

**Portfolio Stochastic Design Scans:  
3D Efficient Frontiers**

Edward L. Stanton, Ph.D.  
CTO Emeritus  
MSC Software Corporation

**“ In the end, how your investments behave is much less important than how you behave. ”**

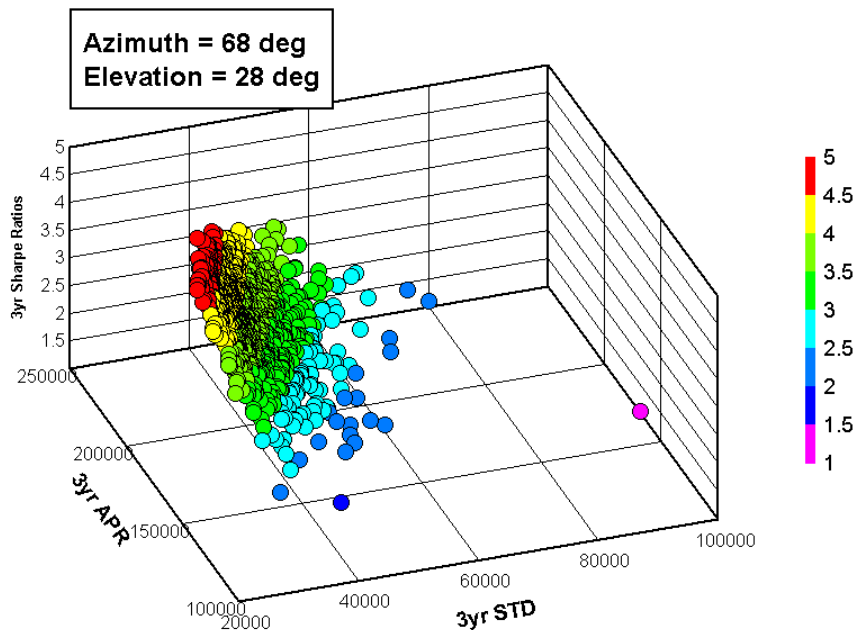
**Benjamin Graham  
The Intelligent Investor**

---

## Portfolio Efficient Frontiers in 3D

The third dimension in this White Paper is Sharpe ratio. Experience with Sharpe Ratio portfolio design continues to expand to a larger investor base and to a larger collection of funds. This expansion required more efficient PSDS access to fund data for scans and 3D scatter plots of the frontier. PSDS changes were made that allowed us to add another dimension to the efficient frontier. In the paper we compare results for 3yr, 5yr and 10yr scans and compute the return, risk and Sharpe ratio for each scan point. The images are thought to be the first published of a surface formed by a 3D cloud of stochastic design scan points.

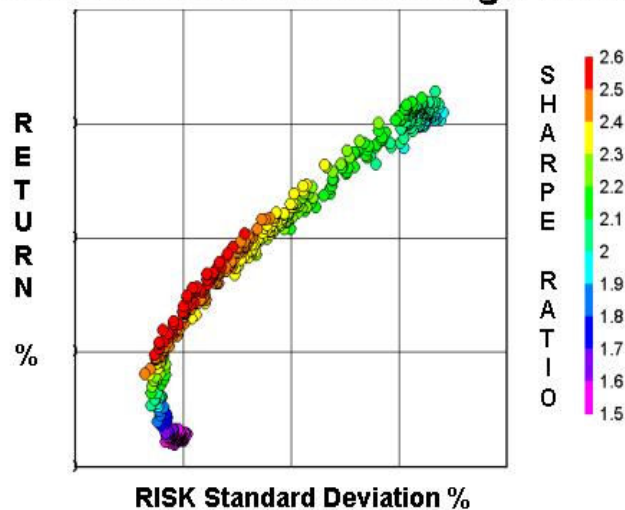
PSDS 1000 Point Design Scan for 9 Fund Portfolios



The 3D image was created using an Excel Add-In, DPLOT, for which PSDS creates 3D scan data. When you examine the equation for Sharpe ratio it clearly creates a surface in the space of the 3 coordinate axes displayed.

