

Risk & Public Private Partnerships

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What is risk?

Medicine: “Risk Factors”

- ◆ Risk factor: Something that increases a person's chances of developing a disease.
(from www.medterms.com/)
- ◆ Defined relative to some baseline (e.g., healthy adult females)
- ◆ Examples: Smoking, obesity, exposure to asbestos

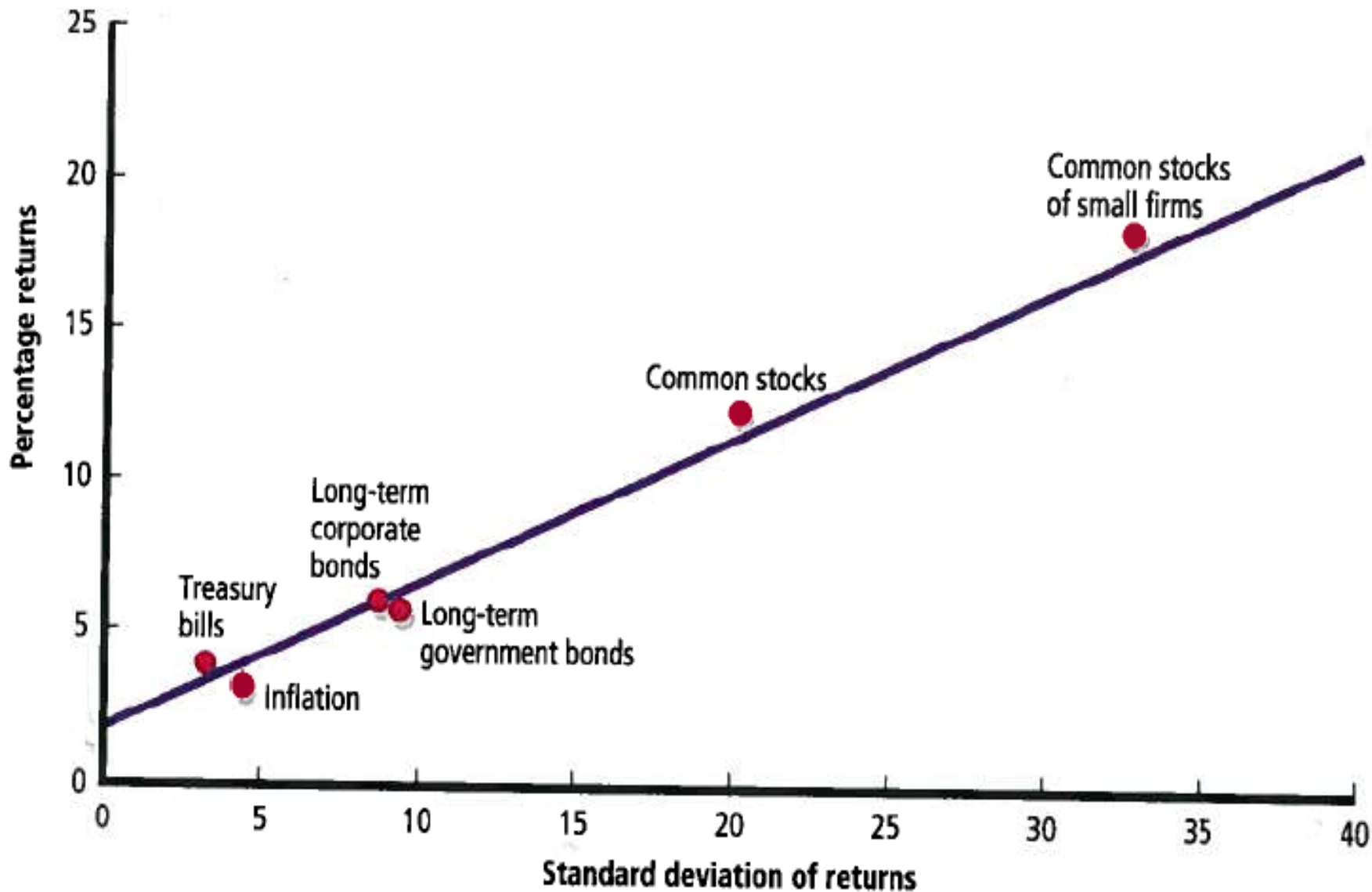
Risk in Engineering

- ◆ Risk in engineering is given as the probability of an outcome multiplied by the consequences of that outcome.
- ◆ Often: (probability)*(consequence)
- ◆ But we need more – Full PDF/CDF of consequences is important!
- ◆ *We describe risk by the probability distribution of losses.*

Risk in Business

危 機

Risk – Return



Two Important Points

- **Need to have measure for uncertainty**
- **Need to have measure for consequences**

Risk Consists of:

1. What can go wrong (scenarios)?
2. With what probability?
3. With what consequences?

Some Consequences in Project Management

1. Schedule “slippage” (**Schedule Risk**)
2. Cost overrun (**Budget Risk**)
3. Deaths and injuries (**Safety Risk**)
4. Facility doesn't meet needs (**Performance Risk**)
5. Facility fails during use (**Performance Risk**)

Let's Think About Risk

Describe some of the risks you face in managing your projects – list some consequences of different outcomes and some things you could do to manage those possibilities.

Different Approaches for Managing Risk

1. Pass it off to someone else
 - ❑ The domain of insurance and contracting
 - ❑ Doesn't change outcome probabilities or consequences (generally)
2. Reduce probability and/or consequences of events
 - ❑ Doesn't necessarily reallocate risk
 - ❑ Reduces overall risk (when done well)

Objective of Risk Analysis

- ◆ To provide basis for comparing alternatives
- ◆ Example: What are the schedule and budget risks associated with a traditional (design-bid-build) approach vs. (design-build) approach?

