Teaching and Educational Methods

Learning about Consumer Demand from Student Surveys

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JEL Codes: A22, D12, Y1
Keywords: Active learning, demand curve, student survey, teaching microeconomics, willingness to pay

Abstract
Active learning can help students to grasp abstract economic concepts and become acquainted with quantitative data analysis. This paper describes how a survey of willingness to pay for pizza that is designed, executed, analyzed, and interpreted by students can motivate learning about consumer demand. The approach, which can be adapted to other consumption goods, builds understanding of consumer demand from the level of the individual to the market.

1 Introduction

For students to "think like an economist" is the goal of most economics teachers. This goal bundles several learning objectives, notably: (1) how economic decisions involve a desired objective but scarce resources for reaching it, (2) how individual decision makers respond to incentives—prices in particular—and (3) how market behavior reflects the aggregation of individual decisions. Students who "get" these ideas are well on their way to thinking like an economist.

Introductory and intermediate microeconomics texts tend to express market demand with graphs and equations, often backed up by numeric examples. Many textbooks include a section on individual consumer choice between two goods, employing the constructs of the budget constraint and the indifference curve (Baye and Prince 2017). In my experience as a teacher, the conceptual leap from individual choice between two goods to market demand for one good can be hard for many students to make. Many students will memorize graphs and try to regurgitate them on exams. Memorization is not thinking like an economist.

A secondary goal for teachers of applied economics is to build quantitative skills that equip students to meet the rising demand for data analytics (Gillespie and Bampasidou 2018). Upper-level undergraduate classes are increasingly offering opportunities for students to work with "big data" (Elliott and Elliott 2020). However, before students can perform thoughtful data analysis, they need to "get" the underlying economic ideas.

How can a teacher narrow the gap so that the conceptual leap from consumer choice to market demand is more easily bridged? Experiential learning from personal experience yields better economic learning outcomes than passive, "chalk and talk" teaching (Eber 2003; Hawtrey 2007), and classroom experiments constitute one way to generate insights from personal experience (Holt 1999). Particularly for ideas related to consumer demand, experiential learning should be easy: we are all consumers who make choices daily. Experiential learning may be especially valuable for students of business management who intentionally chose a very applied field when they could have chosen a more abstract field like mathematics or economics.

Although the economic literature is loaded with studies based on student data, remarkably few involve student learning from the data that they themselves provided. One large body of economic education studies reports surveys of student preferences about pedagogic approaches (Thomas and Galambos 2004). A related literature explores what features students seek from the university

experience (Bruno and Campbell 2016). A large literature in experimental economics relies upon students as research subjects. Apropos of the application in the current article, at least one such study estimated student willingness to pay for pizza (Louviere and Islam 2008), an eminently relatable consumption item. But the study's purpose was to compare methods for eliciting willingness to pay; its audience was researchers, not students.

The few published examples of classroom experiments to generate consumer demand data come from the early years of active learning in economics. The first published case is excellent. In it, Weidenaar (1972) offers a versatile experiment where students are invited to submit purchase contracts to buy apples. The exercise allows construction of a demand schedule and establishment of a market-clearing price when the instructor brings a fixed quantity of apples to the next class. The experiment also enables a lesson in how the instructor, as monopolist, can choose the quantity to supply that maximizes their revenue.

The 1990s and early 2000s saw a flush of pedagogic innovation in economics using classroom games and experiments (Holt 1999; Bergstrom and Miller 2000; Brauer and Delemeester 2001; Eber 2003). Many individual games and experiments from that period are inventoried online at the sites "Games Economists Play" (Delemeester and Brauer 2000) and "Computer Programs for Classroom Games" via the VeconLab (Holt 2012) or in the newsletter *Classroom Expernomics*[1]. One demand experiment examines willingness to pay for an ice-cold soft drink on a hot versus a cold day (Brock 1992), allowing construction of a demand curve and illustration of a shift. Another reported in Eber (2003) involves estimating student price elasticity of demand for candy bars (Hill 2001). In a textbook that is still in print, Bergstrom and Miller (2000) offer a collection of experiments, including two for constructing demand and supply functions in hypothetical settings.

