

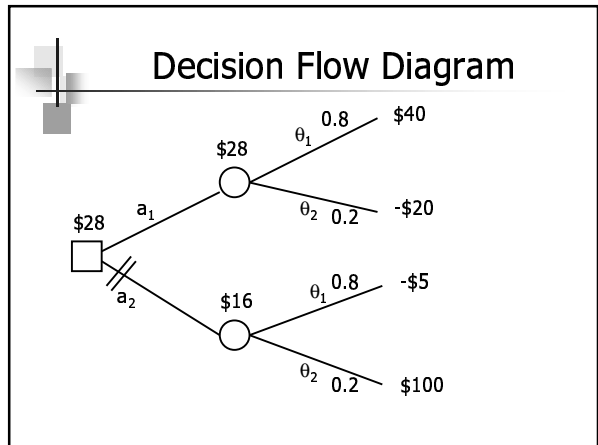
Lecture 2

More Decision Analysis

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- ### Overview
- Review Last Lecture
 - Value of Information
 - Uncertain Payoffs
 - Sampling Costs
 - Measurement Errors
 - Strategies
 - Normal Form of Analysis

- ### A Simple Urn Problem
- Imagine a collection of 1000 urns.
 - 800 urns of type 1 and 200 urns of type 2.
 - Type 1 contains: 4 Red balls and 6 **Black** balls
 - Type 2 contains: 9 Red balls and 1 **Black** ball.
 - Someone chooses a urn at random and asks you to decide what type it is.
 - If you guess type 1 and you are correct you get \$40. If you are wrong you lose \$20.
 - If you guess type 2 and you are right you get \$100. If you are wrong you lose \$5.



- ### Extensive Form of Analysis
- Construct a decision flow diagram
 - Assign payoffs at the leaves.
 - Assign probabilities at all chance nodes.
 - Average out and fold back.

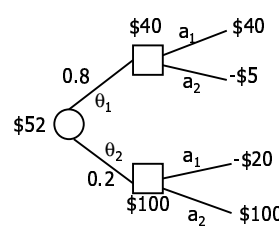
- ### Value of Information
- Before deciding to operate a doctor may run further diagnostic tests.
 - Before drilling for oil a wildcatter might run geological tests.
 - Before starting an advertising campaign a business might do a market survey.

Expected Value of Perfect Information

- Expected Value of Perfect Information (EVPI)

EVPI = EMV with free Perfect Information – EMV with No Information

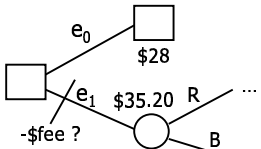
Expected Value of Perfect Information



- EMV with free perfect information = \$52
- EMV with no information = \$28
- EVPI = \$52 - \$28 = \$24

Expected Value of Sample Information

- Now suppose you are allowed to draw a single ball from the urn for a fee.
- How much would you be prepared to pay to draw a single ball?



- EVSI = \$35.20 - \$28 = \$7.20

Expected Value of Sample Information

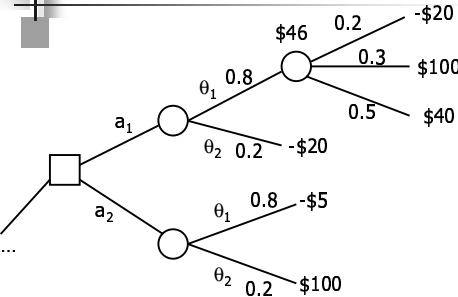
- Expected Value of Sample Information (EVSI)

EVSI = EMV with free Sample Information – EMV with No Information

Uncertain Payoffs

- Suppose instead of getting \$40 for guessing the urn is of type 1 when it is of type 1 you get:
 - \$20 with probability of .2
 - \$100 with probability of .3
 - \$40 with probability of .5

