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Measuring the Value Added of REIT Managers Using MSA Benchmarks: A Return-Based Attribution Analysis Approach

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Abstract

An interesting, important, and challenging financial question both in academic research and in practice is how to determine asset managers' investment performance. That is, how much can be attributed to luck or serendipitous timing and how much is skill? In this paper we demonstrate how return-based style analysis, known as attribution analysis, can be used to ascertain the extent to which managers of REITs add value to their firm's stock returns. Developed by William F. Sharpe, a Nobel Laureate, the attribution analysis technique was originally used to analyze a manager's investment style based on the individual's equity portfolio (e.g., large cap growth versus large cap value) by comparing returns on various indices.1 The manager's style would be inferred according to the extent to which a weighted combination of indices most closely replicated the actual performance of the manager's portfolio over a specified time period. In this way, a fund manager's style is determined by finding the mix of indices that provides returns that are the most similar to the manager's portfolio's returns. The manager's performance can then be assessed from the resulting benchmark portfolio, which is constructed using the various indices. The unmanaged benchmark reflects how an investor would do if he or she owned a portfolio comprising the same indices but didn't have the manager.

Keywords

Cornell, real estate, finance, REIT, portfolio

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EXECUTIVE SUMMARY

The purpose of this paper is to demonstrate how return-based style analysis (attribution analysis) can be used to ascertain the extent to which managers of REITs add value to their firm's stock returns. The only data required to implement this technique are the total returns for the REIT and the returns of a set of passive indexes. In this demonstration, a weighted combination of the passive indexes is used to construct a benchmark portfolio that most closely replicates the actual performance of a manager's portfolio over a specified time period. Management performance is then measured relative to this benchmark portfolio. The weights used to construct the benchmark portfolio provide an insight into the behavior of the REIT.

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An interesting, important, and challenging financial question both in academic research and in practice is how to determine asset managers' investment performance. That is, how much can be attributed to luck or serendipitous timing and how much is skill? In this paper we demonstrate how return-based style analysis, known as attribution analysis, can be used to ascertain the extent to which managers of REITs add value to their firm's stock returns. Developed by William F. Sharpe, a Nobel Laureate, the attribution analysis technique was originally used to analyze a manager's investment style based on the individual's equity portfolio (e.g., large cap growth versus large cap value) by comparing returns on various indices.[1] The manager's style would be inferred according to the extent to which a weighted combination of indices most closely replicated the actual performance of the manager's portfolio over a specified time period. In this way, a fund manager's style is determined by finding the mix of indices that provides returns that are the most similar to the manager's portfolio's returns. The manager's performance can then be assessed from the resulting benchmark portfolio, which is constructed using the various indices. The unmanaged benchmark reflects how an investor would do if he or she owned a portfolio comprising the same indices but didn't have the manager.

[1] William Sharpe, "Determining a Fund's Effective Asset Mix," *Investment Management Review*, 1988, pp. 59-69. See also: William Sharpe, "Asset Allocation: Management Style and Performance Measurement," *Journal of Portfolio Management*, Vol. 18, No. 2 (1992), pp. 7-19.

This type of return-based style analysis can be applied to management of real estate investment trusts (REITs). Instead of equities, we are interested in the management of the REIT. A REIT is analogous to a stock mutual fund in the sense that it is a portfolio of direct real estate investments of various types in various locations. A particular limitation relating to measuring REIT performance is that, in contrast to stocks, bonds, and cash indices, whose returns are available at high frequencies, returns for underlying real estate indices are only available on a quarterly basis. Moreover, indices for direct real estate investment are typically not available for an MSA or city, although that is the measurement we seek to make in this study.

Our analysis focuses on geographical REIT portfolios. While one can use REIT indices for various property types, this approach does not allow one to look at REIT performance in terms of MSA (city) exposures. A possible solution to address this issue is to compare the REIT's performance to an index that includes a portfolio of publicly traded stocks that act as a proxy for the local economy.[2] Since real estate is fixed in location, we argue that the revenue and net income from a given property is tied to the health of the local economy as well as the health of the tenants who are a part of that economy. Property value is also partly tied to the local economy in addition to the national economy.[3] For example, we implicitly assume that real estate in Detroit, Michigan, or in Silicon Valley is tied to the health of the automotive industry in one case and high tech manufacturing in the other. A study by Coulson, Liu, and Villupuram provides evidence that is consistent with this view.[4]

Like other investment analysis techniques, return-based style analysis depends on the correct selection of passive indices, the time frame (window) used, and the return frequency chosen. Return-based analysis also requires a reasonably lengthy time span to detect major changes. Advantages of this type of style analysis are that it is neither expensive nor labor intensive.

For purposes of illustration, we use a hotel REIT, Hersha Hospitality Trust, whose properties are located primarily in the following six MSAs: Boston, Los Angeles, Miami, New York, Philadelphia, and Washington (District of Columbia).[5] Our chief goal is to show the usefulness of attribution analysis in evaluating management performance. This demonstration of attribution analysis also shows the extent to which management adds value by measuring the difference in REIT returns relative to returns on a benchmark portfolio that we construct from cash, investment grade bonds, and the MSA indices. We do not employ a real estate index in our analysis because intuitively the reference indices should be based on asset classes the manager has discretion over. That is, including the FTSE/NAREIT index would simply answer the question, does Hersha look like a REIT?[6]

We include cash because Hersha lists cash and cash equivalents as part of their balance sheet. As for including bonds in the comparison index, certain elements of a hotel investment are not unlike bonds. While Hersha does not hold investment grade bonds, the trust does invest in institutional grade hotels in central business districts, suburban office markets, and stable destinations and secondary markets in the Northeast, as well as selected markets on the West Coast. Moreover, Hersha focuses on high quality upscale hotels in high barrier-to-entry markets. This suggests that the return on these hotels should at least equal to, if not exceed, BBB investment grade bonds, since institutional grade hotels are riskier and thus demand a higher risk premium. For this reason, it is important to add returns on a bond portfolio as one of the indices in the attribution analysis.

It is well known that real estate returns have both a fixed-income-like component (a flow of rents) and an equity-like (property value appreciation) aspect.[7] Real estate's fixed-income investment properties are not the only reason that including a bond return index into attribution analysis is important. This method applies to real estate in general, and thus a general set of benchmarks should be included. Finally, we note the empirical issue regarding the use of fixed-income returns. If the returns generated by a manager do not behave in a fixed-income-like fashion, then the attribution analysis will assign a low weight to the fixed income index, reflecting this property of returns.

While there is no absolute standard regarding the appropriate time frame necessary to analyze a fund manager, we use a five-year (20 quarter) rolling window of quarterly

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[2] Theoretically, we assume that the economic base of a given city is the primary driver of commercial real estate. The economic base is the portfolio of local industries that represents the local economy, especially firms whose goods are exported (i.e., output is in excess of local consumption needs).

[3] Value is also a function of discount rates, which are a function of interest rates at the national level as well as the risk of a given property type, among other factors.

[4] See: N. Edward Coulson, Crocker H. Liu, and Sriram V. Villupuram, "Urban Economic Base as a Catalyst for Movements in Real Estate Prices," Working Paper, Cornell University, 2012. This study differs from the approach in the working paper because their focus is on the link between residential real estate (housing) and local economic conditions.

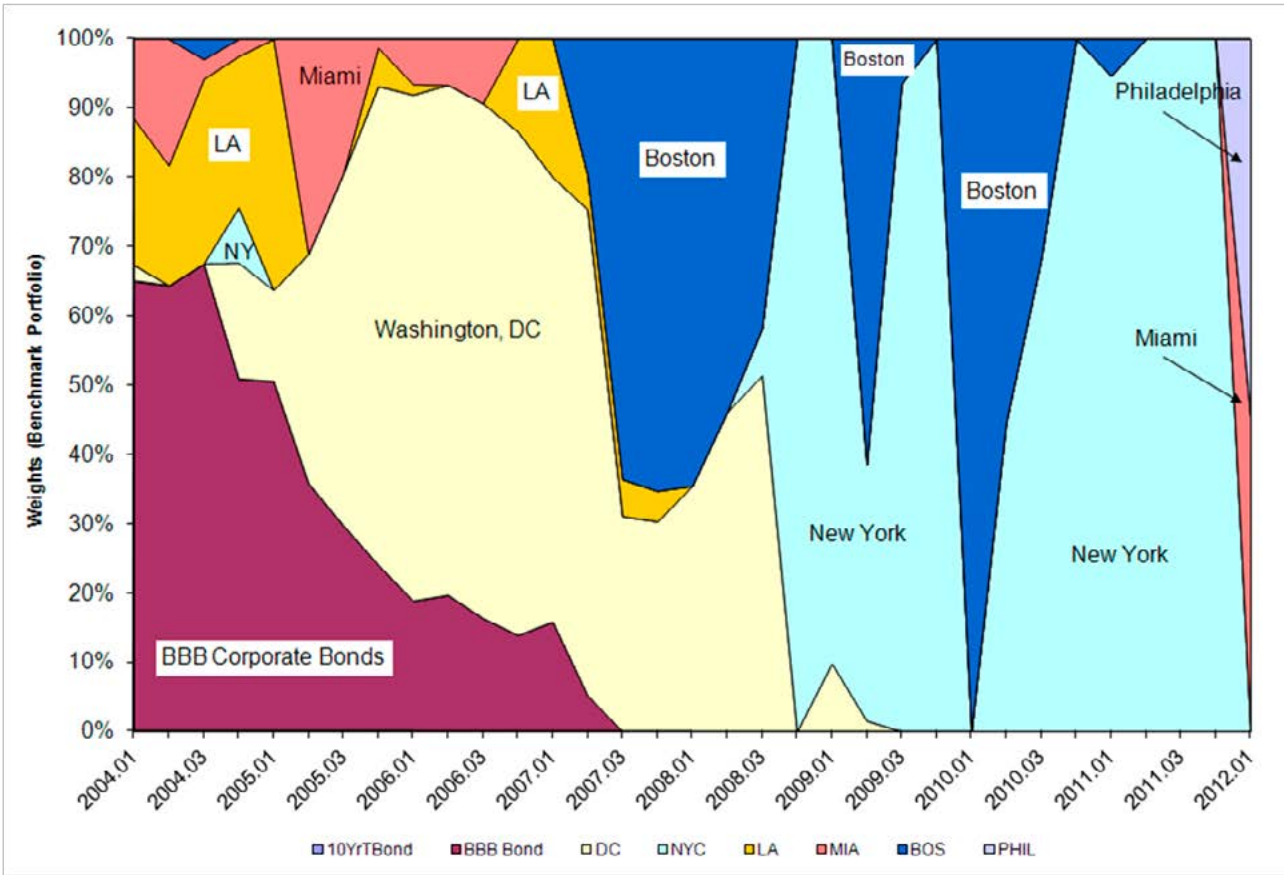
[5] The use of Hersha is without loss of generality. The analysis is well suited for any REIT that has a moderately geographically diversified portfolio.

