

Georgia Southern University

Digital Commons@Georgia Southern

---

Association of Marketing Theory and Practice  
Proceedings 2023

Association of Marketing Theory and Practice  
Proceedings

---

3-6-2023

## Margin Variance Analysis for Informing Customer Engagement Strategy

Timothy J. Smith

*DePaul University*, [tsmith@wiglafpricing.com](mailto:tsmith@wiglafpricing.com)

Follow this and additional works at: [https://digitalcommons.georgiasouthern.edu/amp-proceedings\\_2023](https://digitalcommons.georgiasouthern.edu/amp-proceedings_2023)



Part of the [Management Sciences and Quantitative Methods Commons](#), and the [Marketing Commons](#)

---

### Recommended Citation

Smith, T. J., (2023). Margin variance analysis for informing customer engagement strategy. Association of Marketing Theory and Practice Proceedings 2023. 35. [https://digitalcommons.georgiasouthern.edu/amp-proceedings\\_2023/35](https://digitalcommons.georgiasouthern.edu/amp-proceedings_2023/35)

This conference proceeding is brought to you for free and open access by the Association of Marketing Theory and Practice Proceedings at Digital Commons@Georgia Southern. It has been accepted for inclusion in Association of Marketing Theory and Practice Proceedings 2023 by an authorized administrator of Digital Commons@Georgia Southern. For more information, please contact [digitalcommons@georgiasouthern.edu](mailto:digitalcommons@georgiasouthern.edu).

# Margin Variance Analysis for Informing Customer Engagement Strategy

**Tim J. Smith**

*DePaul University*

## ABSTRACT

A margin variance analysis measures the sources of difference in gross margins between pieces of business within a larger set of business. When the piece of business is defined as the total sales to an individual customer over a period of time, sales and marketing managers can use this analysis to define customer specific engagement strategies to improve customer profitability. In this paper, we clarify how customer engagement strategies can be driven by a margin variance analysis, provide derivations of two equally-valid forms of a simple customer margin variance analysis, and demonstrate the margin variance analysis and the development of customer-specific engagement strategies with a case study example.

**Keywords:** *Pricing, Pricing analytics, Margin variance analysis, Sales variance analysis, Price-mix analysis, Customer engagement strategy, Measurements*

## INTRODUCTION

When developing engagement strategies for specific customers, sales and marketing managers often begin by comparing individual customers to identify how a customer is outperforming or underperforming in specific dimensions. Perhaps the most common point of comparison between customers is size, either measured by the revenue of the customer overall or the revenue contribution of that customer to the company. Unfortunately, customer size is often insufficient in developing actionable insights and sellers typically have limited influence over customer size.

An alternative point of comparison is gross margin which is impacted by both the selling prices of offerings and the mix of offerings sold to individual customers. For many companies, sellers have greater influence over both the price captured and the mix of offerings sold to individual customers than the size of specific customers. A margin variance analysis measures the drivers to variations in margins between pieces of business. For informing sales strategy, the pieces of business are often defined as the sales to a customer or the sales by a salesperson. Other definitions of the pieces of business can be used when comparing different lines of business within a large corporation, different country businesses within a global corporation, or even different brands and categories. The definition of the piece of business under investigation should be adjusted to meet the needs of the decision-makers.

A simple margin variance analysis attributes variations in margins to marketing drivers including price and offering mix sold. Other marketing variables, such as variations in variable cost, new product launches, and discontinuations or currency fluctuations; can be included in the analysis

according to the decision-making need. A margin variance analysis differs strongly from a profit variance analysis in both use and construction.

In use, a margin variance analysis is better for comparing a piece of business to a benchmark average of similar pieces of business within a single time period whereas a profit variance analysis is best for comparing a piece of business to itself over two different time periods or the actual performance of that piece of business against its planned performance. Thus, a margin variance analysis reveals how a piece of business differs from others in a concurrent time period while a profit variance analysis reveals how a piece of business evolved over time.

In construction, the margin variance analysis examines the gross margin measured in percentages rather than the profits measured in currency as is done with a profit variance analysis. By examining gross margins rather than direct profits, the margin variance analysis enables easier managerial comparisons between pieces of business of vastly different sizes. (Factors of one hundred in differences in revenue or selling quantity between specific pieces of business are common and many companies expect to earn similar margins regardless of customer size. In these situations, margin variance analysis is also more useful than studying the lack of correlation between price captured and sales volume.)

For much of the remainder of this paper, we will discuss the margin variance analysis in relation to a customer specifically conducted from transactional data. Two methods for conducting a basic margin variance analysis that attributes differences in gross margin to differences in prices, variable costs, and offering mix are provided in this paper. Both methods are equally valid and we do not state a categorical preference for one or the other. To determine the impact of price and variable cost variances on margin variances, the first uses the customer mix weights while the second uses the company mix weights in conjunction with differences in prices or variable costs from their means. To determine the impact of mix variances on margin variances, the point of reference is switched wherein the first uses the company offering profits while the second uses the customer offering profits in conjunction with a difference in a mix-to-price ratio from the average.

Because the two methods differ mathematically in their definitions of the source of margin variances, they will also differ in their specific results, even though both appear equally valid. That is, while both methods attribute margin variances to variances in price, variable cost, and mix, and the sum of the margin variance attributed to price, variable cost, and mix equals the overall margin variance, the specific amount of variance attributed to price, variable cost, or mix differs between the two methods.

Fortunately, because both methods use differences between the same quantities, they yield attributions of impact in underlying marketing variables of the same sign. Thus, while quantitatively different in specifics, both methods yield directionally equivalent results. For many decision-making purposes, this is sufficient.

At this time, we do not claim that one method is more accurate than the other. Rather, we claim that both of these methods for conducting a margin variance analysis are equally useful for many managerial decisions.

In this paper, we discuss the managerial uses of a customer margin variance analysis, provide the two methods for conducting a margin variance analysis, and then demonstrate their application with a case-study sample company serving six customers with two offerings. Implementation of either of these approaches within a company can be done via spreadsheet analysis or specialized software.

## **RELATED LITERATURE**

Despite its appearance in practice, margin variance analysis has received scant if any formal attention. I am aware that other consultants and software vendors have deployed some form of margin variance analysis yet I have observed that the results of an analysis are presented without describing the method (meaning equations) of the analysis (Wong, Hohenshelt, & Govindarajan, 2011). The one exception identified is a patent wherein a complex set of equations define a complex margin variance analysis that is difficult for most companies to implement without purchasing the patent sponsor's software (United States Patent No. 8,412,598 B2., 2013). Herein, we provide a simple and easy to implement approach by any consultant or software vendor to conducting a margin variance analysis that has not been published before.

