Group A15 Machine Learning Lab 2 block 2

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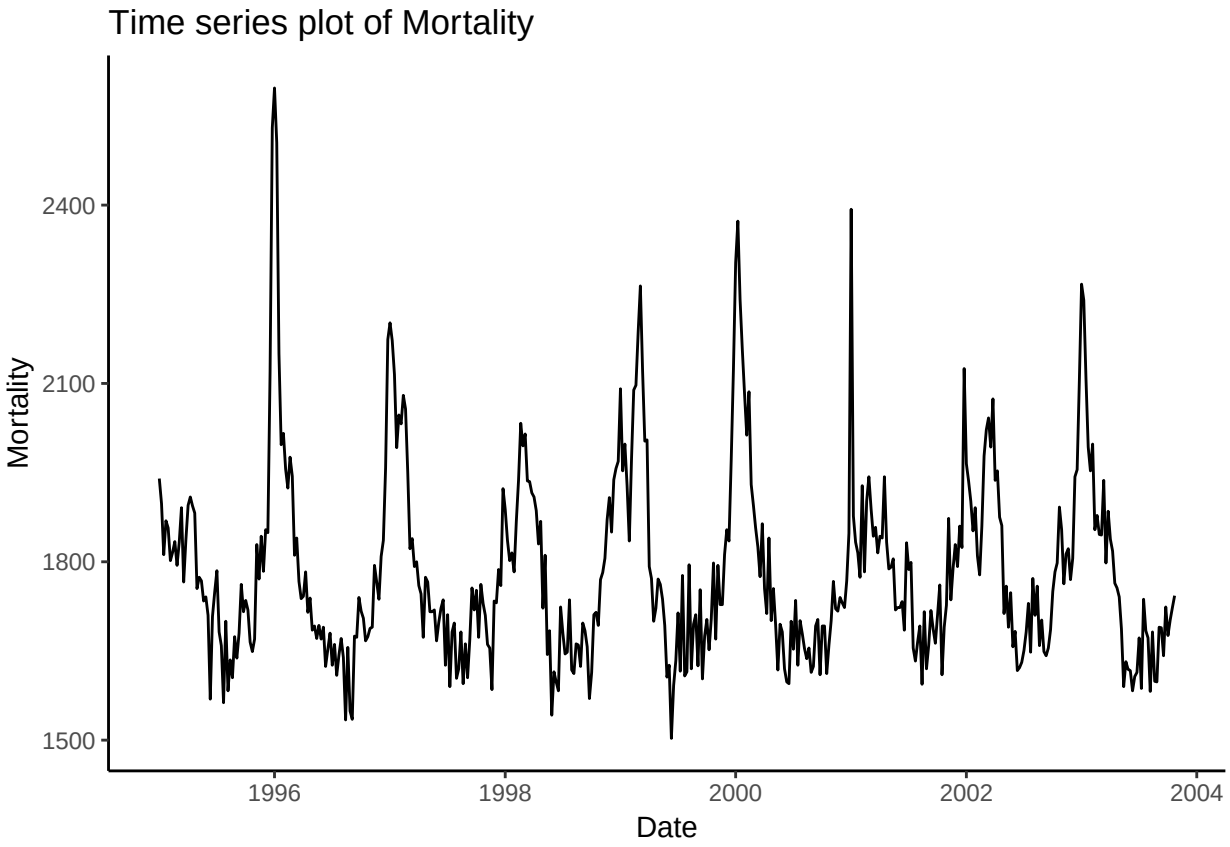
11 December 2018

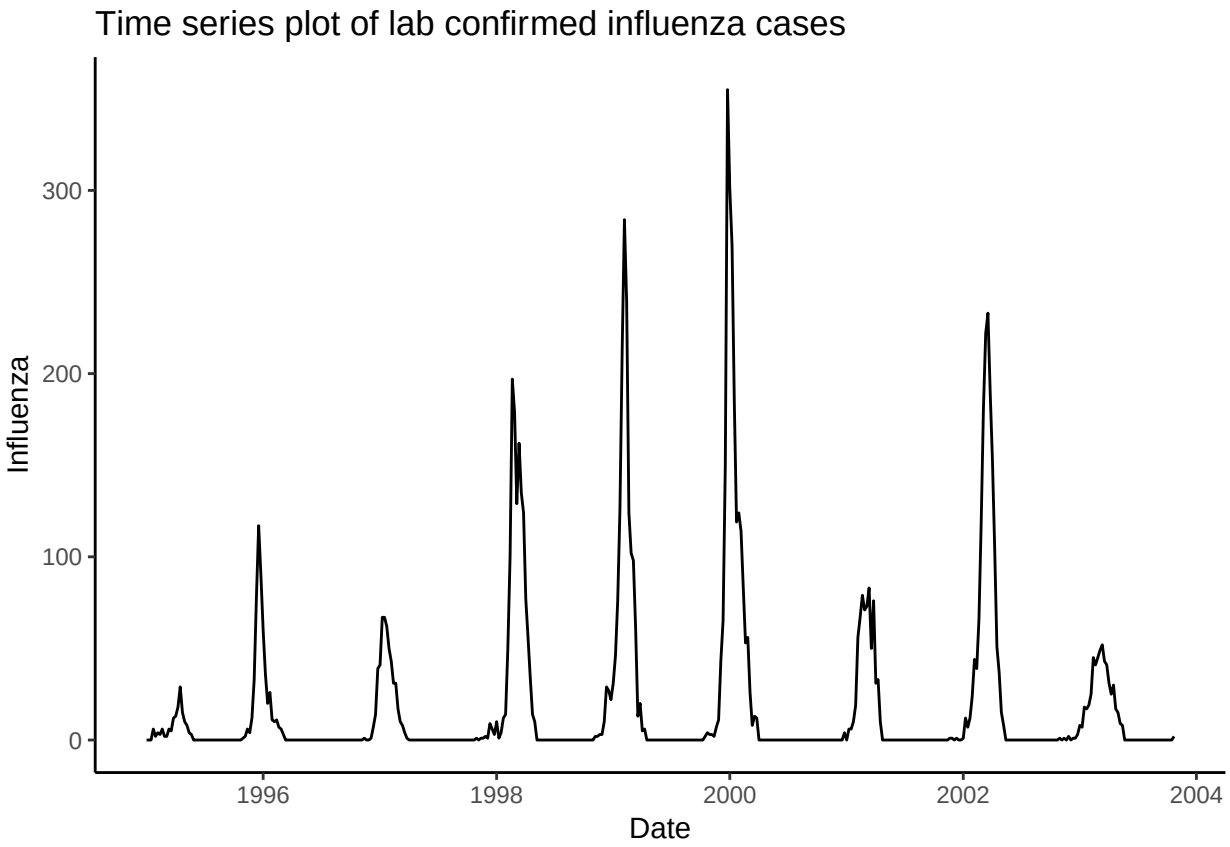
Assignment 1.

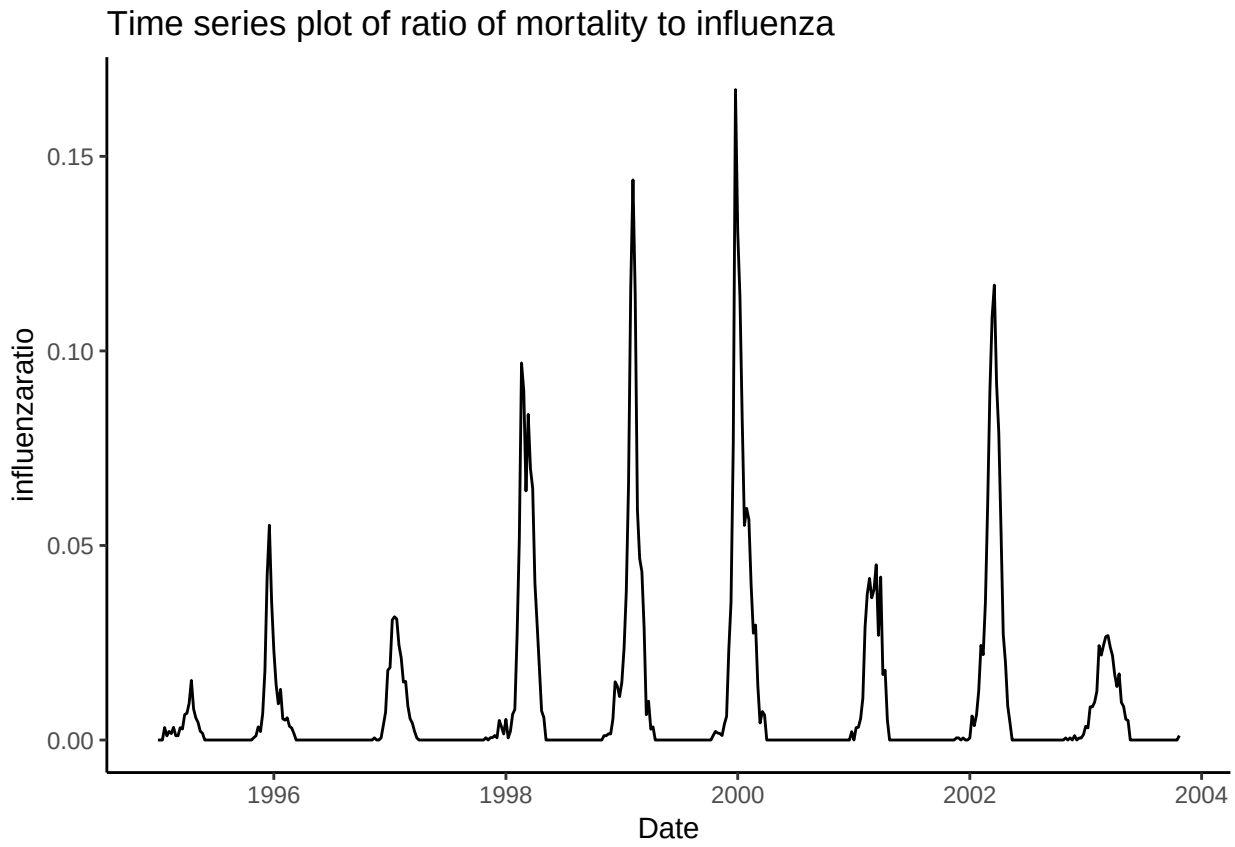
Using GAM and GLM to examine the mortality rates

Q1

From the plots we can see that, Mortality and Influenza peaking during the same time of each year which is the 1st quarter (Jan to March) with Influenza peaking sometimes in December of the previous as well. Although, The highest mortality is in January of 1996 with 2597 deaths and the highest laboratory-confirmed cases of influenza is found in December of 1999 with 355 cases. The third plot shows the percentage of influenza cases that directly attributed to death and it confirms that the two variables are highly correlated.




Time series plot of lab confirmed influenza cases
Influenza
300
200
100
0
1996
1998
2000
2002
2004
Date



Q2

```
##
## Family: gaussian
## Link function: identity
##
## Formula:
## Mortality ~ Year + s(Week, k = length(unique(Influenza$Week)))
##
## Parametric coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -680.598   3367.760  -0.202    0.840
## Year           1.233      1.685   0.732    0.465
##
## Approximate significance of smooth terms:
##           edf Ref.df     F p-value
## s(Week) 14.32  17.87 53.86  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Rank: 52/53
## R-sq.(adj) =  0.677   Deviance explained = 68.8%
## GCV = 8708.6  Scale est. = 8398.9    n = 459
```

