
WHITE PAPER VI

**Medians, Averages, and
Weighted Averages...When to
Use What for Benchmarking?**

ROGER K. HARVEY, D.B.A.

Dr. Roger K. Harvey is President of Value Associates, Ltd., P.O. Box 1156, 564 Graceland, Carbondale, CO 81623. Phone: 970/963-1444. E-Mail: rh Harvey_2@yahoo.com. Value Associates, Ltd. offers consulting services and educational programs on Activity-Based Costing, Customer Profitability Analysis, computer-based financial planning, and wholesale-distribution financial management.

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Medians, Averages, and Weighted Averages . . .

When to Use What for Benchmarking?

By

Roger K. Harvey, D.B.A

I. INTRODUCTION

This paper addresses the question - when should Medians versus Arithmetic Averages versus Weighted Averages be used in measuring or benchmarking financial and operations performance? The answer to this question assumes that you know how each statistic is defined and calculated; only then is it possible to understand how and when the statistic should be used. A sample group of five companies will be used to illustrate what each statistic measures and how it should be used.

II. HOW DO YOU CALCULATE MEDIANS, AVERAGES, AND WEIGHTED AVERAGES?

Table I shows five companies with their Sales, Gross Margins and Gross Margin Percentages. The statistics for the group are reported in the lower half of the table.

TABLE I

<i>Median versus Arithmetic versus Weighted Average</i>					
Company	Sales \$	GM \$	GM %	Weight (by Sales)	Weighted Avg
A	100	30	30%	0.01	0.3%
B	500	105	21%	0.04	0.9%
C	500	100	20%	0.04	0.9%
D	500	75	15%	0.04	0.6%
E	10000	1000	10%	0.86	8.6%
Total	11600	1310	19.2%	1.00	11.3%
Median 20.0%					
Arithmetic Average 19.2%					
Weighted Average..... 11.3%					

The **Median** is the middle number in a sorted group of numbers. When the five GM%'s in our group are sorted from highest to lowest (as already shown in Table I), the middle number in the sorted group of GM%'s is 20%, the value for Company C. Two companies have lower GM%'s, and two companies have higher GM%'s; Company C's value is right in the middle. The middle or **Median** GM%'s for the group is 20%.

The **Arithmetic Average** of the GM%'s is a simple average of the five GM%'s, which is found by adding all five GM%'s and dividing by 5. The **Arithmetic Average** GM%'s for the group is 19.2%.

The **Weighted Average** for our group of five companies is found by, first deciding on a weighting factor, and then multiplying the factor's weight by each number in the group. If we want to assign a weight based on size, Sales might be used as the weighting factor. Using Sales as our weighting factor, we first sum Sales for all five companies (\$11,600 in Table I). Then, for each company's weight, we divide its Sales by Total Sales (.86 for Company E). Next, we multiply each company's weight by the value of its performance measure (GM% in our example) to determine the weighted GM% for the company. Finally, the weighted GM% for all companies is summed to give a Weighted Average GM% for the group. The **Weighted Average** for the group is 11.3%.

An easier but less revealing way to calculate a Weighted Average Gross Margin is simply to sum all the Gross Margin dollars and all the Sales dollars, and divide the two totals. In Table I, Total Gross Margin dollars equal \$1,310 and Total Sales dollars equal \$11,600, which when divided gives us the same Weighted Average GM% of 11.3% that we calculated above. Using this calculation method, it is less obvious that size is being used as the weighting factor, but nevertheless, companies with higher Sales have more of an influence on the statistic than companies with lower Sales.

Why are all three statistics different? Why is the Weighted Average so much lower than the other two statistics? Which statistic do you use for what?

III. WHEN TO USE MEDIANS AND AVERAGES

As difficult as it is to believe, the Arithmetic Average should not be used for benchmarking your financial or operational performance. An Arithmetic Average is too easily distorted by outlier values – outlier values that are either caused by erroneous data reporting or are caused by an aberration in the financial status of one or several survey respondents.