The same software can create 2D views in which the color of the points adds information about the Sharpe ratio of every point. That is shown in an efficient frontier graphic using only two funds, which are representative of a conventional stocks and bonds efficient frontier graphic. Note the stochastic (fuzzy) nature of the frontier that is evident. The highest Sharpe ratios are red and there are many portfolios with high risk-adjusted returns near the highest Sharpe ratio point.

### Stochastic Portfolio Design Scan 2 Funds - Balanced & Foreign Value



The issues we want to examine in the White paper are the nature of the efficient frontier over time and over other investment types. How does the frontier change over 3yr, 5yr and 10yr periods with specific attention to rebalancing and portfolio stability? Also how does the frontier change when Exchange Traded Funds (ETFs) are used in a portfolio design? We seek retirement portfolios with high risk-adjusted returns and that do not require large changes during rebalancing. Keep in mind

**that simple arithmetic says volatility kills compounding and that during retirement stability and regular distributions become as important as accumulation.**

**Although Warren Buffett likes to buy and hold forever you must take distributions at age 70.5 from your IRA portfolio. Buffett once suggested with tongue in cheek that investors might want to take Mark Twain's advice from Pudd'nhead Wilson: "Put all your eggs in one basket – and watch that basket." As long as it is Warren Buffett watching the basket that's pretty safe and I have often thought about putting everything in Berkshire stock and selling a share or two to fund annuity needs each year. That's not what this White paper is about.**

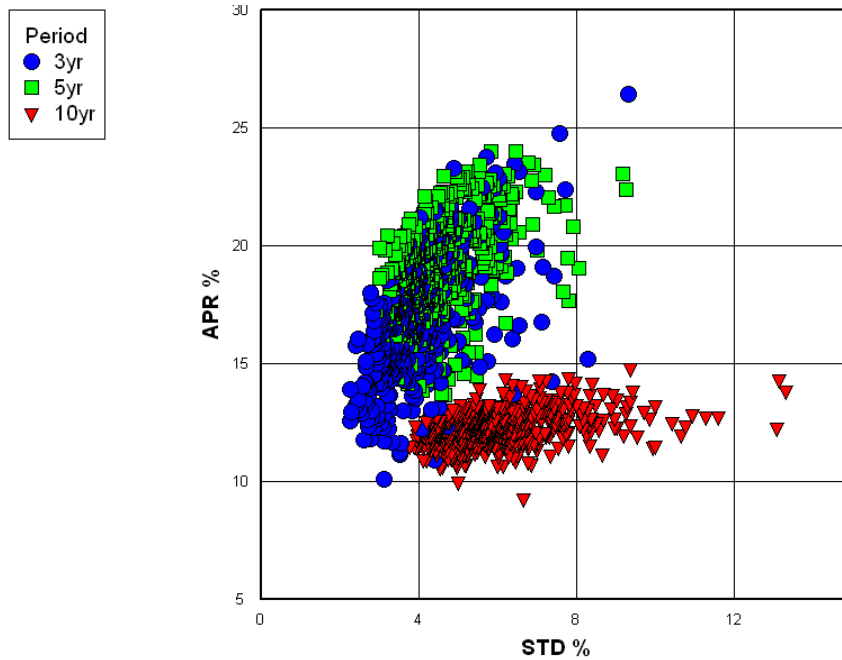
## **Portfolio Design Studio Results**

**PSDS was used to analyze retirement portfolio performance and stability in a design studio with digital access to mutual fund data banks. The first task was to automate data transfer from Morningstar and Thomson data banks to PSDS. That change not only increased scan productivity it greatly increased quality. Data keyed in from a paper source is not only slow; it is error prone at any age. We tested the software using both sources and used the Thomson data bank for the scans in the White paper. The scans used 19971 mutual funds from the data bank and when ETF funds were added the total grew to 21356.**

