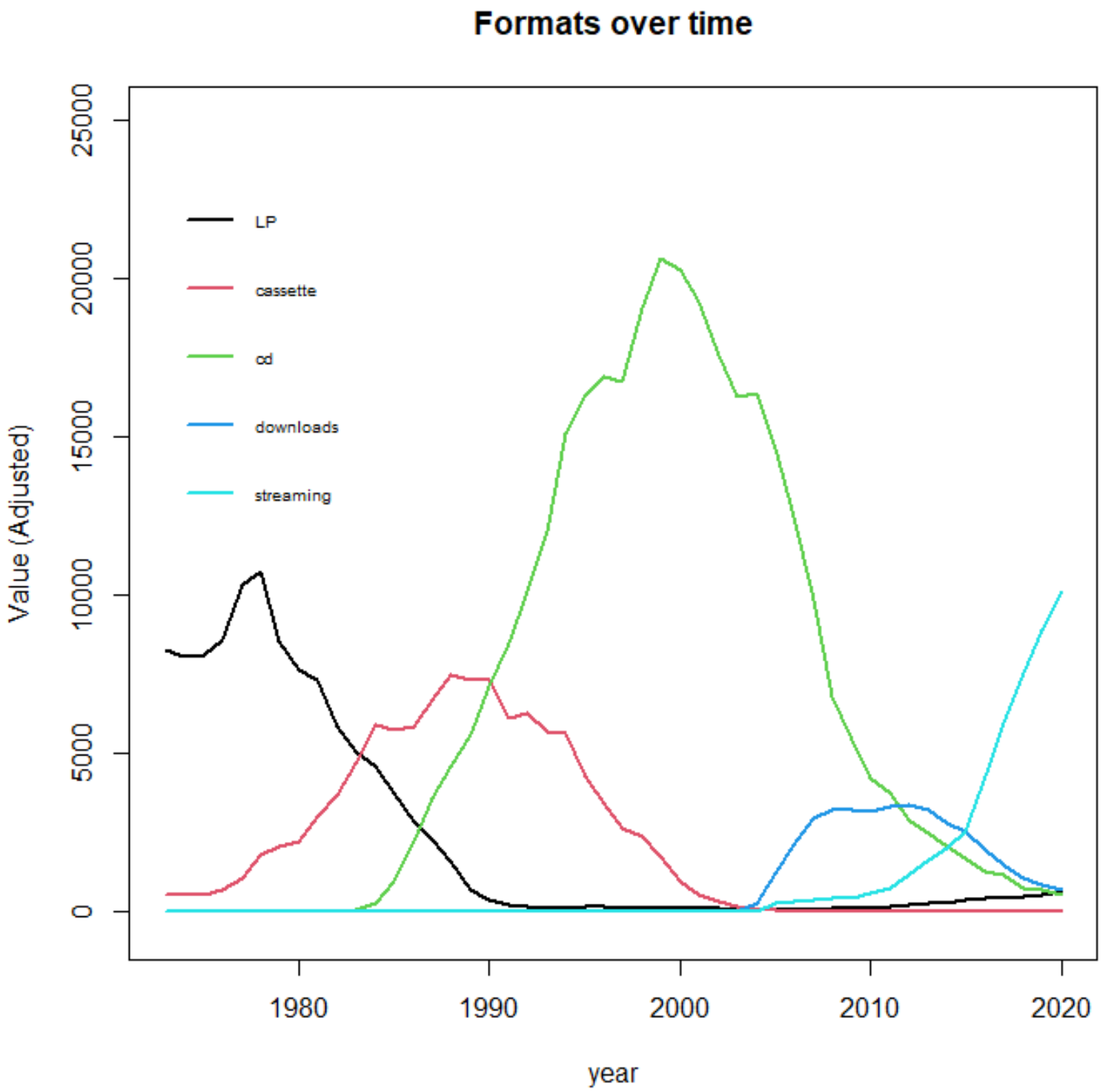
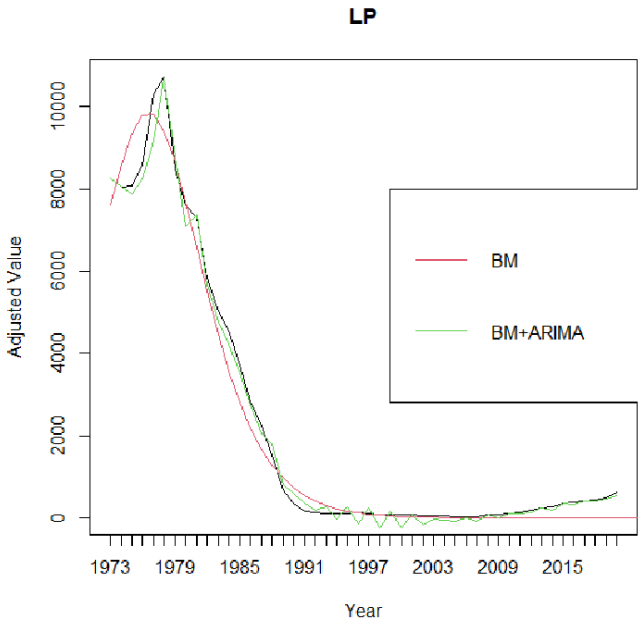
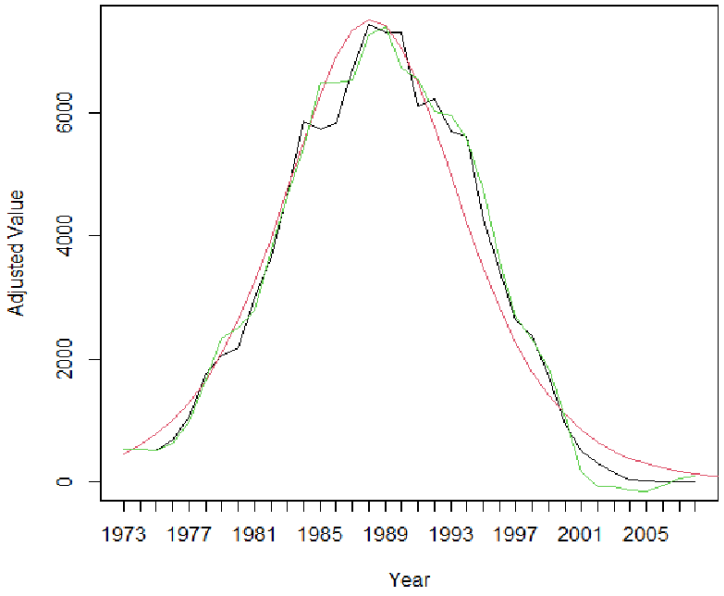
-

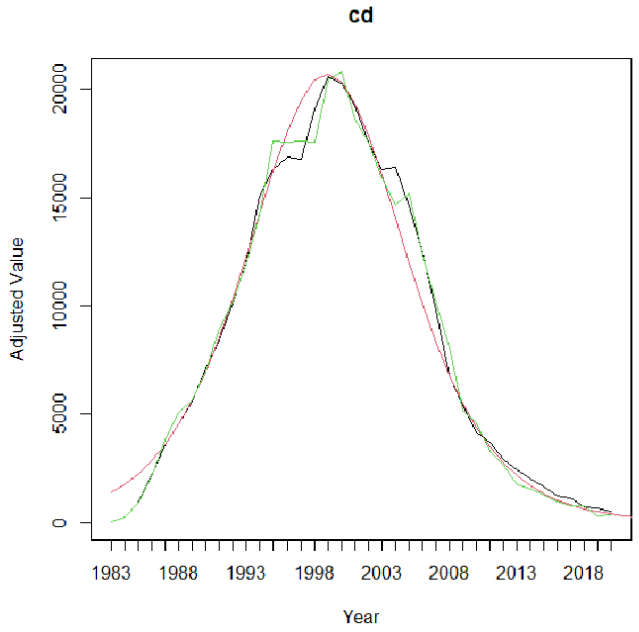

Formats over time
Value (Adjusted)
0
5000
10000
15000
20000
25000
1980
1990
2000
2010
2020
year
LP
cassette
cd
downloads
streaming