Many researchers have discussed profit variance analysis, a subject related to but distinct from margin variance analysis. Initial research on profit variance analysis focused on clarifying the source of profit variance between budgeted performance and actual performance in the field of financial accounting (Calas, 1971) (McIntyre 1976) (McIntyre, 1978) (Piper, 1977) (Shank, 1977). This approach has been expanded to comparisons of profit performance between time periods (United States Patent No. 8,412,598 B2., 2013) (Smith 2021) (Smith, Westra, and Phipps 2021). The importance of the profit variance analysis for marketing and sales decisions has been noted in the field of pricing and revenue management as well (Albers, 1998) (Pollono, 2021).

The importance of offering mix distinct from price is highlighted across both the work on profit variance analysis and that of margin variance analysis (Calas, 1971) (United States Patent No. 8,412,598 B2., 2013)(Smith 2021). This arises naturally from the fact that profits and margins can both be improved by either straightforwardly increasing prices holding all else constant or via shifting the mix of offering sold to higher margin and higher profit offerings holding all else constant. I include this distinction in the current work.

This paper seeks to clarify the derivation and usefulness of a simple and straightforward margin variance analysis, thus solidifying discussions of price management and business performance regarding margin variance analysis to a common understanding and improve the accessibility and dissemination of these metrics to improve managerial decision-making.

## MANAGERIAL USEFULNESS OF A CUSTOMER MARGIN ANALYSIS

A typical question customer-facing managers raise when examining margin variances between customers seeks to understand what is driving differences in margins of certain customers relative to others and why certain customers deliver higher or lower margins than others. The answers to these questions are sought to identify specific actions to take that will lead to higher performance, usually meaning profit, with customers.

Some customers may have higher or lower margins because the company is extracting a higher or lower price relative to the norm, while other customers may have a higher or lower margin because they purchase a higher or lower margin offering mix relative to the norm. Still further drivers arise when variable costs or other variables vary between customers on the same offering. Sales, marketing, and pricing managers use a customer margin variance analysis to reveal how marketing factors impact customer margins.

The detection of the drivers to customer margin variances enables customer-facing managers to develop hypotheses regarding customer-specific engagement strategies that will deliver higher profitability. The impact of marketing factors on customer margins calculated from a customer margin analysis is normally communicated with one of two different data visualizations: scatter plots and stacked bar charts. A potential relationship between the drivers of customer margin variances and recommended customer engagement strategies is definable from either plot. A scatter plot by customer shows the impact of two marketing variable variances on customer margins. A stacked bar chart by customer can show the impact of multiple, meaning any number desired, marketing variable variances on customer margins simultaneously. Typically, customer-facing managers focus on issues of price and mix and ignore potential variations in variable cost of the exact same offering but sold to different customers at different times thus causing a variation in variable costs when conducting a customer margin variance analysis.

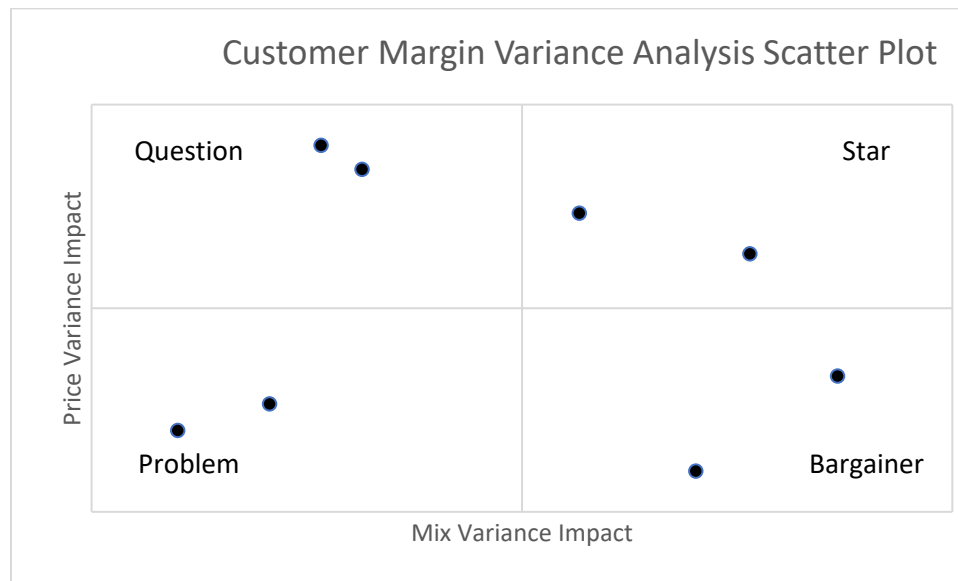
While we provide equations that quantify the impact of variations in variable costs on margin variances, we will assume these impacts to be zero in our case study example and for the remainder of this discussion. This reduces our analysis to two dimensions and enables data visualization on a two-dimensional plane, thus both types of typical data visualization strategies can be demonstrated from the same dataset as is typical in many implementations.

A scatter plot of the impacts of price and mix variances on customer margins yields a four-quadrant plot which handily divides customers into four customer archetypes with four different hypothesis of engagement strategies that lead to higher profitability. We plot the impact of price variance on margins on the vertical axis and the impact of mix variance on margins on the horizontal axis in Figure 1 with each dot depicting the performance of an individual customer.

In quadrant one, both the prices and mix sold to customers are more profitable than average and a customer of this archetype might be designated as a “Star”. In quadrant three, both the prices

and mix sold to customers are less profitable than average and a customer of this archetype might be designated as a “Problem”. Customers in quadrant four have a lower price on average but a richer mix and a customer of this archetype might be designated as a “Bargainer”. Customers in quadrant two have a higher price on average but a poorer mix and might a customer of this archetype might be designated as a “Question”.

**Figure 1. Customer Margin Analysis Representative Scatter Plot**



The four different customer archetypes enable the development of four different hypotheses of engagement strategies to improve profitability. For Star Customers, the prices and mix were both strong reminiscent of a well-desired or outstandingly profitable customer. A common customer engagement strategy hypothesis for Star Customers is that devoting greater resources into or selling higher quantities to that customer or similar customers will improve profitability. When seeking to raise prices in the market, Star Customers might have less pressure applied to them to take a higher price as these customers might be considered at risk of brand betrayal if prices were raised further due to their already achieved status of paying a higher price than average.

