Engineering Economics and Financial Management

CVEN8701

School of Civil and Environmental Engineering
The University of New South Wales

Course Author: David G. Carmichael
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An Invitation to the Reader

These notes are part of an evolving process and I welcome comment and feedback on their content.

If you disagree with opinions given, have alternative interpretations or have something to contribute that would enhance the notes, I would be very pleased to hear from you.

Please contact me directly:

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David G. Carmichael
These notes deal with what are considered the important economic and financial issues facing technical managers. They cover matters of interest to projects, businesses, marketing and general management.

Project finances treats topics such as cost estimating, feasibility studies, life cycle costing, value management and financial planning and replanning. All topics are concerned with the money side of projects.

Many decisions on projects seem to revolve around money. Whether the decisions involve schedules, people, equipment etc, the ramifications are translated back to money. Accordingly, it could be argued that financial management (sometimes called cost management) cannot be studied in isolation from other project functions. Nevertheless it is a convenient way of slicing the project management cake up.

Financial management is crucial to a successful project.

Financial management permits a project's cost constraint of finishing within budget, to be met.

The various tools of financial management assist decision making by all project participants, for example, by:

- Focusing attention on those activities that are critical in terms of achieving a desired project completion cost.
- Identifying potential problem areas.
- Providing timely progress reports.
- Assisting communication between project personnel.
- Providing the means of simulating alternative decisions. (This includes conventionally termed 'what if' or sensitivity studies.)

The benefits of financial management are many. Projects can have a tendency to go over budget. Managing costs can ensure a better return on money invested. Managing costs can also lead to a more satisfying work environment for project personnel.

Business finances examines money in terms of a business entity. Of concern here are methods of financial accounting, financial statements, transactions, ledger accounts, inventory, profit and loss, balance sheets and related topics.

In business, a prime goal is to make a profit, though other goals may exist. There are many types of businesses, for example servicing,
manufacturing, agricultural, mining, retailing etc. Businesses range in size from large multinationals to single people. Common ways of running a business include being a sole trader, or through a partnership or company. The establishment and running of businesses is regulated by governments; these notes do not businesses as legal entities, because the law varies from geographical region to geographical region, but rather the financial side of businesses and this is essentially standard practice irrespective of region.

An adequate accounting system and an accurate measurement of profits are needed in every business. This is particularly true where the net profit is divided among more than one person.

Topics of interest to more general management include demand and supply, depreciation, life cycle costing and value management.

Aims

When you have completed these notes, you should have a better understanding of:

- Elements of project finances.
- Methods of economic comparison and applications.
- Financial planning and replanning.
- Elements of business finances.
- Financial and economic tools available to technical managers.

The intent is to improve your economics and financial management skills. In terms of business finances, the intent is not to make accountants out of you but rather to make you aware of what you do know and do not know, where to turn for advice and what are the correct questions to ask.
Author

David G. Carmichael

David is a graduate of The University of Sydney (B.E., M.Eng.Sc.) and The University of Canterbury (Ph.D.) and is a Fellow of The Institution of Engineers, Australia, a Member of the American Society of Civil Engineers, formerly a Graded Arbitrator with The Institute of Arbitrators, Australia, and a trained mediator. He is currently a Consulting Engineer and Professor of Civil Engineering, and former Head of the Department of Engineering Construction and Management at The University of New South Wales.

He has acted as a consultant, teacher and researcher in a wide range of engineering and management fields, with current strong interests in all phases of project management, construction management and dispute resolution. Major consultancies have included the structural design and analysis of civil and building structures; the planning and programming of engineering projects; the administration and control/replanning of civil engineering projects and contracts; and various construction and building related work. In addition there have been numerous smaller consultancies in the structural, construction and building fields. He has provided expert reports and expert witness in cases involving structural failures, construction accidents and safety, and contractual and liability matters.

He is the author and editor of nineteen books and over sixty five papers in structural and construction engineering and construction and project management.
The Learning Program

The educational strategies and course manual have had input from a variety of people. The course has been prepared using self/independent learning principles whereby students are able to develop their own learning potential at their own pace and in their own surroundings.

