



Instructor guide to Hotelling spatial competition

Laboratory implementation, theoretical foundations,
experimental evidence, and variants

Behavioral and Experimental Economics Research Lab
Department of Economics



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<https://beer-lab.org/>

How to use this guide

This guide supports preparation, implementation, and classroom discussion of the Hotelling spatial-competition family in the Behavioral and Experimental Economics Research Lab (BEER Lab), Department of Economics, Tecnológico de Monterrey. It assumes no previous experience with oTree or laboratory teaching.

The quick route launches a session; operational chapters explain every screen; conceptual chapters provide predictions and evidence for feedback. Common access, rules, participant flow, and reporting are explained once.

Treatment entries describe only what changes: configuration, mechanism, prediction, indicators, discussion, and implementation. English and Spanish configurations use one application and parallel content, so an instructor can choose language without changing the economic design.

Author

This guide was prepared by Stanislaw Maldonado, research professor in the Department of Economics at Tecnológico de Monterrey, Monterrey Campus. For questions or suggestions about its content, please contact the author at stanislao.maldonado@tec.mx.

For the instructor

The guide follows the English interface. Spanish configurations reproduce the same mechanics. Project only aggregate results; never connect participant codes to names, student numbers, seats, or public comments.

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Quick implementation guide

1.1 Access through the updated laboratory website

Start at <https://beer-lab.org/en/>. Select **CLASSROOM** in the top navigation menu; it opens <https://teaching.beer-lab.org/en/>. In the **Classroom experiments** catalog, use the search box to locate the activity by name. You can also filter by **Topic** or **JEL code**. Clear any filters left from an earlier search before looking for another game.

Each family's card distinguishes **Español** and **English** access links. The **Show extended version** checkbox selects that edition before following a link. Catalog language and session language are separate choices: verify both. Students use the room specified by the instructor; the instructor prepares and monitors the session through this family's own administrative pages.



Figure 1.1: Current institutional website. Select CLASSROOM in the top navigation menu to open the teaching experiments. Captured on October 7, 2026.



Figure 1.2: Current catalog: search by title, topic, or JEL code. Then locate this family's card and select language and edition. Captured on October 7, 2026.

Checking resources, comprehension, and participant requirements

Before opening the room, check the selected configuration and the number of students present. The session-creation form states the group size and minimum required by that configuration. An individual activity accepts any positive participant count; an interactive activity must satisfy its stated requirement: complete groups when size is fixed, or a minimum participant count when size is flexible. Requirements may change across treatments, for example when adding a third party or changing an institution's size. If you edit a grouping parameter, check the requirement for the edited configuration, rather than relying only on the demo's suggested count.

In the instructions, ensure that students can identify what each role receives, what they can decide, and how the outcome is calculated. An initial account, a distributable budget, and final earnings need not be the same amount. Refer to the resources panel and the example for the selected treatment. Do not carry the basic edition's endowment into a treatment that changes accounts or introduces additional positions.

ECU stands for *Experimental Currency Units*: the activity's unit of account. An outcome of 100 ECU does not automatically equal 100 pesos or 100 dollars. Conversion depends on the session configuration. Before announcing a payment, confirm with the laboratory whether money is paid, the conversion rate, and which decisions count for payment. In hypothetical modules, describe amounts as outcomes in the stated situation.

When a comprehension check is included, an incorrect response receives an explanation beside that question, identifying the submitted answer and the correct answer. Other answers remain in the form. Ask the student to return to the example, locate the relevant rule, and redo the calculation before correcting the response. Avoid revealing answers to the entire class for an individual error, and do not interpret a comprehension mistake as an economic choice in the game.

a espacial de Hotelling — una ronda	Competencia espacial de Hotelling / Hotelling Spatial Competition — BEER Lab Seleccione una variante de este juego. Select a version of this game.
a espacial de Hotelling — 10 rondas, mismo rival	
a espacial de Hotelling — 10 rondas, rivales reasignados	
patial Competition — one round	
patial Competition — 10 rounds, same rival	
patial Competition — 10 rounds, reassigned rivals	
tendido — referencia con demanda uniforme	
tendido — demanda concentrada a la izquierda	
tendido — dos centros de demanda	
tendido — precios y transporte lineal	
tendido — precios y transporte cuadrático	
tendido — demanda elástica y opción de no comprar	
tendido — costos marginales asimétricos	
tendido — localización secuencial	
ptelling — uniform-demand benchmark	
ptelling — demand concentrated on the left	
ptelling — two demand centers	
ptelling — prices and linear transport	
ptelling — prices and quadratic transport	
ptelling — elastic demand and outside option	
ptelling — asymmetric marginal costs	
ptelling — sequential location	

Figure 1.3: Demo contains only the configurations of this game family, in both languages and editions.

Rooms

Current rooms:

[ES] Competencia espacial de Hotelling
[EN] Hotelling Spatial Competition
[ES] Competencia espacial de Hotelling: extendida
[EN] Hotelling Spatial Competition: extended

Figure 1.4: Rooms contains the four rooms for this family: basic and extended editions in Spanish and English.

Room: [EN] Hotelling Spatial Competition

Create a new session

Session Config

[EN] Hotelling Spatial Competition — one round

Number of participants

Complete groups of 2 participants. Use a multiple of 2; minimum 2.

Create

[Configure session](#) 

App sequence

hotelling_game (10 rounds)

Two firms choose locations and, in selected treatments, prices on a Hotelling street.

Figure 1.5: Session-creation form for the basic English room. Check the selected configuration and participant requirement before creating the session.

Downloading a session with several rounds

For the instructor

Open **Data** within the relevant session and use that session's CSV or CSV-for-Excel download link. The general export has one row per participant and columns for the different rounds. Ten rounds do not necessarily mean ten rows per person. When the family provides its own long-format export, observations may instead be organized by participant and round or another unit defined by the design.

Save the original file together with the configuration name, session code, and active-round count. Check that columns for the last active round are present and that the data belong to the selected session. Empty cells can represent inactive rounds, a pending decision, or a field that does not apply to a role; do not automatically recode them as zeros. To compare learning, preserve round and group identifiers alongside participant identifiers. Share only anonymous aggregates in class, and record session incidents before constructing derived tables.

1.2 Basic facts

Purpose	Study how firms selling a homogeneous product choose location and, in selected treatments, price when consumers compare delivered cost.
Experimental unit	One market with two firms and a simulated population of consumers distributed on a street from 0 to 100.
Basic edition	One round, ten rounds with the same rival, or ten rounds with reassignment; common price and uniform demand.

Extended edition	Concentrated demand, endogenous prices, quadratic travel costs, an outside option, asymmetric costs, and sequential location.
Decision	Integer location; integer price in selected treatments; alternating move order in the sequential version.
Payoff	Firm profit: sales revenue minus variable costs; consumer measures are reported for classroom feedback.
Topics	spatial competition; horizontal differentiation; location choice; price competition; industrial organization.
JEL	C72; C92; D43; L13.
Suggested duration	25–35 minutes for one round; 50–70 minutes for ten rounds plus feedback.
Participants	An even number. Demo sessions use two; four or more create independent markets.
Results	Anonymous report with firm-specific histograms, location paths, prices, coverage, travel, profits, and welfare.

1.3 Decisions before class

Begin with the learning objective rather than the platform. Use one basic round with a common price and uniform demand to introduce minimum differentiation. Keep pairs fixed for ten rounds to study learning within a relationship. Reassign rivals to distinguish experience with one competitor from adaptation to the population. Extended treatments change one economic dimension and should be selected because that dimension belongs in the lesson, not because the menu is larger.

Define the comparison unit. You may compare rounds within a session, simultaneous markets in one classroom, or treatments across sections. Do not present repeated observations from the same pair as statistically independent replications. Those observations contain learning and strategic dependence. Making this point helps students distinguish a classroom illustration from a formal hypothesis test.

For the instructor

A reliable sequence for new students is: private prediction; one baseline round; short discussion without fully revealing the theory; ten rounds; aggregate report; model explanation; and one extension that changes demand or pricing. Theory then becomes an answer to evidence students have just produced.

