



Cash Flow Estimation and Risk Analysis

Estimating cash flows:

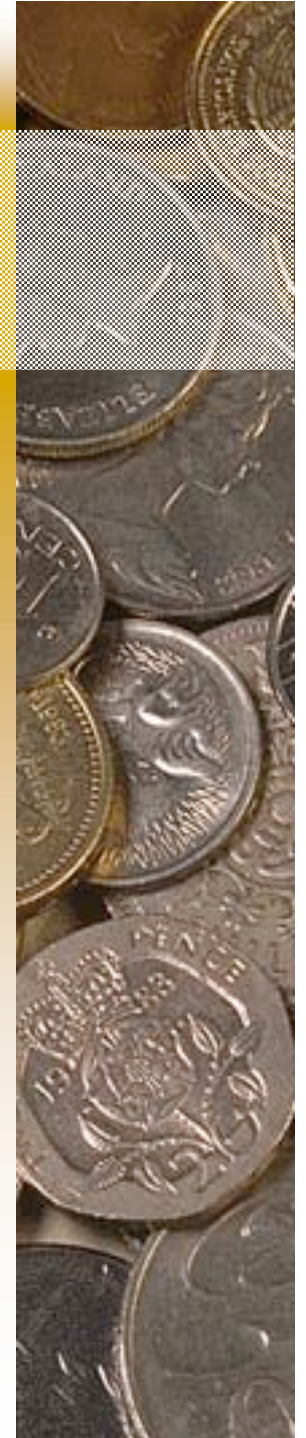
Relevant cash flows

Inflation

Risk Analysis: Sensitivity Analysis, Scenario Analysis, and Simulation Analysis

Incremental Cash Flow for a Project

- Project's incremental cash flow is:
 - Corporate cash flow with the project
 - **Minus**
 - Corporate cash flow without the project.



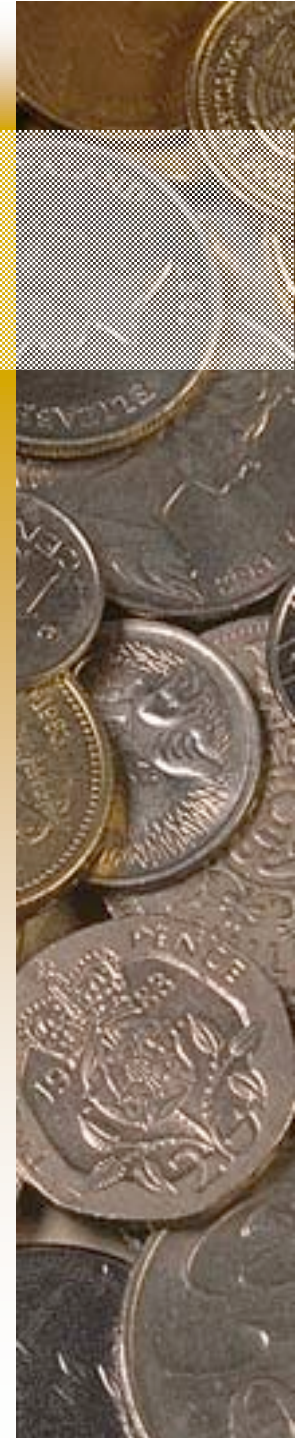
Should you subtract interest expense or dividends when calculating CF?

- **NO.** We discount project cash flows with a cost of capital that is the rate of return required by all investors (not just debtholders or stockholders), and so we should discount the total amount of cash flow available to all investors.
- They are part of the costs of capital. If we subtracted them from cash flows, we would be double counting capital costs.



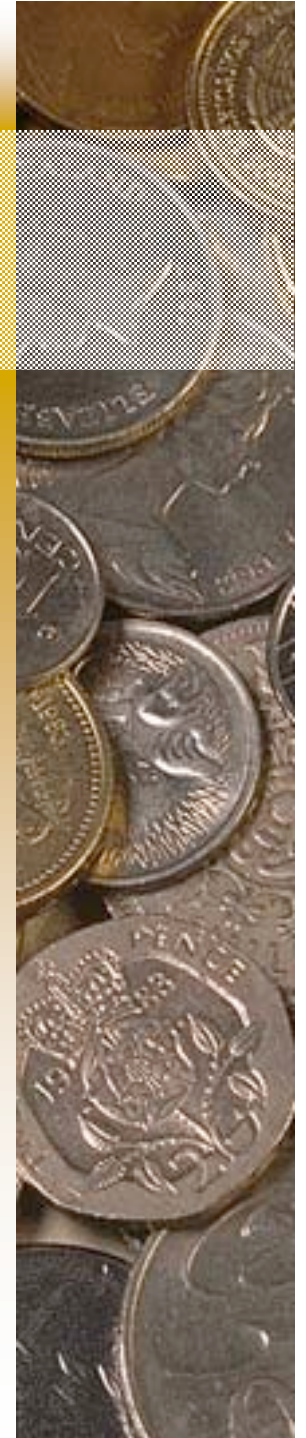
Suppose \$100,000 had been spent last year to improve the production line site. Should this cost be included in the analysis?

- **NO.** This is a sunk cost. Focus on incremental investment and operating cash flows.



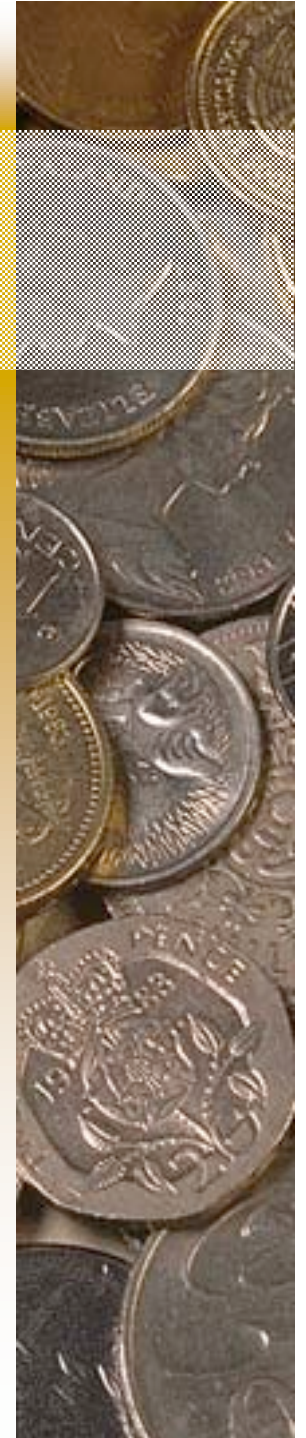
If the space could be leased for \$25,000 a year. Would this affect the analysis?

- **Yes.** Accepting the project means we will not receive the \$25,000. This is an opportunity cost and it should be charged to the project.
- A.T. opportunity cost = $\$25,000 (1 - T) = \$15,000$ annual cost.



If the new product line will decrease sales of an entity's other products by \$50,000 per year, would this affect the analysis?

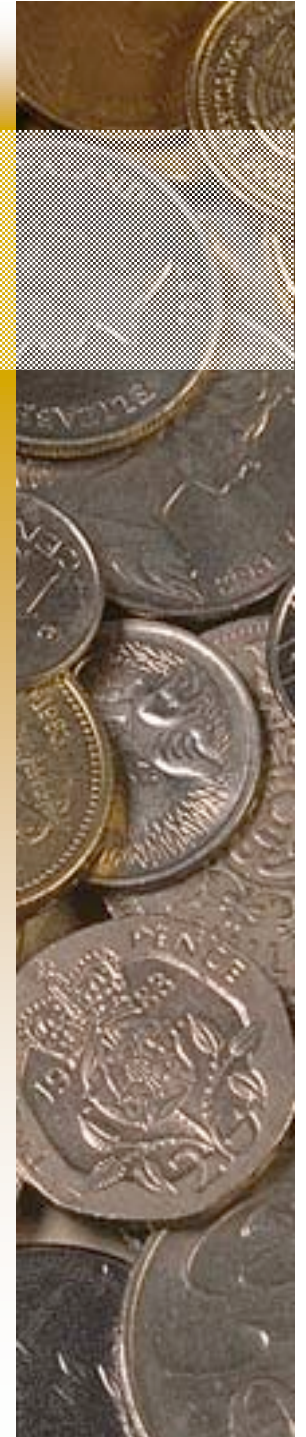
- **Yes.** The effects on the other projects' CFs are “externalities”.
- Net CF loss per year on other lines would be a cost to this project.
- Externalities will be **positive** if new projects are complements to existing assets, **negative** if substitutes.