This article expands upon the approach of Weidenaar (1972) and others to eliciting student willingness-to-pay by explicitly building up from individual consumer demand to market demand and by using a student-designed survey of willingness-to-pay for pizza. It draws upon students' own stated preference data to help them build intuition about demand concepts. The approach can be extended to offer quantitative exercises for demand analysis that students can connect to themselves. The article proceeds to describe learning objectives, the process of developing a demand survey with students, how analyzing the results of past surveys met the learning objectives, and how students of undergraduate managerial economics responded to this approach.

2 Learning Objectives

The learning objectives underpinning introductory demand analysis for a private good can be divided between the individual level and the market level. At the individual level, students should learn how a consumer's willingness to pay for a good arises from both their preferences and their budget to shape that individual's demand schedule. At the market level, students should learn how individual consumer demand schedules build market demand and how movements along a demand curve differ from shifts in a demand curve.

These conceptual learning objectives can easily be connected to objectives for learning about basic quantitative demand analysis. A core learning objective at this level is how to graph market demand using a spreadsheet program. For more advanced learners, quantitative analysis objectives include how to conduct a regression analysis, how to use the resulting demand function to compute own-price elasticity of demand, and how a substitute or complement product can shift market demand. A potential learning objective for highly motivated students is to compare functional forms for fit with the data and with demand theory.

[1] Archived at https://academic.marietta.edu/people/delemeeg/expernom/.

Apart from objectives for learning outcomes, process objectives matter as well. Evidence is strong that many students learn more readily via active learning processes that communicate meaning at a personal level (Hawtrey 2007). For students in managerial business programs, the opportunity to build market research skills adds to the appeal of conducting a survey.

3 Survey Design and Data Collection

This exercise was developed in a junior-level, undergraduate class in managerial economics for students majoring in agribusiness management, food industry management, and environmental economics and management at Michigan State University. The exercise evolved over three years.

The design began when the author invited students to help design market research on student consumption of a common food. The class unanimously identified pizza as a food that all students consume. As the market research was to be conducted via a stated preference survey, the next step was to define the product traits with care, so that survey respondents would understand the hypothetical market (Champ, Boyle, and Brown 2003). Students discussed the type of pizza product, location of purchase, timing of purchase, prior consumption, and available budget.

The initial class in 2018 set a standard for future class surveys by defining the product as pepperoni pizza with mozzarella and tomato sauce, divided into slices that were eighths of a 16-inch pizza. The purchase took place at a pizzeria at 8:00 p.m. after the buyer had not eaten since noon. Prices were arranged above and below local norms, including $0.25, $0.50, $1.00, $1.50, $2.00, and $3.00 per slice. The next year's class added a substitute in consumption: peanut butter and jelly sandwiches (PBJs) at two price levels. The 2018 class identified gender as a potentially relevant consumer trait but decided that budget questions were too sensitive to include. After discussion of results, the 2019 class added gluten intolerance and vegetarianism.

In the survey, each student records the number of pizza slices that they would buy at each of the six pizza prices, while holding constant the price of PBJs, first at $0.50 and then at $2.00 each. In 2018, students completed the original, one-page paper survey form in class. Starting in 2019, the surveys were conducted online using Qualtrics software (see Supplemental Materials).

Using the survey format here requires scant added class time, though advance discussion of what to include increases student buy-in at the analysis stage. Data analysis takes about two hours of instructor time outside of class, with suggested approaches included in the Excel workbook available in the Supplemental Materials. The additional in-class teaching time needed for this survey approach is small because the alternative is typically to teach the material with artificial data examples from a textbook or from other sources.

4 Pizza Survey Results by Learning Objective

I have now conducted the pizza survey with three classes (Fall 2018, Fall 2019, and Fall 2020). The first two were the most actively involved in its design. Although survey completion is voluntary, response rates are high, in part because students received a participation point for completing the survey. Given that the survey's goal is to advance learning objectives, the results are reported and discussed by learning objective.

4.1 Individual Demand

In order to convey ideas about individual choices, it can be helpful to select instructive cases and invite students to debrief. Examples of instructive cases can be ones close to the median that represent typical behavior as well as ones near the high and low consumption extremes. As some students are shy or sensitive about discussing their choices, the author would touch base with selected students ahead of time. He would present the responses of a willing student, showing how many slices of pizza they would buy at each price. The instructor or another student would then interview the student about why they

made their choices. Inviting students to tell their stories can elucidate revealing thought processes. Most classes have at least one student who is willing to buy 40 or more slices. When I asked one student how he could possibly eat that many, he replied that at a price of $0.25/slice, he would stock up for later. Lessons learned: Satiation need not limit demand if storage is possible, and consumers may stock up (but that will affect subsequent demand). In the same class, another student would buy no pizza at any price. She explained that she was gluten intolerant. Lesson learned: Price is not the only driver of demand; other factors can be powerful constraints or motivators.

