ABDUCTIO (Open Evidence Pack): Reproducible Demos & High-Level Validation Map

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Contents

1 Executive Summary

This open pack shows **verifiable evidence** that ABDUCTIO's *buy evidence iff EVSI Cost > 0* gate improves decisions while avoiding over-learning. We publish two fully reproducible experiments and a high-level *validation map* for additional (closed) checks.

- **Experiment 1 (Mock RCT):** a single **Standard Evidence Unit** (SEU) reduces loops and time-to-approval on borderline claims.
- **Experiment 2 (Deterministic EVSI):** using public digits of π, information has value **only at indifference**; the gate buys exactly once and then stops.

A summary table at the end lists other internal validations and their significance **without** disclosing proprietary guard settings.

2 How to Read This

- **What you'll see:** transparent setups, fixed seeds or public sequences, and decision-relevant readouts (continue/stop, deltas).
- **What you won't see:** production parameter values, private datasets, or anything that would allow cloning the closed-source system.

3 Global Conventions (for this open pack)

- **Beliefs:** Bernoulli parameter θ with Beta prior $\mathrm{Beta}(a, b)$, mean $B = a/(a+b)$.
- **One unit of evidence (SEU):** one Bernoulli sample unless noted.
- **Utilities (Exp. 2):** $U_{\text{accept}}(B) = 2B - 1$, $U_{\text{defer}}(B) = 0$. (Exp. 1 uses operational outcomes only.)
- **One-step EVSI (Beta–Bernoulli):**

$$B_1 = \frac{a+1}{a+b+1}, \quad B_0 = \frac{a}{a+b+1}, \quad \text{EVSI} = B\,U^*(B_1) + (1-B)\,U^*(B_0) - U^*(B).$$

4 Experiment 1 — Randomized SEU Trial (Mock Execution)

4.1 Why this experiment?

Show—in a familiar A/B-test style—that commissioning one **Standard Evidence Unit** (SEU) before submitting a borderline claim to a review board can materially improve outcomes (first-pass approvals, fewer re-loops, fewer days).

4.2 Design

- **Population:** 24 borderline claims with pre-computed baseline approval probabilities $\hat{p}$.
- **Arms (1:1):** SEU (commission evidence first) vs Control (submit immediately).
- **Outcomes:** First-pass approval (binary), number of re-review loops, total days to approval.
- **Analysis:** Differences in means/proportions. *Operational EVSI* is expressed in loops/days avoided (no € utilities here).

4.3 Data (fixed, reproducible)

id	arm	p_hat	approve1	loops	days
C1	Control	0.41	0	3	41
C2	Control	0.46	0	3	40
C3	Control	0.48	0	3	40
C4	Control	0.49	0	3	40
C5	Control	0.50	0	3	40
C6	Control	0.51	0	3	40
C7	Control	0.52	0	3	40
C8	Control	0.54	0	3	40
C9	Control	0.55	1	2	35
C10	Control	0.57	1	2	35
C11	Control	0.60	1	2	35
C12	Control	0.62	1	2	35
T1	SEU	0.41	0	2	31
T2	SEU	0.48	1	1	26
T3	SEU	0.50	1	1	26
T4	SEU	0.52	1	1	26
T5	SEU	0.55	1	1	25
T6	SEU	0.60	1	1	25
T7	SEU	0.46	1	1	26
T8	SEU	0.49	1	1	26
T9	SEU	0.51	1	1	26
T10	SEU	0.54	1	1	26
T11	SEU	0.57	1	1	25
T12	SEU	0.62	1	1	25

4.4 Results (SEU Control)

- First-pass approvals: 11/12 = 91.7% vs 4/12 = 33.3% → +58.3 pp (95% CI: +27.4 to +89.2), $p < 0.001$.
- Re-review loops: 1.08 vs 2.67 → −1.58 loops (95% CI: 1.91 to 1.26).
- Days to approval: 26.08 vs 38.42 → −12.33 days (95% CI: 14.04 to 10.63).

4.5 Interpretation

"One unit" buys ~*1.6 loops avoided* and ~*12.3 days saved* on a borderline claim. Multiply by internal rework/day rates to get a **break-even** SEU cost.

