IE 405 – DECISION ANALYSIS
3 SU / 6 ECTS Credits
Summer 2022

Course Instructor   Faran Ahmed
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Office Hours   By Appointment
Class Hours   **Tuesday:** 11:40 – 14:30, FENS, L045
    Wednesday: 08:40 - 11:30, FENS, L062
Recitation   **Friday:** 11:40 – 13:30, FENS, L058
Teaching Assistant   Saied Farham Nia
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COURSE DESCRIPTION

- The course provides a broad practical overview of topics and techniques in the field of decision analysis. As an engineering course for undergraduate students, the course will address advanced technical subjects that can be found in management science and operations research domains. At the end of the semester, the students will be able to formulate decision making problems that have multiple decisions in time, uncertain events, conflicting objectives and multiple decision makers.

PREREQUISITE

- MATH 306 Minimum Grade of D

REQUIRED TEXTBOOK:

- Making Hard Decisions with Decision Tools 3rd Edition, Robert T. Clemen and Terence Reilly, South-Western Cengage Learning, 2014.

ASSIGNMENTS

- Assignment will not be marked

ATTENDANCE

- Attendance will be taken five times throughout the semester at dates that are declared in the first lecture of the course.
  - ✓ **Article 26 (1):** Attendance is compulsory for all courses, implementations and projects undertaken by the students. The attendance status of students is monitored by the related faculty members.

OBJECTION POLICY

- Concerns regarding marks will not be accepted after a week from the posting of the result.

ACADEMIC CONDUCT

- Do not plagiarize other people's work. Students should be aware that anyone who engages in actions prohibited by the University's policy on academic honesty will be subject to disciplinary action.

MARKING SCHEME

- Attendance   10%
- 02 Quizzes   20%
- Midterm   30%
- Final   40%

- **Article 20:** A make-up exam is given to students who cannot take an exam for reasons acceptable to the faculty member.
- Upon furnishing relevant proof (e.g., medical certificate) makeup may be allowed
- Schedule is already shared; I STRONGLY advise you to plan your schedule such that you do not miss any assessment.

CONTENT OF THE COURSE

I - Modeling Decisions

- Elements of Decision Problems
- Brain and Neuroplasticity
- Structuring Decisions
  - ✓ Influence Diagrams (ID)
  - ✓ Decision Trees (DT)
- Making Choices
  - ✓ EMV
  - ✓ Solving ID
  - ✓ Solving DT
- Risk Profiles and Dominance
- Sensitivity

II - Modeling Uncertainty

Subjective Probability

- Bayes Theorem
- Assessing Discrete Probability
  - ✓ Direct
  - ✓ Lottery
  - ✓ Comparison of Game like Lotteries
- Assessing Continuous Probability
  - ✓ Assessing the CDF through reference lotteries
- Discrete Approximation of Continuous Probabilities
  - ✓ Pearson-Tukey
  - ✓ Bracket Medians Method
- Monte Carlo Simulation – ITM
- How we make decisions and how we learn
  - ✓ Neuroplasticity
- How do we judge our Beliefs?
  - ✓ Representativeness
  - ✓ Availability
  - ✓ Anchoring and Adjustment
  - ✓ Framing
- Convergent vs. Divergent Thinking
- Value of Information
  - ✓ EVPI
  - ✓ EVII

III - Modeling Preference

- Risk Attitudes.
    - ✓ St. Petersburg Paradox
    - ✓ Risk Seeking, Risk Averse, Risk Neutral
    - ✓ Expected Utility, Certainty Equivalent, Risk Premium
    - ✓ Assessing the Utility (Using CE, Using PE)
    - ✓ Risk Tolerance and Exponential Utility Function
- Decreasing and Constant Risk Aversion
- Utility Axioms, Paradoxes and Implications
    - ✓ 7 Axioms of Utility (Ordering and Transitivity, Monotonicity, Invariance, etc.)
    - ✓ Allais Paradox (sure thing principle)
    - ✓ Implications on utility assessment and making decisions
- Conflicting Objectives
    - ✓ Additive Utility Function (No interaction among the attributes)
    - ✓ Scales – Nominal, Ordinal, Interval, and Ratio Scales.
    - ✓ Assessing weights
        - ❖ Pricing Out
        - ❖ Swing Weighting
        - ❖ Lottery Weights
    - ✓ Assessing Individual Utility Functions
        - ❖ Proportional Scores
        - ❖ Ratio Scores
        - ❖ Lottery
    - ✓ Multi-attribute Utility Function (Direct Assessment)
    - ✓ Multilinear Utility Function (with interaction among the attributes)
    - ✓ Independence Conditions
        - ❖ Preferential Independence
        - ❖ Utility Independence
        - ❖ Additive Independence
    - ✓ Substitutes and Complements
    - ✓ AHP
        - ❖ Eigenvalue /Eigenvector Method
        - ❖ Measure of Inconsistency
        - ❖ Geometric and Arithmetic Mean Approaches