Individual demand curves illustrate how preferences and budgets shape downward-sloping individual demand schedules. The curves in Figure 1 illustrate more typical choices than the extremes cited above. For example, Student 22 in 2019 preferred only to eat pizza fresh and hot, so even at low prices they would not buy more than the four slices that they could eat at one sitting. This student's behavior exemplifies the concept of diminishing marginal utility; despite falling prices, they opted not to consume more than four slices. Student 24 in the same figure would stock up on cheap pizza and eat it later. Here, the availability of storage (and maybe roommates) explain why that individual's choices seemed inconsistent with diminishing marginal utility.

4.2 Aggregate Demand

Lessons about aggregate demand can be easy extensions from the individual level. Data from selected individual students illustrates how individual demand schedules can be summed horizontally to generate aggregate demand for the group. In Figure 1, the combined curve displays the summation of the individual demands by Students 22 and 24.

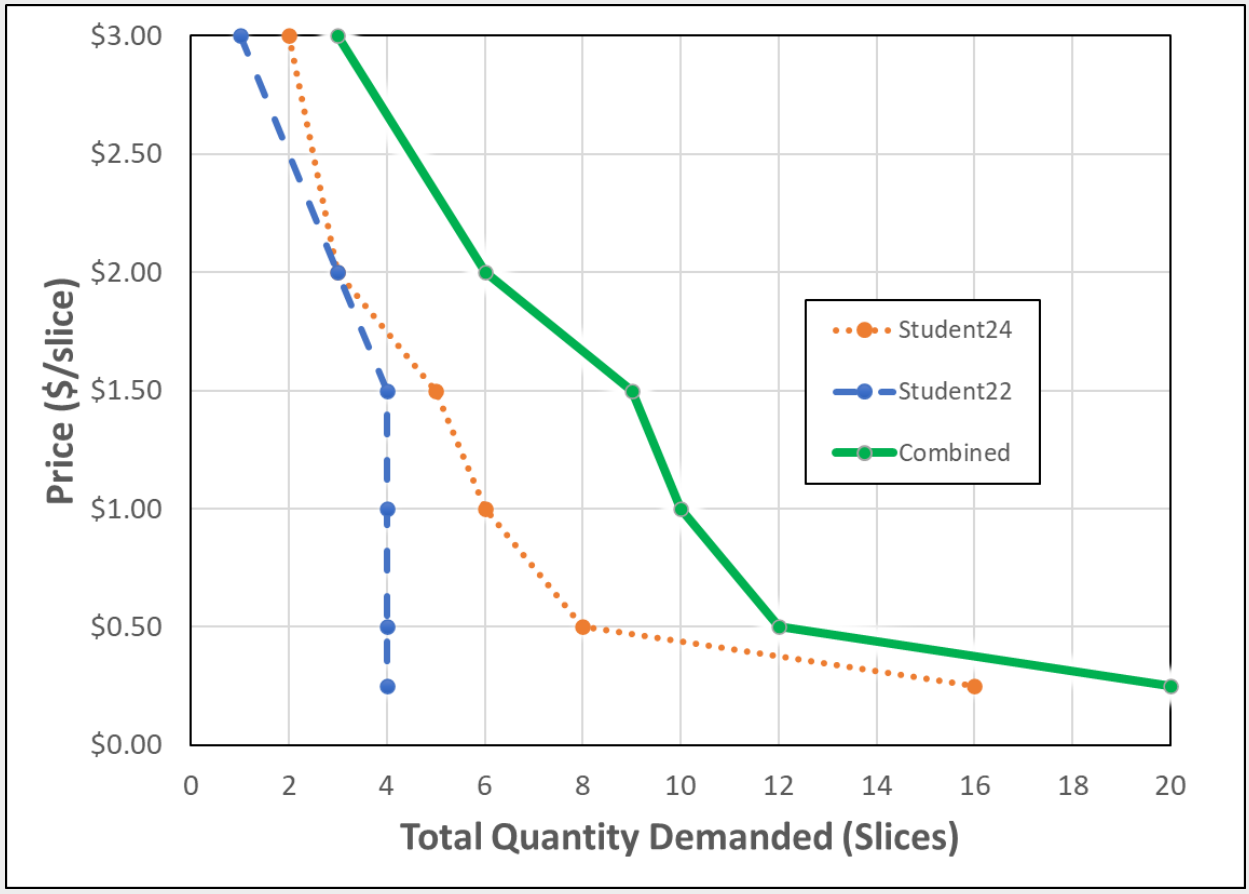

Figure 1. Individual Demand Curves of Two Students Sum Horizontally to Combined Demand (2019 Class)

