Behavioral Tools for Evaluating Insurance Products

CEAR/Huebner Risk Institute, July 30 2014

Center for the Economic Analysis of Risk
Center for the Economic Analysis of Risk (CEAR)

Cooperative effort of:

- GSU Robinson College of Business
  - Department of Risk Management and Insurance (lead unit)
  - Department of Finance
  - School of Accountancy
- GSU Andrew Young School of Policy Studies
  - Department of Economics
- Federal Reserve Bank of Atlanta
Mission is to promote research on the measurement and management of risks faced by individuals, households, institutions and societies

- Not just financial or economic risk
- Not just traded risk
Director

- Glenn Harrison, C.V. Starr Chair of Risk Management & Insurance

Program Directors...
Mark Machina  
**Individual decision-making**

Mark Machina is the CEAR Program Director for the individual decision-making area. Mark is a Distinguished Professor of Economics at UC San Diego, is a major theorist in the fundamentals of individual decision-making. He has also had a long interest in the connections between theory and experimental evidence. His specific interests in CEAR are twofold: the theoretical and empirical connection between risk aversion and uncertainty aversion (aka ambiguity aversion), and thinking carefully about the stochastic, econometric properties of tests of models of attitudes towards risk and uncertainty.

URL: [http://www.econ.ucsd.edu/~mmachina](http://www.econ.ucsd.edu/~mmachina)

Pierre-André Chiappori  
**Household decision-making**

Pierre-Andre Chiappori is the CEAR Program Director for the household decision-making area. PA is the E. Rowan and Barbara Steinschneider Professor of Economics at Columbia University, after many years at Chicago. His interests are in the theoretical modeling of households, in particular the characterization of their behavior as being cooperative, non-cooperative, or some mixture. He has also undertaken innovative empirical research on household behavior.

URL: [http://www.columbia.edu/~pc2167](http://www.columbia.edu/~pc2167)

Jean-Charles Rochet  
**Organizational decision-making**

Jean-Charles Rochet is the CEAR Program Director for the organizational decision-making area. He is a Professor of Banking at the Universitat Zurich, and is a well-known mathematical finance economist. He is perhaps best known for co-authoring the book Microeconomics of Banking, which provides a graduate-level textbook into the application of modern microeconomic theory to banking and financial intermediation. He has also made major contributions to mathematical economics and industrial organization theory.


Christian Gollier  
**Social decision-making**

Christian Gollier is the CEAR Program Director for the social decision-making area. Christian is a Professor of Economics at the University of Toulouse I. He has written extensively on the formal characterization of risk and connections to time preferences, and is perhaps best known as the author of the graduate-level textbook, The Economics of Risk and Time. Most recently he has been working on the effects of uncertainty aversion on portfolio decisions and social discount rates. Much of his foundational work is on the rigorous characterization of conditions under which intuitive results actually apply. He has been applying these ideas to the role of risk and uncertainty on social decision-making with respect to global warming.

URL: [http://idel.fr/member.php?f=40](http://idel.fr/member.php?f=40)
Thomas Rutherford
modeling methods

Thomas Rutherford is the CEAR Program Director for the modeling-simulation area. Tom is a Professor of Agricultural & Applied Economics at the University of Wisconsin - Madison. He is well known as one of the foremost computable general equilibrium (CGE) modelers active today. His formal background is in Operations Research from Stanford, and has made fundamental contributions to the evolution of software for the simulation of constrained optimization and complementarity problems, particularly using GAMS. He is a major player in the policy modeling of global warming, but has specific interests in CEAR because he has developed general tools to extend GAMS to accommodate stochastic event trees. This opens up all of the optimization and equilibrium simulation tools in GAMS to a wide audience interested in risk and uncertainty.

URL: http://www.aee.wisc.edu/faculty/trutherford

Nathaniel Wilcox
econometric methods

Nathaniel Wilcox is the CEAR Program Director for the econometrics methods area. Nat is a Professor of Economics at the Economic Science Institute at Chapman University. Nat has a stellar reputation within experimental economics. He also has a wide knowledge of related areas of research, such as Judgement and Decision-Making as well as Psychology. His most recent work has been on how risk attitudes affect inter-generational decision-making in laboratory environments, and the formal characterization of the effects of different error structures on estimates of risk attitudes. His research contributions are characterized as building bridges between theorists, experimental economists, and econometricians.

