TUTORIAL

Bass Forecasting

Overview

The Bass forecasting model is a tool for forecasting the time-path adoption of new products and new product categories within a target population. It implements the original Bass model (Bass 1969), as well as its extended version, the generalized Bass model (Bass, Krishnan, and Jain 1994). The generalized model expands on the original Bass model by including the effects of advertising and price changes.

The software provides two modes for calibrating the model: (1) by analogy and subsequent refinement (i.e., visual tracking) and (2) by fitting the Bass model to past data using nonlinear least squares (Srinivasan and Mason 1986).

Firms can use the Bass forecasting model to develop marketing programs based on the estimates of future product sales rates for new durables (i.e., products, services, or technologies that are not purchased frequently by a customer). The model can be "calibrated" either based on parameters obtained from available historical data of the penetration of the product in a target population over a defined time period, or based on the time paths of adoptions of similar or analogous products in the target population.

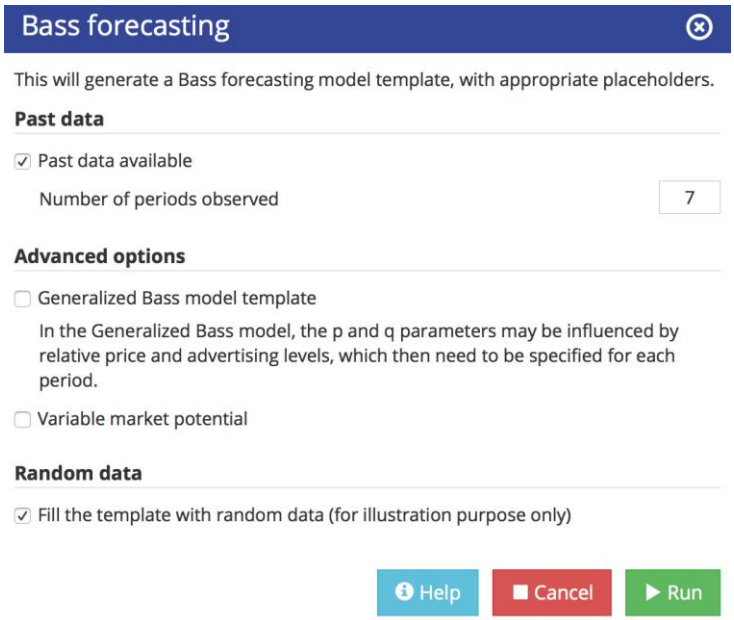
Getting Started

The Bass forecasting model allows you to use your own data directly or to use a preformatted template.

Because the Bass forecasting model requires a specific data format, users with their own data should review the preformatted template to become familiar with the appropriate structure.

Creating a template

The screen capture below shows the dialog box that results from using Enginius Templates (Bass forecasting).



The options are as follows:

- Past data available: If you have past data available, checking this box will allow you to enter the number of periods for which you have past data about adoption rates.
- Advanced options:
    1. Generalized Bass model template: Click the checkbox if you want to set up the Generalized Bass model, which includes two decision variables, pricing and advertising, that determine the speed of diffusion. If the Advanced Bass option is not checked, the template will exclude the pricing and advertising decision variables.
    2. Variable market potential: Check this box if the market potential will change over the forecasting periods.
    3. Number of periods to forecast: The number of periods to forecast will be available if either the Advanced Bass model template or the Variable market potential options are selected. Enter the number of periods you want to forecast. Notice that this option simply creates placeholders for anticipated market potential and/or price and advertising levels; it does not generate forecasts.

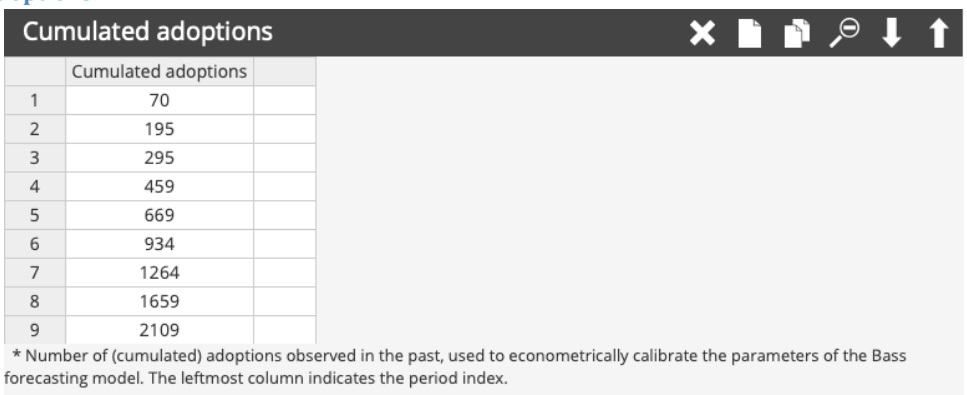
  Note: the check box at the bottom of the dialog box will cause the template to populate with sample (random) data that will allow you to run Bass forecasting immediately so you can preview the output produced.

