Note on Recitation 3 (Problem Set 4) • 1.011 Project Evaluation

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Question 1.

- The $2.4 million figure is the number that the Department of Transportation uses to evaluate investment that will reduce the number of expected fatality by one. It is not the value of life. Do not try to use such statistics as average life expectancy, expected lifetime earnings, etc. to figure out the discount rate.
- When evaluating discount rates, consider the opportunity cost of money. What returns can the same money earn if it wasn't used for this project?
- Use the weighted-average cost of capital.
- If you underestimate discount rates, projects that have implications closer to the present may not get done, with drastic consequences.
- If you overestimate discount rates, project that have large implications in the future won't receive attention "until it's too late".
- For public projects, consider your funding sources: bonds at 4%, taxpayers at perhaps 10%.
- Do not change the rate to suit the project!
- You must evaluate all alternatives with the same discount rate, whatever you choose it to be.

The environmentalist's argument that discount rates should be low is not a valid argument for doing the environmental projects now. The correct argument is that the cost of mitigating the environmental damage, if not attended to now, would grow at a rate that is faster than the discount rate.

We do not discount lives. We discount investment – money is money. To prevent the life loss, it doesn't matter if we invest now or invest just before the toxic plume hits the water supply. The difference is in the amount of that investment.

Question 2.

Many of you listed many ways to filter the water or to find alternative water supply. However, you can also stop the toxic dump from being dumped in the first place; you can simply warn everyone; you can move the town. These are all valid alternatives. Do not become too focused in the engineering solutions. Other (social) solutions are possible, such as educating the population about the dangers.

Question 3.

- Be aware of "legal costs". Values assigned by the court often have no basis, and are not good valuations of either the risk or the consequences of inaction. Instead, societal costs should be considered.
- Quantitative estimates of the number of deaths are required.
- What about non-lethal injuries?
- Consider the context of the ten deaths, or indeed the thousand deaths. How many people were killed in the Second World War? How many people were killed in the World Trade Center bombing? If hundred deaths could be prevented in the next ten years through better fire inspections of nightclubs (versus the ten deaths sixty year later you would prevent by implementing the multi-million toxic mitigation program), which one is more cost-effective? (i.e. more deaths prevented per dollar spent?)

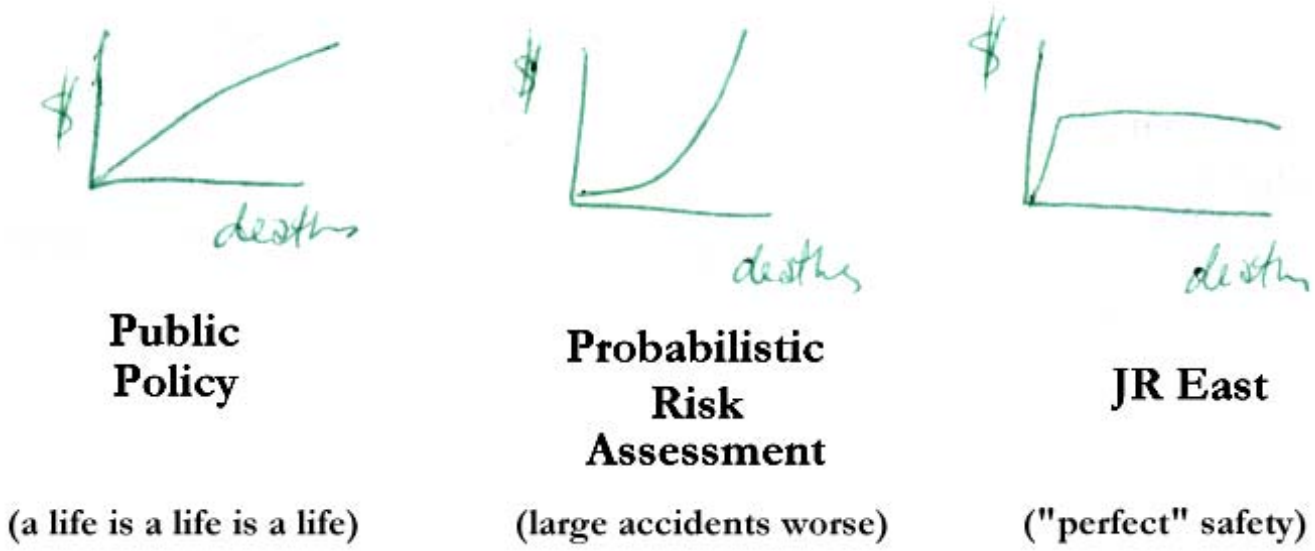
Disaster Grid

Deaths	**1**	**10**	**100**	**1000+**
Events	Shooting Sniper Lightening Bolt Allegric Reaction Rabid Dog	Storm Terrorist Bomb (e.g. Bus) Turnpike Pile-up	Heatwave Fire in Nightclub Plane Crash (e.g. 737)	Terrorist Missile (e.g. WTC) War Mid-Air Collision (2* Boeing 747's) Meteor Sunk Ocean Liner (e.g. Titanic)

When considering the death of ten due to a toxic plume incident, it is important to see those ten deaths in context. Consider the expected number of deaths, then consider the probability of such an incident occurring.

Valuation of Deaths – Risk Profiles

If you are curious about this chart, ask me questions:



Note on Risk and Expected Values

There are two ways to evaluate the risk: (1) given an event occurs, what are the expected losses of life; (2) what is the expected number of events in a given time period. The evaluation of risk relates to both of these parameters.

For instance, a hundred-year flood is a flood which you expect to happen only once in every 100 years. This does not necessarily mean that you cannot have two "hundred-year-floods" between 1900 and 2000. It means that floods of such severity occur on average every hundred years.

Given that a hundred-year-flood has occurred, sometimes, nobody would die because the flood occurred off the coast of Newfoundland where nobody lives. Other times, the flood would occur in downtown Manhattan, and lots of people would drown. Even if the flood occurs in downtown, the death toll is still probabilistic: if the flood occurs on a Sunday, probably not as many would drown as if it occurred on a Weekday at lunchtime.

Thus, when comparing risks, you need to consider both elements. In essence, you are trying to determine the probability that one loss of life would occur due to a particular type of event. Thus:

E(person-deaths this year due to flood) =
E(number of 100-year-floods that will occur this year) *
E(number of deaths resulting from the 100-year-flood)

E(x) = Expected Value of x.

$$\mathrm{E}X = \int_{\Omega} X\,dP$$

(For more information, see http://www.wikipedia.org/wiki/Expected_value)

List of Environmental Technologies

You can pull off sample costs of different technologies that you could use to mitigate a toxic plume off the web. Jodie sent us this example, as part of her investigation into ways of dealing with Brownfields (contaminated land):

Emerging Construction Technologies

Soil Remediation

Fact Sheets

- Funnel and Gate System
- In Situ Enhanced Soil Mixing
- In Situ Remediation using Horizontal Wells
- Jet-Grouting Constructed Laminar Diaphragms
- Glass Diaphragm Walls
- Extraction of Contaminated Soils using High Pressure Jet Grouting Techniques
- Hydraulic and Pneumatic Fracturing for In Situ Remediation
- In Situ Vitrification (ISV)
- Plasma Torch - Soil and Waste

Best Links

- Web Sites
- Literature
- Conferences

Water/Waste Systems

Fact Sheets

- Chemical Cleaning Process for Potable Water Pipes

Best Links

- Web Sites
- Literature

Thank you, Jodie!

http://www.new-technologies.org/ECT/Other/other.htm