URL: http://www.chapman.edu/ESI/people/wilcox.asp

Don Ross
methodology

Don Ross is CEAR Director for the area of Methodology. He is Dean of Commerce and Professor of Economics at the University of Cape Town. His work on economic methodology includes numerous articles, and the book ECONOMIC THEORY AND COGNITIVE SCIENCE: MICROEXPLANATION (MIT Press 2005). He is Co-Editor (with Harold Kincaid) of the OXFORD HANDBOOK OF PHILOSOPHY OF ECONOMICS (2010). At UCT he co-founded the Research Unit in Behavioral Economics and Neuroeconomics (RUBEN), and leads the RUBEN labs that perform, respectively, experimental investigations of risk and time preferences, and fMRI studies. He has been particularly active in studying the economics of problem and addictive gambling, using this as a test-bed for the methodologies he has developed that integrate behavioral experimentation with models of comparative reward value learning in the brain.

URL: http://www.commerce.uct.ac.za/economics/staff/drross/
Outline of talk

> What role for behavioral tools?
> Type of behavioral tools
> Helicopter tour of issues
  o Risk attitudes
  o Time preferences
  o Subjective beliefs
  o Behavioral mechanism design (if time permits)
Different inferential objectives

> Selling more of the “same” product
  o Is “take-up” or “profit” the metric?
  o Short-term or long-term profit?

> Designing new products

> Evaluating welfare effects for cost-benefit analysis
  o Cost-benefit analysis is not cost effectiveness
  o Includes distributional effects (who wins and loses)

> Designing better insurance policies
Why worry about behavioral economics?

> What are the core behavioral “moving parts” in decisions about risk management and insurance?

- Risk Perception
- Time Preferences
- Risk Attitudes
Why worry about behavioral economics?

What are the core behavioral “moving parts” in decisions about risk management and insurance?

- Risk preferences
  - Diminishing marginal utility
  - Probability pessimism
  - Loss aversion
  - Multivariate risk aversion

- Time preferences
  - Degree of impatience
  - Exponential or “hyperbolicky”?
  - Correlation aversion over time

- Subjective beliefs
  - Risk, uncertainty and ambiguity
  - Are beliefs updated “rationally” using Bayes Rule?
Connection to insurance

> The basic insurance contract
  - I give you money now and you promise to pay me something if some bad things happen to me in the future

> Connections
  - Obviously risk attitudes play a role
  - Obviously impatience plays a role
  - Subjective beliefs of risk play a role
    - Subjective risk of the “bad thing” occurring
    - Do these get revised irrationally if the “bad thing” does not occur in one year?
    - Also the subjective risk of the company not honoring the contract
Two types of insight from behavior

> One is just to understand the demand for the product
  o What are the risk attitudes?
  o What are the time preferences?
  o What are the subjective beliefs (over time)?

> Another is to identify ways to improve decisions
  o What if risk attitudes are not “rational”?
  o What if time preferences are not “rational”?
  o What if subjective beliefs are not “rational”?

> These matter depending on who the client is
  o Companies can exploit errors and biases in decisions
  o NGOs and governments should not do this
Why focus just on product “take up”? 

> Easy to measure, but is it the only thing of interest?

> Obviously not of interest at all if we care about the expected welfare of using the product

   o Take-up might be “irrational”
   o Take-up might dissipate once heavy subsidies are removed
   o Do we want to respect individual preferences and beliefs?

> Surely it is of interest to companies …

   o Yes: you have to sell product to make a profit
   o No: short-term take-up often following by heavy attrition

> Key role for behavioral insights here
Behavioral risk management

- Accounting for risk
- Portfolio choice
- **Insurance**
- Self-protection and self-insurance
- Search behavior and the value of information
- Updating risk perceptions and learning
- Real and financial options
- Traded and non-traded risks
Implications

> Lots of ways to manage risk
  - Combinations of portfolios, contracts, own choices
  - Univariate or multivariate risk aversion?

