Risk, Uncertainty, Expected Value, Information

ECO 5370
Risk and Uncertainty

Review... “Cost-benefit analysis often requires us to predict the future.”

The future often involves uncertainty.

Risk and Uncertainty

- Expected Value
- Sensitivity Analysis
- Value of Information.

Risk and Uncertainty

*Expected Value* reflects the basic ideas of uncertainty. Explore fundamental terminology.

- Likely outcomes
- Alternatives
- Probable events
- Expected values
- Contingencies
Risk and Uncertainty

*Sensitivity analysis* subjects the measurement of net benefits to differing levels of uncertainty.

- Identify plausible alternative outcomes.
- Plausibility leads to a “base case.”
- Acknowledge uncertainty of outcomes.
- Recognize different assumptions.

Risk and Uncertainty

*Value of Information* forces policymakers to place values on future outcomes.

- Future choices have different values. *Remember that the values are selected at present.*

Risk and Uncertainty

**Quasi-option Value**

The expected value of information gained by delaying an irreversible decision is called quasi-option value.

- Can quasi-option value be quantified?

Risk and Uncertainty

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Risk and Uncertainty

**Quasi-option Value**

Information gained by exogenous or endogenous learning.

- *When and how does learning occur?*

Risk and Uncertainty

Quasi-option Value

Exogenous: Information is revealed.

Endogenous: Information is gained from the development of the project itself.

Risk and Uncertainty

*Value of Information*

Information assists in reducing uncertainty.

Information will always help in determining future values. Information helps in assigning probabilities to future events, and ultimately, in identifying the accurate value of the net benefit.
Risk and Uncertainty

- A measure of the *likelihood* of the occurrence of an event is the *probability* that the event will occur.

- Assignment of the probability of an event is either subjective or objective.

Policy, Risk, and Uncertainty

- Policy actions and policy goals involve elements of risk and uncertainty – of probability.

- The questions are: how much risk? What level of uncertainty?
Because the assignment of the probability of an event can involve objective criteria, analysts need to understand how similar, past actions have occurred and why these events have happened.

What is the probability that the past will repeat itself?
A current macroeconomic policy issue is the matter of reducing unemployment from its current high level (about 8.0% nationally).

The question is: how long will it take to bring unemployment down to an acceptable level?
To begin ... think that a policy goal – a national policy objective – is the achievement of full employment.

*Full employment* may be defined as that rate of unemployment that prevails when only frictional and structural unemployment exist.
Both monetary policy and fiscal policy claim *full employment* as a policy objective.

Consequently, any level of unemployment above the frictional and structural level is to be reduced.
Uncertainty & Unemployment

Objective: What is the likelihood – the probability – of returning the national unemployment rate to 6 percent?

How can this probability be understood? Be known? Be expected?
Uncertainty & Test 2

Methodology: Look at recent cycles of unemployment peaks, periods of recovery, and finally, extended periods of low unemployment.

What can we learn from review and analysis?
Risk and Uncertainty

“Uncertainty (or risk) is present when there is more than one possible outcome for a decision.”

“Roughly speaking, the greater the dispersion of possible outcomes, the higher the degree of uncertainty.”

Managerial Economics, Samuelson and Marks, 6th Edition, Ch. 12.
Risk and Uncertainty

“Uncertainty is acknowledged in expressions such as ‘it is likely,’ ‘the odds are,’ and ‘there is an outside chance.’”

“The essential means for quantifying statements of likelihood is to use probabilities.”

Risk and Uncertainty

- What is an objective probability?
- What is a subjective probability? How reliable are subject probabilities?
Risk and Uncertainty

- Subjective probabilities are assigned because of knowledge or expertise gained from experience.

- Look at past patterns of the cycle of employment and unemployment to make a forecast.

- There remains a need for information.
Risk and Uncertainty

Objective probabilities are scientific in their nature. Review and analysis of previous events reveal patterns that allow the assignment of risk to an event.

Potential outcomes are “known” (in the sense of having an assigned probability of occurrence, given history)
Risk and Uncertainty

A discussion of subjective probabilities arises because the person or group establishing the likelihood of an outcome or set of outcomes cannot rely on formal, quantitative analysis.

There is little to no information about foregoing similar events. Consequently, assigning probabilities based on formal review and analysis is not an approach.

Managerial Economics, Thomas & Maurice, 9th Edition, Ch. 15.
Risk and Uncertainty

Historical events allow the option – even mandate the task -- of examining patterns of behavior.

Ultimately, historical events lead to the selection of objective probabilities in an array of outcomes.
Risk and Uncertainty

While history plays a role in selecting probabilities for an array of outcomes, contemporary research has turned to the occurrence of "fat tails" and their roles in determining the likelihood of outcomes.

What is a "fat tail"? What is its role in assessing risk?
Risk and Uncertainty

Before looking into a “fat tail” event in the policy framework of unemployment, just start by asking:

*When can the Administration anticipate a reduction in the unemployment rate to 6 percent?*
Risk and Uncertainty

A suggested approach/method:

*Look at the last few recessions, the characteristics of their unemployment, and the timing of their returns to full employment.*
Risk and Uncertainty

Traditionally, the dispersion of data around a central point determines the probability of a discrete event (in an array of events).

How is dispersion affected by a “fat tail?”
Risk and Uncertainty

Think about a “fat tail” in terms of a probability distribution.