[6] An alternative way of looking at this involves considering the original use of attribution analysis. When benchmarking a small cap mutual fund, the reference indices would not include a mutual fund index. It is likely to include a small cap index, small cap value and growth indices, and potentially mid cap indices to examine whether there has been a size drift in the portfolio.

[7] For example, see: David Swensen, *Pioneering Portfolio Management: An Unconventional Approach to Institutional Investment* (New York: Free Press, 2009), a book by Yale's endowment manager.

Exhibit 1

Changing weights on the benchmark portfolio (quarterly returns)



returns since real estate holding periods tend to be at least five years in duration. Another, more practical reason for choosing this time frame is that it reflects the limited time series data available on our MSA indices.

To conduct the attribution analysis, we assume the return on the REIT is equal to the weighted returns on the passive MSA indices plus some random error:

$$R_t = w_{1t}R_{1t} + w_{2t}R_{2t} + w_{3t}R_{3t} + \ldots. + w_{Nt}R_{Nt} + \varepsilon_t \qquad (1)$$

where R_t is the return on the REIT during period t, w_{jt} is the weight of index j, R_{jt} is the return on index j during period t, and ε_t is the residual for period t; for w_{jt}, $j = 1,\ldots.$ N, representing the weights on the 1st through N^{th} indices. N is the total number of passive benchmark indices. This specification assumes that returns on indices, R_{jt}, drive returns on the real estate portfolio, R_t, with weights w_{jt} capturing the contribution of different indices to the return on the portfolio. The return on the real estate portfolio is the weighted average of returns on indices plus an error term, which represents return on the real estate portfolio that cannot be explained by returns on the indices.

To create the benchmark passive portfolio return, we need to estimate the w term in equation (1), that is, the weight that each passive index has in the portfolio. To do this, we need a sensible criterion upon which to base the estimate. The approach we take is to find the portfolio weights that minimize the sum of the squared deviation between the REIT return and the passive indices.[8] Following this approach will allow us to estimate the weights that create the portfolio that most closely matches the REIT's historic performance.

In order for the portfolio weights to make economic sense, we must impose two restrictions on the values that the w's can take in equation (1). First, the weights must sum to 1, since the portfolio weights sum to 100 percent, and, second, each weight must have a value between 0 and 1 (this implies no short sales.) Estimating the weights subject to these constraints is a simple case of constrained optimization:

[8] This criterion follows the same logic as a standard ordinary least squares (OLS) regression.

Exhibit 2

Weights and portfolio return for benchmark portfolio from attribution analysis (quarterly analysis)

	Return			Portfolio Weights from Attribution Analysis								R(Sqrd)	1-R(Sqrd)
	Hotel REIT	Benchmark	Mgmt Value Added Return	10YrTBond	BBB Bond	DC	NYC	LA	MIA	BOS	PHIL	%Benchmark	%Management
2004.01	0.0673		-0.0008	0.000	0.651	0.023	0.000	0.211	0.115	0.000	0.000	0.366	0.634
2004.02	-0.0509	0.0185	-0.0696	0.000	0.645	0.000	0.000	0.173	0.182	0.000	0.000	0.404	0.596
2004.03	-0.0304	0.0369	-0.0619	0.000	0.676	0.000	0.000	0.267	0.029	0.029	0.000	0.393	0.607
2004.04	0.2372	0.0872	0.1378	0.000	0.509	0.167	0.080	0.219	0.025	0.000	0.000	0.452	0.548
2005.01	-0.1135	0.0137	-0.1284	0.000	0.506	0.132	0.000	0.362	0.000	0.000	0.000	0.500	0.500
2005.02	-0.0251	0.0618	-0.0671	0.000	0.359	0.331	0.000	0.000	0.310	0.000	0.000	0.568	0.432
2005.03	0.0597	0.0391	0.0226	0.000	0.298	0.508	0.000	0.000	0.194	0.000	0.000	0.592	0.408
2005.04	-0.0745	0.0128	-0.0636	0.000	0.241	0.691	0.000	0.055	0.012	0.000	0.000	0.578	0.422
2006.01	0.1065	0.0619	0.0389	0.000	0.189	0.731	0.000	0.015	0.065	0.000	0.000	0.593	0.407
2006.02	-0.0327	-0.0447	0.0106	0.000	0.197	0.737	0.000	0.000	0.066	0.000	0.000	0.600	0.400
2006.03	0.0527	0.0252	0.0302	0.000	0.164	0.744	0.000	0.000	0.093	0.000	0.000	0.568	0.432
2006.04	0.2000	0.0749	0.1196	0.000	0.139	0.727	0.000	0.134	0.000	0.000	0.000	0.546	0.454
2007.01	0.0547	0.0157	0.0396	0.000	0.158	0.642	0.000	0.199	0.000	0.000	0.000	0.564	0.436
2007.02	0.0187	0.0052	0.0222	0.000	0.052	0.702	0.000	0.049	0.000	0.197	0.000	0.587	0.413
2007.03	-0.1472	-0.0409	-0.1057	0.000	0.000	0.311	0.000	0.053	0.000	0.636	0.000	0.674	0.326
2007.04	-0.0404	-0.0453	0.0029	0.000	0.000	0.303	0.000	0.044	0.000	0.653	0.000	0.683	0.317
2008.01	-0.0112	-0.0964	0.0845	0.000	0.000	0.355	0.000	0.000	0.000	0.645	0.000	0.708	0.292
2008.02	-0.1440	-0.0331	-0.1080	0.000	0.000	0.461	0.000	0.000	0.000	0.539	0.000	0.654	0.346
2008.03	0.0093	-0.0395	0.0493	0.000	0.000	0.514	0.068	0.000	0.000	0.418	0.000	0.640	0.360
2008.04	-0.5726	-0.2632	-0.2756	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.692	0.308
2009.01	-0.3067	-0.0965	-0.2076	0.000	0.000	0.098	0.902	0.000	0.000	0.000	0.000	0.651	0.349
2009.02	0.3316	0.1899	0.1126	0.000	0.000	0.016	0.370	0.000	0.000	0.614	0.000	0.697	0.303
2009.03	0.2702	0.1483	0.1219	0.000	0.000	0.000	0.936	0.000	0.000	0.064	0.000	0.715	0.285
2009.04	0.0290	0.0362	-0.0085	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.714	0.286
2010.01	0.6656	0.0503	0.5831	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.511	0.489
2010.02	-0.1178	0.0134	-0.0651	0.000	0.000	0.000	0.448	0.000	0.000	0.552	0.000	0.513	0.487
2010.03	0.1571	0.0581	0.0732	0.000	0.000	0.000	0.682	0.000	0.000	0.318	0.000	0.514	0.486
2010.04	0.2838	0.0830	0.1724	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.514	0.486
2011.01	-0.0924	0.0420	-0.1330	0.000	0.000	0.000	0.947	0.000	0.000	0.053	0.000	0.504	0.496
2011.02	-0.0522	0.0225	-0.0602	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.502	0.498
2011.03	-0.3680	-0.1840	-0.1840	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.531	0.469
2011.04	0.4277	0.0370	0.3908	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.478	0.522
2012.01	0.1311	0.1304	0.0109	0.000	0.000	0.000	0.000	0.000	0.452	0.000	0.548	0.565	0.435

$$\min \sum_{T} \varepsilon_t^2$$

subject to

$$w_1 + w_2 + \quad + w_N = 1$$

$$0 \le w_j \le 1 \text{ for all } j$$

An attribution analysis spreadsheet is available on the CREF webpage,[9] and Appendix A in this study shows how to implement this approach by hand using an Excel spreadsheet. For our example, we use the following eight indices: cash, investment grade corporate bonds, and the regional stock indices for Boston, Los Angeles, Miami, New York, Philadelphia, and the District of Columbia. The return associated with our hotel REIT and for the eight indices are reported in Appendix A. The R-squared statistic associated with equation (1) identifies how the returns on our benchmark portfolio tracked the REIT's actual performance over the 2004Q1–2012Q1 period. We then use the constructed passive benchmark portfolio returns to examine the value added of the REIT's management.

Data

We obtained monthly return data for the hotel REIT from the Center for Research in Security Prices (CRSP)[10] with monthly yields on a constant-maturity 10-year Treasury bond and yields on a BBB corporate bond taken from the Federal Reserve website.[11] To construct the city indices for Boston, Los Angeles, Miami, New York, Philadelphia, and Washington, DC, we calculated the value weighted return on all companies headquartered in these cities. We obtain

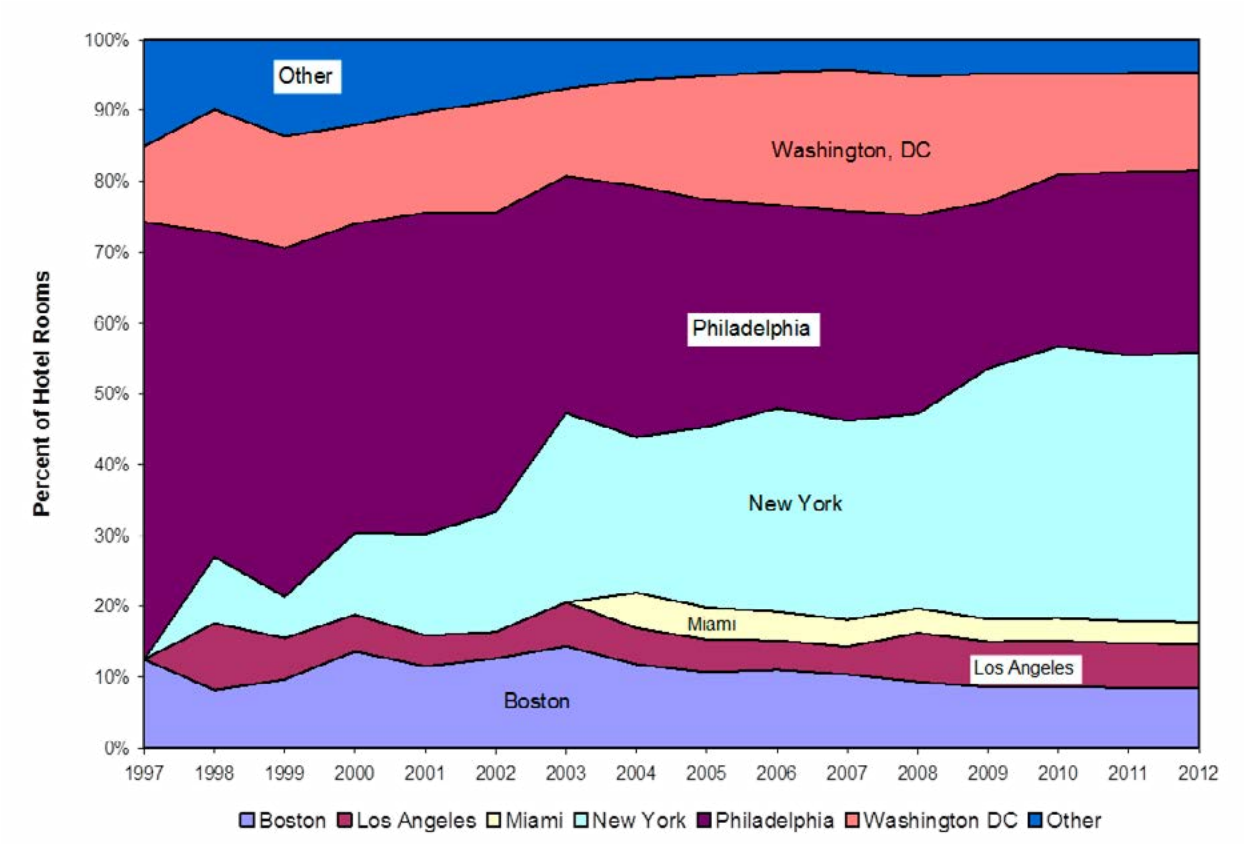
[9] The spreadsheet simply requires a target asset and reference indices. As such, it could be used for any attribution analysis problem, not only the one discussed in this paper.

