
SPEA-V348 Management Science · Week 1 review

Course introduction; break-even and Math/Stats Review I

Both sessions, every slide, fully revealed. Read it without me in the room.
Mon Aug 24 and Wed Aug 26, 2026

The week at a glance

Mon Aug 24	How the course works: the site, Canvas, the 100 points, the 3-3-3 rule, the AI tiers, and your questions
Wed Aug 26	Break-even on the T-shirt puzzle, the three levers, then slope, intercept, and summation
Reading	Taylor 13e, Chapter 1, pp. 22 to 33, stopping at “Computer Solution”
Due	The Week 1 workbook, on Canvas. Tier 1: AI as a tool, with disclosure

ON THE SITE · the Week 1 page

The animations, the two self-checks, and the workbook download all live here.

v348.jima.me/week/w01/



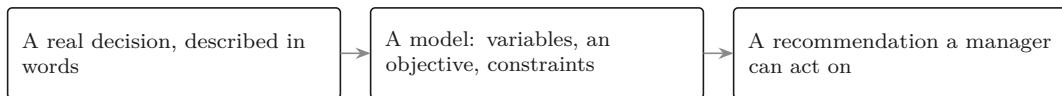
Session 1

Mon Aug 24

What you are signing up for

Management science: turning a messy decision into something you can reason about

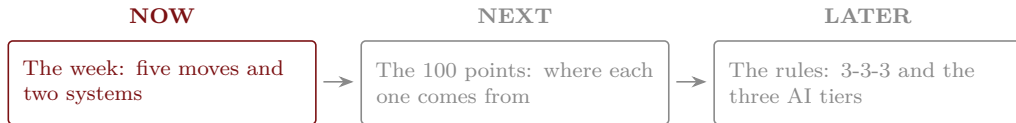
- You will build models of real decisions: **how many, which one, when, how much.**
- The methods have other names you will meet: **operations research, business analytics.**
- What this course certifies is the **whole modeling cycle**, not the number at the end.



the middle step is the one this course grades

Where we are

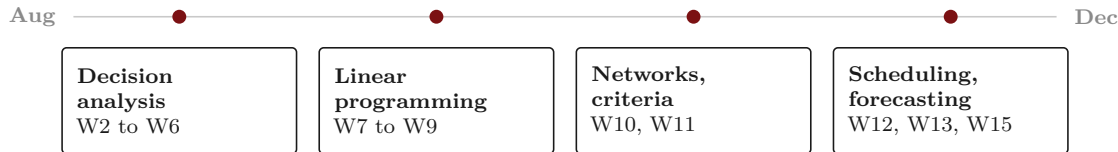
Three blocks today, in this order



The course grades the middle step, the model you build. Where in a week you build one is the first block, what each one is worth in points is the second, and the rules that sit around the work are the third.

The term, in one line

Four families of method, each one a few weeks

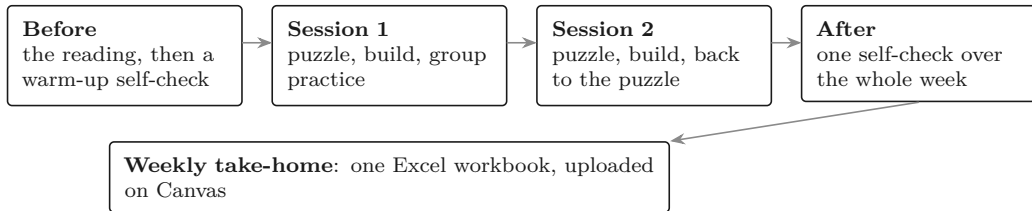


*Our last class is **Wed Dec 9**. The one thing after it is the final, in the **Dec 14 to 18** exam period.*

Week 14 is Thanksgiving break. Week 16 is review, on Dec 7 and Dec 9. The registrar sets the final's exact slot; it is posted on Canvas.

