MANAGERIAL ECONOMICS CHAPTER 2

FUNDAMENTAL ECONOMIC CONCEPT

Fundamental Economic Concepts

Chapter 2

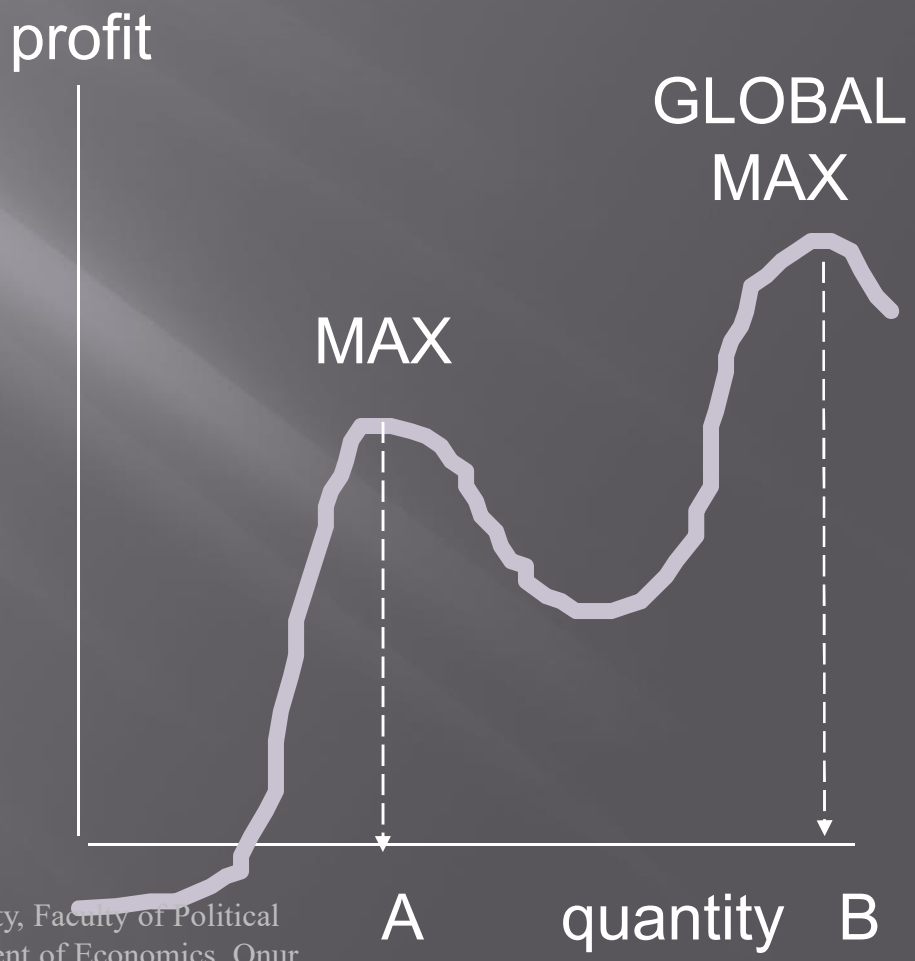
- Total, Average, and Marginal
- Finding the Optimum Point
- Present Value, Discounting & NPV
- Risk and Uncertainty
- Risk-Return & Probability
- Standard Deviation & Coefficient of Variation
- Expected Utility & Risk-Adjusted Discount Rates
- Use of a z-value

How to Maximize Profits

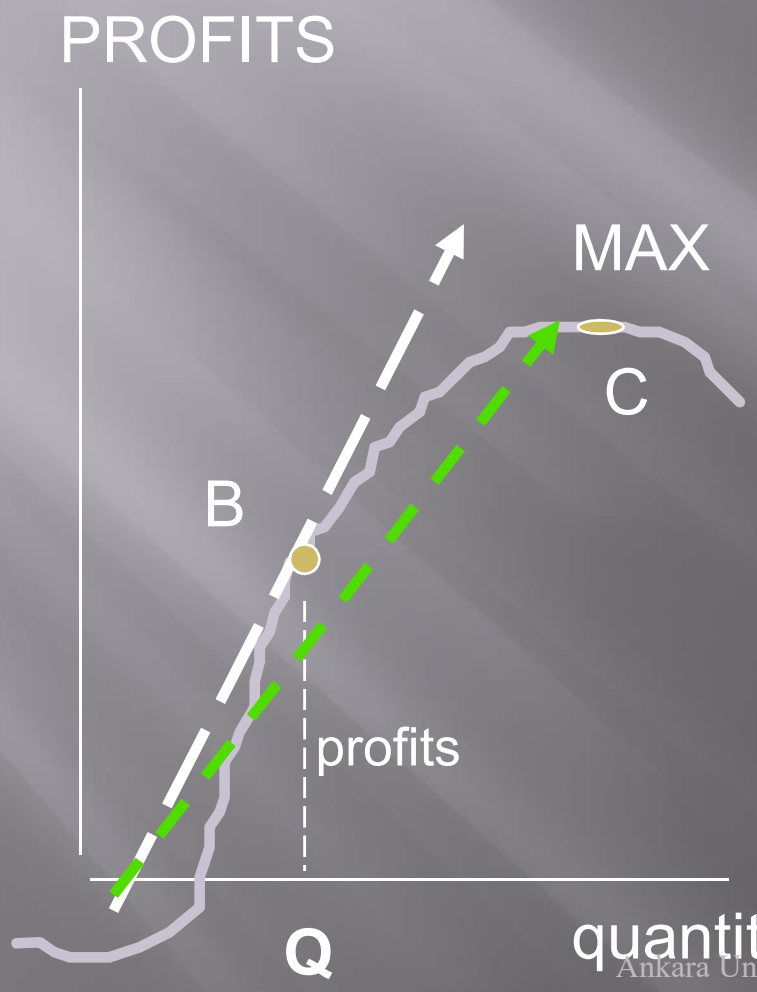
- Decision Making **Isn't** Free
  - Max Profit { A, B}, but suppose that we don't know the Profit {A} or the Profit {B}
  - Should we hire a consultant for $1,000?
- Should we market an *Amoretto* Flavored chewing gum for adults?
  - complex combination of marketing, production, and financial issues

