

EC 718: DECISION THEORY

Spring 2018

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This course is co-taught with Jawwad Noor. This part will focus on *choice under uncertainty*. Topics to be covered include the theory of subjective probability, ambiguity, demand for flexibility, dynamic choice, updating/learning, and some models of "bounded rationality."

The grade for this part of the course will be based on class participation, assignments, and a referee report, with weights to be determined once we meet.

The class will be based mostly on articles, but I recommend that you purchase:

L. J. Savage, *The Foundations of Statistics*, Dover, 1954

D. Kreps, *Notes on the Theory of Choice*, Westview, 1988

The following should help with the big picture:

I. Gilboa, *Theory of Decision under Uncertainty*, Cambridge, 2009 [worth buying]

E. Dekel & B. Lipman, How (not) to do decision theory, *Annual Rev. Econ.* 2 (2010), 257-82

F. Gul & W. Pesendorfer, The case for mindless economics, in *The Foundations of Positive and Normative Economics: A Handbook*, A. Caplin & A. Schotter eds., Oxford, 2008

W. Pesendorfer, Behavioral economics comes of age, *JEL* 44 (2006), 712-21

R. Spiegler, Behavioral economics and the atheoretical style, 2017

#1. SUBJECTIVE PROBABILITY

THE SAVAGE MODEL

Savage: Chs. 1-6; **Kreps: Chs. 4, 8 and 9; Gilboa: Part II

**M. Machina & D. Schmeidler, A more robust definition of subjective probability, *Econometrica* 60 (1992), 745-780

I. Kopylov, Subjective probability on ‘small’ domains, *JET* 133 (2007), 236-265

I. Kopylov, Simple axioms for countably additive subjective probability, *J. Math. Econ.* 46 (2010), 867-76

S.H. Chew and J. Sagi, Event exchangeability: probabilistic sophistication without continuity or monotonicity, *Econometrica* 74 (2006), 771-786

J. Lu, A Bayesian theory of state-dependent utilities, 2016

Kreps, Ch. 11: the exchangeable Bayesian model

THE ANSCOMBE-AUMANN MODEL

**Kreps, Chs. 4 (domains of choice), 5 (the mixture-space theorem), Ch. 7

F. Anscombe & R. Aumann, A definition of subjective probability, *Ann. Math. Stat.* 34 (1963), 199-205

Overviews & critiques

N. Giocoli, Postwar game and decision theory: a historical perspective, 2014 [slides]

I. Kopylov, Subjective and other probabilities, in *Handbook of Probability: Theory and Applications*, ed. T. Rudas, SAGE, 2008

N. Al Najjar and L. de Castro, Subjective probability, in *The Wiley Encyclopedia of Operations Research and Management Science*, 2011

Gilboa, Rationality and the Bayesian paradigm, *J. Econ. Methodology*, 2014

M. Machina, States of the world and the state of decision theory, 2003

E. Karni, States of nature and the nature of states, 2016

**A. Billot, I. Gilboa, D. Samet & D. Schmeidler, Probabilities as similarity-weighted frequencies, *Econometrica* 73 (2005), 1125-1136; and Gilboa, Part IV

#2. AMBIGUITY/Model Uncertainty

D. Ellsberg, Risk, ambiguity and the Savage axioms, *QJE* 75 (1961), 643-669

**Gilboa, Part III.

Gilboa, Postlewaite, & Schmeidler, Rationality of belief or: why Savage's axioms are neither necessary nor sufficient for rationality, *Synthese* 187 (2012), 11-31

M. Siniscalchi, Ambiguity and ambiguity aversion, *Palgrave Dictionary of Economics*.

M. Siniscalchi and M. Machina, Ambiguity and ambiguity aversion, pp. 729-807 in Machina and Viscusi eds., *Handbook of the Economics of Risk and Uncertainty* (vol 1), 2014.