The shape of a week

Same five moves every time, so you always know what is next



ON THE SITE · this week's page

Open Week 1 now. Every week page has exactly these headings, in this order.

v348.jima.me/week/w01/



Two systems, one job each

Learn on the site, hand in on Canvas

v348.jima.me

Week pages: the puzzle, the build, the animations you drive yourself

Self-checks, before and after class, ungraded and retryable

Key Concepts: every term and symbol, with a worked example behind it

The take-home brief and the workbook download

Canvas

Upload the completed workbook, every week

The midterm and the final, in LockDown Browser

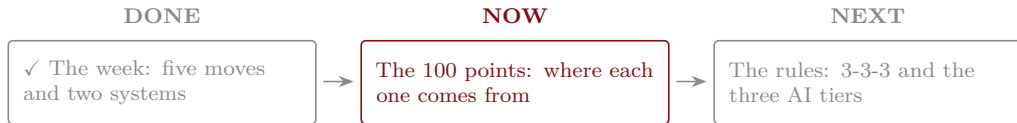
The reading PDFs

Your attendance record and your grades

Everything you learn from is on the site. Canvas is where you hand things in.

Where we are

One block down, two to go



Every week runs the same five moves, you learn from the site and hand in on Canvas, and the last class is Wed Dec 9. None of that says what a week is worth. The 100 points do.

Where the 100 points come from

55

regular take-homes

30

the two exams

15

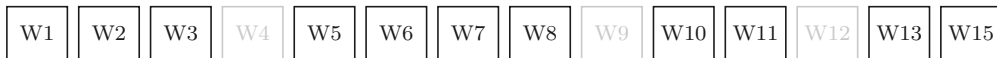
in-class participation

Component	Pts	How it is earned
Regular take-homes	55	Fourteen Excel workbooks in Weeks 1 to 13 and 15, 5 points each. Your best 11 of 14 count
Exams	30	A 10-point midterm on Wed Oct 21 , and a 20-point cumulative final in the Dec 14 to 18 exam period
In-class participation	15	The fifteen group practices, 1 point each

Your point total is your percentage: 93 points is an A. Full table and letter scale on the home page.

Three lowest take-homes drop

What that cushion does, and what it does not touch



your three lowest drop, wherever they fall (say W4, W9, and W12); the other eleven count

- Fourteen workbooks, **eleven** counted. A rough week does not sink the grade.
- The drop forgives a **weak or missing** take-home, never a **late** one: that is a separate cushion.
- It touches take-homes only. The **exams** do not depend on what you submitted.

ON THE SITE · take-home page

The rubric every workbook is graded against, and what a full-credit submission looks like.

v348.jima.me/weekly-take-home/



What a take-home actually is

One workbook, three sheets, and nothing to hand in but the file

1. Instructions

What to do at each step, and why. The AI tier for this week is on row 3.

2. The model sheet

A case brief, then *you* build the model. Every cell you fill is red.

3. Free responses

The written answers, plus the required AI disclosure.

*The brief carries figures your model does not need, and at least one unit you have to convert.
Deciding what to ignore is part of the work.*

ON THE SITE · Week 1 workbook

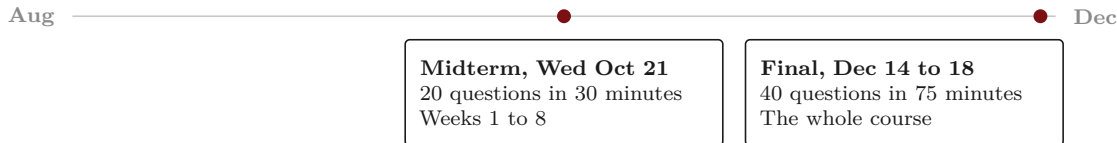
We open this one on the projector now, so you have seen a submission before you owe one. Every week's is due **Sunday at 11:59 PM.**

v348.jima.me/assets/xlsx/v348-w01-break-even.xlsx



The two exams, and why they exist

A midterm at the exact middle of the term, a cumulative final after the last class



- Questions drawn at random from the **self-checks and take-homes** you have already worked. Nothing on either is new.
- Individually, unaided, in **Respondus LockDown Browser** with the Canvas calculator. No Excel.