After selecting the desired model options, click Run to generate the data collection template.

Data blocks

The template will consist of the following data blocks depending on the template options selected.

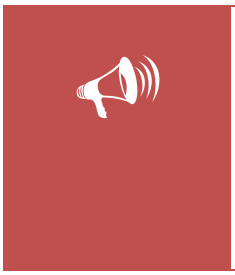
Cumulated adoptions



	Cumulated adoptions	
1	70	
2	195	
3	295	
4	459	
5	669	
6	934	
7	1264	
8	1659	
9	2109	

* Number of (cumulated) adoptions observed in the past, used to econometrically calibrate the parameters of the Bass forecasting model. The leftmost column indicates the period index.

Data consists of the number of cumulated adoptions observed in the past. The leftmost column indicates the period index.



The length of the period is not defined by the software but by the user. One period could represent one week, one month, one year, etc. depending on the data you have available. Remember to be consistent with your definition of the period (eg, if your previous adoption data is in months, your forecasted data will be in months as well).

Market potential

Market potential

	Market potential
1	5000
2	5100
3	5202
4	5306
5	5412
6	5520
7	5631
8	5743
9	5858

* Maximum market potential at each time period (observed or not). The leftmost column indicates the period index.

Data consists of the maximum market potential for each period. The number of periods entered should be the total of the past data and periods to forecast (e.g. 10 periods of past data + 15 periods to forecast = 25 periods of relative price and advertising levels).

Relative price and advertising levels

Relative price and advertising levels

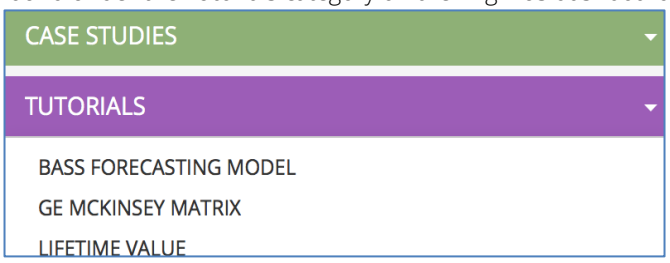
	Price	Advertising
1	1	1
2	0.99	1.01
3	0.98	1.02
4	0.97	1.03
5	0.96	1.04
6	0.95	1.05
7	0.94	1.06
8	0.93	1.07
9	0.92	1.08

* Relative price and advertising levels, compared to launch at period 0. For instance, a relative price level of 1.2 means '20% higher than at introduction'. Relative levels need to be specified for both past and future periods. The leftmost column indicates the period index.

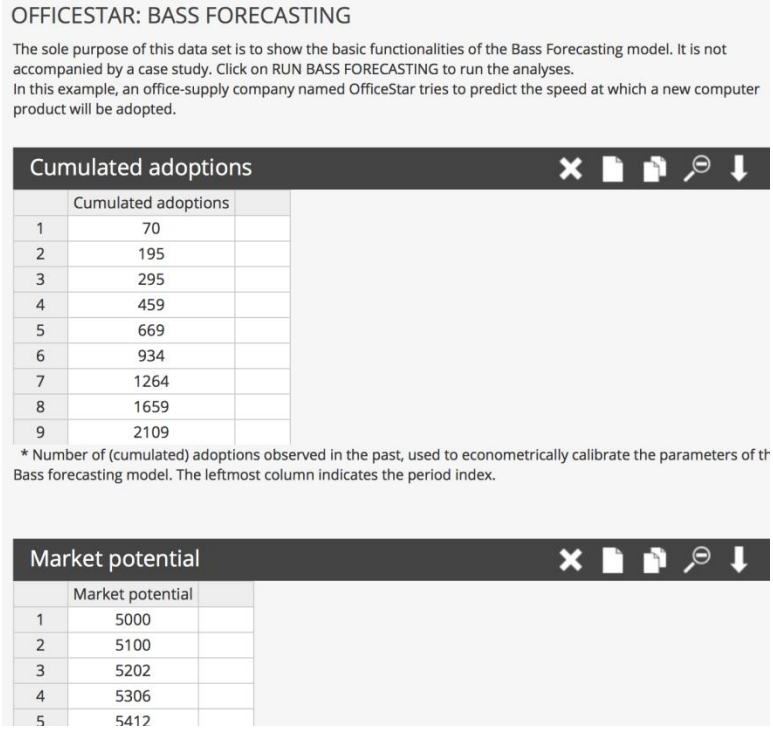
Data consists of the relative price and advertising levels compared to launch at period 0. The number of periods entered should be the total of the past data and periods to forecast.

