

# Decision Analysis

# Outline



- What is Decision Analysis?
- Why use Decision Analysis?
- Game show example
- Key concepts
- Other applications
- Conclusions

# Decision Analysis

- Make decisions
  - Action
  - Irrevocable
  - Allocation of resources
- This is NOT a decision



# Decision Analysis (cont.)

- Make decisions
  - Action
  - Irrevocable
  - Allocation of resources
- This IS a decision



# Decision Analysis (cont.)

- Misnamed: Decision Synthesis
  - Builds up something new, not breaks down something old
- Purpose
  - Simplify reality (retain important information)
- Steps
  - Structure problem
  - Analyze situation
- Advantages
  - Gives perspective on the problem
  - Links facts, judgment, and decisions
- Outcomes
  - Communicate results and rationale with others
  - Helps solve problems

# Decision Analysis Key Concepts

- Framing
- Uncertainty
- Expected value
- Sensitivity analysis
- Risk tolerance
- Utility
- Certain equivalent
- Value of information
- Value of control

# “No Brainer”

- Hypothetical game show
- You’ve won!
- Choose one:
  - \$250,000 house, or
  - year’s supply of Spam (500 cans)

# “Brainer”

- Choose one:
  - \$250,000 house that *may* have been built on an old nuclear waste dump
  - Year’s supply of Spam (500 cans), with one out of every 1,000 cans containing a certificate for a guaranteed income of \$50,000 a year for life
  - \$50,000 cash



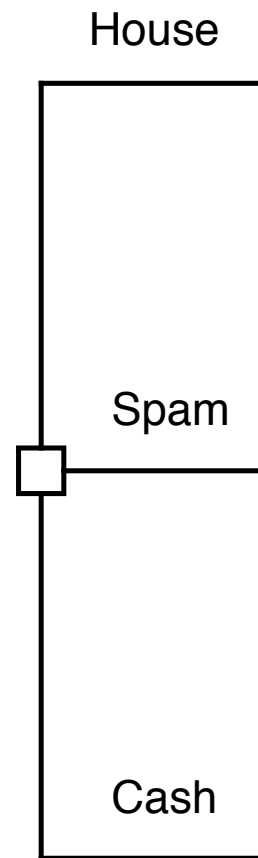
# Word Problem



- Unknowns/ambiguities/uncertainties
- Complexity
- Time is limited
- Important to us

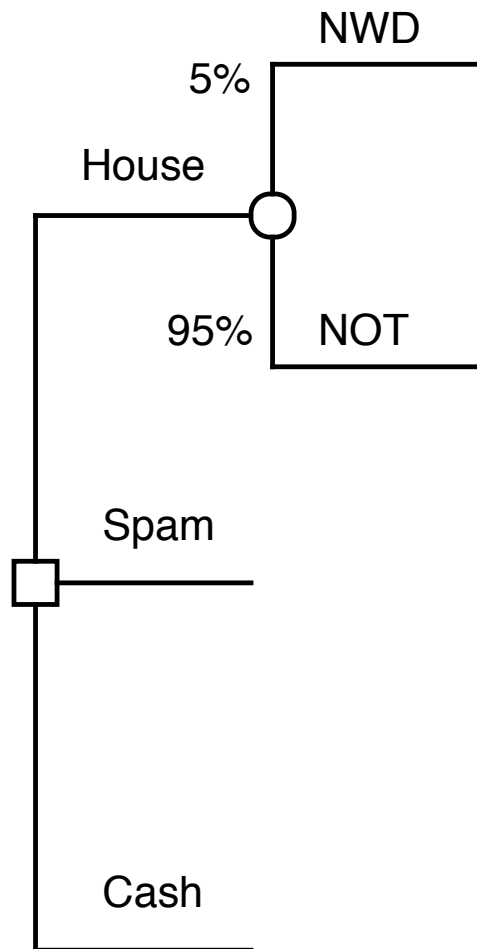
# Key Concepts:

