AAII-Silicon Valley presents

COMPUTERIZED INVESTING: HOW TO VERIFY YOUR INVESTMENT STRATEGY

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Slides available at www.siliconvalleyaaii.org

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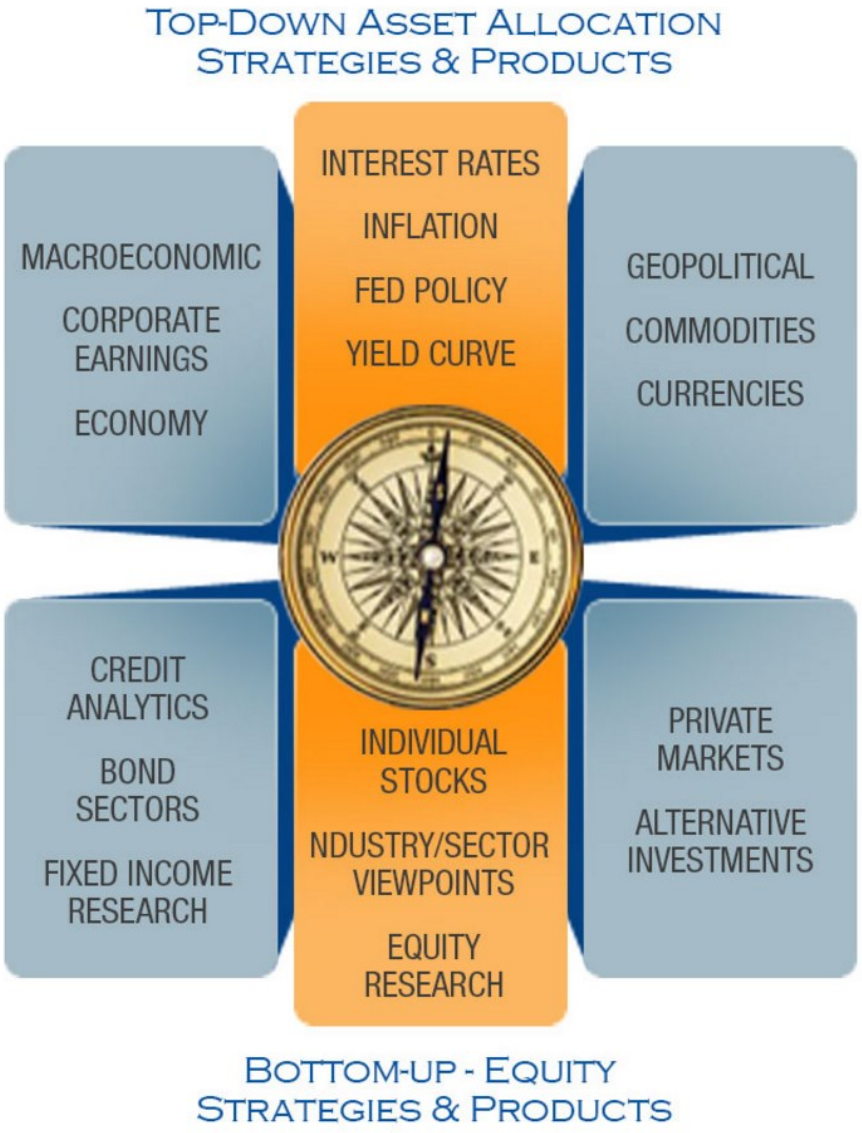
Agenda

- Basic Questions
- The Tool: Portfolio Visualizer
- Asset Allocation Backtest (ETF/Mutual Fund, Indices)
- Monte Carlo simulation: Determine your portfolio's growth and survival rates
- Correlations: How to determine your portfolio's asset correlations
- Summary and Final Q&A

- Extra "Stuff" (on-line)
- References (on-line)



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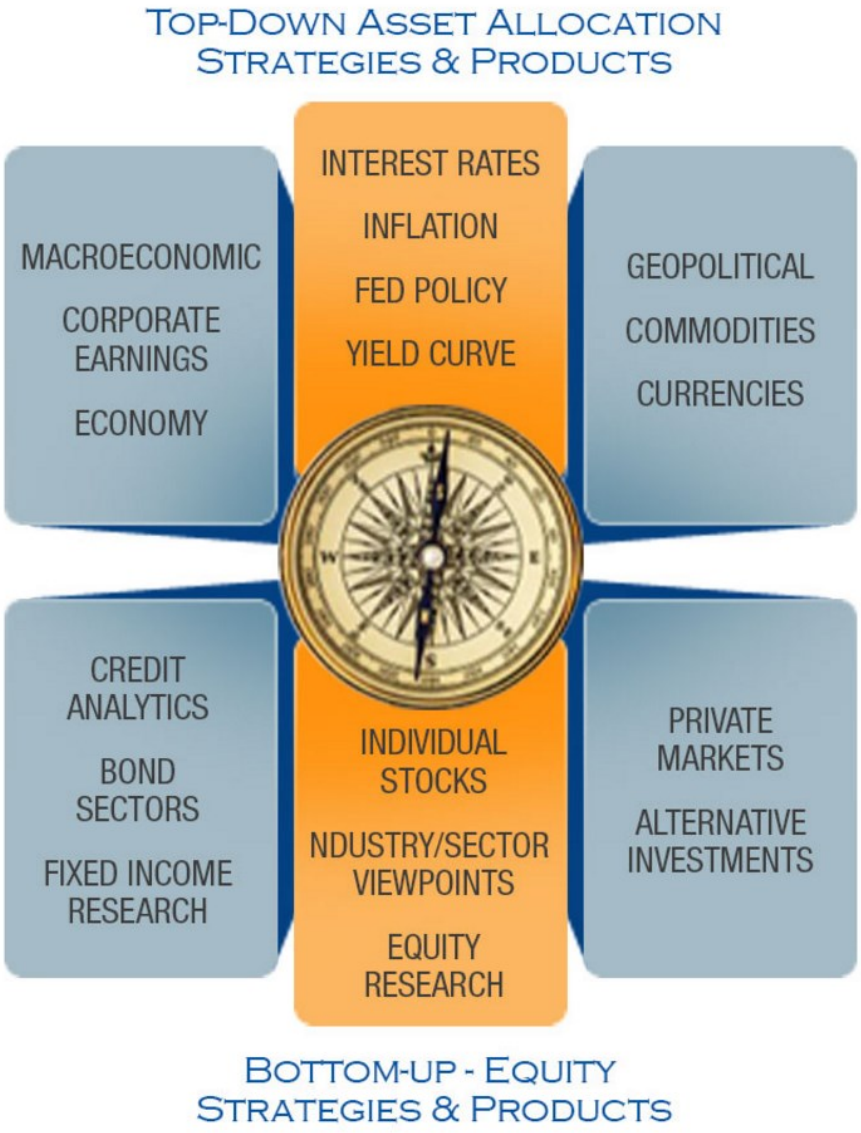

Basic Questions to be Answered

- What does “verifying your strategy” mean??
  - Taking “action” to ensure that your investment plan has a reasonable chance that it will meet your goals (Growth, Risk, Timeframe, etc.)
- Why verify your strategy??
  - Confidence that your strategy will meet your goals
  - Fortitude/discipline to stick to your strategy when “time gets rough” and you are under stress
- Who should verify your investment strategy??
  - Multiple answers: Your (professional) investment advisor, Your (personal/family/friend) investment advisor, YOU
- When/How often should you verify your strategy??
  - Multiple answers: Life goals or circumstances change; Current strategy isn’t meeting your goals; You find a “better” strategy; etc.
- How to verify your investment strategy?? (DIY)
  - Gather portfolio data, crank out the math, analyze results
  - Use a tool to help with the data gathering and “cranking”

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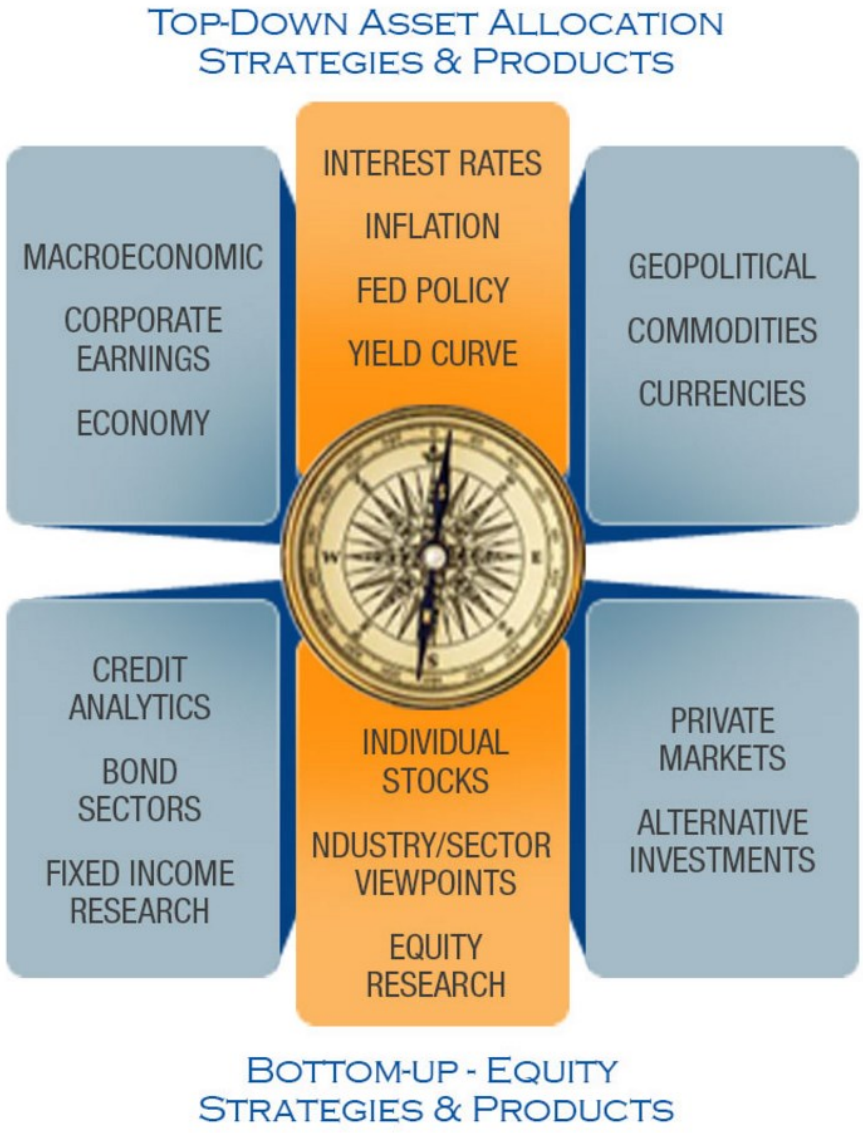


Portfolio Visualizer: Overview

Portfolio Visualizer | Examples | FAQ | Contact | Tools ▾ | Register | Login

About Portfolio Visualizer

Portfolio Visualizer is an online software platform focusing on quantitative, factor based investing tools. Portfolio Visualizer offers a growing set of tools including:

- Portfolio analysis tools for asset class allocation and portfolio backtesting
- Monte Carlo simulation to test long-term expected portfolio growth and survival
- Mean variance optimization and efficient frontier visualization
- Asset analysis tools for asset correlations, factor analysis and performance attribution
- Tools for testing tactical asset allocation models based on moving averages, momentum, market valuation and volatility targeting

Free tool located at
www.portfoliovisualizer.com

About Silicon Cloud Technologies

Silicon Cloud Technologies, LLC is an Austin, TX based software company founded in 2013. Silicon Cloud Technologies, LLC specializes in software solutions for investment research and analysis, portfolio management and financial planning. You can contact us regarding custom software and data analytics projects. Portfolio Visualizer was developed by Silicon Cloud Technologies, LLC and launched in August, 2013.

Why do they offer this??
Marketing/displaying their capabilities…

Portfolio Visualizer: What's It Do??

Backtest Portfolio

Backtest a portfolio asset allocation and compare historical and realized returns and risk characteristics against various lazy portfolios.

Monte Carlo Simulation

Run Monte Carlo simulations for the specified asset allocation based on historical or forecasted returns to test long term expected portfolio growth and survival.

Factor Analysis

Run regression analysis using Fama-French and Carhart factor models for individual assets or a portfolio to analyze returns against market, size, value and momentum factors.

Efficient Frontier

Chart the efficient frontier to explore risk vs. return trade-offs based on historical or forecasted returns, or use mean-variance or Black-Litterman optimization to find the optimal portfolio.

Asset Correlations

View correlations for asset classes and selected tickers for a given time period including rolling correlations over time.

Timing Models

Compare and test market timing models based on moving averages, momentum, the Shiller PE ratio valuation, and target volatility.

Portfolio Visualizer: How Good is the Data??

- When doing this type of work your results are only as good as your data – GIGO
- PV provides in-depth background on where they get their data..
  - Federal agencies, academic/research sites, csidata, index providers (MSCI, etc.), ….
  - We will go over these ***in depth*** next …
- What about survivorship bias??
  - Survivorship: Stocks, ETFs and Mutual Funds that are no longer with us; e.g., ENRON
  - Since PV deals with indices, sub-indices, etc. they largely avoid this problem
- Can I get results out of PV??
  - Yep! In CSV format. (I love this tool….)
- Can I get my special "home brew" data series into PV?
  - You betcha!! (I *really* love this tool….)

Portfolio Visualizer: How Good is the Data??

▼ Data Sources for Asset Class Returns

The data sources for annual asset class returns are listed below. Special thanks to Trevh/Cb/Alec from Vanguard Diehards / Bogleheads forum for compiling parts of this data from various sources. You can also import a custom return series for use as an asset class, portfolio asset, or benchmark.

US Stock Market
CRSP Market Decile 1-10 1972-1992
Vanguard Total Stock Market Index Fund (VTSMX) 1993-2015

US Large Cap Blend
S&P 500: Standard & Poors 1972-1976
Vanguard 500 Index Fund (VFINX) 1977-2015

US Large Cap Value
Fama and French 1972-1978
Russell 1000 Value Index 1979-1992
Vanguard Value Index Fund (VIVAX) 1993-2015

US Large Cap Growth
Fama and French 1972-1978
Russell 1000 Growth Index 1979-1992
Vanguard Growth Index Fund (VIGRX) 1993-2015

US Mid Cap Blend
CRSP Decile 3-5 1972-1978
Russell Mid Cap Index 1979-1998
Vanguard Mid Cap Index Fund (VIMSX) 1999-2015

US Mid Cap Growth
Russell Mid Cap Growth Index 1986-1995
MSCI Mid Cap Growth Index 1996-2006
Vanguard Mid-Cap Growth Index Fund (VMGIX) 2007-2015

US Mid Cap Value
Russell Mid Cap Value Index 1986-1995
MSCI Mid Cap Value Index 1996-2006
Vanguard Mid-Cap Value Index Fund Investor Shares (VMVIX) 2007-2015

US Small Cap Blend
Ibbotson 1972-1978
Russell 2000 Index 1979-1991
Vanguard Small Cap Index Fund (NAESX) 1992-2015

US Small Cap Value
Ibbotson 1972-1978
Russell 2000 Value Index 1979-1998
Vanguard Small Cap Value Index Fund (VISVX) 1999-2015

US Small Cap Growth
Ibbotson 1972-1978
Russell 2000 Growth Index 1979-1998
Vanguard Small Cap Growth Index Fund (VISGX) 1999-2015

US MicroCap Blend
CRSP Decile 10 1972-1997
Bridgeway Ultra Small Market (BRSIX) 1998-2015

Real Estate (REIT)
National Association of Real Estate Investment Trusts 1972-19
Vanguard REIT Index Fund (VGSIX) 1997-2015

International Stock Market
MSCI EAFE Index 1972-1987 (Developed Only)
85% EAFE Index / 15% EM 1988-1996
Vanguard Total International Index Fund (VGTSX) 1997-2015

International Developed Markets (EAFE)
MSCI EAFE Index 1972-2000 (Developed Only)
Vanguard Developed Markets Index (VTMGX) 2001-2015

Emerging Markets
IFA Emerging Market Index 1972-1987
MSCI Emerging Markets Index 1988-1994
Vanguard Emerging Markets Index (VEIEX) 1995-2015

Europe Stock Market
MSCI Data 1972-1984
Vanguard Europe Stock Index (VEURX) 1991-2015

Pacific Region Stock Market
MSCI Data 1972-1990
Vanguard Pacific Stock Index (VPACX) 1991-2015

International Value
IFA International Value Index 1972-1974
MSCI EAFE Value 1975-1996
Vanguard Intl Value Fund (VTRIX) 1997-2005
iShares MSCI EAFE Value ETF (EFV) 2006-2015

International Small Cap
Dimensional International Small Cap Index 1972-2004
FTSE Global Small Cap ex US Index 2005-2009 (see ftse.com)
Vanguard FTSE All-World ex-US Small Cap Index (VFSVX) 2010-2015

Total Bond Market
Ibbotson 1972
Barclays U.S. Aggregate Bond Index (see barcap.com) 1973-1990
Vanguard Total Bond Index Fund (VBMFX) 1991-2015

Short Term Treasuries
IFA Two-Year Global Fixed Income Index 1972-1991
Vanguard Short Term Treasury Fund (VFISX) 1992-2015

Intermediate Term Treasuries
TAM Asset Management Spreadsheet 1972-1991
Vanguard Intermediate-Term Treasury Fund (VFITX) 1992-2015

Long Term Government Bonds
TAM Asset Management Spreadsheet 1972-1986
Vanguard Long Term Treasury (VUSTX) 1987-2015

TIPS
Synthetic TIPS data 1972-2000 (S.P. Kothari, Jay A. Shanken - Asset Alloca Protected Bonds)
Vanguard Inflation-Protected Security Fund (VIPSX) 2001-2015

Cash / Treasury Bills - Risk Free Return Benchmark
Treasury Bills (www.federalreserve.gov) 1972-1983
Treasury Bills (Professor Kenneth French's Data Library) 1984-2015

Short Term Tax Exempt
Vanguard Short-Term Tax-Exempt Fund (VWSTX) 1980-2015

Intermediate Term Tax Exempt
Vanguard Intermediate-Term Tax-Exempt Fund (VWITX) 1980-2015

Long Term Tax Exempt
Vanguard Long-Term Tax-Exempt Fund (VWLTX) 1980-2015

Corporate Bonds
Barclays U.S. Corporate Bond Index (see barcap.com) 1973-2010
Vanguard Intermediate-Term Corporate Bond Index Fund (VICSX) 2011-2015

High Yield Corporate
Vanguard High Yield Corporate Fund (VWEHX) 1985-2015

Short Term Investment Grade
Vanguard Short Term Investment Grade Fund (VFSTX) 1985-2015

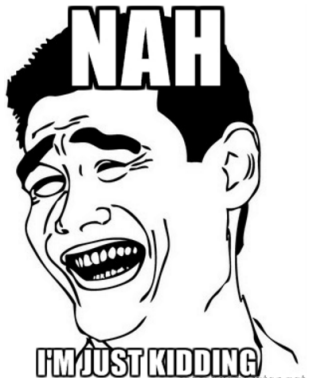
Global Bonds (Unhedged)
JP Morgan Global Government Bond 1987-1996
PIMCO Global Bond Fund (PIGLX) 1997-2015

Gold
KITCO returns (kitco.com) 1972-2004
GLD ETF 2004-2015

Precious Metals
Vanguard Precious Metals (VGPMX) 1985-2015

Commodities / Natural Resources
Chase Physical Commodity Index 1972-1990
DJ-AIJ plus T-Bills 1991-1996
DJ-AIG plus Yahoo's IPS 'category' returns 1997-2001 (prior to VIPSX)
DJ-AIJ plus VIPSX 2001-2002
PIMCO Commodity Real Return Strategy Fund (PCRIX) 2003-2015