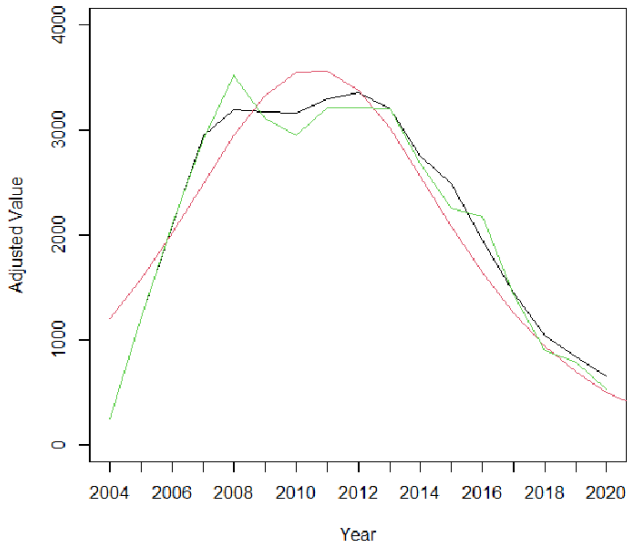

```
Call: ( Standard Bass Model )

  BASS.standard(sales = dati_lp$x, prelimestimates = c(1e+05, 0.01,
    0.1), ous = 100, display = F)

Residuals:
    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-978.72 -725.48 -384.22   31.29  695.07 3127.31

Coefficients:
        Estimate    Std.Error        Lower        Upper
m   1.063627e+05 1.896874e+02 1.059909e+05 1.067345e+05
p   6.125063e-02 1.944739e-03 5.743902e-02 6.506225e-02
q   2.318278e-01 8.234892e-03 2.156877e-01 2.479679e-01
     p-value
m   3.76e-88 ***
p   2.66e-32 ***
q   3.27e-30 ***
---
 Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Residual standard error  992.55  on  45  degrees of freedom
 Multiple R-squared:   0.9985859   Adjusted R-squared:   0.9984895
 Residual squared sum:  46349312
```



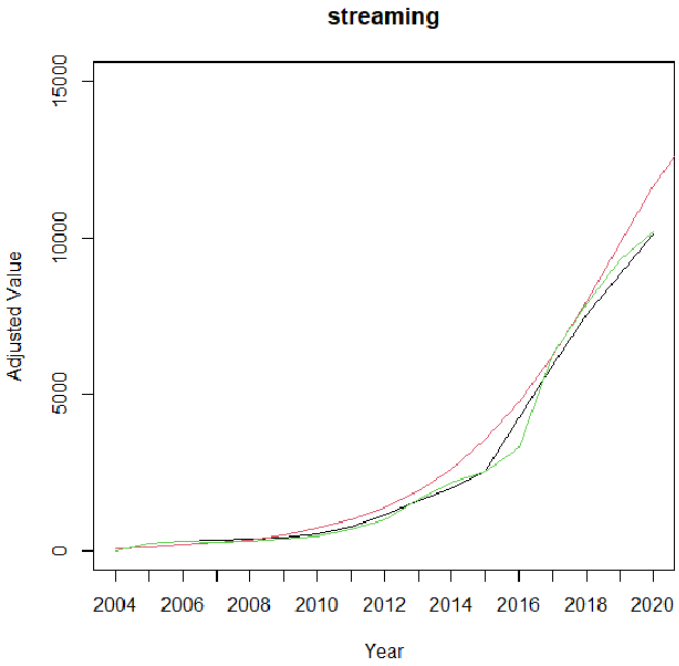

```
Call: ( Standard Bass Model )

  BASS.standard(sales = dati_cassette$x[1:36], prelimestimates = c(1e+05,

    0.01, 0.1), ous = 100, display = F)

Residuals:
     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-1430.06  -460.20   -13.91    18.04   448.13  1515.85

Coefficients:
        Estimate    Std.Error        Lower        Upper  p-value
m   1.086295e+05 2.986321e+02 1.080442e+05 1.092148e+05 4.86e-61 ***
p   3.243891e-03 1.222430e-04 3.004299e-03 3.483483e-03 7.75e-24 ***
q   2.704426e-01 3.265611e-03 2.640421e-01 2.768430e-01 7.31e-40 ***
---
 Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Residual standard error  771.7766  on  33  degrees of freedom
 Multiple R-squared:   0.9996717   Adjusted R-squared:   0.9996409
 Residual squared sum:  20859090
```



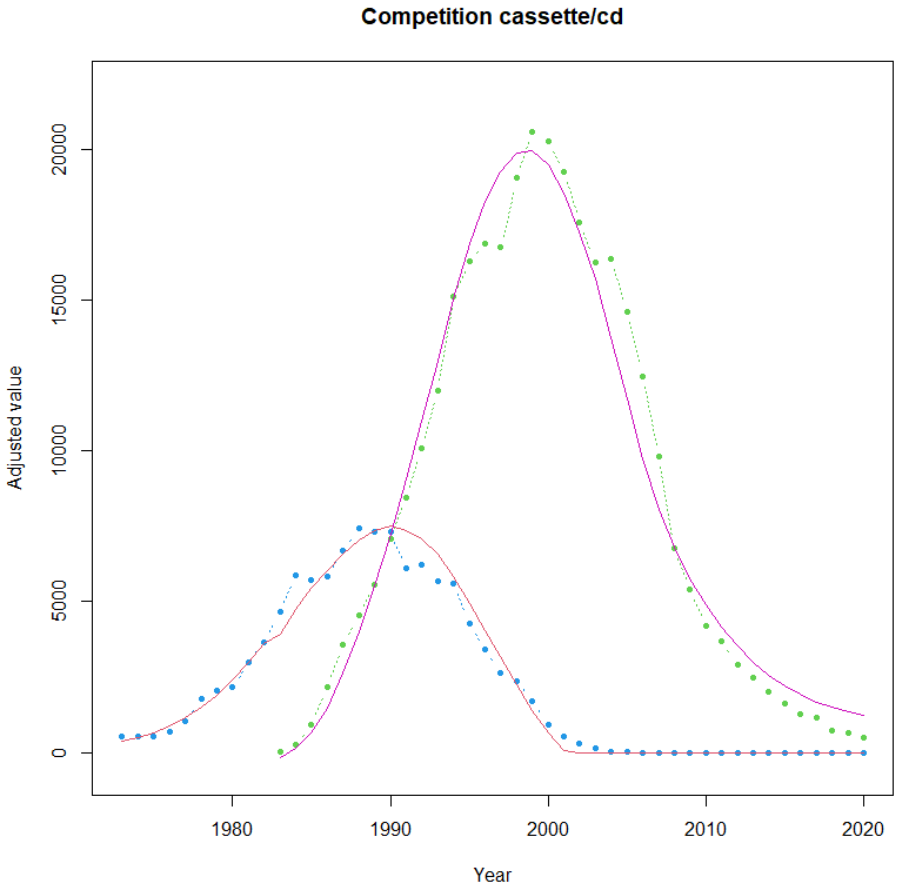

```
Call: ( Standard Bass Model )

  BASS.standard(sales = dati_cd$x[11:48], prelimestimates = c(3e+05,
    0.01, 0.1), ous = 100, display = F)

Residuals:
    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-3912.8 -1371.2  -274.2  -451.9   200.8  3234.7

Coefficients:
         Estimate    Std.Error        Lower        Upper  p-value
m   3.205831e+05 6.809984e+02 3.192484e+05 3.219179e+05 3.97e-68 ***
p   3.355413e-03 9.433460e-05 3.170521e-03 3.540306e-03 4.56e-29 ***
q   2.514489e-01 2.346044e-03 2.468508e-01 2.560471e-01 1.18e-45 ***
---
 Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Residual standard error  1734.291  on  35  degrees of freedom
 Multiple R-squared:   0.9997965   Adjusted R-squared:   0.9997785
 Residual squared sum:  119046801
```