- Framing
- Decision Tree
- Decision Node



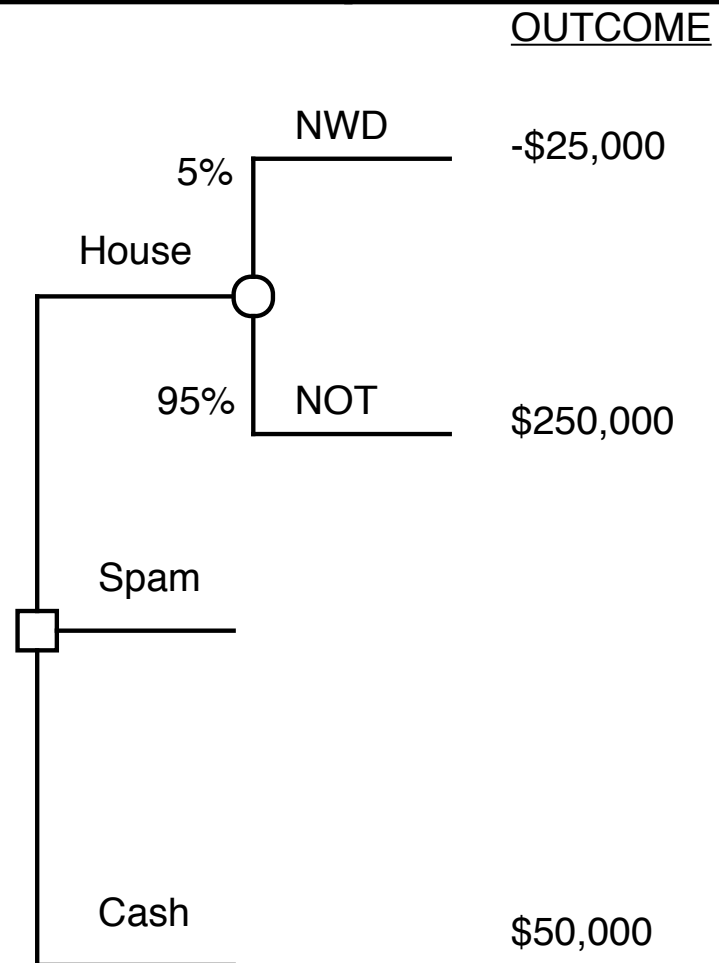
# Key Concepts:

- Uncertainty
- Probability
- Time
- Lottery



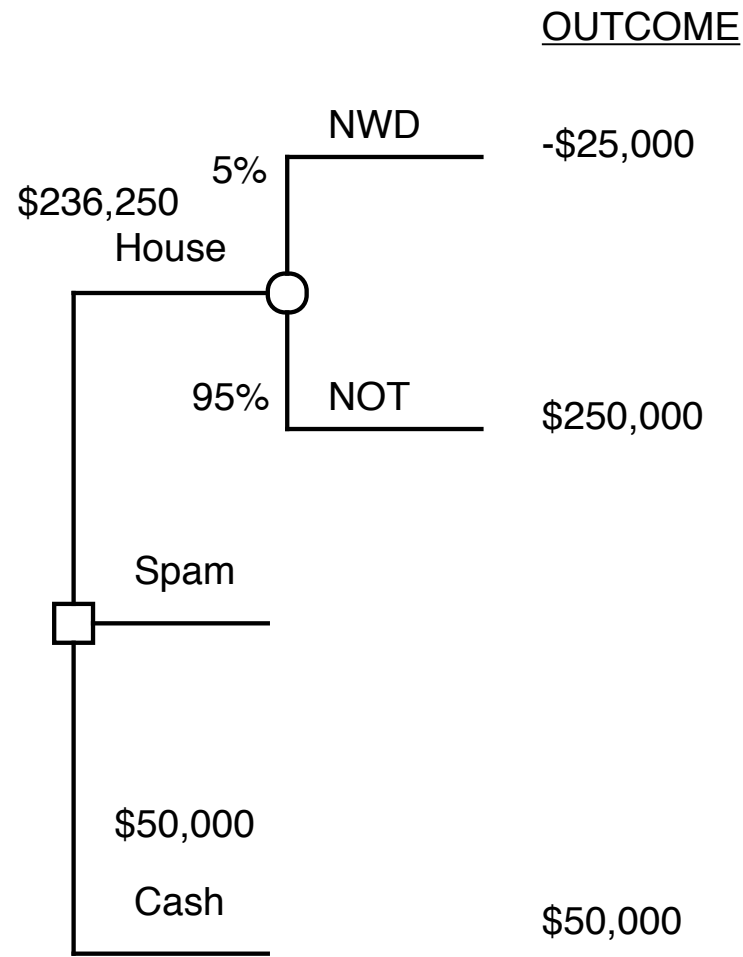
# Key Concepts:

- Outcome



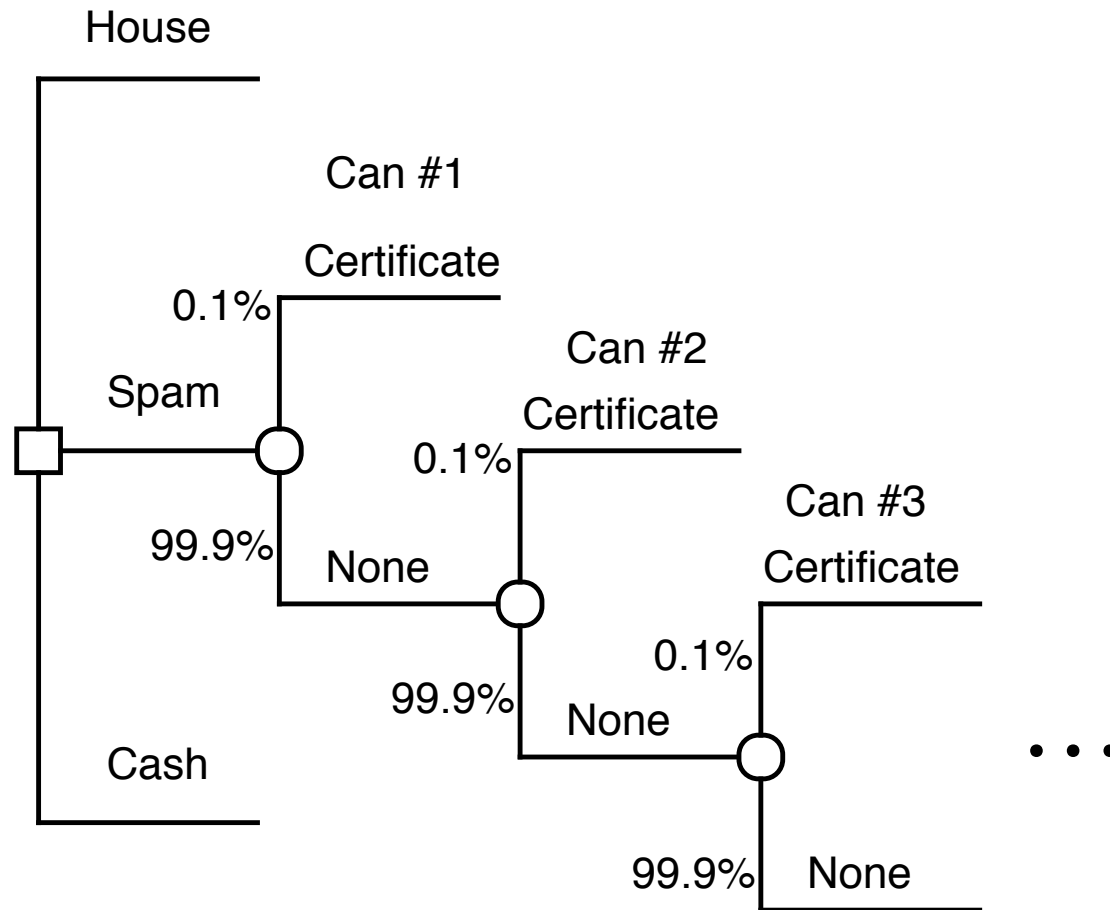
# Key Concepts:

