Forecast From The Past

Many planners may not fully understand the limitations of traditional estimation methods when using historical data to create an optimized portfolio.

By Richard O. Michaud and C. Michael Carty

Financial planners are concerned with defining and maintaining an optimal or efficient asset mix for their clients. Estimates of the returns and levels of risk used as inputs to determine optimal weighting of individual assets are typically based on historical series of returns over some recent or appropriate time period. The historical estimated inputs usually include the average return of each asset class, its variability or variance, and correlation or covariance with other classes.

Many financial planners may not fully understand the limitations of traditional input estimation methods, and the impact those limitations can impose, on optimized asset allocations. They often rely on an optimizer's "black box" for the estimation of returns, volatility and correlations for assets in the study. This is unfortunate, as well as unnecessary, since current modern estimation methods are theoretically superior and often lead to dramatically different and better performing optimized portfolios.

The most popular and useful Stein method for defining inputs for an asset allocation study is probably the James-Stein estimator (named after Charles Stein, a pioneer in modern multivariate statistical estimation). It uses information in the group of return estimates to improve the estimates for each asset. For example, the global mean or average of the estimated returns of all the assets is a useful reference point to determine whether a given estimate is normal or extreme. Intuitively, a return estimate far from the global mean may not be as reliable a forecast as one closer to the average. This is because assets with extreme returns often revert back to less extreme returns in the following period. Another consideration is the variability of the return estimate. An extreme estimate with a small variance may be less likely to revert to the mean than one with a large variance.

The James-Stein estimator considers all these issues. The formula measures the distance of the return estimate from the global mean and the level of variability relative to other estimates. The formula adjusts the return estimate by "shrinking" it toward the global mean. The further the estimate is from the global mean and the larger the variance, the more the James-Stein estimator shrinks it toward the global mean. In many cases of practical interest the James-Stein estimator may shrink the return estimate all the way to the global mean.

Stein estimators require familiarity. While the method and results are often intuitive, they are not familiar. This is because the investment community has

Illustration: SIS/Michael Aveto

Figure 1

Averages and Standard Deviations (%)

Annualized Monthly U.S. Dollar (net) Return Premiums
January 1978 - December 1995

The data for five equity markets—Canada, France, Germany, Japan and the United Kingdom—are Morgan Stanley Capital International U.S. dollar total return indexes net of withholding taxes. S&P 500 Index total returns are the U.S. equity data. The 30-day T-bill returns are from Salomon Brothers. The two bond data indexes are the Lehman Brothers government/corporate U.S. bond index and U.S. dollar Eurobond global index. The Lehman Brothers Eurobond Global Index was available from January 1978 to November 1994. The Eurobond returns for the remaining months were from Lehman Brothers Eurobond Global Issues Index. The limited availability of long-term Eurobond returns governed the choice of time period used in this example.

	Canada	France	Germany	Japan	U.K.	U.S.	Bonds	Euros
Returns	4.6	10.5	6.4	10.5	9.5	8.5	3.0	3.2
Risk	19.0	24.4	21.5	24.4	20.8	14.9	7.0	5.4

Source: R. Michaud, Efficient Asset Management, *Harvard Business School Press, Boston*

largely ignored modern statistics in asset management practice. This is indeed unfortunate. Many modern methods in statistics have the potential for substantially enhancing the value financial planners can bring to asset allocation decisions.

Some issues need further clarification. The James-Stein return estimate is not a better way to describe historical data. Its purpose is to optimally forecast return from historical data. This is the reason why the James-Stein estimator, and not the historical average, is the input of choice for defining an optimal asset mix. Also, the James-Stein estimator is designed to realistically use the information in historical data. This can lead to surprising results. If a return estimate has little forecast information, the James-Stein estimator may shrink the return forecast to the global mean. Interestingly, shrinkage to the global mean often happens in practice. This is because pure historical data often has little useful forecast information.

The James-Stein estimator can be viewed as a theoretically valid approach to understanding and forecasting "reversal to the mean." This effect is very common in experience. The "rookie of the year" often has a "sophomore slump." The sophomore slump is very often evident in finance. The security, fund, manager or asset class that performs well above average in one time period often does far less well in a subsequent one. Stein estimators provide the proper theoretical framework to make adjustments suitable for forecasting.

The James-Stein estimator can be readily applied to historical return data that may be used in a global asset allocation study. To illustrate, the data in Figure 1 provide the average returns and standard deviations for eight large asset classes. These are the Canadian, French, German, Japanese, U.K. and U.S. equity markets and U.S. corporate/government bonds and Eurobonds. The data represent 18 years of monthly returns (216 monthly returns) in U.S. dollars adjusted for withholding taxes and the monthly risk-free rate from January 1978 to December 1995.

Over this 18-year period, the French and Japanese were the markets with superior returns (France's return was slightly higher than Japan's but is not visible due to degree of significance of the data in the table). U.S. bonds, on the other hand, had the lowest return of all eight asset classes. Note that while U.S. stocks had lower returns than France, Japan or the U.K., it also had substantially less risk.