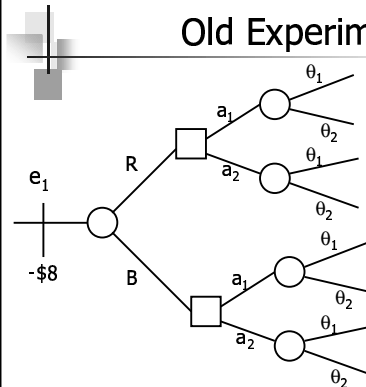
Uncertain Payoff



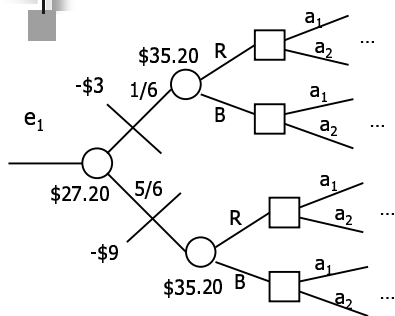
Sampling Cost

- Suppose for the case of sampling one ball, instead of a toll of \$8 the toll is:
 - \$3 with probability $1/6$.
 - \$9 with probability $5/6$.

Old Experiment e_1



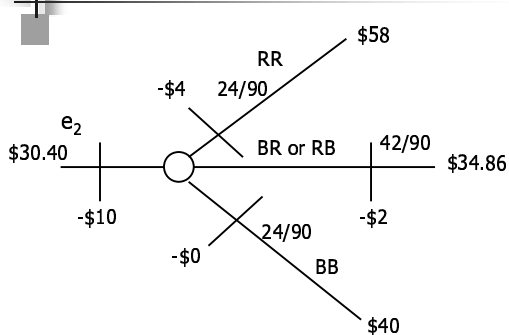
New Experiment e_1



Sampling Cost

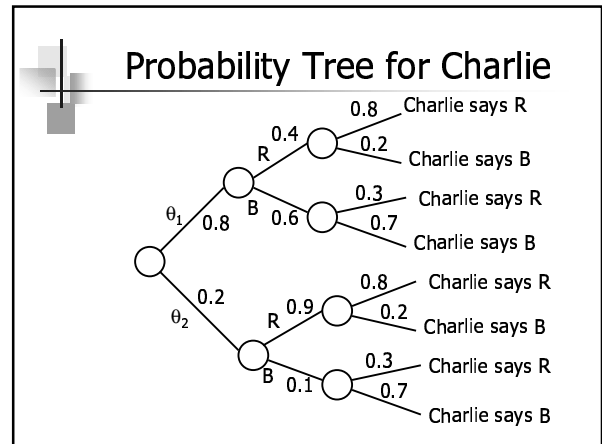
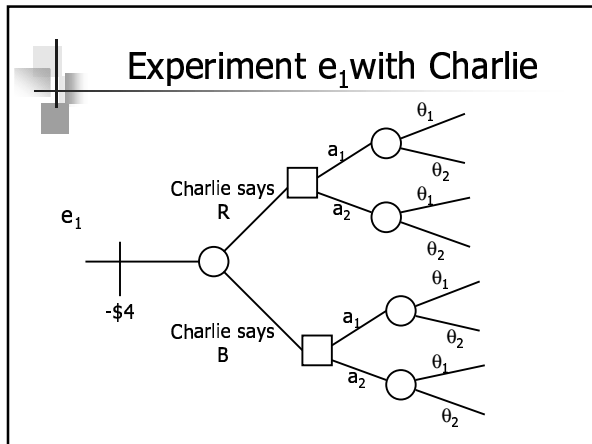
- Sometimes the cost of sampling depends on the outcome.
- Suppose for the case of sampling 2 balls, instead of a toll \$12 the toll is:
 - \$10 plus a penalty of \$2 for every Red ball drawn.

