CEE 631 - CONSTRUCTION DECISIONS UNDER UNCERTAINTY
Winter 2026 (W Jan 7 – Tu Apr 21)

Lectures: MW 3:00PM - 4:30PM, 2153 GGBL

Instructor: Professor Photios G. Ioannou (pronounced "ee-o-a´-nou")
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Text: CEE 631 Class Notes (available on Canvas)

Recommended textbooks

Howard R. and Abbas A., *Foundations of Decision Analysis*, Pearson, ISBN: 9781292079691

Clemen R. and Reilly T., *Making Hard Decisions*, Duxbury Press, Brooks Cole, Thomson Learning, ISBN 0-534-36597-3

Benjamin J.R., Cornell C.A., *Probability Statistics and Decision for Civil Engineers*, McGraw Hill, New York, NY, ISBN 07-004549-6

deNeufville R., *Applied System Analysis: Engineering Planning and Technology Management*, McGraw Hill, New York, NY, ISBN 07-016372-3

Topics (will match student background and interests)

Introduction to Probability and Statistics (depends on student background)
Basic probability of events, Conditional probability, Independence, Total Probability Theorem, Bayes Theorem, Discrete and continuous distributions, Joint distributions, Expected value - variance – covariance and their properties, Basic distributions (Binomial, Geometric, Negative Binomial, Exponential, Uniform, Normal, Beta, Gamma), Simple statistics.

Introduction to Project Evaluation (depends on student background)
Time-value of money, Net present value, Internal Rate of Return, Risk and discount rates, Financial management and the capital asset pricing model.

Introduction to Decision Analysis
Probability schools, Bayesian statistics, Decision language, Possibilities, Uncertainty, Relevance, Risk attitude, Decision trees, Influence diagrams, Sensitivity analysis, Information gathering, Value of information, Sequential sampling, Optimal policies

Framing a decision, Options and dynamic sequential decisions

Advanced information topics: Inference, decisions and experimentation, Value of multiple sources, Sources with multiple readings, Decisions with influences.

Risk preference (risk-aversion)
Utility theory, Axioms, Risk Tolerance, Certain equivalent, Risk premium, Utility assessment, Sensitivity analysis, Utility & asset position, Group utility, Exponential utility, Delta property, Risk preference and Value of information, Log u-curves, Linear risk tolerance u-curves, Certain equivalent approximations, Probabilistic dominance. Risk pricing, Risk contracts, Insurance.

Subjective Probability Assessment
Probability encoding, Biases, Correlation, Range estimating, PERT approximations,

Perry & Greig approximations, Distribution of utility, Computing by discretization, Conditional expectation.

Simulation, Numerical computation, Optimization (DPL, Yasai, Risk Solver)

Decision Analysis Applications

Example applications are drawn from construction contracting, transportation, bridges, tunneling, water supply systems, environmental impacts, public policy making, etc.

Competitive Bidding Models

Data-based models. Low bid. Friedman's model. Gates' model. Trial and error solutions, direct solutions, Average bid model. Variations.

Decisions with Multiple Attributes

Multiattribute utility, Preferential independence, Utility independence, Encoding, Applications to large-scale projects.

Discrete Event Simulation of Construction Processes (Cyclone, EZStrobe, Stroboscope)

Homework:	Weekly assignments (50% of final grade)
Midterm Exam:	In-class, open book (20% of final grade) – Mon. March 9, 2026
Final Exam:	Take-home exam (30% of final grade)

CEE 631 HONOR CODE POLICY

All work is performed under the College of Engineering Honor Code.

All work, including problem sets, homework assignments and exams, are to be completed by each student working independently. Students should not consult with other students. All work, whether in scrap or final form, must be generated by each student working alone.

Students are not allowed to possess, look at, use, or in anyway derive advantage from the existence of problem sets, exams, solutions, term projects, or any work prepared by others in this or past terms.

All work done using a computer must be yours alone. Students must have entered every keystroke or mouse command for their own work.

Exams are taken with open books. All work during exams must be completely independent.

Violation of this policy is grounds to initiate action that would be filed with the Dean's office and would come before the College of Engineering's Honor Council. If you have any questions about this policy, please do not hesitate to contact the Instructor.