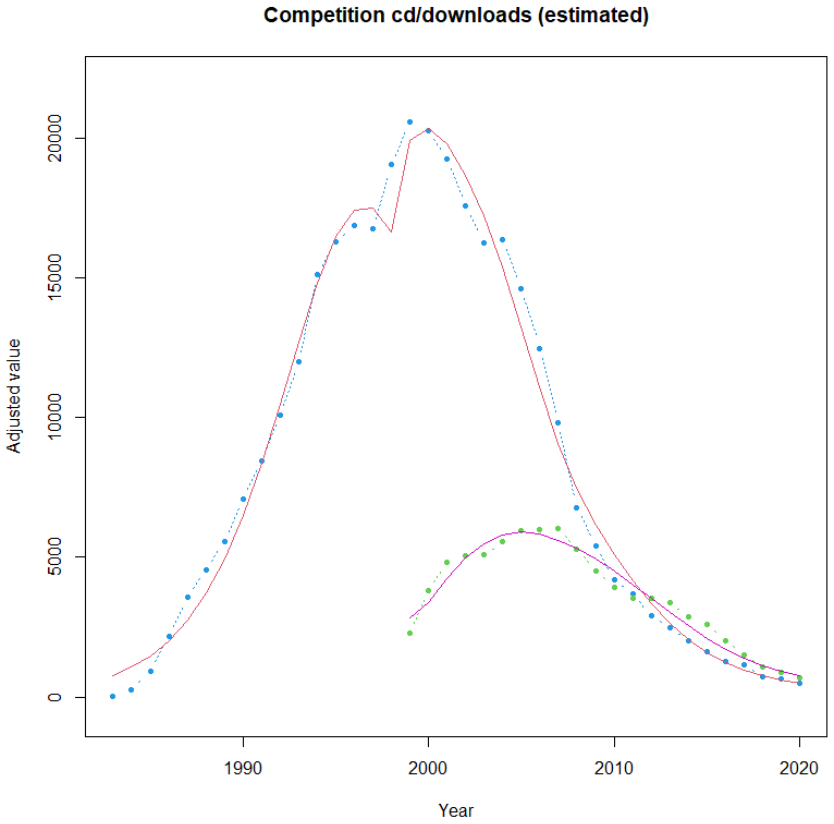

```
Call: ( Standard Bass Model )

  BASS.standard(sales = dati_downloads$x[32:48], prelimestimates = c(50000,

    0.01, 0.1), ous = 100, display = F)

Residuals:
     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-964.848 -174.861    2.885  -91.783   55.411  521.981

Coefficients:
         Estimate    Std.Error        Lower        Upper  p-value
m   3.845157e+04 4.345350e+02 3.759990e+04 3.930324e+04 1.21e-20 ***
p   2.327663e-02 1.272833e-03 2.078192e-02 2.577133e-02 3.61e-11 ***
q   3.245578e-01 1.364374e-02 2.978166e-01 3.512990e-01 1.01e-12 ***
---
 Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Residual standard error  399.748  on  14  degrees of freedom
 Multiple R-squared:   0.9990257   Adjusted R-squared:   0.9988009
 Residual squared sum:  2699984
```



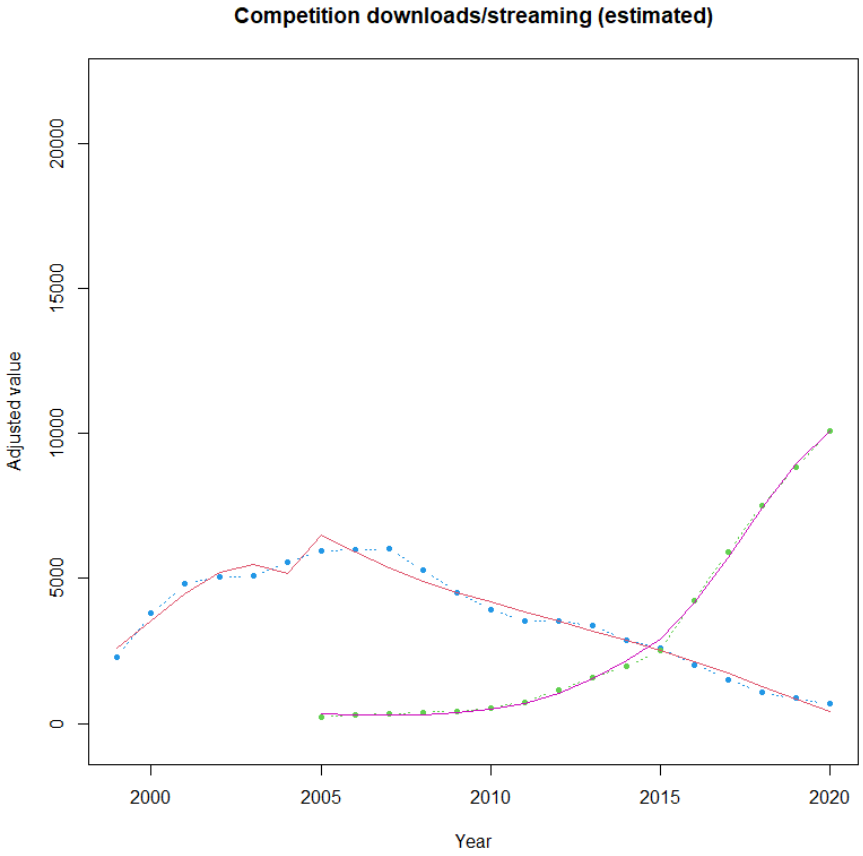

```
Call: ( Standard Bass Model )

  BASS.standard(sales = dati_streaming$x[32:48], prelimestimates = c(250000,
    0.01, 0.1), ous = 100, display = F)

Residuals:
    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-627.59  -67.51  196.16   87.50  337.10  397.23

Coefficients:
         Estimate    Std.Error        Lower        Upper  p-value
m   1.636942e+05 2.695230e+04 1.108687e+05 2.165197e+05 2.87e-05 ***
p   3.931891e-04 3.392868e-05 3.266901e-04 4.596880e-04 1.46e-08 ***
q   3.451971e-01 1.148913e-02 3.226789e-01 3.677154e-01 4.09e-14 ***
---
 Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Residual standard error  317.7552  on  14  degrees of freedom
 Multiple R-squared:   0.9994527   Adjusted R-squared:   0.9993264
 Residual squared sum:  1745641
```




```
Call: ( UCRCD Model )

  UCRCD(sales1 = cassette, sales2 = cd, c2 = 10, display = F, par = "unique"

Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-2509.82   -527.25    131.00     84.36    460.89   2877.99

Coefficients:
            Estimate    Std.Error         Lower         Upper   p-value
m      6.777478e+04 2.884245e+04  1.124461e+04  1.243050e+05  5.11e-02   .
p      4.637524e-03 1.636395e-03  1.430248e-03  7.844800e-03  2.53e-02   *
q      3.010249e-01 2.677260e-02  2.485516e-01  3.534983e-01  9.83e-06 ***
mc     4.154137e+05 1.202873e+03  4.130561e+05  4.177713e+05 7.40e-115 ***
p1c    7.780665e-03 1.246729e-03  5.337122e-03  1.022421e-02  2.93e-08 ***
p2c   -9.198117e-04 1.224928e-03 -3.320627e-03  1.481004e-03  4.55e-01
q1c   -8.682596e-02 7.584192e-03 -1.016907e-01 -7.196122e-02  1.07e-17 ***
q2c    2.888458e-01 8.304368e-03  2.725695e-01  3.051220e-01  6.58e-46 ***
delta  2.449417e-01 2.043248e-02  2.048948e-01  2.849887e-01  1.25e-18 ***
---
 Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Residual standard error  813.4585  on  77  degrees of freedom
 Multiple R-squared:   0.9988619   Adjusted R-squared:   0.9987755
 Residual squared sum:  1036078028
```