4.6 Reproducibility (Python; optional)

```
import pandas as pd
from scipy import stats
data = {
    'id': ['C1','C2','C3','C4','C5','C6','C7','C8','C9','C10','C11','C12',
           'T1','T2','T3','T4','T5','T6','T7','T8','T9','T10','T11','T12'],
    'arm': ['Control']*12 + ['SEU']*12,
    'approve1': [0]*8 + [1]*4 + [0,1,1,1,1,1,1,1,1,1,1,1],
    'loops': [3]*8 + [2]*4 + [2,1,1,1,1,1,1,1,1,1,1,1],
    'days': [41,40,40,40,40,40,40,40,35,35,35,35,31,26,26,26,25,25,26,26,26,26,25,25]
}
df = pd.DataFrame(data)
g = df.groupby('arm').mean(numeric_only=True)
print(g[['approve1','loops','days']])
```

5 Experiment 2 — EVSI with Public Digits of π (Deterministic)

5.1 Why this experiment?

To show—without randomness—that with a threshold policy and simple utilities, **information has value only at indifference**. We use digits of π so the evidence stream is public and verifiable.

5.2 Setup

- **Prior:** Beta(a, b) with mean $B = a/(a + b)$.
- **Decision:** Accept if $B \geq 0.5$, else Defer.
- **Utilities:** $U_{\text{accept}}(B) = 2B - 1$, $U_{\text{defer}}(B) = 0$.
- **Evidence unit:** One Bernoulli where a decimal digit of π is success if ≥ 5, failure otherwise (sequence $1, 4, 1, 5, 9, 2, 6, 5, \ldots$).

5.3 Key fact (closed-form EVSI at the knife-edge)

For $B = 0.5$ (i.e., Beta(a, a)):

$$\text{EVSI} = \tfrac{1}{2}\left(2\tfrac{a+1}{2a+1} - 1\right) = \frac{1}{4a+2} > 0.$$

Away from 0.5, the one-step decision won't flip in expectation $\rightarrow$ EVSI $= 0$.

5.4 Execution trace (knife-edge start)

- Start $B = 0.5$ with Beta$(5, 5)$. EVSI $= 1/22 \approx 0.045 > 0 \rightarrow$ **CONTINUE**.
- First π digit is $1 \rightarrow$ **failure** $\rightarrow$ posterior Beta$(5, 6)$ with $B = 5/11 \approx 0.455$.
- Now $B < 0.5$: next step won't flip the decision in expectation $\rightarrow$ EVSI $= 0 \rightarrow$ **STOP**.

5.5 Interpretation

The gate **buys exactly one unit** at indifference, then stops once the posterior moves off the threshold—precisely the intended "learn-once, then stop" behavior near simple boundaries.

6 Results at a Glance (Other Validations — details redacted)

The following checks exist in the closed pack. We summarize **what they test** and **why it matters**, while withholding implementation knobs.

Area (closed tests)	What it tests
Asymmetric risk, learn-once behavior	EVSI near a risk-adjusted threshold
Cost/Delay envelope	Straight-edge break-even line $c + \delta t$ vs EVSI
SEU movement calibration & drift	Predicted vs realized log-odds movement per unit
Prior lock-in resilience (ESS caps)	Restores flip feasibility near threshold
Boundary propagation guard (AND/OR)	Feasible dependence (PSD-tightened Fréchet) near flips
Native vs projection EVSI (escalation)	When a Beta projection underestimates EVSI under curv
Two-step lookahead (KG-2)	Option value of a cheap probe before an expensive test
Overlap leakage guard (pooling)	Overlap-aware assessor pooling to prevent double-countin

7 Minimal Reproducibility Notes

- **Dependencies (Exp. 1 only):** `pandas>=2.0`, `scipy>=1.10`. Pin versions if you want exact numbers replicated.
- **Randomness:** None used here beyond deterministic data; π digits are public.

8 License for Code Snippets

The code blocks in this document are released under the MIT License. Replace/augment if you prefer a different license.

9 How to Cite

"/ABDUCTIO (Open Evidence Pack): Reproducible Demos & High-Level Validation Map/, v1.0. Experiments 1–2 fully reproducible; additional validations summarized without disclosing production parameters."