```
% Homework 2 - Question 2
data = csvread('brca.csv');

lambda = generate_lambda(0, 0.1, 0.01);
Y = data(:, end);
X = data(:, 1:end-1);

%a)
disp("2a) 5-fold CV")
perform_cross_validation(X,Y,5, lambda, 1);
disp("Average MSE and Sparsity as a function of lambda")
snapnow
%b)
disp("")
disp("2b) 10-fold CV")
perform_cross_validation(X,Y,10, lambda, 3);
disp("Average MSE and Sparsity as a function of lambda");
snapnow

disp(" The optimal lambda value is same in case of 5-fold CV and 10-fold CV. The number of non-zeros decreases as we increase lambda.")
%c)
disp("")
rng default
disp("2c) 5-fold CV using lassoplot")
use_built_in(X, Y, 5, lambda);

disp("10-fold CV using lassoplot")
use_built_in(X, Y, 10, lambda);

disp("The optimal lambda value might have differed if the input data wasnt randomly permuted.");
disp("Also, lassoplot ignores lamda=0, as it reduces to OLS in this case");

function perform_cross_validation(X,Y,k, lambda, fig_no)
    average_MSE = zeros(size(lambda));
    average_non_zeros = zeros(size(lambda));
    for j = 1:length(lambda)
        c = lambda(j);
        chunk_size = size(Y,1)/k;
        for i=1:k
            index = (i * chunk_size) - chunk_size;
            X_test = X(index+1:index+chunk_size, :);
            Y_test = Y(index+1:index+chunk_size, :);
            X_train = [X(1:index, :);X(index+chunk_size+1:end, :)];
            Y_train = [Y(1:index);Y(index+chunk_size+1:end)];
            [B,FitInfo]  = lasso(X_train, Y_train, "Lambda", c);
            coef0 = FitInfo.Intercept;
            average_MSE(j) = average_MSE(j) + mean((Y_test-(X_test * B + coef0)).^2);
            average_non_zeros(j) = average_non_zeros(j) + nnz(B);
        end
    end
    average_MSE = average_MSE/k;
    average_non_zeros = average_non_zeros/k;
    %subplot(2,1,1);
    %disp("Average MSE as a function of lambda = ")
    figure(fig_no);
    plot(lambda, average_MSE);
    xlabel('lambda')
    ylabel('Mean Squared Error')
    figure(fig_no+1);
    %subplot(2,1,2);
    %disp("Sparsity as a function of lambda = ")
    plot(lambda, average_non_zeros);
    xlabel('lambda')
    ylabel('Number of non zero coefficients')
    [M, min_idx] = min(average_MSE);
    lamda_optimal = lambda(min_idx)
end


function use_built_in(X,Y, k, lambda)
    [B, FitInfo] = lasso(X,Y,'Lambda', lambda, 'CV', k);
    lassoPlot(B,FitInfo,'PlotType','CV');
    snapnow
end


function lambda = generate_lambda(min, max, spacing)
    lambda = [];
    i = min;
    while i <= max
        lambda = [lambda; i];
        i = i + spacing;
    end
end
```