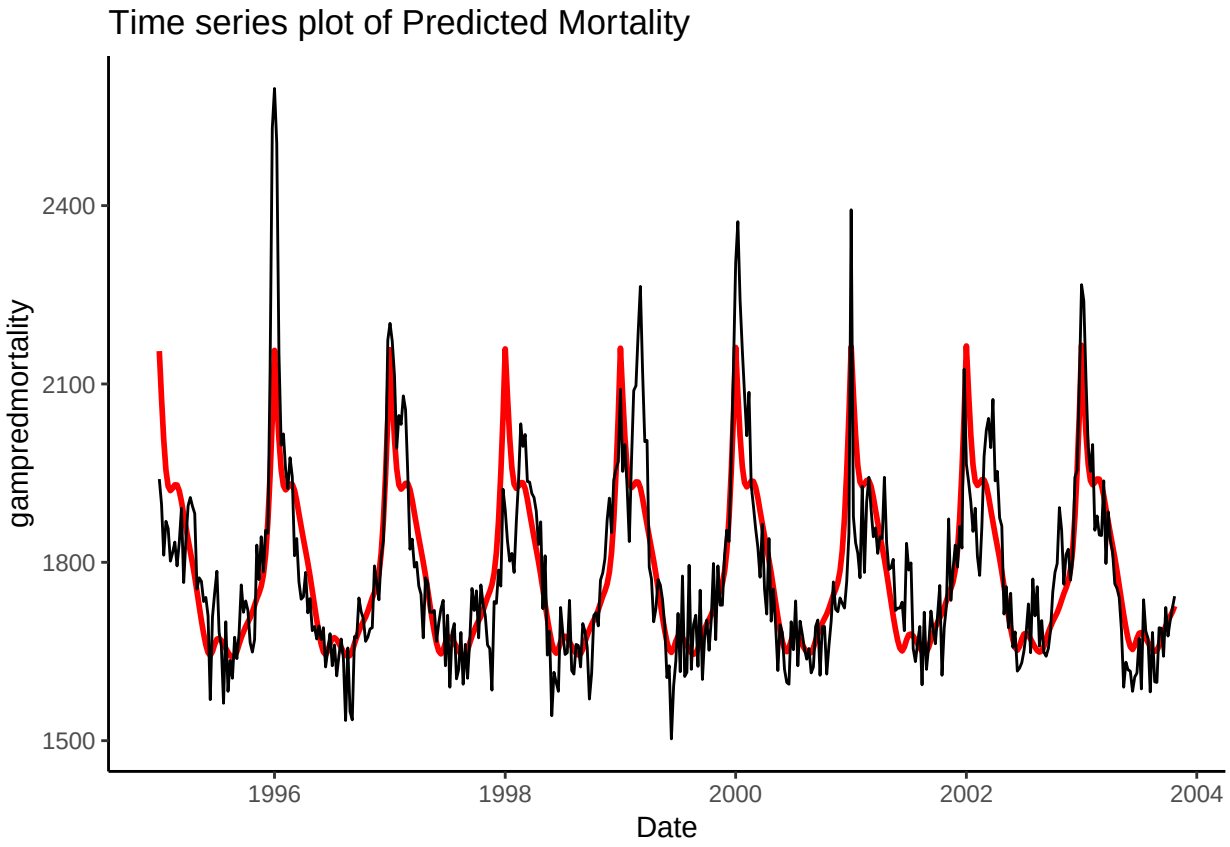
Underlying probablistic equation of the model :

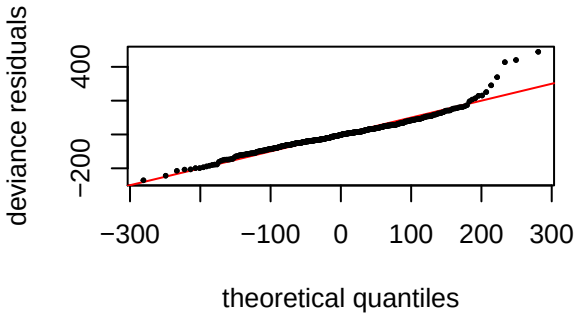
$$Mortality = N(\mu, \sigma^2)$$

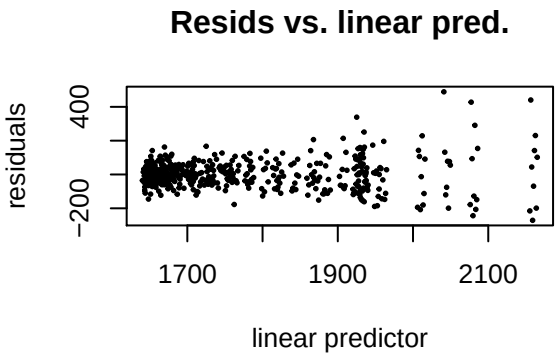
$$g(\mu) = Intercept + Beta_{year} * Year + s(Week)$$

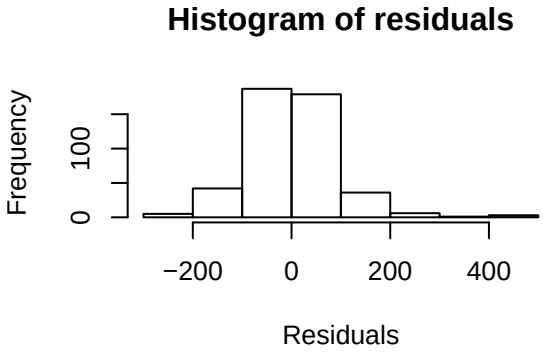
Where g is the link function, in this case it is a normal distribution

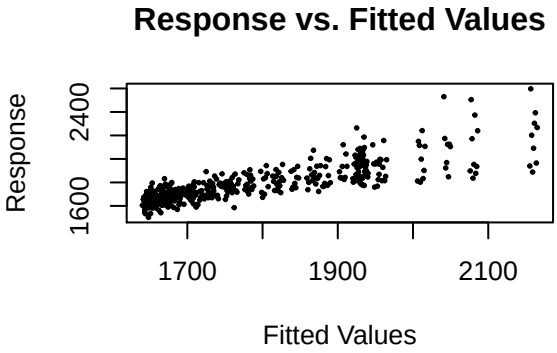
Q3



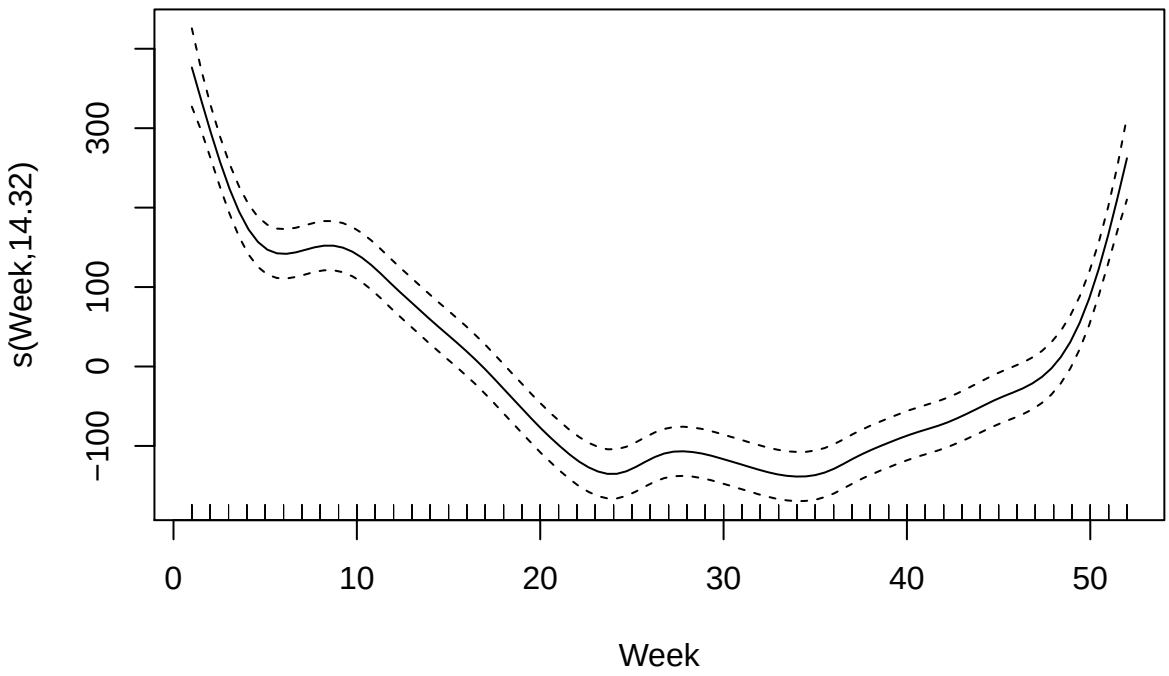









```
##
## Method: GCV   Optimizer: magic
## Smoothing parameter selection converged after 9 iterations by steepest
## descent step failure.
## The RMS GCV score gradient at convergence was 0.00106719 .
## The Hessian was positive definite.
## Model rank =  52 / 53
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
## indicate that k is too low, especially if edf is close to k'.
##
##           k'  edf k-index p-value
## s(Week) 51.0 14.3    1.09    0.99
```