You ***MUST*** account for inflation when estimating cash flows

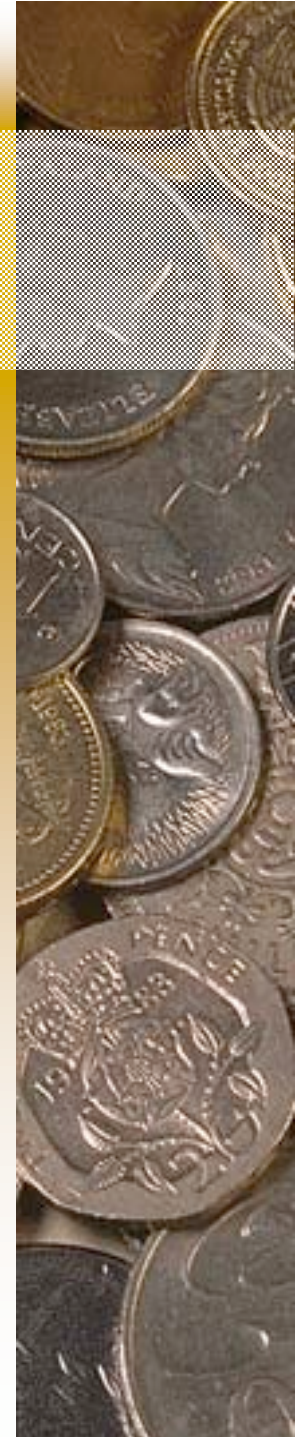
- Nominal $r >$ real r . The cost of capital, r , includes a premium for inflation.
- Nominal CF $>$ real CF. This is because nominal cash flows incorporate inflation.
- If you discount real CF with the higher nominal r , then your NPV estimate will be too low.

Continued...



Inflation (Continued)

- Nominal CF should be discounted with nominal r , and real CF should be discounted with real r .
- Business analysts usually act like it's more realistic to find the nominal CF (i.e., increase cash flow estimates with inflation) than it is to reduce the nominal r to a real r .

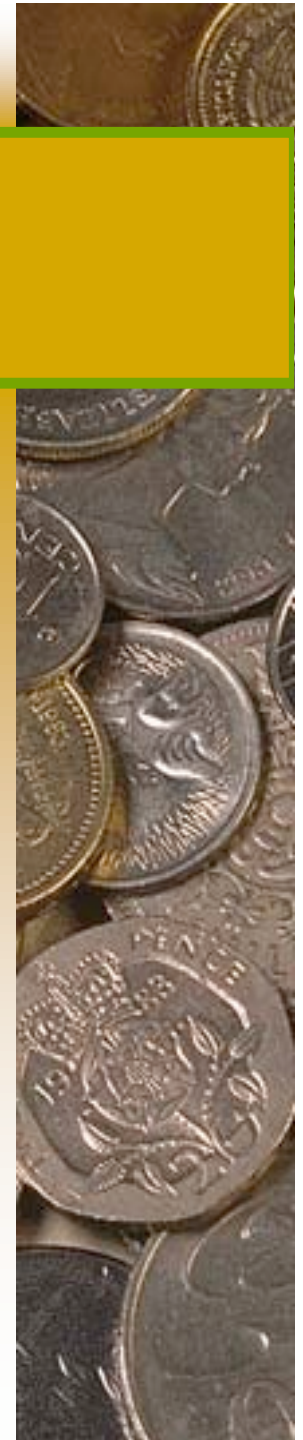




**Presentation skips to next
class**

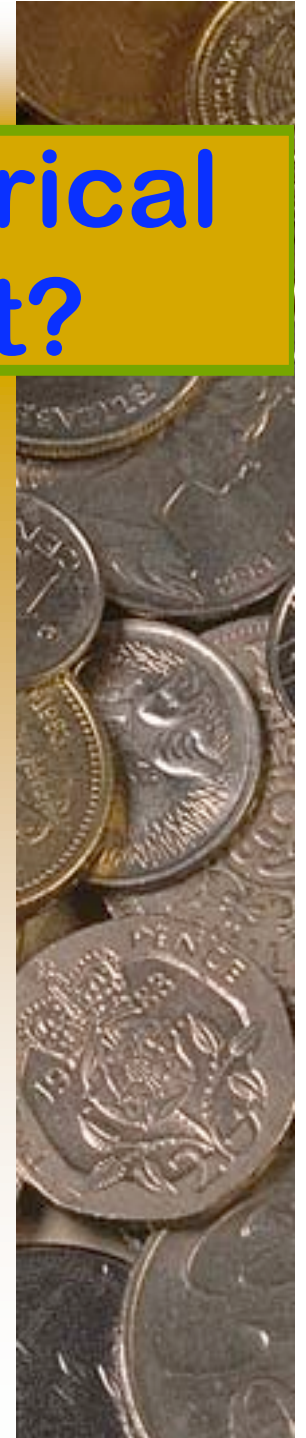
What does “risk” mean in capital budgeting?

- **Uncertainty** about a project’s future **profitability**.
- Measured by σ_{NPV} , σ_{IRR} , beta.
- Will taking on the project increase the firm’s and stockholders’ risk?



Is risk analysis based on historical data or subjective judgment?

- Can sometimes use historical data, but generally cannot.
- So risk analysis in capital budgeting is usually based on **subjective judgments.**



What three types of risk are relevant in capital budgeting?

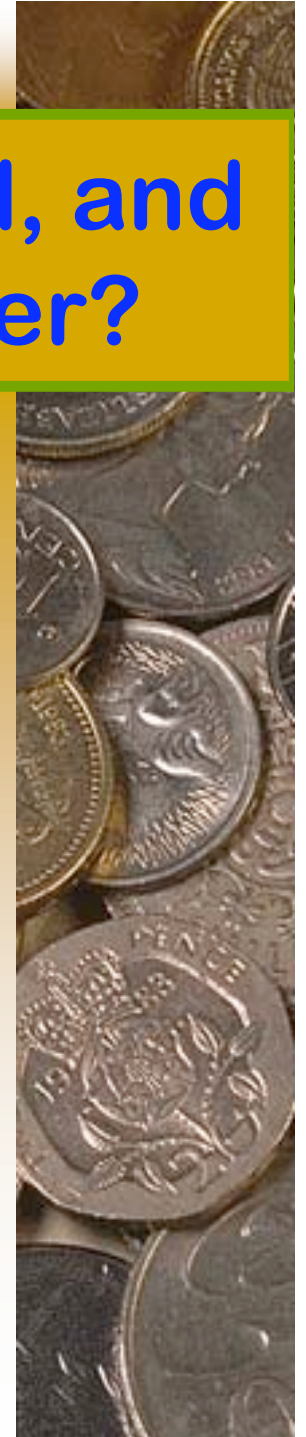
- Stand-alone risk
- Corporate risk
- Market (or beta) risk



