4.1: Risk

To prepare for this lecture, read Hirschey, chapter 16, 631 – 644

Hirschey lists 11(!) "General risk categories":
(Cross listed with Buehler & Pritsch's taxonomy[1])

Business risk (Operational)
Market risk (Market)
Inflation risk (Market)
Interest rate risk (Market)
Credit risk (Credit)
Liquidity risk (Market)
Derivative risk (Market)
Cultural risk (Operational)
Currency risk (Market)
Government policy risk
Expropriation risk

A more manageable taxonomy might include only 4:

<u>Market risk</u>
Exposure to adverse price movements

<u>Credit risk</u>
Exposure to failures to honor contractual obligations

<u>Operational risk</u>
Exposure to losses due to inadequate internal controls

<u>Business volume risk</u>
Exposure to revenue volatility due to changes in demand and/or supply

In truth, no such taxonomies are perfect and comprehensive.

Measurement of Risk: Mean-Variance Approach
The standard approach to measuring risk is to look at past data on a variable and calculate measures of central tendency (mean, median, etc.) and dispersion (variance, standard deviation, etc.). This approach is known as the mean-variance method. We will consider three metrics for measuring risk in this way:

1. Expected Value $$E[x] = \sum_x \Pr(x)x$$

[1] Buehler, Kevin S. and Gunnar Pritsch, "Running with risk." *McKinsey Quarterly*, 2003, Number 4, 40 – 49.

2. Standard Deviation $\sigma_x = \sqrt{\sum_x (x - E[x])^2 \Pr(x)}$

3. Coefficient of Variation $cv_x = \sigma / E[x]$

Economic Meaning of Risk Aversion

In general, economists employ two approaches to the definition of ***risk aversion*** (conversely, ***risk tolerance***):

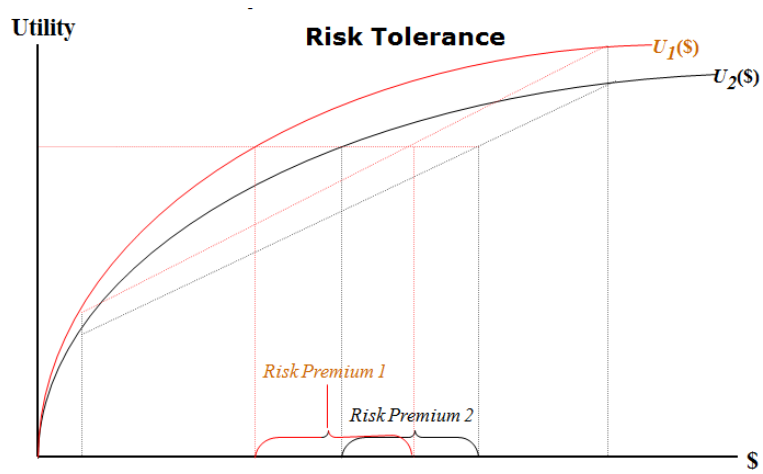
1. <u>Choices in terms of mean-variance</u>
   Given a choice between two options with equal expected values and different standard deviations, a risk averse person will choose the option with the lower standard deviation (and where $\succ$ may be read as "is preferred to"):

$$If\ E[X_1] = E[X_2],\ and\ \sigma_1 < \sigma_2,\ then\ 1 \succ 2$$

   Furthermore, given a choice between two options with equal standard deviations and different expected values, a risk-averse person will choose the option with the higher expected value:

$$If\ \sigma_1 = \sigma_2,\ and\ E[X_1] > E[X_2],\ then\ 1 \succ 2$$

2. <u>Nonlinearity in the utility of wealth or income</u>
   In general, a risk averse person is someone who is willing to pay a risk premium for the removal of risk. The general idea behind this concept and the non-linearity of wealth or income is usually summarized with a diagram such as this:



Risk Premium 1 > Risk Premium 2 : *Agent 1 is more risk averse than Agent 2*
Agent 2 is more risk tolerant than Agent 1

Relevant Textbook Problems: 16.4, 16.5