

Lab4

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```
#install.packages('kernlab')
#install.packages("AtmRay") # To make 2D grid like in Matlab's meshgrid.
library(kernlab)
library(AtmRay)

# ----- TEST -----
ell <- 1
SEkernel <- rbfdot(sigma = 1/(2*ell^2)) # Note how I reparametrize the rbfdot (which is the SE kernel)
SEkernel(1,2) # Just a test - evaluating the kernel in the points x=1 and x'=2.
# Computing the whole covariance matrix K from the kernel. Just a test.
#kernelMatrix(kernel = SEkernel, x = X, y = Xstar) # So this is K(X,Xstar).
# -----End TEST-----

cov_function = function(X, Xstar){
  return(kernelMatrix(kernel = SEkernel, x=X, y=Xstar))
}

# cov_function(1,2)

posteriorGP = function(X_input, y_targets, k_cov_function, sigmaNoise=1, XStar){

  # wehre to implement noise(sigmaNoise)?
  A = k_cov_function(X_input, X_input)
  A = A + diag(length(X_input))*sigmaNoise^2
  L = t(chol(A)) # chol Returns t(L)
  L_y = solve(L, y_targets)
  alpha = solve(t(L), L_y)

  k_star = k_cov_function(X_input, XStar)
  f_star = t(k_star)%*%alpha
  v = solve(L,k_star)

  V_f_star = k_cov_function(XStar, XStar) - t(v)%*%v
  return(list("mean"=f_star, "cov" = V_f_star))
}

sigma_f = 1
ell = 0.3
SEkernel <- rbfdot(sigma = 1/(2*ell^2))

sigma_n = 0.1
x=0.4
```

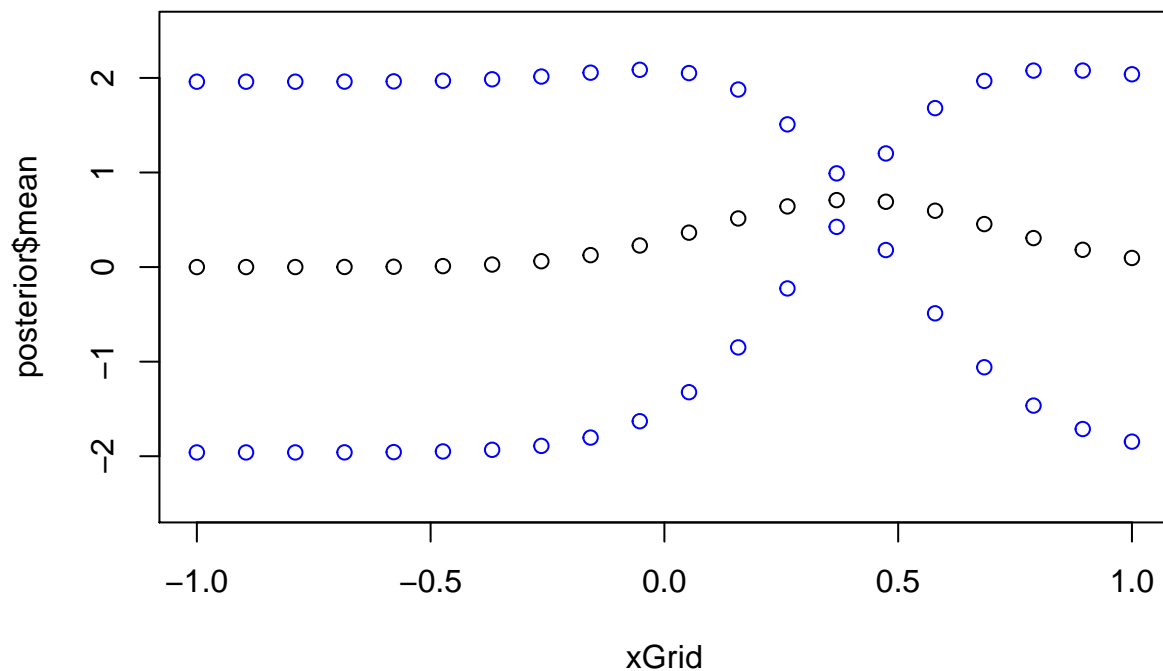
```

y=0.719
xGrid <- seq(-1,1,length=20) # x-star??

posterior = posteriorGP(x, y, cov_function, sigma_n, xGrid)

