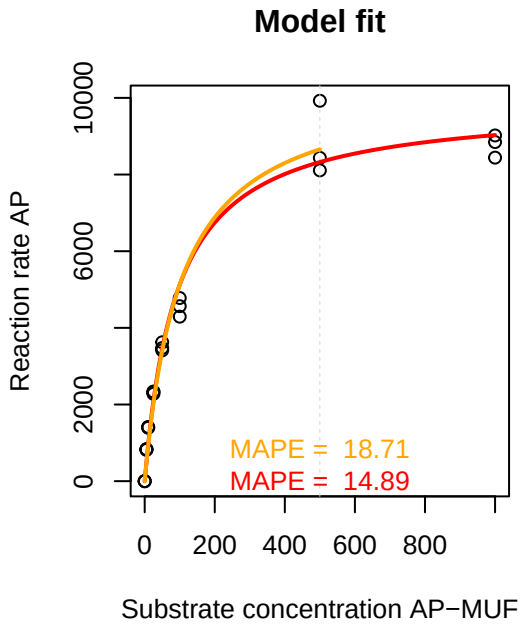
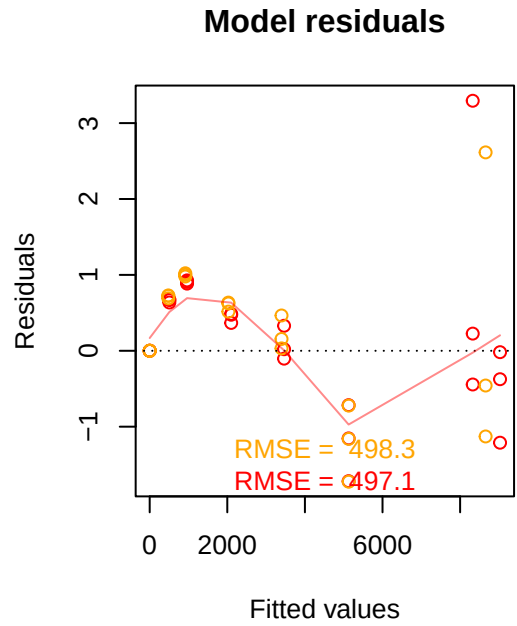
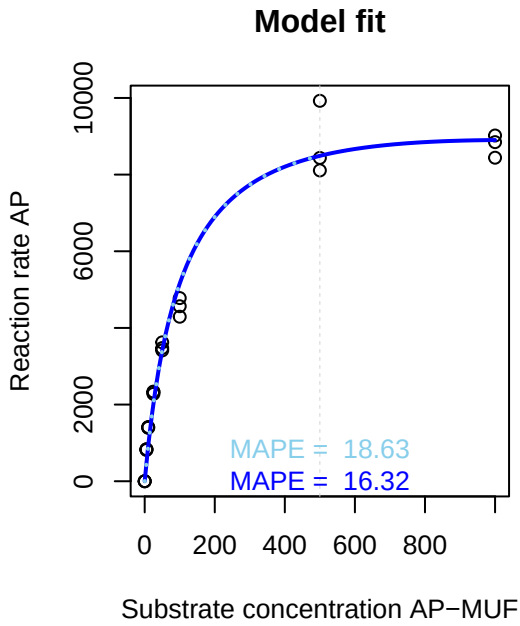
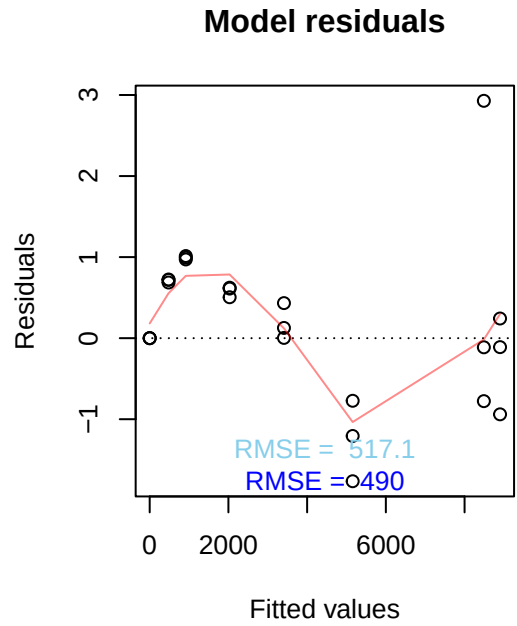
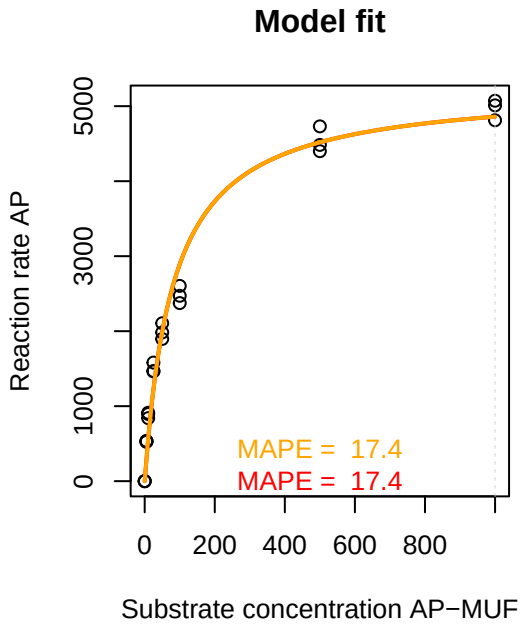
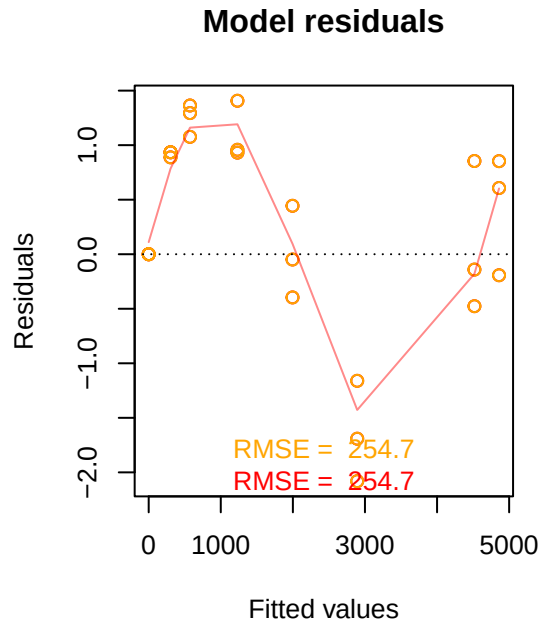

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
MAPE = 18.71
MAPE = 14.89
Substrate concentration AP−MUF

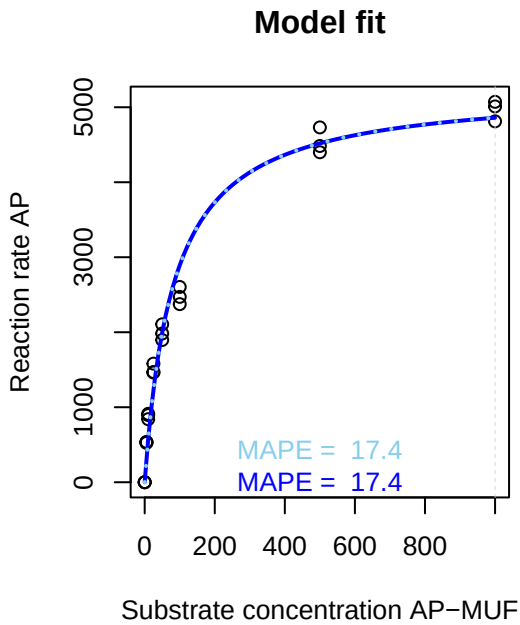

Model residuals
Residuals
−1
0
1
2
3
0
2000
6000
RMSE = 498.3
RMSE = 497.1
Fitted values

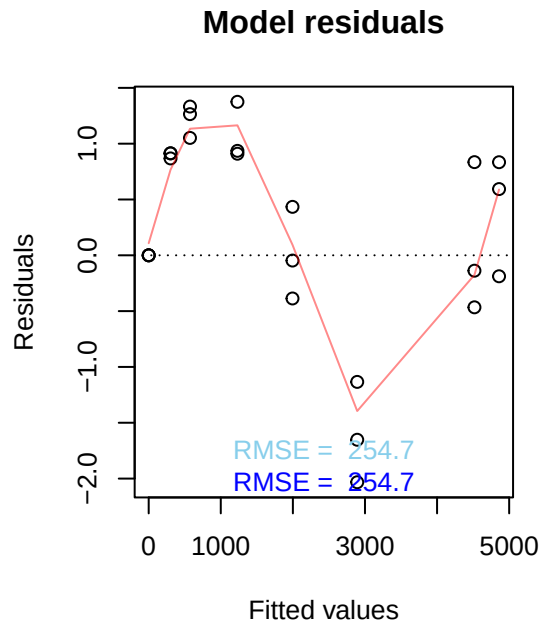

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
MAPE = 18.63
MAPE = 16.32
Substrate concentration AP−MUF

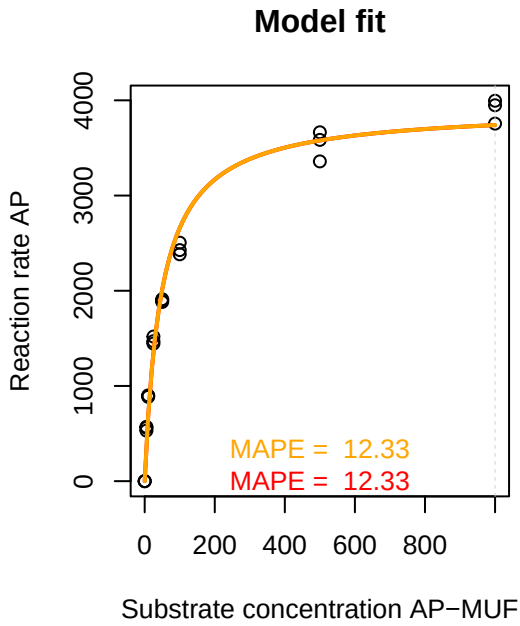

Model residuals
Residuals
−1
0
1
2
3
0
2000
6000
RMSE = 517.1
RMSE = 490
Fitted values

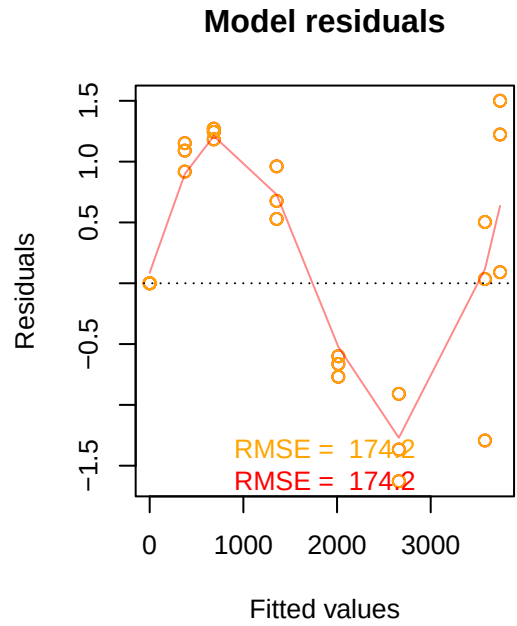

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 17.4
MAPE = 17.4

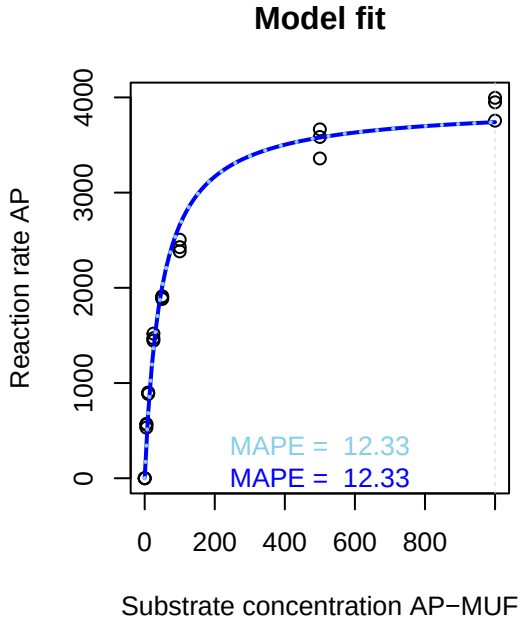

Model residuals
Residuals
−2.0
−1.0
0.0
1.0
0
1000
3000
5000
Fitted values
RMSE = 254.7
RMSE = 254.7

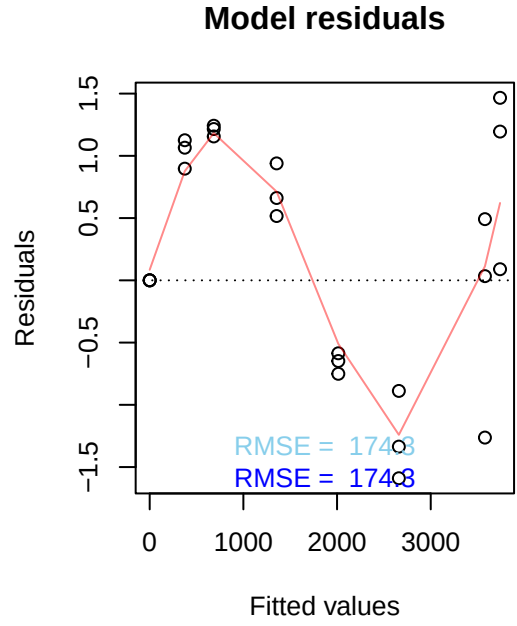

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 17.4
MAPE = 17.4

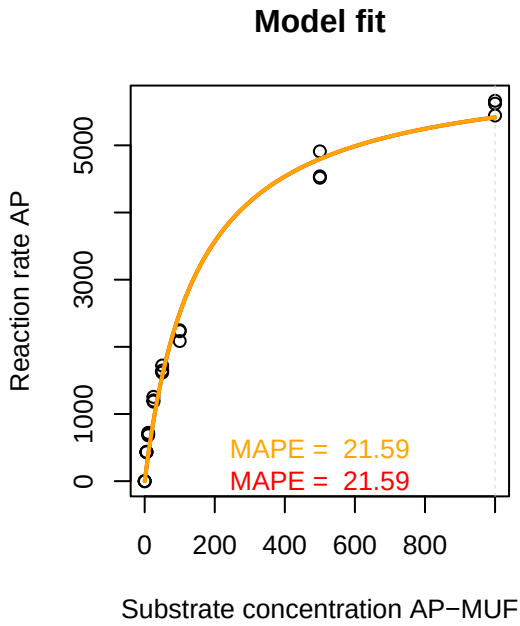

Model residuals
Residuals
−2.0
−1.0
0.0
1.0
0
1000
3000
5000
Fitted values
RMSE = 254.7
RMSE = 254.7

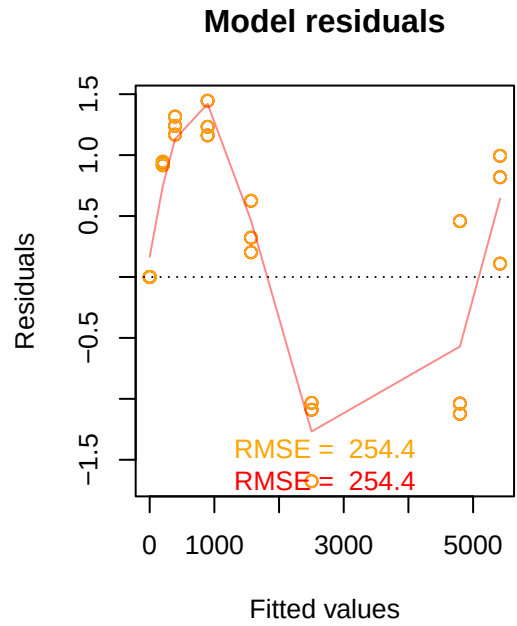

Model fit
Reaction rate AP
0
1000
2000
3000
4000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 12.33
MAPE = 12.33

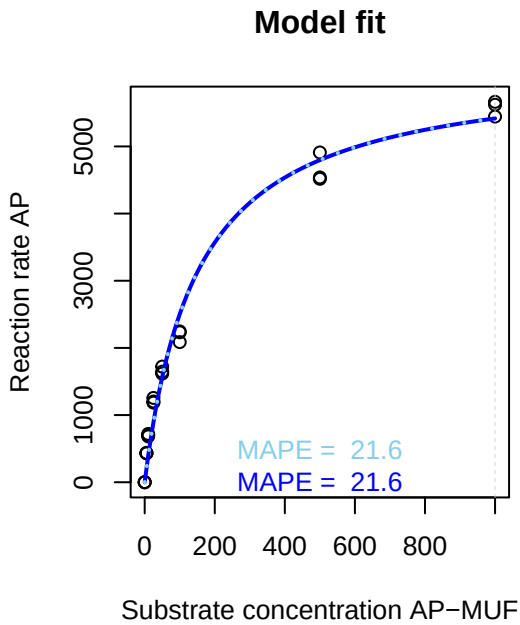

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
1000
2000
3000
Fitted values
RMSE = 1742
RMSE = 1742

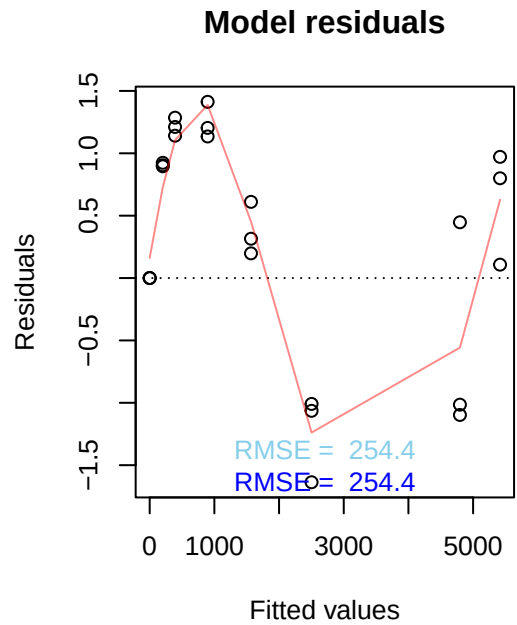

Model fit
Reaction rate AP
0
1000
2000
3000
4000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 12.33
MAPE = 12.33

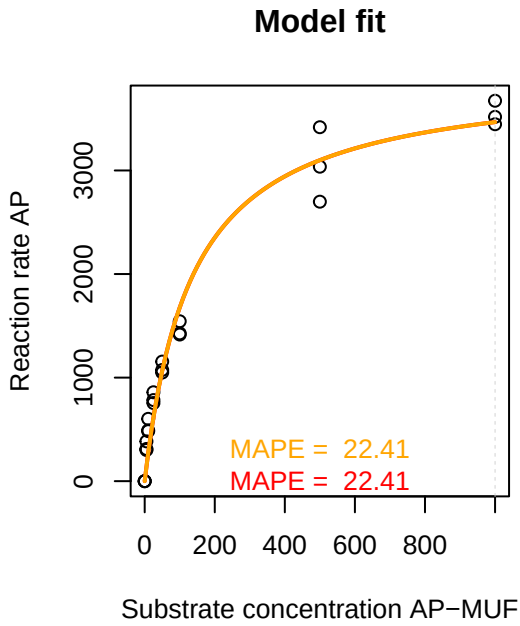

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
1000
2000
3000
Fitted values
RMSE = 1743
RMSE = 1743

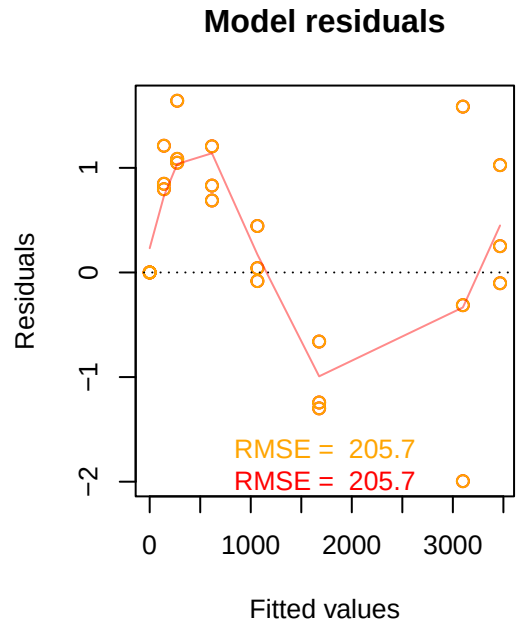

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 21.59
MAPE = 21.59

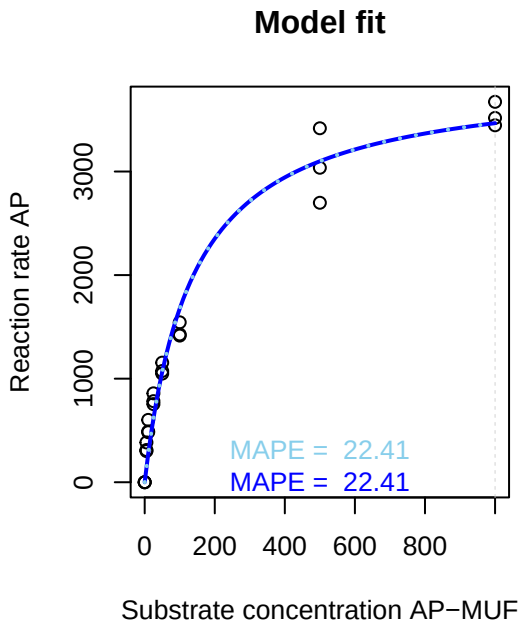

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
1000
3000
5000
Fitted values
RMSE = 254.4
RMSE = 254.4

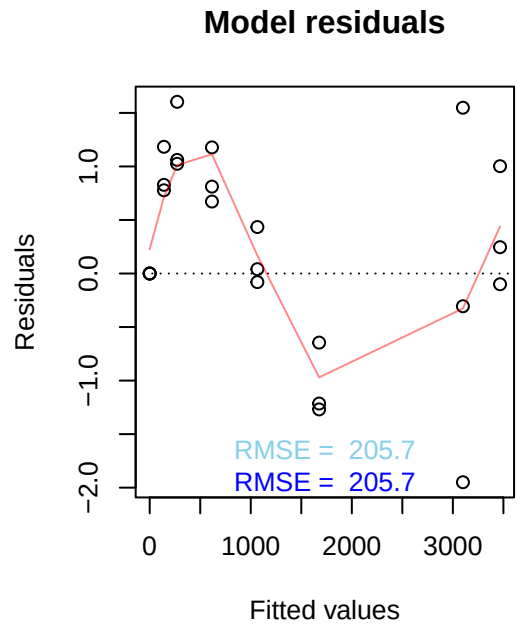

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 21.6
MAPE = 21.6

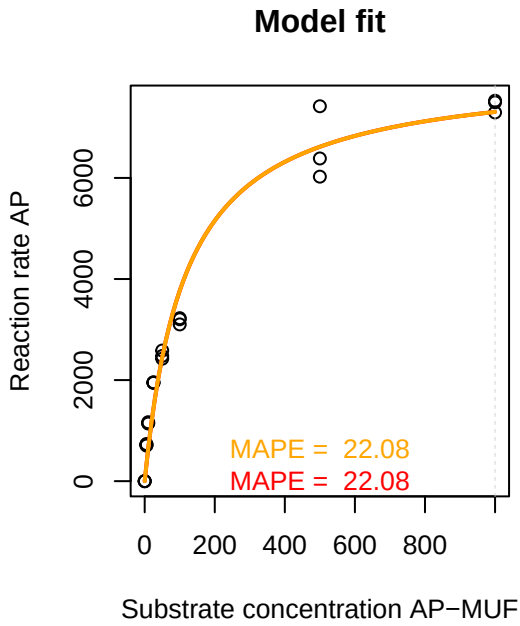

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
1000
3000
5000
Fitted values
RMSE = 254.4
RMSE = 254.4

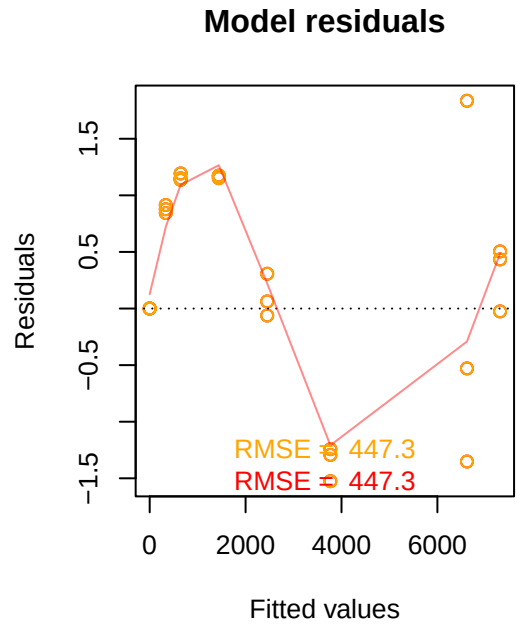

Model fit
Reaction rate AP
0
1000
2000
3000
MAPE = 22.41
MAPE = 22.41
0
200
400
600
800
Substrate concentration AP−MUF

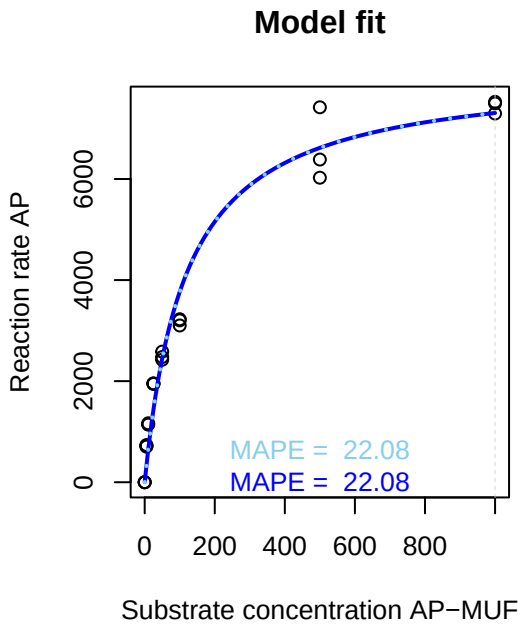

Model residuals
Residuals
−2
−1
0
1
RMSE = 205.7
RMSE = 205.7
0
1000
2000
3000
Fitted values

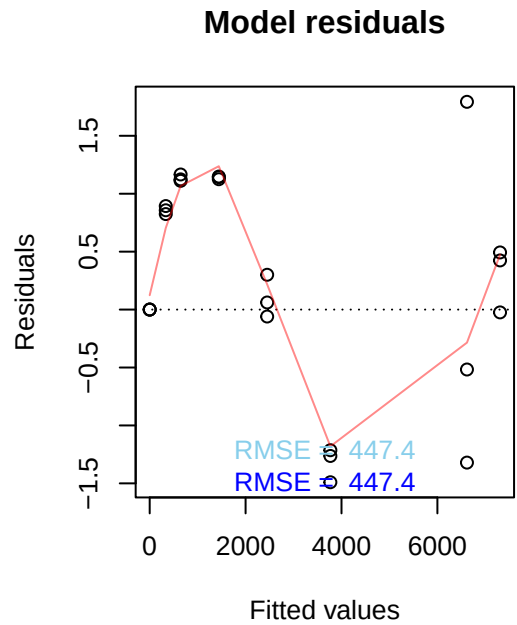

Model fit
Reaction rate AP
0
1000
2000
3000
MAPE = 22.41
MAPE = 22.41
0
200
400
600
800
Substrate concentration AP−MUF

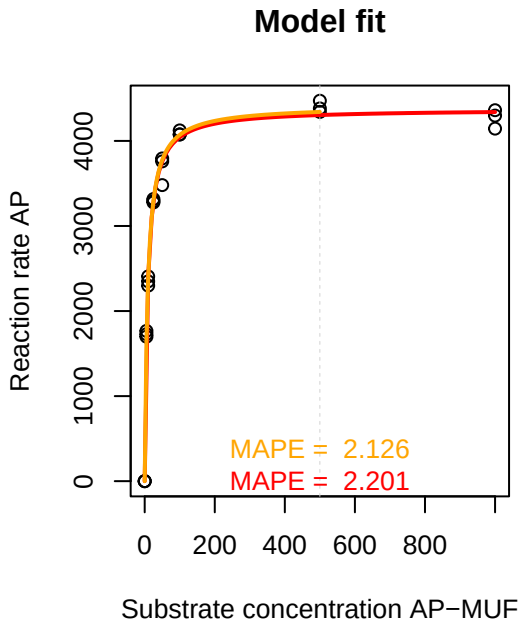

Model residuals
Residuals
−2.0
−1.0
0.0
1.0
RMSE = 205.7
RMSE = 205.7
0
1000
2000
3000
Fitted values

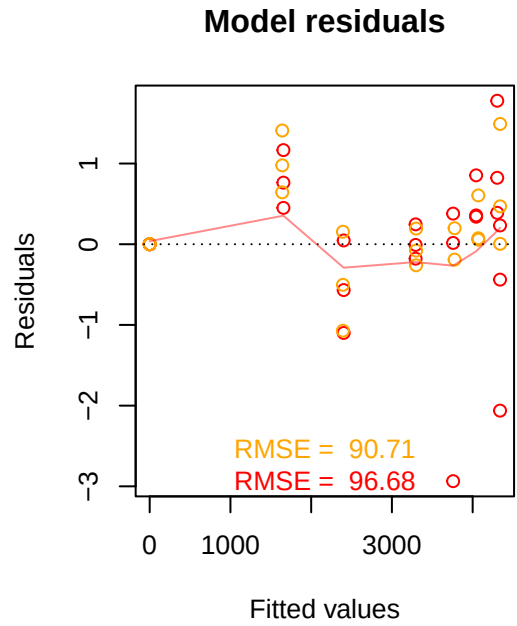

Model fit
Reaction rate AP
0
2000
4000
6000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 22.08
MAPE = 22.08

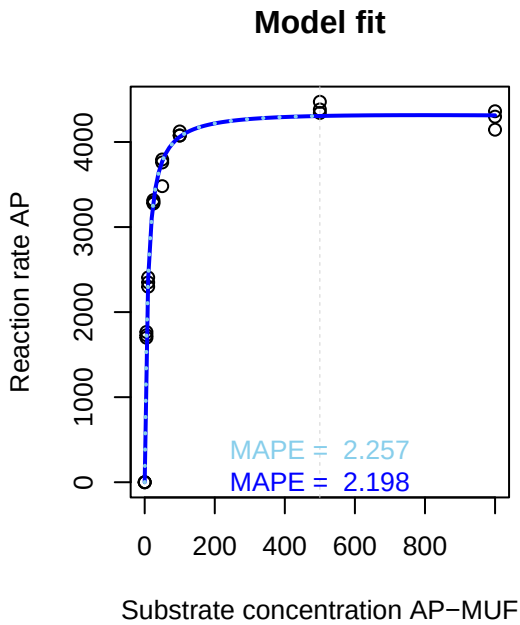

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
2000
4000
6000
Fitted values
RMSE = 447.3
RMSE = 447.3

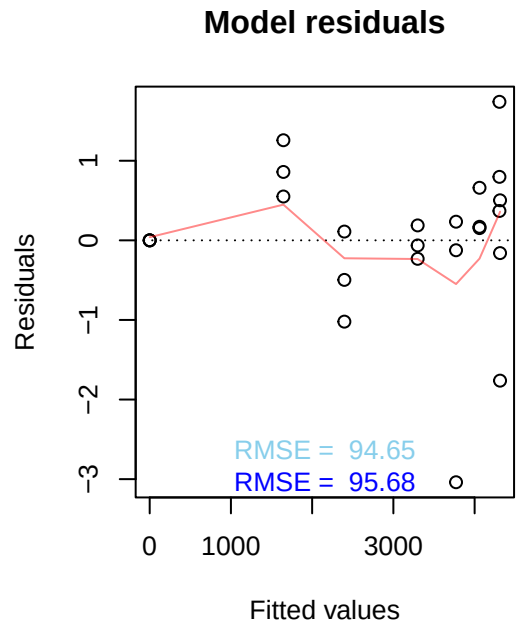

Model fit
Reaction rate AP
0
2000
4000
6000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 22.08
MAPE = 22.08

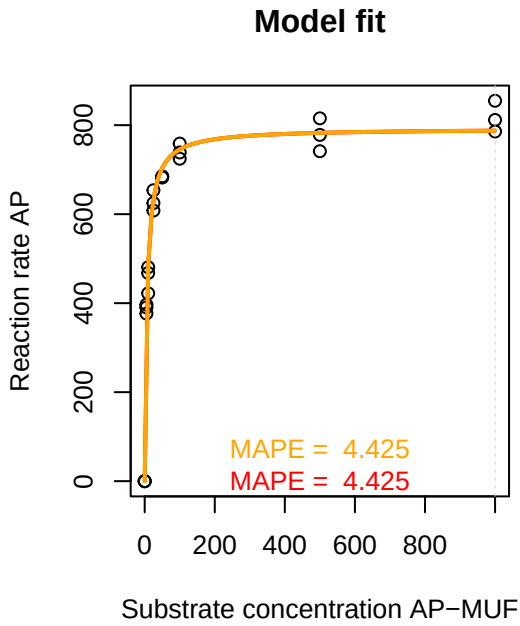

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
2000
4000
6000
Fitted values
RMSE = 447.4
RMSE = 447.4

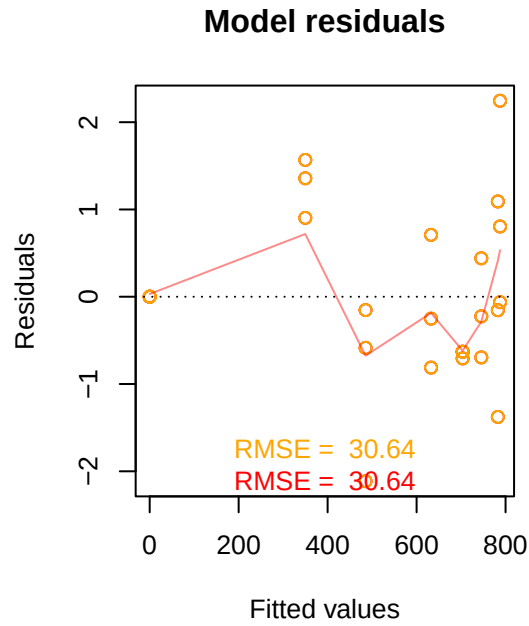

Model fit
Reaction rate AP
0
1000
2000
3000
4000
MAPE = 2.126
MAPE = 2.201
0
200
400
600
800
Substrate concentration AP−MUF

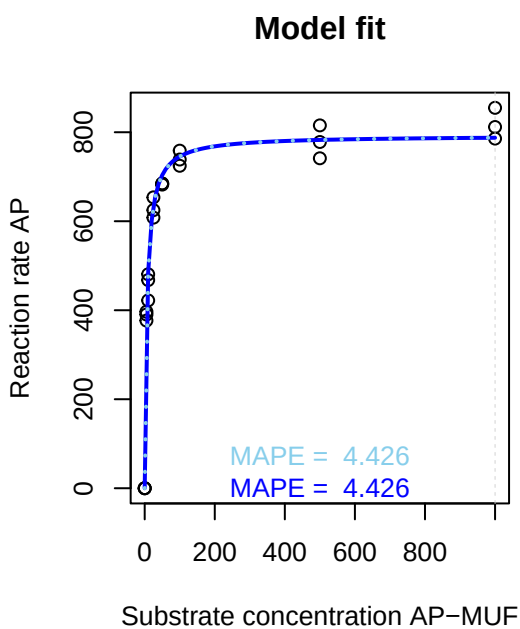

Model residuals
Residuals
−3
−2
−1
0
1
RMSE = 90.71
RMSE = 96.68
0
1000
3000
Fitted values

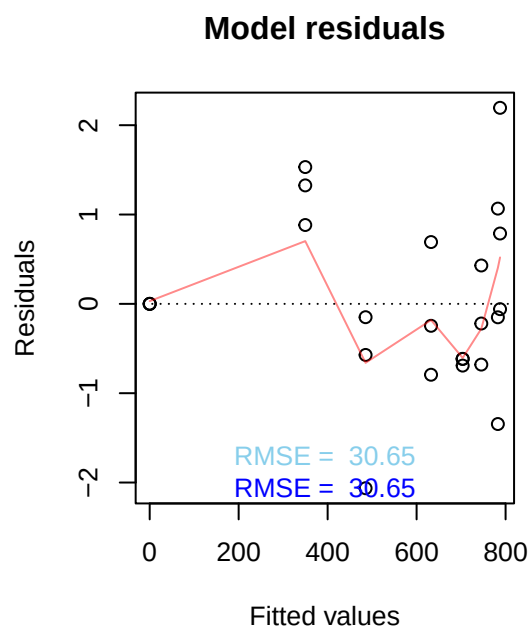

Model fit
Reaction rate AP
0
1000
2000
3000
4000
MAPE = 2.257
MAPE = 2.198
0
200
400
600
800
Substrate concentration AP−MUF

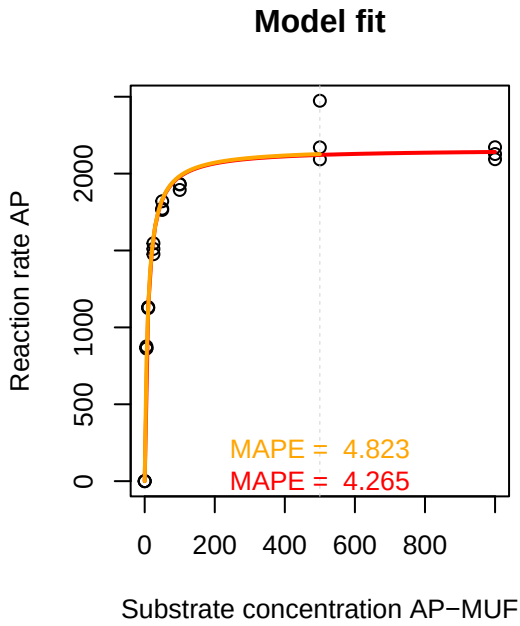

Model residuals
Residuals
−3
−2
−1
0
1
RMSE = 94.65
RMSE = 95.68
0
1000
3000
Fitted values

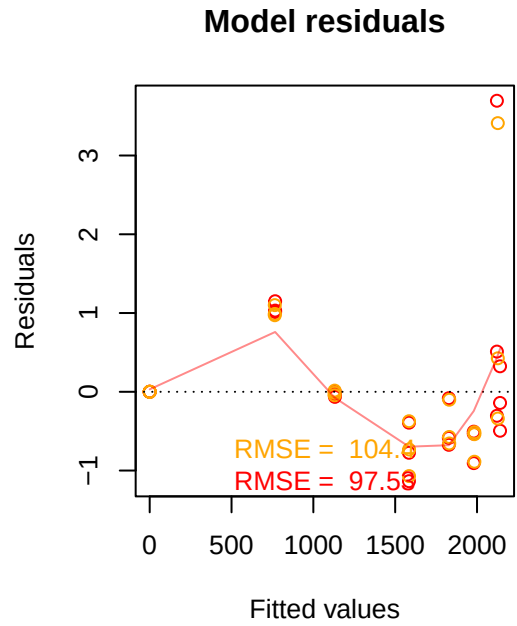

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 4.425
MAPE = 4.425
0
200
400
600
800

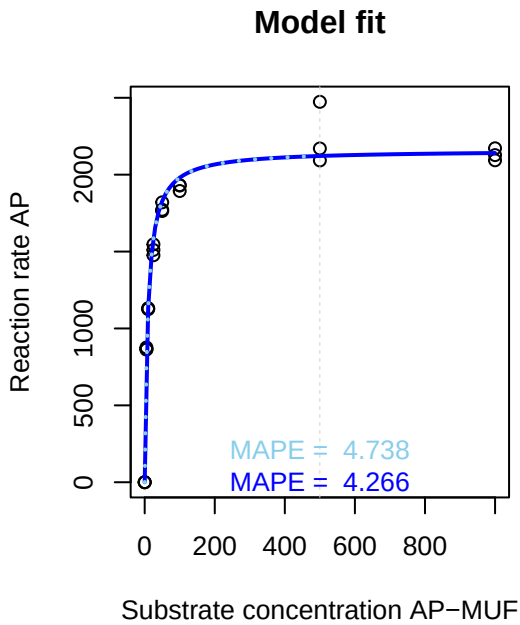

Model residuals
Residuals
Fitted values
RMSE = 30.64
RMSE = 30.64
−2
−1
0
1
2
0
200
400
600
800

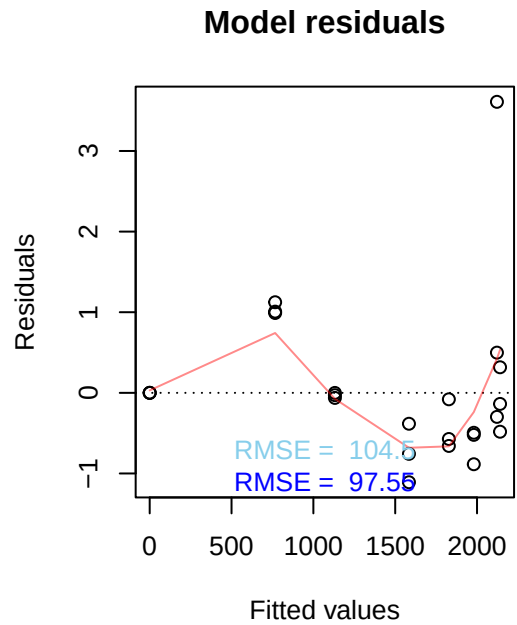

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 4.426
MAPE = 4.426
0
200
400
600
800

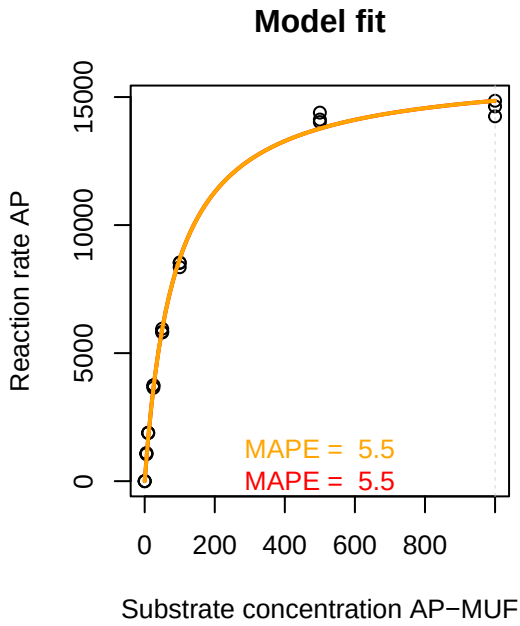

Model residuals
Residuals
Fitted values
RMSE = 30.65
RMSE = 30.65
−2
−1
0
1
2
0
200
400
600
800

