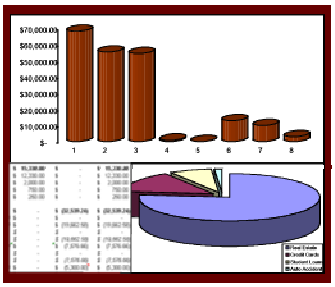


Week 4: Decision Theory

- ✓ Quiz:
  When should you use a deterministic approach to solve business problems? When should you use a stochastic approach?

- ✓ Quiz for next week:
  What is a decision tree?

- ✓ Assignments due this week:
  - Biography: Henry Gantt
  - Paper: "Deterministic Processes versus Stochastic Processes"
  - Spreadsheet: Create a spreadsheet that compares the probability of a player picking the winning numbers if we use one, two, three, four, or five numbers in our lottery.

- ✓ Assignments due next week:
  - Biography: Abraham de Moivre
  - Paper: Discuss (in 200 words or more) a decision with which you are, or could be, involved. Identify the options from which you could choose, and how one or more states of nature could impact the outcome.

- ✓ Three Decision-Making Environments for Managers
  - Decision-making under certainty
    - Deterministic. You know the outcome when you make the decision.
    - "If I buy this 12-month CD, I will have a yield of 5.25%."
    - Typically a logical or mathematical solution.
  - Decision-making under uncertainty
    - Stochastic. Multiple possible outcomes, with no probabilities assigned to them.
    - "If we launch this product we may make a profit."
    - Three approaches: MAXIMAX, MAXIMIN, and MINIMAX Regret
  - Decision-making under risk
    - Stochastic. Multiple possible outcomes, with probabilities assigned to them.
    - "If we buy a new machine there is a 5% chance that we will need to have it overhauled during the project, but if we use

our old machine there is a 50% chance that it will need to be overhauled."

- ✓ Decision-Making Under Certainty
  - Build a model using the approach we discussed in Week 1.
- ✓ Decision-Making Under Uncertainty
  - MAXIMAX - The Optimistic Approach
  - This is the way to answer the CEO when she asks, "How can we make the most money?"
  - Find the maximum value in each row. Choose the maximum of the maximums.

MAXIMAX Example

	State of Nature			
Alternative	**Favorable Market**	**Unfavorable Market**	**Max**	
Construct a large plant	$ 200,000	$ -180,000	$ 200,000	←
Construct a small plant	$ 100,000	$ -20,000	$ 100,000	
Do nothing	$ 0	$ 0	$ 0	

  - MAXIMIN - The Pessimistic Approach
  - This is the way to answer the CFO when he asks, "How can we lose the least money?"
  - Find the minimum value in each row. Choose the maximum of the minimums.

MAXIMIN Example

	State of Nature			
Alternative	**Favorable Market**	**Unfavorable Market**	**Min**	
Construct a large plant	$200,000	$-180,000	$-180,000	
Construct a small plant	$100,000	$ -20,000	$ -20,000	
Do nothing	$ 0	$ 0	$ 0	←

- MINIMAX Regret - The BOD Approach
- This is the way to answer the BOD when they ask, "How can we balance the best and worst case scenarios?"

MINIMAX Regret Example

Step 1: Build your Alternatives table.

	State of Nature			
Alternative	**Favorable Market**	**Unfavorable Market**		
Construct a large plant	$200,000	$-180,000		
Construct a small plant	$100,000	$ -20,000		
Do nothing	$ 0	$ 0		

Step 2: Build an Economic Opportunity Loss (EOL) table by subtracting the value in each cell from the largest value in that cell's column.

