CITS) takes one or more University systems offline for up to 12 hours to complete routine repairs. During these Scheduled Maintenance windows major maintenance may take place and may affect multiple systems. You should plan for limited or no access to Curtin systems and network, including the possible absence of internet connectivity.

You will be notified two weeks prior to the Scheduled Maintenance window with a detailed list of affected IT services and their associated outage windows. Notices about scheduled maintenance periods are posted in OASIS and will indicate which systems will be affected. When Blackboard is affected specifically, notices about upcoming outages will also be posted on the Blackboard login page. **Please pay attention to these notices as they will affect your access to the system (thus your assessment submission!).**

You may also refer to the following link for updates on maintenance work (scroll to the bottom of the screen for "Blackboard Maintenance"): http://cits.curtin.edu.au/support/scheduled_maintenance_service_availability.cfm

Submission of all Written Assignments through Turnitin

The majority of your written assessments will be submitted through *Turnitin via* Blackboard. Submission upload links are located in the 'Assessment' section on Blackboard within their respective assessment 'folder' (in most units). You will also be given the option to upload a draft of each assessment to Turnitin *prior* to your final submission. If you choose to upload a draft (referred to in Turnitin as a "Revision"), Turnitin will generate an **Originality Report** to help you pinpoint any referencing issues. Make good use of this feedback to improve your writing before uploading your final submission.

If you require further information about how to reference correctly, please visit the Library website (http://libguides.library.curtin.edu.au/content.php?pid=141214), book in to a Library workshop, or access the online Referencing module in the **SUCCESS for CGSB Students** Blackboard site (a link to the SUCCESS site appears alongside the other Blackboard sites you have access to).

Assessment Guidelines

Marks for each assignment are posted into the Blackboard Grade Centre which is the University's official repository for all grades. Whilst Grade Centre access is restricted to Curtin staff only (UC, Lecturers and LMS support personnel), students can view their grades via *My Grades*. The *My Grades* option is accessible off the main menu in all CGSB Blackboard units.

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This policy, taken from the University's Assessment and Student Progression Policy, ensures requirements for submission of assignments (and other work) to be assessed are fair, transparent, equitable and that penalties are consistently applied.

Referencing Style

Students must use the Chicago author-date 16th edition referencing style when preparing assignments. More information can be found on this style from the Curtin Library website:
http://libguides.library.curtin.edu.au/referencing

When using EndNote, the style system that should be used is Chicago 16th B Curtin.

Important Information for Students:

Please read the **Current Students** section of the CGSB website
(http://business.curtin.edu.au/schools/cgsb/current_students/index.cfm) for further information on the following:

- unit availability
- timetables
- re-enrolment procedures
- fee information
- the CGSB Alumni Chapter, and
- Emergency Procedures

Any enquiries concerning your enrolment can be sent to currentstudents@gsb.curtin.edu.au

Enrolment

It is your responsibility to ensure that your enrolment is correct - you can check your enrolment through the eStudent option on OASIS, where you can also print an Enrolment Advice.

Student Rights and Responsibilities

It is the responsibility of every student to be aware of all relevant legislation, policies and procedures relating to their rights and responsibilities as a student. These include:

- the Student Charter
- the University's Guiding Ethical Principles
- the University's policy and statements on plagiarism and academic integrity
- copyright principles and responsibilities
- the University's policies on appropriate use of software and computer facilities

Information on all these things is available through the University's "Student Rights and Responsibilities" website at:
students.curtin.edu.au/rights.

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Student Equity

There are a number of factors that might disadvantage some students from participating in their studies or assessments to the best of their ability, under standard conditions. These factors may include a disability or medical condition (e.g. mental illness, chronic illness, physical or sensory disability, learning disability), significant family responsibilities, pregnancy, religious practices, living in a remote location or another reason. If you believe you may be unfairly disadvantaged on these or other grounds please contact Student Equity at eesj@curtin.edu.au or go to http://eesj.curtin.edu.au/student_equity/index.cfm for more information

You can also contact Counselling and Disability services: http://www.disability.curtin.edu.au or the Multi-faith services: http://life.curtin.edu.au/health-and-wellbeing/about_multifaith_services.htm for further information.

