WFA8433-Natural Resource & Conservation Decision Making

Class 4 Decision trees and decision models

Housekeeping

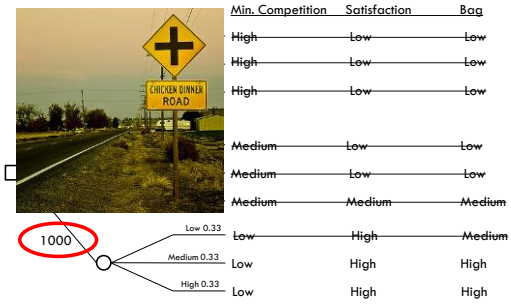
- Suggested readings:
  - Smart Choices Chapters 7 & 8
  - Conroy & Peterson 159-160
- Assignment(s): None
- Group work: Will assign today

Best alternative?

Alternatives

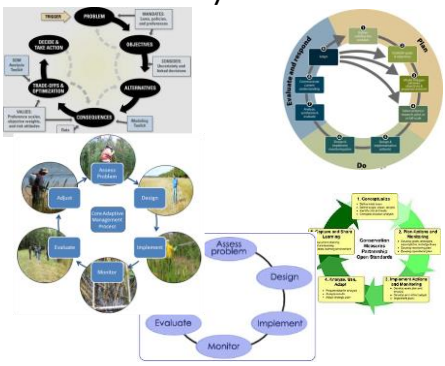
1. Stock 300 Trout
2. Stock 500 Trout
3. Stock 1000 Trout

What is the best decision?

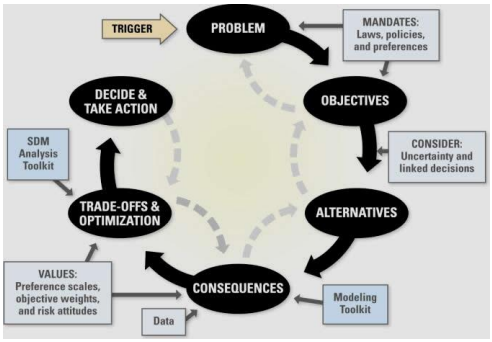


What if some information is known about return to creel?

Folksy to Formal



PrOACT



Class objectives

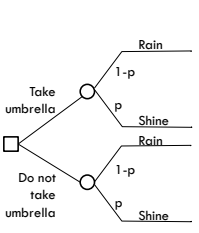
1. Further understanding of decision trees incorporating uncertainty
2. Expected value
3. Risk profiles
4. Dealing with multiple objectives
5. Curse of dimensionality

Simple decision tree

Should I take an umbrella?

- Decision alternatives
  - Take umbrella, Do not take umbrella
- Uncertainty: Will it rain (1-p) or not (p)

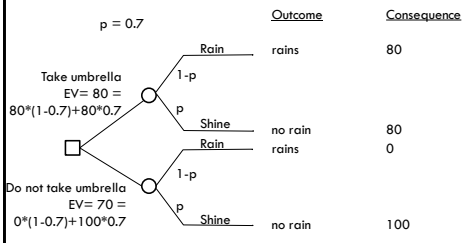
Umbrella decision



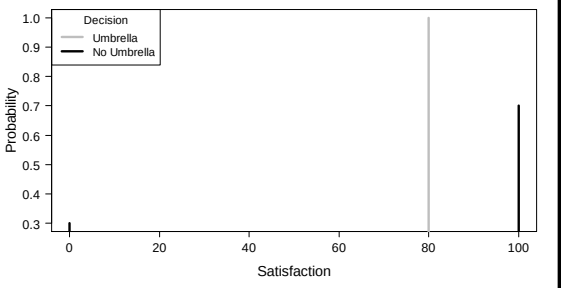
Outcome	Consequence
Take umbrella & rains	80
Take umbrella & no rain	80
Do not take umbrella & rains	0
Do not take umbrella & no rain	100

Best possible outcome

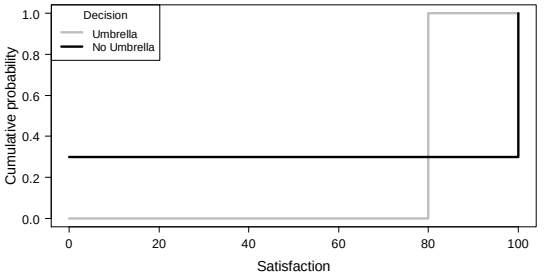
Umbrella decision: Expected value (EV)



Risk profile



Cumulative Risk Profile



A more complicated tree

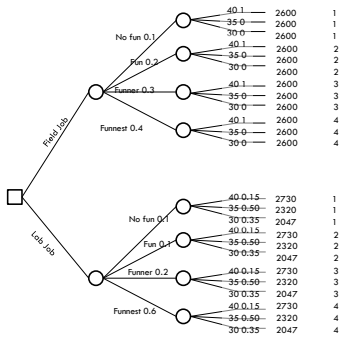
Which Summer internship offer should I take?