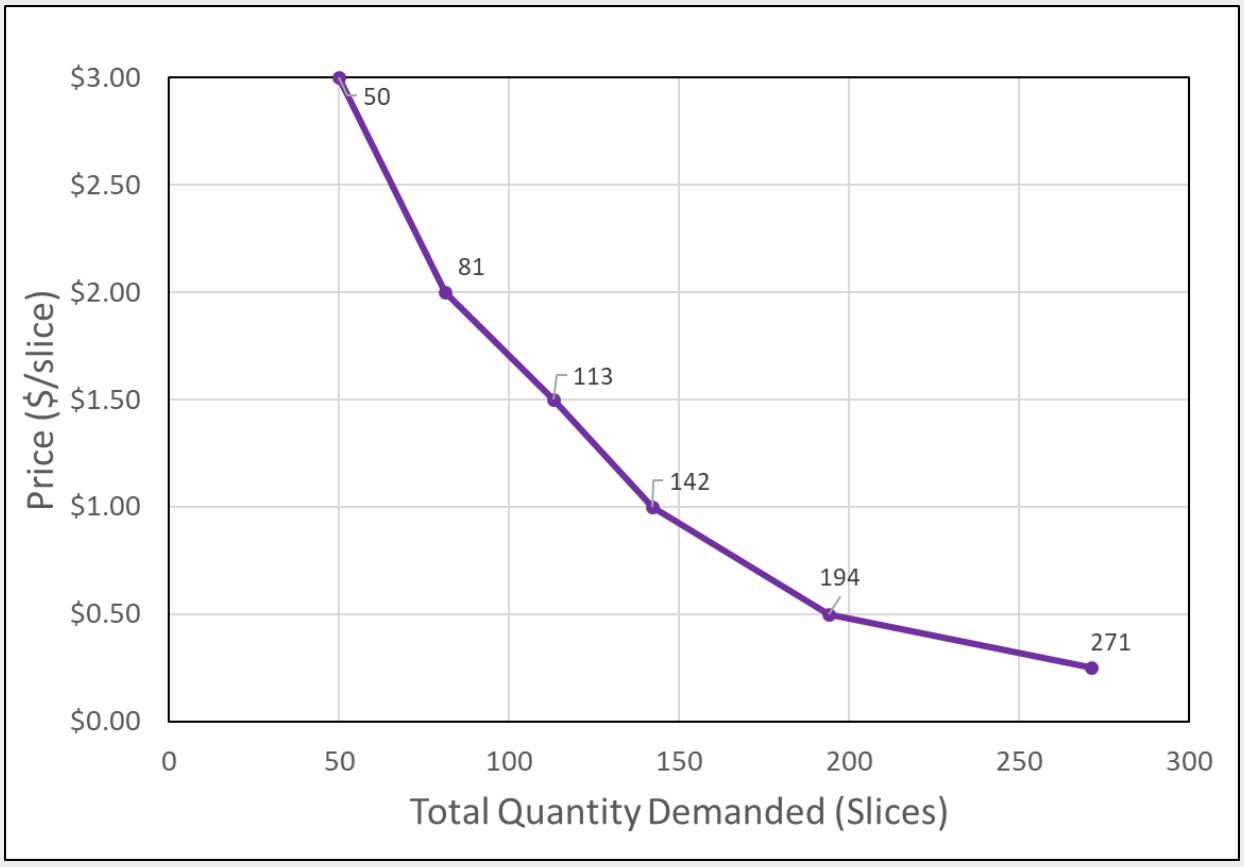

Figure 2. Aggregate Class Demand for Pepperoni Pizza at 8:00 pm if PBJ Price Is $2.00 (2019 Class)