- Expected Value



# Key Concepts:

- Compound Probabilities



# Key Concepts:

- Compound Probabilities
- Present Value

## ■ Compound probabilities

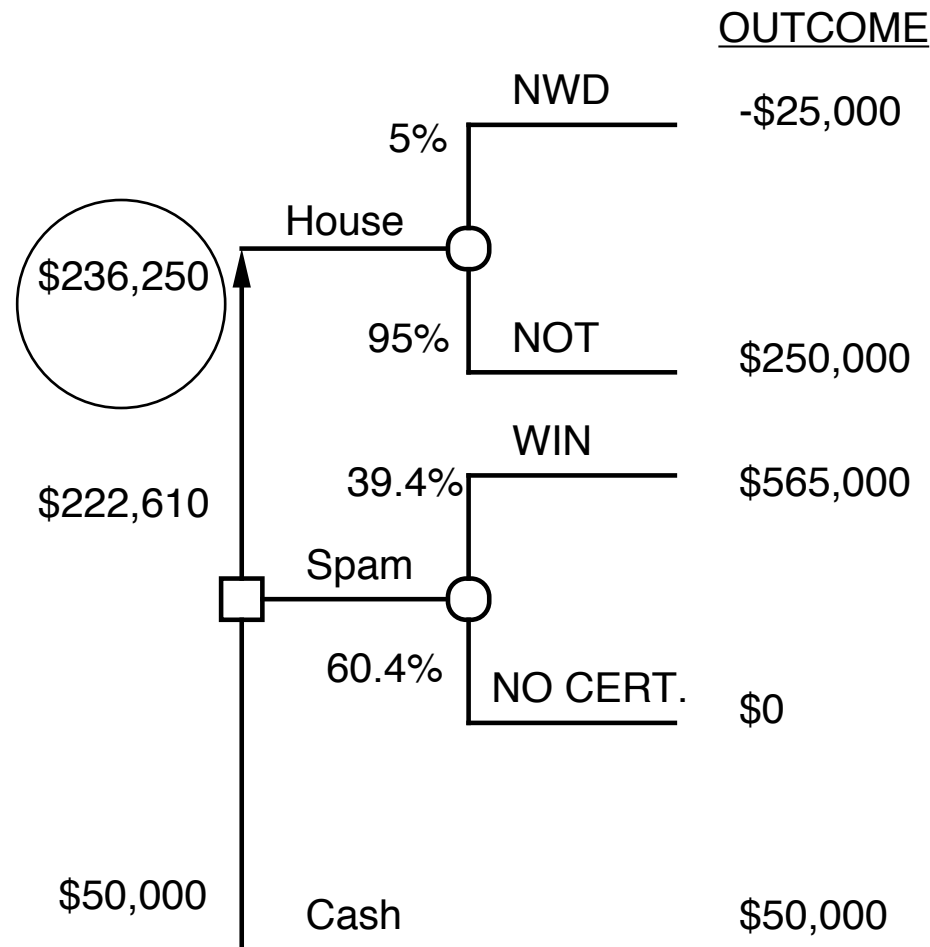
- 500 cans and every 1/1,000 has a certificate
- Probability of no certificate =  $99.9\%^{500} = 60.6\%$
- Probability of certificate =  $1 - 60.6\% = 39.4\%$
- Probability of an average drug lead being marketed is 2.08% ( $24\% * 40\% * 84\% * 84\% * 52\% * 65\% * 91\%$ )

## ■ Present value

- A dollar today is worth more than a dollar next year
  - » Can invest today's dollar
  - » Finite time horizons (get to use today's dollar longer)
- \$50,000 a year for life
- Equals  $\$50k + \$50k/(1+r) + \$50k/(1+r)^2 + \$50k/(1+r)^3 \dots$
- Equals \$565,000 (approximately 30 years at 8%)