Inflation (CPI-U)
BLS Consumer Price Index (Urban) 1972-2015
Compiled by Bureau of Labor and Statistics (see Consumer Price Index History Table)



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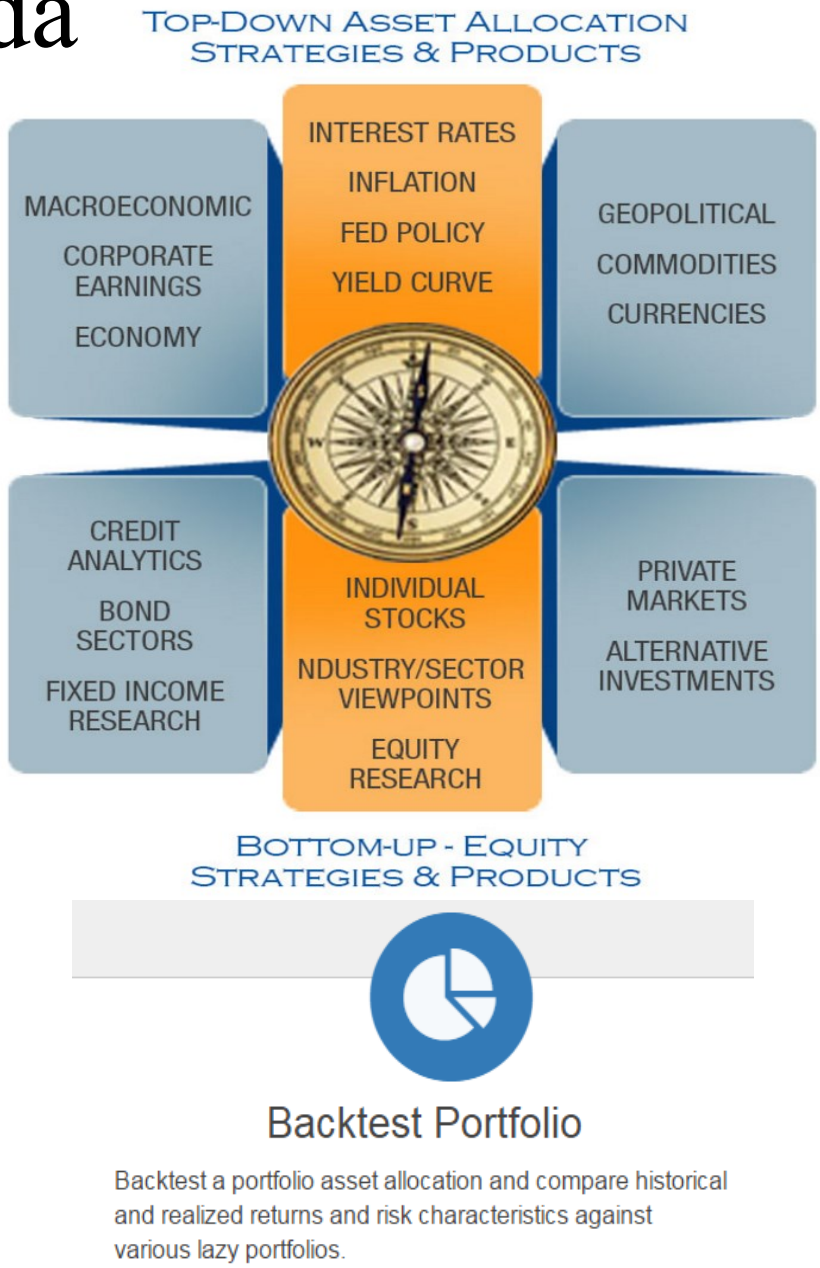


Backtest Portfolio Asset Class Allocation

This online portfolio backtesting tool allows you to construct a portfolio based on the selected asset class allocation to analyze and backtest portfolio returns, risk characteristics (Sharpe ratio, Sortino ratio), standard deviation, annual returns and rolling returns. The results include a visualization of the portfolio growth chart and rolling returns, CAGR, standard deviation, annual returns and inflation adjusted returns. An annual contribution or withdrawal amount, which is automatically inflation adjusted, can be applied in addition to annual rebalancing. You can also compare the given portfolio allocation against multiple lazy portfolios in the advanced mode. If only one portfolio is specified the annual returns will include the annual asset class returns for the selections, otherwise the annual returns are shown for each portfolio. You can also use the portfolio backtesting tool to build a portfolio based on specific mutual funds, ETFs and stocks and use associated returns for comparison.

Backtest Portfolio

Backtest a portfolio asset allocation and compare historical and realized returns and risk characteristics against various lazy portfolios.

Contribute/withdraw fixed amount; withdraw fixed %

No or annual rebalance

SP4/5/600 or ETF/MF

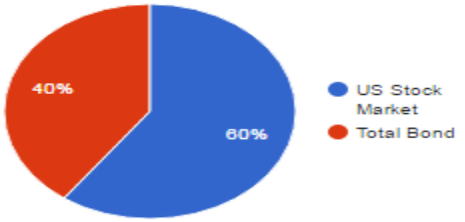
Mode	Advanced		
Start Year	1972		
End Year	2015		
Initial Amount	$ 10000 .00		
Annual Adjustment	None		
Rebalancing	Rebalance annually		
Benchmark	None		
Asset Allocation	Custom	Custom	Custom
US Stock Market	%	%	%
Large Cap Value	%	%	%
Large Cap Blend	%	%	%
Large Cap Growth	%	%	%
Mid Cap Value	%	%	%
Mid Cap Blend	%	%	%
Mid Cap Growth	%	%	%

Portfolio 1

60/40 Stock Bond

Asset Class	Allocation
US Stock Market	60.00%
Total Bond	40.00%

Asset allocation saved as 'Classic 60-40'. Manage saved models »

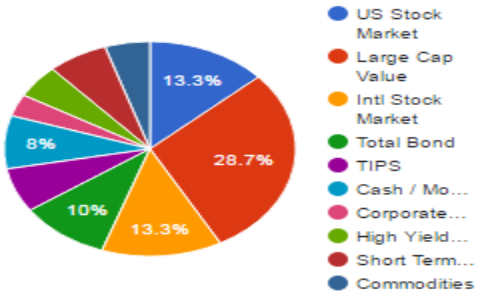


Portfolio 2

Benz/Morningstar

Asset Class	Allocation
US Stock Market	13.33%
Large Cap Value	28.67%
Intl Stock Market	13.33%
Total Bond	10.00%
TIPS	6.67%
Cash / Money Market	8.00%
Corporate Bonds	3.33%
High Yield Bond	5.00%
Short Term Inv Grade	6.67%
Commodities	5.00%

Asset allocation saved as 'Benz Retirement'. Manage saved models »



Backtest Portfolio

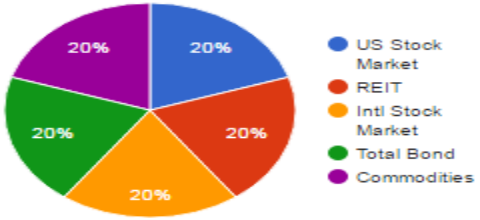
Backtest a portfolio asset allocation and compare historical and realized returns and risk characteristics against various lazy portfolios.

Portfolio 3

Faber 5

Asset Class	Allocation
US Stock Market	20.00%
REIT	20.00%
Intl Stock Market	20.00%
Total Bond	20.00%
Commodities	20.00%

Asset allocation saved as 'Faber 5'. Manage saved models »



Portfolio Returns

Benz

60/40

60/40

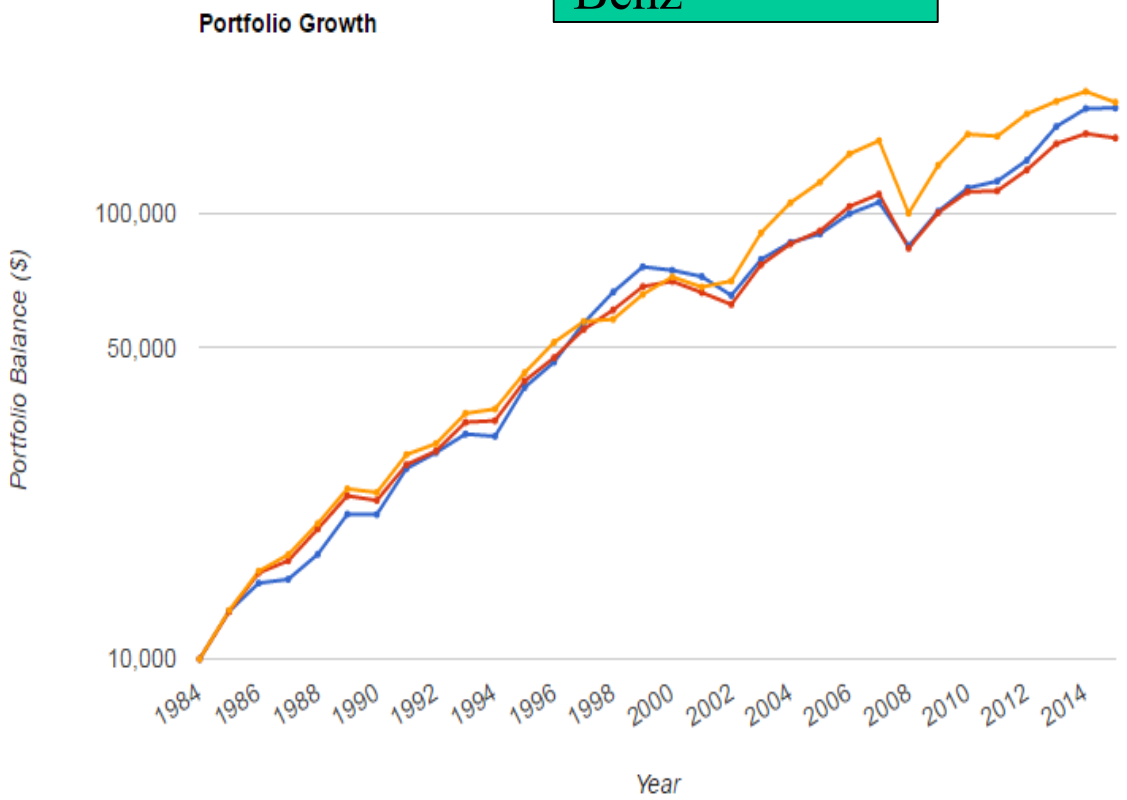
60/40

#	Initial Balance	Final Balance	CAGR	Std.Dev.	Best Year	Worst Year	Max. Drawdown	Sharpe Ratio	Sortino Ratio	US Mkt Correlation	Intl Mkt Correlation
1	$10,000	$172,894	9.63%	11.22%	28.75%	-20.20%	-20.20%	0.61	1.30	0.98	0.67
2	$10,000	$148,088	9.08%	10.85%	27.74%	-24.40%	-24.40%	0.58	1.09	0.92	0.84
3	$10,000	$178,020	9.73%	12.23%	28.56%	-31.29%	-31.29%	0.58	1.06	0.79	0.82

Faber 5

YEARLY basis
Benz

Faber 5



PF1 60/40
PF2 Benz
PF3 Faber5

Backtest Portfolio

Backtest a portfolio asset allocation and compare historical and realized returns and risk characteristics against various lazy portfolios.

Portfolio Return | Annual Returns | Rolling Returns

60/40 Benz Faber5

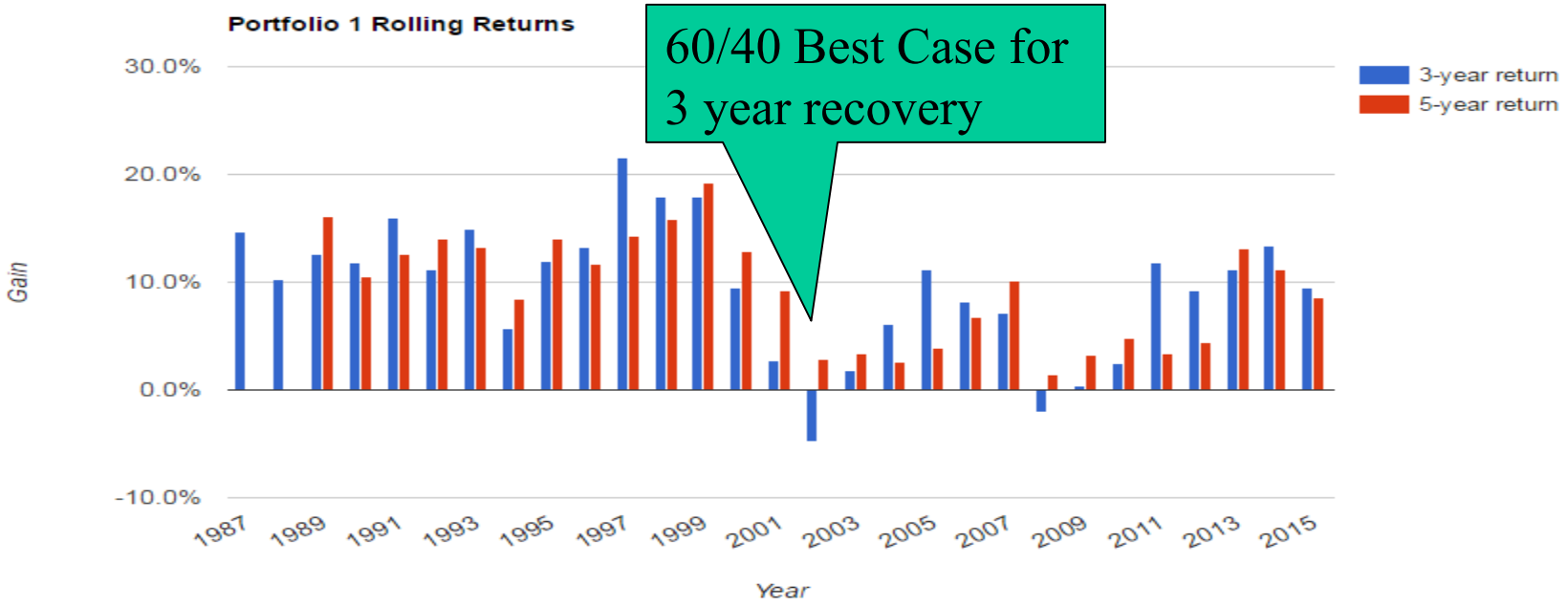
Year	Inflation	US Stock Market	Total Bond	Large Cap Value	Intl Stock Market	TIPS	Cash / Money Market	Corporate Bonds	High Yield Bond	Short Term Inv Grade	Commodities	REIT	PF #1 Return	PF #1 Inflation Adjusted Return	PF #1 Year End Balance	PF #2 Return	PF #2 Inflation Adjusted Return	PF #2 Year End Balance	PF #3 Return	PF #3 Inflation Adjusted Return	PF #3 Year End Balance
1985	3.80%	31.95%	22.11%	31.22%	56.87%	8.68%	7.72%	24.10%	21.78%	14.90%	13.03%	18.85%	28.01%	23.33%	$12,801	27.74%	23.06%	$12,774	28.56%	23.86%	$12,856
1986	1.10%	15.88%	15.26%	19.75%	68.33%	21.96%	6.16%	16.50%	16.86%	11.40%	-6.19%	18.95%	15.63%	14.37%	$14,803	22.21%	20.88%	$15,611	22.45%	21.11%	$15,742
1987	4.43%	1.51%	2.76%	0.29%	26.45%	8.18%	5.47%	2.60%	2.65%	4.46%	17.91%	-3.80%	2.01%	-2.32%	$15,100	6.48%	1.96%	$16,623	8.97%	4.34%	$17,153
1988	4.42%	17.78%	7.89%	22.94%	29.99%	18.66%	6.35%	9.20%	13.55%	6.95%	18.50%	13.26%	13.82%	9.01%	$17,187	17.86%	12.87%	$19,592	17.48%	12.51%	$20,152
1989	4.65%	28.66%	14.53%	24.94%	18.58%	5.89%	8.37%	14.10%	1.89%	11.45%	27.72%	8.57%	23.01%	17.54%	$21,142	18.68%	13.40%	$23,251	19.61%	14.30%	$24,105
1990	6.11%	-6.18%	8.96%	-8.29%	-21.54%	5.99%	7.81%	7.10%	-5.85%	9.23%	25.13%	-15.58%	-0.12%	-5.88%	$21,116	-2.34%	-7.96%	$22,708	-1.84%	-7.49%	$23,661
2010	1.50%	17.09%	6.42%	14.28%	11.12%	6.17%	0.12%	9.00%	12.40%	5.21%	24.13%	28.30%	12.82%	11.15%	$114,285	11.39%	9.75%	$112,059	17.41%	15.68%	$150,933
2011	2.96%	0.96%	7.56%	1.00%	-14.56%	13.24%	0.04%	7.94%	7.13%	1.93%	-7.56%	8.47%	3.60%	0.62%	$118,400	0.49%	-2.40%	$112,605	-1.03%	-3.87%	$149,384
2012	1.74%	16.25%	4.05%	15.00%	18.14%	6.78%	0.06%	11.39%	14.36%	4.52%	5.31%	17.53%	11.37%	9.47%	$131,862	11.41%	9.51%	$125,455	12.26%	10.34%	$167,693
2013	1.50%	33.35%	-2.26%	32.85%	15.04%	-8.92%	0.02%	-1.79%	4.54%	0.97%	-14.81%	2.31%	19.11%	17.35%	$157,055	14.54%	12.85%	$143,697	6.73%	5.15%	$178,972
2014	0.76%	12.43%	5.76%	13.05%	-4.24%	3.83%	0.02%	7.45%	4.58%	1.76%	-18.06%	30.13%	9.76%	8.93%	$172,387	5.36%	4.56%	$151,396	5.20%	4.41%	$188,286
2015	0.73%	0.29%	0.30%	-1.03%	-4.37%	-1.83%	0.02%	0.93%	-1.39%	1.03%	-25.70%	2.22%	0.29%	-0.43%	$172,894	-2.18%	-2.89%	$148,088	-5.45%	-6.14%	$178,020

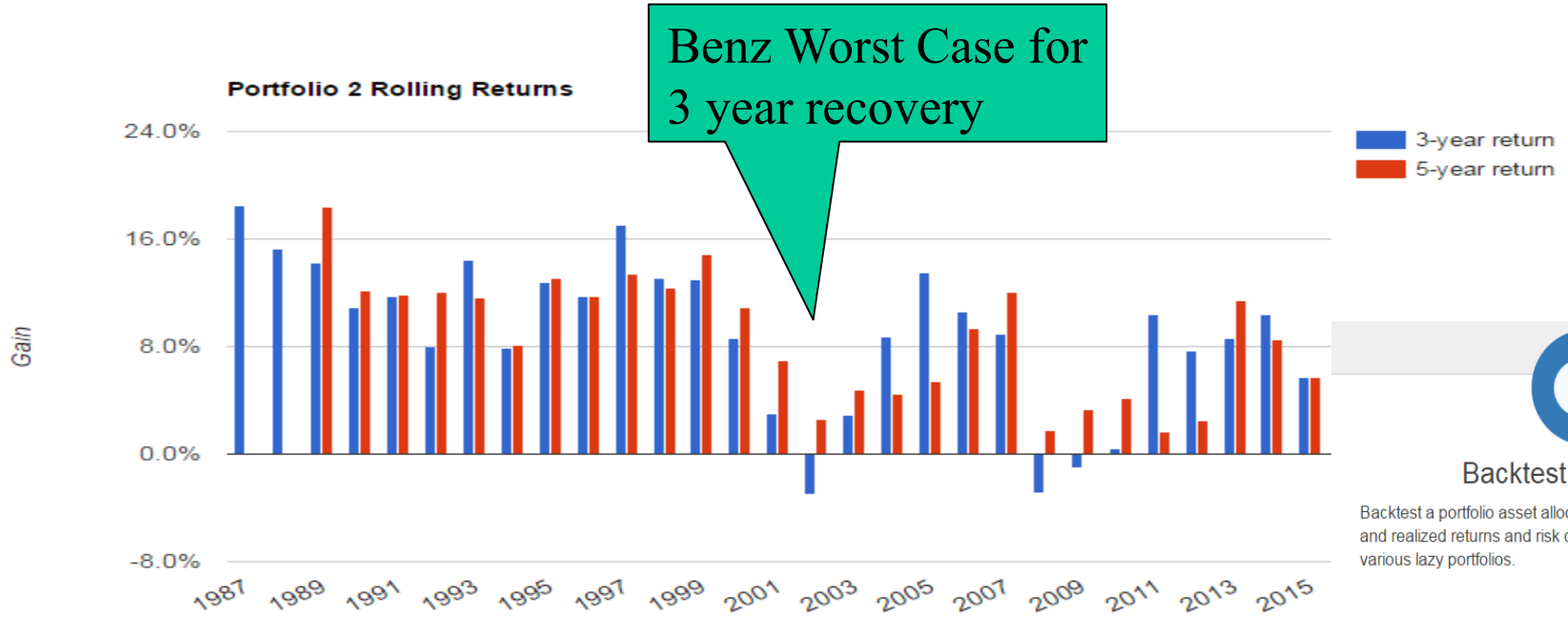
Inflation

Asset class returns

Backtest Portfolio

Backtest a portfolio asset allocation and compare historical and realized returns and risk characteristics against various lazy portfolios.





