

Evidence Updating and Decision Loss

Practice Exercises

These exercises move from calculation to executive authorization. Show assumptions, units, and decision logic. A numerically correct answer that omits authority, distributional effects, or hard constraints remains incomplete.

Control	Specification
Module	EP-M03
Asset	EP-M03-A03 Practice Exercises
Recommended time	120 to 150 minutes
Companion	EP-M03-A08 Companion Notebook v0.2
Sectors	Agriculture, Education, Health, Habitat

Part A Core reasoning

Exercise 1 Prior odds and evidence weight

An education authority assigns prior probability 0.30 to the state that a tutoring programme produces a meaningful learning gain. A new evaluation result is 3 times as likely when the programme is effective as when it is ineffective.

1. Convert the prior probability to odds.
2. Apply the likelihood ratio.
3. Convert posterior odds to probability.
4. Explain why the posterior alone does not authorize scale-up.

Exercise 2 Bayes rule from likelihoods

A health surveillance alert has sensitivity 0.85 and false-positive probability 0.20. The prior probability of a serious event is 0.10. Calculate the posterior probability following an alert. State one reason the result may not transport to another district.

Exercise 3 Loss threshold

In a habitat inspection, evacuation costs 12 when the structure is safe and 0 when unsafe. Non-evacuation costs 0 when safe and 48 when unsafe. Derive the posterior probability threshold above which evacuation minimizes expected loss.

Part B Canonical agriculture case

Input	Limited outbreak	Severe outbreak
Prior probability	0.60	0.40
P(positive signal state)	0.30	0.80
Loss if monitor	0	20
Loss if intervene	8	0

Exercise 4 Update and decide

1. Calculate the probability of a positive signal.
2. Calculate the posterior probability of severe outbreak.
3. Calculate posterior expected loss for monitoring and intervention.
4. Select the Bayes action and quantify the expected-loss advantage.
5. Identify one ecological or rights constraint that could make the Bayes action inadmissible.

Exercise 5 Sensitivity and reversal

Hold the loss matrix constant. Derive the severe-outbreak probability at which the recommendation changes. Then test posterior probabilities 0.20, 0.30, 0.50, and 0.70. Report the action in each case and explain the governance significance of a posterior near the threshold.

Exercise 6 Value of information

Using the canonical agriculture posterior and losses, calculate expected loss with perfect information and EVPI. A same-day diagnostic costs 1.2 loss units and produces expected posterior minimum loss of 1.712. Calculate EVSI and net value of sample information. Should the authority wait for the diagnostic if waiting itself adds 0.4 loss units?

Part C Sector decision cases

Exercise 7 Agriculture

A locust-control team must choose ACT, PILOT, or WAIT AND LEARN while evidence quality differs across districts and pesticide exposure falls disproportionately on pastoral communities.

1. Define states and admissible actions.
2. Propose a prior range and state its provenance.
3. Specify evidence likelihoods and key quality threats.
4. Construct a loss matrix that makes distributional effects visible.
5. Name a hard constraint and a missing state.
6. Select a provisional action and state the reversal condition.
7. Define monitoring triggers, review date, and accountable authority.

Exercise 8 Education

A ministry must decide whether to scale an AI-assisted tutoring system after a positive pilot with attrition, teacher effects, and uncertain transfer to rural schools.

1. Define states and admissible actions.
2. Propose a prior range and state its provenance.
3. Specify evidence likelihoods and key quality threats.
4. Construct a loss matrix that makes distributional effects visible.
5. Name a hard constraint and a missing state.
6. Select a provisional action and state the reversal condition.
7. Define monitoring triggers, review date, and accountable authority.

Exercise 9 Health

A health authority must decide whether to expand screening when false negatives carry high clinical loss but false positives create referral congestion and anxiety.

1. Define states and admissible actions.
2. Propose a prior range and state its provenance.
3. Specify evidence likelihoods and key quality threats.
4. Construct a loss matrix that makes distributional effects visible.
5. Name a hard constraint and a missing state.

6. Select a provisional action and state the reversal condition.
7. Define monitoring triggers, review date, and accountable authority.

Exercise 10 Habitat

A city must decide whether to evacuate a flood-prone settlement when sensor evidence is incomplete, tenure is contested, and delayed action could cost lives.

1. Define states and admissible actions.
2. Propose a prior range and state its provenance.
3. Specify evidence likelihoods and key quality threats.
4. Construct a loss matrix that makes distributional effects visible.
5. Name a hard constraint and a missing state.
6. Select a provisional action and state the reversal condition.
7. Define monitoring triggers, review date, and accountable authority.

Part D Executive synthesis

Exercise 11 Evidence Update and Decision Loss Matrix

Choose one sector case and complete the matrix below. Keep entries concise enough for an approval meeting, but preserve every assumption needed for independent challenge.

Field	Executive record
Decision question	
Authority and deadline	
States	
Actions	
Prior and provenance	
Evidence and likelihoods	
Posterior and range	

Field	Executive record
Loss matrix	
Hard constraints	
Bayes action	
Reversal conditions	
Value of further information	
Distributional effects	
Monitoring and exit rules	
Final authorization	

Exercise 12 Oral defense

Prepare a five-minute recommendation to a skeptical authorization committee. State the decision, the strongest evidence, the dominant loss asymmetry, the most plausible reversal, who bears the losses, and the condition under which the authorization expires.

Submission standard

- All probabilities and losses carry clear definitions and units.
- Every calculation is reproducible.
- Sensitivity includes at least one prior, likelihood, and loss variation.
- At least one omitted state and one distributional effect are addressed.
- The final action includes authority, monitoring, review, and exit rules.