
SPEA-V348 Management Science · Week 6 review

Revising a belief, and pricing what you learn

Both sessions, every slide, fully revealed. Read it without me in the room.

Mon Sep 28 and Wed Sep 30, 2026

The week at a glance

Mon Sep 28	Prior, likelihood, joint, posterior: Bayes' rule in a five-column table, once per survey result
Wed Sep 30	The survey-or-not tree, EVSI against EVPI, then utility: attitudes, certainty equivalent, risk premium, the re-fold in utiles
Reading	Taylor 13e, Chapter 12, pp. 596 to 604, after re-reading Chapter 11, pp. 550 to 551
Due	The Week 6 workbook and a picture of your tree from the tree builder, on Canvas. Tier 1: AI as a tool, with disclosure

ON THE SITE · the Week 6 page

Both browser tools, the self-checks and the workbook.

v348.jima.me/week/w06/

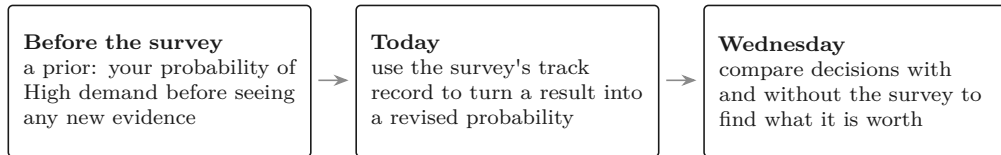


Session 1

Mon Sep 28

What an imperfect survey can tell you

Start with a belief, observe a result, revise the belief



*Two questions: today you **revise** a belief, Wednesday you **price** the revision.*

The developer

The question this session answers

PUZZLE

A developer is deciding whether to invest in a project. If demand turns out **High** it is worth **+\$200k**; if **Low** it loses **\$100k**. Right now they believe **High 0.6, Low 0.4**.

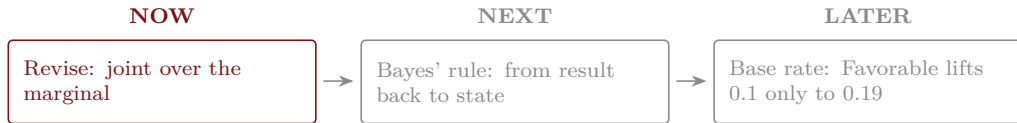
Before committing they could buy a market **survey**. It only ever comes back “favorable” or “unfavorable,” and it is not perfect.

Without a survey, investing has expected value $0.6(200) + 0.4(-100) = 80$, so invest. The survey is about whether the 0.6 should still be 0.6 once it has spoken.

*How should a survey result **change what they believe** about demand?*

Where we are

One revision, three ways



The 0.6 is a prior and the survey's answer is a signal. You make the move first by counting, on 1,000 projects like the developer's, then in Taylor's table, once per survey result, and last on a long-shot project whose prior is lopsided enough to swallow a good signal.

Likelihoods: the survey's track record

How often it says each thing, given what is actually true

If demand is truly	Says Favorable	Says Unfavorable	Row sum
High	0.95	0.05	1.0
Low	0.45	0.55	1.0

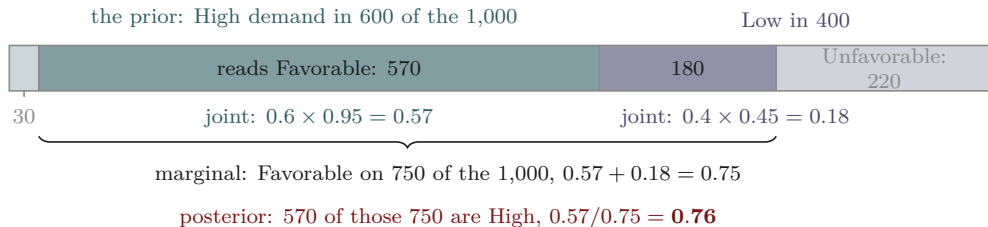
Each row runs **state** → **result** and sums to 1, because the survey must say something. The 0.45 is the false alarm: a Low market that still reads Favorable, almost half of the time.

*On survey day you hold the **result** and want the **state**. Run the survey on 1,000 projects like this one and you can count your way to the flip.*

Taylor 13e, p. 597. These are conditional probabilities; a vendor's headline "95% accurate" is only the top-left cell.

One revision, counted on 1,000 projects

The survey says Favorable. What should the 0.6 become?



*The 750 Favorable reads are the new whole, and 570 of them are High: the survey moves 0.6 to **0.76**. Two joints, their sum, then the ratio; the \$200k and the \$100k never entered it.*

Read the other way, the bar is where a track record comes from: 570 of the 600 High projects is the 0.95, 180 of the 400 Low ones the 0.45, each over its own row's total. The take-home hands you such counts.

Four words this week runs on

The ladder every table today climbs

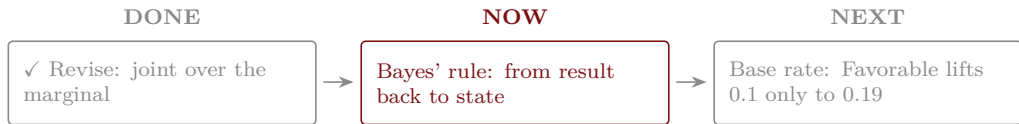
Prior what you believed before the signal: High 0.6, the 600 of 1,000	Likelihood how the signal behaves given the truth: $P(\text{Fav} \mid \text{High}) = 0.95$	Joint prior times likelihood, both true at once: $0.6 \times 0.95 = 0.57$	Posterior what you believe after the signal, the joint re-based on its column: 0.76
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Prior, likelihood, joint, posterior. Every table today is those four columns in that order.

Taylor 13e, Table 12.12, p.601, heads the columns prior, conditional, prior $\times$ conditional, posterior; Chapter 11, pp.550 to 551, calls the prior a marginal. Likelihood is our word for the conditional.