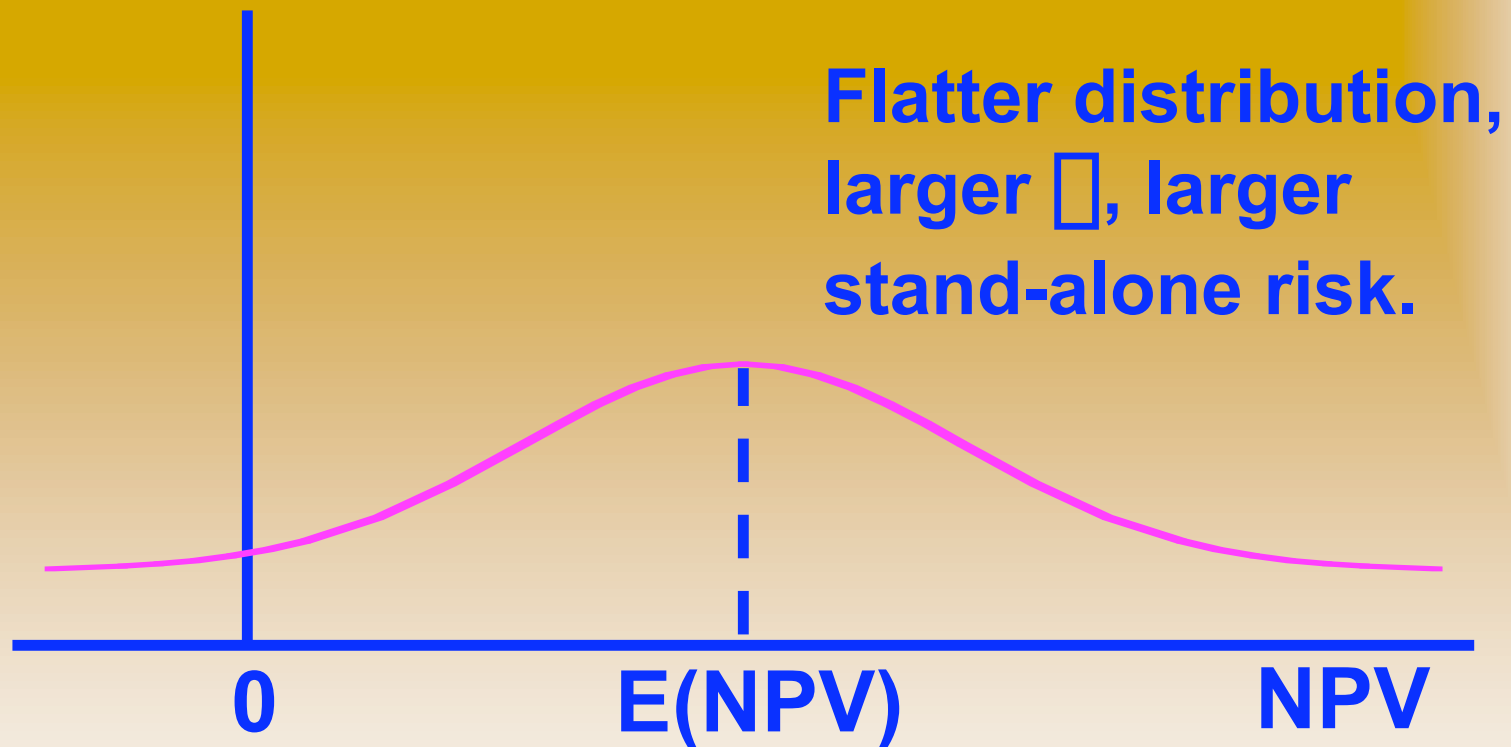
How is each type of risk measured, and how do they relate to one another?

1. Stand-Alone Risk:

- The project's risk if it were the firm's only asset and there were no shareholders.
- Ignores both firm and shareholder diversification.
- Measured by the σ or CV of NPV, IRR, or MIRR.



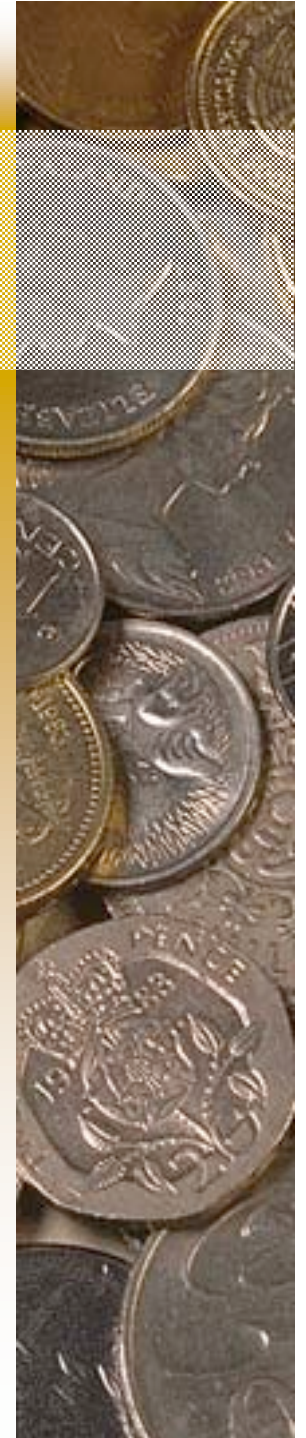
Probability Density

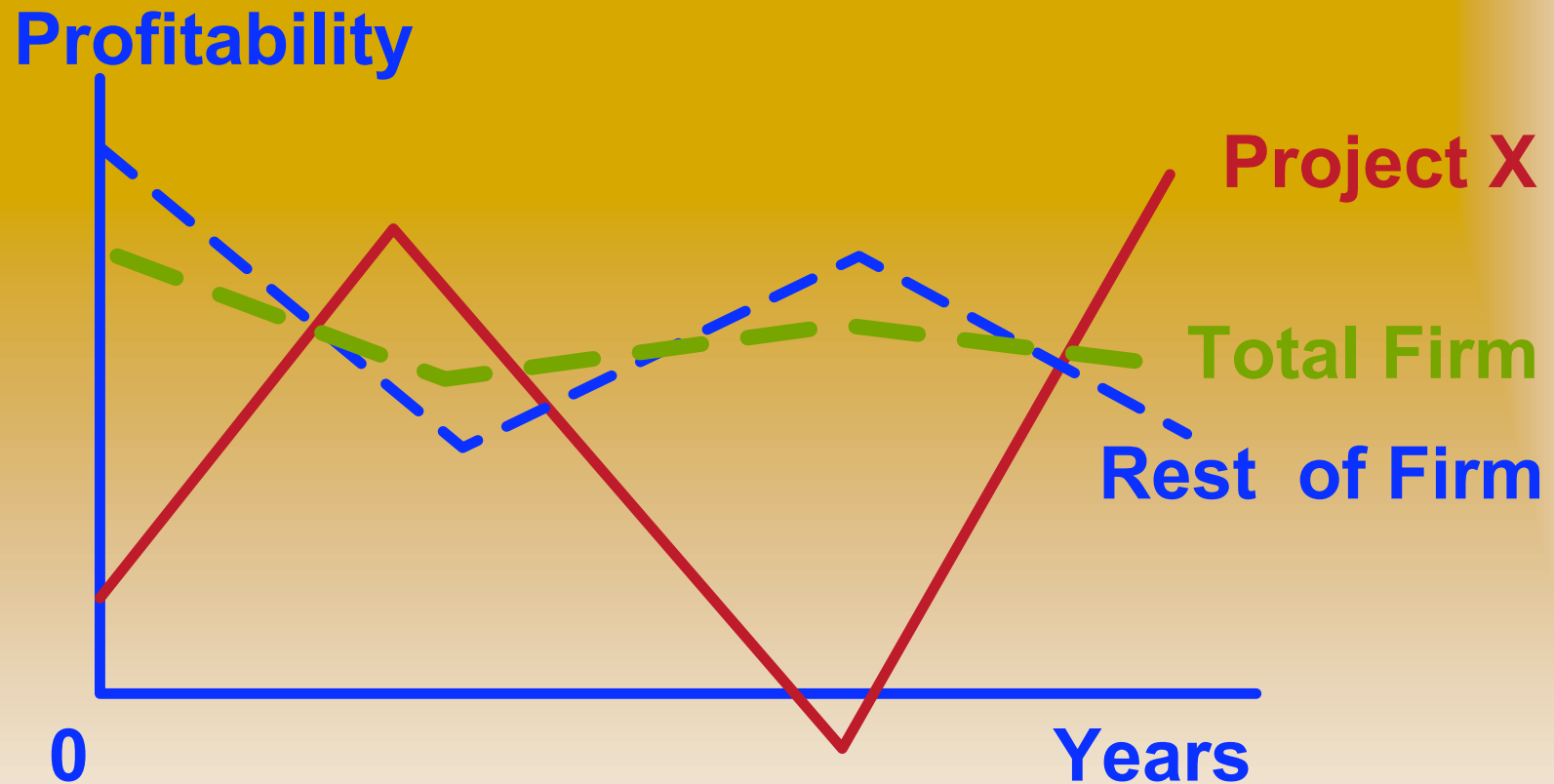


Such graphics are increasingly used by corporations.

2. Corporate Risk:

- Reflects the project's effect on corporate earnings stability.
- Considers firm's other assets (diversification within firm).
- Depends on:
 - project's β , and
 - its correlation, ρ , with returns on firm's other assets.
- Measured by the project's corporate beta.

