Course Instructor: Kemal Kılıç, kkilic@sabanciuniv.edu
Office: FENS 1032
Tel: 216- 483 9596
Office Hours: Wednesday 14:40-15:30
Class Hours and Venue: Tuesday (08:40-09:30) UC G030
  Wednesday (15:40-16:30) UC G030
Teaching Assistants: Saied Farham Nia, sfarhamnia@sabanciuniv.edu
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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.

Course Web Site:

Class overheads, supplementary readings will be available on SuCourse.

Marking Scheme:

Attendance	10 %
Midterm I	25 %
Midterm II	25 %
Final	40 %
Total	**100 %**

Exams

There will be two midterms and a final exam. The midterm dates and locations will be announced soon. The final exam date will be scheduled by Student Resources and will be declared towards the end of the semester.

Attendance

> **Article 26 (1):** <u>Attendance is compulsory</u> for all courses, implementations and projects undertaken by the students. The attendance status of students is monitored by the related faculty members.

Attendance will be taken *six* times throughout the semester *on prespecified dates* which will be announced during the first week of the semester. The attendance will be taken by means of a simple quiz during the lecture (*might be any time!*). You can take the quiz physically (i.e., *in-class*) or virtually (*SuCourse*). Each quiz will worth 2 points. Top five quizzes will be counted while calculating your final course grade (i.e., maximum grade you can receive from attendance will be 10 points, that is to say attendance has 10% share in your final course grade). Each correct answer will yield *Full Grade* and a wrong answer will yield *Half Grade* in the quizzes. So the attendance doesn't aim to only address your existence physically and/or virtually in the lecture, but also mentally as well. That is to say, if you can't correctly answer any question in a particular quiz, you will receive only 1 point from that quiz.

Make-Up Policy (from the Instruction Letters For Undergraduate Education)

> **Article 20:** A make-up exam is given to students who cannot take an exam for reasons <u>acceptable to the faculty member</u>.

I need to talk with your physician ***before the exam*** if you want to take the make-up exam.

Tutorials/Recitations

Recitations are as follows:
       Section A – Monday 17:40-18:30
       Section B – Wednesday 17:40-18:30
       Section C – Tuesday 18:40-19:30
       Section D – Friday 17:40-18:30

You are expected to attend the recitations. Important problems, assignment/test solutions will be taken up by your TAs during the recitation sessions.

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.

Course Schedule and Disclaimer

The course schedule can be found in ***Fall 2022 DA Schedule.xlsx*** which is posted on the SuCourse. When necessary, the flow of the course will be modified and modifications will be announced in class. Students are responsible for announced changes.

Content of the Course (*Italics are just mentioned but will not be covered in detail*)

I - Modeling Decisions
- Neuroplasticity
- Elements of Decision Problems
- Structuring Decisions
  - Influence Diagrams
  - Decision Trees
- Making Choices
  - EMV
  - Solving ID
  - Solving DT
- Risk Profiles and Dominance
- Sensitivity

II - Modeling Uncertainty
- Subjective Probability
  - Bayes Theorem
  - Value of Information
    - EVPI
    - EVII (EVSI)
  - Assessing Discrete Probability
    - Direct
    - Lottery
    - Comparison of Game like Lotteries
  - Assessing Continuous Probability
    - Assessing the CDF through reference lotteries
    - *Fitting a distribution to historical Data*
      - *Check the independence*
        - *Correlation Plot and Scatter Diagrams*
      - *Hypothesize a Family*
        - *Descriptive Statistics, Box-Plots, Histograms*
      - *Determine the parameters*
        - *MLE, LSE*
      - *Goodness-of-Fit Tests*
        - *Graphical*
          - *P-P Plot, Q-Q Plot, Box-plot comperison*
        - *Hypothesis Testing*
          - *Chi-Square, Kolmogorov-Smirnoff, Anderson-Darling*
  - Discrete Approximation of Continuous Probabilities
    - Pearson-Tukey
    - Bracket Medians Method

- o Monte Carlo Simulation – ITM
- o How we make decisions and how we learn
  - ▪ Neuroanatomy and Neuroplasticity
  - ▪ Convergent and Divergent Thinking
- o How do we judge our Beliefs, Heuristics and Biases
  - ▪ Representativeness
  - ▪ Availability
  - ▪ Anchoring and Adjustment
  - ▪ Framing

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