Where we are

One revision down, two to go



Of 1,000 projects like this one, 750 read Favorable and 570 of those are High: 0.76. Two joints, their sum, then the ratio. Bayes' rule is that ratio written in probabilities, and Taylor's table is where it runs when nobody hands you 1,000 projects.

Bayes' rule, in symbols

Among projects with this survey result, what share have High demand?

$$P(S \mid R) = \frac{P(R \mid S) P(S)}{P(R)}$$

On top, the joint: likelihood times prior. High and Favorable: $0.95 \times 0.6 = 0.57$

Underneath, the marginal: every joint for that result, added down the column. $0.57 + 0.18 = 0.75$

The ratio, the posterior: the same cases, re-based on the world where the survey said Favorable. $0.57/0.75 = 0.76$

S is the state, R the result. Taylor 13e, pp.597 to 598 and 600 to 601. The denominator is the column sum, which is why the posteriors in a column always add to 1.

The revision, as a table

The survey says Favorable: the 1,000 projects, as Taylor's five columns

State	Prior	$P(\text{Fav} \mid \text{state})$	Joint	Posterior
High	0.6	0.95	0.57	0.76
Low	0.4	0.45	0.18	0.24
Column sum			0.75	1.00

The joint column sums to $P(\text{Favorable}) = 0.75$, the 750 of the 1,000: the chance the survey comes back Favorable at all, before you have seen it. Divide each joint by it and the posteriors appear.

*A Favorable survey lifts High from **0.6 to 0.76**. The likelihood is $570/600 = 0.95$, a share of High projects. The posterior is $570/750 = 0.76$, a share of Favorable reads.*

The other column: the survey says Unfavorable

State	Prior	$P(\text{Unfav} \mid \text{state})$	Joint	Posterior
High	0.6	0.05	0.03	0.12
Low	0.4	0.55	0.22	0.88
Column sum			0.25	1.00

Unfavorable flips the belief to **High 0.12, Low 0.88**. The marginals $0.75 + 0.25$ add to 1; so does each posterior column.

Those four posteriors, $0.76 / 0.24$ and $0.12 / 0.88$, are the inputs to everything on Wednesday.

The revision, on your laptop

IN CLASS

Open the widget on the Week 6 page: the 1,000 projects, split by the prior and then by what the survey reads. Press **Favorable survey**: the 750 Favorable reads are kept and re-based to a whole bar, 570 of 750 = 0.76. Press **Unfavorable survey** for 30 of 250 = 0.12. Then drag the prior down to 0.10 and press **Favorable survey** again: 95 of 500, only 0.19.

ON THE SITE · the posterior widget

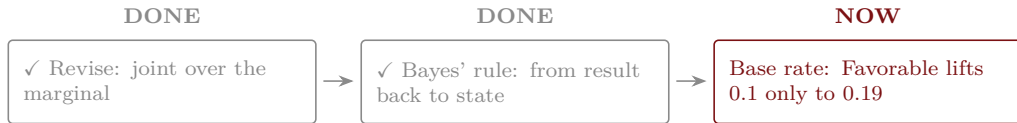
The same two-by-two revision is worked in full, both columns, just below the widget.

v348.jima.me/week/w06/



Where we are

Two revisions down, one to go



Favorable lifts High from 0.6 to 0.76 and Unfavorable drops it to 0.12, with the column sums 0.75 and 0.25 waiting for Wednesday. The developer's 0.6 was close to even; the last block runs the same survey on a project where High is a long shot.

The same survey on a long-shot project

State	Prior	$P(\text{Fav} \mid \text{state})$	Joint	Posterior
High	0.1	0.95	0.095	0.19
Low	0.9	0.45	0.405	0.81
Column sum			0.50	1.00

500 of 1,000 such projects read Favorable, and only 95 of them are High: a 45% false alarm on 900 Low projects outnumbers a 95% hit on 100 High ones.

*The track record did not change; the prior did. The **base rate** sits between headline accuracy and the posterior you act on.*

Software that revises for you

The Bayes calculator checks your hand table

Enter a prior and two likelihoods. The calculator shows each step from joint to posterior.

ON THE SITE · the Bayes calculator

Switch between the developer's two survey results. Then change the prior to check the long-shot project.

v348.jima.me/bayes/

Optional: work the revision by hand, then check it here.



The same arithmetic on a water sensor

The long-shot lesson, on a public monitoring program

Site is	Prior	$P(\text{alert} \mid \text{site})$	Joint	Posterior
Contaminated	0.10	0.90	0.09	0.333
Clean	0.90	0.20	0.18	0.667
Column sum			0.27	1.000

A sensor that catches 90% of contamination and false-alarms on 20% of clean sites raises concern from 10% to **33%**, and no further. Two clean sites trip it for every contaminated one, because clean sites are nine times as common.

Carry the prior through before acting: this alert is right a third of the time.

The public-sector transfer, worked in full on the Week 6 page: the developer's five columns, with a lopsided prior.

In practice: the inputs come from different places

IN PRACTICE

Priors are often subjective; likelihoods are often a track record. “High 0.6” is a read of the market, and two analysts with different priors reach different posteriors from the same survey. “Favorable 95% of the time when demand is High” is a relative frequency across the vendor’s past jobs.

Vendors quote their best case. That 0.95 is the flattering cell. Ask how it was measured, and re-run the table with a less generous value.

Base rates matter. The same survey lifts the long-shot project only to 0.19, which is why a positive rare-disease test can still be probably wrong.

Name the source of each input next to the posterior. It is only as honest as its two parents.

Back to the developer

- The survey is neither gospel nor noise. **Favorable**: High 0.6 becomes **0.76**, Low 0.24. **Unfavorable**: High becomes **0.12**, Low 0.88.
- Before either result arrives, Favorable is the likelier one: 0.75 against 0.25. Those two marginals are what Wednesday's tree hangs on its first circle.
- Where you start decides how far a result moves you: on the long-shot project the same Favorable read lifts 0.1 only to **0.19**.