Analysis Procedure

1. Figure out what could go wrong (*hazard identification*)
2. Figure out what would happen next (*event propagation*)
3. Figure out what the outcomes would be (*consequence calculation*)
4. Consider risk level & what you can/should do about it (*Risk Assessment & Mitigation*)

“Event Tree”



<u>Outcome</u>	<u>Probability</u>
500k	0.005
900k	0.010
1M	0.070
1.4M	0.06
1.5M	0.855

Expected Value: \$1.448M

What is a Decision?

A decision is a choice between alternatives that involves an irrevocable allocation of resources.

- ◆ No choice?
Not a decision.
- ◆ No irrevocable allocation of resource?
Not a decision.

Do the following statements represent decisions?

- ◆ I've decided the sky is blue.
- ◆ I've decided that I deserve an A in 349.
- ◆ I've decided to mow the lawn today.
- ◆ I've decided to give you all an A in this course.
- ◆ I've decided that the framing crew needs more help so I am hiring two day laborers to help them.
- ◆ I've decided that we should buy a two story house rather than a single story house.

What Makes Decisions Hard?

1. Complexity – many issues to organize
2. Uncertainty about outcomes
3. Multiple objectives to consider

Uncertainty Example

- ◆ Assume you are managing the construction of the arena.
- ◆ Some sources of uncertainty:
 - ◆ Time required for different tasks
 - ◆ Material delivery dates
 - ◆ Cost of materials
 - ◆ Weather
 - ◆ Labor strikes/labor shortages
 - ◆ Etc.

Examples of Multiple Objectives

- ◆ Multiple objectives can [and often do] conflict
- ◆ Examples of objectives with the arena example:
 - ◆ Maximize long-term profit
 - ◆ Maximize comfort for audience
 - ◆ Maximize number of seats
 - ◆ Minimize construction cost
 - ◆ Maximize architectural impact
 - ◆ Maximize # of construction jobs given to local citizens
 - ◆ Etc.

What is Decision Analysis?