This is what makes AI help safe to allow: the preparation is wide open, and the answering is yours alone.

Install LockDown Browser before the term starts, from the link in Canvas, on the laptop you bring to class.

Participation is the group practice

Fifteen of them, one point each

- Most Session 1 meetings close with a **one-page problem you work by hand**, in a small group. Put every member's name on it, then one of you **photographs the sheet and uploads the photo to Canvas** before you leave.
- That sheet is also **half your attendance record** for the day. The sign-in signature is the other half.
- Week 1's practice runs **Wednesday**, not today. Monday of Week 1 is the only session with nothing to hand in.

ON THE SITE · participation page

What the practices look like and how the point is recorded.

v348.jima.me/in-class-practice/



Where we are

Two blocks down, one to go



Take-homes are 55 with your best 11 of 14 counting, the two exams are 30 and draw from work you have already seen, and fifteen group practices are 15. What a missed class or a late file costs, and where AI is allowed, is the part no point total covers.

The 3-3-3 rule

Three of each, no questions asked

3 absences

free, no explanation needed

3 late submissions

free, no advance notice

3 days

how long each late pass covers

- After three absences, each one costs **1 point** off your final grade. **Nine absences is an automatic F.**
- That deduction sits **outside** the 100 points in the grading table.

Written this plainly so you never have to ask permission or explain yourself for the ordinary things.

Present means two things

A signature, and that session's work

Sign the sheet

It comes around once, at a moment we do not announce.

Hand in that session's work

Where there is any. On a session with none, the signature alone does it.

A sheet with only your name on it counts as nothing handed in.

- In-class work is earned in the room. Miss it and that item is **0**, with no make-up.
- A free absence waives the **attendance penalty** only. It never gives back the points of an item you missed.
- Attendance goes into Canvas after each session. Check it yourself; **disputes close one week** after each posting.

Late work

Three passes, 72 hours each

on time: graded as submitted	72 hours: a late pass covers it	after that: 0, passes or not
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the deadline, Sunday 11:59 PM

72 hours later

- Three free late passes a term. No explanation, no advance notice: just submit.
- A pass covers **72 hours** of clock time, weekends included. Past that it is a **0**, even with passes left.
- If anything was in on time, **your last on-time version is what we grade**. A later replacement is not evaluated, and it does not spend a pass.
- In-class items cannot be late. You were in the room or you were not.

*So if you think you will need a late pass, do not upload a placeholder first.
That placeholder becomes your graded work.*

AI, in three tiers

Which tier applies is printed on the work itself

Tier	What is allowed	Where it applies
Tier 0	No AI. Unaided, in class	The midterm and the final
Tier 1	AI allowed as a tool, disclosed	The fourteen regular take-homes
Tier 2	AI expected, and critiquing it is the whole task	The ungraded Week 8 debug practice

ON THE SITE · the AI policy

The full policy, including what counts as disclosure and what crosses the line.

v348.jima.me/using-ai/



Bring a laptop, with these on it

Tool	What for	From when
Excel, with the Solver add-in enabled	Every workbook; Solver for the optimization weeks	Week 1, Solver from Week 8
Respondus LockDown Browser	The midterm and the final	Any week from Week 1
The course's tree builder, in the browser	Decision trees	Week 5
The course's Bayes calculator, in the browser	Check Bayesian revision	Week 6, optional

Install links are on the home page under Software & setup. Do the Solver and LockDown steps this week, not the night before.

Before Wednesday

The only homework tonight

- Read **Taylor, Chapter 1, pp. 22 to 33**, and stop at the “Computer Solution” heading partway down p.33. Wednesday opens with an ungraded warm-up self-check on the algebra it runs on; it is on the Week 1 page if you want an early look.
- One warning about the chapter: **Taylor’s letters are not ours**. The book writes the quantity as v ; this course writes it as q and uses v for the variable cost per unit. Translate as you read.

ON THE SITE · reading and warm-up

The page range and what to take from each section. The warm-up sits at the top of Wednesday’s session.

v348.jima.me/week/w01/



Your questions

For as long as they last

How much math do I need?