Revised beliefs are a means, not an answer. Wednesday asks whether the survey is worth its price.

Wednesday

posterior

prior times likelihood,
over the column sum

0.75 / 0.25

how often each result
arrives

0.76 / 0.12

High, after Favorable
and after Unfavorable

base rate

why Favorable lifts a
long shot only to 0.19

*Wednesday hangs those numbers on a decision tree: the marginals on the first circle, the posteriors on the circles under each report. The gap it opens is what the survey is **worth**.*

Group practice

IN CLASS

A campus clinic's rapid test: a student has a **20%** prior chance of being infected, an infected student reads Positive 85% of the time, and a healthy one still reads Positive 10% of the time. One test just came back **Positive**. Fill the prior and likelihood table, compute both joints and the marginal, then the two posteriors, and write one sentence on why the answer surprises people. **Every member's name goes on the sheet**; one of you photographs it and **uploads the photo to Canvas** before leaving. One participation point, half today's attendance record.

ON THE SITE · Week 6 practice sheet

The same sheet is on the site if you want it on a screen.

v348.jima.me/assets/docx/v348-w06-s1-group-practice.docx



Photograph your attempt, then check it together

Two minutes to capture your work; eight for the instructor's demonstration

IN CLASS

Check every member's name and photograph your group's own attempt before the solution is shown. One member uploads the photo to Canvas by the end of class.

We close by checking the method, the main results with units, and a common mistake. Participation credit is for attempting the work.

Session 2

Wed Sep 30

Two questions the posteriors raise

The question this session answers

PUZZLE

The developer can invest now, or get a survey and decide after seeing its result.

How much more could they earn, on average, by using the survey? What is the most they should pay for it?

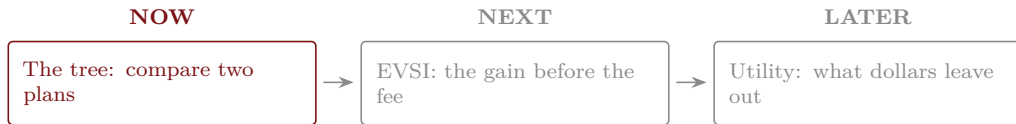
And separately: the project risks a real \$100k loss. Even if expected value says invest, **why might a cautious owner still walk away?**

Invest pays +\$200k if demand is High and −\$100k if Low; staying out pays 0. Before a survey, High has probability 0.6 and Low 0.4.

The survey can help because you choose whether to invest after hearing its result.

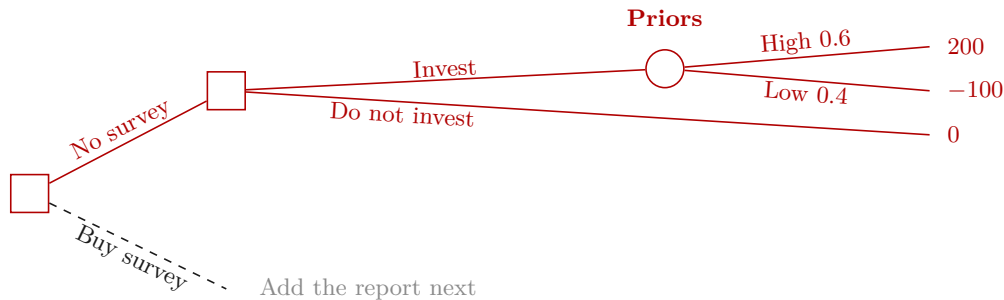
Where we are

Two blocks in dollars, one in utiles



***Expected value of sample information (EVSI)** is the improvement in expected payoff from using the survey, before its fee. The tree compares the plans; EVSI gives the most you should pay. Utility then addresses the risk of a large loss.*

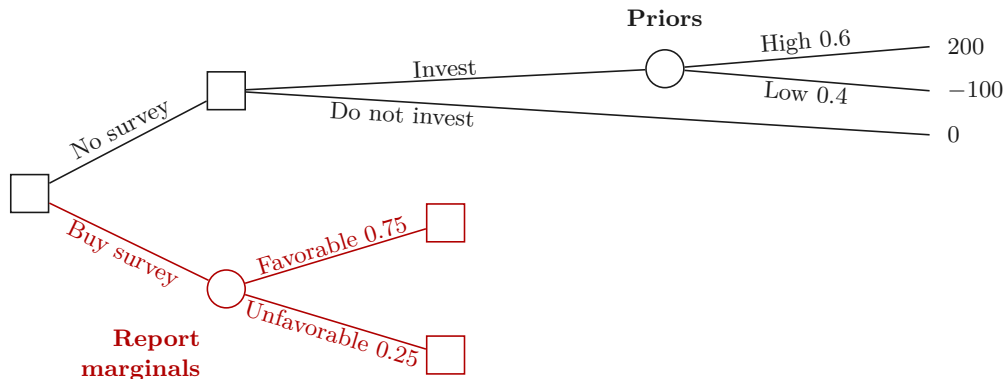
Build the tree: start without a survey



The first square asks whether to buy information. On the **No survey** branch, choose Invest or Do not invest. The demand circle uses the **priors**, High 0.6 / Low 0.4.

Week 6 page. Red: new this step. Payoffs in \$ thousands (200 = \$200,000); survey price excluded.