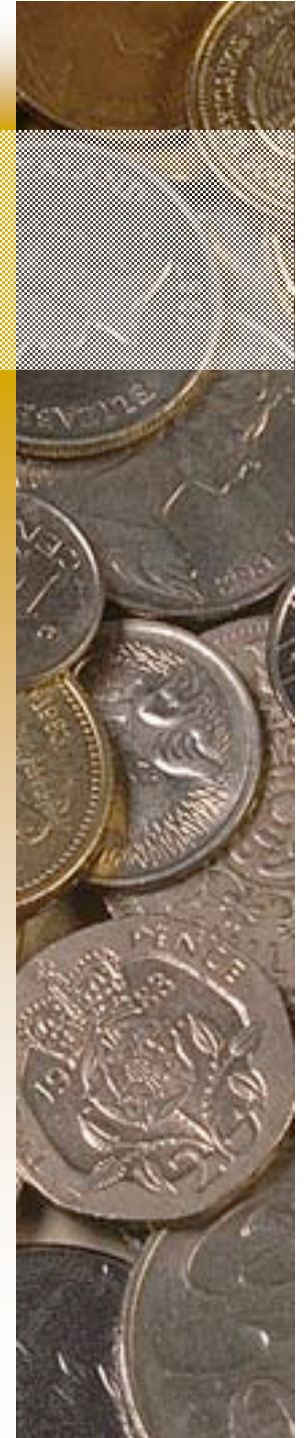




1. Project X is negatively correlated to firm's other assets.
2. If $\rho < 1.0$, some diversification benefits.
3. If $\rho = 1.0$, no diversification effects.

3. Market Risk:

- Reflects the project's effect on a well-diversified stock portfolio.
- Takes account of stockholders' other assets.
- Depends on project's β and correlation with the stock market.
- Measured by the project's market beta.



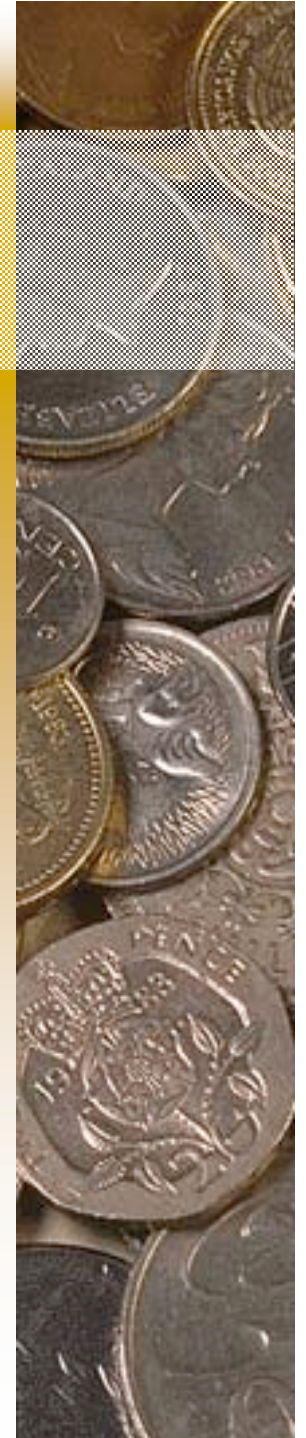
How is each type of risk used?

- Market risk is **theoretically best** in most situations.
- However, creditors, customers, suppliers, and employees are more affected by corporate risk.
- Therefore, **corporate risk is also relevant.**

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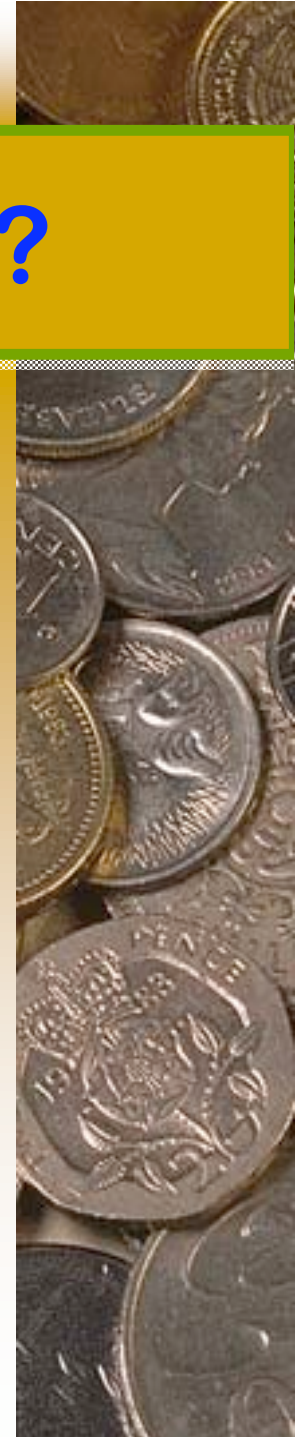


- Stand-alone risk is **easiest** to measure, more **intuitive**.
- Core projects are highly **correlated with other assets**, so stand-alone risk generally reflects corporate risk.
- If the project is highly **correlated with the economy**, stand-alone risk also reflects market risk.



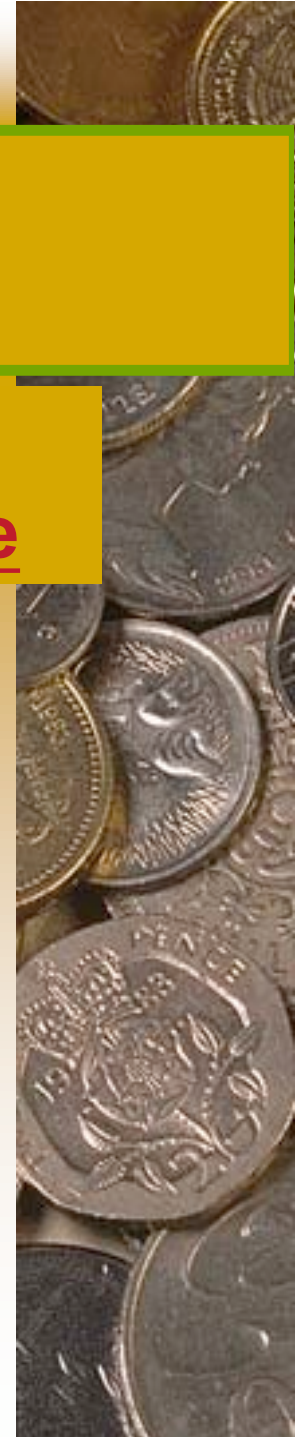
What is sensitivity analysis?