What if I miss a Wednesday?

How heavy is the workload?

I have never used Solver

Anything else. Nothing on this list is off limits.

Wednesday we do the first real tool: break-even analysis, and the algebra the rest of the term runs on.

Session 2

Wed Aug 26

Warm-up, on your laptop

Two minutes, ungraded, retry as often as you like

IN CLASS

Open the Week 1 page and work the warm-up self-check. Nothing in it is new: every item is arithmetic you already have, and it decides which piece I slow down on for the next hour.

ON THE SITE · warm-up self-check

Order of operations, a per-unit rate read off a coefficient, one linear equation, the square root Week 2 needs, and a plain exponent rule.

v348.jima.me/week/w01/



The club T-shirts

The question this session answers

PUZZLE

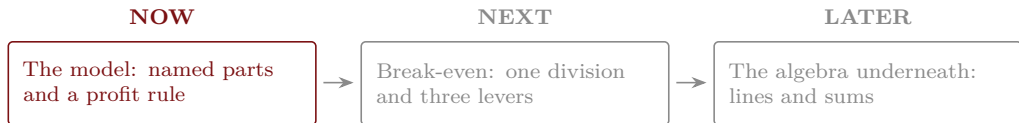
Your student club wants to print T-shirts. The print shop charges a flat **\$300 setup**, paid once no matter how many you order, plus **\$6 to make each shirt**. You plan to sell them at **\$15 each**.

How many shirts must you sell before the club stops losing money?

Hold the number you would guess. In twenty minutes you will have a method that produces it, and tells you what would change it.

Where we are

Three blocks today, in this order



The \$300, the \$6, and the \$15 become one profit rule in the first block. The second block solves that rule for the number of shirts and asks what would move it. The third is the algebra both of them ran on, and every later week runs on it too.

A model has named parts

Learn the four words now: every week from here reuses them

Decision variable
what you choose

q, the shirts you order

Parameters
the numbers handed
to you

\$300, \$6, \$15

Objective
what you push up
or down

profit

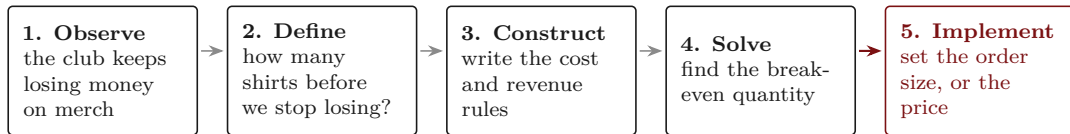
Constraint
a limit you cannot
cross

a \$1,000 print budget

*Break-even has no binding constraint yet. Holding the word now is what makes **linear programming** in Week 7 feel like the same thing, bigger.*

Five steps, run once on the T-shirts

The arc every week of this course follows



Step 5 is the one students skip and managers care about. A break-even quantity that changes nothing was not worth computing.

Cost splits in two

And the split is the whole model

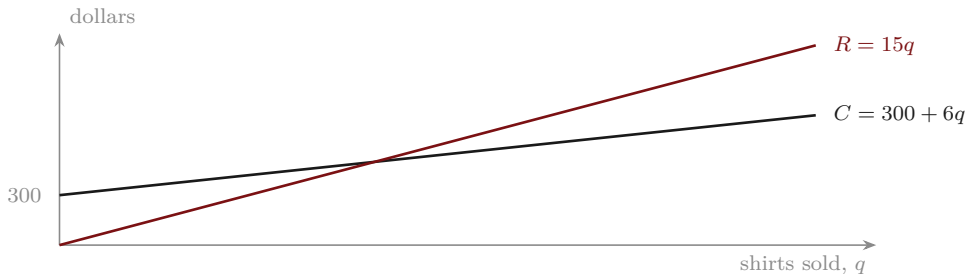
	Fixed cost	Variable cost
What it does	Paid once, whatever the volume	Grows with every unit
In the T-shirts	The \$300 setup	The \$6 per shirt
On a chart	The intercept	The slope

$$\text{Cost}(q) = 300 + 6q, \quad \text{Revenue}(q) = 15q.$$

Read them as rules, not answers: hand each one a number of shirts and it hands back dollars. The club loses money whenever cost sits above revenue.