Break Decisions Into Smaller Units: How Much to Produce ?

- Graph of output and profit
- *Possible* Rule:
  - Expand output until profits turn down
  - But problem of local maxima *vs.* global maximum



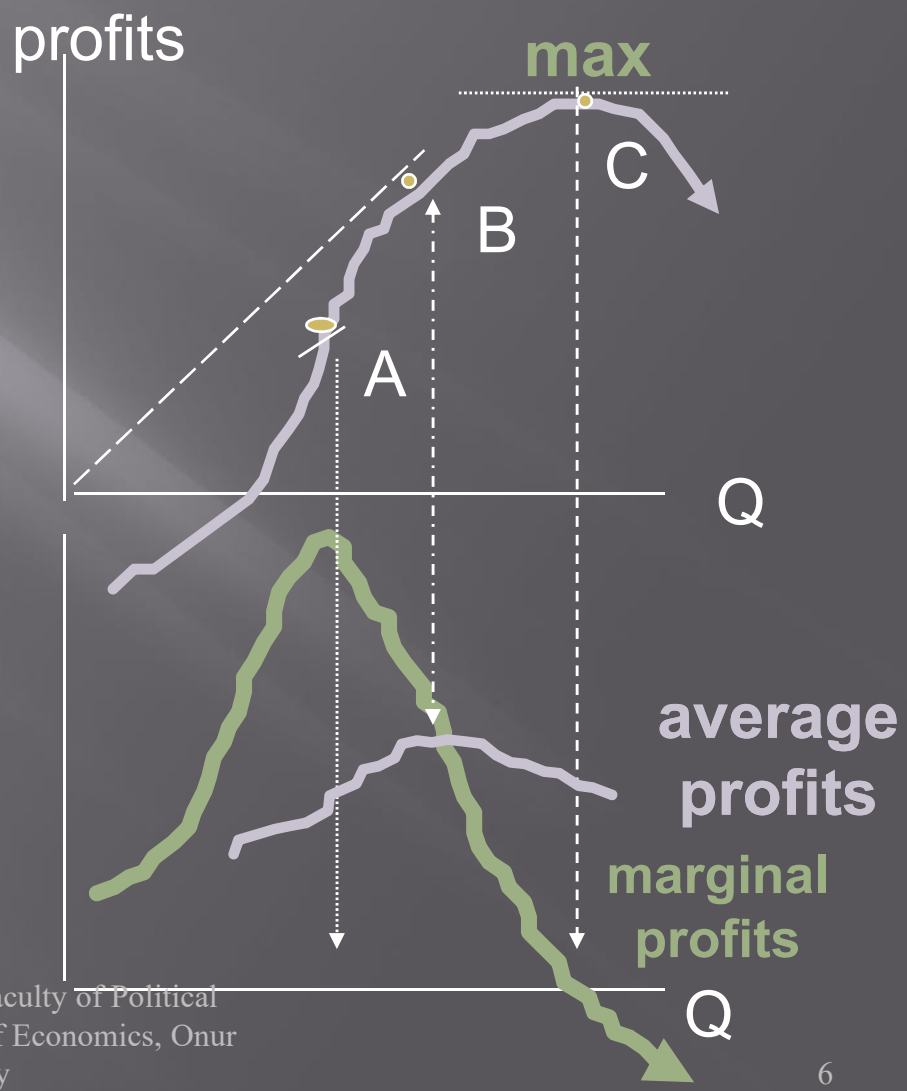
Average Profit = Profit / Q



- Slope of ray from the origin
  - Rise / Run
  - Profit / Q = average profit
- Maximizing **average profit** doesn't maximize **total profit**

Marginal Profits = $\Delta\Pi/\Delta Q$

- profits of the last unit produced
- maximum marginal profits occur at the inflection point (A)
- **Decision Rule:** produce where marginal profits = 0.



