CAMBRIDGE

Cambridge University Press
978-0-521-89902-4 - Intermediate Microeconomics with Microsoft Excel
Humberto Barreto
Excerpt
More information

# Introduction

Economics is the science which studies human behavior as a relationship between given ends and scarce means which have alternative uses.

Lionel Robbins

Economists use a particular framework to interpret observed reality. This framework has been called the economic way of thinking, the economic approach, and the method of economics.

This book is different from the many other books that attempt to teach microeconomics in three ways:

- It explicitly applies the recipe of the economic approach in every example.
- It uses concrete examples via Microsoft Excel in every application, which enables the reader to manipulate live graphs and learn numerical methods of optimization.
- It is written in a terse, word-minimizing fashion. The majority of the content is in the Excel workbooks that accompany the book.

You learn by doing, so let's begin.

## The Tech Support Example

Suppose that you manage a tech support service for a major software company.

You have two types of callers:

- Regular customers
- Preferred customers

Preferred customers have paid extra money for faster access, which means they expect to spend less time waiting on hold. There are equal numbers of the two types of customers and they call with equal frequency.

Management has given you a fixed number of worker hours per day to answer calls from users needing help.

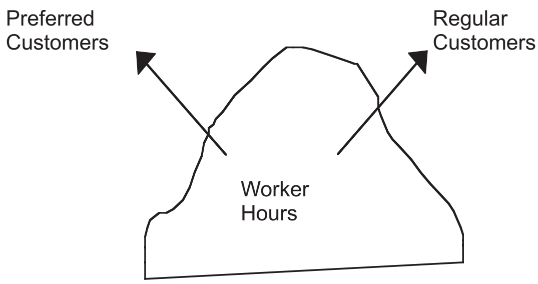


Figure 1. Allocating a scarce resource to two competing ends.

Daily, you have 10 workers, each working 8-hour shifts, and 5 part-time workers (4-hour shifts). Thus, you have 100 hours per day to support customers calling for help. These hours comprise your Total Resources.

When customers call, an automatic message is played asking the caller to input an ID number and the caller is put on hold. The ID number is used to identify the caller as a regular or preferred customer.

Keeping callers on hold creates frustrated, unhappy customers. The callers are already angry since something has gone wrong with the software and they need help. The faster you get support to the caller the better.

The time waiting (the amount of time, in seconds, that the caller is on hold) depends on the number of worker hours available to answer the calls.

To keep things simple, suppose time waiting = 6000/worker hours.

So, say there are 100 worker hours available to answer calls in a day. Dividing 6000 by 100 yields 60, which means the hold time is 60 seconds.

If, on the other hand, only 10 worker hours are available, then the hold time is 600 seconds (since 6000/10 = 600). Ten minutes is a long time to wait on the phone!

Given that you have two types of callers, you must decide how to allocate your worker hours.

The more you allocate to one type of caller, the lower that type of caller's wait time. That's the good news.

The bad news is that the fixed amount of support resources means that more time devoted to one type of caller results, by definition, in fewer hours to the other type and, therefore, higher waiting times for the other type.

So the general structure of the problem is clear: You must decide how to allocate scarce support resources (worker hours) to two competing ends. Figure 1 shows a simplified picture of the problem.

### A Complication

It is unclear exactly what preferred customers expect.

Do they expect to get help twice as fast or 10 times as fast as regular customers?

To incorporate the fact that the preferred customer merits greater attention, management gives you a value weight parameter. The value weight tells you how much more valuable the preferred caller is compared to the regular caller.

The objective function is 6000/RegHours + ValueWeight*6000/PrefHours.

In the objective function, the time spent waiting by the preferred caller is Value Weight*6000/PrefHours. PrefHours is the number of worker hours allocated to preferred callers. If value weight = 1, then preferred and regular callers are equally valuable.

Management has decreed that value weight = 2; you (the call center manager) cannot change this parameter.