Running Analysis

Each model includes a sample data set (OfficeStar) that can be found under the Tutorials category on the Enginius dashboard.



The remainder of this tutorial uses the Bass OfficeStar data set as the starting data set.



OFFICESTAR: BASS FORECASTING

The sole purpose of this data set is to show the basic functionalities of the Bass Forecasting model. It is not accompanied by a case study. Click on RUN BASS FORECASTING to run the analyses.
In this example, an office-supply company named OfficeStar tries to predict the speed at which a new computer product will be adopted.

Cumulated adoptions

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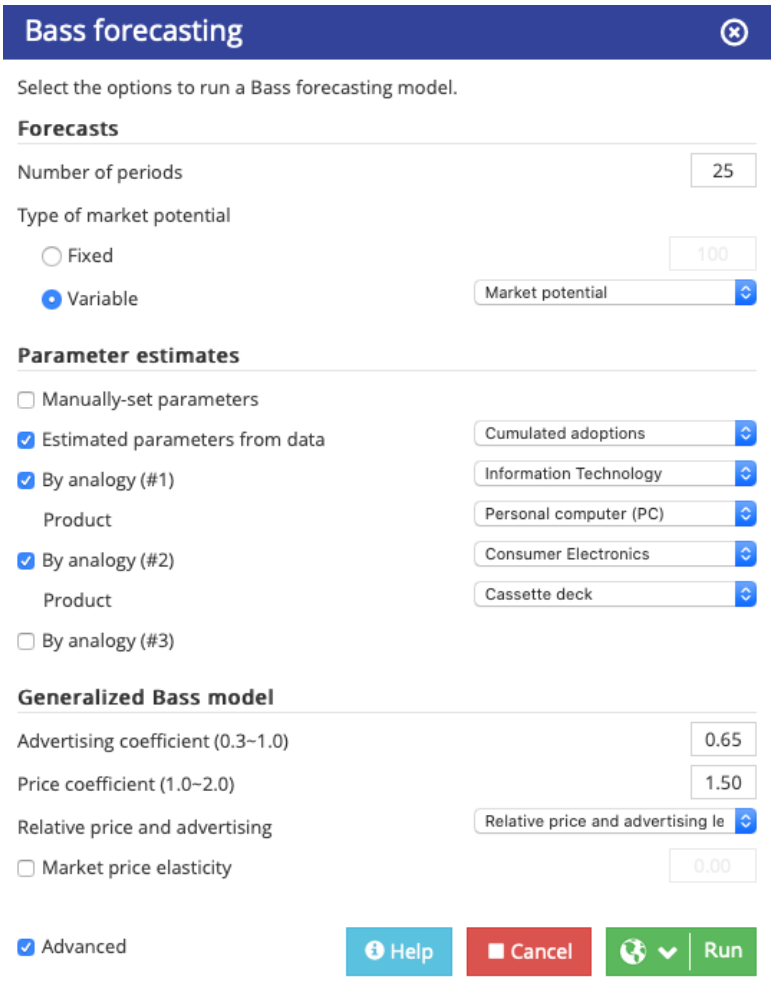


Bass forecasting requires:

- Forecasts:
  1. Number of periods: The number of periods for the forecast. If you have past data, those periods should be included in this number (e.g. enter 25 for number of periods if you have 10 periods of past data and 15 periods to forecast).
  2. Type of market potential: Select whether your market potential is fixed or variable. If variable, select the data block that contains your variable market potential data.
- Parameter estimates:
  1. Manually-set parameters: Enter your own *p* and *q* values. Roughly speaking, *p* is the proportion of non-adopters who would adopt the product in the current period, independent of whether others adopt the product. Typically, its value is in the range 0.01 to 0.05, with an average around 0.035. *q* ranges from low values of around 0.01 to 1.0, with an average equal to 0.4. If *q* is equal to 1, it means that when a non-adopter hears about the product from an adopter, it is nearly certain that the non-adopter would adopt the product. If *q* is equal to 0.1, it means (roughly speaking) that a non-adopter would have to be exposed to 10 adopters before being convinced to adopt the product.