1.4 Minimum sequence

1. Confirm an even number of participants, treatment, rounds, and matching rule.
2. Visit beer-lab.org, enter the teaching area, and open teaching.beer-lab.org.
3. Locate **Hotelling Spatial Competition** and open instructor access.
4. Under **Rooms**, choose the basic or extended English room and one configuration.
5. Create the session for the students present. Keep **Monitor** and **Report** in separate tabs.
6. Share only the room route. Require silence and allow everyone to finish comprehension.

7. Do not explain equilibrium during decisions. Answer questions only about rules.
8. Wait for every market; reveal aggregate results; describe facts before interpreting them.
9. Export data for section comparisons while preserving anonymous codes and never projecting identifiers.

Checkpoint

Before starting: correct room and configuration; even attendance; correct language; projector free of individual data; public link ready; treatment order recorded; recovery plan for a disconnected computer.

Platform access and family architecture

2.1 From the lab portal to the game

Navigation begins at beer-lab.org. The teaching area opens teaching.beer-lab.org, where each card represents an isolated family. The Hotelling card leads to its dedicated subdomain. Isolation is both pedagogical and operational: an instructor entering Hotelling should see exactly 22 Hotelling configurations and four rooms, without dictator, public goods, election, or other games.

2.2 Participant and instructor routes

Participants use a stable room under hotelling.beer-lab.org. The four available rooms are: The stable basic English room is:

https://hotelling.beer-lab.org/room/hotelling_en

- `hotelling_es` and `hotelling_en` for the basic family;
- `hotelling_extendido` and `hotelling_extended` for the extended family.

A basic room contains one round, ten rounds with the same rival, and ten rounds with reassignment; an extended room contains eight treatments. Instructors use `/demo` for rehearsals or **Rooms** for a stable class session.

Attention

Do not share administrative access, passwords, or individual links on public slides. Participants need only the room URL. If the panel lists families other than Hotelling, stop and report an isolation problem before creating a session.

2.3 Creating and monitoring a session

After a configuration is selected, oTree provides participant links and access to Monitor, Data, and Report. In a class, students normally use the stable room; individual links support demonstrations and controlled recovery. Monitor displays progress through anonymous codes. A short wait is

normal because a firm may need its rival's decision. A long wait usually means someone remains on an earlier page.

The report remains hidden until every active market-round is complete. This rule prevents locations or prices from being revealed while another pair is deciding. When pending reaches zero, the instructor presses **Reveal results**. The action is reversible; **Hide results** returns to a neutral screen before another question or treatment.

The screenshot shows the oTree web interface for a session titled "[EN] Hotelling Spatial Competition — 10 rounds, same rival: session 'or5g0lqp' (demo)". The top navigation bar includes links for Demo, Sessions, Rooms, Data, Server Check, and Logout. Below the title, there are icons and links for New, Links, Monitor, Data, Payments, Report, and Description. A note states: "Below are temporary links for testing and demonstration. To launch a real study, either create persistent links by setting up a [room](#), or create a session through the [sessions page](#)." It then asks the user to "Choose one of the following options to play the session:". Under "Combined views", there are two buttons: "Split-screen view" with a "Launch" link, and "Grid view" which is "Not available". Under "Session-wide testing link", it instructs to "Open the below link in up to 2 browser tabs." and provides the URL <http://127.0.0.1:8057/join/riputig>. Under "Single-use links", it instructs to "Open each link in its own browser tab." and lists two participant links: P1 with URL <http://127.0.0.1:8057/initializeParticipant/uzmosbwi> and P2 with URL <http://127.0.0.1:8057/initializeParticipant/0x2bmx72>.

Figure 2.1: Links and administrative tools for a demonstration session.

Common mechanics and participant flow

3.1 The spatial market

Two firms sell the same product to consumers located on a street from 0 to 100. Each consumer compares posted price plus travel cost from the consumer's position to each firm. Under linear transport,

$$d_i(x) = p_i + |x - z_i|,$$

where p_i is firm i 's price, z_i its location, and x the consumer's location. The consumer buys from the lower delivered-cost firm. Demand at an exact tie is split evenly.

In the basic version, $p_A = p_B = 50$ and both firms have marginal cost $c = 20$. With total consumer mass normalized to one, operating profit is

$$\pi_i = (p_i - c_i)s_i,$$

where s_i is share served. The platform adds a 20 ECU base to keep intended round results nonnegative. The base does not change marginal incentives: maximizing the round result is equivalent to maximizing operating profit.

Theoretical foundation

Students control firms; consumers are simulated. The platform applies the demand rule deterministically. This design focuses attention on strategic interdependence, makes markets comparable, and allows welfare to be computed without recruiting a large consumer side.

3.2 Welcome, rules, and instructions

The cover presents the BEER Lab, states the teaching purpose, and requires acceptance of silence, privacy, and continuity rules. It avoids wording that recommends a strategy. The instructor may read procedural rules but should not add advice about the center, endpoints, or pricing.

Instructions define delivered cost, profit, price, marginal cost, and share. The numerical example shows that a 40% share with a margin of 30 generates 12 ECU of operating profit and 32 ECU after the base. Confirm that students understand the difference between a proportion in the formula and the percentage displayed on screen.

**BEER Lab****Hotelling Spatial Competition**

Two firms will choose where to locate on a street. Demand will depend on location and, in some treatments, price.

Welcome to the laboratory

The Behavioral and Experimental Economics Research Lab in the Department of Economics at Tecnológico de Monterrey is a space designed to learn about economic decision-making through controlled activities.

General rules

- Remain silent and do not talk to other participants.
- Make decisions individually and privately.
- Follow the instructions on each screen.
- Do not refresh, close, or leave the page.
- If you encounter a problem, raise your hand and wait for private assistance.

☐ I have read and agree to follow these rules.

Start

Powered by [oTree](#)

Figure 3.1: Institutional cover and general laboratory rules.



basic version - one interaction

How the market works

Resources and unit of account

Monetary base of your account per round: 20 ECU. The outcome adds income or bonuses and deducts the costs or losses specified in the instructions.

ECU stands for Experimental Currency Units. It is the unit of account for this activity.

This session does not convert ECU into real money.

You manage one of two firms selling the same product. The street runs from 0 to 100. Consumers buy from the firm offering the lowest delivered cost.

Delivered cost

$$\text{delivered cost} = \text{price} + \text{travel cost}$$

In this treatment both firms charge 50 ECU. Each firm has a marginal cost of 20 ECU.

Travel cost increases linearly with distance.

Profits

$$\text{profit} = (\text{price} - \text{marginal cost}) \times \text{market share}$$

The platform adds a 20 ECU base to the round result. Consumers are simulated; the strategic decisions belong to the two firms.

Example

If your firm charges 50, has marginal cost 20, and serves 40% of the market, operating profit is $(50 - 20) \times 0.40 = 12$ ECU. Your round result is 32 ECU after adding the 20 ECU base.

Conditions in this session: common price and uniform demand

Continue

Powered by [oTree](#)

Figure 3.3: Current instructions for the basic edition: initial resources, decision rules, and experimental units. Continuation 2/2.

3.3 Comprehension and choice

The comprehension check asks how consumers choose, what directly raises profit, and what force appears with equal prices and uniform demand. Incorrect answers return a concise reminder. Attempts are not displayed in the classroom report and should not be graded without a prior protocol.




Review the marked questions. Each shows your answer and an explanation; your other answers are retained.



Comprehension questions

1. How does a consumer choose between the firms?

☐ Chooses the lowest price plus travel cost
☒ Always chooses the closest firm
☐ Chooses randomly

Your answer: Always chooses the closest firm. The correct answer is Chooses the lowest price plus travel cost. Review the rules: consumers compare delivered costs, and profit combines margin and demand.

2. What directly raises operating profit?

☒ A larger margin and a larger market share
☐ A longer consumer trip
☐ A higher location number

3. With equal prices and uniform consumers, what strategic force arises?

☒ Moving toward the center to capture consumers
☐ Always moving to the endpoints
☐ Location does not matter

Continue

Powered by [oTree](#)

Figure 3.4: Current comprehension check with an incorrect answer, its specific explanation, and retained responses.