The predicted mortality fits quite well with the time (x axis) i.e the peaks and troughs match with the actual mortality value but it is a repeating function that does not capture the the mortality values in the model and hence not a very good model to predict. It is observed that the linear component of year is not significant but the spline component of Week is a significant term with a very low p value. From the plot of the spline component it is seen that mortality peaks in the winter of each year and are the least in the summer of each year.

```
##
## Family: gaussian
## Link function: identity
##
## Formula:
## Mortality ~ Year + s(Week, k = length(unique(Influenza$Week)))
##
## Estimated degrees of freedom:
## 14.3  total = 16.32
##
## GCV score: 8708.581     rank: 52/53
```

```
##
## Family: gaussian
## Link function: identity
##
## Formula:
## Mortality ~ Year + s(Week, k = length(unique(Influenza$Week)))
##
```

```
## Parametric coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -680.598   3367.760  -0.202    0.840
## Year           1.233      1.685   0.732    0.465
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## Approximate significance of smooth terms:
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## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Rank: 52/53
## R-sq.(adj) =  0.677   Deviance explained = 68.8%
## GCV = 8708.6  Scale est. = 8398.9    n = 459
```
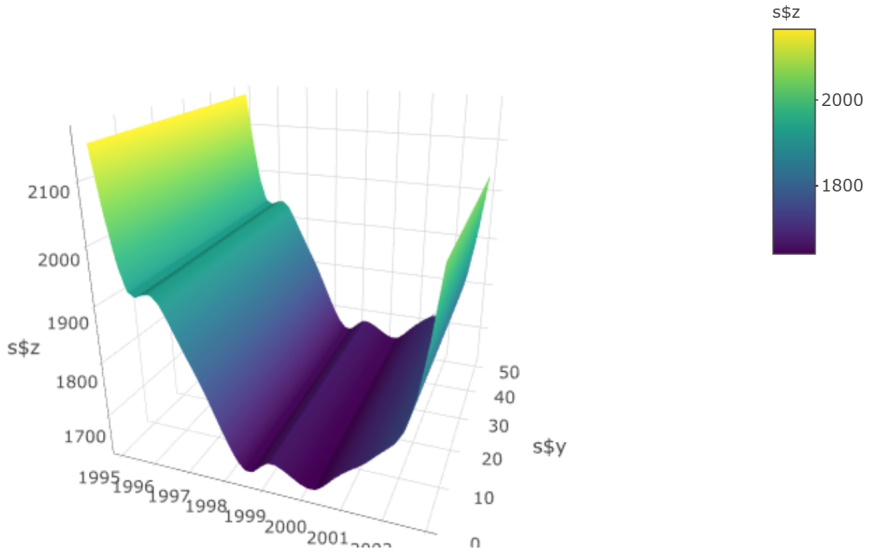
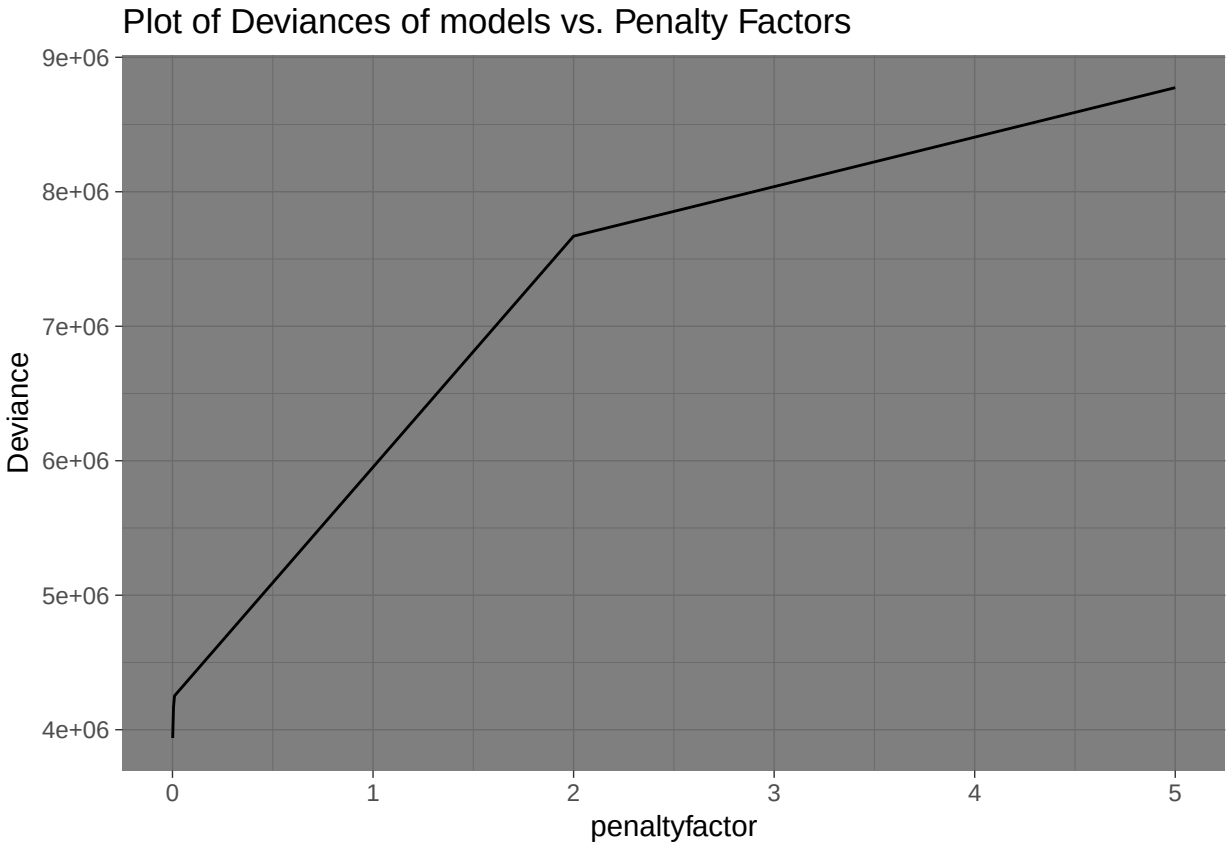
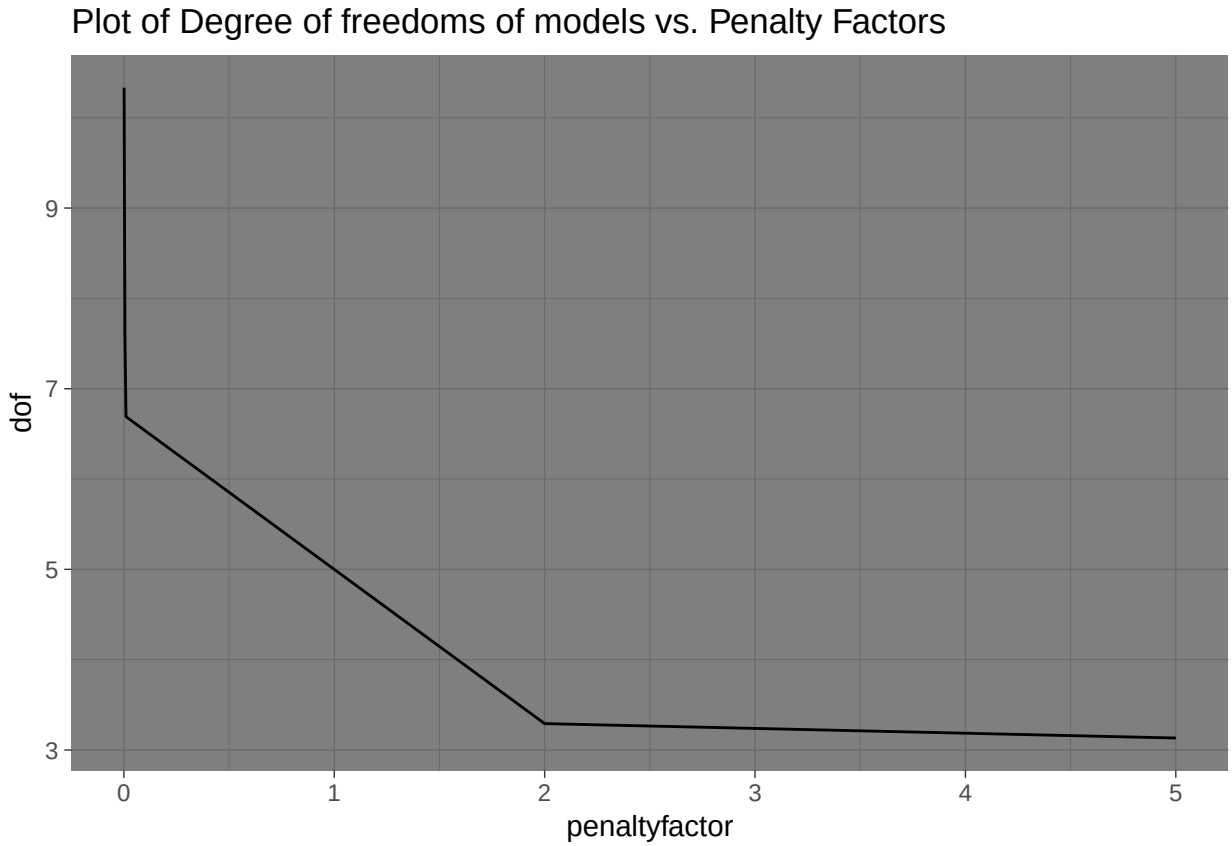
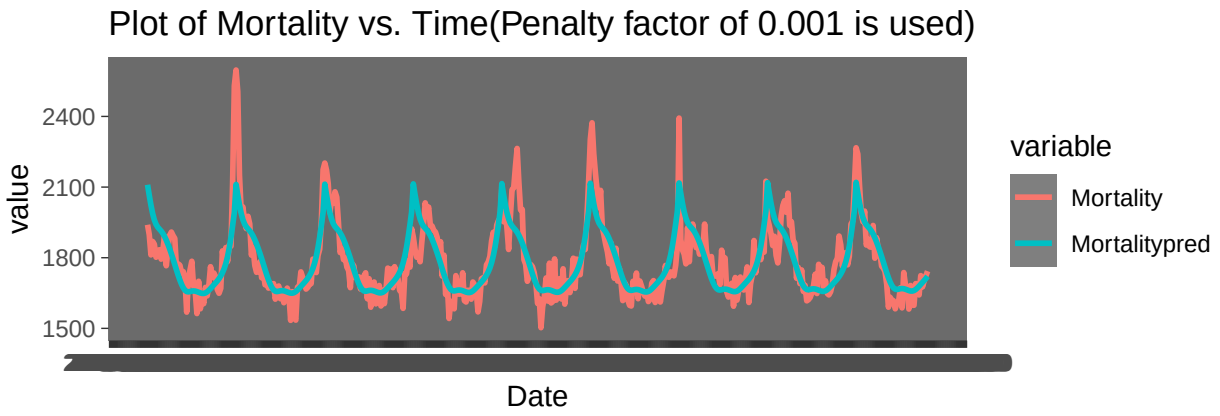

```
##      s(Week)
## 0.0001131932
```

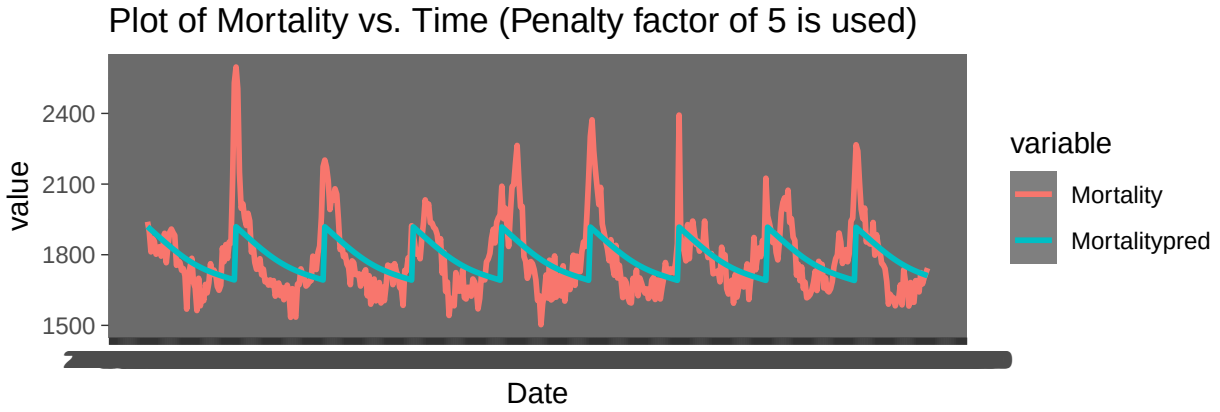


Q4


Plot of Deviances of models vs. Penalty Factors
Deviance
9e+06
8e+06
7e+06
6e+06
5e+06
4e+06
0
1
2
3
4
5
penaltyfactor

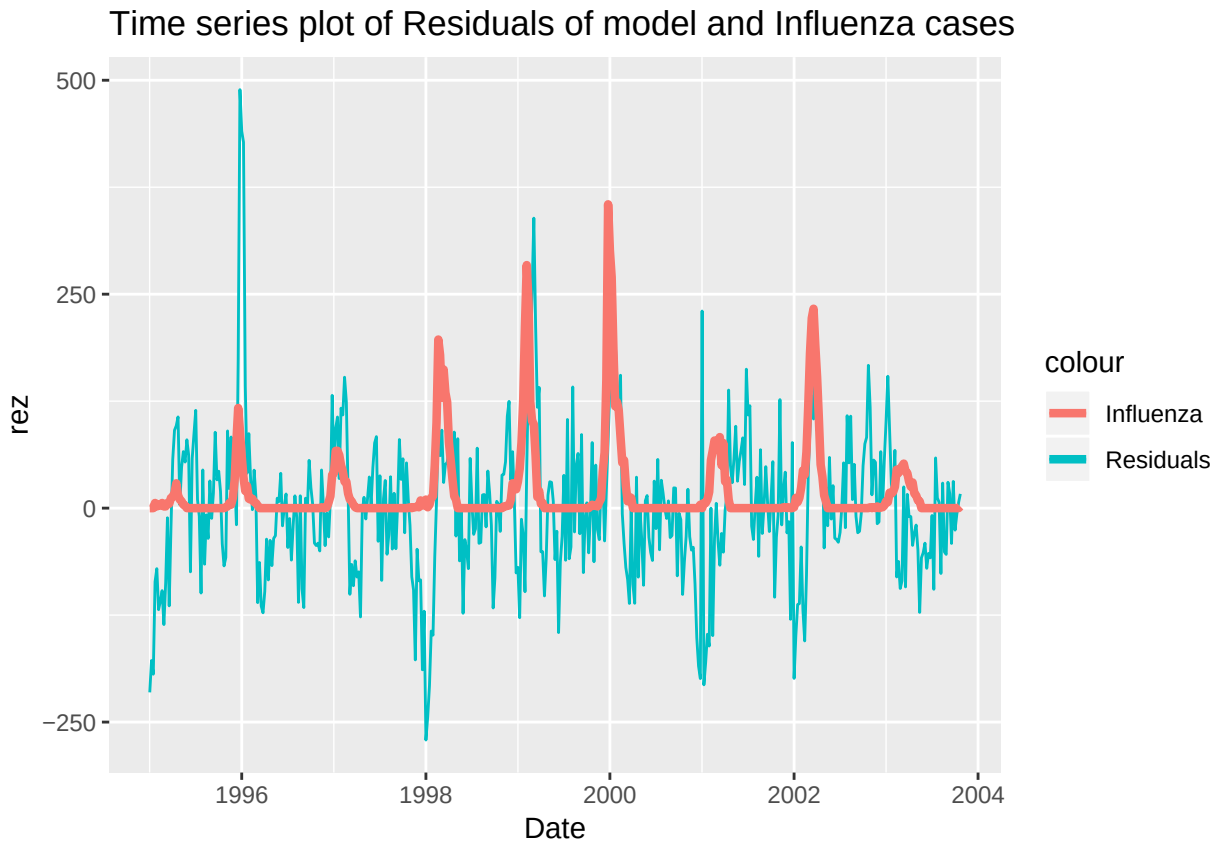

Plot of Degree of freedoms of models vs. Penalty Factors
dof
9
7
5
3
0
1
2
3
4
5
penaltyfactor