The two rules, as lines

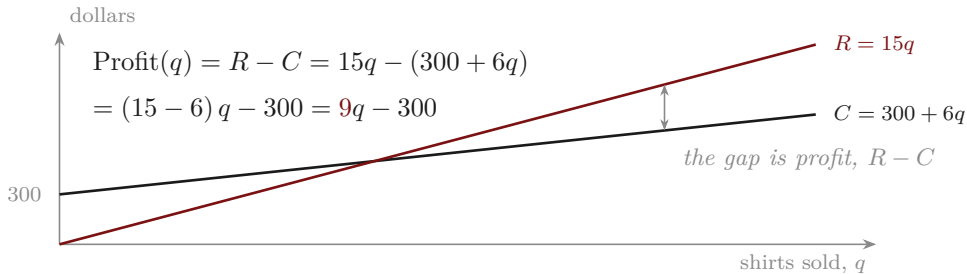
Cost starts at \$300 and climbs \$6 a shirt; revenue starts at zero and climbs \$15



Two rules, two lines. At any number of shirts the gap between them is what the club makes or loses, and where the lines cross is the whole question.

Write profit as its own object

It is the gap between the two lines, and the gap has a one-line rule



The \$9 that fell out is the **contribution margin**: what each shirt adds toward the \$300 the club is behind before it has sold anything.

Break-even is now a question you can answer by hand: for which q is $9q - 300$ equal to zero? On the picture, that is where the gap closes.

The profit equation, in symbols

Three pieces, and you have met all three already

$$\text{profit} = pq - F - vq$$

Revenue, pq : the price times how many you sell. Here $p = 15$

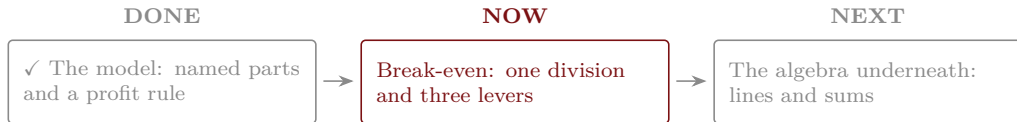
Fixed cost, F : paid once, whatever q turns out to be. Here $F = 300$

Variable cost, vq : the per-unit cost times the same q . Here $v = 6$

In this course q is the quantity and v is the variable cost per unit. Taylor 13e, p. 30 uses v for the quantity and c_v for the cost, and writes $Z = vp - c_f - vc_v$. Same model, different letters.

Where we are

One block down, two to go



Profit is $9q - 300$, or $pq - F - vq$ in symbols: every shirt adds \$9 and the setup takes the first \$300 of it. You have the rule; the q that turns it positive is what comes next.

Break-even, in symbols

Why the answer to “how many” is a division

$$q^* = \frac{F}{p - v}$$

On top: what you owe before you have sold anything. Here $F = 300$

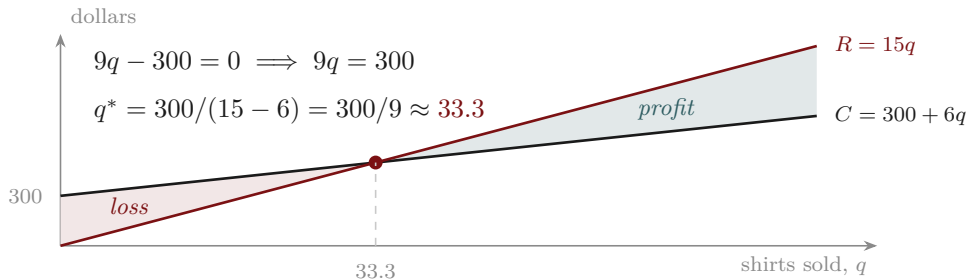
Underneath: what one more unit chips in. Here the \$9 margin you just found

The quotient: how many of those chips it takes to cover it

*It is a division because the question is a division: **how many of these fit into that?***

Solve it

Where the gap closes



You cannot sell a third of a shirt, so round **up**: the club must sell **34 shirts** to stop losing money. Every shirt after that adds its \$9 straight to profit.

