What if there are only two farms?

A second strawberry farm opens across the road from Mateo's. Each farm picks how many crates to bring, and the price falls until buyers take them all. Each answers the other's quantity; the answers meet at 8 and 8, a price between monopoly and competition. More farms push the price toward cost, and a cartel cracks because its quota is not a best reply.

1 One seller, then two

Micro 1, Lessons 7 and 8

- Demand `P = 30 − Q` (crates a day) · cost **$6** a crate · **MR** = extra money from one more crate · **MC** = cost of one more crate
- Alone (Micro 7) ⇒ `MR = 30 − 2Q = 6` ⇒ **12 crates**, **$18**, profit `12 × 12 = $144`
- Micro 8 ⇒ two moves (high · low) in a 2×2 matrix · now **any** quantity ⇒ where does the game settle?

2 Best reply

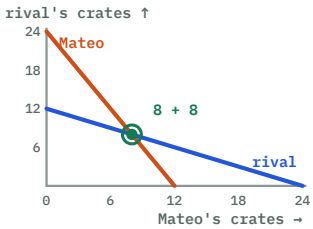
Games 2

- **Best reply** = the quantity that earns the most, **given** what the rival brings
- Rival 8 ⇒ what is left `P = 22 − q` ⇒ best **8** crates, $14, `8 × 8 = $64` (6 or 10 ⇒ $60)
- `P = 30 − q₁ − q₂` → `MR = 30 − q₂ − 2q₁` → `= 6` ⇒ `q₁ = (24 − q₂) ÷ 2`
- **Best-reply line** slopes down ⇒ rival 0 → 12 · 8 → 8 · 16 → 4 · 24 → 0
- Practice · fish `P = 26 − Q`, $8 ⇒ `q₁ = (18 − q₂) ÷ 2` · rival 4 ⇒ **7**, $15, $49 · rival 10 ⇒ 4

3 Cournot equilibrium

Cournot, 1838

- **Cournot equilibrium** = each firm brings its best reply to the other ⇒ nobody wants to move · a **Nash equilibrium** (John Nash, American mathematician · Games 2)
- Lines cross at **8 + 8** ⇒ 16 crates ⇒ `30 − 16 = $14` ⇒ `(14 − 6) × 8 = $64` each · $128 together < $144 alone
- Augustin **Cournot**, French mathematician, **1838** · two owners of mineral springs
- Practice · fish ⇒ **6 + 6**, $14, $36 each · ferries, costs $10 and $16 ⇒ **12 + 6**, $22, $144 and $36 ⇒ lower cost, bigger share

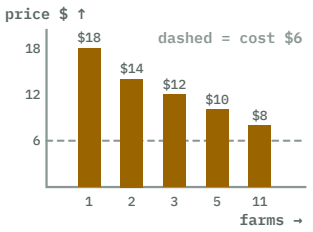


Market	Crates	Price	Profit each
One farm	12	$18	$144
Two (Cournot)	16	$14	$64
Many	24	$6	$0

4 More farms · cartel

Micro 6 · Games 5

- **n** equal farms ⇒ each `24 ÷ (n + 1)` ⇒ 1 → 12 · 2 → 8 · 3 → 6 (18 crates, **$12**) · 11 → 2 (22 crates, $8) ⇒ price → **$6** cost (Micro 6)
- **Cartel** = rivals agree to hold back · 6 + 6 ⇒ $18 ⇒ **$72** each > $64
- Best reply to 6 = `(24 − 6) ÷ 2 = 9` ⇒ 15 crates, $15 ⇒ cheater `9 × 9 = $81` · loyal `9 × 6 = $54` ⇒ the deal **cracks** ⇒ both end at 8 + 8
- Practice · coffee `P = 34 − Q ÷ 2`, $10 ⇒ deal 12 + 12, $144 · cheat 18 ⇒ **$162**, loyal $108 · no deal 16 + 16, $128



5 Other ways to play

idea 7 of 11

- **Stackelberg** · Heinrich von Stackelberg, German economist, **1934** · one farm commits first ⇒ 12 vs 6 ⇒ $72 vs $36 · first-mover edge (Games 4)
- **Bertrand** · Joseph Bertrand, French mathematician, **1883** · identical crates, firms pick **prices** ⇒ undercut to **$6**, profit 0 (Bertrand paradox: two sellers already give the cost price) · real duopolies (two sellers) in between: limited capacity (Edgeworth, 1897), berries never quite the same (Games 2)
- Sort · monopoly (one seller) · Cournot (rivals answer quantities) · cartel (a deal to hold back) · competition (many small sellers)
- **Eleven ideas behind the curves** · `1 · A demand curve is a chain of best bundles` `2 · A price change is two effects: substitution and income` `3 · Selling what you own is the same choice` `4 · Risk has a price: the risk premium` `5 · Cost curves come from the cheapest mix of inputs` `6 · A seller with many prices takes the buyers' surplus` `7 · Rivals answer each other's quantities: more firms, lower price` · next at university: Cournot with different costs

Watch out: two firms do **not** each sell the monopoly 12 (24 crates ⇒ $6) · nor share it as 6 + 6 (not a best reply) · Cournot = 8 + 8 · the cheater's gain is partly the rival's loss