Learning is optimised through the management of the course material by a course coordinator and by the students themselves. Efficient learning practices and the motivation to learn, centre on the weekly units and interaction with others. This also enables a student's progress to be monitored. The contribution to the learning process of formally undertaking the course, on top of the content of the course manual, should not be underestimated.

There are four components to the learning resources for this course:

- The course manual.
- The interaction with the coordinator.
- The interaction with fellow students, colleagues and mentors.
- Supplementary reading.

The course manual is intended to be relatively self-contained although references to other sources are provided. The manual is a study guide with readings from other sources included as appropriate. It is divided into twelve units, with each unit representing material to be covered in one week. The manual is intended to guide you through the material at your own pace in your own surroundings. Exercises are set regularly throughout the manual to test your understanding of the course material and to take you beyond the material.

Each week candidates are expected to work through the relevant unit including the exercises. This is an essential requirement for successful study. It provokes the need to interact with the coordinator, fellow students, colleagues and mentors on matters raised from that work, from further reading that has been done, or from discussions with third parties. Attention should be concentrated on those matters considered important in understanding the material. The interaction provides feedback on your progress. The coordinator, an expert in the subject and one who is familiar with self/independent learning principles, assists with additional insight and understanding resulting from his/her experience and also provides feedback.

Your fellow students, colleagues and mentors also assist in the learning process through the sharing of experiences and through their
questioning and discussion of the course material. The interaction enhances the learning experience.

It is suggested that you choose a mentor from among your workplace colleagues or supervisors. This mentor should be someone to whom you can relate well on a personal basis and a person with experience in the field of study. Your mentor can have valuable input in discussions on the course and relate the material to the workplace.

Supplementary reading may be from your personal library, your workplace library or an institution library. References to other sources are contained in the course manual.

**Study Guide Exercises**

As part of the learning process, exercises are set throughout the Study Guide to:

- Make you think about and reinforce the material you have just read.
- Test your understanding of the Study Guide material.
- Make you think beyond the issues covered in the Study Guide.
- Get you actively involved in the learning process.

According to the Confucian saying:

\[
\begin{align*}
I & \text{ hear and I forget} \\
I & \text{ see and I remember} \\
I & \text{ do and I understand}
\end{align*}
\]

In management, there is frequently no right or wrong answer. In most cases people are satisfied with a satisfactory outcome. The idea of an optimum solution may not exist. People from technical backgrounds may initially have difficulty in accepting that there is no right/wrong, black/white, on/off, yes/no answer.

Spaces are left for your use in doing the exercises. The size of the space should not be interpreted as the length of the optimum answer. If you are happy with your understanding of the exercise, move on. You do not have to use the space provided.

**Humour Icon**

An icon is used to guide you through the humour in the manual, in case you miss the joke!
Assessment - General

Assessment is a part of the learning process and is designed to reinforce the course material and take you beyond. Inclusion of information by you in your submissions that means you are taking the learning to your workplace is encouraged. Submitted material also provides an opportunity for feedback to the student.

Examinations, although perhaps not having universal approval for encouraging learning, are also part of the assessment.

Assessment for the course comprises 5 components:

<table>
<thead>
<tr>
<th>Component</th>
<th>Max. Mark</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. To Lead and Promote Class Discussion on a Topic</td>
<td>15</td>
<td>To be emailed to you</td>
</tr>
<tr>
<td>B. To Contribute to Class Discussion on Topics</td>
<td>15</td>
<td>Throughout Session</td>
</tr>
<tr>
<td>C. Assignment 1</td>
<td>15</td>
<td>Submit whenever you like, but late penalties apply after 5pm August 29</td>
</tr>
<tr>
<td>D. Assignment 2</td>
<td>15</td>
<td>Submit whenever you like, but late penalties apply after 5pm October 17</td>
</tr>
<tr>
<td>E. Final examination</td>
<td>40</td>
<td>Week of 4-9 November</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td></td>
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Satisfactory performance in all assessment components is necessary in order to pass the course.

Criteria for Assessment

Unless otherwise specified, the following criteria will be applied in assessing your written work:

- Evidence of understanding of the concepts, theories and ideas developed in the course.
- Ability to apply these concepts to examples from your own experience.
- Clarity of description, explanation and attention to the focus of the assignment.
• Capacity to structure an assignment logically and limit it to the length required.
• Degree to which the material submitted for assessment addresses the specified or negotiated assignment requirements.