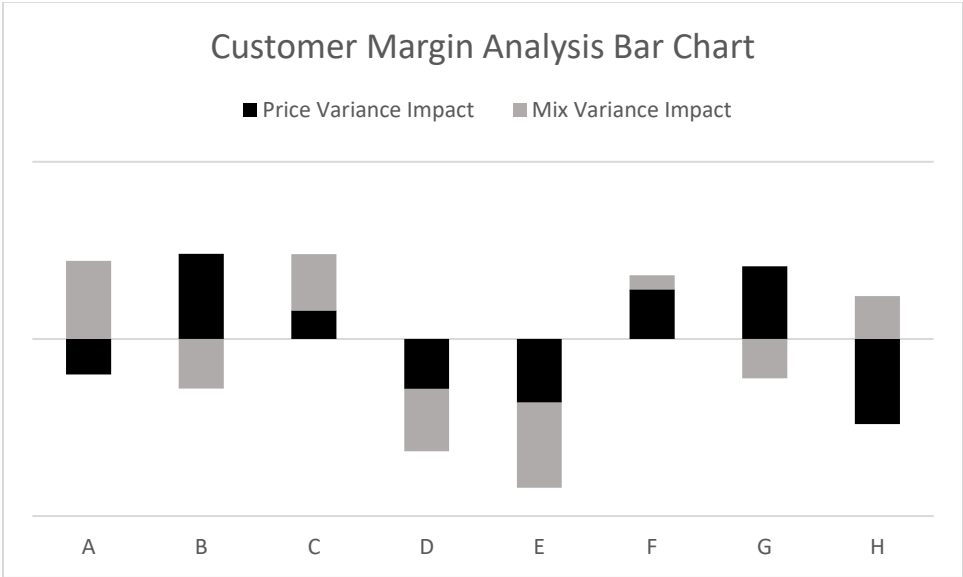
For Problem Customers, the prices and mix were both weak which makes them a potential problem. A common customer engagement strategy hypothesis for Problem Customers is that reducing the resources deployed to those customers or taking actions to reduce the business’s dependence on Problem Customers will improve profitability or business resiliency. When seeking to raise prices in the market, Problem Customers might have the greatest pressure applied to take a higher price to align the price captured from these customers with their industry peers under the belief that these customers could not acquire similar offerings of similar quality and reliability at a similarly low price from peer competitors.

For Bargainer Customers, the prices were weak, but the mix was strong. These are Bargainer Customers due to their demonstrated behavior of purchasing the offerings at a reduced price. A

common customer engagement strategy hypothesis for Bargainer Customers is that raising prices in alignment with peer customers while leaving their mix unchanged will improve profitability. The impetus behind this customer engagement tactic is similar to that behind Problem Customers but the importance of implementing this tactic is reduced by their mitigating behavior of purchasing a strong mix.

For Question Customers, the prices were strong, but the mix was weak. These are Question Customers precisely because the recommended customer engagement strategy varies greatly with the reasons that drove the customer to buy a specific mix from the business, reasons which a margin variance analysis alone does not sufficiently address. For instance, if these customers are constrained by budget or need in their purchases to lower-margin offerings, the customer engagement strategy might be to restrain price increases among Question Customers due to the suspected risk of customer brand betrayal if the prices become significantly higher than those of competitors. In contrast, if these customers are suspected of treating the business as a supplier of second choice from which they buy only a portion of their inputs while reserving the higher purchase quantities and purchases of higher value offerings for a competing supplier, the customer engagement strategy might be more aggressive. The initial customer engagement strategy with these kinds of Question Customers might be to sell more high-margin offerings and restrain raising their prices further above the average to tempt them to switch from treating the business as a supplier of second choice to one of first choice. If that strategy fails and the business is relegated to being a supplier of second choice, one which is used to ensure supply redundancy for the customer, the customer engagement strategy may flip to driving the acceptance of small price increases above the norm as the need of the customer is not for the business to be the lowest cost provider but rather to ensure supply redundancy. Turning to the second type of visualization of a customer margin analysis, a stacked bar chart of the impacts of price and mix variances on customer margins yields readily identifies customers by their price and mix performance as shown in Figure 2.

**Figure 2. Customer Margin Analysis Representative Stacked Bar Chart**



When a company is seeking to drive a price increase into the market using a stacked bar chart alone, the customer engagement tactic may yield strict requirements on customers that were getting a relatively low price on offerings to accept the higher prices or take their business elsewhere. This would include customers A, D, E, and H in Figure 2. Managers may formulate this strategy on the rationale that (1) the low-paying customers had been “taking advantage” of the company in the past and such a relationship is unsustainable moving forward, (2) that the low-paying customer also knows that they had been getting a low price they could not attain from a peer competitor and, as such, are more likely to begrudgingly accept a price increase, or (3) that raising prices on high-paying customers increases the risk of brand betrayal so it is best to seek any price increase from lower-paying customers. Simple sorting of customers by their relative price performance is often directionally sufficient for identifying how much pressure or resolve to apply to which customers when raising prices.

Alternatively, when a company seeks to drive a silent price increase into the market in the form of encouraging customers to purchase a more profitable offering mix, the customer engagement strategy may encourage applying greater pressure on customers to upgrade their purchasing mix on those that had been purchasing a poor mix. This would include customers B, D, E, and G in Figure 2. Managers may formulate this tactic under the belief that it is easier to encourage customers that had been purchasing a poor mix to purchase a richer mix similar to their peer customers than it is to encourage customers with an already rich mix to enrich it further. Simple sorting of customers by their relative mix performance may be directionally sufficient for identifying how much pressure to apply to which customers to improve their mix of offerings consumed.

The above examples demonstrate the potential usefulness of a customer margin variance analysis for identifying recommended customer engagement strategy despite quantitative indefiniteness due to its value of providing directionally definitive results. Both of the quantitative methods we provide yield directionally equivalent results of the impacts of variances in price, variable costs, and mix to a customer’s margin variance, and hence both methods, or even an average of both, are useful for managerial decision-making in defining customer engagement strategies.

