
Exercise 3-2, d): Gaussian Process Regression

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```
clear; close all; clc
```

2di)

Application to real world problem using the carsmall data set and MATLAB ML-Toolbox

```
% Load the carsmall data set with 'Displacement','Horsepower','Weight' as
predictors

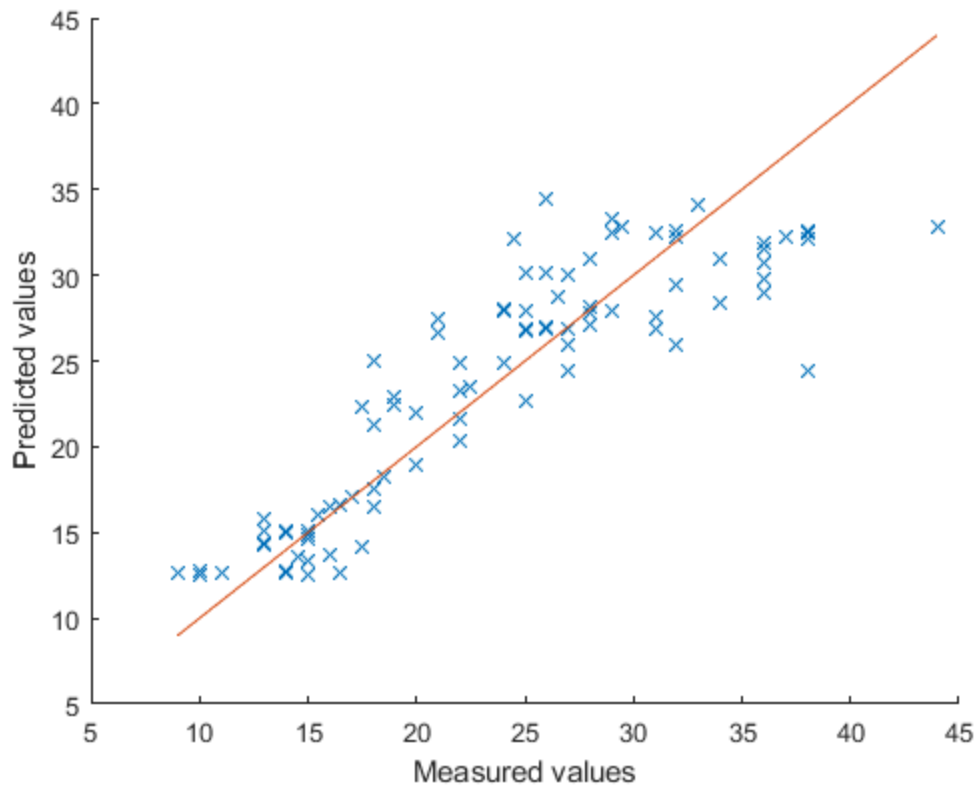
load carsmall
ds = table(Displacement,Horsepower,Weight,MPG, ...
    'VariableNames',{'Displacement','Horsepower','Weight','MPG'});

% Fit a GPR to the data
gprMdl = fitrgp(ds,'MPG','KernelFunction','ardsquaredexponential');

% Predict the output for the training data
[ypred,ysd,yint] = predict(gprMdl,[ds(:,1) ds(:,2) ds(:,3)]);

% Plot prediction vs. the training data
figure
hold on
plot(ds.MPG,ypred,'x')
plot([min(ds.MPG) max(ds.MPG)],[min(ds.MPG) max(ds.MPG)])
xlabel('Measured values')
ylabel('Predicted values')

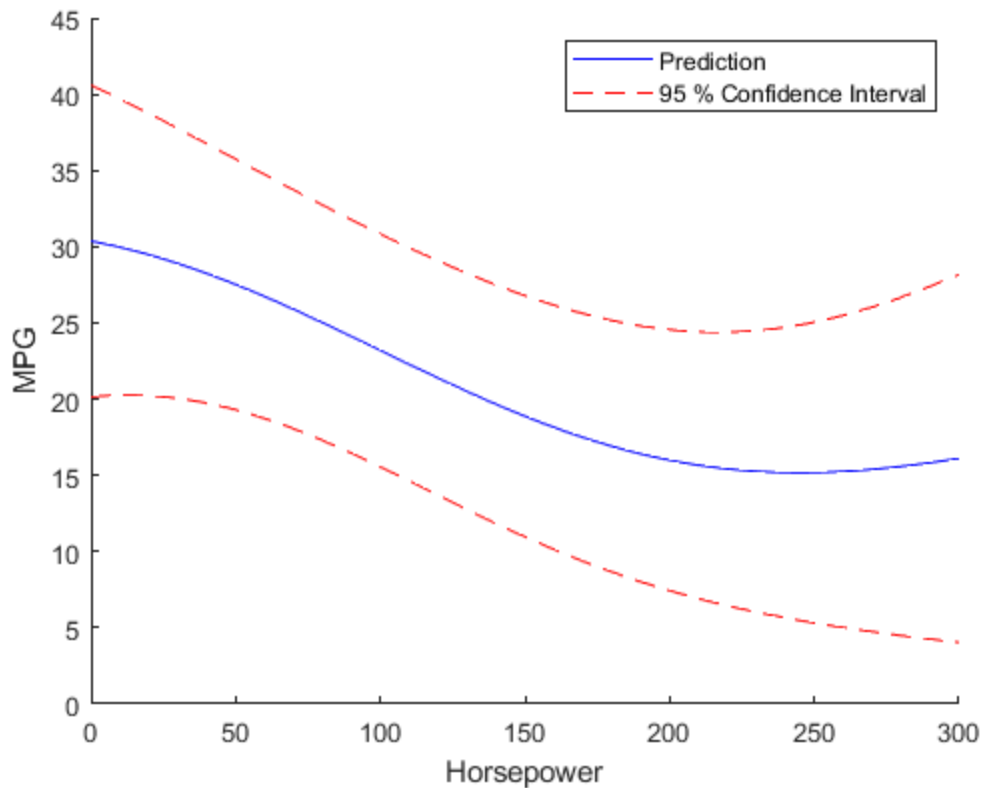
% Calculate MSE
MSE = nanmean((ypred-ds.MPG).^2);
```



2dii)

Predict MPG for varying 'Horsepower' with constant remaining predictors