Detailed criteria are given below.

**Grading**

University grading is as follows:

<table>
<thead>
<tr>
<th>Percentage Range</th>
<th>Grade</th>
<th>Grade Description</th>
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</thead>
<tbody>
<tr>
<td>0%-49%</td>
<td>FL</td>
<td>Fail</td>
</tr>
<tr>
<td>50%-64%</td>
<td>PS</td>
<td>Pass</td>
</tr>
<tr>
<td>65%-74%</td>
<td>CR</td>
<td>Credit</td>
</tr>
<tr>
<td>75%-84%</td>
<td>DN</td>
<td>Distinction</td>
</tr>
<tr>
<td>85%-100%</td>
<td>HD</td>
<td>High Distinction</td>
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Notes on Assignment Submissions
(Assessment Components C and D)

You are required to write on two topics for your 'hand-in' (electronically) assignments (Assessment Component C - Assignment 1 and Assessment Component D - Assignment 2).

**Length, margins**

Length - maximum 3 pages (including appendices). Anything beyond 3 pages will not be looked at. Use 25 mm margins (left, right, top, and bottom).

Be concise. Get to the point of the assignment quickly. Do not pad submissions; do not regurgitate or paraphrase material from the Study Guide - reference it only.

Remember Forde's Third Law: *The longer the letter, the less chance of its being read.*

Do not repeat the wording of the assignment. Do not give a table of contents.

**No assignment cover page, no headers or footers**

Do not use a cover page. Use the first two lines of your submission for: Course name, particular assignment title chosen, and your name (all 12 point type).

Do not put anything into the headers or footers.

**Transmission**

Submit electronically to WebCTvista as an MSWord document.

**Presentation**

Use 12 point type and a standard font, single spaced.

Assignment material presented in a non-professional format will not be marked. It is strongly recommended that assignments be laid out professionally in order to demonstrate your communication ability.
A writing style involving subheadings, with a well developed logic flow, is recommended. Bullet points are acceptable within the submission, but not as the total submission.
Source material

Where the words of others are used, place these inside inverted commas, and quote the source. Where the ideas of others are used, cite the source *adjacent to its usage* (as well as in the Reference List at the end) with sufficient detail that the reader can find it. Do not attempt to pass off others' work as your own. That is, do not indulge in *plagiarism*. There is strength, not weakness, in acknowledging the work and ideas of others. Assignments will be marked down, and in extreme cases harsher action may be taken, for not citing sources of material. Quoting huge slabs of text is not recommended.

Referencing within the text may be done by either *Author (Date)* or by number - *bracketed numbers* [ ] are preferred; don't use superscripted numbers. The Reference List will be ordered to suit your chosen referencing method, that is, either alphabetically or numerically.

Do not use *footnotes*.

A complete *Reference List* and a complete *Bibliography* should be included, containing for each source (including private communications): author, title of article, publisher, volume, number, pages, and date. Assignments will be marked down for *incomplete citations*. [A Reference List includes only those sources directly referred to in the text. A Bibliography includes any related material that influenced your thinking.]

Marking scheme

The marking scheme is as follows.

High marks, up to fifteen (15 out of a total of 15), will be given for a contribution that:
- Is interesting.
- Contains personal and original critical appraisal/thought.
- Shows breadth of reading/knowledge/thinking.

Lesser marks will be given for a contribution that:
- Contains grammatical or spelling errors.
- Has not been proofread before submission.
- Doesn't address the topic.
- Is poorly structured.
- Is too discursive, not concise.
- Has insufficient content.
- Is too long.
- Doesn't cite the sources of quotes and ideas within the body of the submission and in a reference list at the end.
No (0) marks will be given for a contribution that:
• Is not up to postgraduate level.
• Contains plagiarised material.
Late submission penalty - Deductions of 1 mark will occur for every calendar day late after the date nominated. So, for example, if your submission is graded 10 out of 15, and you are 10 or more days late on submission, the mark you receive is 0.

