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

Least-Squares Algorithm Sample Complexity

```
% Setup & initialise variables:

n = 100; % largest number of dimensions.
m = 500; % number of test data point used for each error estimation.
loop = 50; % number of runs per dimension.
GenErrLim = 0.1; % point where 10% error reached as per handout
 definition
NumSamples = zeros(n, loop); % initialise Sample Complexity variable

for i = 1:n   % change size of column of data set

    for l = 1:loop

        % generate test and training data  from a uniformly randomly
        % genrated data set ([-1,1]^n)

        trainX = randi([0 1], m, i); %uniform random set of [0,1]
        testX = randi([0 1], m, i);

        %convert data into -1 ,1
        trainX = trainX.*2 - ones(size(trainX));
        testX = testX.*2 - ones(size(testX));

        trainY = trainX(:, 1); %select first column
        testY = testX(:, 1);

        % initialise error and counter values:
        Counter = 0;  % sample complexity counter
        GenErr = 1000; % start by setting at an artificially high
 number

        while(GenErr > GenErrLim)

           % Keep track of the number of training samples used in the
 loop:
           Counter = Counter + 1;

           % get weight vector (w) applying the least-squares
 algorithm on
           % the training data:
           w = pinv(trainX(1:Counter, :)) * trainY(1:Counter);

           % apply the learned weight to the test data and convert
 into
           % a [-1,1] Y predicted value (yP).
            yP = sign(testX * w);
```

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            % count number of miss-matches between predicted and true
 Y values
            % and calculate the generalisation error estimate as a
 proportion
            % of the amount of test data instances (m).
            loss = sum(yP ~= testY);
            GenErr = (loss)/m;

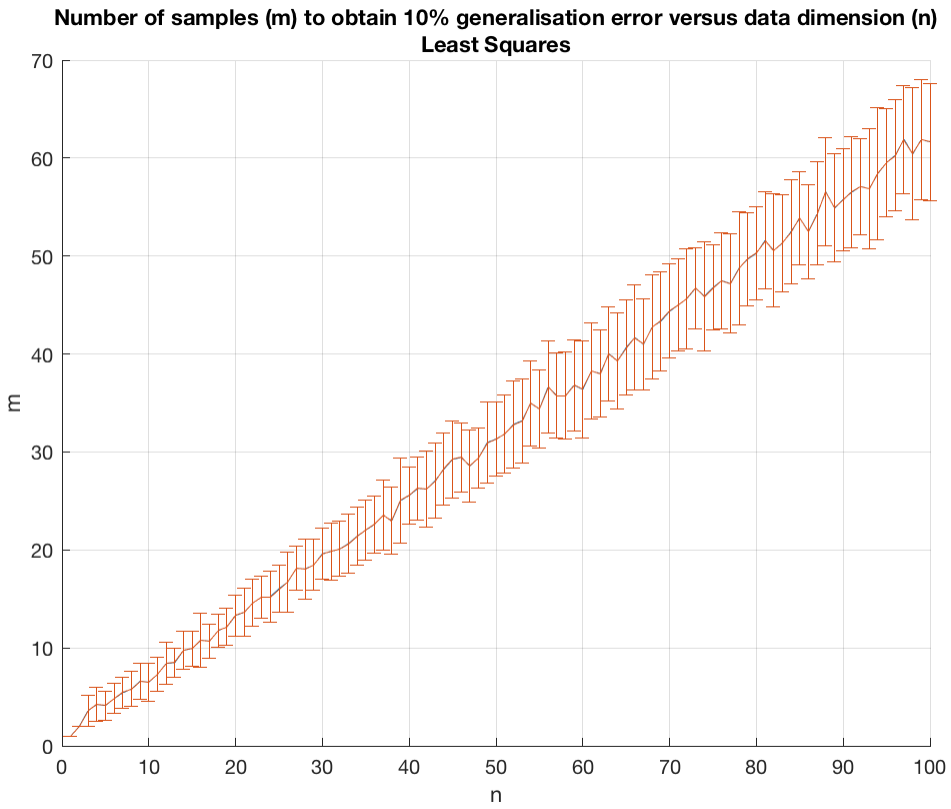
        end

        % sample complexity as a function of the n dimension of data:
        NumSamples(i,l) = Counter;
    end

end


% calculate means and standard deviations of number of samples needed
meanNumSamples = mean(NumSamples,2);
sdNumSamples = std(NumSamples,[],2);

figure;
hold on;
plot(meanNumSamples)
title({'Number of samples (m) to obtain 10% generalisation error
 versus data dimension (n)', 'Least Squares'});
ylabel('m');
xlabel('n');
errorbar(1:n, meanNumSamples, sdNumSamples);
hold off;
grid on;
```



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