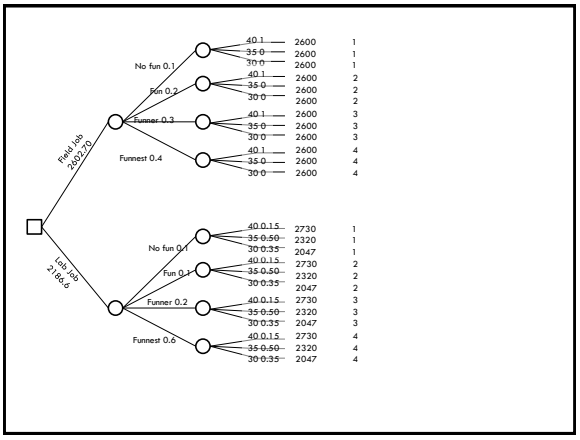
- Decision alternatives
  - field experience or lab experience
- Uncertainty
  - How many hours will I get to work
  - How fun will it be?

Uncertainties

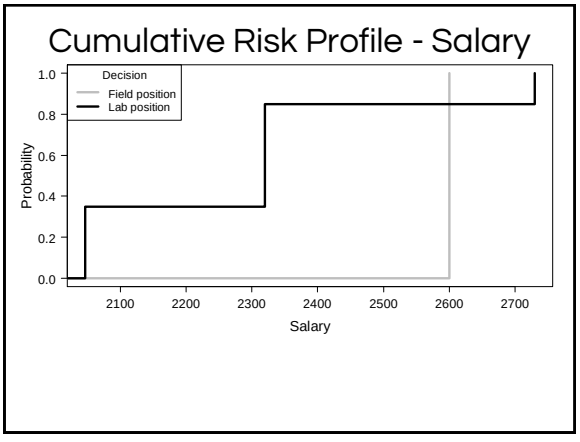
Decision	Fun level	Probability
Field Job	No fun	0.1
	Fun	0.2
	Funner	0.3
	Funnest	0.4
Lab Job	No fun	0.1
	Fun	0.1
	Funner	0.2
	Funnest	0.6

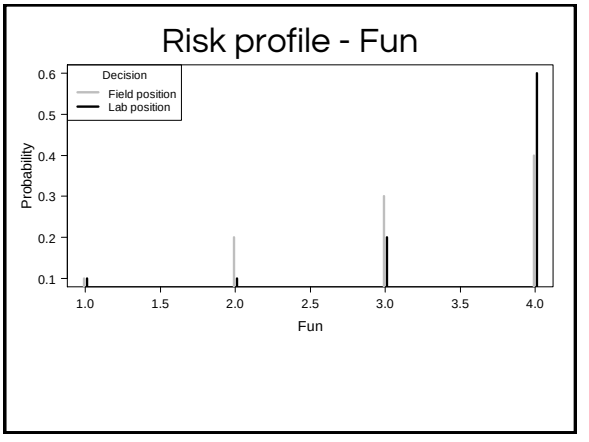
Decision	Hours/Wk	Probability
Field Job	30	0
	35	0
	40	1
Lab Job	30	0.35
	35	0.50
	40	0.15