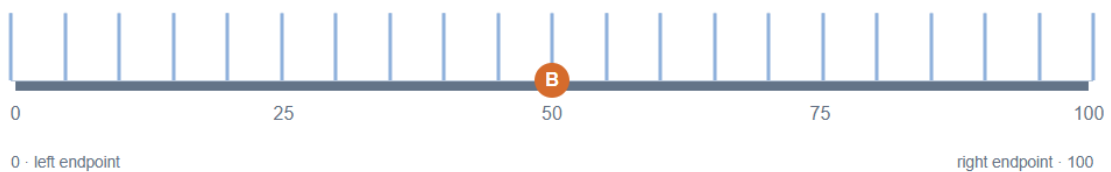
The location screen assigns each person Firm A or B. Blue consistently denotes A and orange denotes B. Vertical bars show consumer density: equal heights mean uniform demand, while sloped or bimodal patterns show other treatments. The slider accepts integer locations from 0 to 100 and moves the firm's marker before confirmation.

Firm B

Choose your firm's location

Select an integer point from 0 to 100.

Consumer density: a taller bar indicates greater demand around that point.



50

Conditions in this session: common price and uniform demand

Confirm decision

Powered by [oTree](#)

Figure 3.5: Location choice with uniform demand and color-coded role.

3.4 Market result and completion

The result shows locations, the approximate boundary, prices, shares, and operating profits for both firms. Lower cards add coverage, mean travel, delivered cost, consumer surplus, welfare, and the participant's round result. Describe these measures before evaluating them. High profit alone does not imply efficiency; low price does not guarantee short travel; central clustering may intensify competition while increasing trips for consumers at the endpoints.

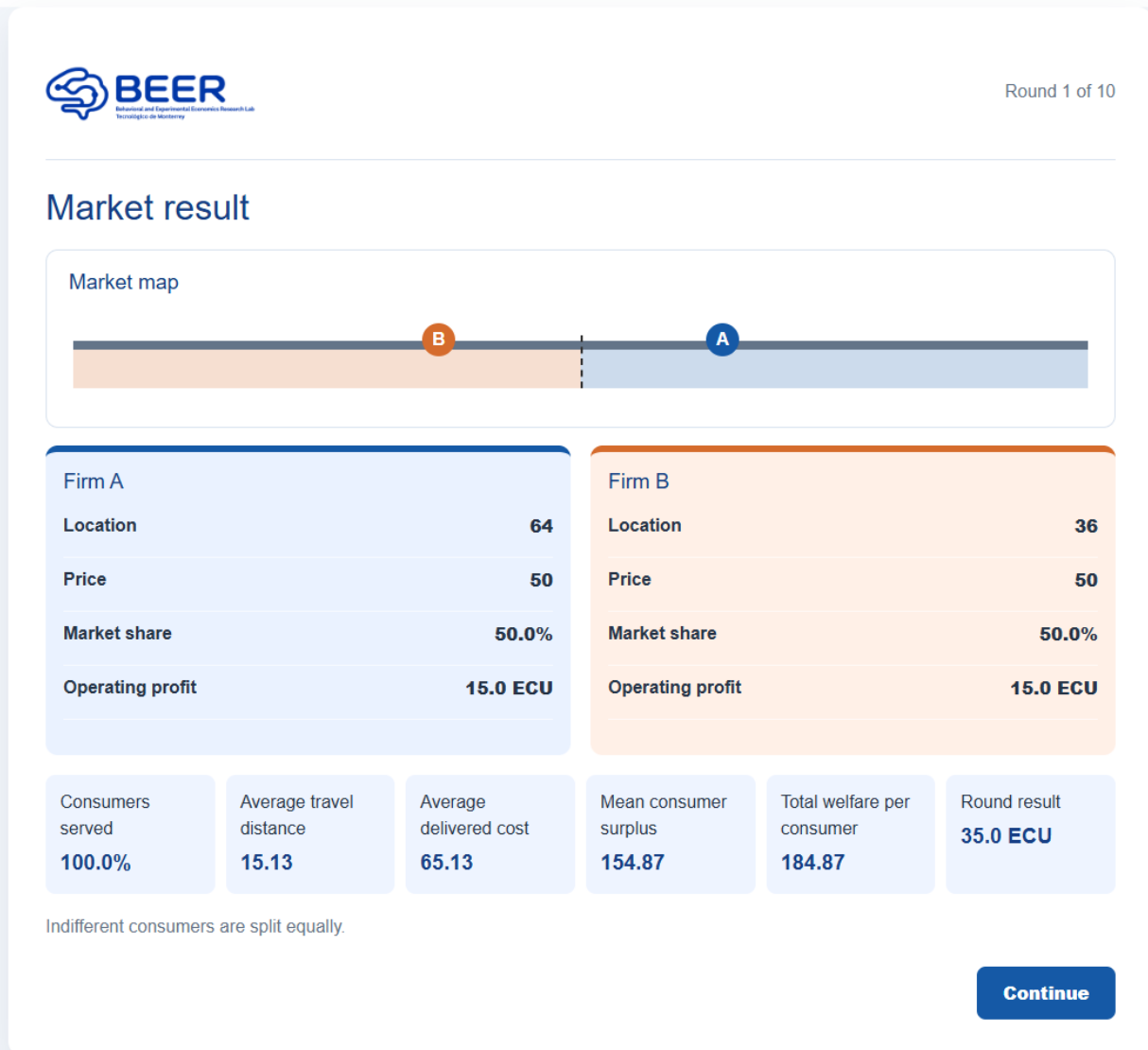


Figure 3.6: Market result with territories, boundary, and indicators.

The final page confirms that choices were recorded and asks participants to wait. It replaces the generic “No more pages left” message with a clear conclusion. A ten-round session also summarizes cumulative ECU, mean location, mean operating profit, and mean share for that participant's firm.



Activity completed

Your decisions have been recorded. Wait for the instructor's directions and do not close this window.

Cumulative ECU
350.0

Mean location
40.5

Mean operating
profit
15.0

Mean market share
50.0%

Powered by [oTree](#)

Figure 3.7: Explicit completion screen.

Theoretical foundations

4.1 The principle of minimum differentiation

[Hotelling \(1929\)](#) studies competition on a line and identifies a force toward proximity. In the elementary two-firm game with fixed equal prices, uniform inelastic consumers, and linear transport, suppose $z_A < z_B$. The indifferent consumer solves $|x - z_A| = |x - z_B|$ and lies at $(z_A + z_B)/2$. A serves consumers to the left and B those to the right. If A moves slightly toward B without passing it, the boundary shifts and A gains demand; B has the symmetric incentive. The process leads both firms to the center.

This prediction is minimum differentiation: locations or products become similar because each firm tries to capture the marginal consumer. It is a Nash equilibrium of the location game with a common price. It is not a universal claim that real firms always cluster. The result relies on uniform demand, full coverage, two firms, homogeneous products, exogenous price, one-dimensional mobility, and no location capacity or fixed costs.

The model immediately raises a normative distinction. When both firms locate at 50, each serves half the market, but total travel is not minimized. Placing firms at 25 and 75 reduces average travel when customers use the nearest outlet. Competition produces private convergence even though service planning favors separation. This tension makes the game useful in microeconomics, industrial organization, urban economics, and public economics.

Feedback script

Ask first, “Where did firms locate?” Then ask, “Which locations would minimize total travel?” Finally ask, “Why would a firm refuse to maintain that allocation?” The sequence separates description, efficiency, and strategic stability.

4.2 Best responses, equilibrium, and dynamics

An equilibrium is not the socially preferred outcome or the average decision. It is a profile in which no firm can raise profit through a unilateral change. If firms are separated under a common price, one can usually move inward and capture demand. If both stand at the center, moving to one side leaves the mover with less than half the market, while staying preserves the split. That unilateral comparison supports equilibrium.

Observed dynamics can differ because of limited reasoning, search, reciprocity, attempts to differentiate, or learning. A path toward 50 suggests discovery of best responses; oscillation may reflect leapfrogging; stable choices at 25 and 75 may be an efficient yet vulnerable convention. The round report supports these interpretations without claiming to identify individual motives.