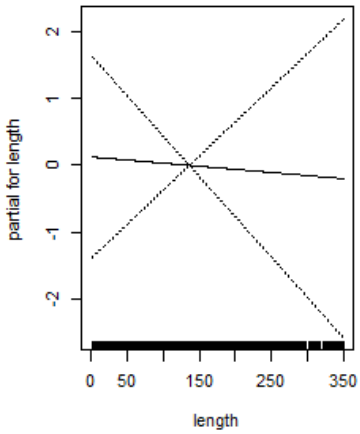

```
Call: ( UCRCD Model )

  UCRCD(sales1 = cd, sales2 = downloads, c2 = 16, par = "unique")

Residuals:
      Min.    1st Qu.     Median       Mean    3rd Qu.       Max.
-1096.671  -475.000    -9.604    12.937   327.459  2407.351

Coefficients:
            Estimate    Std.Error         Lower         Upper  p-value
m      2.111830e+05 9.492797e+03  1.925774e+05  2.297885e+05 9.87e-12 ***
p      3.135425e-03 1.451066e-04  2.851021e-03  3.419828e-03 1.43e-11 ***
q      3.273994e-01 1.110075e-02  3.056424e-01  3.491565e-01 2.70e-13 ***
mc     2.662846e+05 1.380137e+03  2.635796e+05  2.689896e+05 1.87e-58 ***
p1c    6.835341e-02 2.816756e-03  6.283267e-02  7.387415e-02 9.81e-25 ***
p2c    1.099743e-02 2.810954e-03  5.488063e-03  1.650680e-02 3.66e-04 ***
q1c   -4.041173e-01 6.324789e-02 -5.280809e-01 -2.801537e-01 1.67e-07 ***
q2c    5.678225e-01 6.382568e-02  4.427265e-01  6.929185e-01 7.93e-11 ***
delta  6.232907e-01 8.496439e-02  4.567635e-01  7.898178e-01 8.68e-09 ***
---
 Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Residual standard error  637.4017  on  51  degrees of freedom
 Multiple R-squared:   0.9999161   Adjusted R-squared:   0.9999066
 Residual squared sum:  69901437
```

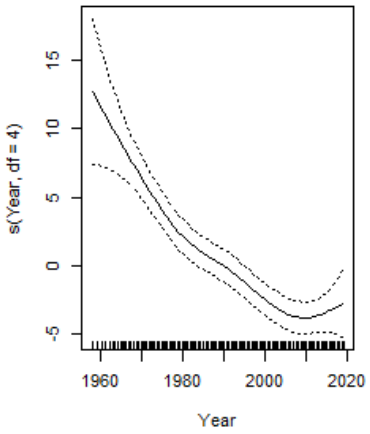


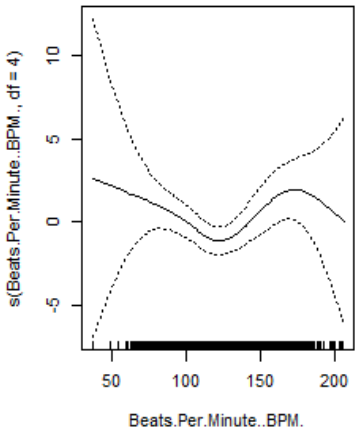

```
Call: ( UCRCD Model )

  UCRCD(sales1 = downloads, sales2 = stream_services, c2 = 6, par = "double")

Residuals:
     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-543.587 -153.466   39.354    3.361   94.914  632.345

Coefficients:
            Estimate    Std.Error         Lower         Upper  p-value
m      4.190094e+04 5.125905e+03  3.185435e+04  5.194753e+04 3.83e-03  **
p      5.204701e-02 3.466983e-03  4.525185e-02  5.884217e-02 6.42e-04 ***
q      4.137025e-01 6.344159e-02  2.893593e-01  5.380457e-01 7.33e-03  **
mc     1.742739e+05 1.147254e+04  1.517882e+05  1.967597e+05 3.94e-14 ***
p1c    4.062460e-02 2.928671e-03  3.488451e-02  4.636469e-02 3.03e-13 ***
p2c    2.511830e-03 1.405027e-03 -2.419713e-04  5.265632e-03 8.59e-02   .
q1c   -6.609308e-02 1.190525e-02 -8.942693e-02 -4.275922e-02 9.01e-06 ***
q2c    5.379306e-01 4.620929e-02  4.473621e-01  6.284991e-01 1.37e-11 ***
delta  1.115620e-02 1.867904e-02 -2.545405e-02  4.776646e-02 5.56e-01
gamma  5.703325e-01 5.544553e-02  4.616612e-01  6.790037e-01 1.81e-10 ***
---
 Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Residual standard error  240.3842  on  28  degrees of freedom
 Multiple R-squared:   0.999918   Adjusted R-squared:   0.9998989
 Residual squared sum:  2575121
```