## NOTATION

Identify specific sales with subscripts *i* for the transaction, *j* for the offering, and *k* for the customer. Thus, the gross margin on the single sale *i* of offering *j* to customer *k* is

$$GM_{ijk} = \frac{Q_{ijk}(P_{ijk}-V_{ijk})}{Q_{ijk}P_{ijk}} \quad (1)$$

where we have used *Q* for quantity, *P* for price, *V* for variable costs, and *GM* for gross margin. With this notation, we can identify the gross margin of the company (*GM*) and the gross margin earned from sales to specific customer *k* (*GM<sub>k</sub>*).



$$GM = \frac{\sum_{ijk} Q_{ijk}(P_{ijk}-V_{ijk})}{\sum_{ijk} Q_{ijk}P_{ijk}} \quad (2)$$

$$GM_k = \frac{\sum_{ij} Q_{ijk}(P_{ijk}-V_{ijk})}{\sum_{ij} Q_{ijk}P_{ijk}} \quad (3)$$

Acknowledging that the gross margin of the company is also the weighted average gross margin across all customers, we identify the difference between the gross margin earned from sales to specific customer k and the average margin earned from sales to the average customer ( $DGM_k$ ).

$$\Delta GM_k = GM_k - GM \quad (4)$$

The algebraic goal of the customer margin variance analysis is to attribute differences in gross margin between a specific customer k and the average customer to differences in the mix sold, price captured, or variable cost expended. That is, we wish to express the  $DGM_k$  as the sum of the impacts in variations in mix, price, and variable costs denoted as  $DGMWX_k$ ,  $DGMPX_k$  and  $DGMVX_k$  respectively.

$$\Delta GM_k = \Delta GMWX_k + \Delta GMPX_k + \Delta GMVX_k \quad (5)$$

A conceptual goal of a good customer margin variance analysis is to define the impacts of variations in mix, price, and variable costs in a manner in which (1) the sum of the parts equals the whole (that is, in which Equation 5 is true) and (2) the individual mathematical parts are logically meaningful representations of the concepts they embody. If given a choice, one would prefer a solution which also has mathematical beauty in some form of symmetry or simplicity, over one that does not. We will present two means in which both of the first two conditions are true, identified by  $X=1$  and  $X=2$ , but both solutions lack the symmetry desired.

To simplify the expression of the resulting equations, we introduce further notation regarding mix weightings, average prices, and average variable costs taken at the company overall level, offering level, and customer-specific offering levels. (A bar above variables denotes an average is taken and the choice of subscripts identifies the level which the term represents.)

The quantity weighted average price across all offerings sold by the company ( $\bar{P}$ ) or to specific customer k ( $\bar{P}_k$ ) is as follows.

$$\bar{P} = \frac{\sum_{ijk} Q_{ijk}P_{ijk}}{\sum_{ijk} Q_{ijk}} \quad (6)$$

$$\bar{P}_k = \frac{\sum_{ij} Q_{ijk}P_{ijk}}{\sum_{ij} Q_{ijk}} \quad (7)$$

The quantity weighted average price for specific offering j sold by the company ( $\bar{P}_j$ ) or to specific customer k ( $\bar{P}_{jk}$ ) is as follows.

$$\bar{P}_j = \frac{\sum_{ik} Q_{ijk}P_{ijk}}{\sum_{ik} Q_{ijk}} \quad (8)$$

$$\bar{P}_{jk} = \frac{\sum_i Q_{ijk}P_{ijk}}{\sum_i Q_{ijk}} \quad (9)$$

The quantity weighted average variable costs for specific offering j sold by the company ( $\bar{V}_j$ ) or to specific customer k ( $\bar{V}_{jk}$ ) is as follows.

$$\bar{V}_j = \frac{\sum_{ik} Q_{ijk} V_{ijk}}{\sum_{ik} Q_{ijk}} \quad (10)$$

$$\bar{V}_{jk} = \frac{\sum_i Q_{ijk} V_{ijk}}{\sum_i Q_{ijk}} \quad (11)$$

And the quantity-based mix weights for specific offering j sold by the company ( $w_j$ ) or to specific customer k ( $w_{jk}$ ) is as follows.

$$w_j = \frac{\sum_{ik} Q_{ijk}}{\sum_{ijk} Q_{ijk}} \quad (12)$$

$$w_{jk} = \frac{\sum_i Q_{ijk}}{\sum_{ij} Q_{ijk}} \quad (13)$$

With the notation introduced in Equations 6-13, we can write the margin of the company and that earned from specific customer k (Equations 2 and 3) in a simplified and condensed format as follows.

$$GM = \left(1/\bar{P}\right) \sum_j w_j (\bar{P} - \bar{V}_j) \quad (14)$$

$$GM_k = \left(1/\bar{P}_k\right) \sum_j w_{jk} (\bar{P}_k - \bar{V}_{jk}) \quad (15)$$

## MARGIN VARIANCE ANALYSIS VIA METHOD ONE

In Method One, we denote the concepts of the mix, price, and variable cost variance margin impacts as  $\Delta GMW1_k$ ,  $\Delta GMP1_k$  and  $\Delta GMV1_k$  respectively. With this notation, Equation 5 is written as follows.

$$\Delta GM_k = \Delta GMW1_k + \Delta GMP1_k + \Delta GMV1_k \quad (16)$$

Begin by rewriting the gross margin for customer k in Equation 15 by adding zero in the form of sums of the addition and subtraction of the company's average price and variable cost on specific offering j weighted at the customer level and divided by the customer average price to get Equation 17, also written in a rearranged but more useful form in Equation 18.

$$GM_k = \left(1/\bar{P}_k\right) \sum_j w_{jk} (\bar{P}_{jk} - \bar{V}_{jk}) + \left(1/\bar{P}_k\right) \sum_j w_{jk} (\bar{P} - \bar{P}_k) - \left(1/\bar{P}_k\right) \sum_j w_{jk} (\bar{V}_j - \bar{V}_{jk}) \quad (17)$$

$$GM_k = \sum_j \frac{w_{jk}}{\bar{P}_k} (\bar{P} - \bar{V}_j) + \sum_j \frac{w_{jk}}{\bar{P}_k} (\bar{P}_{jk} - \bar{P}_k) - \sum_j \frac{w_{jk}}{\bar{P}_k} (\bar{V}_{jk} - \bar{V}_j) \quad (18)$$

Insert the gross margin earned from customer k as expressed in Equation 18 and the gross margin of the average customer as expressed in Equation 14 into the expression of the customer margin variance of Equation 4 and simplify to write as follows.