> Not just financial, or using market instruments
  - Financial risk management and operational risk management

> Need to look at the “whole picture”
  - If you study the demand for insurance in isolation from the whole picture of risk management you get a distorted view
  - Especially true in developing countries with fewer formal tools for risk management
Behavioral economics

> Originated in experimental economics
  o Testing economic theory, especially market equilibrium and models of risk preferences and time preferences
  o Estimating economic models
  o Lab and field, as complements

> Moved into being any non-standard modeling
  o Often a superficial nod to “facts” about behavior
  o Often contrasted with straw men: “homo economicus”?
  o Behavioral finance is a different breed again

> Beware of behaviorists bearing easy insights
  o For instance, the Randomistas
Types of experiments

- Thought experiments
- Lab experiments
- Artefactual, framed or natural field experiments
- Social experiments
- Natural experiments

Field Experiments

Glenn W. Harrison and John A. List

Journal of Economic Literature
Types of experiments

- Thought experiments
- Lab experiments
- Artefactual, framed or natural field experiments
- Social experiments
- Natural experiments

Field Experiments

Glenn W. Harrison and John A. List

Journal of Economic Literature
Randomized Control Trials (RCTs)

> Very popular again
  - On a good day, allows strong causal statements
  - Usually associated with seductive slogans: “what works”

> Limitations
  - Some stuff cannot be randomized
  - Cost effectiveness of one issue, not cost-benefit analysis
  - Only causal statements about observables
  - Only looks at average effects
    - Ignores the tails, and “winners” and “losers” that net out
  - Scaling up, since N $\rightarrow 1$
  - Sample selection/attrition issues (e.g., randomization bias)
Summary so far

> Behavior plays a key role describing insurance decisions
  o Gives us a structural understanding of insurance purchases

> Behavior underlies the evaluation of insurance decisions
  o Welfare evaluation: the expected consumer surplus
  o Welfare evaluation: are observed decisions “rational”?  
  o Long-term profitability, and profitability of new products

> Three key components of behavior
  o Risk attitudes, time preferences, and subjective beliefs

> Central role of experiments
  o Lab and field experiments
Risk attitudes, I

> Tests of Expected Utility Theory (EUT)
  o Lots of “trip wire” tests
    ▪ Looking at choice patterns, not implications for risk attitudes
  o Many are just an illusion: the Allais Paradox
  o Many are real: Common Ratio tests, tests of ROCL

> Idea of mixture models
  o Often 50% EUT and 50% RDU/CPT

> Probability weighting

> Reference dependence is very tricky
  o Disappointment aversion and elation loving
  o Utility loss aversion
  o Probabilistic loss aversion
Risk attitudes, II

- Higher-order risk preferences
  - Aversion to variability of final outcomes, not just variance
  - Preferences towards skewness and kurtosis

- Multivariate risk aversion
  - Literature on background risk aversion
  - In the absence of complete markets, risk aversion is matrix valued (later)

- Atemporal risk aversion
  - Also later
Time preferences, I

> Access to perfect capital markets
  o Fisherian Separation theorem

> Imperfect capital markets
  o Then no “utility-free” investment rule (Pye JOB 1966)
  o The intertemporal budget constraint is not defined until we know the time preferences of the agent

PRESENT VALUES FOR IMPERFECT CAPITAL MARKETS*

GORDON PYE

THE JOURNAL OF BUSINESS
1966
Time preferences, II

> Various discounting models of effect of horizon
  
  o Characterize in terms of fixed and variable costs of time delay
    ▪ Exponential discounting: zero fixed cost, constant variable cost
    ▪ Hyperbolic discounting: zero fixed cost, declining variable cost
    ▪ Quasi-hyperbolic: positive fixed cost (a fixed fraction of principal), constant variable cost
  
  o Time distortion models from psychology

> Claims of a “magnitude effect”

> Early evidence
  
  o Hypothetical survey questions
  o Small stakes, if any real stakes
  o Students
  o Implicitly assuming a linear utility function
Modern experiments with real rewards, correction for non-linear utility, and non-student populations

- Monetary discount rates of 25% p.a.
- Utility discount rates of 10% p.a.