A James-Stein estimate of the returns in Figure 1 is given in Figure 2. The perhaps surprising result is that, except for the United States, all remaining equity market returns were shrunk to the global mean. Even over an 18-year period of monthly data, there was not enough reliable information in the historical return series to forecast return differences between the five equity markets! Alternatively, the data indicate that the United States was the only market with sufficiently reliable information in the return series to be considered the superior return forecast in an asset allocation study for these eight assets. Note that the bond return estimates were not shrunk much because they have little variance.

As a further illustration, Figure 3 provides the annualized average monthly returns and standard deviations for seven well-known no-load mutual funds and one popular small-cap load fund. The chosen funds represent a broad spectrum of traditional classifications:

Figure 2

James-Stein Return Estimates (%)

Annualized Monthly U.S. Dollar (net) Return Premiums
January 1978 - December 1995

	Canada	France	Germany	Japan	U.K.	U.S.	Bonds	Euros
Returns	7.0	7.0	7.0	7.0	7.0	7.2	3.7	3.7

large-cap growth and value, mid-cap growth and value, small-cap growth and value, long-term corporate bonds and short-term U.S. Treasurys. The data span 10 years of monthly total returns (120 monthly returns) from October 1988 through September 1998.

Over this 10-year period, Fidelity Growth and Skyline Special Equities funds provided the highest returns. On the other hand, Managers Bond and Dreyfus U.S. Treasury had the lowest. Note that while Weitz Value fund had lower returns than the top two performing funds, it also had the least risk of all equity funds.

James-Stein estimates for the return data in Figure 3 are provided in Figure 4. Given the results in Figure 2, the perhaps anticipated result is that the Weitz value fund has the superior forecast return. Except for the Weitz and Lexington funds, the two with the lowest levels of risk, all remaining equity fund historical returns were shrunk to the global mean. A 10-year history of returns was not sufficient to differentiate between the performances of most of the six equity funds.

The Stein estimated returns show that traditional estimation methods are likely to yield severely misleading forecasts of return. Therefore, asset-mix studies based on these traditional methods are likely to have serious, if not fatal, investment limitations. On the other hand, the James-Stein estimated returns provide a most interesting perspective of future performance that had valuable investment information in hindsight.

Given their importance to financial planning and asset management, it may be surprising to know that James-Stein estimators are not a recent development. The original formula was given nearly 40 years ago. More recently, Stein estimators have also become available for estimating variances and correlations. Some Stein risk estimators also can be used when the number of historical periods is less than the number of assets in the optimization, a problem often encountered in optimizing large portfolios of equities.

Stein estimators represent an important set of procedures for understanding the forecast value of historical data and improving the practical value of asset allocation studies. It is hard to rationalize continued use of input estimates based on probably inferior methods. It is also increasingly hard to rationalize many ad hoc methods currently being used. On the other hand, the properties of Stein estimators show that pure historical data will often not have sufficient information for many financial planning purposes. Serious practitioners may want to devote attention to the new additional methods that are now available to improve the investment value of asset allocation studies in practice. **FP**

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Figure 3

Averages and Standard Deviations (%)

Annualized Monthly Total Returns
October 1988 - September 1998

Investment Style	Mutual Fund	Ticker Symbol	Average Return	Standard Deviation
Large-Cap Growth	Fidelity Growth	FDGRX	18.65	19.45
Large-Cap Value	Lexington Corp Leaders	LEXCX	15.57	13.86
Mid-Cap Growth	Harbor Growth	HAGWX	10.39	20.06
Mid-Cap Value	Weitz Value	WVALX	16.93	12.50
Small-Cap Growth	Hancock Emerging Growth B	TSEGX	16.11	24.44
Small-Cap Value	Skyline Special Equities	SKSEX	17.19	18.00
Long-Term Bonds	Managers Bond	MGFIX	9.76	6.34
Short-Term Treasury's	Dreyfus U.S. Treasury	DRTSX	7.45	3.28

Source: Morningstar

Figure 4

James-Stein Return Estimates (%)

Annualized Monthly Total Returns
October 1988-September 1998

Investment Style	Mutual Fund	Ticker Symbol	Average Return
Large-Cap Growth	Fidelity Growth	FDGRX	14.01
Large-Cap Value	Lexington Corp Leaders	LEXCX	14.33
Mid-Cap Growth	Harbor Growth	HAGWX	14.01
Mid-Cap Value	Weitz Value	WVALX	15.05
Small-Cap Growth	Hancock Emerging Growth B	TSEGX	14.01
Small-Cap Value	Skyline Special Equities	SKSEX	14.01
Long-Term Bonds	Managers Bond	MGFIX	10.46
Short-Term Treasurys	Dreyfus U.S. Treasury	DRTSX	7.74

Source: Morningstar