Bayesian Filtering and Smoothing
Exercise Set 11

1. For the data in `linreg_mcmc.m`, estimate the parameters of the line $\theta_1 + \theta_2 t$ and the noise parameter $\theta_3 = \log(\sigma^2)$. Use the prior $p(\theta_1, \theta_2, \theta_3) \propto 1$.

2. A rule of thumb says that the posterior variance is inversely proportional to the number of observations. Investigate the validity of this rule by trying different values of `nk` in `example12_1.m`. By extrapolation from these results, what value of `nk` would be needed to estimate R to within a standard deviation of 0.01?

3. Estimate Q and R for the data of `example12_1.m` using gradient-free optimisation.

4. Estimate Q and R for the data of `example12_1.m` using gradient-based optimisation function `fmincon` with

   ```
   options=optimoptions(@fmincon,'GradObj','on')
   ```

   Your objective function should compute both φ_T and its gradient with respect to (Q,R).

5. In set 6 question 5 the sensor location $\theta = (0.5, 0.1)$ is given. Use the data to find the MAP estimate of the sensor location, with the prior $\theta \sim \mathrm{N}((0.5, 0.1), \mathrm{diag}(0.5, 0.1))$.

6. Prove the identity

   ```
   log(det(2*pi*P))/2 = sum(log(diag(chol(2*pi*P))))
   ```

Answers

3. $\hat{Q} = 1.38$, $\hat{R} = 0.85$. 4. $\hat{Q} = 1.38$, $\hat{R} = 0.85$. 5. $\hat{\theta} = (0.26, 0.22)$