AC 2008-2312: THE TREATMENT OF ENGINEERING ECONOMY IN OTHER ENGINEERING TEXTS

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The Treatment of Engineering Economy in Other Engineering Texts

Abstract

This paper looks at how engineering economy subjects are treated in non-engineering-economy texts. Over the years, the author of this paper has taught an eclectic variety of both engineering and non-engineering courses and has often been surprised by the treatment of engineering economy in the texts used in these courses. When asked to review an otherwise good text in cost estimation, this author was surprised by the treatment of one engineering economy topic in an area so essential to the development of the inputs to the economic analysis at the core of engineering economy. This paper discusses these treatments and their implications for the engineering economy discipline.

Introduction

The intent of this paper is not to point fingers at specific authors for their treatment of engineering economy topics. The intent is to start a discussion of what the discipline needs to do to encourage better treatment of these topics in order that students have a better appreciation of the how to apply engineering economy in the practice of engineering. The idea for this paper has been a long time in bubbling up to the surface. The author has been involved in project analysis and justifications since graduating with a BIE degree in 1970. Since 1993, the author has been teaching engineering economy on a regular basis in a variety of programs and for a variety of audiences at both the undergraduate and graduate level. During this time the author of this paper list 58 different courses on his cv in programs as diverse as industrial engineering, engineering management, manufacturing engineering, industrial management, and technology management.

During the past thirteen years, the author has regularly attended the annual ASEE conferences and attended countless sessions. These sessions have been eye-opening and thought provoking and well worth the time to attend. At the same time it has educated this author to the wide range of thought on many subjects. In one session, a presenter explained how he taught students to reduce lot sizes using the economic order quantity (EOQ) equations – he instructed the students to keep raising the inventory carrying cost until the lot size was the desired size of one. In another session one of the presenters explained how he had students work with companies to evaluate projects using a technique which went against the key concepts of engineering economy – a copy of the handout from this presentation is on this author's self as a precautionary artifact. These two examples are part of the reason for the current policy in several divisions of ASEE – including the two divisions where these sessions occurred – that there must be a peer reviewed paper accepted before the presentation is allowed. Having reviewed papers for the engineering economy, this author will claim that it has paid dividends – such as the paper on teaching economics (macro or micro) to engineers which the paper's authors thought was the same as engineering economics.

If we see (or more accurately have seen) this at profession conferences, we can hardly be surprised if it occurs elsewhere. This was brought home forcefully to this author when to his surprise he read an article[1] in *Industrial Management*, an IIE publication, advocating return on investment (ROI) as the appropriate evaluation tool for projects and programs. This is not an isolated occurrence. Recently, in a graduate engineering economy course being taught by this author, part of the course required each student to write an application paper in which they applied engineering economy principles to evaluate a project – preferably one at work since most of the students were working professionals. One student submitted a paper in which the student evaluated a training program which the student was eager to initiate. The evaluation technique selected was ROI. This selection was based on the student's use of a book on training – this book said use ROI because net present worth and internal rate of return were too difficult to understand, use or explain. The student was offended by this author's grading of the paper.

These last two incidents were the genesis of this paper. In thinking about these two incidents which this author saw as very problematic, remembrances of the way engineering economy topics were treated in other courses taught were brought to mind. The following discussion of these remembrances is only a partial list based on limited time spent going through some of the texts used in the 58 courses mention on this author's curriculum vita.

An Innocuous Example

In one human factors text[2] there is a section on cost/benefit analysis (not benefit costs as the equation is done). The example given ignores the time value of money – it uses the initial cost to perform the human factors analysis and then looks at the savings over a years use. The savings are generated from a software improvement which reduces use of a certain screen. Ignoring the time value of money is not appropriate.

As a practitioner, I have a further problem with the savings calculation – the screen use reduction is three 3 seconds per use (60 times per day, 230 days per year, 250 users). There is no mention of fewer people, more output. Saving three minutes per person per day – does this really generate a savings? No more output and no fewer people equals no savings to the organization.

Another Generally Innocuous Example

In a safety and health text[3] the author of this paper is using – it covers the subject topic very well – in the section on safety and cost, two concepts are briefly touched on: (1) cost-benefit ratio (under which net benefits, rate of return, and payback period are included) and (2) return on investment. The discussion is less than a page and no numerical example is given. Again an engineering text ignores the time value of money and this time seems to endorse ROI, since it is widely used.

A Somewhat Problematic Example

In a project management text[4] – and one this author has used for years – there is a section on numerical models used in problem selection in which the authors of the text briefly discuss, in order: (1) payback period, (2) average rates of return, (3) discounted cash flow (net present

worth), (4) internal rate of return, (5) profitability index (in one paragraph), and (6) other profitability models. The authors follow the discussions on these methods with comments on them – both "pro" and "con". These authors tell the student that they can find a fuller discussion of these models in any standard text on financial management (no mention of engineering economy texts). ROI is then mentioned in passing. While these authors note that payback is a very common technique they do go on to state a preference for discounted cash flow methods.

This text is reasonably balanced in its treatment of the topic (on 6 out of 647 total pages). The issue for the author of this paper is that (1) NPV is listed after average rates of return – I also see payback period as a popular and useful screening tool but not as an evaluation tool and would argue that it is not really used as a risk reduction scheme, (2) in this day and age, use of spreadsheets to solve theses problems is the norm, (3) no definitive "correctness" for NPV (and IRR if done correctly) is made, and (4) ROI is implied to be a form of NPV or IRR.

It is only fair to note that this text, while commonly used in engineering courses, is more correctly a management text. The author of this paper continues to use it for an undergraduate course in project management and would strongly consider it even for a course in project management for undergraduate engineering students.

A Final Example

The final example for this paper comes from a book[5], the author of this paper was asked to review for *IIE Transactions on Operations Engineering* a few years ago. The book is an excellent presentation of cost estimating principles however its treatment of engineering economy is problematic in several regards.

One fault which the author of this paper has is with the depreciation section which does not seem to use the current MACRS but the older ACRS. While the text does suggest that interested readers go to the relevant IRS documents, it seems that even a hypothetical example in a text so closely related to engineering economics would reflect current practice. This seems problematic.

Additionally, in the chapter on engineering economy it presents return on investment first. ROI is presented without the strongest of caveats although a preference for time value of money methods follows this section.

Why Is This An Issue?

With the pressure placed on programs to keep the hours in a degree to 120 (semester) hours, programs are always looking for courses to drop or compress into other courses. A common practice in many engineering programs is to include engineering economy as a module in the capstone design course. This may include use of a text such as in "The Somewhat Problematic Example" above. Another alternative is to give an abbreviated series (or single) lectures on the topic during the course from instructor's notes. A third alternative seems to be to ignore the topic and hope the student a "course" to prepare for the fundamentals of engineering examination[6] in which the topic of engineering economics typically is covered in one one-to-three hour session.

In one university at which this author taught, engineering economy was an elective (which a large portion of the students took as part of a minor in engineering management). It was not at all uncommon for students who were taking the engineering economy course and the capstone design course to be getting different messages in the two courses. On more that one occasion, students who had taken the engineering economy course would return to this author to ask questions about what they were being told to do to evaluate their project. Fortunately, the issue was usually explainable as being due to assumptions that were probably being made in the methods they were being taught.

In any event it seems very important that engineering economy get the appropriate message out to engineering students – there are appropriate methods to use to evaluate projects. To insure that this message is coming though it seems to be important that the noise (ROI is appropriate for example) be minimized. Students seem to believe what they read. How do we minimize the noise in their reading?

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