Using Equations

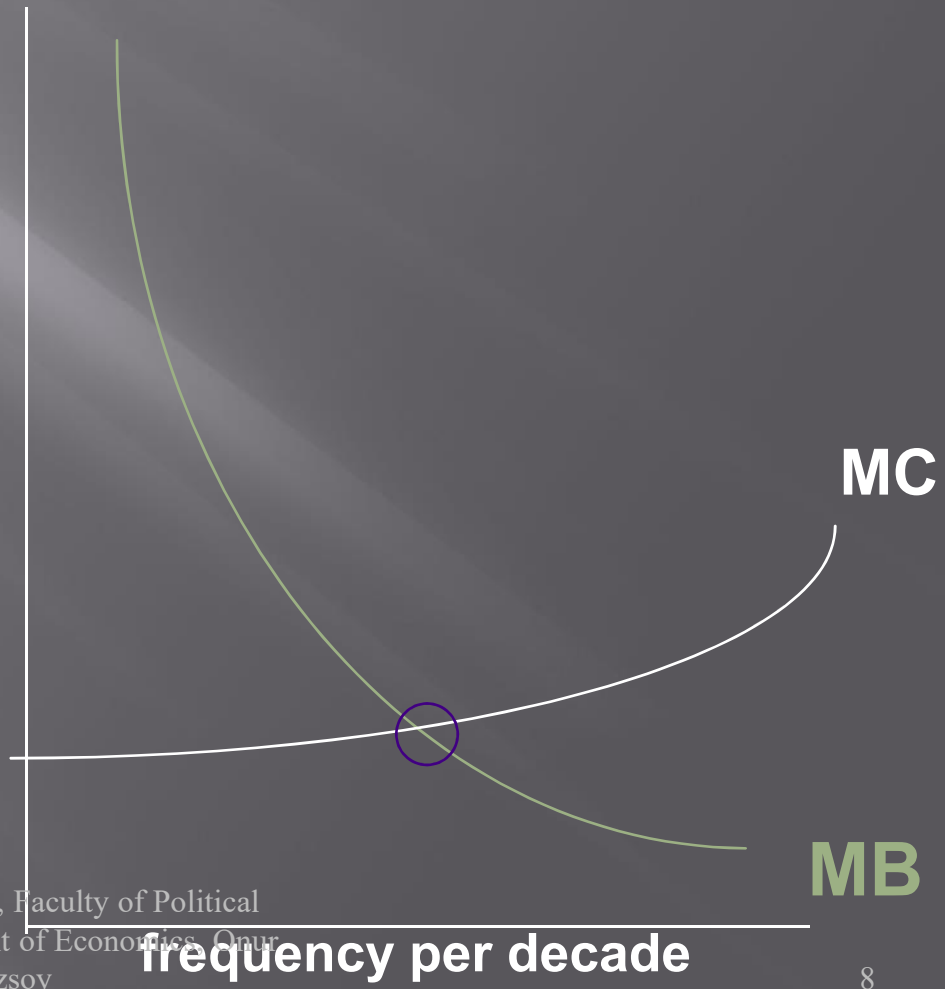
- profit = f(quantity) or
- $\Pi = f(Q)$
  - dependent variable & independent variable(s)
  - average profit = Π/Q
  - marginal profit = $\Delta\Pi / \Delta Q$

Optimal Decision (one period)
example of using marginal reasoning

- The scale of a project should expand until
- MB = MC

Example: screening for prostate or breast cancer

- How often?



Present Value

- Present value recognizes that a dollar received in the future is worth less than a dollar in hand today.
- To compare monies in the future with today, the future dollars must be discounted by a *present value interest factor*, **PVIF= 1/(1+i)**, where **i** is the interest compensation for postponing receiving cash one period.
- For dollars received in *n* periods, the discount factor is $\mathbf{PVIF_n = [1/(1+i)]^n}$

- ***Net Present Value***
  - **NPV** = Present value of future returns *minus* Initial outlay.
  - This is for the simple example of a single cost today yielding a benefit or stream of benefits in the future.
- For the more general case, NPV = Present value of all cash flows (both positive and negative ones).
- **NPV Rule**: Do all projects that have positive net present values. By doing this, the manager **maximizes shareholder wealth**.
- Some investments may increase NPV, but at the same time, they may increase risk.