$$\Delta GM_k = \sum_j \left( \frac{w_{jk}}{P_k} - \frac{w_j}{\bar{P}} \right) (\bar{P}_j - \bar{V}_j) + \sum_j \frac{w_{jk}}{P_k} (\bar{P}_{jk} - \bar{P}_j) - \sum_j \frac{w_{jk}}{P_k} (\bar{V}_{jk} - \bar{V}_j) \quad (19)$$

The first term in Equation 19 contains a sum of differences related to mixes. Specifically, it contains differences between the ratio of the mix weight of offering j sold to specific customer k and the average price extracted from that customer for all offerings, and the ratio of the mix weight of offering j sold across all customers and the average price extracted from all customers for all offerings, multiplied by the profit margins as the difference in average price and variable costs of offering j sold across all customers. Method One defines the impact of mix variances (DGMW1<sub>k</sub>) as this first term.

$$\Delta GMW1_k = \sum_j \left( \frac{w_{jk}}{P_k} - \frac{w_j}{\bar{P}} \right) (\bar{P}_j - \bar{V}_j) \quad (20)$$

The second term in Equation 19 contains a sum of differences in prices. Specifically, it contains the difference in the average price of specific offering j sold to customer k to that of the average customer for offering j, multiplied by the ratio of the mix weight of offering j sold to customer k and the average price extracted from that customer across all offerings. Method One defines the impact of price variances (DGMP1<sub>k</sub>) as this second term.

$$\Delta GMP1_k = \sum_j \frac{w_{jk}}{P_k} (\bar{P}_{jk} - \bar{P}_j) \quad (21)$$

The third term in Equation 19 contains a sum of differences in variable costs. Specifically, it contains the difference in the average variable cost of specific offering j sold to customer k to that of the average customer for offering j, multiplied by the ratio of the mix weight of offering j sold to customer k and the average price extracted from that customer across all offerings. Method One defines the impact of variable cost variances (DGMV1<sub>k</sub>) as this third term.

$$\Delta GMV1_k = - \sum_j \frac{w_{jk}}{P_k} (\bar{V}_{jk} - \bar{V}_j) \quad (22)$$

Method One makes attributions that are somewhat logical though not perfectly defensible. Two issues make it unattractive: a kluge and a lack of symmetry. First, it is unsettling that the term ascribing the impact of mix variance on margin variances has mix weight differences divided by two different average prices, yet I am unable to identify a simple and rational approach which avoids this kluge. The different denominators in these ratios are a natural consequence of trying to define a metric for the customer margin variance as a difference between two gross margins when the underlying concept of gross margin is that of a ratio. Managerial decision-makers have expressed confusion and discomfort when presented variances in margin from a mean expressed as a ratio or index and have specifically requested to be presented with simple differences. Hence, we provide the difference and accept this kluge.

Second, the lack of symmetry across the equations ascribing the impact of variances of price and variable costs on margin variances is unsettling. Both Equations 21 and 22 use a ratio of the customer weights to a customer's average price. A more symmetrical result might use simply

that ratio for the company or, more complexly, the geometric mean of the ratios for customer k and the company. Either of these results would yield a definition wherein switching the relation between “customer k” and “company” would yield equal but opposite results. Method One lacks this mirror symmetry.

A similar but different approach yields a similar but different set of attributions of the drivers of margin variance. Unfortunately, this method too suffers from the same kluge and similar deficiency in symmetry.

## MARGIN VARIANCE ANALYSIS VIA METHOD TWO

In Method Two, we denote the concepts of the mix, price, and variable cost variance margin impacts as  $\Delta GMW2_k$ ,  $\Delta GMP2_k$  and  $\Delta GMV2_k$  respectively. With this notation, Equation 5 is written as follows.

$$\Delta GM_k = \Delta GMW2_k + \Delta GMP2_k + \Delta GMV2_k \quad (23)$$

Begin by rewriting the gross margin of the average customer in Equation 14 by adding zero in the form of sums of the addition and subtraction of specific customer k average price and variable cost on specific offering j weighted by the average customer’s mix and divided by the average customer’s average price to get Equation 24, also written in a rearranged but more useful form in Equation 25.

$$GM = \left(\frac{1}{\bar{p}}\right) \sum_j w_j (\bar{p}_j - \bar{v}_j) + \left(\frac{1}{\bar{p}}\right) \sum_j w_j (\bar{p}_{jk} - \bar{p}_{jk}) - \left(\frac{1}{\bar{p}}\right) \sum_j w_j (\bar{v}_{jk} - \bar{v}_{jk}) \quad (24)$$

$$GM = \sum_j \frac{w_j}{\bar{p}} (\bar{p}_{jk} - \bar{v}_{jk}) - \sum_j \frac{w_j}{\bar{p}} (\bar{p}_{jk} - \bar{p}_j) + \sum_j \frac{w_j}{\bar{p}} (\bar{v}_{jk} - \bar{v}_j) \quad (25)$$

Insert the gross margin earned from customer k as expressed in Equation 15 and the gross margin of the average customer as expressed in Equation 25 into the expression of the customer margin variance of Equation 4 and simplify to write as follows.

$$\Delta GM_k = \sum_j \left( \frac{w_{jk}}{\bar{p}_k} - \frac{w_j}{\bar{p}} \right) (\bar{p}_{jk} - \bar{v}_{jk}) + \sum_j \frac{w_j}{\bar{p}} (\bar{p}_{jk} - \bar{p}_j) - \sum_j \frac{w_j}{\bar{p}} (\bar{v}_{jk} - \bar{v}_j) \quad (26)$$

The first term in Equation 26 contains a sum of differences related to mixes. Specifically, it contains differences between the ratio of the mix weight of offering j sold to specific customer k and the average price extracted from that customer for all offerings, and the ratio of the mix weight of offering j sold across all customers and the average price extracted from all customers for all offerings, multiplied by profit margins of the difference in average price and variable costs of offering j sold to specific customer k. Method Two defines the impact of mix variances ( $\Delta GMW2_k$ ) as this first term.

$$\Delta GMW2_k = \sum_j \left( \frac{w_{jk}}{\bar{p}_k} - \frac{w_j}{\bar{p}} \right) (\bar{p}_{jk} - \bar{v}_{jk}) \quad (27)$$

The second term in Equation 26 contains a sum of differences in prices. Specifically, it contains the difference in the average price of specific offering  $j$  sold to customer  $k$  to that of the average customer for offering  $j$ , multiplied by the ratio of the mix weight of offering  $j$  sold to the average customer and the average price extracted from the average customer across all offerings. Method Two defines the impact of price variances ( $DGMP2_k$ ) as this second term.

