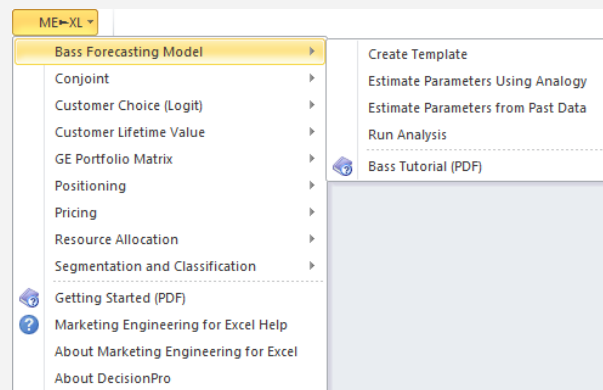Tutorial

Bass Forecasting

Marketing Engineering for Excel is a *Microsoft Excel* add-in. The software runs from within Microsoft Excel and only with data contained in an Excel spreadsheet.

After installing the software, simply open *Microsoft Excel*. A new menu appears, called *"ME▸XL."* This tutorial refers to the *"ME▸XL/Bass Forecasting Model"* submenu.

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.

> **F.Y.I.**
>
> This section explains how to create an easy-to-use template to enter your own data.
>
> If you want to run Bass forecasting immediately, open the example file "*OfficeStar Data (Bass Forecasting).xls*" and jump to "Step 5: Running analyses." By default, the example files install in "*My Documents/My Marketing Engineering/.*"

Step 1   Creating a template

In Excel, if you click on ME ▸ XL → BASS FORECASTING MODEL → CREATE TEMPLATE, the following dialog box appears. This box represents the first step in creating a template for running the Bass forecasting model.

The options are as follow:

▪ **Generalized Bass Model**. 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 generalized Bass option is not checked, the template will exclude the pricing and advertising decision variables.

   ▪ **Advertising Coefficient**. The generalized Bass model assumes that relative changes in advertising affect the speed of diffusion of a new product in a population. If the advertising level increases (compared with a base advertising level at the time of introduction of the new product), potential adopters adopt faster than they would have without

that increase in advertising. Research shows that the advertising coefficient usually falls between 0.3 and 1.0.

- **Price Coefficient**. The generalized Bass model assumes relative changes in price also affect the speed of diffusion. If the relative price decreases, potential adopters adopt faster. Documented values for the price coefficient typically range between 1.0 and 2.0.

- **Number of Periods to Forecast**. Enter the number of periods you want to forecast. Notice that this option simply creates placeholders for anticipated price and advertising levels; it does not generate forecasts.

- **Forecasting Scenarios**. Running the Bass forecasting model using different estimates for adoption parameters and market potential provides comparative forecasts. This control enables you to decide how many forecasting scenarios you wish to compare, and creates placeholders in the spreadsheet for each scenario.

- **Past Data.** This function indicates the number of periods for which you have past data about adoption rates. If you have no past data, enter 0; you still can parameterize the model selecting one or more analogous products.

After completing the dialog box, click OK to generate the data template, as shown below for a generalized Bass model with 10 available past data periods.

Step 2   Entering your data

In this tutorial, we use the example file "*OfficeStar Data (Bass Forecasting).xls,*" which by default appears in "*My Documents/My Marketing Engineering/.*"

To view a proper data format, open that spreadsheet in Excel. A snapshot is reproduced below.

Bass Parameters

Total Market Potential	5000	Total number of potential adopters before period 1.
Market Penetration Before Period 1	0	Total number of actual adopters before period 1.
Market Growth Rate	2.0%	Growth rate of the market potential.
Market Price Elasticity	0.0%	Percentage increase of market potential with a 1% decrease in price.
Advertising Coefficient	0.7%	Percentage increase in speed of market penetration with a 1% increase in advertising.
Price Coefficient	1.5%	Percentage increase in speed of market penetration with a 1% decrease in price.

Forecasting Scenario

Scenario labels, total market potentials, and parameters p and q, used for different forecasting scenario.

