Parametric Portfolio Policy Adaptive Elastic Net

* R tool box for backtesting/trading parametric porfolio strategies.
* R + Rcpp + Amardilo (C++ linear algeba library)
* Find optimal portfolio weights (wi,t ) that maximize a given utility/objective function.
  + parametric weights:
    - benchmark weights
      * zero weights
      * equally weighted
      * volatility parity
      * risk parity
    - active weights (deviations from benchmark):
      * Cross sectional (relative value: mean 0, variance 1)
      * Time series (absolute value: sign or trend strength)
  + Utility functions
    - Mean Variance (quadratic) utility
    - Power Utility (CRRA) utility
  + Transaction costs
    - Re-balancing costs
      * Turnover of the portfolio
      * proportional cost
      * quadratic cost (market impact)
  + Weights constraint:
    - Max gross leverages
    - Max leverages for long side
    - Max leverages for short side
* Flexiablie for constructing trading strategies:
  + trend following strategy:
    - binary (sign)/time series trend signals
      * Momentum
      * EMA1(n) Exponential Moving Average
      * EMA2(n1, n2) Exponential Moving Average Crossover
      * MACD(nFAST, nSlow, nSig)MACD Oscillator
      * TRIX(n, nSig)Triple Smoothed Exponential Oscillator
      * RSI(n)Relative Strength Index
      * BBands
      * DonchianChannel
      * OBV
      * stoch
    - risk adjusted trend:
  + cross sectional strategy
    - relative momentum strategy
      * momentum
      * cross over of exponentially weighted moving average (EWMA)
    - value strategy
      * value: difference between a fundamental asset price and its prevailing market price.
      * FX:
        + relative PPP (purchasing power parity) as value indicator
      * Equities:
        + dividend yield
      * Commodities:
        + value: today's deflated price divided by the deflated historical average price (expanding window of all prices available)
      * Swap Rates:
        + difference between the 10Y swap rate and the most recent nominal GDP growth rate (release quartely)
        + difference between the 10Y swap rate and the most recent yoy CPI inflation (consumer price index)
    - carry strategy
      * FX:
        + slope of the futures/forward curve
        + 3-month Libor rate differential between the foreign and USD markets
        + the front and back futures contracts (maturing after T1 and T2 days) / (T2 - T1)
      * Equity indices:
        + slope of futures curve
        + the front and back futures contracts (maturing after T1 and T2 days) / (T2 - T1)
        + the front and back futures contracts: using interpolation, the future price for a maturity of one month and compare this with the prevailing spot price of the index
        + need to adjust seasonality (12 month moving average filter of the raw carry signals)
      * Commodities:
        + the front and back futures contracts (maturing after T1 and T2 days) / (T2 - T1)
        + need to adjust seasonality (12 month moving average filter of the raw carry signals)
      * Government Bonds:
        + the quality of historical futures data, except for the front contract, is very poor for Government Bonds.
        + estimate the slope: using the spot price of a bond with maturity of 9 years and 11 months and a sythetic 10-years bond futures price with maturity of one month.

use of zero-coupon yield data (Bloomberg) for maturities of 9 and 10 years. The 9 years and 11 months yield is trivially estimated using linear interpolation.

the futures price of a 10 years bond with maturity of one month is equal to the respective bond price accrued to the risk-free rate for a month.

use 3 month Libor rate for the respective country.

* + - * Swap rates:
        + carry: carry + roll down
  + cross sectional risk allocation
    - volatility parity
    - volatility parity with pairwise correlation
    - risk parity
  + time series risk allocation
    - Constant volatility (target vol)
* PPP + Adaptive Elastic Net: overfitting and multicollinearity issues
  + Features:
    - Lasso term: shrinkage (Characteristics/signals selection).
    - Ridge term: stabilize solution path.
    - Adaptive Elastic Net takes care of over-fitting issue and has the oracle property when there are large number of variables that are correlated.
  + Model family:
    - (Adaptive) Lasso
    - Ridge
    - Elastic Net
    - Adaptive Elastic Net
  + Estimation Algorithm
    - L1 norm is not differentiable
    - with No transaction cost:
      * Quadratic approximation
      * Coordinate descent algorithm
        + Kkt conditions
        + Warm start
        + Active set
        + Cyclic decent
        + Stochastic decent
        + Parallel ccd for large scale data/factor
        + Cloud computing
    - with transaction cost:
      * L1 norm approximation
      * Gradient based algorithm (e.g. LBFGS, Newton Conjugate Gradient)
    - Cost types:
      * No cost
        + No transaction cost in optimization process
        + Not optimally re-balancing the portfolio
        + Coordinate descent works as before
      * Extra cost
        + Approximation: cost associated with trading each characteristic independently
        + Works when combining various trading strategies (each strategy trades individual characteristic)
        + Over estimate the transaction cost when combining characteristic
        + Ignore the reduction in re-balancing the portfolio
        + Coordinate descent works well
      * Exact cost
        + Approximation of L1 norm by a smooth function

Huber function

pseudo-Huber function

Convolution based smooth approximation

* + - * + Reduction in transaction cost via optimally re-balancing the portfolio
        + Gradient based algorithm works

Newton Conjugate Gradient

Orthant-Wise Limited- memory Quasi-Newton (OWL-QN) optimization algorithm: OWL-QN is a modified Limited-memory Broyden-Fletcher-Goldfarb-Shanno (L-BFGS) algorithm that allows for allow for L1 penalties

* + - Cross validation
      * k-folds cross validation is performed to determine the tuning parameters for AENET
      * Model is firstly estimated on the training set. The coefficients are then re-estimated for validation set
      * Average sample criterion is calculated across folds and tuning parameters are chosen based on minimizing the criterion
        + CEG: Certainty Equivalent Gain
        + SR: Sharpe Ratio
        + SOR: Sortino Ratio, R - T / DR (downside deviation: standard deviation of negative asset returns)
        + OMG: Omega Ratio, measure of the likelihood of achieving a given return, such as a minimum acceptable return (MAR) or a target return. The higher the omega value, the greater the probability that a given return will be met or exceeded.
    - Inference
      * Bootstrapping Method for Standard Errors and Confidence Intervals
      * Significance and Marginal contributions of characteristic
* Backtesting: Access the performance of the model in test set
  + Benchmark strategy:
    - Benchmark returns from benchmark weights
    - Other benchmarks
      * Barclay CTA Index
      * SG CTA Trend Index
  + Strategy performance
    - returns measure
      * sharpe
      * Sortino
      * Omega
      * Cagr
      * Cumulative performance
      * 12 month rolling
    - risk measure
      * volatility
      * maxDD
      * avgDD
      * VaR
      * CVaR
    - Moment
      * Skewness
      * kurtosis
    - Turnover
      * Exposure
      * AveNetLeverage
      * AveGrossLeverage
      * MaxNetLeverage
      * MaxGrossLeverage
    - Trade performance
      * Win Percent Month
      * Best Month
      * Worst Month
    - Weights measure
      * allocation in time
      * allocation in sector
    - Performance table (month by month)