From this two-person "market," it is an easy conceptual next step to aggregate all students in the class to define a small market. As instructor, I invite students to imagine an entrepreneur who wishes to open a pizzeria by analyzing the demand of students in the class. Summing pizza quantity demanded horizontally across the entire class while holding constant the price of PBJs as a consumption substitute generates six demand points, as shown in Figure 2. I invite students to interpret what they see. Typically, they will note that the points are not in a straight line (unlike demand curves in most undergraduate textbooks). This creates an opportunity to measure differences in arc elasticities, comparing one pair of demand points at high prices with another pair at low prices. For example, the data from Figure 2 show that the own-price arc elasticity of demand between the highest priced two points is -1.18, whereas between the two lowest priced points it is -0.50.[2] As price falls, demand becomes less elastic (setting the scene for future lessons on how firms with market power should set prices to maximize profit).

The demand curve in Figure 2 also carries a teaching opportunity about consumer surplus. Pick any particular price, say $1.00 per pizza slice, and the graph reveals the area of consumer surplus. By measuring and discussing it, students begin to grasp the notion of aggregate social welfare on the consumer side.

The important distinction between movement along the demand curve and a shift in the demand curve can be illustrated with student data on what happens to the demand for pizza in response to a change in the price of a related good. Figure 3 illustrates the leftward shift in student demand for pepperoni pizza when PBJ prices fall from $2.00 to $0.50. Students can readily see that demand changes,

[2] Arc elasticity between the two highest priced points in Figure 2 is $(\Delta Q/Q)/(\Delta P/P) = (-31/65.5)/(1/2.5)$. Between the two lowest priced points, it is $(-77/232.5)/(0.25/0.375)$.

