Assignment 5.

1. Case study: Historical (HS & WHS) Simulation, Bootstrap and PCA for VaR & ES in a linear portfolio

At the end of the 5th of July 2012 an asset manager due to different rules on three company units (portfolios) has to compute risk measures according to the following rules:

A. Portfolio 1 with: Total (25K shares), Telefonica (20K Shares), Enel (25K Shares), Volkswagen (15K Shares). Compute daily VaR and ES with a 4y estimation using the dataset provided via a Historical Simulation approach and a Bootstrap method with 300 simulations.
B. Portfolio 2 with equally weighted equity: Telefonica, AXA, Enel, BMW and Schneider. Compute daily VaR and ES with a 4y estimation using the dataset provided via a Weighted Historical Simulation approach with lambda = 0.9.
C. Portfolio 3. An equally weighted equity portfolio with the last 25 shares (in alphabetic order) in the EUROSTOXX 50 (starting from France Telecom excluded). Compute 10 days VaR and ES with a 2y estimation using the dataset provided via a (standard) Gaussian parametric approach and via a Gaussian parametric PCA approach using the first four principal components. What would be the impact of considering just the first two principal components?

For the three portfolios he checks results' order of magnitude via a Plausibility check.

2. Exercise: Full Monte-Carlo and Delta normal VaR

At the end of the 14th of Sep 2009 consider a portfolio formed by stocks of Vivendi for 1,913,220 Euro and the same <u>number</u> of put options with expiry on the 16^{th} of Nov 2009, with strike 23 Euro and volatility equal to 21.4% (r = 3.8% and dividend yield of 5.1%). Compute a 10dd/99% VaR via a Full Monte-Carlo and a Delta normal approaches (only delta term). Use a 2y Historical Simulation for the underlying.
Can you improve the Delta normal VaR?
Why the Full Monte-Carlo can be numerical intensive for an <u>exotic</u> derivative that cannot be priced via a closed formula?

3. **Exercise**: Credit Simulation

Given *survival probability* at time t up to T: $P(t,T) = e^{-\lambda(T-t)}$, $\lambda = 50$ bps, T-t = 30y

a. Simulate the *default time* τ.
b. Fit survival probability.

Fit the distribution of default times using a sample of 10^3 points. Provide Estimator and Confidence Interval (CI) measured as the standard deviation of the Estimator. Plot the "experimental" survival probability and the one obtained from the fit (in a loglinear scale) with the CI.

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4. Theoretical Exercise

Show that Garman–Kohlhagen formula for a European Call option holds for an underlying with interest rates, continuous dividends and volatilities deterministic functions of time.
Hint: the formula is exactly the same of the classical one considering their average value over the time-to-maturity instead of the constant values in the "standard formula".

Function signatures

[ES, VaR] = HSMeasurements(returns, alpha, weights, portfolioValue)
samples = bootstrapStatistical(numberOfSamplesToBootstrap, returns)
[ES, VaR] = WHSMeasurements(returns, alpha, lambda, weights, portfolioValue)
[ES, VaR] = PrincCompAnalysis(yearlyCovariance, yearlyMeanReturns, weights, H, alpha, numberOfPrincipalComponents, portfolioValue)
VaR = plausibilityCheck(returns, portfolioWeights, alpha, portfolioValue)
VaR = FullMonteCarloVaR(logReturns, numberOfShares, numberOfPuts, stockPrice, strike, rate, dividend, volatility, timeToMaturityInYears, riskMeasureTimeIntervalInYears, alpha)
VaR = DeltaNormalVaR(logReturns, numberOfShares, numberOfPuts, stockPrice, strike, rate, dividend, volatility, timeToMaturityInYears, riskMeasureTimeIntervalInYears, alpha)

Please remember that all vectors are column vectors.

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