Strategic Analytics and SAS®
Using Aggregate Data to Drive Organizational Initiatives

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Setting the Stage for Customer Strategic Analytics

Introduction

This book will help bridge the gap between the detailed customer data records typically used for tactical projects and programs and the high-level, sweeping analytics that are typically used for understanding general trends, setting corporate directions, or planning the next stages for customer growth. What if a C-level executive or senior vice president asked you the following questions?

- Can we improve our customer satisfaction ratings, and, if so, how will such improvements grow our revenues and increase customer tenure?
- How likely are we to continue to hit our revenue targets over the next two quarters?
- Can physicians discern early warning signs of eminent life threats from sets of symptoms documented by medical professionals?

Questions such as these are strategic because they ask for high-level direction. However, the answers can be obtained from low-level customer or patient attributes. For example, in my previous position, a market research director had just conducted a survey that captured the attitudes toward information technology (IT). The market director asked me if there was a way we could use the results of a survey to improve customer offers and messaging in our tactical marketing programs. He also wondered if overarching marketing directions could be influenced by the attitudinal information obtained from the survey.
These were indeed intriguing questions, and I had to probe a bit to see if the survey answers could be linked to our customer data records. When I found out that they could, the task was to find a method or technique that would allow the linkage between detailed customer data and the high-level survey. What resulted was a set of analytics that enabled me to predict the five attitudinal segments with 85% accuracy on the customer base and also to combine the behavioral customer data attributes with the predicted attitudinal segments. This enabled strategic direction-setting for customers with certain behaviors and attitudes about IT to be combined in a way not ever before attempted. We could have a single segmentation that could provide both the product offer as well as the messaging, depending on the attitudinal segment. This capability was used to alter strategic planning for campaigns in several technology groups.

### Basis for Aggregating Customer Data and Predictive Models

On what basis can we do these high-level strategic analytics by aggregating data and predictive model estimates and develop high-level models that provide answers to questions similar to those in the previous section? The answer is surprisingly simple.

But first let me tell you about an experience that changed my understanding of a subject many find very dry: statistics. As an engineering major, I was required to take at least one course in elementary statistics. I dreaded it greatly. I didn’t believe I was learning anything, and the professor was drier than the Sahara desert! I just couldn’t see the reason for all those bell-shaped curves and the like, and I didn’t understand how it applied to me. This remained true until I worked in manufacturing, and we came across some problems that we desperately needed to solve, and quickly. We had a very likable consultant come in who was highly knowledgeable in practical experimentation, and he made practical statistics truly come alive. It wasn’t dry at all. Engaging and intuitive, he held our attention, showing us some very simple techniques (really just simple addition and multiplication and very little algebra) that allowed us to find the root cause of the issues in some of our semiconductor manufacturing equipment. After designing some experimental manufacturing test runs, we aggregated each of them to form averages so that we could find the main effects of certain attributes such as temperature or voltage settings. These average estimates allowed us to make some general conclusions as to not only the main effects of our attributes, but also if one attribute was affecting another (called an interaction) like pressure and temperature. All of this from simple addition and multiplication!

The key was the design of the test runs and the levels of the attributes that made up those runs. In essence, the averages from certain runs of the designed experiment helped us to form conclusions from hypotheses that were based on our previous knowledge about how the process worked. This is a very simplistic form of a strategic analytic result that came from a design that allowed conclusions from a few runs, which in turn gave strategic insight into the root cause of the issue in our manufacturing process.
In this book, we’ll discover ways to create a provisional design from the key attributes that are needed depending on the overall desired outcome. This type of design is not a factorial matrix like the designed experiment described earlier. Rather, it is an ad hoc design that will allow high-level analysis derived from low-level customer data records. The beauty behind this configuration is that once the high-level scenarios are fully explored, the plans that influence those strategic decisions can be implemented at the lower level. This is the case because the aggregation path used to produce those high-level analyses is linked to the lower level data.

Let’s consider a simple pictorial example. Suppose you have a customer business-to-business data set that has the form shown in Figure 1.1 on page 3.

**Figure 1.1  Customer Data Example**

This data set contains more columns of data than what is shown here. However, the main demographics are displayed. If a senior marketing executive asked you where the organization should next focus its efforts to drive increased customer revenue, perhaps you could start with the industries that are represented by their Industry Segment Code column and where the company is located in the US Region Location of Business column. These columns, along with the revenues received last year and the estimated spending column, might be used to help answer that question. The aggregated data of approximately 100,000 customer data records totals to 109 records shown in Figure 1.2 on page 4.

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1 All data set attributes are described in the appendix given in the Example Code and Data found on the author’s page (http://support.sas.com/publishing/authors/collica.html).
The average spending can be plotted against the average revenue received per year. If we were to plot these average revenues in a scatter plot, we might better understand the high-level relationship that might exist. As you can see in Figure 1.2 on page 4, a column labeled as _FREQ_ contains the counts of how many observations were aggregated from the original data set. The scatter plot in Figure 1.3 on page 5 gives the Log of Estimated Spending on the vertical axis and the Log of Revenues (added to 50) on the horizontal axis. The addition of 50 will is explained below.
The scatter plot from the aggregated customer detail data indicates that there is some curvature in the relationship between the Log of Estimated Spending attribute and the Log of Revenues, which was generated from customers this year. We add 50 to move the data to the right along the horizontal axis by 50 units in order to avoid negative values, since you cannot take the log of a negative number. This addition doesn’t change the general shape of the relationship of the two attributes. It just scales the data so that the relationship can be more easily observed. This simple exercise shows how detailed data can be aggregated and how the general high-level relationship between two customer attributes can be observed graphically.