Net Present Value (NPV)

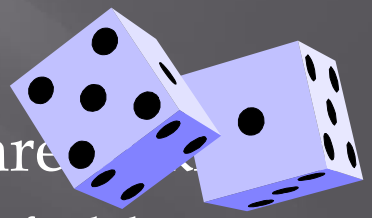
- Most business decisions are long term
  - capital budgeting, product assortment, etc.
- Objective: max the present value of profits
- NPV = PV of future returns - Initial Outlay
- $NPV = \Sigma_{t=0} NCF_t / (1 + r_t)^t$
  - where NCF_t is the net cash flow in period t
- Good projects have
  - High NCF's
  - Low rates of discount

Sources of Positive NPVs

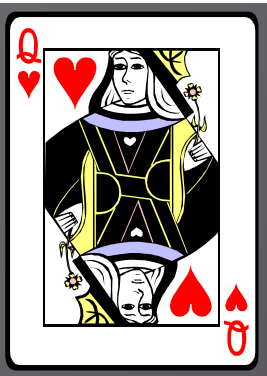
- Brand identify and loyalty
- Control over distribution
- Patents or legal barriers to entry
- Superior materials
- Difficulty for others to acquire factors of production
- Superior financial resources
- Economies of large scale or size
- Superior management

Risk and Uncertainty

- Most decisions involve a gamble
- Probabilities can be known or unknown, and outcomes can be known or unknown
- **Risk** -- exists when:
  - Possible outcomes and probabilities are known
  - *e.g.,* Roulette Wheel or Dice
- **Uncertainty** -- exists when:
  - Possible outcomes or probabilities are unknown
  - e.g., Drilling for Oil in an unknown field



Concepts of Risk



- When probabilities are known, we can analyze risk using **probability distributions**
  - Assign a probability to each state of nature, and be **exhaustive**, so that $\Sigma p_i = 1$

Strategy	States of Nature: Recession p = .30	Economic Boom p = .70
Expand Plant	- 40	100
Don't Expand	- 10	50

Payoff Matrix

- Payoff Matrix shows payoffs for each state of nature, for each strategy
- **Expected Value** = $\hat{r} = \Sigma\ r_i\ p_i$.
- $\hat{r} = \Sigma\ r_i\ p_i$ = (-40)(.30) + (100)(.70) = 58 if Expand
- $\hat{r} = \Sigma\ r_i\ p_i$ = (-10)(.30) + (50)(.70) = 32 if Don't Expand
- Standard Deviation = $\sigma = \sqrt{\Sigma\ (r_i - \hat{r})^2 . p_i}$

Example of Finding Standard Deviations

σ_{expand} = SQRT{ (-40 - 58)^2(.3) + (100-58)^2(.7)} = SQRT{(-98)^2(.3)+(42)^2 (.7)} = SQRT{ 4116} = **64.16**

$\sigma_{don't}$ = SQRT{(-10 - 32)^2 (.3)+(50 - 32)^2 (.7)} = SQRT{(-42)^2 (.3)+(18)^2 (.7) } = SQRT { 756} = **27.50**

Expanding has a greater standard deviation, but higher expected return.

Coefficients of Variation or Relative Risk

- **Coefficient of Variation** (C.V.) =

  - C.V. is a measure of risk per dollar of expected return.

- The discount rate for present values depends on the risk class of the investment.
  - Look at similar investments
    - Corporate Bonds, or Treasury Bonds
    - Common Domestic Stocks, or Foreign Stocks

Projects of Different Sizes:

If double the size, the C.V. is not changed!!!