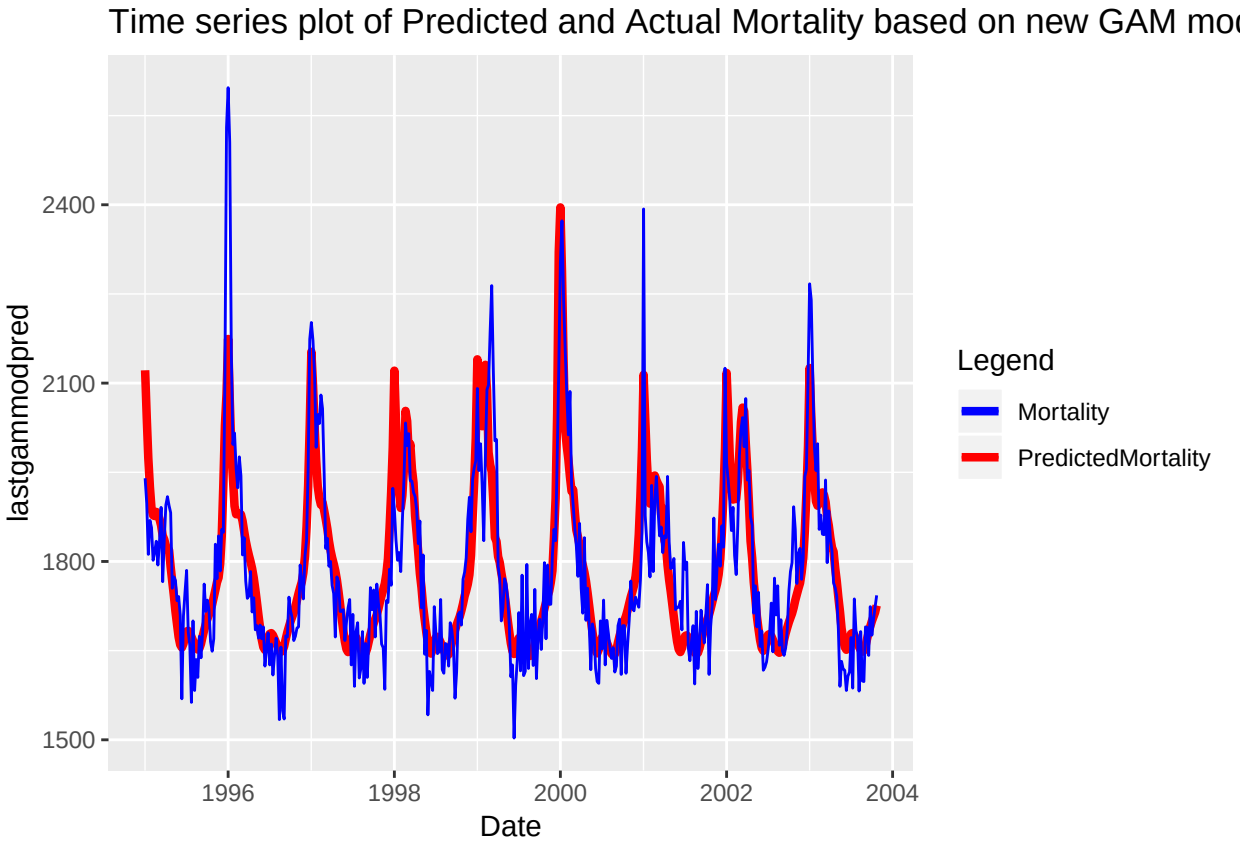
A directly propotional relationship is seen between penalty factor and deviance. Higher the penalty factor , higher is the deviance. With a higher penalty factor comes less complexity and more bias in the model. An inverse relationship is seen between penalty factor and degree's of freedom. Lower the penalty factor, Higher is the degree of freedom. yes, this is confirmed from our results.

Q5



the temporal pattern in the residuals can be linked to the periodic outbreak of influenza to an extent. The Three largest outbreaks of influenza also have residuals peaking in the positive direction while it is seen that the residuals have negative troughs right before the influenza peaks that is for the last quarter of the year.

Q6



Yes, this Generalised Additive Model is better than the previous models as the predicted fit is good not only in the x axis but also matches the actual value peaks and troughs. It can be concluded that Mortality can be described well with non linear spline functions of Year and Week along with the linear function of Influenza. Hence, Outbreaks of Influenza in the winters have a direct effect on Mortality.

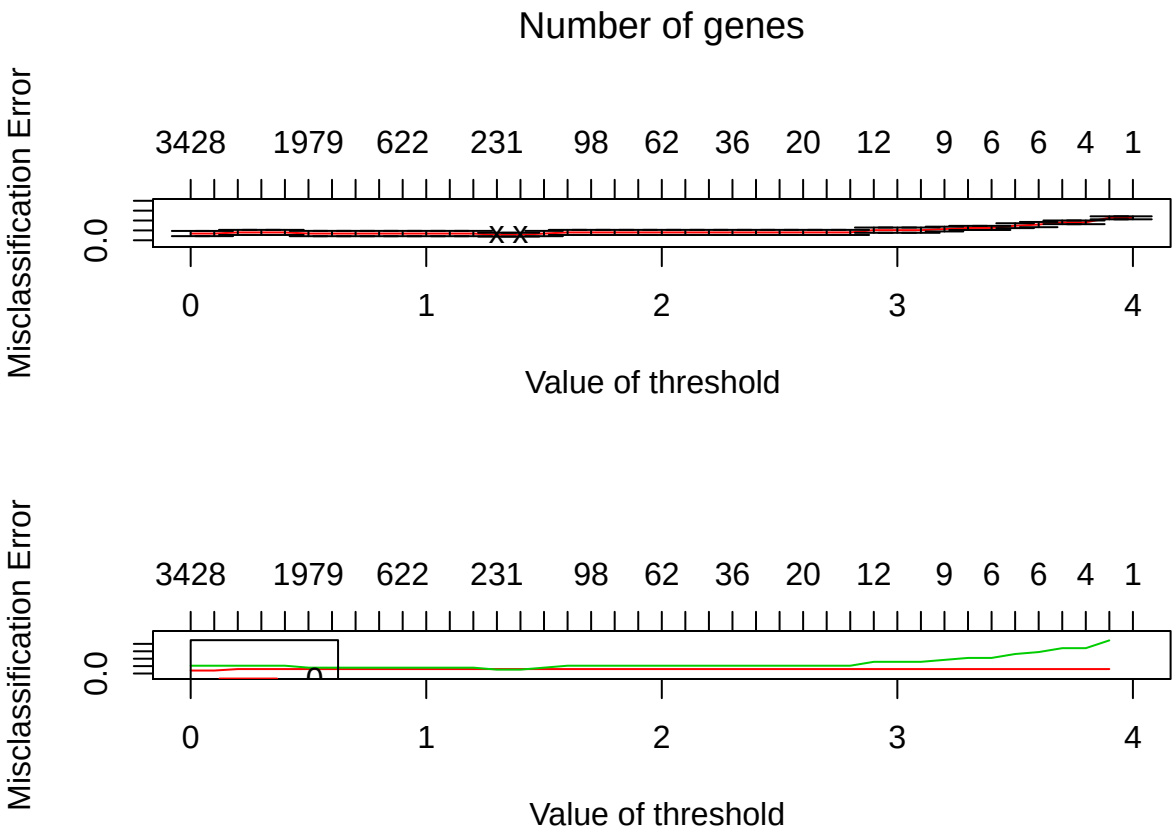
Assignment 2.

High-dimensional methods

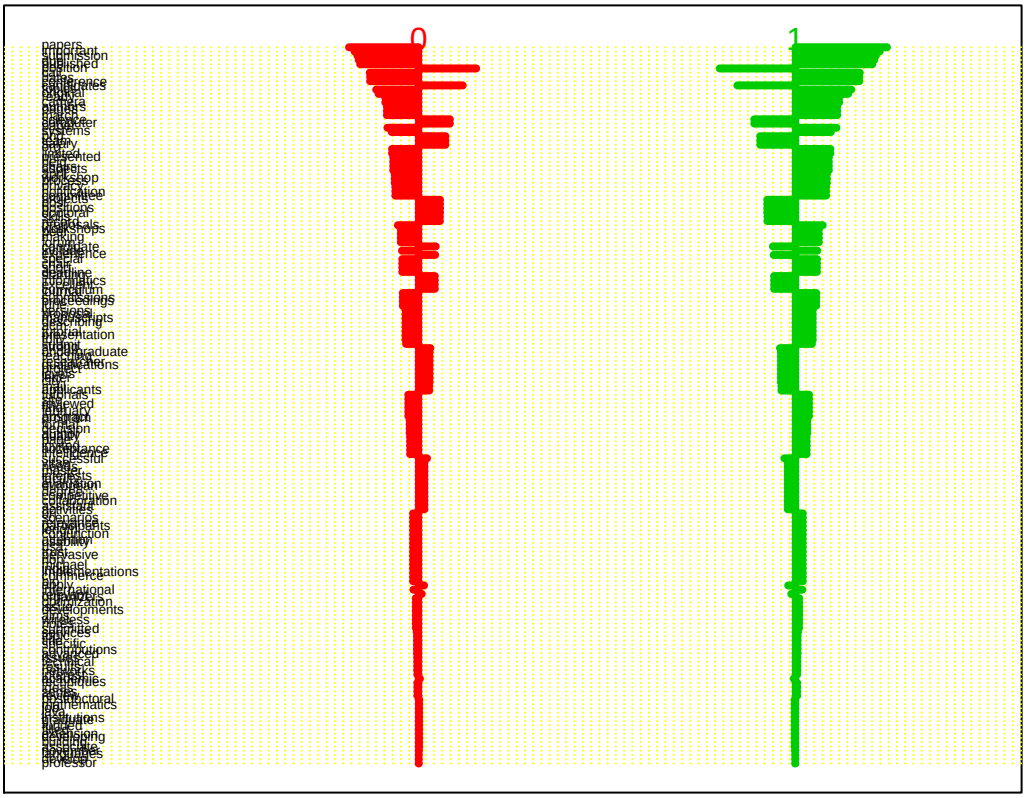
Q1

```
## 12345678910111213141516171819202122232425262728293031323334353637383940 41

## 12Fold 1 :12345678910111213141516171819202122232425262728293031323334353637383940 41
## Fold 2 :12345678910111213141516171819202122232425262728293031323334353637383940 41
## Fold 3 :12345678910111213141516171819202122232425262728293031323334353637383940 41
## Fold 4 :12345678910111213141516171819202122232425262728293031323334353637383940 41
## Fold 5 :12345678910111213141516171819202122232425262728293031323334353637383940 41
## Fold 6 :12345678910111213141516171819202122232425262728293031323334353637383940 41
## Fold 7 :12345678910111213141516171819202122232425262728293031323334353637383940 41
## Fold 8 :12345678910111213141516171819202122232425262728293031323334353637383940 41
## Fold 9 :12345678910111213141516171819202122232425262728293031323334353637383940 41
## Fold 10 :12345678910111213141516171819202122232425262728293031323334353637383940 41

## Call:
```

```
## pamr.cv(fit = model, data = myemailtrain)
##    threshold nonzero errors
## 1  0.0       3428    6
## 2  0.1       3409    6
## 3  0.2       3114    7
## 4  0.3       3024    7
## 5  0.4       3000    7
## 6  0.5       1979    6
## 7  0.6        852    6
## 8  0.7        841    6
## 9  0.8        673    6
## 10 0.9        622    6
## 11 1.0        297    6
## 12 1.1        293    6
## 13 1.2        272    6
## 14 1.3        231    5
## 15 1.4        170    5
## 16 1.5        138    6
## 17 1.6        129    7
## 18 1.7         98    7
## 19 1.8         88    7
## 20 1.9         71    7
## 21 2.0         62    7
## 22 2.1         47    7
## 23 2.2         43    7
## 24 2.3         36    7
## 25 2.4         30    7
## 26 2.5         20    7
## 27 2.6         20    7
## 28 2.7         14    7
## 29 2.8         12    7
## 30 2.9         12    9
## 31 3.0         12    9
## 32 3.1         11    9
## 33 3.2          9    10
## 34 3.3          9    11
## 35 3.4          6    11
## 36 3.5          6    13
## 37 3.6          6    14
## 38 3.7          6    16
## 39 3.8          4    16
## 40 3.9          2    20
## 41 4.0          1    20
```


Number of genes
Misclassification Error
3428 1979 622 231 98 62 36 20 12 9 6 6 4 1
0.0
0 1 2 3 4
Value of threshold