The \$300 setup absorbs $300/9 \approx 33.3$ shirts' worth of margin before the club sees a cent: that is the loss wedge on the left.

Three levers, and only three

A model earns its keep when you ask what would change the answer

Move	New q^*	Why
Price \$15 to \$18	25	margin widens to \$12, so $300/12$
Variable cost \$6 to \$9	50	margin shrinks to \$6, so $300/6$
Setup \$300 to \$180	20	same \$9 margin, less to cover

ON THE SITE · break-even widget

Drag price, variable cost, and fixed cost yourself. Watch the crossing move and the equations rewrite themselves.

v348.jima.me/week/w01/



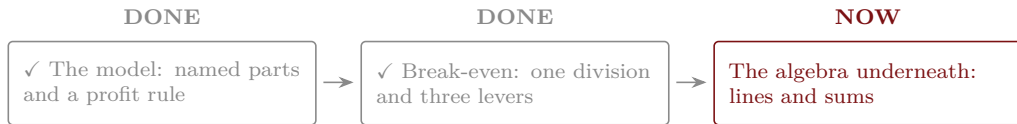
Say it in one sentence

- Every one of those three moves works through the same quantity: the gap between p and v .
- Reading a model that way is **sensitivity analysis**, and it is most of what you will do in Excel this term.
- It also tells you *which* lever to argue for. A club that cannot raise the price can still negotiate the setup fee, though dollar for dollar the margin is the stronger lever: one more dollar on the price takes q^* from 33.3 to $300/10 = 30$; one dollar off the setup moves it a ninth of a shirt.

*Anything that **widens the margin** (a higher price, a lower variable cost) lowers break-even. Raising the **fixed cost** raises it.*

Where we are

Two blocks down, one to go



The club needs 34 shirts, because \$300 of setup over a \$9 margin is 33.3, and only price, variable cost, and setup can move that. The lines you read it off are half of the algebra underneath; the other half is how to add up shirts sold in five batches at five prices without writing five terms, which Week 2 needs.

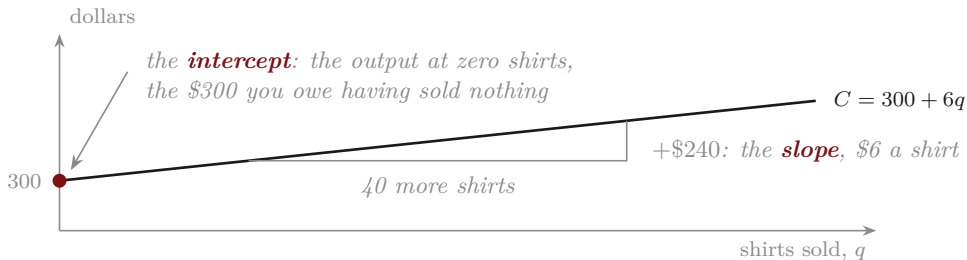
The algebra underneath

Math and stats review I

Functions, slope, intercept

You have been reading these all session

$C(q) = 300 + 6q$ is a **linear function**: hand it a number of shirts and it hands back dollars, and its graph is the cost line you have been reading since the first block.



Spotting the slope and the intercept inside a cost formula is how you read a model at a glance, before solving anything.

The shirts went out at five prices

A second question on the same order, and one number you need

PUZZLE

The plan said \$15 a shirt. Suppose the order sells out in five batches, each at its own price: the activity fair, a member discount, the home game, a dorm's bulk order, and a few online. Batch i sold q_i shirts at p_i dollars each, and you need the club's **total revenue**.

How do you write “multiply each batch's count by its own price, then add them all up” without writing five separate terms?