Coefficient of Variation is good for comparing projects of different sizes

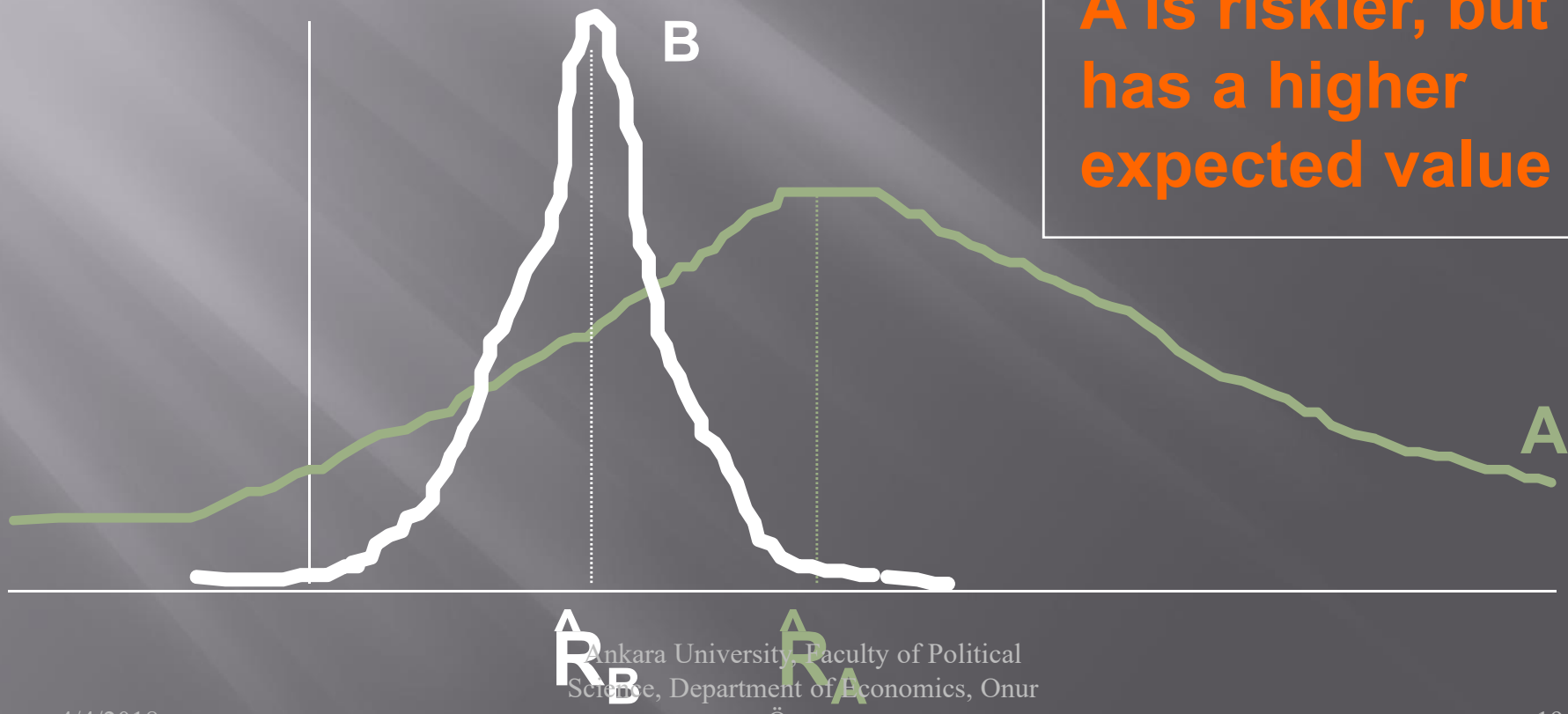
Example of Two Gambles

A:	Prob	X	}	R = 15
	.5	10	}	σ = SQRT{(10-15)^2(.5)+(20-15)^2(.5)]
	.5	20	}	= SQRT{25} = 5
				C.V. = 5 / 15 = .333

B:	Prob	X	}	R = 30
	.5	20	}	σ = SQRT{(20-30)^2 ((.5)+(40-30)^2(.5)]
	.5	40	}	= SQRT{100} = 10
				C.V. = 10 / 30 = .333

Continuous Probability Distributions (*vs.* Discrete)

- Expected valued is the mode for symmetric distributions



A is riskier, but it has a higher expected value

What Went Wrong at LTCM?

- **Long Term Capital Management** was a 'hedge fund' run by some top-notch finance experts (1993-1998)
- LTCM looked for small pricing deviations between interest rates and derivatives, such as bond futures.
- They earned 45% returns -- but that may be due to high risks in their type of arbitrage activity.
- The Russian default in 1998 changed the risk level of government debt, and LTCM lost $2 billion