New Experiment e_2



Biased Measurements

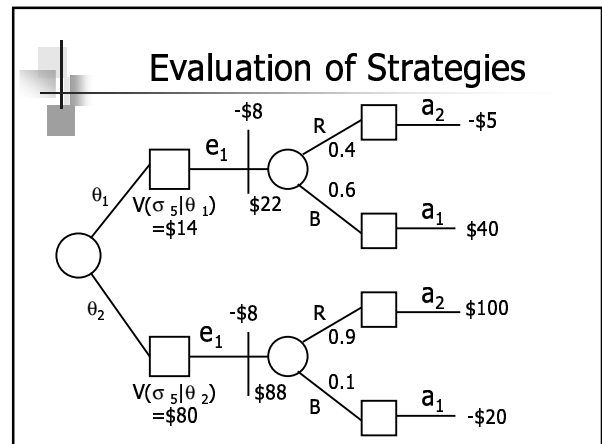
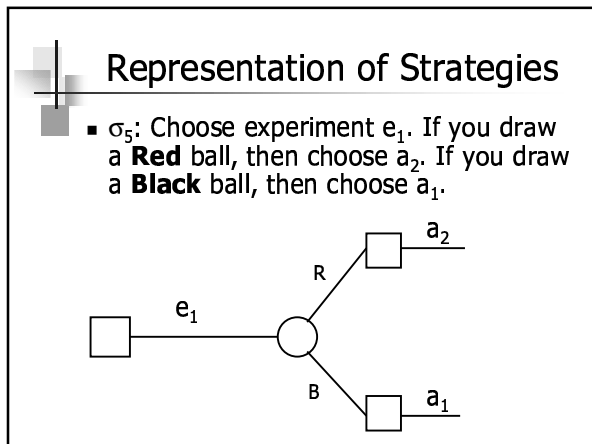
- Assume that the cost for sampling is cut in half if you get Charlie to do the sampling for you.
- The problem is Charlie will only identify
 - Red balls correctly 80% of the time, and
 - Black** balls correctly 70% of the time.

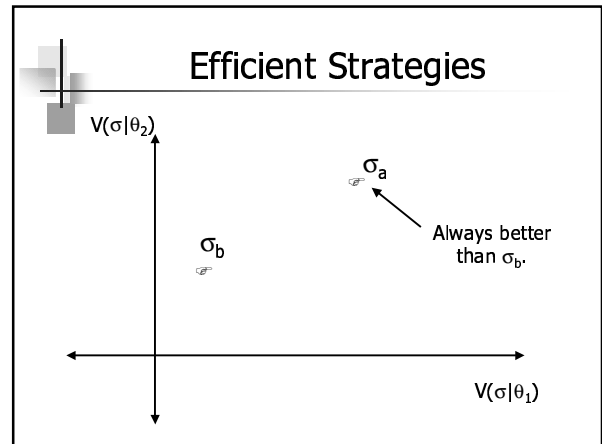
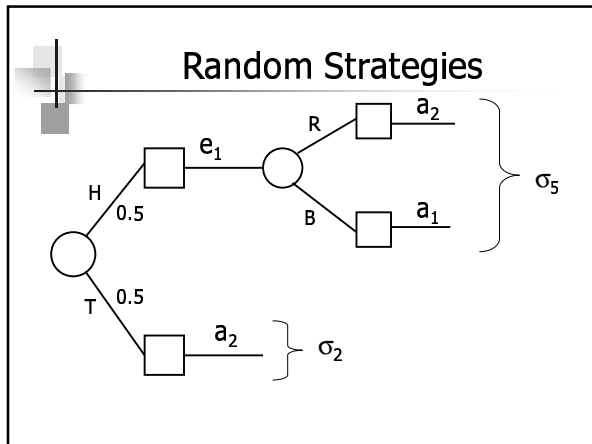


- ### Example Strategies
- σ_1 : Choose a_1 without experimenting.
 - σ_2 : Choose a_2 without experimenting.
 - σ_5 : Choose experiment e_1 . If you draw a **Red** ball, then choose a_2 . If you draw a **Black** ball, then choose a_1 .
 - σ_{96} : Choose experiment e_5 . If you draw a **Black** ball, then choose a_1 . If you draw **Red** ball, then sample again without replacement. If you then draw a **Red** ball, then choose a_2 , else choose a_1 .

Strategy

A decision rule that one can give to an agent, that unambiguously tells the agent what to do given any past history up to that time.





- ### Normal Form of Analysis
- Find all the strategies.
 - Evaluated all the strategies.
 - Find the efficient strategies.
 - Find the strategy that has to the maximum expected monetary value.