2. Estimated parameters from data: Select the data block that contains your cumulated adoptions observed in the past. *p* and *q* values will be calculated from the past data during analysis and used for forecasting.

3. By analogy: Select similar products for which the parameters have already been estimated. If you wish to run the analysis with different parameters estimated from various products, repeat these steps for each scenario in your model to populate the *p* and *q* values for forecasting. The first dropdown (optional) in the row allows filtering by categories while the second dropdown will contain the analogous product.

- Generalized Bass model (options only available if you check "Advanced" at bottom)

1. Advertising Coefficient (Generalized Bass model only): The percentage increase in speed of market penetration with a 1% increase in advertising. The advertising coefficient does not change the number of potential adopters, but rather, it changes the speed at which they adopt; it reflects the percentage increase in the speed of market acceptance with a 1% increase in advertising. (Recall that the documented values for the advertising coefficient typically range between 0.3 and 1.). For completely new technologies for which advertising drives product awareness and knowledge, the coefficient will be closer to the higher end of the range. For products such as TV and mobile phones, where there is at least some knowledge of the product category (e.g., familiarity with the general product category, and how the product is used), the advertising coefficient is likely to be closer to the lower end of the range.

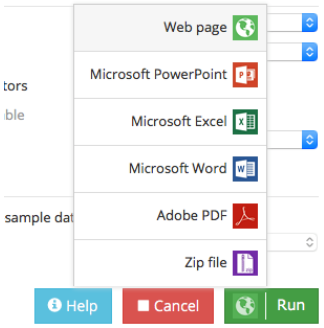
2. Price Coefficient (Generalized Bass model only): The percentage increase in speed of market penetration with a 1% decrease in price. The price coefficient reflects the percentage increase in speed of market acceptance with a 1% decrease in price. The Price coefficient has a wide range of feasible values from 0% to 4%. For some categories, price may be very critical (e.g., discretionary items), and the coefficient value could be high. For other categories (e.g., necessities), the price coefficient is likely to be small. In some rare cases (e.g., high-end products), the price coefficient could even be negative.

3. Relative price and advertising: Select the data block that contains your relative price and advertising data.

4. Market Price Elasticity (Generalized Bass model only): The percentage increase of market potential with a 1% decrease in price. There is no precise way to determine a good answer for this question, but the following guidelines should be useful. Typically, in the initial stages of a product's introduction, prices are high, but the demand is inelastic (i.e., elasticity is near 0) because innovators are not price-driven. If price falls below, say $500 for a household durable, then it enters into the price-elastic mass market. Estimates of price elasticity in this situation are typically in the range of 0.1 to 0.5 (i.e., a 0.1% to 0.5% increase in market potential for a 1% decrease in price).

Make the desired selections for the above data blocks and click the Run button.

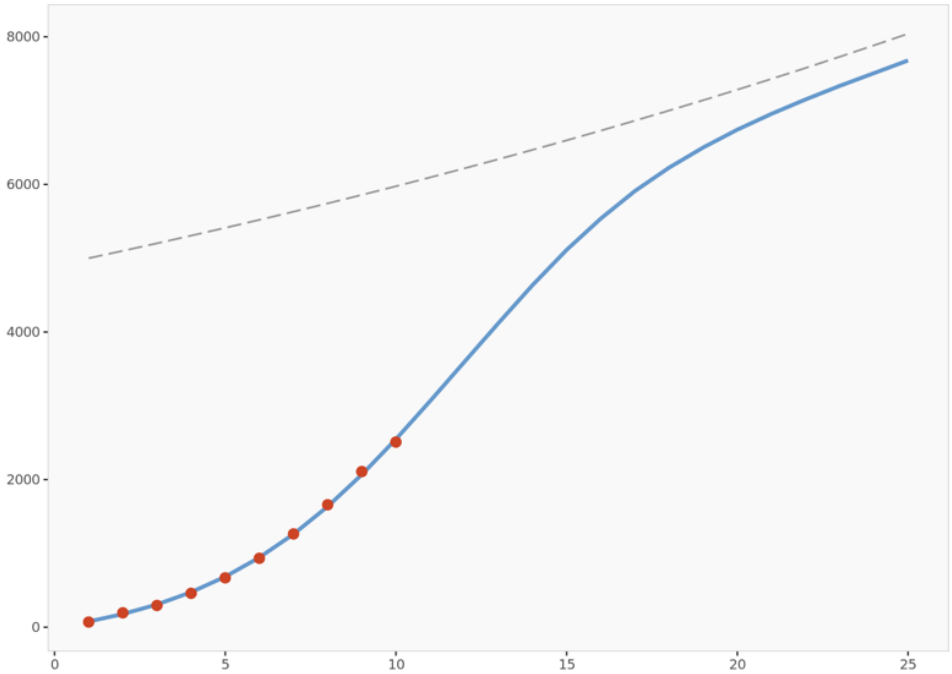
Reminder: Clicking the world icon beside the "Run" option will allow you to choose a different output format for the report.