So, if you decide to allocate 50 hours each to the regular and preferred customers, then both types of customers will wait 6000/50 = 120 seconds and your objective function will be 120 + 2*120 = 360 seconds. Is there a better allocation, one that yields a smaller total time waiting (adjusted with the value weight), than 50/50?

This concrete problem, how to allocate 100 worker hours to answering calls from regular and preferred customers in order to minimize value weighted total time waiting, has a concrete solution.

## *Setting Up the Problem*

We will solve this problem by first setting it up. Optimization problems can always be set up the same way. The three parts to the setup are the goal, the endogenous variables, and the exogenous variables.

The goal is synonymous with the objective function. Endogenous variables are those variables that can be controlled by the decision maker. They are also known as choice variables. Exogenous variables are given, fixed constants that cannot be changed by the decision maker. The exogenous variables (sometimes called parameters or independent variables) form the environment under which the decision maker acts.

In the tech support problem, we can organize the information like this:

1. Goal: minimize total time waiting (value weighted)
2. Endogenous variables: worker hours allocated to preferred and regular customers
3. Exogenous variables: total worker hours and value weight.

**Step** Open the Excel workbook Introduction.xls and read the *Intro* sheet, then go to the *SetUp* sheet to see how this problem is laid out.

This workbook (along with all of the files that accompany this book) is available for download at <www.depauw.edu/learn/microexcel>. The user guide has detailed instructions on how to properly configure Excel before downloading and opening these files.


Figure 2. The Solver dialog box.

***Step*** Try the three questions in column A (below the goal, endogenous, and exogenous variables). Check yourself by clicking the See Answer buttons.

### *Finding the Initial Solution*

There are two ways to solve optimization problems:

- Analytical (algebra and calculus) methods
- Numerical (computer) methods.

We will ignore the analytical approach in this example and concentrate on numerical methods.

***Step*** In Excel 2007, click Data in the Ribbon, then Solver (in the Analysis group) to bring up the Solver dialog box (as in Figure 2). (In earlier versions of Excel, execute Tools: Solver.) If Solver is not available, then use the Add-in Manager (as explained in the user guide) to install it.

Note that the important information is already entered. The target cell is the (value weighted) total time waiting, the changing cells (the endogenous variables) are the worker hours devoted to the regular and preferred customers, and the constraint is that the sum of the worker hours not exceed the 100 hours you have been given.

The SolverInstructions.doc file in the SolverCompStaticsWizard folder has documentation on each of the Solver options in the dialog box.

***Step*** Click the Solve button to find the solution to the problem.

You, the call center manager, have optimally allocated your scarce resources. It makes sense that preferred callers have more hours allocated to them because they are more valuable.

### *Comparative Statics*

We have found the initial solution, but we are usually much more interested in a follow up question: How will the optimal solution change if the environment changes?

*Comparative statics* is a shorthand way of describing the following procedure: Change an exogenous variable, holding the other parameters constant, and track how the optimal solution changes in response to the shock.

Like finding the initial solution, comparative statics can be done via analytical (algebra and calculus) and numerical (computer) methods.

The Comparative Statics Wizard (CSWiz) add-in was used to explore how the optimal allocation of total worker hours would change if worker hours were increased by 10 hours.

**Step** See the results of the comparative statics analysis by going to the *CS1* sheet.

The results (produced by the CSWiz add-in) show that increased total worker hours are allocated to regular and preferred customers in a stable pattern.

The Comparative Statics Wizard add-in will be introduced later and you will learn how to do your own comparative statics analyses.

## Introducing Optimization

This chapter used an example of an optimization problem to show how Excel's Solver can find the optimal solution. It introduced the basics of optimization, including the three parts of every optimization problem:

- Goal (or objective function),
- Endogenous variables, and
- Exogenous variables.

In the chapters that follow, you will learn how to use analytical methods to solve optimization problems. You will also learn how to do comparative statics analysis via analytical and numerical methods.