$$\Delta GMP2_k = \sum_j \frac{w_j}{\bar{P}} (\overline{P}_{jk} - \bar{P}_j) \quad (28)$$

The third term in Equation 26 contains a sum of differences in variable costs. Specifically, it contains the difference in the average variable cost of specific offering  $j$  sold to customer  $k$  to that of the average customer for offering  $j$ , multiplied by the ratio of the mix weight of offering  $j$  sold to the average customer and the average price extracted from the average customer across all offerings. Method Two defines the impact of variable cost variances ( $DGMV2_k$ ) as this third term.

$$\Delta GMV2_k = - \sum_j \frac{w_j}{\bar{P}} (\overline{V}_{jk} - \bar{V}_j) \quad (29)$$

As before, Method Two makes attributions that appear somewhat logical though imperfectly attractive for the same two issues: a kluge and the lack of mirror symmetry. Regarding the kluge, equation 27 ascribing the impact of mix variance on margin variances has mix weights divided by different average prices once again which is unattractive for the same reasons as stated regarding Method One. Second, mirror symmetry is distinctly absent in the equation ascribing the impact of mix variances and incomplete regarding the impact of price and variable cost variances.

## EXAMPLE APPLICATION

Both Method One and Two yield a set of metrics that purport to measure the impact of variances in mix, price, and variable costs on variances in margin. Both make attributions that appear reasonable and sensible, both yield parts which add to the whole, and both suffer from similar deficits. Yet, we have also claimed that both are useful. To demonstrate, we turn to a practical application on a hypothetical firm.

Our hypothetical firm has six customers and two offerings. Data regarding customers and sales for a period are contained in Table 1. To make our exploration simpler to follow, we do not list every individual transaction but rather have taken the first steps of the margin analysis of calculating the total quantity sold per customer by offering and the average price extracted from that customer by offering, and the average variable cost of offerings sold to that customer by offering. (In effect, one could say we applied equations 7 and 9 on individual transaction data to yield the customer summary transaction data presented to reduce the amount of data needed to be presented for following the analysis.)

**Table 1. Transaction Data for a Hypothetical Firm**

Customer	Product	Price	Variable Cost	Quantity
Terrier	A	15	12	190
Terrier	B	90	50	44
Poodle	A	25	12	110
Poodle	B	110	50	15
Shephard	A	20	12	15
Shephard	B	125	50	100
Spaniel	A	16	12	1000
Spaniel	B	85	50	0
Collie	A	22	12	200
Collie	B	92	50	18
Bulldog	A	13	12	85
Bulldog	B	112	50	9

The prices paid and quantities sold of individual offerings varied by customer for our hypothetical firm. Some customers paid more while others paid less for the same offering which is common for many businesses, especially those selling to other businesses. Some customers bought more than others and the mix of offerings bought varies by customer, which is again common for many businesses. Both the variation in prices paid and the mix sold impact customer margins and their impacts are the focus of this study.

The average price paid for offering A by any specific customer varied between 13 and 25 and, given a variable cost of 12, the average margin on offering A for specific customers varied between 8% and 52%. Across all customers, the average price paid for offering A was 17.1 with an average margin of 29.9%. The average price paid for offering B by any specific customer varied between 90 and 125 and, with a variable cost of 50, the average margin on offering B for specific customers varied between 44% and 60%. Across all customers, the average price paid for offering B was 111.7, and the average margin of 55.2%. Hence, offering B has a higher margin than offering A, and the margins extracted from customers varied in our hypothetical firm, as is reflective of a common situation across many businesses.

The quantity sold of offering A to any specific customer varied between 15 and 1000 units and the total quantity sold to all customers was 1600. For offering B, the quantity sold to any specific customer varied between 0 and 100 units and the total quantity sold to all customers was 186. This results in customers buying a varying mix of high- and low-margin offerings. The variable costs of the two offerings, A and B, are constant across all sales to all customers during this period for our hypothetical company at 12 and 50 respectively. We made our dataset for our hypothetical firm have constant variable costs per offering for two reasons. One, many companies take an accounting approach which makes variable costs appear constant across a reporting period for both financial reports and for conducting other forms of analysis such as customer profitability analysis. Two, it simplifies the margin variance analysis to the two terms

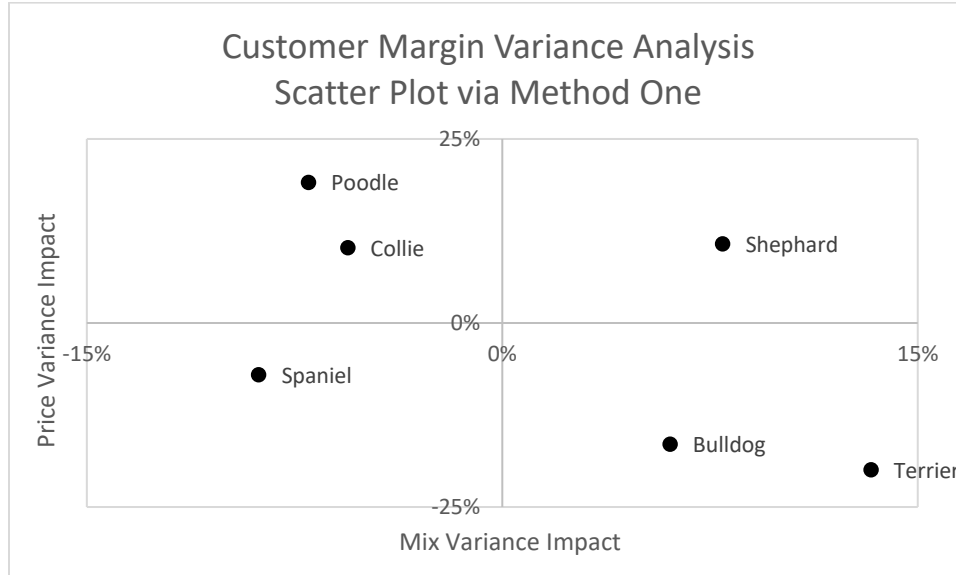
that clarify the impact of price and mix variances which are of the greatest interest to sales, marketing, and pricing managers in understanding customer behavior. A direct calculation of the difference between the average customer margin and specific customer margins reveals that some customers had higher margins while others had lower margins, as is typical for many businesses.