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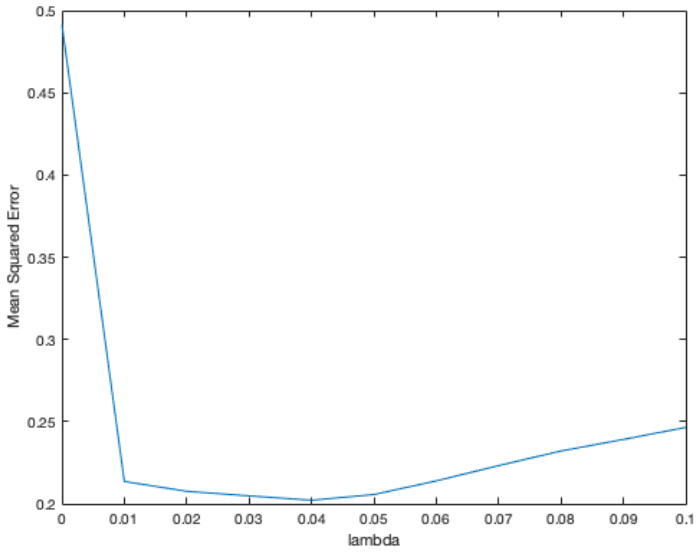
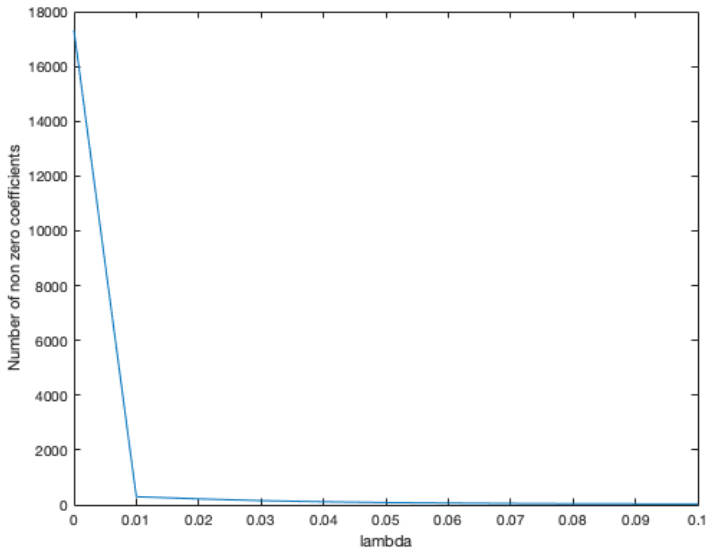
2a) 5-fold CV
```

```
lamda_optimal =

    0.0400
```

```
Average MSE and Sparsity as a function of lambda
```



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2b) 10-fold CV
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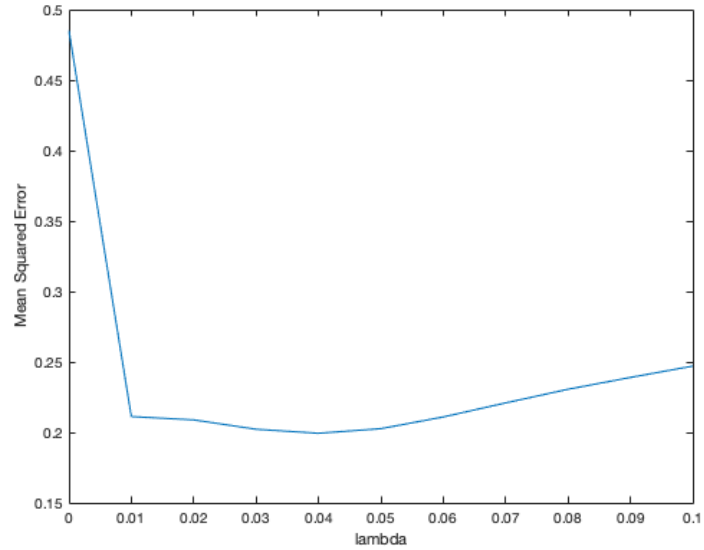
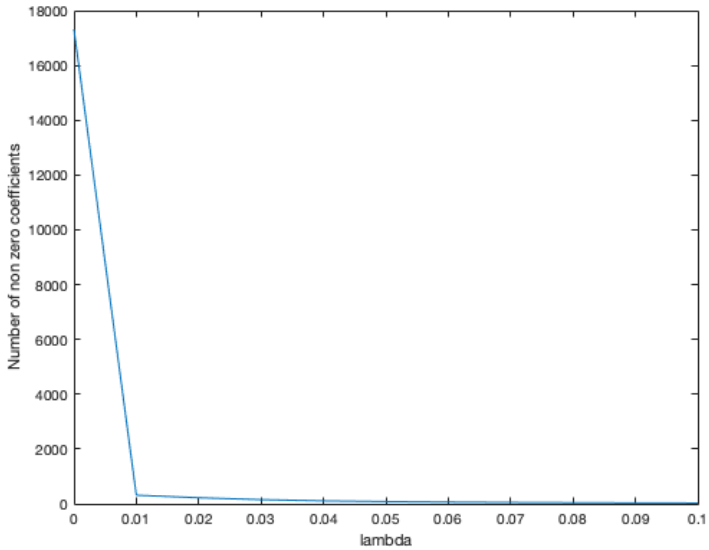
```
lamda_optimal =