_Econometrica_, Vol. 76, No. 3 (May, 2008), 583–618

ELICITING RISK AND TIME PREFERENCES

BY STEFFEN ANDERSEN, GLENN W. HARRISON, MORTEN I. LAU, AND E. ELISABET RUTSTRÖM
Modern experiments with real rewards, correction for non-linear utility, and non-student populations

- Monetary discount rates of 25% p.a.
- Utility discount rates of 10% p.a.
- No evidence for “hyperbolicky” discounting
- No evidence for “magnitude effect”
Modern experiments with real rewards, correction for non-linear utility, and non-student populations

- Monetary discount rates of 25% p.a.
- Utility discount rates of 10% p.a.
- No evidence for “hyperbolically” discounting
- No evidence for “magnitude effect”

Limitations

- Assumes no “projection bias” w.r.t. utility function
- Assumes additive intertemporal utility function
Multiattribute risk aversion

> Two attributes: health and income
  
  o Let \( \{x, X\} = X \) be health states, where \( x < X \)
  
  o Let \( \{y, Y\} = Y \) be income states, where \( y < Y \)

> Define the lottery \( \alpha \) as 50:50 mix of \( \{x, Y\} \) and \( \{X, y\} \)
  
  o Get bad/good OR good/bad over attributes

> Define the lottery \( \beta \) as 50:50 mix of \( \{x, y\} \) and \( \{X, Y\} \)
  
  o Get all-bad OR all-good over attributes

> Risk attitudes towards attributes (if incomplete markets)
  
  o Correlation averse or mRA: prefer \( \alpha \) to \( \beta \) for all \( x, X, y, Y \)
  
  o Correlation neutral or mRN: indifferent between \( \alpha \) and \( \beta \)
  
  o Correlation loving or mRL: prefer \( \beta \) to \( \alpha \)
Intuition and older literature

> Multiattribute risk aversion (mRA) is like one-attribute risk aversion (1RA)
  
  o 1RA prefers non-extreme payoffs within an attribute
  o mRA prefers non-extreme payoffs across attributes

> Keeney 1973: conditional risk aversion
> Multiattribute risk aversion (mRA) is like one-attribute risk aversion (1RA)
  - 1RA prefers non-extreme payoffs within an attribute
  - mRA prefers non-extreme payoffs across attributes
> Keeney 1973: conditional risk aversion
> Richard 1975: multivariate risk aversion
Intuition and older literature

Multiattribute risk aversion (mRA) is like one-attribute risk aversion (1RA)

- 1RA prefers non-extreme payoffs within an attribute
- mRA prefers non-extreme payoffs across attributes

- Keeney 1973: conditional risk aversion
- Richard 1975: multivariate risk aversion
- Epstein & Tanny CJE 1980: correlation aversion
Let \( x \) and \( y \) be typical elements of \( X \) and \( Y \), respectively, and \( U(x, y) \) be the multiattribute utility function.

- Agent is mRA or CA iff \( \frac{\partial^2 U}{\partial x \partial y} < 0 \)
  - So mRA bears no necessary relation to 1RA in either attribute, which is \( \frac{\partial^2 U}{\partial x^2} < 0 \) or \( \frac{\partial^2 U}{\partial y^2} < 0 \)

- Additive U iff mRN or CN
  - Becomes important when looking at risk over time (later)

- Only separable U that allows CA or CL is non-additive
When can we say that one agent is more mRA than another?

- Akin to the Arrow-Pratt question in a 1RA context

**Kihlstrom-Mirman *JET* 1974**

- Assume that the ordinal preferences of two utility functions over non-stochastic outcomes are the same
  - Nasty assumption, particularly if comparing two decision-makers
- Then just check if the Hessian is negative semi-definite

**Relax the strong Kihlstrom-Mirman assumption**

- Measures of risk aversion then matrix-valued
  - Duncan *Econometrica* 1977
  - Karni *Econometrica* 1979
Application to household risk

- Household Utility
  - Parents
    - Dad
    - Mum
  - Kids
    - Boys
    - Girls

Nested CES functions
Summary on multiattribute risk aversion

> Important extension of univariate risk aversion
  
  o Related to results on effect of background risk on foreground risk aversion
  o Related to “higher-order” risk aversion concepts such as prudence and temperance
  o Related to findings on “risk over time” discussed next

> Formal characterization requires departure from additivity

> Wide applications to individuals, households and groups
Correlation aversion, re-stated