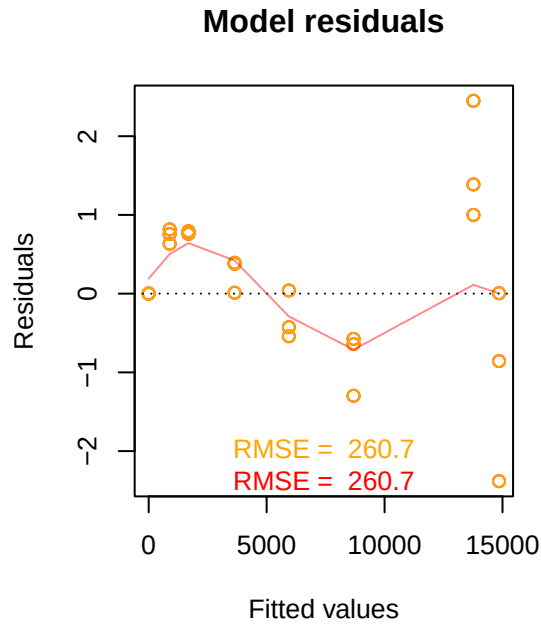

Model fit
Reaction rate AP
0
500
1000
2000
MAPE = 4.823
MAPE = 4.265
0
200
400
600
800
Substrate concentration AP−MUF

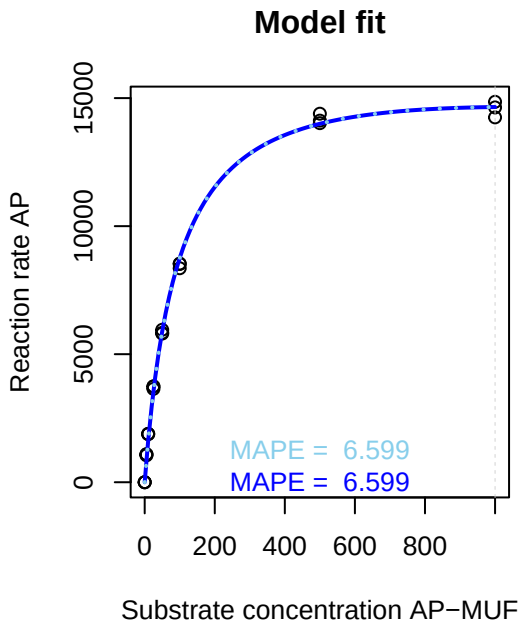

Model residuals
Residuals
−1
0
1
2
3
RMSE = 104.6
RMSE = 97.58
0
500
1000
1500
2000
Fitted values

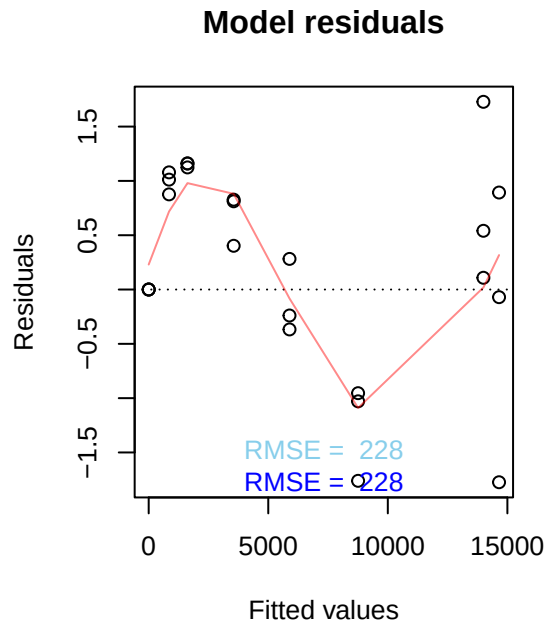

Model fit
Reaction rate AP
0
500
1000
2000
MAPE = 4.738
MAPE = 4.266
0
200
400
600
800
Substrate concentration AP−MUF

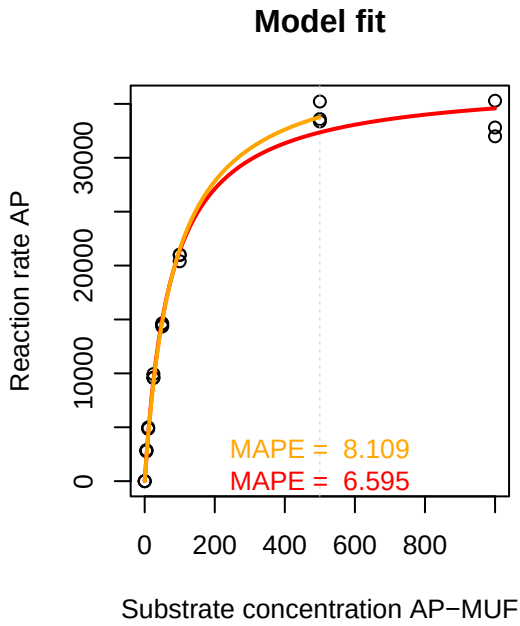

Model residuals
Residuals
−1
0
1
2
3
RMSE = 104.5
RMSE = 97.55
0
500
1000
1500
2000
Fitted values

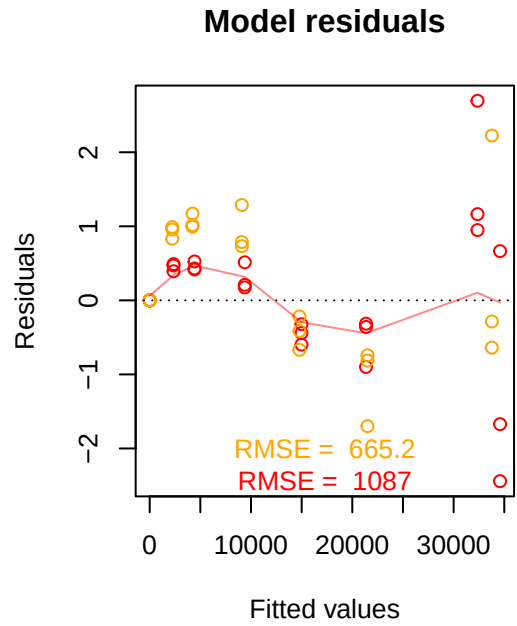

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 5.5
MAPE = 5.5

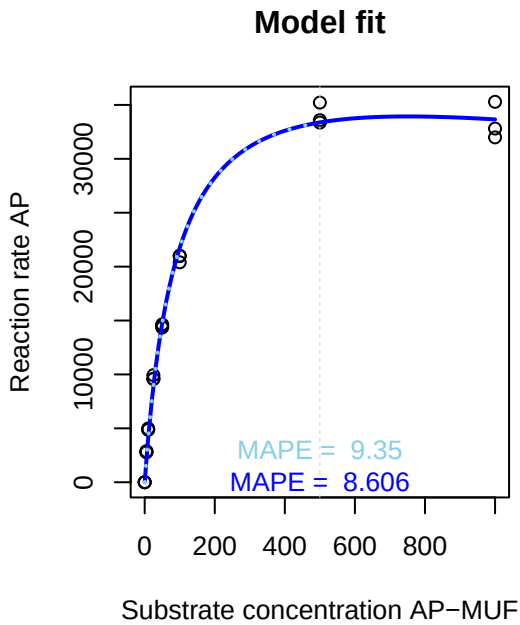

Model residuals
Residuals
−2
−1
0
1
2
0
5000
10000
15000
Fitted values
RMSE = 260.7
RMSE = 260.7

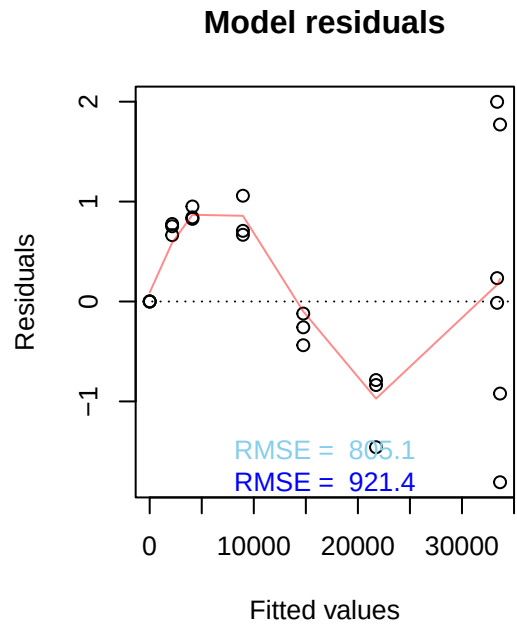

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 6.599
MAPE = 6.599

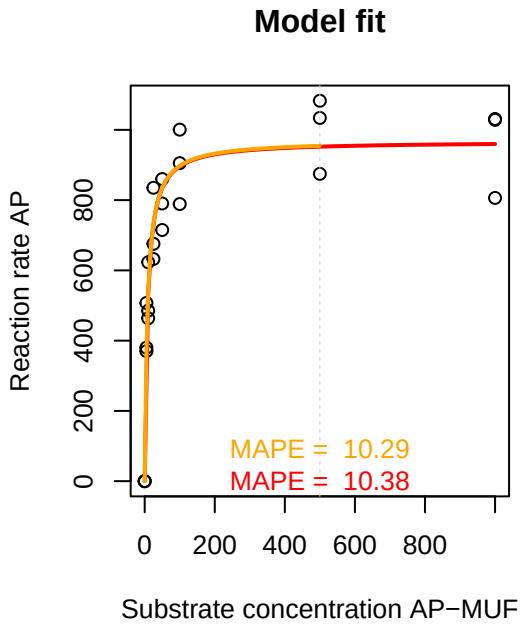

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
5000
10000
15000
Fitted values
RMSE = 228
RMSE = 228

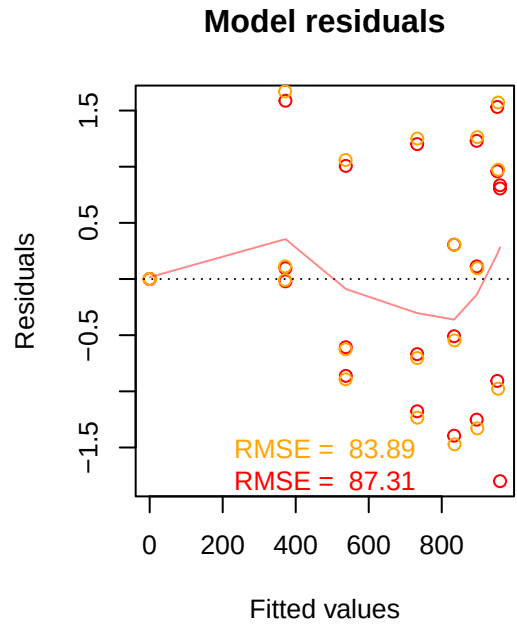

Model fit
Reaction rate AP
0
10000
20000
30000
0
200
400
600
800
MAPE = 8.109
MAPE = 6.595
Substrate concentration AP−MUF

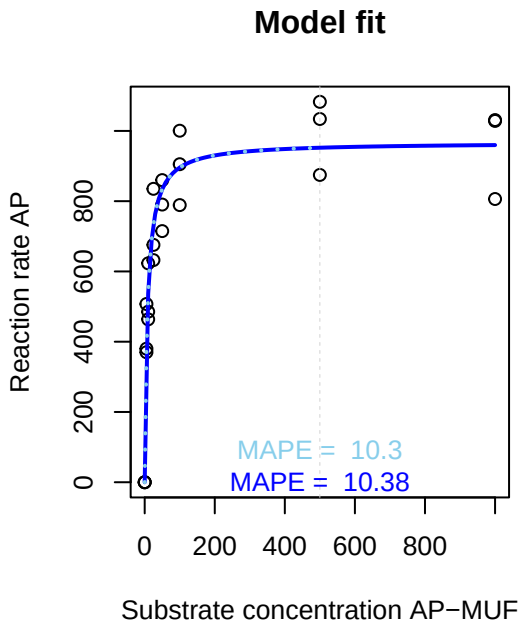

Model residuals
Residuals
−2
−1
0
1
2
0
10000
20000
30000
RMSE = 665.2
RMSE = 1087
Fitted values

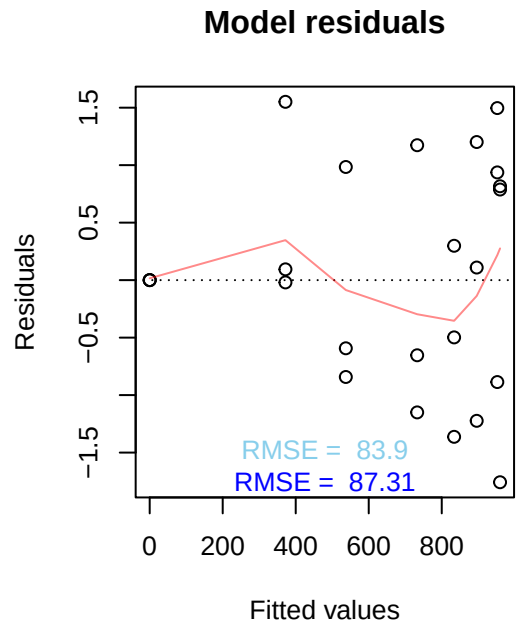

Model fit
Reaction rate AP
0
10000
20000
30000
0
200
400
600
800
MAPE = 9.35
MAPE = 8.606
Substrate concentration AP−MUF

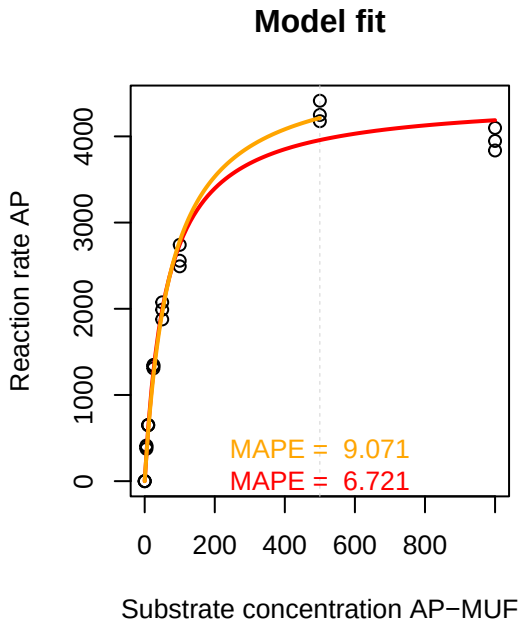

Model residuals
Residuals
−1
0
1
2
0
10000
20000
30000
RMSE = 805.1
RMSE = 921.4
Fitted values

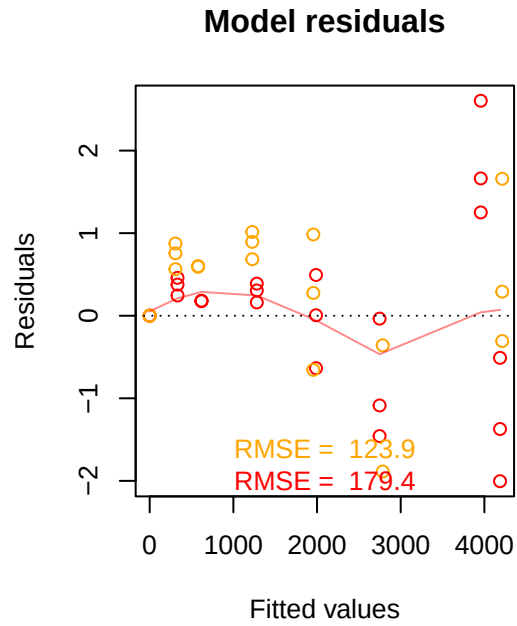

Model fit
Reaction rate AP
0
200
400
600
800
MAPE = 10.29
MAPE = 10.38
0
200
400
600
800
Substrate concentration AP−MUF

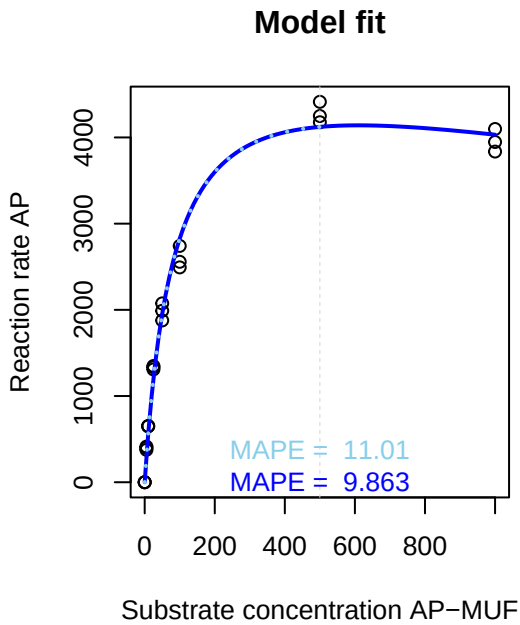

Model residuals
Residuals
1.5
0.5
−0.5
−1.5
RMSE = 83.89
RMSE = 87.31
0
200
400
600
800
Fitted values

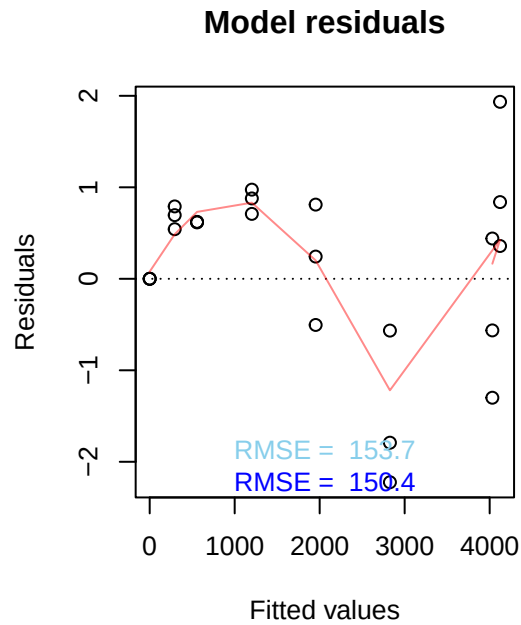

Model fit
Reaction rate AP
0
200
400
600
800
MAPE = 10.3
MAPE = 10.38
0
200
400
600
800
Substrate concentration AP−MUF

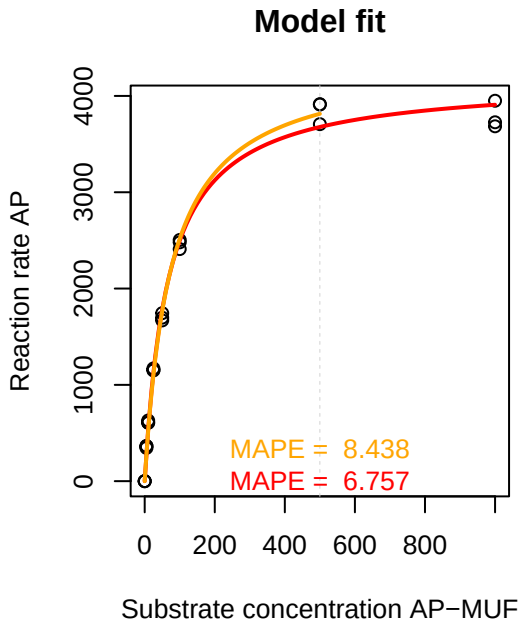

Model residuals
Residuals
1.5
0.5
−0.5
−1.5
RMSE = 83.9
RMSE = 87.31
0
200
400
600
800
Fitted values

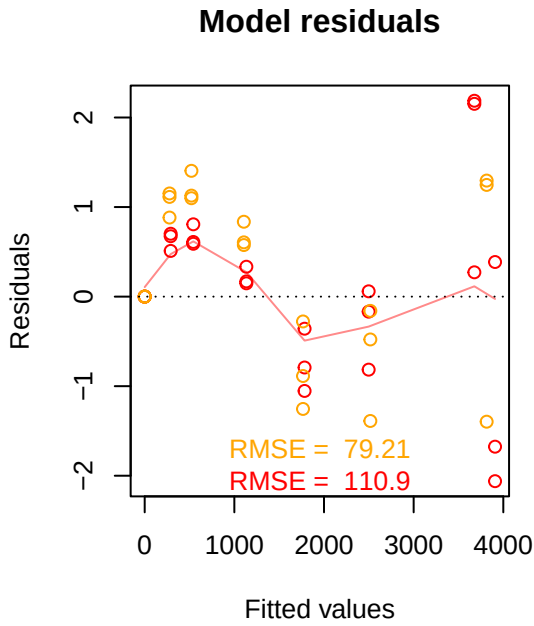

Model fit
Reaction rate AP
0
1000
2000
3000
4000
MAPE = 9.071
MAPE = 6.721
0
200
400
600
800
Substrate concentration AP−MUF

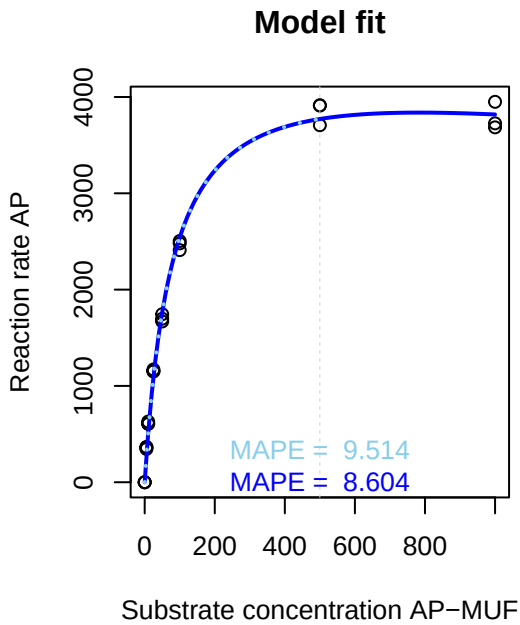

Model residuals
Residuals
−2
−1
0
1
2
RMSE = 123.9
RMSE = 179.4
0
1000
2000
3000
4000
Fitted values

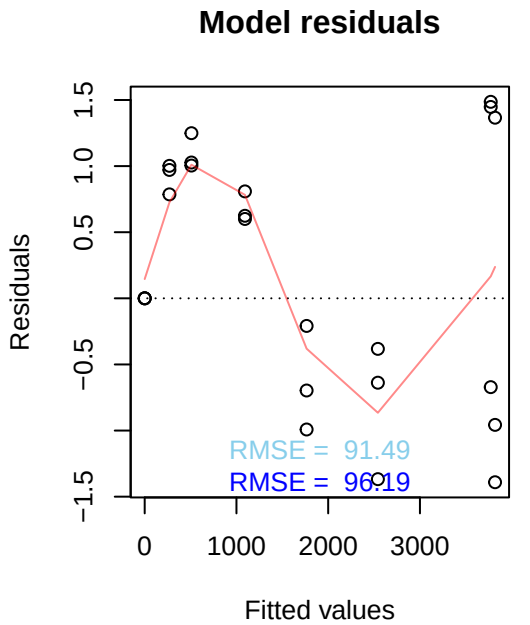

Model fit
Reaction rate AP
0
1000
2000
3000
4000
MAPE = 11.01
MAPE = 9.863
0
200
400
600
800
Substrate concentration AP−MUF

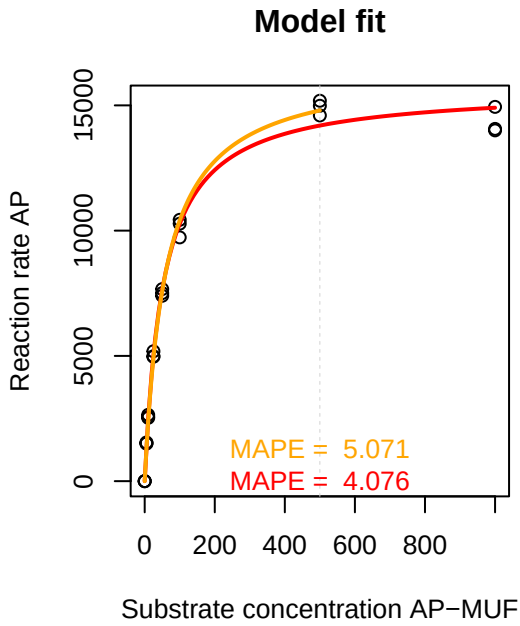

Model residuals
Residuals
−2
−1
0
1
2
RMSE = 153.7
RMSE = 150.4
0
1000
2000
3000
4000
Fitted values

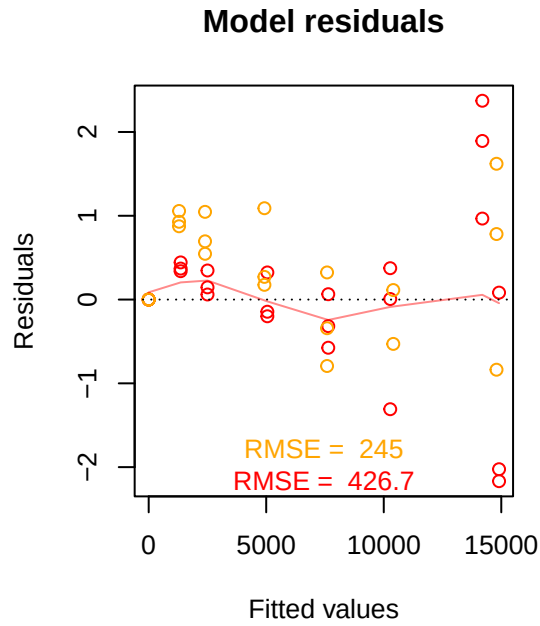

Model fit
Reaction rate AP
0
1000
2000
3000
4000
0
200
400
600
800
MAPE = 8.438
MAPE = 6.757
Substrate concentration AP−MUF

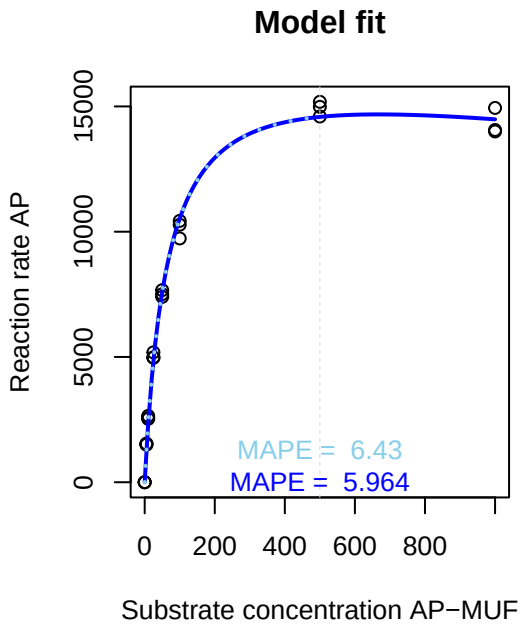

Model residuals
Residuals
−2
−1
0
1
2
0
1000
2000
3000
4000
RMSE = 79.21
RMSE = 110.9
Fitted values

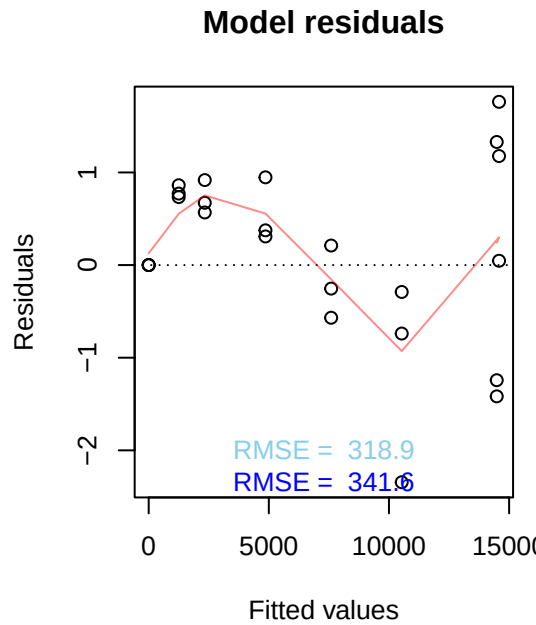

Model fit
Reaction rate AP
0
1000
2000
3000
4000
0
200
400
600
800
MAPE = 9.514
MAPE = 8.604
Substrate concentration AP−MUF

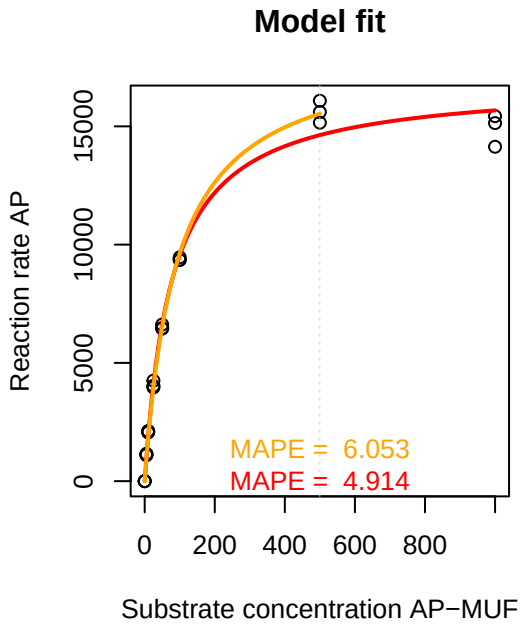

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
1000
2000
3000
RMSE = 91.49
RMSE = 96.19
Fitted values

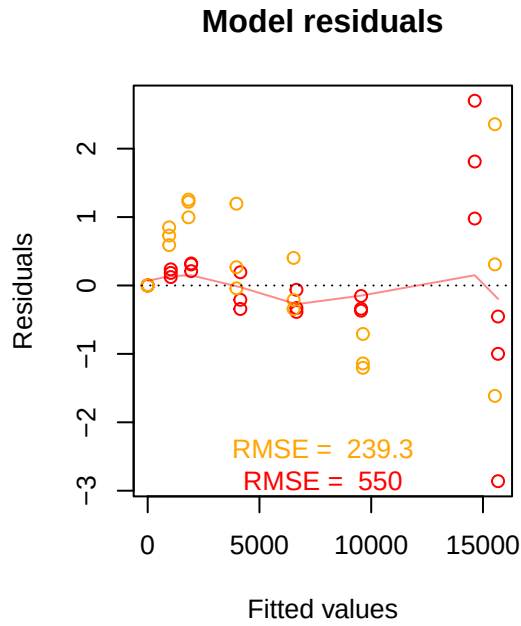

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 5.071
MAPE = 4.076

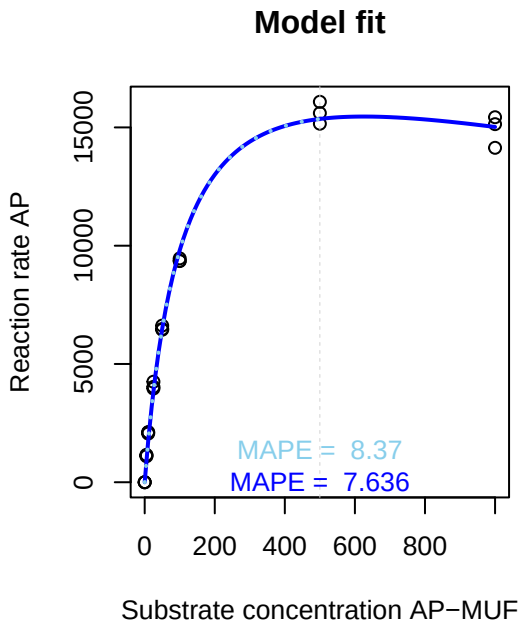

Model residuals
Residuals
−2
−1
0
1
2
0
5000
10000
15000
Fitted values
RMSE = 245
RMSE = 426.7

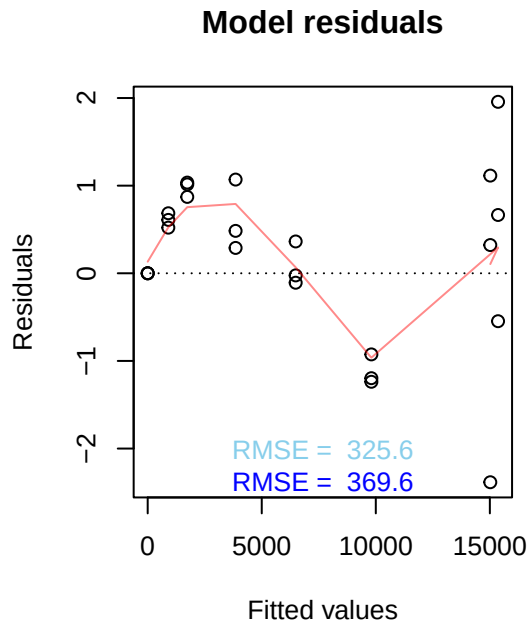

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 6.43
MAPE = 5.964

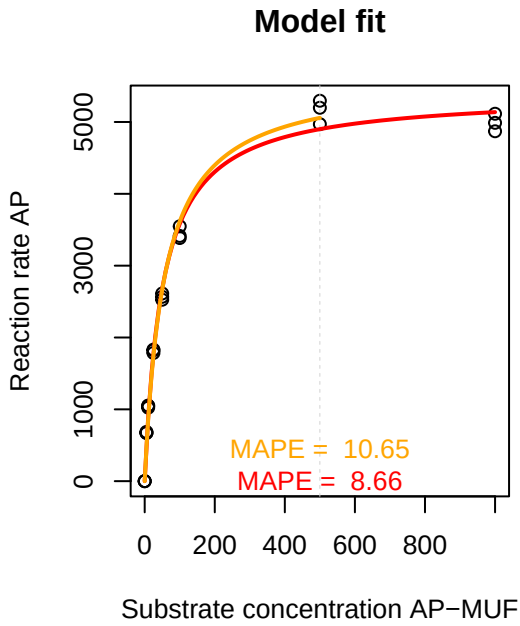

Model residuals
Residuals
−2
−1
0
1
0
5000
10000
15000
Fitted values
RMSE = 318.9
RMSE = 341.6

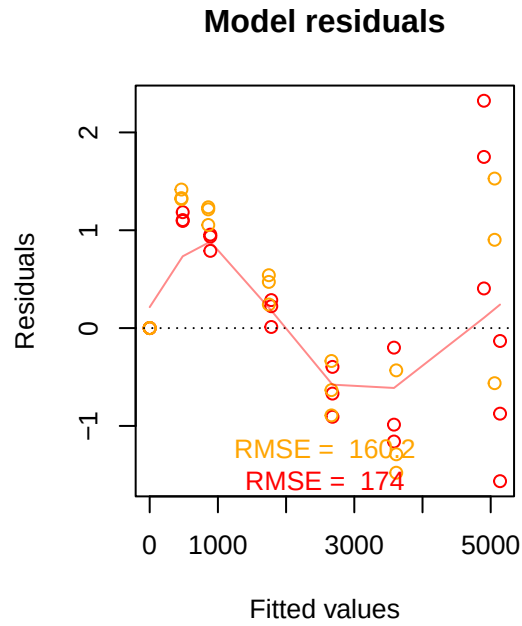

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 6.053
MAPE = 4.914

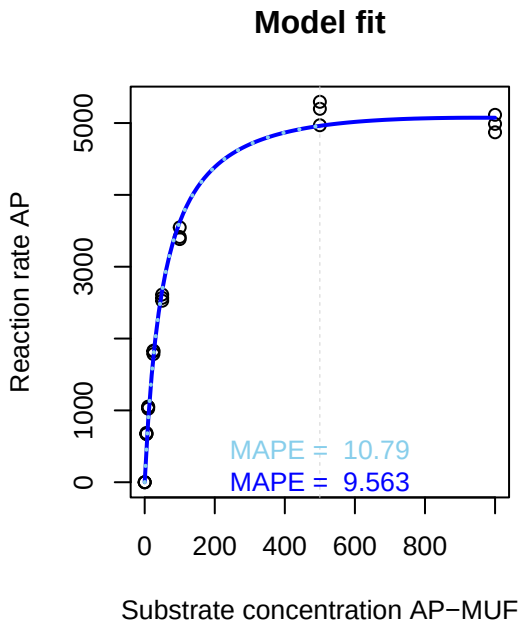

Model residuals
Residuals
−3
−2
−1
0
1
2
0
5000
10000
15000
Fitted values
RMSE = 239.3
RMSE = 550

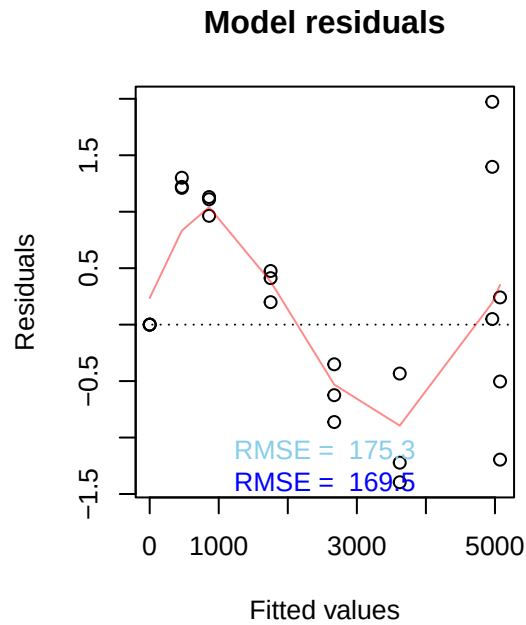

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 8.37
MAPE = 7.636

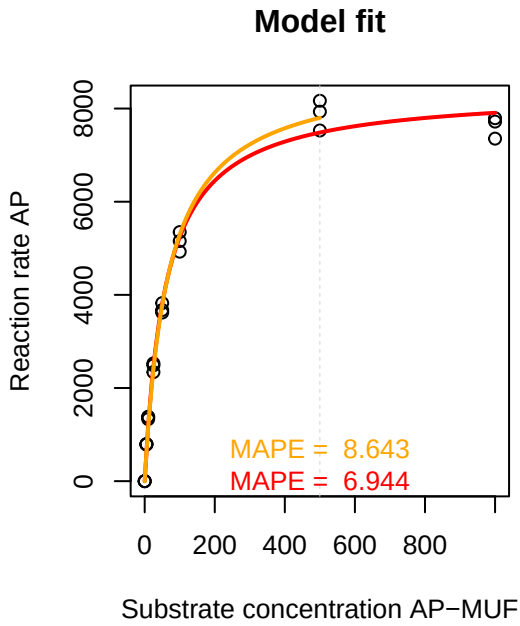

Model residuals
Residuals
−2
−1
0
1
2
0
5000
10000
15000
Fitted values
RMSE = 325.6
RMSE = 369.6

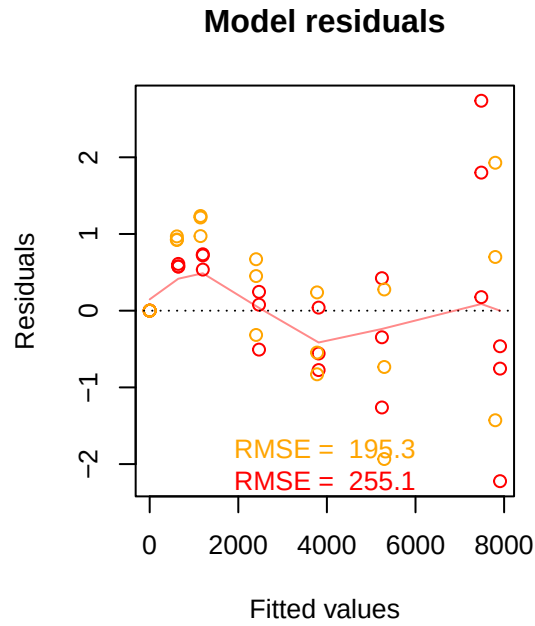

Model fit
Reaction rate AP
0
1000
3000
5000
MAPE = 10.65
MAPE = 8.66
0
200
400
600
800
Substrate concentration AP−MUF

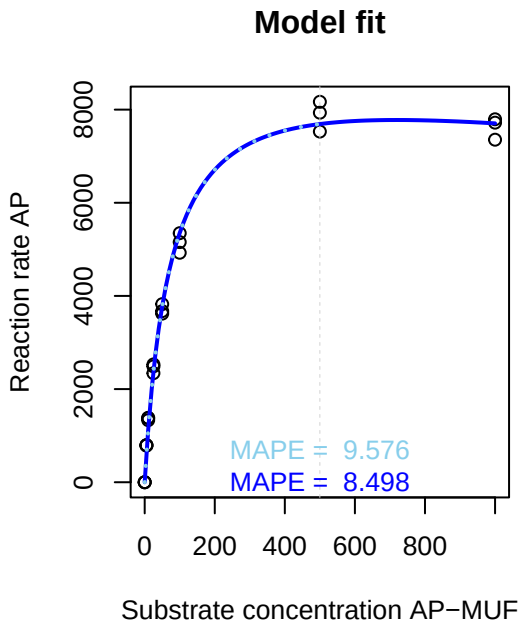

Model residuals
Residuals
−1
0
1
2
RMSE = 1602
RMSE = 174
0
1000
3000
5000
Fitted values

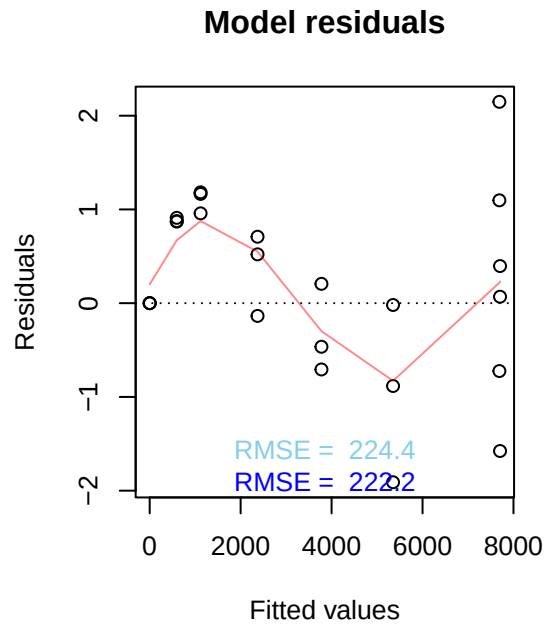

Model fit
Reaction rate AP
0
1000
3000
5000
MAPE = 10.79
MAPE = 9.563
0
200
400
600
800
Substrate concentration AP−MUF

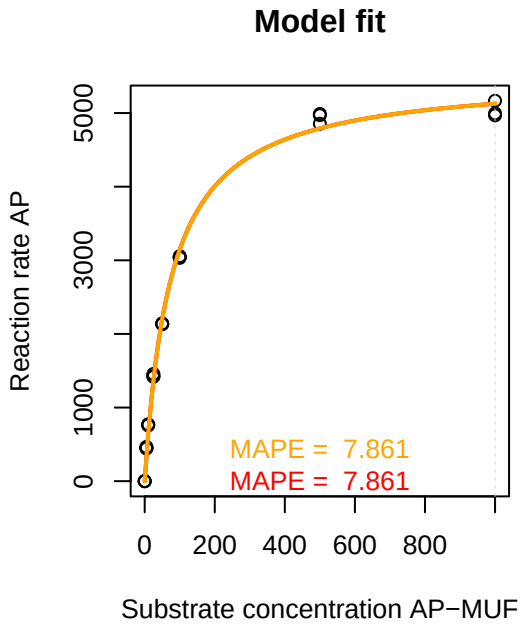

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
RMSE = 175.3
RMSE = 169.5
0
1000
3000
5000
Fitted values