Fixed rivals create a shared history. Students can react to the previous choice, attempt punishment, or coordinate separation. Reassignment retains experience but changes the relationship, shifting attention toward population learning rather than bilateral reputation. A one-shot session removes within-session learning but not prior intuition. These modes alter the strategic environment and are not merely different lengths.

4.3 Price competition and the 1979 critique

When price is chosen, location and pricing interact. Nearby firms are closer substitutes, so a small price cut can redirect much demand. Separated firms receive some spatial protection but impose longer travel. First-stage location anticipates second-stage rivalry.

[d'Aspremont et al. \(1979\)](#) show that linear transport with endogenous prices can create discontinuities and a failure of pure-strategy price equilibrium when firms are too close. Their quadratic specification produces a better-behaved price subgame and may generate maximum differentiation. The lesson is not to memorize an endpoint. It is to identify how predictions change when the mechanism changes and which assumption supports each result.

The platform implements both technologies. Linear transport equals distance; quadratic transport is 0.04 times squared distance. The constant keeps classroom magnitudes manageable. This is a discrete pedagogical adaptation: consumers occupy 101 points, prices and locations are integers, and sessions have a finite horizon. Numerical outcomes belong to this implementation, while comparative logic links to the theory.

4.4 Welfare, coverage, and market power

Delivered cost combines a monetary transfer and travel burden for teaching purposes. Consumer surplus is reservation value minus the lowest delivered cost. Profit sums margins over quantity, and welfare adds surplus and profit. Under full coverage, price is largely a transfer and travel is the main real loss; with elastic demand, excluded consumers create an additional loss.

The measures support several evaluation criteria. A regulator may prioritize coverage, travel, or consumer surplus. A firm prioritizes profit. A planner may compare total welfare. The report does not label a round good or bad because ranking depends on the stated objective. Declare the criterion before ordering outcomes.

4.5 Experimental evidence and cautious interpretation

Location experiments reveal adjustment processes omitted by static equilibrium. [Brown-Kruse et al. \(1993\)](#) study experimental spatial competition and find that choices can depart from simple benchmarks as conditions and experience change. [Huck et al. \(2002\)](#) show that with more firms central clustering can emerge, connecting theory, learning, and market size. The broader literature underscores design details: discrete or continuous locations, fixed or chosen prices, known demand, communication, repetition, and payoff rules.

A class session does not estimate a general causal effect. The group is small, students share a room, and previous exposure may differ. It still produces disciplined evidence for reasoning. Describe frequencies and paths, compare them with a conditional prediction, and propose alternative mechanisms. “In this session we observed” is warranted; “firms always do” is not.

Do not equate convergence with understanding. Firms can reach the center by imitation, chance,

or search, while a separated pair may understand equilibrium and prefer a convention that raises joint returns. Follow-up questions can distinguish accounts but cannot identify motives with certainty. Research use would require additional consent, protocol, sample-size, and preregistration procedures.

For the instructor

Use the literature as a framework rather than an answer students must reproduce. The laboratory is valuable because it confronts a transparent conditional prediction with visible decisions and asks why they agree or diverge.

Instructor report and feedback strategy

5.1 Hidden results and reveal

Before completion, the report shows participants, expected markets, completed markets, and pending markets, while hiding the figures. This protection is essential in simultaneous treatments. Projecting locations during choice would change the information environment.

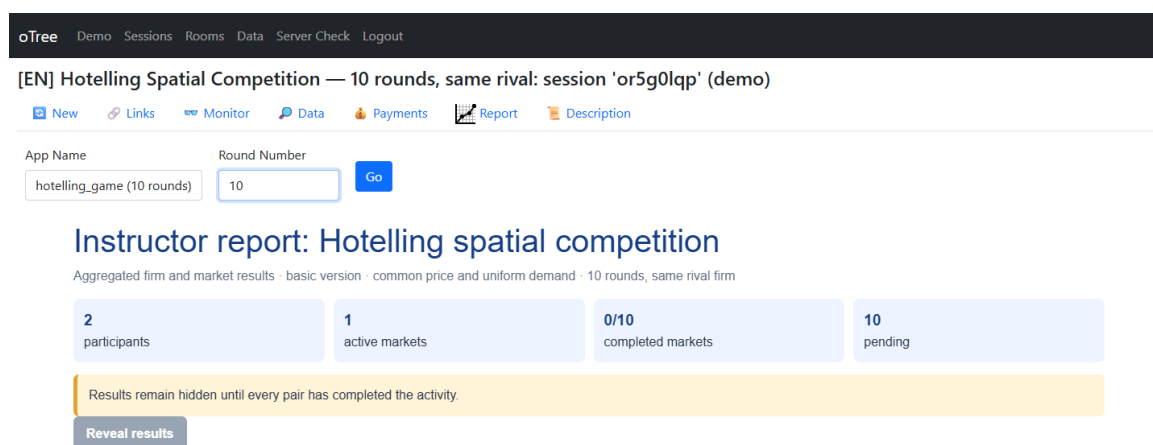


Figure 5.1: Protected report while markets remain pending.

After completion, the report displays eight indicators, a treatment-specific theory note, firm-specific location histograms, round evolution, and a detailed table. Color preserves the distinction between A and B. The evolution graph connects role means; with reassignment, it is not an individual firm's path.

5.2 Recommended reading order

Begin with completeness: how many markets and rounds underlie the display? Move to locations: mean A, mean B, gap, and distance from center. Inspect the distribution because equal means can conceal polarization. Use evolution to discuss learning. Only then bring in prices, profits, coverage, travel, and welfare. This order prevents payoffs from becoming the explanation before the spatial facts are established.

Use the round table selectively: first versus final round; before and after convergence; linear versus quadratic treatment. Do not narrate every cell. Choose comparisons tied to the lesson. With