> Let \{x, X\} = X be income to be received sooner, x < X
> Let \{y, Y\} = Y be income to be received later, y < Y
> Define the lottery \( \alpha \) as 50:50 mix of \{x, Y\} and \{X, y\}
  - Get bad/good OR good/bad over time-dated incomes
> Define the lottery \( \beta \) as 50:50 mix of \{x, y\} and \{X, Y\}
  - Get all-bad OR all-good over time-dated incomes
> Risk attitudes towards intertemporally correlated payoffs
  - Correlation averse: prefer \( \alpha \) to \( \beta \) for all x, X, y, Y
  - Correlation neutral: indifferent between \( \alpha \) and \( \beta \)
  - Correlation loving: prefer \( \beta \) to \( \alpha \)
Let $x$ and $y$ be typical elements of $X$ and $Y$, respectively, and $U(x, y)$ be the intertemporal utility function.

Agent is CA iff $\partial^2 U/\partial x \partial y < 0$

- So CA bears no necessary relation to a-temporal RA in sooner or later time periods, which is $\partial^2 U/\partial x^2 < 0$ or $\partial^2 U/\partial y^2 < 0$

Additive $U$ iff correlation neutral

- So familiar specification $U(x, y) = D^S u(x) + D^L u(y)$ implies CN

Allows “a-temporal risk preferences” and “time preferences” to differ
> Can we replace objective probabilities in our models with subjective probabilities?

- Savage 1954: yes, if we make some really strong assumptions
- Ellsberg 1961: no, since those assumptions are wrong
Why is ROCL so important?

- OK to say you have a subjective probability of $\pi$
- But surely it is not that precise: what about $\pi - 0.01$ or $\pi + 0.01$?
- What about $\pi - 0.02$ or $\pi + 0.02$?

You actually have subjective belief distribution

- A distribution is not a probability
- Terminology: a non-degenerate statistical distribution

ROCL explains how you “boil down” a subjective belief distribution to a subjective probability…
Applying ROCL

> Subjective probability distribution $\pi$

- $\pi = 0.6$ with “prior” probability 0.1
- $\pi = 0.7$ with “prior” probability 0.6
- $\pi = 0.8$ with “prior” probability 0.3
- Average $\pi = 0.72$
Applying ROCL

> Subjective probability distribution $\pi$

- $\pi = 0.6$ with “prior” probability 0.1
- $\pi = 0.7$ with “prior” probability 0.6
- $\pi = 0.8$ with “prior” probability 0.3
- Average $\pi = 0.72$

> Lottery in which you get $x$ if event occurs, or $0$ otherwise

- $EU = 0.1 \times 0.6 \times U(x) + 0.1 \times 0.4 \times U(0) + 0.6 \times 0.7 \times U(x) + 0.6 \times 0.3 \times U(0) + 0.3 \times 0.8 \times U(x) + 0.3 \times 0.2 \times U(0)$
- $EU = (0.1 \times 0.6 + 0.6 \times 0.7 + 0.3 \times 0.8) \times U(x) + (0.1 \times 0.4 + 0.6 \times 0.3 + 0.3 \times 0.2) \times U(0)$
- $EU = 0.72 \times U(x) + 0.28 \times U(0)$

> Same thing holds for non-discrete distributions
Your subjective beliefs

Symmetric Subjective Probability Distributions

Mean = .5

Subjective Probability $\pi$
Your subjective beliefs on ROCL

Symmetric Subjective Probability Distributions

- Mean = 0.5

Subjective Probability \( \pi \)
Asymmetric Subjective Probability Distributions

- Mean = 0.35
- Mean = 0.23
- Mean = 0.16
- Mean = 0.13
Your subjective beliefs on ROCL

Asymmetric Subjective Probability Distributions

Mean = .35

Mean = .23

Mean = .16

Mean = .13
Subjective Beliefs in the Wild and Tamed by ROCL
Summary on ROCL

> Savage did **not** assume people used a specific subjective probability
  
  o He allowed for “non-degenerate” subjective belief distributions

> But he **did** assume that people

  o used these distributions as if they were compound lotteries
  o and behaved consistently with ROCL

> Easy to be critical now, but at the time this was important

  o Lots of modeling built on assuming objective probabilities
  o Opened the way for more exciting treatments of uncertainty

> Now have good tools to elicit subjective beliefs under SEU
Elicitation of Personal Probabilities and Expectations

LEONARD J. SAVAGE

SCORING RULES FOR CONTINUOUS PROBABILITY DISTRIBUTIONS*

JAMES E. MATHESON† AND ROBERT L. WINKLER‡§**
Eliciting the whole distribution

What is the official unemployment rate for everyone 16 and over in the United States as of February 2013?