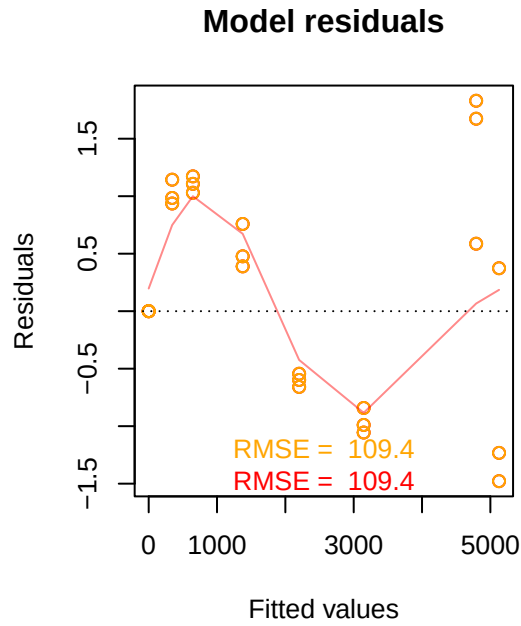

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 8.643
MAPE = 6.944
0
2000
4000
6000
8000
0
200
400
600
800

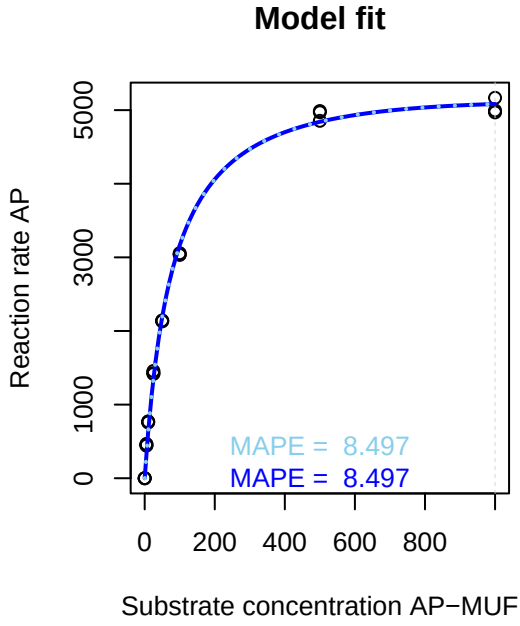

Model residuals
Residuals
Fitted values
RMSE = 195.3
RMSE = 255.1
−2
−1
0
1
2
0
2000
4000
6000
8000

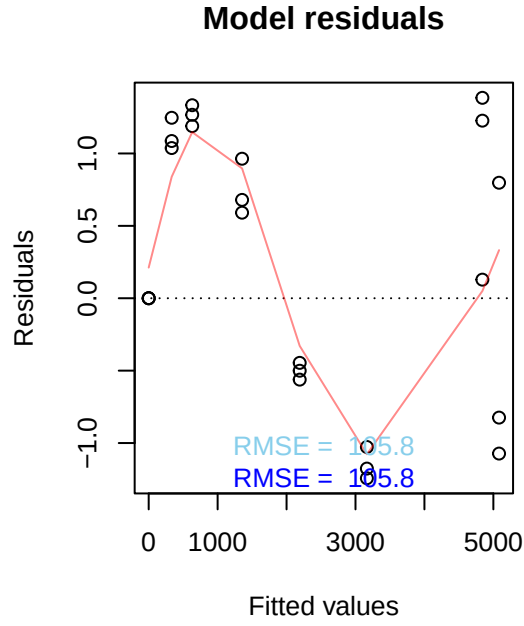

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 9.576
MAPE = 8.498
0
2000
4000
6000
8000
0
200
400
600
800

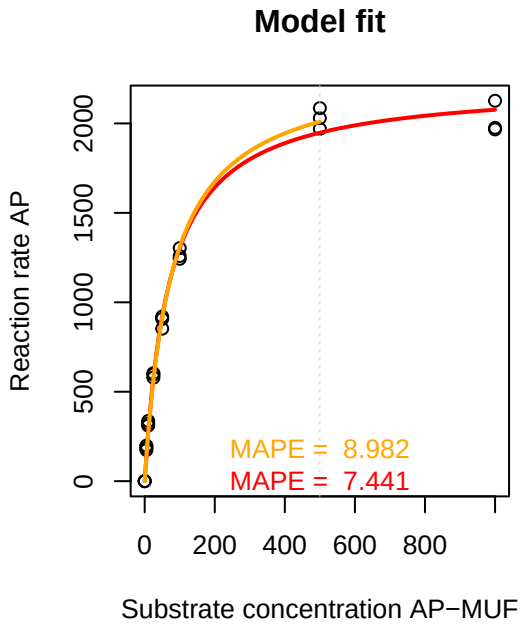

Model residuals
Residuals
Fitted values
RMSE = 224.4
RMSE = 222.2
−2
−1
0
1
2
0
2000
4000
6000
8000

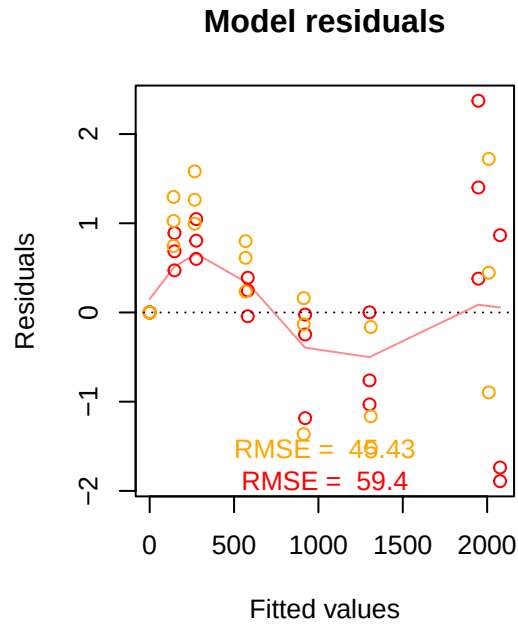

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
MAPE = 7.861
MAPE = 7.861
Substrate concentration AP−MUF

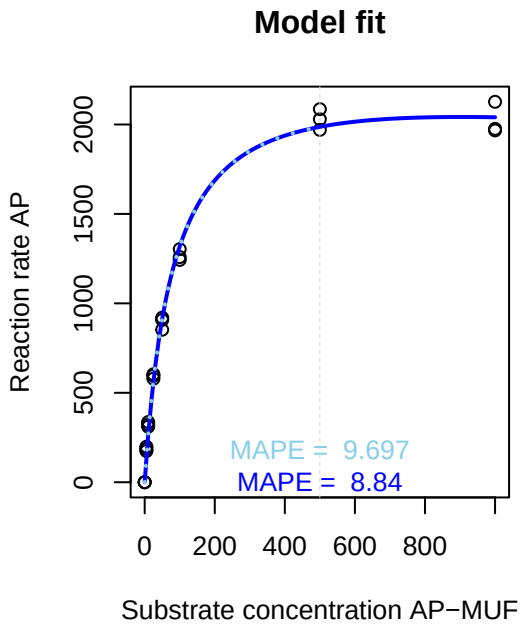

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
1000
3000
5000
RMSE = 109.4
RMSE = 109.4
Fitted values

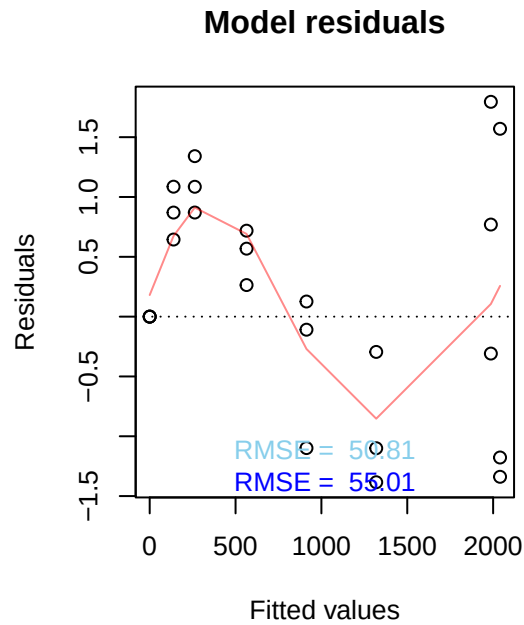

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
MAPE = 8.497
MAPE = 8.497
Substrate concentration AP−MUF


Model residuals
Residuals
−1.0
0.0
0.5
1.0
0
1000
3000
5000
RMSE = 105.8
RMSE = 105.8
Fitted values

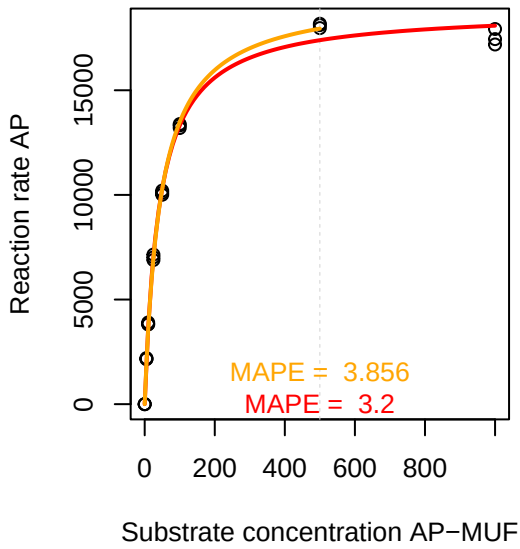

Model fit
Reaction rate AP
0
500
1000
1500
2000
0
200
400
600
800
MAPE = 8.982
MAPE = 7.441
Substrate concentration AP−MUF


Model residuals
Residuals
−2
−1
0
1
2
0
500
1000
1500
2000
RMSE = 59.43
RMSE = 59.4
Fitted values

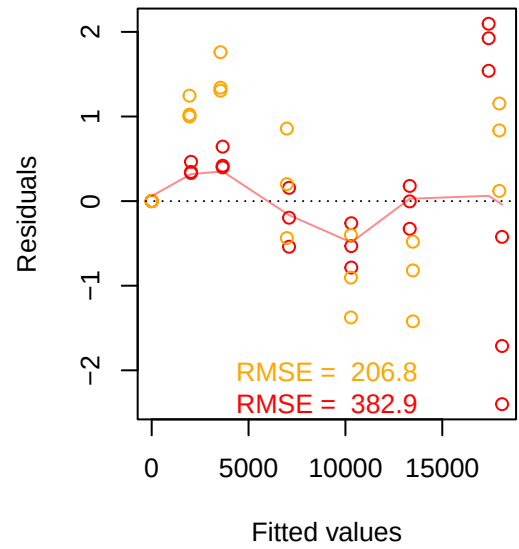

Model fit
Reaction rate AP
0
500
1000
1500
2000
0
200
400
600
800
MAPE = 9.697
MAPE = 8.84
Substrate concentration AP−MUF


Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
500
1000
1500
2000
RMSE = 56.81
RMSE = 55.01
Fitted values

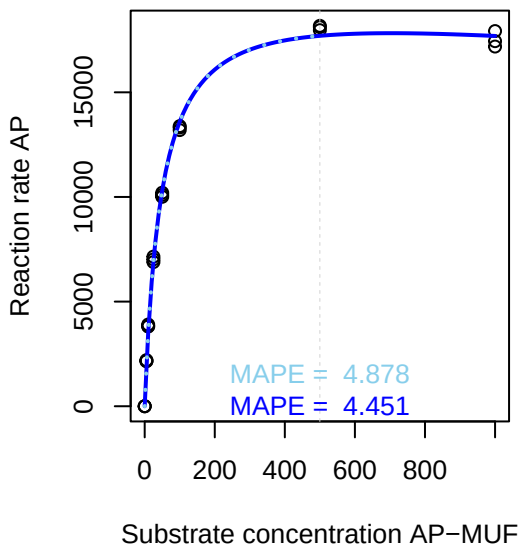
Model fit



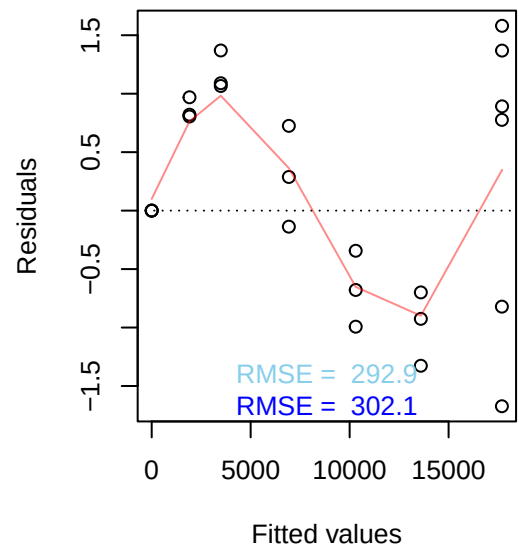
Model residuals

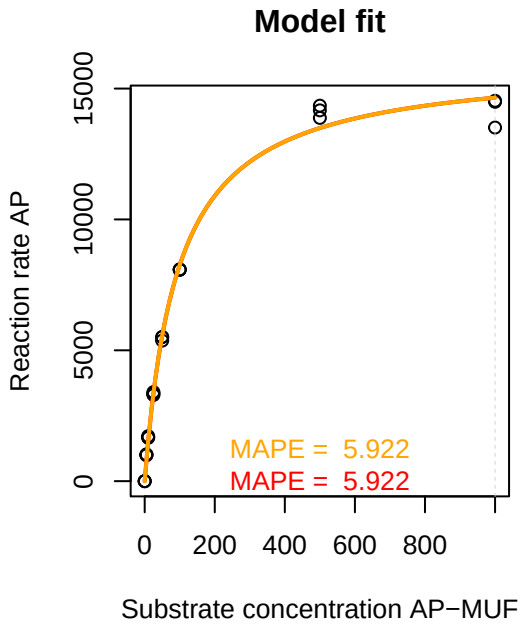


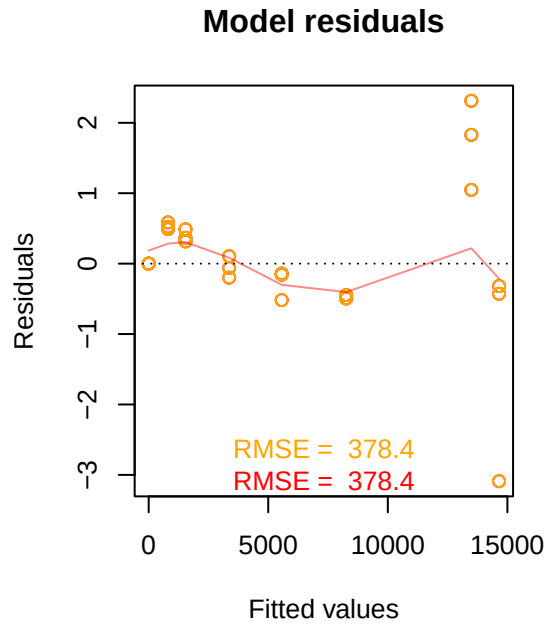
Model fit

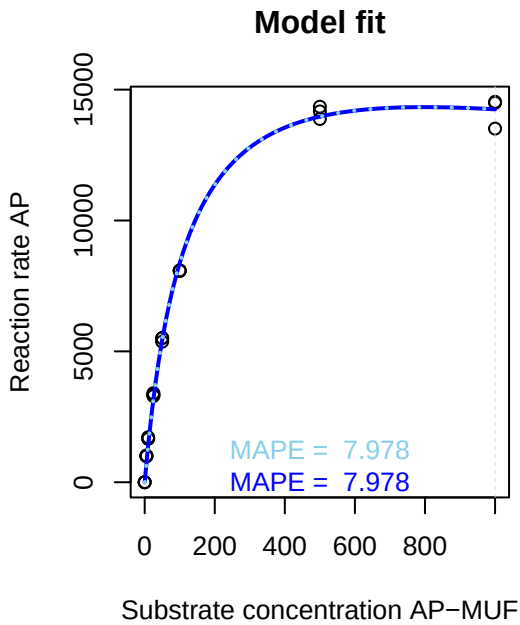


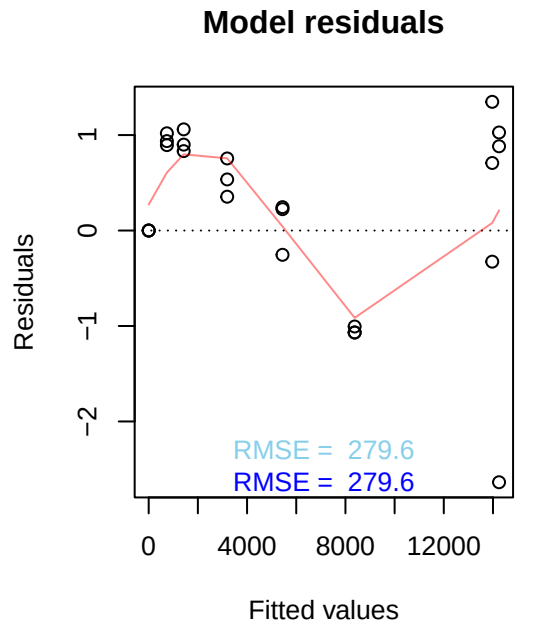
Model residuals

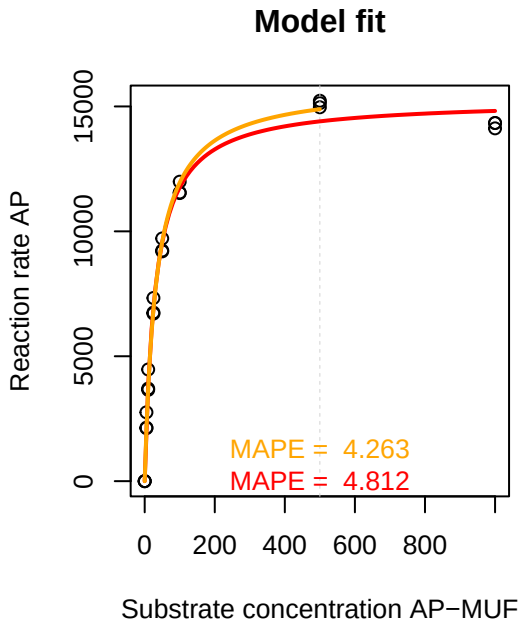


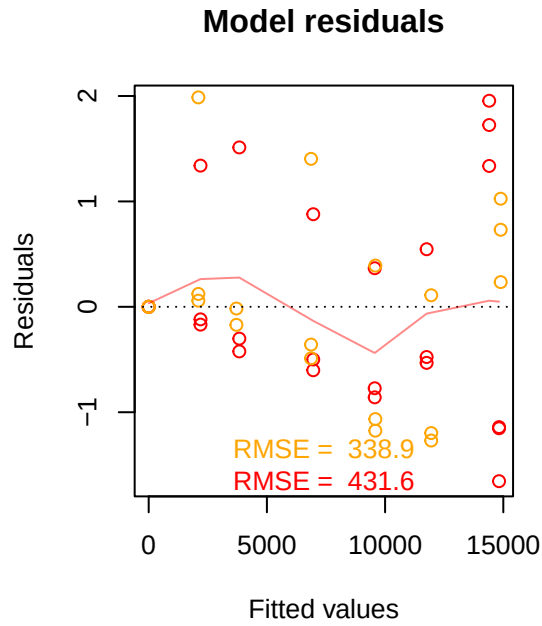

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 5.922
MAPE = 5.922

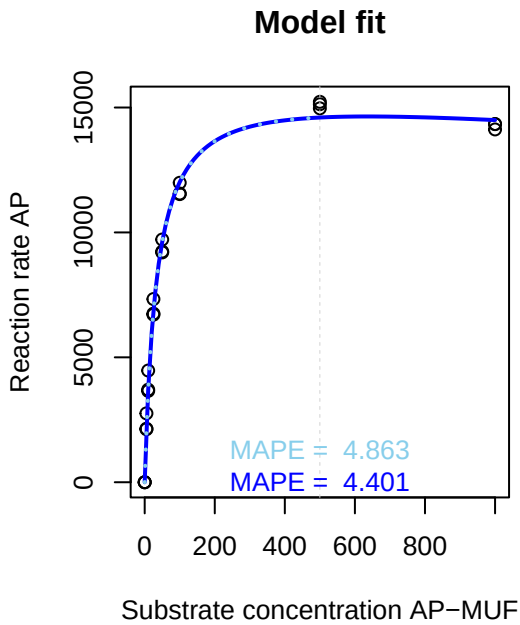

Model residuals
Residuals
−3
−2
−1
0
1
2
0
5000
10000
15000
Fitted values
RMSE = 378.4
RMSE = 378.4

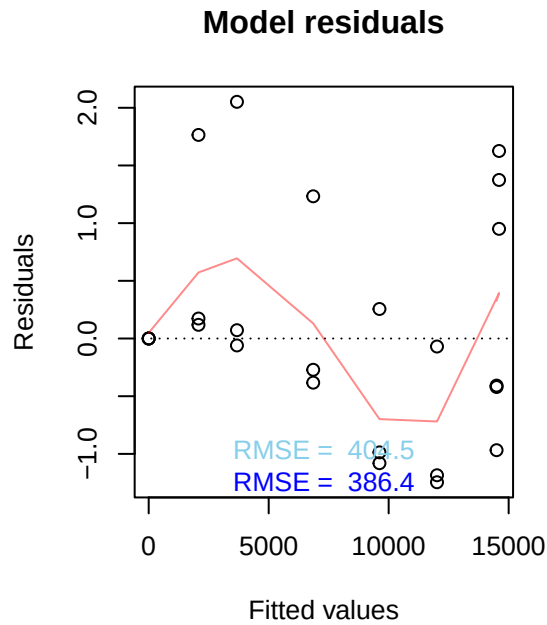

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 7.978
MAPE = 7.978

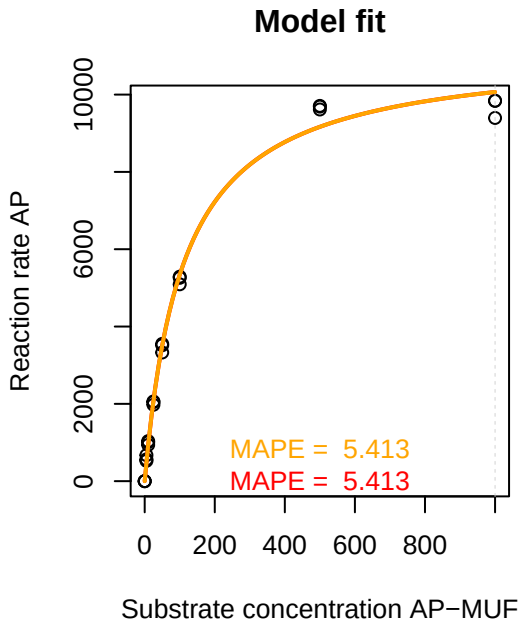

Model residuals
Residuals
−2
−1
0
1
0
4000
8000
12000
Fitted values
RMSE = 279.6
RMSE = 279.6

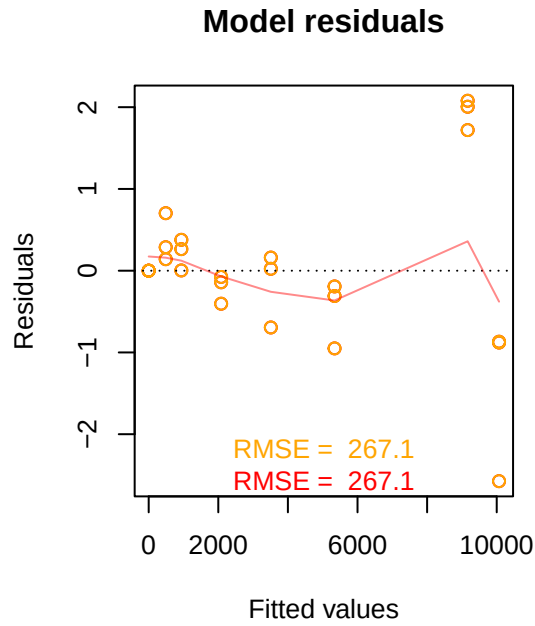

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 4.263
MAPE = 4.812

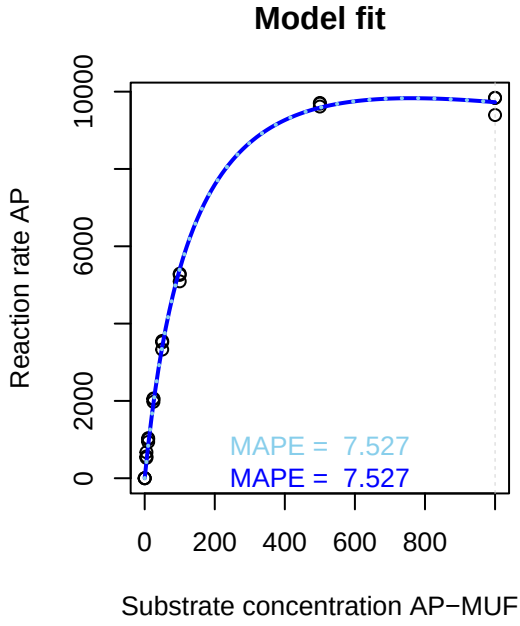

Model residuals
Residuals
−1
0
1
2
0
5000
10000
15000
Fitted values
RMSE = 338.9
RMSE = 431.6

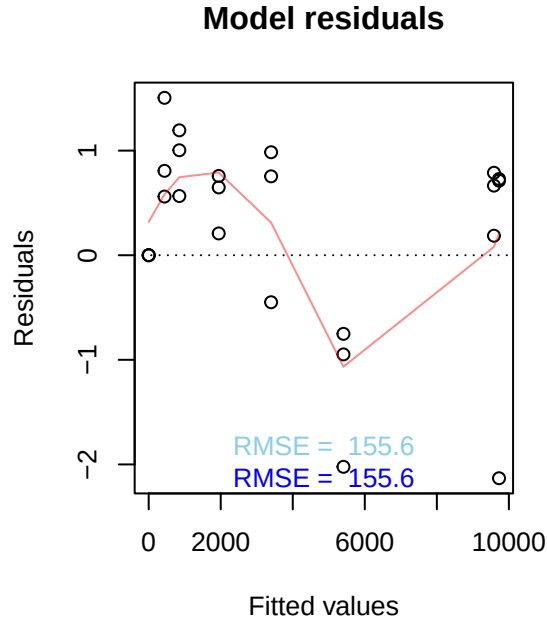

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 4.863
MAPE = 4.401

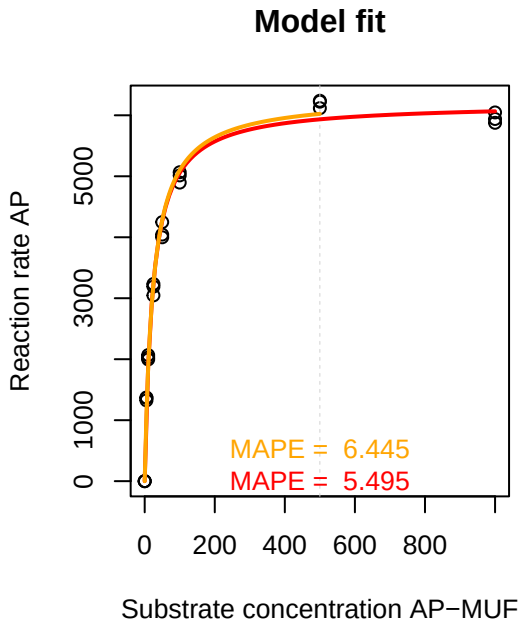

Model residuals
Residuals
−1.0
0.0
1.0
2.0
0
5000
10000
15000
Fitted values
RMSE = 404.5
RMSE = 386.4

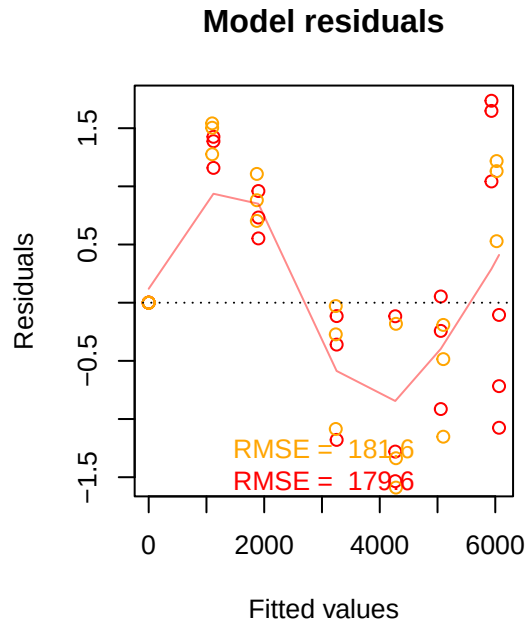

Model fit
Reaction rate AP
0
2000
6000
10000
MAPE = 5.413
MAPE = 5.413
0
200
400
600
800
Substrate concentration AP−MUF

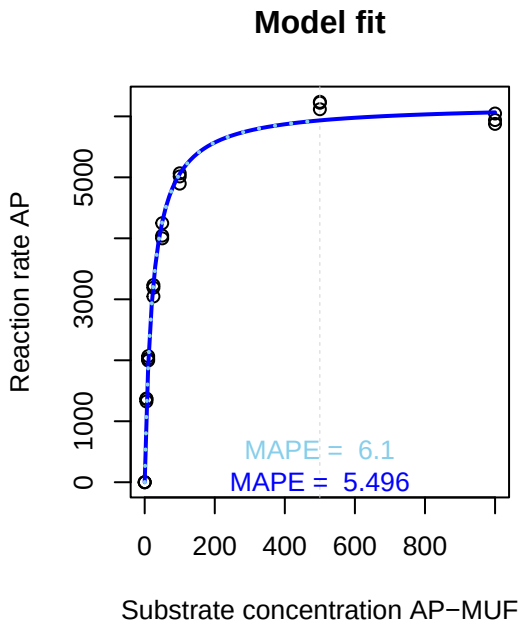

Model residuals
Residuals
−2
−1
0
1
2
RMSE = 267.1
RMSE = 267.1
0
2000
6000
10000
Fitted values

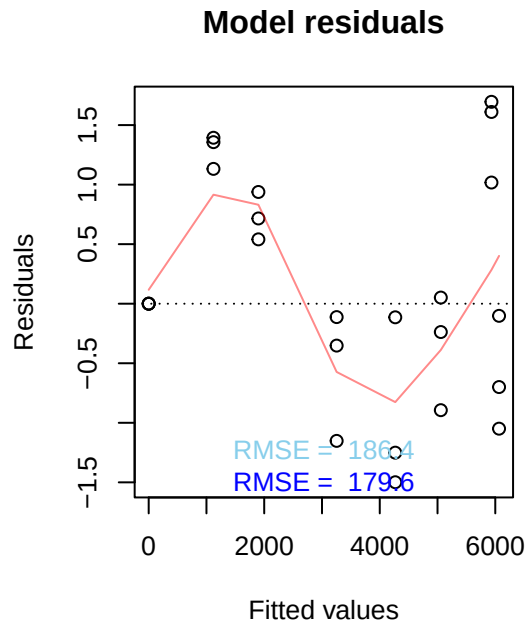

Model fit
Reaction rate AP
0
2000
6000
10000
MAPE = 7.527
MAPE = 7.527
0
200
400
600
800
Substrate concentration AP−MUF

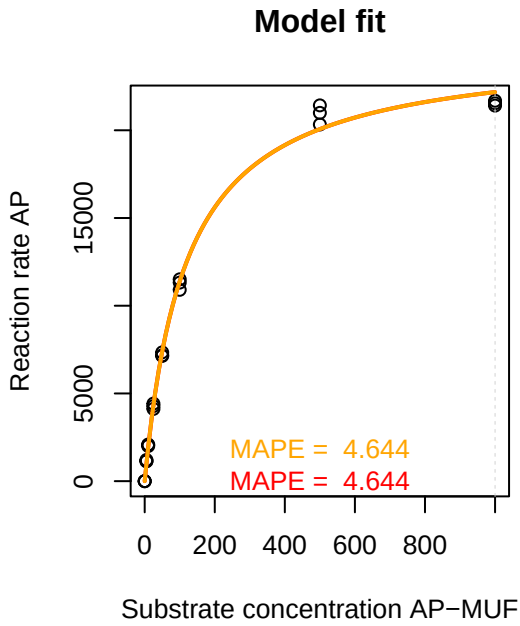

Model residuals
Residuals
−2
−1
0
1
RMSE = 155.6
RMSE = 155.6
0
2000
6000
10000
Fitted values

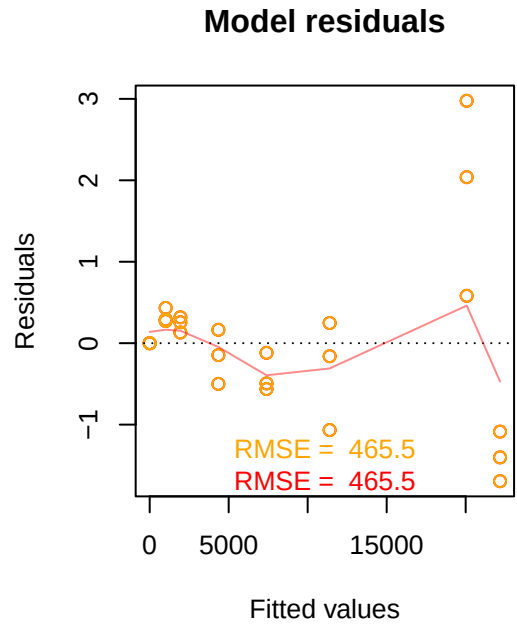

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
MAPE = 6.445
MAPE = 5.495
Substrate concentration AP−MUF

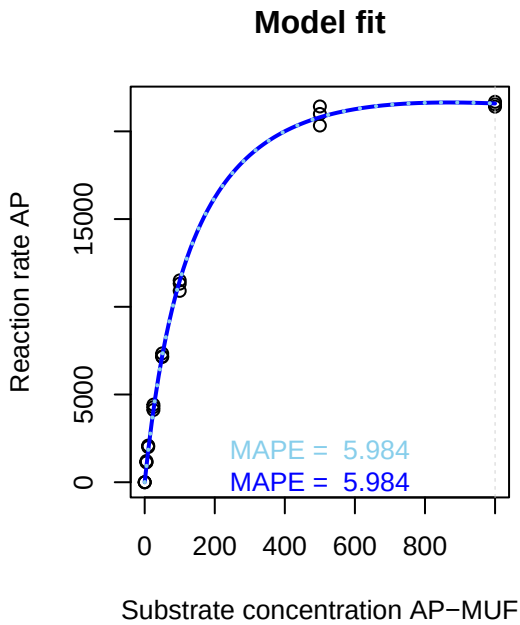

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
2000
4000
6000
RMSE = 1816
RMSE = 1796
Fitted values

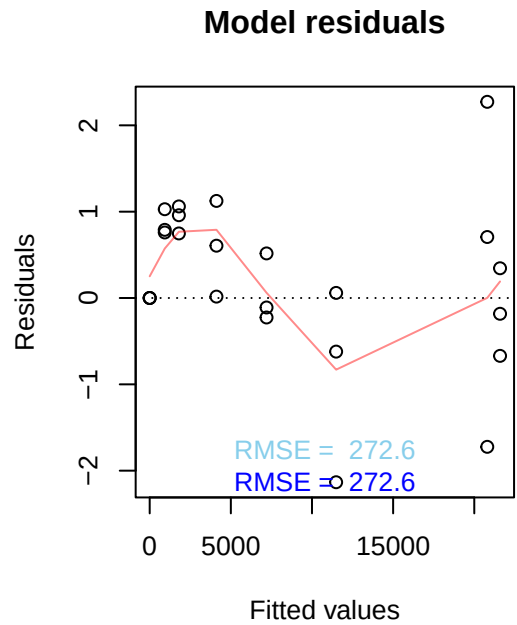

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
MAPE = 6.1
MAPE = 5.496
Substrate concentration AP−MUF

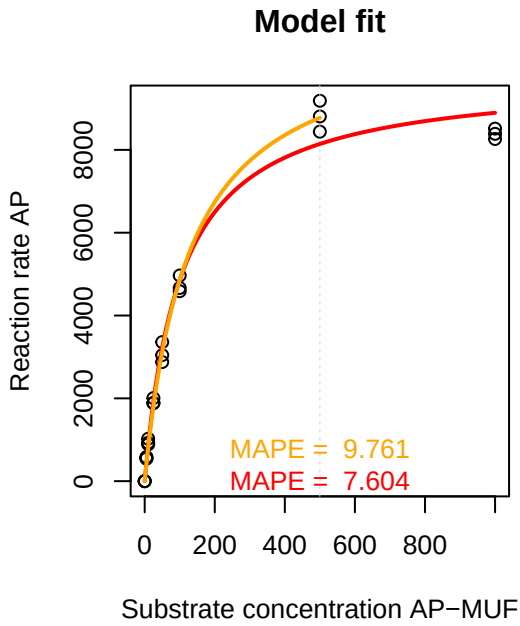

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
2000
4000
6000
RMSE = 1864
RMSE = 1796
Fitted values

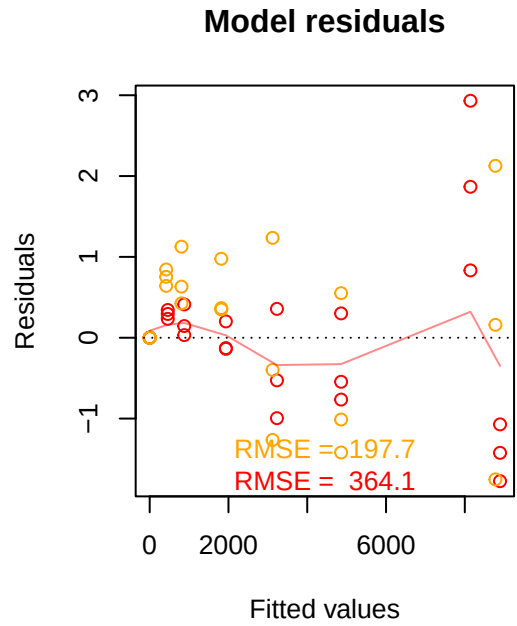

Model fit
Reaction rate AP
0
5000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 4.644
MAPE = 4.644

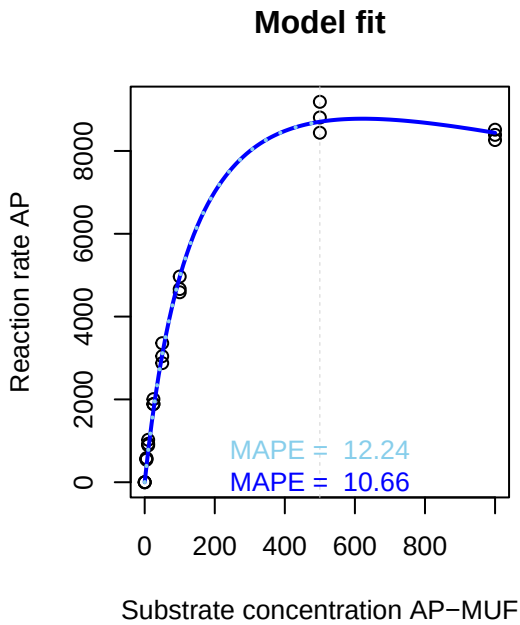

Model residuals
Residuals
−1
0
1
2
3
0
5000
15000
Fitted values
RMSE = 465.5
RMSE = 465.5

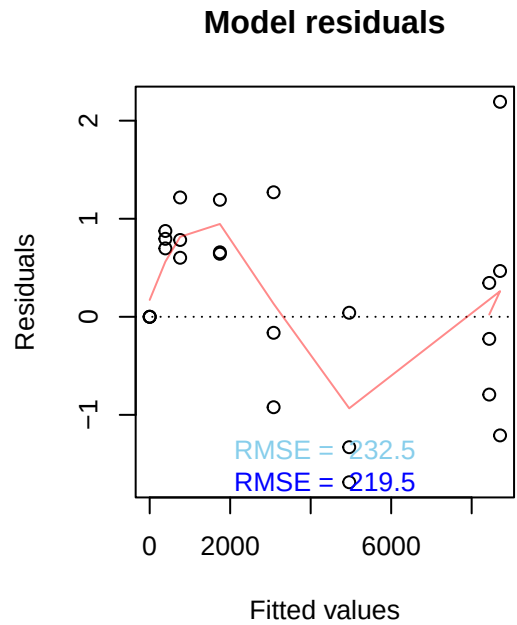

Model fit
Reaction rate AP
0
5000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 5.984
MAPE = 5.984

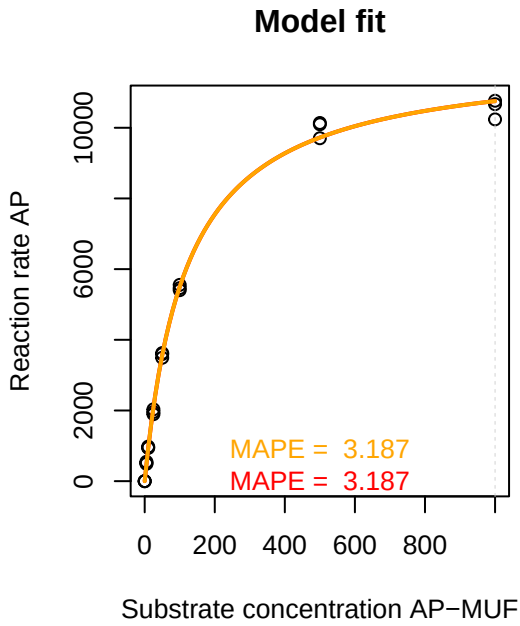

Model residuals
Residuals
−2
−1
0
1
2
0
5000
15000
Fitted values
RMSE = 272.6
RMSE = 272.6

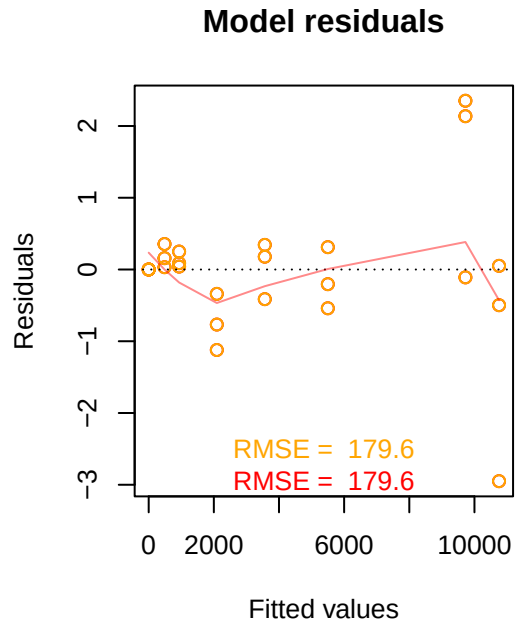

Model fit
Reaction rate AP
0
2000
4000
6000
8000
0
200
400
600
800
MAPE = 9.761
MAPE = 7.604
Substrate concentration AP−MUF

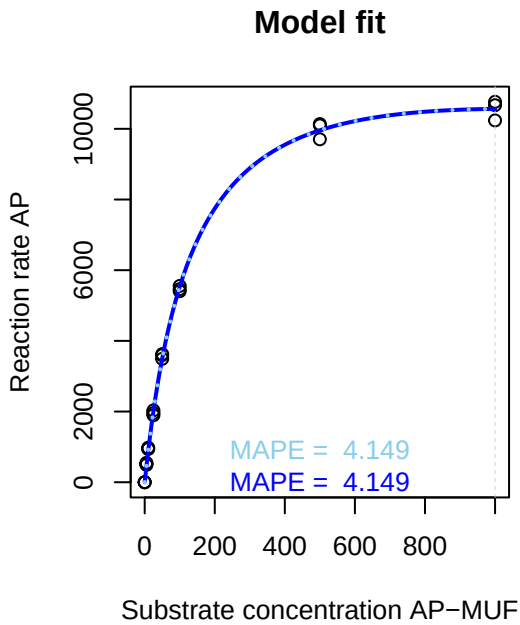

Model residuals
Residuals
−1
0
1
2
3
0
2000
6000
RMSE = 197.7
RMSE = 364.1
Fitted values