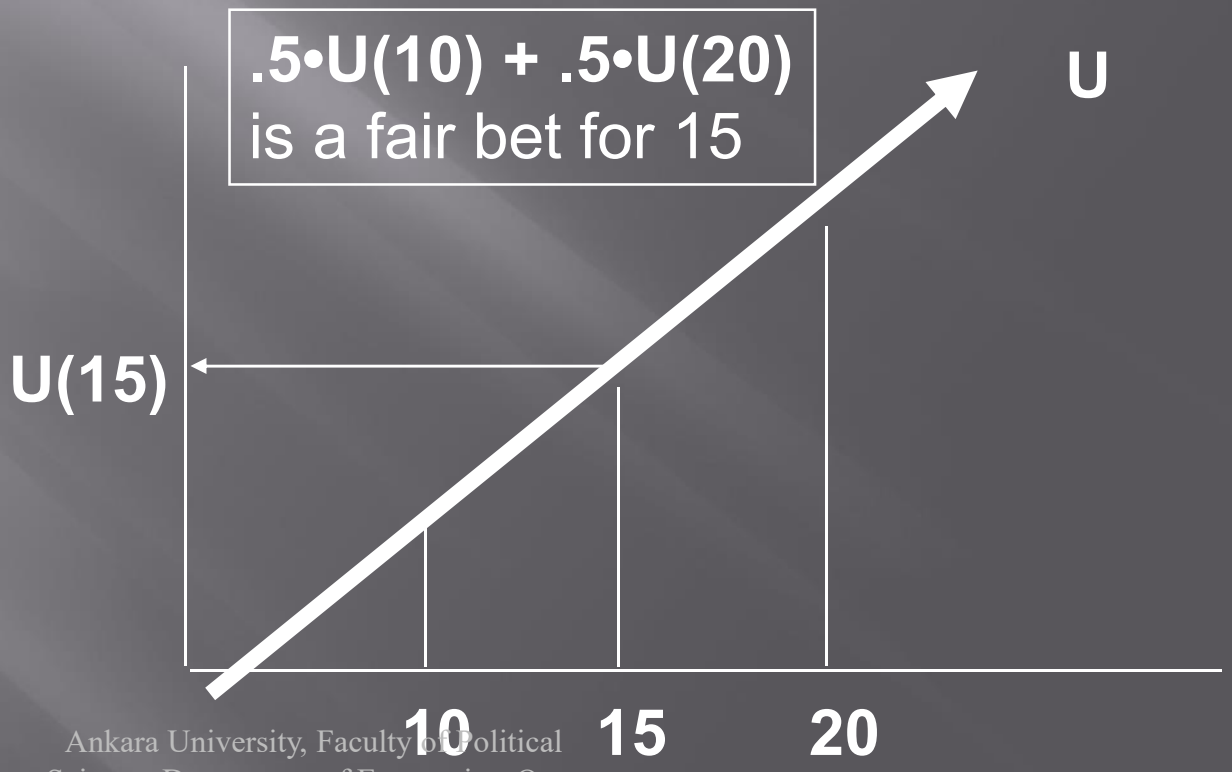
The St. Petersburg Paradox

- *The St. Petersburg Paradox* is a gamble of tossing a fair coin, where the payoff doubles for every consecutive head that appears. The *expected monetary value* of this gamble is: $\$2\cdot(.5) + \$4\cdot(.25) + \$8\cdot(.125) + \$16\cdot(.0625) + \ldots = 1 + 1 + 1 + \ldots = \infty$.
- But no one would be willing to wager all he or she owns to get into this bet. It must be that people make decisions by criteria other than maximizing expected monetary payoff.

Expected Utility Analysis to Compare Risks

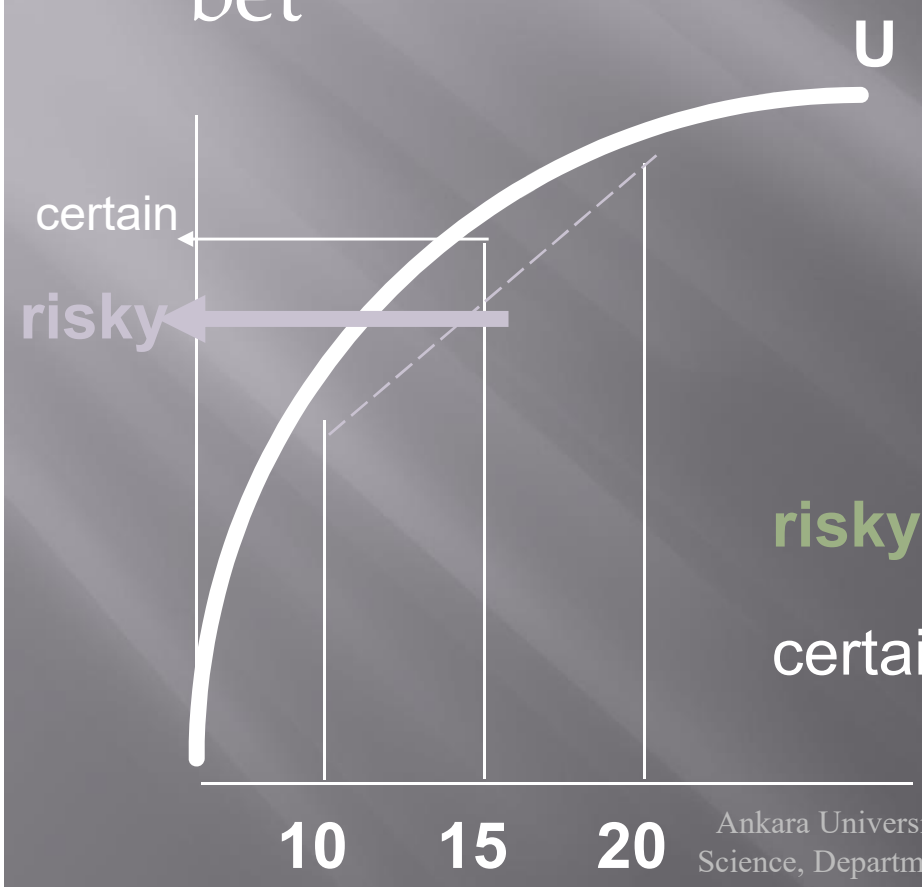
- Utility is "satisfaction"
- Each payoff has a utility
- As payoffs rise, utility rises