Unallocated tokens: 100

Submit

You must allocate all tokens before you are able to submit.
Eliciting a non-degenerate distribution
Eliciting a degenerate distribution

What is the official unemployment rate for everyone 16 and over in the United States as of February 2013?

Unallocated tokens: 0

Submit your decision or continue making choices
Risk

- Objective probabilities
- Subjective probabilities
  - subjective belief distributions tamed by ROCL
Risk and uncertainty

> Risk
  - Objective probabilities
  - Subjective probabilities
    - subjective belief distributions tamed by ROCL

> Uncertainty
  - Subjective belief distribution in the Wild
    - when ROCL does not apply
Risk, uncertainty and ambiguity

> Risk
  - Objective probabilities
  - Subjective probabilities
    - subjective belief distributions tamed by ROCL

> Uncertainty
  - Subjective belief distribution in the Wild
    - when ROCL does not apply

> Ambiguity
  - When we do not have a (complete) subjective belief distribution
  - When some information is missing, maybe not all
“By any other name”

- Risk
  - The Known
- Uncertainty
  - The Unknown
- Ambiguity
  - The Unknowable
“By any other name”

- Risk
  - Known knowns
- Uncertainty
  - Known unknowns
- Ambiguity
  - Unknown unknowns

Reports that say that something hasn’t happened are always interesting to me, because as we know, there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns -- the ones we don't know we don't know. – Donald Rumsfeld, February 2002, on WMD in Iraq
Most of the literature on uncertainty refers to it as ambiguity

- Very little interest, it seems, in being a bit more careful
- Still extraordinarily important
- Not sure why there is confusion...

_Econometrica_, Vol. 57, No. 3 (May, 1989), 571–587

SUBJECTIVE PROBABILITY AND EXPECTED UTILITY WITHOUT ADDITIVITY

_BY DAVID SCHMEIDLER_1

1. J. Mack Robinson College of Business
Some confusing terminology

> Schmeidler (1989; p.582)

We now introduce formally the concept of uncertainty aversion alluded to in the Introduction. A binary relation $\succeq$ on $L$ is said to reveal uncertainty aversion if for any three acts $f$, $g$, and $h$ in $L$ and any $\alpha$ in $[0,1]$: If $f \succeq h$ and $g \succeq h$, then $\alpha f + (1 - \alpha)g \succeq h$. Equivalently we may state: If $f \succeq g$, then $\alpha f + (1 - \alpha)g \succeq g$. For definition of strict uncertainty aversion the conclusion should be a strict preference $>$. However, some restrictions then have to be imposed on $f$ and $g$. One such obvious restriction is that $f$ and $g$ are not comonotonic. We will return to this question in a subsequent remark.

Intuitively, uncertainty aversion means that “smoothing” or averaging utility distributions makes the decision maker better off. Another way is to say that substituting objective mixing for subjective mixing makes the decision maker better off. The definition of uncertainty aversion may become more transparent when its full mathematical characterization is presented.
Attitudes towards uncertainty

Symmetric Subjective Probability Distributions

Mean = .5

Subjective Probability $\pi$
Modeling attitudes towards uncertainty

> Assume the worst possible outcome
  o “Maxmin EU” model of Gilboa and Schmeidler *JMathE* 1989
  o You do not need to know the other outcomes or probabilities
  o Hence truly a model of **ambiguity** aversion

> Assume the worst or best outcome with some weight
  o Simple extension of the “maximin EU” model, less pessimistic
  o Also a model of **ambiguity** aversion, since no info on in-between

> Assume a utility of EU of each node of the compound lottery
  o “Smooth model” of Klibanoff, Marinacci & Mukerji *Econometrica* 2005
  o Model of **uncertainty** aversion
  o So uncertainty aversion works just like risk aversion
    ▪ You do not like **subjective** variability of outcomes
Illiteracy, Risk and Uncertainty