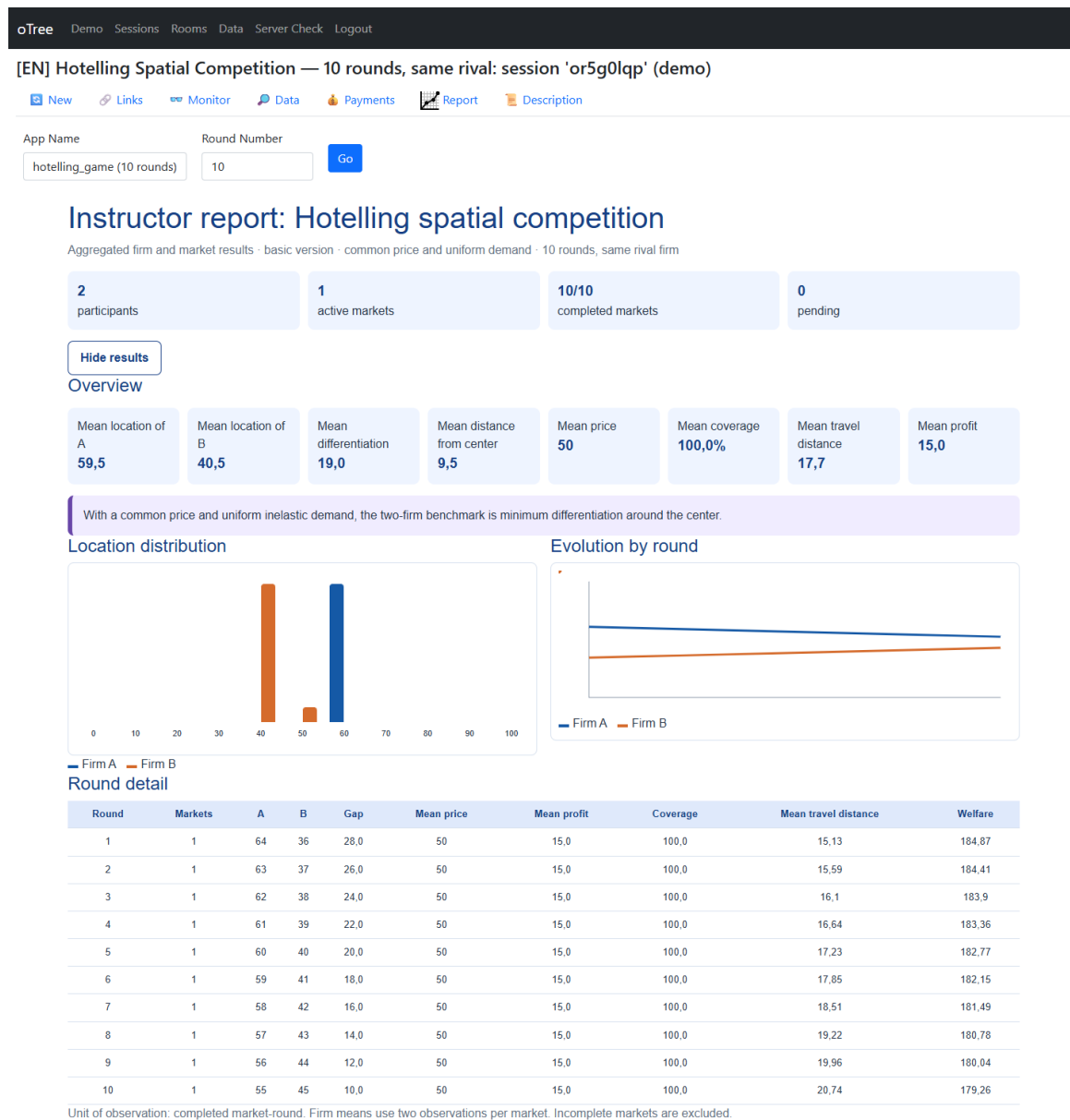


Figure 5.2: Aggregate instructor report after reveal.

several markets, pair means with histograms; an average at 50 may mean every firm chose 50 or half chose 20 and half chose 80.

Feedback script

State three visible facts. Formulate the model prediction under this session's assumptions. Identify one match and one departure. Offer a mechanism for the departure and a treatment that could distinguish it. End by asking whether the outcome was stable for firms and efficient for consumers.

5.3 Common interpretation errors

Do not call the last period an equilibrium merely because it is last. Do not treat a mean location of 50 as minimum differentiation without dispersion. Do not compare profits across different costs or demand without reconstructing the formula. Do not read coverage as completion rate. Do not infer causality from sections that differ in schedule or composition. Do not connect projected roles to names.

When a figure is surprising, verify configuration, active rounds, treatment, and complete markets. The configuration screenshot and data export reconstruct the session. Incomplete pairs are excluded and shown in counts. Exclusion protects calculations but can affect comparability if many pairs fail to finish.

Extended-family treatments

All eight treatments share the institutional cover, comprehension, two-firm structure, report, and completion page. Each entry below describes only what changes. Screenshots come from the working application rather than reconstructed illustrations.

6.1 Uniform benchmark

Configuration: `hotelling_extended_baseline`.

Mechanism

This treatment keeps consumers uniform, a common price of 50 ECU, marginal cost of 20 ECU, and ten rounds with the same rival. It isolates the location incentive in the original model: each firm wants to stand slightly closer to the center than its competitor in order to capture more demand.

Prediction

The equilibrium benchmark is minimum differentiation at the center. Round data may reveal gradual convergence toward 50, coordination away from the center, or alternating positions. Repetition does not mechanically produce equilibrium; it can also sustain conventions and reciprocal responses.

How to read the report

Compare mean locations, the gap between firms, distance from the center, and consumer travel. Ask whether convergence represents intense competition, social efficiency, or both. Then contrast the private gain from moving inward with the travel burden borne by consumers.

Implementation

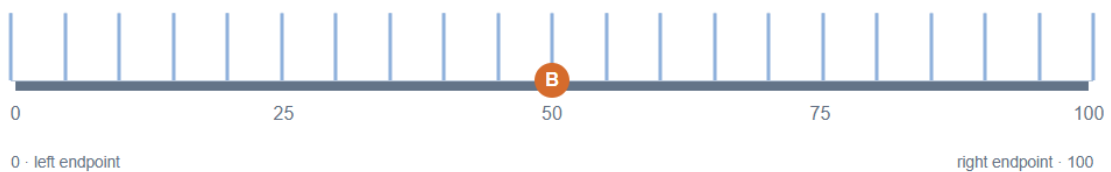
Use it after a one-shot baseline to study learning. Do not announce the equilibrium before play. Keep rounds and group size constant when comparing sections.

Firm B

Choose your firm's location

Select an integer point from 0 to 100.

Consumer density: a taller bar indicates greater demand around that point.



50

Conditions in this session: common price and uniform demand

Confirm decision

Powered by [oTree](#)

Figure 6.1: Specific decision screen for uniform benchmark.

6.2 Demand concentrated on the left

Configuration: `hotelling_extended_left_demand`.

Mechanism

Consumer mass declines as one moves to the right. Bars above the street make local density visible, so students can see that the geometric midpoint no longer equals the economic center of the market.

Prediction

Best responses shift toward the high-demand area. There is no reason to predict convergence at 50; the relevant focal point moves toward the median consumer. The treatment distinguishes physical midpoint, median location, and average location of demand.

How to read the report

Project the location distribution and identify where the class clusters. Ask which statistic of demand best predicts decisions. Discuss why a firm may leave remote consumers to its right even though they remain part of the market.

Implementation

Run it immediately after uniform demand. Hold prices and costs fixed so observed changes can be attributed to market geography.

6.3 Two demand centers

Configuration: `hotelling_extended_bimodal_demand`.

Mechanism

Demand is concentrated near two areas, around 25 and 75. Firms decide whether to compete for the same customer cluster or specialize spatially in separate centers.

Prediction

Bimodality can sustain differentiation because separation reduces direct rivalry and consumer travel. Each firm nevertheless retains an incentive to approach the more attractive cluster, so the data may show coordination, invasion, or cyclical movement.

How to read the report

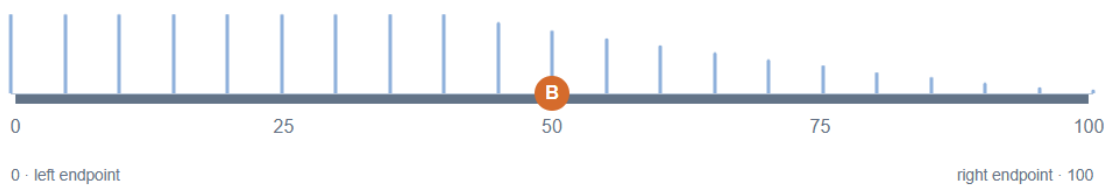
Use firm-specific histograms to see whether A and B occupy different centers. Ask whether separation reflects explicit coordination, tacit learning, or best responses. Compare welfare, mean travel, and profits with uniform demand.

Firm B

Choose your firm's location

Select an integer point from 0 to 100.

Consumer density: a taller bar indicates greater demand around that point.



Conditions in this session: demand concentrated on the left

Confirm decision

Powered by [oTree](#)

Figure 6.2: Specific decision screen for demand concentrated on the left.

Implementation

This version is useful for market segmentation. Avoid describing a cluster as belonging to one firm; roles and positions may switch across rounds.



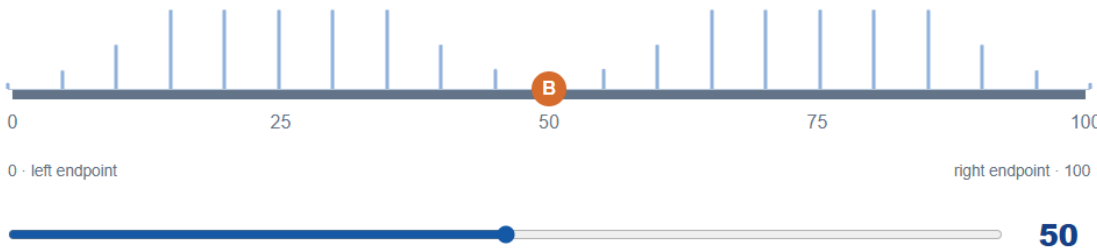

Round 1 of 10

Firm B

Choose your firm's location

Select an integer point from 0 to 100.

