

University of Pennsylvania
School of Engineering and Applied Science

Syllabus

ESE 400/540 – ENGINEERING ECONOMICS

Professor Tom Cassel
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Office hours by appointment

Course Description:

This course investigates methods of economic analysis for decision making among alternative courses of action in engineering, business and government applications. Topics include: cost-driven design economics, break-even analysis, money-time relationships and equivalent worth, rates of return, cost estimation, pricing strategy, depreciation and taxes, inflation, foreign currency exchange rates, life cycle analysis, benefit/cost ratio analysis, replacement analysis, dealing with uncertainty, probabilistic risk analysis, capital financing and cost of capital, and financial statement analysis. Case studies, performed by student teams, apply these topics to real-world problems. Written and verbal communication skills are emphasized in case study presentations.

Prerequisites:

Knowledge of calculus and probability is a prerequisite for the course. The course is designed for undergraduates and assumes no prior business or finance coursework. The course is cross-listed for graduate students who are expected to provide more in-depth case study analysis and complete expanded assignments.

Course Materials:

Textbook (Required): Sullivan, W., E. Wicks and J. Luxhoj. Engineering Economy, 13th Edition, Prentice Hall, NJ 2006.

Additional readings and notes are handed out in class or posted from time to time on the Blackboard course website.

Blackboard Course Website:

The Blackboard course website may be accessed at <http://courseweb.library.upenn.edu>. All course announcements and assignments are posted on this site. Supplementary readings may also be posted on this site from time to time.

Grading:

Course grades are determined approximately as follows:

- Individual homework assignments: 35%
 - Team case study assignments: 20%
 - In-class quizzes: 5%
 - Exams: 40%
- 100%

Grade adjustments are made for class attendance, participation, and extra credit opportunities during the course of the semester. Excessive unexcused absences are penalized.

Attendance:

Attendance at all class sessions is presumed. Excessive, unexcused absences are penalized in the course grade. As a common courtesy to other students and the instructor, use of cell phones, laptops and other distracting devices or activities are not permitted in the classroom.

Assignments:

Written homework assignments must be submitted at the beginning of class on the due date. Late submittals generally will not be accepted. All work must be shown and must be written neatly and concisely on 8½ x 11 inch paper. Multiple pages must be stapled together. All individual assignments, quizzes and exams must be the product of a student's own effort, consistent with the University's Code of Academic Integrity at <http://www.vpul.upenn.edu/osl/acadint.html>.

Quizzes and Exams:

Unannounced quizzes are given from time to time during the semester. These are brief, open-notes, closed-book tests, typically covering material from the preceding class session.

Two exams are given during the semester: a mid-term exam covering material from the first half of the course; and an exam near the end of the semester covering material from the second half of the course. These two exams are given within regularly scheduled class meeting times. An optional final exam is given during the University's final exam week. Students may elect to take the optional final exam to improve their course grade. The score from this optional exam will replace the lower of the above two exam scores. If the optional exam score is lower than both of the above exam scores, it is discarded. There will be no make-up exams except as required by University policy.

Re-Grading Policy:

All re-grade requests must be made in writing within one week of the day the assignment, quiz or exam is returned. The request must be specific and identify the question(s) to be re-graded and the reason for the re-grade. If a question is submitted for re-grading, the entire assignment or exam may be re-graded at the instructor's discretion.

Course Outline (Spring Term):

The following course outline is typical for the spring term when the course meets one day per week in a 3-hour session. The outline is subject to change at the instructor's discretion. Students are advised to check the Blackboard course website regularly for updated assignments.