```
hpnew = linspace(0,300,100)';  
xnew = [repmat(200,100,1) hpnew repmat(3000,100,1)];  
  
[ynew,ysdnew,yintnew] = predict(gprMdl,xnew);  
  
% Plot the prediction together with the 95 % confidence interval  
figure  
hold on  
plot(hpnew,ynew,'b')  
plot(hpnew,yintnew(:,1),'--r')  
plot(hpnew,yintnew(:,2),'--r')  
legend('Prediction','95 % Confidence Interval')  
xlabel('Horsepower')  
ylabel('MPG')  
axis([0 300 0 45])
```



2diii)

Repeat i) and ii) with different kernel functions

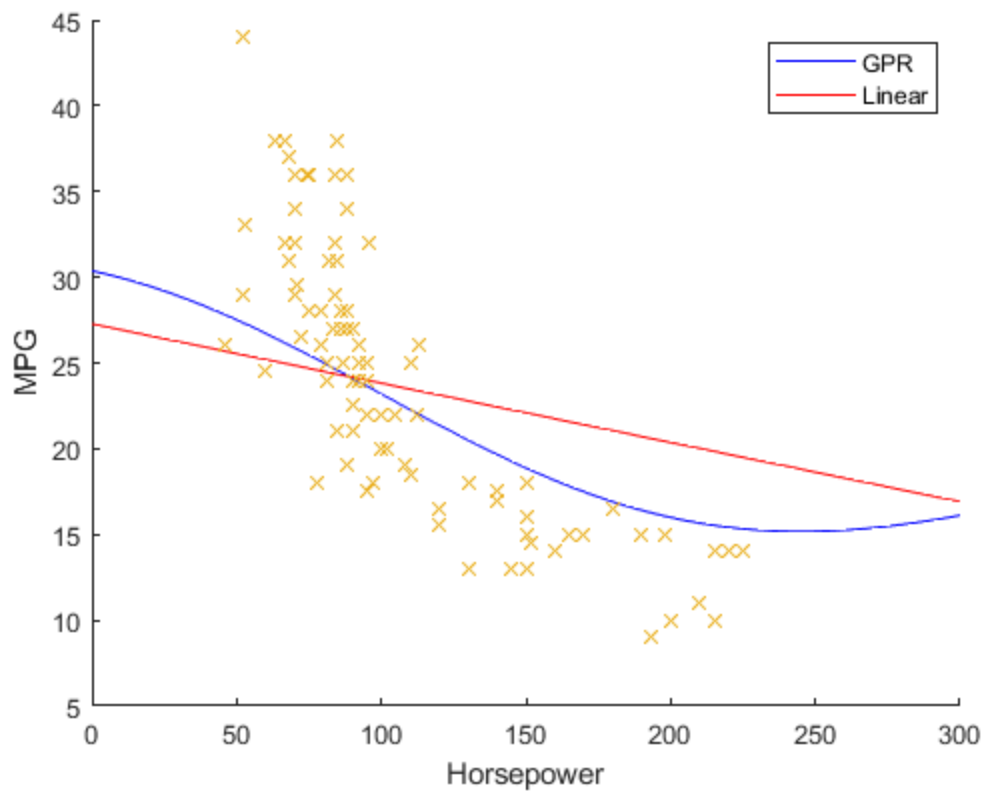
2div)

Estimate a linear regression model with the `linmod` function and compare the results with your GPR model

```
linmod = fitlm(ds); % Fit a linear regression model

rmse_gpr = sqrt(MSE); % Calculate the RMSE for the GPR model
rmse_lin = linmod.RMSE; % Calculate the RMSE for the linear model

figure % Plot predictions for GPR and linear model
hold on
plot(hpnew, ynew, 'b')
plot(hpnew, predict(linmod, xnew), 'r')
plot(Horsepower, MPG, 'x')
xlabel('Horsepower')
ylabel('MPG')
legend('GPR', 'Linear')
```



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