Scenario					
Total Market Potential	5000	5000	5000	5000	5000
Parameter p					
Parameter q					

Past Data, Price and Advertising Data

Adoptions per period, and relative price and advertising levels
By default, relative price and relative advertising are set to 1.0 in the first period

Period / Data	Adoptions/ Period	Cumulated Adoptions	Relative Price	Relative Advertising
1	70	70	1.00	1.00
2	125	195	0.99	1.01
3	100	295	0.98	1.02
4	164	459	0.97	1.03
5	210	669	0.96	1.04
6	265	934	0.95	1.05
7	330	1264	0.94	1.06
8	395	1659	0.93	1.07
9	450	2109	0.92	1.08
10	400	2509	0.91	1.09
11			0.90	1.10
12			0.90	1.12
13			0.89	1.13
14			0.88	1.12

BASS Template

A Bass model spreadsheet contains different areas in which data must be entered or populated by the software after the model estimates are computed.

Bass Parameters

▪ **Total Market** is the total estimated number of adopters, that is, the total number of customers who eventually will adopt the product. It is important to note that the total market is the accessible market given the market context at the time of a product introduction. For example, it is possible that at the time of the new product introduction (i.e., the start of the diffusion process), only half the total population would be potential adopters. However, others in the population could become potential adopters at a future point when the price of the product is reduced (see Market Growth Rate and Market Price Elasticity below). Note also that the total market refers to the eventual number of adopters of a product. Thus, if a person buys two units of the product, that person should still be counted as just one adopter. Multiple purchases, repeat purchases, and

other phenomena have to be externally superimposed on to the diffusion curve obtained from the model.

- **Market Penetration Before Period 1** represents the total number of potential adopters who *already* have adopted. This number could be non-zero if the company has provided free samples or beta versions to seed the market.

- **Market Growth Rate** is the estimated growth rate per period. If the market growth rate is 2% and market potential (supplied by the user) initially is 100, then market potential will be 102 in period 1, 104 in period 2, 106.1 in period 3, and so forth. This type of market growth occurs independent of any actions taken by the firm, for example, via population growth.

- **Market Price Elasticity** (generalized Bass model only) is 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).

- **Advertising Coefficient** (generalized Bass model only) is 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.

- **Price Coefficient** (generalized Bass model only) is 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.

Forecasting Scenario

A **forecasting scenario** is a placeholder that enables users to store multiple parameter values for the three key elements of the Bass model and then compare adoption forecasts.

- **Total Market Potential** is the total market size in units for the market. By default, any change in cell C3 automatically gets reported here; you thus can change the value manually in this cell.

- **Parameter *p*** represents the propensity to adopt, independent of how many customers have previously adopted, also referred to as the "innovation" component of the model.

- **Parameter _q_** represents the propensity to adopt as a function of the number of existing adopters, also referred to as the "imitation" component of the model.

> *The Bass forecasting model provides two different approaches to determining the values for p and q. The first approach analyzes past data and infers actual values through statistical estimation. The second approach uses analogy, that is, p and q values estimated from other products that resemble the one under investigation. Please refer to sections "Step 3: Estimating parameters using analogy" and "Step 4: Estimating parameters from past data."*

Past Data

Past data placeholders appear only if you previously selected the Past Data option. For each period, enter the number of adoptions for that period; the total (accumulated adoptions) through that period will get updated automatically.

Price and Advertising Data

These placeholders appear only if you previously selected the generalized Bass model. For each prior period (if past data exist) and future period (if forecasting periods are greater than 0), enter the relative price and advertising levels compared with the first period (i.e., at the time of product introduction). A relative price level of 1.2 indicates that price increased by 20% compared with the price level of 1.0 during the first period. The first row reveals the "level" of price and advertising. All other entries are relative to the first row. For example, if price is set to 50 in the first row, it might be 49 (decrease) or 51 (increase) in the next period.

Step 3 Estimating parameters using analogy

The Bass forecasting model in ME ▸ XL provides two methods of estimating the values for _p_ and _q_. The first method estimates parameters using analogies to other products for which the parameters already have been estimated.

