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Costs in the Short Flight - A Game for Explaining Short-run Production and Costs

This game intuits the concept of short-run production and costs by having the students play the role of a paper airplane manufacturer. By measuring costs in terms of time, this game can illustrate total, fixed, variable, average fixed, average variable, and marginal costs.

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1. Introduction

Short-run costs in microeconomics can be difficult for many introductory students to understand. Many of the topics in an introductory class are topics that a layperson probably interacts with daily, e.g., markets and competition, but few students are actively involved with running a business. This article presents a game/classroom experiment to reinforce the economic intuition involved with short-run production. It can be used as a supplement to a principles lecture or as the focus of a high school economics class.

Most instruction in an economics classroom takes place via the "chalk and talk" method (Asarta, Chambers, & Harter, 2021). In the case of short-run production and costs, that often means sketching cost curves and filling out large tables associated with the various short-run costs. Instructor-crafted methods, such as this game, offer an alternative to a lecture to better engage students (Picault, 2019). Classroom experiments have shown to improve student performance, especially in kinesthetic learners (Durham, Mckinnon, & Schulman, 2007). Paper airplanes specifically have a history of being used as an example for modeling in the economics classroom (Geerling, Mateer, & O'Roark, 2019). This game builds on that tradition. Also, while many games or simulations take place online; such as the Moneyball Simulation or the Econland Simulation Game, this game can be played offline and with materials likely available to any educator (Rogmans, 2018; White & Wooten, 2023).

A. Materials Needed

- Standard 8.5 x 11 in. or A4 paper
- Stopwatch, preferably with a lap function, usually standard on any smartphone

B. The Story

The student is told that they are now part of an incredibly prestigious industry, the (paper) airplane manufacturing industry, with impressive competition such as Origami Airbus and The Folded Boeing Company. As new manufacturers, however, they need to understand their production and costs. To do so they are going to measure the time it takes to produce various quantities of paper airplanes, because, after all, time is money.

C. The Game

Students start the game in the "manufacturing plant," an area designated where they will craft paper airplanes. The raw materials, sheets of paper, are located across the room, or in a place far enough from the manufacturing plant that it takes a measurable amount of time to go and retrieve them. The students then craft a predetermined number of paper airplanes. Crafting paper airplanes comes in 3 steps:

Step 1:

Retrieve materials. Students must retrieve the quantity of paper necessary to craft their given quantity of paper airplanes. All the paper can be retrieved at once and they only need to take this step once.

Step 2:

Craft. Students are to craft a paper airplane suitable for flight. Instructions on how to fold a paper airplane can be found in multiple places, such as wikiHow https://www.wikihow.com/Make-a-Paper-Airplane.

Step 3:

Testing. No respectable paper airplane manufacturer would let an airplane go to market without a test flight. Designate a space or distance that each paper airplane must fly past, and then be retrieved before moving back to Step 2.

Each student repeats steps 2 and 3 until the designated quantity of paper airplanes has been reached.

D. Measuring Costs

Each student manufacturer needs to be accompanied by a timekeeper with a stopwatch. After explaining the game, a discussion can be held over what aspects of the game will relate to total costs, fixed costs, variable costs, and marginal costs. As the game is taking place the timekeeper can keep track of the different costs such as: how long it takes to retrieve the materials, how long it takes to craft each airplane, how long it takes to test each airplane, or simply how long it takes to craft and test each airplane. A stopwatch with a lap function is beneficial for this process. After raw materials are retrieved and each time an airplane is completed, a lap can be set. The initial lap represents fixed costs, the first and second laps represent the cost of the first airplane, and each additional lap represents the marginal cost of each additional airplane after the first.

- Breaking down the costs should be relatively easy for the students. This information is also included at the end of the article as a definition handout:
- Total costs: Definition--All costs incurred in production, generally represented as fixed costs plus variable costs. Measurement in the game--The total time taken to craft the set number of airplanes.
- Fixed cost: Definition--Costs that remain constant as output quantity changes. Measurement in the game--The time of retrieving the materials. It is the same no matter how many airplanes are crafted.
- Variable costs: Definition--Costs that change with the level of output. Measurement in the game--The time spent crafting and then testing each airplane. The variable costs increase when more airplanes are made.
- Average total cost: Definition--Total costs divided by output. Measurement in the game--Total time divided by the number of airplanes crafted or average time per airplane
- Average variable cost: Definition--Variable costs divided by total output. Measurement in the game--Variable costs divided by the number of airplanes crafted, or average time to craft a airplane once materials are obtained.
- Marginal costs: Definition--The unit cost to create one more unit. Measurement in the game--The time to craft the next airplane.

Following the assignment students will be able to fill out a short-run costs table with costs measured in time. Table 1 is an example of an answer key. An example worksheet is included at the end of this article.

