Oligopoly in Advanced Microeconomics for Managers

A Business Training Manual for Competitive Decision Making

Model Selection Matrix

Use this matrix before applying any model. Your first task is to identify which competitive regime you are in.

Market Structure	Customer Perception	Model
Capacity constrained	Identical or near identical	Cournot
Capacity plentiful	Identical or near identical	Bertrand
Brand and feature driven	Differentiated	Logit and Hotelling
New or rapidly scaling	High entry cost	Stackelberg

If multiple conditions apply, treat the market as hybrid and use scenario analysis rather than relying on a single model.

Legal and Governance Guardrail

All models in this manual describe how markets behave when firms observe and respond to each other through lawful market actions such as pricing, capacity, investment, and product design. Any communication, signalling, or agreement with competitors to coordinate output, prices, or market allocation is illegal under competition law in most jurisdictions.

Managers must never:

- Share future pricing, capacity, or production plans with rivals.
- Seek or accept assurances of coordination.
- Use trade associations, analysts, or intermediaries to transmit strategic intent.

All strategic coordination described in this manual occurs only through unilateral, public market actions and rational rival response.

Information Lag and Uncertainty

In practice, managers never observe rival output Q_2, rival marginal cost c_2, or rival demand in real time. They observe them with delay, noise, and inference.
Therefore, all quantitative models in this manual must be run using ranges rather than single point estimates.

Every strategic decision must be tested under three rival behaviour cases:

- Aggressive. The rival expands output or cuts price.
- Stable. The rival holds current behaviour.
- Retreating. The rival contracts output or raises prices.

A strategy is only robust if it produces acceptable outcomes in all three cases.

Endogenous Cost Warning

In many oligopolies, marginal cost c is not fixed. It depends on output Q through:

- Scale economies
- Learning curves
- Utilisation rates
- Supplier pricing

Reducing output to protect price can raise unit cost, making a firm vulnerable to a rival that keeps volume high.

Every quantity decision must therefore be tested for its effect on both price and cost.

Repeated Game Overlay

Oligopoly is not a one period interaction. Firms meet repeatedly over time.
This creates three behavioural phases:

- Cooperative equilibrium. Firms tacitly respect pricing and capacity discipline.
- Punishment phase. A firm defects. Rivals respond aggressively to restore discipline.
- Forgiveness phase. After punishment, firms gradually return to restraint.

Managers must identify which phase they are in before acting. Applying a one-shot model to a repeated game leads to catastrophic mispricing and misallocation of capacity.

1. What Oligopoly Means for Managers

An oligopoly exists when a small number of firms account for most total sales. Each firm is large enough that its actions change market conditions for all others. This creates a brutal reality. Every serious business decision is a strategic move.
In a competitive market, the market absorbs changes to price or output. In an oligopoly, competitors respond. Profit depends on three variables: your own decisions, customer demand, and how rivals react to what you do. Oligopoly theory provides the discipline to predict and manage those reactions.

1.1 The Core Profit Equation

$$\pi_i = (P - C_i) \times Q_i$$

Where:

- π_i: total profit for firm i
- P: market price
- C_i: average cost per unit for firm i
- Q_i: quantity sold by firm i

This identity dictates that profit equals margin multiplied by volume. In an oligopoly, these two levers are in constant tension. If you push for volume (Q), you inevitably degrade the price (P). Success requires managing the Elasticity of the Rival. You must calculate whether a gain in market share will be offset by the margin destruction caused by your competitors' defensive pricing.

2. Quantity Competition and Capacity Strategy (Cournot)

2.1 The Managerial Problem. The Utilisation Trap

Operations managers often face pressure to maximise plant utilisation to lower per unit overheads. However, in an oligopoly, running at 100 percent capacity can be a financial disaster. The Cournot model identifies the Profit Maximising Ceiling where the benefit of extra volume is higher than the damage of the resulting price drop.