**The first scan results are for 3yr, 5yr, and 10yr periods and for an 8 Mutual Fund portfolio design for an IRA. It is obvious in looking at the composite scatter plot that the market since the dot.com bubble and 9/11 has been very positive and before that pretty flat. A reminder that**

market changes can be dramatic even for the best of funds. In this portfolio the 8 funds were all 4 and 5 stars in existence for over 10 years,

### PSDS 8 Fund Scans for 3yr 5yr and 10 yr Periods

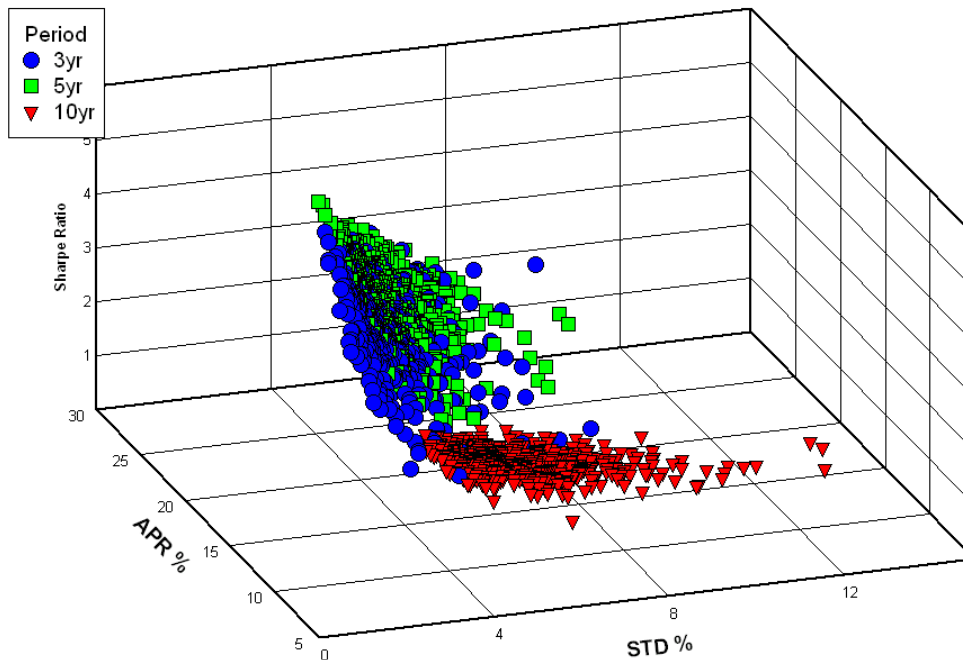


DODBX, AEPGX, FLPSX, LSBDX, PRWCX, SGENX, TAVFX, and VHGX were the funds. I have owned all these funds at various times and several for over twenty years. Clearly rebalancing cannot change market norms but 12.27% over the last ten years is not bad. It's twice the SP500 return over same period. The 3yr and 5yr returns were way above average as evidenced by very high Sharpe ratios for these periods,

	APR%	STD%	Sharpe Ratio
3yr	17.80	2.84	4.86
5yr	19.99	3.08	5.19
10yr	12.27	3.93	2.13

The 3D scatter plot shows graphically just how high the Sharpe ratios were for the latest 3yr and 5yr periods. In these scans 500 points per scan were sampled. The images using 1000-point scans were so dense it became hard to see the trends seen here in the 500-point scans.

## PSDS 8 Fund Scans for 3yr 5yr and 10 yr Periods



Before automating data access, multiple scan periods like this could take almost a day to run and image. These results took just a few minutes. The scans help a designer “see” what regression to the mean looks like for a portfolio over a ten-year period. Table data show the same but do not show the change with the same impact, in my opinion. Graphics are an important part of the design process in finance as well as engineering.