Backtest Portfolio

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Portfolio Returns

Faber 5

60/40 60/40 60/40

60/40

#	Initial Balance	Final Balance	CAGR	IRR	Std.Dev.	Best Year	Worst Year	Max. Drawdown	Sharpe Ratio	Sortino Ratio	US Mkt Correlation	Intl Mkt Correlation
1	$10,000	$48,774	5.24%	11.09%	11.22%	28.75%	-20.20%	-20.20% (-23.69%)	0.61	1.30	0.98	0.67
2	$10,000	$41,776	4.72%	10.97%	10.85%	27.74%	-24.40%	-24.40% (-27.42%)	0.58	1.09	0.92	0.84
3	$10,000	$50,220	5.34%	11.67%	12.23%	28.56%	-31.29%	-31.29% (-34.04%)	0.58	1.06	0.79	0.82

* The number in parenthesis shows the calculated value taking into account the percentage based periodic withdrawals.

Faber 5

Faber 5

Benz

PF1 60/40
PF2 Benz
PF3 Faber5

4%/year withdrawal rate

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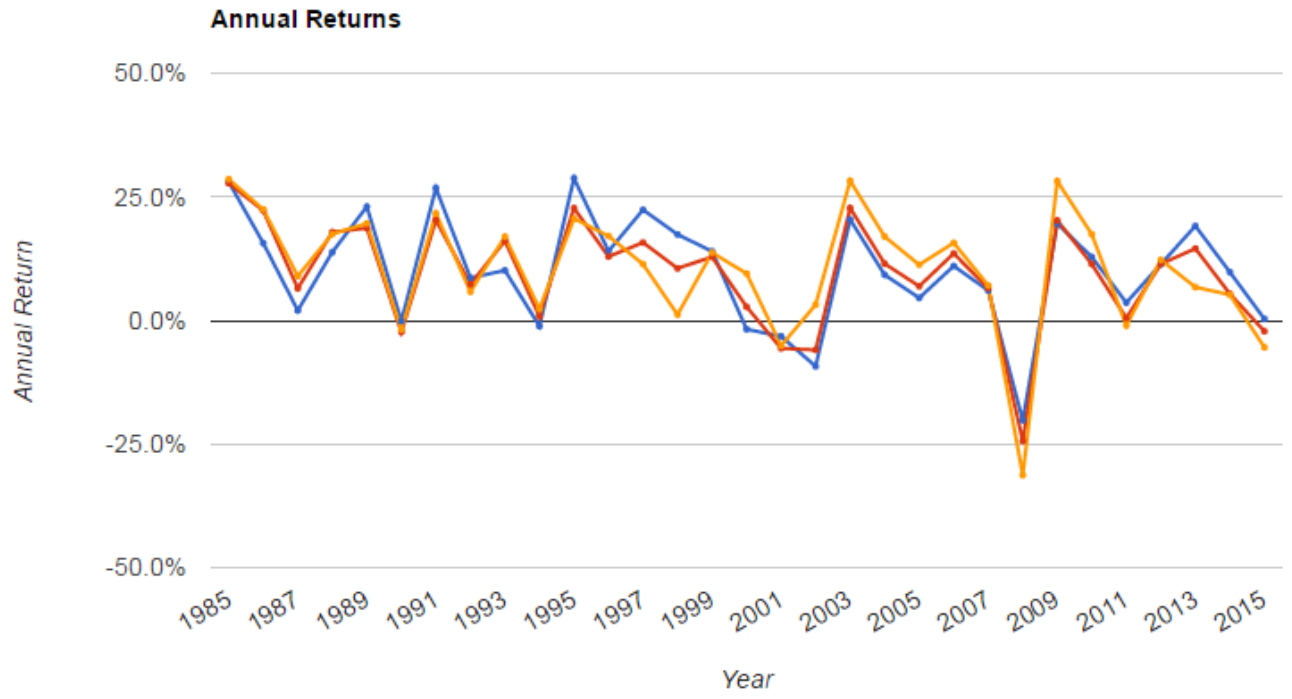

PF1 60/40
PF2 Benz
PF3 Faber5

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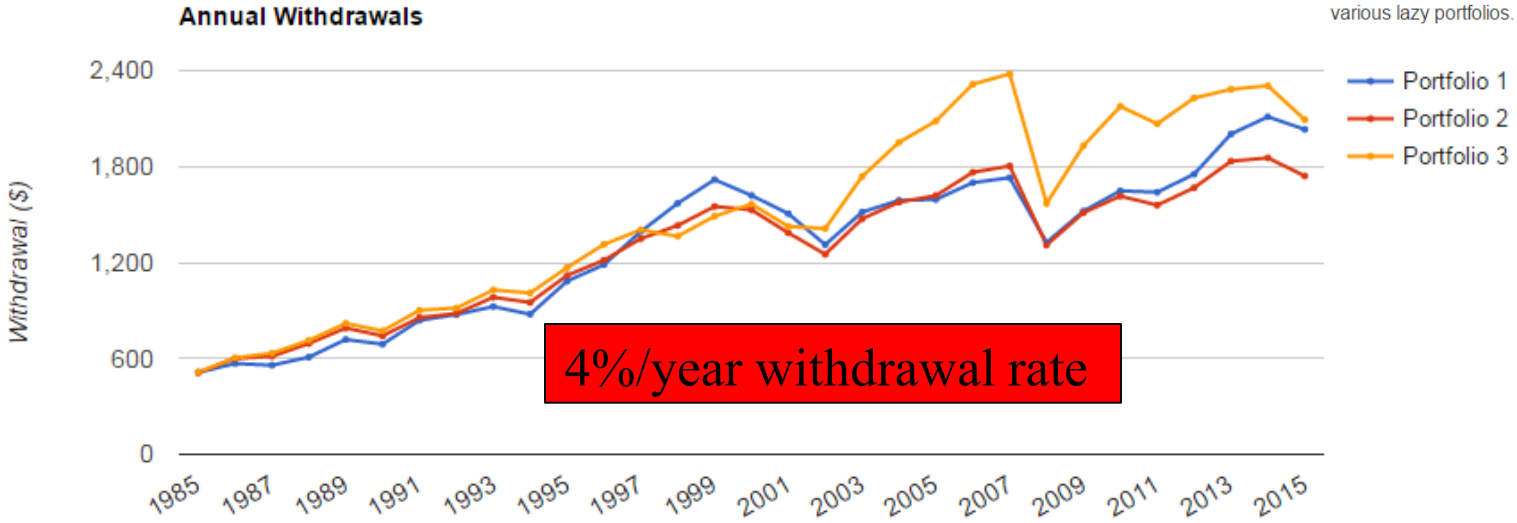


4%/year withdrawal rate

Portfolio Return | Annual Returns | Rolling Returns

4%/year withdrawal rate

Year	Inflation	US Stock Market	Total Bond	Large Cap Value	Intl Stock Market	TIPS	Cash / Money Market	Corporate Bonds	High Yield Bond	Short Term Inv Grade	Commodities	REIT	PF #1 Return	PF #1 Inflation Adjusted Return	PF #1 Annual Adjustment	PF #1 Year End Balance	PF #2 Return	PF #2 Inflation Adjusted Return	PF #2 Annual Adjustment	PF #2 Year End Balance	PF #3 Return	PF #3 Inflation Adjusted Return	PF #3 Annual Adjustment	PF #3 Year End Balance
1985	3.80%	31.95%	22.11%	31.22%	56.87%	8.68%	7.72%	24.10%	21.78%	14.90%	13.03%	18.85%	28.01%	23.33%	$-512	$12,289	27.74%	23.06%	$-511	$12,263	28.56%	23.86%	$-514	$12,342
1986	1.10%	15.88%	15.26%	19.75%	68.33%	21.96%	6.16%	16.50%	16.86%	11.40%	-6.19%	18.95%	15.63%	14.37%	$-568	$13,642	22.21%	20.88%	$-599	$14,387	22.45%	21.11%	$-604	$14,508
1987	4.43%	1.51%	2.76%	0.29%	26.45%	8.18%	5.47%	2.60%	2.65%	4.46%	17.91%	-3.80%	2.01%	-2.32%	$-557	$13,360	6.48%	1.96%	$-613	$14,707	8.97%	4.34%	$-632	$15,176
1988	4.42%	17.78%	7.89%	22.94%	29.99%	18.66%	6.35%	9.20%	13.55%	6.95%	18.50%	13.26%	13.82%	9.01%	$-608	$14,598	17.86%	12.87%	$-693	$16,640	17.48%	12.51%	$-713	$17,116
1989	4.65%	28.66%	14.53%	24.94%	18.58%	5.89%	8.37%	14.10%	1.89%	11.45%	27.72%	8.57%	23.01%	17.54%	$-718	$17,239	18.68%	13.40%	$-790	$18,958	19.61%	14.30%	$-819	$19,654
1990	6.11%	-6.18%	8.96%	-8.29%	-21.54%	5.99%	7.81%	7.10%	-5.85%	9.23%	25.13%	-15.58%	-0.12%	-5.88%	$-689	$16,529	-2.34%	-7.96%	$-741	$17,775	-1.84%	-7.49%	$-772	$18,521
2010	1.50%	17.09%	6.42%	14.28%	11.12%	6.17%	0.12%	9.00%	12.40%	5.21%	24.13%	28.30%	12.82%	11.15%	$-1,648	$39,541	11.39%	9.75%	$-1,615	$38,770	17.41%	15.68%	$-2,176	$52,220
2011	2.96%	0.96%	7.56%	1.00%	-14.56%	13.24%	0.04%	7.94%	7.13%	1.93%	-7.56%	8.47%	3.60%	0.62%	$-1,639	$39,325	0.49%	-2.40%	$-1,558	$37,401	-1.03%	-3.87%	$-2,067	$49,617
2012	1.74%	16.25%	4.05%	15.00%	18.14%	6.78%	0.06%	11.39%	14.36%	4.52%	5.31%	17.53%	11.37%	9.47%	$-1,752	$42,045	11.41%	9.51%	$-1,667	$40,002	12.26%	10.34%	$-2,228	$53,470
2013	1.50%	33.35%	-2.26%	32.85%	15.04%	-8.92%	0.02%	-1.79%	4.54%	0.97%	-14.81%	2.31%	19.11%	17.35%	$-2,003	$48,075	14.54%	12.85%	$-1,833	$43,986	6.73%	5.15%	$-2,283	$54,784
2014	0.76%	12.43%	5.76%	13.05%	-4.24%	3.83%	0.02%	7.45%	4.58%	1.76%	-18.06%	30.13%	9.76%	8.93%	$-2,111	$50,657	5.36%	4.56%	$-1,854	$44,489	5.20%	4.41%	$-2,305	$55,329
2015	0.73%	0.29%	0.30%	-1.03%	-4.37%	-1.83%	0.02%	0.93%	-1.39%	1.03%	-25.70%	2.22%	0.29%	-0.43%	$-2,032	$48,774	-2.18%	-2.89%	$-1,741	$41,776	-5.45%	-6.14%	$-2,093	$50,220

PF1 60/40 Withdrawal: 23.7% MDD '99-'03
PF2 Benz Withdrawal: 27.4% MDD '07-'08
PF3 Faber5 Withdrawal: 34% MDD '07-'08

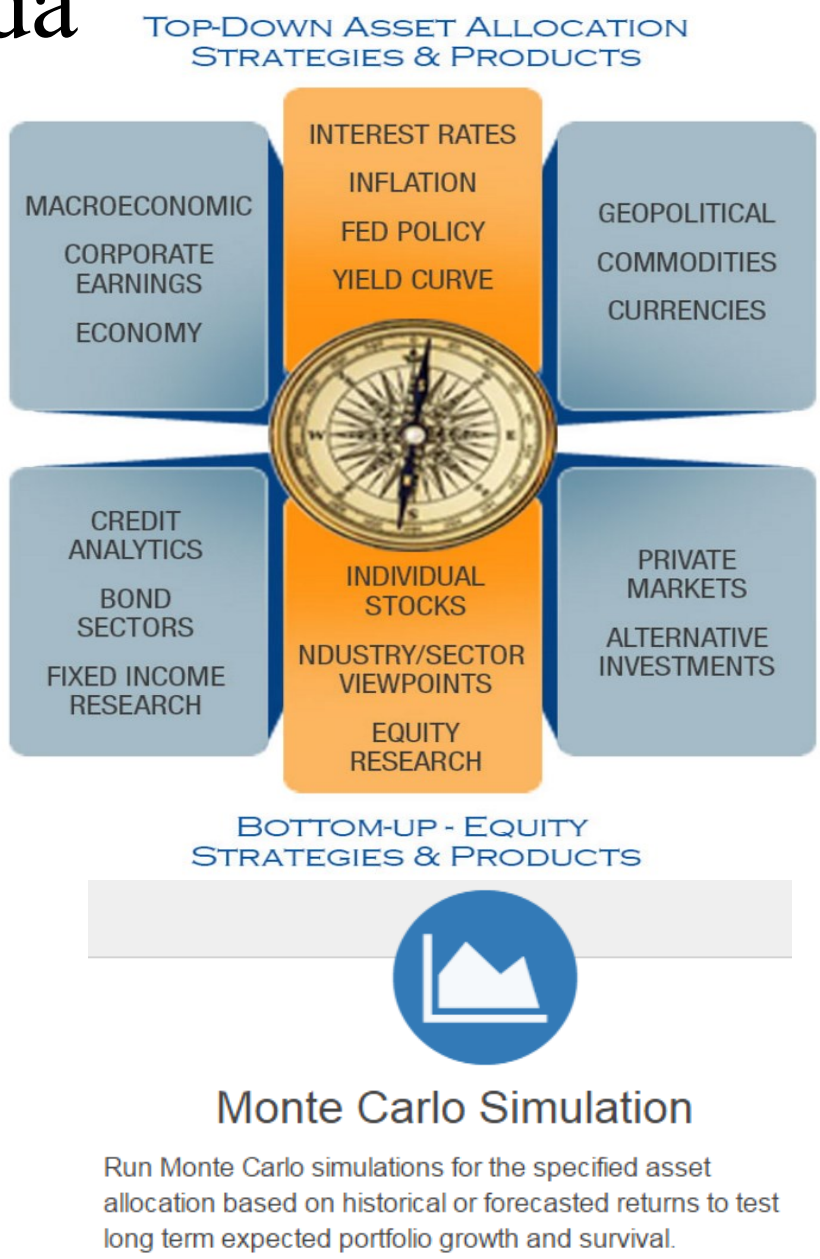
Backtest Portfolio

Backtest a portfolio asset allocation and compare historical and realized returns and risk characteristics against various lazy portfolios.

Agenda

- Basic Questions
- The Tool: Portfolio Visualizer
- Asset Allocation Backtest (ETF/M-Fund, Indices)
- **Monte Carlo simulation: Determine your portfolio's growth and survival rates**
- Correlations: How to determine your portfolio's asset correlations
- Summary and Final Q&A

- Extra "Stuff" (on-line)
- References (on-line)



Monte Carlo Simulation: Overview

- What is Monte Carlo Simulation??
  - Monte Carlo simulations are computational algorithms that rely on repeated ***random*** sampling to obtain numerical results. The idea is using randomness to solve problems that might be deterministic in principle.
- Why use Monte Carlo techniques??
  - We cannot predict "the" future. Monte Carlo analysis projects thousands of possible futures and lets you know see the statistics of where you might end up…

Monte Carlo Simulation

This online Monte Carlo simulation tool provides a means to test long term expected portfolio growth and portfolio survival based on withdrawals, e.g., testing whether the portfolio can sustain the planned withdrawals during the retirement years. The following simulation models are supported for portfolio returns:

- **Historical Returns** - Simulate future annual returns by randomly selecting the returns for each year from the database of available annual returns
- **Statistical Returns** - Simulate future annual returns based on the mean and standard deviation of the selected asset allocation's actual historical return
- **Forecasted Returns** - Simulate future annual returns based on any forecasted mean and standard deviation of asset classes
- **Parameterized Returns** - Simulate future annual returns based on the specified statistical distribution

You can choose from several different withdrawal models including:

- **Fixed annual withdrawal or contribution** - Apply a fixed annual withdrawal or contribution. Yearly inflation adjustments are by default done for the specified withdrawal or contribution amount based on the selected model.
- **Fixed annual percentage** - Withdraw a fixed percentage of the portfolio balance annually. This model ensures that the portfolio never runs out, but the annual spending amount varies based on the portfolio growth.
- **Life expectancy based annual withdrawal** - This model withdraws a variable percentage of the portfolio balance based on life expectancy. This is the RMD approach where the withdrawal percentage is 1 / Life Expectancy.

