Homework 5 – Assigned: February 11, 2026, Due: February 18, 2026

Weld Quality Monitor

The construction of the ABC Chemical Plant involves the installation of a very large amount of process piping that needs to be welded together. Because weld quality is crucial to the success of the project, the contract requires it to be monitored during construction. You are the project manager for this job and must choose between two alternative weld monitoring systems: "System X" and "System Y". System X has well-known properties. If it proves to be a success (P[XS]=0.8) you will make a profit of $150k. If it works poorly (P[XF]=0.2) your profit will decrease to $90k. On the other hand, System Y appears promising, but you have not used it on a construction project before. If it works, your profit will be $300k, but if it does not, your profit will be -$45k (a loss). You estimate that these outcomes are equally likely (P[YS]=P[YF]=0.5).

System Y has been developed in Germany and is not available for testing prior to purchase. System X, however, is widely available and you have the option to test its suitability to the job. You estimate that the test will indicate that X will be a success with probability P[IXS]=0.75. You also estimate that the test will indicate that X will be a success given that it really works with probability P[IXS|XS]=0.9.

a. Ignoring the test possibility, which monitoring system, X or Y, should you use?
b. What is the "EVPI for the performance of System X"?
c. What is the "EVPI for the performance of System Y"?
d. What is the "EVPI for the performance of both Systems X and Y"? Explain your results.
e. What is the "EVSI for the above test on X"?

Lost Records

You can purchase one of two plots of land (called X and Y) for $4M (million). The value of plot X or Y depends on what you can build on it. Last year, engineers took a set of 10 borings from each plot. In one set, 3 borings showed a hard rock base (RB) and 7 showed compressed soil (CS), indicating that this plot will support a high-rise building, making it worth $6.5 M. In the other set, 5 borings showed loose soil (LS) and the other 5 showed compressed soil (CS), indicating that this plot will only support houses, making it worth $3M. The difficulty is that someone has lost the record of which set of samples goes with which plot! (Notice that if you end up with the plot that only supports houses you will lose $1M.)

The owner of the two plots will allow you to obtain one new boring from plot X, but only if you commit to buy at least one of the two plots that you can choose afterwards. You estimate that the probability of getting a boring of a specific type is proportional to the number in the original set of samples. For example, the probability of getting a boring showing compressed soil (CS) from the $6.5M plot is 0.7; but you do not know which of the two plots, X or Y, is the $6.5M plot.

a. Construct your decision tree with the decision alternatives and possible profit outcomes.
b. Find the "EVPI for the value of plot X". (What is the most you would pay for a boring)?
c. What are the *posterior* conditional probabilities for the dollar value of the plot X that will be tested with the new boring? (Consider each one of the three possible test outcomes.)
d. What is the most you should pay to obtain the new boring from plot X?
e. Suppose that the cost of the boring is $0.5M. What is your best strategy?