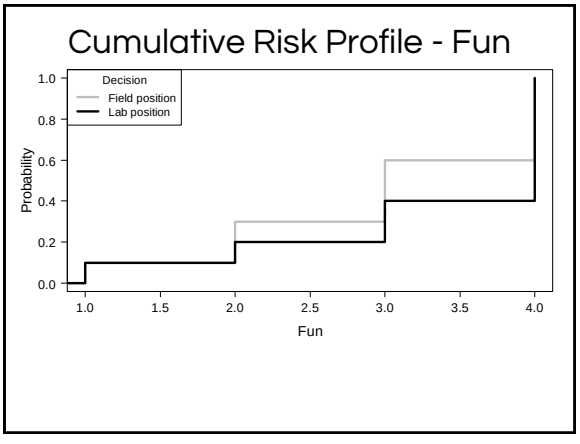


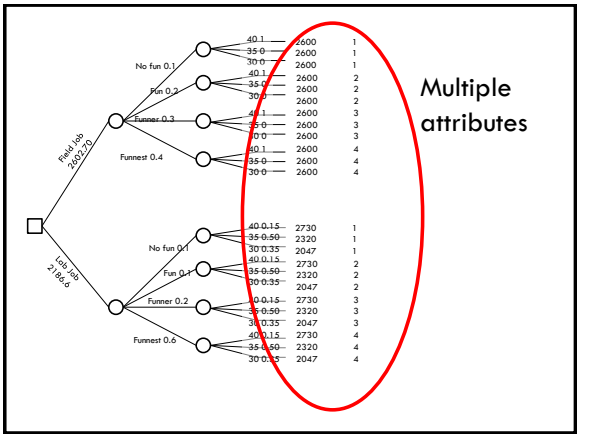

Field Job
2602.70
Lab Job
2186.6
No fun 0.1
Fun 0.2
Funner 0.3
Funnest 0.4
No fun 0.1
Fun 0.1
Funner 0.2
Funnest 0.6
40 1 2600 1
35 0 2600 1
30 0 2600 1
40 1 2600 2
35 0 2600 2
30 0 2600 2
40 1 2600 3
35 0 2600 3
30 0 2600 3
40 1 2600 4
35 0 2600 4
30 0 2600 4
40 0.15 2730 1
35 0.50 2320 1
30 0.35 2047 1
40 0.15 2730 2
35 0.50 2320 2
30 0.35 2047 2
40 0.15 2730 3
35 0.50 2320 3
30 0.35 2047 3
40 0.15 2730 4
35 0.50 2320 4
30 0.35 2047 4


Risk profile - Salary
Decision
Field position
Lab position
Probability
1.0
0.8
0.6
0.4
0.2
2100
2200
2300
2400
2500
2600
2700
Salary


Cumulative Risk Profile - Salary
Decision
Field position
Lab position
Probability
1.0
0.8
0.6
0.4
0.2
0.0
2100
2200
2300
2400
2500
2600
2700
Salary


Risk profile - Fun
Decision
Field position
Lab position
Probability
0.6
0.5
0.4
0.3
0.2
0.1
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Fun


Cumulative Risk Profile - Fun
Decision
Field position
Lab position
Probability
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Fun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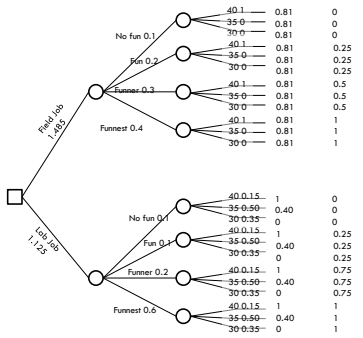
No fun 0.1
Fun 0.1
Funner 0.2
Funnest 0.6
Multiple attributes

Proportional scoring

$$Utility = \frac{Value - min(Value)}{max(Value) - min(Value)}$$

$$Utility = \frac{2600 - 2047}{2730 - 2047}$$

$$Utility = 0.81$$



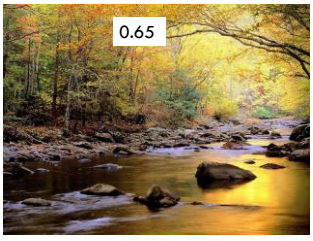
More uncertainty

- Effects on populations?
- Habitat?

N_t → N_{t+1} → N_{t+2}

Timber harvest?