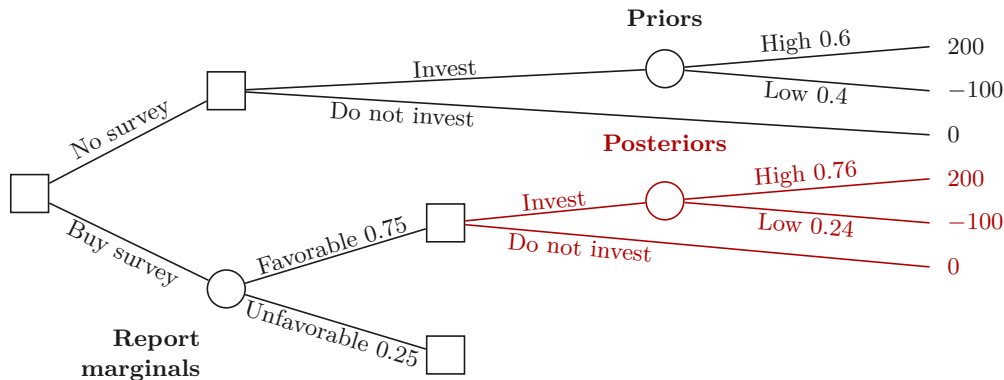
Build the tree: add the possible reports



The **report circle** carries the marginals: $P(\text{Favorable}) = 0.75$, $P(\text{Unfavorable}) = 0.25$. Each report ends at a **new square**: you choose after hearing it.

Week 6 page. Red: new this step. Payoffs in \$ thousands (200 = \$200,000); survey price excluded.

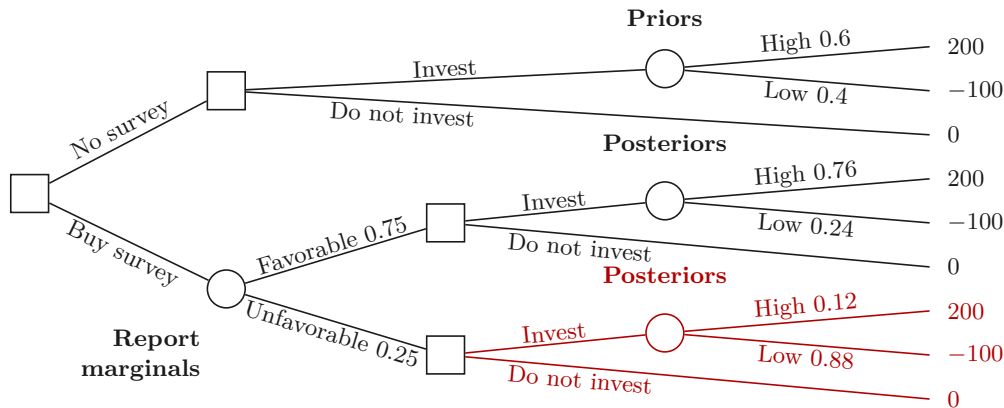
Build the tree: after Favorable



From the **Favorable square**, add Invest and Do not invest. Its demand circle uses **posteriors**: $P(\text{High} \mid \text{Favorable}) = 0.76$, Low 0.24. The payoffs stay 200, -100, and 0.

Week 6 page. Red: new this step. Payoffs in \$ thousands (200 = \$200,000); survey price excluded.

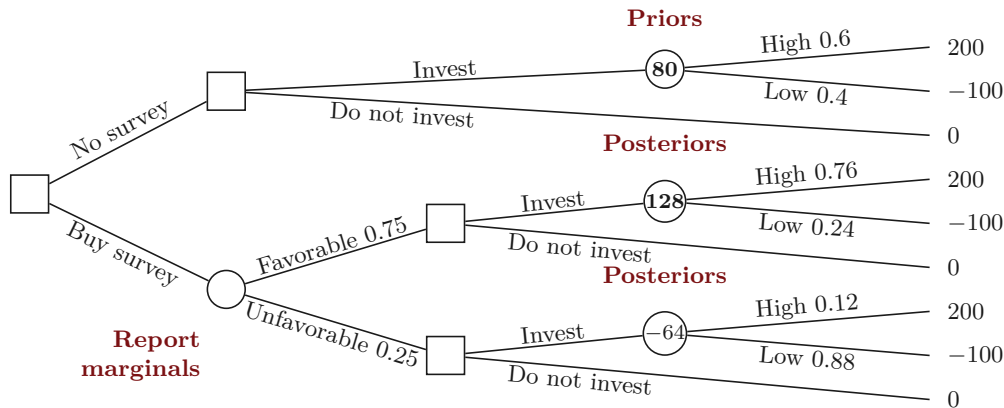
Build the tree: after Unfavorable



From the **Unfavorable square**, add the same two choices. Its demand circle uses $P(\text{High} \mid \text{Unfavorable}) = 0.12$, Low 0.88. Each circle has its own pair summing to 1.

Week 6 page. Red: new this step. Payoffs in \$ thousands (200 = \$200,000); survey price excluded.

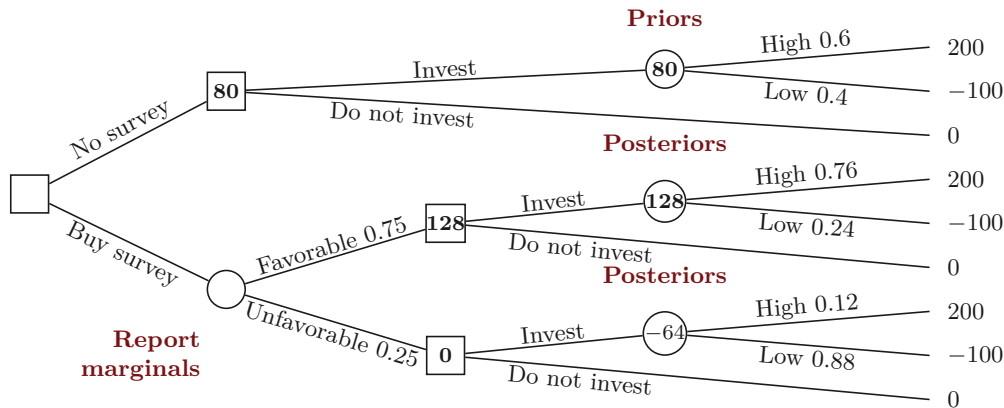
Fold the tree: average the demand circles



No survey: $0.6(200) + 0.4(-100) = 80$. **Favorable:** $0.76(200) + 0.24(-100) = 128$.
Unfavorable: $0.12(200) + 0.88(-100) = -64$. Each answer sits inside its demand circle.

