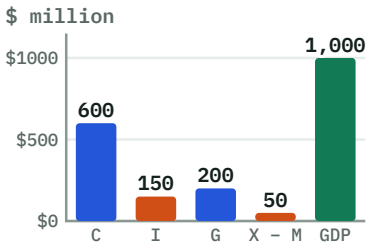
Can you read any formula?

Three moves for any formula: **read it in words** (each letter, each sign) → **draw it** (a line, a hill, an area, two paths) → **check one number** you know. Six formulas from six courses + MR = MC. Tool 11 of the eleven.

1 Three moves

tool 11 · a sum

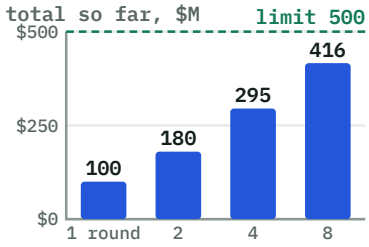
- **Lia** (draws) + **Sam** (formulas) · **Coralia** (toy island, $) · nothing is advice · **1 Words**: each letter, each sign (=, +, ×, ÷, Δ "the change in") · **2 Draw** · **3 Check one number**
- **GDP = C + I + G + (X − M)** (Macroeconomics 1) · GDP = gross domestic product = value of all made in a year · C households · I firms (machines) · G government · X exports − M imports (goods made abroad) = net exports, NX in Macro 1 · `600 + 150 + 200 + (250 − 200) = 1,000` $M · long sum = **Σ** (sigma) "add them all up"



2 Money goes round

multiplier · MV = PY

- **MPC** = marginal propensity to consume = share of each extra dollar spent · **multiplier = 1 ÷ (1 − MPC)** (Macroeconomics 5)
- MPC 0.8 → `1 ÷ 0.2 = 5` → $100M → **$500M** · rounds 100 + 80 + 64 + … = series `1 ÷ (1 − x)` (Math 9) · 0.75 → ×4 · 0.5 → ×2 · 0.9 → ×10 · assumes **no taxes, no imports, fixed prices** → imports leak → **smaller**
- **M × V = P × Y** (Macroeconomics 9) · M money · V velocity (times a $ is spent a year) · P price level (average price) · Y real output (goods, fixed prices) · `200 × 5 = 2 × 500` · % changes **add** (tool 3): V steady → money % = prices % + output % · `5% − 2% = 3%`



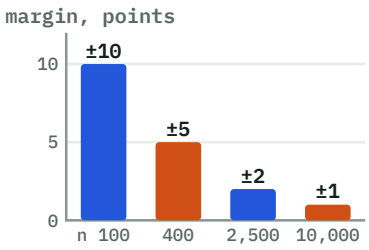
3 %, √n, r > g

three more readings

- **ε = %ΔQ ÷ %ΔP** (ε epsilon; Microeconomics 3, Math 7) = slope × P ÷ Q · kiosk at $4.50: `−40 × 4.5 ÷ 60 = −3` · slope −40 has units (cones per $), ε **none** → goods comparable
- **margin ≈ 100 ÷ √n** points (Data 7) · n = people asked · √n × √n = n · 19 polls in 20 · **random sample** only · ×4 people → ½ margin (not ×2)

n	100	400	1,600	2,500	10,000
√n	10	20	40	50	100
margin	±10	±5	±2.5	±2	±1

- **r > g** (Thinkers 10) · wealth at r = 5% vs income at g = 2% · $100 → 198 → **392** (14, 28 years; `70 ÷ 5 = 14`) vs 132 → 174



4 Which tool?

work one out

- **MR = MC** (Microeconomics 7, Math 5) · q hundred rides, P = 40 − 2q · MR = 40 − 4q (marginal revenue: extra from one more) · MC = $10 (marginal cost) · `40 − 4q = 10` → `4q = 30` → **q = 7.5** = 750 rides · P = 40 − 15 = **$25** · = slope of profit zero

Tool · ask	Examples
Slope (4, 5) · steepness, "one more"	MC · MR · MR = MC: the profit hill flat
Area (6) · height × width, ½	buyers' gain at $3: `½ × 3 × 120 = $180` · tax `$2 × 100 = $200` · deadweight `½ × 2 × 20 = $20` · profit `(P − ATC) × Q = (8 − 5) × 40 = $120` (ATC = average cost per unit)
Sum, series (9) · an adding up	GDP · `1 ÷ (1 − MPC) = 1 + MPC + MPC² + …` · total cost = rent + wages + flour
% ÷ % (7) · % over %	ε of demand · of supply · of income

5 So what?

tool 11 of 11

- **Exams** · AP Micro (US): arithmetic, **no calculus**, graphs · IB HL **Paper 3** (International Baccalaureate): quantitative, **30%** of HL grade · AQA A-level (UK): **≥ 20%** quantitative marks · check your syllabus
- **Eleven tools to read any formula** · **1 · A line is a start and a slope: Q = a − bP** · **2 · Two equations, one answer: set them equal** · **3 · Growth multiplies; the rule of 70 counts the doublings** · **4 · Marginal = the slope of the total** · **5 · The top of the hill is where the slope is zero** · **6 · An area adds up the marginals** · **7 · Elasticity = % ÷ %, so the units cancel** · **8 · The best bundle is where the two slopes match** · **9 · Tomorrow is worth today ÷ (1 + r); a series adds up to 1 ÷ (1 − x)** · **10 · Expected value = each outcome × its chance, added up** · **11 · Read it in words, draw it, check one number**

Watch out: never trust a formula you **cannot say in words** or a number you **did not check** · a formula holds only where its **assumptions** hold: no taxes or imports (simple multiplier), a random sample (margin) · slope ≠ elasticity