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Initial Amount	$ 1000000 .00	
Annual Adjustment	Withdraw fixed percentage annually	
Annual Percentage	4.0 %	Typical withdrawal rate
Simulation Period (years)	40	~years to go to 100 years
Simulation Model	Historical Returns	Replaying history
Use Full History	Yes	
Bootstrap Model	Single Year	
Inflation Model	Historical Inflation	

Asset Allocation		**Allocation**	Swedroe mix
Asset 1	Large Cap Value	15 %	
Asset 2	Small Cap Value	15 %	
Asset 3	Small Cap Blend	13 %	
Asset 4	Emerging Markets	4 %	

Monte Carlo Simulation Results

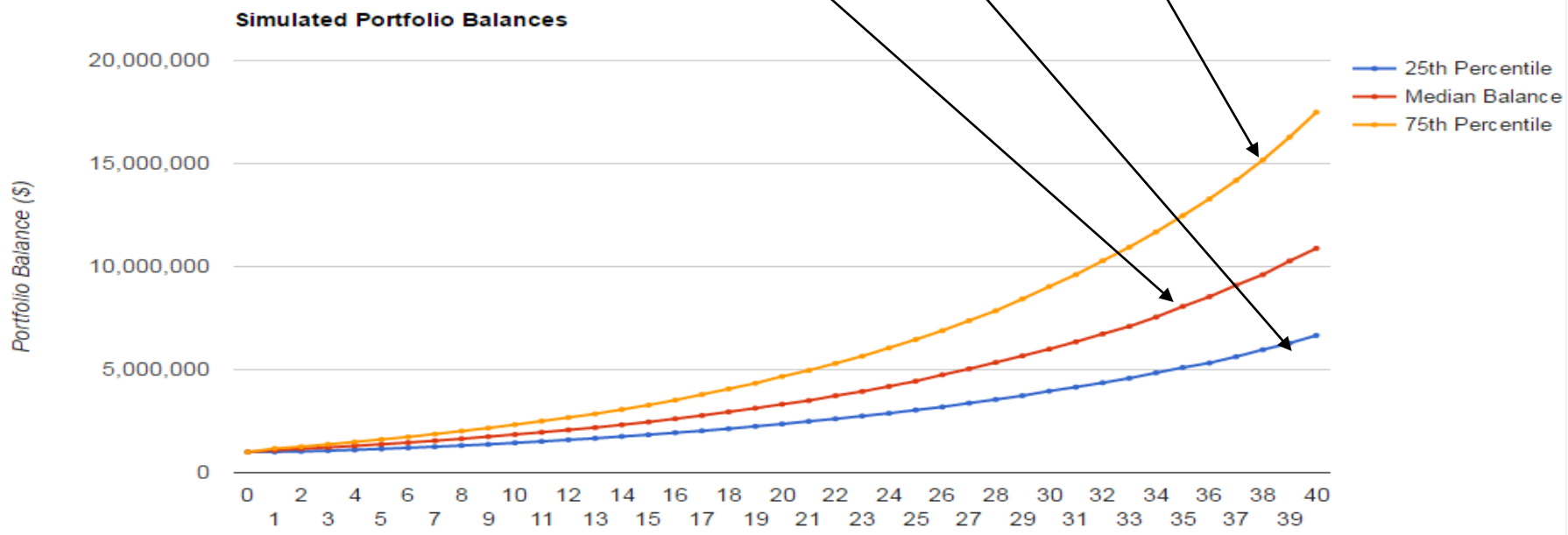
Link Print Download

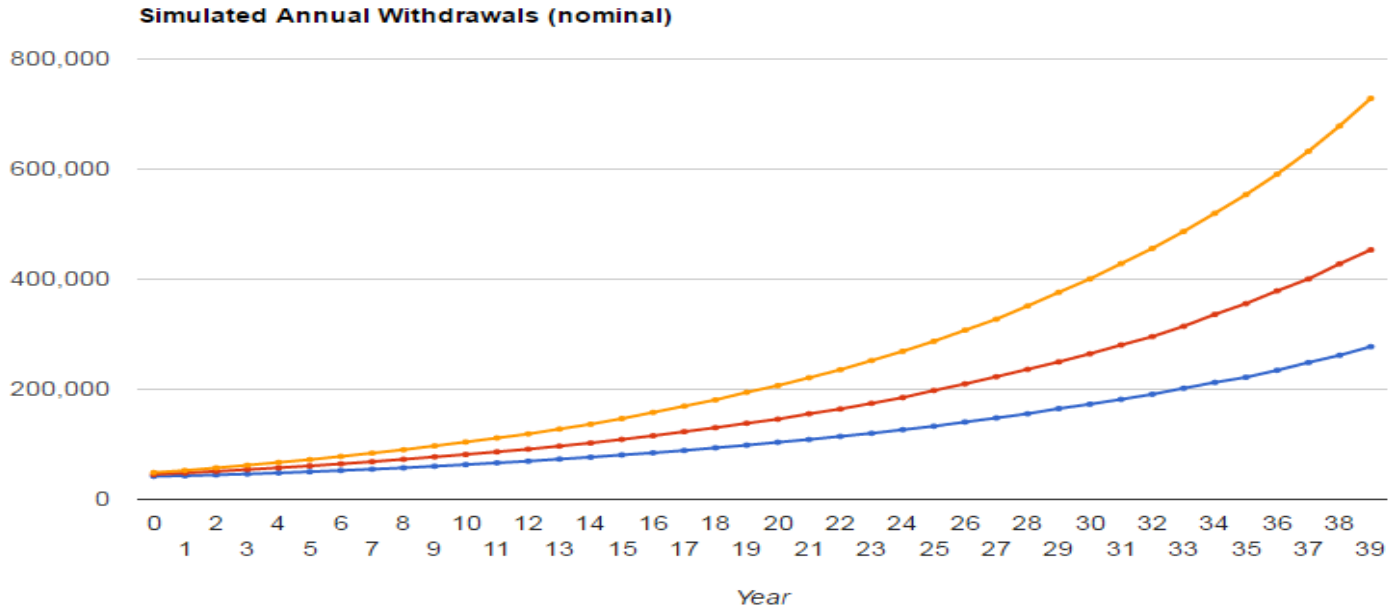
Monte Carlo simulation results for 10000 portfolios with $1,000,000 initial portfolio balance using available asset class data from 1972 to 2015. The historical return for the selected allocation from 1972 to 2015 was 11.19% mean return with 12.04% standard deviation. The results are based on simulated nominal returns and fixed 4.00% annual withdrawals. The simulated inflation model used historical inflation with 4.10% mean and 3.14% standard deviation based on the Consumer Price Index (CPI-U) data from 1972 to 2015.

Simulation Summary | Histograms

Allocation	Annual Adjustment	Years	Median End Balance	25th Percentile End Balance	75th Percentile End Balance	Max. Drawdown	Probability of Success
15.00% Large Cap Value 15.00% Small Cap Value 13.00% Small Cap Blend 4.00% Emerging Markets 13.00% Intl Value Stocks 40.00% TIPS	-4.00%	40	$10,880,512	$6,658,616	$17,485,929	Mean: -27.96% Median: -26.62% StdDev: 10.50%	100%

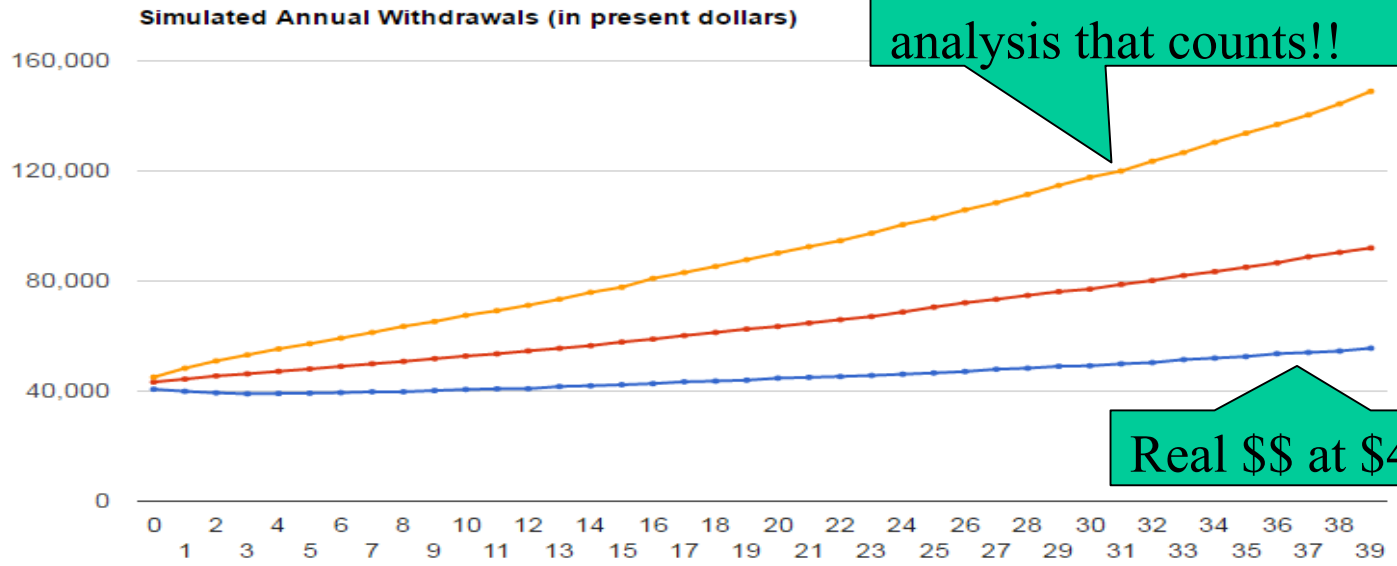
Save portfolio »





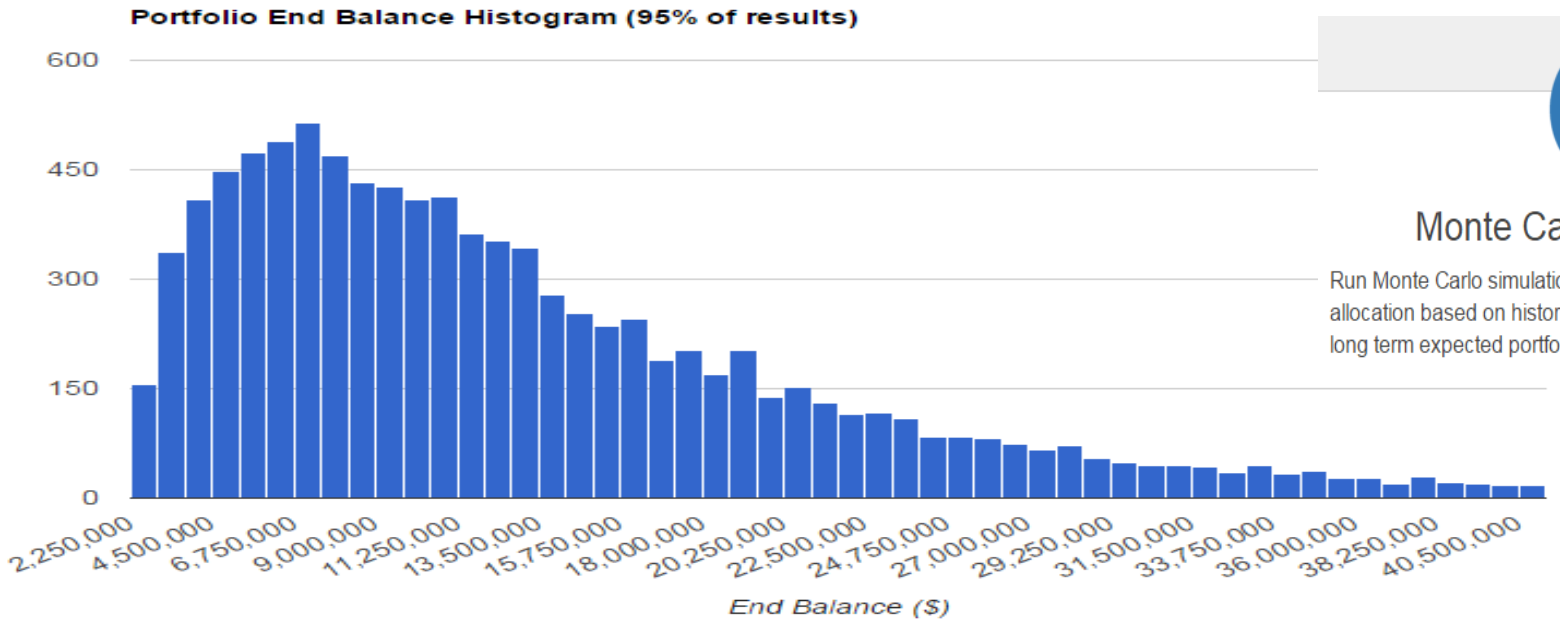
Monte Carlo Simulation

Run Monte Carlo simulations for the specified asset allocation based on historical or forecasted returns to test long term expected portfolio growth and survival.



Real dollars – the analysis that counts!!

Real $$ at $40k or above



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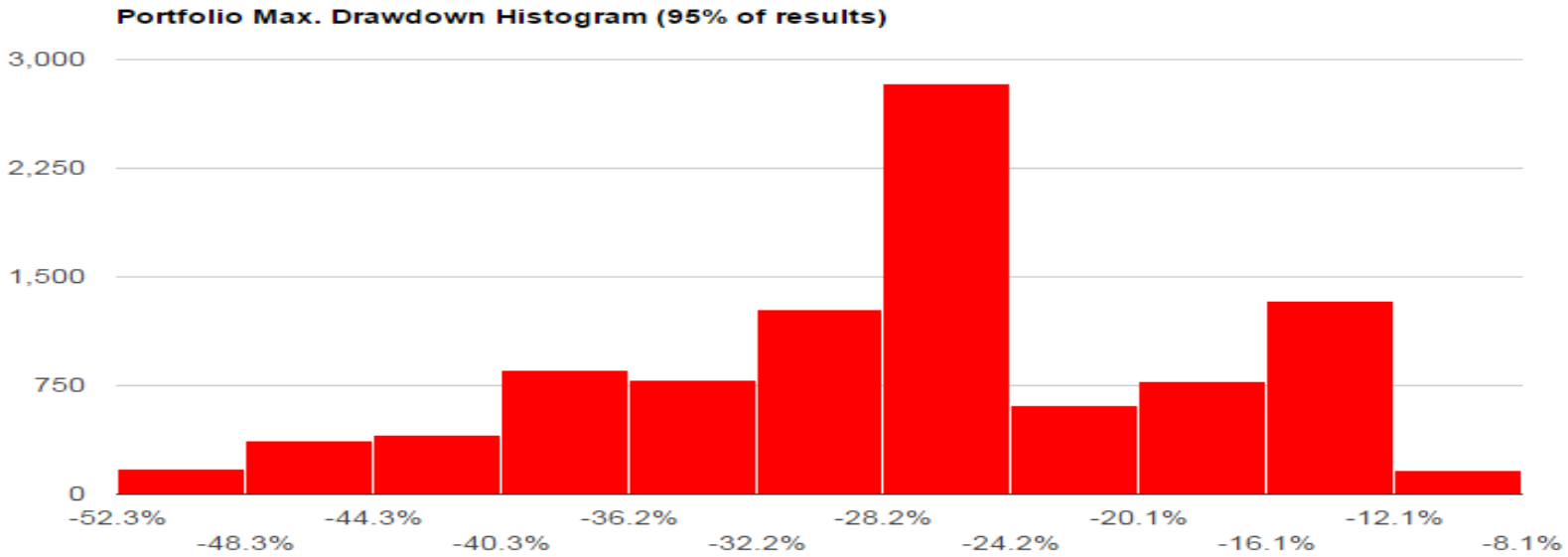


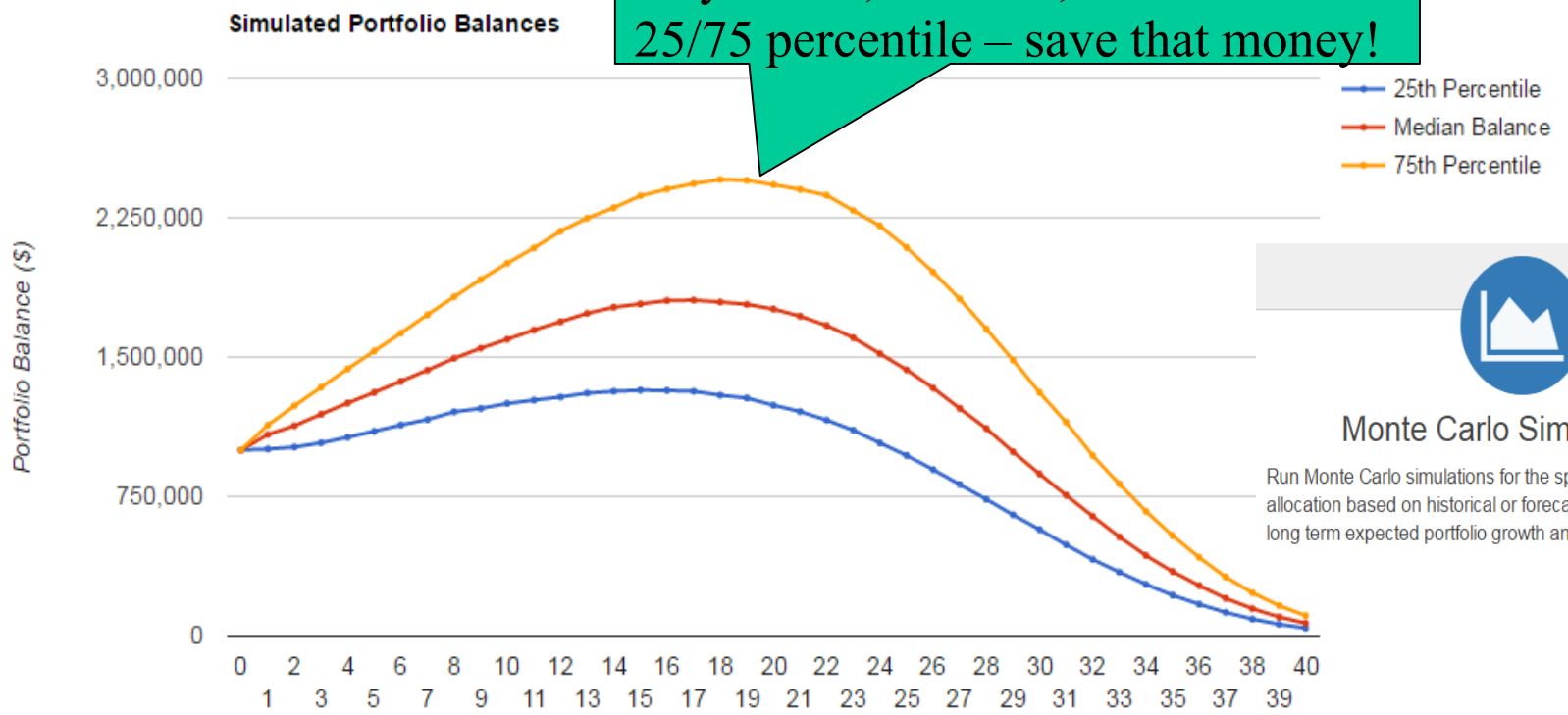
Simulation Summary | Histograms

Life Expectancy/RMD, 40 Years Example

Allocation	Annual Adjustment	Years	Median End Balance	25th Percentile End Balance	75th Percentile End Balance	Max. Drawdown	Probability of Success
15.00% Large Cap Value 15.00% Small Cap Value 13.00% Small Cap Blend 4.00% Emerging Markets 13.00% Intl Value Stocks 40.00% TIPS	Life Expectancy Based	40	$67,854	$41,318	$108,561	Mean: -96.62% Median: -96.94% StdDev: 1.78%	100%

Save portfolio »

18 years in, ~80 YO, $1.3M/$2.5M
25/75 percentile – save that money!