Week 6 page, Session 2. Payoffs in \$ thousands; 200 means \$200,000. Survey price excluded.

Fold the tree: choose at each investment square

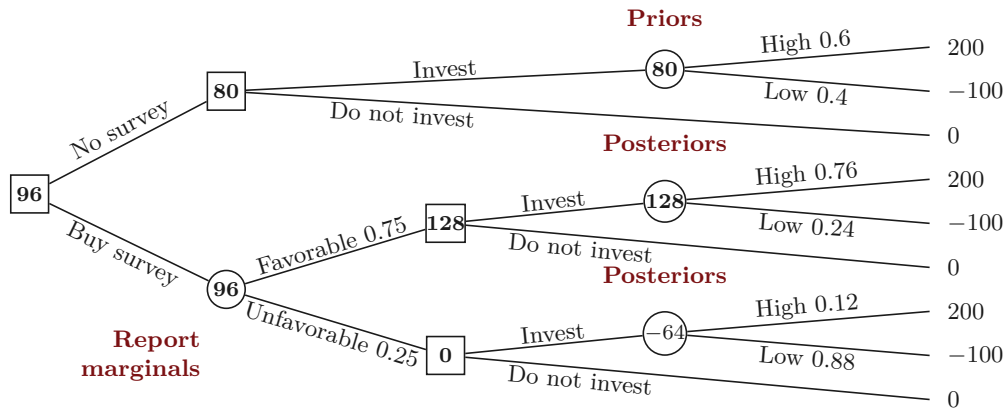


No survey: keep Invest, 80 over 0. **Favorable:** keep Invest, 128 over 0.

Unfavorable: keep Do not invest, 0 over -64. Those chosen values go inside the squares.

Week 6 page, Session 2. Payoffs in \$ thousands; 200 means \$200,000. Survey price excluded.

Fold the tree: compare the two plans



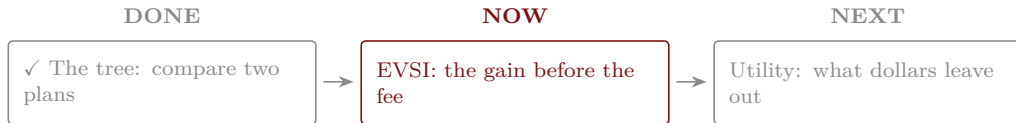
Report circle: $0.75(128) + 0.25(0) = 96$. **No survey:** 80.

EVSI: $96 - 80 = 16$ (\$16k). The fee is excluded; buy only if it is below this gain.

Week 6 page, Session 2. Payoffs in \$ thousands; 200 means \$200,000. Survey price excluded.

Where we are

One block down, two to go



The best plan without a survey earns \$80k in expectation. Using the survey raises that to \$96k before its fee. The \$16k improvement is EVSI; now compare it with the fee, then with perfect information.

EVSI: the improvement before the fee

Sample information is an imperfect signal, such as this survey

$$\text{EVSI} = V_S - V_N$$

V_S : with survey, before its fee.

Invest after Favorable; stay out after Unfavorable. $0.75(128) + 0.25(0) = 96$

V_N : best without survey. Invest beats staying out at 0. $0.6(200) + 0.4(-100) = 80$

EVSI: the improvement. $96 - 80 = 16$, or \$16k. Subtraction removes what you could earn without the survey

Compare the improvement with the fee

Suppose this survey costs \$10k

Plan	Expected payoff (\$ thousands)
Without survey: invest	80
With survey: follow the report, then pay the fee	$96 - 10 = 86$
Net advantage of buying	$86 - 80 = 6$

The same net advantage is **EVSI minus the fee**: $16 - 10 = 6$. The 96 includes the project's earnings; only the 16 is added by the survey.

Buy below \$16k; at \$16k the plans tie; above \$16k, skip the survey. Subtract its fee only once.

Week 6 page, Session 2. The \$10k fee is an illustration; EVSI is \$16k before any fee.

When is a survey worth nothing at all?

The developer's long-shot project: High has prior probability 0.1

Information available	EV if you invest	Best choice
No survey, High 0.1	$0.1(200) - 0.9(100) = -70$	Stay out: 0
Favorable, High 0.19	$0.19(200) - 0.81(100) = -43$	Stay out: 0
Unfavorable, High 0.01	$0.01(200) - 0.99(100) = -97$	Stay out: 0

Both plans are worth 0 before the fee, so EVSI is $0 - 0 = 0$. Changed beliefs add no value when they leave the best action unchanged.

Week 6 page, long-shot project. Payoffs in \$ thousands. Same survey; a different prior.

Against the ceiling

EVPI, and the survey's efficiency

\$40k

EVPI: the oracle's 120 minus 80

\$16k

EVSI: the survey's 96 minus 80

40%

efficiency: EVSI over EVPI

- A perfect forecast invests only when demand is High: $0.6(200) + 0.4(0) = 120$, against 80 blind, so **EVPI is 40**.
- The survey captures **40%** of that. Its track record is what makes it noisy: it misses a High market one time in twenty, and reads a Low one as Favorable almost half of the time.

EVSI never exceeds EVPI. Efficiency says how much of the ideal a real study buys, before you pay for it. Taylor 13e, p. 602.

A sharper survey: revise the probabilities

Same developer; likelihoods change from 0.95 / 0.45 to 0.9 / 0.1

	Favorable	Unfavorable
Marginal on the report branch	$0.54 + 0.04 = 0.58$	$0.06 + 0.36 = 0.42$
Posterior High at the demand circle	$0.54/0.58 \approx 0.931$	$0.06/0.42 \approx 0.143$
Posterior Low at the demand circle	$0.04/0.58 \approx 0.069$	$0.36/0.42 \approx 0.857$
Invest EV, using those posteriors	$0.931(200) - 0.069(100)$ ≈ 179.3	$0.143(200) - 0.857(100)$ ≈ -57.1

Choose Invest after Favorable (179.3 over 0); Do not invest after Unfavorable (0 over -57.1).

