Decisions. Why I Care

By Brad Morantz PhD

Decisions

We are all faced throughout our lives with agonizing decisions, moral choices. Some are on a grand scale. Most of these choices are on lesser points. But, we define ourselves by the choices we have made. We are, in fact, the sum total of our choices.

Events unfold, so unpredictably, so unfairly. Humans happiness does not seem to have been included in the design of creation. It is only we, with our capacity to love, that gives meaning to the indifferent universe.

And yet, most human beings seem to have the ability to keep trying. And to even find joy from simple things like their family, their work, and even from the hope that future generations might understand more.

Louis Levy from Woody Allen's Crime and Misdemeanors.

I can’t decide if I should attend this class

Did you ever get a sweepstakes package in the mail saying that you won:

- A zillion dollars?
- Half of the JB Hunt estate?
- A week vacation in Brentwood with Cato?
- Rights to the popcorn sales at the Atlanta Zoo?

Pro’s

- Maybe you really did win something

Con's

- Time to fill in and mail back the form
- Maybe you will buy a magazine
- Postage to mail it back
- Gets you on mailing lists (see my Data Mining class)

How do you decide?

- “Good” decision making is a science!

Enter Decision Sciences

- Combination of:
  - Applied mathematics
    - Emphasis on quantitative methods & statistics
  - Cognitive psychology
  - Computer Science
  - Modeling & Simulation
  - Problem solving
  - Decision theory
  - Artificial intelligence

Herb Simon Method

- Intelligence
  - Learn about the problem
- Design
  - Possible solutions or paths
- Choice
  - Choose best one and implement

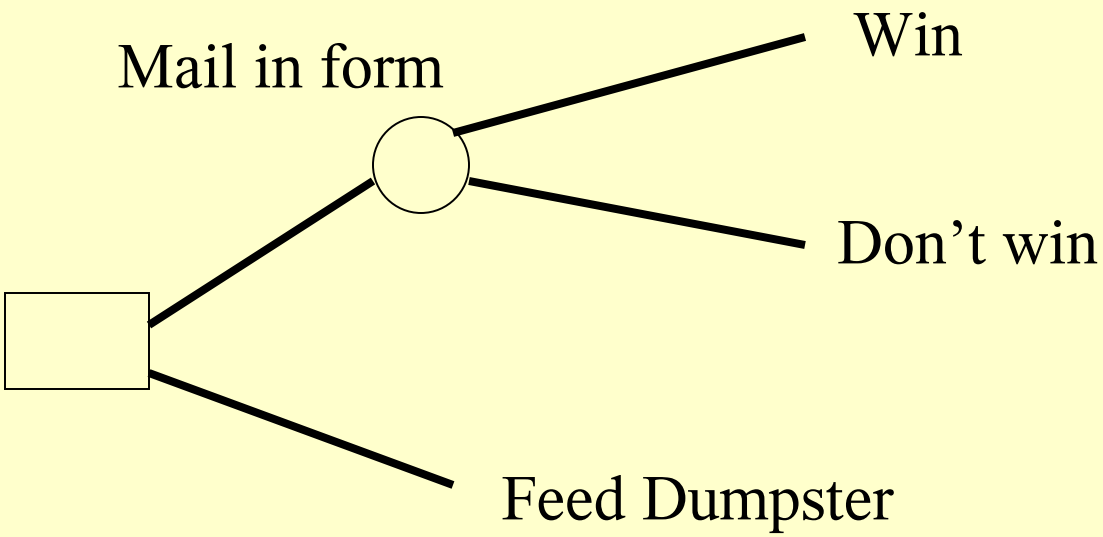
Now what about the sweepstakes?

- Intelligence
  - Looks for odds on back of form
- Design the paths or solutions
  - Mail in the form
  - Feed it to the dumpster
- Choice
  - Build a decision tree to model outcomes of both paths

Decision Nodes

- Certainty
  - It is known what the outcome will be
- Ignorance
  - The outcome of an action is unknown
- Risk
  - A probability can be assigned to each outcome

Decision Tree



We make a decision

Uncertainty

Consequences

- Win
  - Prizes (and Uncle Sam is quickly on your tail to get his share)
- Lose
  - Lost $0.34 plus all of other problems
- Feed Dumpster
  - No gain, no loss

Probabilities

- Probabilities of winning
  - From back of form (by law)
- Grand Prize $ 20 million
  - 1 in 500 million entries
- Runner up prize $1,000.00
  - 50 Winners out of 500 million entries
- Magazine Winners ($15 value)
  - 1000 winners out of 500 million entries

Lets do the math

- Many of these “sweepstakes” come in the mail
- Calculate Expected Monetary Value (EMV)
  - EMV = Σ probability * Value
    - $2 \times 10^{-9} * \$20$ million = \$0.04
    - $1 \times 10^{-7} * \$1000 = \$0.0001$
    - $2 \times 10^{-6} * \$15 = \$0.00002$
    - Total is \$0.04012
- Cash cost of entry is \$0.34
- Consequence is total of above = -\$0.29988

Choose Between

- Enter game
  - Lose about $0.30
- Throw it away
  - Lose nothing

Implement

- “The choice phase is not completed until it is implemented” Harvey Brightman
- Now go feed the dumpster

More Examples

- Oil well drilling
- Enter into Contract
- Start a new venture
- Acquire a company
- Etc etc

Can we improve our probabilities?

- YES!!!
  - Historical data
  - Experts
  - Testing
  - More knowledge
  - Boosting & bagging
- These are all topics for other classes

Combining Information/Data Fusion

- Bayes
  - Conditional probabilities
  - Accepted mathematical routines
- Dempster-Shafer Theory
- Ling & Rudd
- Modeling & Simulation MBDSS
  - Mathematical
  - Neural Network

Hypothesis Testing

- Tire factory states life is 50,000 miles
- If less
  - Too many warranty claims
  - Bad reputation
- If more
  - Could raise price
  - Losing money
- If test tire, it is worn out & can't sell

Hypothesis Testing Solution

- Put random sample on employees' cars
- Look at cars in parking lot
- Employee feedback
- Do statistical analysis
  - Sample mean, standard error, t test
- Ho: true mean is 50,000 miles (at certain confidence level)
- Reject or fail to reject null hypothesis

Statistical Analysis

- Can give probabilities that can help make intelligent decision
- Other statistical analysis methods
  - ANOVA, MANOVA, ANCOVA, MANOCOVA
  - OLS regression, canonical correlation
  - Discriminant analysis, cluster analysis
  - Monte Carlo analysis

Neural Network Applications

- Pattern recognition
- Classification
- Forecasting
- Can use in MBDSS

More Applications

- Investing
- Credit vetting
- Target recognition/selection
- Financial
- Life

More Information

- The Internet
- Decision Sciences Institute
- *Choices, an Introduction to Decision Theory,* Michael D Resnik
- Georgia State University, Decision Sciences Dept
- Books: Quantitative Methods for Business Decisions by L Lapin
  Mathematics for Managerial Decisions by R Childress
  and other books

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