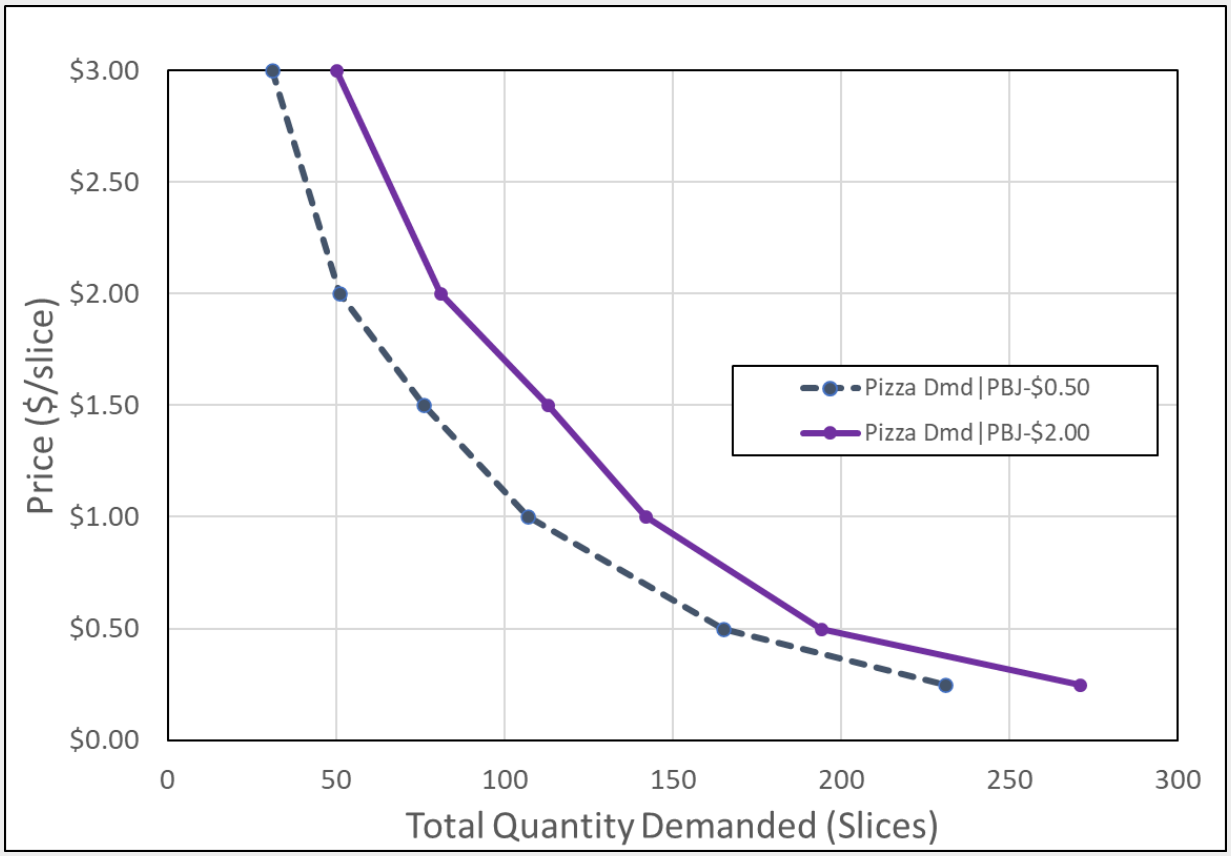

Figure 3. Aggregate Demand for Pepperoni Pizza at Two PBJ Prices (2019 Class)

even though the price of the pizza stays constant. Asked to interpret why pizza demand seems to shift out when PBJ prices rise, students will eventually hit upon the economic concept of substitutes in consumption.

4.3 Introduction to Regression Analysis

The very small size of the aggregate, class-level data set makes it easy to introduce the intuition behind regression analysis. The six demand points for pizza slices while holding the PBJ price constant facilitate discussing the shape of the demand curve. What do we expect a demand function to look like? Is it linear? Curvilinear? What kind of slope?

Many spreadsheet programs can run linear regressions. One common example is Microsoft Excel, with the (free) Data Analysis add-in. For students who are unfamiliar with regression, it can be helpful not just to demonstrate how to run a simple regression, but also to show how to calculate predicted values and to plot a fitted curve against the original data points. I typically invite students to compare linear, quadratic, and logarithmic functional forms where quantity demanded depends only on the price of pizza slices.

In three years of pizza surveys, the classroom demand curves have never been linear. Asked if the data points are randomly scattered around the fitted curves, students will note that the linear function underestimates demand at both high and low prices. That observation sets the stage for introducing curvilinear forms. Although the quadratic form sometimes fits the data over the observed range better than the logarithmic, the latter tends to fit quite well (with adjusted R^2 values of 0.91 to 0.99).