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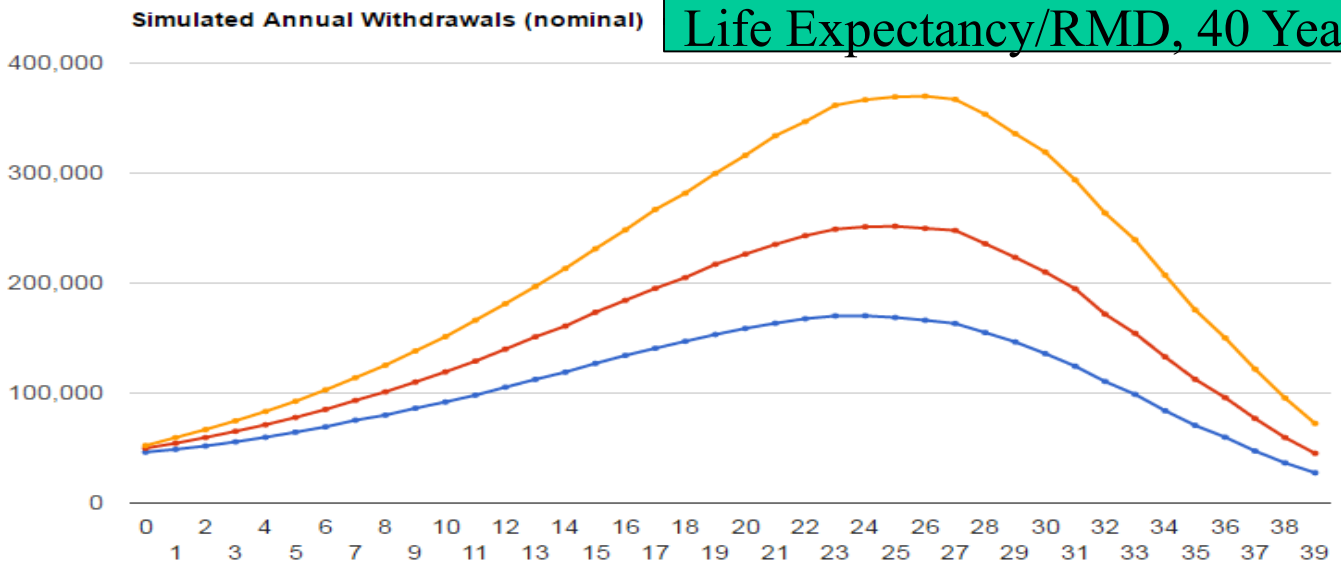
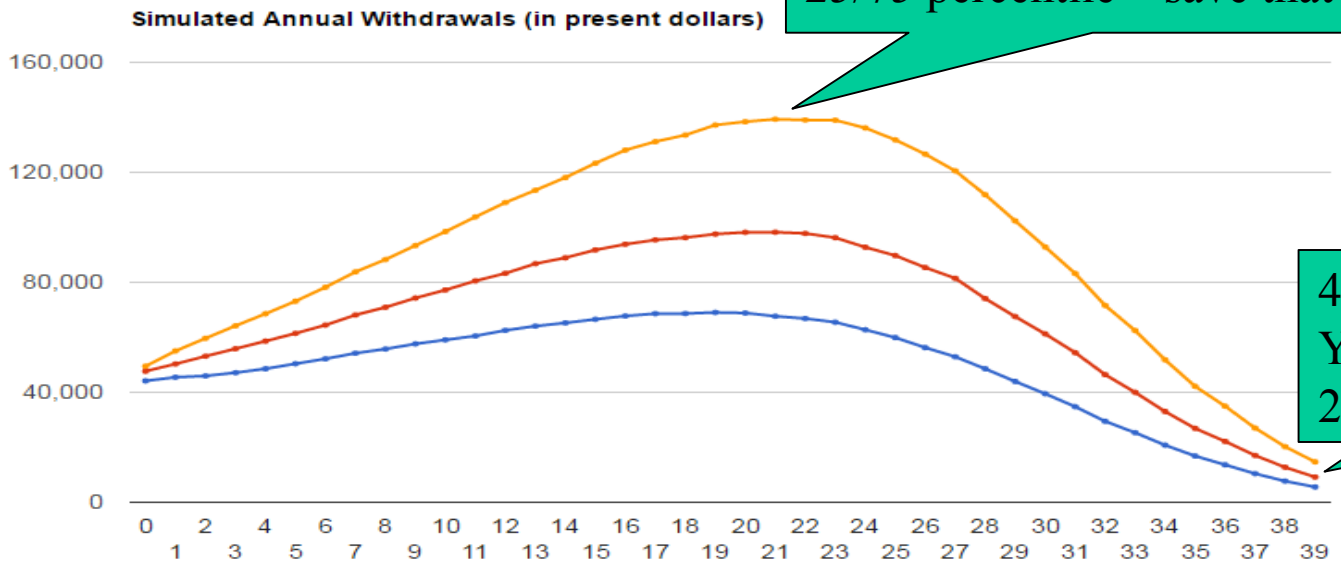


Monte Carlo Simulation

Run Monte Carlo simulations for the specified asset allocation based on historical or forecasted returns to test long term expected portfolio growth and survival.

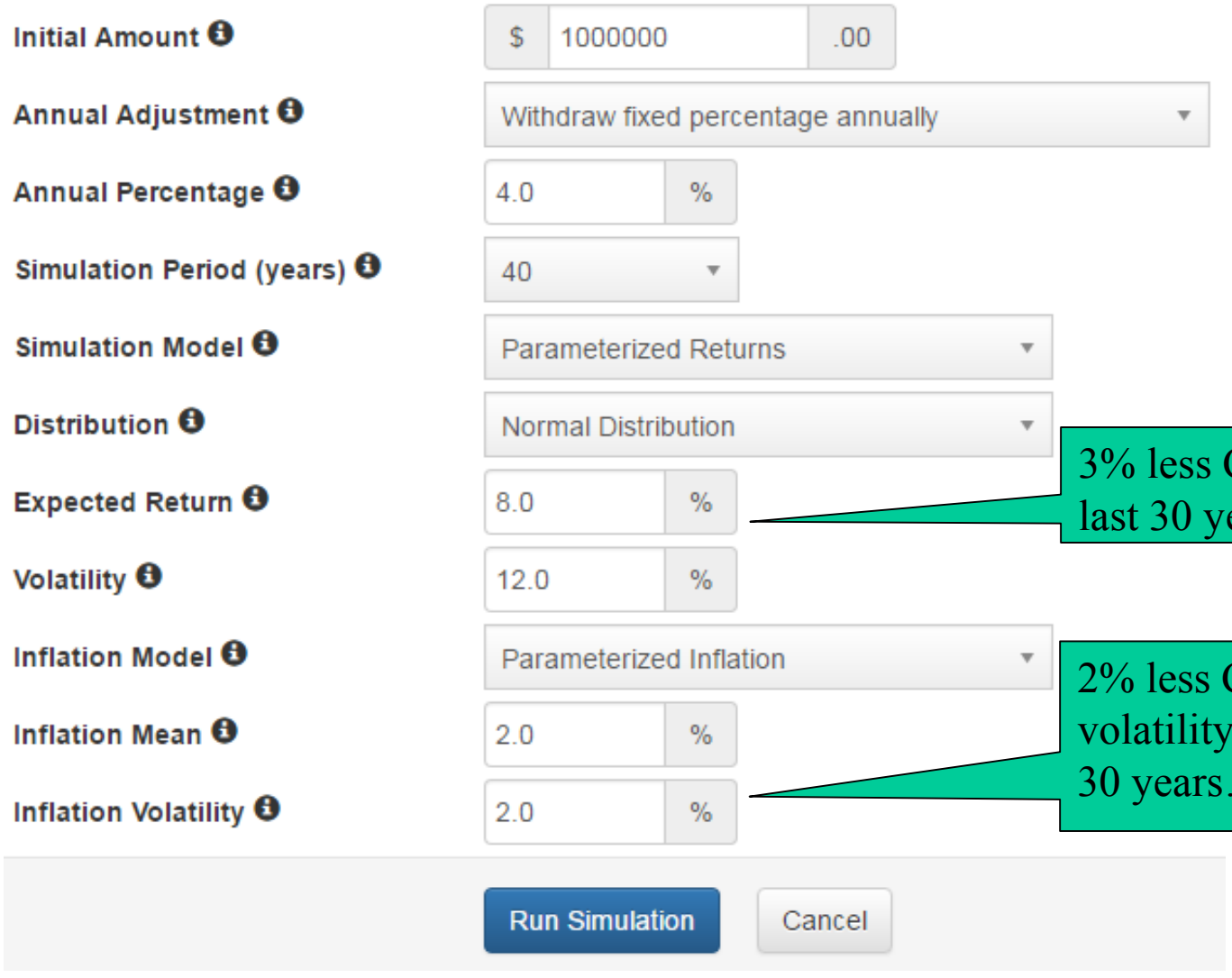
21 years in, ~83 YO, $68k/139k 25/75 percentile – save that money!



40 years in, ~102 YO, $5.6k/14.7k 25/75 percentile –

Monte Carlo Simulation

4% Withdrawal rate, 40 Years Example
Parameterized future returns, inflation



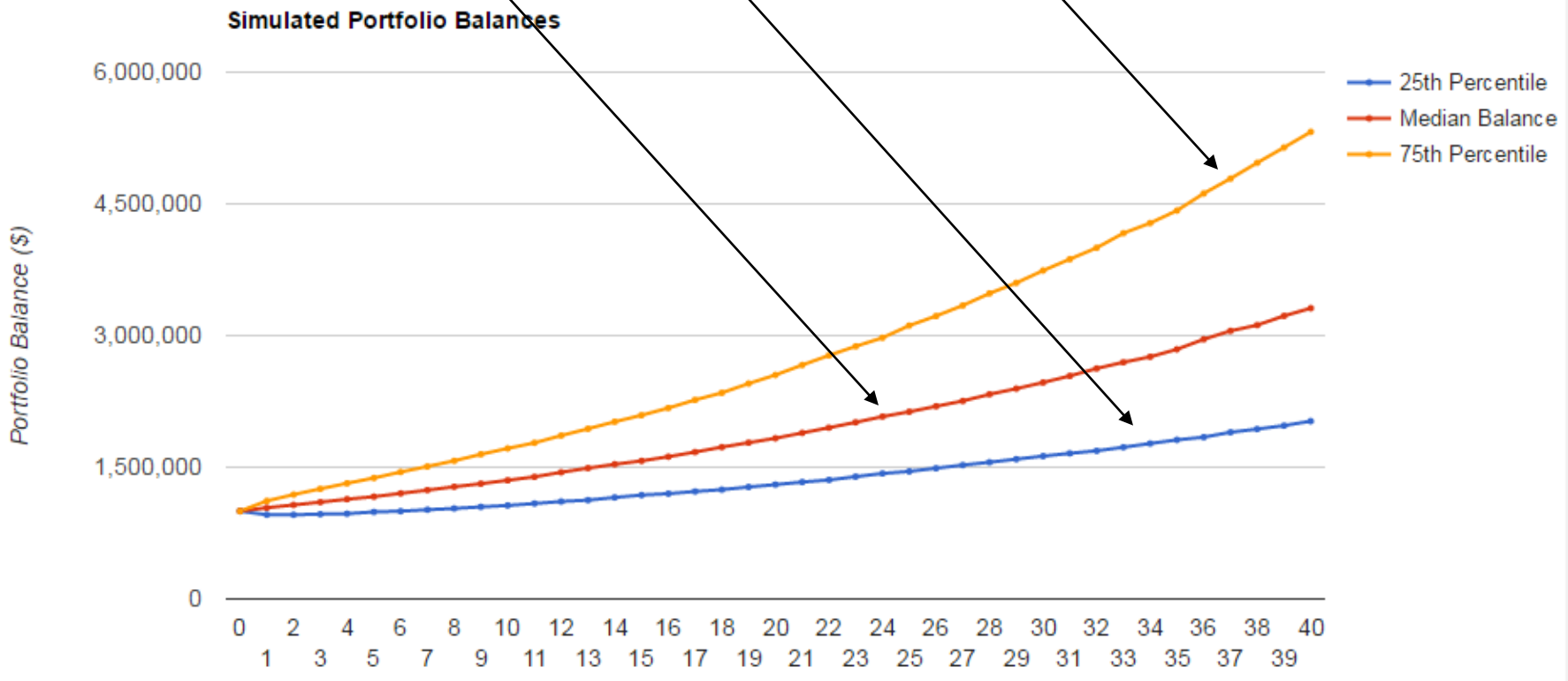
3% less CAGR than over the last 30 years…

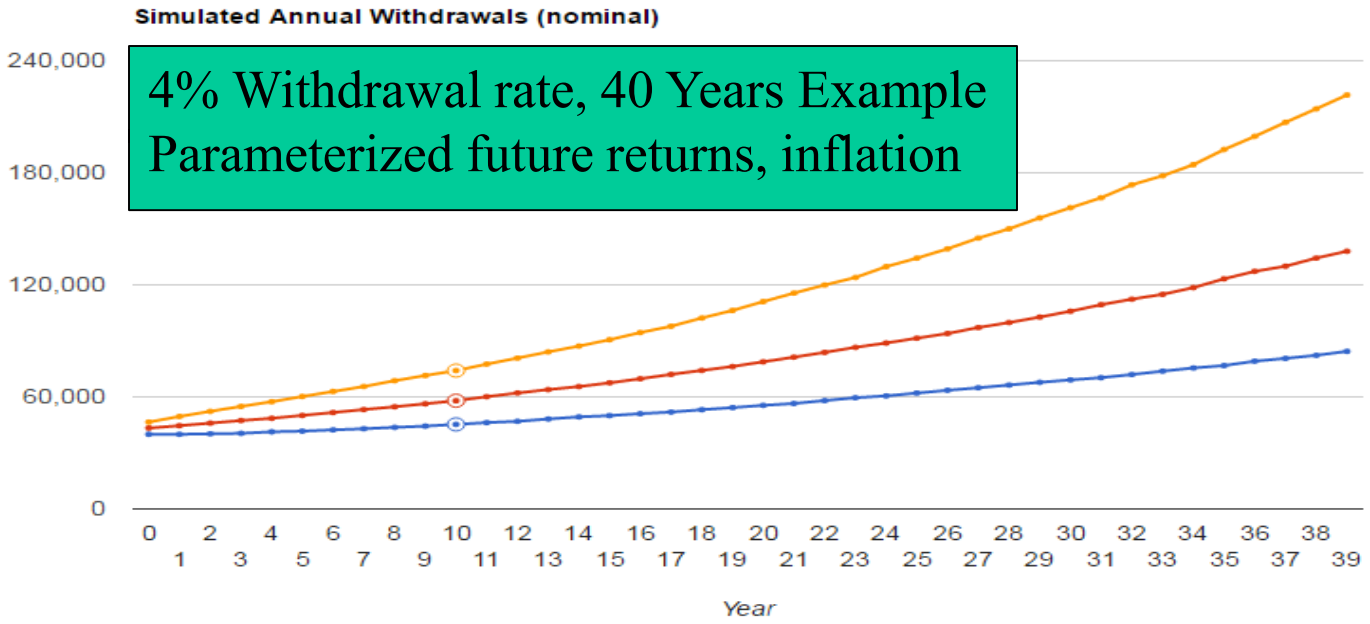
2% less CPI, 1% less volatility than over the last 30 years…

4% Withdrawal rate, 40 Years Example Parameterized future returns, inflation

Simulation Summary | Histograms

Annual Adjustment	Years	Median End Balance	25th Percentile End Balance	75th Percentile End Balance	Max. Drawdown	Probability of Success
-4.00%	40	$3,311,927	$2,025,232	$5,319,819	Mean: -34.39% Median: -32.69% StdDev: 12.21%	100%





4% Withdrawal rate, 40 Years Example
Parameterized future returns, inflation

Monte Carlo Simulation

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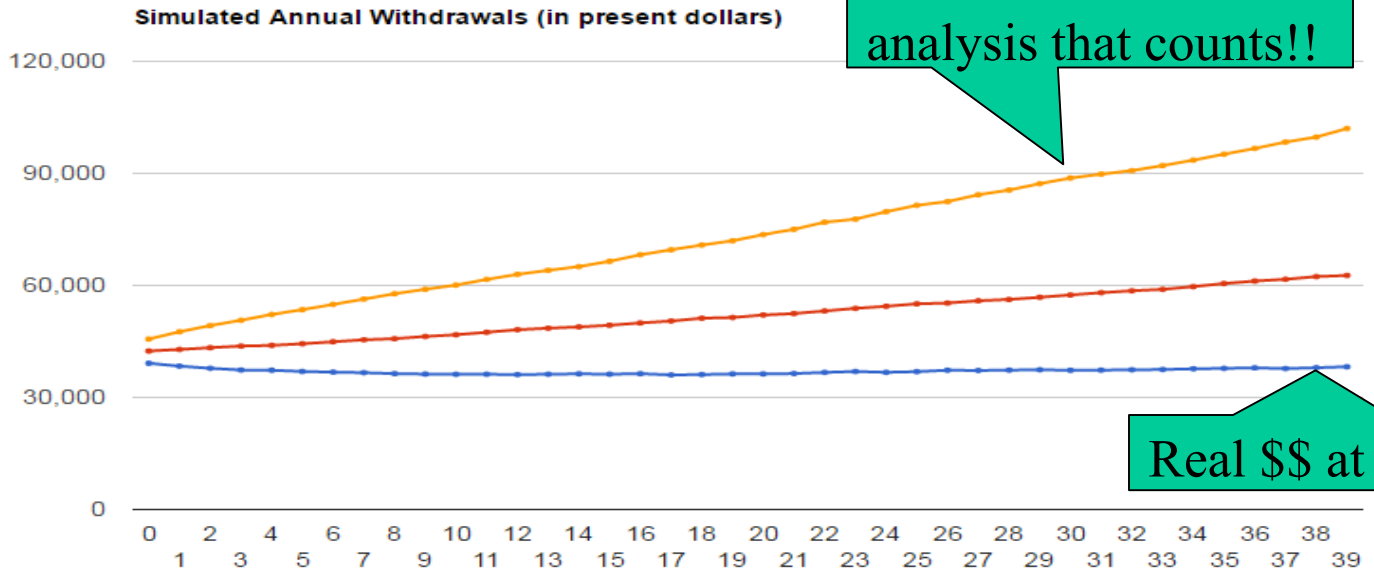


Real dollars – the analysis that counts!!