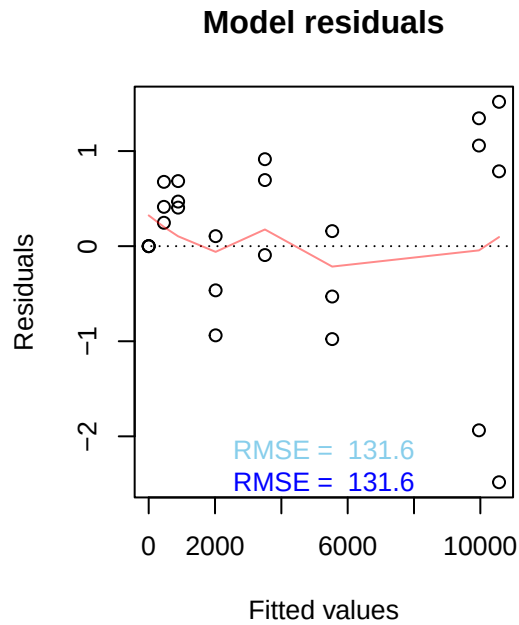

Model fit
Reaction rate AP
0
2000
4000
6000
8000
0
200
400
600
800
MAPE = 12.24
MAPE = 10.66
Substrate concentration AP−MUF

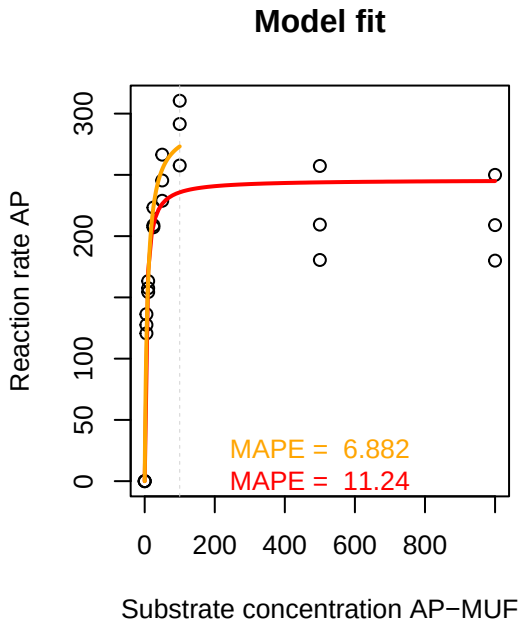

Model residuals
Residuals
−1
0
1
2
0
2000
6000
RMSE = 232.5
RMSE = 219.5
Fitted values

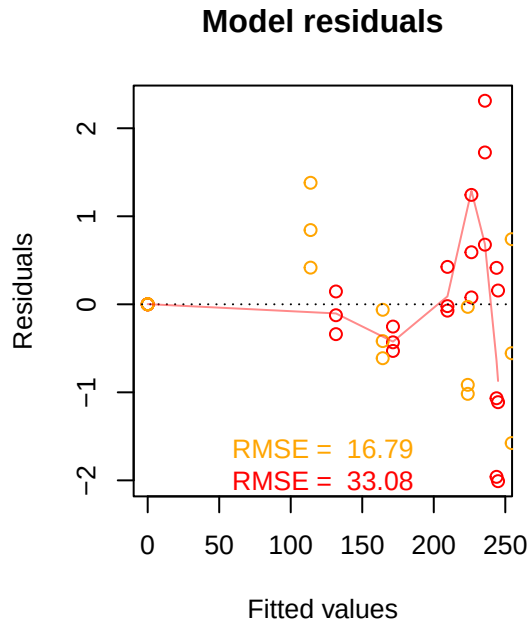

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
MAPE = 3.187
MAPE = 3.187
Substrate concentration AP−MUF

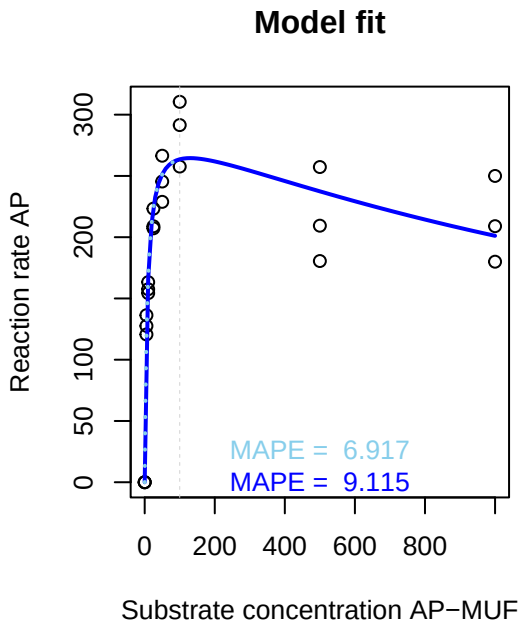

Model residuals
Residuals
−3
−2
−1
0
1
2
0
2000
6000
10000
RMSE = 179.6
RMSE = 179.6
Fitted values

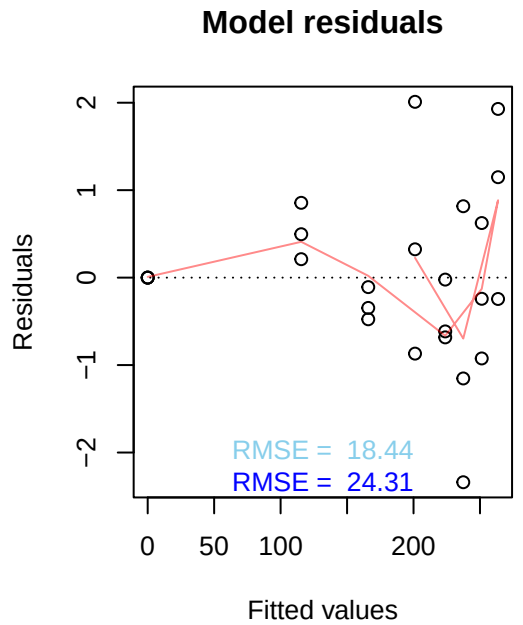

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
MAPE = 4.149
MAPE = 4.149
Substrate concentration AP−MUF

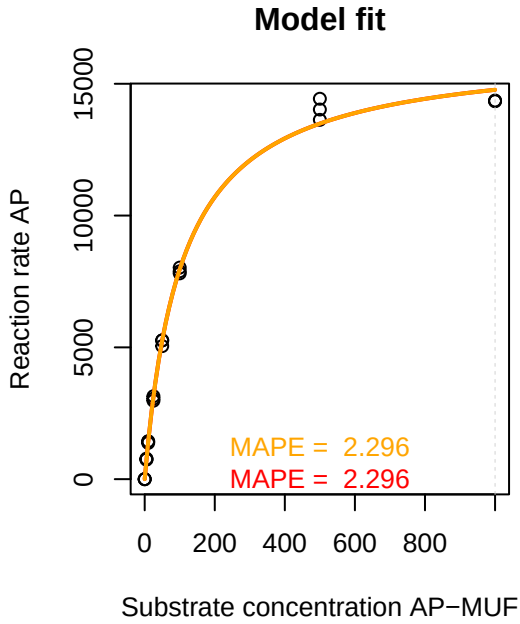

Model residuals
Residuals
−2
−1
0
1
0
2000
6000
10000
RMSE = 131.6
RMSE = 131.6
Fitted values

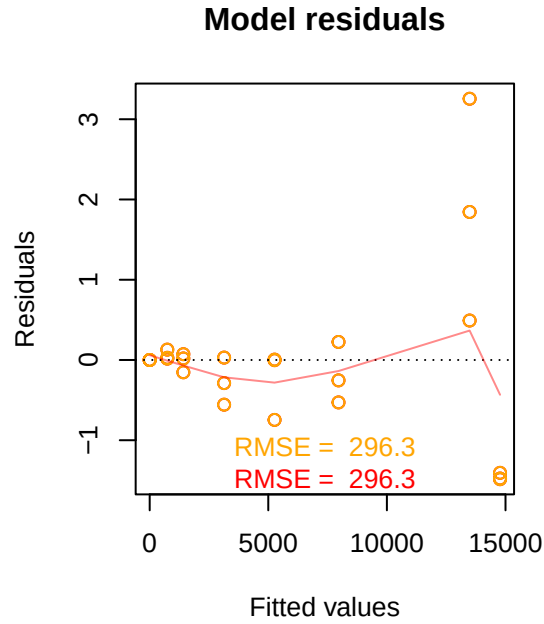

Model fit
Reaction rate AP
0
50
100
200
300
0
200
400
600
800
MAPE = 6.882
MAPE = 11.24
Substrate concentration AP−MUF

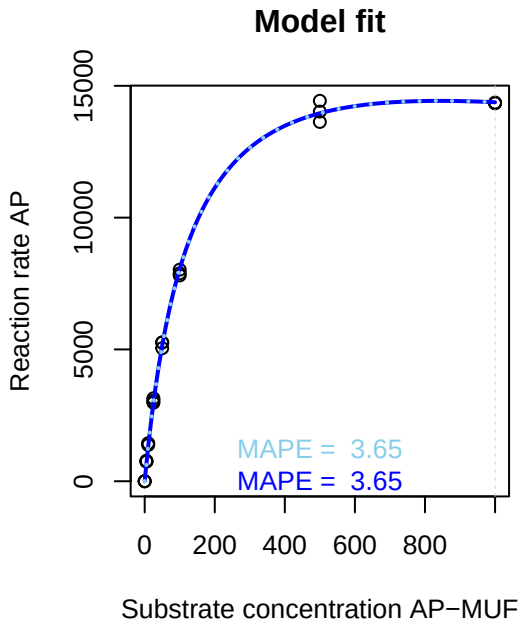

Model residuals
Residuals
−2
−1
0
1
2
0
50
100
150
200
250
RMSE = 16.79
RMSE = 33.08
Fitted values

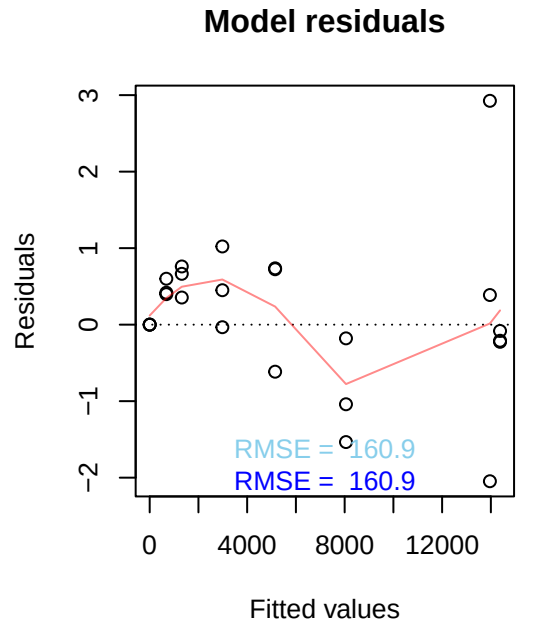

Model fit
Reaction rate AP
0
50
100
200
300
0
200
400
600
800
MAPE = 6.917
MAPE = 9.115
Substrate concentration AP−MUF

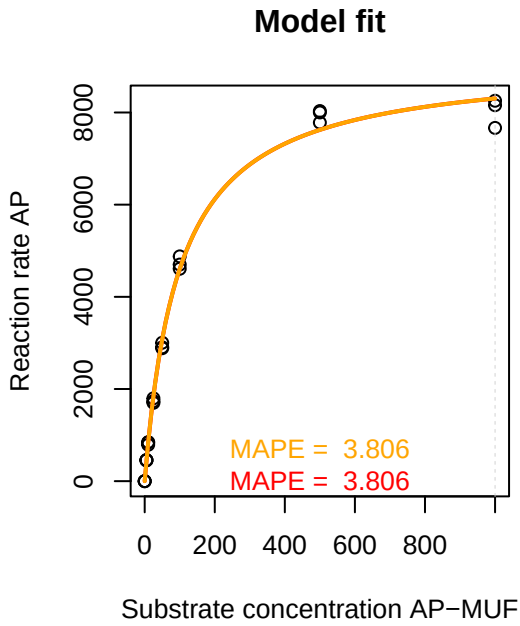

Model residuals
Residuals
−2
−1
0
1
2
0
50
100
200
RMSE = 18.44
RMSE = 24.31
Fitted values

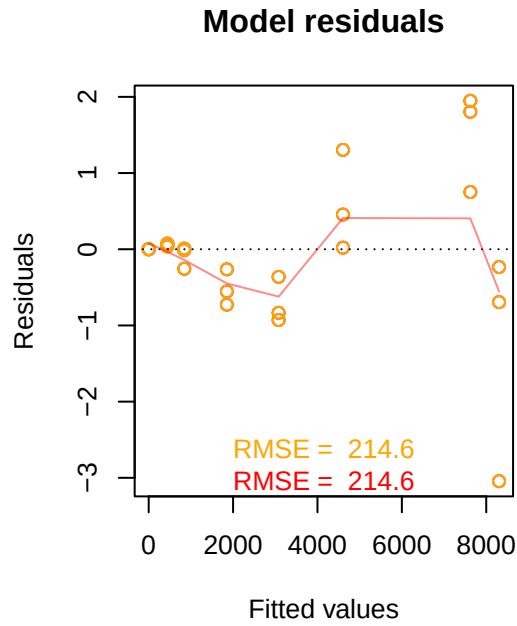

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 2.296
MAPE = 2.296

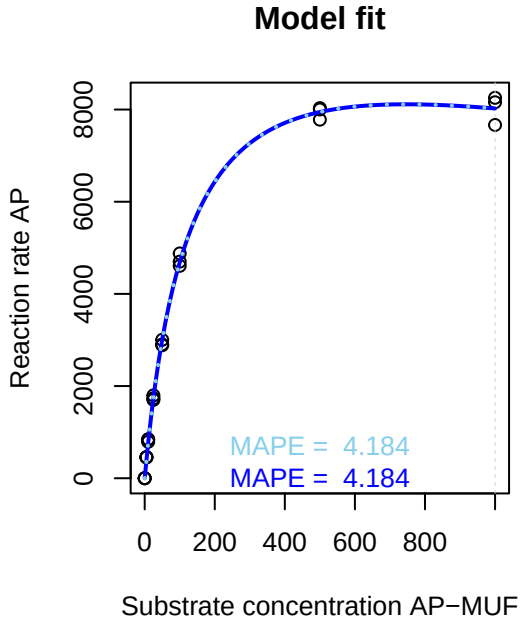

Model residuals
Residuals
−1
0
1
2
3
0
5000
10000
15000
Fitted values
RMSE = 296.3
RMSE = 296.3

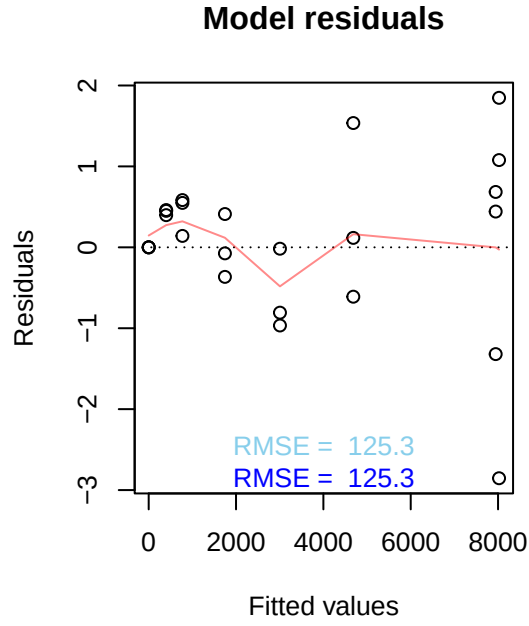

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 3.65
MAPE = 3.65

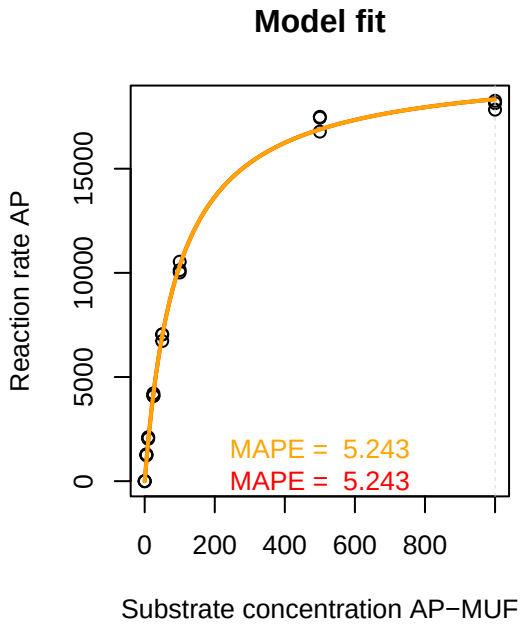

Model residuals
Residuals
−2
−1
0
1
2
3
0
4000
8000
12000
Fitted values
RMSE = 160.9
RMSE = 160.9

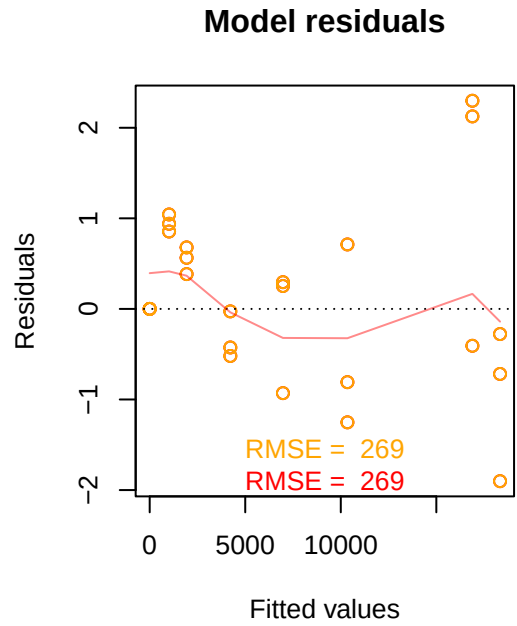

Model fit
Reaction rate AP
0
2000
4000
6000
8000
MAPE = 3.806
MAPE = 3.806
0
200
400
600
800
Substrate concentration AP−MUF

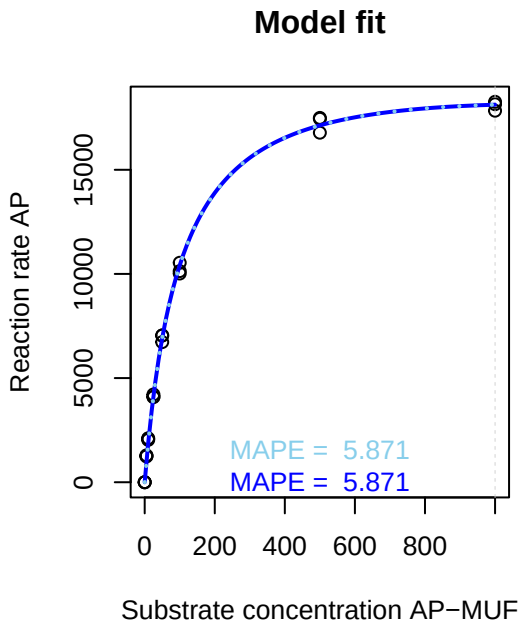

Model residuals
Residuals
2
1
0
−1
−2
−3
RMSE = 214.6
RMSE = 214.6
0
2000
4000
6000
8000
Fitted values

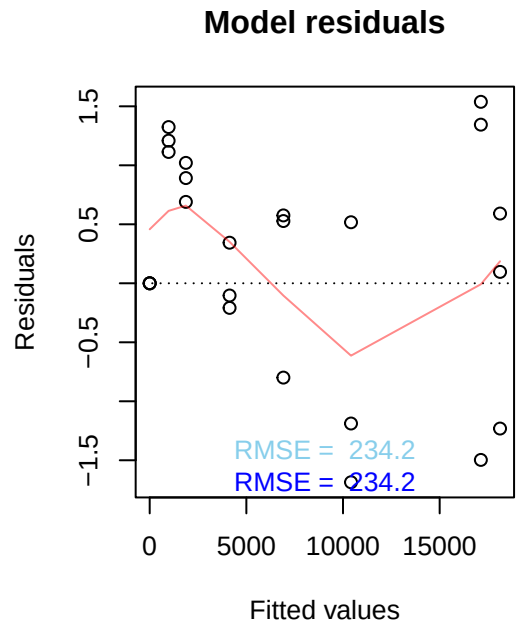

Model fit
Reaction rate AP
0
2000
4000
6000
8000
MAPE = 4.184
MAPE = 4.184
0
200
400
600
800
Substrate concentration AP−MUF

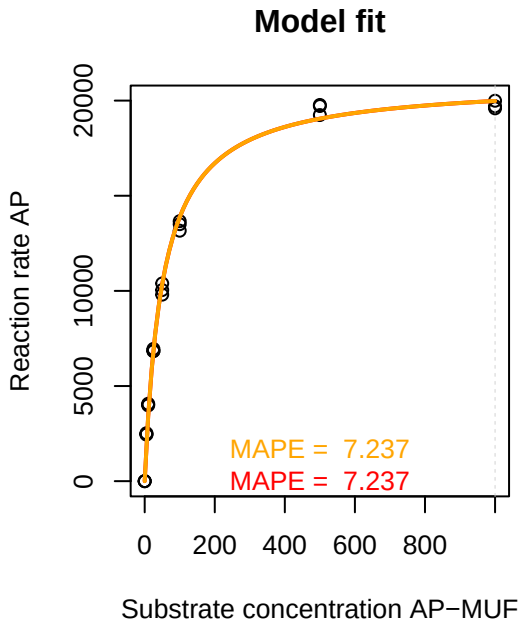

Model residuals
Residuals
2
1
0
−1
−2
−3
RMSE = 125.3
RMSE = 125.3
0
2000
4000
6000
8000
Fitted values

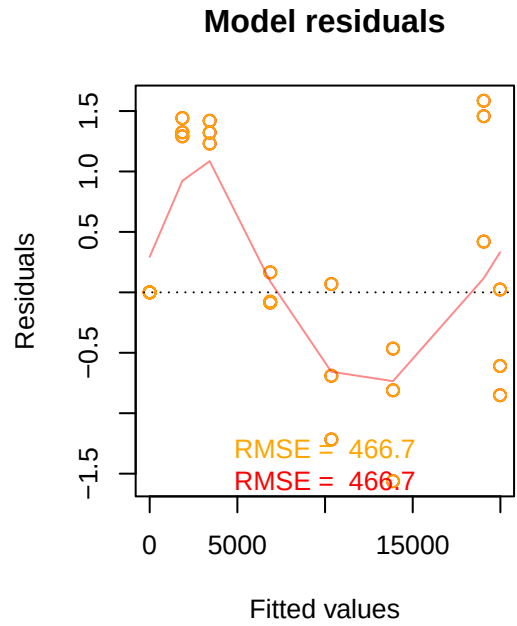

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
MAPE = 5.243
MAPE = 5.243
Substrate concentration AP−MUF

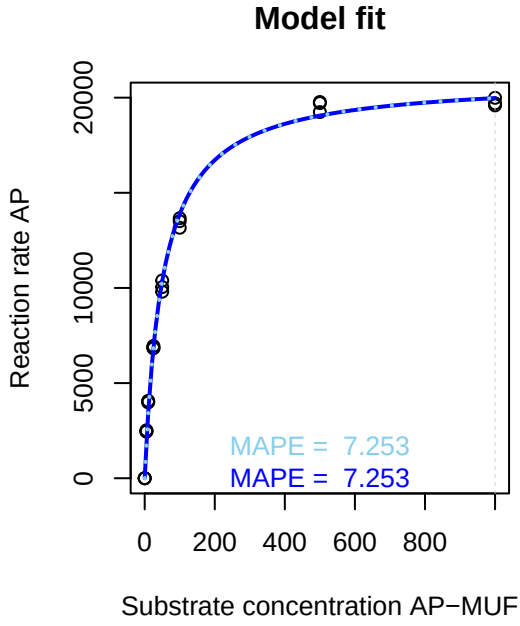

Model residuals
Residuals
−2
−1
0
1
2
0
5000
10000
RMSE = 269
RMSE = 269
Fitted values

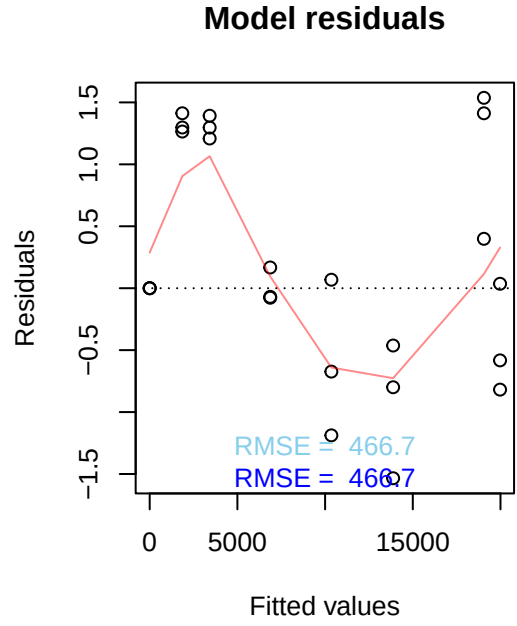

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
MAPE = 5.871
MAPE = 5.871
Substrate concentration AP−MUF

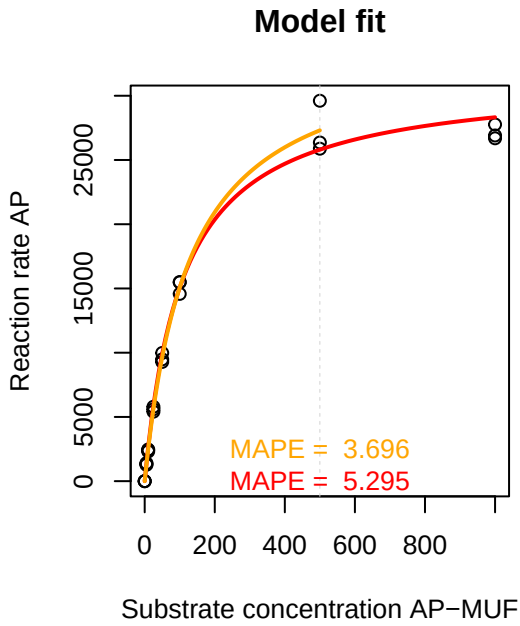

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
5000
10000
15000
RMSE = 234.2
RMSE = 234.2
Fitted values

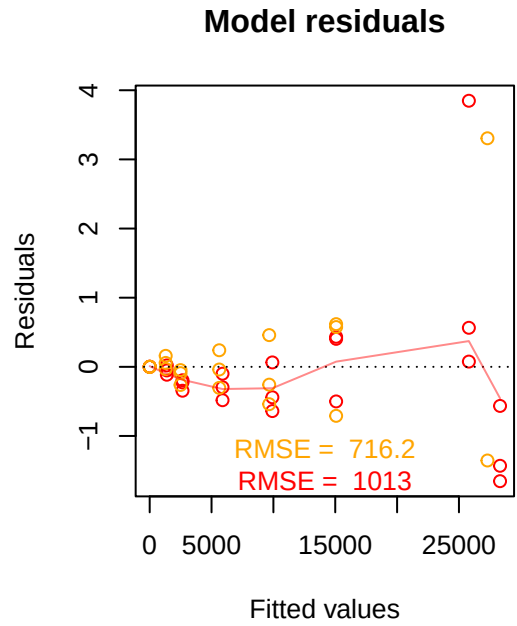

Model fit
Reaction rate AP
0
5000
10000
20000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 7.237
MAPE = 7.237

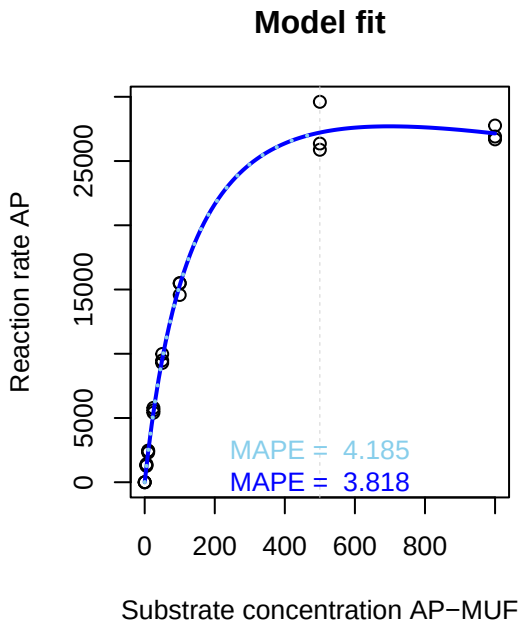

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
5000
15000
Fitted values
RMSE = 466.7
RMSE = 466.7

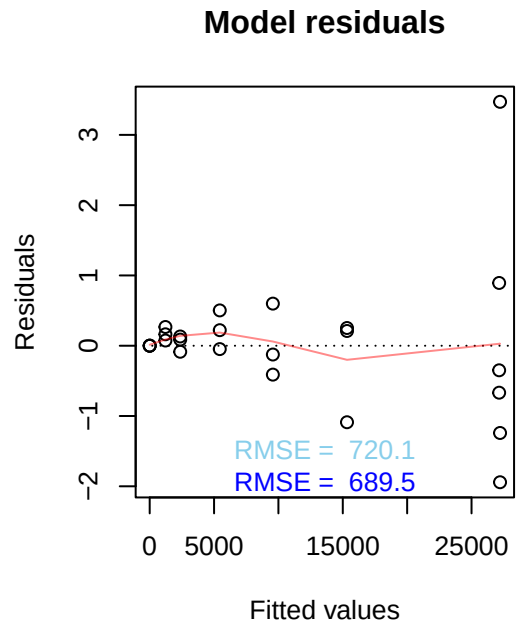

Model fit
Reaction rate AP
0
5000
10000
20000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 7.253
MAPE = 7.253

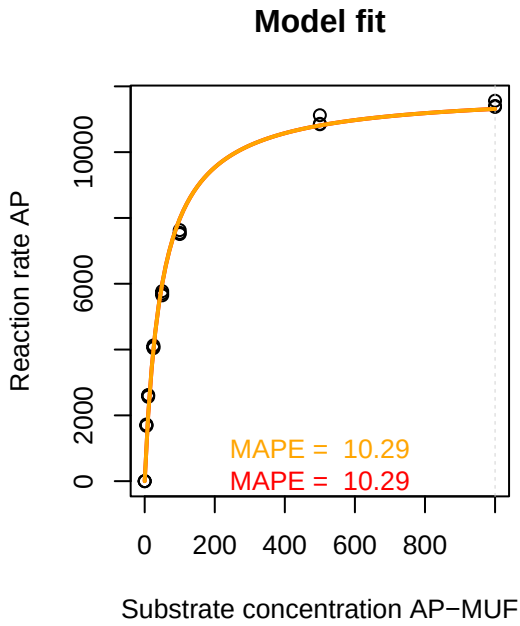

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
5000
15000
Fitted values
RMSE = 466.7
RMSE = 466.7

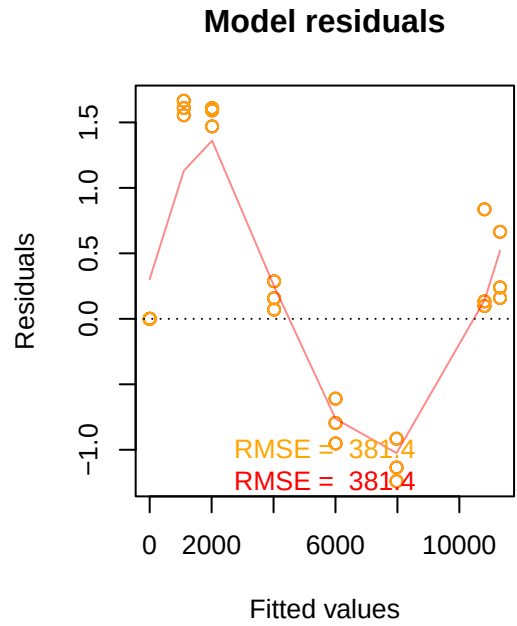

Model fit
Reaction rate AP
0
5000
15000
25000
0
200
400
600
800
MAPE = 3.696
MAPE = 5.295
Substrate concentration AP−MUF

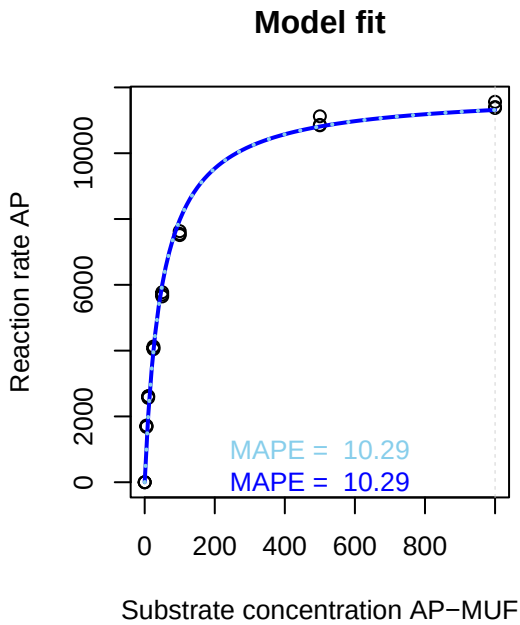

Model residuals
Residuals
−1
0
1
2
3
4
0
5000
15000
25000
RMSE = 716.2
RMSE = 1013
Fitted values

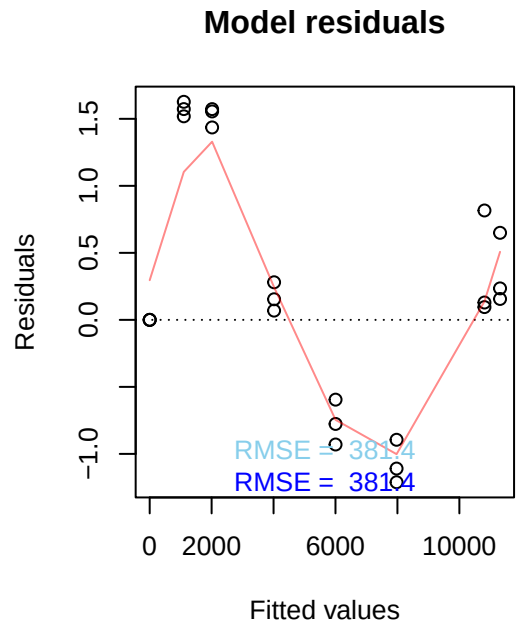

Model fit
Reaction rate AP
0
5000
15000
25000
0
200
400
600
800
MAPE = 4.185
MAPE = 3.818
Substrate concentration AP−MUF

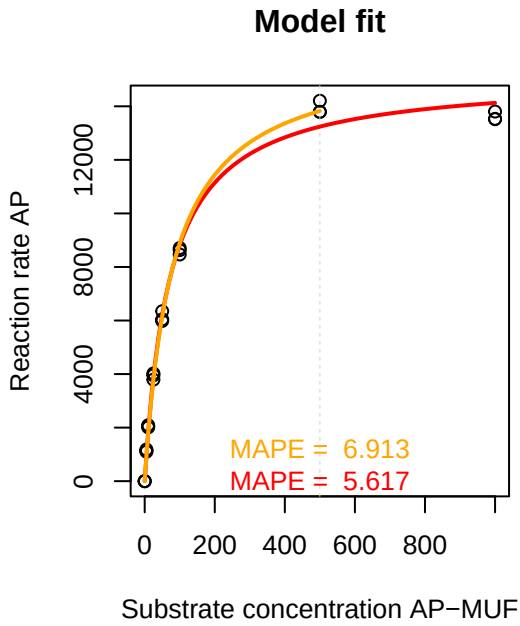

Model residuals
Residuals
−2
−1
0
1
2
3
0
5000
15000
25000
RMSE = 720.1
RMSE = 689.5
Fitted values

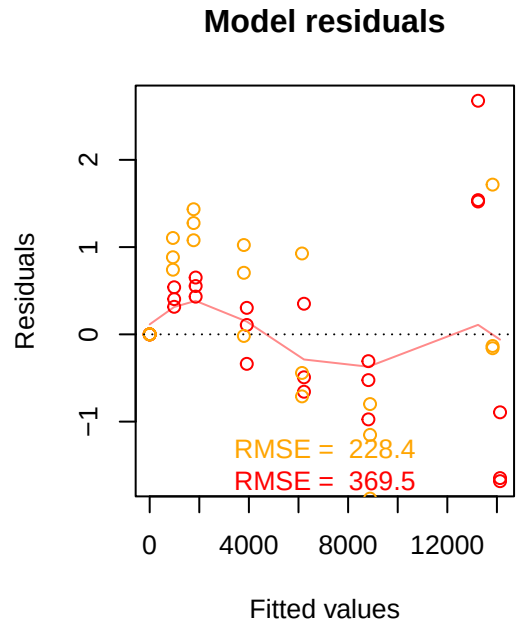

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 10.29
MAPE = 10.29

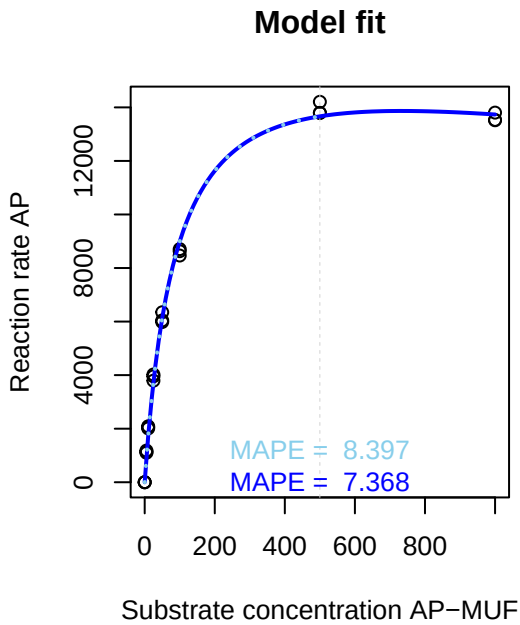

Model residuals
Residuals
−1.0
0.0
0.5
1.0
1.5
0
2000
6000
10000
Fitted values
RMSE = 3814
RMSE = 3814

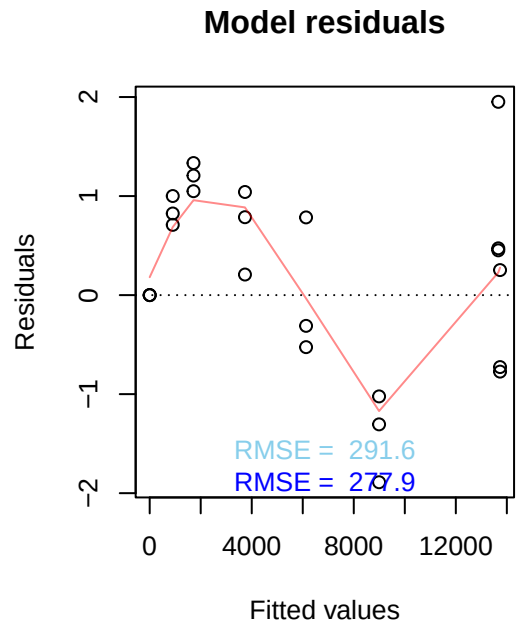

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 10.29
MAPE = 10.29

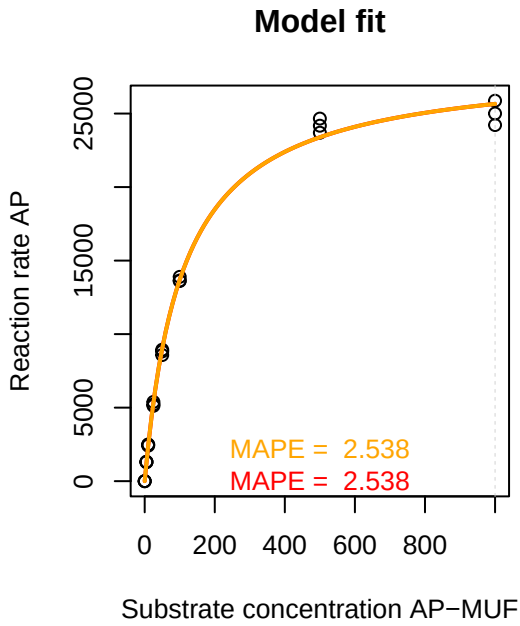

Model residuals
Residuals
−1.0
0.0
0.5
1.0
1.5
0
2000
6000
10000
Fitted values
RMSE = 3814
RMSE = 3814

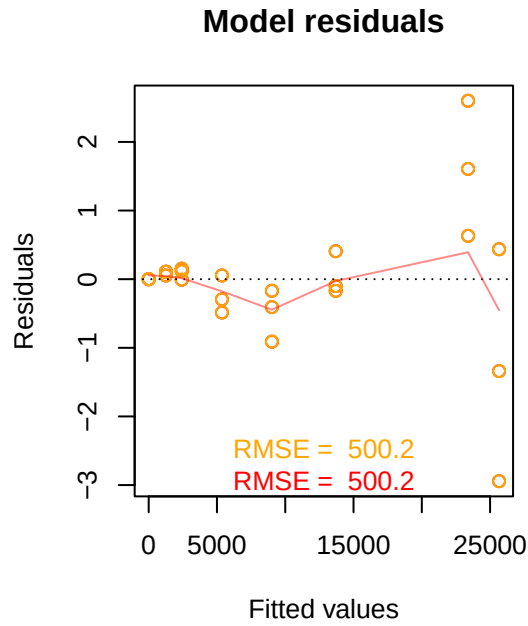

Model fit
Reaction rate AP
0
4000
8000
12000
MAPE = 6.913
MAPE = 5.617
0
200
400
600
800
Substrate concentration AP−MUF

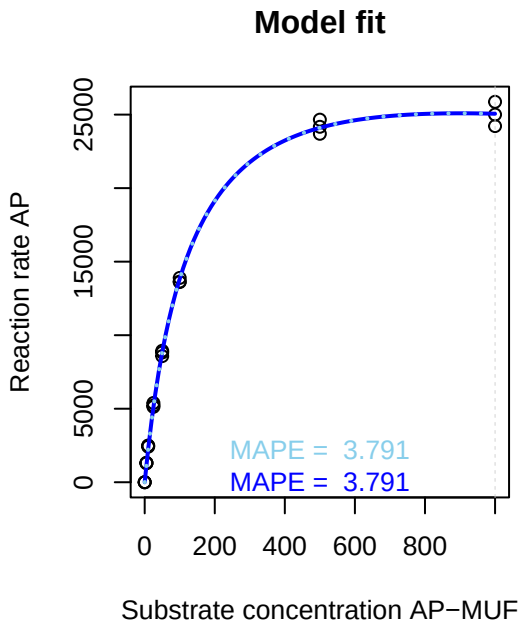

Model residuals
Residuals
−1
0
1
2
RMSE = 228.4
RMSE = 369.5
0
4000
8000
12000
Fitted values