Interpreting the Results

Model fit

If using past data, the p and q values will be calculated based on past data and calibrated forecasting model will be displayed.



Model calibration. Bass model calibrated on observed data.

As well as the calculated p and q values.

	Parameters
p	0.01515
q	0.30321

Model parameters. p (innovation) and q (imitation) values estimated from data

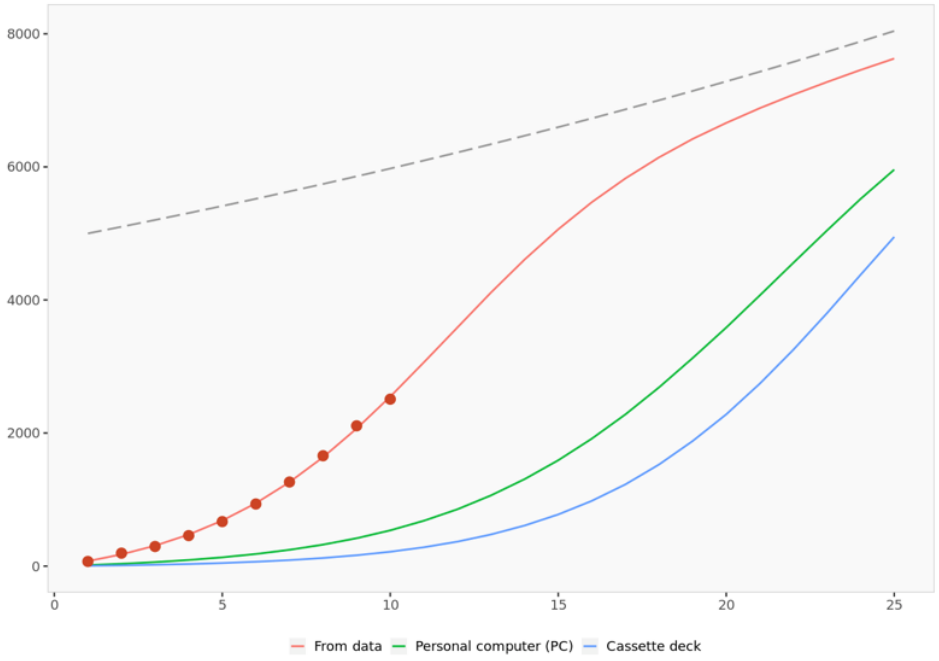
Cumulated adoptions

The table will display the forecasts for the different scenarios, along with past data when available.