Because submission can be whenever you like up to the date nominated, no excuse will be accepted for late submission. It is suggested that you submit early if you anticipate any troubles whatsoever (eg dog ate floppy disk, computer malfunction, boss asks you to do some work for a change, illness, death, away from civilisation) in submitting.

Resubmissions

Submissions may be asked to be resubmitted if they are lacking in some way, and generally below Pass standard. Resubmitted work may or may not be assessed, depending on performance in the rest of the course.

KEEP A COPY OF EVERYTHING SUBMITTED IN CASE SUBMISSIONS GET LOST OR MISLAID.
Assessment Details

Assessment Component A

To Lead and Promote Class Discussion on a Topic

A1. You will be given a topic, selected from the Study Guide. This topic (and given dates) will be emailed to your student z email address. You will be expected to lead and promote an email-based class discussion on this topic between the given dates. This will involve you in preparing and presenting (correct English please and no SMS abbreviations) on the topic, information such as (500 words maximum):

- Your understanding of the topic, or your answer if the topic is an Exercise.
- The understanding of other sources (written and personnel), if relevant, on the topic.
- Any relevant workplace experience.
- Any issue debatable or controversial on the topic.
- Thought provoking questions for the rest of the class.

And (250 words maximum on each occasion):

- Reply to others' input to the discussion. There is no need for an instant reply; a reply within one day is acceptable in order that you can give a considered response to the discussion point. It is acceptable to hold different opinions as long as you can justify your viewpoint. (Private communications to others can be done at any time, but of course these don't get marked.)
  or
- If there is little or no response to your lead contribution, then give alternative viewpoints, situations, experiences, ..., perhaps play the devil's advocate. Keep on trying to promote discussion.

Also:

- Summarise the discussion after all the discussion is complete.

A2. Post your initial lead discussion on the start date emailed to you. Discussion and your replies will stop on the finish date emailed to you.

A3. Use the email list server set up for the course (so that everyone in the course receives the message). Send your email to CVEN8701@civeng.unsw.edu.au. If you are using an email address other than your student z email address, you will first have to subscribe
this address yourself, otherwise the list serve will not accept your email. Do not cc to the Course Coordinator because s/he is already a member of the course email list.

Use as the email subject line: **CVEN8701 Topic #**, and insert relevant Topic number (eg, CVEN8701 Topic 10). This is to facilitate people filtering the emails. **Do not use any other email subject line**.

A4. Signing with a first name or pen name is sufficient, in order that others have a name to communicate with.

A5. **Do not use attachments** to emails, because many people have trouble opening them.

A6. Allowance will be made for those leading a discussion early in the session, compared to those leading a discussion later in the session. Allowance will be made for topics that are more challenging than others.

A7. Topics and discussion start dates will be allocated 'randomly' to class members. **Please, no requests for changing topics or dates!** Date changes will only be made if you have a significant reason. Forward separate third party documentation (eg doctor's certificate, wedding booking) supporting your reason. Work commitments are not normally considered justification. A letter from a relative or work colleague is not acceptable third party documentation.

A8. The **marking scheme** is as follows.

Fifteen (15) marks will be given for a contribution that:
- Is interesting.
- Contains personal and original critical appraisal/thought.
- Shows breadth of reading/knowledge/thinking.

Lesser marks will be given for a contribution that:
- Contains grammatical or spelling errors.
- Has not been proofread before submission.
- Is poorly structured.
- Is too discursive, not concise.
- Has insufficient content.
- Is too long.
- Doesn't cite the sources of quotes and ideas.

No (0) marks will be given for a contribution that:
- Is not up to postgraduate level.
- Contains plagiarised material.
- Doesn't address the topic.
Assessment Component B

To Contribute to Class Discussion on Topics as Instigated by Others (under Assessment Component A)

B1. Meaningful, related and contentful discussion will only be assessed. This will include contributing (correct English please and no SMS abbreviations) between given dates (250 words maximum on each occasion):

- Any counter or alternative views on the topic.
- Any relevant workplace experience.
- Any issue debatable or controversial on the topic.
- Thought provoking questions for the rest of the class or lead discusser.