Misclassification Error
3428 1979 622 231 98 62 36 20 12 9 6 6 4 1
0.0
0 1 2 3 4
Value of threshold




```
##         id   0-score 1-score
##    [1,] 3036 -0.369   0.4856
##    [2,] 2049 -0.3396 0.4468
##    [3,] 4060 -0.3244 0.4269
##    [4,] 1262 -0.3178 0.4181
##    [5,] 3364 -0.31   0.4079
##    [6,] 3187 0.3056  -0.4022
##    [7,] 596  -0.2593 0.3412
##    [8,] 869  -0.2574 0.3387
##    [9,] 1045 -0.2574 0.3387
##   [10,] 607  0.2344  -0.3085
##   [11,] 4282 -0.2252 0.2963
##   [12,] 2990 -0.2123 0.2793
##   [13,] 599  -0.1765 0.2322
##   [14,] 3433 -0.1765 0.2322
##   [15,] 389  -0.1684 0.2216
##   [16,] 2588 -0.1684 0.2216
##   [17,] 3022 -0.1684 0.2216
##   [18,] 850  0.1661  -0.2186
##   [19,] 3725 0.1661  -0.2186
##   [20,] 3035 -0.1654 0.2176
##   [21,] 4129 -0.1427 0.1878
##   [22,] 3125 0.1427  -0.1878
##   [23,] 4177 0.1424  -0.1874
##   [24,] 3671 0.1424  -0.1874
##   [25,] 2974 -0.141  0.1856
```

```
##  [26,] 2463 -0.141  0.1856
##  [27,] 329  -0.1349 0.1774
##  [28,] 681  -0.1349 0.1774
##  [29,] 1891 -0.1349 0.1774
##  [30,] 3243 -0.1349 0.1774
##  [31,] 283  -0.1268 0.1669
##  [32,] 4628 -0.1268 0.1669
##  [33,] 3286 -0.1268 0.1669
##  [34,] 3274 -0.1237 0.1627
##  [35,] 810  -0.1237 0.1627
##  [36,] 2889 -0.1237 0.1627
##  [37,] 1233 0.1141  -0.1501
##  [38,] 3188 0.1141  -0.1501
##  [39,] 3191 0.1141  -0.1501
##  [40,] 3312 0.1141  -0.1501
##  [41,] 3891 0.1133  -0.1491
##  [42,] 3458 0.1133  -0.1491
##  [43,] 3324 -0.11   0.1447
##  [44,] 1643 -0.0946 0.1244
##  [45,] 2561 -0.0946 0.1244
##  [46,] 3090 -0.0946 0.1244
##  [47,] 4629 -0.0946 0.1244
##  [48,] 606  0.091   -0.1197
##  [49,] 2058 -0.0881 0.1159
##  [50,] 1501 0.0881  -0.1159
##  [51,] 3952 -0.0869 0.1143
##  [52,] 680  -0.0869 0.1143
##  [53,] 3836 -0.0869 0.1143
##  [54,] 1061 -0.0867 0.1141
##  [55,] 1007 0.0864  -0.1137
##  [56,] 1477 0.0864  -0.1137
##  [57,] 2103 0.0864  -0.1137
##  [58,] 3992 0.0864  -0.1137
##  [59,] 2295 -0.084  0.1105
##  [60,] 4061 -0.084  0.1105
##  [61,] 2305 -0.0838 0.1103
##  [62,] 3285 -0.0838 0.1103
##  [63,] 92   -0.07   0.0921
##  [64,] 1127 -0.07   0.0921
##  [65,] 2583 -0.07   0.0921
##  [66,] 3323 -0.07   0.0921
##  [67,] 4500 -0.07   0.0921
##  [68,] 1698 -0.07   0.0921
##  [69,] 3241 -0.07   0.0921
##  [70,] 4364 -0.07   0.0921
##  [71,] 4062 -0.0665 0.0875
##  [72,] 4039 0.0626  -0.0823
##  [73,] 740  0.059   -0.0776
##  [74,] 2438 0.059   -0.0776
##  [75,] 2442 0.059   -0.0776
##  [76,] 3311 0.059   -0.0776
##  [77,] 3383 0.059   -0.0776
##  [78,] 3559 0.059   -0.0776
##  [79,] 4176 0.059   -0.0776
```

```
##  [80,] 4402 0.059   -0.0776
##  [81,] 267  0.057   -0.075
##  [82,] 2553 0.057   -0.075
##  [83,] 63   -0.0549 0.0723
##  [84,] 1563 -0.0549 0.0723
##  [85,] 1594 -0.0549 0.0723
##  [86,] 3589 -0.0549 0.0723
##  [87,] 3882 -0.0549 0.0723
##  [88,] 4365 -0.0549 0.0723
##  [89,] 3301 -0.048  0.0632
##  [90,] 1636 -0.0478 0.0629
##  [91,] 1072 -0.0478 0.0629
##  [92,] 386  -0.0478 0.0629
##  [93,] 2198 -0.0455 0.0599
##  [94,] 3021 -0.0455 0.0599
##  [95,] 3386 -0.0455 0.0599
##  [96,] 76   -0.0452 0.0594
##  [97,] 2150 -0.0452 0.0594
##  [98,] 4075 0.0448  -0.0589
##  [99,] 107  0.0316  -0.0416
## [100,] 336  0.0316  -0.0416
## [101,] 776  0.0316  -0.0416
## [102,] 831  0.0316  -0.0416
## [103,] 1088 0.0316  -0.0416
## [104,] 1450 0.0316  -0.0416
## [105,] 1456 0.0316  -0.0416
## [106,] 1542 0.0316  -0.0416
## [107,] 2170 0.0316  -0.0416
## [108,] 2613 0.0316  -0.0416
## [109,] 2837 0.0316  -0.0416
## [110,] 4529 0.0316  -0.0416
## [111,] 363  -0.0297 0.0391
## [112,] 879  -0.0297 0.0391
## [113,] 2433 -0.0297 0.0391
## [114,] 3051 -0.0297 0.0391
## [115,] 3514 -0.0297 0.0391
## [116,] 3711 -0.0297 0.0391
## [117,] 4449 -0.0297 0.0391
## [118,] 501  -0.0297 0.0391
## [119,] 803  -0.0297 0.0391
## [120,] 2046 -0.0297 0.0391
## [121,] 2082 -0.0297 0.0391
## [122,] 2690 -0.0297 0.0391
## [123,] 2877 -0.0297 0.0391
## [124,] 3118 -0.0297 0.0391
## [125,] 4342 -0.0297 0.0391
## [126,] 4451 -0.0297 0.0391
## [127,] 4452 -0.0297 0.0391
## [128,] 272  0.0294  -0.0386
## [129,] 2175 -0.0276 0.0364
## [130,] 3515 0.017   -0.0224
## [131,] 172  -0.0152 0.02
## [132,] 1149 -0.0152 0.02
## [133,] 2219 -0.0152 0.02
```

```
## [134,] 2964 -0.0152 0.02
## [135,] 2984 -0.0152 0.02
## [136,] 2887 -0.0152 0.02
## [137,] 4605 -0.0152 0.02
## [138,] 4064 -0.0149 0.0196
## [139,] 3800 -0.0106 0.014
## [140,] 134  -0.0091 0.0119
## [141,] 919  -0.0091 0.0119
## [142,] 3957 -0.0091 0.0119
## [143,] 4268 -0.0091 0.0119
## [144,] 4281 -0.0091 0.0119
## [145,] 2220 -0.0079 0.0104
## [146,] 2847 -0.0079 0.0104
## [147,] 3582 -0.0079 0.0104
## [148,] 4181 -0.0079 0.0104
## [149,] 2167 -0.0073 0.0096
## [150,] 67   0.0073  -0.0095
## [151,] 2005 -0.0071 0.0094
## [152,] 4185 -0.0071 0.0094
## [153,] 3588 -0.0071 0.0094
## [154,] 3794 -0.0071 0.0094
## [155,] 579  0.0038  -0.005
## [156,] 1147 0.0038  -0.005
## [157,] 1524 0.0038  -0.005
## [158,] 1591 0.0038  -0.005
## [159,] 1702 0.0038  -0.005
## [160,] 1797 0.0038  -0.005
## [161,] 2141 0.0038  -0.005
## [162,] 2251 0.0038  -0.005
## [163,] 2278 0.0038  -0.005
## [164,] 2619 0.0038  -0.005
## [165,] 3194 0.0038  -0.005
## [166,] 340  0.0038  -0.005
## [167,] 2894 0.0024  -0.0032
## [168,] 1144 0.0017  -0.0022
## [169,] 2392 0.0017  -0.0022
## [170,] 3295 0.0017  -0.0022
```

```
##      predicted
## ytest  0  1
##     0 10  0
##     1  2  8
```

```
## [1] "The misclassificaiton rate is 0.1"
```

```
##        id   0-score 1-score
##   [1,] 3036 -0.369  0.4856
##   [2,] 2049 -0.3396 0.4468
##   [3,] 4060 -0.3244 0.4269
##   [4,] 1262 -0.3178 0.4181
##   [5,] 3364 -0.31   0.4079
##   [6,] 3187 0.3056  -0.4022
##   [7,] 596  -0.2593 0.3412
```

```
##   [8,] 869  -0.2574 0.3387
##   [9,] 1045 -0.2574 0.3387
##  [10,] 607  0.2344  -0.3085
##  [11,] 4282 -0.2252 0.2963
##  [12,] 2990 -0.2123 0.2793
##  [13,] 599  -0.1765 0.2322
##  [14,] 3433 -0.1765 0.2322
##  [15,] 389  -0.1684 0.2216
##  [16,] 2588 -0.1684 0.2216
##  [17,] 3022 -0.1684 0.2216
##  [18,] 850  0.1661  -0.2186
##  [19,] 3725 0.1661  -0.2186
##  [20,] 3035 -0.1654 0.2176
##  [21,] 4129 -0.1427 0.1878
##  [22,] 3125 0.1427  -0.1878
##  [23,] 4177 0.1424  -0.1874
##  [24,] 3671 0.1424  -0.1874
##  [25,] 2974 -0.141  0.1856
##  [26,] 2463 -0.141  0.1856
##  [27,] 329  -0.1349 0.1774
##  [28,] 681  -0.1349 0.1774
##  [29,] 1891 -0.1349 0.1774
##  [30,] 3243 -0.1349 0.1774
##  [31,] 283  -0.1268 0.1669
##  [32,] 4628 -0.1268 0.1669
##  [33,] 3286 -0.1268 0.1669
##  [34,] 3274 -0.1237 0.1627
##  [35,] 810  -0.1237 0.1627
##  [36,] 2889 -0.1237 0.1627
##  [37,] 1233 0.1141  -0.1501
##  [38,] 3188 0.1141  -0.1501
##  [39,] 3191 0.1141  -0.1501
##  [40,] 3312 0.1141  -0.1501
##  [41,] 3891 0.1133  -0.1491
##  [42,] 3458 0.1133  -0.1491
##  [43,] 3324 -0.11   0.1447
##  [44,] 1643 -0.0946 0.1244
##  [45,] 2561 -0.0946 0.1244
##  [46,] 3090 -0.0946 0.1244
##  [47,] 4629 -0.0946 0.1244
##  [48,] 606  0.091   -0.1197
##  [49,] 2058 -0.0881 0.1159
##  [50,] 1501 0.0881  -0.1159
##  [51,] 3952 -0.0869 0.1143
##  [52,] 680  -0.0869 0.1143
##  [53,] 3836 -0.0869 0.1143
##  [54,] 1061 -0.0867 0.1141
##  [55,] 1007 0.0864  -0.1137
##  [56,] 1477 0.0864  -0.1137
##  [57,] 2103 0.0864  -0.1137
##  [58,] 3992 0.0864  -0.1137
##  [59,] 2295 -0.084  0.1105
##  [60,] 4061 -0.084  0.1105
##  [61,] 2305 -0.0838 0.1103
```

```
##  [62,] 3285 -0.0838 0.1103
##  [63,] 92   -0.07   0.0921
##  [64,] 1127 -0.07   0.0921
##  [65,] 2583 -0.07   0.0921
##  [66,] 3323 -0.07   0.0921
##  [67,] 4500 -0.07   0.0921
##  [68,] 1698 -0.07   0.0921
##  [69,] 3241 -0.07   0.0921
##  [70,] 4364 -0.07   0.0921
##  [71,] 4062 -0.0665 0.0875
##  [72,] 4039 0.0626  -0.0823
##  [73,] 740  0.059   -0.0776
##  [74,] 2438 0.059   -0.0776
##  [75,] 2442 0.059   -0.0776
##  [76,] 3311 0.059   -0.0776
##  [77,] 3383 0.059   -0.0776
##  [78,] 3559 0.059   -0.0776
##  [79,] 4176 0.059   -0.0776
##  [80,] 4402 0.059   -0.0776
##  [81,] 267  0.057   -0.075
##  [82,] 2553 0.057   -0.075
##  [83,] 63   -0.0549 0.0723
##  [84,] 1563 -0.0549 0.0723
##  [85,] 1594 -0.0549 0.0723
##  [86,] 3589 -0.0549 0.0723
##  [87,] 3882 -0.0549 0.0723
##  [88,] 4365 -0.0549 0.0723
##  [89,] 3301 -0.048  0.0632
##  [90,] 1636 -0.0478 0.0629
##  [91,] 1072 -0.0478 0.0629
##  [92,] 386  -0.0478 0.0629
##  [93,] 2198 -0.0455 0.0599
##  [94,] 3021 -0.0455 0.0599
##  [95,] 3386 -0.0455 0.0599
##  [96,] 76   -0.0452 0.0594
##  [97,] 2150 -0.0452 0.0594
##  [98,] 4075 0.0448  -0.0589
##  [99,] 107  0.0316  -0.0416
## [100,] 336  0.0316  -0.0416
## [101,] 776  0.0316  -0.0416
## [102,] 831  0.0316  -0.0416
## [103,] 1088 0.0316  -0.0416
## [104,] 1450 0.0316  -0.0416
## [105,] 1456 0.0316  -0.0416
## [106,] 1542 0.0316  -0.0416
## [107,] 2170 0.0316  -0.0416
## [108,] 2613 0.0316  -0.0416
## [109,] 2837 0.0316  -0.0416
## [110,] 4529 0.0316  -0.0416
## [111,] 363  -0.0297 0.0391
## [112,] 879  -0.0297 0.0391
## [113,] 2433 -0.0297 0.0391
## [114,] 3051 -0.0297 0.0391
## [115,] 3514 -0.0297 0.0391
```

```
## [116,] 3711 -0.0297 0.0391
## [117,] 4449 -0.0297 0.0391
## [118,] 501  -0.0297 0.0391
## [119,] 803  -0.0297 0.0391
## [120,] 2046 -0.0297 0.0391
## [121,] 2082 -0.0297 0.0391
## [122,] 2690 -0.0297 0.0391
## [123,] 2877 -0.0297 0.0391
## [124,] 3118 -0.0297 0.0391
## [125,] 4342 -0.0297 0.0391
## [126,] 4451 -0.0297 0.0391
## [127,] 4452 -0.0297 0.0391
## [128,] 272  0.0294  -0.0386
## [129,] 2175 -0.0276 0.0364
## [130,] 3515 0.017   -0.0224
## [131,] 172  -0.0152 0.02
## [132,] 1149 -0.0152 0.02
## [133,] 2219 -0.0152 0.02
## [134,] 2964 -0.0152 0.02
## [135,] 2984 -0.0152 0.02
## [136,] 2887 -0.0152 0.02
## [137,] 4605 -0.0152 0.02
## [138,] 4064 -0.0149 0.0196
## [139,] 3800 -0.0106 0.014
## [140,] 134  -0.0091 0.0119
## [141,] 919  -0.0091 0.0119
## [142,] 3957 -0.0091 0.0119
## [143,] 4268 -0.0091 0.0119
## [144,] 4281 -0.0091 0.0119
## [145,] 2220 -0.0079 0.0104
## [146,] 2847 -0.0079 0.0104
## [147,] 3582 -0.0079 0.0104
## [148,] 4181 -0.0079 0.0104
## [149,] 2167 -0.0073 0.0096
## [150,] 67   0.0073  -0.0095
## [151,] 2005 -0.0071 0.0094
## [152,] 4185 -0.0071 0.0094
## [153,] 3588 -0.0071 0.0094
## [154,] 3794 -0.0071 0.0094
## [155,] 579  0.0038  -0.005
## [156,] 1147 0.0038  -0.005
## [157,] 1524 0.0038  -0.005
## [158,] 1591 0.0038  -0.005
## [159,] 1702 0.0038  -0.005
## [160,] 1797 0.0038  -0.005
## [161,] 2141 0.0038  -0.005
## [162,] 2251 0.0038  -0.005
## [163,] 2278 0.0038  -0.005
## [164,] 2619 0.0038  -0.005
## [165,] 3194 0.0038  -0.005
## [166,] 340  0.0038  -0.005
## [167,] 2894 0.0024  -0.0032
## [168,] 1144 0.0017  -0.0022
## [169,] 2392 0.0017  -0.0022
```