## Exercises

Open Word and answer the following questions. Save the document and print it when you are done.

1. Suppose Management decides that preferred customers are three times as important as regular customers, so that the value weight = 3. With 100 workers hours, what is the optimal solution? Describe your procedure and report the optimal values of PrefHours and RegHours.
2. Compared to the initial solution, when value weight = 2, what is the change in the number of hours allocated to the preferred customers?

3. The percentage change in value weight is 50% (from 2 to 3). What is the percentage change in the number of hours allocated to the preferred customer?

## References

Each chapter in this book ends with references. A citation for the epigraph (lead quotation) of the chapter is provided. Chapter references may also contain citations documenting sources used, additional information on the history of a concept or person, and suggestions for further reading.

The epigraph to this chapter is found on page 16 of the second edition of *An Essay on the Nature and Significance of Economic Science* by Lionel Robbins. This book was originally published in 1932 and the second edition is available online at <www.mises.org/books/robbinsessay2.pdf>. Robbins clearly lays out a definition of economics based on optimization and comparative statics. Robbins made the definition of economics (in the epigraph to this chapter) famous, but he includes a footnote that cites various precursors who used a similar description of economics.

For more on Robbins, visit <www.econlib.org/library/Enc/bios/Robbins.html>. This site says that Robbins' *Essay* is "one of the best-written prose pieces in economics."

Nobel laureate Gary Becker's *The Economic Approach to Human Behavior* (first published in 1976) has a classic introductory chapter on the meaning of the economic approach and applies economic analysis to such non-standard topics as discrimination, crime, and marriage. Becker's statement, "what most distinguishes economics as a discipline from other disciplines in the social sciences is not its subject matter but its approach" (p. 5), greatly extends the scope of economics.

An introductory economics text called *The Economic Way of Thinking* (first published in 1973) by Paul Heyne focuses on the tools of analysis used by economists. It is full of interesting applications and ideas. The current version is the 11th edition, authored by Heyne, Boettke, and Prychitko.

Cambridge University Press
978-0-521-89902-4 - Intermediate Microeconomics with Microsoft Excel
Humberto Barreto
Excerpt
More information

# Part I

## The Theory of Consumer Behavior

Perhaps science does not develop by the accumulation of individual discoveries and inventions.

Thomas S. Kuhn

The Theory of Consumer Behavior posits that buyers choose the bundle of goods that maximize satisfaction, subject to a budget constraint. There are many applications from this basic idea. The material is organized as shown in Figure I.1.

By changing the price of a good, holding everything else constant, we can derive a demand curve. This is the most important concept in the Theory of Consumer Behavior.

Although deriving demand is undoubtedly our prime objective, Figure I.1 also shows the flexibility of the Theory of Consumer Behavior. It can be applied to such wide-ranging topics as charitable giving, driving a car, and asset allocation.

This part concludes with search theory and behavioral economics – special topics built from relaxing assumptions in the basic theory.

After finishing the Theory of Consumer Behavior (from which we get demand), we tackle the Theory of the Firm (and derive the supply curve). The third and final part is the Market System, which studies supply and demand as a resource allocation mechanism.

### References

The epigraph is from the second page of the introductory chapter to Thomas S. Kuhn's classic, *The Structure of Scientific Revolutions* (originally published in 1962). Kuhn argued that progress in science is not generated by bit-by-bit puzzle solving (what he called normal science), but that periods of calm are followed by crises that lead to paradigm shifts. The book was as revolutionary as the material it covered, causing debate and controversy in philosophical and scientific circles.