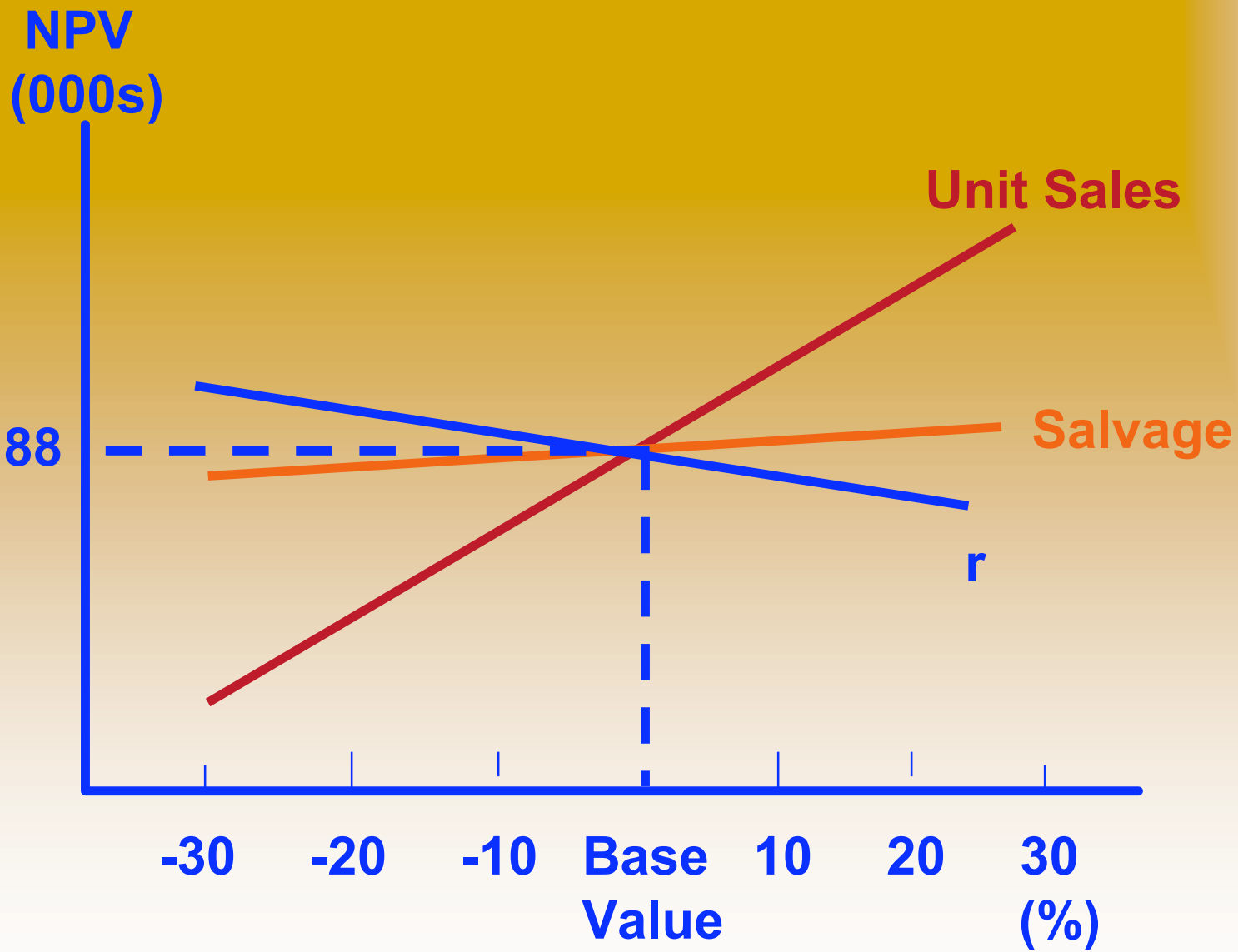
- Shows how **changes** in a variable such as unit sales **affect NPV or IRR**.
- Each variable is fixed except one. **Change** this one variable to see the effect on NPV or IRR.
- Answers “**what if**” questions, e.g. “What if sales decline by 30%?”



Sensitivity Analysis

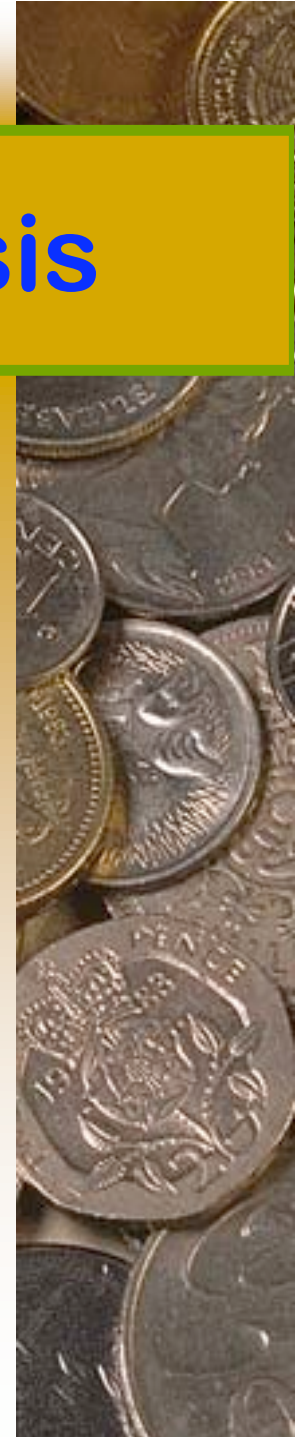
<u>Change from Base Level</u>	<u>Resulting NPV (000s)</u>		
	<u>r</u>	<u>Unit Sales</u>	<u>Salvage</u>
-30%	\$113	\$17	\$85
-15%	\$100	\$52	\$86
0%	\$88	\$88	\$88
15%	\$76	\$124	\$90
30%	\$65	\$159	\$91





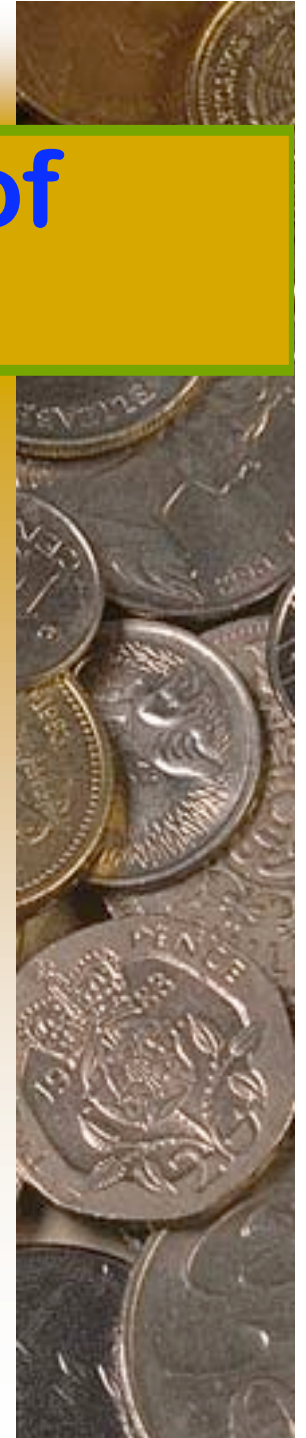
Results of Sensitivity Analysis

- **Steeper sensitivity lines show greater risk.** Small changes result in large declines in NPV.
- Unit sales line is **steeper** than salvage value or r , so for this project, should worry most about accuracy of sales forecast.



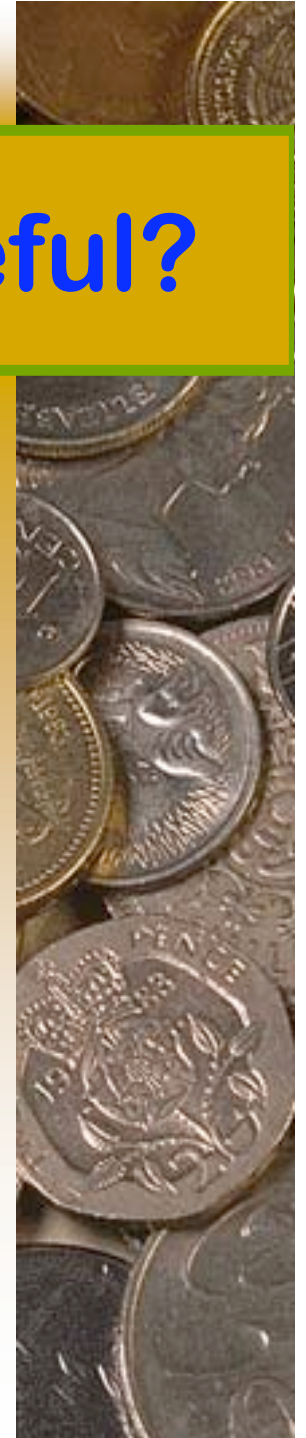
What are the weaknesses of sensitivity analysis?

- Says nothing about the **likelihood of change** in a variable, i.e. a steep sales line is not a problem if sales won't fall.
- Ignores **relationships** among variables.



Why is sensitivity analysis useful?

- Gives some idea of stand-alone risk.
- Identifies dangerous variables.
- Gives some breakeven information.



What is scenario analysis?

- Examines several possible situations, usually **worst** case, **most likely** case, and **best** case.
- Provides a **range** of possible outcomes.



