

# Kernel Ridge Regression

**Introduction:** Implementation of Kernel Ridge Expression for polynomial and radial kernels

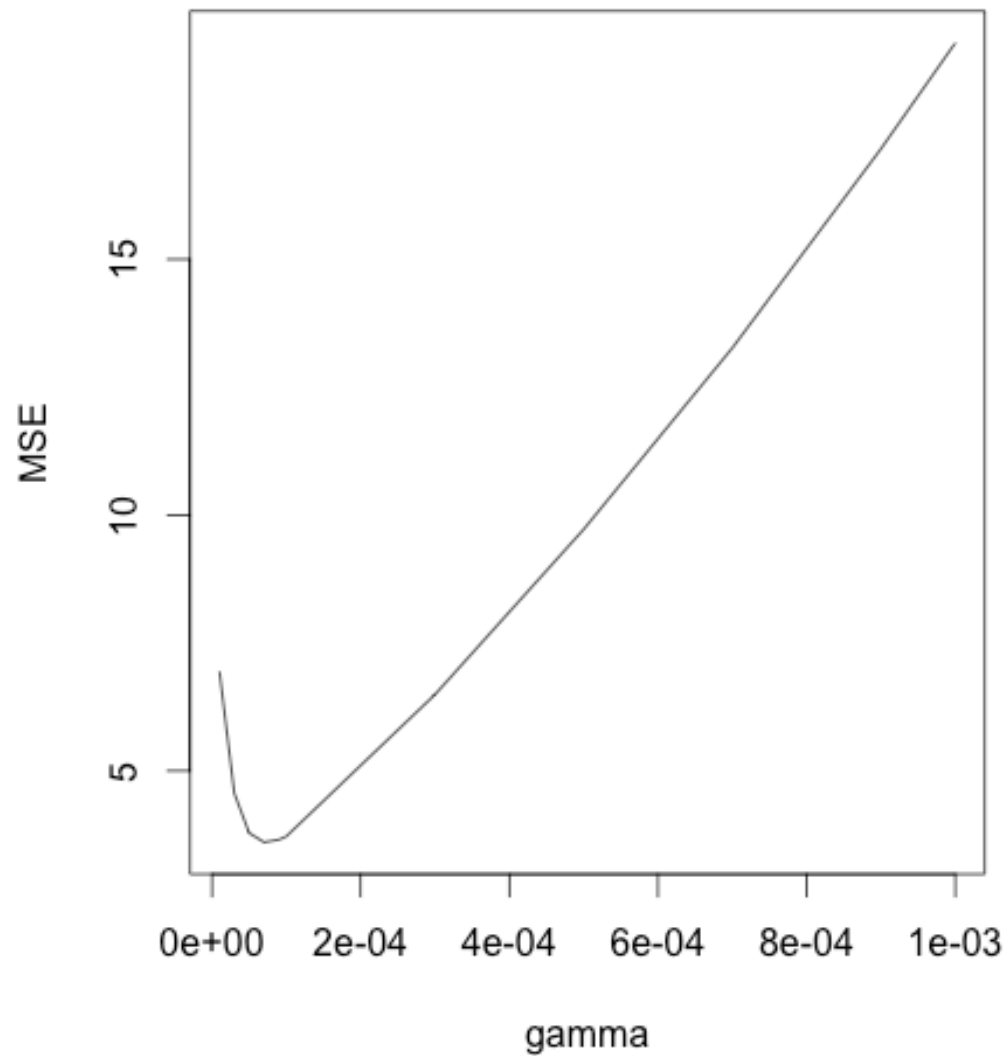
## **Results:**

### 1. Without Normalization

#### a. Radial Kernels

<b>GAMMA</b>	<b>MSE</b>
0.00001	6.945512
0.00003	4.56309
0.00005	3.7847
0.00007	3.606197
0.00009	3.654706
0.0001	3.720106
0.0003	6.491944
0.0005	9.720727
0.0007	13.26568
0.0009	17.15971
0.001	19.22906