Consumer density: a taller bar indicates greater demand around that point.



0 - left endpoint right endpoint - 100

Conditions in this session: two demand centers

Confirm decision

Powered by [oTree](#)

Figure 6.3: Specific decision screen for two demand centers.

6.4 Endogenous prices and linear transport

Configuration: `hotelling_extended_linear_prices`.

Mechanism

After fixing locations, both firms observe the map and set prices simultaneously. Consumers compare price plus distance. This second strategic stage means proximity increases price pressure.

Prediction

With linear transport costs, the price subgame may lack a pure-strategy equilibrium when firms are too close. The difficulty emphasized by d'Aspremont, Gabszewicz, and Thisse prevents a mechanical extension of the minimum-differentiation result from fixed prices.

How to read the report

Analyze location gap, price, market share, and profit jointly. A firm can attract demand by cutting price, relocating, or both. Ask which instrument was more costly and whether proximity produced a price war.

Implementation

Spend extra time on timing. Location is fixed before price choice and cannot be revised after seeing the rival's price.



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Round 1 of 10

Firm B

Choose a price

Locations are fixed. Choose an integer price within the permitted range.

Market locations

A: 58 B: 42

Your marginal cost

20 ECU

50

ECU per unit

Confirm decision

Powered by [oTree](#)

Figure 6.4: Specific decision screen for endogenous prices and linear transport.

6.5 Endogenous prices and quadratic transport

Configuration: `hotelling_extended_quadratic_prices`.

Mechanism

The game retains two stages, but travel cost rises with squared distance. A very distant firm quickly loses appeal, while some separation lowers substitutability and softens price competition.

Prediction

The quadratic specification of d'Aspremont, Gabszewicz, and Thisse creates a well-behaved price subgame and a force toward greater differentiation. Its prediction deliberately contrasts with clustering under a common price.

How to read the report

Compare mean prices, location gaps, and profits with linear transport. Ask why separation can support higher prices while raising travel costs. Use welfare to show that private profitability and efficiency are distinct criteria.

Implementation

The comparison is clearest when students play linear and then quadratic costs without hearing the prediction. Record treatment order when using separate sections.



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Round 1 of 10

Firm B

Choose a price

Locations are fixed. Choose an integer price within the permitted range.

Market locations

A: 58
B: 42

Your marginal cost

20 ECU

ECU per unit

50

Confirm decision

Powered by [oTree](#)

Figure 6.5: Specific decision screen for endogenous prices and quadratic transport.

6.6 Elastic demand and outside option

Configuration: `hotelling_extended_elastic_demand`.

Mechanism

Consumers buy only when the lowest delivered cost does not exceed their valuation. High prices or distant locations can leave part of the market unserved. The report adds coverage, consumer surplus, and welfare.

Prediction

With an outside option, a firm does more than steal customers from its rival; it may bring into the market consumers who would otherwise abstain. Total demand is no longer fixed, and price affects margin, share, and market size.

How to read the report

Begin with coverage. If it falls, diagnose price, distance, or both. Ask whether a price cut can increase profits through market expansion. Compare consumer surplus with profits when discussing regulation.

Implementation

Clarify that consumers are simulated and share the stated valuation. Coverage is a market outcome, not the share of students who completed the task.

6.7 Asymmetric marginal costs

Configuration: `hotelling_extended_asymmetric_costs`.

Mechanism

Firm A produces at 15 ECU per unit and B at 30 ECU. Each participant sees the firm's own cost before pricing. Locations are selected first, so the cost advantage can be used for a lower price, a larger margin, or both.

Prediction

The efficient firm has a wider range of profitable prices. Market share and profit still depend on both locations. A high-cost firm may protect demand through spatial differentiation rather than matching the efficient firm's price.

How to read the report

Keep A and B separate in the analysis. Compare price, share, and profit by role; a pooled mean would hide the treatment's central heterogeneity. Ask whether the efficient firm passed its



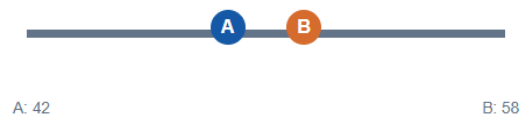
Round 1 of 10

Firm A

Choose a price

Locations are fixed. Choose an integer price within the permitted range.

Market locations



Your marginal cost

20 ECU**Confirm decision**Powered by [oTree](#)

Figure 6.6: Specific decision screen for elastic demand and outside option.

advantage to consumers or retained it as margin.

Implementation

Do not announce the rival's cost during decisions if the intended experience is private cost information. Reveal both costs during feedback to reconstruct alternatives.



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Round 1 of 10

Firm B

Choose a price

Locations are fixed. Choose an integer price within the permitted range.

Market locations

A: 58 B: 42

Your marginal cost

30 ECU

ECU per unit **50**

Confirm decision

Powered by [oTree](#)

Figure 6.7: Specific decision screen for asymmetric marginal costs.

6.8 Sequential location

Configuration: `hotelling_extended_sequential_location`.

Mechanism

One firm moves first and the second observes that location before responding. Leadership alternates across rounds. The follower's screen displays the rival marker on the same demand map.

Prediction

Commitment changes best responses. The leader anticipates the follower's reaction; the follower uses information unavailable to the leader at the moment of choice. First movement can create an

advantage or disadvantage depending on market conditions.

How to read the report

Compare the same participant as leader and follower. Ask whether followers copied, avoided, or leapfrogged leaders. Use round evolution to detect adaptation when order changes.

Implementation

This version requires synchronization. Keep the monitor open and explain that waiting is normal. Do not permit communication about locations outside the interface.





Round 1 of 10

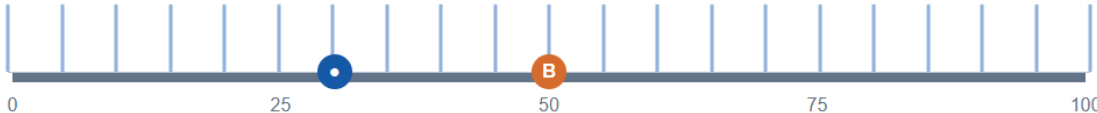
Firm B

The other firm has already chosen

Select an integer point from 0 to 100.

Observed location of the other firm: **30**

Consumer density: a taller bar indicates greater demand around that point.



0
25
50
75
100

0 - left endpoint
right endpoint - 100

50

Conditions in this session: sequential location

Confirm decision

Powered by [oTree](#)

Figure 6.8: Specific decision screen for sequential location.

Class plans and extension activities

7.1 A 50-minute plan

During the first five minutes, request a private location prediction and one reason. Spend ten minutes on the cover, instructions, and comprehension. Run one round and reserve five minutes for students to record what they expected from the rival. Run ten fixed-rival rounds for about fifteen minutes. Use the final fifteen minutes to reveal the report, derive the indifferent consumer, and compare equilibrium with travel-minimizing locations.

The format requires discipline. Do not add endogenous prices to the same short session. Students should leave distinguishing best response, equilibrium, efficiency, and learning. An exit ticket can request the theoretical prediction, one observed fact, one critical assumption, and one application in which the line represents physical distance or an attribute space.

7.2 A 90-minute plan

Use the short plan in the first half. After the conceptual pause, assign one extension: concentrated demand for urban economics, quadratic transport for industrial organization, elastic demand for regulation, or sequential location for game theory. Request a new prediction before displaying the configuration. Run the treatment, reveal results, and end with a benchmark-extension comparison table.

Ask groups to state what remained fixed, what changed, and which indicator tests the prediction. This prevents vague explanations. If the extension changes prices, analyze location and price jointly; if it changes demand, identify median and demand centers; if it changes order, separate leader and follower behavior.

7.3 After-class activities

One quantitative exercise calculates the boundary for given locations and prices. Another constructs discrete best responses by fixing the rival and comparing share after a one-point move. A normative activity compares observed travel with locations 25 and 75. Advanced courses can derive pricing conditional on location under a well-behaved specification and explain why the linear case may fail.