In Excel, if you click on ME ▸ XL → Bass Forecasting Model → Estimate Parameters Using Analogy, the following dialog box will open:
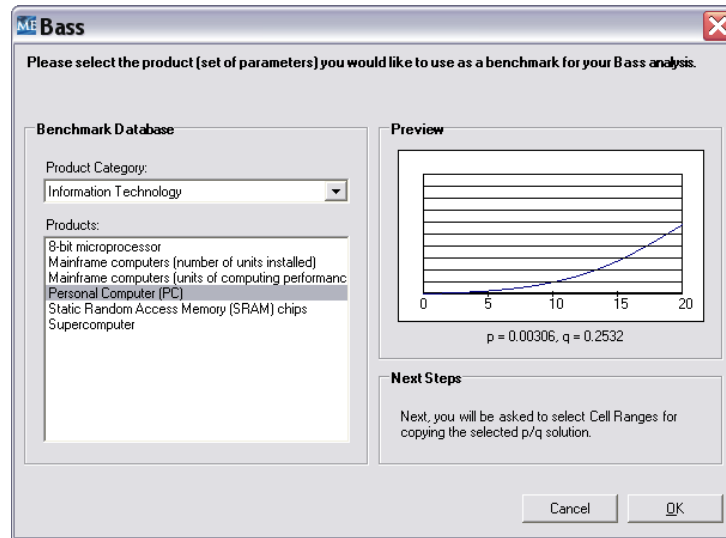
Use the scroll bar to move through the product categories and select a product that is close in characteristics to the product you are forecasting. Click OK to accept the *p* and *q* values for that product. You can also search subcategories of products, such as "Consumer Electronics," to find the analogous products to the one for which you want to estimate the penetration rate.

When you click OK, you must select a forecasting scenario placeholder, or cell range, to copy the *p* and *q* parameters in your spreadsheet. If you are using a *Marketing Engineering for Excel* template, the destination cells for your selection will be pre-selected within the Forecasting Scenario portion of the template. If you are not using a template, you must select the appropriate destination cells.
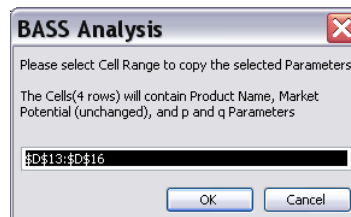
If you wish to run the analysis with different parameters estimated from various products, repeat these steps for each scenario in your model to populate the *p* and *q* values for forecasting. In addition to obtaining *p* and *q* from analogous product(s), you could simply insert suitable values of *p* and *q* that you think are appropriate. 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.

Step 4　Estimating parameters from past data

The second way to estimate p and q parameters analyzes past data (if available) and statistically infers parameter estimates. In Excel, if you click on ME ▸ XL → BASS FORECASTING MODEL → ESTIMATE PARAMETERS FROM PAST DATA, the following dialog box opens:
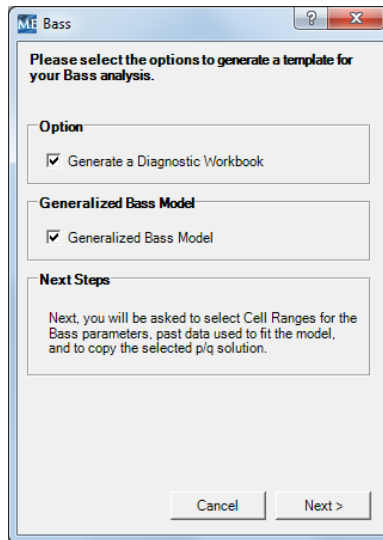

This dialog box begins the analysis process of determining the appropriate p and q values for your model on the basis of the past data you have available. Indicate whether you want to generate a diagnostic workbook at the end of the analysis and whether you are using the generalized Bass model, and then click Next to begin the analysis.