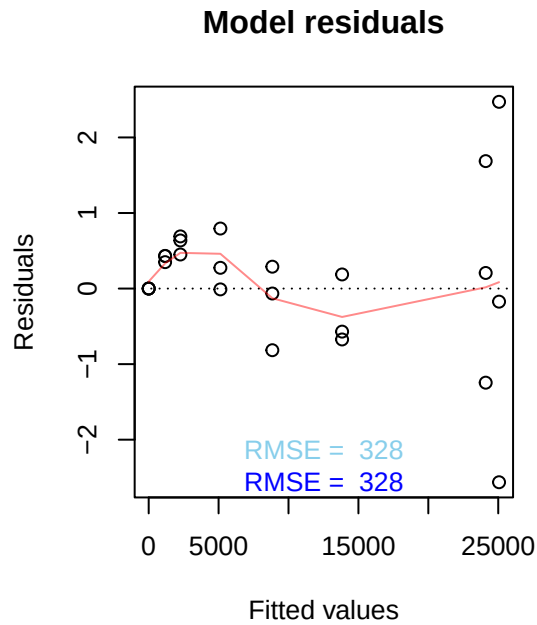

Model fit
Reaction rate AP
0
4000
8000
12000
MAPE = 8.397
MAPE = 7.368
0
200
400
600
800
Substrate concentration AP−MUF

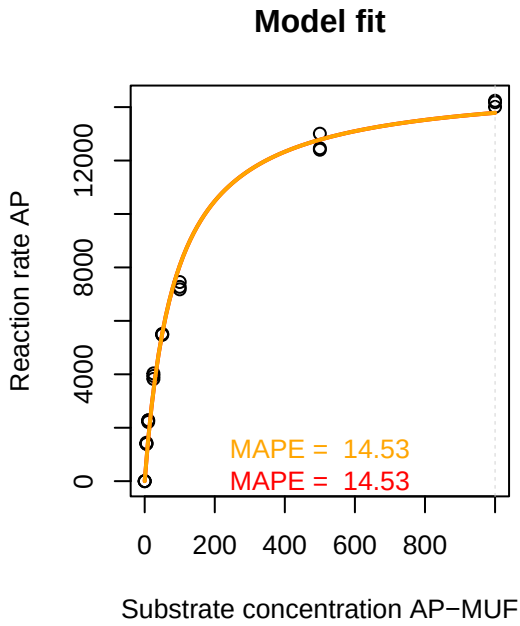

Model residuals
Residuals
−2
−1
0
1
2
RMSE = 291.6
RMSE = 277.9
0
4000
8000
12000
Fitted values

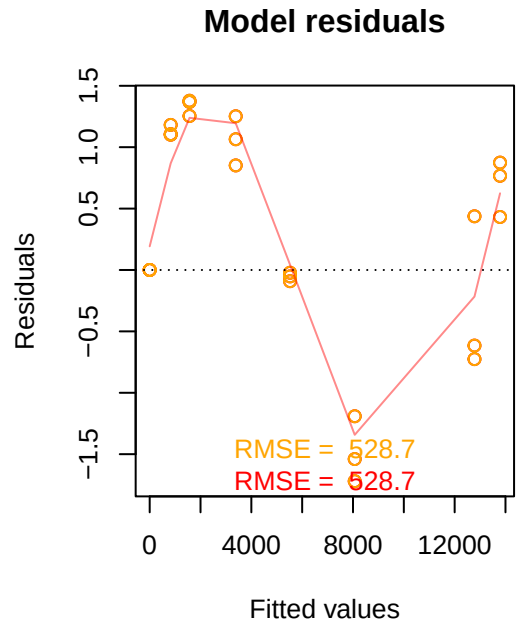

Model fit
Reaction rate AP
0
5000
15000
25000
0
200
400
600
800
MAPE = 2.538
MAPE = 2.538
Substrate concentration AP−MUF

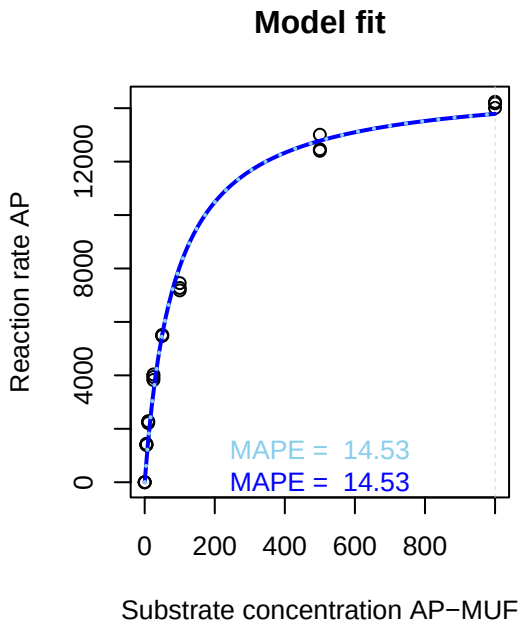

Model residuals
Residuals
−3
−2
−1
0
1
2
0
5000
15000
25000
RMSE = 500.2
RMSE = 500.2
Fitted values

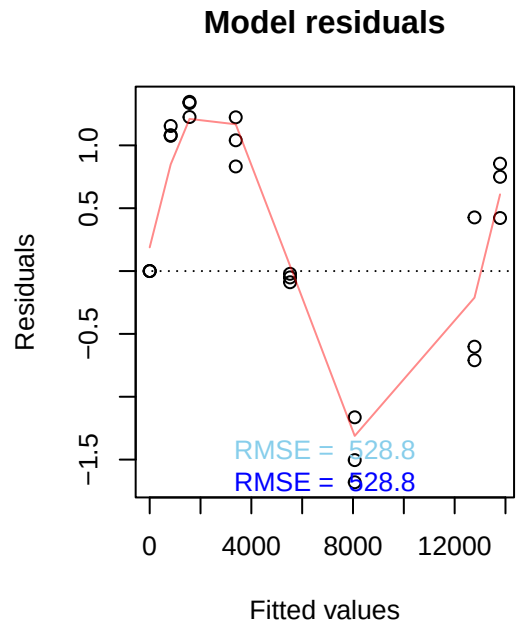

Model fit
Reaction rate AP
0
5000
15000
25000
0
200
400
600
800
MAPE = 3.791
MAPE = 3.791
Substrate concentration AP−MUF

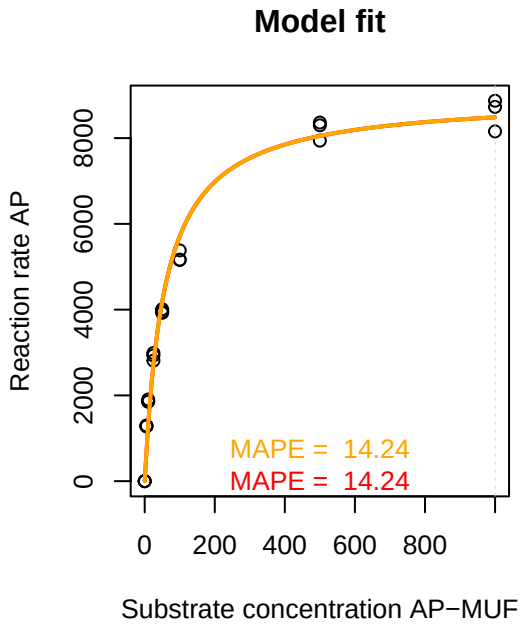

Model residuals
Residuals
−2
−1
0
1
2
0
5000
15000
25000
RMSE = 328
RMSE = 328
Fitted values

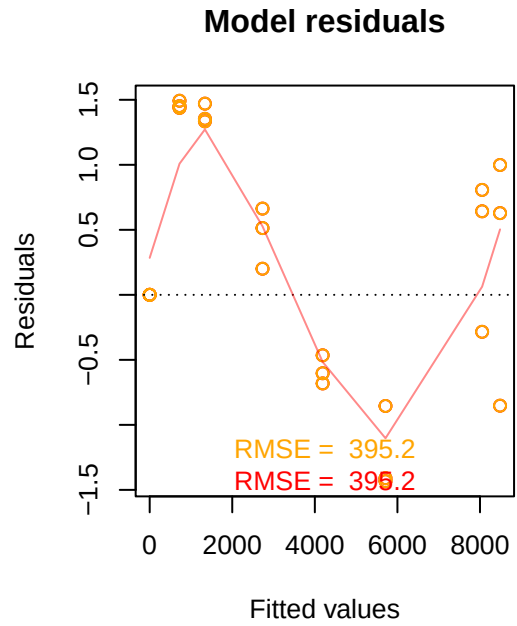

Model fit
Reaction rate AP
0
4000
8000
12000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 14.53
MAPE = 14.53

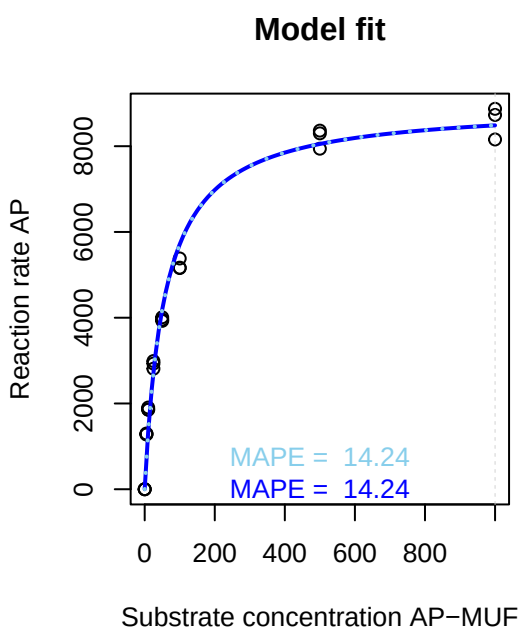

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
4000
8000
12000
Fitted values
RMSE = 528.7
RMSE = 528.7

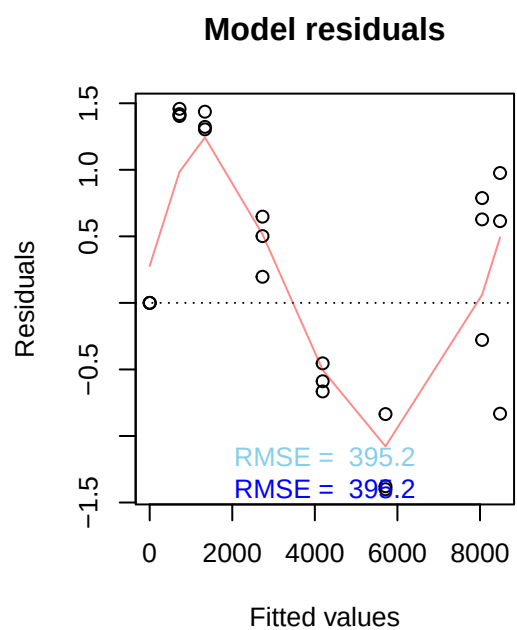

Model fit
Reaction rate AP
0
4000
8000
12000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 14.53
MAPE = 14.53

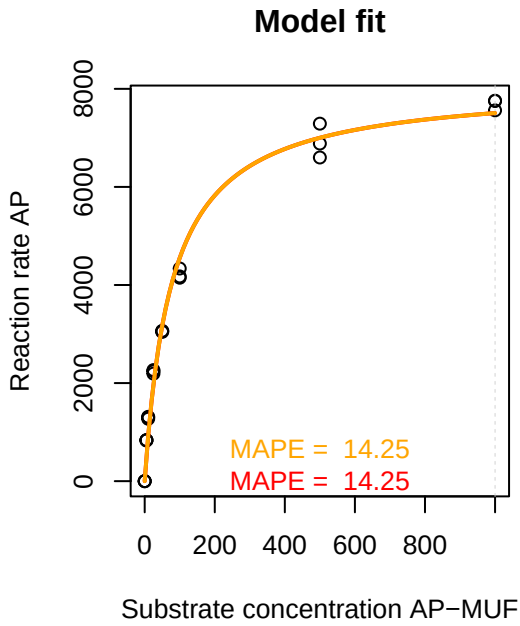

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
0
4000
8000
12000
Fitted values
RMSE = 528.8
RMSE = 528.8

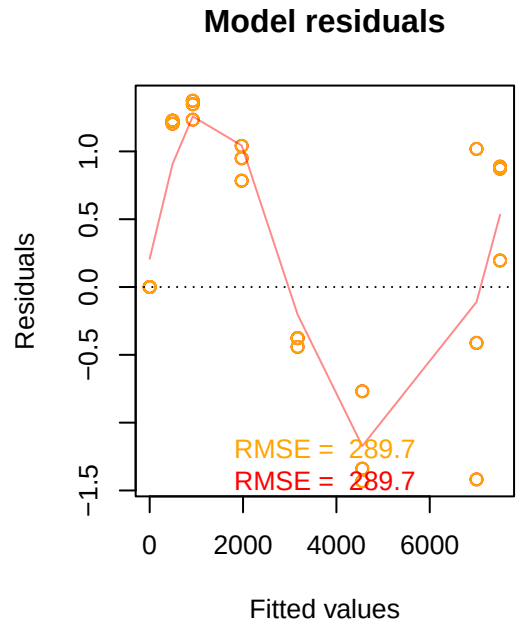

Model fit
Reaction rate AP
0
2000
4000
6000
8000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 14.24
MAPE = 14.24

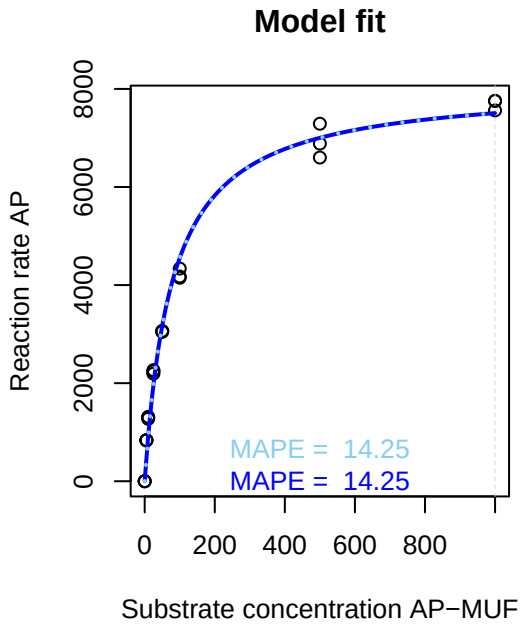

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
2000
4000
6000
8000
Fitted values
RMSE = 395.2
RMSE = 395.2

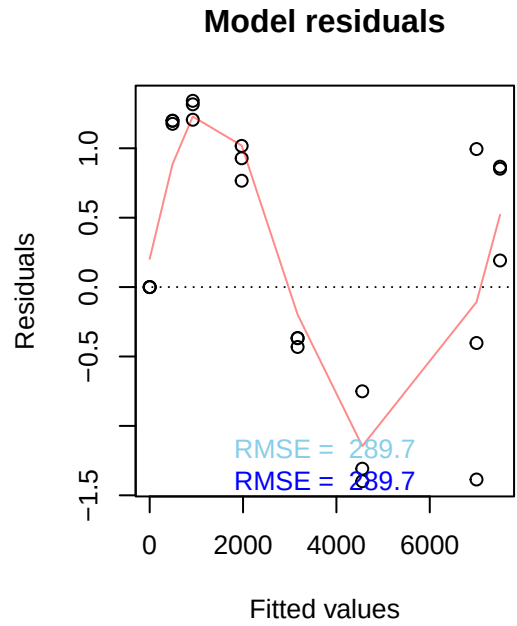

Model fit
Reaction rate AP
0
2000
4000
6000
8000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 14.24
MAPE = 14.24

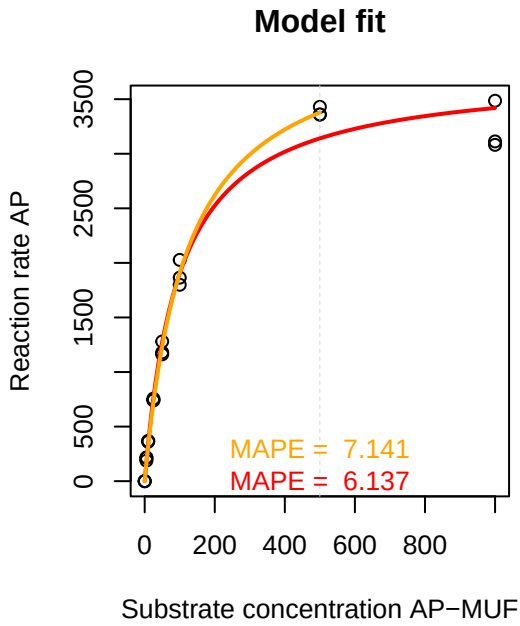

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
2000
4000
6000
8000
Fitted values
RMSE = 395.2
RMSE = 395.2

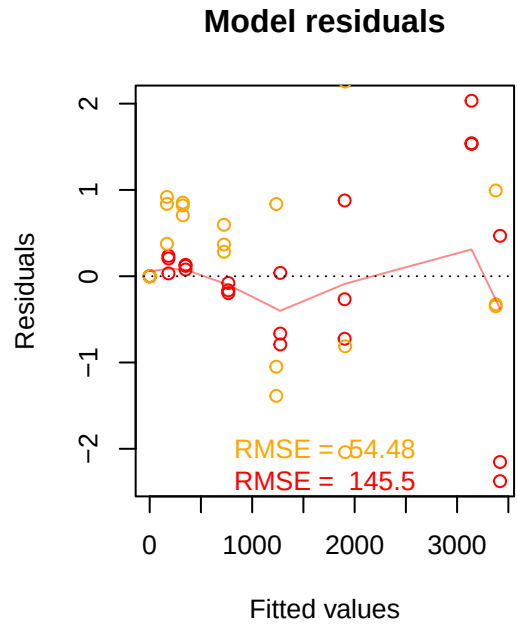

Model fit
Reaction rate AP
0
2000
4000
6000
8000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 14.25
MAPE = 14.25

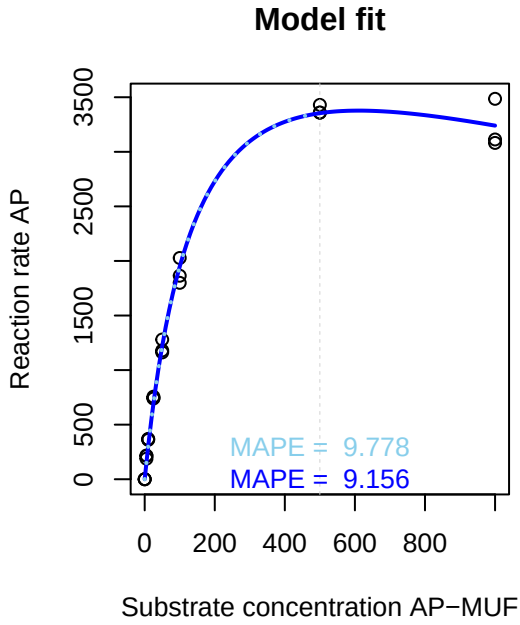

Model residuals
Residuals
−1.5
−0.5
0.0
0.5
1.0
0
2000
4000
6000
Fitted values
RMSE = 289.7
RMSE = 289.7

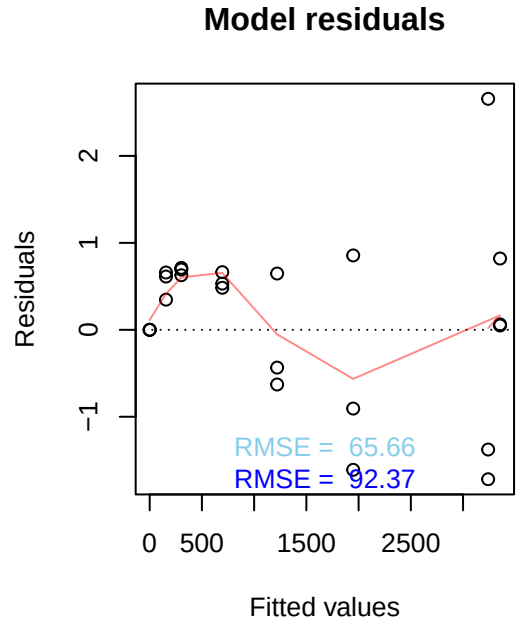

Model fit
Reaction rate AP
0
2000
4000
6000
8000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 14.25
MAPE = 14.25

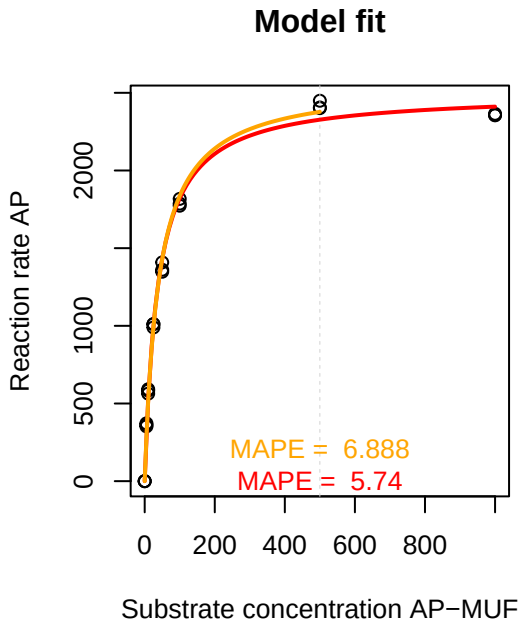

Model residuals
Residuals
−1.5
−0.5
0.0
0.5
1.0
0
2000
4000
6000
Fitted values
RMSE = 289.7
RMSE = 289.7

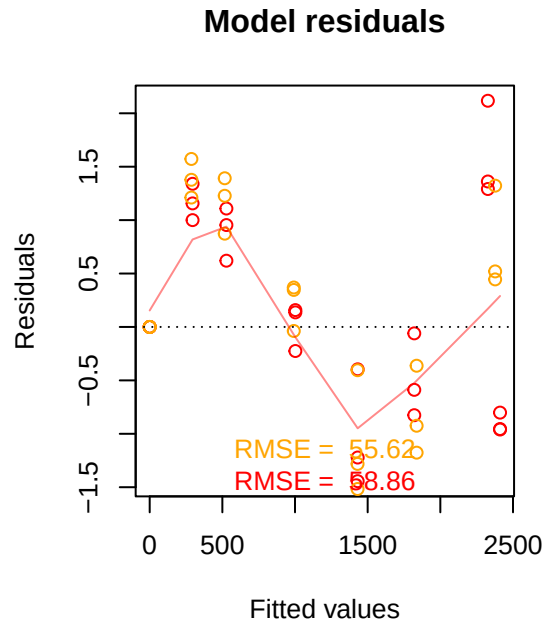

Model fit
Reaction rate AP
0
500
1500
2500
3500
MAPE = 7.141
MAPE = 6.137
0
200
400
600
800
Substrate concentration AP−MUF

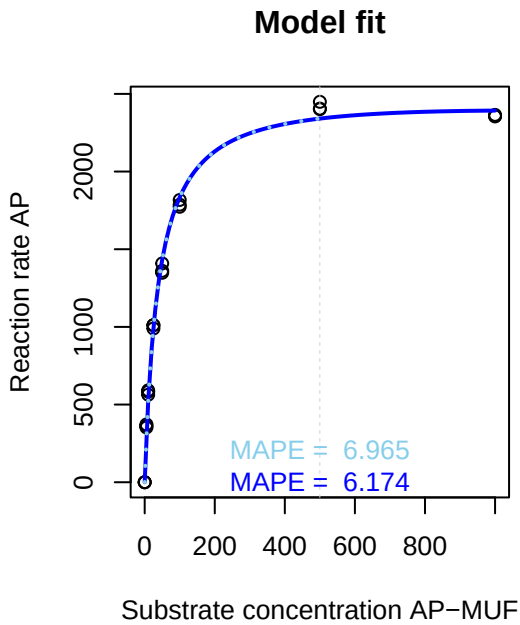

Model residuals
Residuals
−2
−1
0
1
2
RMSE = 54.48
RMSE = 145.5
0
1000
2000
3000
Fitted values

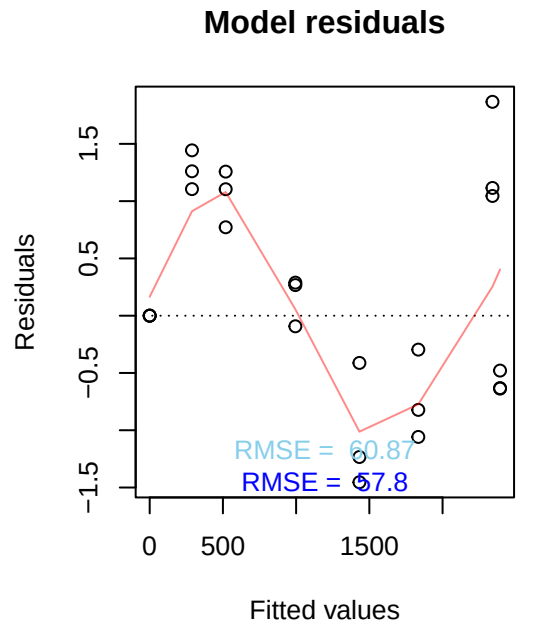

Model fit
Reaction rate AP
0
500
1500
2500
3500
MAPE = 9.778
MAPE = 9.156
0
200
400
600
800
Substrate concentration AP−MUF

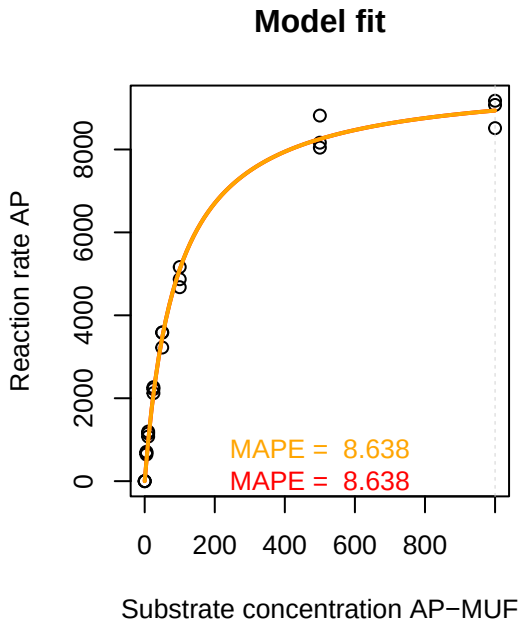

Model residuals
Residuals
−1
0
1
2
RMSE = 65.66
RMSE = 92.37
0
500
1500
2500
Fitted values

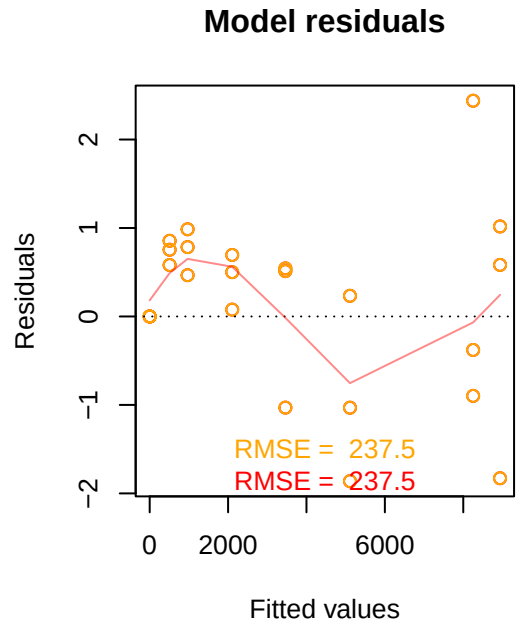

Model fit
Reaction rate AP
0
500
1000
2000
0
200
400
600
800
MAPE = 6.888
MAPE = 5.74
Substrate concentration AP−MUF

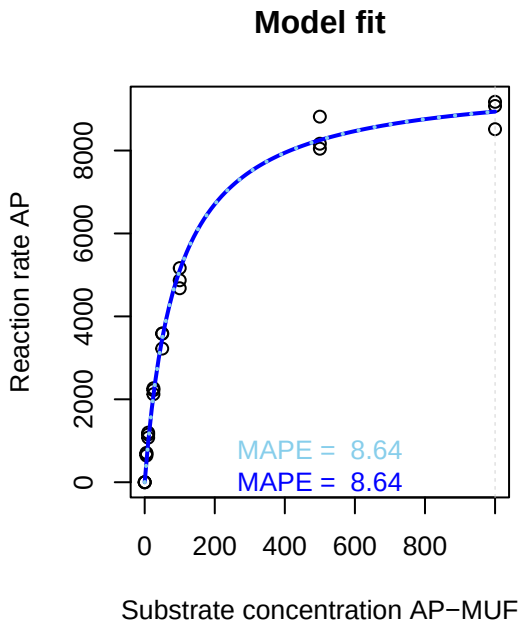

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
500
1500
2500
RMSE = 55.62
RMSE = 58.86
Fitted values

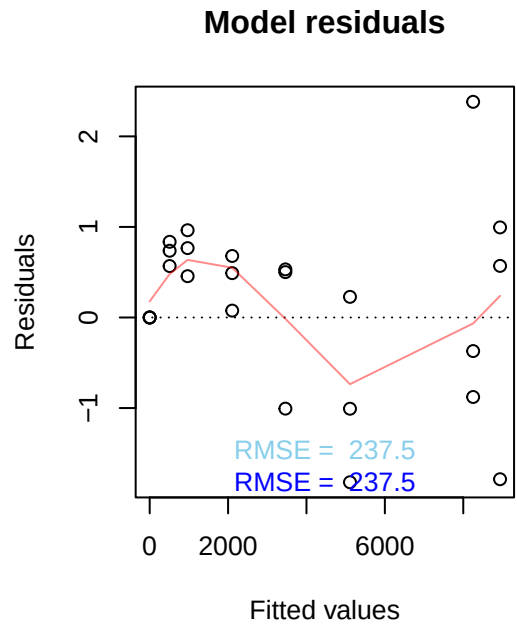

Model fit
Reaction rate AP
0
500
1000
2000
0
200
400
600
800
MAPE = 6.965
MAPE = 6.174
Substrate concentration AP−MUF

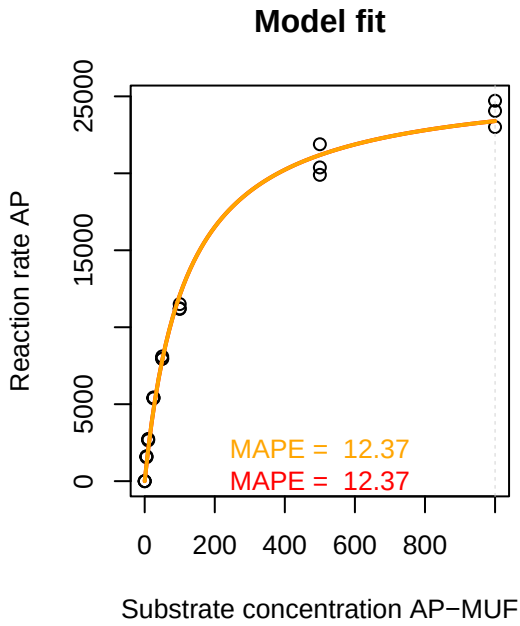

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
500
1500
RMSE = 60.87
RMSE = 57.8
Fitted values

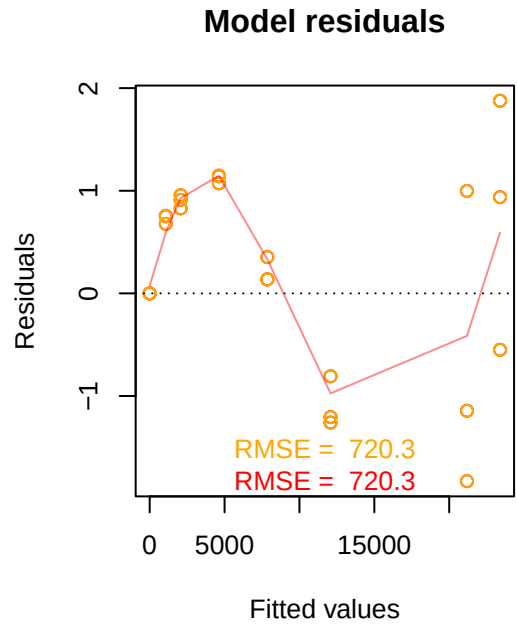

Model fit
Reaction rate AP
0
2000
4000
6000
8000
MAPE = 8.638
MAPE = 8.638
0
200
400
600
800
Substrate concentration AP−MUF

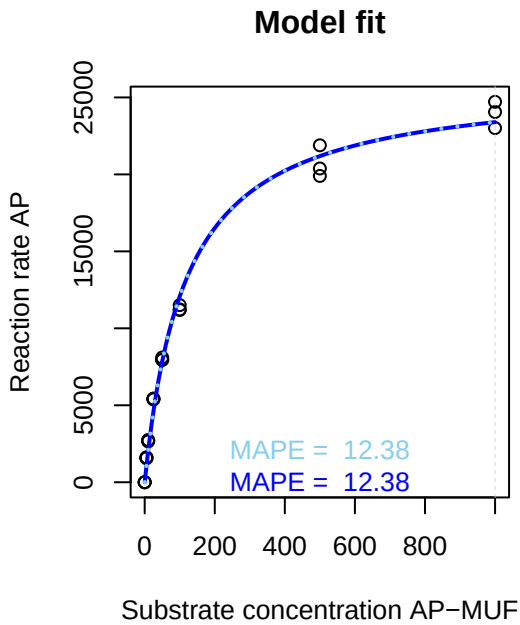

Model residuals
Residuals
−2
−1
0
1
2
RMSE = 237.5
RMSE = 237.5
0
2000
6000
Fitted values

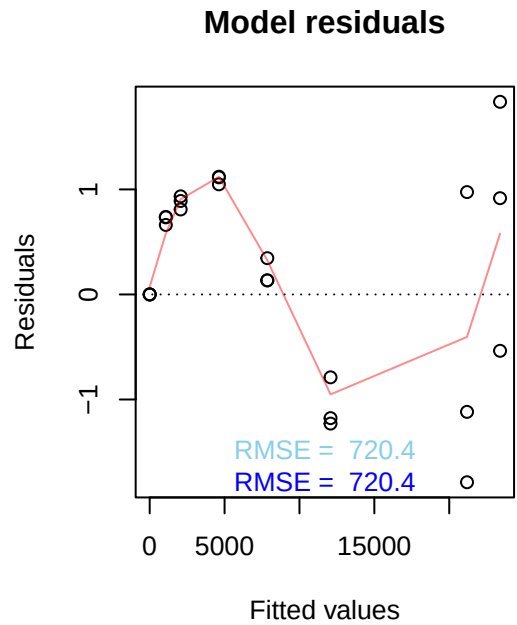

Model fit
Reaction rate AP
0
2000
4000
6000
8000
MAPE = 8.64
MAPE = 8.64
0
200
400
600
800
Substrate concentration AP−MUF

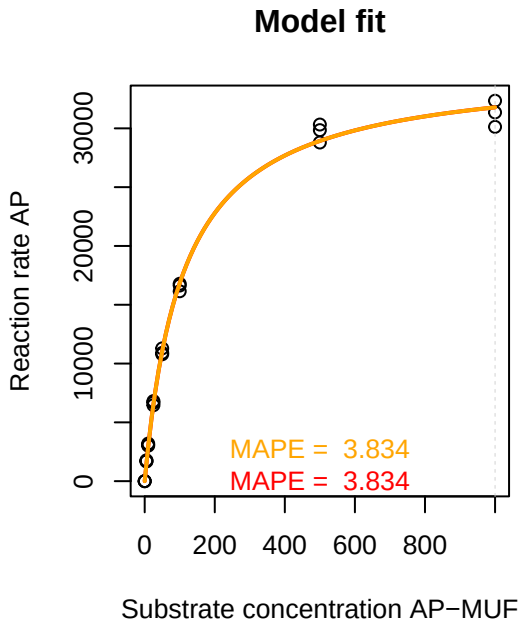

Model residuals
Residuals
−1
0
1
2
RMSE = 237.5
RMSE = 237.5
0
2000
6000
Fitted values

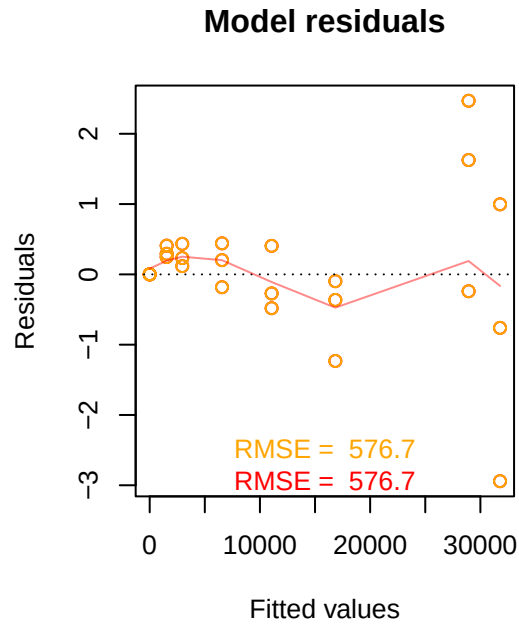

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 12.37
MAPE = 12.37
0
5000
15000
25000
0
200
400
600
800

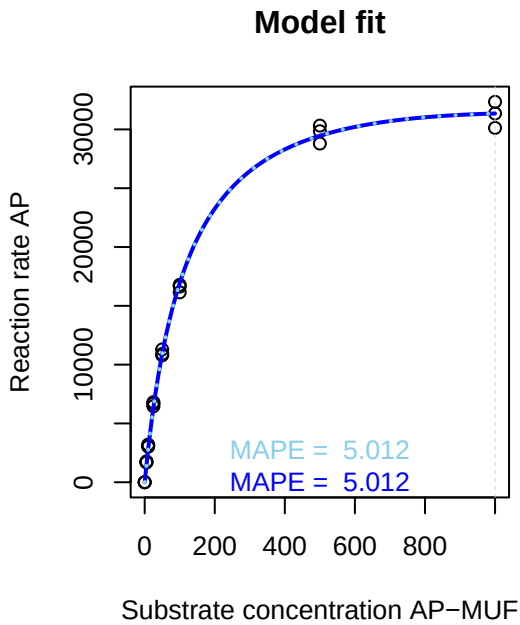

Model residuals
Residuals
Fitted values
RMSE = 720.3
RMSE = 720.3
−1
0
1
2
0
5000
15000

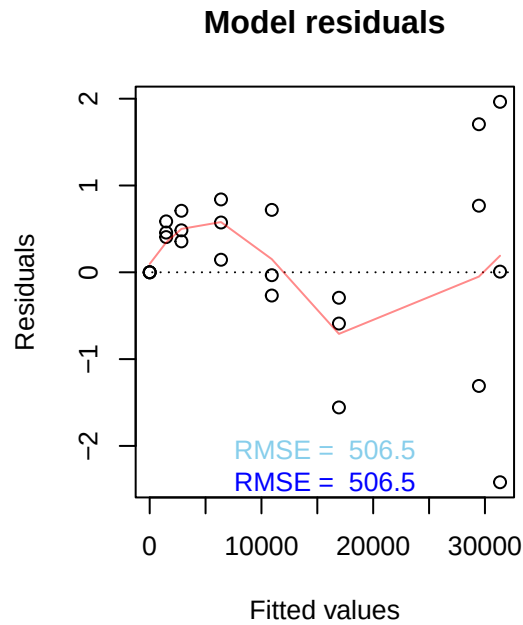

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 12.38
MAPE = 12.38
0
5000
15000
25000
0
200
400
600
800

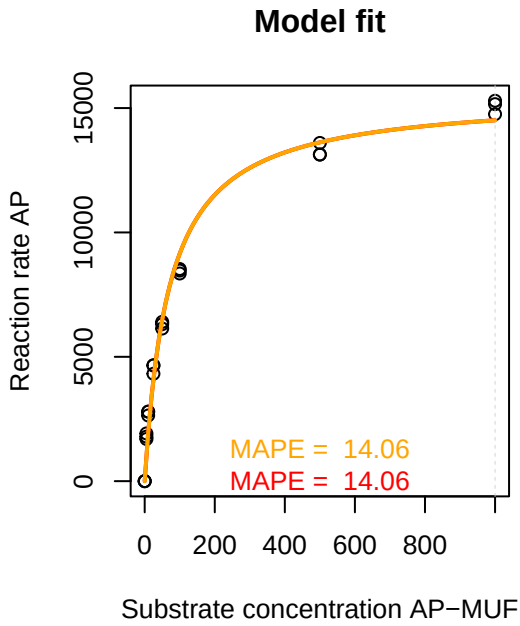

Model residuals
Residuals
Fitted values
RMSE = 720.4
RMSE = 720.4
−1
0
1
0
5000
15000

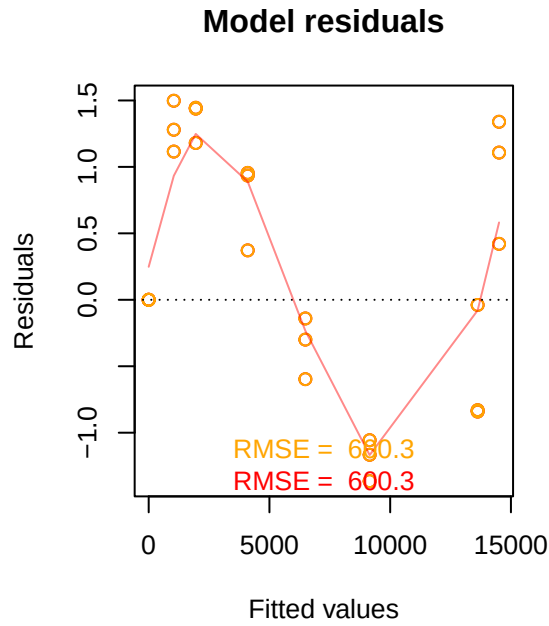

Model fit
Reaction rate AP
0
10000
20000
30000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 3.834
MAPE = 3.834

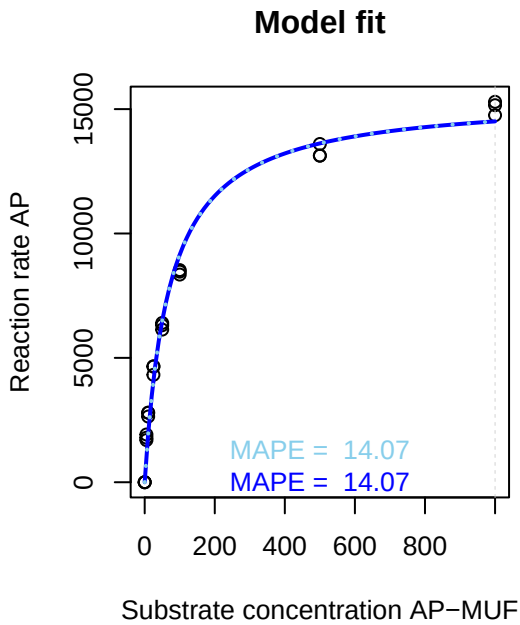

Model residuals
Residuals
−3
−2
−1
0
1
2
0
10000
20000
30000
Fitted values
RMSE = 576.7
RMSE = 576.7

