

Bayesian Models

CSE458

David Albrecht

Overview

- Course Information
- Decision Theory
- An Urn Problem
- Decision Flow Diagrams and EMV

Lecturer

- David Albrecht
- Office: Room 113 Building 75
- Email: dwa@csse.monash.edu.au
- Tel: 9905 5526

Courseware Page

- Lectures
- Assessment
- References
- Other Material

An Oil Drilling Problem

An oil wildcatter must decide whether or not to drill at a given site.

Areas of uncertainty:

- Cost of drilling, size of deposits, cost of raising oil, future price of oil, etc.

Information:

- Records of other drillings, opinions of experts, etc.

Options:

- Conduct seismic soundings, get another opinion, etc.

A Medical Problem

A patient arrives with an acute abdominal pain, and the doctor needs to decide what treatment to give.

Areas of uncertainty:

- Cause: *functional disorder, colic, acute cholecystitis, gastric ulcer, perforated gastric ulcer, acute pancreatitis, acute hepatitis, appendicitis, ruptured spleen, etc.*

Information:

- Symptoms, patient's history, medical knowledge, etc.

Options:

- Physical examination, lab tests, exploratory operation, etc.

A Political Problem

A government committee must decide whether to permit the use of a chemical which maybe carcinogenic.

Areas of uncertainty:

- Long term benefits, health hazards, costs, public reaction, etc.

Information:

- Opinions of experts, case studies, etc.

Options:

- Permit the use, ban it, restrict the use, conduct experiments to determine the carcinogenic potential and possibility of exposure, etc.

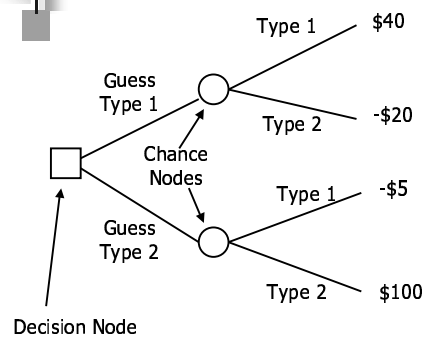
Decision Analysis

- A means for making a rational decision under uncertainty.
- Causes of uncertainty (Russell & Novig):
 - Laziness
 - Theoretical ignorance
 - Practical ignorance

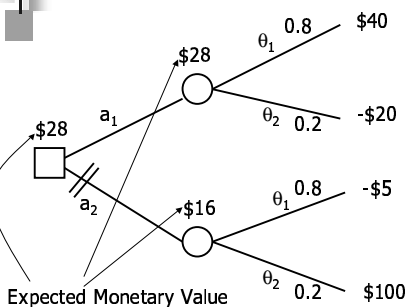
A Simple Urn Problem

- 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.

Decision Flow Diagram



Decision Flow Diagram



Experiments

- Now suppose you are allowed to make only one of the following experiments.
 - e_1 : For \$8 you are allowed to draw a single ball from the urn.
 - e_2 : For \$12 you can draw two balls from the urn.
 - e_3 : For \$9 you can draw a single ball from the urn with the option of another draw for \$4.50. You also have the option of replacing the first ball before drawing the second.