- Risk Neutral -- if indifferent between risk & a fair bet



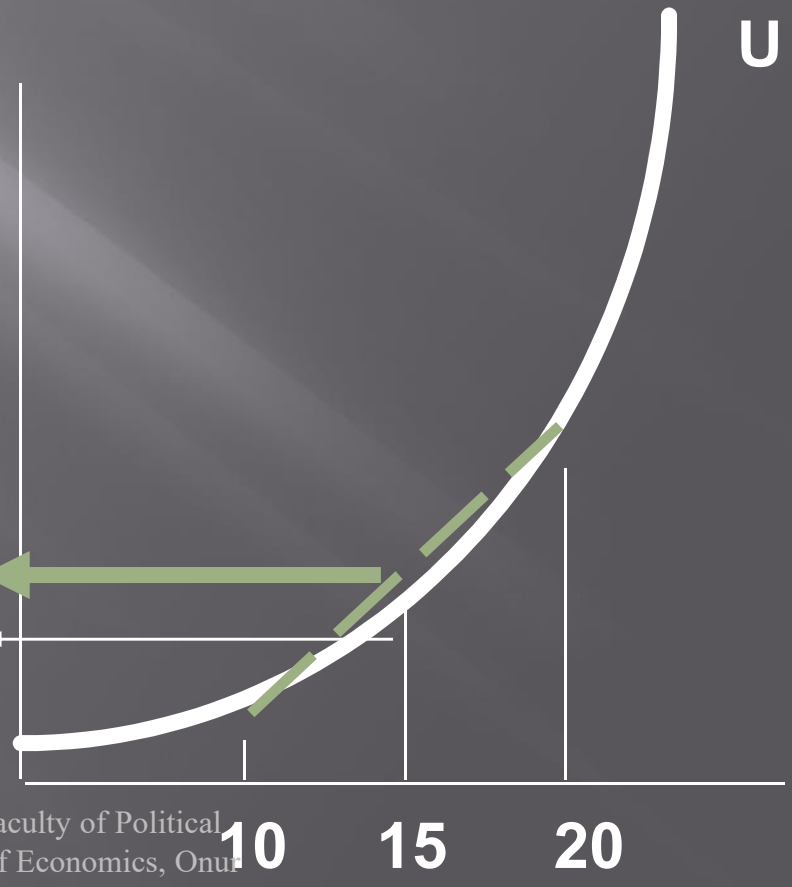
Risk Averse

- Prefer a certain amount to a fair bet



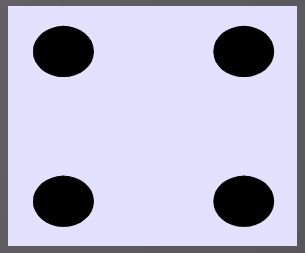
Risk Seeking

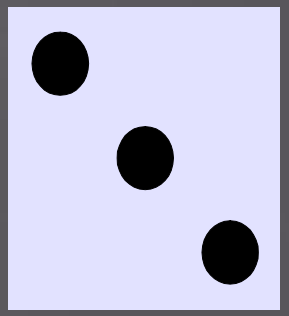
- Prefer a fair bet to a certain amount



Expected Utility: *an example*

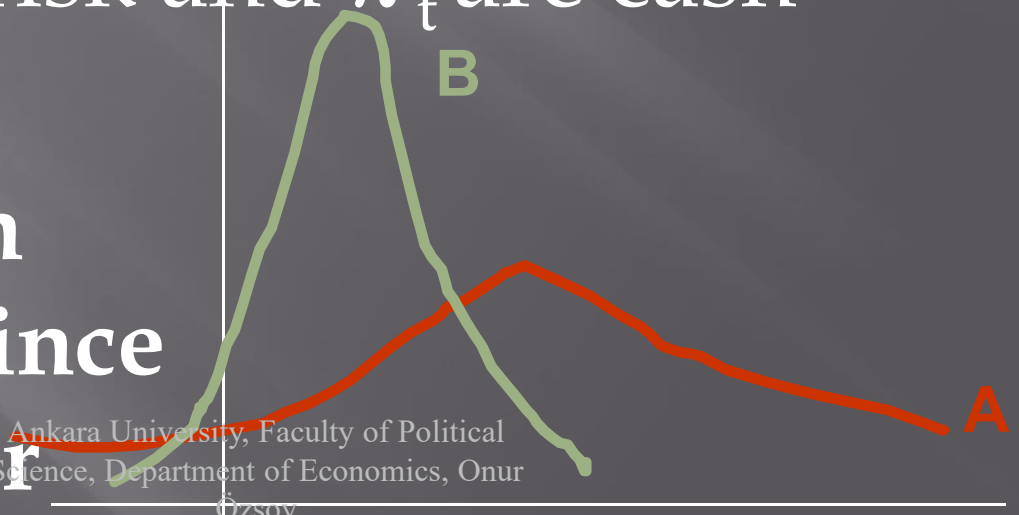
- Suppose we are given a quadratic utility function:
- $U = .09\,X - .00002\,X^2$
- **Gamble**: 30% probability of getting 100; 30% of getting 200; and a 40% probability of getting 400.
  - Versus a **certain** $150?
  - U(150) = 13.05 (plug X=150 into utility function)
- Find "Expected Utility" of the gamble
- $EU = \Sigma\, p_i\, U(X_i)$
- EU = .30(8.8) + .30(17.2) + .40(32.8) = 20.92