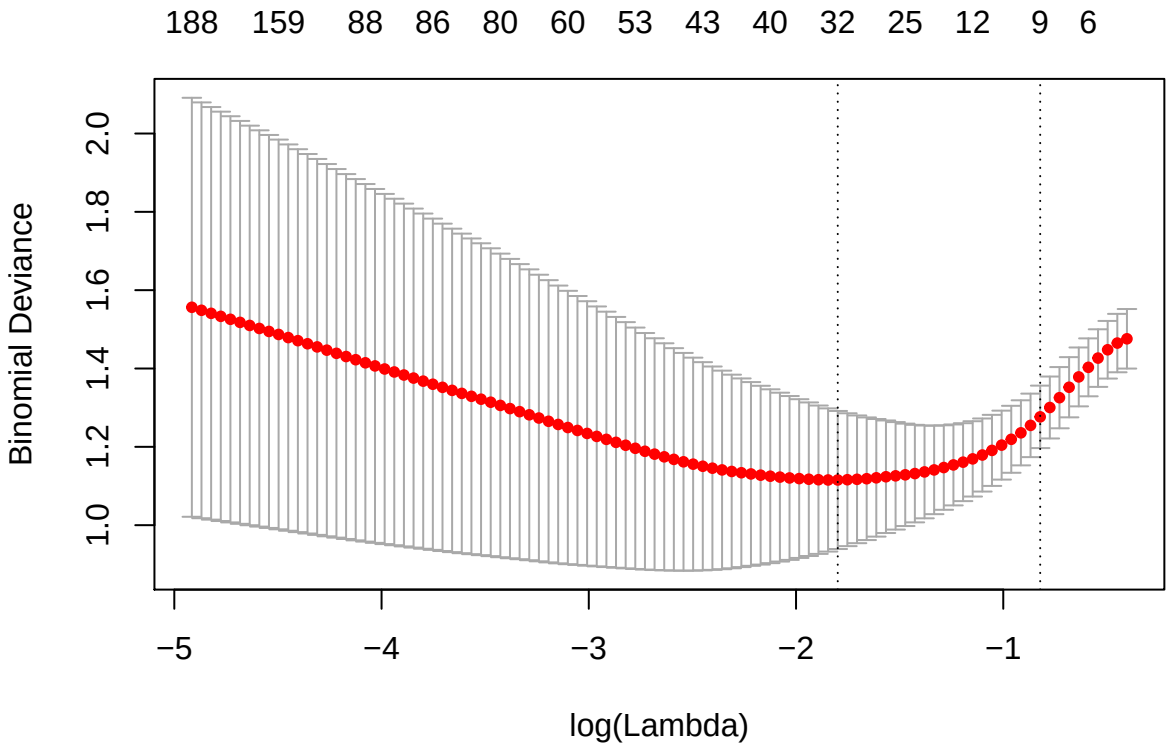
```
## [170,] 3295 0.0017  -0.0022
```

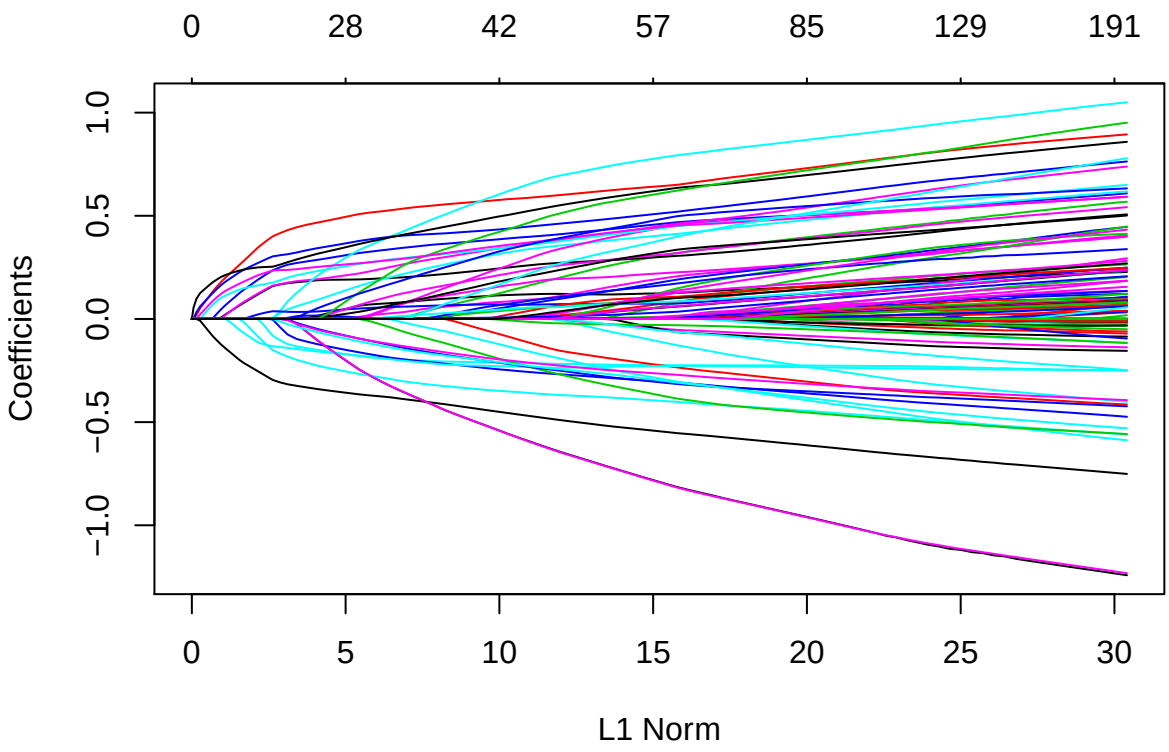
Table 1: Top 10 Important features by NSC

x
acceptance
X59â
adhere
X1st
acquiring
accessibility
agenda
aicit
X5102011
agents

From the plot generated of threshold vs misclassification error. It is observed that when the threshold value is 1.4, the misclassification error is at its lowest. 170 features were selected by this model and top 10 features are listed below. The misclassification error rate is 10%. The confusion matrix reveals that 'everything else' is classified with 10/10 times while 'announces of conferences' is classified 8/10 times.

Q2a






```
##       elasticpredict
## ytest2  0  1
##      0 10  0
##      1  2  8
```

```
## [1] "The misclassificaiton rate is 0.1"
```

The Elastic net model has a misclassification error rate of 10%. This model selects the least number of features i.e 39 features.

Q2b

```
##  Setting default kernel parameters
```

```
##            Predicted svm
## Actual Test  0  1
##           0 10  0
##           1  1  9
```

```
## [1] "The misclassificaiton rate is 0.05"
```

Table 2: Contributing features of elastic net model

x
(Intercept)
abstracts
aspects
bio
call
candidates
computer
conceptual
conference
dates
due
evaluation
exhibits
important
languages
making
manuscripts
original
papers
peer
position
process
projects
proposals
published
queries
record
relevant
scenarios
spatial
submission
team
versions

Table 3: Comparsion of the models

	Nearest Shrunken Centroid Model	ElasticNet Model	SVM Model
Accuracy	90.0	90.0	95.00
Number of Features	170.0	33.0	43.00
Misclassifcation error rate	0.1	0.1	0.05

The SVM model can be chosen as the misclassification error rate is the least when tested on unknown data and the number of features are also close to the minimum of the three models i.e 43 features selected.