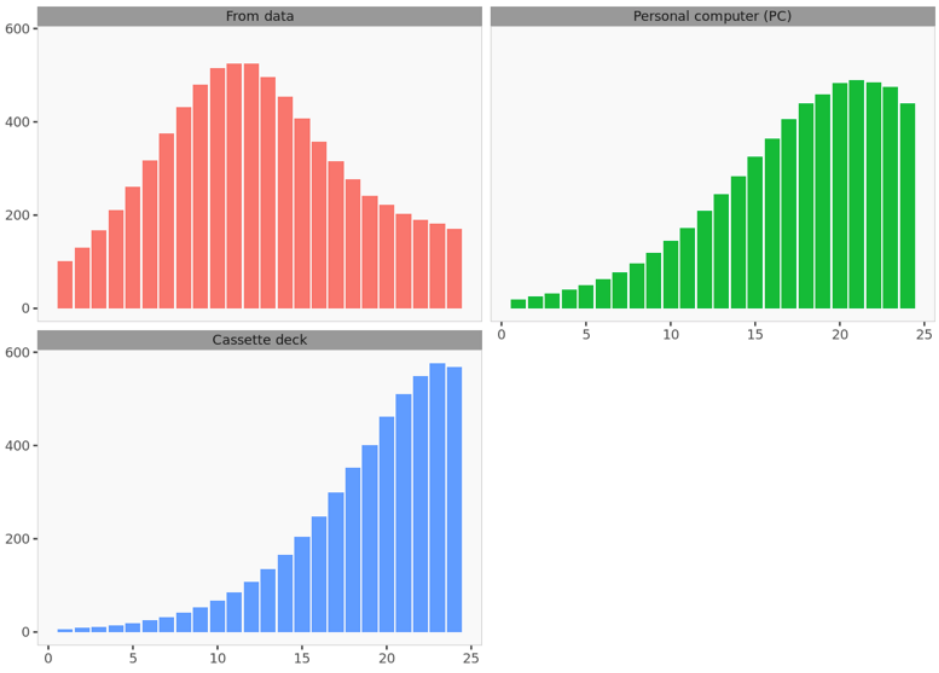
	Market potential	From data	Personal computer (PC)	Cassette deck
1	5 000.0	75.763	15.300	5.0000
2	5 100.0	176.657	35.141	11.6721
3	5 202.0	307.323	60.323	20.3957
4	5 306.0	474.414	92.154	31.7648
5	5 412.0	684.979	132.226	46.5401
6	5 520.0	945.774	182.471	65.6930
7	5 631.0	1 262.213	245.204	90.4600
8	5 743.0	1 636.852	323.155	122.4039
9	5 858.0	2 067.861	419.505	163.4925
10	5 975.0	2 547.605	537.864	216.1787
11	6 095.0	3 062.312	682.225	283.4905
12	6 217.0	3 587.306	854.926	368.1828
13	6 341.0	4 113.017	1 063.609	476.2510
14	6 468.0	4 608.283	1 307.883	610.5763
15	6 597.0	5 062.092	1 591.098	776.7529
16	6 729.0	5 469.767	1 916.174	981.3432
17	6 864.0	5 827.444	2 280.710	1 228.7962
18	7 001.0	6 143.062	2 686.620	1 527.3960
19	7 141.0	6 419.919	3 126.853	1 880.0353
20	7 284.0	6 660.730	3 585.326	2 281.1046
21	7 430.0	6 882.570	4 069.191	2 742.9745
22	7 578.0	7 085.598	4 559.351	3 253.4226
23	7 730.0	7 275.367	5 044.875	3 802.1879
24	7 884.0	7 457.030	5 519.144	4 379.0154
25	8 042.0	7 627.859	5 958.814	4 947.7790

Bass forecasts (cumulated). Forecasts of cumulated adoptions per period

The results are also plotted on the next charts.



Bass forecasts. Forecasts of cumulated adoptions



Speed of adoption. Number of adoptions per period

Technical Note

Bass forecasts rely either on a continuous-time model of the adoption phenomenon, or its discrete-time approximation. While the continuous model is more theoretically justified and is usually recommended, it cannot easily accommodate changes (e.g., growth) in potential market size. For consistency, the discrete model is used throughout in Enginius. The user should note that comparisons with the continuous version of the Bass model may lead to slightly different parameter estimates or forecasts.

For further readings:

Bass, Frank M. 1969. A new product growth for model consumer durables.
Management Science 15 215-227.

Mahajan, Vijay, Charlotte H. Mason, V. Seenu Srinivasan. 1986. An evaluation of estimation procedures for new product diffusion models. In Innovation Diffusion Models of New Product Acceptance, Vijay Mahajan and Yoram Wind, eds. Cambridge, MA: Ballinger Publishing Company.

Schmittlein, David C., Vijay Mahajan. 1982. Maximum likelihood estimation for an innovation diffusion model of new product acceptance. Marketing Science 1 (1) 57-78.

Srinivasan, V. Seenu and Charlotte Mason. 1986. Nonlinear least squares estimation of new product diffusion models. Marketing Science, 5 (2), 169-178.

Appendix

This table summarizes the estimated values of the *p* and *q* parameters of the Bass model for various product categories. For each product, the reported values here are the average values of these parameters obtained from an exhaustive search of the literature. (Compiled by Christophe Van den Bulte).