### RadialKernel MSE wrt gamma without normalizat



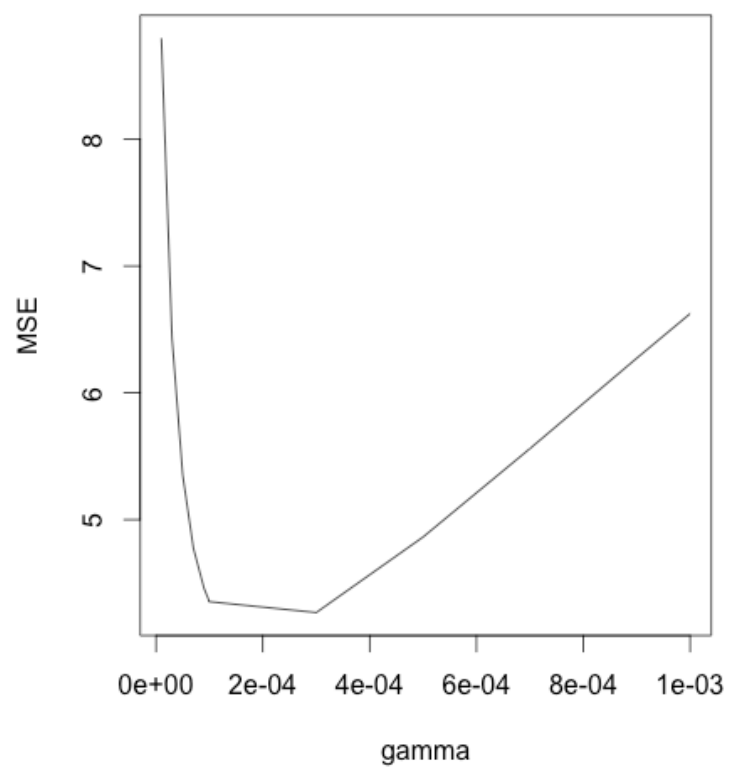
b. Polynomial Kernel without regularisation

Degree = 2 , MSE = 0.3526

## 2. With Normalization

GAMMA	MSE
0.00001	8.79725
0.00003	6.42651
0.00005	5.349803
0.00007	4.774777
0.00009	4.456962
0.0001	4.352904
0.0003	4.267085
0.0005	4.862891
0.0007	5.559816
0.0009	6.273054
0.001	6.624348