2.2 Strategic Interpretation of the Variables

$$P = a - b(Q_1 + Q_2)$$

Where:

- P: market price
- a: choke price
- b: price–volume gradient
- Q_1: your output
- Q_2: rival output

- The Choke Price (a). The maximum price the market will bear. If you overestimate this, you will build capacity for demand that does not exist.
- The Price Volume Gradient (b). The "Bleed Rate." It tells you exactly how many pence of price you lose for every additional unit you put into the market.
- Total Market Quantity ($Q_1 + Q_2$). Your price is "held hostage" by your rival. You cannot forecast your margin without first forecasting your competitor's production schedule.
- Cross Elasticity and a. The choke price is not fixed. It collapses when a close substitute becomes cheaper or better. Estimate cross elasticity using relative price changes of close substitutes. If a substitute's price falls by 10 percent and your demand falls by 5 percent at unchanged price, your effective a has shifted downward.

2.3 The Applied Logic. How the Formula Solves the Problem

To find the optimal output, you must identify the point where the Marginal Revenue from one extra unit equals the Marginal Cost of producing it. The Reaction Function performs this calculation by accounting for the rival's volume.

$$Q_1 = (a - c - bQ_2) \div (2b)$$

Where:

- Q_1: your optimal output
- a: choke price (demand intercept)
- c: your marginal cost
- b: price–volume gradient
- Q_2: rival output

The Mechanical Logic.

- The Marginal Trade off. Every unit you add increases your total volume but lowers the price for every other unit you are already selling. The formula calculates the tipping point where that price drop costs you more than the new unit earns.
- The Rival's Weight. The term - bQ_2 in the numerator represents the "stolen" market space. If your rival increases production, they move the market further down the demand curve. The formula then forces your Q_1 to decrease to prevent the price from falling below your marginal cost (c).
- The Decision Rule. If your data team calculates that the rival's Q_2 has risen, you must idle capacity. Running at 100 percent utilisation in this scenario would mean the Price Bleed (calculated by b) would exceed your production margin, resulting in a lower total profit (π) despite higher sales.

2.4 Worked Numerical Scenarios (Juxtaposed)

Worked Example 1. Training Numbers. Simple values to validate mechanics.

Assume: $a = 100$. $b = 2$. $c = 40$. Rival output $Q_2 = 10$.

Best response output:

$$Q_1 = (100 - 40 - 2 \times 10) \div (2 \times 2)$$

$$Q_1 = (100 - 40 - 20) \div 4 = 10$$

Total quantity: $Q = 20$. Market price: $P = 60$. Profit: $\pi_1 = 200$.

Worked Example 2. Industry Shaped. Large volumes where small b still bites.

Assume: $a = 12.00$. $b = 0.000002$. $c = 4.00$. Rival output $Q_2 = 1{,}500{,}000$.

$$Q_1 = (12.00 - 4.00 - 3.00) \div 0.000004 = 1{,}250{,}000$$

$P = 6.50$. Profit $\pi_1 = 3{,}125{,}000$.

Worked Example 3. The "Real World" Stress Test (Range + Cost Feedback).

Uncertainty Calculation: You observe rival Q_2 only as a range: 1.4M to 1.6M.

Endogenous Cost Check: If you cut production below 1.2M units, your unit cost (c) jumps from 4.00 to 4.50 due to lost overhead absorption.

- Scenario A (Optimistic): Rival $Q_2 = 1.4$M. Ideal $Q_1 = 1.3$M. Profit = 3.38M.

- Scenario B (Pessimistic): Rival $Q_2 = 1.6M$. Ideal Q_1 formula says cut to 1.2M.
- The Cost Trap: If you cut to 1.2M, your cost rises to 4.50.
  - Profit at 1.2M output with 4.50 cost $= (6.40 - 4.50) \times 1.2M = 2.28M$.
  - Profit at 1.3M output (ignoring advice) with 4.00 cost $= (6.20 - 4.00) \times 1.3M = 2.86M$.
- Corrected Decision: In this case, maintaining volume (violating pure Cournot) is better because the Endogenous Cost penalty outweighs the Price Benefit.