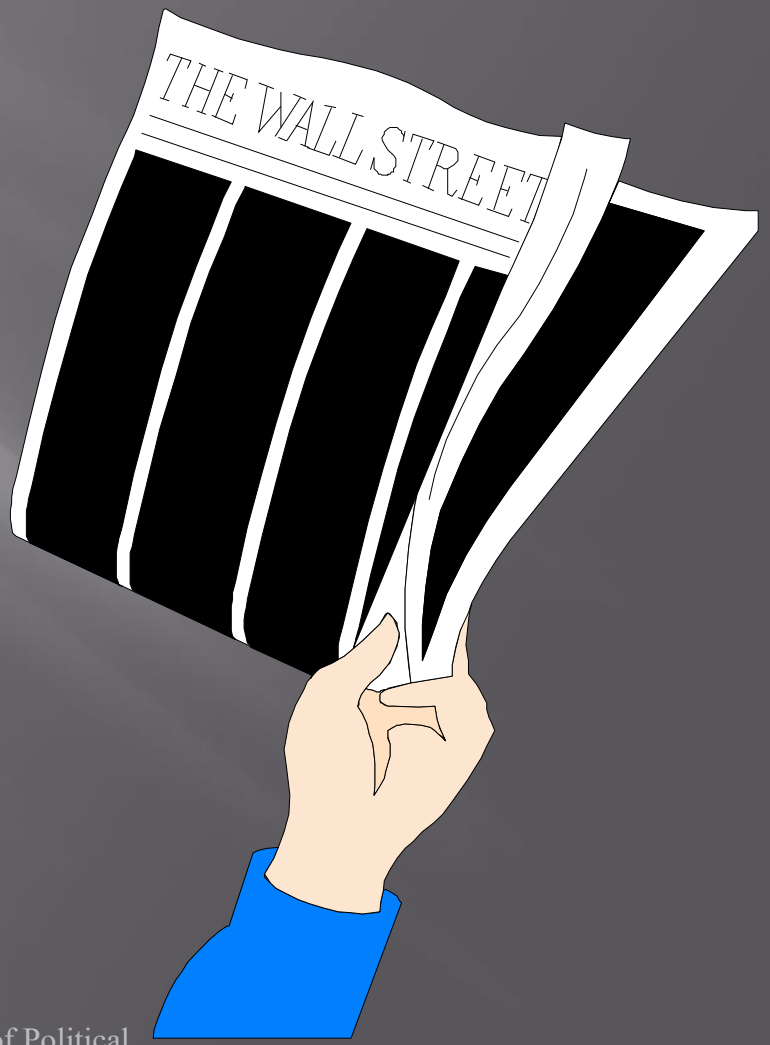
Risk Adjusted Discount Rates

- Riskier projects should be discounted at higher discount rates
- $PV = \Sigma \pi_t / (1 + \mathbf{k})^t$ where **k** varies with risk and π_t are cash flows.
- **$k_A > k_B$ as in diagram since A is riskier**



Sources of Risk Adjusted Discount Rates

- **Market-based rates**
  - Look at equivalent risky projects, use that rate
  - Is it like a Bond, Stock, Venture Capital?
- **Capital Asset Pricing Model (CAPM)**
  - Project's "beta" and the market return



z-Values

- z is the number of standard deviations away from the mean
- $z = (r - \hat{r}) / \sigma$
- 68% of the time within 1 standard deviation
- 95% of the time within 2 standard deviations
- 99% of the time within 3 standard deviations

Problem: income has a mean of $1,000 and a standard deviation of $500.

What's the chance of losing money?

Diversification

The ***expected return on a portfolio*** is the weighted average of expected returns in the portfolio.

Portfolio risk depends on the weights, standard deviations of the securities in the portfolio, and on the correlation coefficients between securities.

The risk of a two-security portfolio is:

$$\sigma_p = \sqrt{(W_A^2 \cdot \sigma_A^2 + W_B^2 \cdot \sigma_B^2 + 2 \cdot W_A \cdot W_B \cdot \rho_{AB} \cdot \sigma_A \cdot \sigma_B)}$$

- If the correlation coefficient, ρ_{AB}, equals one, no risk reduction is achieved.
- When $\rho_{AB} < 1$, then $\sigma_p < w_A \cdot \sigma_A + w_B \cdot \sigma_B$. Hence, portfolio risk is less than the weighted average of the standard deviations in the portfolio.