Students can also write a one-page memo for an authority assigning location permits. The memo must choose a criterion, use two report indicators, and acknowledge one limitation. Another task compares a geographic street with a line of product attributes such as taste, ideology, quality, or delivery time. Students explain what distance means and which assumptions change.

Discussion and assessment

8.1 Conceptual questions

1. Why does rationality not necessarily imply central location when prices are endogenous?
2. How do geometric midpoint, median consumer, and mean demand location differ?
3. Why can socially efficient locations be strategically unstable?
4. How does repetition differ with a fixed or reassigned rival?
5. What additional information is needed to compare welfare across treatments?
6. Why does a mean of 50 fail to prove convergence?
7. What force is introduced by an outside option?
8. How can a high-cost firm protect itself through location?
9. How do first-mover commitment and follower information differ?
10. What must change to represent more than two firms?

Every answer should name a mechanism and connect it to an observable. “Differentiation rose” is incomplete; a strong answer notes a larger mean gap, separated histograms, and a corresponding price or travel change. Evidence requirements constrain retrospective stories that could explain any outcome.

8.2 Numerical problems

Let A stand at 30 and B at 70 with prices of 50. The indifferent consumer is at 50 and each firm serves half under uniform demand. If A moves to 50 while B remains at 70, the boundary becomes 60 and A serves 60%. With a margin of 30, operating profit rises from 15 to 18 ECU. This calculation identifies the deviation that makes separation vulnerable.

Now place A at 30 with price 45 and B at 70 with price 55. Under linear transport, solve $45 + |x - 30| = 55 + |x - 70|$ for a consumer between them, compute shares, and compare with the screen. Then raise B’s marginal cost and ask which prices remain feasible. The exercise connects algebra, interface, and strategy.

Under elastic demand, use reservation value 82. A consumer at 0 facing A at 30 with price 60 has delivered cost 90 and does not buy. Ask whether B can serve that consumer and what maximum price permits coverage. The problem separates share between firms from total market coverage.

8.3 A short rubric

An excellent answer states assumptions, formulates a prediction, uses specific evidence, acknowledges an alternative, and separates stability from efficiency. An adequate answer identifies the mechanism with partial evidence. An insufficient answer lists outcomes without a causal connection, treats averages as individual choices, or generalizes from one session. Apply the rubric to oral discussion, an exit ticket, or a short memo.

Guided cases for interpreting results

9.1 Two sessions with a mean of 50

Suppose every firm in the first session locates at 50, while half the firms in the second choose 20 and half choose 80. Both sessions may have a mean of 50, but only the first displays minimum differentiation. The second contains dispersion and perhaps market-level specialization. Diagnosis requires histograms, within-pair gaps, and the round table. Check whether A and B systematically occupy different sides or whether both colors appear at both endpoints. The case teaches that a mean answers where the center of choices lies, while a distribution describes how choices are organized. Ask students for two other configurations with the same mean and different welfare, then ask for the minimum additional statistic needed to distinguish them. A valid answer requires dispersion or pair-level data rather than another average.

9.2 Convergence with fixed and reassigned rivals

Suppose the mean gap falls from 30 to 5 over ten rounds. With fixed rivals, the path can reflect best-response learning, imitation, leapfrogging, or a convention developed within the pair. With reassignment, the same trend points more toward learning a general rule, although past population behavior may still matter. Compare adjustment speed, variance across markets, and persistence after a rival changes. Ask what evidence would separate bilateral reputation from experience. One design changes matching while holding payoffs constant, announces the change, and tests whether decisions restart or continue. The goal is not to declare a definitive mechanism but to propose a comparison that makes mechanisms more distinguishable.

9.3 Proximity and a price war

In a price treatment, firms may begin apart and move inward because they expect to capture demand. They then discover that proximity makes consumers highly price-sensitive and compresses margins. A subsequent move apart reveals a tension between attracting demand and avoiding rivalry. Read location, price, and profit on the same timeline. A price decline together with a smaller gap is consistent with greater substitutability; a decline without spatial movement needs another explanation. Ask what happens to share if both prices remain fixed and one firm moves, then hold locations fixed and examine a unilateral price cut. The exercise shows why solving each stage in isolation can be misleading when locations anticipate price competition.

9.4 High profits and low welfare

Consider a round with high prices, full coverage, and widely separated firms. Profits may be high because each firm has spatially captive customers. Mean travel can also be high and consumer surplus low. Before labeling the result inefficient, specify which welfare components are real resources and which are transfers. In the platform, price reduces surplus and raises profit; travel reduces surplus without becoming firm revenue. Compare total profit, surplus, and travel. Ask which policy addresses the diagnosed problem: price cap, location permits, transport subsidy, or entry. Each acts on a different margin and can have unintended effects on coverage and competition.

9.5 The economic center moves

With demand concentrated on the left, one class may continue choosing 50 because the previous game anchors them. Another may shift immediately toward 30. The first pattern does not prove irrationality; it can reflect slow learning, a geometric interpretation of the center, or an expectation that the rival also stays at 50. Show demand bars and ask students to locate the approximate median, then compare early and late rounds. Movement left suggests updating. If choices remain at 50, construct a concrete deviation and compute its share. The treatment separates an inherited focal point from incentives created by current demand.

9.6 Cost advantage: margin or price

With asymmetric costs, A can use its advantage to set a lower price, retain the same price and earn a larger margin, or combine both. Mean profit does not reveal the channel. Separate roles and reconstruct margin, share, and location. If A prices much lower without higher profit, it may have passed the advantage to consumers. If it prices similarly and earns more, it retained margin. If B moves away and preserves demand, differentiation cushions its disadvantage. Ask for a recommendation to B and require consideration of A's response. The requirement turns unilateral intuition into strategic reasoning.

9.7 An incomplete market

Under elastic demand, shares of 60% and 40% can sum to 100% among purchasers even when only 70% of potential consumers buy. The interface reports each firm's allocation and total coverage separately, so the instructor must state denominators. Locate unserved regions using price, valuation, and distance. Ask whether a price reduction expands demand enough to offset the lower margin. Compare spatial movement with a price cut: both can raise coverage, but their strategic costs differ. The case connects industrial organization with service access, remote retail, and digital coverage.

9.8 Leader and follower

If a leader chooses 30 and the follower chooses 31, proximity may reflect imitation or an attempt to capture the interior. If the follower chooses 70, it may avoid competition or target the other side. Alternate roles and compare the same person across positions; differences then reflect strategic position as well as individual heterogeneity. Ask leaders what response they expected and followers which alternatives they considered, without treating retrospective reports as causal evidence.

Organize report observations by role and odd or even round. A pooled mean can cancel order effects. This case prepares commitment, backward induction, and subgame-perfect equilibrium.

9.9 A five-step diagnostic protocol

Apply the same sequence to any result. First identify the effective configuration: language, treatment, rounds, and matching. Second verify completeness and unit of observation. Third describe locations and dispersion without yet using equilibrium or efficiency. Fourth reconstruct incentives through one concrete unilateral deviation. Fifth evaluate consumer consequences with coverage, travel, surplus, and welfare. Only then compare with the literature or another section. The routine prevents choosing an explanation simply because it fits the graph.

To practice, provide an unlabeled report image and ask what information is missing. Students should request configuration, costs, demand, and timing rather than guess. Reveal these elements in stages. The exercise demonstrates that a figure cannot be interpreted outside the mechanism that generated it. It also develops reproducible analysis: every claim should connect to a rule, variable, and observation.

Connections across economics courses

10.1 Microeconomics and game theory

The game turns best responses and Nash equilibrium into visible choices. Location is a strategy, share determines payoffs, and the rival changes returns. Sequential location adds commitment and order; endogenous prices create a multi-stage game. An instructor can sketch the reduced tree, solve the pricing stage conceptually, and ask what locations anticipate it. Repetition supports learning discussions without turning the activity into an infinitely repeated game: the horizon here is known and finite.