CAT1	CAT2	Products	p	q
Agricultural	High p / High q	Artificial insemination	0.014	0.437
Agricultural	High p / High q	Bale hay	0.0095	0.519
Agricultural	High p / High q	Corn	0.0388	1.00534
Agricultural	Low p / High q	Hybrid corn	0.00000001	0.7975
Agricultural	High p / Low q	Tractor	0.0072	0.11795
Consumer Electronics	High p / Low q	Cable TV	0.02116	0.2698
Consumer Electronics	Low p / High q	Calculator	0.00136	0.438
Consumer Electronics	Low p / High q	Camcorder	0.000094	0.4679
Consumer Electronics	Low p / Low q	Cassette deck	0.001	0.2875
Consumer Electronics	High p / High q	CD player	0.0017	0.3991
Consumer Electronics	Low p / High q	Cell telephone	0.00471	0.506
Consumer Electronics	Low p / High q	Cordless telephone	0.002	0.388
Consumer Electronics	Low p / Low q	Digital watch	0.0056	0.3542
Consumer Electronics	High p / High q	Diskdrive	0.0208	0.995
Consumer Electronics	High p / Low q	Kodak instant camera	0.13846	0.00005
Consumer Electronics	Low p/Low q	Laser disc player	0.0025	0.3242
Consumer Electronics	High p / Low q	Polaroid instant camera	0.09228	0.00006
Consumer Electronics	High p / High q	Radio	0.01034	0.4537
Consumer Electronics	Low p / Low q	Recording media (records, cassette tapes, CDs)	0.00874	0.32847
Consumer Electronics	Low p / Low q	Telephone	0.0075	0.082
Consumer Electronics	Low p / High q	Telephone answering machine	0.000000058	0.5443
Consumer Electronics	High p / Low q	Turntable	0.0577	0.21
Consumer Electronics	Low p / High q	TV (Black & White)	0.00064	0.416
Consumer Electronics	Low p / High q	TV (Color)	0.00005	0.648
Consumer Electronics	Low p / Low q	TV (Projection)	0.00512	0.2062
Consumer Electronics	Low p / High q	VCR	0.00015	0.7564
Consumer Electronics	High p / Low q	Videogames	0.01979	0.3066
Household Appliances	High p / Low q	Automatic coffee maker	0.01082	0.22588
Household Appliances	Low p / High q	Blender	0.0000038	0.4726
Household Appliances	Low p / High q	Broiler	0.000000036	0.9668
Household Appliances	High p / Low q	Can opener	0.01924	0.2903

Household Appliances	Low p / HIgh q	Clothes dryer	0.0000014	0.4792
Household Appliances	Low p / Low q	Clothes washer	0.00162	0.2687
Household Appliances	Low p / High q	Coffee maker ADC (Automatic Drip Coffee)	0.000035	0.4086
Household Appliances	High p / High q	Curling iron	0.0603	0.454
Household Appliances	High p / High q	Deep fryer	0.0337	0.74
Household Appliances	High p / Low q	Dishwasher	0.0128	0.1845
Household Appliances	High p / High q	Disposer	0.0101	1.0873
Household Appliances	High p / Low q	Electric coffee maker	0.0215	0.2025
Household Appliances	High p / Low q	Electric knife	0.11495	0.27515
Household Appliances	Low p / High q	Electric range	0.00246	0.4984
Household Appliances	High p / High q	Electric toothbrush	0.11	0.548
Household Appliances	Low p / Low q	Fluorescent lamp	0.0008	0.0546
Household Appliances	High p / Low q	Fire extinguisher	0.0694	0.16
Household Appliances	High p / High q	Food processor	0.0182	0.5633
Household Appliances	High p / High q	Fondue	0.166	0.44
Household Appliances	Low p / High q	Freezer	0.000038	0.3814
Household Appliances	High p / Low q	Frypan	0.2215	0
Household Appliances	High p / Low q	Hair setter	0.1305	0.35
Household Appliances	Low p / Low q	Heating pad	0.0035	0.3463
Household Appliances	High p / Low q	Hot plates	0.0755	0.0715
Household Appliances	High p / High q	Knife sharpener	0.0655	0.5
Household Appliances	Low p / Low q	Lawnmower	0.0000079	0.3091
Household Appliances	Low p / Low q	Microwave oven	0.000004	0.3451
Household Appliances	Low p / Low q	Mixer	0.00011	0.14823
Household Appliances	Low p / Low q	Power leaf blower (gas or electric)	0.013	0.315
Household Appliances	High p / Low q	Range	0.0375	0.0325
Household Appliances	High p / Low q	Range (built-in)	0.04067	0.22651
Household Appliances	Low p / Low q	Refrigerator	0.00037	0.2308
Household Appliances	Low p / High q	Room AC	0.000000044	0.5701
Household Appliances	Low p / Low q	Electric Shaver	0.000098	0.2775
Household Appliances	High p / High q	Slow cooker	0.0436	0.59733
Household Appliances	Low p / High q	Steam iron	0.00012	0.3819
Household Appliances	High p / Low q	Styling dryer	0.0777	0.253
Household Appliances	High p / Low q	Toaster	0.0385	0.131
Household Appliances	Low p / High q	Trash compactor	0.000065	0.9498
Household Appliances	Low p / Low q	Vacuum cleaner	0.00406	0.1805
Household Appliances	High p / High q	Waffle iron	0.0128	0.43