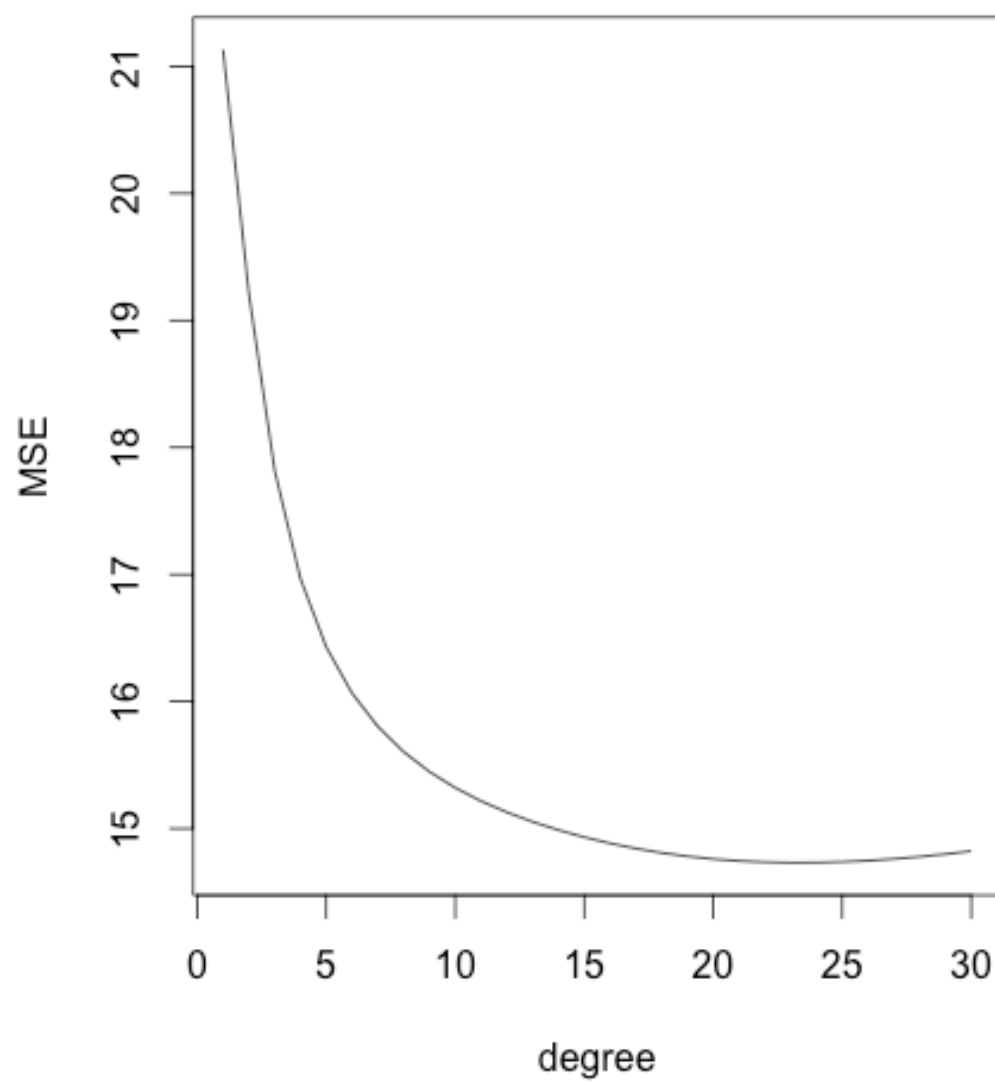
**RadialKernel MSE wrt gamma**



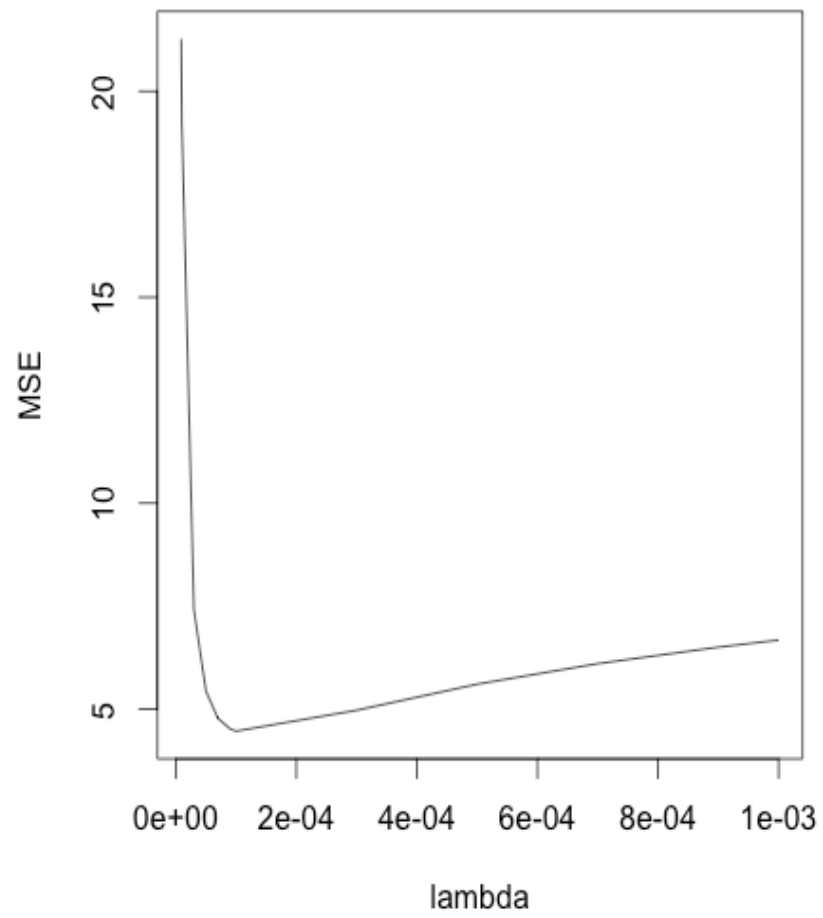
c. Polynomial Kernel MSE with different degrees