2.5 Variable Sourcing Guidance

- **a** comes from willingness to pay research, historical peak pricing, and conjoint studies.
- **b** comes from empirical price volume regression, controlled pricing tests, and elasticity estimation.
- **c** comes from marginal cost accounting, contribution margin, and variable cost build ups.
- **Q_2** comes from competitor disclosures, channel intelligence, import export statistics, and third-party shipment trackers.

2.6 Failure Conditions and Misuse Warnings

Cournot becomes unreliable when:

- Capacity is highly flexible and can be adjusted quickly at low cost.
- Firms compete primarily on price with instant switching, which pushes the market toward Bertrand logic.
- Demand is unstable and firms ration output rather than optimise it.
- Products are materially differentiated, so price is less sensitive to total Q.

2.7 Competitive Feedback Loop

- Step 1. You raise output to improve utilisation. Price falls.
- Step 2. Rival defends share by raising output or refusing to cut. Price falls further.
- Step 3. Margins compress. Finance pushes volume to cover fixed costs.
- Step 4. The cycle reinforces until a low cost player forces restructuring, consolidation, or exit.

- Repeated Game Tactic: If you are in a "Punishment Phase" (Section 3.6), do not optimise for short-term profit. Purposefully expand Q_1 beyond the optimum to signal aggression and force the rival back to discipline.

2.8 Diagnostic Checklist

- Is capacity a binding constraint for at least one major player?
- Are output changes visible to rivals within a quarter?
- Does a small increase in industry volume cause a meaningful fall in price?
- Do competitors publicly discuss utilisation, load factors, or capacity discipline?

If yes to most, Cournot is a useful base model.

3. Price Competition and the Bertrand Trap

3.1 The Managerial Problem. The Commodity Hell

Pricing managers often believe a 2 percent price cut will capture the entire market. The Bertrand model proves that in a commodity market, your rival must match you to survive, leading to an immediate collapse of industry margins.

3.2 The Applied Logic. Why the Trap Snaps Shut

The mechanic here is Perfect Substitutability. If there is zero cost for a customer to switch, your market share is a vertical cliff.

- The Logic of $P = c$. If you undercut a rival, they lose 100 percent of their volume. To prevent bankruptcy, they must undercut you back. This mechanical cycle only stops when price equals marginal cost.
- The Decision Rule. If your internal audit shows that your product is viewed as interchangeable with the rival, you cannot use price as a weapon. Any price cut will be matched instantly, leaving you with the same market share but lower margins.
- The Solution. You must spend the price cut budget on creating Switching Friction, for example proprietary software or loyalty contracts. This blunts the Bertrand mechanic by ensuring a 1 percent price difference no longer causes a 100 percent shift in volume.

3.3 Worked Numerical Scenarios (Juxtaposed)

Worked Example 1. Training Numbers. Why undercutting collapses to cost.

Assume marginal cost $c = 10$. Two firms sell identical products.

- Firm A sets $P = 14.00$. Firm B sets $P = 13.99$. Firm B captures almost all demand.
- Firm A responds with $P = 13.98$. Firm A captures almost all demand.
- This repeats until P reaches 10.00. At that point, any further undercut makes negative margin. The cycle stops.

Worked Example 2. Industry Shaped. Subscription category with fast matching.

Assume $c = 18$ per customer per month. Current price is 30. You cut to 28. Rival matches to 28 within two weeks.
If you have 2,000,000 customers, the monthly margin loss is: $(30 - 18) - (28 - 18) = 2$ per customer.

Monthly profit loss $= 2 \times 2{,}000{,}000 = 4{,}000{,}000$.

3.4 Variable Sourcing Guidance

c must come from marginal cost per unit or per customer, not fully absorbed cost. Use contribution margin, direct variable cost build up, and unit economics.

3.5 Failure Conditions

Bertrand logic weakens when:

- Switching costs exist, such as contracts, integration, data lock in, loyalty benefits.
- Products are differentiated in customers' minds.
- Capacity is constrained, so a low price cannot serve the whole market.
- Prices are not transparent, so undercutting does not instantly redirect demand.