[10] For practitioners who don't have access to CRSP, returns can be downloaded through a downloadable Bloomberg terminal.

[11] www.federalreserve.gov/econresdata/statisticsdata.htm.

Exhibit 3

Percentage of hotel rooms in each MSA for our hotel REIT



company headquarters from COMPUSTAT and company return data from CRSP.[12]

We use quarterly returns in our analysis to match the quarterly frequency of most commercially available databases on institutional fund managers, including NCREIF. In addition to this, the model implicitly assumes a normal distribution of returns, and quarterly returns are more likely to be normally distributed. Moreover, changes in real estate holdings are only reported in the 10Q on a quarterly basis at best. While we could have used monthly returns in lieu of quarterly returns, Lieberman shows there is little difference in monthly versus quarterly style classifications if enough data are available.[13] She further argues that results must be consistent using either monthly or quarterly data for return-based analysis to be useful. To convert monthly returns to quarterly returns, we used the following calculation: add 1 to each of the monthly returns for three successive months and then multiply the three terms together, subtracting 1 from the result and converting to percentage:

$$R_q = (1+R_{t1})(1+R_{t2})(1+R_{t3}) - 1$$

For example, suppose that the return is -0.0384 for month 1, 0.0672 for month 2, and -0.1362, for month 3. Then the return for the first quarter is -11.36 percent, as follows:

R_{Q1} = (1-0.0384)*(1+0.0672)*(1-0.1362) - 1 = -0.1136 (*100 percent)

Results

Quarterly Analysis

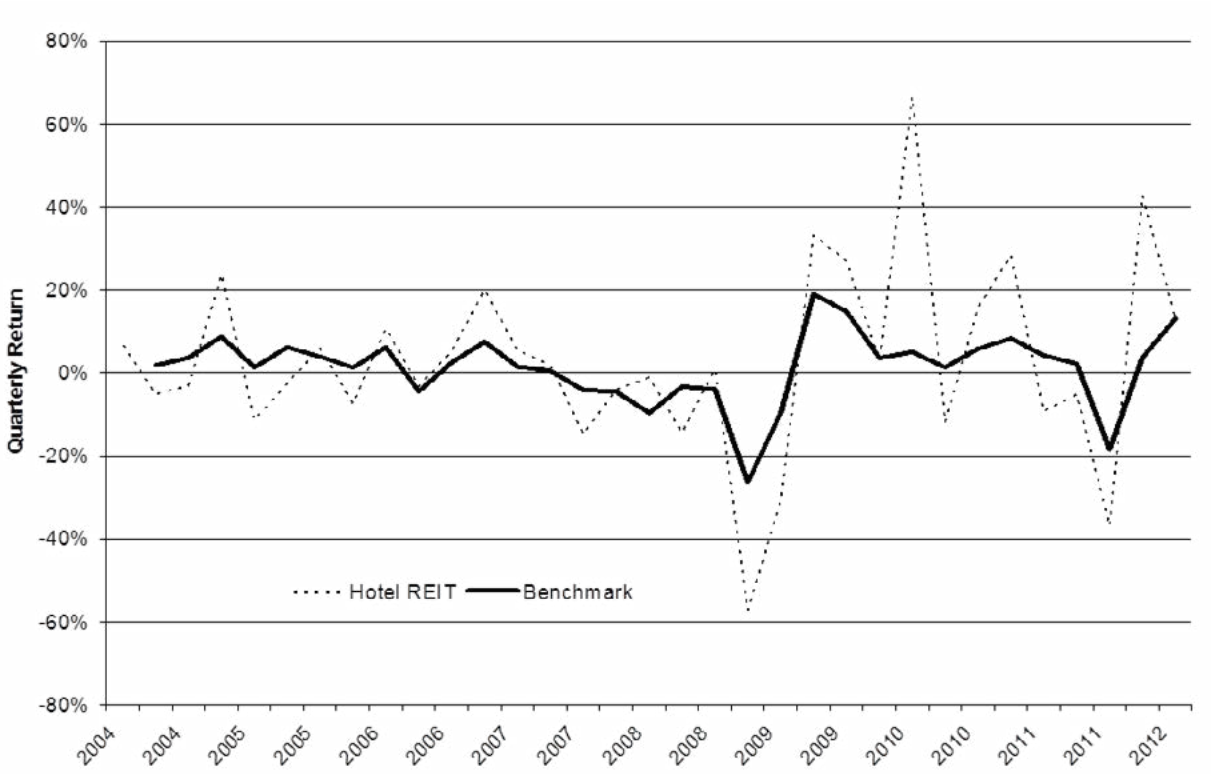
Exhibit 1 (page 7)shows the changing weights or exposures to the eight indexes that we used to create a benchmark portfolio for the purpose of attribution analysis (also known as an exposure distribution area graph). The graph represents one of the easiest ways to assess a REIT's stability, that is, to gauge the stability of its exposure with respect to the eight indices over time.

[12] An alternative set of indices would be the Bloomberg regional indices for these markets. The tickers for the Bloomberg regional indices are BBNX for Boston, BOCX for Los Angeles, BMHX for Miami, BCNY for New York, INQB for Philadelphia, and BDCAX for Washington, DC.

[13] Diana Lieberman, "Return-Based Style Analysis: Are Quarterly Returns as Meaningful?," *Journal of Investing,* Vol. 5, No. 3 (1996), pp. 51-55.

Exhibit 4

Performance of REIT relative to benchmark portfolio



Looking at Exhibit 2 (page 8), which reports the actual weights in conjunction with Exhibit 1, the benchmark portfolio in our example for the first quarter of 2004 (2004Q1) consists of 65.1 percent BBB investment grade corporate bonds, 2.3 percent District of Columbia, 21.1 percent Los Angeles, and 11.5 percent Miami. This benchmark portfolio represents a reasonable passive alternative to the REIT manager's active management. This suggests that over this time period, the REIT's institutional grade hotels exhibited similar performance behavior to BBB investment grade corporate bonds. Notice that the exposure to various indices changes over time. Early on, the benchmark portfolio had large exposures to BBB investment grade corporate bonds and Washington, D.C. (2004Q1 to 2007Q2). Subsequent to 2007Q2, when other markets were in recession, a large portion of the hotel REIT returns is attributable to the Boston and D.C. local economies (2007Q3 to 2008Q3). A large vacillating exposure to either the New York City or Boston economy followed during the 2008Q4 to 2011Q4 period with more recent exposure to the economies of Miami and Philadelphia in 2012Q1. Thus, it appears that the investment grade hotels acquired over time outperformed BBB investment grade corporate bonds, with the exposure to the six MSA economies changing over time.

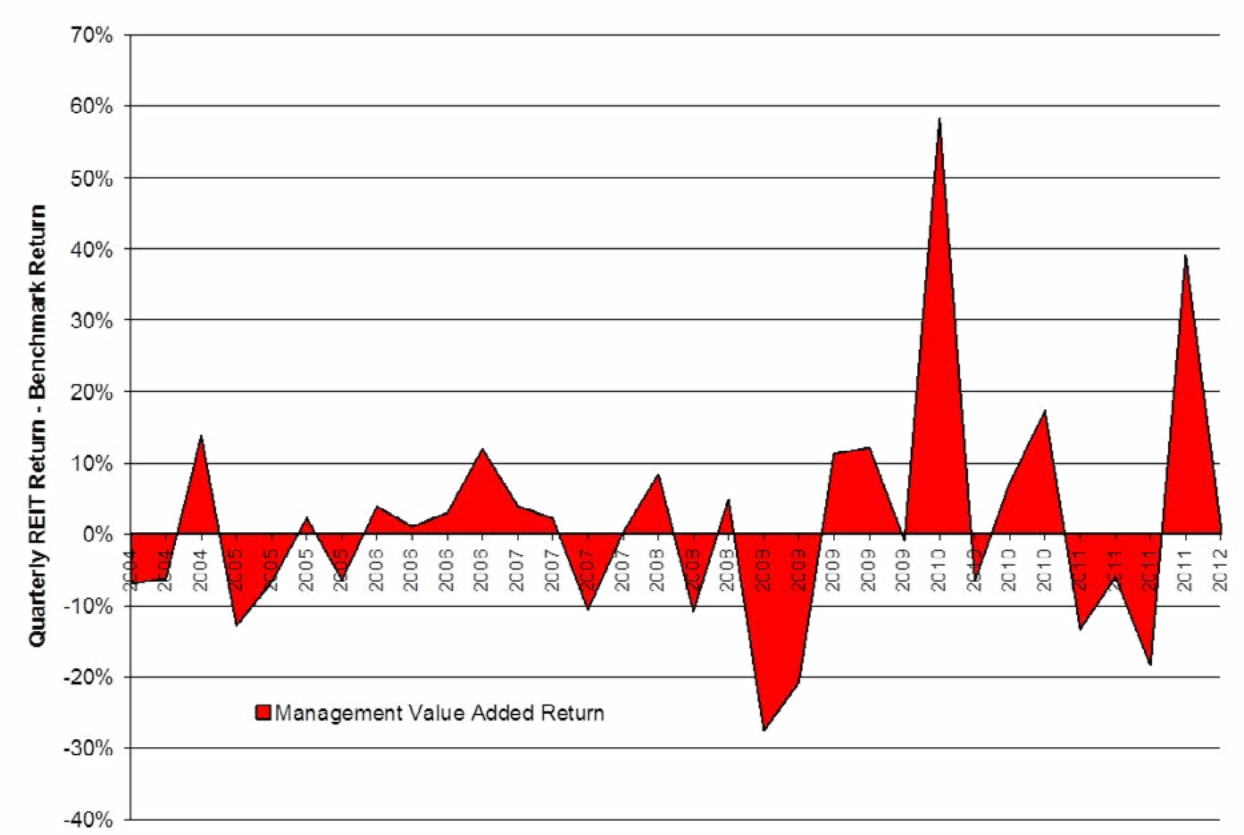
The change in the exposure to local economies is partly the result of when hotels in a given MSA were acquired or sold, in addition to the average daily rate setting in each of the local economies. Exhibit 3 (page 9) provides the percentage of hotel rooms in each MSA for our hotel REIT which is constructed from the REIT's various 10Ks and annual reports. A comparison of Exhibit 3 with the exposure distribution graph in Exhibit 1 reveals that the percentage distribution of hotel rooms differs from MSA exposures in terms of the benchmark portfolio. What is not available from SEC filings is the contribution that hotels in aggregate for each MSA make to the profits (and RevPAR) of the hotel REIT.[14] This information provides a better basis for comparison with Exhibit 3.[15]