Models

**I. Gilboa & D. Schmeidler, Maxmin expected utility with non-unique prior, *J. Math. Econ.* 18 (1989), 141-153.

F. Maccheroni, M. Marinacci & A. Rustichini, Ambiguity aversion, robustness and the variational representation of preferences, *Econometrica* 74 (2006), 1447- 1498

T. Bewley, Knightian decision theory (part I), *Decisions in Econ. and Finan.* 2002, 79-110

Gilboa et al, Objective and subjective rationality in a multiple prior model, *Econometrica* 2010

P. Klibanoff, M. Marinacci & S. Mukerji, A smooth model of decision making under ambiguity, *Econometrica* 73 (2005), 1849-1892

Epstein & Seo, Exchangeable capacities, parameters and incomplete theories, *JET* May 2015

Critiques/extensions

M. Machina, Ambiguity aversion with three or more outcomes, *AER* Dec 2014

K. Saito, Preferences for flexibility and randomization under uncertainty, *AER* March 2015

S. Ke and Q. Zhang, Randomization and ambiguity aversion 2017

T. Hayashi et al, Attitude toward imprecise information, *JET* 140 (2008), 27-65

Experiments/measurements

Y. Halevy, Ellsberg revisited: an experimental study, *Econometrica* 75 (2007), 503-536.

S. Trautman and G. van de Kuilen, S. Trautman and G. van de Kuilen, Ambiguity attitudes, in G. Keren and G. Wu (eds.), *The Wiley Blackwell Handbook of Judgement and Decision Making*, Blackwell, 2015

E. Calford, Uncertainty aversion in game theory: experimental evidence 2015

Chew, Miao and Zhong, Partial ambiguity, *Econometrica* 2017

Applications

Epstein and Schneider, Ambiguity and asset markets, *Ann. Rev. Finan. Econ.* vol 2, 2010

D. Dicks and P. Fulghieri, Uncertainty aversion and systemic risk, *JPE* forthcoming

S. Bose and L. Renou, Mechanism design with ambiguous communication devices, *Econometrica* 82 (2014), 1853-1872

G. Carroll, Robustness and linear contracts, *AER* 2015. S. Auster, Robust contracting under common value uncertainty, *TE* 2017

K. Hasset and W. Zhong, The observable implications of Knightian uncertainty 2017

**Epstein, Kaido and Seo, Robust confidence regions for incomplete models, *Econometrica* 2016

#3. DEMAND FOR FLEXIBILITY/Subjective States

**Kreps: A representation theorem for preference for flexibility, *Econometrica* 47 (1979), 565-578; Static choice in the presence of unforeseen contingencies, in *Essays in Honour of F. Hahn*, P. Dasgupta et al eds., MIT Press, 1992

**Dekel, Lipman & Rustichini, A unique subjective state space for unforeseen contingencies, *Econometrica* 69 (2001), 891-934. Corrigendum with T. Sarver (2006)

D. Ahn and T. Sarver, Preference for flexibility and random choice, *Econometrica* (2013), 341-61

H. Ergin and T. Sarver, A unique costly contemplation representation, *Econometrica* (2010), 1285-1339

Amador, Werning and Angeletos, Commitment vs flexibility, *Econometrica* 2005

K. Saito, Preferences for flexibility and randomization under uncertainty, *AER* March 2015

T.C. Koopmans, On flexibility of future preference, Cowles Foundation, 1964, 243-254

K. Hyogo, A subjective model of experimentation, *JET* 2007

N. Takeoka, Subjective probability over a subjective decision tree, *JET* 2007

Dillinberger, Lleras, Sadowski and Takeoka, A subjective theory of learning, *JET* 2014

R.V. Krishna and P. Sadowski, Dynamic preference for flexibility, *Econometrica* 82 (2014), 655-703

#4. RISK and TIME

**M. Machina, Dynamic consistency and non-expected utility models of choice under uncertainty, *JEL* 27 (1989), 1622-1668

L. Selden, A new representation of preference over 'certain x uncertain' consumption pairs, *Econometrica* 46 (1978), 1045-60; and *Rev. Econ. Stud.* 46 (1979), 73-82

**Kreps and Porteus, Temporal resolution of uncertainty and dynamic choice theory, *Econometrica* 46 (1978), 185-200

**Epstein & Zin, Substitution, risk aversion and the temporal behavior of consumption and asset returns: a theoretical framework, *Econometrica* 57 (1989), 937-969

Epstein, Farhi and Strzalecki, How much would you pay to resolve long-run risk? *AER* 2014