# Key Concepts:

- Net Present Value
- “Best” Alternative



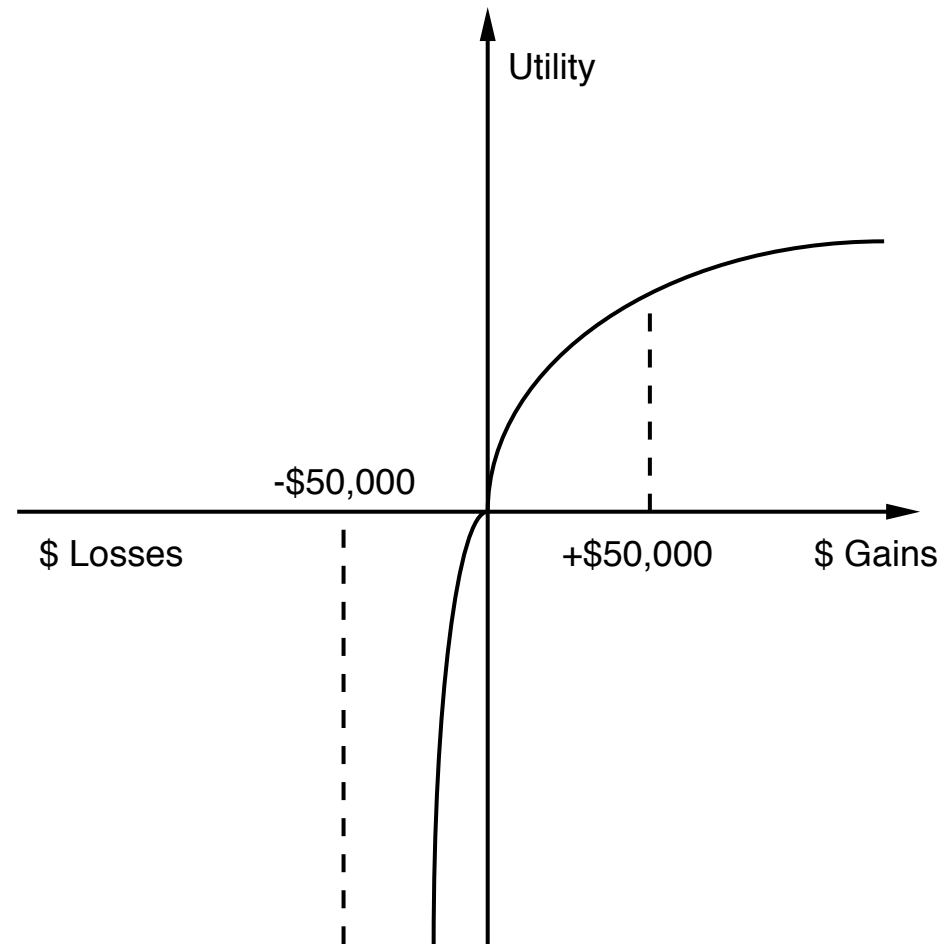


# Sensitivity Analysis

- Probability of “Nuclear Waste Dump” necessary to swing decision = 10%
- Probability of “Win” necessary to swing decision = 41.8%
- Value of “Nuclear Waste Dump” necessary to swing decision = -\$297,800
- Value of “Cash” necessary to swing decision = \$236,250