[14] The level of financial disclosure made by REITs with respect to portfolio cash flows is quite varied. While all firms report company level cash flows, the granularity with which they disclose segment level cash flows (i.e., market by market) in their financial supplements differs widely. Due to Regulation FD, if these data are not disclosed in the firm's financial supplement, it is unlikely the investor could readily obtain them from the company or other sources.

[15] Attribution analysis is especially useful when geographical mix of properties is available for the company being researched, but one cannot obtain the figures for profit contribution from different geographical areas.

Exhibit 5

Management value-added return



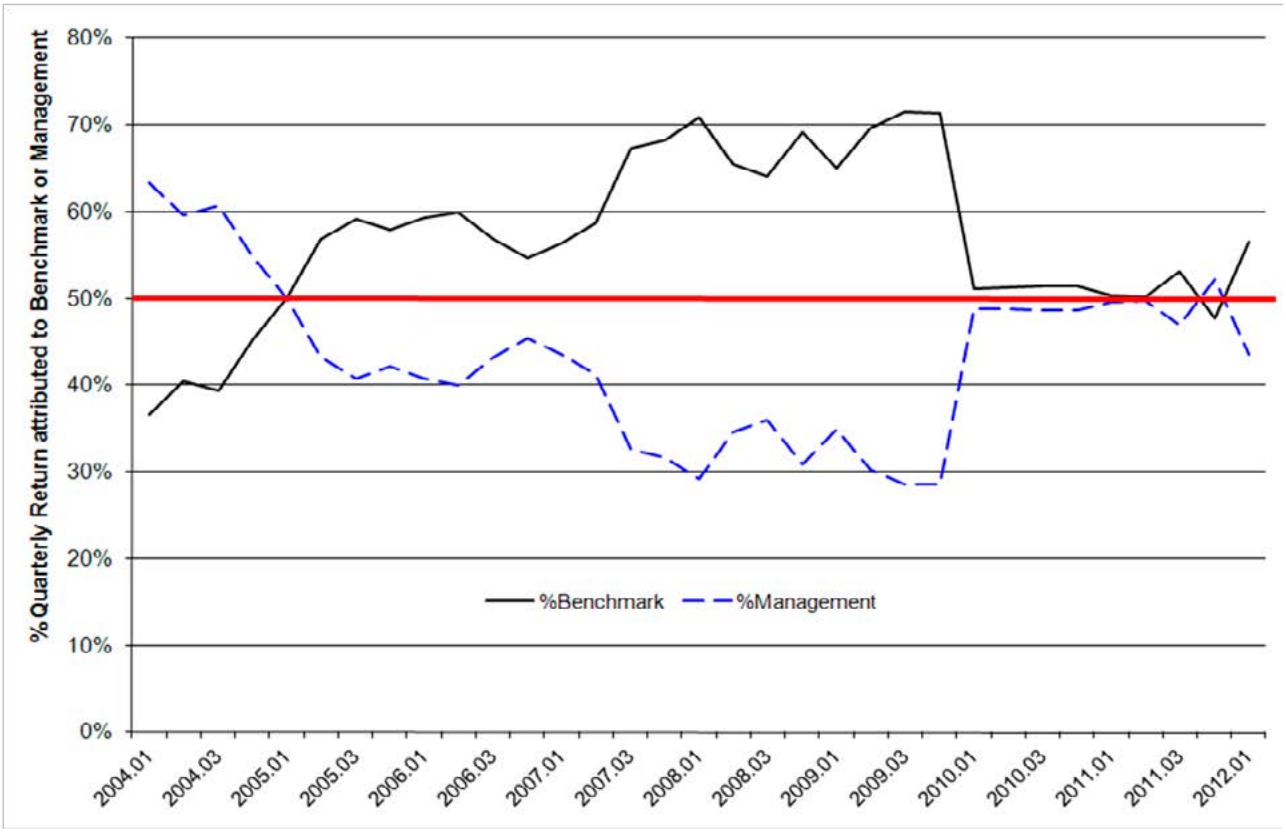
Given these weights in time period *t* (say, 2004Q1), we can compare the performance of the benchmark portfolio to that of the actual REIT over a subsequent time period, say, the next quarter (2004Q2). That is, we compare returns for the eight indices with the returns for our REIT, one quarter ahead. (See Appendix A for a description of how to calculate these returns.) If we assume that our chosen set of passive indices fully captures both the MSA exposures (inclusive of cash and investment grade bond weights) and the manager's style, and if we also assume that there was no change in style in the five-year period used to create the benchmark portfolio (in this example, the second quarter of 1999 (1999Q2) to the first quarter of 2004 (2004Q1)) and the evaluation period (in this example, 2004Q2), the difference in returns between this benchmark and the actual fund represent the return arising from the manager's active strategies regarding the setting of daily rents (since it is a hotel REIT), along with acquisitions and disposal of hotel properties. The intuition for using weights calculated in the prior five-year period and applied to returns in the subsequent quarter meets the criteria for measuring the manager's performance. In particular, the benchmark portfolio is easily constructed, identifiable in advance, and represents a viable alternative to investing in the REIT. The method allows for the weights to vary according to time—that is, estimated weights can change from quarter to quarter. To the extent that managers may be engaged in picking markets in which they operate—and therefore changing their exposure to different real estate markets—by allowing the estimated weights to change from period to period our proposed measurement approach captures and reflects this variability in exposure to different markets.

Exhibit 4 shows the quarterly return performance of our hotel REIT relative to the benchmark portfolio, while Exhibit 5 summarizes the difference in performance that is shown in Exhibit 4. This represents the REIT management's value added return. On average, the management adds value to the tune of 1.51 percent per quarter or 6.2 percent per annum.[16] During periods when the REIT's management outperformed the benchmark, they generally did so by a large amount.

[16] To calculate the per annum return, we compound the quarterly returns: (1+.0151)4 – 1 = .0620 or 6.2%

Exhibit 6

Portion of quarterly returns attributed to benchmark versus management



The R^2 statistic identifies how well the constant allocation (portfolio weights) tracked our REIT's actual performance over each five-year period (rolling by quarter). Stated differently, the higher the percentage value of the R^2, the better, as this indicates that the benchmark portfolio more consistently accounts for the long-term behavior of the REIT. In this case, the weighted allocation was associated with 36.6 percent of the variation in the REIT manager's actual performance (weighted as given in Exhibit 2, 2004Q1), as follows: 10-year Treasury bond, 0; BBB investment grade corporate bond, .651; Washington DC, .023; New York City, 0; Los Angeles, .211; Miami, .115; Boston, 0; and Philadelphia, 0. The remaining 63.4 percent is attributable to some combination of the manager's exposure to MSAs other than the six included in this analysis, the manager's acquisition and disposal of (hotel) properties, daily rent-setting behavior, efficiency of operations (control of expenses), market timing, or statistical error. Exhibit 6 shows the time series portion of the quarterly returns attributed to REIT management relative to the benchmark portfolio. On average, 42 percent of the REIT performance is attributable to the style behavior of the REIT manager with a low of 30 percent occurring during the 2007 to 2009Q2 period and nearly 50 percent after 2009Q4.

Summary

We demonstrate how to evaluate whether REIT management adds value to their firm's stock performance using attribution analysis, a technique developed by William F. Sharpe. To achieve this, a benchmark portfolio is constructed using a weighted combination of indices that most closely replicates the actual performance of a manager's portfolio over a specified time period. The benchmark reflects how an investor would do if he or she didn't have the manager. The novel feature of this analysis is that we look at REIT performance in terms of MSA exposures using city-level stock indices which represent a portfolio of publicly traded stocks as a proxy for the local economy. Comparing a hotel REIT to indices for cash, BBB investment grade corporate bonds, and MSA indices for Boston, Los Angeles, Miami, New York, Philadelphia, and Washington, D.C., we show that management of our hotel REIT does add value. The resulting weights from this attribution analysis reveal the style behavior of the REIT manager and which local economies where properties are located in are the primary drivers of REIT returns since hotels are fixed in location. ■

Appendix: Sharpe Return Based Attribution Analysis Using Excel

Suppose that we have the following returns on a hotel REIT together with returns for cash (yield on a constant maturity 10-year Treasury bond), for a BBB quality corporate bond, and for a value weighted portfolios of common stocks whose firms have a major presence in Boston, Los Angeles, Miami, New York, Philadelphia, and Washington, D.C.