- ◆ *A normative, quantitative method for helping decision-makers make better decisions.*
- ◆ Involves analyzing uncertainties, alternatives, and preferences.
- ◆ Historically based in economics, but used very widely (engineering, business, military, medicine, forestry, etc.)

Normative vs. Descriptive

- ◆ Descriptive: The way things are
- ◆ Normative: The way things should be

- ◆ DA is ***Normative***: DA is the way decisions “should” be made (assuming you follow certain axioms...)

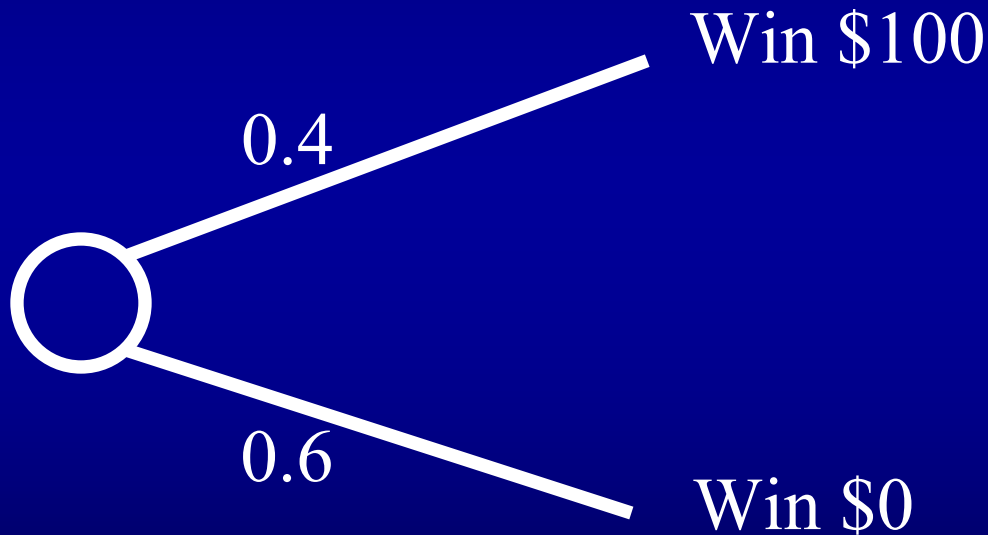
What is a Good Decision?

- ◆ The one that gives the best outcome?
- ◆ An example:
 - ◆ You bet your entire net worth on a single roll of a pair of dice. If a 2 (1-1) is rolled, you double your net worth. If anything else is rolled you lose everything. A 2 is rolled – you win.
 - ◆ Did you make a good decision?

Lucky Outcome vs. Good Decision

- ◆ You can make a good decision and have an unlucky outcome.
- ◆ You can make a bad decision and have a lucky outcome.
- ◆ A good decision is one in which you consider your preferences, your information, and your alternatives in an organized, logical way.
- ◆ In the long-run, good decisions maximize your chances of getting good outcomes.

A "Lottery"



How much would you pay for this lottery?

Performance Contracts

- ◆ Government Motivation:
 - ◆ Budget limitation, but need for services
 - ◆ Stimulate private sector development
 - ◆ Long-term (better) planning
 - ◆ Fight inefficiencies (bureaucracy?)
- ◆ Private Sector Motivation:
 - ◆ New projects – opportunities in what you do best

Typical Form

- ◆ Who pays for initial capital investment?
 - ◆ Private Sector (gets a loan from bank)
- ◆ How it gets compensated?
 - ◆ Periodic payments for services by government
- ◆ What is the criteria for payments?
 - ◆ Performance standards

Examples

- ◆ Energy performance-based contracts
 - ◆ New HVAC, building envelope, etc.
- ◆ Infrastructure operation/maintenance services contracts
 - ◆ Trash collection
 - ◆ Parks, streets, roads, buildings, etc. maintenance
- ◆ New services/buildings or reconstruction
 - ◆ Library, bridge, other real estate