Table 1: Example Answer Key

Quantity (Q)	Total Cost (seconds)	Fixed Cost (seconds)	Variable Costs (seconds)	Average Total Costs (seconds/Q)	Average Variable Costs (seconds/Q)	Marginal Cost (seconds)
1	$1^{st} + 2^{nd}$ laps	1^{st} lap	2^{nd} lap	$1^{st} + 2^{nd}$ laps	2^{nd} lap	2^{nd} lap
2	$1^{st} + 2^{nd} + 3^{rd}$ laps	1^{st} lap	$2^{nd} + 3^{rd}$ laps	($1^{st} + 2^{nd} + 3^{rd}$ laps) / 2	($2^{nd} + 3^{rd}$ laps) / 2	3^{rd} lap
3	$1^{st} + 2^{nd} + 3^{rd} + 4^{th}$ laps	1^{st} lap	$2^{nd} + 3^{rd} + 4^{th}$ laps	($1^{st} + 2^{nd} + 3^{rd} + 4^{th}$ laps) / 3	($2^{nd} + 3^{rd} + 4^{th}$ laps) / 3	4^{th} lap
4	$1^{st} + 2^{nd} + 3^{rd} + 4^{th} + 5^{th}$ laps	1^{st} lap	$2^{nd} + 3^{rd} + 4^{th} + 5^{th}$ laps	($1^{st} + 2^{nd} + 3^{rd} + 4^{th} + 5^{th}$ laps) / 4	($2^{nd} + 3^{rd} + 4^{th} + 5^{th}$ laps) / 4	5^{th} lap

E. Variations

The game can be played in multiple rounds with one student to illustrate fixed costs better. Students do one theoretical day where they produce one airplane and then another where they produce two, another for producing three, and another for producing four. The time it takes to retrieve the materials should remain relatively constant, illustrating how fixed costs are the same no matter how much is produced. It also makes dividing time into fixed and variable costs clearer. Instead of lapping each time an airplane is crafted, students can lap once for fixed costs and then lap when all airplanes have been made. Lap 1 would illustrate fixed costs and lap 2 would illustrate variable costs. This variation adds significant time to the game. This variation may be best used as an in-class assignment over 20-30 minutes, similar to a science class lab.

For a quicker demonstration, multiple students can craft differing quantities simultaneously. In this case, one student would craft one airplane, one student would craft two, one student would craft three, etc. In this variation, it can be important to discuss the differences in ability/crafting skill between producers.

For strictly increasing marginal costs, friction can be added for each additional airplane such as having to test the second airplane twice, the third three times, and so forth.

F. Tips

In introducing students to the game one can easily incorporate a discussion on paper airplanes as models (Geerling, Mateer, & O'Roark, 2019). It is also a good time to ensure all students know how to make a paper airplane. Throughout the crafting process, the classroom environment can become hectic, especially if competition among manufacturers has been encouraged. It is recommended there be plenty of space and/or a speed walk rule be enforced for the students doing the manufacturing to avoid any accidental collisions. It is possible to do the game with only two manufacturers and many timekeepers. The definition table and worksheet make a cohesive handout and quick reference when printed two-sided.

References

Asarta, C. J., Chambers, R. G., & Harter, C. 2021. Teaching methods in undergraduate introductory economics courses: Results from a sixth national quinquennial survey. *The American Economist*, 66(1), 18–28. DOI: 10.1177/0569434520974658

Durham, Y., Mckinnon, T., & Schulman, C. 2007. Classroom experiments: Not just fun and games. *Economic Inquiry*, 45(1), 162–178. DOI: 10.1111/j.1465-7295.2006.00003.x

Geerling, W., Mateer, G. D., & O'Roark, B. 2019. The view from 30,000 feet: Using paper airplanes to understand economic modeling. *Journal of Economics and Finance Education*, 18(1), 18-24. DOI: 10.2139/ssrn.5114227

Picault, J. 2019. The economics instructor's toolbox. *International Review of Economics Education*, 30, 100154. DOI: 10.1016/j.iree.2019.01.001

Rogmans, T. 2018. Teaching macroeconomics with the Econland simulation game and learning platform. *Journal of Economics Teaching*, 2(2). 92-103. DOI: 10.58311/jeconteach/892413d590665dfe858e06a93abd1697c16b00f7

White, D. R., & Wooten, J. 2023. Moneyball as a resource for teaching economics. *Journal of Economics Teaching*, 8(3). 194-197. DOI: 10.58311/jeconteach/2f01aef770c564bf21101944ccf2f84738bfa803

Table 2: Example Definition Table

Term	Definition	Measurement in Game
Total Costs	All costs incurred in production. Total costs are generally represented as fixed costs plus variable costs.	The total time taken to craft the set quantity of airplanes.
Fixed Costs	Costs that remain constant as the quantity of output changes.	The time of retrieving the materials. It is the same no matter how many airplanes are crafted.
Variable Costs	Costs that change with the level of output.	The time spent crafting and then testing each airplane. The variable costs increase when more airplanes are made.
Average Total Cost	Total costs divided by output.	Total time divided by the number of airplanes crafted or average time per airplane.
Average Variable Cost	Variable costs divided by total output.	Variable costs divided by the number of airplanes crafted, or average time to craft a airplane once materials are obtained.
Marginal Costs	The cost to create one more unit of output.	The time to craft the next airplane.

Table 3: Example Worksheet--Costs in the Short Flight

A game for explaining short-run production and costs.

Quantity (Q)	Total Cost (seconds)	Fixed Cost (seconds)	Variable Costs (seconds)	Average Total Costs (seconds/Q)	Average Variable Costs (seconds/Q)	Marginal Cost (seconds)
1						
2						
3						
4						
5						