Exhibit A: REIT Return Data

YearQtr	Hotel REIT	Rtn(10YTB)	Rtn(BBB)	Rtn(DC)	Rtn(NYC)	Rtn(LA)	Rtn(Miami)	Rtn(Boston)	Rtn(Phil)
1999.02	0.0096	0.0554	0.0774	0.0562	0.0593	0.1028	0.1783	0.0540	0.1870
1999.03	-0.1111	0.0588	0.0810	-0.0794	-0.0826	-0.0704	-0.2257	-0.0112	-0.0847
1999.04	0.0360	0.0614	0.0824	0.1505	0.1328	0.1700	0.2175	0.4068	0.0998
2000.01	0.0360	0.0648	0.0833	-0.0298	0.0228	0.1520	0.1084	0.1066	-0.0887
2000.02	0.1235	0.0618	0.0859	-0.0447	-0.0304	-0.0812	-0.2324	0.0059	-0.1365
2000.03	0.1366	0.0589	0.0832	-0.0264	0.0288	0.0604	0.0270	0.1325	-0.0438
2000.04	-0.0429	0.0557	0.0821	-0.1764	-0.0218	-0.2549	-0.1590	-0.2974	0.0282
2001.01	0.0211	0.0505	0.0788	-0.1078	-0.1015	-0.1554	-0.0702	-0.3610	-0.0833
2001.02	0.1236	0.0527	0.0804	0.0492	0.0760	0.1276	0.3145	0.0999	0.1274
2001.03	-0.0700	0.0498	0.0795	-0.1405	-0.1050	-0.2900	-0.2558	-0.3356	-0.1625
2001.04	0.0889	0.0477	0.0792	0.0693	0.1059	0.2230	0.1558	0.2566	0.1170
2002.01	0.1719	0.0508	0.0796	-0.0532	-0.0288	0.0187	-0.0421	-0.0595	0.0273
2002.02	-0.0185	0.0510	0.0802	-0.0711	-0.1743	-0.1346	-0.1482	-0.2440	-0.0945
2002.03	0.0000	0.0426	0.0763	-0.1457	-0.1637	-0.1712	-0.1768	-0.2267	-0.1848
2002.04	0.0864	0.0401	0.0760	0.0579	0.1097	0.0473	0.0786	0.1937	0.0897
2003.01	0.0818	0.0392	0.0712	-0.0329	-0.0383	0.0145	-0.0489	-0.0110	-0.0676
2003.02	0.2104	0.0362	0.0647	0.1506	0.1536	0.1730	0.3162	0.2796	0.1505
2003.03	0.1652	0.0423	0.0681	0.0600	-0.0046	0.0658	0.0853	0.0932	0.0277
2003.04	0.1347	0.0429	0.0666	0.1383	0.1117	0.1461	0.1602	0.1138	0.1012
2004.01	0.0673	0.0402	0.0627	-0.0143	0.0201	0.0700	0.0628	0.0868	-0.0234
2004.02	-0.0509	0.0460	0.0666	0.0287	-0.0157	0.0037	-0.0254	0.0098	0.0082
2004.03	-0.0304	0.0430	0.0645	0.0131	-0.0318	-0.0332	-0.0230	-0.0645	-0.0193
2004.04	0.2372	0.0417	0.0619	0.1351	0.0758	0.1175	0.1092	0.0901	0.1490
2005.01	-0.1135	0.0430	0.0597	-0.0127	-0.0351	0.0068	0.0286	-0.1307	0.0123
2005.02	-0.0251	0.0416	0.0597	0.0417	0.0038	0.0356	0.0385	0.0268	-0.0172
2005.03	0.0597	0.0421	0.0598	0.0208	0.0251	0.0318	0.0782	0.0265	0.0091
2005.04	-0.0745	0.0449	0.0634	0.0108	0.0203	0.0136	0.0628	0.0273	-0.0004
2006.01	0.1065	0.0457	0.0631	0.0753	0.0408	0.1117	0.1417	0.0734	0.0376
2006.02	-0.0327	0.0507	0.0674	-0.0299	-0.0211	-0.0277	-0.0679	-0.0985	0.0351
2006.03	0.0527	0.0490	0.0659	0.0546	0.0755	0.0078	-0.0221	0.0224	0.0398
2006.04	0.2000	0.0463	0.0628	0.0759	0.0787	0.1048	0.0448	0.0854	0.0935
2007.01	0.0547	0.0468	0.0630	0.0006	-0.0089	-0.0025	0.0051	-0.0064	-0.0127
2007.02	0.0187	0.0485	0.0649	0.0483	0.0544	0.0467	0.0269	0.0776	0.0758
2007.03	-0.1472	0.0473	0.0663	-0.0036	-0.0219	-0.0076	-0.0750	0.0256	-0.0877
2007.04	-0.0404	0.0426	0.0651	-0.1423	-0.0773	-0.0422	-0.0630	-0.0369	-0.1418
2008.01	-0.0112	0.0366	0.0675	-0.1422	-0.1234	-0.0738	-0.0955	-0.0573	-0.0337
2008.02	-0.1440	0.0389	0.0699	-0.0662	-0.0578	0.0523	-0.0792	-0.0201	-0.0072
2008.03	0.0093	0.0386	0.0721	-0.1470	-0.0663	-0.1043	-0.0715	-0.0614	-0.0089
2008.04	-0.5726	0.0325	0.0884	-0.2672	-0.2235	-0.2246	-0.2496	-0.2343	-0.2241
2009.01	-0.3067	0.0274	0.0821	-0.1900	-0.0865	-0.0527	-0.0540	-0.0053	-0.1608
2009.02	0.3316	0.0331	0.0798	0.2644	0.1602	0.1862	0.2368	0.1506	0.1451
2009.03	0.2702	0.0352	0.0666	0.1887	0.1609	0.1552	0.1745	0.1336	0.1843
2009.04	0.0290	0.0346	0.0633	0.0438	0.0341	0.0772	0.0484	0.0300	0.0366
2010.01	0.6656	0.0372	0.0629	0.0728	0.0470	0.0681	0.0870	0.0581	0.1229
2010.02	-0.1178	0.0349	0.0618	-0.1154	-0.1077	-0.0938	-0.0875	-0.0734	-0.0774
2010.03	0.1571	0.0279	0.0578	0.0785	0.1311	0.0832	0.1882	0.1007	0.1119
2010.04	0.2838	0.0286	0.0591	0.0849	0.1036	0.1464	0.1427	0.1175	0.1342
2011.01	-0.0924	0.0346	0.0609	0.0694	0.0541	0.0683	-0.0110	0.0825	0.0855
2011.02	-0.0522	0.0321	0.0585	0.0040	0.0159	-0.0164	0.0132	0.0344	0.0070
2011.03	-0.3680	0.0243	0.0546	-0.2042	-0.1517	-0.1869	-0.1876	-0.1874	-0.1913
2011.04	0.4277	0.0205	0.0525	0.1214	0.1092	0.1530	0.1421	0.0836	0.1494
2012.01	0.1311	0.0624	0.1643	0.0907	0.1304	0.1245	0.1260	0.0268	0.1156

Using the return data in Exhibit A, we wish to determine the extent to which this REIT's actual performance is replicable using the Solver subroutine in Microsoft's Excel software to reveal the implicit management style of the REIT.

Step 1: Open the Excel Spreadsheet and using the information given in Exhibit A, perform the following operations (an example of what your spreadsheet should resemble follows):
Enter your returns in column B through column J after the third row
Put the initial weights above each return column excluding the REIT return column. Set each weight equal to 1/n where n = 8 asset classes or 1/8 (.125). Notice that the weights sum to 1 and that each weight is between 0 and 1.

	A	B	C	D	E	F	G	H	I	J	K	L
1											R(Sqrd)	1-R(Sqrd)
2		**Weights**	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.0000	1.000
3	Date	Hotel REIT	Rtn(10YTB)	Rtn(BBB)	Rtn(DC)	Rtn(NYC)	Rtn(LA)	Rtn(Miami)	Rtn(Boston)	Rtn(Phil)	Residual	$(Y_i - Y(Avg))^2$
4	1999.02	0.0096	0.0554	0.0774	0.0562	0.0593	0.1028	0.1783	0.0540	0.1870	0.007522	0.002804601
5	1999.03	-0.1111	0.0588	0.0810	-0.0794	-0.0826	-0.0704	-0.2257	-0.0112	-0.0847	0.003522	0.030149046
6	1999.04	0.0360	0.0614	0.0824	0.1505	0.1328	0.1700	0.2175	0.4068	0.0998	0.016677	0.000703506
7	2000.01	0.0360	0.0648	0.0833	-0.0298	0.0228	0.1520	0.1084	0.1066	-0.0887	0.00027	0.000703507
8	2000.02	0.1235	0.0618	0.0859	-0.0447	-0.0304	-0.0812	-0.2324	0.0059	-0.1365	0.028889	0.00371811

Set cell K2 equal to K27 (=K27) and set cell L2 equal to L27 (=L27)

	A	B	C	D	E	F	G	H	I	J	K	L
1											R(Sqrd)	1-R(Sqrd)
2		**Weights**	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	=K27	=L27
3	Date	Hotel REIT	Rtn(10YTB)	Rtn(BBB)	Rtn(DC)	Rtn(NYC)	Rtn(LA)	Rtn(Miami)	Rtn(Boston)	Rtn(Phil)	Residual	$(Y_i - Y(Avg))^2$
4	1999.02	0.0096	0.0554	0.0774	0.0562	0.0593	0.1028	0.1783	0.0540	0.1870	0.007522	0.002804601
5	1999.03	-0.1111	0.0588	0.0810	-0.0794	-0.0826	-0.0704	-0.2257	-0.0112	-0.0847	0.003522	0.030149046

In cell B25 (column B, row 25), use the AVERAGE command in excel to calculate the average REIT return (average of column B) of cell B4 through cell B23

	A	B	C	D	E	F	G	H	I	J	K	L
22	2003.04	0.1347	0.0429	0.0666	0.1383	0.1117	0.1461	0.1602	0.1138	0.1012	0.000603748	0.006865983
23	2004.01	0.0673	0.0402	0.0627	-0.0143	0.0201	0.0700	0.0628	0.0868	-0.0234	0.000853432	0.000700514
24										**SumWts**	**SS(Resid)**	**SS(Total)**
25	Mean of Y	=AVERAGE(B4:B23)								1.0000	0.162731429	0.145634354
26											**R-Sqd**	**1-Rsqd**
27											0.0000	1.000

In cell K4 (column K, row 4) subtract the sum of the weights multiplied by the returns on each asset (index) class from the REIT return in cell B4. Square this difference e.g., input into cell K4 the following:
=(B4-($C$2*C4+$D$2*D4+$E$2*E4+$F$2*F4+$G$2*G4+$H$2*H4+$I$2*I4+$J$2*J4))^2

In cell L4 (column L, row 4), subtract the REIT return in cell B4 from the average (mean) of the REIT return that is located in cell B25 (cell B25 =AVERAGE(B4:B23)) . Square this difference e.g., input into cell L4 the following:
=(B4-$B$25)^2

	E	F	G	H	I	J	K	L
1							R(Sqrd)	1-R(Sqrd)
2	0.125	0.125	0.125	0.125	0.125	0.125	0.0000	1.000
3	Rtn(DC)	Rtn(NYC)	Rtn(LA)	Rtn(Miami)	Rtn(Boston)	Rtn(Phil)	Residual	$(Y_i - Y(Avg))^2$
4	0.0562	0.0593	0.1028	0.1783	0.0540	0.1870	=(B4-($C$2*C4+$D$2*D4+$E$2*E4+$F$2*F4+$G$2*G4+$H$2*H4+$I$2*I4+$J$2*J4))^2	=(B4-$B$25)^2

Copy and paste the contents of cell K4 into cell K5 through cell K23. Using the same logic process, copy and paste the contents of cell L4 into cell L5 through cell L23.