B2. You do not have to contribute on all topics, only those on which you think that you can add something meaningful to the discussion. If you have nothing relevant to contribute, please don't. In order to get full marks, it is sufficient that you contribute something meaningful to only three topics (or more topics, if your contributions are of lesser content.)

B3. The marking scheme is as follows.

Fifteen (15) marks will be given for a contribution that:
- Is interesting.
- Contains personal and original critical appraisal/thought.
- Shows breadth of reading/knowledge/thinking.

Lesser marks will be given for a contribution that:
- Contains grammatical or spelling errors.
- Has not been proofread before submission.
- Is poorly structured.
- Is too discursive, not concise.
- Has insufficient content.
- Is too long.
- Doesn't cite the sources of quotes and ideas.

No (0) marks will be given for a contribution that:
- Is not up to postgraduate level.
- Contains plagiarised material.
- Doesn't address the topic.

B4. Multiple contributions to the one topic are allowed, but only if you have something to contribute.
B5. Discussion should only be made between the given start and finish dates for each topic. Your discussion should not be posted before that of the topic's lead discusser.

B6. Use the email list server set up for the course (so that everyone in the course receives the message). Send your email to CVEN8701@civeng.unsw.edu.au If you are using an email address other than your student z email address, you will first have to subscribe this address yourself, otherwise the list serve will not accept your email. Do not cc to the Course Coordinator because s/he is already a member of the course email list.

Use as the email subject line: CVEN8701 Topic #, and insert relevant Topic number (eg, CVEN8701 Topic 10). This is to facilitate people filtering the emails. Do not use any other email subject line.

B7. Signing with a first name or pen name is sufficient, in order that others have a name to communicate with.

B8. Do not use attachments to emails, because many people have trouble opening them.

B9. (Private communications to others can be done at any time, but of course these don't get marked.)
Assessment Component C

Assignment 1

C1. Submission may be whenever you like, but note that late penalties apply if submitted after the date nominated above.

C2. Title your submission Surname8701Ass1.doc in order that it doesn't get confused with other student submissions, other courses and other assignments. Don't use any other title.

C3. PLEASE READ ALL the earlier notes on assignment submissions, including plagiarism and referencing.

C4. Answer parts separately. Use a heading for each part.

ATTEMPT EITHER X OR Y

X. Intangibles

In Unit 5, Economic Appraisal IV, pages 15-20, mention is very briefly made of intangibles that might be considered in an economic appraisal. These include:

- Environmental matters such as flora, fauna, noise, pollution, sustainability etc
- Social impacts on the community such as unemployment, recreation etc
- Human factors such as accidents, death etc

Step 1 Intangible chosen
Choose one very specific intangible. Don't choose something general. State what you have chosen.

Step 2 Industry conversion to money
How does industry try to convert this intangible into money terms? Cite any sources.

Step 3 Rationality
Comment on the rationality of the Step 2 approach.

Step 4 Example
Give an example if you have one, preferably from your workplace. Cite any sources.
Y. Methods of economic appraisal

There are a number of methods of economic appraisal given in the Study Guide, such as benefit-cost ratio, internal rate of return, payback period, annual worth and present value.

The Study Guide gives circumstances where the methods lead to apparently different conclusions when comparing alternative ventures. See pages 4-12 of Economic Appraisal III (Unit 5).

Make some sense out of what is given on pages 4-12 of Economic Appraisal III (Unit 5) and your other reading. As suggestions for you to follow or not follow - Give some system and structure as to why the methods lead to apparently different conclusions. Can you categorise the circumstances under which the methods will lead (or will not lead) to different conclusions, and why they lead to different conclusions? Can you provide some unifying theory that covers all methods? For example, would it be better to talk in terms of feasibility rather than B/C or B - C?
Assessment Component D

Assignment 2

D1. Submission may be whenever you like, but note that late penalties apply if submitted after the date nominated above.

D2. Title your submission Surname8701Ass2.doc in order that it doesn't get confused with other student submissions, other courses and other assignments. Don't use any other title.

D3. PLEASE READ ALL the earlier notes on assignment submissions, including plagiarism and referencing.

D4. Answer parts separately. Use a heading for each part.