The Difference between Tactical and Strategic Analytics

Data and analytics at the individual customer level imply that an estimate, prediction, or classification takes place at a customer detail level, and, therefore, any business action taken
will also be at that level; and this is a tactical example. For example, if customers are classified into segments that each represent customers with relatively similar attributes, then any action within those segments will generally be at the customer level. An example might be a marketing campaign that is targeting the segment that the customer is associated with. In strategic analytics, the model is at higher levels than the detail data. You wouldn’t apply or score data records at the customer level that was developed from a model aggregated at a high level. This principle applies to data mining, machine learning, and in time-series forecasting. Therefore, the questions about business activities are referenced at the aggregate level rather than at the detail level. While this seems rather straightforward, the additional elements needed for best-in-class strategic analytics will typically involve some model scores or estimates of the following:

- Market share estimates obtained from syndicated data sources
- Regional or demographic econometric data elements or estimates
- Overlaid model scores that are obtained from third-party data providers at a high level, such as geography or econometric measures

These types of data, combined with aggregate customer or organizational data, will help form the basis to answer business questions such as the following:

1. Where should our organization focus its sales efforts next year by each industry market segment?
2. Is our share-of-wallet market too low in some region, industry, or country where we desperately need to improve?
3. Has our customer loyalty improved in some regions but not in others? What are the main factors driving this behavior? Can something be done to improve this situation?

### Use Cases Described in This Book

These questions are directed at organizational shift areas. Data at the detail customer or transactional level needs to be aggregated in order to answer such questions. In Chapter 2, we’ll look at a case study of customer loyalty behavior, attempt to answer the third question above, and offer some estimates of the driving mechanisms and the rates of potential improvements that might be obtained.

In Chapter 3, we will look at taking customer revenue transactions and aggregating them to understand risk of revenue decline and how to estimate customer risk at an organizational level.

Chapter 4 uses health care adverse event data to explore the potential mechanisms and explain the driving forces behind these adverse events, answering questions such as, Do hospital locations make a difference in the types of events observed?
And, finally, Chapter 5 takes a look at how we can envision these strategic analytics and develop methods for communicating the results of these high-level strategic analytics for consumption by a broader audience.

Note: In each use case example, the analyses presented are reflective of the ad hoc nature of the data. The actions that should be taken after such analyses are to design carefully controlled experiments to test and verify the alleged mechanisms to observe if they are real or just happenstance occurrences in the data.
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About This Book

Purpose

This manuscript is a culmination of my desire to help organizations that are struggling to connect the dots between detail data on their customers, patients, partners, and so on, and the high-level business objectives that support key goals and initiatives of these organizations. The shift from answering tactical business issues to answering both tactical and strategic business issues allows an organization to have a bigger picture view on how the analytics that they perform can affect their business.

Is This Book for You?

If you are a data miner, data scientist, or senior business analyst who desires to improve business outcomes, then this book will assist you in achieving that objective. If you are a director of analytics or customer experience, then this book can help you and your team see how your own detail data and model results can be used in more strategic initiatives.

Prerequisites

Users should be familiar with (but not necessarily expert in) regression techniques and methods, logistic analysis, confidence intervals, and a basic understanding of hypothesis tests. In addition, familiarity with machine learning and data mining techniques will also be helpful but not mandatory.
What's New?

What is different or new in this document when compared to the last version (optional)?

Scope of This Book

This book will help bridge the gap between the detailed customer data records typically used for tactical projects and programs and the high-level sweeping analytics used typically for understanding general trends, setting corporate directions, or planning the next stages for customer growth. What if a C-level executive or senior vice president asked you the following questions?

- Can we improve our customer satisfaction ratings, and, if so, how will such improvements grow our revenues and increase customer tenure?
- How likely are we to continue to hit our revenue targets over the next two quarters?
- Can physicians discern early warning signs of eminent life threats from sets of symptoms documented by medical professionals?

About the Examples

Software Used to Develop the Book's Content


Example Code and Data

My Author page will contain a ZIP file that has all the SAS code examples as well as the SAS Enterprise Miner and SAS Text Miner XML diagrams and data sets that complete each example.
Output and Graphics Used in This Book

For most of the exercises, SAS/GRAPH, SAS Statistical Graphics, and ODS were used to generate the graphics within SAS Enterprise Guide. Some of the graphics were within SAS Enterprise Miner and SAS Text Miner. Chapter 5’s visualizations are all SAS Visual Analytics.

Exercise Solutions

All of the solutions are given in the data and code examples obtained on my Author page in a ZIP file that contains chapter folders. All of the SAS Enterprise Guide projects, SAS code, data sets, and completed XML diagrams are given as well.

Additional Resources

At the end of each chapter, there are additional resources and reference materials that pertain to each chapter’s subject matter.

Keep in Touch

We look forward to hearing from you. We invite questions, comments, and concerns. If you want to contact us about a specific book, please include the book title in your correspondence.

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Randall S. Collica is a Principal Solutions Architect at SAS supporting the retail, communications, consumer, and media industries. His research interests include segmentation, clustering, ensemble models, missing data and imputation, Bayesian techniques, and text mining for use in business and customer intelligence. He has authored and coauthored 11 articles and a book, *Customer Segmentation and Clustering Using SAS® Enterprise Miner™, Second Edition*. He holds a US patent titled “System and Method of Combining Segmentation Data.” He received a BS degree in electronic engineering from Northern Arizona University.
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