# Key Concepts:

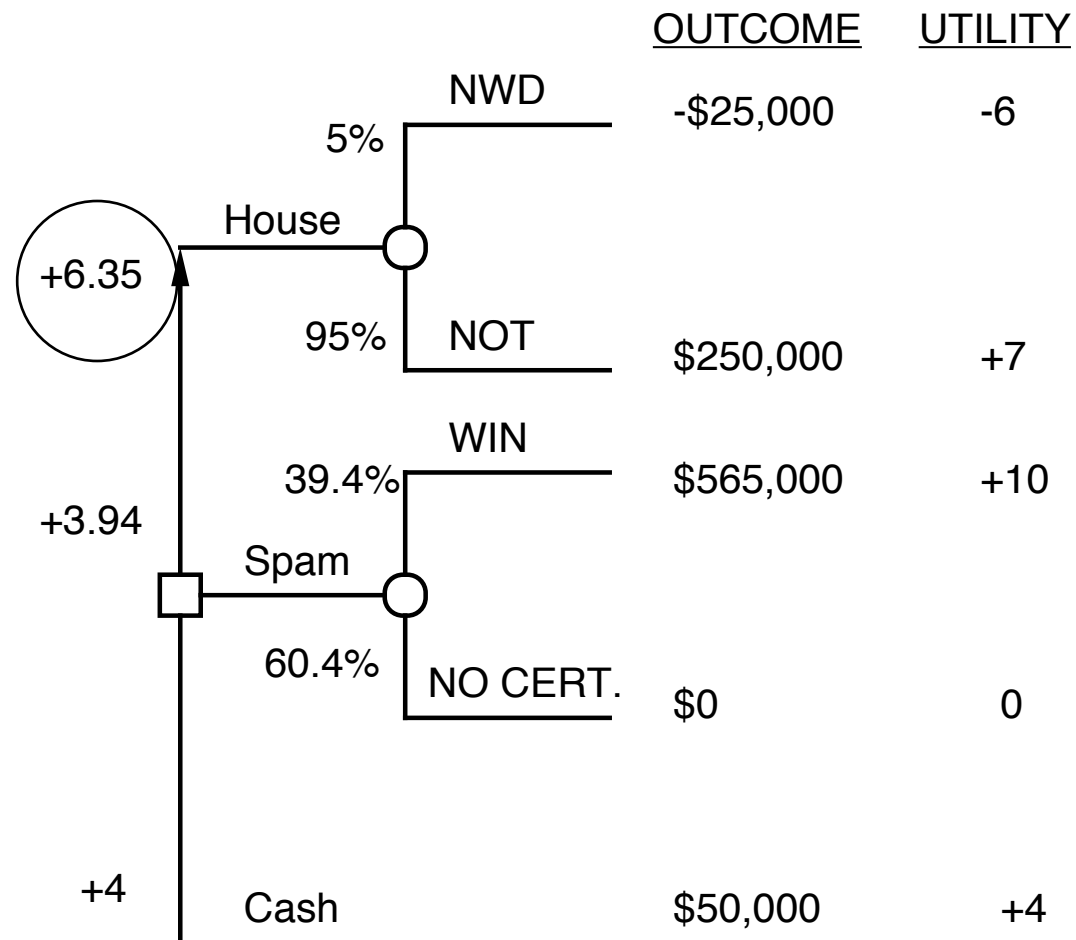
- Risk Tolerance and Utility



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# Key Concepts:

- Expected Utility



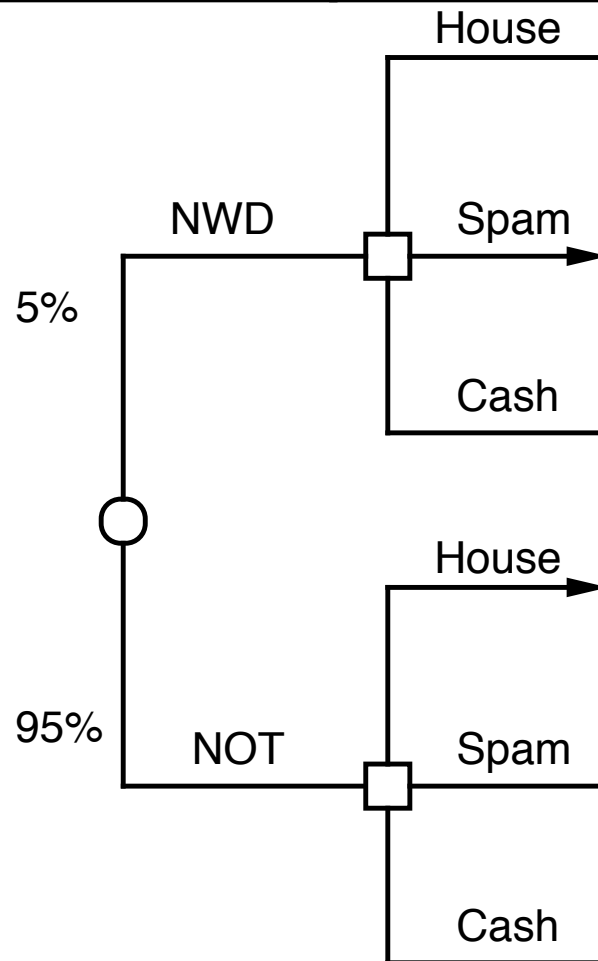
# Key Concepts:

- Certain Equivalent

- Expected utility = 6.35
- Use utility function to convert back to dollars
- Certain equivalent = \$125,000
- The certain equivalent is what you would pay today to play in this lottery given your risk tolerance and time preference (discount rate) profile

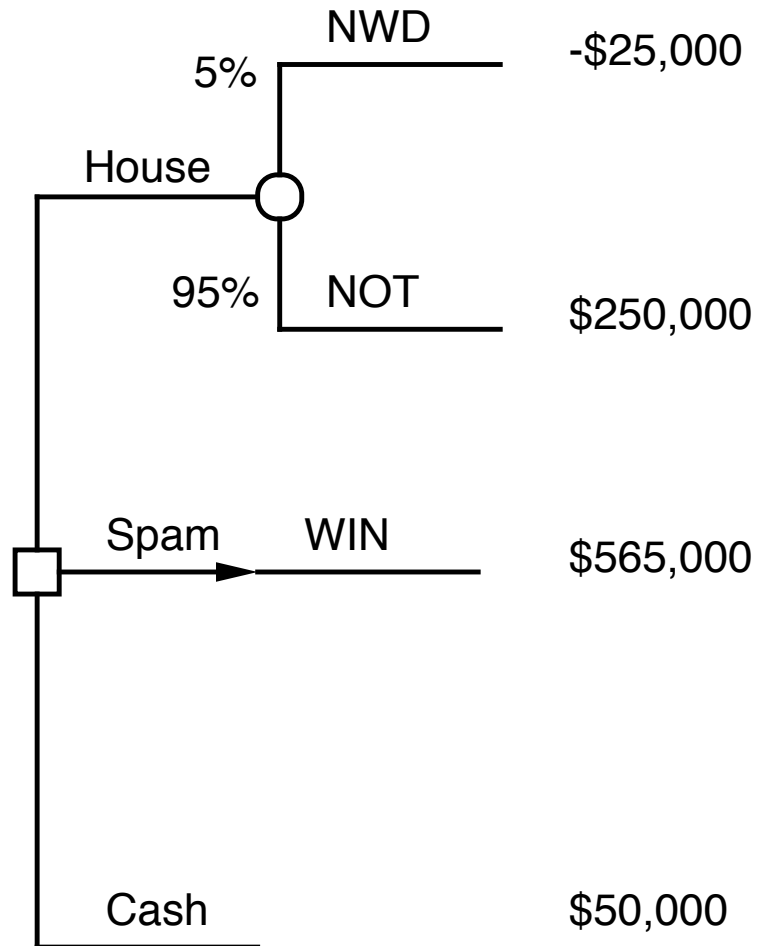
# Key Concepts:

- Value of Information = \$12,380 = \$248,630 - \$236,250



# Key Concepts:

- Value of Control = \$328,750 = \$565,000 - \$236,250



# Key Concepts:

- Value of Information/Control Summary

- The value of information is passive
  - How much would I pay to know something?
    - » Example: Would I pay \$5 million to determine if this compound treats Hepatitis C?
- The value of control is active
  - How much would I pay to make things go my way?
    - » Example: Would I pay \$10 million for a marketing program that will raise market share to 20%?
  - Actions are limited by legal and moral considerations
- The value of information and the value of control are the MOST you would pay for perfect information and perfect control
  - Real information is never perfect

# Decision Analysis Applications

- DTC advertising?
- Manufacture overseas?
- Business development
  - Buy?
  - Joint Venture?
  - License?
  - Co-promotion?
- Contract bidding
- R&D investment decisions
- Promotional levels/programs
- Product pricing
- Expansion/contraction?
- Litigate or settle?
- Set up marketing and sales organizations?



# Decision Analysis Conclusions

- Decisions *must* be made
  - But are rarely made on “facts” alone
  - Decision analysis links facts, judgment, and decisions
- Value of Decision Analysis
  - Decompositional approach
  - Clarifies situations
  - Quantify sensitivity to assumptions
  - Provides value of information and control
  - *Communicates and supports decisions*