Uncertainty-Stream condition

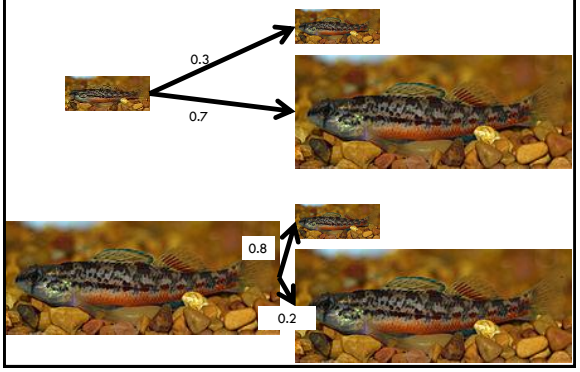


Current Fish Population Size

0.8

0.2

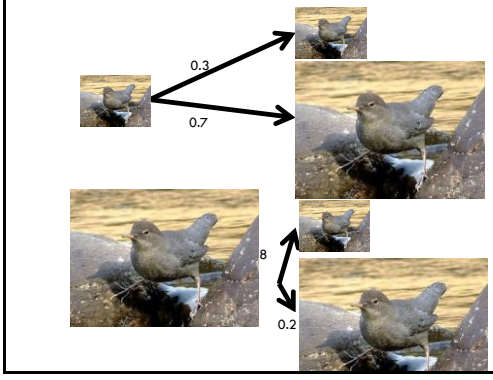
Future Population Size



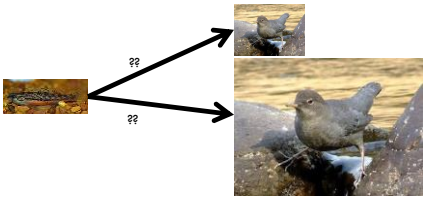
Consequences

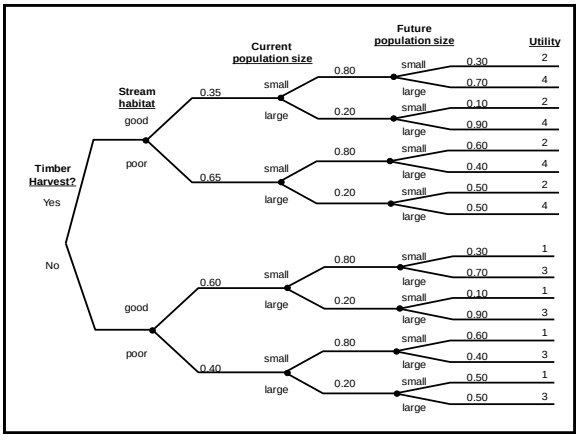
Decision	Future population	Utility
Harvest	Small	2
	Large	4
No harvest	Small	1
	Large	3

Future Population Size



Future Population Size



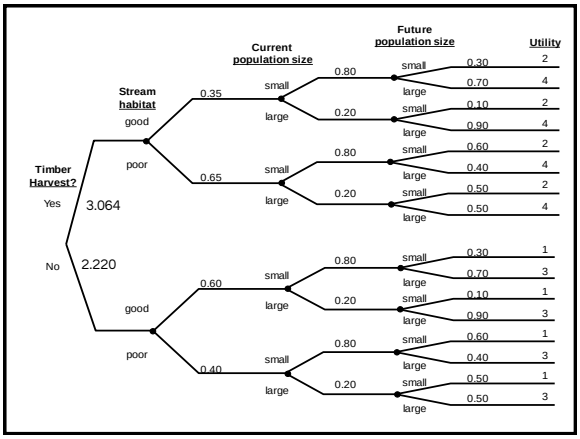


Harvest

Stream habitat	Population size: Current	Population size: Future	Tree branch product
good	small	small	0.35*0.80*0.30*2
good	small	large	0.35*0.80*0.70*4
good	large	small	0.35*0.20*0.10*2
good	large	large	0.35*0.20*0.90*4
poor	small	small	0.65*0.80*0.60*2
poor	small	large	0.65*0.80*0.40*4
poor	large	small	0.65*0.20*0.50*2
poor	large	large	0.65*0.20*0.50*4
		sum	3.064

No Harvest

Stream habitat	Population size		Tree branch product
	Current	Future	
good	small	small	0.6*0.8*0.3*1
good	small	large	0.6*0.8*0.7*3
good	large	small	0.6*0.2*0.1*1
good	large	large	0.6*0.2*0.9*3
poor	small	small	0.4*0.8*0.6*1
poor	small	large	0.4*0.8*0.4*3
poor	large	small	0.4*0.2*0.5*1
poor	large	large	0.4*0.2*0.5*3
		sum	2.220



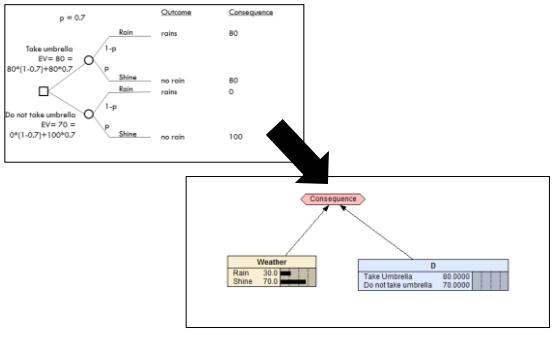
In class exercise

The Curse of Dimensionality

Discretization

- Take values and condense to fewer bins
  - 0 to 0.1, 0.11 to 0.2, 0.21 to 0.3,…0.91 to 1 10 bins
  - 0 to 0.25, 0.251 to 0.5, 0.51 to 0.75, 0.751 to 1, 4 bins
  - 0 to 0.25, 0.251 to 0.5, 0.5+

Introduction to Netica



Group assignments

- Find group
- Discuss potential final project ideas