Real $$ at $37k or above

Monte Carlo Simulation Results

Link Print Download

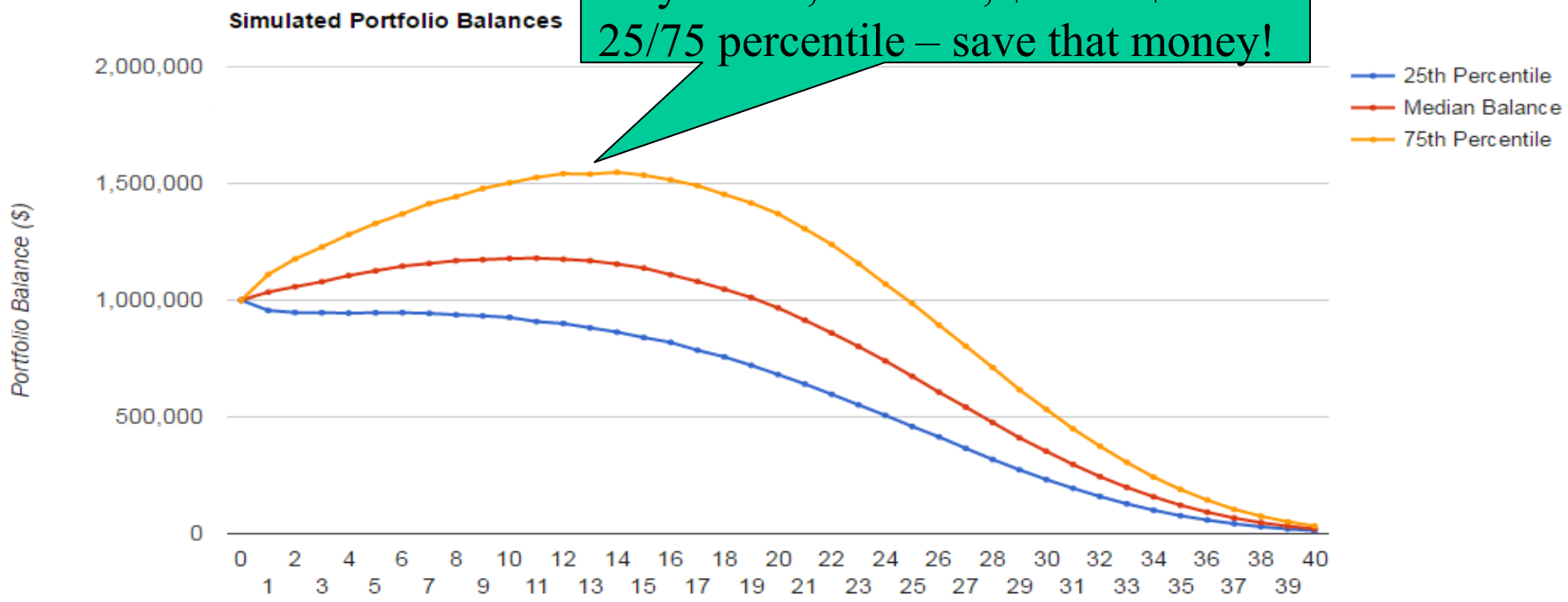
Monte Carlo simulation results for 10000 portfolios with $1,000,000 initial portfolio balance using the normal distribution with 8.00% mean and 12.00% standard deviation for annual returns. The results are based on simulated nominal returns and life expectancy based variable percentage annual withdrawals (62-year old, Single Life Expectancy). The simulated inflation model used normal distribution with 2.00% mean and 2.00% standard deviation based on the parameters.

Simulation Summary | Histograms

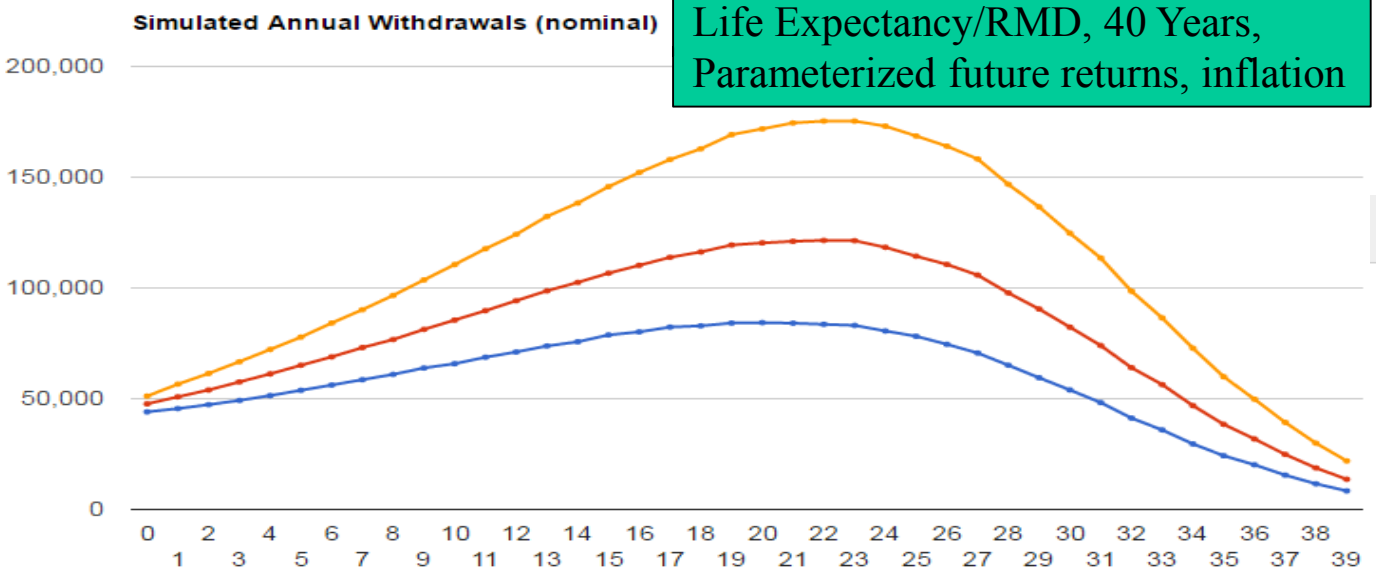
Life Expectancy/RMD, 40 Years Example
Parameterized future returns, inflation

Annual Adjustment	Years	Median End Balance	25th Percentile End Balance	75th Percentile End Balance	Max. Drawdown	Probability of Success
Life Expectancy Based	40	$20,451	$12,612	$32,892	Mean: -98.43% Median: -98.65% StdDev: 0.96%	100%

14 years in, ~76 YO, $1.3M/$863k
25/75 percentile – save that money!



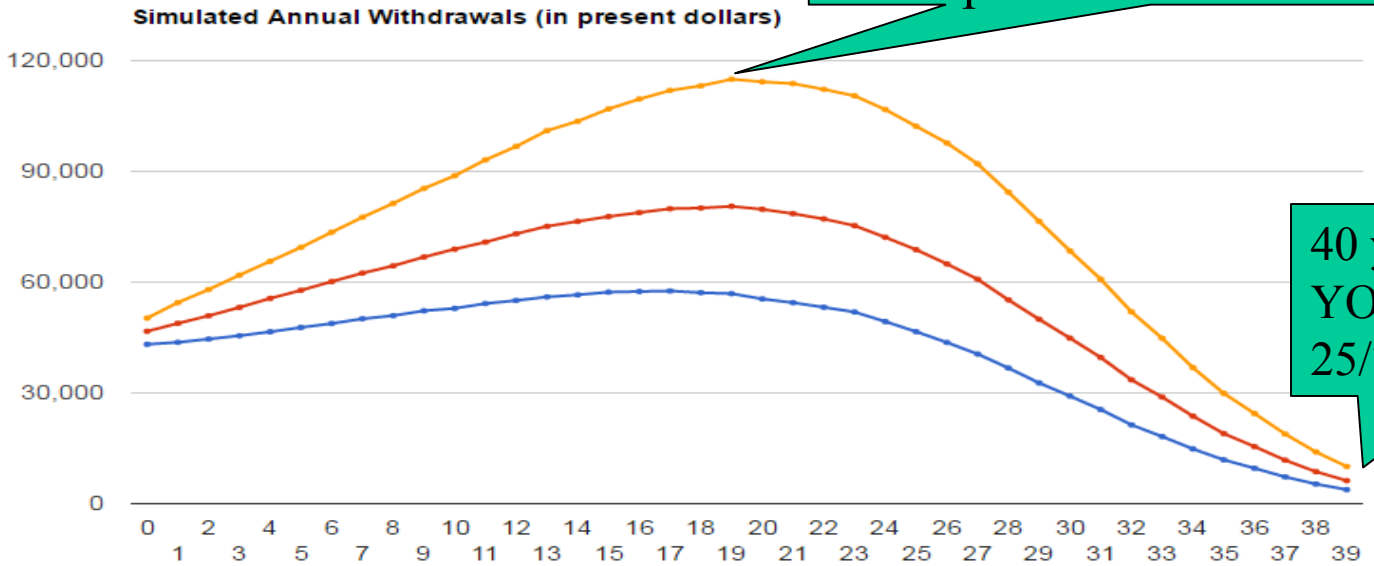
Life Expectancy/RMD, 40 Years, Parameterized future returns, inflation



Monte Carlo Simulation

Run Monte Carlo simulations for the specified asset allocation based on historical or forecasted returns to test long term expected portfolio growth and survival.

19 years in, ~81 YO, $115k/$57k 25/75 percentile – save that money!



40 years in, ~102 YO, $3.8k/10k 25/75 percentile –

Agenda

- Basic Questions
- The Tool: Portfolio Visualizer
- Asset Allocation Backtest (ETF/M-Fund, Indices)
- Monte Carlo simulation: Determine your portfolio's growth and survival rates
- **Correlations: How to determine your portfolio's asset correlations**
- Summary and Final Q&A

- Extra "Stuff" (on-line)
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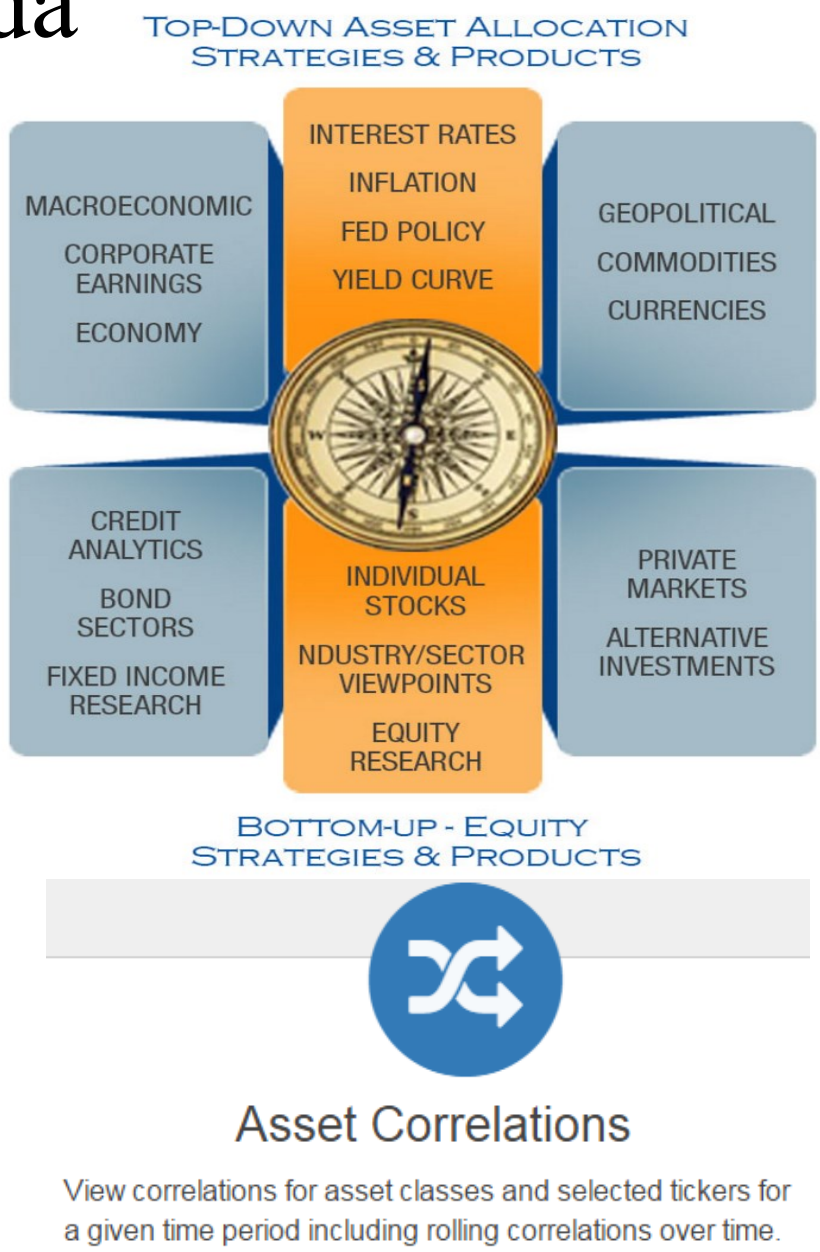
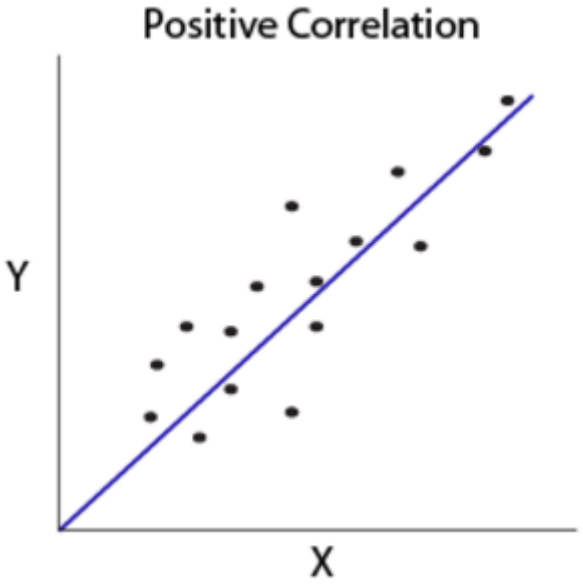
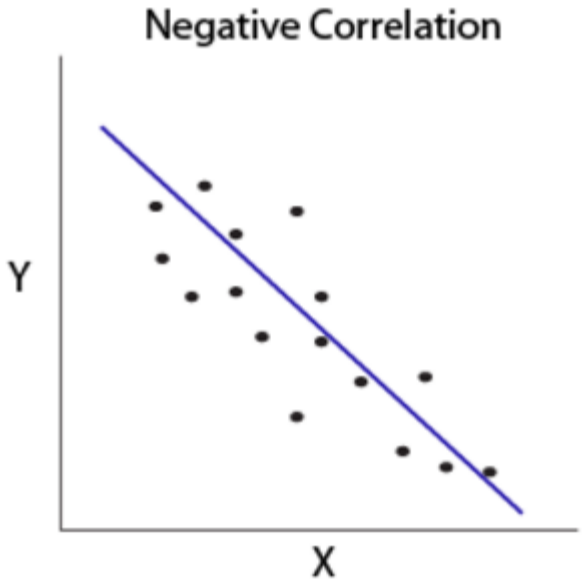


Correlation Tool : Overview

- What is correlation??
  - Correlations measure the relationship between the changes of two or more financial variables in time.
  - For example, stocks and bonds often move in opposite directions: when investors sell stocks, they often use the proceeds to buy bonds and vice versa. In this case, stocks and bonds are ***negatively correlated***.



- Why use correlations??
  - Financial correlations play a key role in finance.
  - Under the capital asset pricing model, CAPM an increase in diversification increases the return/risk ratio.
  - ***Diversification is synonymous with inverse correlation:*** the lower the correlation between the constituent holdings, (preferably negative), the lower the risk of holding the combined portfolio.



Asset Correlations

This online asset correlation testing tool allows you to view correlations for stocks, ETFs and mutual funds for the given time period. You also view the rolling correlation for a given number of trading days to see how the correlation between the assets has changed over time. You can also view correlation matrix for common asset class ETFs or test assets for autocorrelation and cointegration.

Tickers VFINX VFIIX VWEHX

Start Date 11/12/1996

End Date 11/10/2016

Correlation Basis Daily Returns

Rolling Correlation 20 Trading Days

View Correlation | Cancel

Up to 5 tickers. Here we have the SP500, GNMAs and Junk

Also monthly, yearly

Shortest time period

Correlation Results

Link | Print | Download

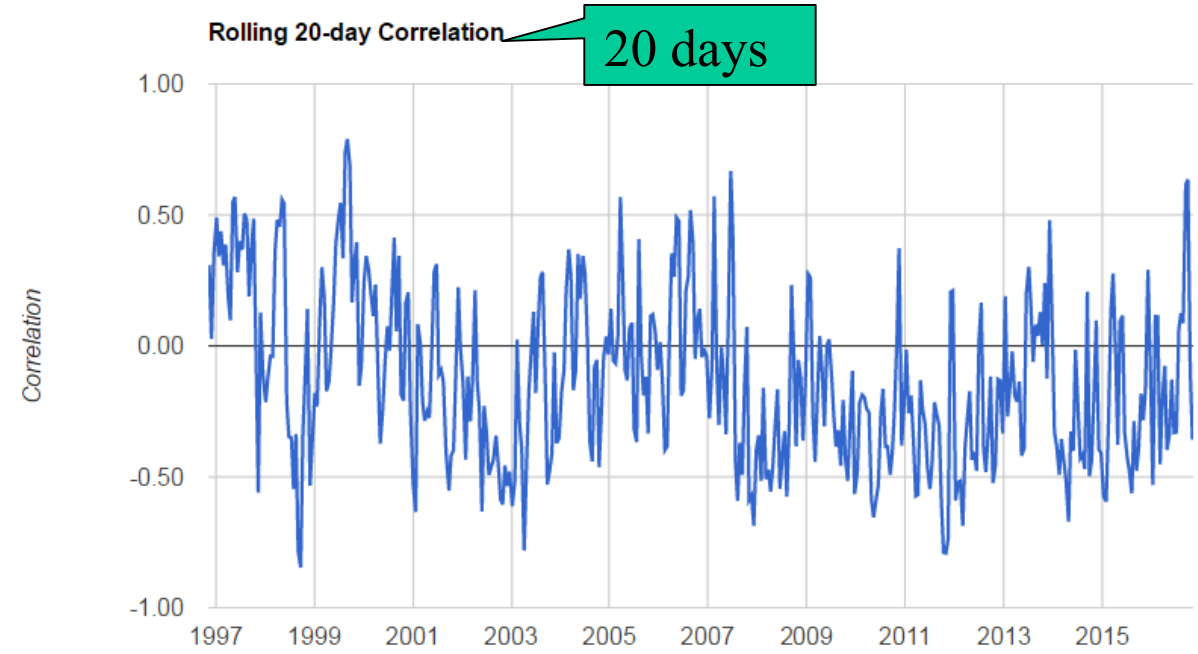
Asset correlations for time period 11/12/1996 - 11/09/2016 based on daily returns.

