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:

- Market risk
  Exposure to adverse price movements
- Credit risk
  Exposure to failures to honor contractual obligations
- Operational risk
  Exposure to losses due to inadequate internal controls
- Business volume risk
  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

\[ E[x] = \sum_{i} Pr(x_i) x_i \]

2. Standard Deviation

\[ \sigma_x = \sqrt{\sum_{x} (x - E[x])^2 Pr(x)} \]

3. Coefficient of Variation

\[ CV_x = \frac{\sigma}{E[x]} \]

**Economic Meaning of Risk Aversion**

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

1. **Choices in terms of mean-variance**
   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 \( > \) 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. **Nonlinearity in the utility of wealth or income**
   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:

   ![Diagram of Utility vs. Risk Tolerance](image)

   - 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