The normal distribution posits that “nearly all” likely events occur within 3 standard deviations of the mean.

Traditionally, it is “highly unlikely” that any outcome would lie beyond “3 sigmas”.
Risk and Uncertainty

Look, for example, at the normal distribution. Observe that .4772 (47.72%) observations fall between the mean and +2.0 standard deviations. Another .4772 observations fall between the mean and −2.0 standard deviations. Hence, 95.44% of all observations are within +/- 2.0 standard deviations of the mean (event).

This review reinforces the notion that “nearly all” likely events occur within 3 standard deviations of the mean.
Risk and Uncertainty

With the prospect of a fat tail, there is a higher likelihood — higher probability — of an event occurring in the range of (traditionally) highly unlikely events.

“A fat tailed probability distribution is one in which extreme events are more probable.”

(http://moneyterms.co.uk)
Risk and Uncertainty

*Note that a normal distribution is typically a good fit over a wide range of outcomes.*

“But the prospects of some events – an extreme event – may be more probable than the distribution suggests.”

([http://moneyterms.co.uk](http://moneyterms.co.uk))
Risk and Uncertainty

*Suggestion:* review the likelihood of outcomes through a table of areas under the normal curve with the standard deviation up to 3.9.

See how extremes are highly unlikely in this distribution.
Risk and Uncertainty

The concept of the fat tail has led to a re-thinking of risk management.

Again, recall that risk management under objective conditions allows for the assignment of probabilities in the context of a standard normal distribution.
Risk and Uncertainty

- Risk management ultimately implies the assignment of a risk-adjusted discount rate for the valuation of securities, bonds, other financial instruments.

- The standard normal distribution has occupied a central position in risk assignment.

- Are there alternatives?
Risk and Uncertainty

In *When Markets Collide* (McGraw-Hill, 2008), economist and fund manager Mohamed El-Erian emphasizes the need for decision-makers – particularly in finance and economics – to improve their risk management skills.

“The importance of enhanced risk management cannot be overstated.”

“Insights from traditional economics and finance suggest that structural transformation inevitably leads to asymmetrical reactions and challenge the robustness of exiting (sic) activities and institutions.”

Risk and Uncertainty

Author and essayist, Nassim Nicholas Taleb, attempts to describe how highly improbable events occur, particularly when structural transformations in economies are taking place.

In *The Black Swan* (Random House, 2007), he describes how modern decision-makers (“we” or “men and women” or “analysts” or “government officials”) rarely account for the occurrence of a “Black Swan.”

What is a “Black Swan?”
Risk and Uncertainty

According to Taleb, “Black Swans” include...

-- a terrorist attack;

-- Google, the firm;

-- the recent recession, now officially over, but with its impact remaining.
Risk and Uncertainty

A “Black Swan” may be thought of as a “fat tail” event.

Such an event is often not even on a practitioner’s radar screen.

The likelihood is never considered.
“Nassim Taleb’s work is consistent with the hypothesis that the transformations increase the probability of “Black Swans” for which market participants are already ill equipped to deal with, in part because they are largely uninsured against “fat tail” events. Indeed, his work illustrates the excessive way in which the traditional probabilistic approach to mapping outcomes is blinded by the median and, therefore, underestimates the tails.”

Risk and Uncertainty

- A discussion of the “left tail” ensues.
- Why the left tail (and not the right)?
- How can uncertainty be discussed here?

Risk and Uncertainty

Regarding recent events at Citigroup and the termination of its former CFO, one analyst commented: “There was not an appropriate amount of understanding of the risks they bore... the chief financial officer has to be able to assess the myriad risks that a large financial institution faces.”

Risk and Uncertainty

Regarding the financial crisis of 2007 to 2009 and onwards, former Fed Chairman current world financial crisis, Alan Greenspan, has written: “The crisis will have many casualties. Particularly hard hit will be much of today’s financial risk-evaluation system, significant parts of which failed under stress. Those of us who look to the self-interest of lending institutions to protect shareholder equity have to be in a state of shocked disbelief.”

Alan Greenspan, “We will never have a perfect model of risk,” *Financial Times*, March 16, 2008.
Risk and Uncertainty

Assuming that much economic analysis relies on traditional probability models -- even as structural transformation takes place almost continuously -- are we mistaken in not attempting re-evaluation of our models?

What will the next “Black Swan” look like?

In order to survive, will market economics (capitalism) require re-thinking for its longevity?
Risk and Uncertainty

To answer that question, must traditional, free-market economists turn to some sort of central authority to mitigate the damage that may arise after “Black Swan” events wreak havoc on traditional institutions?

Does an answer rest with careful regulation (from central authorities) of traditional and new institutions, investment vehicles, financial solutions?
Risk and Uncertainty

Another conundrum arises:

Isn’t careful regulation also subject to a “Black Swan” event?
Risk and Uncertainty

As we close, suppose we ask: What is the role of central authority – government – in assuring the long-term likelihood of economic efficiency and equality delivered through the capitalist model?

Can we agree that efficiency and equality are economic goals that all societies should pursue?

Are there other, equally worthy, goals?

Identify one or more.
Risk and Uncertainty

Summarize the terms that we have covered in this discussion:

- risk
- uncertainty
- efficiency
- equity
- fat tail
- mean
- median
- dispersion
- event
- normal distribution
- probability
- expectation
- stability
- risk assessment
- expected value
Risk and Uncertainty

Finish / Part 2