    0.0400
```

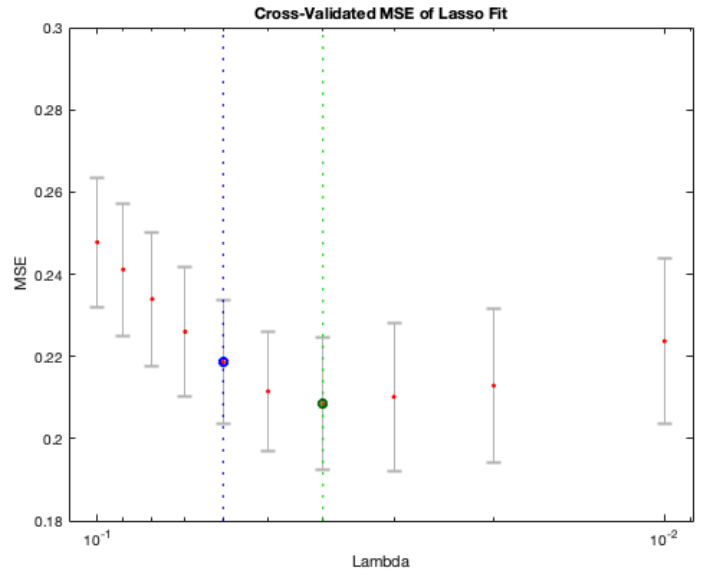
```
Average MSE and Sparsity as a function of lambda
```



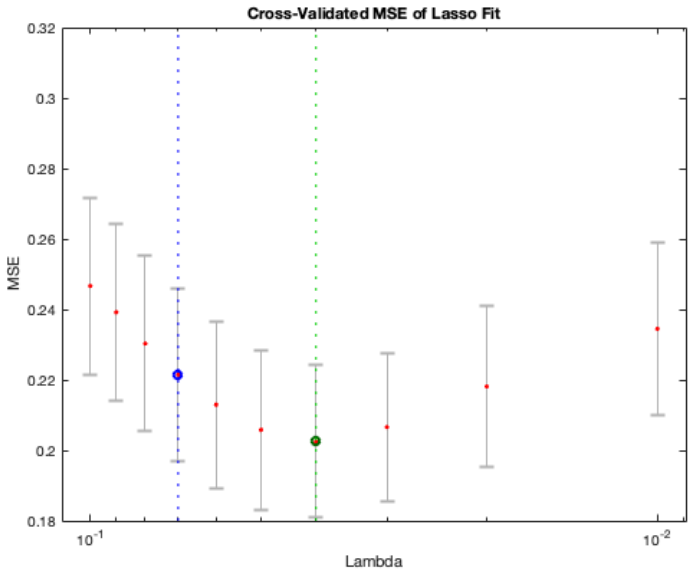


The optimal lambda value is same in case of 5-fold CV and 10-fold CV. The number of non-zeros decreases as we increase lambda.

2c) 5-fold CV using lassoplot



10-fold CV using lassoplot




```
The optimal lambda value might have differed if the input data wasnt randomly permuted.
Also, lassoplot ignores lamda=0, as it reduces to OLS in this case
```

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