Week 6 page, sharper survey. Priors High 0.6 / Low 0.4; payoffs 200 / -100, in \$ thousands. Posteriors are rounded.

A sharper survey, for scale

Both surveys lead to Invest after Favorable and Do not invest after Unfavorable

	Monday's survey	Sharper survey
Report circle: average the chosen values	$0.75(128) + 0.25(0) = 96$	$0.58(179.3) + 0.42(0) \approx 104$
EVSI: subtract the no-survey 80	$96 - 80 = 16$	$104 - 80 = 24$
EVPI: the same ceiling	$120 - 80 = 40$	$120 - 80 = 40$
Efficiency: EVSI / EVPI	$16/40 = \mathbf{40\%}$	$24/40 = \mathbf{60\%}$

The payoffs and prior stay fixed. Fewer false alarms outweigh more misses here: efficiency rises from 40% to 60%.

Week 6 page, Session 2. Payoffs in \$ thousands. Sharper survey branch exactly: $0.54(200) - 0.04(100) = 104$.

The ceiling, seen from the regret side

- **EVPI equals the expected opportunity loss of the best blind decision.** Investing blind regrets 0 if demand is High and 100 if it is Low (you should have stayed out), so its EOL is $0.4(100) = 40$.
- The same 40 as the oracle route. The regret you cannot dodge with your best blind choice is exactly the profit a perfect forecast would recover.

Crystal ball or unavoidable regret: one number, and it is the ceiling every imperfect signal sits under.

The survey tree, on your laptop

IN CLASS

Open the survey-or-not tree on the Week 6 page and press **Fold back**. It settles one layer at a time: the demand circles reach 80, 128, and -64 ; the investment squares keep 80, 128, and 0; the report circle averages to 96. The root chooses the survey because this tree leaves its fee at zero. Press **Reset**, then explain the difference between the plan's value of 96 and EVSI of 16.

ON THE SITE · the survey-or-not tree

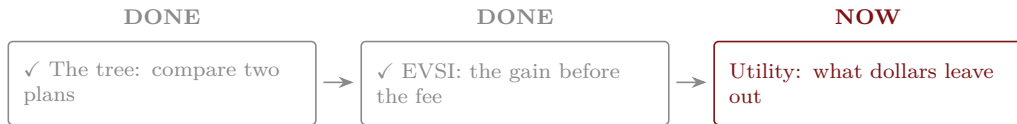
The illustrated build comes first; the completed tree and its Fold back button follow it.

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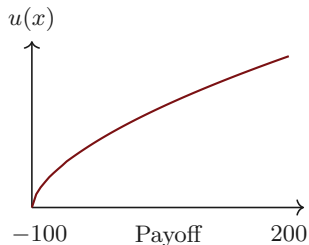
Where we are

Two blocks down, one to go



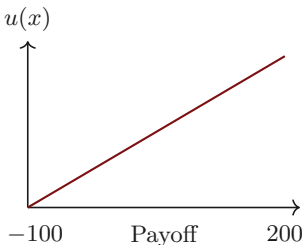
The survey is worth at most \$16k, 40% of the \$40k ceiling, and it earns all of it by backing the developer out after Unfavorable. Every number so far assumed a \$100k loss hurts exactly as much as a \$100k gain helps; the last block asks what changes when it does not.

What dollars leave out



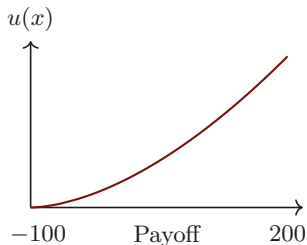
Risk-averse

Bends down: each extra dollar adds less utility.



Risk-neutral

Straight line: a dollar always adds the same utility.



Risk-seeking

Bends up: each extra dollar adds more utility.

Straight-line utility keeps EV rankings; curved utility can change them.

Week 6 page: curves extend Taylor 13e, p.603. Payoffs in \$ thousands. Taylor's names: risk averter, indifferent to risk, risk taker.

Make it bite: cover for the \$100k loss

The partner absorbs a Low-market loss; the fee of 50 is paid in either state

	High (0.6)	Low (0.4)	Expected payoff
Invest without cover	200	-100	$0.6(200) + 0.4(-100) = 80$
Invest with cover	$200 - 50 = 150$	$0 - 50 = -50$	$0.6(150) + 0.4(-50) = 70$

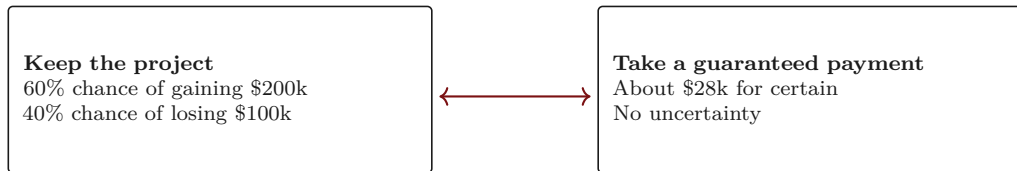
The Low outcome improves from -100 to -50 , but EV falls from 80 to 70. An owner whose firm could not survive a loss of 100 might accept that trade.

Cover costs 10 in expected payoff to limit the loss. Whether that is worth it depends on the owner's risk attitude.

Week 6 page. Payoffs in \$ thousands. Taylor 13e, pp. 602 to 603 uses auto insurance to illustrate the same trade.