Q3

```
## [1] 0.0003765147
```

```
##           pvalue variable status   Variable_name
## 1   1.116910e-10     3036  FALSE          papers
## 2   7.949969e-10     4060  FALSE      submission
## 3   8.219362e-09     3187  FALSE        position
## 4   1.835157e-07     3364  FALSE       published
## 5   3.040833e-07     2049  FALSE       important
## 6   3.983540e-07      596  FALSE            call
## 7   5.091970e-07      869  FALSE      conference
## 8   8.612259e-07      607  FALSE      candidates
## 9   1.398619e-06     1045  FALSE           dates
## 10  1.398619e-06     3035  FALSE           paper
## 11  5.068373e-06     4282  FALSE          topics
## 12  7.907976e-06     2463  FALSE         limited
## 13  1.190607e-05      606  FALSE       candidate
## 14  2.099119e-05      599  FALSE          camera
## 15  2.099119e-05     3433  FALSE           ready
## 16  2.154461e-05      389  FALSE         authors
## 17  3.382671e-05     3125  FALSE             phd
## 18  3.499123e-05     3312  FALSE        projects
## 19  3.742010e-05     2974  FALSE             org
## 20  5.860175e-05      681  FALSE          chairs
## 21  6.488781e-05     1262  FALSE             due
## 22  6.488781e-05     2990  FALSE        original
## 23  6.882210e-05     2889  FALSE    notification
## 24  7.971981e-05     3671  FALSE          salary
## 25  9.090038e-05     3458  FALSE          record
## 26  9.090038e-05     3891  FALSE          skills
## 27  1.529174e-04     1891  FALSE            held
## 28  1.757570e-04     4177  FALSE            team
## 29  2.007353e-04     3022  FALSE           pages
## 30  2.007353e-04     4628  FALSE        workshop
## 31  2.117020e-04      810  FALSE       committee
## 32  2.117020e-04     3285  FALSE     proceedings
## 33  2.166414e-04      272  FALSE           apply
## 34  2.246309e-04     4039  FALSE          strong
## 35  2.295684e-04     2175  FALSE   international
## 36  3.762328e-04     1088  FALSE          degree
## 37  3.762328e-04     1477  FALSE       excellent
```

```
##  38  3.762328e-04     3191  FALSE           post
##  39  3.765147e-04     3243  FALSE      presented
##  40  4.638692e-04     2588   TRUE          march
##  41  4.952306e-04      267   TRUE     applicants
##  42  5.380303e-04     3274   TRUE        privacy
##  43  5.876764e-04     4061   TRUE    submissions
##  44  6.063457e-04     1061   TRUE       deadline
##  45  7.844017e-04     1233   TRUE       doctoral
##  46  7.844017e-04     2438   TRUE         letter
##  47  7.844017e-04     3188   TRUE      positions
##  48  7.844017e-04     3383   TRUE  qualifications
##  49  8.815982e-04     1563   TRUE       february
##  50  8.815982e-04     1643   TRUE          forum
##  51  8.815982e-04     4629   TRUE      workshops
##  52  1.111221e-03     4129   TRUE        systems
##  53  1.125532e-03      329   TRUE        aspects
##  54  1.125532e-03      680   TRUE          chair
##  55  1.340994e-03     2728   TRUE         mobile
##  56  1.340994e-03     3952   TRUE        special
##  57  1.385179e-03     3324   TRUE      proposals
##  58  1.385179e-03     4451   TRUE            usa
##  59  1.408380e-03     1501   TRUE     experience
##  60  1.500237e-03       77   TRUE       accepted
##  61  1.500237e-03     2847   TRUE       networks
##  62  1.595112e-03     3725   TRUE        science
##  63  1.597427e-03     1007   TRUE     curriculum
##  64  1.597427e-03     1702   TRUE         funded
##  65  1.597427e-03     2251   TRUE           java
##  66  1.597427e-03     2442   TRUE         levels
##  67  1.597427e-03     4176   TRUE       teaching
##  68  2.321154e-03     3311   TRUE        project
##  69  2.588482e-03      283   TRUE          april
##  70  2.588482e-03      386   TRUE         author
##  71  2.588482e-03     3836   TRUE          short
##  72  2.879855e-03       92   TRUE            acm
##  73  2.879855e-03     3323   TRUE       proposal
##  74  2.879855e-03     3361   TRUE      publicity
##  75  3.186651e-03      336   TRUE      assistant
##  76  3.186651e-03      756   TRUE        closing
##  77  3.186651e-03      831   TRUE    competitive
##  78  3.186651e-03     1450   TRUE       european
##  79  3.186651e-03     1797   TRUE       graduate
##  80  3.186651e-03     2613   TRUE         master
##  81  3.186651e-03     4426   TRUE   universities
##  82  3.622243e-03     4062   TRUE         submit
##  83  3.825379e-03     2198   TRUE        invited
##  84  3.843991e-03      791   TRUE            com
##  85  3.843991e-03     3301   TRUE        program
##  86  3.917877e-03      850   TRUE       computer
##  87  3.917877e-03     3755   TRUE       security
##  88  4.791732e-03      413   TRUE     background
##  89  4.791732e-03     3992   TRUE       starting
##  90  5.156010e-03     2058   TRUE        include
##  91  5.678572e-03     2177   TRUE       internet
```

```
## 92  5.678572e-03     3090   TRUE            peer
## 93  5.832310e-03      603   TRUE          canada
## 94  5.832310e-03     1818   TRUE            grid
## 95  5.832310e-03     2986   TRUE      organizing
## 96  5.832310e-03     3216   TRUE   practitioners
## 97  5.832310e-03     4364   TRUE        tutorial
## 98  5.832310e-03     4500   TRUE        versions
## 99  6.245001e-03      107   TRUE      activities
## 100 6.245001e-03      340   TRUE       associate
## 101 6.245001e-03     1424   TRUE           equal
## 102 6.245001e-03     3194   TRUE    postdoctoral
## 103 6.245001e-03     4529   TRUE           vitae
## 104 6.939558e-03       76   TRUE      acceptance
## 105 6.939558e-03     1636   TRUE          format
## 106 6.939558e-03     3794   TRUE          series
## 107 7.927262e-03     1743   TRUE         general
## 108 7.927262e-03     2220   TRUE          issues
## 109 8.463230e-03      899   TRUE         contact
## 110 8.581177e-03       80   TRUE          access
## 111 8.600080e-03     4075   TRUE      successful
## 112 8.884208e-03     2295   TRUE         journal
## 113 8.884208e-03     3800   TRUE        services
## 114 8.898143e-03      815   TRUE  communications
## 115 8.898143e-03     1662   TRUE          france
## 116 8.898143e-03     2984   TRUE      organizers
## 117 8.898143e-03     3589   TRUE        reviewed
## 118 8.898143e-03     3882   TRUE            site
## 119 8.898143e-03     4605   TRUE        wireless
## 120 9.619705e-03     2170   TRUE       interests
## 121 9.619705e-03     4045   TRUE        students
## 122 9.619705e-03     4402   TRUE   undergraduate
## 123 1.018054e-02       67   TRUE        academic
## 124 1.018054e-02     3306   TRUE     programming
## 125 1.078220e-02     2553   TRUE            mail
## 126 1.155545e-02      803   TRUE        commerce
## 127 1.155545e-02      879   TRUE     conjunction
## 128 1.155545e-02     1291   TRUE       economics
## 129 1.155545e-02     2046   TRUE implementations
## 130 1.155545e-02     2433   TRUE          length
## 131 1.155545e-02     2583   TRUE     manuscripts
## 132 1.155545e-02     2690   TRUE         michael
## 133 1.155545e-02     3241   TRUE    presentation
## 134 1.155545e-02     3514   TRUE       relevance
## 135 1.155545e-02     3943   TRUE           spain
## 136 1.155545e-02     4452   TRUE       usability
## 137 1.155545e-02     4606   TRUE       wisconsin
## 138 1.194587e-02      919   TRUE   contributions
## 139 1.194587e-02     3898   TRUE           smart
## 140 1.206071e-02     1139   TRUE        detailed
## 141 1.206071e-02     1372   TRUE        employer
## 142 1.206071e-02     1524   TRUE       extension
## 143 1.206071e-02     2141   TRUE    institutions
## 144 1.206071e-02     2278   TRUE             job
## 145 1.206071e-02     2770   TRUE       motivated
```

```
## 146 1.302056e-02     1498   TRUE        expected
## 147 1.459963e-02     2005   TRUE           ideas
## 148 1.666073e-02     2305   TRUE            june
## 149 1.666073e-02     3021   TRUE            page
## 150 1.666073e-02     3582   TRUE         results
## 151 1.804880e-02      172   TRUE            aims
## 152 1.804880e-02     1594   TRUE           final
## 153 1.804880e-02     2219   TRUE           issue
## 154 1.804880e-02     2964   TRUE    optimization
## 155 1.804880e-02     3040   TRUE        parallel
## 156 1.804880e-02     3242   TRUE   presentations
## 157 1.804880e-02     4365   TRUE       tutorials
## 158 1.804880e-02     4377   TRUE      ubiquitous
## 159 1.805157e-02     3286   TRUE         process
## 160 1.882562e-02     2619   TRUE     mathematics
## 161 1.882562e-02     3559   TRUE      researcher
## 162 1.882562e-02     3994   TRUE       statement
## 163 1.951854e-02     1044   TRUE            date
## 164 2.080810e-02     2961   TRUE     opportunity
## 165 2.080810e-02     3295   TRUE       professor
## 166 2.250253e-02      598   TRUE           calls
## 167 2.250253e-02     2359   TRUE           korea
## 168 2.250253e-02     2877   TRUE             non
## 169 2.250253e-02     3196   TRUE          poster
## 170 2.250253e-02     3333   TRUE       protocols
## 171 2.250253e-02     4212   TRUE            term
## 172 2.250253e-02     4435   TRUE    unpublished
## 173 2.250253e-02     4526   TRUE   visualization
## 174 2.250253e-02     4664   TRUE            yang
## 175 2.303834e-02     1591   TRUE          filled
## 176 2.303834e-02     3297   TRUE     proficiency
## 177 2.303834e-02     3991   TRUE           start
## 178 2.420131e-02     2561   TRUE          making
## 179 2.426178e-02     4427   TRUE      university
## 180 2.426178e-02     1395   TRUE         english
## 181 2.712967e-02     2167   TRUE        interest
## 182 2.934388e-02      757   TRUE           cloud
## 183 2.934388e-02      981   TRUE           cross
## 184 2.934388e-02     4281   TRUE           topic
## 185 3.052161e-02     3515   TRUE        relevant
## 186 3.573002e-02       63   TRUE        abstract
## 187 3.573002e-02     1127   TRUE      describing
## 188 3.573002e-02     1149   TRUE    developments
## 189 3.573002e-02     1766   TRUE         germany
## 190 3.573002e-02     2059   TRUE        included
## 191 3.573002e-02     2248   TRUE           japan
## 192 3.573002e-02     2643   TRUE           media
## 193 3.573002e-02     2887   TRUE           notes
## 194 3.573002e-02     3570   TRUE        resource
## 195 3.573002e-02     3732   TRUE           scope
## 196 3.573002e-02     3816   TRUE           share
## 197 3.573002e-02     4342   TRUE           trust
## 198 3.582313e-02     2735   TRUE          models
## 199 3.598686e-02     1144   TRUE         develop
```

```
## 200 3.720192e-02     4181   TRUE       technical
## 201 3.883086e-02     4280   TRUE             top
## 202 4.331307e-02      155   TRUE          agents
## 203 4.331307e-02      196   TRUE         allowed
## 204 4.331307e-02      311   TRUE    arrangements
## 205 4.331307e-02      501   TRUE             bio
## 206 4.331307e-02      856   TRUE        concepts
## 207 4.331307e-02      940   TRUE       copyright
## 208 4.331307e-02      967   TRUE        covering
## 209 4.331307e-02     1048   TRUE           david
## 210 4.331307e-02     1560   TRUE         feature
## 211 4.331307e-02     1587   TRUE         figures
## 212 4.331307e-02     1708   TRUE          fusion
## 213 4.331307e-02     1814   TRUE           green
## 214 4.331307e-02     1859   TRUE            hand
## 215 4.331307e-02     1861   TRUE         handled
## 216 4.331307e-02     2082   TRUE           india
## 217 4.331307e-02     2110   TRUE infrastructures
## 218 4.331307e-02     2197   TRUE          invite
## 219 4.331307e-02     2274   TRUE             jin
## 220 4.331307e-02     2332   TRUE           kevin
## 221 4.331307e-02     2334   TRUE         keynote
## 222 4.331307e-02     2481   TRUE             liu
## 223 4.331307e-02     2546   TRUE         madison
## 224 4.331307e-02     2723   TRUE             mit
## 225 4.331307e-02     2810   TRUE         nanyang
## 226 4.331307e-02     2948   TRUE      ontologies
## 227 4.331307e-02     3051   TRUE    participants
## 228 4.331307e-02     3199   TRUE         posting
## 229 4.331307e-02     3259   TRUE         pricing
## 230 4.331307e-02     3591   TRUE       reviewing
## 231 4.331307e-02     3703   TRUE     scalability
## 232 4.331307e-02     3711   TRUE       scenarios
## 233 4.331307e-02     3802   TRUE        sessions
## 234 4.331307e-02     4142   TRUE          taiwan
## 235 4.331307e-02     4145   TRUE           takes
## 236 4.331307e-02     4202   TRUE        template
## 237 4.331307e-02     4303   TRUE          tracks
## 238 4.331307e-02     4423   TRUE      universite
## 239 4.331307e-02     4499   TRUE         version
## 240 4.331307e-02     4506   TRUE          vienna
## 241 4.331307e-02     4553   TRUE            wang
## 242 4.373782e-02      103   TRUE          action
## 243 4.373782e-02      147   TRUE     affirmative
## 244 4.373782e-02      275   TRUE     appointment
## 245 4.373782e-02      454   TRUE       beginning
## 246 4.373782e-02      630   TRUE           carry
## 247 4.373782e-02      806   TRUE      commission
## 248 4.373782e-02      821   TRUE         company
## 249 4.373782e-02      865   TRUE         conduct
## 250 4.373782e-02      913   TRUE        contract
## 251 4.373782e-02     1089   TRUE         degrees
## 252 4.373782e-02     1134   TRUE       desirable
## 253 4.373782e-02     1178   TRUE        directly
```

```
## 254 4.373782e-02     1230   TRUE             doc
## 255 4.373782e-02     1429   TRUE      equivalent
## 256 4.373782e-02     1651   TRUE      foundation
## 257 4.373782e-02     1660   TRUE             fp7
## 258 4.373782e-02     1913   TRUE          hiring
## 259 4.373782e-02     2115   TRUE       initially
## 260 4.373782e-02     2140   TRUE     institution
## 261 4.373782e-02     2279   TRUE            jobs
## 262 4.373782e-02     2396   TRUE         largest
## 263 4.373782e-02     2510   TRUE         looking
## 264 4.373782e-02     2663   TRUE          member
## 265 4.373782e-02     2760   TRUE          months
## 266 4.373782e-02     2924   TRUE        obtained
## 267 4.373782e-02     2945   TRUE         ongoing
## 268 4.373782e-02     3053   TRUE    participated
## 269 4.373782e-02     3339   TRUE          proven
## 270 4.373782e-02     3469   TRUE             ref
## 271 4.373782e-02     4095   TRUE     supervision
## 272 4.373782e-02     4163   TRUE           tasks
## 273 4.373782e-02     4209   TRUE          tenure
## 274 4.373782e-02     4239   TRUE          thesis
## 275 4.373782e-02     4615   TRUE           women
## 276 4.737923e-02      134   TRUE        advanced
## 277 4.737923e-02      318   TRUE      artificial
## 278 4.737923e-02      381   TRUE       australia
## 279 4.737923e-02      708   TRUE            chen
## 280 4.737923e-02     3973   TRUE        springer
## 281 4.737923e-02     4268   TRUE           title
```

```
##          pvalue variable status Variable_name
## 1  1.116910e-10     3036  FALSE        papers
## 2  7.949969e-10     4060  FALSE    submission
## 3  8.219362e-09     3187  FALSE      position
## 4  1.835157e-07     3364  FALSE     published
## 5  3.040833e-07     2049  FALSE     important
## 6  3.983540e-07      596  FALSE          call
## 7  5.091970e-07      869  FALSE    conference
## 8  8.612259e-07      607  FALSE    candidates
## 9  1.398619e-06     1045  FALSE         dates
## 10 1.398619e-06     3035  FALSE         paper
## 11 5.068373e-06     4282  FALSE        topics
## 12 7.907976e-06     2463  FALSE       limited
## 13 1.190607e-05      606  FALSE     candidate
## 14 2.099119e-05      599  FALSE        camera
## 15 2.099119e-05     3433  FALSE         ready
## 16 2.154461e-05      389  FALSE       authors
## 17 3.382671e-05     3125  FALSE           phd
## 18 3.499123e-05     3312  FALSE      projects
## 19 3.742010e-05     2974  FALSE           org
## 20 5.860175e-05      681  FALSE        chairs
## 21 6.488781e-05     1262  FALSE           due
## 22 6.488781e-05     2990  FALSE      original
## 23 6.882210e-05     2889  FALSE  notification
## 24 7.971981e-05     3671  FALSE        salary
```

```
## 25 9.090038e-05     3458  FALSE        record
## 26 9.090038e-05     3891  FALSE        skills
## 27 1.529174e-04     1891  FALSE          held
## 28 1.757570e-04     4177  FALSE          team
## 29 2.007353e-04     3022  FALSE         pages
## 30 2.007353e-04     4628  FALSE      workshop
## 31 2.117020e-04      810  FALSE     committee
## 32 2.117020e-04     3285  FALSE   proceedings
## 33 2.166414e-04      272  FALSE         apply
## 34 2.246309e-04     4039  FALSE        strong
## 35 2.295684e-04     2175  FALSE international
## 36 3.762328e-04     1088  FALSE        degree
## 37 3.762328e-04     1477  FALSE     excellent
## 38 3.762328e-04     3191  FALSE          post
## 39 3.765147e-04     3243  FALSE     presented
```

