EconS 450 Advanced Farm Management

Risk – Part I

Risk and Uncertainty

Is risk a four letter word?

Are you willing to pay to avoid risk?

Are you willing to pay to expose yourself to risk?

In almost every case the answer to both of these questions is "yes".

Management and Risk

Many decisions are made in an environment of relative certainty, while others are not.

Risk and uncertainty are factors in many business decisions.

Management and Risk

Economic Risk – the chance of loss because all possible outcomes and their probability of happening are unknown.

Uncertainty – when outcomes of managerial decisions cannot be predicted, but all possible outcomes and their associated probabilities are known.

Risk and Uncertainty

Actions taken under risky decision environments are purely speculative.

Under conditions of uncertainty, informed managerial decisions are possible.

Managing Risk

Two things are important when incorporating risk/uncertainty in the decision making process.

- decision makers attitude toward risk
- probabilities or other information allowing the calculation of expected outcomes

Risk Preference Simplified

- Risk averse
  The value of a risky stream of payments is less than the value of a certain stream to a risk averse person
- Risk loving
  The value of a risky stream of payments is greater than that of a certain stream

Types of Risk

Risk can be categorized in an effort to incorporate it into decision making.

- Business Risk
  The chance of loss associated with a given managerial decision

Types of Risk

- Market Risk
  The chance that investments will lose money because of changes in the financial markets

  In agriculture, market risk describes the chance that crop or livestock values will change due to changes in overall market conditions

Types of Risk

- Inflation Risk
  The risk that a general increase in the price level will undermine the real economic value of contracts or obligations
- Interest-rate risk
  Changes in interest rates impact the value of long-term obligations in much the same way as inflation

Types of Risk

- Credit Risk
  The chance that creditors will fail to abide by their contractual obligations
- Liquidity Risk
  Market conditions move in such a way that assets cannot be sold or transferred at favorable prices

Types of Risk

- Derivative Risk
  The chance that futures and options could create losses in underlying investments by increasing rather than decreasing price volatility

Types of Risk

- Cultural Risk
  Companies active in global markets are exposed to risks specific to different cultures
- Currency Risk
  Risk arising due to investments in foreign currency and changes in exchange rates

Types of Risk

- Government Policy Risk
  Company assets at risk due to fiscal and monetary policies of host country governments
- Expropriation Risk
  Risk that business property located abroad can be seized by host governments

Probability Concepts

In order to understand approaches to mitigating risk, a clear understanding of probability concepts is necessary.

Probability – *the chance, or odds that an event will occur.*

Probability Concepts

If all possible outcomes are listed, and a probability assigned to each outcome, you get a *probability distribution*.

Probability Distribution

For example, a manager observes that there is a 70% chance a customer will place an order, versus a 30% chance they will not. We could describe this distribution as:

Event	Probability
Receive order	0.7 or 70%
Do not receive	0.3 or 30%

Probability Distribution

Note that the probabilities must sum to 1.0 (100%)

In a management situation, the probability distributions of alternative decisions can be very informative.

Probability Distribution

For example, a firm has two investment alternatives, each calling for a $10,000 investment. How much they earn depends on the alternative they choose and the state of the economy.

Probability Distribution

Given two alternative decisions and three possible states of the economy, potential profits are predicted as follows:

State of the Economy	Project A	Project B
Recession	$4,000	$0
Normal	$5,000	$5,000
Boom	$6,000	$12,000

Probability Distribution

Economic research predicts that the probabilities associated with the different states of the economy are as follows:

State of Economy	Probability
Recession	0.2
Normal	0.6
Boom	0.2

Expected Value

If we know the projected payoffs, and the probabilities associated with the states of the economy, we can calculate the expected value of each alternative

$$\text{Expected Profit} = \mathrm{E}(\pi) = \sum_{i=1}^{n} \pi_i p_i$$

Expected Value

Given this formula it is clear that the expected profit is simply a weighted average of the possible outcomes, using the probabilities as weights.

Expected Value

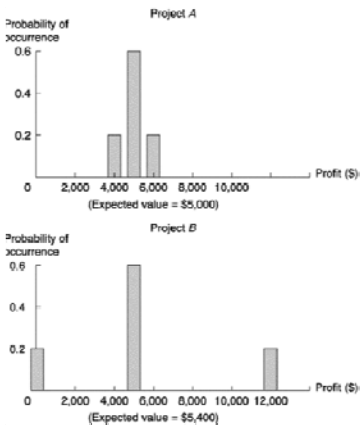
For this example:

	Economy	p_i	π_i	$p_i \times \pi_i$
Project A	Recession	0.2	4000	800
	Normal	0.6	5000	3000
	Boom	0.2	6000	1200
	sum	1.0		5000
Project B	Recession	0.2	0	0
	Normal	0.6	5000	3000
	Boom	0.2	12000	2400
	sum	1.0		5400

Probability Distribution

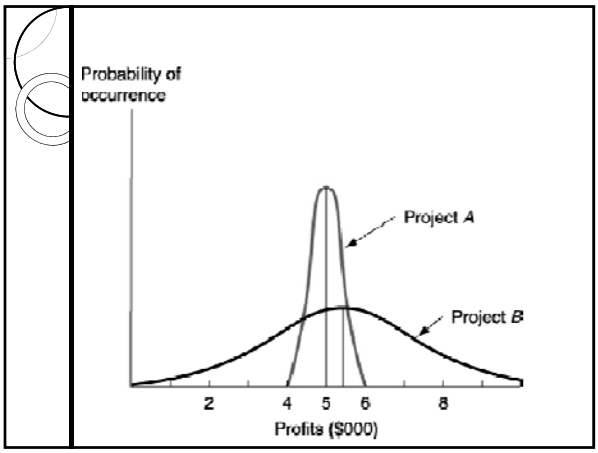
The results from the previous table can also be illustrated using a bar chart (histogram).

Charts are a useful way to understand the shape of the probability density function (pdf)



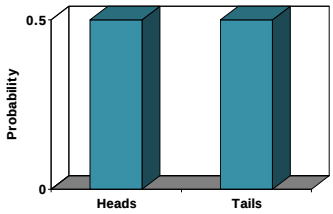
Probability Distribution

When viewed this way it is obvious that while alternative B has a higher expected profit, it also has greater uncertainty (that is the distribution is considerably "wider").

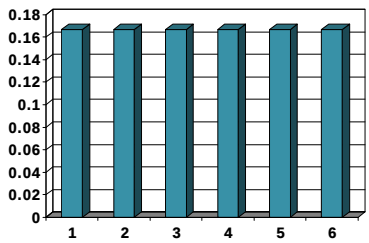


Understanding the Distribution

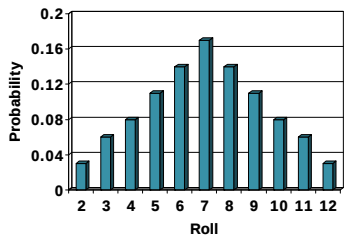
We all have experience with probability distributions. Take for example, a coin toss:



Rolling a Single Die



Rolling the Dice



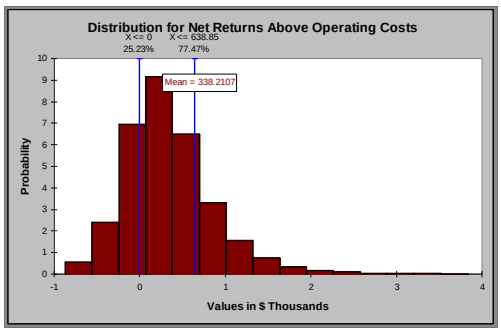
Developing a PDF

A probability density function can be developed for most series, whether they are prices, yields, or sales.

You simply have to put together a histogram to get an idea of the shape of the distribution.

An Idaho Example

Net returns for fresh market potatoes



Absolute Risk Measurement

The mean of a distribution is what most people think of when they consider (for example) what prices they may pay or receive.

The mean doesn't tell us about the absolute risk associated with a decision however. For that we need the standard deviation.

Absolute Risk Measurement

The standard deviation of a series is computed as the square root of the variance.

$$\text{Variance} = \sigma^2 = \frac{\sum_{i=1}^{n} [x_i - \bar{x}]^2}{n-1}$$

Standard Deviation

From our previous example, we find that the standard deviation of alternative A is 632.46 while the standard deviation for B is 3826.23.

Thus, though B has a higher mean, it also has a much higher standard deviation (as illustrated by the graphs).

Coefficient of Variation

Standard deviation is not the best measure for comparing alternatives however.

Standard deviation is relative to the mean and therefore *not scale-free*.

That is, you cannot use it to compare alternatives with large differences in their means

Coefficient of Variation

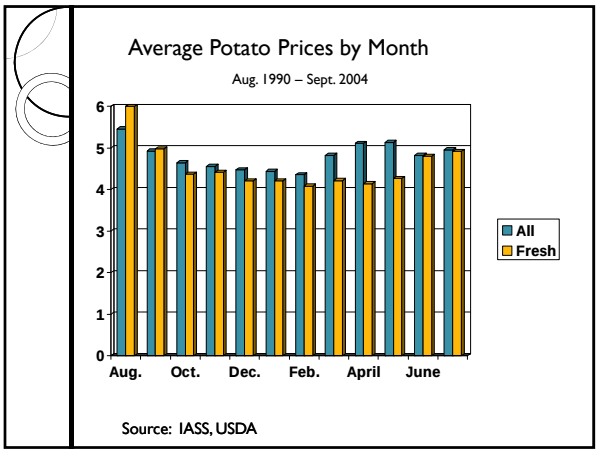
The coefficient of variation provides a scale-free measure of risk.