The anatomy of a sum

Three parts, and the notation is nothing but the three of them

$$\sum_{i=1}^5 p_i q_i$$

Where you stop: the last value the index takes. Here 5

What you repeat: the term, written once. Here $p_i q_i$

Where you start: the first value of the index. Here $i = 1$

So the total revenue is exactly $\sum_{i=1}^5 p_i q_i$, and **summation** notation is the whole answer to the puzzle.

Run it once by hand

The notation only clicks after you have computed one

i	Batch	Price p_i	Shirts q_i	Term $p_i q_i$	
1	Activity fair	\$15	10	150	$p_1 q_1 = 15 \times 10$
2	Member discount	\$10	40	400	
3	Home game	\$15	20	300	$p_3 q_3 = 15 \times 20$
4	Dorm order	\$12	25	300	
5	Online	\$18	5	90	$p_5 q_5 = 18 \times 5$
Total			100	1,240	$\sum_{i=1}^5 p_i q_i$

Read the last column downward and add: $150 + 400 + 300 + 300 + 90 = 1,240$ dollars of revenue on 100 shirts. Setting i to a row number is all the notation ever asks you to do.

Two things that come back all term

- **The index is a row number, not a quantity.** $i = 3$ is not the number three: it points at the home game, so $p_3 = 15$ and $q_3 = 20$. When the term is a formula in i instead, substitute each value in turn: $\sum_{i=1}^3 (i + 1) = 2 + 3 + 4 = 9$.
- **A sum of products is not a product of sums.** The price the club really averaged is $1,240/100 = \$12.40$, not the plain average of the five prices (\$14), and certainly not $100 \times 14 = \$1,400$ of revenue.

A sum of products keeps each batch's own count attached to its own price. That is why Excel has SUMPRODUCT and not just SUM, and it is the arithmetic behind every expected value in Week 2.

The same break-even, a public decision

A weekend mobile clinic

The figures	The model
Van, permits, and setup: \$2,400	$F = 2,400$
Reimbursement per visit: \$70	$p = 70$
Medical supplies per visit: \$30	$v = 30$

$$q^* = \frac{2,400}{70 - 30} = \frac{2,400}{40} = \mathbf{60} \text{ visits}$$

Sixty is not a forecast. It is the number the program manager holds up against **expected demand** before approving the weekend.

In practice: the numbers came from somewhere

IN PRACTICE

The \$6 per shirt hides an assumption. It is the price for *this* order size. Order fewer and the shop may charge more per shirt, and the fixed-variable split shifts under you. It also has to arrive per shirt: a shop quoting \$72 a dozen still gives you $v = 6$, once you divide.

Real setups have costs the tidy \$300 does not cover: design time, a table at the activity fair, the shirts nobody buys. A break-even that ignores them is optimistic.

Every parameter in a model is somebody's estimate. Knowing whose, and how firm, is part of reading the answer.

In practice: what the answer does not say

IN PRACTICE

Break-even is a volume, not a guarantee. The model says 34 shirts. It says nothing about whether the market, the donors, or the crowd will absorb 34 shirts. For a manager deciding whether to run a program at all, that is the caveat that matters: compare the threshold with expected demand. Estimating that demand is what forecasting, in Week 13, is for.

Index bookkeeping is silent when it fails. Start the sum at $i = 0$ instead of $i = 1$, or line up prices against the wrong batches, and SUMPRODUCT returns a confident, wrong total.

Back to the T-shirts

- **34 shirts** clears the break-even point of 33.3, and each one after that adds \$9.
- At 50 shirts the club nets $15(50) - (300 + 6 \cdot 50) = 750 - 600 = \textbf{\$150}$.
- The model did not just produce a number. It said *why*: the \$300 setup absorbs 33.3 shirts' worth of \$9 margin.
- Sold at five prices, the club averaged \$12.40 a shirt, so its real margin was \$6.40 and its real break-even $300/6.40 \approx 46.9$, so **47 shirts**: the price lever moved under it. That is the comparison the take-home asks for.

That number sets a real decision: the order size to place, the price to charge, or whether to run the thing at all.