Degrees	MSE
1	21.13168
2	19.2124
3	17.82129
4	16.96763
5	16.42973
6	16.06593
7	15.8037
8	15.60458
9	15.44779
10	15.32113
11	15.21659
12	15.12863
13	15.05344
14	14.98856
15	14.93243
16	14.88414
17	14.84314
18	14.80905
19	14.78157
20	14.7604
21	14.74524
22	14.73576
23	14.73161
24	14.73244
25	14.73788
26	14.74759
27	14.76122
28	14.77847
29	14.79902
30	14.82261

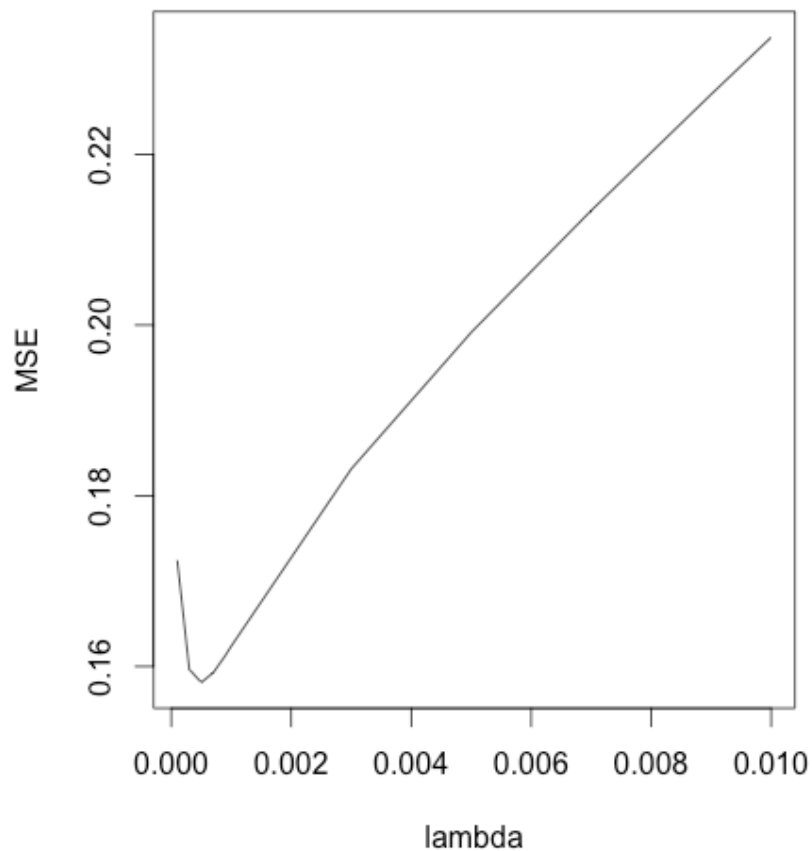
**PolynomialKernel MSE wrt degrees**



**PolynomialKernel MSE wrt lamda**



### RadialKernel MSE wrt lambda with normalizatio



### Observations:

1. Radial kernel gives MSE less than polynomial kernel
2. For more than degree 2 polynomial kernel does not give value as it becomes non invertible. For that we have to use normalization to get values for polynomial kernel with more than degree 2.
3. After degree 20 polynomial kernel does not improve by much
4. Normalization is not always reducing MSE
5. For radial kernel,  $\lambda = 0.0005$  gives lowest MSE
6. For polynomial kernel,  $\lambda = 0.0001$  gives lowest MSE