It is important to note that the staff of the university may not be able to meet your needs if they are not informed of your individual circumstances so please get in touch with the appropriate service if you require assistance. For general wellbeing concerns or advice please contact Curtin's Student Wellbeing Advisory Service at: http://life.curtin.edu.au/health-and-wellbeing/student_wellbeing_service.htm

Recent unit changes

Students are encouraged to provide unit feedback through **eVALUate**, Curtin's online student feedback system. For more information about **eVALUate**, please refer to evaluate.curtin.edu.au/info/.
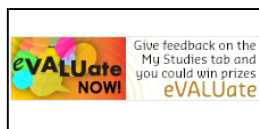
eVALUate NOW! Give feedback on the My Studies tab and you could win prizes eVALUate	To view previous student feedback about this unit, search for the Unit Summary Report at https://evaluate.curtin.edu.au/student/unit_search.cfm. See https://evaluate.curtin.edu.au/info/dates.cfm to find out when you can **eVALUate** this unit.

Recent changes to this unit include:

This unit has been updated based on feedback received through eValuate.

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Program calendar

Preparatory Reading

WEEK	Preparatory reading for following modules	Reading material
29 Aug - 4 Sep	1	P. Guj, 2013, Chapter 9, Reprint in Blackboard
		Torries, T.F. – 1998 – Evaluating Mineral Projects: Applications and Misconceptions – Society for Mining, Metallurgy and Exploration, Inc. - ISBM 0-87335-159-2
		Review of "Mineral finance and project evaluation" 601, Course Notes
		P. Guj, 2013, First half of Chapter 10, Reprint in Blackboard.
		J. Kim and D. Wallace, 1998, Mean-semivariance analysis: risk and opportunity, Reprint in Blackboard
5 - 11 Sep	2	Benninga, Simon. 2008. *Financial Modelling*. 3rd ed. Cambridge MA: The MIT Press, Chapters dealing with the lognormal distribution.
		Salahor, G – 1998 – Implications of output price risk and operating leverage for the evaluation of petroleum development projects – The Energy Journal v.19 (1) – pp. 13-46
12 - 18 Sep	3	Salahor, G – 1998 – Implications of output price risk and operating leverage for the evaluation of petroleum development projects – The Energy Journal v.19 (1) – pp. 13-46
		Guj, P. and Garzon, R.- 2007 – Modern Asset Pricing – A valuable Real Option complement to Discounted Cash Flow modelling of mining projects – Proceedings of the AusIMM's "Project Evaluation" Conference, Melbourne, 2007
19 - 25 Sep	4	Copeland, Thomas and Vladmir Antikarov. 2003. *Real options: a practitioner's guide*. New York: Texere, with particular emphasis on the Modern Asset Disclaimer (MAD) approach.
26 Sep - 2 Oct	5	Guj, P., 2010, Real option valuations using binomial lattices, Reprint in Blackboard
		Mun, J. – 2002 – Real Options Analysis – John Wiley and Sons Inc. – Hoboken, New Jersey – ISBN 0-471-25696-X, with particular emphasis on Chapter 12.
		Borison A., 2005 – Real Options Analysis: Where are the Emperor's clothes? – Journal of applied corporate finance, v.17, n. 2, pp. 17-31
		P. Guj and A. Chandra, 2012 (In review), Real option valuation of mineral exploration / mining projects using decision trees: Differentiating market risk from private risk, Proceedings of the AusIMM, "Project Evaluation – 2012" Conference, Melbourne.
		Brandao L.E., Dyer J.S. and Hahn W.J., 2005 – Using binomial decision trees to solve real-option valuation problems – Decision Analysis, Vol.2, N. 2, June 2005, pp. 69-88
3 - 9 Oct	6	P. Guj, 2013, Second half of Chapter 10, Reprint in Blackboard
		Guj P., 2011, A practical real option methodology for the evaluation of farm-in/out joint venture agreements in mineral exploration, Resources Policy 36

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			(2011) 80–90	
			Monkhouse, P.H.L., and Yeates, G. – Beyond naïve optimisation – 2002 - AusIMM, Spectrum Series Volume 14, Orebody Modelling and Strategic Mine Planning	