Subjective Probability $\pi$

Literate without ROCL

Illiterate without ROCL

Literate with ROCL

Illiterate with ROCL
Illiteracy, Risk and Uncertainty

Is this person better off exhibiting illiteracy aversion?
Ignorance, Risk and Uncertainty

Subjective Probability $\pi$

Literate without ROCL

Ignorant without ROCL

Subjective Probability $\pi$

Literate with ROCL

Ignorant with ROCL

Subjective Probability $\pi$
Subjective Probability $\pi$

Ignorance, Risk and Uncertainty

Ignorance aversion has nothing to “bite” on! Maybe regulation is needed?
Dynamic risk perceptions

> Updating static expectations after new information

> Bayes Rule

- Does it have any normative status?
  - Savage only proposed it for “small worlds,” where you knew all of the consequences of your actions
  - Is it attractive for uncertain or ambiguous settings?

- Behavioral validity depends on presentation
  - Frequency formats versus probability formats…
Further effects of representations

**Natural Sampling**

![Diagram of natural sampling](image)

- **p(disease|symptom)**
  \[
  p(disease|symptom) = \frac{8}{8 + 95}
  \]

**Standard Probability**

- **p(H)**
  \[= .01\]
- **p(D|H)**
  \[= .80\]
- **p(D|-H)**
  \[= .096\]

- **p(disease|symptom)**
  \[
  p(disease|symptom) = \frac{.01 \times .80}{.01 \times .80 + .99 \times .096}
  \]

*Figure 1.* Bayesian inference and information representation (natural sampling of frequencies and standard probability format).
Dynamic risk perceptions

> Updating static expectations after new information

> Bayes Rule

- Does it have any normative status?
  - Savage only proposed it for “small worlds,” where you knew all of the consequences of your actions
  - Is it attractive for uncertain or ambiguous settings?
- Behavioral validity depends on presentation
  - Frequency formats versus probability formats

> “Overconfidence”

- **Overestimation** of one’s actual ability or performance
- **Overplacement** of one’s self relative to others
- **Overprecision**: excessive certainty about accuracy
Behavioral mechanism design, I

> What if you get to write the game or insurance contract?

> Your objective
  - Maximize your utility
  - Maximize some social utility

> Constraints
  - Players are strategic
  - May or may not want to participate

> The Revelation Principle

> Specification as a mathematical programming problem
Mechanism design: definitions

> Mechanism
  o A set of rules mapping admissible messages into outcomes

> Direct scheme
  o Each agent reports his own “type”
  o Does not report what he thinks other agents’ types are

> Revelation scheme
  o Each agent truthfully reveals his type

> Revelation Principle
  o Given any feasible mechanism, there exists an equivalent DRM
  o So what is a “feasible mechanism”?
Any mechanism that satisfies three conditions defined over arbitrary messages m(t) defined over all agent types t

Three conditions:
- TP: trivial probability constraints
- IR: individual rationality constraints (voluntary participation)
- IC: incentive compatibility constraints (tell the truth)

Feasible mechanism need not be direct, nor does it have to be a revelation mechanism
Mechanism design: the basic logic

- Principal can always implement $m(t)$ if he can get agents to truthfully admit $t$ in a DRM.

- So if agent is in a Bayesian Nash Equilibrium with $m(t)$, he will only hurt himself by unilaterally lying in the DRM.

- This is the stuff of the 2007 Nobel Prizes:
  - Hurwicz
  - Maskin
  - Myerson
Ensuring truthful revelation

- May be multiple equilibria with lying: assumed away!
- Just tighten constraints
  - $\text{EU(\text{truth})} \geq \text{EU(\text{lie})} + \delta$ for $\delta > 0$
  - $\text{EU(\text{participate})} \geq \text{EU(\text{not participate})} + \epsilon$ for $\epsilon > 0$
Lots of behavioral tools needed to evaluate expected welfare costs of insurance decisions

- Lots of rich theory now
- Impossible to operationalize with naturally occurring data
- Needs lab experiments, or artefactual field experiments
- Fair progress on some of the basics

We certainly should not use crude metrics, such as take-up, to evaluate insurance products

Beware of behaviorists bearing “stories”