Household Appliances	High p / Low q	Water softener	0.0177	0.29695
Information Technology	Low p / High q	8-bit microprocessor	0.00783	0.58466
Information Technology	High p / Low q	Copying machines	0.01208	0.1456
Information Technology	Low p / Low q	Portable dictation machine	0.00078	0.2141
Information Technology	High p / High q	Mainframe computers (number of units installed)	0.05911	0.38379
Information Technology	High p / High q	Mainframe computers (units of computing performance)	0.02845	0.72294
Information Technology	Low p / High q	PC Printer	0.00071	0.8037
Information Technology	Low p / Low q	Personal Computer (PC)	0.00306	0.2532
Information Technology	High p / High q	Static Random Access Memory (SRAM) chips	0.02562	1.10136
Information Technology	High p / Low q	Supercomputer	0.07063	0.17513
Information Technology	Low p / High q	Fax	9.1E-09	0.766
Information Technology	Low p / High q	Linked-In	0.00234	0.58383
Information Technology	Low p / High q	3-D Printers	0.00403	0.54646
Medical	High p / High q	CT scanner for head only	0.0411	1.0896
Medical	High p / High q	CT scanner for whole body	0.0335	1.3895
Medical	High p / High q	CT scanners (all types for hospitals with 50-99 beds)	0.04	0.461
Medical	High p / Low q	CT scanners (all types for hosptitals with >100 beds)	0.035	0.261
Medical	Low p / High q	Mammography	0.00494	0.70393
Medical	High p / Low q	Population using florinated water (community adoption)	0.2648	0.3352
Medical	Low p / High q	Ultrasound imaging (adoption by hospitals)	0.00312	0.50625
Medical	High p / Low q	Antihypertensive	0.04476	0
Medical	Low p / High q	Beta Blockers	0.00206	0.50323
Medical	High p / Low q	Diuretic	0.011	0.066
Other Products	Low p / Low q	Bed cover	0.00566	0.15109
Other Products	Low p / Low q	Electric Blanket	0.000057	0.2489
Other Products	HIgh p / Low q	Boat trailer	0.0088	0.37585
Other Products	High p / Low q	Diaper	0.0238	0.2684
Other Products	High p / High q	Drillbit for oil wells	0.1102	0.4154
Other Products	Low p / High q	Milkpack (containers for milk)	0.00079	0.39606
Other Products	Low p / Low q	Nylon cord	0.00415	0.2335
Other Products	Low p / High q	Oxygen steel furnace (USA)	0.001	0.456
Other Products	High p / Low q	Plastic milk containers (1 gallon)	0.0123	0.3327
Other Products	High p / Low q	Plastic milk containers (half gallon)	0.0114	0.3007
Other Products	Low p / High q	Retail scanner equipment (POS Scanners)	0.00392	1.17359
Other Products	High p / Low q	Structural wood panel (plywood, waferboard)	0.01656	0.03535
Other Products	High p / High q	Styling mousse	0.2028	0.9864
Other Products	High p / Low q	Toothbrush	0.0826	0.13

Other Products	Low p / Low q	Universal Product Code (UPC)	0.0076	0.1808
Services	Low p / High q	AOL (change in subscriptions)	0.00018	1.1827
Services	Low p / Low q	Solar energy (BTU generated)	0.00112	0.0719
Services	Low p / High q	Cable TV (change in subscription)	0.0000061	0.5012
Services	Low p / High q	Accelerated program (educational innovation)	0.00262	0.91303
Services	Low p / High q	ATM machines (adoption by banks)	0.00053	0.4957
Services	Low p / High q	Foreign language (educational innovation)	0.0034	0.6186
Services	High p / Low q	HoJo (Number of restaurants)	0.0208	0.25762
Services	High p / High q	McDonalds (Number of restaurants)	0.01801	0.53817
Services	High p / Low q	Motel	0.0109	0.3379
Services	High p / High q	Phone banking	0.0143	0.88378
Services	High p / Low q	Satellite TV (change in subscriptions)	0.04693	0.3346
Transportation	High p / High q	Electronic Fuel Injection (Proportion of car models)	0.00878	0.576
Transportation	Low p / Low q	Diesel cars in Europe (Proportion of new cars)	0.0037	0.1706
Transportation	Low p / Low q	ABS (Antilock Braking) (Proportion of cars sold)	0.0026	0.2056