3.6 Capacity-Constrained Bertrand (Edgeworth Risk)

If capacity limits prevent the lowest-price firm from serving the whole market, undercutting does not instantly capture 100 percent of demand. This often produces price cycles: firms cut to fill capacity, then raise once rivals are full. Decision rule: treat price as a short-run

utilisation lever, not a share-capture weapon, and scenario-test outcomes under aggressive matching.

3.7 Competitive Feedback Loop

- Step 1. One firm cuts price. Rival matches.
- Step 2. Both firms lose margin. Both firms chase volume to recover profit.
- Step 3. Customers learn to wait for discounts. Willingness to pay erodes.
- Step 4. The category becomes structurally low margin unless differentiation is rebuilt.
- Repeated Game Tactic: Implement "Tit-for-Tat" matching. If a rival cuts price, match it immediately (not weeks later). This "trains" the rival that price cuts yield zero volume gains, only margin losses, forcing them back to the Cooperative Equilibrium.

3.8 Diagnostic Checklist

- Can customers switch quickly with minimal penalty?
- Do customers compare offers on one screen?
- Do price cuts trigger immediate matching?
- Do discounts fail to produce sustainable share gains?
- If yes to most, assume Bertrand risk is high.

4. First Mover Advantage (Stackelberg Strategy)

4.1 The Managerial Problem. Pioneer or Follower?

Should you commit to a massive new factory before anyone else? The Stackelberg model shows that being first creates a permanent profit advantage, but only if the move is hard and irreversible.

4.2 The Applied Logic. Manipulating Rival Math

The mechanic here is Commitment. The Leader moves first to claim the most profitable part of the demand curve, leaving only the scraps for the Follower.

$$(6.40 - 4.50) \times 1.2M = 2.28M$$

$$(6.20 - 4.00) \times 1.3M = 2.86M$$

- The Mechanic. By building a massive, custom facility (QL), you change the rival's Cournot calculation. When the Follower looks at the market, they see so much supply

that their own Best Response formula forces them to choose a low volume (QF) to keep the market price above their costs.

- The Requirement of Sunk Costs. This only works if your investment is irreversible. If you can easily scale back, the Follower will ignore your threat and produce more, leading to a Cournot price war.

- The Decision Rule. Move first only if you can signal that you are locked in. This bullying of the market math allows you to capture double the profit of the firm that waits.

4.3 Worked Numerical Scenarios (Juxtaposed)

Worked Example 1. Training Numbers.

Assume a = 100. b = 2. c = 40.

$$(30 - 18) - (28 - 18) = 2$$

$$2 \times 2{,}000{,}000 = 4{,}000{,}000$$

Where:

- Q_L: leader output (first mover)
- Q_F: follower output (second mover)
- **a**: choke price (demand intercept)
- **c**: marginal cost
- **b**: price–volume gradient (slope of demand)

Worked Example 2. Industry Shaped.

Assume a = 12.00. b = 0.000002. c = 4.00.

$$Q_L = (a - c) \div (2b)$$

$$Q_F = (a - c) \div (4b)$$

4.4 Failure Conditions and Diagnostics

Failure conditions:

- Commitment is reversible, so rivals discount the threat.
- Demand is uncertain and the first mover is stuck with excess capacity.
- Rivals can finance rapid matching capacity within your payback period.

Diagnostics:

- Is the investment sunk and visible?
- Would reversing the move be prohibitively expensive?
- Can rivals match within your payback period?
- Repeated Game Tactic: If the Follower tries to "bluff" by overproducing, the Leader must not retreat. You must maintain QL to validate the threat, even if it causes a temporary price crash (Punishment Phase), to force the Follower into submission.

5. Differentiation and Pricing Power

5.1 The Applied Logic of Hotelling (The Gap Strategy)

If you are too similar to your rival, you are close to them in the customer's mind, which triggers Bertrand price wars.

- The Mechanic of Distance. Distance represents anything that makes it inconvenient to switch, such as physical location or technical specifications.
- The Decision Rule. Do not cluster with your rival's features. By moving your product specifications to an empty gap in the market, you create a Local Monopoly. This distance acts as a buffer, allowing you to raise prices without customers fleeing, because the cost of switching to the rival's different offering is now too high.