Correlation Matrix | Rolling Correlations

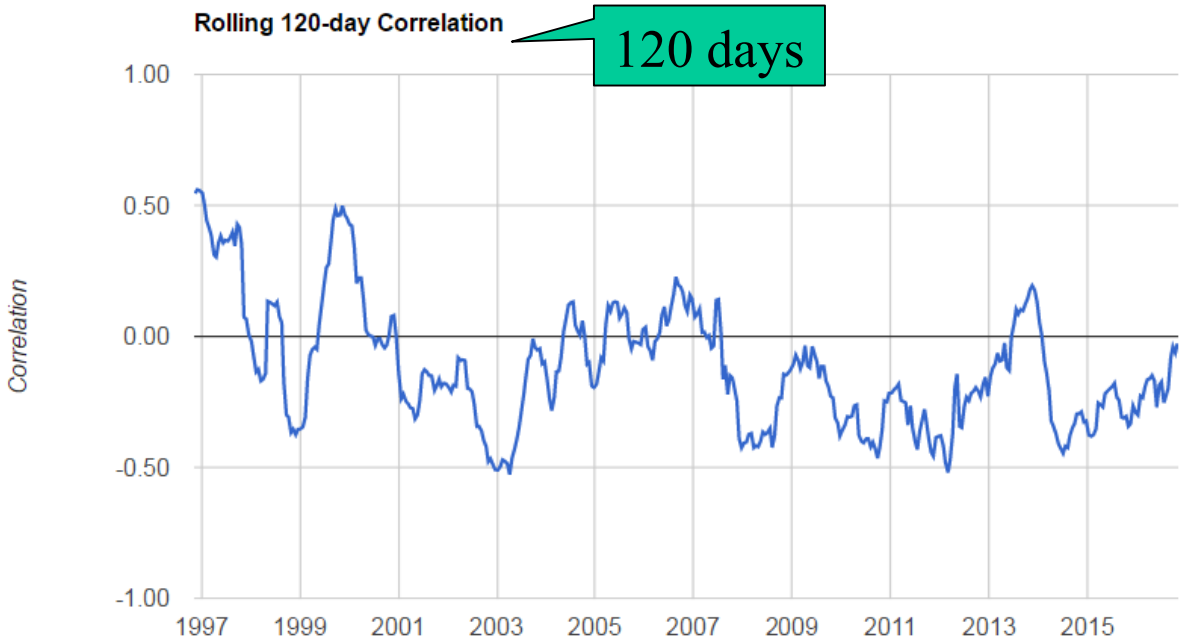
Correlation matrix

Statistics for each ticker

Name	Ticker	VFINX	VFIIX	VWEHX	Annualized Return	Daily Standard Deviation	Monthly Standard Deviation	Annualized Standard Deviation
Vanguard 500 Index Fund	VFINX	-	-0.13	0.18	7.46%	1.24%	4.42%	15.47%
Vanguard GNMA Fund	VFIIX	-0.13	-	0.29	5.27%	0.23%	0.81%	2.80%
Vanguard High Yield Corporate Fund	VWEHX	0.18	0.29	-	6.21%	0.29%	2.19%	7.69%

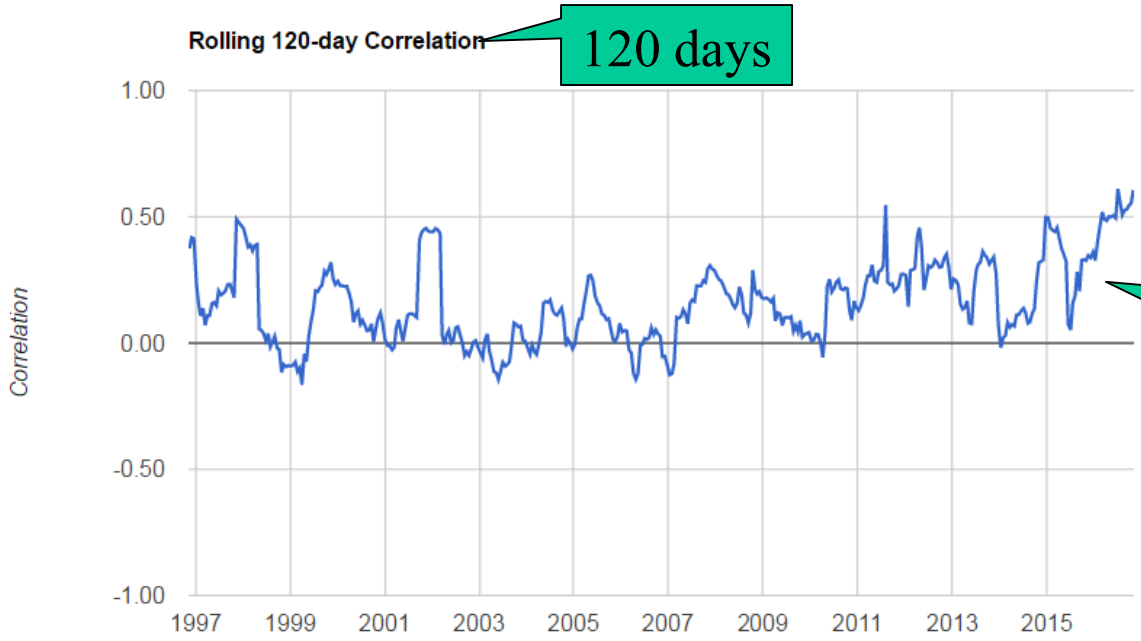


In general, the SP500 and GNMAs have been negatively correlated

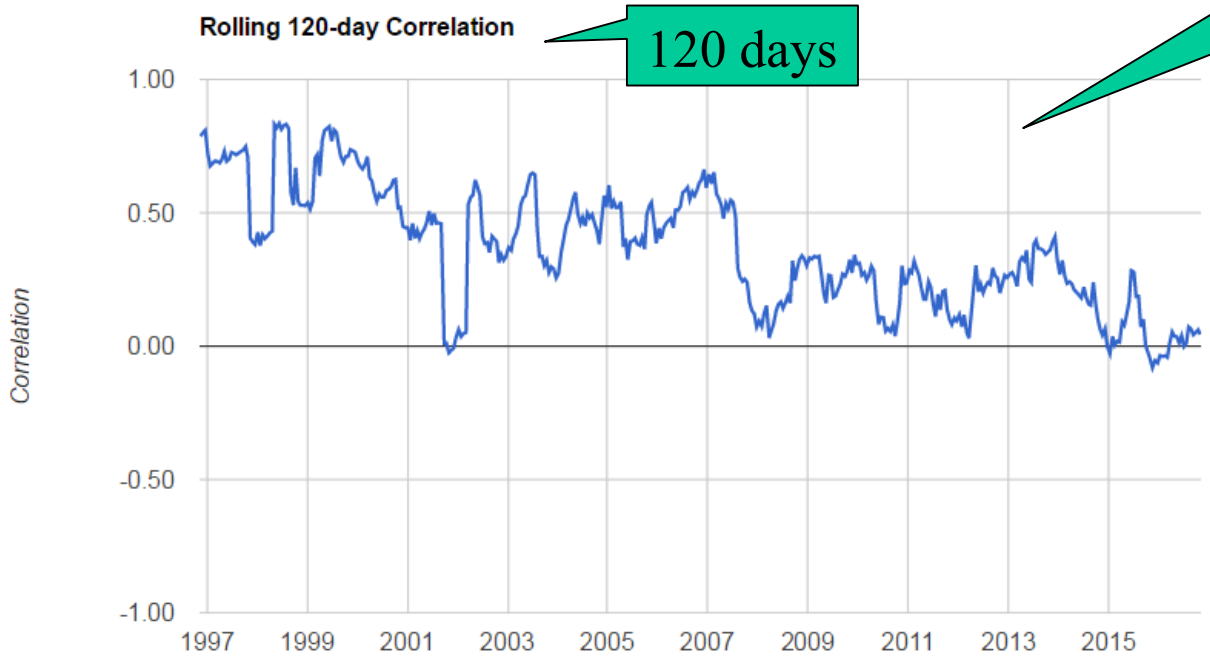


Asset Correlations

View correlations for asset classes and selected tickers for a given time period including rolling correlations over time.



In general, the SP500 and Junk have been *positively* correlated



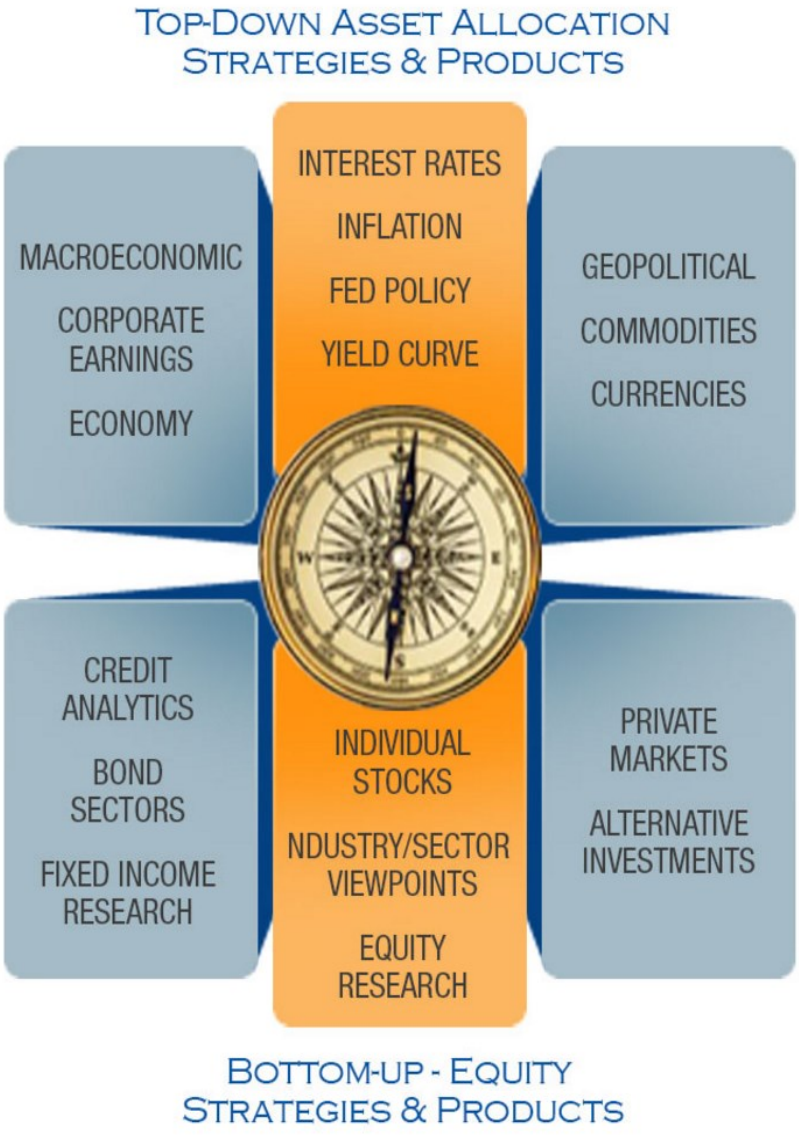
In general, GNMAs and Junk have been *positively* correlated

Asset Correlations

View correlations for asset classes and selected tickers for a given time period including rolling correlations over time.

Session Summary

- Basic Questions: Verify your strategy so you have confidence – and the discipline – to meet your goals
- Portfolio Visualizer: A freeware tool that puts significant analysis power in your hands
- Asset Allocation Backtest: Put your portfolio – and famous ones – to the test
- Monte Carlo simulation: Determine your portfolio's growth and survival rates
- Correlations: How to determine your portfolio's asset correlations – and meet CAPM requirements

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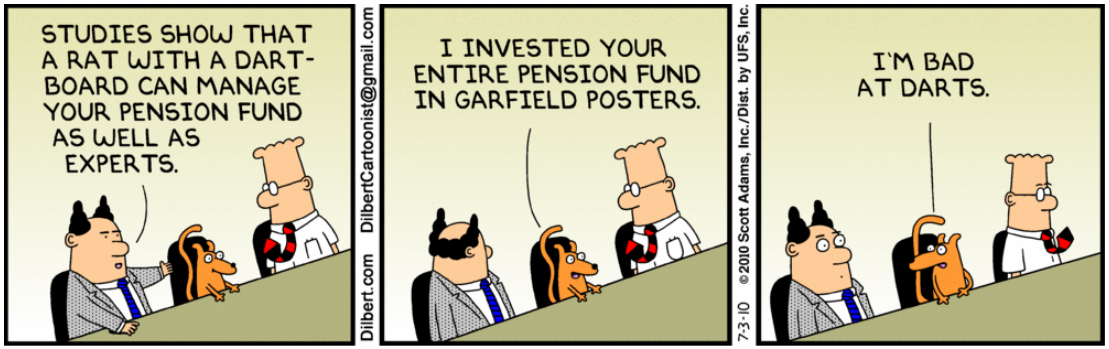
STUDIES SHOW THAT A RAT WITH A DART-BOARD CAN MANAGE YOUR PENSION FUND AS WELL AS EXPERTS.
I INVESTED YOUR ENTIRE PENSION FUND IN GARFIELD POSTERS.
I'M BAD AT DARTS.
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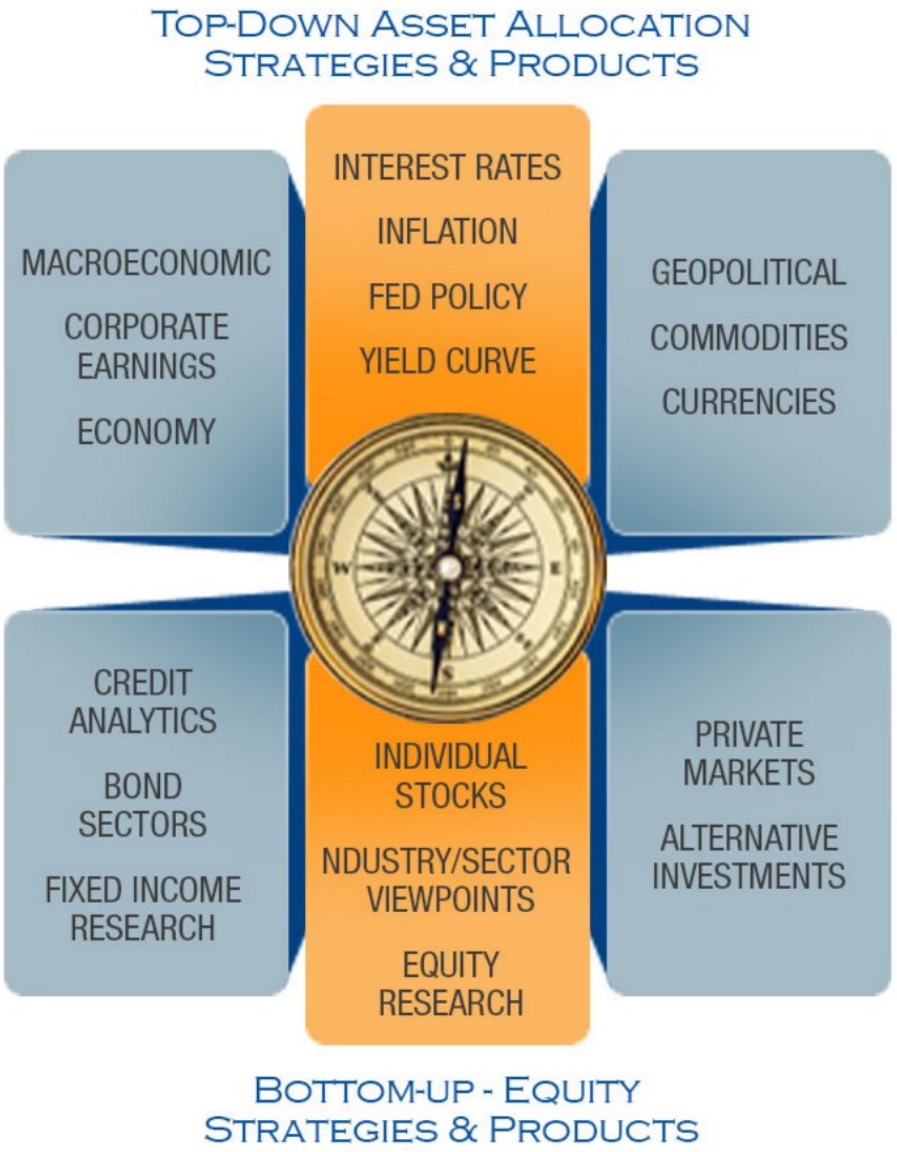
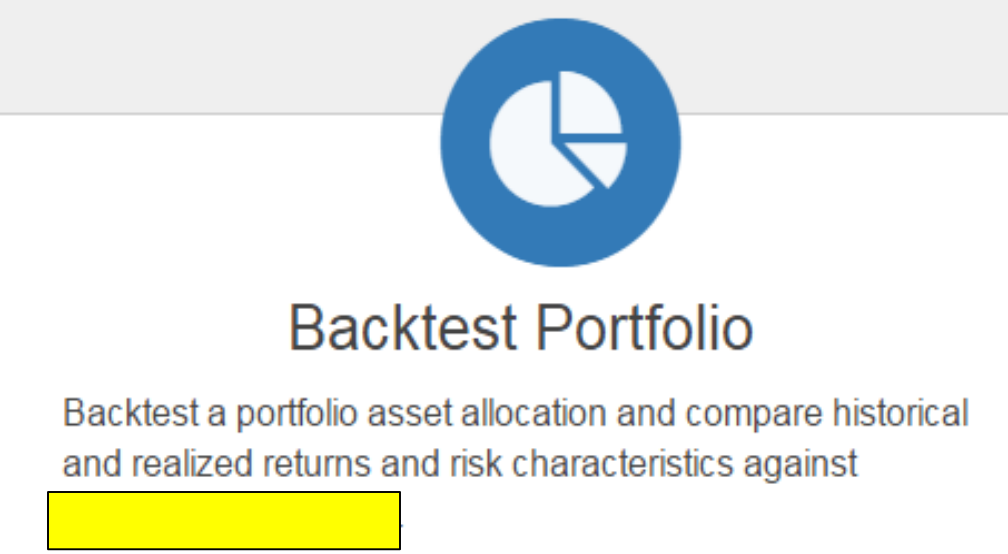
7-3-10

Extra "Stuff"

- Back-testing a Few Lazy Portfolios
- Robo-Advisors: The Good, the Bad and the Ugly





Part II: Back-testing Lazy Portfolios

Backtest Portfolio Asset Allocation

This online portfolio backtesting tool allows you to construct one or more portfolios based on the selected mutual funds, ETFs and stocks to analyze and backtest portfolio returns, risk characteristics, standard deviation, annual returns and rolling returns. The results include a visualization of the portfolio growth chart and rolling returns, CAGR, standard deviation, Sharpe ratio, Sortino ratio, annual returns and inflation adjusted returns. A periodic contribution or withdrawal can also be specified together with the preferred portfolio rebalancing strategy. You can also analyze and compare asset class based lazy portfolios with a longer time horizon starting from 1972.

Time Period	Year-to-Year
Start Year	1985
End Year	2016
Initial Amount	$ 10000 .00
Periodic Adjustment	None
Rebalancing	Rebalance annually
Display Income	No
Benchmark	None

Yearly, Monthly

Contribute/withdraw fixed amount; withdraw fixed %

No or 1, 3, 6, 12 months or tolerance

Any mix of stocks, ETFs or MFs you want

Portfolio Assets		**Portfolio #1**	**Portfolio #2**	**Portfolio #3**
Asset 1	VTSMX	50 %	30 %	%
Asset 2	VGTSX	30 %	%	%
Asset 3	VBMFX	10 %	%	%
Asset 4	VIPSX	10 %	15 %	40 %

Summary | Metrics | Annual Returns | Monthly Returns | Drawdowns | Assets | Rolling Returns

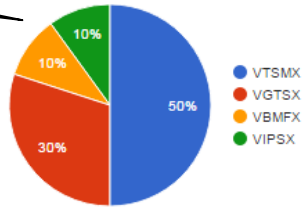
Portfolio Allocations

Portfolio 1

Ticker	Name	Allocation
VTSMX	Vanguard Total Stock Market Index Fund	50.00%
VGTSX	Vanguard Total International Stock Index Fund	30.00%
VBMFX	Vanguard Total Bond Market Index Fd	10.00%
VIPSX	Vanguard Inflation Protected Securities Fund	10.00%

Save portfolio »

Boglehead 4 Fund

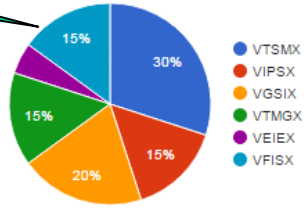


Portfolio 2

Ticker	Name	Allocation
VTSMX	Vanguard Total Stock Market Index Fund	30.00%
VIPSX	Vanguard Inflation Protected Securities Fund	15.00%
VGSIX	Vanguard REIT Index Fund	20.00%
VTMGX	Vanguard Developed Markets Index Admiral	15.00%
VEIEX	Vanguard Emerging Markets Stock Index Fund	5.00%
VFISX	Vanguard Short-Term Treasury Fund	15.00%

Save portfolio »

Swenson Lazy

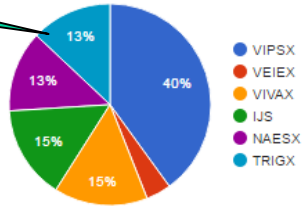


Portfolio 3

Ticker	Name	Allocation
VIPSX	Vanguard Inflation Protected Securities Fund	40.00%
VEIEX	Vanguard Emerging Markets Stock Index Fund	4.00%
VIVAX	Vanguard Value Index Fund	15.00%
IJS	iShares S&P SmallCap 600 Values Index Fund ETF	15.00%
NAESX	Vanguard Small-Cap Index Fund	13.00%
TRIGX	T. Rowe Price International Growth & Income Fund	13.00%

Save portfolio »

Swedroe Simple



Used to get longer back test

Backtest Portfolio

Backtest a portfolio asset allocation and compare historical and realized returns and risk characteristics against various lazy portfolios.