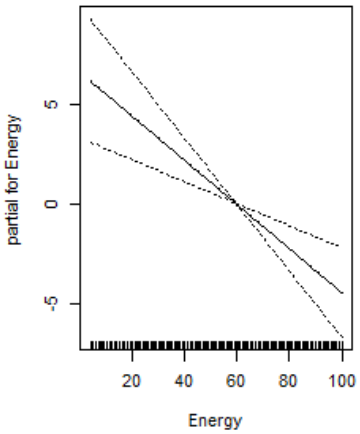
GAM

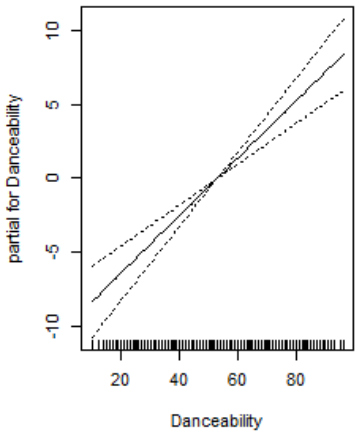
- **Partial dependence plots**

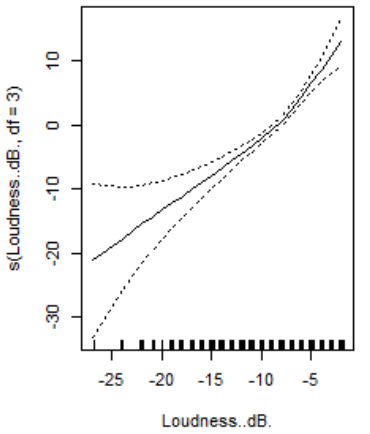


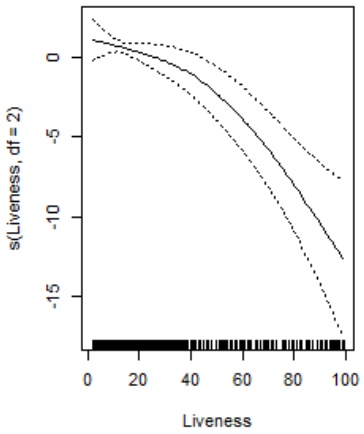


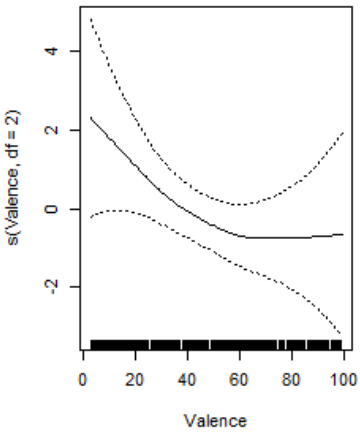


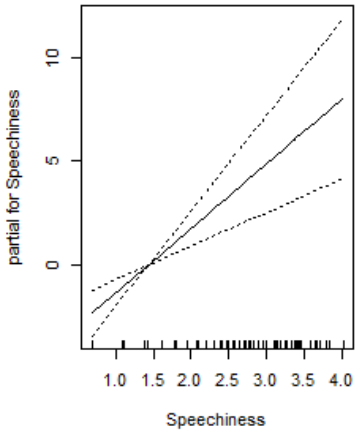


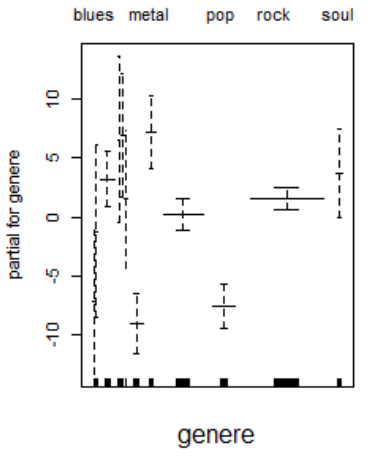










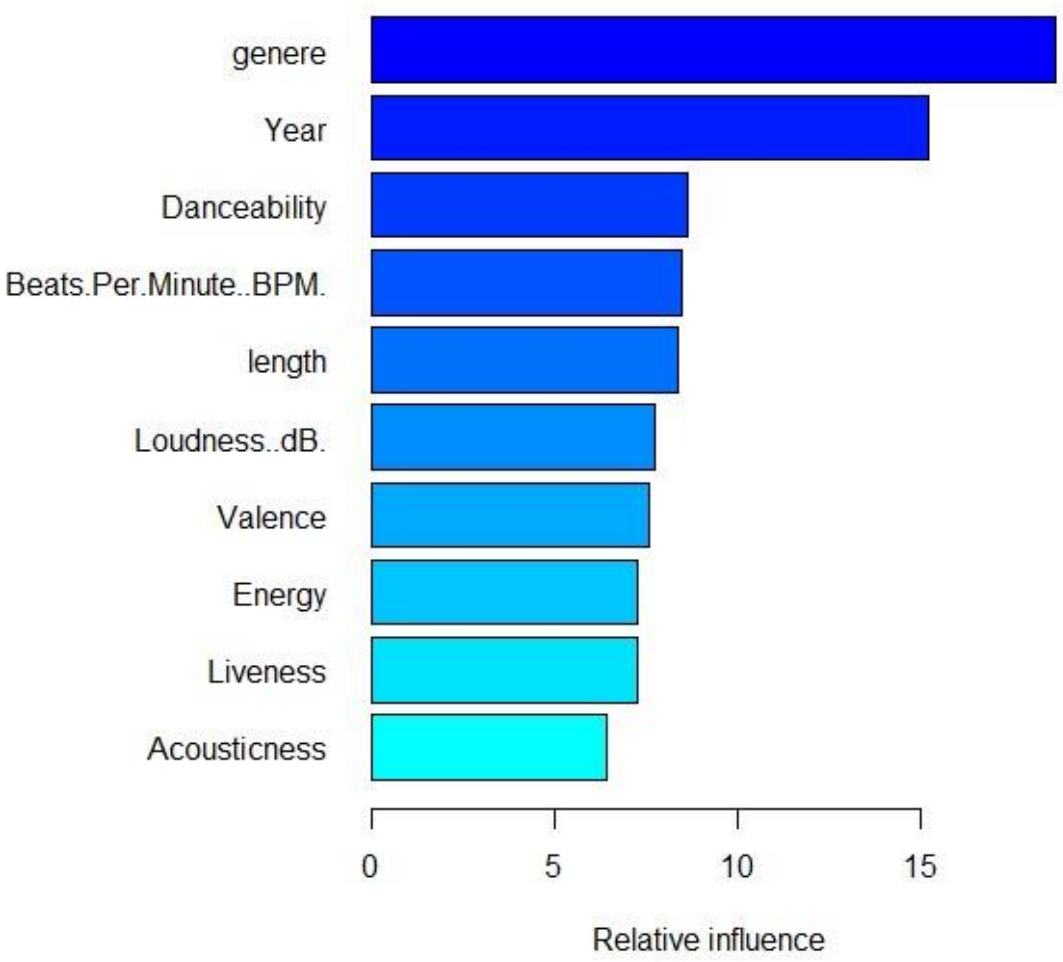


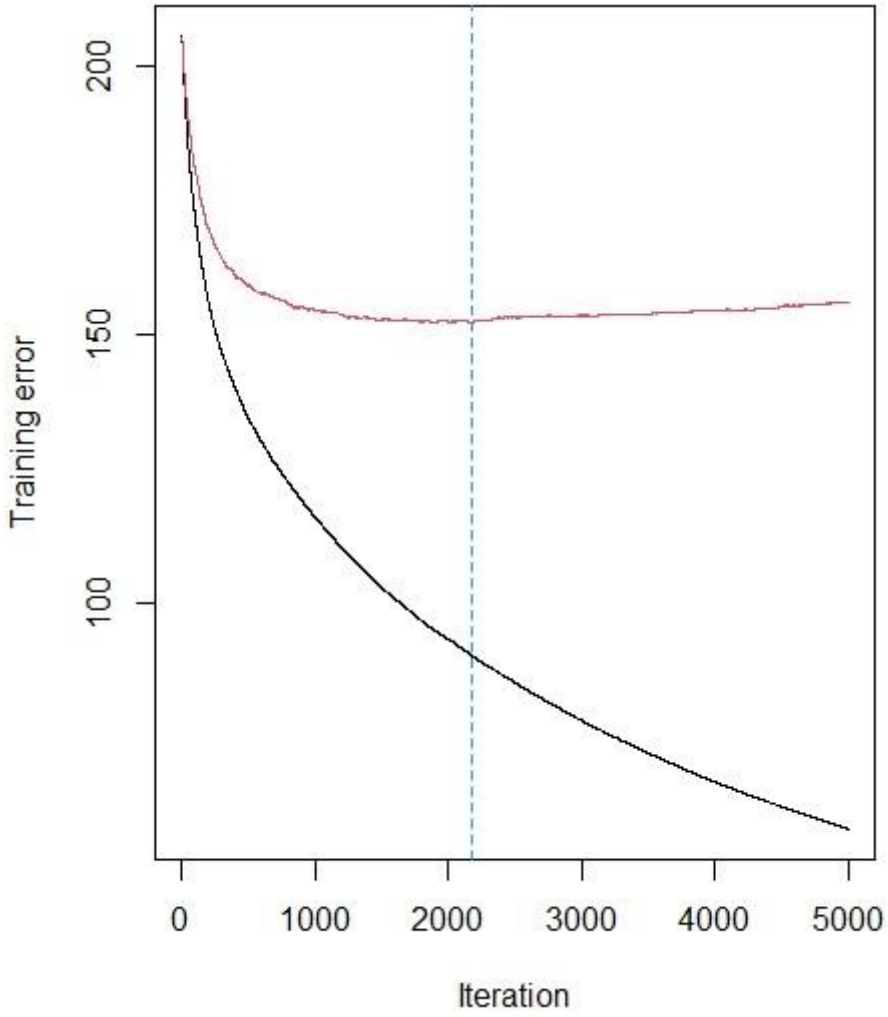
- **Summary**

```
Call: gam(formula = Popularity ~ length + s(Year, df = 4) + s(Beats.Per.Minute..BPM.,
    df = 4) + Energy + Danceability + s(Loudness..dB., df = 3) +
    s(Liveness, df = 2) + s(Valence, df = 2) + Speechiness +
    genere, data = dati.train, trace = FALSE)
Deviance Residuals:
    Min      1Q  Median      3Q     Max
-43.230  -8.020   1.038   8.701  38.759

(Dispersion Parameter for gaussian family taken to be 157.8086)

    Null Deviance: 287315.2 on 1394 degrees of freedom
Residual Deviance: 215250.9 on 1364 degrees of freedom