Session	Classroom Topic(s)	Assignments Due ^a
1	Introduction: Principles and Procedure; Terminology; Price Elasticity; Life Cycle Cost; Optimal and Break-Even Demand; Cost-Driven Design Optimization; Time Value of Money; Simple and Compound Interest; Present, Future and Annual Equivalence; Multiple Interest Formulas.	
2	HW #1 review; Uniform Gradient Series Cash Flows; Variable, Nominal and Effective Interest Rates; Compounding More Often than Annually; Continuous Compounding of Discrete Cash Flows; Present Worth; Future Worth; Annual Worth; Internal Rate of Return (IRR); External Rate of Return (ERR); Payback Period; Bond Value; Capitalized Worth Method.	Read S: Ch 1, 2 and 4.1-4.12 HW #1: Ch 2 and 4 problems
3	HW #2 review; Introduction to Corporate Finance; Capital Structure; Cost of Capital; Minimum Attractive Rate of Return; Leverage and Weighted Average Cost of Capital; Capital Asset Pricing Model (CAPM); Optimal Capital Structure; Financial Statements.	Read S: Ch 4.13-4.21 and 5 HW #2: Ch 4 and 5 problems
4	HW #3 review; Incremental Analysis; Comparing Alternatives with Unequal Lives; Repeatability; Co-Termination; Imputed Market Value; Cost Estimating; Work Breakdown Structure; Estimating Data; Pricing Strategy.	Read S: Ch 13 HW #3: Ch 13 and CAPM problems. Workbook: "Assessing a Firm's Future Financial Health"
5	HW #4 review; Bond discount amortization; Index, Unit, and Factor Estimating Techniques; Parametric Estimating: Power Sizing and Learning Curves; Cost Estimating Relationships; Value Engineering. Effective Presentations.	Read S: Ch 6 HW #4: Ch 6 problems Case Study: "Lex Service PLC – Cost of Capital"
6	HW #5 review; Student case presentations & review; Book & Tax Depreciation; Placed-in-Service Conventions; Review for Exam #1.	Read S: Ch 3 HW #5: Ch 3 problems Case Study: "Belgrave Corp."
7	Exam #1. Trade-ins; Depletion; After-Tax Cash Flow Analysis; Effective and Marginal Tax Rates; Gain (Loss) on Disposal of Asset; Economic Value Added.	
8	HW #6 review; Review of Exam #1; Student case presentations & review; Inflation Indices; Foreign Currency Devaluation & Exchange Rates.	Read S: Ch 7 HW #6: Ch 7 problems Case Study: "Reto S.A."
9	HW #7 review; Replacement Analysis; Dealing with Uncertainty; Break-Even and Sensitivity Analysis; Risk-Adjusted Returns.	Read S: Ch 8 HW #7: Ch 7 and 8 problems, Depletion problem
10	HW #8 review; Student case presentations & review; Probabilistic Risk Analysis; Discrete and Continuous Random Variables; Monte Carlo Simulation.	Read S: Ch 9 HW #8: Ch 9 problems Case Study: "Pressco, Inc."
11	HW #9 review; Student case presentations & review; Cost-Benefit Ratio Analysis; Operating and Capitalized Leases.	Read S: Ch 10 and 12 HW #9: Ch 10 and 12 problems Case Study: "MSDI-Alcala de Henares, Spain"
12	HW #10 review; Student case presentations & review; Review for Exam #2.	Read S: Ch 11 HW #10: Ch 11 problems Case Study: "Airbus A3XX: Building the World's Largest Commercial Jet"
13	Exam #2.	
14	HW #11 review; Student case presentations & review; Review of Exam #2.	HW #11: Capital lease problem Case Study: "Northeastern Power Company – NEPCO"
	Optional Final Exam	

^a Course text ("S"): Sullivan, W.G., E.M. Wicks and J.T. Luxhøj, *Engineering Economy*, 13th Ed., Prentice Hall, NJ 2006.

Expected ABET Course Outcomes:

Students completing the course shall:

1. Be able to optimize system design and production levels based on economic criteria [ABET Program Outcome A].
2. Be able to apply probabilistic risk analysis methods, including Monte Carlo simulation, to evaluate uncertainty in engineering economic problems [ABET Program Outcome A].
3. Understand the methodology of cost-driven design optimization [ABET Program Outcome C].
4. Be able to choose among alternative system or project designs based on optimal equivalent worth (e.g., present, future or annual worth) or return (e.g. internal or external rate of return) [ABET Program Outcome C].
5. Be able to work effectively in teams of 4 or 5 to perform case study analyses and to present findings in written reports and verbal presentations [ABET Program Outcome D].
6. Be able to deliver effective verbal presentations including responses to audience questioning [ABET Program Outcome G].
7. Understand and be able to apply the principles of engineering economics to assess the impacts of engineering solutions including identifying alternative courses of action, selecting appropriate units of measure, determining appropriate decision criteria, and quantifying economic outcomes [ABET Program Outcome H].
8. Understand concepts of foreign currency exchange in projects of international scope [ABET Program Outcome H].
9. Be able to apply concepts of economic analysis to a real-world, contemporary case study [ABET Program Outcome J].