Applying Method One to our hypothetical firm yields the margin variance analysis results shown in Table 2, Figure 3, and Figure 4. Table 2 provides the difference in specific customer margins from the average as well as the drivers of margins variance by customer. Figure 3 is the scatter plot depicting the price and mix variance impact on margins per customer and enabling ready identification of Star, Problem, Bargainer, and Question Customers. Figure 4 is the stacked bar chart again depicting the price and mix variance impact on margins per customer enabling the ready identification of impacts of price and mix variances on customer margins simply as positive or negative.

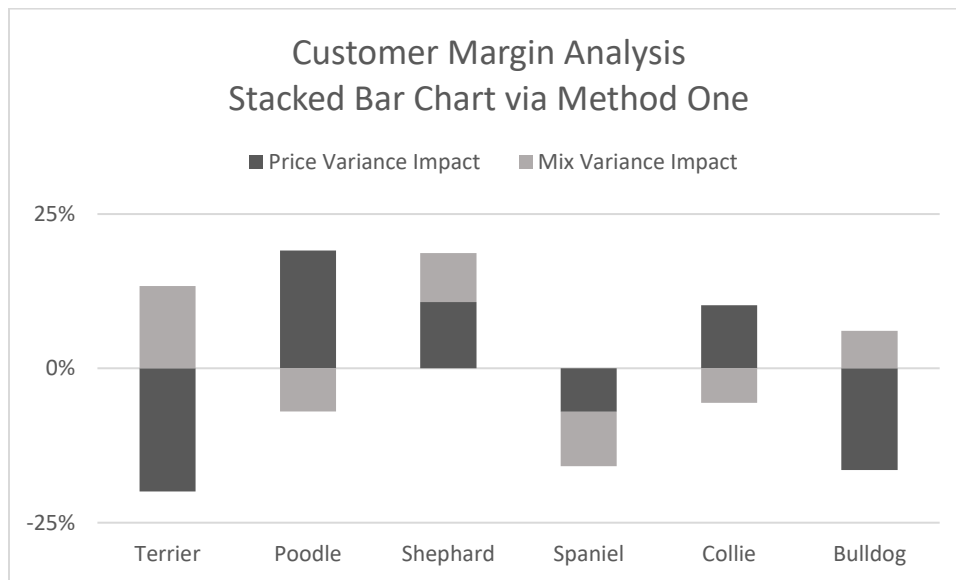
**Table 2. Customer Margin Variance Analysis via Method One for Hypothetical Firm**

<b>Customer</b>	<b>Impact of Price Variance on Margin Variance via Method 1</b>	<b>Impact of Mix Variance on Margin Variance via Method 1</b>	<b>Customer Margin Variance</b>
	<b>DGMPI<sub>k</sub></b>	<b>DGMW<sub>1k</sub></b>	<b>DGM<sub>k</sub></b>
Terrier	-20%	13%	-7%
Poodle	19%	-7%	12%
Shephard	11%	8%	19%
Spaniel	-7%	-9%	-16%
Collie	10%	-6%	5%
Bulldog	-16%	6%	-10%

**Figure 3. Customer Margin Analysis Scatter Plot for Hypothetical Firm Using Method One**



**Figure 4. Customer Margin Analysis Stacked Bar Chart for Hypothetical Firm Using Method One**



Applying Method Two to our hypothetical firm yields the margin variance analysis results shown in Table 3, Figure 5, and Figure 6. Table 3 provides the difference in specific customer margins from the average as well as the drivers of margins variance by customer. Notice that the overall customer margin variances in Table 3 from Method Two match those in Table 2 of Method One, the attribution of the variations in gross margins to impacts in price and mix variances differ, and the signs of the impacts of price and mix variances on margin variances are constant. Figure 5 is

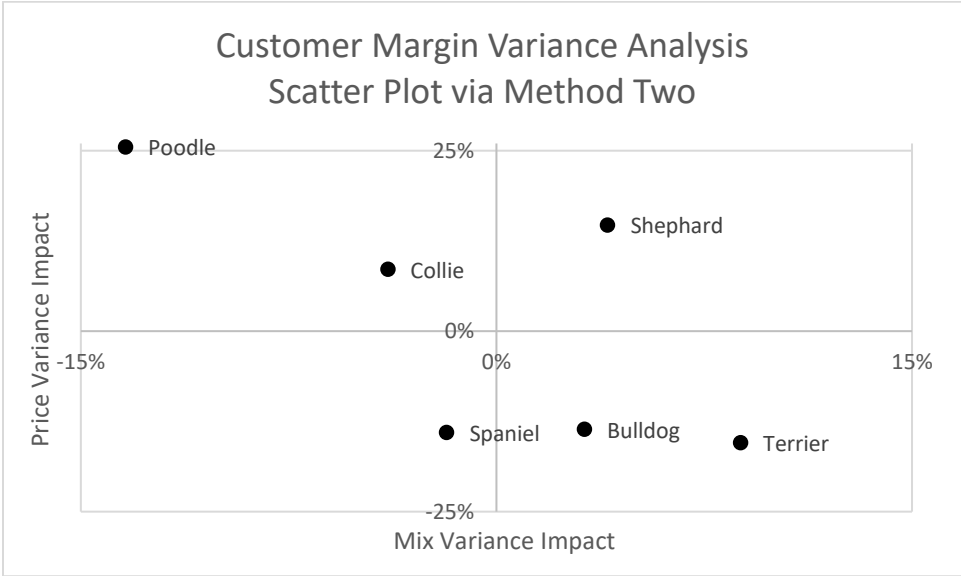


the scatter plot depicting the price and mix variance impact on margins per customer and enabling ready identification of Star, Problem, Bargainer, and Question Customers. Figure 6 is the stacked bar chart again depicting the price and mix variance impact on margins per customer enabling the ready identification of impacts of price and mix variances on customer margins simply as positive or negative.