AIC: 11052.12

Number of Local Scoring Iterations: NA

Anova for Parametric Effects
                                  Df Sum Sq Mean Sq F value
length                             1     12    12.0  0.0762
s(Year, df = 4)                    1   8134  8134.1 51.5442
s(Beats.Per.Minute..BPM., df = 4)  1      0     0.0  0.0000
Energy                             1   5480  5480.4 34.7280
Danceability                       1   7432  7432.5 47.0979
s(Loudness..dB., df = 3)           1  14722 14721.6 93.2874
s(Liveness, df = 2)                1   4200  4199.9 26.6140
s(Valence, df = 2)                 1    941   941.3  5.9646
Speechiness                        1   3440  3440.3 21.8006
genere                            11  24869  2260.8 14.3261
Residuals                       1364 215251   157.8
                                    Pr(>F)
length                              0.78262
s(Year, df = 4)                   1.147e-12 ***
s(Beats.Per.Minute..BPM., df = 4)   0.99703
Energy                            4.771e-09 ***
Danceability                      1.022e-11 ***
s(Loudness..dB., df = 3)          < 2.2e-16 ***
s(Liveness, df = 2)               2.851e-07 ***
s(Valence, df = 2)                  0.01472 *
Speechiness                       3.323e-06 ***
genere                            < 2.2e-16 ***
Residuals
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Anova for Nonparametric Effects
                                  Npar Df Npar F    Pr(F)
(Intercept)
length
s(Year, df = 4)                         3 5.0257 0.001817 **
s(Beats.Per.Minute..BPM., df = 4)       3 3.5404 0.014202 *
Energy
Danceability
s(Loudness..dB., df = 3)                2 4.4911 0.011374 *
s(Liveness, df = 2)                     1 7.9657 0.004836 **
s(Valence, df = 2)                      1 2.4827 0.115336
Speechiness
genere
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

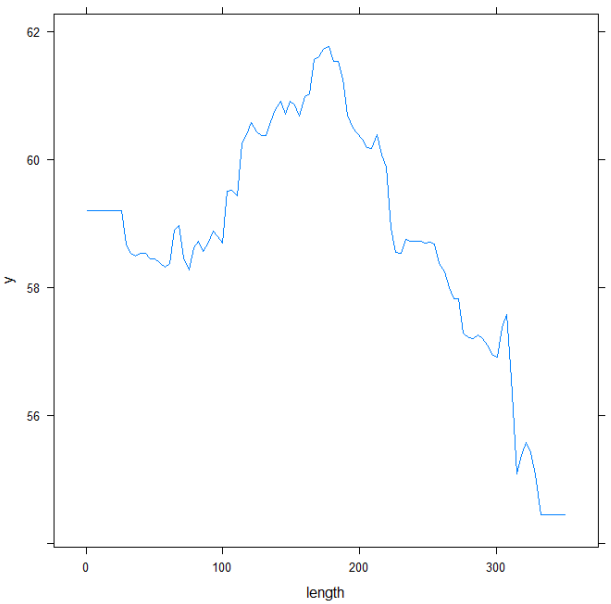
GBM