Several dialog boxes ask you to select the Bass parameters (three rows in the simple Bass model; six rows in the generalized Bass model), past data (including relative price and advertising levels in the generalized Bass model), and the destination cell range for the output (estimated) parameters.
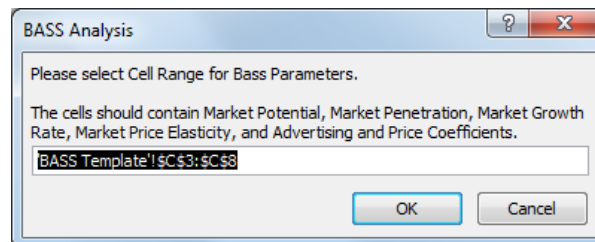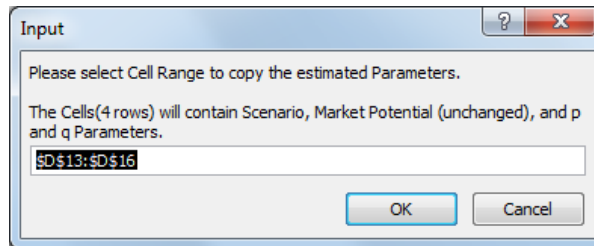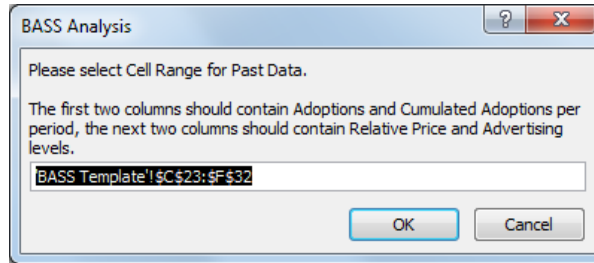
If you have selected the Generate Template option of *Marketing Engineering for Excel*, the appropriate ranges are pre-selected.

After selecting the appropriate cell ranges and clicking OK, the newly generated workbook (if you have selected the Generate Diagnostic Workbook option) includes tabs showing the values generated by the Bass forecasting model on the basis of your past data. The *p* and *q* values are stored automatically in the cells you selected in your original (template) workbook. (Note: You may use a combination of data by analogy and past data to complete your forecasting scenario and then compare the different parameterizations.)

Step 5   Running analyses

To run the forecasting analyses, your spreadsheet should now contain:

- **Bass parameters**: A list of three key parameters (or six for the generalized Bass model, as shown below).

- **Forecasting scenario**: Different parameter estimates of total market potential, *p* and *q*, for which the parameters have been estimated either using analogy (see Step 3) or statistical analysis of past data (see Step 4).

- **Past data**, if available.

- **Relative price and relative advertising**: Levels (in the generalized Bass model) reflecting not only past data (if available) but also future periods (estimations) to indicate the effects of the most likely future changes in price and advertising levels on rate of adoption and market potential.

	A	B	C	D	E	F	G	H	I	J
1										
2		**Bass Parameters**								
3		Total Market Potential	5000	Total number of potential adopters before period 1.						
4		Market Penetration Before Period 1	0	Total number of actual adopters before period 1.						
5		Market Growth Rate	2.0%	Growth rate of the market potential.						
6		Market Price Elasticity	0.0%	Percentage increase of market potential with a 1% decrease in price.						
7		Advertising Coefficient	0.7%	Percentage increase in speed of market penetration with a 1% increase in advertising.						
8		Price Coefficient	1.5%	Percentage increase in speed of market penetration with a 1% decrease in price.						
9										
10										
11		**Forecasting Scenario**								
12		Scenario labels, total market potentials, and parameters p and q, used for different forecasting scenario.								
13		Scenario	Personal Computer (PC)	Cassette deck	Estimated From Past Data					
14		Total Market Potential	5000	5000	5000	5000	5000			
15		Parameter p	0.00306	0.01253	0.0149					
16		Parameter q	0.2532	0.2272	0.3009					
17										
18										
19		**Past Data, Price and Advertising Data**								
20		Adoptions per period, and relative price and advertising levels								
21		By default, relative price and relative advertising are set to 1.0 in the first period								
22		Period / Data	Adoptions/ Period	Cumulated Adoptions	Relative Price	Relative Advertising				
23		1	70	70	1.00	1.00				
24		2	125	195	0.99	1.01				
25		3	100	295	0.98	1.02				
26		4	164	459	0.97	1.03				
27		5	210	669	0.96	1.04				
28		6	265	934	0.95	1.05				
29		7	330	1264	0.94	1.06				
30		8	395	1659	0.93	1.07				
31		9	450	2109	0.92	1.08				
32		10	400	2509	0.91	1.09				
33		11			0.90	1.10				
34		12			0.90	1.12				