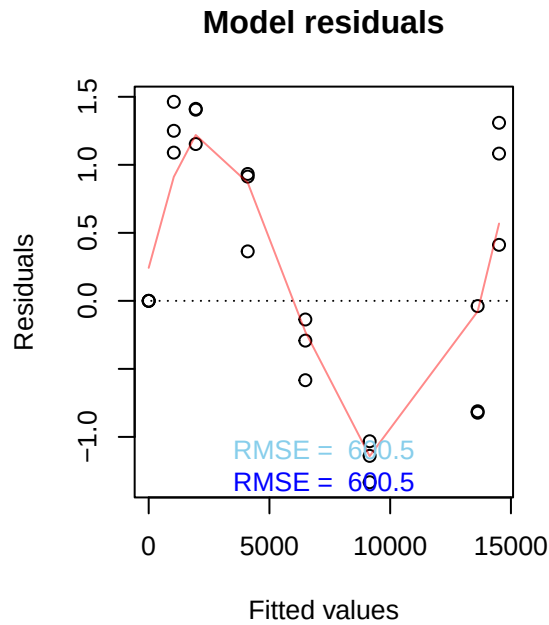

Model fit
Reaction rate AP
0
10000
20000
30000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 5.012
MAPE = 5.012

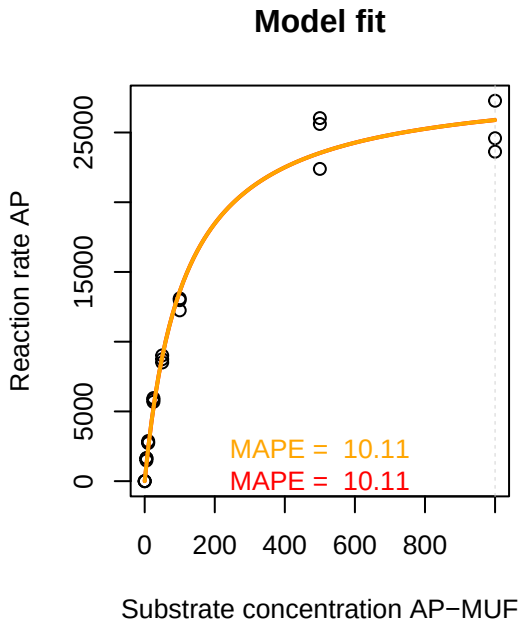

Model residuals
Residuals
−2
−1
0
1
2
0
10000
20000
30000
Fitted values
RMSE = 506.5
RMSE = 506.5

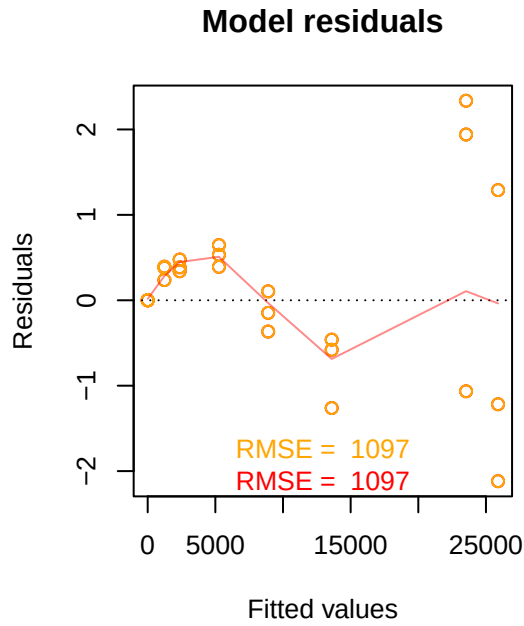

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 14.06
MAPE = 14.06

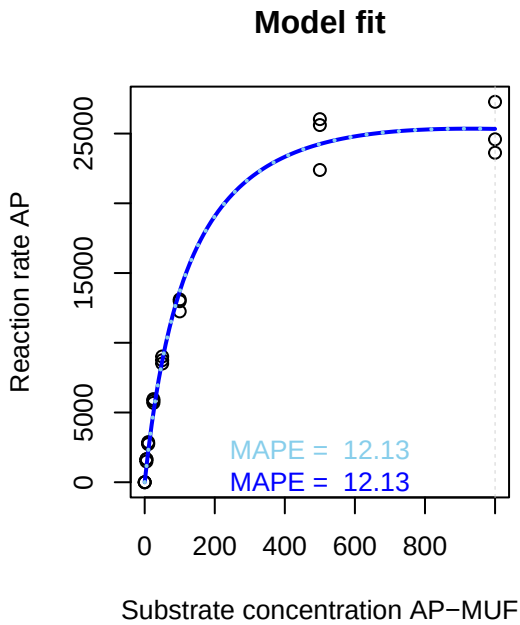

Model residuals
Residuals
−1.0
0.0
0.5
1.0
1.5
0
5000
10000
15000
Fitted values
RMSE = 600.3
RMSE = 600.3

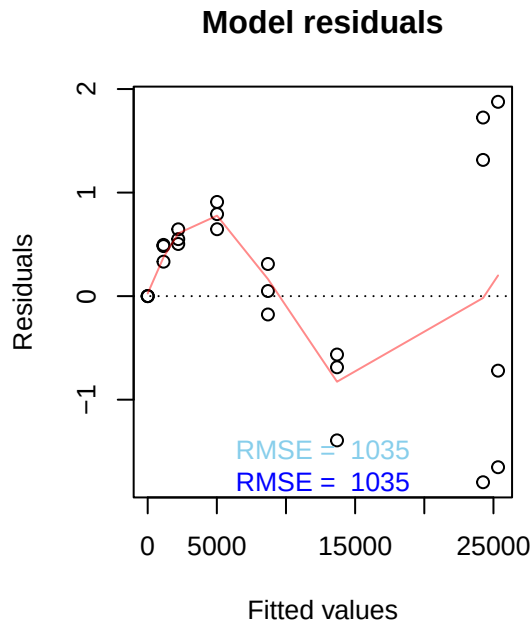

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 14.07
MAPE = 14.07

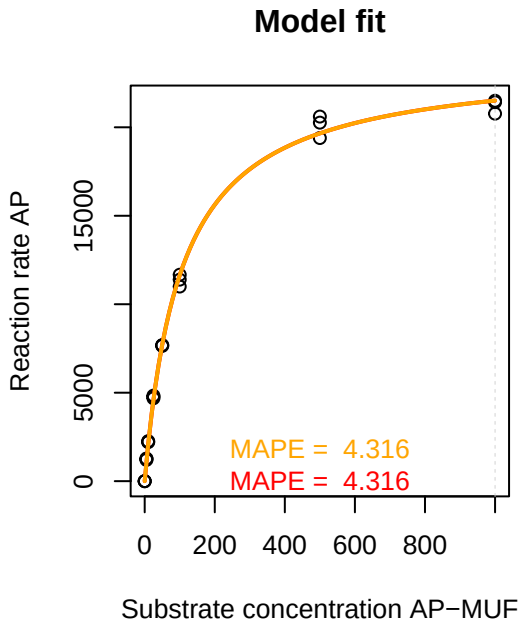

Model residuals
Residuals
−1.0
0.0
0.5
1.0
1.5
0
5000
10000
15000
Fitted values
RMSE = 600.5
RMSE = 600.5

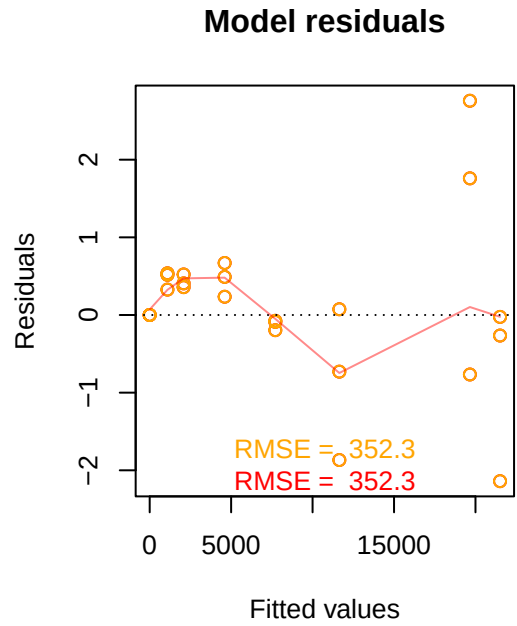

Model fit
Reaction rate AP
0
5000
15000
25000
0
200
400
600
800
MAPE = 10.11
MAPE = 10.11
Substrate concentration AP−MUF

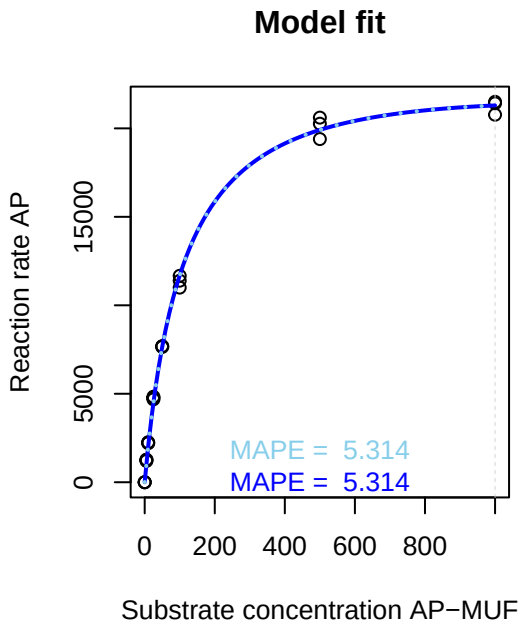

Model residuals
Residuals
−2
−1
0
1
2
0
5000
15000
25000
RMSE = 1097
RMSE = 1097
Fitted values

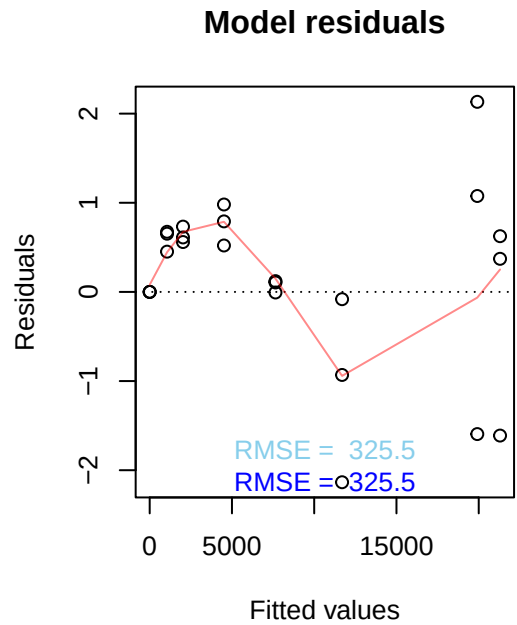

Model fit
Reaction rate AP
0
5000
15000
25000
0
200
400
600
800
MAPE = 12.13
MAPE = 12.13
Substrate concentration AP−MUF

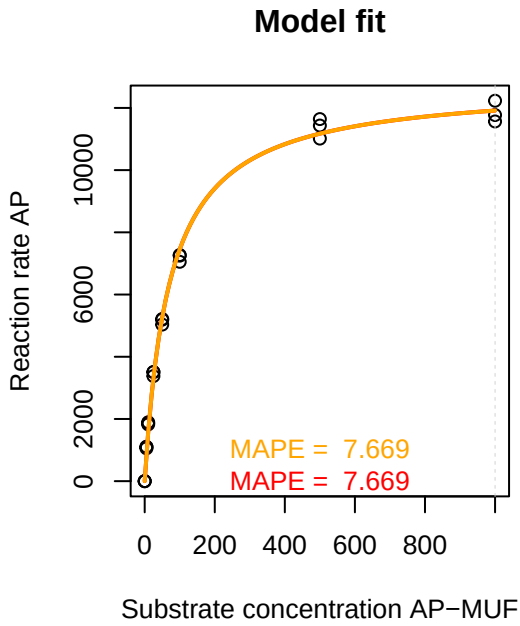

Model residuals
Residuals
−1
0
1
2
0
5000
15000
25000
RMSE = 1035
RMSE = 1035
Fitted values

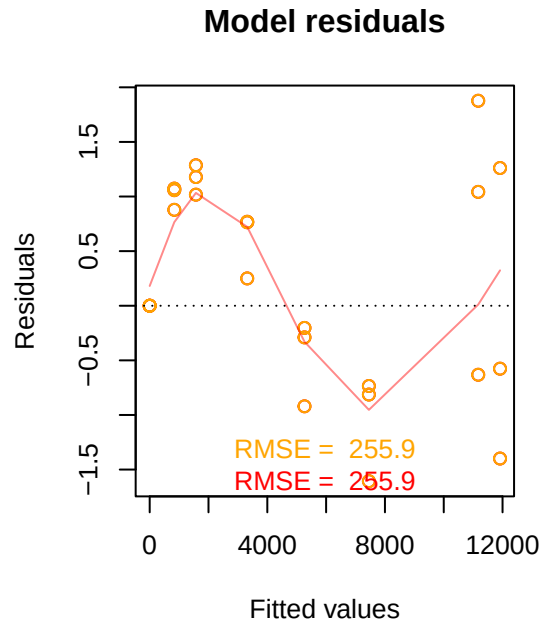

Model fit
Reaction rate AP
0
5000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 4.316
MAPE = 4.316

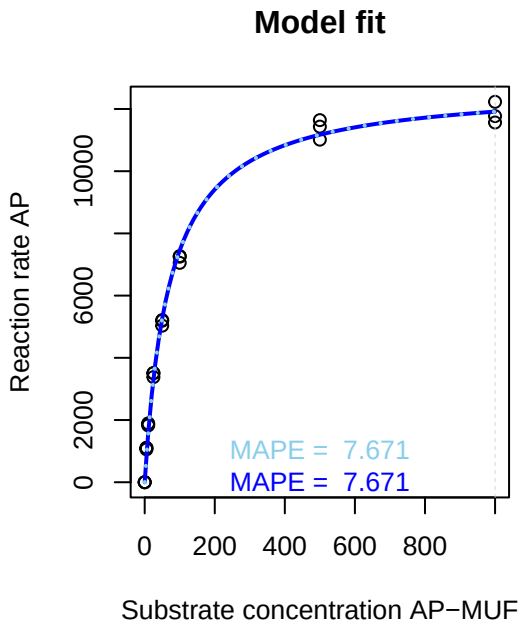

Model residuals
Residuals
−2
−1
0
1
2
0
5000
15000
Fitted values
RMSE = 352.3
RMSE = 352.3

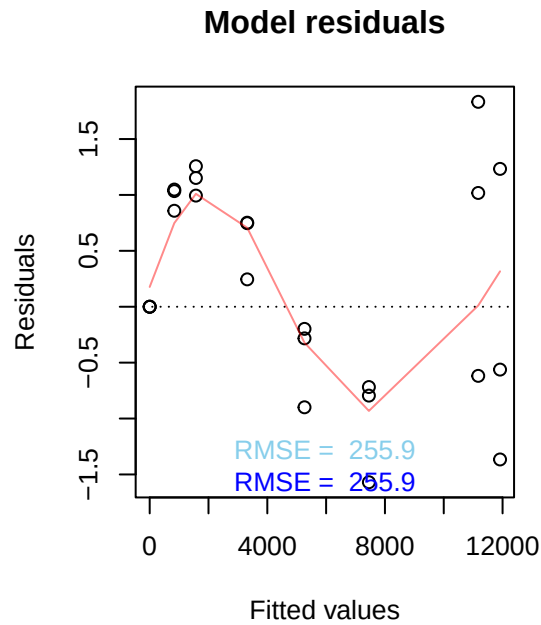

Model fit
Reaction rate AP
0
5000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 5.314
MAPE = 5.314

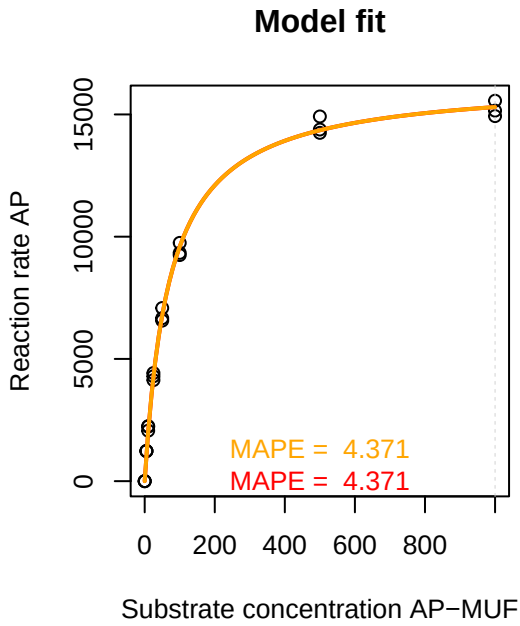

Model residuals
Residuals
−2
−1
0
1
2
0
5000
15000
Fitted values
RMSE = 325.5
RMSE = 325.5

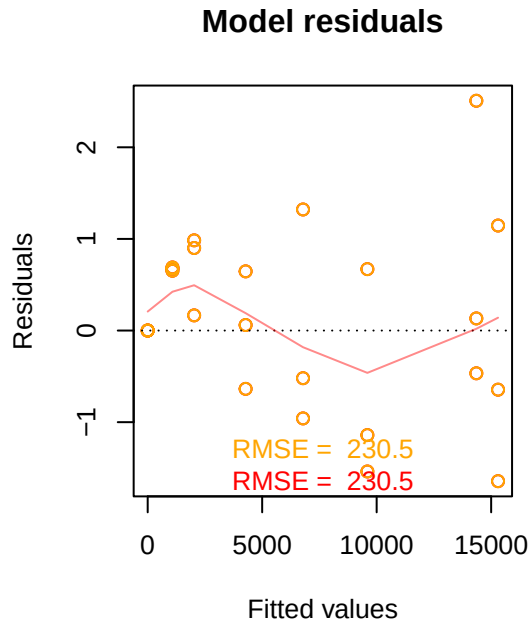

Model fit
Reaction rate AP
0
2000
6000
10000
MAPE = 7.669
MAPE = 7.669
0
200
400
600
800
Substrate concentration AP−MUF

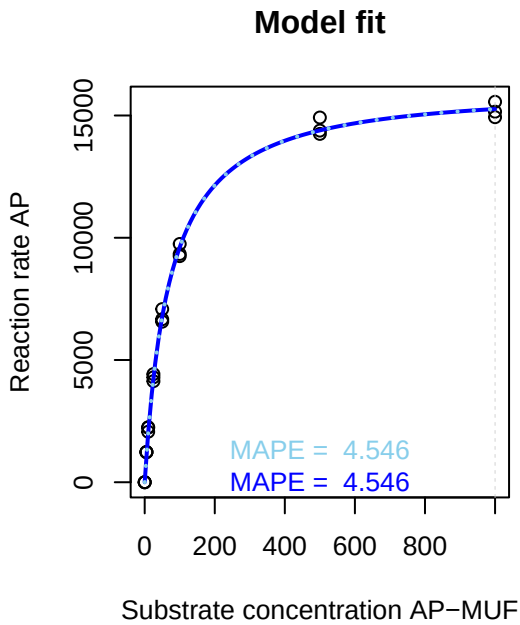

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
RMSE = 255.9
RMSE = 255.9
0
4000
8000
12000
Fitted values

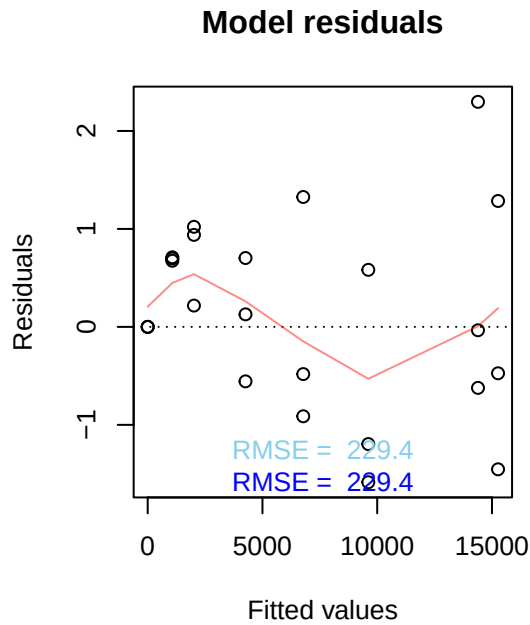

Model fit
Reaction rate AP
0
2000
6000
10000
MAPE = 7.671
MAPE = 7.671
0
200
400
600
800
Substrate concentration AP−MUF

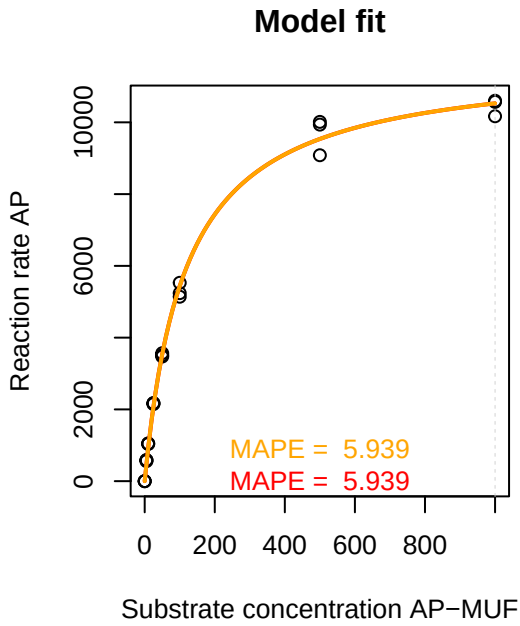

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
RMSE = 255.9
RMSE = 255.9
0
4000
8000
12000
Fitted values

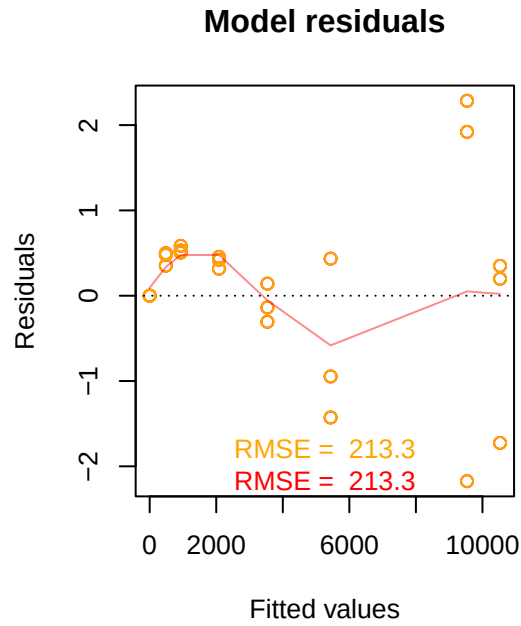

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 4.371
MAPE = 4.371

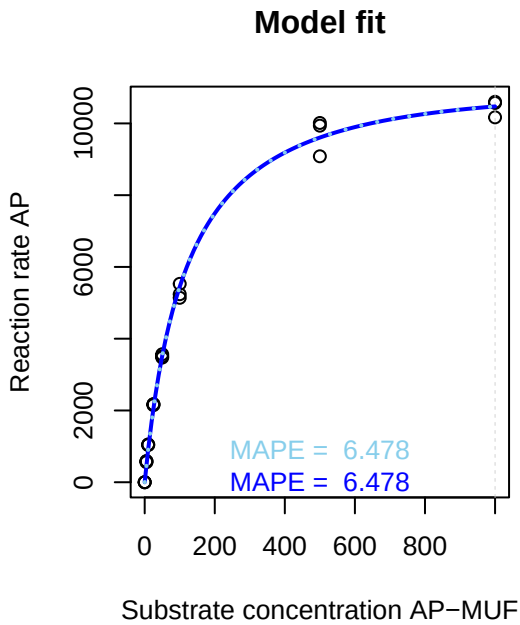

Model residuals
Residuals
−1
0
1
2
0
5000
10000
15000
Fitted values
RMSE = 230.5
RMSE = 230.5

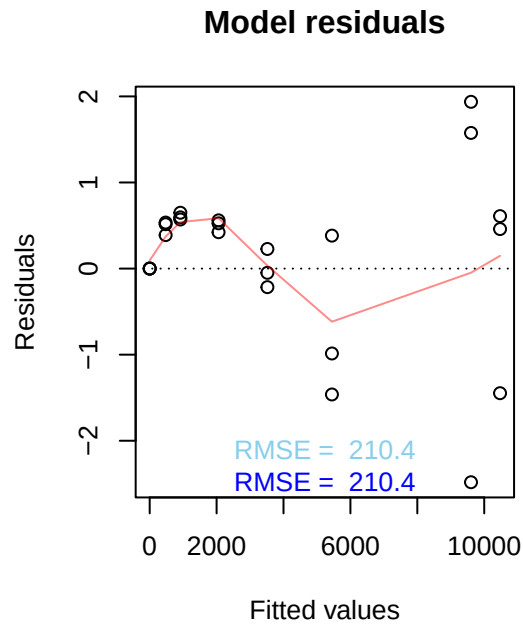

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 4.546
MAPE = 4.546

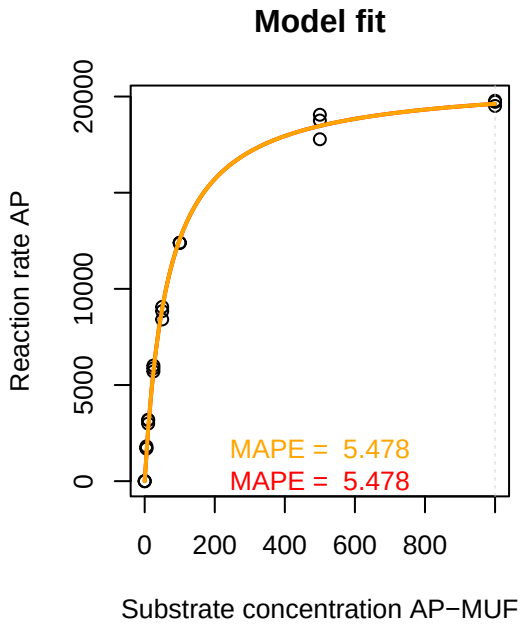

Model residuals
Residuals
−1
0
1
2
0
5000
10000
15000
Fitted values
RMSE = 229.4
RMSE = 229.4

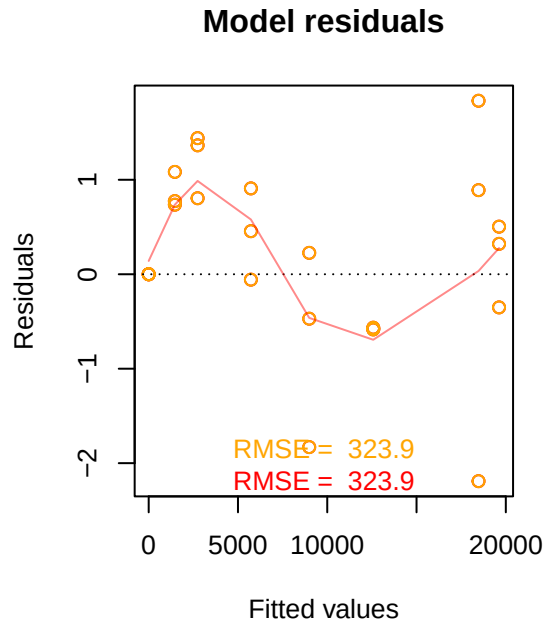

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
MAPE = 5.939
MAPE = 5.939
Substrate concentration AP−MUF

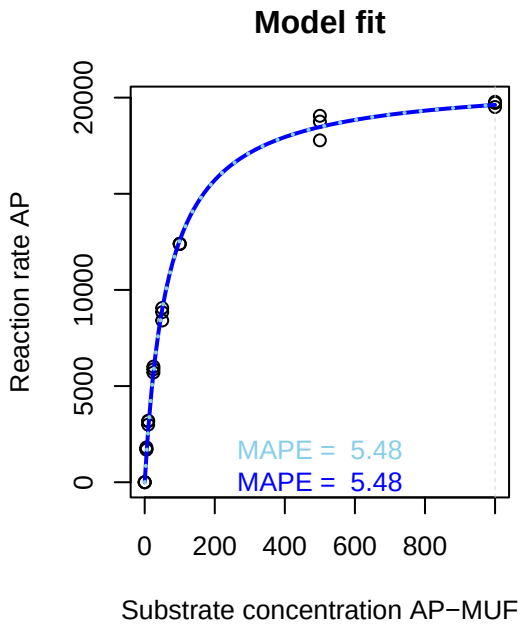

Model residuals
Residuals
−2
−1
0
1
2
0
2000
6000
10000
RMSE = 213.3
RMSE = 213.3
Fitted values

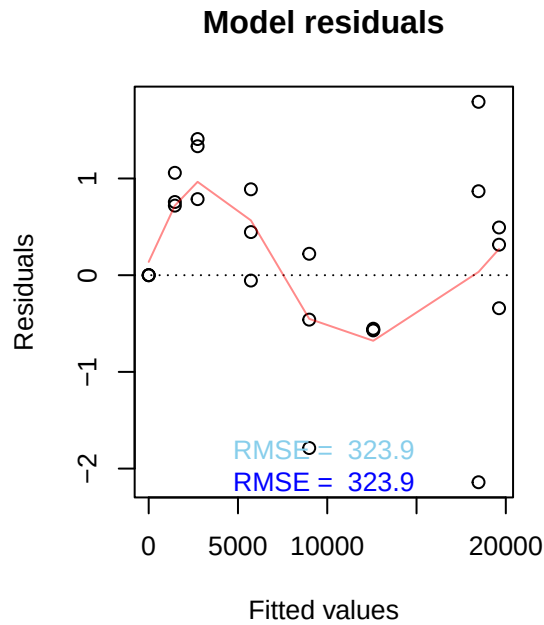

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
MAPE = 6.478
MAPE = 6.478
Substrate concentration AP−MUF

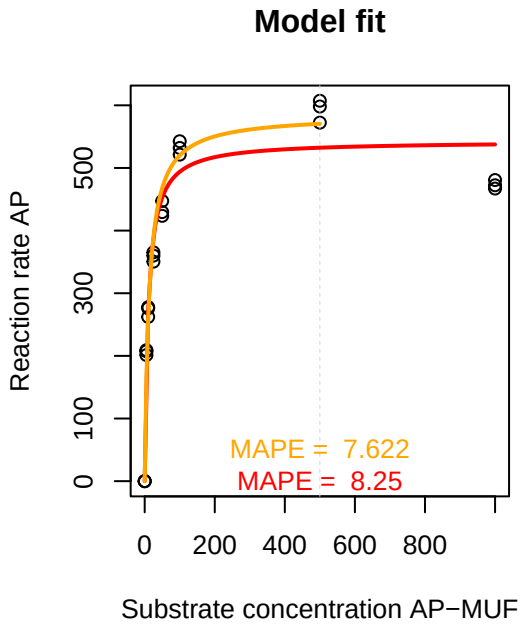

Model residuals
Residuals
−2
−1
0
1
2
0
2000
6000
10000
RMSE = 210.4
RMSE = 210.4
Fitted values

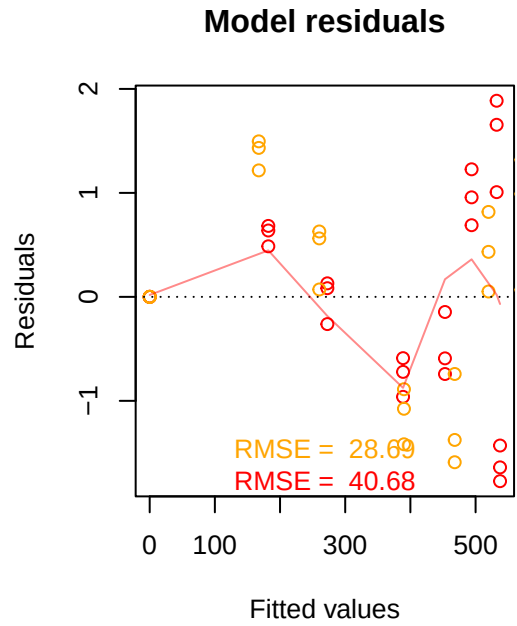

Model fit
Reaction rate AP
0
5000
10000
20000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 5.478
MAPE = 5.478

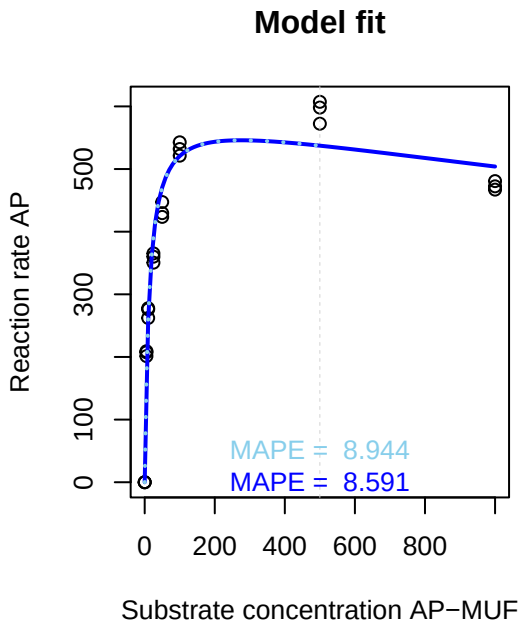

Model residuals
Residuals
−2
−1
0
1
0
5000
10000
20000
Fitted values
RMSE = 323.9
RMSE = 323.9

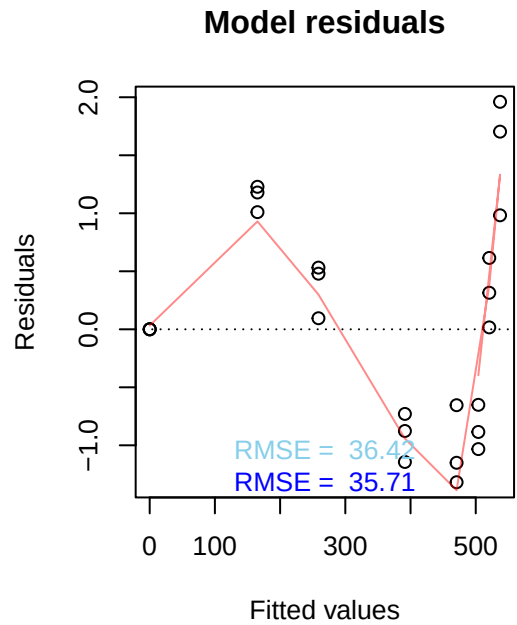

Model fit
Reaction rate AP
0
5000
10000
20000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 5.48
MAPE = 5.48

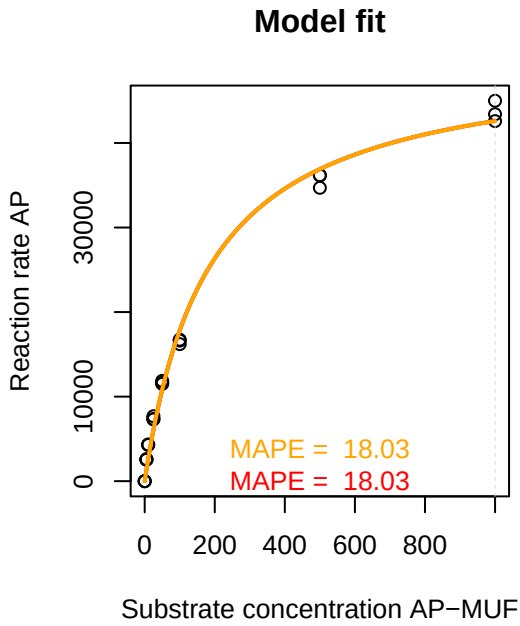

Model residuals
Residuals
−2
−1
0
1
0
5000
10000
20000
Fitted values
RMSE = 323.9
RMSE = 323.9

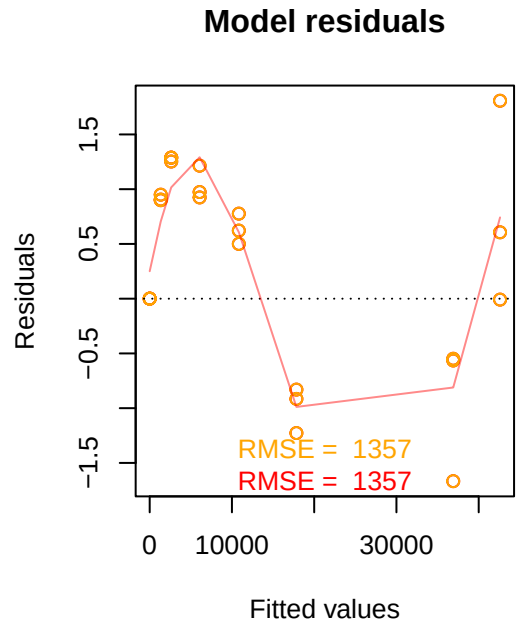

Model fit
Reaction rate AP
0
100
300
500
0
200
400
600
800
MAPE = 7.622
MAPE = 8.25
Substrate concentration AP−MUF

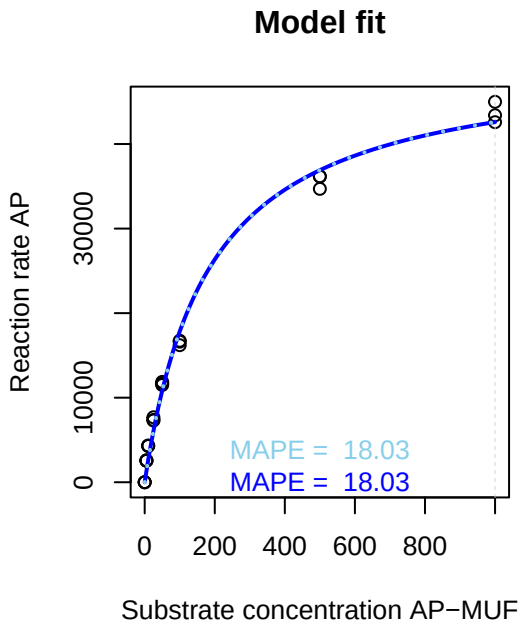

Model residuals
Residuals
−1
0
1
2
0
100
300
500
RMSE = 28.69
RMSE = 40.68
Fitted values

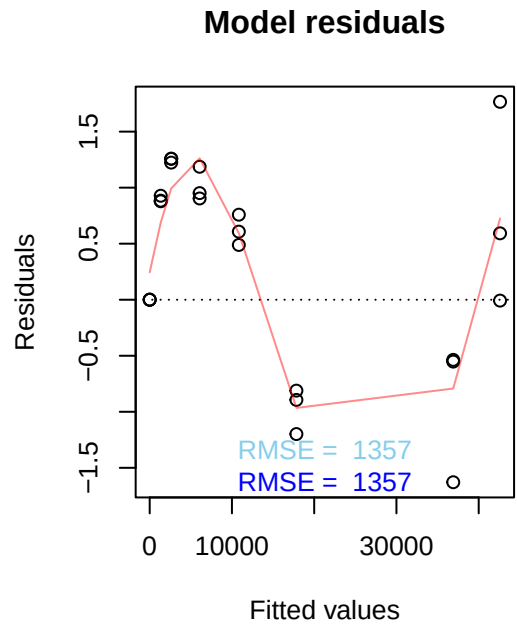

Model fit
Reaction rate AP
0
100
300
500
0
200
400
600
800
MAPE = 8.944
MAPE = 8.591
Substrate concentration AP−MUF

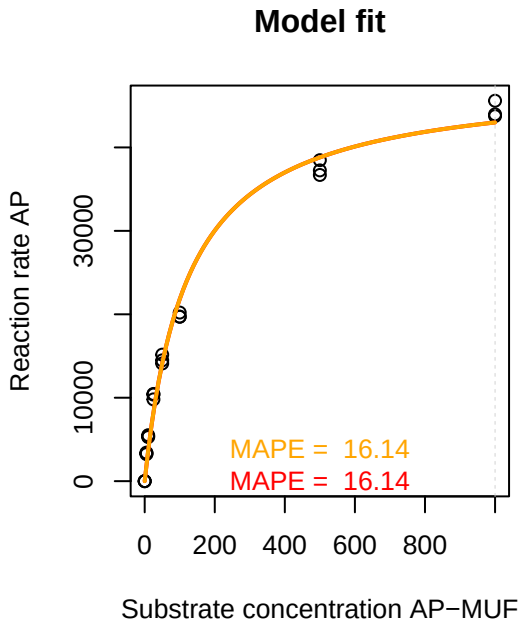

Model residuals
Residuals
−1.0
0.0
1.0
2.0
0
100
300
500
RMSE = 36.42
RMSE = 35.71
Fitted values

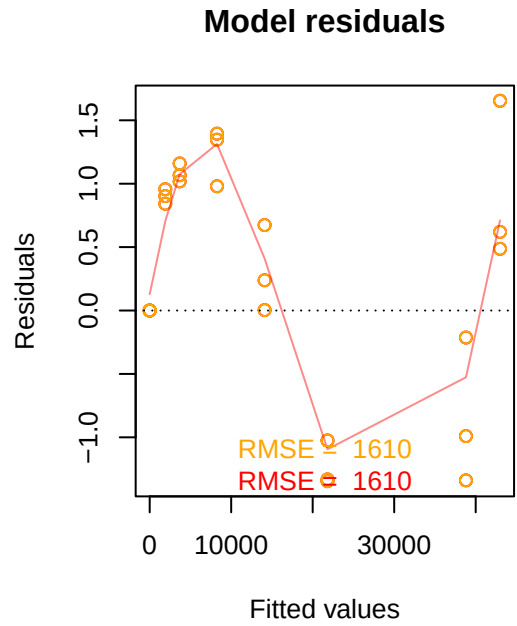

Model fit
Reaction rate AP
0
10000
30000
MAPE = 18.03
MAPE = 18.03
0
200
400
600
800
Substrate concentration AP−MUF

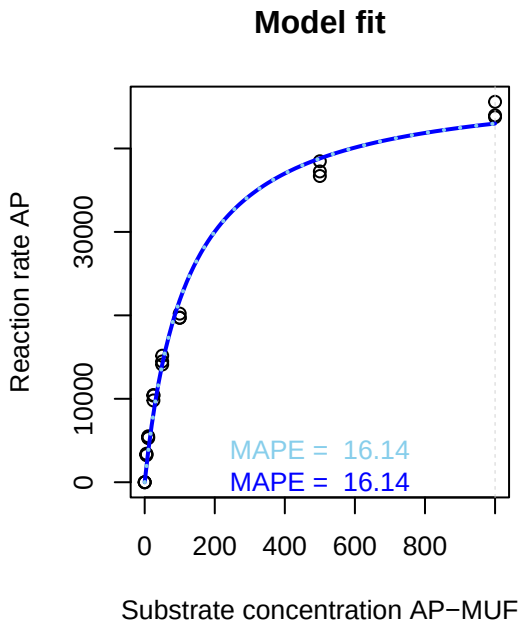

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
RMSE = 1357
RMSE = 1357
0
10000
30000
Fitted values