ATTEMPT EITHER X, Y OR Z

X. Earned value

Unit 9 on Project Finances - Replanning on page 21 lists some deficiencies in the earned value approach to reporting.

Comment in turn on each deficiency mentioned, either as you think it is a deficiency as stated, or not a deficiency. Use a subheading for each suggested deficiency. Give reasoned argument supporting your views. Terse examples of bits of projects would be good to see to support your arguments.

OR

Y. Workplace experience - depreciation

Consider the topic of asset depreciation (or appreciation).

Step 1  Actual Situation
In about 1 typed page, describe a situation, event, practice, occurrence, ... in your workplace (past or present) related to that topic.

Step 2  Critical Analysis (Study Guide)
Then, separately in about 1 typed page, critically analyse what you have just described according to the material given in the Study Guide. If
material in the Study Guide does not cover your issues, this step may be omitted, but state why this is so.

**Step 3 Critical Analysis (Other Sources)**

Then, separately in about 1 typed page, critically analyse what you have just described according to material that you have come across in other sources (written, experienced, colleagues or otherwise).

In your analysis, be careful to distinguish between provable fact (repeatable, objective), and opinion (subjective, anecdotal). Better marks will be obtained by those submissions that recognise the difference. Opinion is acceptable for inclusion as long as the writer demonstrates that s/he recognises it as such.

In your analysis, be systematic and structured. Better marks will be obtained by those submissions that are systematic and structured.

Do not include any information that is copyright, confidential, or libellous, would cause embarrassment or similar. If necessary, slightly colour the real facts.

OR

**Z. Individual thinking**

The Study Guide expresses many opinions; there are anecdotal and subjective views given. Not everything in the Study Guide is objective or can be justified rigorously through the scientific method.

This assignment is intended to make you into a questioning animal rather than an accepting animal.

1. **Study Guide bit**

Select ONE thing from the Study Guide to which you hold an alternative view. Briefly quote the Study Guide's version (use inverted commas), and the relevant Unit and page and paragraph numbers.

Obviously the more **substantial** and the more **detailed** the topic chosen, the better will be your arguments in the following steps, and the better will be your assignment grade. **Don't choose something trivial or broad.**

2. **Your alternative view**
Give your alternative view. If the Study Guide already gives an alternative view, then don't repeat the same alternative view; present a different alternative view.

3. Justification
Give your reasons why an alternative view is possible. If you believe the Study Guide is wrong, it is alright to say so as long as you can justify your argument. The justification and your reasoning are the most important part of this assignment.

In your analysis, be careful to distinguish between provable fact (repeatable, objective), and opinion (subjective, anecdotal). Better marks will be obtained by those submissions that recognise the difference. Opinion is acceptable for inclusion as long as you demonstrate that you recognise it as such.

In your analysis, be systematic and structured. Better marks will be obtained by those submissions that are systematic and structured.

Why this assignment?

One major outcome of postgraduate study (besides the knowledge and qualifications) is that you develop into a questioning animal; you no longer accept everything on its face value. You question everything (in a productive, not destructive, sense). You are possibly saying to yourself that you agree with the Study Guide content - it's all black and white and straightforward? But there are many alternative views to those expressed in the Study Guide out there in the ether; the author of the Study Guide does not agree with them, but you may. On many issues the Study Guide takes a lone stance. Alternative (different, and even including contrary) thinking is encouraged. Most importantly, the assignment asks you to justify whatever view you hold, to substantiate your position.

Note
Please use the English 'alternative', not the double-meaning American 'alternate'.
Assessment Component E

Final Examination

Typical examination format

• The final examination is closed book, except that material in your own handwriting may accompany you.

• Non-programmable calculators are permitted.

• Time allowed: 3 hours duration plus 10 minutes reading time

• Number of questions: Typically 5 or 6

• Questions need not be of equal value.

• Questions are to be answered in the order asked in specially provided examination answer books.

• Blue or black pen is to be used.

• Questions will typically be based on the exercises found in the Study Guide. Recommended examination preparation, accordingly, is to review your answers to the Study Guide exercises.

• The choice of the date and time is by mutual agreement between you and a supervisor, but within a nominated examination week.

• The examination procedures are based on trust and it is hoped that this trust will not be abused.