BASS Template

After entering the data in an Excel spreadsheet with the appropriate format, click on ME▶XL → BASS FORECASTING MODEL→ RUN ANALYSIS. The dialog box that appears enables you to set the options to perform a Bass forecasting analysis of your data.
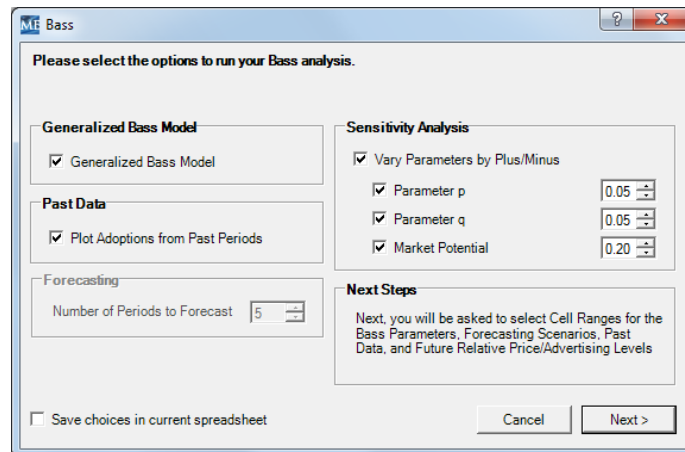

Options

- **Generalized Bass Model** is pre-selected if you previously specified the generalized Bass model.
- **Plot adoptions from past periods** is available if your spreadsheet contains past data. If this option is checked, generated charts contain not

only forecasts but also the past data. You must select the cell ranges that contain this data. If you specified Past Data in your template, these cells will be pre-selected.

- **Forecasting** specifies the number of periods ahead for which you would like to generate forecasts. For the simple Bass model, you may enter as many periods as you would like, but in the generalized Bass model, the forecasts require additional data about future price and relative advertising levels, so the highest levels of this field should equal the number of periods for which you have supplied such data.

- **Sensitivity analysis** allows you to run forecasting analyses by slightly perturbing p, q, and/or the market potential variables for each forecasting scenario. This feature is particularly useful in cases in which you want to determine if the forecasts are highly sensitive to small changes in some parameters. The chosen sensitivities get charted in the output.

After selecting the desired options, click Next. The software presents three dialog boxes that enable you to select the data on which to perform the analysis. If you have used the Generate Template option, the cell ranges are pre-selected.
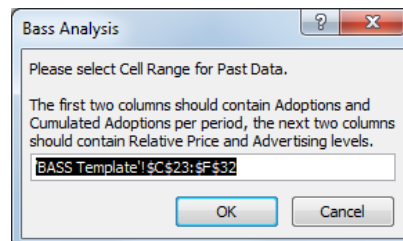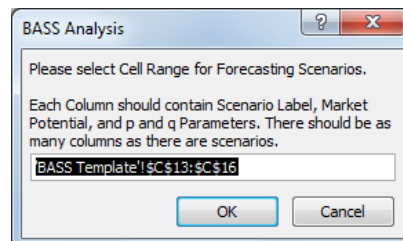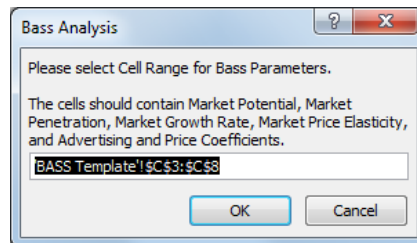
If you are running the generalized Bass model, a fourth and final dialog box will prompt you to select future relative price and advertising levels. The simple Bass model does not require such data to run.
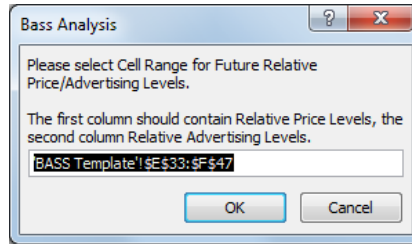
After clicking OK, a diagnosis spreadsheet is created, with the forecasts made by the Bass model.

