



INFORMS Transactions on Education

Publication details, including instructions for authors and subscription information:
<http://pubsonline.informs.org>

Case—Starting with Good Inputs: Unconstraining Demand Data in Revenue Management

Mark Ferguson, Carrie Queenan,

To cite this article:

Mark Ferguson, Carrie Queenan, (2009) Case—Starting with Good Inputs: Unconstraining Demand Data in Revenue Management. INFORMS Transactions on Education 9(3):182-183. <https://doi.org/10.1287/ited.1090.0032cs>

Full terms and conditions of use: <https://pubsonline.informs.org/Publications/Librarians-Portal/PubsOnLine-Terms-and-Conditions>

This article may be used only for the purposes of research, teaching, and/or private study. Commercial use or systematic downloading (by robots or other automatic processes) is prohibited without explicit Publisher approval, unless otherwise noted. For more information, contact permissions@informs.org.

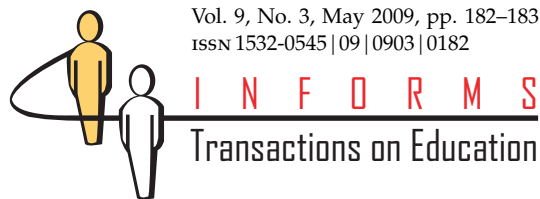
The Publisher does not warrant or guarantee the article's accuracy, completeness, merchantability, fitness for a particular purpose, or non-infringement. Descriptions of, or references to, products or publications, or inclusion of an advertisement in this article, neither constitutes nor implies a guarantee, endorsement, or support of claims made of that product, publication, or service.

Copyright © 2009, INFORMS

Please scroll down for article—it is on subsequent pages



With 12,500 members from nearly 90 countries, INFORMS is the largest international association of operations research (O.R.) and analytics professionals and students. INFORMS provides unique networking and learning opportunities for individual professionals, and organizations of all types and sizes, to better understand and use O.R. and analytics tools and methods to transform strategic visions and achieve better outcomes. For more information on INFORMS, its publications, membership, or meetings visit <http://www.informs.org>



Case

Starting with Good Inputs: Unconstraining Demand Data in Revenue Management

Mark Ferguson

College of Management, Georgia Institute of Technology, Atlanta, Georgia 30332,
mark.ferguson@mgt.gatech.edu

Carrie Queenan

Mendoza College of Business, University of Notre Dame, Notre Dame, Indiana 46556,
c_queenan@nd.edu

Catherine Carlin starts every day by reading the *Wall Street Journal* and running five miles through midtown Atlanta. During her run she passes the Sunrise Hotel, the hotel she manages. One morning, she continues to ponder an article from the *Journal* that discussed how shoe stores lose revenue because they do not know how many women's size 12 shoes they can sell. Shoe store owners sell very few women's shoes in size 12, so they may only order one pair of size 12 shoes per year. If they sell that pair, then they order a new pair of size 12 shoes for the next year to replace it. Following this pattern, however, the store owners never find out whether they could have sold more than one pair (perhaps many more) in a year, if they had ordered more. According to the article (Chasan 2004), retailers "don't know how many they can sell, so manufacturers don't make them to sell to retailers." The article cited an expert who estimated that shoe stores could increase revenues by 8% simply by stocking more of the larger sizes of women shoes.

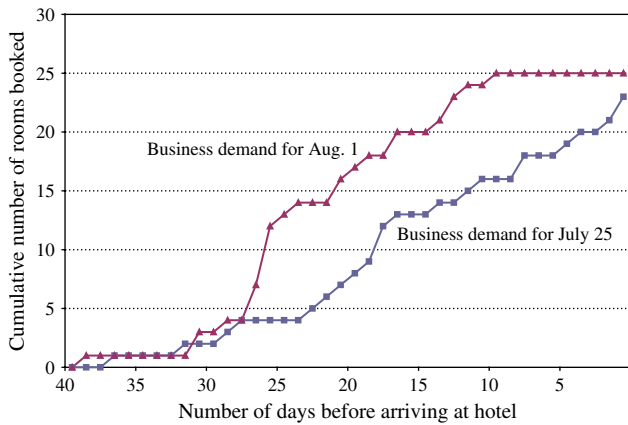
As Catherine runs down Peachtree Street looking at her large feet, it seems silly to her that store owners would only order one pair of shoes per year instead of ordering more shoes to find out how many shoes they could actually sell. She cuts the thought short as she eyes her own hotel and thinks, "Are we guilty of the same sort of short-sightedness? Do we know how many more rooms we could have sold if we had more available?" She realizes that hotels face the same problem as shoe sellers. All the rooms in Sunrise Hotel have the same amenities, but the Sunrise offers two room rates: a leisure rate (low price) for \$100 and a business rate (high price) for \$300. In general, the leisure customers book before the business