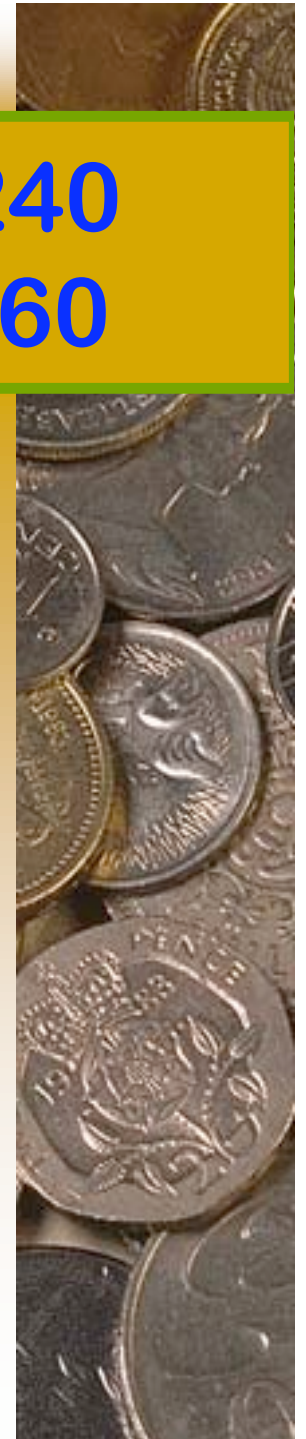
Best scenario: 1,600 units @ \$240
Worst scenario: 900 units @ \$160

<u>Scenario</u>	<u>Probability</u>	<u>NPV(000)</u>
Best	0.25	\$ 279
Base	0.50	88
Worst	0.25	-49

$$E(\text{NPV}) = \$101.5$$

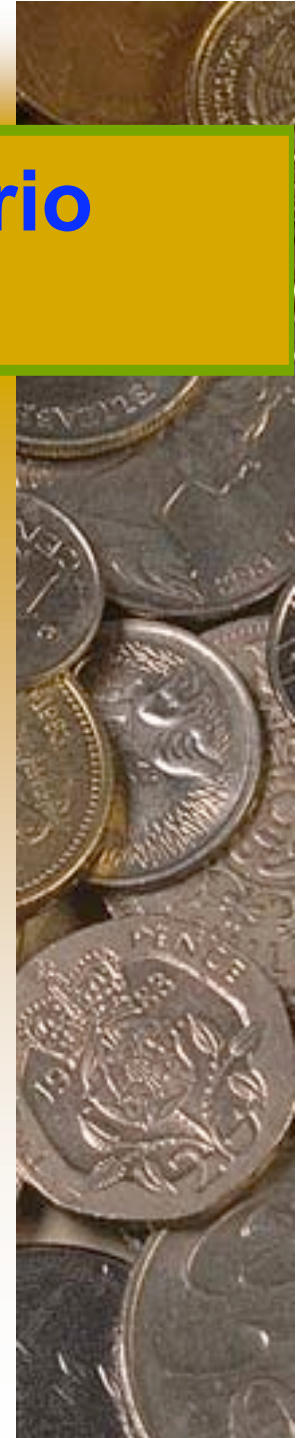
$$\sigma(\text{NPV}) = 75.7$$

$$CV(\text{NPV}) = \sigma(\text{NPV})/E(\text{NPV}) = 0.75$$



Are there any problems with scenario analysis?

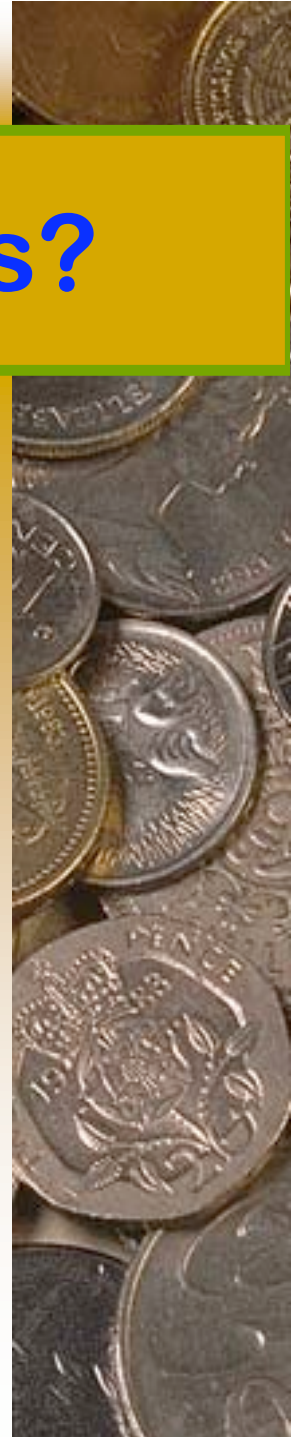
- Only considers a few possible outcomes.
- Assumes that inputs are perfectly correlated--all “bad” values occur together and all “good” values occur together.
- Focuses on stand-alone risk, although subjective adjustments can be made.



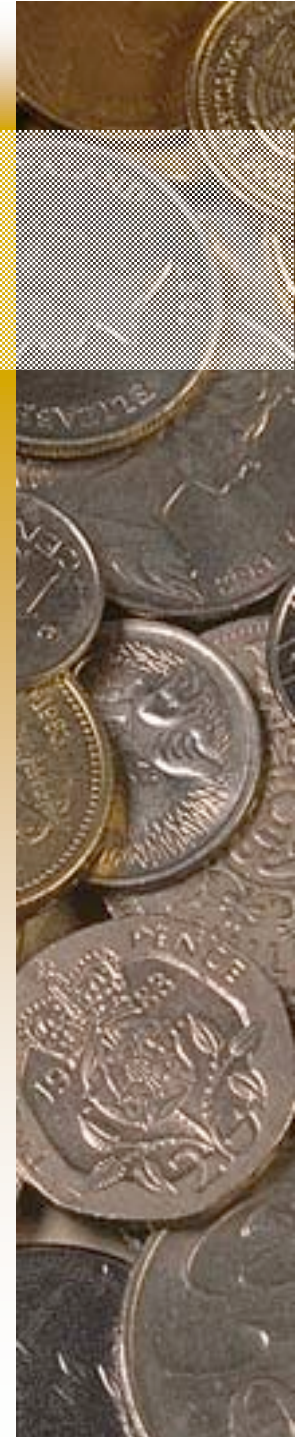
What is a simulation analysis?

- A computerized version of scenario analysis which uses **continuous probability distributions**.
- Computer selects values for each variable based on given probability distributions.

(More...)

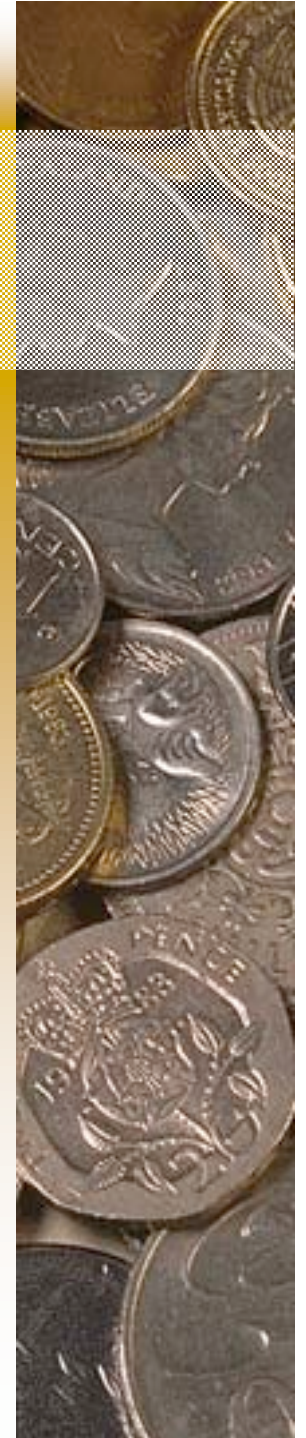


- **NPV and IRR are calculated.**
- **Process is repeated many times (1,000 or more).**
- **End result: Probability distribution of NPV and IRR based on sample of simulated values.**
- **Generally shown graphically.**



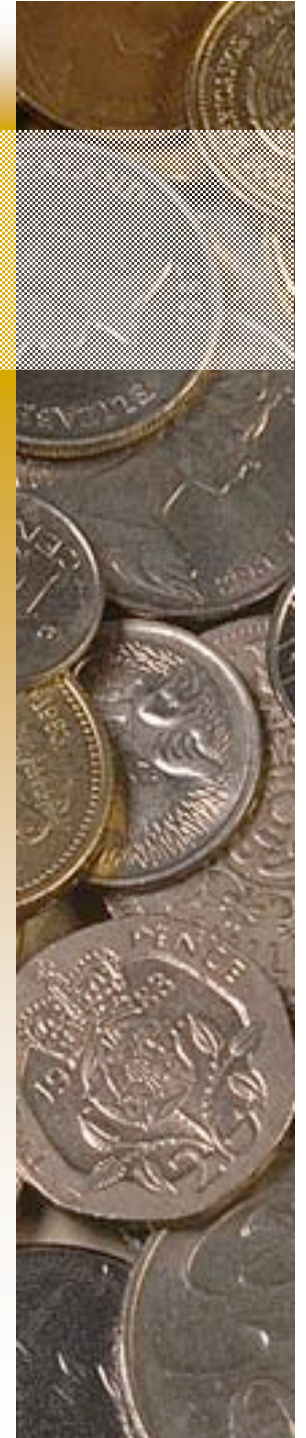
Simulation Example

- Assume a:
 - Normal distribution for unit sales:
 - Mean = 1,250
 - Standard deviation = 200
 - Triangular distribution for unit price:
 - Lower bound = \$160
 - Most likely = \$200
 - Upper bound = \$250