	State of Nature			
Alternative	**Favorable Market**	**Unfavorable Market**		
Construct a large plant	$200,000 - $200,000	$ 0 - $-180,000		
Construct a small plant	$200,000 - $100,000	$ 0 - $ -20,000		
Do nothing	$200,000 - $ 0	$ 0 - $ 0		

Which becomes:

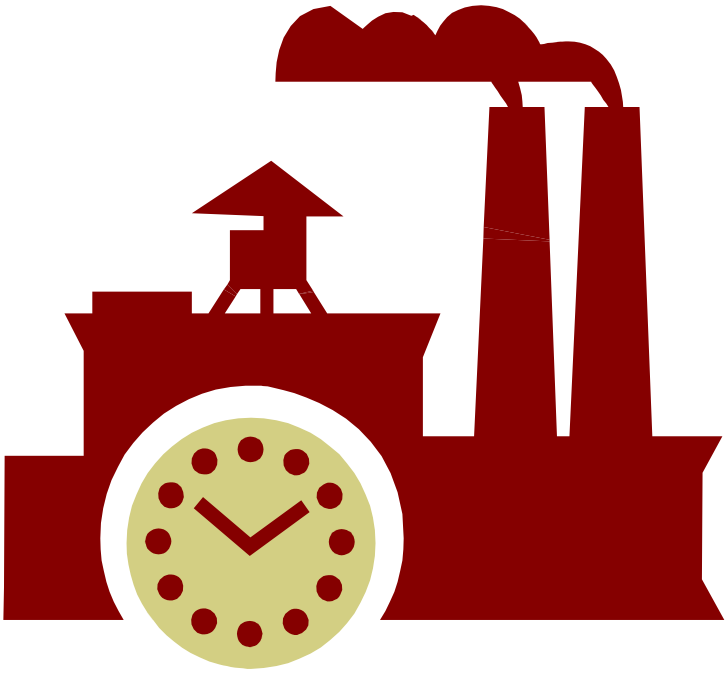
	State of Nature			
Alternative	**Favorable Market**	**Unfavorable Market**		
Construct a large plant	$ 0	$180,000		
Construct a small plant	$100,000	$ 20,000		
Do nothing	$200,000	$ 0		

Step 3: Take the maximum value for each row (each alternative):

	State of Nature			
Alternative	**Favorable Market**	**Unfavorable Market**	**Row Max**	
Construct a large plant	$ 0	$180,000	$180,000	
Construct a small plant	$100,000	$ 20,000	$100,000	
Do nothing	$200,000	$ 0	$200,000	

Step 4: Take the minimum of the maximum values:

	State of Nature			
Alternative	**Favorable Market**	**Unfavorable Market**	**Row Max**	
Construct a large plant	$ 0	$180,000	$180,000	
Construct a small plant	$100,000	$ 20,000	$100,000	←
Do nothing	$200,000	$ 0	$200,000	



Decision-Making Under Risk

- The Expected Monetary Value (EMV) Approach
- This is a way to answer, "How can we balance risk and reward?"

Step 1: Assign a probability to each state of nature:

	State of Nature			
Alternative	**Favorable Market**	**Unfavorable Market**		
Construct a large plant	$200,000	$-180,000		
Construct a small plant	$100,000	$- 20,000		
Do nothing	$ 0,000	$ 0		
Probability	0.5	0.5		

Step 2: Multiply the value in each cell by the probability for that state of nature:

	State of Nature			
Alternative	**Favorable Market**	**Unfavorable Market**		
Construct a large plant	$200,000 x 0.5 =$100,000	$-180,000 x 0.5 =$-90,000		
Construct a small plant	$100,000 x 0.5 =$50,000	$-20,000 x 0.5 =$-10,000		
Do nothing	$ 0 x 0.5 =$0	$ 0 x 0.5 =$0		

Step 3: Compute the EMV by adding across each row:

	State of Nature			
Alternative	**Favorable Market**	**Unfavorable Market**	**EMV**	
Construct a large plant	$100,000	$-90,000	$10,000	
Construct a small plant	$50,000	$-10,000	$40,000	
Do nothing	$0	$0	$0	

Step 4: Select the alternative with the highest EMV:

	State of Nature			
Alternative	**Favorable Market**	**Unfavorable Market**	**EMV**	
Construct a large plant	$100,000	$-90,000	$10,000	
Construct a small plant	$50,000	$-10,000	$40,000	←
Do nothing	$0	$0	$0	