In cell J25 (column J, row 25), use the SUM command in excel to sum the weights located in cell C2 through cell J2. Recall that the sum of the weights equal 1 (w1 + w2 + …. + wN = 1).

	A	B	C	D	E	F	G	H	I	J	K	L
22	2003.04	0.1347	0.0429	0.0666	0.1383	0.1117	0.1461	0.1602	0.1138	0.1012	0.000603748	0.00674798
23	2004.01	0.0673	0.0402	0.0627	-0.0143	0.0201	0.0700	0.0628	0.0868	-0.0234	0.000853432	0.000626148
24										SumWts	SS(Resid)	SS(Total)
25	Mean of Y	0.0625								=SUM(C2:J2)	0.162731429	0.145154711
26											R-Sqd	1-Rsqd
27											0.0000	1.000

In cell K25, use the SUM command in excel to sum the residuals that you calculated in cell K4 through cell K23. In a similar fashion, in cell L25, use the SUM command in excel to sum the squared differences that you calculated in cell L4 through cell L23.

	A	B	C	D	E	F	G	H	I	J	K	L
22	2003.04	0.1347	0.0429	0.0666	0.1383	0.1117	0.1461	0.1602	0.1138	0.1012	0.000603748	0.00674798
23	2004.01	0.0673	0.0402	0.0627	-0.0143	0.0201	0.0700	0.0628	0.0868	-0.0234	0.000853432	0.000626148
24										SumWts	SS(Resid)	SS(Total)
25	Mean of Y	0.0625								1.0000	=SUM(K4:K23)	=SUM(L4:L23)
26											R-Sqd	1-Rsqd
27											0.0000	1.000

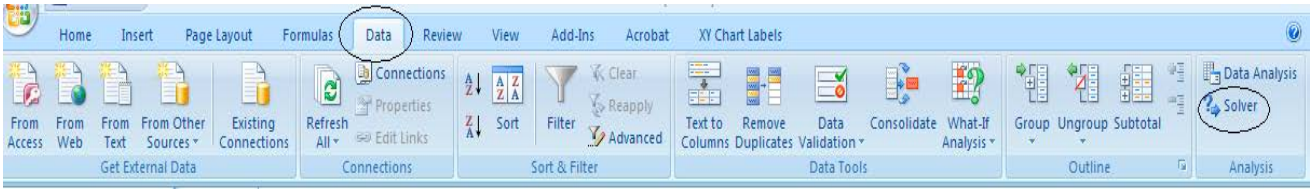
• In cell K27, calculate the R-squared (the percentage of the variation in REIT returns that our set of cash, bond, and MSA equity indices accounts for). R-squared is calculated as 1 minus the ratio of the sum of squared residuals (SS(Resid)) located in cell K25 to the sum of squared total (SS(Total)) located in cell L25. In cell L27, calculate 1 minus the R-squared which is equal to the portion of the REIT return that reflects management's value added arising from their active management strategies such as changes in their rental rates, acquisitions and/or dispositions of properties, etc (portion of the return that is not attributable to the cash, bond, and MSA indices).

	A	B	C	D	E	F	G	H	I	J	K	L
22	2003.04	0.1347	0.0429	0.0666	0.1383	0.1117	0.1461	0.1602	0.1138	0.1012	0.000603748	0.00674798
23	2004.01	0.0673	0.0402	0.0627	-0.0143	0.0201	0.0700	0.0628	0.0868	-0.0234	0.000853432	0.000626148
24										SumWts	SS(Resid)	SS(Total)
25	Mean of Y	0.0625								1.0000	0.162731429	0.145154711
26											R-Sqd	1-Rsqd
27											=IF(1-(K25/L25)<0,0,1-(K25/L25))	=1-K27

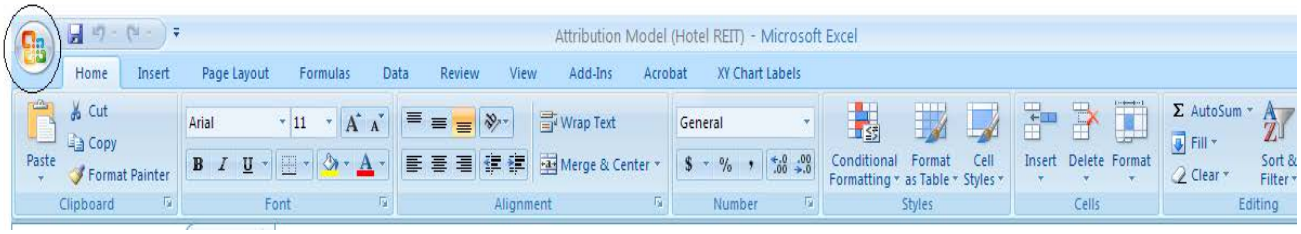
Following is what your completed spreadsheet should look like using 5 years of quarterly returns (20 quarters of data):

	A	B	C	D	E	F	G	H	I	J	K	L
1											R(Sqrd)	1-R(Sqrd)
2		**Weights**	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.0000	1.000
3	Date	Hotel REIT	Rtn(10YTB)	Rtn(BBB)	Rtn(DC)	Rtn(NYC)	Rtn(LA)	Rtn(Miami)	Rtn(Boston)	Rtn(Phil)	Residual	$(Y_i - Y(Avg))^2$
4	1999.02	0.0096	0.0554	0.0774	0.0562	0.0593	0.1028	0.1783	0.0540	0.1870	0.007522004	0.002804601
5	1999.03	-0.1111	0.0588	0.0810	-0.0794	-0.0826	-0.0704	-0.2257	-0.0112	-0.0847	0.00352209	0.031124756
6	1999.04	0.0360	0.0614	0.0824	0.1505	0.1328	0.1700	0.2175	0.4068	0.0998	0.016677489	0.001478376
7	2000.01	0.0360	0.0648	0.0833	-0.0298	0.0228	0.1520	0.1084	0.1066	-0.0887	0.000269939	0.001647203
8	2000.02	0.1235	0.0618	0.0859	-0.0447	-0.0304	-0.0812	-0.2324	0.0059	-0.1365	0.028889347	0.001982641
9	2000.03	0.1366	0.0589	0.0832	-0.0264	0.0288	0.0604	0.0270	0.1325	-0.0438	0.009303222	0.003643512
10	2000.04	-0.0429	0.0557	0.0821	-0.1764	-0.0218	-0.2549	-0.1590	-0.2974	0.0282	0.0025023	0.013244047
11	2001.01	0.0211	0.0505	0.0788	-0.1078	-0.1015	-0.1554	-0.0702	-0.3610	-0.0833	0.013193254	0.002974754
12	2001.02	0.1236	0.0527	0.0804	0.0492	0.0760	0.1276	0.3145	0.0999	0.1274	5.90611E-05	0.003224775
13	2001.03	-0.0700	0.0498	0.0795	-0.1405	-0.1050	-0.2900	-0.2558	-0.3356	-0.1625	0.005625532	0.017162787
14	2001.04	0.0889	0.0477	0.0792	0.0693	0.1059	0.2230	0.1558	0.2566	0.1170	0.001842677	0.000433278
15	2002.01	0.1719	0.0508	0.0796	-0.0532	-0.0288	0.0187	-0.0421	-0.0595	0.0273	0.029868073	0.01031219
16	2002.02	-0.0185	0.0510	0.0802	-0.0711	-0.1743	-0.1346	-0.1482	-0.2440	-0.0945	0.005398541	0.007479472
17	2002.03	0.0000	0.0426	0.0763	-0.1457	-0.1637	-0.1712	-0.1768	-0.2267	-0.1848	0.014102677	0.004407898
18	2002.04	0.0864	0.0401	0.0760	0.0579	0.1097	0.0473	0.0786	0.1937	0.0897	5.9341E-08	0.000345161
19	2003.01	0.0818	0.0392	0.0712	-0.0329	-0.0383	0.0145	-0.0489	-0.0110	-0.0676	0.008278874	0.000131718
20	2003.02	0.2104	0.0362	0.0647	0.1506	0.1536	0.1730	0.3162	0.2796	0.1505	0.002014167	0.022584395
21	2003.03	0.1652	0.0423	0.0681	0.0600	-0.0046	0.0658	0.0853	0.0932	0.0277	0.012204943	0.01279902
22	2003.04	0.1347	0.0429	0.0666	0.1383	0.1117	0.1461	0.1602	0.1138	0.1012	0.000603748	0.00674798
23	2004.01	0.0673	0.0402	0.0627	-0.0143	0.0201	0.0700	0.0628	0.0868	-0.0234	0.000853432	0.000626148
24										**SumWts**	**SS(Resid)**	**SS(Total)**
25	Mean of Y	0.0625								1.0000	0.162731429	0.145154711
26											**R-Sqd**	**1-Rsqd**
27											0.0000	1.000

Step 2: Click on the **Data** tab in Excel 2007 and select the **Solver** option (see circled areas below).