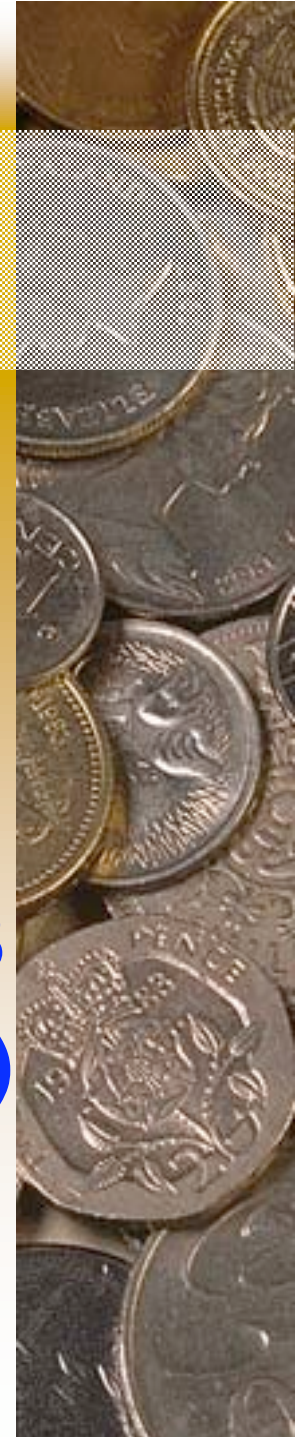
Simulation Process

- Pick a random variable for unit sales and sale price.
- Substitute these values in the spreadsheet and calculate NPV.
- Repeat the process many times, saving the input variables (units and price) and the output (NPV).



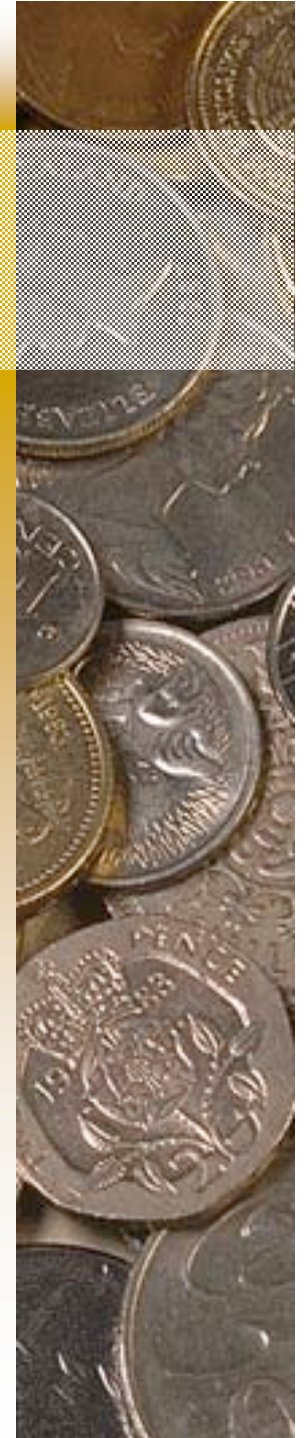
Simulation Results (1000 trials)

	<u>Units</u>	<u>Price</u>	<u>NPV</u>
Mean	1260	\$202	\$95,914
St. Dev.	201	\$18	\$59,875
CV			0.62
Max	1883	\$248	\$353,238
Min	685	\$163	(\$45,713)
Prob NPV>0			97%

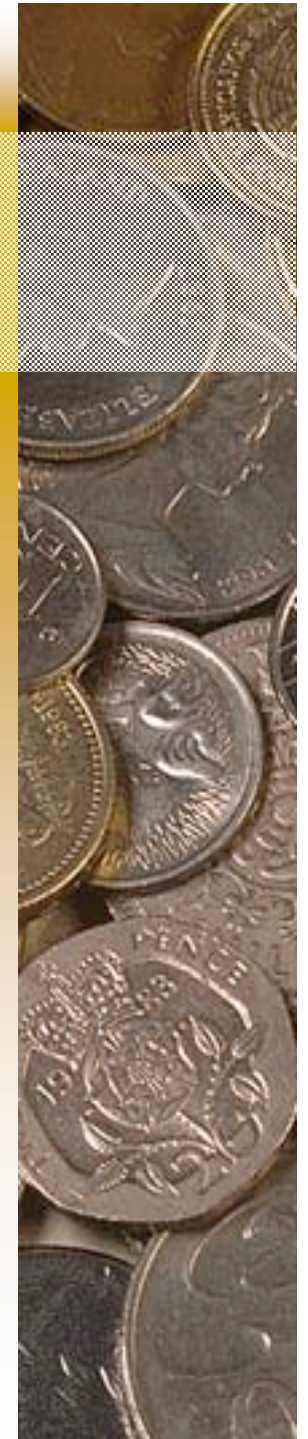
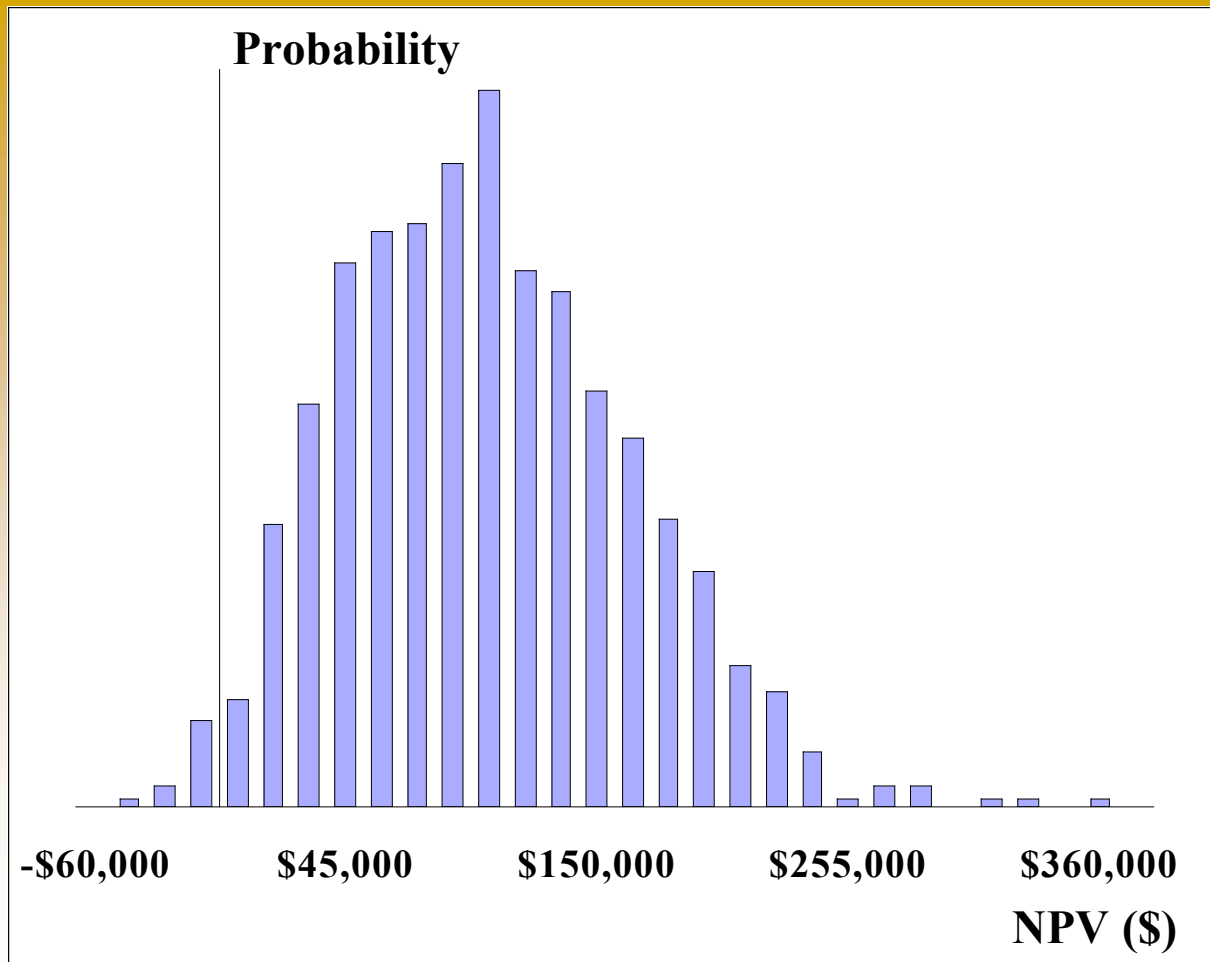


