

QR 26: Choice and Chance The Mathematics of Decision Making

Unit IV Study Guide: Judgement and Decisions Under Uncertainty

Synopsis: In the past chapters, we have talked about how to measure, calculate with, and optimize *values* in decision situations. Now we turn to the question of *judgement*, how to measure and calculate with *uncertainties*. *Probabilities* form a natural language for discussing uncertainty, but the many commonly-held interpretations of what a probability is can lead to contradictory results. We will choose an interpretation – *subjective probability* – that best fulfills the requirements of decision analysis. Then we will try to join our *uncertainty analysis* together with the *value analysis* that we have studied in the first three units, using the notions of *expectation value* and *utility*. These theoretical developments will enable us to solve decision problems in which the outcomes are not known with certainty.

References: All readings are found in the sourcebook or required books.

- [R&P1] Raiffa, Howard, and John Winsor Pratt. “An Informal Treatment of Foundations,” *Introduction to Statistical Decision Theory*, p. 11-46. (In sourcebook.)
- [R&P2] Raiffa, Howard, and John Winsor Pratt. “Analysis of Decision Trees,” *Introduction to Statistical Decision Theory*, p. 11-46. (In sourcebook.)
- [R] Raiffa, Howard. “Analysis of Your Basic Problem,” “The Use of Judgemental Probability,” *Decision Analysis*, p. 7-38, 104-128.
- [SC] Hammond, et al., *Smart Choices*. Chapters 7, 8, 10.
- [CDA] Weinstein and Feinberg, *Clinical Decision Analysis*, selections.

For Class IV.1 on Thursday, March 16, 2000

Topics: Uncertainty vs. certainty; motivating decision examples; the decision-tree notation; risk profiles and the separation principle. Behavioral realities (descriptive); decision traps (prescriptive). The language of probability; classical, canonical, frequentist, subjectivist interpretations; mathematical probability.

Read: [SC] Chapter 7 on risk profiles and decision trees; [CDA] 12-42 (sourcebook 10-24) on decision trees and probability; [R] p. 104-116 (sourcebook 206-212) (consistency of probabilities) and [R&P1] sections 2.2 (canonical probability) and 2.6 (consistency requirements for judgemental probability) sourcebook pages 134-5 and 148-154.

(Please note: these readings are slightly redundant from a technical standpoint, and it is not necessary to finish them all at once. However, they present the material from many different perspectives -- perspectives that will deepen your understanding of probability and make it more “functional” in your daily life. You should be sure to survey them all before the end of the unit.)

For Class IV.2 on Tuesday, March 21, 2000

Topics: The sapling; substitution of lotteries with canonical probabilities; determination of BRiLT utilities. Analysis of chance nodes: the case of canonical lotteries with monetary payoffs; reduction of lotteries via EMV and expectation value; criticism of EMV as a decision criterion; canonical lotteries with BRiLT payoffs.

Due: Unit IV activity.

Read: [SC] chapter 8 on risk attitudes; remainder of [R&P1] (sourcebook 133-158) on reduction of lotteries (do NOT read section 2.8!); [R] p. 117-124 on reduction of lotteries (sourcebook 212-216); [CDA], p. 49-61 (sourcebook 31-42) on reduction of trees and EV's.

For Sections IV.1 (March 21 22, 2000)

Midterm exam review! Come with questions!

MIDTERM: Thursday, March 23, 2000

For Class IV.3 on April 4, 2000

Topics: Inventory models; critical fractile analysis for distributions; assessment of continuous utility functions; logarithmic utility; Ces and RPs; the phenomenon of decreasing marginal utility.

Read: Be sure to finish up the readings from the previous lectures.

For Class IV.4 on April 6, 2000.

Topics: The Bernoulli data generating process; random number generators and simulations in Excel; "hot-hand" fallacy. Classic paradoxes of decision-making under uncertainty: Allais paradox, Ellsberg paradox, Russian Roulette.

Due: Unit IV problem set, and case study (TBA).

Read: A[R&P1] section 2.8 (sourcebook 158-164) on conditional utilities and probabilities.