5.2 The Applied Logic of Logit (Measuring Brand Equity)

$$s_j = exp((v_j - p_j) \div \mu) \div \Sigma\, exp((v_k - p_k) \div \mu)$$

Where:

- s_j: market share of firm j
- v_j: perceived value (utility) of firm j
- p_j: price of firm j
- μ: market noise / differentiation factor
- Σ: sum across all firms k in the choice set
- v_k, p_k: value and price of each competitor k
- The Mechanic of Sensitivity (μ). μ represents the "noise" or uniqueness in the market. If μ is low, the market is a pure price comparison.
- The Decision Rule. If a 2 percent price increase causes a 10 percent drop in share, your μ is too low. The manager must increase vj (Value) through features that the rival cannot match. This formula allows a pricing manager to calculate exactly how much

Brand Equity is worth. It is the amount you can raise price (p) before the exponent collapses your market share (s).

5.3 Worked Numerical Scenarios (Juxtaposed)

Worked Example 1. Training Numbers.

Assume two products only. $\mu = 5$. Your $vj = 40$. Your $pj = 30$. Rival $vr = 38$. Rival $pr = 28$.

- For you: $(40 - 30) \div 5 = 2$.
- For rival: $(38 - 28) \div 5 = 2$.
- exp(2) equals exp(2), so your share is 50 percent.
- Now raise your price by 2. pj becomes 32.
- $(40 - 32) \div 5 = 1.6$.
- Your exp term falls from exp(2) to exp(1.6), so your share falls below 50 percent.

Worked Example 2. Industry Shaped.

Assume $\mu = 12$, reflecting higher preference dispersion and greater switching friction. Your $vj = 80$. Your $pj = 60$. Rival $vr = 72$. Rival p_r = 52.

- Raise your price by 5. pj becomes 65.
- $(80 - 65) \div 12 = 1.25$.
- Your exp term falls, so share declines, but the decline is less violent than in the $\mu = 5$ case. That is the managerial meaning of a higher μ.

5.4 Variable Sourcing Guidance

- vj can be proxied from conjoint analysis, feature adoption, win loss reasons, NPS drivers, and retention uplift from feature releases.
- μ can be estimated from how sensitive share is to price changes, ideally using controlled tests. If you cannot run tests, use natural experiments such as price changes in one segment, channel, or region.

5.5 Failure Conditions and Diagnostics

Failure conditions:

- The market has distinct segments, so one μ misrepresents reality.
- Bundling changes the choice set, breaking single product assumptions.
- Channel constraints cap share regardless of preference.

Diagnostics:

- Do different segments show materially different price sensitivity?
- Do feature upgrades move share without discounting?
- Does retention remain stable after price increases?

6. Product Lines and Strategic Blocking

6.1 The Applied Logic. The Fighter Brand

Managers use product lines to solve the Entry Problem. If you leave a Value gap in your portfolio, a rival will use it to enter your market.

- The Mechanic of Pre-emption. By launching a cheaper Fighter Brand, you occupy the lower tier demand.
- The Strategic Intent. This line is “Defence Cost." Even if it has low margins, it protects your Premium line by making it mathematically impossible for a new rival to find enough free customers to justify the cost of entry. You are effectively using your portfolio to clutter the demand curve and leave no room for opponents.

6.2 Diagnostics and Failure Conditions

Diagnostics:

- Is there a low-price segment where we have no credible offer?
- Is an entrant already targeting that segment?
- Would an entrant gain scale quickly if we did nothing?