customers. To accommodate the later-arriving business customers, the Sunrise reserves rooms especially for them. If Sunrise Hotel saves too many rooms for business guests and those guests do not book, then they do not get any revenue for those rooms. If they book too few rooms for business guests, they lose the \$200 difference in the room rates between business and leisure guests. To make a good decision of how many rooms to reserve for the business guests, it is important to understand the business guests' demand distribution. Catherine concludes that Sunrise Hotel faces the same problem as the shoe sellers every time it does not reserve enough rooms for business guests and the hotel ends up being booked at capacity.

Once a hotel sells out of rooms, the hotel stops taking reservations, so management does not know how many more rooms could have been sold. Hotel management could try to track customers who continue to inquire about rooms, but many problems arise. First, customer service representatives answering the phone struggle to distinguish between those who would actually book a room if one were available versus those shopping around for the best price. Second, often hotels do not directly book their customers: Many customers book through third-party sites such as Expedia.com and Orbitz.com, among others. Once a hotel sells out, it will not appear on a third-party website, and thus it is very difficult to determine who would have booked a room if that room had been available.

Catherine wonders if she could make better pricing and capacity allocation decisions if she took into account that the hotel's demand data are constrained. "Unconstrained" demand data represent the

Figure 1 Hotel Booking Curves for Business Customers



actual, or true, demand, which would be observed if no customer segment was ever capacity constrained. Of course, as with shoe stores, most hotels only have constrained demand data, or the actual number of rooms sold to each customer segment. Thus, if all the rooms in a hotel are booked but 20 additional customers arrive, ask for a room, and are turned away, then the unconstrained demand will be 20 units higher than the constrained demand.

After Catherine finishes her run, she pulls up the Sunrise Hotel reservation data, presented in the form of a “booking curve,” which illustrates how reservations accumulate over time. The hotel maintains separate booking curves for leisure customers and business customers. The number of rooms booked on a given day is called the “booking rate.” The sum of the booking rates until the day of arrival (i.e., the booking curve value on that day) represents the total demand for that night’s stay. Booking curves and booking rates provide Sunrise Hotel with more detailed information than just total demand for a given night, and Catherine wonders whether this information could be used to approximate the unconstrained demand.

Figure 1 provides the business customer booking curves for two separate night at Sunrise Hotel (which corresponds with the first two booking curves in the

accompanying data set for this Case). Note that time is counted backward from the number of days before arrival at the hotel to the day of arrival (0). Catherine looks at the first booking curve for business demand on July 25 and notices that the total business customer demand for this night was 23, less than the 25-room capacity for this customer segment. Thus, she feels confident that the demand data for this particular night reflect the true demand. She then looks at the second booking curve for business customer demand on August 1. She notices that nobody has reserved a room 40 days prior to August 1; 20 people have booked rooms 15 days prior to August 1; and by 10 days prior to August 1, all 25 rooms for this customer segment have been booked. Even though only 25 rooms were sold, it is probable that more could have been sold during days 10–0. Unfortunately, she does not know exactly how many extra customers in the high-price customer class would have booked rooms had they been available.

Catherine and her team typically forecast demand for an upcoming night for a given night of the week based on the historical booking curves of the same given night of the week. So, she pulls up the previous 20 Thursday nights’ booking curves (Data.xls)¹ for the business segment. Sunrise Hotel set the protection level at 25 for all 20 of these historical booking curves. Observing the final demand for each of these nights, she notices that 12 of the 20 showed a total demand of 25; the remaining 8 showed a total demand of less than 25. She suspects that for the 12 nights when the total demand reached the capacity limit of 25, the total demand may be higher than this amount. However, how could she be sure? Could she somehow use the demand data from the 8 nights where total demand was less than 25 to help her estimate what the total demand could have been for the nights when it was at least 25?

Reference

Chasan, E. 2004. When the shoes don’t fit. *Wall Street Journal* (July 27) B1.

¹This Excel spreadsheet file can be found and downloaded from <http://ite.pubs.informs.org/>.