

Case Study 1

StashAway uses a range of ETFs to track a variety of asset classes or indices. These asset classes or indices in turn become building blocks of users' portfolios. We need historical data on these ETFs to estimate expected returns, volatilities and correlations. These are inputs to the optimiser which tries to maximize return by allocating among ETFs subject to meeting a certain volatility target.

However, we are often confronted with ETFs having insufficient historical data. This reduces the accuracy of estimating expected returns. One such example is the iShares All Country Asia ex Japan (AAXJ) ETF. It was only launched in Aug 2008, correlating well with the MSCI AC Asia ex Japan Net Total Return Index (NDUECAXJ) which was launched in 2001.



	AAXJ	AAXJ_INDE...
Mean	66.90597	56.63269
Median	65.05710	60.79866
Maximum	97.01410	108.1933
Minimum	28.56550	14.53633
Std. Dev.	14.56000	25.32192
Skewness	-0.138100	-0.019874
Kurtosis	2.996716	1.983309
Jarque-Bera	0.467318	10.30928
Probability	0.791632	0.005773
Sum	9835.178	13535.21
Sum Sq. Dev.	30951.06	152605.5
Observations	147	239

Above, we show the complete dataset for both the ETF and the underlying index (scaled) and some summary statistics. How would you harness the additional historical data available through the underlying index to calculate expected returns of the ETF more accurately?

Files:

1. AAXJ.csv
2. NDUECAXJ.csv

Case Study 2

Once we have accurately calculated the expected returns and volatility of the ETFs, we want to find a way to best invest amongst the different ETFs. Below, we show the data of some of the ETFs we have in our fund. How would you decide to allocate amongst these funds?

Asset Class	Ticker	Expected Return	Volatility	Dividend Yield	Expense Ratio
Unites States	IVV US	5.52%	16.30%	1.98%	0.03%
Europe	VGK US	6.86%	15.42%	2.26%	0.08%
Asia ex-Japan	AAXJ US	3.84%	17.58%	2.54%	0.68%
Australia	EWA US	6.97%	14.60%	4.03%	0.50%
Canada	EWC US	2.95%	17.81%	2.64%	0.49%
Japan	EWJ US	-0.89%	22.69%	2.42%	0.49%
Emerging Markets	SPEM US	5.40%	22.40%	3.85%	0.11%
US 1-3M Cash Equiv	BIL US	1.52%	0.11%	2.05%	0.14%
US 1-3y Govt Bonds	SHY US	1.95%	1.30%	1.94%	0.15%
US 3-10y Govt Bonds	SCHR US	1.83%	4.53%	2.12%	0.05%
US REITs	VNQ US	6.18%	22.93%	4.13%	0.12%
Global ex-US REITs	VNQI US	1.03%	24.89%	7.58%	0.12%
Precious Metals (Gold)	GLD US	4.81%	12.91%	0.00%	0.40%

Suppose now that the client believes the USD is likely to depreciate and hence wants to reduce his exposure to the currency. How would you design a portfolio that fulfills his requirements?

Files:

1. asset_classes.csv
2. covariance_matrix.csv
3. asset_class_currency_exposure.csv

Deliverables

Please present your findings in a clear and concise manner. We are open to seeing solutions in IPython / Jupyter / R / Julia. You can host the solution on a private repository on Github / Bitbucket and grant us access to it.