One observation is that over long periods a portfolio Watch List process is required even with the best of funds. Morningstar helps to do this with its Star rating

system but I prefer to focus on Sharpe ratio for the same purpose. If a fund Sharpe ratio drops below 1.0 it is on the list and if it stays below 1.0 for more than 4 quarters it is usually replaced.

To illustrate this process consider the real estate sector fund TAREX that I owned and placed on my Watch List. That triggered a series of calculations to see if “Mr. Market” was miss pricing the fund based on the cash income it produced. That calculation used a simple on-line calculator for discounted cash flows. There are many of them. I used one at [www.moneychimp](http://www.moneychimp) and in particular the DCF calculator. I assumed 0% dividend growth and took the default alternative return of the S&P 500 (11%) provided by the calculator. December TAREX price and cash distribution per share data for the last two years were taken from the Yahoo finance website.

	Price/shr	Distribution/shr	DCF Price
2007	\$27.21	\$3.847	\$35.00
2006	\$34.64	\$3.524	\$32.00

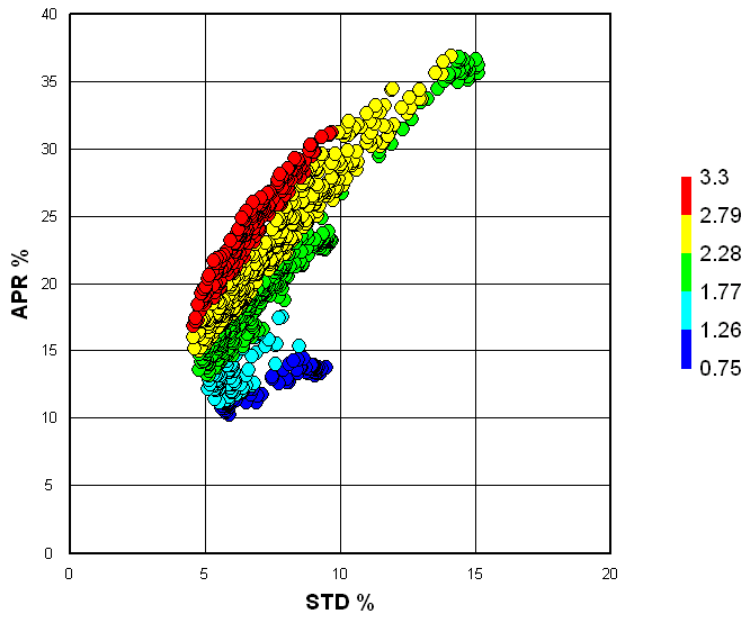
Based on this price check,  $(\$27.21 + \$3.847) < \$35$ , I kept TAREX in the portfolio but still on the Watch List. After four quarters on the list I finally sold the Fund. This Watch List process is a reminder that PSDS is not the only tool needed to design and maintain retirement portfolios. Over a period of years it is necessary, in my opinion, to occasionally replace funds on the Watch List with ones that better meet the role they provide in the portfolio. In this instance the Third Avenue Value fund TAVFX has several of the same real estate holdings but also has many other value investments. TAVFX replaced TAREX for the real estate role.