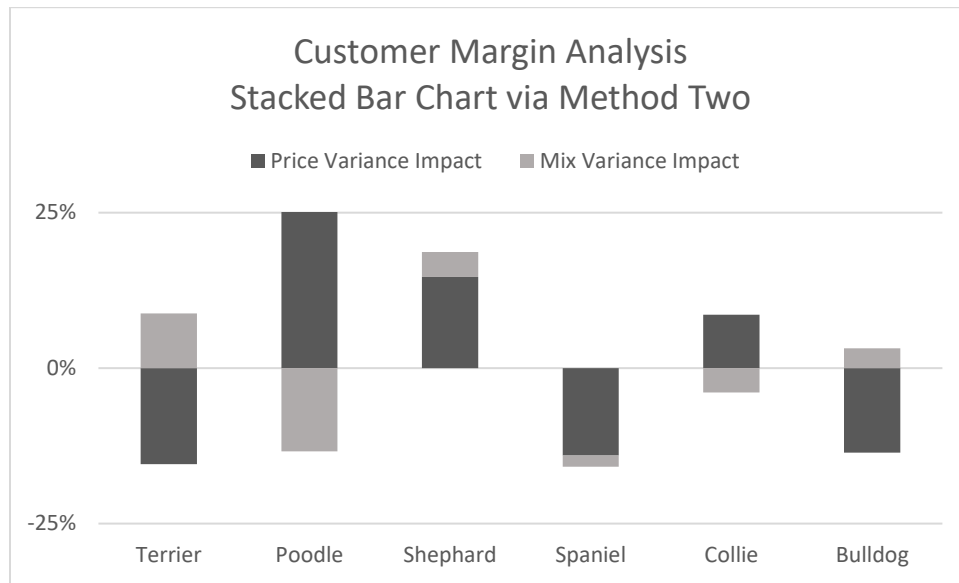
**Table 3. Customer Margin Variance Analysis via Method Two for Hypothetical Firm**

Customer	Impact of Price Variance on Margin Variance via Method 2	Impact of Mix Variance on Margin Variance via Method 2	Customer Margin Variance
	DGMP2 <sub>k</sub>	DGMW2 <sub>k</sub>	DGM <sub>k</sub>
Terrier	-15%	9%	-7%
Poodle	25%	-13%	12%
Shephard	15%	4%	19%
Spaniel	-47%	31%	-16%
Collie	9%	-4%	5%
Bulldog	-14%	3%	-10%

**Figure 5. Customer Margin Analysis Scatter Plot for Hypothetical Firm Using Method Two**



**Figure 6. Customer Margin Analysis Stacked Bar Chart for Hypothetical Firm Using Method Two**



Though numerical differences, and therefore visual differences, are identifiable between Method One and Two, both methods of a customer margin analysis yielded directionally equivalent results for individual customers. Thus, both methods are equally useful for many managerial decisions regarding actions to take with specific customers.

In our hypothetical firm, both methods revealed that Terrier, Bulldog, and Spaniel had lower margins than the average customer while Poodle, Collie, and Shephard had higher margins. When examining the drivers to margin variance, we find Terrier and Bulldog had low prices but a rich mix while Poodle and Collie had higher prices but an impoverished mix. Shephard had both high prices and a rich mix while Spaniel had both lower prices and impoverished mix. (Now who is a good dog? They all are but some need more training than others.)

## DISCUSSION

We have clarified two methods to derive and define elements of a simple margin variance analysis that can be used for any piece of business within a business provided sufficient transaction level data is available. The methods disagree on details but agree in providing directionally equivalent insights useful for many decisions. We also applied both methods of a margin variance analysis on a sample dataset and numerically and visually demonstrated the similarity and differences in the results.

For a customer margin variance analysis specifically, we demonstrated the potential managerial decision-making value of this form of analysis by indicating relationships between the

quantitative outputs of such an analysis to recommended customer-specific engagement strategies to improve performance. We have not however stated that one or the other method is to be preferred, nor have we stated that either method is definitively the best. Further research would be required to make this claim if such a claim can be definitively made. We are well aware some researchers dispute the potential to definitively conduct any profit or margin variance analysis which disambiguates the impacts of price, variable costs, and mix. We leave these questions for others to address.

Also left for further research are validating the numerous hypotheses regarding the drivers of customer margin variances and recommended customer engagement strategies to improve profitability. Translating a customer margin variance analysis into action can bring great value to many sales, marketing, and pricing managers. While many hypotheses and recommendations were provided, we did not prove these hypotheses to be true. Hypothesis testing and further academic discussion are needed to support the theories presented.

## REFERENCES

- Albers, S. (1998). A framework for analysis of sources of profit contributions. *International Journal of Research in Marketing*, XV(2), 109-122. DOI: [https://doi.org/10.1016/S0167-8116\(97\)00038-4](https://doi.org/10.1016/S0167-8116(97)00038-4)
- Calas, R. (1971, July). Variance analysis in profit planning. *Management Accounting*, VIII(1), 31.
- Early, J. L. (2013). *United States Patent No. 8,412,598 B2*.
- McIntyre, E. W. (1976, January). A note on the joint variance. *The Accounting Review*, 51(1), 151-155. Retrieved March 3, 2021, from <http://www.jstor.org/stable/245383>
- McIntyre, E. W. (1978). The joint variance: A reply. *The Accounting Review*, LIII(2), 534-537.
- Piper, R. M. (1977). The joint variance: A comment. *The Accounting Review*, LII(2), 527-533.
- Pollono, E. P. (2021). Sales variance analysis: how state-of-the-art analytical tools can contribute to increased profitability. *J Revenue Pricing Manag.* DOI: <https://doi.org/10.1057/s41272-021-00369-0>
- Shank, J. K. (1977). Variance management: A management-oriented approach. *Accounting Review*, VII(4), 950. Retrieved January 28, 2021, from <https://search-ebSCOhost-com.ezproxy.depaul.edu/login.aspx?direct=true&db=bsh&AN=4505030&site=ehost-live&scope=site> .
- Smith, T. J. (2021, January 4). Normative decomposition of the profit bridge into the impact of changes in marketing variables. *Journal of Revenue and Pricing Management*. DOI: <https://doi.org/10.1057/s41272-020-00278-8>

Smith, T. J., Westra, Kyle T., Phipps, Nathan L. (2021). Profit bridges that disambiguate impacts of currency fluctuations from other marketing variables. *Journal of Revenue and Pricing Management*, 22, 34-43. <https://doi.org/10.1057/s41272-021-00366-3>

Wong, P., Hohenshelt, C., & Govindarajan, S. (2011, December). *Where did my gross margins go? An analytical framework*. Retrieved 07 30, 2022, from PWC.com: <https://www.pwc.com/gx/en/technology/publications/assets/technology-news-gross-margin-analysis.pdf>

## **ABOUT THE AUTHOR**

**Tim J. Smith** (Ph.D., University of Chicago). Dr. Smith is the founder and CEO of Wiglaf Pricing and an Adjunct Professor of Marketing at DePaul University where he specializes in Pricing Strategy.