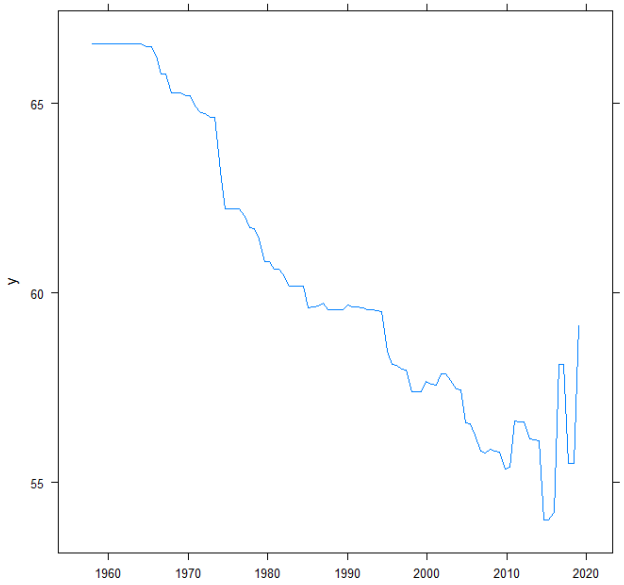
- **Relative Influence plot / Training error plot**

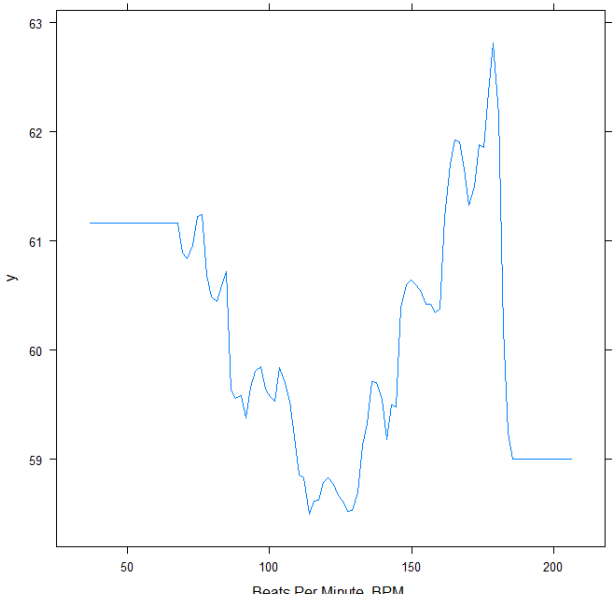


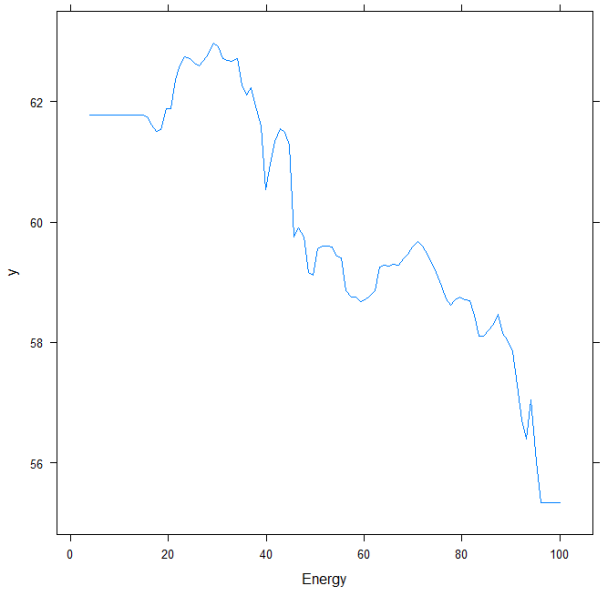


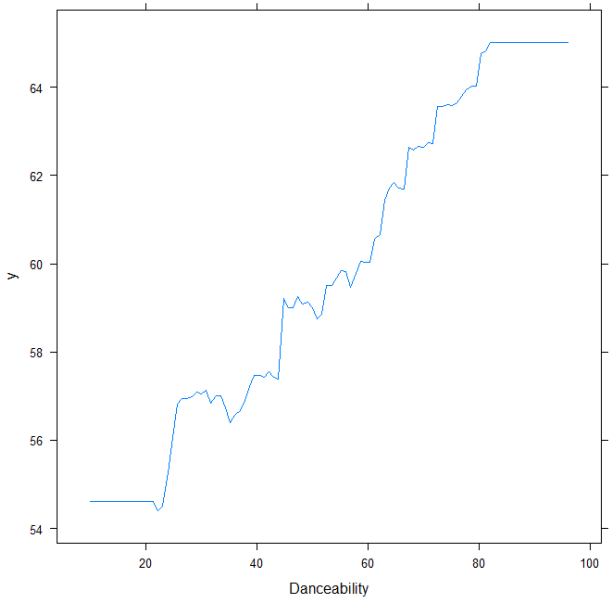
- **Partial dependence plots**

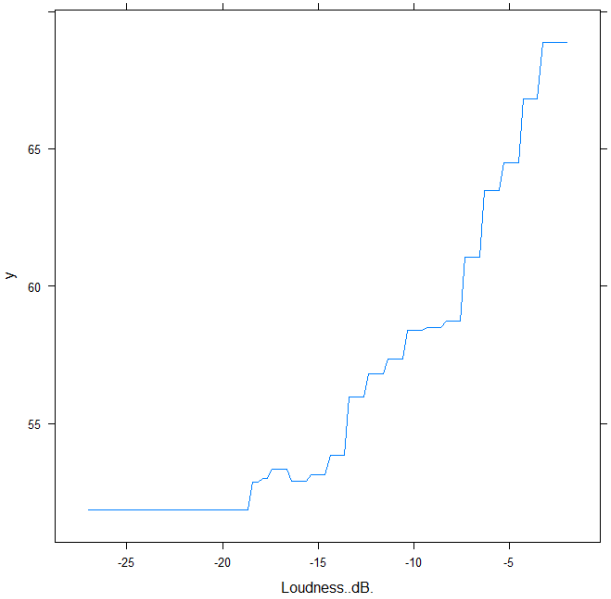


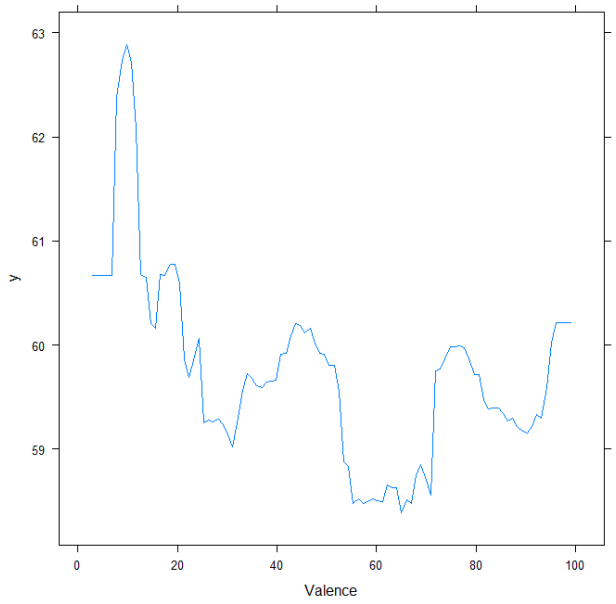


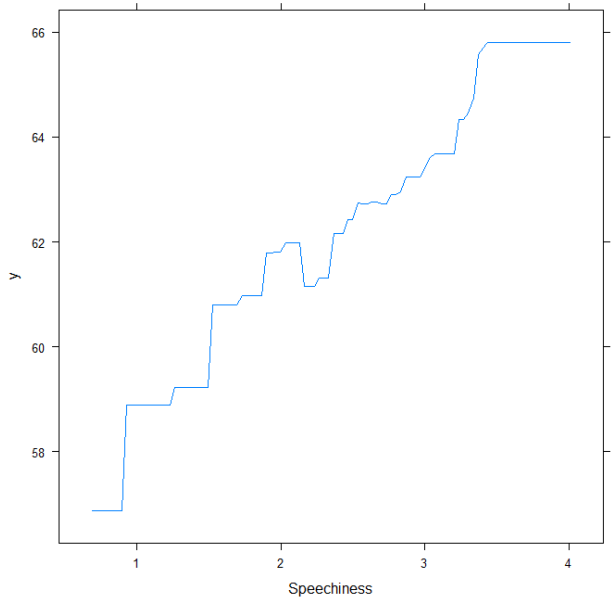


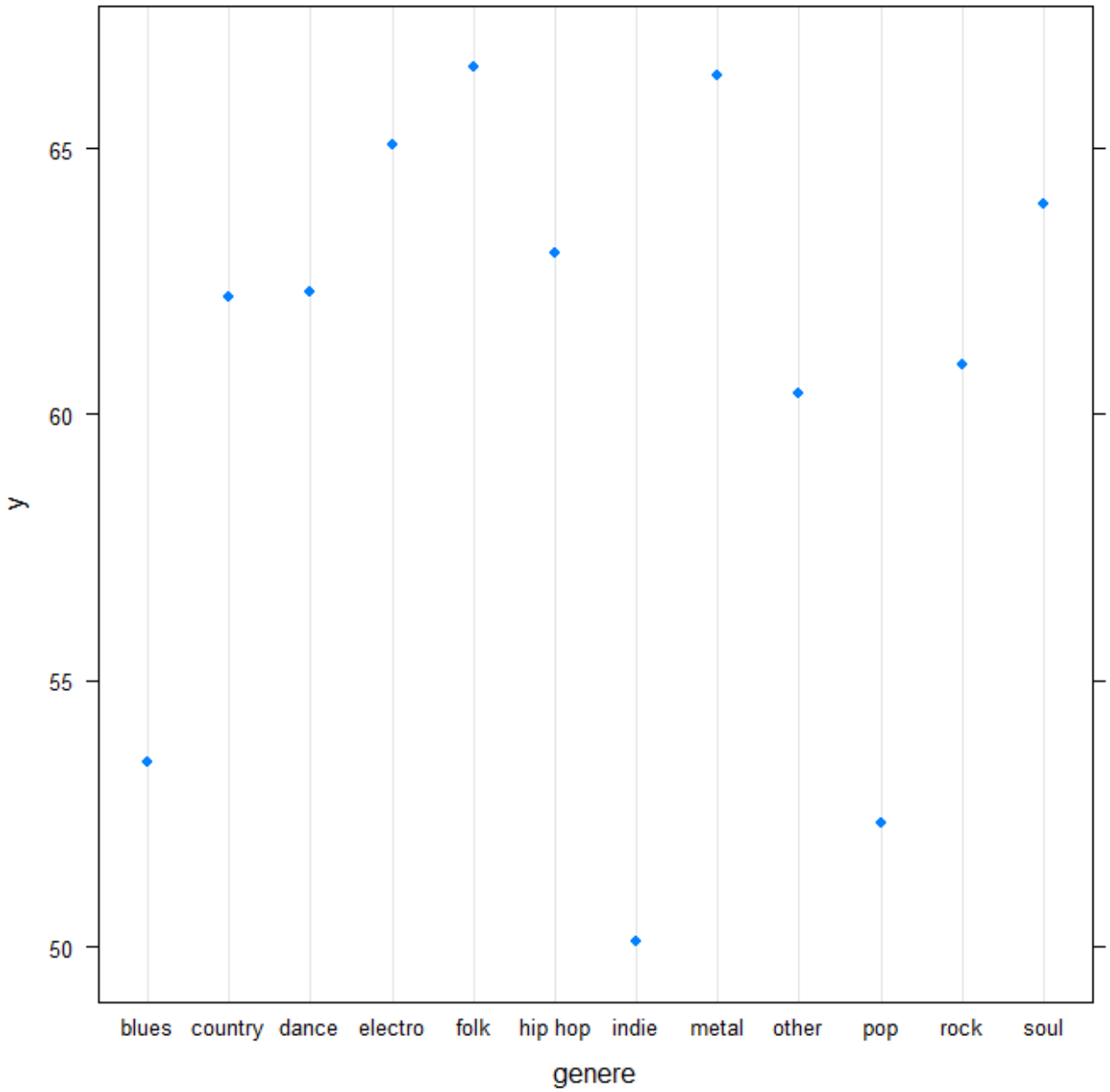


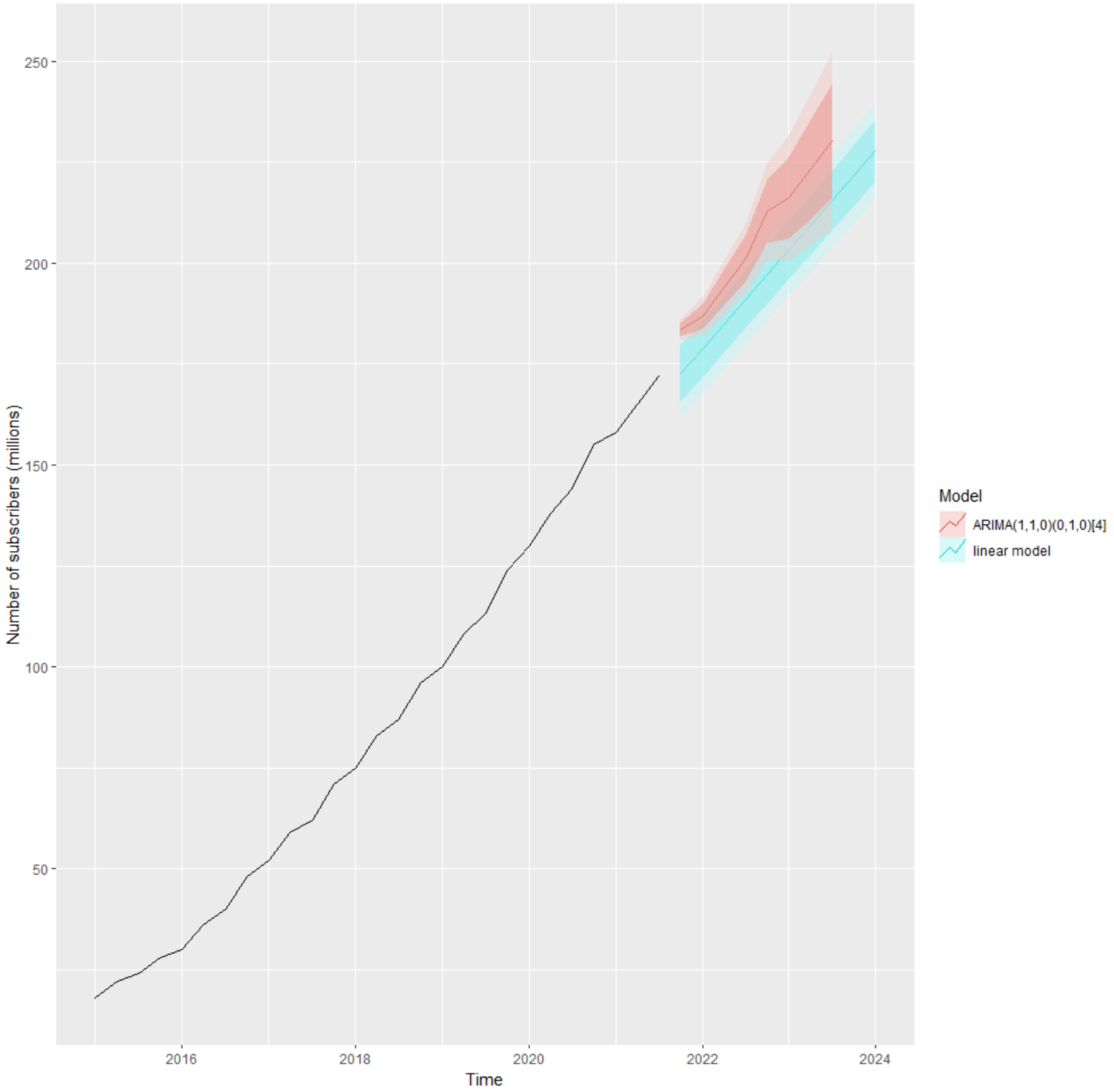


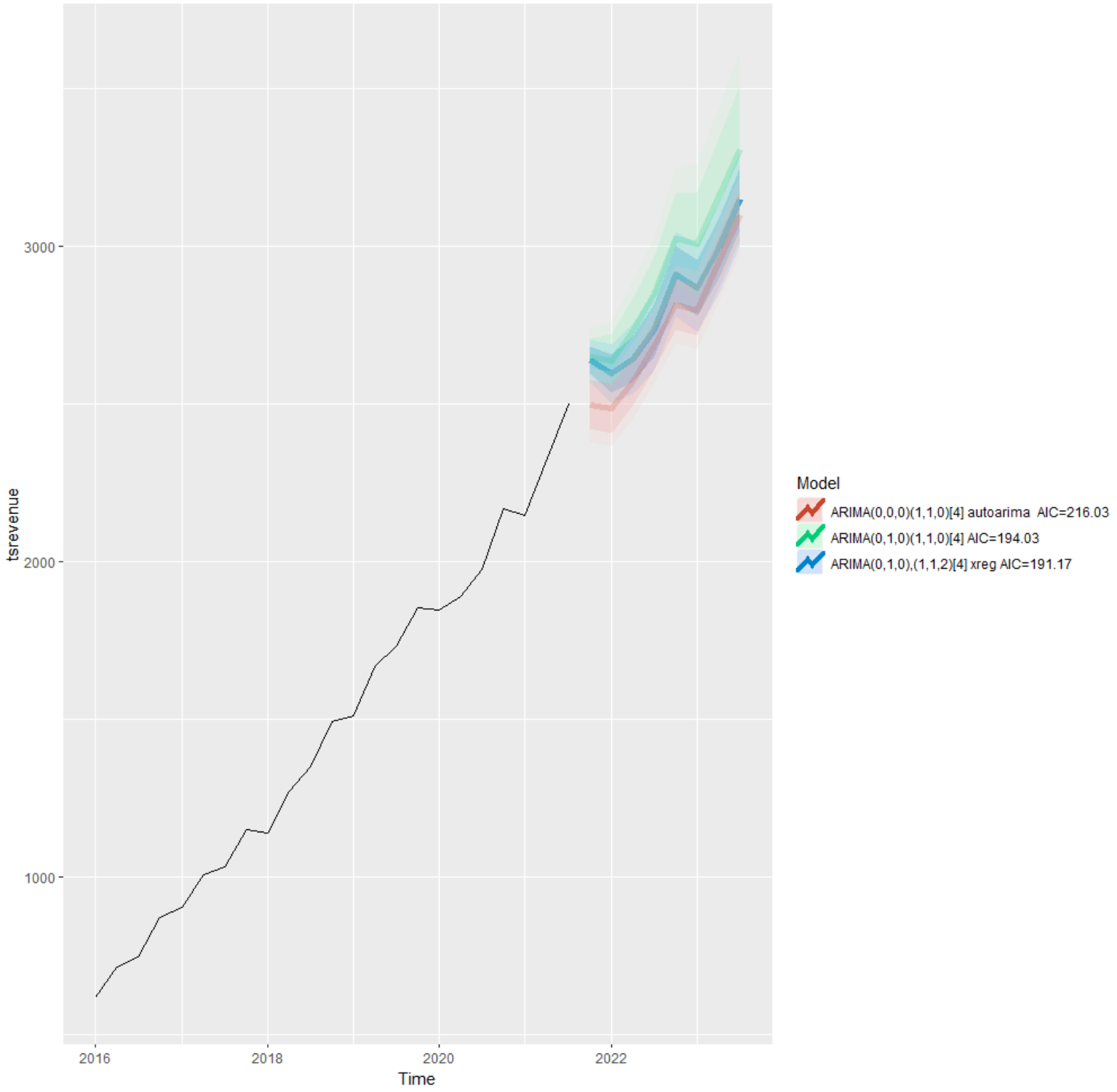



63
62
61
60
59
y
0
20
40
60
80
100
Valence


66
64
62
60
58
y
1
2
3
4
Speechiness


65
60
55
50
y
blues
country
dance
electro
folk
hip hop
indie
metal
other
pop
rock
soul
genere


250
200
150
100
50
Number of subscribers (millions)
2016
2018
2020
2022
2024
Time
Model
ARIMA(1,1,0)(0,1,0)[4]
linear model


3000
2000
1000
tsrevenue
2016
2018
2020
2022
Time
Model
ARIMA(0,0,0)(1,1,0)[4] autoarima AIC=216.03
ARIMA(0,1,0)(1,1,0)[4] AIC=194.03
ARIMA(0,1,0),(1,1,2)[4] xreg AIC=191.17