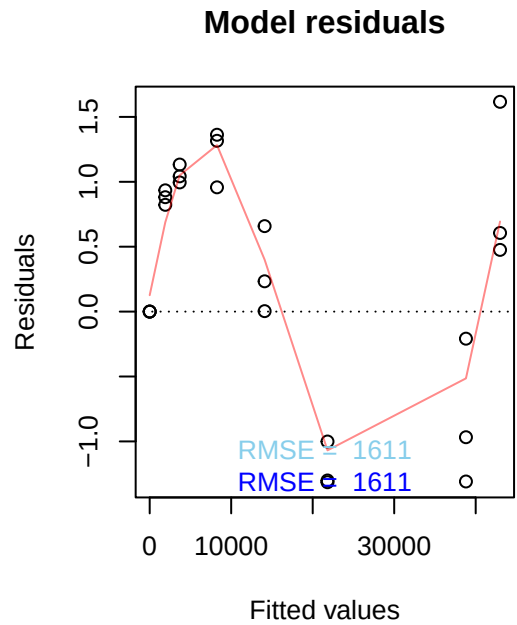

Model fit
Reaction rate AP
0
10000
30000
MAPE = 18.03
MAPE = 18.03
0
200
400
600
800
Substrate concentration AP−MUF

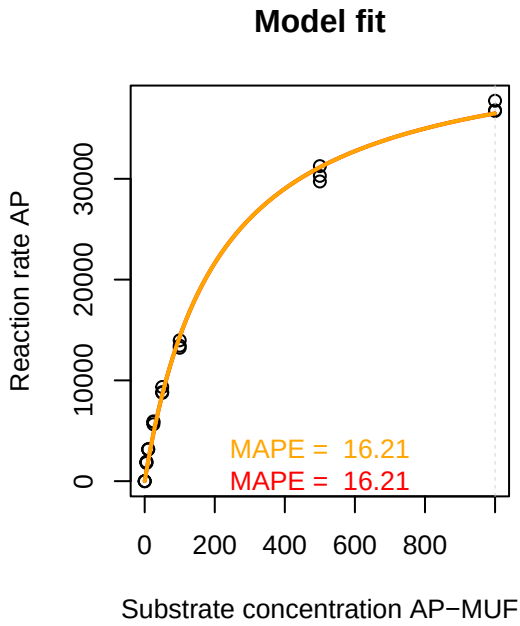

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
RMSE = 1357
RMSE = 1357
0
10000
30000
Fitted values

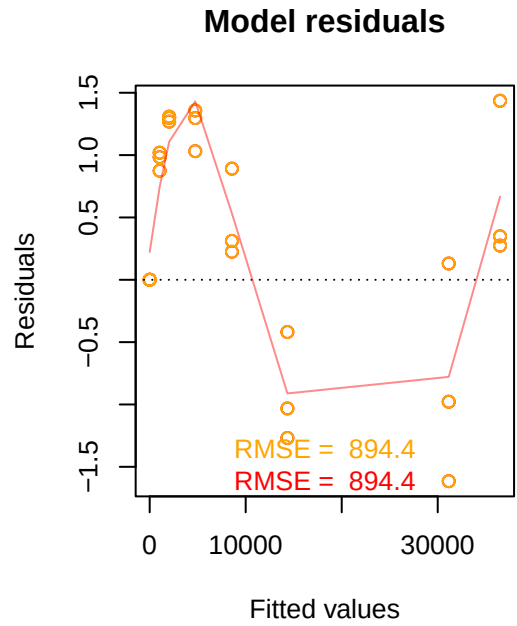

Model fit
Reaction rate AP
0
10000
30000
0
200
400
600
800
MAPE = 16.14
MAPE = 16.14
Substrate concentration AP−MUF

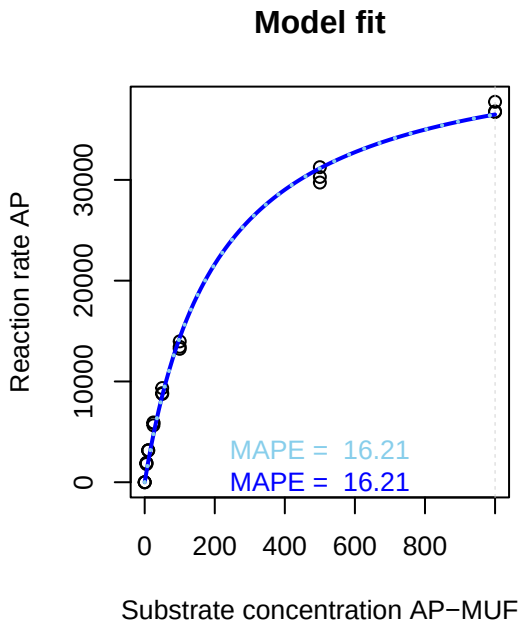

Model residuals
Residuals
−1.0
0.0
0.5
1.0
1.5
0
10000
30000
RMSE = 1610
RMSE = 1610
Fitted values

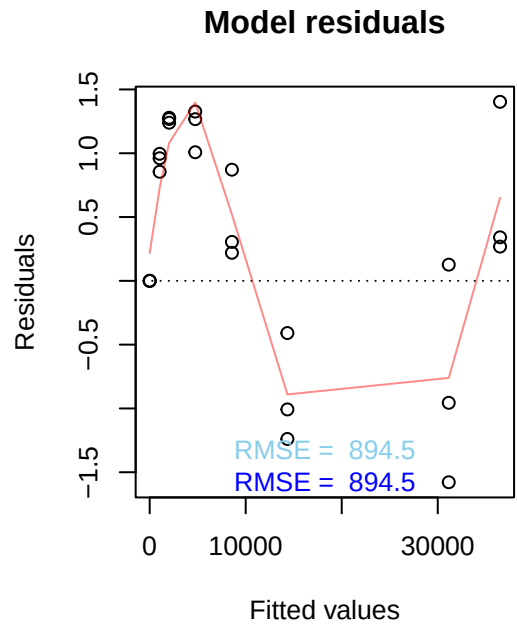

Model fit
Reaction rate AP
0
10000
30000
0
200
400
600
800
MAPE = 16.14
MAPE = 16.14
Substrate concentration AP−MUF

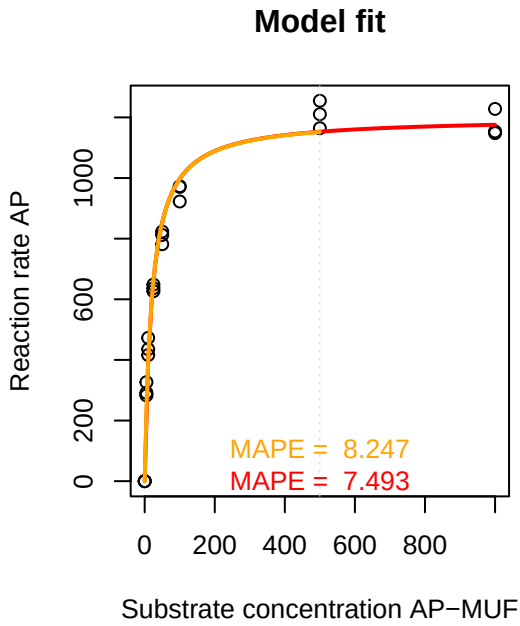

Model residuals
Residuals
−1.0
0.0
0.5
1.0
1.5
0
10000
30000
RMSE = 1611
RMSE = 1611
Fitted values

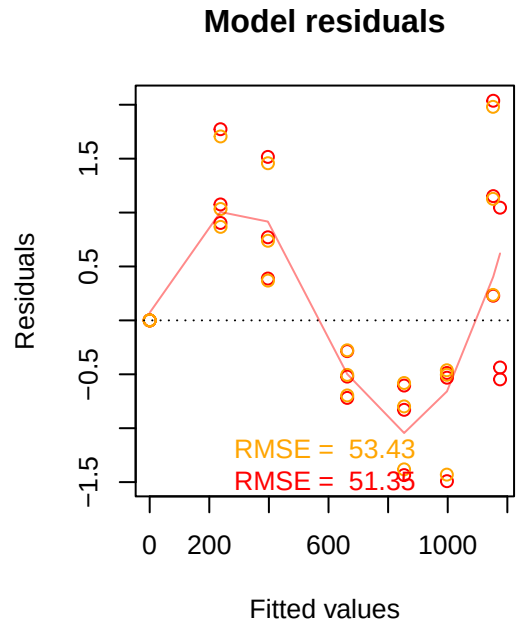

Model fit
Reaction rate AP
0
10000
20000
30000
0
200
400
600
800
MAPE = 16.21
MAPE = 16.21
Substrate concentration AP−MUF

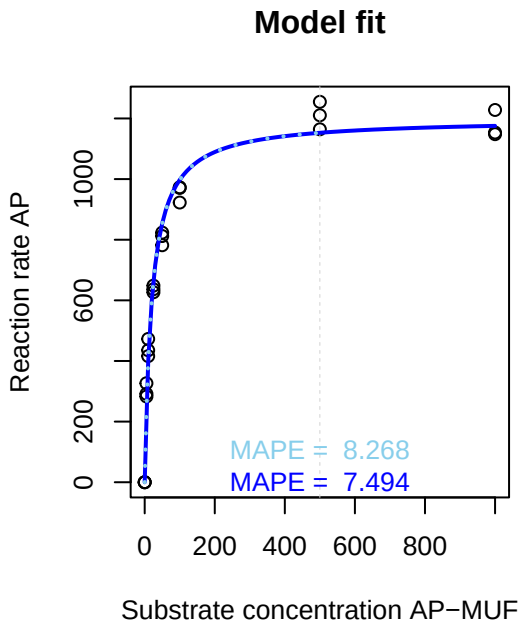

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
10000
30000
RMSE = 894.4
RMSE = 894.4
Fitted values

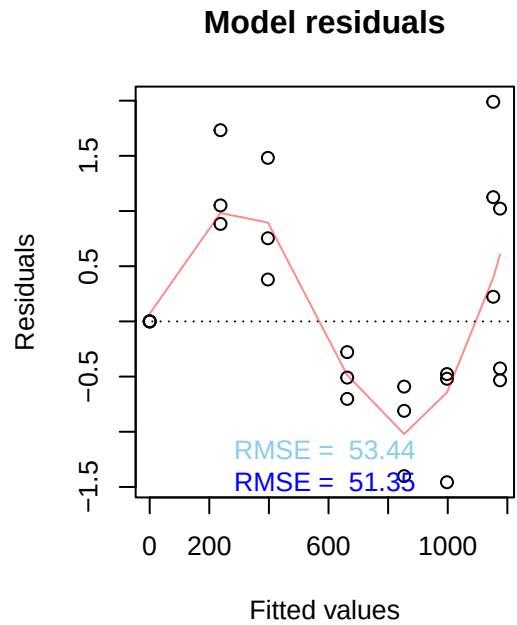

Model fit
Reaction rate AP
0
10000
20000
30000
0
200
400
600
800
MAPE = 16.21
MAPE = 16.21
Substrate concentration AP−MUF

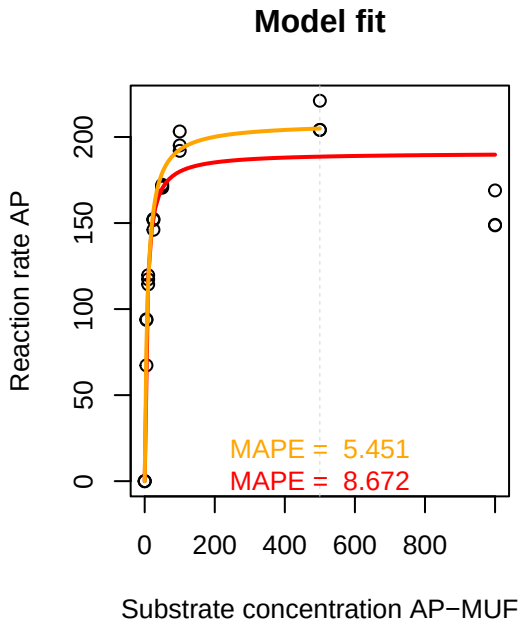

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
10000
30000
RMSE = 894.5
RMSE = 894.5
Fitted values

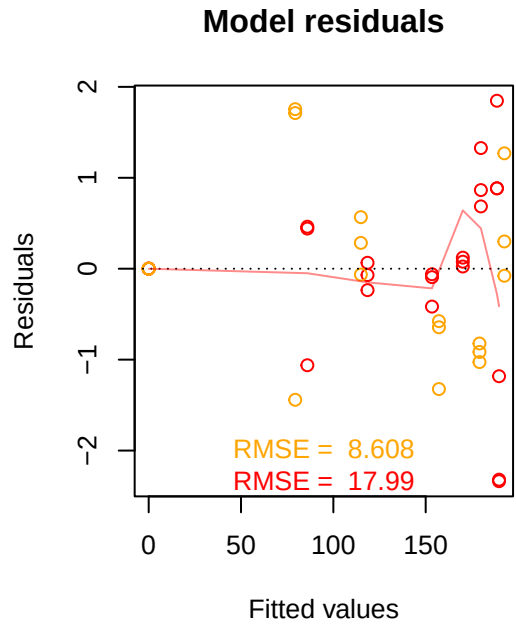

Model fit
Reaction rate AP
0
200
600
1000
MAPE = 8.247
MAPE = 7.493
0
200
400
600
800
Substrate concentration AP−MUF

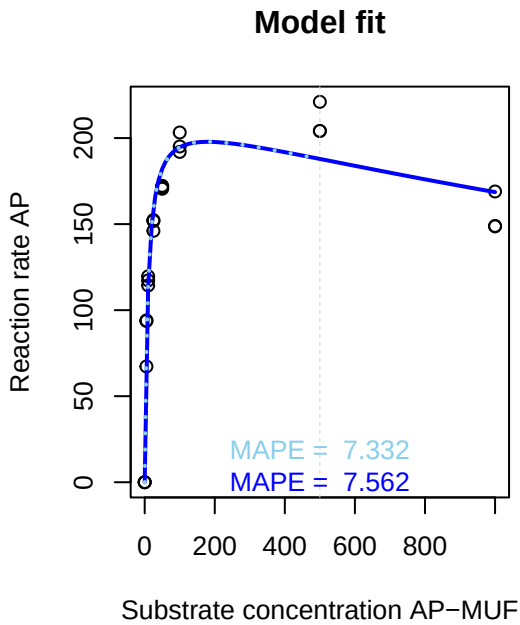

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
RMSE = 53.43
RMSE = 51.35
0
200
600
1000
Fitted values

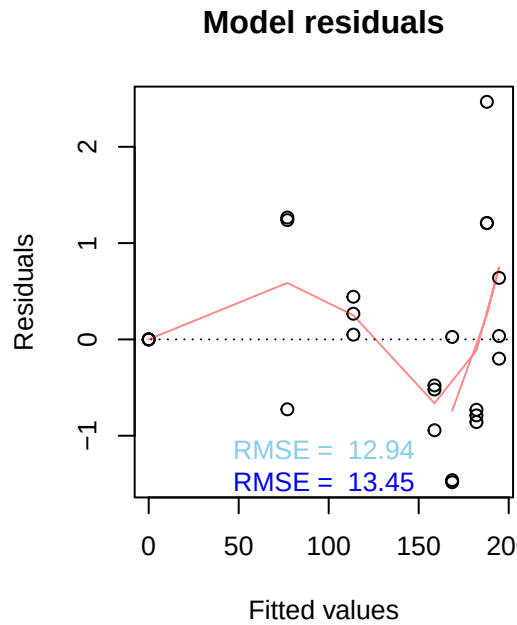

Model fit
Reaction rate AP
0
200
600
1000
MAPE = 8.268
MAPE = 7.494
0
200
400
600
800
Substrate concentration AP−MUF


Model residuals
Residuals
−1.5
−0.5
0.5
1.5
RMSE = 53.44
RMSE = 51.35
0
200
600
1000
Fitted values

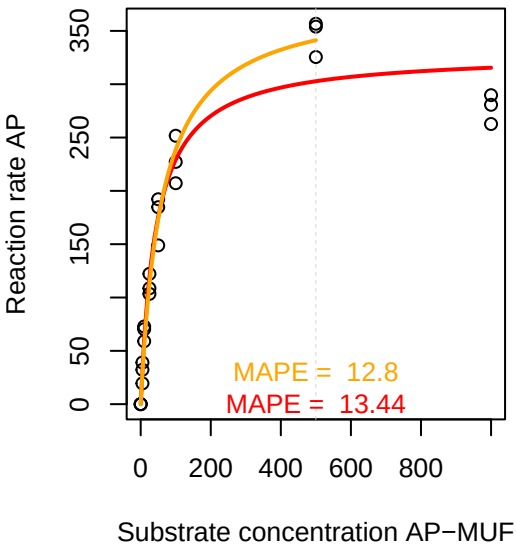

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 5.451
MAPE = 8.672
0
50
100
150
200
0
200
400
600
800


Model residuals
Residuals
Fitted values
RMSE = 8.608
RMSE = 17.99
−2
−1
0
1
2
0
50
100
150

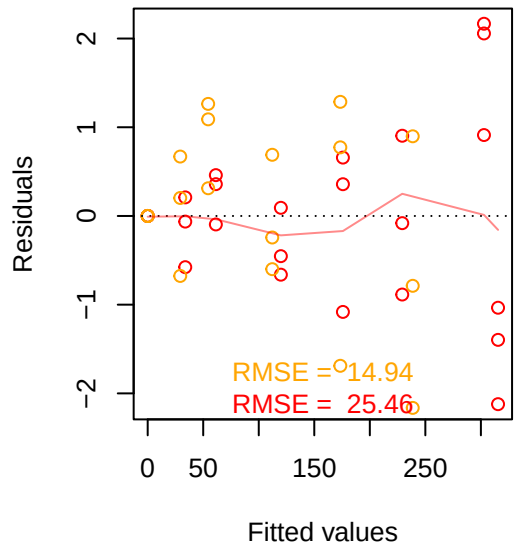

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 7.332
MAPE = 7.562
0
50
100
150
200
0
200
400
600
800


Model residuals
Residuals
Fitted values
RMSE = 12.94
RMSE = 13.45
−1
0
1
2
0
50
100
150
200

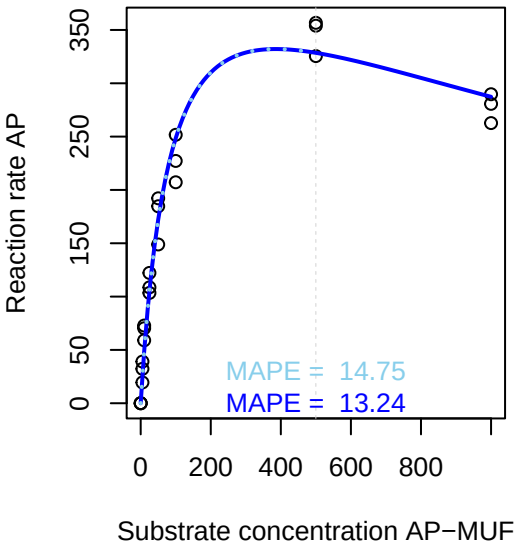
Model fit



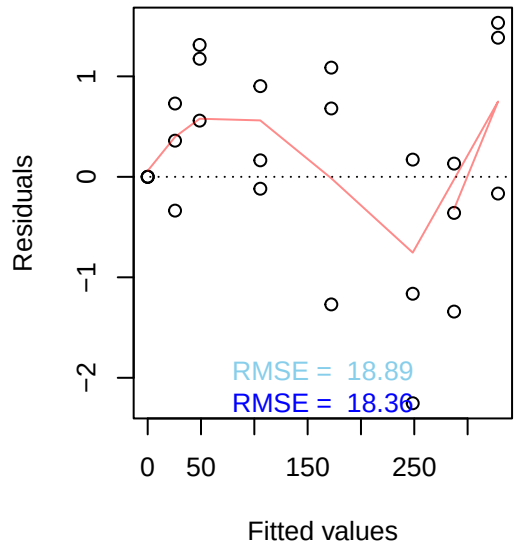
Model residuals

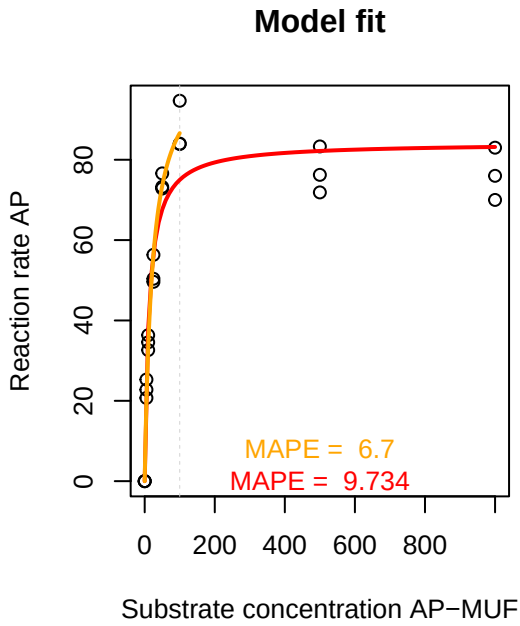


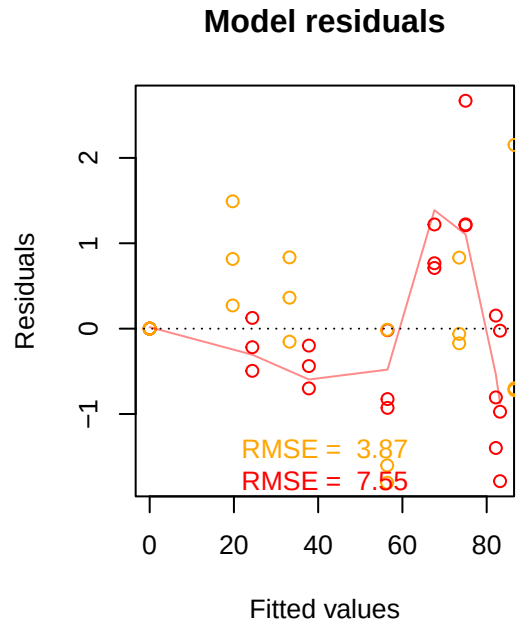
Model fit

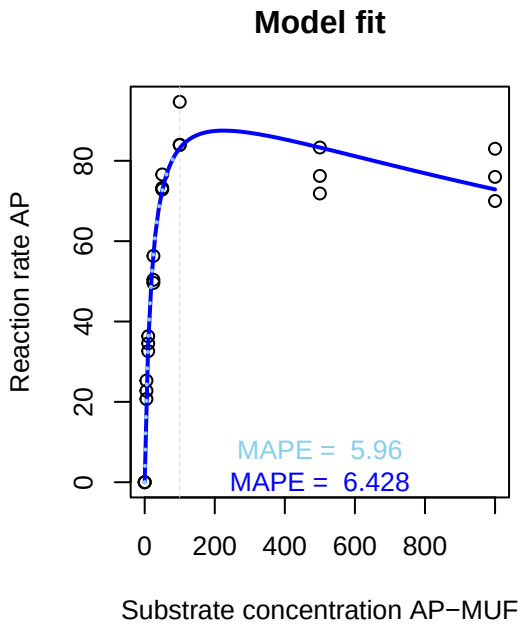


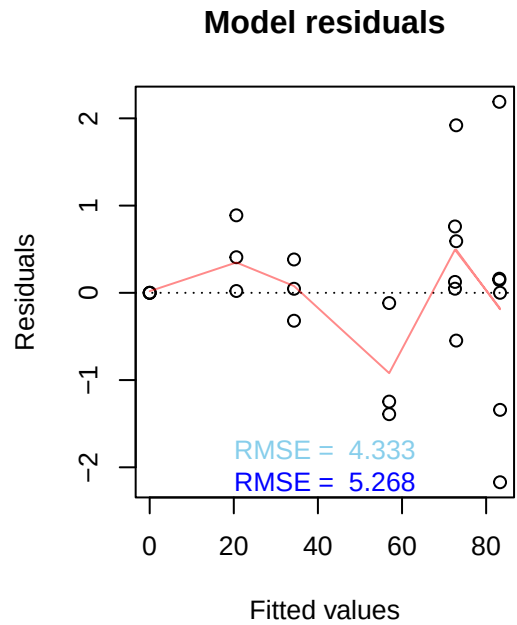
Model residuals

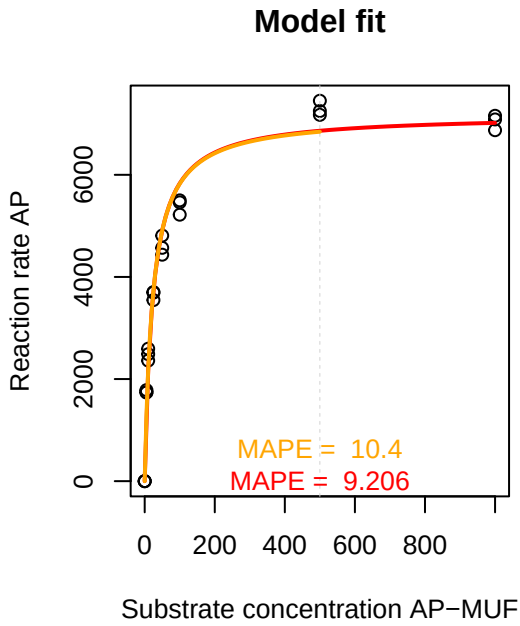


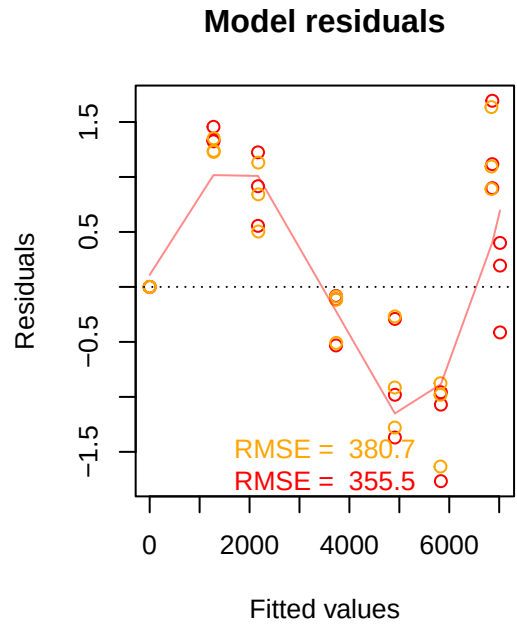

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 6.7
MAPE = 9.734
0
20
40
60
80
0
200
400
600
800

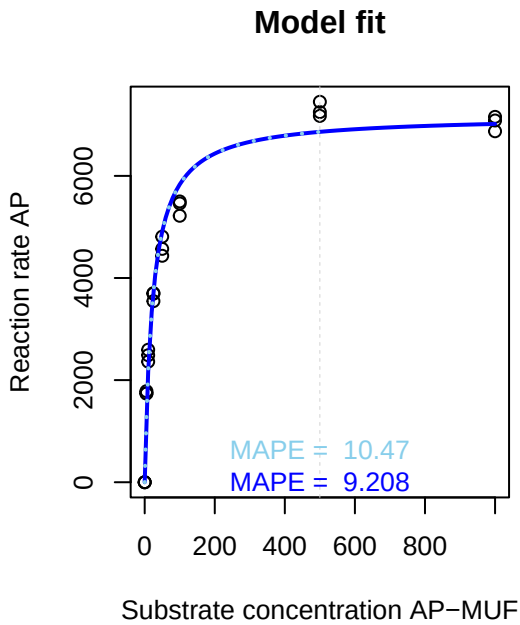

Model residuals
Residuals
Fitted values
RMSE = 3.87
RMSE = 7.55
−1
0
1
2
0
20
40
60
80

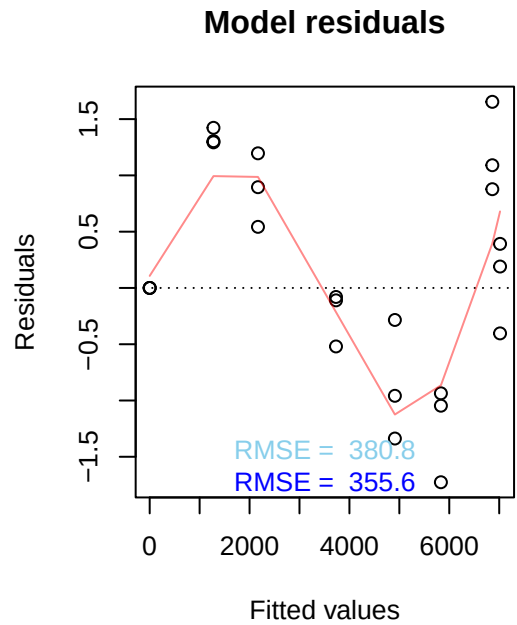

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 5.96
MAPE = 6.428
0
20
40
60
80
0
200
400
600
800

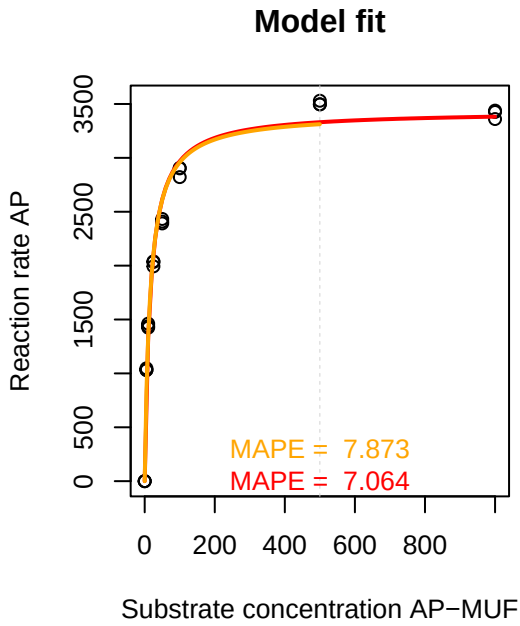

Model residuals
Residuals
Fitted values
RMSE = 4.333
RMSE = 5.268
−2
−1
0
1
2
0
20
40
60
80

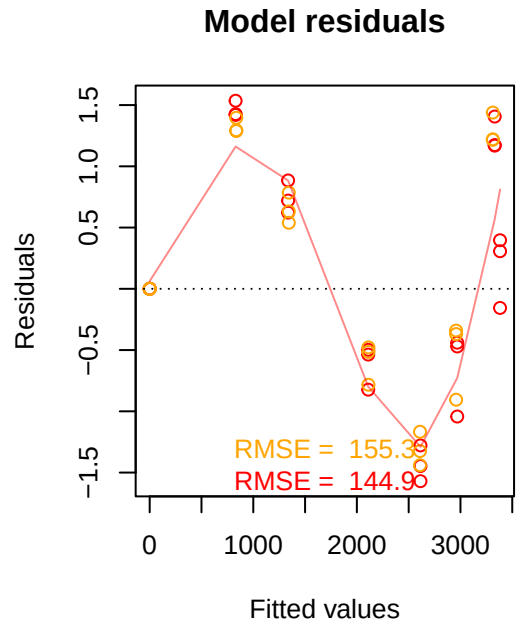

Model fit
Reaction rate AP
0
2000
4000
6000
0
200
400
600
800
MAPE = 10.4
MAPE = 9.206
Substrate concentration AP−MUF

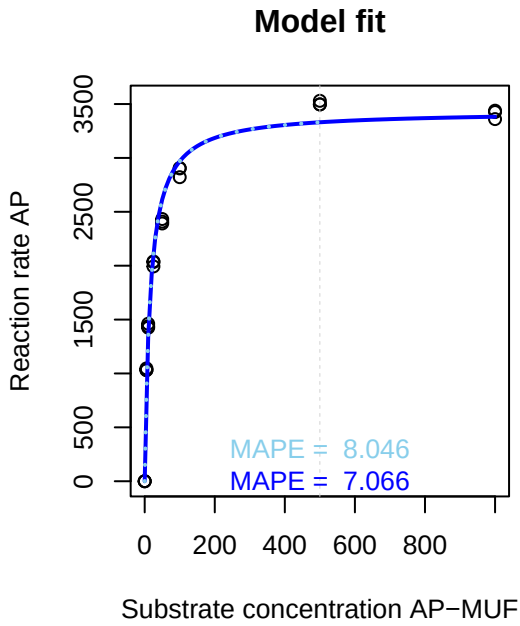

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
2000
4000
6000
RMSE = 380.7
RMSE = 355.5
Fitted values

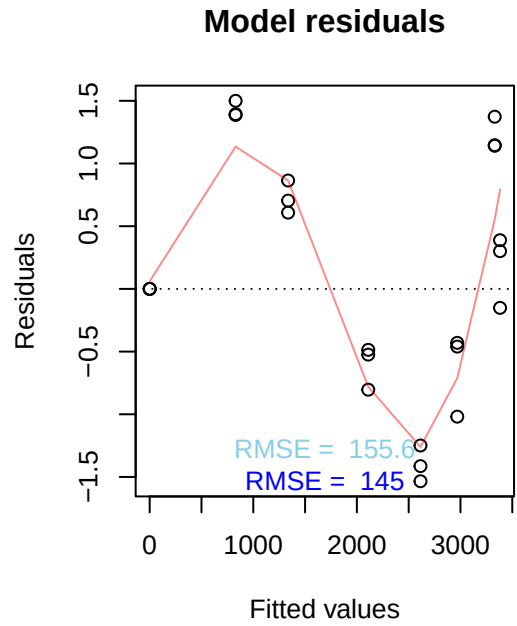

Model fit
Reaction rate AP
0
2000
4000
6000
0
200
400
600
800
MAPE = 10.47
MAPE = 9.208
Substrate concentration AP−MUF

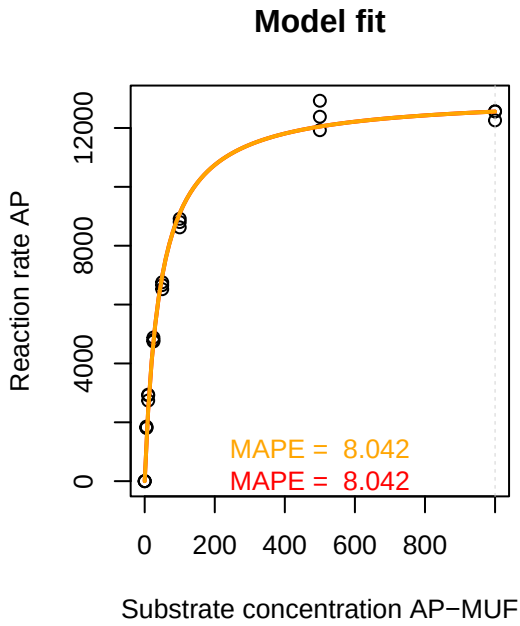

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
2000
4000
6000
RMSE = 380.8
RMSE = 355.6
Fitted values

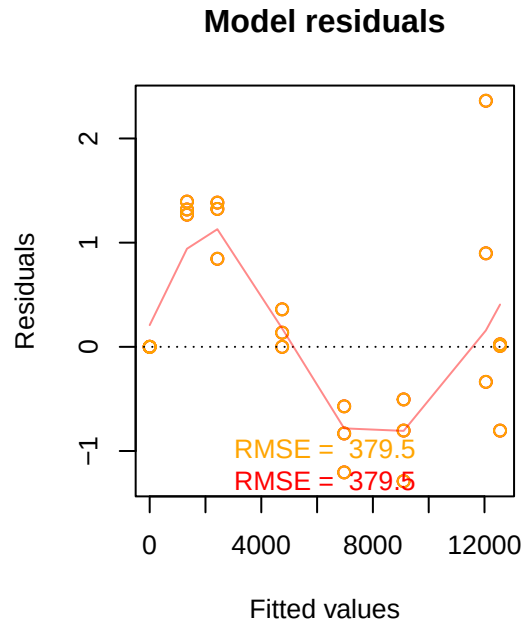

Model fit
Reaction rate AP
0
500
1500
2500
3500
MAPE = 7.873
MAPE = 7.064
0
200
400
600
800
Substrate concentration AP−MUF

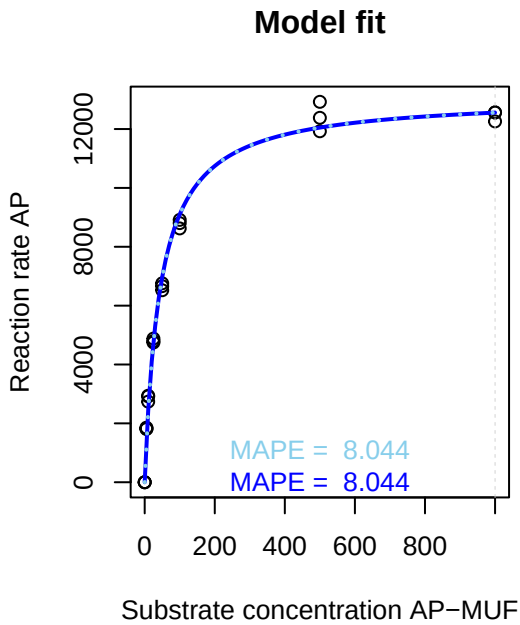

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
RMSE = 155.3
RMSE = 144.9
0
1000
2000
3000
Fitted values

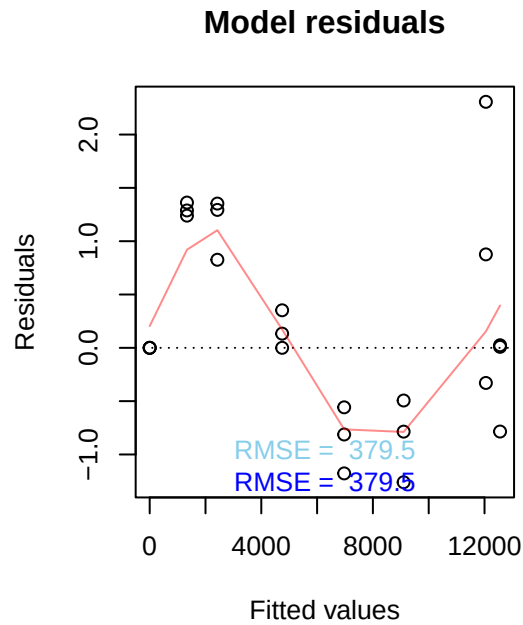

Model fit
Reaction rate AP
0
500
1500
2500
3500
MAPE = 8.046
MAPE = 7.066
0
200
400
600
800
Substrate concentration AP−MUF

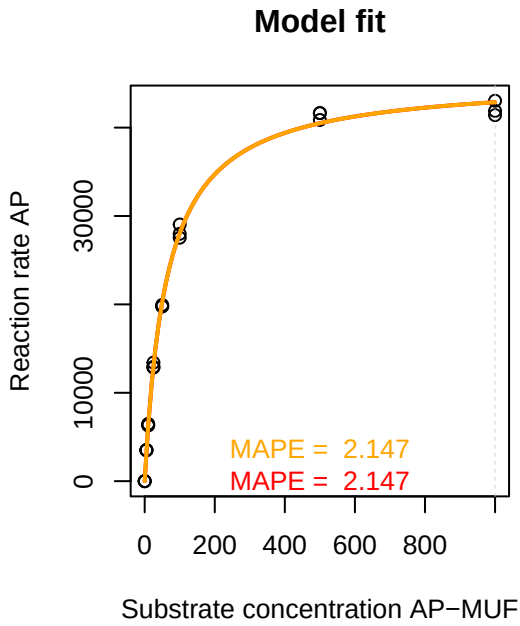

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
RMSE = 155.6
RMSE = 145
0
1000
2000
3000
Fitted values

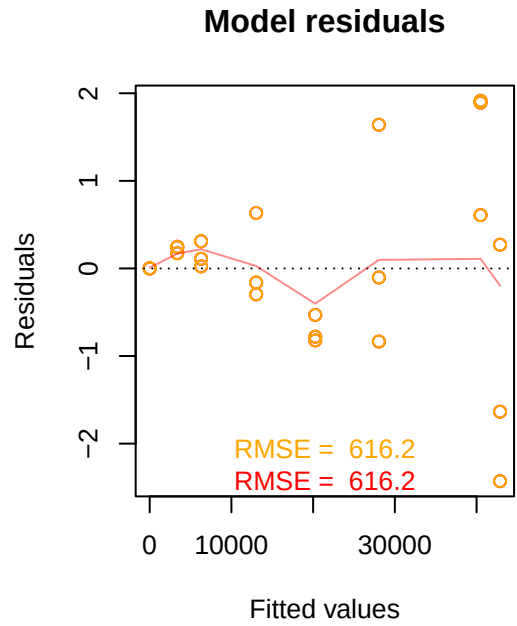

Model fit
Reaction rate AP
0
4000
8000
12000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 8.042
MAPE = 8.042

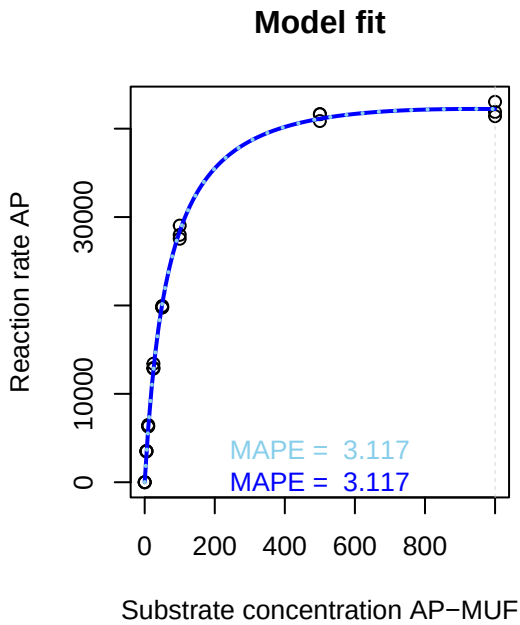

Model residuals
Residuals
−1
0
1
2
0
4000
8000
12000
Fitted values
RMSE = 379.5
RMSE = 379.5

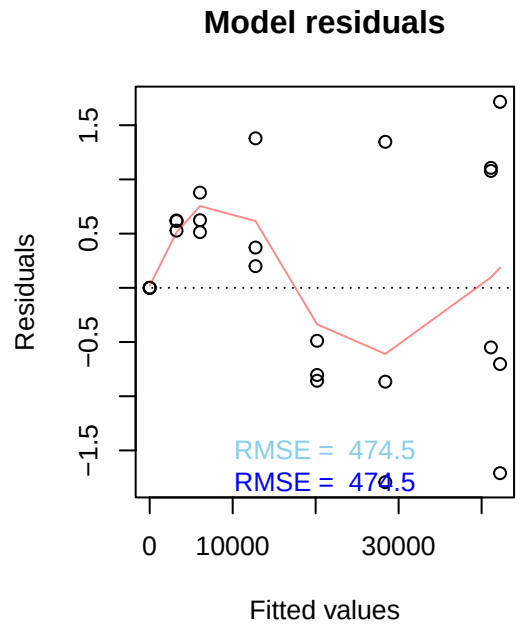

Model fit
Reaction rate AP
0
4000
8000
12000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 8.044
MAPE = 8.044

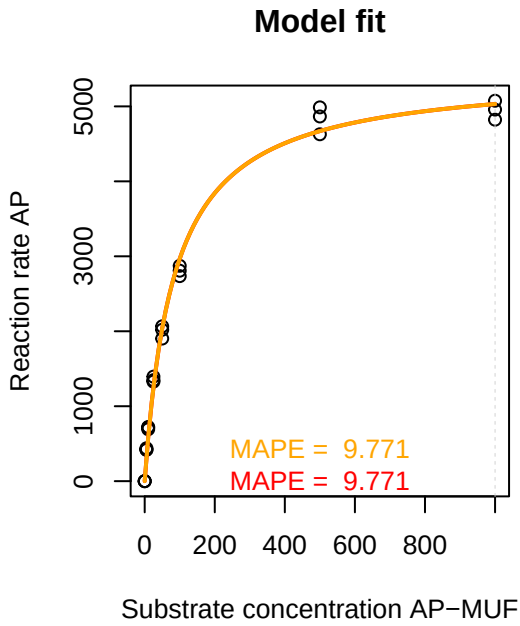

Model residuals
Residuals
−1.0
0.0
1.0
2.0
0
4000
8000
12000
Fitted values
RMSE = 379.5
RMSE = 379.5