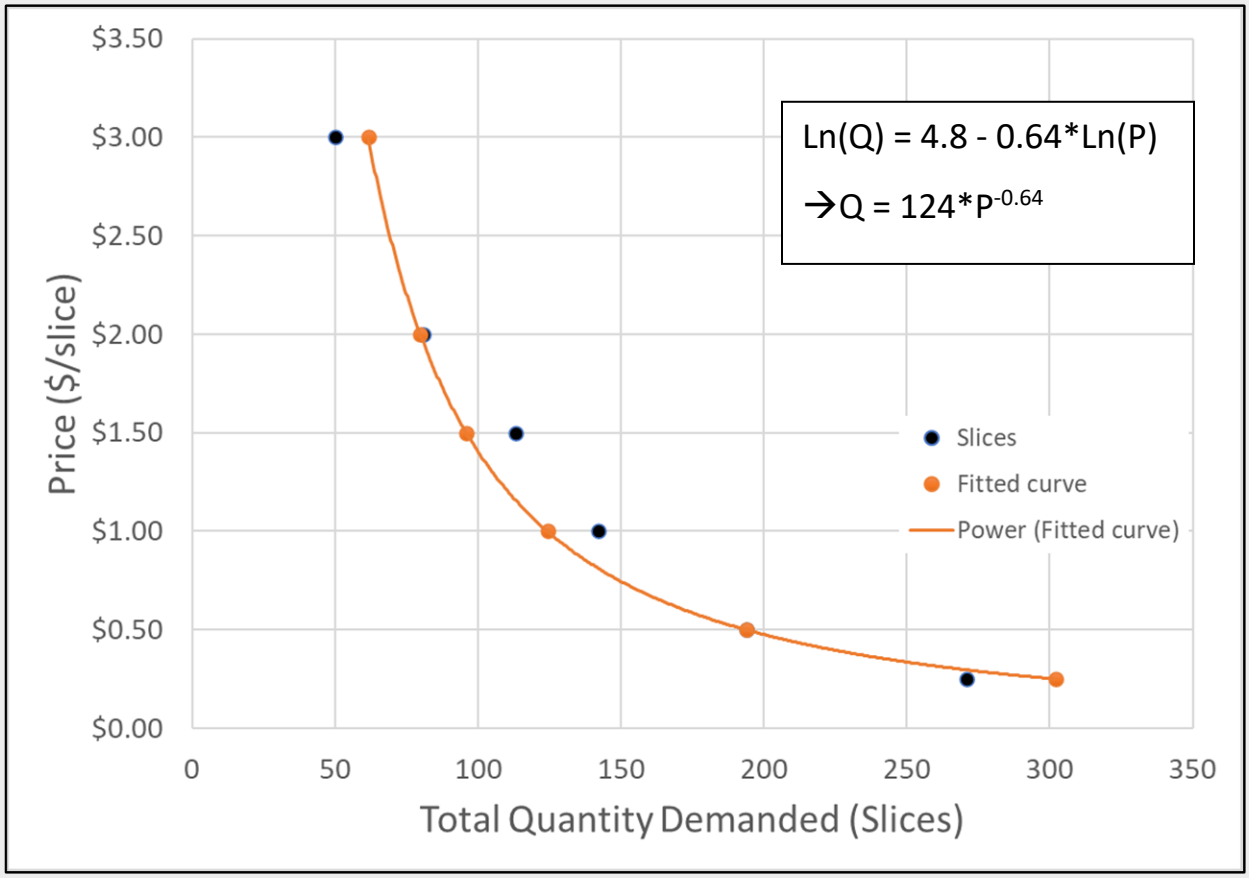

Figure 4. Fitted Logarithmic Curve of Class Aggregate Demand for Pepperoni Pizza as a Function of Own Price (Holding PBJ Price Constant at $2.00; 2019 Class)

The logarithmic form in Figure 4 enables introducing the concept of a demand function with constant elasticity. The simple, log-log demand functions have yielded own-price elasticities of demand of -0.80 (2018 class with no PBJ price) and -0.64 and -0.66 (when PBJ prices were included in the survey, but not in the regression model).

A logical extension of estimating demand only as a function of own price is to include the price of a substitute—representing the kind of data behind Figure 3. The log-log regression based on the prices of both pizza slices and PBJs from that data set (2019 class) yields an own-price elasticity of demand for pizza of -0.71 and a cross-price elasticity of pizza demand in response to PBJ price of +0.23 (both coefficient estimates with *p* values under 0.01). This result can support a subsequent lesson about cross-price elasticities for substitutes (positive in sign) versus complements (negative in sign). The Excel workbook in Supplemental Materials provides the data and graphs from the 2019 class survey.

5 Discussion and Conclusion

The purpose of this article is to share a teaching technique, not to provide a formal evaluation of its effectiveness. With that caveat, this instructor found it much more fun to teach these concepts by inviting students to interpret their own data. Students certainly appeared more motivated than when discussing artificial data sets.

Students were most enthusiastic in the first two years when they actively engaged in planning the surveys. Their involvement at the design stage yielded two unexpected benefits. First, it clearly motivated greater interest in the data. Second, the process of relying on consumer demand theory to inform the survey design helped students to "think like an economist" even before they interpreted results. In 2020,

while teaching online due to COVID-19, I chose to save time by skipping the survey design step. With wisdom of hindsight, that decision sacrificed both an important learning opportunity and a degree of student enthusiasm.

For instructors who wish to mine student data for market research nuggets, much more is possible. Students can explore segmenting the market by gender, budget, or age. They can add questions about demand response to non-price promotions, like "buy-one-get-one-free" deals. In senior undergrad or graduate classes, students can compare demand studies based on real local pizza prices to the stated-preference survey here, perhaps discovering how much harder it is to estimate market demand when prices of related consumption goods are not held constant.

The key takeaway message is that involving students in the design, execution, data analysis, and interpretation of a commonly consumed good can greatly motivate learning about consumer demand. Pizza is the good that my students identified, but other students would identify other goods with similar advantages for learning demand concepts and how to conduct basic data collection and analysis. Whatever the product, engaging in market research is a fun, motivating, and instructive way to teach about consumer demand.

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Acknowledgements: The author thanks Judhajit Chakraborty for comments and Qualtrics programming assistance, and Abubakr Ayesh, David Hennessy, Maria Porter, and Hanzhe Zhang for helpful comments. This paper was found by the Human Research Protection Program at Michigan State University not to qualify as human subject research (correspondence of May 26, 2021 on Study 00006270).

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3(3) doi: 10.22004/ag.econ.313691