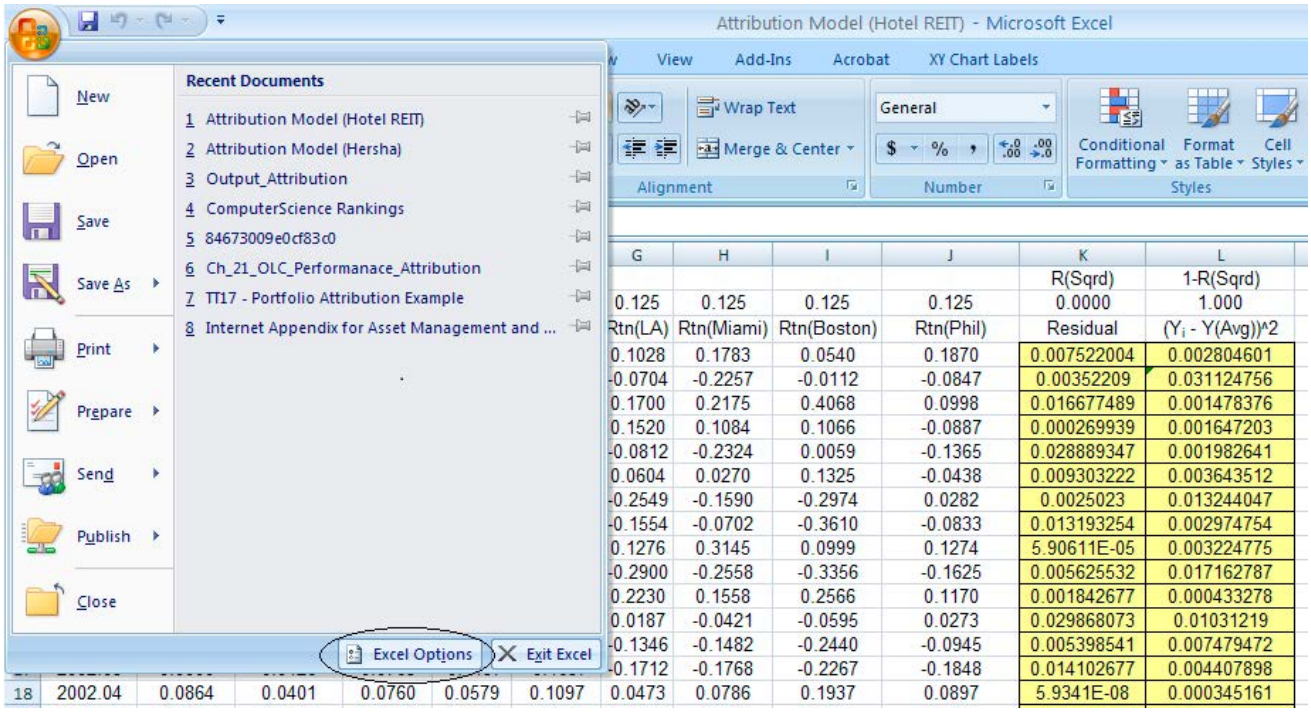


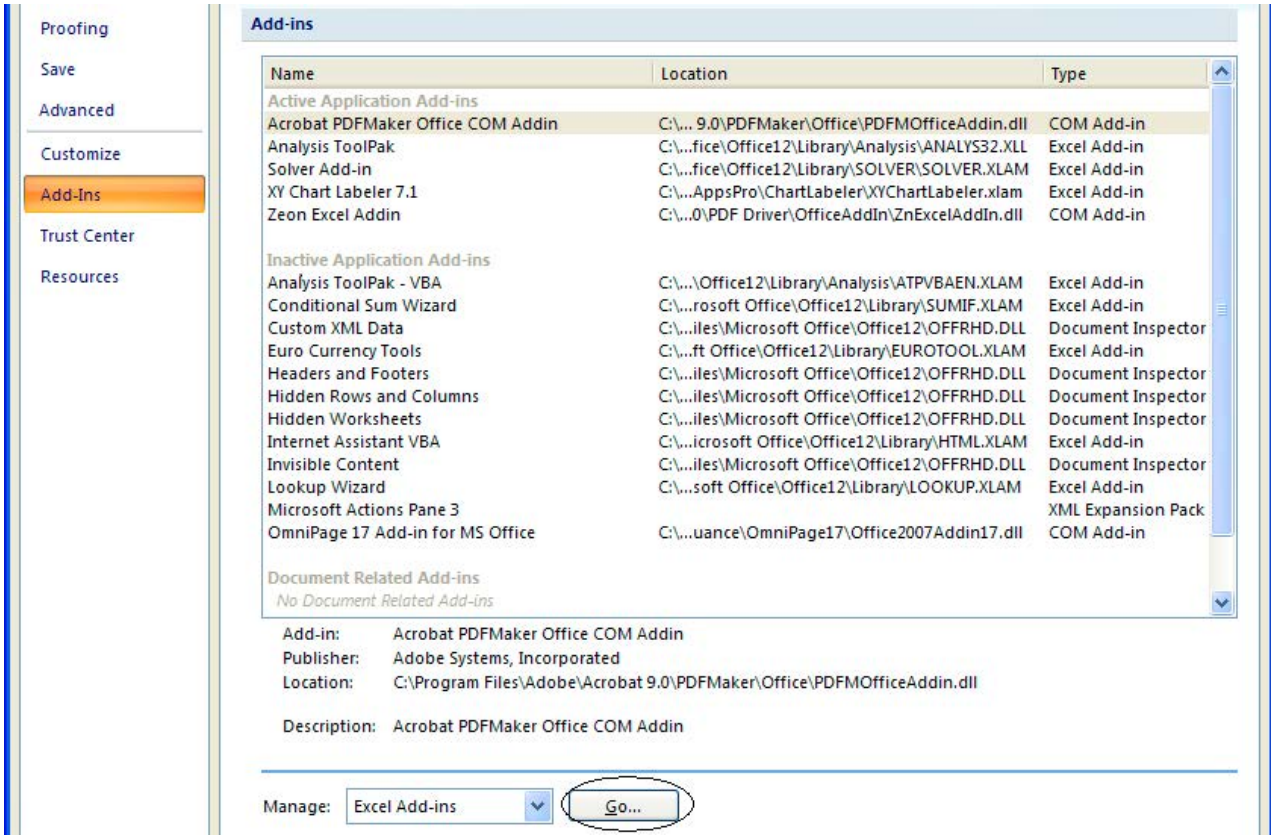
If you do not see the **Solver** option, you will need to install it using the following procedure. Click on the **Office Button** located in the upper left corner of the Excel 2007 spreadsheet.



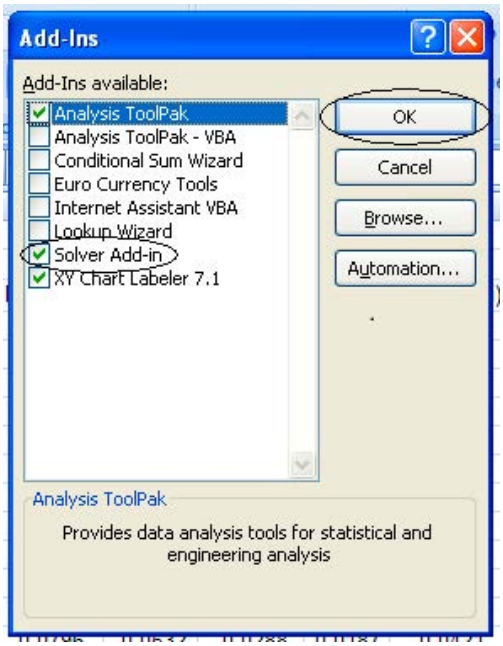
You should see the following window. At the bottom of this window, click on the button labeled **Excel Options**.

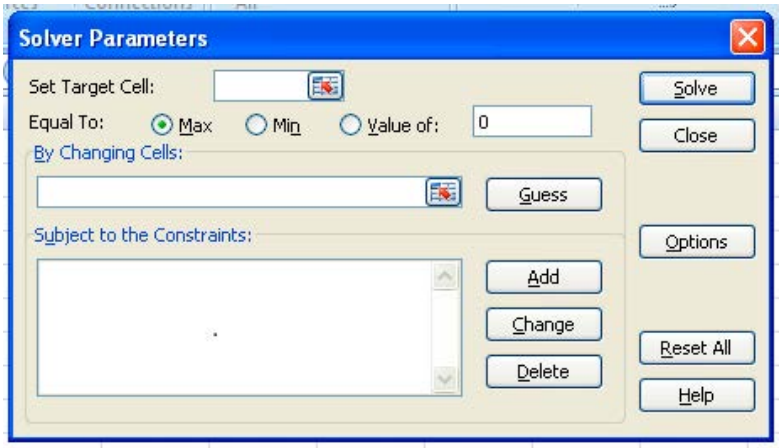
Click on **Add-Ins** located in the left side box. The following box should now appear. At the bottom of the page, click on the **Go...** button.





This should bring up the **Add-Ins** box. Select the **Solver Add-in** box by clicking in the box next to it and then click the OK button. When you now click on the **Data** tab you should now see the **Solver** option (see circled areas below). Clicking on the Solver subroutine should bring up the following box





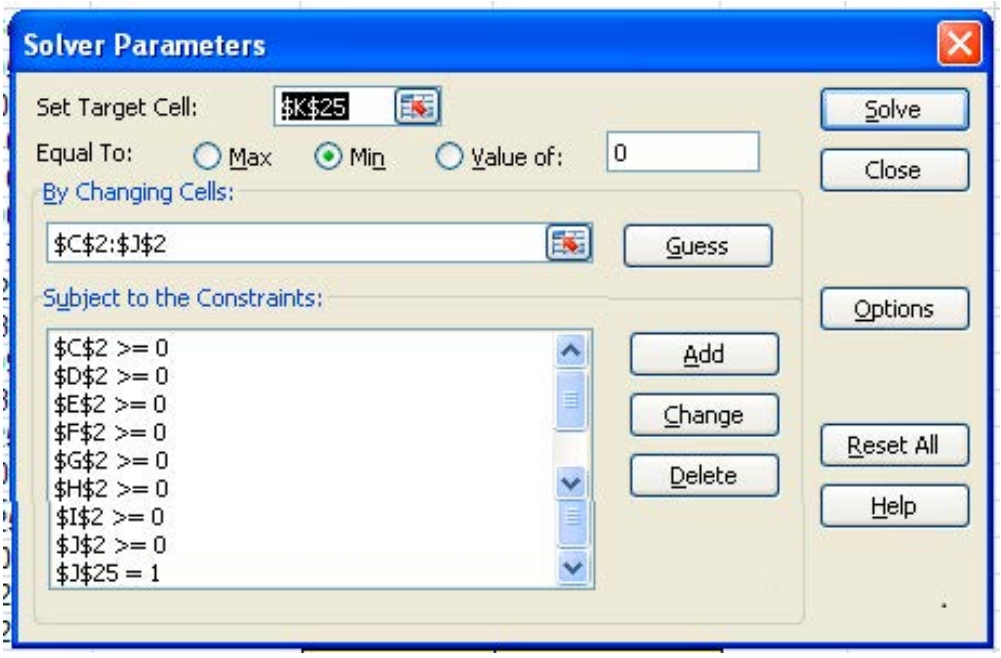
Fill in the boxes as follows:

Set Target Cell: $K$25 The target cell is the cell you're minimizing
Equal to: ⊙ Min (You're minimizing the sum of the squared residuals)
By Changing Cells: $C$2:$J$2 (These are the cells containing the initial weights = .125)

Subject to the Constraints: $J$25 = 1 Note: you need to click on the **Add** button to add this constraint. The cell reference is $J$25, pull down the arrow and choose =, then type 1 in the constraint: box. Click on the **OK** button.