## **Portfolio Efficient Frontiers with ETF Funds**

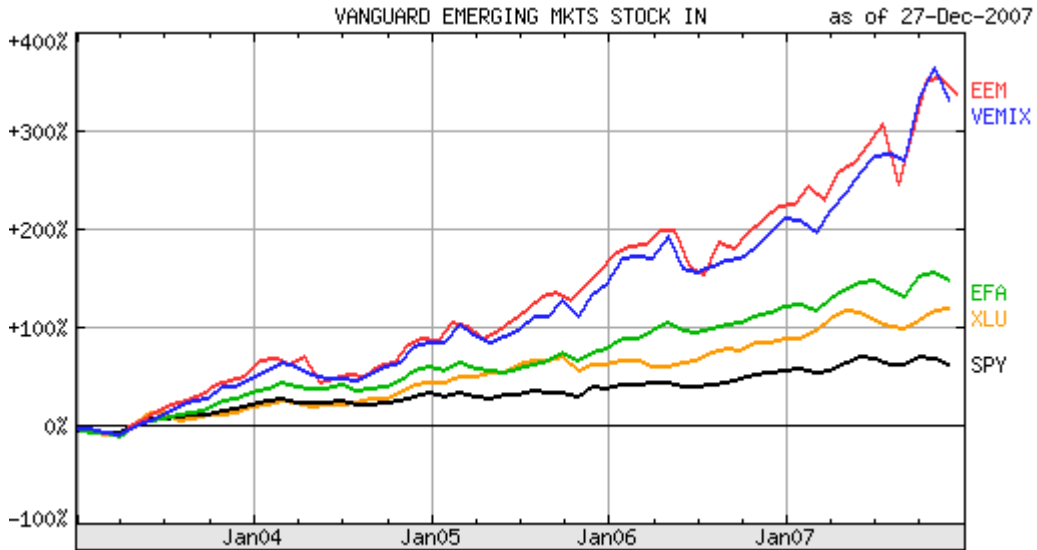
**The rapid growth of ETF fund offerings and a huge influx of money have resulted in these funds showing up in many retirement portfolios. The conservative AAll and others now even maintain model ETF portfolios for their members to consider. The January 5, 2008 issue of the WSJ had an interesting review of several mutual-fund companies that are adding ETFs to their products and services. That was enough to persuade me to take a look. Since very few have been around for 10 years, I limited the scans to 3yr and 5yr periods.**

**After looking at a few hundred ETFs in the Thompson data bank I selected four to begin the study; SPY, EFA, EEM and XLU. The oldest is SPY, which began in 1993, then XLU in 1999, EFA in 2001 and EEM in 2003. This is not a portfolio that many retirees would consider because of the emerging market exposure but I was interested. As the 5yr scan shows the best Sharpe ratio portfolio is over 3.0 using just these 4 ETF funds. The ETF data for the scan came from the Thompson data bank. The scan results also were a reminder that having only four funds often increases volatility and that's not good in retirement. Having the money in ETF funds compounds any volatility problem by being very easy to trade. That can be a fatal attraction. To provide diversification, the four funds were expanded to 10 ETF funds. This reduced the impact of EEM from roughly 25% to 10%, which reduced volatility by a factor of two with little change in return. The 10 ETF funds were EEM, EFA, SPY, XLU, IEV, MDY, DVY, IWS, EWS, and RSP. They compare well with a similar Mutual-Fund IRA design and each portfolio had 10 funds.**