Step 6   Interpreting the results

Forecasting Scenarios

The first sheet contains forecasts for the different scenarios, along with past data when available.

A	B	C	D	E	F	G
1						
2	**Forecasting Scenarios**					
3	Cumulated adoptions per period, forecasted using different parameter scenarios.					
4	**Period / Forecasting Scenarios**	**Past Data**	**Personal Computer (PC)**	**Cassette deck**	**Estimated From Past Data**	**Market Potential**
5	**Total Market Potential**	N/A	5000	5000	5000	
6	**Parameter p**	N/A	0.003	0.013	0.015	
7	**Parameter q**	N/A	0.253	0.227	0.301	
8	0	0.00	0.00	0.00	0.00	5000.00
9	1	70.00	15.61	63.90	76.08	5100.00
10	2	195.00	35.84	144.32	177.23	5202.00
11	3	295.00	61.52	242.97	308.03	5306.04
12	4	459.00	93.98	362.99	475.09	5412.16
13	5	669.00	134.84	507.70	685.41	5520.40
14	6	934.00	186.05	680.48	945.78	5630.81
15	7	1264.00	249.99	884.50	1261.70	5743.43
16	8	1659.00	329.42	1122.45	1635.99	5858.30
17	9	2109.00	427.57	1396.13	2067.26	5975.46
18	10	2509.00	548.11	1706.07	2548.48	6094.97
19	11		695.10	2051.10	3066.55	6216.87
20	12		872.83	2428.07	3603.14	6341.21
21	13		1085.60	2831.75	4137.29	6468.03
22	14		1335.81	3252.38	4645.66	6597.39
23	15		1627.72	3684.13	5116.50	6729.34

The results are also plotted on the next chart

Forecasting Scenarios
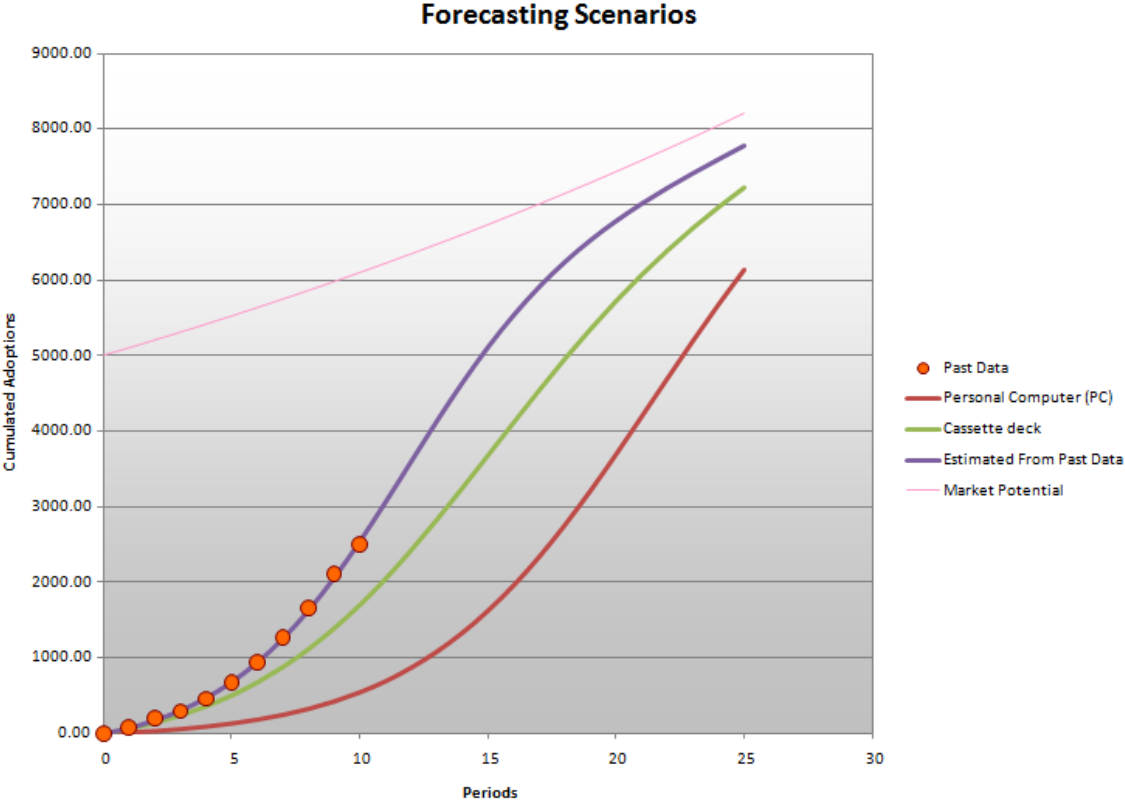
Sensitivity Analysis