Face to Face Class Sessions

Session	Class Date	Module Topic	Readings	Study Questions and Assessment Due Dates
1	Monday 10 Oct 8:30 - 1:30pm Afternoon/evening class group assignment	Course introduction Review of project evaluation DCF modelling methodologies: • The "Investment decision": Discounted Cash Flow (DCF) models in real and nominal dollars, under assumption of certainty and 100% equity • The "Financing decision": Introducing debt, financial leverage and financial risk • Discount rates, discounting intervals and continuous discounting, Capital Asset Pricing Model (CAPM) and Weighted Average Cost of Capital (WACC) • DCF criteria of value for "accept-reject" decisions	**Preparatory reading on**: Probability theory and probability distributions, sensitivity and scenario analyses and Monte Carlo simulation (Guj, first half of Chapter 10)	
2	Tuesday 11 Oct 8:30 - 1:30pm	**Class presentations of Group Assignment Part 1** Risk analysis: • Uncertainty and risk • Expected value (EV) and risk-neutral decisions • The binomial distribution: Risk of Gambler's ruin and determining risk exposure in mineral exploration • Spreading risk through joint ventures (JVs) • Review of probability theory	**Preparatory reading on:** Log-normal distribution and financial derivatives (Benninga) Geometric Brownian Motion (GBM), reverting and non-reverting prices models and general concepts and fundamental principles of real option valuations (Guj, Chapter 10).	**Group Assignment Part 1:** constructing a simple DCF model of a mine

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		- Conditional (Baysian) probabilities - Mean-variance analysis **Utility theory:** - Risk preferences and risk profiles - The exponential utility function and certainty equivalents (CE) - Expected preference value (EPV) and risk-averse decisions - Determining the risk tolerance (RT) coefficient		
3	Wednesday 12 Oct 8:30 - 1:30pm	**Decision trees in financial and risk analysis:** - Structure of decision trees: decision and probability nodes - Discretising continuous distributions - Maximising EV - Maximising CE - Potential applications in mining **Stochastic processes for forward prices forecasts:** - Log-normal distribution of commodity prices - Geometric Brownian Motion (GBM) - Reverting and non-reverting price models	**Preparatory reading on**: Modern Asset Pricing (MAP) valuations (Guj, Chapter 10 and Guj et al., 2007) and the binomial lattice method with "state prices" (Benninga).	
4	Thursday 13 Oct 8:30 - 1:30pm Afternoon/evening group assignment	**Review of individual assignment Part 1** - Modern Asset Pricing (MAP) model of a mine: - Weaknesses and biases in DCF/NPV - Application of the no-arbitrage and replicating portfolio concepts to a mining project - Comparison of discount		**Individual Assignment Part 1:** Problems involving the binomial distribution, conditional (Baysian) probabilities and the use of decision trees in mineral exploration and mining.

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		rates in DCF analysis and in MAP/ROV • Constructing a simple MAP model **Financial and commodities derivatives:** • General • Forwards/futures prices and hedging • Call and put options • Option payoff diagrams and simple option strategies • Options valuations using closed-form equations, e.g. Black and Scholes (B-S) formula		
5	Friday 14 Oct 8:30 - 1:30pm	**Class presentations of Group Assignment Part 2** **Real options valuations (ROV) - General concepts and fundamental principles** • The value of flexibility, • Static "now or never" versus dynamic "now or later" investment decisions • The project as a tree of successive decisions with the benefit of hindsight to: "commence/delay", "stage/expand/reduce" and "suspend/resume" and "continue/abandon" production • Evaluation of simple real options using the B-S formula	**Preparatory reading on**: Real options valuations using the binomial lattice methodology and "risk-neutral" probabilities (Guj, Chapter 10 and Mun).	**Group Assignment Part 2:** Construct a mine model and value it using DCF analysis and MAP applying the GBM forward price model to it. Compare and discuss results.
6	Monday 17 Oct 8:30 - 1:30pm	**Real options valuations using the binomial lattice method neutralising risk using:** • "Replicating portfolios", • "State prices" and • "Risk-neutral" probabilities • Methods to calculate the volatility (sigma) of the net operating cash flows of a project	**Preparatory reading**: Application of binomial lattices and "risk-neutral" probabilities to the evaluation of mining projects Guj, 2010)	

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| 7 | Tuesday 18 Oct

8:30 - 1:30pm | **Review of Individual Assignment Part 2**

Constructing more sophisticated ROV models using the binomial lattice method:

● Valuing the option to expand mine production
● Optimising pre-production stripping
● Valuing tonnage-grade trade-off options
● Assessing the option value of a multi-phase joint venture agreement

Conclusions, recap and examination discussion | | **Individual Assignment Part 2:** Real option valuations using the B-S formula and the binomial lattice methods. |
| 8 | Wednesday 19 Oct

8:30 - 11:30am | Final Exam (8:30 - 11:30am) | | |

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