Homework 8 – Decision Trees

Due: 1:30pm, May 21, 2025

1. Review examples on Bayes' Rule (Winston, 2004, pages 100 – 103)

2. Winston (2004), Section 2.3, Prob. 14

A patient enters the hospital with severe abdominal pains. Based on past experience, Doctor Craig believes there is a 28% chance that the patient has appendicitis and a 72% chance that the patient has nonspecific abdominal pains. Dr. Craig may operate on the patient now or wait 12 hours to gain a more accurate diagnosis. In 12 hours, Dr. Craig will surely know whether the patient has appendicitis. The problem is that in the meantime, the patient's appendix may perforate (if he has appendicitis), thereby making the operation much more dangerous. Again based on past experience, Dr. Craig believes that if he waits 12 hours, there is a 6% chance that the patient will end up with a perforated appendix, a 22% chance the patient will end up with "normal" appendicitis, and a 72% chance that the patient will end up with nonspecific abdominal pain. From past experience, Dr. Craig assesses the probabilities shown in Table 1 of the patient dying. Assume that Dr. Craig's goal is to maximize the probability that the patient will survive. Use a decision tree to help Dr. Craig make the right decision.

Table 1 The probabilities of the patient dying

Situation	Probability that patient will die
Operation on patient with appendicitis	0.0009
Operation on patient with nonspecific abdominal pain	0.0004
Operation on perforated appendix	0.0064
No operation on patient with nonspecific abdominal pain	0.0000

Submission requirements:

1. For each (sub)problem, name the solution file as "*problem_x.ext*," where "*x*" represents the (sub)problem number (*x* = 1, 2, 3 or *x* = 1a, 1b, 1c) and the file extension "*ext*" depends on the file type (Word, Excel, PDF, etc.). If the solution to a (sub)problem contains multiple files (e.g., a Python package), organize the file(s) into a folder and name the folder as "*problem_x*."

2. Note that your Python files must be able to be executed directly. So use relative paths instead of absolute paths. If necessary, you may provide a short "user manual" of instructions on how to execute your codes.

   Warning: If the TAs have to manipulate your Python package to verify your solutions, you will be deducted points from your grade.

3. Pack all the "(sub)problem" folders in a zip file and name the zipped file "*hw_##_Chinese name.zip*," where "##" (two digits) represents the homework number, for example, "*hw_08_赵磊.zip*."