10.2 Industrial organization and urban economics

The line can represent geography or product characteristics. A cafe chooses a neighborhood, a platform chooses features, an airline selects a departure time, or a news outlet takes an editorial position. Define distance, price, and switching cost in each application. Concentrated demand connects with urban density; the outside option with underserved regions; asymmetric costs with productivity; differentiation with market power. Ask which analogies preserve the mechanism and which introduce omitted elements such as capacity, congestion, multiple products, or entry.

10.3 Public economics and regulation

The gap between equilibrium and travel minimization opens a discussion of licensing, zoning, and public provision. An authority may want facilities separated to reduce travel, but a relocated firm may want to move inward. Regulating price without location can strengthen other responses. Entry changes coverage and competition. Ask students to design one intervention, anticipate the strategic response, identify the report indicator that measures success, and name an important outcome missing from the model.

10.4 Political economy and the Downs model

Downs shares the spatial logic: candidates occupy an ideological line and voters choose proximity. Hotelling's business framing retains firms, prices, costs, consumers, profit, and welfare. Candidates seek votes and face electoral institutions; firms seek profit and may set prices. Comparing the games separates mathematical structure from economic interpretation. One should not replace the other when a course requires mechanism-specific language. The Hotelling family studies business competition; the election family studies platforms, participation, and representation.

Facilitating the classroom conversation

11.1 Before revealing the report

Ask each student to record the firm's own location, the rival location they expected, and one reason for the choice. Keep responses private for one minute. Then request a prediction about the aggregate display: central clustering, separation, asymmetry, or dispersion. This pause prevents the first speaker from defining the class's collective memory. It also creates a comparison between individual beliefs and the group outcome.

Before pressing reveal, restate the actual configuration. Write fixed or endogenous price, demand shape, costs, timing, and matching on the board. Without these details, discussion may attribute to the model a prediction that belongs to a different treatment. Ask one student to restate the consumer rule in a sentence. Only then display the report.

Ask for three observations that contain no causal language. Examples include a mean location, a change in the gap, a difference between colors, or a coverage rate. If students immediately say firms "learned", "cooperated", or "were irrational", return to the graph and ask what is directly visible. The distinction between observation and explanation is a transferable empirical skill.

11.2 Moving from facts to mechanisms

Organize the conversation in four columns: fact, prediction, alternative mechanism, and test. A fact is verifiable, such as "the mean gap fell from 28 to 10". A prediction names the assumptions under which it follows. An alternative mechanism explains a departure. A test proposes a new comparison, such as reassigned rivals, bimodal demand, or quadratic transport. This structure turns isolated comments into cumulative economic reasoning.

When a student gives a psychological explanation, ask what observable pattern would distinguish it. When a student gives a mechanical explanation, ask whether it requires anticipating the rival. When a student claims efficiency, ask which measure and objective support the claim. These questions refine contributions rather than reject them. Keep rival hypotheses on the board and return to them after an extension.

One useful technique is counterfactual reconstruction. Select a round and hold the rival fixed. Ask what would happen if A moved one point, then ten points, while prices stayed constant. Next hold locations fixed and change one price. Finally ask which counterfactual is actually available in the treatment. Students learn that a profitable action in an imagined game may be unavailable in the game they played.

11.3 Inclusive participation

Do not ask identified students to defend choices that can be inferred in a small market. Use whole-class questions, anonymous responses, or small-group discussion. Colors A and B denote roles, not permanent teams. If a strategy attracts laughter or criticism, return attention to incentives rather than people. A dominated choice may reflect misunderstanding, but it also creates an opportunity to construct the deviation that demonstrates dominance.

Invite descriptive contributions from students with less formal preparation before deriving equations. Graphs permit participation without algebra; later calculations connect intuition to theory. In advanced courses, rotate tasks: one student formulates a deviation, another evaluates welfare, and another challenges assumptions. The rotation prevents a single skill from dominating feedback.

Silence is productive after a difficult question. Give students thirty seconds to inspect the graph and then compare answers in pairs. Ask for the evidence behind each response rather than voting immediately. If disagreement remains, frame it as a design question: what additional treatment or variable would adjudicate the competing accounts?

11.4 Closing the learning cycle

End with a conditional statement rather than a slogan. For example: “With two firms, a common price, uniform inelastic demand, and linear transport, unilateral incentives push toward the center; endogenous prices or nonuniform demand can change that force.” Ask students to identify every condition and name the treatment that changes it. This limits mechanical transfer of minimum differentiation to every market.

The exit ticket should require evidence and scope. A useful four-sentence structure is prediction, result, explanation, and limitation. Grade it quickly with the rubric in this guide. Save a few anonymous responses to open the next class: display two interpretations and ask which uses the evidence more carefully.

For cumulative assessment, ask students to design a ninth treatment. They must state one changed assumption, preserve all others, predict movement in two report indicators, and identify a confound. Examples include three firms, costly relocation, capacity constraints, communication, or uncertain demand. The design exercise demonstrates understanding more effectively than recalling the phrase “minimum differentiation”.

Operations and troubleshooting

12.1 Data and reproducibility

The export contains session, anonymous code, round, language, edition, treatment, matching, group, role, move order, location, price, cost, share, profit, coverage, travel, surplus, and welfare. Keep a session note with date, course, configuration, attendance, incidents, and feedback timing. Without it, similarly named files can describe different designs.

Preserve definitions across sections. Do not treat percentages as proportions in one table and percentages in another. Identify markets rather than only participants. Firm measures provide two observations per market-round, while coverage and welfare are market outcomes and should not be duplicated without an analytical reason. Descriptive graphs are often sufficient for teaching. Inference requires attention to pair-level and repeated dependence.

12.2 Privacy and responsible use

Codes coordinate the platform; they are not labels for public identification. Project aggregates and do not connect codes to attendance lists. Use beyond immediate teaching may require consent, institutional policy review, and a research protocol. Never turn experimental profit into a personality judgment. Choices reflect incentives, comprehension, beliefs, and context.

Avoid labeling a participant or firm irrational. A departure from equilibrium starts a question about comprehension, search, efficiency concerns, conventions, errors, or reaction to a rival. The design identifies choices, not complete motives. Careful language protects participants and improves economic analysis.

12.3 Frequent problems

If a participant sees “Please wait”, inspect Monitor before refreshing. In simultaneous games, the page advances when the rival confirms. If the browser closed, reopen the same room; oTree often recognizes the browser code while the session remains active. After a database reset, an old link may say the participant does not exist; create a new session and distribute the current room route.

If the instructor sees other game families, the instance or `GAME_FAMILY` isolation is wrong; do not work around the issue by searching a huge catalog. If Hotelling is absent, confirm the family is **hotelling**. If report figures are empty, check pending markets and then reveal. If price is absent, confirm that a price treatment was selected; the basic benchmark fixes price.

Operational precaution. Never reset a production database during class. Local testing uses the isolated Hotelling database on port 8057. Production changes require a backup, a window with no active sessions, and a rollback procedure.

References and recommended reading

The foundational reading is [Hotelling \(1929\)](#). The endogenous-price critique and extension is [d’Aspremont et al. \(1979\)](#). Experimental evidence appears in [Brown-Kruse et al. \(1993\)](#) and [Huck et al. \(2002\)](#). Industrial organization and game-theory texts connect differentiation, best responses, subgame-perfect reasoning, and welfare.

Brown-Kruse, J., Cronshaw, M. B., and Schenk, D. J. (1993). Theory and experiments on spatial competition. *Economic Inquiry*, 31(1), 139–165.

d’Aspremont, C., Gabszewicz, J. J., and Thisse, J.-F. (1979). On Hotelling’s “Stability in Competition”. *Econometrica*, 47(5), 1145–1150.

Harrington, J. E. (2014). *Games, Strategies, and Decision Making*. Worth.

Hotelling, H. (1929). Stability in competition. *The Economic Journal*, 39(153), 41–57.

Huck, S., Müller, W., and Vriend, N. J. (2002). The East End, the West End, and King’s Cross: On clustering in the four-player Hotelling game. *Economic Inquiry*, 40(2), 231–240.

Tirole, J. (1988). *The Theory of Industrial Organization*. MIT Press.