This week's take-home

One file, on Canvas, by Sunday at 11:59 PM

- A break-even model for a student **bike-repair pop-up**, and the model is **not built for you**. One figure is priced by the dozen, one belongs to last semester.
- Then it stops being arithmetic: the pop-up beat its break-even volume and still cleared almost nothing, because one month ran a discount. Find the fee it really averaged, and run the model again.

ON THE SITE · the brief and the workbook

Download the workbook here. **Tier 1**: AI as a tool, with the disclosure cell filled in.

v348.jima.me/week/w01/



Carry into Week 2

$$q^* = F/(p - v)$$

break-even, in four
letters

$$C = F + vq$$

a line: intercept and
slope

$$\sum$$

a sum of products, not
of sums

what-if

which lever moves the
answer

*Next week the future stops being certain. Weight each outcome by its **probability** instead of by a count of shirts, add the products exactly as you just did, and the total is the **expected value**.*

Group practice

Fifteen minutes, with your group

IN CLASS

Work a fresh break-even by hand, on the sheet. **Every member's name goes on it**, then one of you photographs it and **uploads the photo to Canvas** before you leave. It is worth 1 participation point and it is half your attendance record for today.

ON THE SITE · Week 1 practice sheet

The same sheet is on the site if your group wants it on a screen as well as on paper.

v348.jima.me/assets/docx/v348-w01-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.

Review

Week 1

Can you define these without looking?

Twelve terms this week introduced, and every later week reuses

model	decision variable	parameter	objective
constraint	fixed cost	variable cost	profit equation
break-even quantity	contribution margin	linear function	summation

ON THE SITE · Key Concepts

Every one of these has a one-line definition and a worked example behind it. Search or filter by week.

v348.jima.me/concepts/



Definitions: a model and its parts

Model	A simplified description of a real system, written so you can reason about it
Decision variable	The thing you choose. Its solved value is the recommendation
Parameter	A number handed to you: a price, a cost, a capacity
Objective	The quantity you push up or down
Constraint	A limit you cannot cross

Definitions: break-even, and the algebra

Fixed cost F	Paid once, whatever the volume. The intercept of the cost line
Variable cost v	Paid per unit. The slope of the cost line
Profit equation	$\text{profit} = pq - F - vq$
Break-even q^*	The quantity at which profit is zero: $q^* = F/(p - v)$
Contribution margin	$p - v$: what one more unit adds toward covering F
Linear function	A rule whose graph is a line, with a slope and an intercept
Summation	$\sum_{i=1}^n x_i$: add the term once for each value of the index

Test yourself

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

1. A print shop drops its setup fee from \$300 to \$210 and nothing else changes. What happens to q^* , and by how much?
2. Your margin is \$4 a unit and your fixed cost is \$1,000. Someone proposes a price rise that adds \$1 to the margin. How many units of break-even does that buy back?
3. Why does rounding a break-even quantity always go *up*, never to the nearest whole number?
4. In $\sum_{i=1}^5 p_i q_i$, what does i point at, and why is the answer not $(\sum p_i)(\sum q_i)$?
5. A colleague says the model proves the club will make money. What is wrong with the word “proves”?

Numbers worth remembering

\$9

contribution margin
per shirt, $15 - 6$

33.3

break-even quantity,
 $300/9$

34

shirts, because you
round up

\$1,240

revenue over five
batches, $\sum p_i q_i$

If this moves

q^* becomes

Because

Price \$15 to \$18

25

the margin widens to \$12

Variable cost \$6 to \$9

50

the margin shrinks to \$6

Setup \$300 to \$180

20

the same \$9 margin has less to
cover

Carry into Week 2

- Week 1 assumed you knew what would happen. Week 2 drops that: the future arrives as a set of **states** with **probabilities** on them.
- The sum of products is the bridge. Week 2 writes **expected value** as $E[X] = \sum_i x_i p_i$: the same pattern, with each outcome weighted by its probability.
- The four letters stay. F , p , v , and q turn up again the moment a payoff has to be computed.

ON THE SITE · Week 2

The reading and the before-class self-check are posted. Do the self-check before Monday.

v348.jima.me/week/w02/