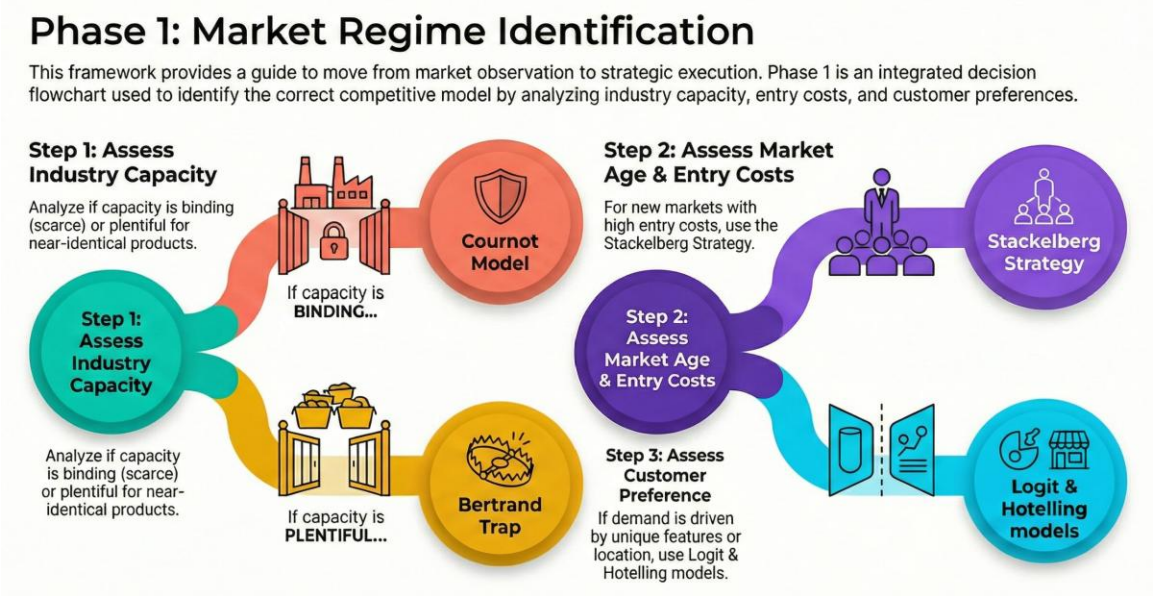
Failure conditions:

- The fighter brand cannibalises premium volume more than it blocks entry.
- The fighter offer damages brand trust in the premium tier.
- Channel conflict forces discounting across the portfolio.

7. The Strategic Execution Framework

Use this guide to move from market observation to strategic execution.

Integrated Decision Flowchart



Phase 2: Applied Logic and Mechanical Decision Rules

Cournot (Quantity/Capacity):

- The Mechanic: Marginal revenue is suppressed by the Price Bleed (b) on all existing units.
- Calculation: Solve $Q_1 = (a - c - bQ_2) \div (2b)$.
- Decision Rule: If current Q exceeds the calculated Q_1 ceiling, idle capacity to protect total profit.

Bertrand (Price/Commodity):

- **The Mechanic**: Perfect substitutability creates a vertical cliff for market share.
- **Decision Rule**: Do not cut price; it will be matched instantly until $P = c$ (price equals marginal cost).
- **Action**: Pivot budget to Switching Friction (e.g., proprietary software) to blunt undercutting.

Stackelberg (First-Mover):

- The Mechanic: Use sunk costs (irreversible investment) to claim high-value demand.
- Decision Rule: Commit to high volume (QL) to force followers into a lower-volume response (QF).

Logit/Hotelling (Differentiation):

- The Mechanic: Create distance (uniqueness) to reduce price sensitivity (μ).
- Decision Rule: Increase perceived value (v) until a price hike results in minimal share drop.

Phase 3: Risk and Governance Validation

- Scenario Analysis: Test every decision against Aggressive, Stable, and Retreating rival responses.
- Cost Check: Ensure reducing output does not raise unit costs through lost scale economies or low utilisation.
- Legal Check: Ensure the move is a unilateral market action; avoid any signalling or assurances of coordination with rivals.
- Defensive Check: Launch a Fighter Brand to occupy value gaps and pre-empt rival entry.

9. Final Message

In an oligopoly, you do not manage a company in a vacuum. You manage a game against intelligent opponents. Managers who ignore these dynamics create price wars and capacity gluts. Managers who master these models shape the market by forcing rivals to react to them, rather than the other way around.