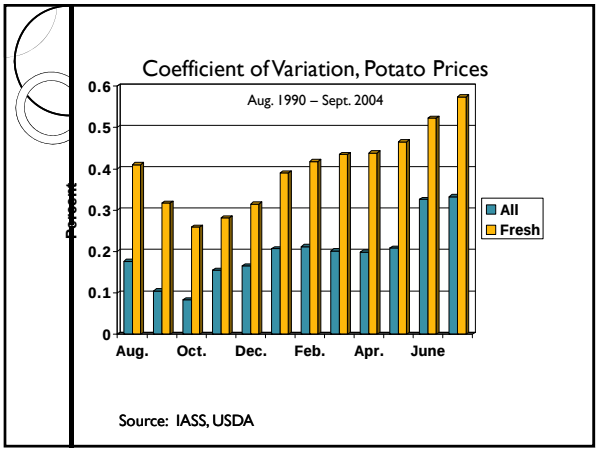
$$\text{Coefficient of Variation} = \frac{\sigma}{\mathrm{E}(\pi)}$$

In general, the coefficient of variation is calculated by dividing the standard deviation by the mean.

Coefficient of Variation

Because it is divided by the mean, the coefficient of variation is a percentage measure and can be compared across activities with very different means.





Standard Normal Concepts

Though not always an accurate portrayal of historic variation, the normal distribution is a way people often view risk.

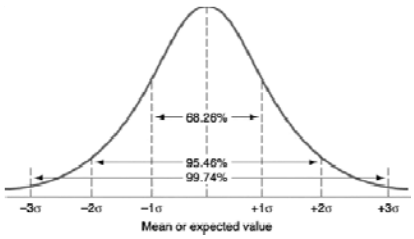
The normal distribution is continuous with a symmetrical dispersion about the mean.

Standard Normal Concepts

The mean plus or minus 1 standard deviation encompasses 67% of the area under a normal distribution.

Plus or minus 2 standard deviations increases this to 95%, and 3 to 99%

Probability Ranges for a Normal Distribution



Standardized Variables

The distribution of any variable can be standardized so that it has a mean of zero and a standard deviation of 1.

$$z = \frac{x - \mu}{\sigma}$$

Here μ and σ are the mean and standard deviation of the series in question and x is any observation of interest.

Standardized Variables

Using this formula if z = 1, this would indicate that x is exactly one standard deviation away from the mean.

The probability of any occurrence more than 2 standard deviations from the mean is slim, more than three… near zero.

Attitudes Toward Risk

As we have indicated previously, economists generally assume that people fall into one of three categories:

- Risk averse
- Risk neutral
- Risk loving

Attitudes Toward Risk

Risk averse

A risk averse individual will seek to avoid or minimize risk exposure

Risk neutral

A risk neutral individual focuses on expected returns (means) and is not concerned with dispersion around the mean.

Attitudes Toward Risk

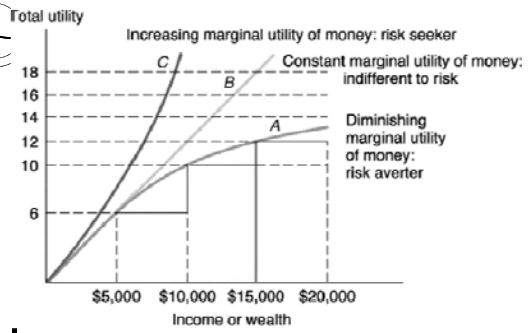
Risk Loving

A risk loving individual prefers risk and given the same expected return would choose the alternative with the highest coefficient of variation.

Relation Between Money and Utility

Risk aversion is based on the notion of diminishing marginal utility for money.

For a risk neutral individual the marginal utility for money is constant.



Valuation under Risk

When adjusting values for risk exposure, the certainty equivalent is useful standard.

A certainty equivalent is the amount under certainty that a decision maker regards as comparable to the expected value of a risky investment.

Certainty Equivalent

Suppose you face the following choices:

1. Invest 100,000 if you are successful you receive 1,000,000 if not, you receive 0, the probability of either outcome is 50%
2. Keep the 100,000

If you are indifferent, then your certainty equivalent is $100,000