# PSDS Scan of 4 ETF Fund Portfolios



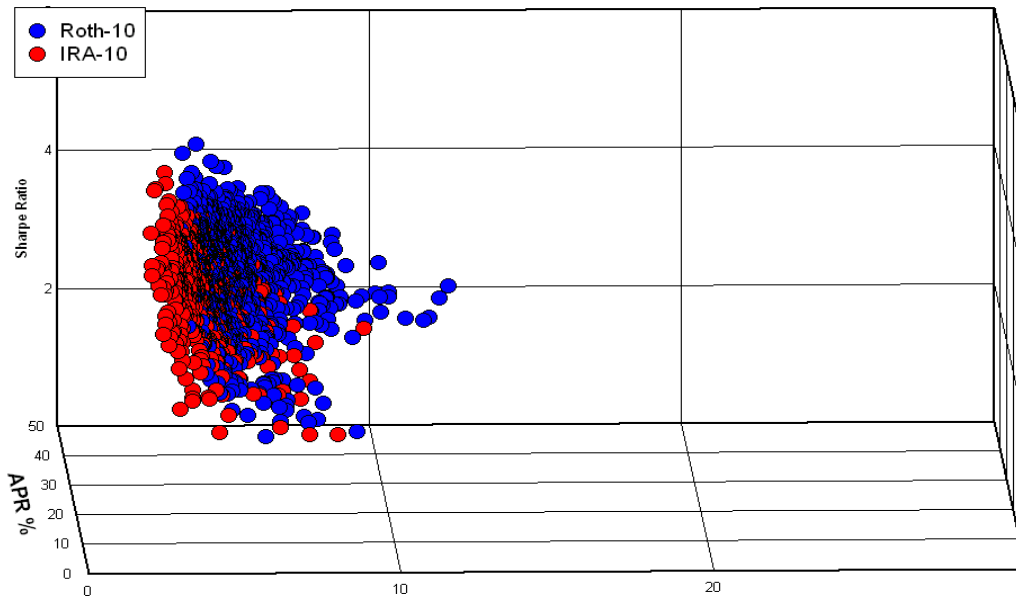
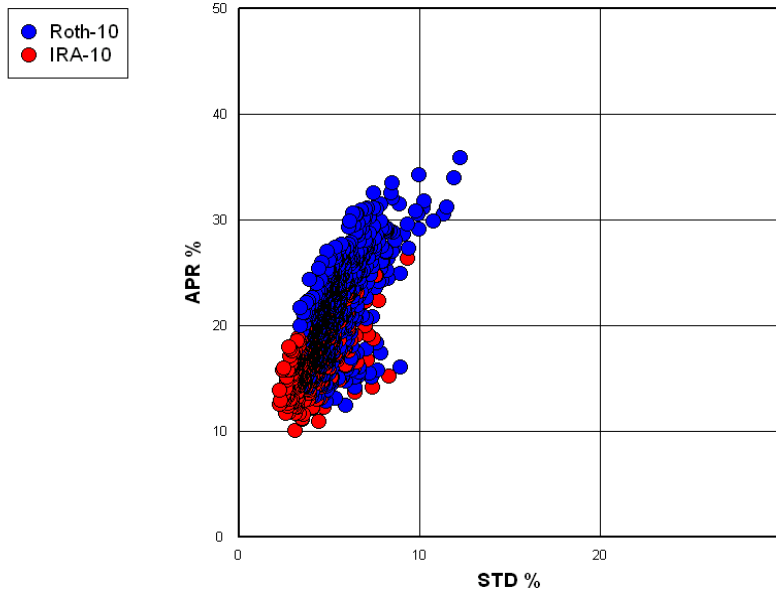
MSP, WPK, DB (Database), etc



Copyright 2007 Yahoo! Inc.

<http://finance.yahoo.com/>

# Merged Scans of ETF & Mutual Fund IRAs



## Conclusions

Portfolio efficient frontiers changed dramatically between 5yr and 10yr periods reflecting the impact of “dot.com” and “9/11” market changes. Images of the 3D scans were made using an Excel Add-In that displayed the Sharpe ratio of each portfolio in the scan. The images added focus to the risk adjusted reward data by showing the surface formed by the design-scan points. That surface has a well-defined region of high value portfolios without a sharp peak. In other words the best design is stable in the sense that small changes in asset allocation produce small changes in expected return. The study of 3D efficient frontiers was greatly facilitated by automated access to digital data banks from Thompson and Morningstar.

The study of ETF fund portfolios showed that using only four funds may add volatility but that expanding the number of funds can reduce that volatility. Simple diversification to 10 funds reduced the standard deviation by a factor of almost two with no change in 3yr return.

	APR%	STD%	SR
4 ETF Fund Portfolio	24.26	6.58	3.08
10 ETF Fund Portfolio	24.31	3.93	5.17
10 Mutual Fund Portfolio	18.61	2.77	5.28

ETFs with Sharpe ratios greater than 1.0 were hand selected and the same selection criteria was used for selecting the Mutual Fund portfolio for comparison. Their surfaces overlapped over significant regions of the design space and they have similar Sharpe ratios.