Uncaught data reporting errors can seriously distort the Arithmetic Average while having little effect on the Median. For example in Table I, suppose a zero was left-off Company E's Gross Margin. The resulting GM% for Company E would be 1% (= $\$100/\$10,000 * 100$). The new Arithmetic Average for the group would be 17%;

the Median would not change – it remains 20%. You can argue that the misreported Gross Margin should have been caught, but it only takes one or two errors in a survey to seriously distort the Arithmetic Average.

A second more common problem in financial reporting is an aberration in the financial data. For example, let's assume that we are calculating the Arithmetic Average for Return on Equity. Suppose one or two companies have very low Equity (usually the result of sustained losses on several previous years) and this year they make a profit. This results in an extremely high Return on Equity for the companies, possibly above 1000%. Again, values of this magnitude in a group of data that typically varies between 0% and 25% seriously distort the Arithmetic Average. They will have very little, if any, effect on the Median for the group.

For companies who wish to benchmark their performance, the Median is the best statistical measure to “central tendency.” The Median is the “typical” value. In terms of Table I, the Median GM% of 20% is the typical GM% for the group. If your company's GM% is 18%, your performance is below the typical company in the group.

The Median by itself, however, offers inadequate information about your performance; you should also benchmark your performance relative to range measures such as the Lower Quartile and Upper Quartile. In our example, you would evaluate your relative performance very differently if the Lower Quartile GM% was 19% versus 12%, keeping in mind that the Median was 20%. If the Lower Quartile was 19%, your performance is below the Median and the Lower Quartile – this means more than 75% of the reporting firms are doing better than you are in terms of their GM%. If the Lower Quartile was 10% (versus your GM% of 18% and the Median of 20%), you are not doing badly – slightly below the Median.

Benchmarking your performance against the Lower Quartile, Median and Upper Quartile gives you information on the range of performance, and where you fall in that range... much more information than knowing you are below or above the Median. The Arithmetic Average should not be used for benchmarking because reported survey data behind the benchmark is too vulnerable to outlier values.

IV. WHEN TO USE WEIGHTED AVERAGES

Suppose you want to measure industry-wide performance. For example, suppose you want to determine the GM% for all firms in the U.S. or Canada, or the GM% for all firms in a region.

If you just want to know the “typical” GM% for all companies in the country or region, then you would use the Median GM% for the country or region. In terms of our example and assuming it applied to all firms in U.S. or Canada, you would say, “the GM% of the typical firm in the U.S. or Canada is 20%.” This is not the country or region's GM%; it is the typical company's GM% in the country or region.

If you want to know the “average” GM% for the whole country or region, you would use a Weighted Average statistic. You would take all Sales in the country or region and all Gross Margin dollars earned in the country or region, sum them, and divide the two totals. As we saw above, this is just an alternative way to calculate the Weighted Average. In effect, you would be allowing big companies to influence the statistic more than small companies – you would be taking size into consideration.

In Table I we used Sales as a weighting factor; the Weighted Average GM% for our group is 11.3%, the same value we found by simply totaling Sales and Gross Margin, and dividing the two sums. When you take into account all the Sales in the country or region, and all the Gross Margin dollars earned on those Sales, you have calculated average GM% for the entire country or region. You would say, “the average GM% in the country or region is 11.2%.

With the Weighted Average statistic, you are typically measuring performance of the group—of the country, of the region, or of the industry. You are not benchmarking a specific company against “typical” performance; rather, you are going to make a pronouncement about “average” performance for an entire group.

V. CONCLUSION

The Median, Arithmetic Average and Weighted Average statistics are used in different ways to measure and report financial and operations performance. For benchmarking purposes, we use the Median, never the Arithmetic Average. For measuring the performance of a combined group such as all firms in a country or region, we use the Weighted Average. All three measures have their purposes. Before using any one of these statistics, carefully consider the purpose for the statistic and how it will be used. Hopefully, a little careful thought upfront, along with this White Paper, will point you to the correct statistic.