

## Worksheet 7

1) [✱] Use the Monte Carlo algorithm to compute the 5% 10 day VaR of a holding of 1 ACME corporation stock. Assume that the current stock price of ACME is \$100, the volatility is 0.2. Use RiskMetrics assumptions for the drift.

(Solution: see the file `testAcme.m` in `lecture7.zip`)

2) [✱] Use the parametric VaR algorithm to compute the 5% 10 day VaR of a holding of 1 ACME corporation call option with strike 110 and maturity 100.

(Solution: see the file `testAcme.m` in `lecture7.zip`)

3) [✱] Write a function `expectedShortfall` which takes a vector of prices and produces the expected price for the worst  $p\%$  of cases.

(Solution: see the file `expectedShortfall.m` in `lecture7.zip`)

4) [✱] Enhance the `monteCarloVar` function given so that it provides a confidence interval for the estimate of VaR.

(Solution: see the file `monteCarloVarWithConfidence.m` in `lecture7.zip`)

5) Find an analytical formula for the VaR of a call option assuming that the stock follows the Black Scholes model with drift  $\sigma^2/2$ . Use this to check your answers to the first two questions. Explain why Monte Carlo VaR and parametric VaR are still useful ideas.

(Solution: see the file `analyticalVar.m` in `lecture7.zip`)

6) [✱] Use the Monte Carlo algorithm to compute the CVaR of a call option on the ACME corporation with parameters as above.

(Solution: see the file `testAcme.m` in `lecture7.zip`)

7) Suppose that we have  $n$  risk factors  $P^{(1)}, P^{(2)}, \dots$ . The logs of these risk factors  $p^{(a)}$  each follow a Brownian motion with drift  $\mu^a$ . The covariance matrix of the log-returns is  $\Sigma$ . What is the parametric VaR of a portfolio  $\alpha$  consisting of  $\alpha_a$  units of each risk factor  $P^{(a)}$ ? Is this formula an approximation of the VaR or is it the exact VaR of the portfolio?

8) How would you simulate the risk factors  $P^{(a)}$  in the question above if you wished to compute the Monte Carlo VaR?

9) [★] Plot the efficient frontier for the Markowitz model with UKX data when short selling is not allowed.

(Solution: see the file `markowitzOptimizeRetNoShortSell.m` in `lecture10.zip`)

10) [★★] 2014 Q2

11) 2013 Q5