Certainty equivalent: a payment as good as the gamble

Keep the developer's project; set the survey aside



This owner values the two options equally

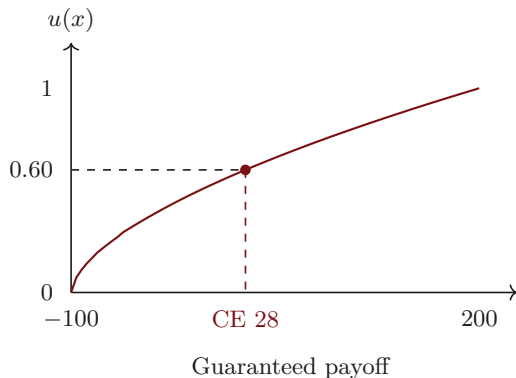
The **certainty equivalent (CE)** is the guaranteed amount that makes the owner indifferent. Above \$28k, take the payment; below it, keep the project.

CE depends on the owner's preferences. The gamble's EV is \$80k; this owner's guaranteed equivalent is about \$28k.

Week 6 page, Risk-averse curve. CE is rounded; a different owner's curve gives a different CE.

Read CE: match utility, then read dollars

The curve represents one owner's preferences; amounts in \$ thousands

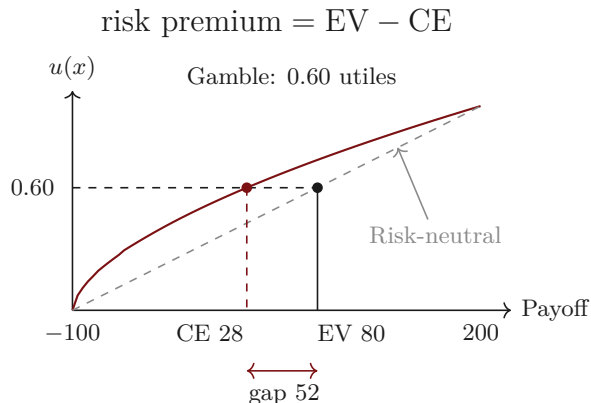


1. Average utilities. With $u(200) = 1$ and $u(-100) = 0$, the gamble gives $0.6(1) + 0.4(0) = 0.60$ utiles

2. Match that height. Move across from 0.60 to the curve: a guaranteed payoff here has the same utility as the gamble

3. Read the dollars. Drop to about 28. A sure \$28k and the gamble are equally preferred: $u(28) \approx 0.60$

Risk premium: expected dollars given up



Expected dollars: $0.6(200) + 0.4(-100) = 80$. Its guide meets the straight risk-neutral line at 0.60 utiles

Certainty equivalent: a sure 28 has the same utility as the gamble, 0.60. This owner is indifferent between them

Risk premium: $80 - 28 = 52$, or \$52k of expected payoff given up to receive the guaranteed 28

Week 6 page, risk-averse preset: $u(x) = ((x + 100)/300)^{0.6}$; payoffs in \$ thousands, from -100 to 200. Curve, CE and premium extend Taylor.

The curve, on your laptop

IN CLASS

Open the utility widget on the Week 6 page. Press **Risk-averse**: trace 0.60 utiles across to the curve and down to CE 28. Explain why this owner values a sure \$28k like the project, whose EV is \$80k. Press **Risk-neutral**, then **Risk-seeking**, and compare CE with EV. Last, drag toward **more cautious** until the sure-\$0 dot is above 0.60 and turns orange. Its vertical guide meets the payoff axis at 0; this owner now stays out.

ON THE SITE · the utility widget

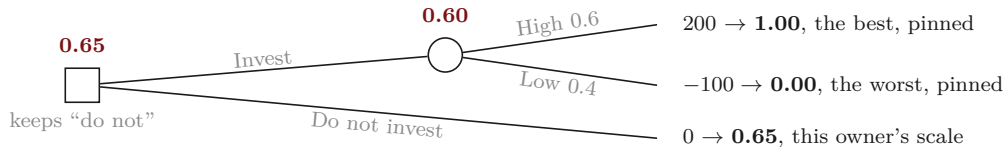
The three shapes, with the certainty equivalent and the risk premium marked on each.

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Re-fold the tree in utils

Same tree, the dollars swapped for what they are worth to this owner



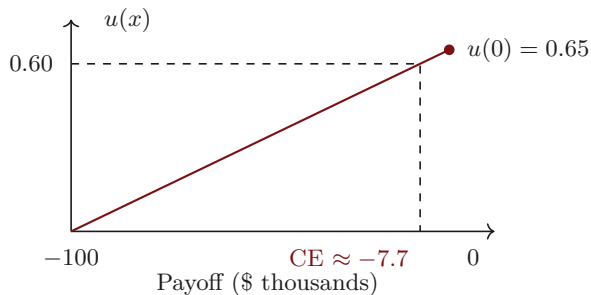
- A straight line puts the sure \$0 at $100/300 = 0.33$. This more cautious owner assigns it **0.65** utils, as shown at the Do not invest leaf.
- Invest, the average at the circle: $0.6(1.00) + 0.4(0.00) = \mathbf{0.60}$ utils.
- Do not invest: $u(0) = \mathbf{0.65}$ utils, and the square keeps the larger.

*0.65 beats 0.60: the tree now says **walk away**, though in dollars invest won 80 to 0. The -100 leaf was punished harder than the +200 leaf was rewarded.*

Taylor 13e, pp. 602 to 603. The no-survey side only; the survey side re-folds the same way.

A negative CE makes staying out preferable

The more cautious owner; amounts in \$ thousands



On this straight segment, the gamble's 0.60 utiles is 0.60/0.65 of the way from utility 0 to 0.65, so move the same fraction from -100 to 0

$$\text{CE} = -100 + \frac{0.60}{0.65}(100) \approx -7.7$$

The gamble is as attractive as a sure loss of about \$8k. Staying out at \$0 is better.

Week 6 page. Piecewise linear utility; risk premium $80 - (-7.7) \approx 87.7$, about \$88k.