plot(xGrid, posterior$mean, ylim = c(-2.5,2.5)) # posterior mean
std_dev = sqrt(diag(posterior$cov))
points(xGrid, posterior$mean + 1.96*std_dev, col="blue")
points(xGrid, posterior$mean - 1.96*std_dev, col="blue")

```



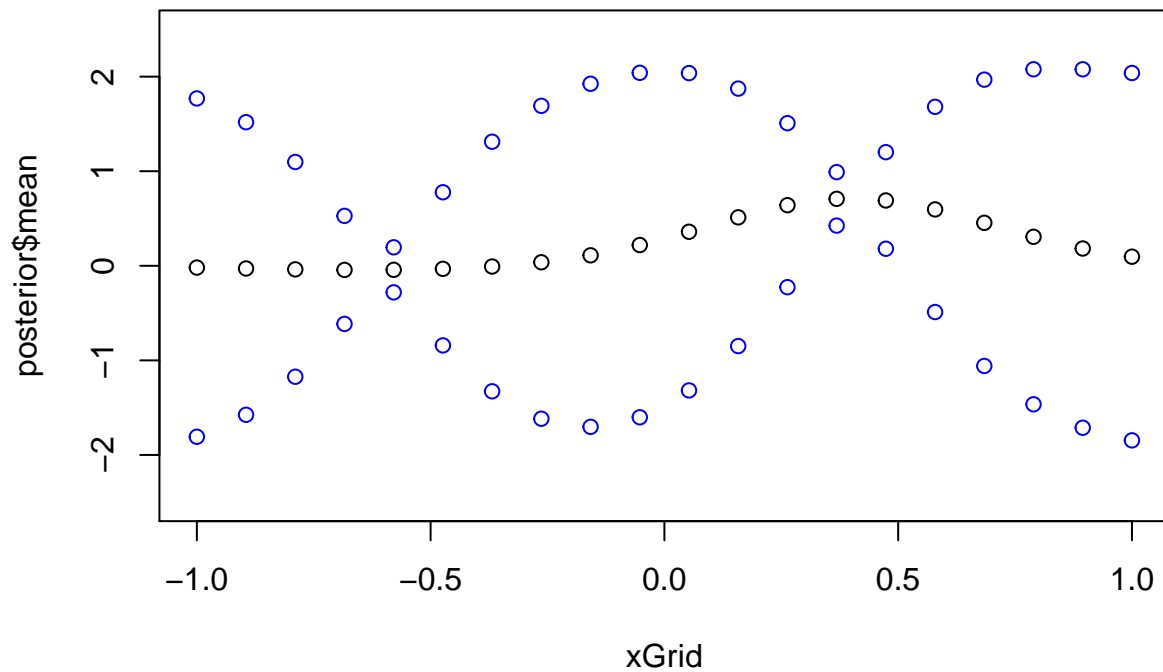
```

#max(posterior$mean)

# 3
x = c(0.4, -0.6)
y = c(0.719, -0.044)
posterior = posteriorGP(x, y, cov_function, sigma_n, xGrid)

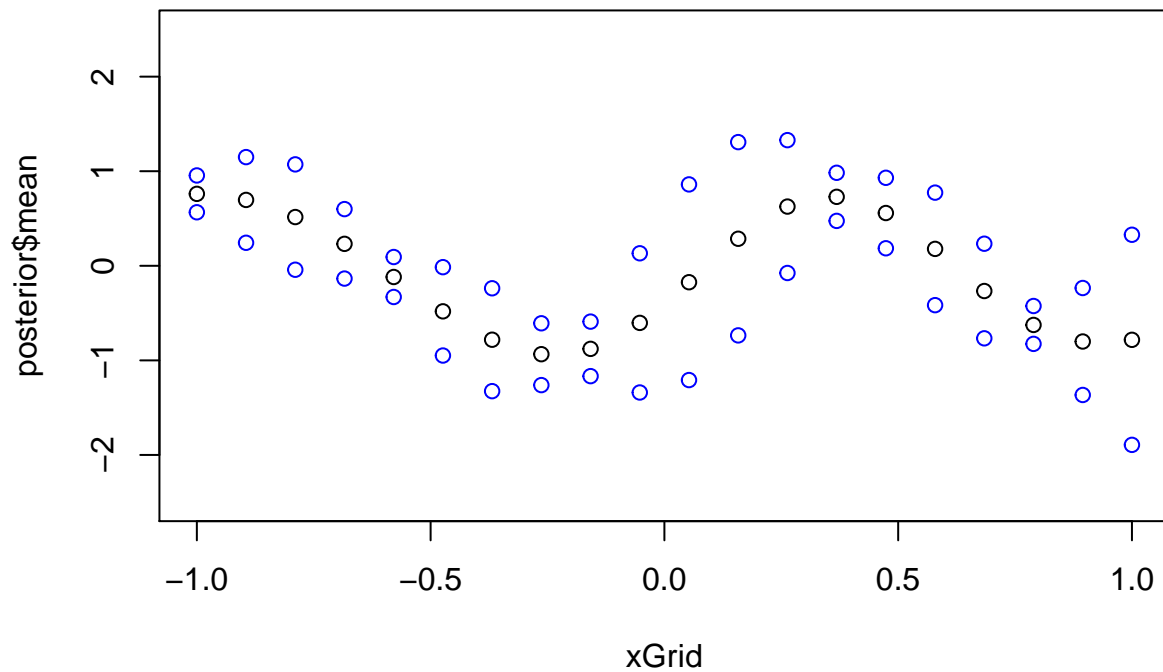
plot(xGrid, posterior$mean, ylim = c(-2.5,2.5)) # posterior mean
std_dev = sqrt(diag(posterior$cov))
points(xGrid, posterior$mean + 1.96*std_dev, col="blue")
points(xGrid, posterior$mean - 1.96*std_dev, col="blue")

```



```
# 4
x = c(-1.0, -0.6, -0.2, 0.4, 0.8)
y = c(0.768, -0.044, -0.940, 0.719, -0.664)
posterior = posteriorGP(x, y, cov_function, sigma_n, xGrid)

plot(xGrid, posterior$mean, ylim = c(-2.5, 2.5)) # posterior mean
std_dev = sqrt(diag(posterior$cov))
points(xGrid, posterior$mean + 1.96*std_dev, col="blue")
points(xGrid, posterior$mean - 1.96*std_dev, col="blue")
```



```
# 5
sigma_f = 1
ell = 1
SEkernel <- rbfdot(sigma = 1/(2*ell^2))

x = c(-1.0, -0.6, -0.2, 0.4, 0.8)
y = c(0.768, -0.044, -0.940, 0.719, -0.664)
posterior = posteriorGP(x, y, cov_function, sigma_n, xGrid)

plot(xGrid, posterior$mean, ylim = c(-2.5, 2.5)) # posterior mean
std_dev = sqrt(diag(posterior$cov))
points(xGrid, posterior$mean + 1.96*std_dev, col="blue")
points(xGrid, posterior$mean - 1.96*std_dev, col="blue")
```

