

## 1 Overview

We did a performance evaluation between Random Forrest (RF) and Radial Basis Function (RBF) methods. Both their codes can be found in the Github Milestone 3 folder. Our performance evaluation used a 10 time 10-Fold Cross Validation on MSE and  $R^2$ . We then used a sign test to determine which method was better.

## 2 Building the Model

Feature transformation can be seen in our CV file. We used the exact same feature transformation for both models and evaluated both of them using MSE and  $R^2$ . Obviously, we also used the same data sets.

## 3 Performance Comparison

Shown in the chart below of MSE and  $R^2$  results of each 10-Fold CV run, we can clearly see RBF performed better, without needing a statistical test. RBF had a an average MSE of 263.978 and  $R^2 = 0.963$ , while RF had an average MSE of 306.370 and  $R^2 = 0.944$ .

Radial Basis Function	Random Forrest MSE
262.5985366	303.6532045
267.9457534	303.8587778
257.5202242	302.5003372
262.6737912	307.1074524
269.1830831	309.8886417
262.9140346	308.2303146
258.2630138	305.4271171
260.8670629	303.7194937
266.8477001	308.9703277
270.9681429	310.3464214

Radial Basis Function	Random Forrest $R^2$
0.96605323	0.94276311
0.96424532	0.94348625
0.96383856	0.94450098
0.96290045	0.94301274
0.96303105	0.94357927
0.96234136	0.94456929
0.9570156	0.94250103
0.96217001	0.94406294
0.96173273	0.94380939
0.96460249	0.94420705

## 4 Statistical Sign-Test

We use a non-parametric test because RF and RBF are both non-parametric methods. The data set is also right-skewed. As both  $R^2$  and MSE both had the same amount, we will only do the test once to represent both metrics. The null hypothesis for the sign-test is  $H_0 : p(RBF_{win} > RF_{win}) = 0.5$ .

For sign-test would reject the null hypothesis. For  $\alpha = 0.05$  and  $n = 10$ , we need  $RBF_{win} or RF_{win} > 8$ , and all 10 experiments in RBF do better than RF. Thus, we reject the null hypothesis and with the sign test, RBF performs better than method RF with a 95 percent confidence..