A. Kochov, Bommier and Le Grand, On monotone recursive preferences, *Econometrica* 2017

T. Sarver, Mixture-averse preferences 2017

F. Kubler, Is intertemporal choice theory testable? *JME* 2004

Nonrecursive models

A. Caplin and J. Leahy, Psychological expected utility and anticipatory feelings, *QJE* 2001, 65-80; and The supply of information by a concerned expert, *Econ. J.* (2004), 487-505

K. Eliaz and R. Spiegel, Can anticipatory feelings explain anomalous choices of information sources? *Games Econ. Behav.* (2006), 87-104

Epstein, Living with risk, *Restud* 2008

T. Eisenbach and M. Schmalz, Anxiety in the face of risk, *JFE* 2016

E. Lipnowski and L. Mathevet, Disclosure to a psychological audience 2017

#5. AMBIGUITY and TIME (Updating)

P. Ghirardato, Revisiting Savage in a conditional world, *ET* 20 (2002), 83-92

R.H. Berk, Limiting behavior of posterior distributions when the model is incorrect, *Ann. Math. Stats.* 37 (1966), 51-58

A. Elga, Bayesian humility, *Phil. Sc.* 83 (2016), 305-23

Gilboa and Schmeidler, Updating ambiguous beliefs, *JET* 59 (1993), 33-49

M. Marinacci, Learning from ambiguous urns, *Statistical Papers* 43 (2002), 143-51

Epstein & Schneider, Recursive multiple-priors, *JET* 2003; and

Learning under ambiguity, *Rev. Econ. Stud.* 2007; Ambiguity, information quality and asset pricing, *J. Finance* 2008

Gul & Pesendorfer, Evaluating ambiguous random variables and updating by proxy 2017

R. Guong and Xiao-Li Meng, Judicious judgment meets unsettling updating: dilation, sure loss, and Simpson's Paradox 2017

S. Bradley and K. Steele, Can free evidence be bad? value of information for the imprecise probabilist, *Phil. Sc.* 83 (2016), 1-28

Gilboa, Samuelson & Schmeidler, *Analogies and Theories: Formal Models of Reasoning*, Oxford 2015

#5. "BOUNDED RATIONALITY"

Attention

A. Ellis, Foundations for optimal inattention, *JET* forthcoming

H. Oliveira, Axiomatic foundations for entropic costs of attention, 2014

Denti, Oliveira, Mihm, and Ozbek, Rationally inattentive preferences with hidden information costs, *TE* 2017

A. Caplin and M. Dean, Revealed preference, rational inattention and costly information acquisition, *AER* 2015?; Rational inattention, and state dependent stochastic choice, 2013. And Caplin, Rational inattention and revealed preference: the data-theoretic approach to economic modeling, *Research in Economics* Dec 2014

Chambers, Liu and Rehbeck, Nonseparable costly attention and revealed preference 2017

J. Lu, Random choice and private information, *Econometrica* 84 (2016), 1983–2027 [we may consider an extension due to Yi-Hsuan Lin]

Foresight

J. Rust, Do people behave according to Bellman's principle of optimality, 1992

D. Kreps. Anticipated utility and dynamic choice, in D. Jacobs, E. Kalai and M. Kamien eds. *Frontiers of Research in Economic Theory*, Cambridge U. Press, 1995

A. Kochov, A behavioral definition of unforeseen contingencies 2018

Shaowei Ke, Boundedly rational backward induction 2017

Shaowei Ke, Rational expectation of mistakes and a measure of error-proneness, *TE* forthcoming

Framing

**Tversky and Kahneman, The framing of decisions and the psychology of choice, *Science* 211 (1981), 453-8

D. Ahn & H. Ergin, Framing contingencies, *Econometrica* 78 (2010), 655-695

I. Kopylov, Framing in expected utility and multiple-priors models 2017

R. Spiegel, Bayesian networks and boundedly rational expectations, *QJE* 2016

Correlation

**A. Ellis and M. Piccione, Correlation misperception in choice, *AER* 2017

G. Levy and R. Razin, Combining forecasts: why decision makers neglect correlation, 2017

Epstein and Y. Halevy, Ambiguous correlation 2017 [experiment]

Response time

**D. Fudenberg, P. Strack and T. Strzalecki, Speed accuracy & optimal timing of choices, 2016

F. Echenique & K. Saito, Response-time and utility 2015

D. Kahneman, *Thinking, Fast and Slow* 2011