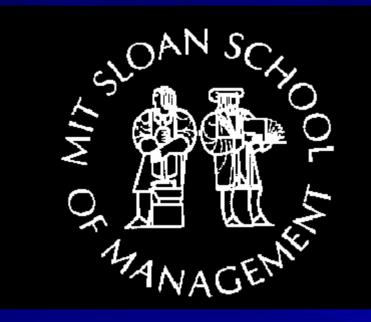# Kendall Crab & Lobster Case

Summer 2003

Why Learn Decision Trees?

- Organize limited data
- Make assumptions explicit
- Learn useful managerial tools
- Enhance thinking skills
- Make better decisions
- Communicate more effectively
- Prepare foundation for further study of simulation and modeling

Decision Analysis Procedure

- List the GOOP
- Construct a decision tree
- Evaluate the endpoints (outcomes)
- Assess probabilities for the branches
- "Expect out and fold back" – Backwards induction
- Sensitivity Analysis
- Interpretation – what does it mean? What decisions should we make?

A (Lobster) Tail of Two Cities

What is the GOOP?

- Goals:

- Options:

- Outcomes:

- Probabilities:

Please see the "Kendall Crab and Lobster Case" in Chapter 1 of the course textbook.

Trees Help Combine Probabilities

■ Which would you prefer,

A. win $300 for sure

B. play a gamble in which you have an 80% chance of winning $450, otherwise $0

■ Which would you prefer,

C. play a gamble with a 75% chance of winning $300, otherwise $0

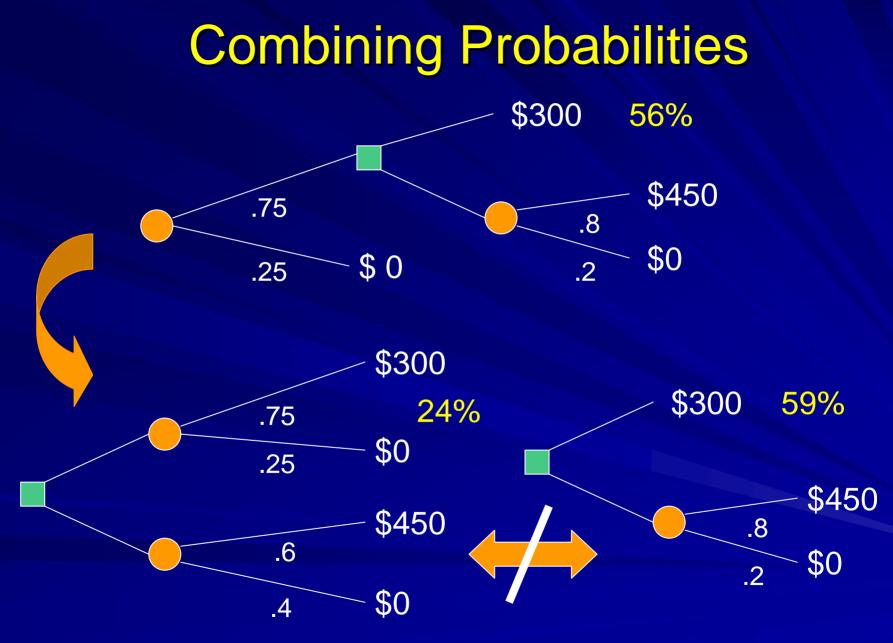D. play a gamble with a 60% chance of winning $450, otherwise $0

Combining Probabilities, continued

- Suppose you must choose the second part of a two-stage gamble now. In the first stage, there is a 25% chance that you will get $0, and a 75% chance that you will go on to the second stage. In the second stage, you can either

  A. win $300 for sure

  B. play a gamble in which you have an 80% chance of winning $450, otherwise $0

- You must choose A or B before you know the first-stage result. Which would you choose?

Combining Probabilities

$300   56%

.75

.25 $ 0

.8 $450

.2 $0

$300

24%   .75

.25 $0

$450

.6

.4 $0

$300   59%

.8 $450

.2 $0

Conditional Probabilities

- P=.8 chance of winning $450 if you get to the second stage is a conditional probability p(win$450/2nd stage)

- The Third Law of Probability (more later):

  $$P(A/B) = P(A \text{ and } B)/P(B)$$

  $$P(A \text{ and } B) = P(A/B) \times P(B)$$

- P (winning $450 and getting to second stage) = .8 X .75 = .6

Probability Tables

	Win first stage	Lose first stage	Total
Win second stage	.75 X .8 = .6	.25 X .8 = .2	.6 + .2 = .8
Lose second stage	.75 X .2 = .15	.25 X .2 = .05	.15 + .05 = .2
Total	.6 + .15 = .75	.2 + .05 = .25	.8 + .2 = 1 = .75 + .25

KCL Sensitivity Analysis

- Does considering goodwill costs/demand cannibalization affect the solution?

  No. Canceling the orders and sending coupons is not part of the optimal tree, even under the more optimistic scenario considered here.

- How sensitive is the solution to the probability the storm hits Boston (p)?

  The optimal solution is to pack and wait as long as the EMV of this decision is greater than the EMV of the EPD option. We can easily see this is the case for all values of p. Thus, the optimal solution stays the same even if p=1.

Sensitivity Analysis (continued)

- How sensitive is the solution to the probability that Logan will close given a storm (q)?

  The optimal solution is to pack and wait as long as the EMV of this decision is greater than the EMV of the EPD option: $20250. Thus:

  $0.5(30000) + 0.5\{q(-15000) + (1-q)30000\}>20250$

  $0.5(-45000q)>20250 - 15000 - 15000$

  $-22500q>-9750$

  $q<9750/22500$

  $q<0.433$

  Thus, the optimal solution remains unchanged for a value of q as high as 0.433

What About Risk?

Optimal Strategy

EMV: $25500	
Event	Probability
$30000	.5+.5(.8)=0.90
-$27000	(.5)(.2)(.33)=.033
-$9000	(.5)(.2)(.67)=.067

Using EDP

EMV: $20250	
Event	Probability
$18000	0.50
$21000	0.25
$24000	0.25

Should Jeff change his strategy?

What would you do?

Is $27,000 a catastrophic loss for KCL? An embarrassment? A career limiting result?

Creative Alternatives

- Send an early partial shipment from Logan (UE or competitive alternative)
- Select orders for closer/important clients for ground delivery
- …

Summary

- Decision trees are a helpful tool to organize our thinking and address some failures of intuition

- Decision trees provide shared language and tools to communicate more easily and precisely

- Judgment is needed in structuring decisions for analysis, examining sensitivities, and suggesting creative alternatives (new options)

- Much value comes from sensitivity analysis, which is part art, part science