39 features correspond to the rejecting the null hypothesis, according to the BH rejection threshold. These contain variable names such as 'notification','workshop','conference','candidates','published','topics' to name a few of the 39 features. These reject that the null hypothesis that states that these features have no effect in the classification of into conference and non-conference.

From the first table , it is observed that 281 features have significant p values. Features such as 'committee', 'conference','process','optimization','arrangements' make sense in the usage.

Apendix

```
knitr::opts_chunk$set(echo = TRUE)
library(dplyr)
library(plotly)
library(ggplot2)
library(xlsx)
library(readxl)
library(tidyr)
library(lubridate)
library(stringr)
library(mgcv)
library(gridExtra)
library(akima)
library(reshape)
library(pamr)
library(glmnet)
library(pROC)
library(kernlab)
library(e1071)
Influenza = read.xlsx("Influenza.xlsx",sheetName = "Raw data",header = TRUE)
Influenza$Date=date_decimal(Influenza$Time)
Influenza$influenzaratio<-((Influenza$Influenza)/(Influenza$Mortality))
p1<-ggplot(Influenza,aes(Date,Mortality))+geom_line(color="black")+scale_fill_brewer()+theme_classic()+g
p1

p2<-ggplot(Influenza,aes(Date,Influenza))+geom_line(color="black")+scale_fill_brewer()+theme_classic()+g
p2
```

```
p3<-ggplot(Influenza,aes(Date,influenzaratio))+geom_line(color="black")+scale_fill_brewer()+theme_classi
p3

gammer<-mgcv::gam(data=Influenza, Mortality ~ Year + s(Week,k=length(unique(Influenza$Week))), method="
summary(gammer)

Influenza$gampredmortality<-mgcv::predict.gam(gammer,newdata = Influenza,type = "link")


p4<-ggplot(Influenza)+geom_line(aes(x=Date,y=gampredmortality),color="red",size=1)+geom_line(aes(x=Date

p4

gam.check(gammer,pch=19,cex=.3)
plot(gammer)
gammer1<-mgcv::gam(data=Influenza, Mortality ~ Year + s(Week,k=length(unique(Influenza$Week))))

s=interp(Influenza$Year, Influenza$Week, fitted(gammer1))
print(gammer1)
summary(gammer1)
gammer1$sp
#plot_ly(x=~s$x, y=~s$y, z=~s$z, type="surface")
knitr::include_graphics("surface.png")

modeldev <- NULL
for(sp in c(0.001, 0.01, 0.005, 2, 5))
{
  k=length(unique(Influenza$Week))
gammod <- mgcv::gam(data = Influenza, Mortality~Year+s(Week, k=k, sp=sp), method = "GCV.Cp")
temp <- cbind(gammod$deviance, gammod$fitted.values, gammod$y, Influenza$Date,
              sp, sum(influence(gammod)))
modeldev <- rbind(temp, modeldev)
}

modeldev <- as.data.frame(modeldev)
colnames(modeldev) <- c("Deviance", "Mortalitypred", "Mortality", "Date",
                            "penaltyfactor", "dof")

modeldev$Date <- as.Date(modeldev$Date, origin = '1995-01-01')
#deviance plot
p5 <- ggplot(data=modeldev, aes(x = penaltyfactor, y = Deviance)) +geom_line() +theme_dark() +
ggtitle("Plot of Deviances of models vs. Penalty Factors")
p5
#degree of freedom plot
p6 <- ggplot(data=modeldev, aes(x = penaltyfactor, y = dof)) +geom_line() +theme_dark() +
ggtitle("Plot of Degree of freedoms of models vs. Penalty Factors")
p6

modeldevwide <- melt(modeldev[,c("Date", "penaltyfactor",
                                          "Mortality", "Mortalitypred")],
                           id.vars = c("Date", "penaltyfactor"))

#predicted vs observed mortality
```

```
p7 <- ggplot(data=modeldevwide[modeldevwide$penaltyfactor == 0.001,], aes(x= Date, y = value)) +
  geom_line(aes(color = variable), size=1) +scale_fill_brewer() +theme_dark() +ggtitle("Plot of Mortali

p8 <- ggplot(data=modeldevwide[modeldevwide$penaltyfactor == 5,], aes(x= Date, y = value)) + geom_line(a

grid.arrange(p7,p8,ncol=1)

Influenza$rez<-gammer$residuals
p9<-ggplot(Influenza,aes(x=Date))+geom_line(aes(y=rez,color="Residuals"))+geom_line(aes(y=Influenza,colo
p9

lastgammod <- mgcv::gam(data = Influenza, Mortality~s(Year,k=length(unique(Influenza$Year)))+s(Week, k=

Influenza$lastgammodpred<-mgcv::predict.gam(lastgammod,newdata = Influenza,type = "link")

p10<-ggplot(Influenza,aes(x=Date))+geom_line(aes(y=lastgammodpred,color="PredictedMortality"),size=1.5)+
p10

data<-read.csv2("data.csv",header = TRUE,sep=";")
email<-as.data.frame(data)
email$Conference<-as.factor(email$Conference)
rownames(email)=1:nrow(email)

n=dim(email)[1]
set.seed(12345)
id=sample(1:n, floor(n*0.7))
train=email[id,]
test=email[-id,]
xtrain=t(train[,-4703])
ytrain=train[[4703]]
xtest=t(test[,-4703])
ytest=test[[4703]]
myemailtrain=list(x=xtrain,y=ytrain,geneid=as.character(1:nrow(xtrain)),genenames=rownames(xtrain))
myemailtest=list(x=xtest,y=ytest,geneid=as.character(1:nrow(xtest)),genenames=rownames(xtest))
model=pamr.train(myemailtrain,threshold = seq(0,4,0.1))

cvmodel=pamr.cv(model,myemailtrain)
print(cvmodel)

pamr.plotcv(cvmodel)

pamr.plotcen(model,myemailtrain,threshold=1.4)

a=pamr.listgenes(model,myemailtrain,threshold=1.4)
cat(paste(colnames(myemailtrain)[as.numeric(a[,1])],collapse = '\n'))

predicted <- pamr.predict(model, newx = xtest, threshold = 1.4)

contab <- table(ytest, predicted)
contab
names(dimnames(contab)) <- c("Test Actual", "Predicted by Nearest Shrunken Centroid on test")
contabres<-caret::confusionMatrix(contab)
mse1<-(1-(sum(diag(contab))/sum(contab)))
```

```r
paste("The misclassificaiton rate is",mse1)

var<- as.data.frame(pamr.listgenes(model, myemailtrain, threshold = 1.4))
knitr::kable(colnames(data[,head(var$id,10)]), caption = "Top 10 Important features by NSC ")

xtrain2<-as.matrix(train[,-4703])
ytrain2<-as.matrix(train[,4703])
xtest2<-as.matrix(test[,-4703])
ytest2<-as.matrix(test[,4703])

cvmodel2<-cv.glmnet(x=xtrain2,y=ytrain2,alpha = 0.5,family="binomial")
model2<-glmnet(x=xtrain2,y=ytrain2,alpha = 0.5,family="binomial")
elasticpredict<-predict.cv.glmnet(cvmodel2, newx = xtest2, s = "lambda.min", type = "class")
elasticpredict2<-predict(model2, xtest2, type = "response")
contab22 <- table(ytest2, elasticpredict)
plot(cvmodel2)
plot(model2)
contab2 <- table(ytest2, elasticpredict)
contab2
contab2res<-caret::confusionMatrix(contab2)
mse2<-(1-(sum(diag(contab2))/sum(contab2)))
paste("The misclassificaiton rate is",mse2)
names(dimnames(contab2)) <- c("Actual Test", "Predicted by ElasticNet model")

elasticcoefs<- coef(cvmodel2, s = "lambda.min")
elasticvars <- list(name = elasticcoefs@Dimnames[[1]][elasticcoefs@i + 1])
knitr::kable(elasticvars, caption = "Contributing features of elastic net model")
set.seed(12345)
svmmodel<- ksvm(xtrain2, ytrain2, kernel="vanilladot",scaled=FALSE)
svmpredict<- predict(svmmodel, xtest2, type="response")

consvm<- table(ytest2, svmpredict)
names(dimnames(consvm)) <- c("Actual Test", "Predicted svm")
consvmres<-caret::confusionMatrix(consvm)
consvm
mse3<-(1-(sum(diag(consvm))/sum(consvm)))
paste("The misclassificaiton rate is",mse3)
comptab<- as.data.frame(cbind(contabres$overall[[1]]*100,
                      contab2res$overall[[1]]*100,
                      consvmres$overall[[1]] *100))
countf <- cbind(nrow(var), length(elasticcoefs@i), length(svmmodel@coef[[1]]))
mse <- c(mse1,mse2,mse3)
comptab <- rbind(comptab, countf)
comptab <- rbind(comptab, mse)
colnames(comptab) <- c("Nearest Shrunken Centroid Model",
                           "ElasticNet Model", "SVM Model")
rownames(comptab) <- c("Accuracy", "Number of Features","Misclassifcation error rate")
knitr::kable(comptab, caption = "Comparsion of the models")

set.seed(12345)
p<-c()
x<-email[,-4703]
for (i in 1:(length(email)-1)){
```

```
  x<-email[,i]
res<-t.test(x~Conference,data=email,alternative="two.sided")
p[i]<-res$p.value
}

pvalues<- data.frame(pvalue=p,variable=1:(length(email)-1))
pvalues<- pvalues[order(pvalues$pvalue),]


alpha<-0.05
l<-c()
o<-1
for(j in 1:length(p)){
 if( pvalues$pvalue[j]< alpha*(j/nrow(pvalues)) ){
   l[o]<-j
   o<-o+1
 }
}
pl = pvalues$pvalue[max(l)]
pl
for(j in 1:nrow(pvalues)){
  if(pvalues$pvalue[j]<= pl){
    pvalues$status[j]<-FALSE
  }
  else{
    pvalues$status[j]<-TRUE
  }
}

significantp<-filter(pvalues,pvalue<=0.05)
significantp<-cbind(significantp,Variable_name=colnames(email[significantp$variable]))
significantp

finalbh<-filter(pvalues,status==FALSE)
finalbh<-cbind(finalbh,Variable_name=colnames(email[finalbh$variable]))
finalbh
```