Portfolio Returns

Swedroe

Swedroe

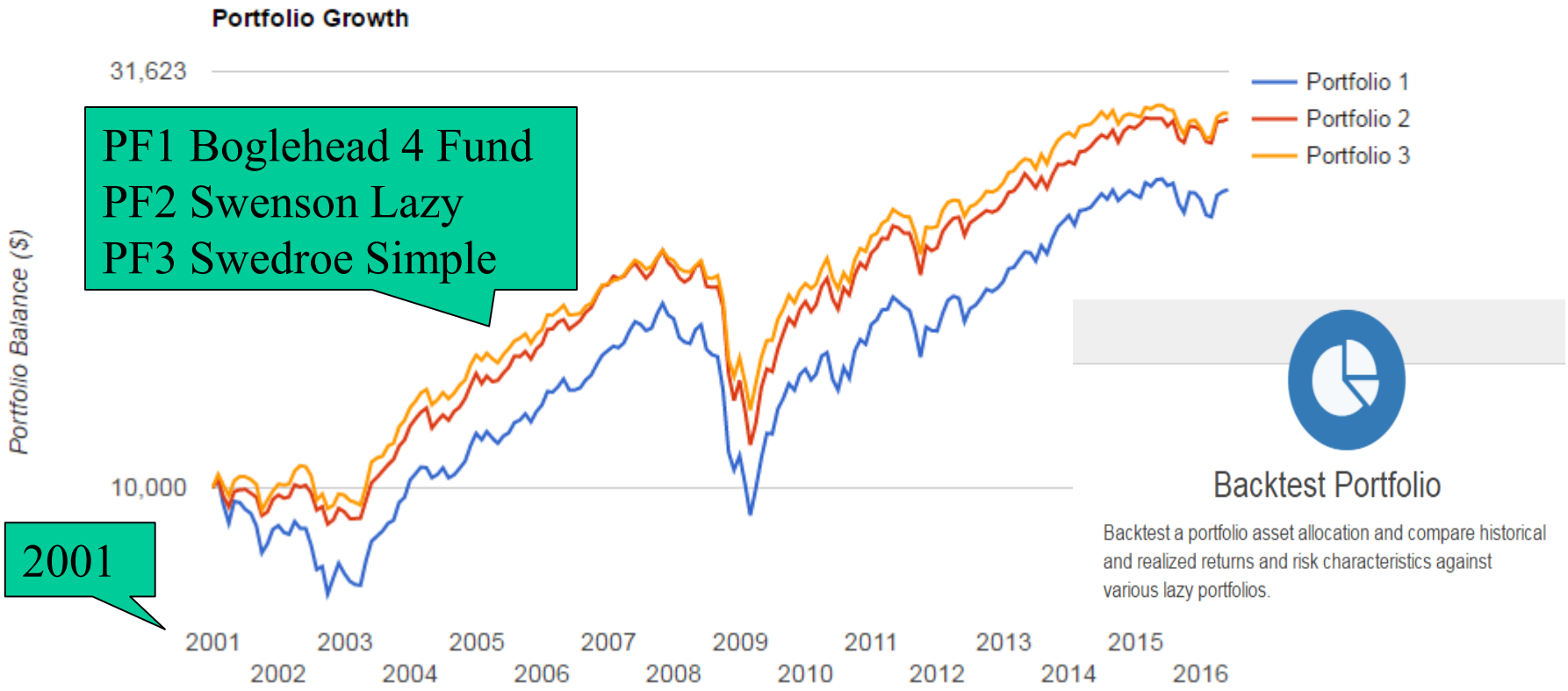
#	Initial Balance	Final Balance	CAGR	Std.Dev.	Best Year	Worst Year	Max. Drawdown	Sharpe Ratio	Sortino Ratio	US Mkt Correlation
1	$10,000	$22,802	5.49%	12.72%	29.47%	-31.53%	-44.34%	0.38	0.53	0.97
2	$10,000	$27,742	6.84%	11.51%	26.78%	-26.78%	-41.63%	0.52	0.73	0.91
3	$10,000	$28,176	6.95%	10.60%	27.37%	-23.58%	-35.76%	0.56	0.81	0.92

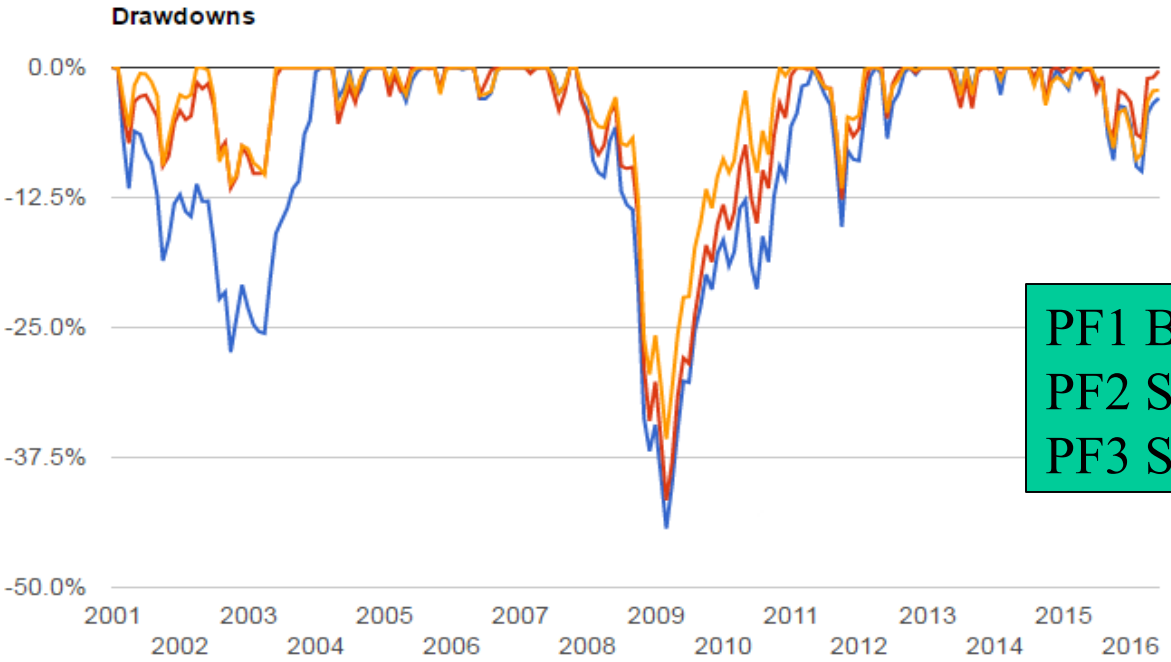
Swedroe

Swedroe

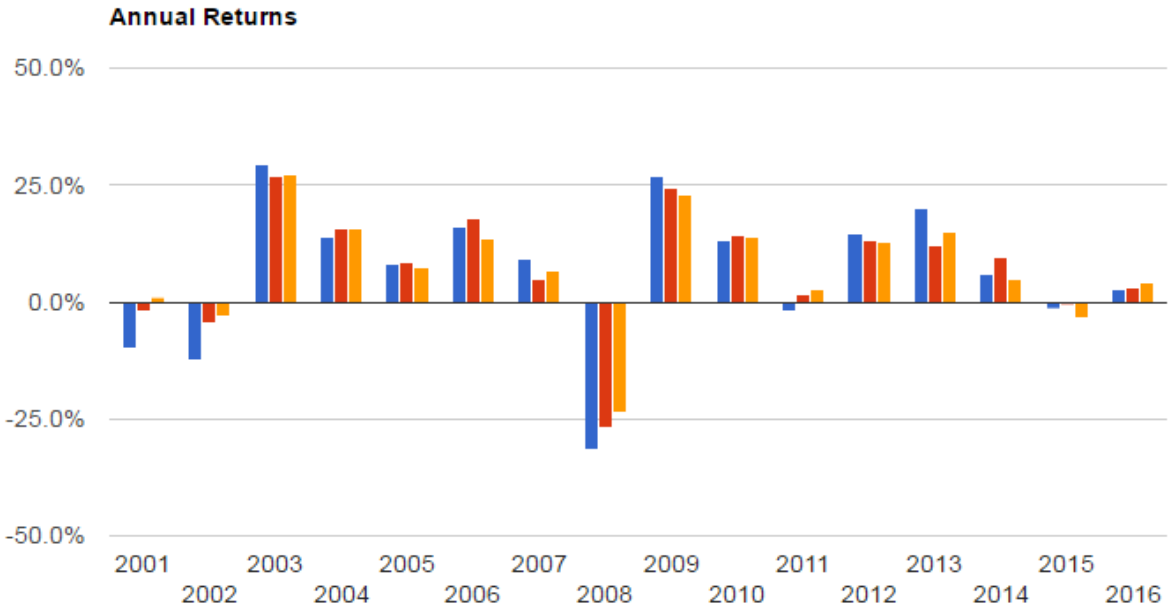
Swedroe

Swenson





PF1 Boglehead 4 Fund
PF2 Swenson Lazy
PF3 Swedroe Simple



Backtest Portfolio

Backtest a portfolio asset allocation and compare historical and realized returns and risk characteristics against various lazy portfolios.

Summary | Metrics | Annual Returns | Monthly Returns | Drawdowns | Assets | Rolling Returns

Metric	Portfolio #1	Portfolio #2	Portfolio #3
Mean Return (monthly)	0.51%	0.61%	0.61%
Mean Return (annualized)	6.33%	7.54%	7.54%
Compound Return (monthly)	0.45%	0.55%	0.56%
Compound Return (annualized)	5.49%	6.84%	6.95%
Volatility (monthly)	3.62%	3.27%	3.02%
Volatility (annualized)	12.72%	11.51%	10.60%
Max. Drawdown	-44.34%	-41.63%	-35.76%
Market Correlation	0.97	0.91	0.92
Beta(*)	0.81	0.69	0.63
Alpha (annualized)	1.18%	3.07%	3.41%
R^2	93.54%	82.45%	81.87%
Sharpe Ratio	0.38	0.52	0.56
Sortino Ratio	0.53	0.73	0.81
Treynor Ratio (%)	5.84	8.53	9.28
Skewness	-0.73	-1.05	-0.97
Excess Kurtosis	1.87	4.21	3.72
Historical Value-at-Risk (95%)	-6.69%	-5.27%	-4.65%
Delta Normal Value-at-Risk (95%)	-6.08%	-5.53%	-5.10%
Conditional Value-at-Risk (95%)	-8.45%	-7.82%	-7.21%
Positive Periods	110 out of 185 (59.46%)	120 out of 185 (64.86%)	118 out of 185 (63.78%)
Gain/Loss Ratio	0.99	0.89	0.97

(*) Beta is calculated against S&P 500 Total Return. Market correlation is against US stock market.

Alternative Risk measures

PF1 Boglehead
PF2 Swenson
PF3 Swedroe

Backtest Portfolio

Backtest a portfolio asset allocation and compare historical and realized returns and risk characteristics against various lazy portfolios.

Portfolio Returns

Yearly Rebalance

#	Initial Balance	Final Balance	CAGR	Std.Dev.	Best Year	Worst Year	Max. Drawdown	Sharpe Ratio	Sortino Ratio	US Mkt Correlation
1	$10,000	$22,802	5.49%	12.72%	29.47%	-31.53%	-44.34%	0.38	0.53	0.97
2	$10,000	$27,742	6.84%	11.51%	26.78%	-26.78%	-41.63%	0.52	0.73	0.91
3	$10,000	$28,176	6.95%	10.60%	27.37%	-23.58%	-35.76%	0.56	0.81	0.92

Portfolio Returns

Monthly Rebalance

#	Initial Balance	Final Balance	CAGR	Std.Dev.	Best Year	Worst Year	Max. Drawdown	Sharpe Ratio	Sortino Ratio	US Mkt Correlation
1	$10,000	$22,198	5.31%	12.99%	29.08%	-32.74%	-45.33%	0.36	0.50	0.97
2	$10,000	$27,159	6.70%	11.85%	26.21%	-27.67%	-42.71%	0.49	0.70	0.91
3	$10,000	$27,532	6.79%	10.90%	26.85%	-24.91%	-37.05%	0.53	0.76	0.92

Monthly hurts the stats very slightly

PF1 Boglehead 4 Fund
PF2 Swenson Lazy
PF3 Swedroe Simple

Robo-Advisors: The Good, the Bad and the Ugly

Robos: Basics & Pitfalls

Matthew Bajowski

- **What are Robos??**
  - Robo-advisers are online wealth management services that provide automated portfolio management and advice…. Their goal is to make investing easier for those who don't want to actively manage their own portfolios.
  - The term is loosely applied to a wide range of online investment services
  - They tend to "bucket" investors based on risk/reward assumptions as opposed to creating a customized risk/reward profile
  - Much of the decision-making process that robo-advisers use, comes from the concepts of modern portfolio theory (MPT)

- **Weaknesses:**
  - ***Lack of Personal Investment Advice***: Many robo services ask a series of questions (usually no more than 10) in order to generate a risk/return profile.
  - ***Robos May Not Act in the Client's Best Interest:*** Human financial advisers who are programming….each robo uses different "rebalancing bands" ….. robo-advisers use affiliated brokers, custodians, clearing firms….
  - ***Robos Don't Necessarily Cut Costs:*** Some robos collect no direct fees… but often receive other forms of compensation…. example, robos may not charge a commission… but the investor must still pay the (ETFs) or MF expense ratios

Robos: Why Use One??

Wes Gray

A good fit for small investors…..

- **Robos Leverage Technology**
  - Managing a portfolio costs labor, so traditional advisers don't work with the smallest clients… maintain a $1 million minimum for separately managed accounts
  - By leveraging technology, and simplifying the menu of services, robos can take advantage of MPT… to offer world-class asset management for a fraction of the cost
- **Robos Systematize Discipline**
  - The hardest parts of investing is adhering to an investment plan
  - Since they are automated, robos can save investors from… their own emotions
- **Robos Save Time**
  - Instead of spending hours every month studying a portfolio, preparing a list of trades, and executing those trades, investors simply rely on a robo-adviser
- **Robos Eliminate Pushy Salesmen**
  - Goodbye to your suit-wearing adviser trying to upsell you into overpriced products

Robos: 3 Reasons to Embrace the Technology

Sharon Mallory

An RIA's view…..

- **Less Risk:**
  - Technology to "assist" with investment selection is nothing new …. no portfolio that is being actively managed should see declines in the 20% to 30% range—and that includes those that are managed by robo-technology!
- **Tax Efficiency:**
  - Tax efficiency is typically implemented via tax-loss harvesting… harvests previously unrecognized investment losses to offset taxes due on your other gains and income.
- **Lower Cost:**
  - Firms that can't afford to hire an entire investment team, or a CFA, robo-technology has leveled the playing field…. Passing the cost savings on to investors allows more investors with less assets to better afford advisory services

What Do Robos Offer?

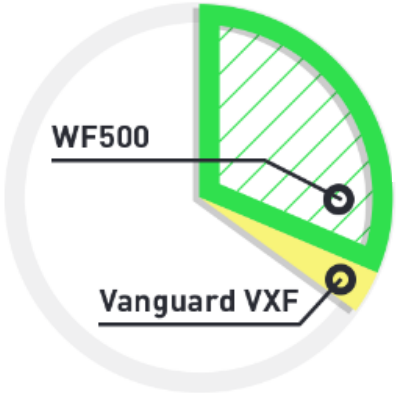
Jaclyn McClellan

	Features	Port-folio Review	Secur-ities	Tax Guid-ance	Retire-ment Withd-rawal Guid-ance	Mana-ger of Money	Staff Commun-ication	Licen-sing Require-ments	Fees	Mini-mum Account Size
Betterment	financial advising, broker/ dealer	✓	ETFs	✓	✓	firm	phone, email, app	none	0.15%-0.35% of AUM	none
Wealthfront	Investment mgmt and advice	✓	ETFs			firm	website, phone, app	none	0.25% for >$10k	$5,000

Wealthfront
Direct Indexing

SINGLE U.S. STOCK ETF

INDEX REPLACEMENT



Whoa... Will Wealthfront really buy up to 1,000 individual stocks on my behalf?

That's right. We're able to do it because we are the largest automated investment service. Our software algorithms are able to efficiently trade and tax-loss harvest all of the hundreds of stocks we buy on your behalf commission-free – something that is incredibly challenging and expensive to do in any other way.

As a result, we're able to bring a service that has normally only been available to investors with $5 million or more to investors like you.

What's more, with the added tax-loss harvesting opportunities of individual stocks, our research shows that incorporating Tax-Optimized Direct Indexing into your Wealthfront portfolio could potentially add an average of 2.03% to your annual after-tax returns. Read Our White Paper.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&
A
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Reference Material

Web Sites, Tools, Data Sources, etc.

- General information
  - http://www.aaii.com articles, spreadsheets, portfolios, etc.
  - http://finance.yahoo.com/?u great general site
- Blogs
  - http://www.hussmanfunds.com blog, economic financial studies
  - http://www.ritholtz.com/blog/ Famous financier blog
  - http://www.johnmauldin.com/ Another famous financier
- Data, reference sites
  - http://www.investorwords.com/ investment dictionary
  - http://www.standardandpoors.com/home/en/us S&P site
  - http://www.wikiposit.org/w great free financial data
  - http://www.calculatedriskblog.com/ the best pure economic charting site
  - http://research.stlouisfed.org/fred2/series/STLFSI/downloaddata?cid=98 FRED – Fed data
  - http://www.pinnacledata.com/index.html http://quotes-plus.com/joomla/; http://www.fasttrack.net/ data sources (fees)
- Brokerages: Proprietary information, tools, etc.
  - https://www.schwab.com/ https://us.etrade.com/e/t/home https://www.fidelity.com
  - https://www.folioinvesting.com www.motifinvesting.com

Web Sites, Tools, Data Sources, etc.

- Tools
  - http://www.assetcorrelation.com/ Generates correlations across instruments
  - http://stockcharts.com/ Draw complex charts
  - http://www.google.com/ Can find anything
  - http://sumgrowth.com/ momentum & timing site (fees after trial period)
  - https://www.vectorvest.com/vvlogin/login.aspx back testing tool (fees)
  - http://www.portfolio123.com/ back testing toll (fees)
  - http://www.qmatix.com/XLQ.htm (good Excel plug-in for Yahoo! Data, SIPro)
  - Excel, Visual Basic: do a lot of hacking with this tool
  - SIPro: best reasonably priced stock screener out there
- Economics, Finance sites
  - http://advisorperspectives.com/dshort/ mix of economic and market, very understandable, lots of fun charts
  - http://www.businesscycle.com/ ECRI – famous economic forecaster, downloadable info
  - http://gfs.eiu.com/about/ monthly economic forecast (free – I think)
- Quant sites (mostly blogs)
  - http://cssanalytics.wordpress.com/ Lots of algs, models, ideas
  - http://www.cxoadvisory.com/ Lots of algs, models, economic forecasts, etc
  - http://www.mebanefaber.com/ Faber' blog; some algs, lots of good reading references, ideas
  - http://marketsci.wordpress.com/ Lots of algs, models, ideas
  - http://boards.fool.com/mechanical-investing-100093.aspx board with lots of ideas, algs