Interpreting the Results

- **Inputs are consistent with specified distributions.**
 - **Units: Mean = 1260, St. Dev. = 201.**
 - **Price: Min = \$163, Mean = \$202, Max = \$248.**
- **Mean NPV = \$95,914. Low probability of negative NPV (100% - 97% = 3%).**

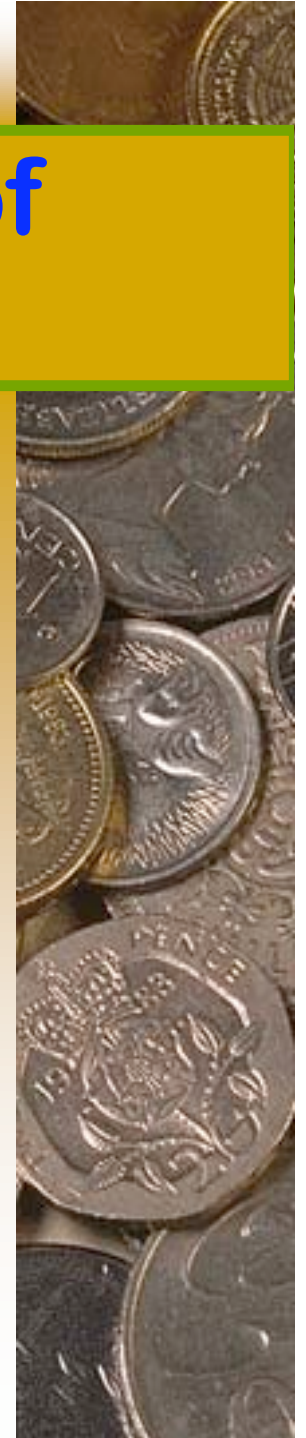


Histogram of Results



What are the advantages of simulation analysis?

- Reflects the probability distributions of each input.
- Shows range of NPVs, the expected NPV, σ_{NPV} , and CV_{NPV} .
- Gives an intuitive graph of the risk situation.



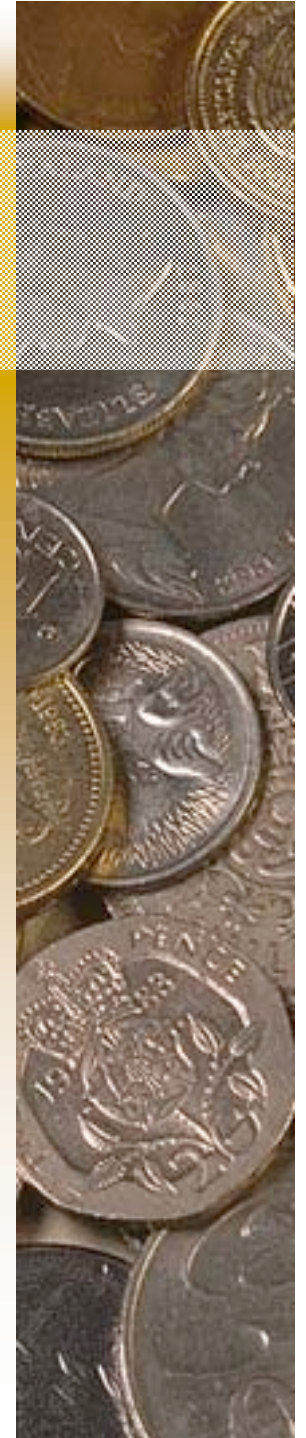
What are the disadvantages of simulation?

- **Difficult to specify** probability distributions and correlations.
- If inputs are bad, output will be bad: “Garbage in, garbage out.”

(More...)

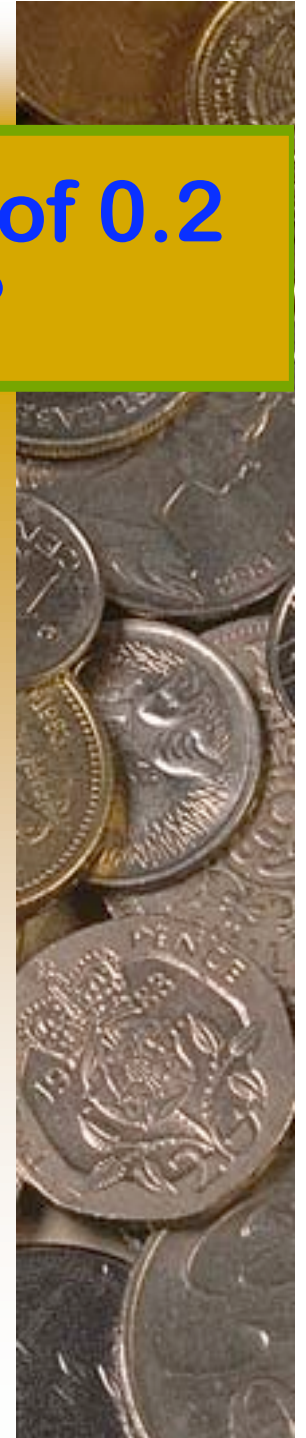


- Sensitivity, scenario, and simulation analyses **do not provide a decision rule**. They do not indicate whether a project's expected return is sufficient to compensate for its risk.



If the firm's average project has a CV of 0.2 to 0.4, is this a high-risk project?

- CV from scenarios = 0.74, CV from simulation = 0.62. Both are > 0.4 , this project has **high risk**.



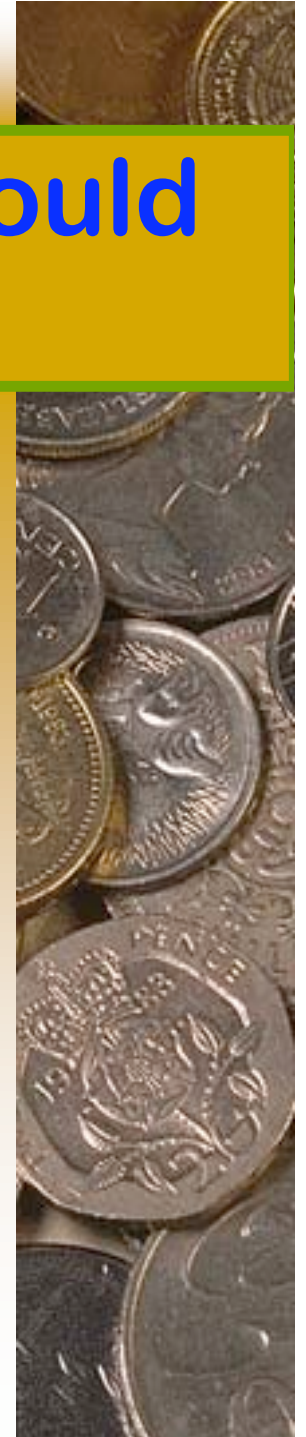
What type of risk is being measured?

- CV measures a project's **stand-alone risk**.
- High stand-alone risk usually indicates high corporate and market risks.



With a 3% risk adjustment, should our project be accepted?

- Project $r = 10\% + 3\% = 13\%$.
- That's 30% above base r .
- NPV = \$65,371.
- Project remains acceptable after accounting for differential (higher) risk.



Should subjective risk factors be considered?

- **Yes.** A numerical analysis may not capture all of the risk factors inherent in the project.
- For example, if the project has the potential for bringing on **harmful lawsuits**, then it might be **riskier** than a standard analysis would indicate.

