CS 691A - Introduction to Game Theory

K. Subramani
LDCSEE,
West Virginia University,
Morgantown, WV
k.subramani@mail.wvu.edu

1 General Information

(a) Instructor: K. Subramani.

(b) Meeting Times: Mon-Wed 3:00 am - 4:15 pm.
Location: MRB-E 209.

(c) Contact Information: 347 AERB.

(d) Office Hours: By appointment.

(e) Prerequisites: CS 220 or permission of instructor.

(f) Textbook - [Pet09] will be the main text, although [Spa11] is highly recommended as a supplementary text.

(g) Assessment:

(a) Homework Assignments - You will be handed four homework assignments. These assignments constitute 80% of your grade. Table (1) details the homework schedule.

Assignment Date	**Submission Date**
09/08	09/15
10/06	10/13
11/08	11/15
11/30	12/07

Table 1: Homework Schedule

(b) Presentations - You will be required to present allotted material. The presentations will be graded on the basis of clarity, comprehensiveness and effectiveness. The presentations will be worth 20% of your grade.

A maximum of 5 bonus points will be awarded for class performance.

(h) Grade Boundaries:

Grade	Boundary
A	80 and up
B	$65 - 79$
C	$50 - 64$
D	$45 - 49$
F	$0 - 44$

Table 2: Grade Boundaries

(i) Grading policy - If you have any questions about the grading, you must contact the instructor within two days of your paper being returned.

(j) Makeup Policy - If for some reason, you are unable to attend a test or an exam, please meet me at the earliest and I will set an alternate date.

(k) **Course Objectives** - The objectives of this course are as follows:

(a) To introduce notions such as decision theory, game theory and social choice theory.

(b) To introduce the notion of a Decision Matrix and Utility.

(c) To introduce the basic concepts of two person games.

(d) To introduce probability theory and games of chance.

(e) To discuss Nash equilibrium in games.

(l) **Learning Outcomes** - Upon successful completion of this course, students will:

(i) Be able to appreciate the essentials of game theory.

(ii) Understand the notions of decision theory, game theory and social choice theory,

(iii) Apply utility theory and backwards induction to selected games.

(iv) Apply Nash equilibria to applications in economics.

1.1 Introduction

Normative and descriptive decision theory, Rational and right decisions, Risk, ignorance and uncertainty, Social choice theory and game theory, A brief history of decision theory. This material will be covered from Chapter 1 of [Pet09].

1.2 The Decision Matrix

States, Outcome, Acts, Rival Formalizations. This material will be covered from Chapter 2 of [Pet09].

1.3 Decisions under ignorance

Dominance, Maximin and lexicon, Maximax and the optimism-pessimism rule, Minimax regret, The principle of insufficient reason, Randomized acts. This material will be covered from Chapter 3 of [Pet09].

1.4 Decisions under risk

Maximizing expected utility, The axiomatic approach, Allais' paradox, Ellsberg's paradox, The St. Petersburg paradox, The two-envelope paradox. This material will be covered from Chapter 4 of [Pet09].

1.5 Utility

Constructing an ordinal scale, von Neumann and Morgenstern's interval scale, Utility on a ratio scale, Defining and measuring utility. This material will be covered from Chapter 5 of [Pet09].

1.6 The mathematics of probability

The probability calculus, Conditional probability, Bayes' theorem, The problem of unknown priors. This material will be covered from Chapter 6 of [Pet09].

1.7 The philosophy or probability

The classical interpretation, The frequency interpretation, The propensity interpretation, Logical and epistemic interpretation. This material will be covered from Chapter 7 of [Pet09].

1.8 Preference Axioms

Properties of preference axioms, The multi-attribute approach, Rational preferences and the independence axiom, Risk aversion. This material will be covered from Chapter 8 of [Pet09].

1.9 Causal vs. evidential decision theory

Newcomb's problem, Causal decision theory, Evidential decision theory. This material will be covered from Chapter 9 of [Pet09].

1.10 Bayesion vs. non-Bayesian decision theory

Bayesianism, Arguments for and against Bayesianism, Non-Bayesian approaches. This material will be covered from Chapter 10 of [Pet09].

1.11 Game theory I: Basic concepts and zero-sum games

The prisoner's dilemma, A taxonomy of games, Common knowledge and dominance reasoning, Two-person zero-sum games, Mixed strategies and the minimax theorem. This material will be covered from Chapter 11 of [Pet09].

1.12 Game theory II: Nonzero-sum and cooperative games

The Nash equilibrium, The battle of the sexes and chicken, The bargaining problem, Iterated games, Game theory and evolution, Game theory and ethics. This material will be covered from Chapter 12 of [Pet09].

1.13 Social choice theory

The social choice problem, Arrow's impossibility theorem, Sen on liberalism and the Pareto principle, Harsanyi's utilitarian theorems. This material will be covered from Chapter 13 of [Pet09].

1.14 Descriptive decision theory

Violations of the expected utility principle, Prospect theory, Violations of transitivity and completeness, The relevance of descriptive decision theory. This material will be covered from Chapter 14 of [Pet09].

I would like to reiterate that this is a sketch of the topics that we will be covering. For various reasons, I may choose to drop a mentioned topic or cover a new topic. In such cases, advance notice will be given.

2 Inclusivity Statement

West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Accessibility Services (293-6700). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives, please see http://diversity.wvu.edu.

References

[Pet09] Martin Peterson. *An Introduction to Decision Theory*. Cambridge University Press, 1^{st} edition, 2009.

[Spa11] William Spaniel. *Game Theory* 101. CreateSpace Independent Publishing Platform, 1^{st} edition, 2011.