In practice: neither perfect information nor perfect rationality

IN PRACTICE

Imperfect is the normal case. Surveys, tests and pilots are all sometimes wrong, which is exactly why EVSI sits below EVPI. The efficiency ratio says how much of the ideal a real study buys, so you do not overpay.

The revision is only as good as its inputs. The posteriors rest on an estimated prior and estimated likelihoods. If either is off, EVSI is off; re-run it with pessimistic likelihoods before you trust it.

People are not expected-value maximizers. Loss aversion, thin capital, and bet-the-company stakes can make a positive-EV decision the wrong human decision. Utility does not excuse the arithmetic; it extends it, by re-folding in utiles.

Report the dollar answer and the utility answer, and say which scale the recommendation is on.

Back to the developer

- For an expected-value maximizer the survey is worth **at most \$16k**, 40% of the \$40k a perfect forecast would be worth. Buy below that fee; at \$16k the plans tie. Act on it by backing out after Unfavorable. On the long-shot project it is worth nothing.
- The first owner's CE is about \$28k: that guaranteed payment is as attractive as the project, and both beat staying out at \$0. The more cautious owner's CE is about -\$8k, so a sure \$0 is better than the project. That owner **does not invest**, even though the project's EV is positive.

Decision analysis gives you both: the dollar value of information, and the language to respect a risk attitude.

This week's take-home

Two files, on Canvas, by Sunday at 11:59 PM

- A state workforce agency: **fund a training program**, and pay \$250k for an evaluator's assessment first? The prior is the agency's own record; the **likelihoods come out of validation counts**, each dividing by a different total.
- Write both conditionals in words before any arithmetic: $P(\text{promising} \mid \text{effective})$ and $P(\text{effective} \mid \text{promising})$ are very different numbers there, on purpose.
- Then today's ladder: revise, price the assessment against its own ceiling, and re-fold on the director's utility scale, where the recommendation **changes**. Fold the assessment-or-not tree in the **tree builder** too: its **picture** is the second file.

ON THE SITE · the brief and the workbook

Download the workbook here. **Tier 1**: AI as a tool, disclosed.

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Carry into Week 7

$EVSI \leq EVPI$

a real signal never beats a
perfect one

16 of 40

this survey: 40% efficient

$CE < EV$

whenever the curve
bends down

re-fold

swap dollars for utiles,
same rules

*Next week uncertainty leaves the room. Every input is a known number, there are **limits** instead of odds, and the question becomes how much of each thing to make: **linear programming**, the tool of Weeks 7 to 11.*

Review

Week 6

Can you define these without looking?

prior	likelihood	joint probability	marginal of a result
posterior	Bayes' rule	base rate	sample information
EVSI	efficiency	utility, utiles	risk attitudes
expected utility	certainty equivalent	risk premium	re-fold in utiles

ON THE SITE · Key Concepts

Most of these have a one-line definition and a worked example behind them. Filter by week; the next two frames define most of them.

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Definitions: revising

Prior	What you believed about the state before the signal: $P(\text{state})$
Likelihood	How the signal behaves given the truth: $P(\text{result} \mid \text{state})$, one row per state, each row summing to 1
Joint	Prior times likelihood: the state and the result both true at once
Marginal of a result	The joints for that result added down the column: how often the result arrives at all
Posterior	Joint over marginal: $P(\text{state} \mid \text{result})$. The posteriors in a column sum to 1
Base rate	The prior of a rare state. It is why a positive result from an accurate test can still be probably wrong

Definitions: pricing, and what dollars leave out

Sample information	Any imperfect signal. On the tree, the report circle carries the marginals and the state circles under it the posteriors
EVSI	Improvement before the fee: best EV with the signal minus best EV without it. Here $96 - 80 = 16$; compare 16 with the fee
Efficiency	EVSI over EVPI: how much of a perfect forecast the real signal delivers
Utility, utiles	What each dollar amount is worth to you, on a scale pinned at the best (1) and worst (0) outcome
Certainty equivalent	The guaranteed payment you value exactly as much as the gamble. It depends on your preferences
Risk premium	EV minus the certainty equivalent: the expected value you give up to escape the uncertainty

Test yourself

If one of these is slow, that is where to reread

1. A test reads positive 90% of the time when someone is infected. A colleague says “so a positive result means a 90% chance of infection.” Which two names are confused, and what missing number decides how wrong that is?
2. The joints in the Favorable column are 0.57 and 0.18. Without any other number, write the two posteriors and say what the 0.75 you divided by means.
3. On the long-shot project a Favorable read lifts High only to 0.19. Why does that make the survey worth nothing there?
4. EVSI came out at 16 and EVPI at 40. What does the 40% tell a buyer, and why can the first number never exceed the second?
5. In dollars, invest wins 80 to 0. In utiles, do not invest wins 0.65 to 0.60. Which single utility value made the difference, and what attitude does it encode?

Numbers worth remembering

0.76 / 0.12

High, after Favorable
and after Unfavorable

96 vs 80

before survey fee:
 $\text{EVSI } 96 - 80 = 16$

16 of 40

EVSI against EVPI:
40% efficient

0.65 vs 0.60

do not invest against
invest, in utiles

Question	Developer	The move
What a Favorable survey does to the 0.6	0.76	$0.95 \times 0.6 = 0.57$, over $0.57 + 0.18 = 0.75$
What the survey is worth	\$16k, 40%	fold with it (96) and without (80); the gap, over EVPI 40
Why a cautious owner declines	CE below \$0	swap dollars for utiles and re-fold: 0.65 beats 0.60

Carry into Week 7

- Week 7 **takes the uncertainty away entirely**. Every input is a known number; what limits you is scarce resources, not odds.
- The question becomes how much of each thing to make, and the answer is a **linear program**: decision variables, an objective, and constraints, solved on a graph.
- Everything from this block comes back in Week 16, when a situation arrives with no chapter attached and you have to say which tool fits it.

ON THE SITE · Week 7

The reading is the one chapter all term that is read straight through. Do the self-check before Monday.

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