If the option is checked, several charts also output the forecasts by varying some parameters. This analysis helps identify those parameters that most affect the forecasts.

Sensitivity Analysis (Estimated From Past Data)
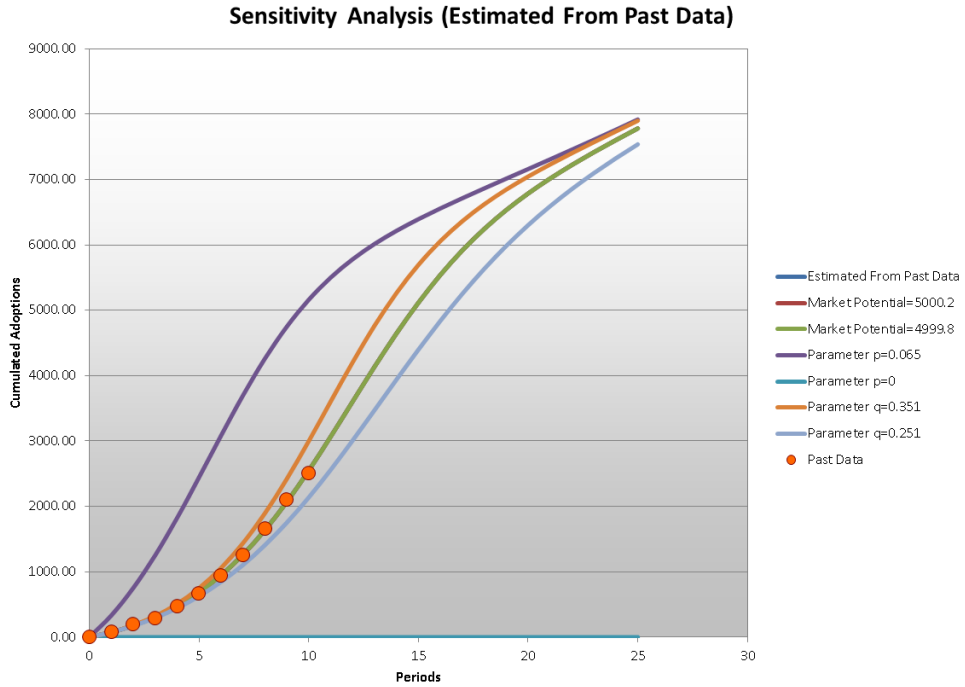
In the above chart, slightly varying the *p* parameter (the purple line) drastically changes the rate of adoptions, while modifying the *q* parameter has little impact.