$C$2 => 0	The % invested in Cash (10 Year Treasury bond) is ≥ 0
$D$2 => 0	The % invested in BBB Investment Grade Corporate Bond is ≥ 0
$E$2 => 0	The % invested in a portfolio of Washington DC stocks is ≥ 0
$F$2 => 0	The % invested in a portfolio of New York City stocks is ≥ 0
$G$2 => 0	The % invested in a portfolio of Los Angeles stocks is ≥ 0
$H$2 => 0	The % invested in a portfolio of Miami stocks is ≥ 0
$I$2 => 0	The % invested in a portfolio of Boston stocks is ≥ 0
$J$2 => 0	The % invested in a portfolio of Philadelphia stocks is ≥ 0

The result should resemble the following:



Click on the **Solve** button should yield the following output with the revised set of weights which minimize the sum of squared residuals:

	A	B	C	D	E	F	G	H	I	J	K	L
1											R(Sqrd)	1-R(Sqrd)
2		Weights	0	0.651256	0.02253	0	0.2112	0.11497	0	0	0.3913	0.609
3	Date	Hotel REIT	Rtn(10YTB)	Rtn(BBB)	Rtn(DC)	Rtn(NYC)	Rtn(LA)	Rtn(Miami)	Rtn(Boston)	Rtn(Phil)	Residual	$(Y_i - Y(Avg))^2$
4	1999.02	0.0096	0.0554	0.0774	0.0562	0.0593	0.1028	0.1783	0.0540	0.1870	0.007111894	0.002804601
5	1999.03	-0.1111	0.0588	0.0810	-0.0794	-0.0826	-0.0704	-0.2257	-0.0112	-0.0847	0.014700585	0.031124756
6	1999.04	0.0360	0.0614	0.0824	0.1505	0.1328	0.1700	0.2175	0.4068	0.0998	0.006719411	0.001478376
7	2000.01	0.0360	0.0648	0.0833	-0.0298	0.0228	0.1520	0.1084	0.1066	-0.0887	0.003864471	0.001647203
8	2000.02	0.1235	0.0618	0.0859	-0.0447	-0.0304	-0.0812	-0.2324	0.0059	-0.1365	0.012639079	0.001982641
9	2000.03	0.1366	0.0589	0.0832	-0.0264	0.0288	0.0604	0.0270	0.1325	-0.0438	0.004500898	0.003643512
10	2000.04	-0.0429	0.0557	0.0821	-0.1764	-0.0218	-0.2549	-0.1590	-0.2974	0.0282	0.000412356	0.013244047
11	2001.01	0.0211	0.0505	0.0788	-0.1078	-0.1015	-0.1554	-0.0702	-0.3610	-0.0833	0.000172524	0.002974754
12	2001.02	0.1236	0.0527	0.0804	0.0492	0.0760	0.1276	0.3145	0.0999	0.1274	5.01576E-05	0.003224775
13	2001.03	-0.0700	0.0498	0.0795	-0.1405	-0.1050	-0.2900	-0.2558	-0.3356	-0.1625	0.000781021	0.017162787
14	2001.04	0.0889	0.0477	0.0792	0.0693	0.1059	0.2230	0.1558	0.2566	0.1170	0.000857585	0.000433278
15	2002.01	0.1719	0.0508	0.0796	-0.0532	-0.0288	0.0187	-0.0421	-0.0595	0.0273	0.014929675	0.01031219
16	2002.02	-0.0185	0.0510	0.0802	-0.0711	-0.1743	-0.1346	-0.1482	-0.2440	-0.0945	0.000558492	0.007479472
17	2002.03	0.0000	0.0426	0.0763	-0.1457	-0.1637	-0.1712	-0.1768	-0.2267	-0.1848	0.000102149	0.004407898
18	2002.04	0.0864	0.0401	0.0760	0.0579	0.1097	0.0473	0.0786	0.1937	0.0897	0.000274298	0.000345161
19	2003.01	0.0818	0.0392	0.0712	-0.0329	-0.0383	0.0145	-0.0489	-0.0110	-0.0676	0.001496421	0.000131718
20	2003.02	0.2104	0.0362	0.0647	0.1506	0.1536	0.1730	0.3162	0.2796	0.1505	0.008463423	0.022584395
21	2003.03	0.1652	0.0423	0.0681	0.0600	-0.0046	0.0658	0.0853	0.0932	0.0277	0.009180531	0.01279902
22	2003.04	0.1347	0.0429	0.0666	0.1383	0.1117	0.1461	0.1602	0.1138	0.1012	0.001511379	0.00674798
23	2004.01	0.0673	0.0402	0.0627	-0.0143	0.0201	0.0700	0.0628	0.0868	-0.0234	2.30031E-05	0.000626148
24										SumWts	SS(Resid)	SS(Total)
25	Mean of Y	0.0625								1.0000	0.088349351	0.145154711
26											R-Sqd	1-Rsqd
27											0.3913	0.609

These are the weights associated with 2004Q1. To calculate the weights for 2004Q2, replace cell A4 through cell J23 with return data from 1999.03 through 2004.02 e.g., replace 1999Q2 – 2004Q1 with 1999Q3 – 2004Q2. We are dropping one quarter and adding one quarter of data so that we are using a 5 year (20 quarter) moving window.

To calculate the weights for 2004Q2, your new setup should resemble the following:

	A	B	C	D	E	F	G	H	I	J	K	L
1											R(Sqrd)	1-R(Sqrd)
2		**Weights**	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.0000	1.000
3	Date	Hotel REIT	Rtn(10YTB)	Rtn(BBB)	Rtn(DC)	Rtn(NYC)	Rtn(LA)	Rtn(Miami)	Rtn(Boston)	Rtn(Phil)	Residual	$(Y_i - Y(Avg))^2$
4	1999.03	-0.1111	0.0588	0.0810	-0.0794	-0.0826	-0.0704	-0.2257	-0.0112	-0.0847	0.00352209	0.029107559
5	1999.04	0.0360	0.0614	0.0824	0.1505	0.1328	0.1700	0.2175	0.4068	0.0998	0.016677489	0.001054801
6	2000.01	0.0360	0.0648	0.0833	-0.0298	0.0228	0.1520	0.1084	0.1066	-0.0887	0.000269939	0.001136665
7	2000.02	0.1235	0.0618	0.0859	-0.0447	-0.0304	-0.0812	-0.2324	0.0059	-0.1365	0.028889347	0.00269491
8	2000.03	0.1366	0.0589	0.0832	-0.0264	0.0288	0.0604	0.0270	0.1325	-0.0438	0.009303222	0.004626438
9	2000.04	-0.0429	0.0557	0.0821	-0.1764	-0.0218	-0.2549	-0.1590	-0.2974	0.0282	0.0025023	0.0114917
10	2001.01	0.0211	0.0505	0.0788	-0.1078	-0.1015	-0.1554	-0.0702	-0.3610	-0.0833	0.013193254	0.002530664
11	2001.02	0.1236	0.0527	0.0804	0.0492	0.0760	0.1276	0.3145	0.0999	0.1274	5.90611E-05	0.002806628
12	2001.03	-0.0700	0.0498	0.0795	-0.1405	-0.1050	-0.2900	-0.2558	-0.3356	-0.1625	0.005625532	0.015627224
13	2001.04	0.0889	0.0477	0.0792	0.0693	0.1059	0.2230	0.1558	0.2566	0.1170	0.001842677	0.000718951
14	2002.01	0.1719	0.0508	0.0796	-0.0532	-0.0288	0.0187	-0.0421	-0.0595	0.0273	0.029868073	0.012855073
15	2002.02	-0.0185	0.0510	0.0802	-0.0711	-0.1743	-0.1346	-0.1482	-0.2440	-0.0945	0.005398541	0.005443867
16	2002.03	0.0000	0.0426	0.0763	-0.1457	-0.1637	-0.1712	-0.1768	-0.2267	-0.1848	0.014102677	0.004310604
17	2002.04	0.0864	0.0401	0.0760	0.0579	0.1097	0.0473	0.0786	0.1937	0.0897	5.9341E-08	0.000556236
18	2003.01	0.0818	0.0392	0.0712	-0.0329	-0.0383	0.0145	-0.0489	-0.0110	-0.0676	0.008278874	0.000543691
19	2003.02	0.2104	0.0362	0.0647	0.1506	0.1536	0.1730	0.3162	0.2796	0.1505	0.002014167	0.022264314
20	2003.03	0.1652	0.0423	0.0681	0.0600	-0.0046	0.0658	0.0853	0.0932	0.0277	0.012204943	0.015044641
21	2003.04	0.1347	0.0429	0.0666	0.1383	0.1117	0.1461	0.1602	0.1138	0.1012	0.000603748	0.009449007
22	2004.01	0.0673	0.0402	0.0627	-0.0143	0.0201	0.0700	0.0628	0.0868	-0.0234	0.000853432	0.000750218
23	2004.02	-0.0509	0.0460	0.0666	0.0287	-0.0157	0.0037	-0.0254	0.0098	0.0082	0.004380268	0.007252367
24										**SumWts**	**SS(Resid)**	**SS(Total)**
25	Mean of Y	0.0595								1.0000	0.159589692	0.150265558
26											**R-Sqd**	**1-Rsqd**
27											0.0000	1.000

Step 3: Calculating the return on the benchmark portfolio. Recall that the return on a portfolio is

$R_t = w_{1t}R_{1t} + w_{2t}R_{2t} + w_{3t}R_{3t} + \ldots. + w_{Nt}R_{Nt}$

where w_{jt} j = 1,…. N represents the weights on the 1st through N^{th} indices.

R_{jt} j=1,…., N represents the returns on the 1st through Nth indices; N is the total number of passive benchmark indices. N = 8 indices in our example. From our example, the weights for the first quarter, 2004Q1 are

	Portfolio Weights from Attribution Analysis							
	10YrTBond	BBB Bond	DC	NYC	LA	MIA	BOS	PHIL
2004.01	0.000	0.651	0.023	0.000	0.211	0.115	0.000	0.000

And the corresponding returns on the 8 indices for the *subsequent* quarter, 2004Q2, are

	Returns on Eight Indices							
	Rtn(10YTB)	Rtn(BBB)	DC	NYC	LA	MIA	BOS	PHIL
2004.02	0.0460	0.0666	0.0023	-0.0020	-0.0944	-0.0435	0.0084	0.0073

So it follows given the formula above that the return on the benchmark portfolio for 2004Q2 is 1.85%.

	10YrTBond	BBB Bond	DC	NYC	LA	MIA	BOS	PHIL
Wts (2004Q1)	0.000	0.651	0.023	0.000	0.211	0.115	0.000	0.000
* Rtns (2004Q2)	0.0460	0.0666	0.0023	-0.0020	-0.0944	-0.0435	0.0084	0.0073
WtdRtn (2004Q2)	0.000	0.043	0.000	0.000	-0.020	-0.005	0.000	0.000
Sum(WtdRtn)	0.0185							

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