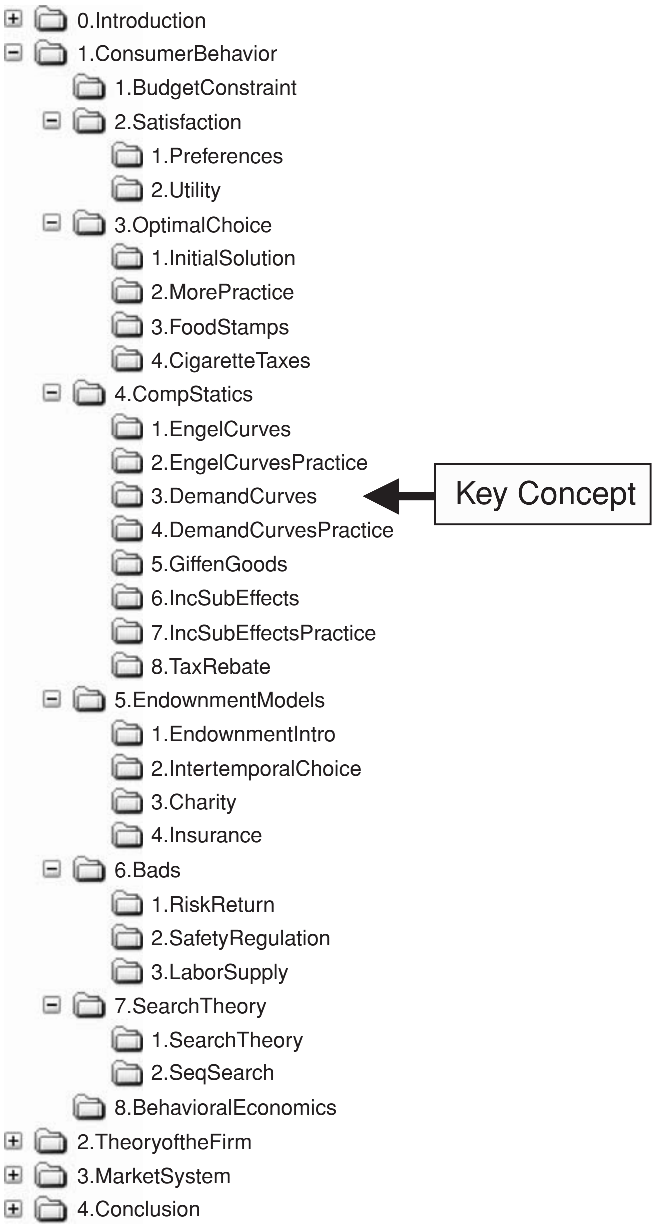


Figure I.1. Content map with focus on consumer behavior.

Modern economics pays little attention to its own history and how it changes. The epigraphs in this book highlight important contributions and individuals in the development of modern microeconomic theory.

# 1.1

## Budget Constraint

# 1.1.1

## Budget Constraint

If we hold money income constant and allow the price of X to change, the price ratio line will rotate about a pivot on the Y axis.

Milton Friedman

The basic idea of the Theory of Consumer Behavior is simple: Given a budget constraint, the consumer buys a combination of goods and services that maximizes satisfaction (utility). By changing a price, *ceteris paribus* (everything else held constant), we derive a demand curve.

This chapter focuses on the budget constraint and how it changes when prices or income change. We cannot answer the question of how much the consumer wants to buy with the budget constraint alone, but the buyer's budget is obviously a key factor in predicting buying behavior.

### The Budget Constraint in the Abstract

$$p_1x_1 + p_2x_2 \leq m$$

This equation says that the sum of the amount of money spent on good $x_1$, which is the price of $x_1$ times the number of units purchased, or $p_1x_1$, and the amount spent on good $x_2$, which is $p_2x_2$, must be less than or equal to the amount of income, $m$, the consumer has available. You can spend less, but not more, than what you have.

Obviously, the model would be more realistic if we had many products that the consumer could buy, but the gain in realism is not worth the additional cost in computational complexity. We can easily let $x_2$ stand for "all other goods."

Another simplification allows us to transform the inequality in the equation to a strict equality. We assume that no time elapses so there is no saving (not spending all of the income available) or borrowing. In other words, the consumer lives for a nanosecond – buying, consuming, and dying the