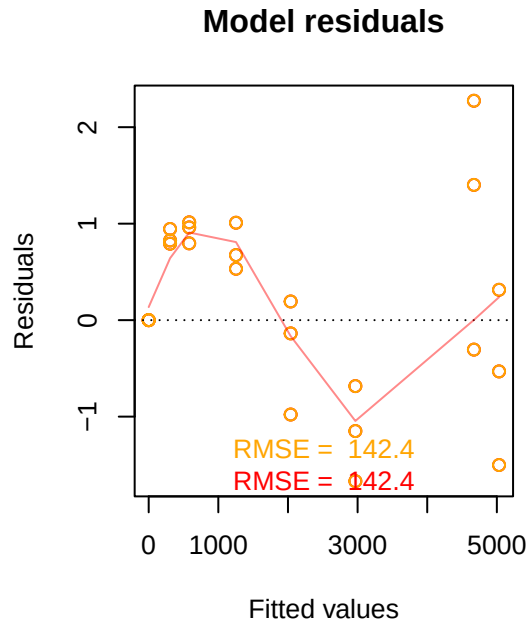

Model fit
Reaction rate AP
0
10000
30000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 2.147
MAPE = 2.147

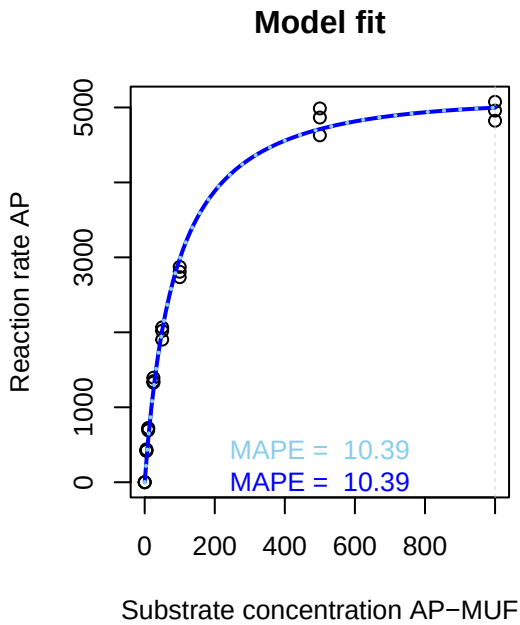

Model residuals
Residuals
−2
−1
0
1
2
0
10000
30000
Fitted values
RMSE = 616.2
RMSE = 616.2

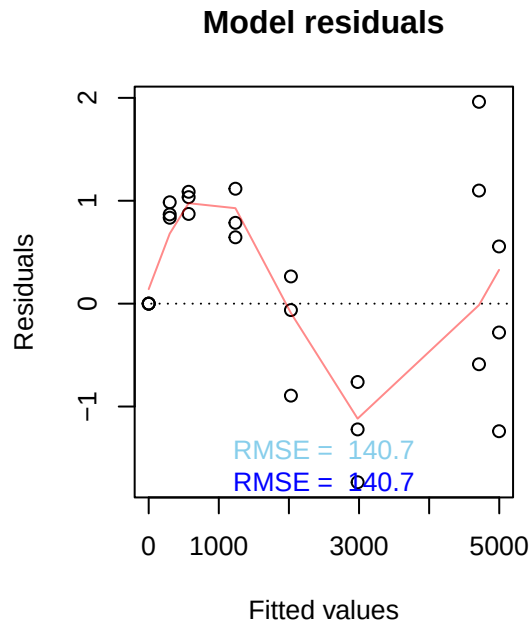

Model fit
Reaction rate AP
0
10000
30000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 3.117
MAPE = 3.117

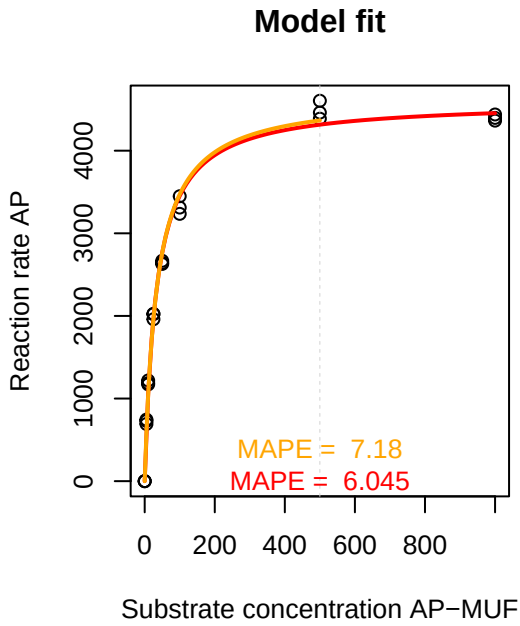

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
10000
30000
Fitted values
RMSE = 474.5
RMSE = 474.5

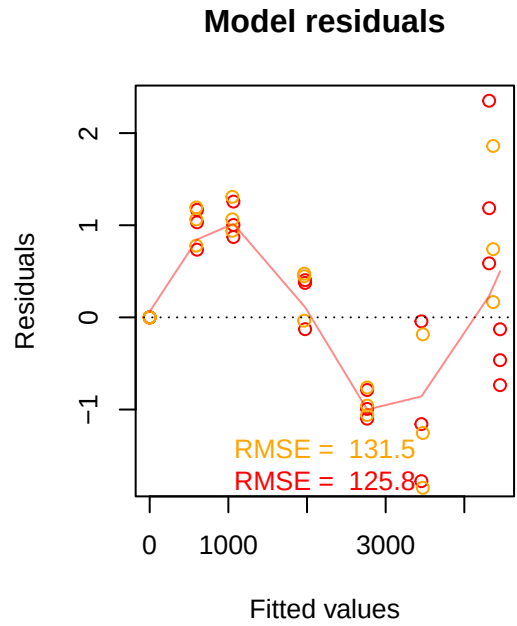

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 9.771
MAPE = 9.771
0
1000
3000
5000
0
200
400
600
800

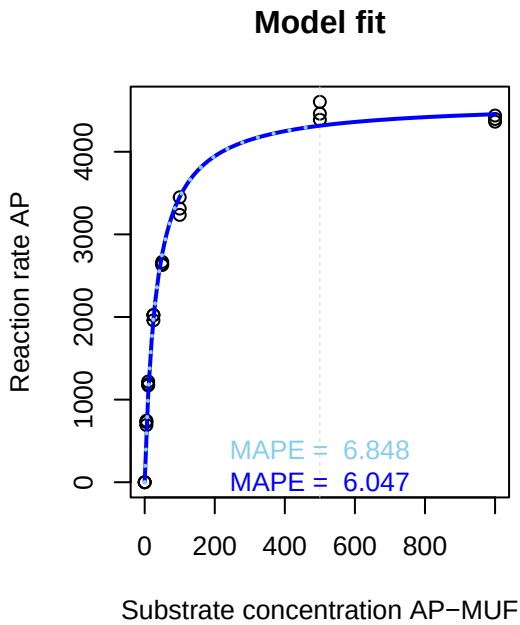

Model residuals
Residuals
Fitted values
RMSE = 142.4
RMSE = 142.4
−1
0
1
2
0
1000
3000
5000

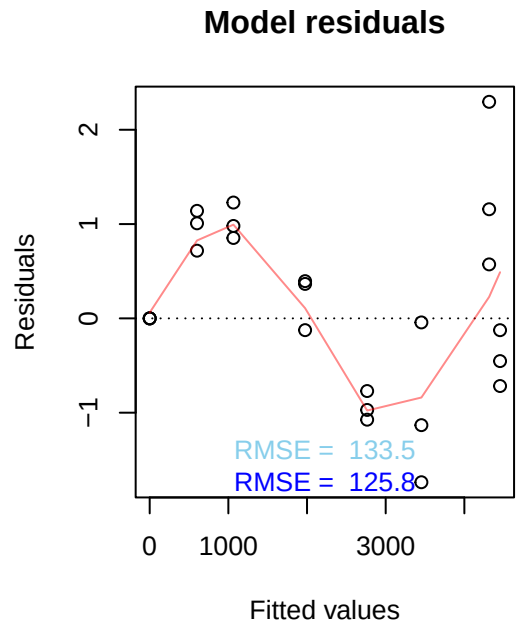

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 10.39
MAPE = 10.39
0
1000
3000
5000
0
200
400
600
800


Model residuals
Residuals
Fitted values
RMSE = 140.7
RMSE = 140.7
−1
0
1
2
0
1000
3000
5000

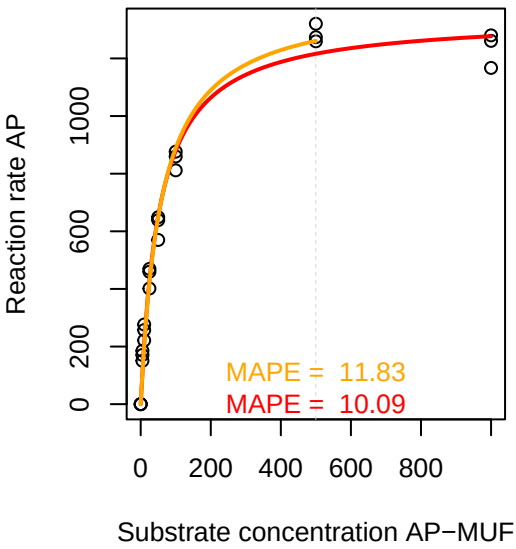

Model fit
Reaction rate AP
0
1000
2000
3000
4000
MAPE = 7.18
MAPE = 6.045
0
200
400
600
800
Substrate concentration AP−MUF


Model residuals
Residuals
−1
0
1
2
RMSE = 131.5
RMSE = 125.8
0
1000
3000
Fitted values

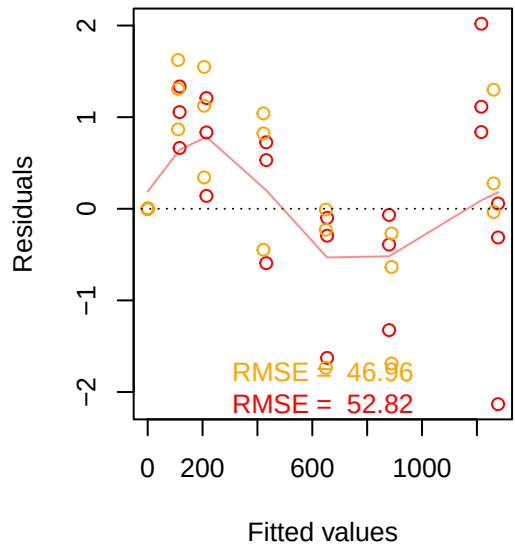

Model fit
Reaction rate AP
0
1000
2000
3000
4000
MAPE = 6.848
MAPE = 6.047
0
200
400
600
800
Substrate concentration AP−MUF


Model residuals
Residuals
−1
0
1
2
RMSE = 133.5
RMSE = 125.8
0
1000
3000
Fitted values

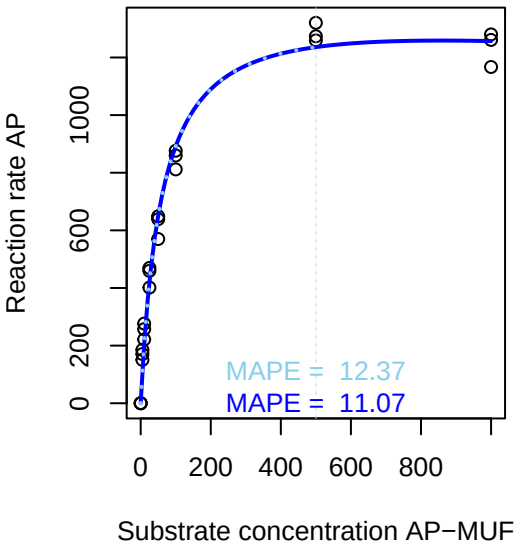
Model fit



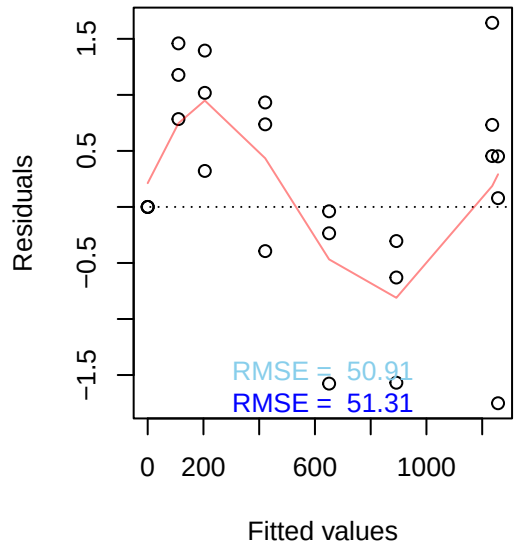
Model residuals

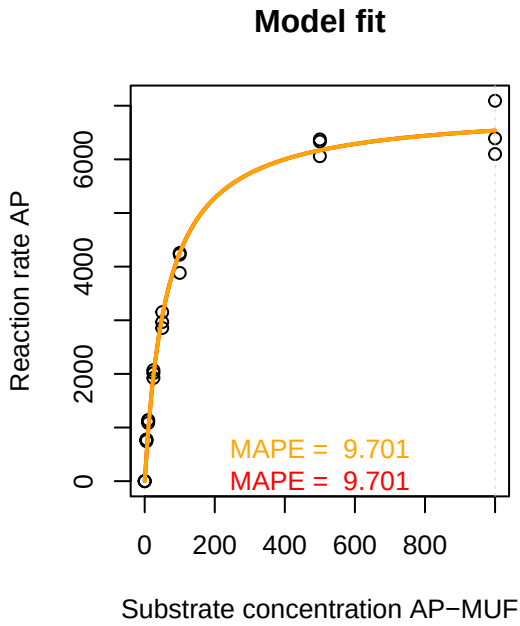


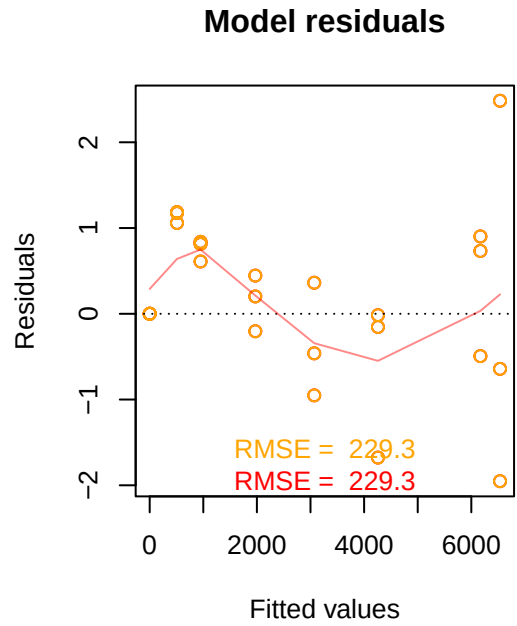
Model fit

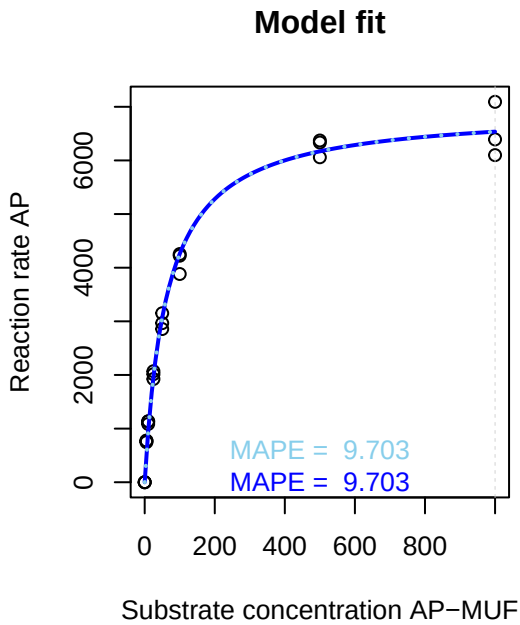


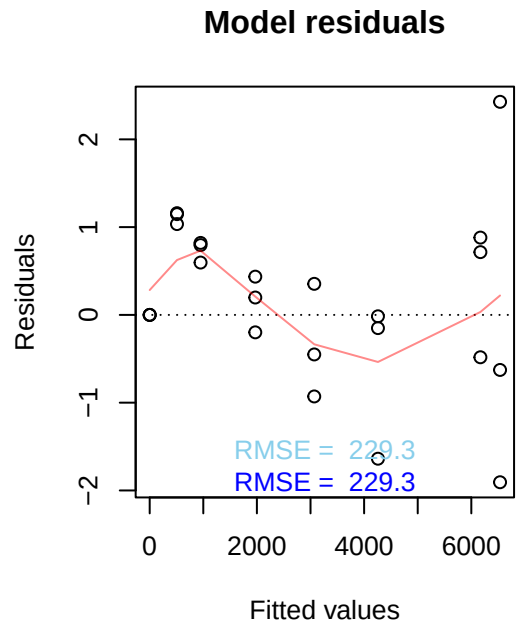
Model residuals

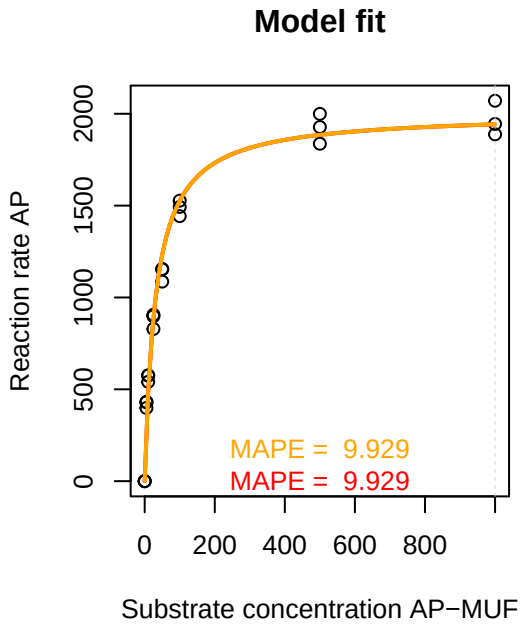


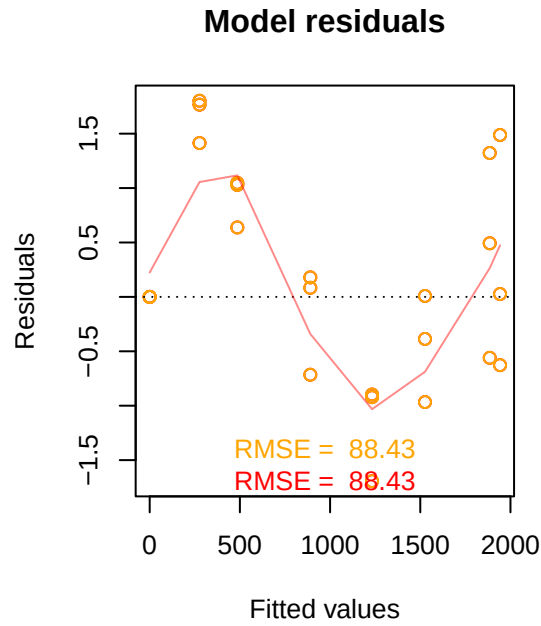

Model fit
Reaction rate AP
0
2000
4000
6000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 9.701
MAPE = 9.701

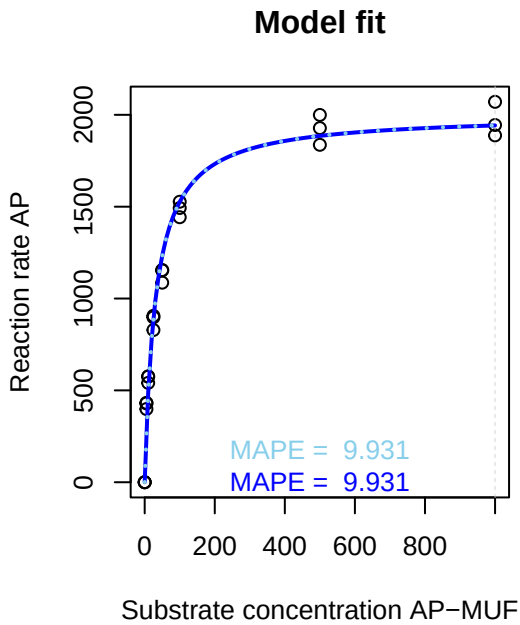

Model residuals
Residuals
−2
−1
0
1
2
0
2000
4000
6000
Fitted values
RMSE = 229.3
RMSE = 229.3

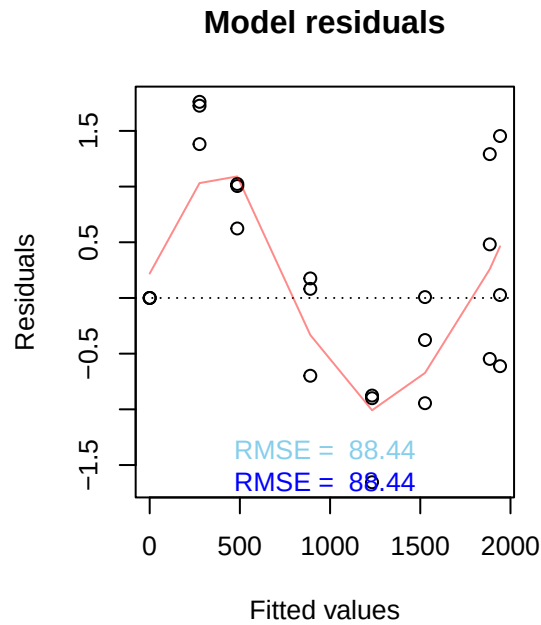

Model fit
Reaction rate AP
0
2000
4000
6000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 9.703
MAPE = 9.703

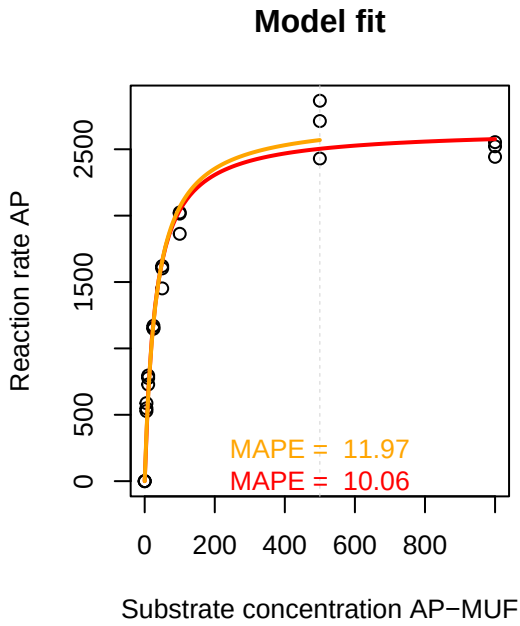

Model residuals
Residuals
−2
−1
0
1
2
0
2000
4000
6000
Fitted values
RMSE = 229.3
RMSE = 229.3

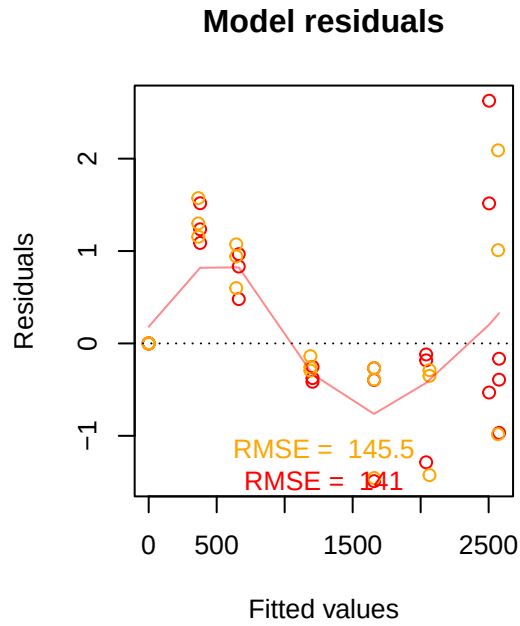

Model fit
Reaction rate AP
0
500
1000
1500
2000
0
200
400
600
800
MAPE = 9.929
MAPE = 9.929
Substrate concentration AP−MUF

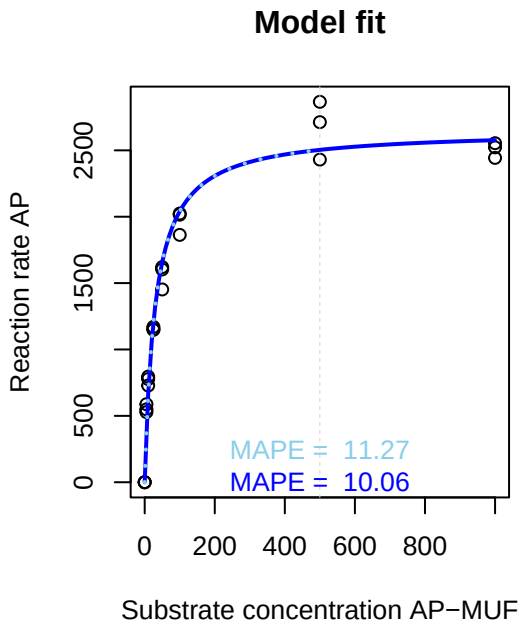

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
500
1000
1500
2000
RMSE = 88.43
RMSE = 88.43
Fitted values

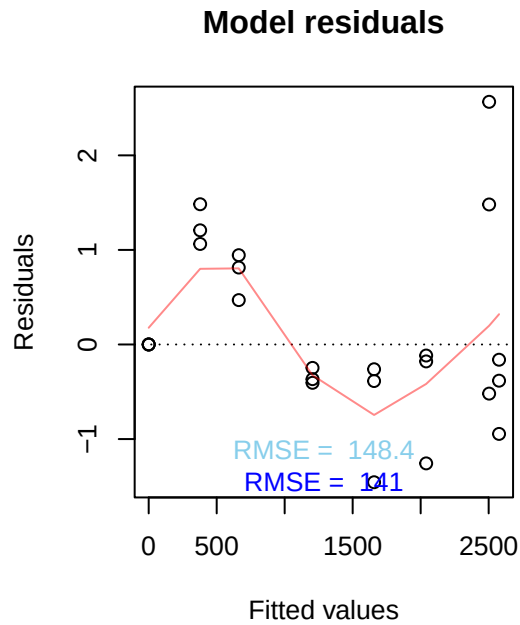

Model fit
Reaction rate AP
0
500
1000
1500
2000
0
200
400
600
800
MAPE = 9.931
MAPE = 9.931
Substrate concentration AP−MUF

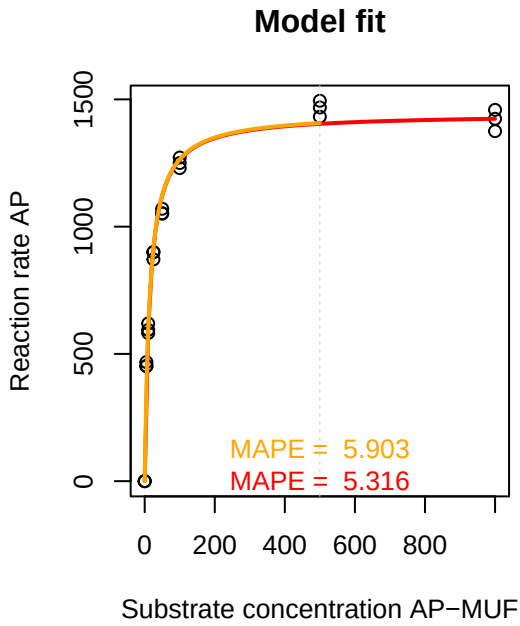

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
500
1000
1500
2000
RMSE = 88.44
RMSE = 88.44
Fitted values

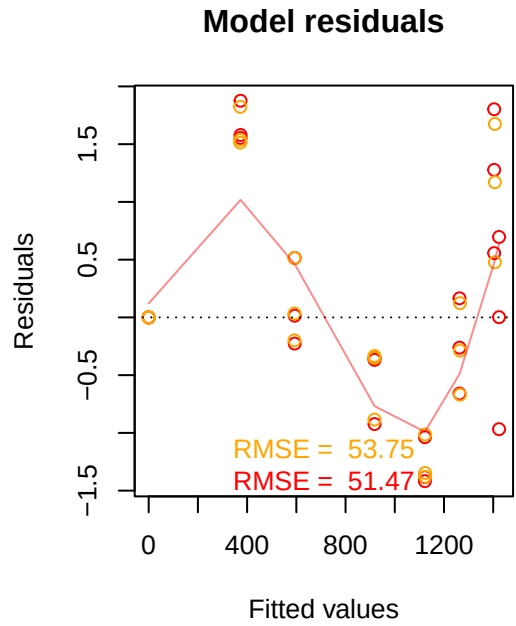

Model fit
Reaction rate AP
0
500
1500
2500
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 11.97
MAPE = 10.06

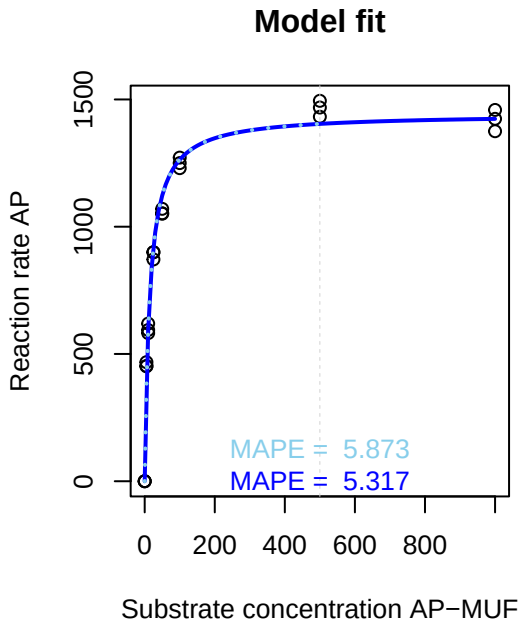

Model residuals
Residuals
−1
0
1
2
0
500
1500
2500
Fitted values
RMSE = 145.5
RMSE = 141

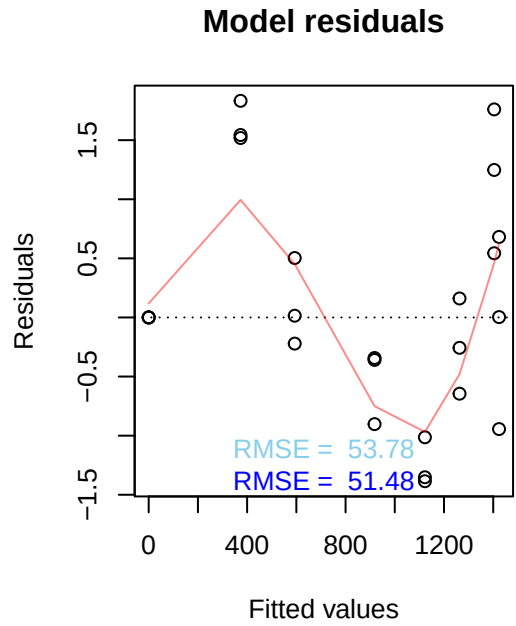

Model fit
Reaction rate AP
0
500
1500
2500
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 11.27
MAPE = 10.06

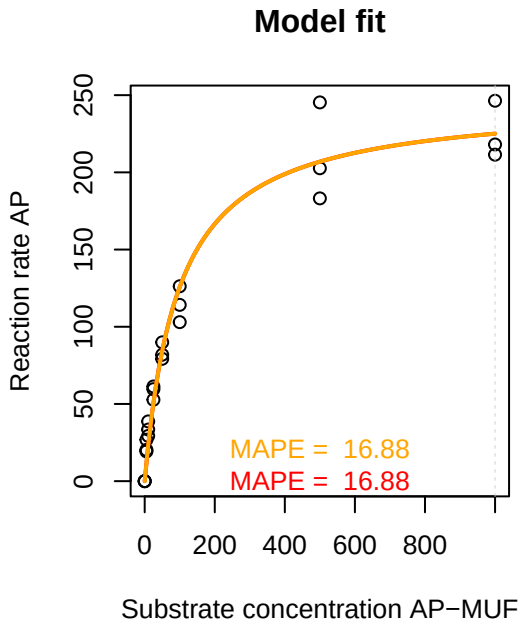

Model residuals
Residuals
−1
0
1
2
0
500
1500
2500
Fitted values
RMSE = 148.4
RMSE = 141

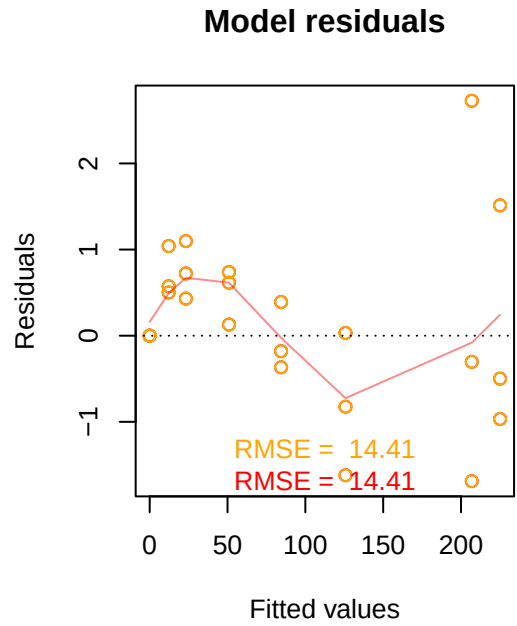

Model fit
Reaction rate AP
0
500
1000
1500
MAPE = 5.903
MAPE = 5.316
0
200
400
600
800
Substrate concentration AP−MUF

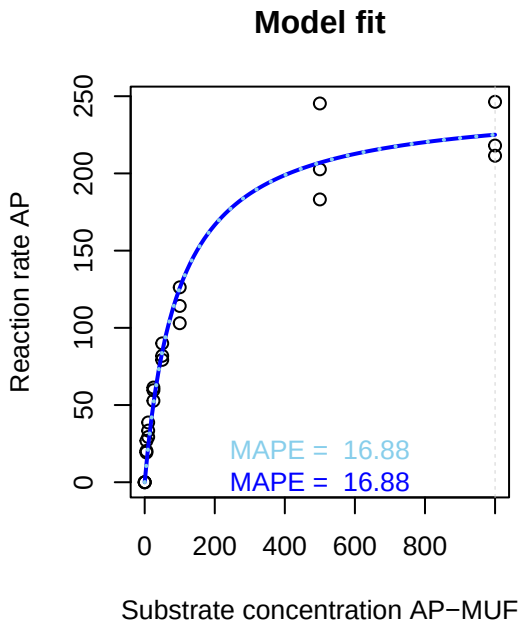

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
RMSE = 53.75
RMSE = 51.47
0
400
800
1200
Fitted values

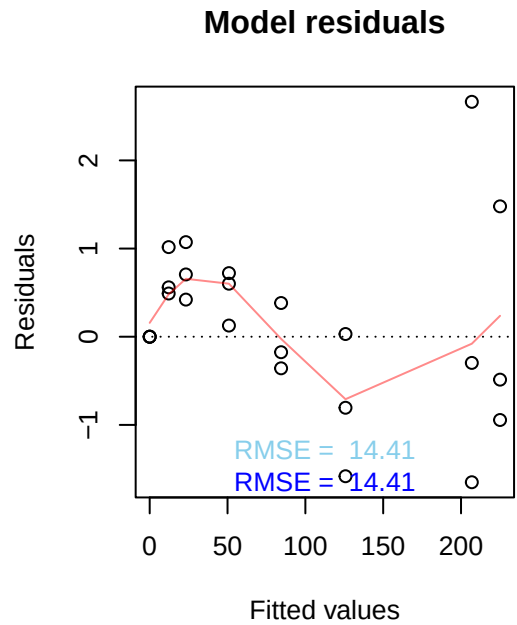

Model fit
Reaction rate AP
0
500
1000
1500
MAPE = 5.873
MAPE = 5.317
0
200
400
600
800
Substrate concentration AP−MUF

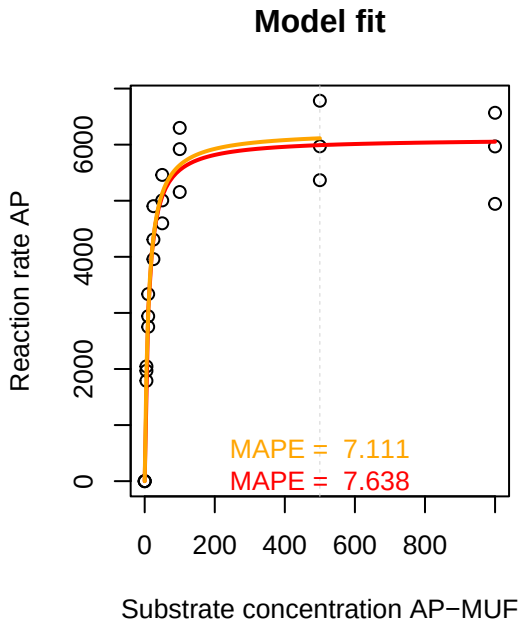

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
RMSE = 53.78
RMSE = 51.48
0
400
800
1200
Fitted values

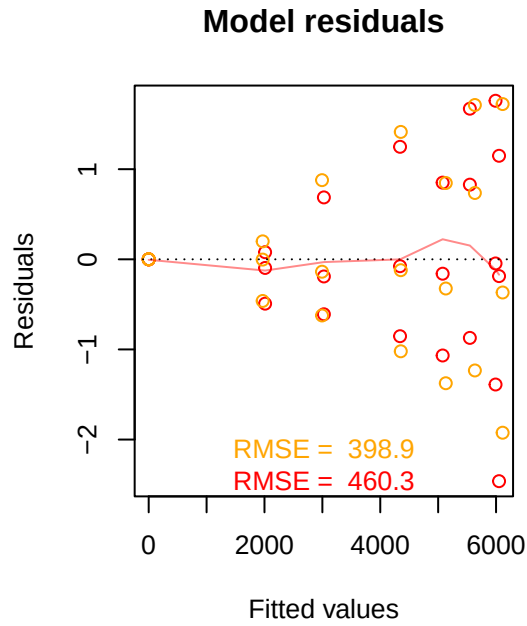

Model fit
Reaction rate AP
0
50
100
150
200
250
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 16.88
MAPE = 16.88

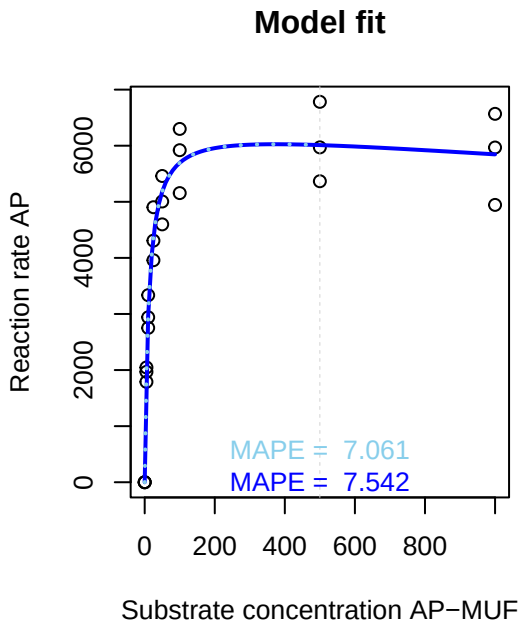

Model residuals
Residuals
−1
0
1
2
0
50
100
150
200
Fitted values
RMSE = 14.41
RMSE = 14.41

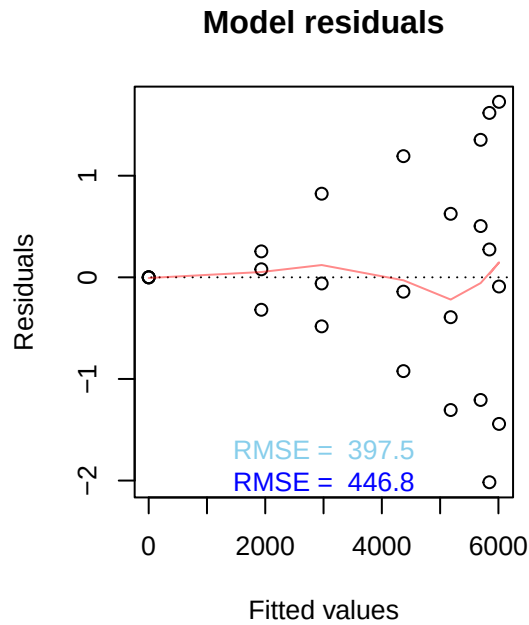

Model fit
Reaction rate AP
0
50
100
150
200
250
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 16.88
MAPE = 16.88

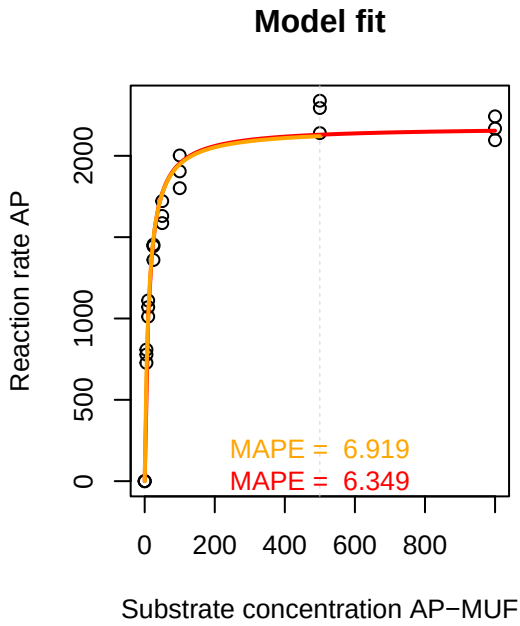

Model residuals
Residuals
−1
0
1
2
0
50
100
150
200
Fitted values
RMSE = 14.41
RMSE = 14.41

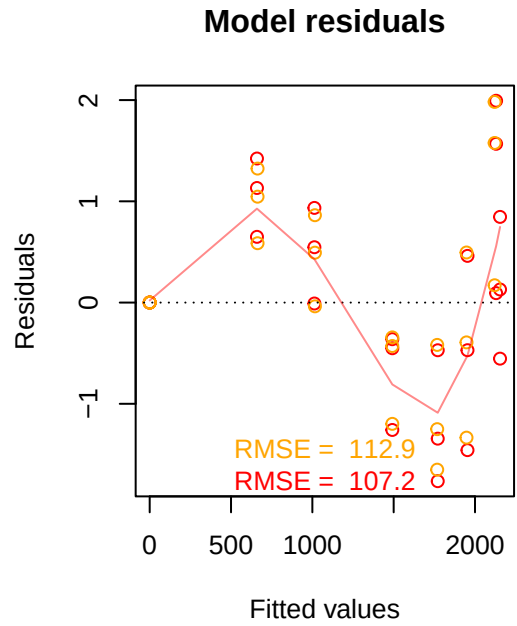

Model fit
Reaction rate AP
0
2000
4000
6000
0
200
400
600
800
MAPE = 7.111
MAPE = 7.638
Substrate concentration AP−MUF

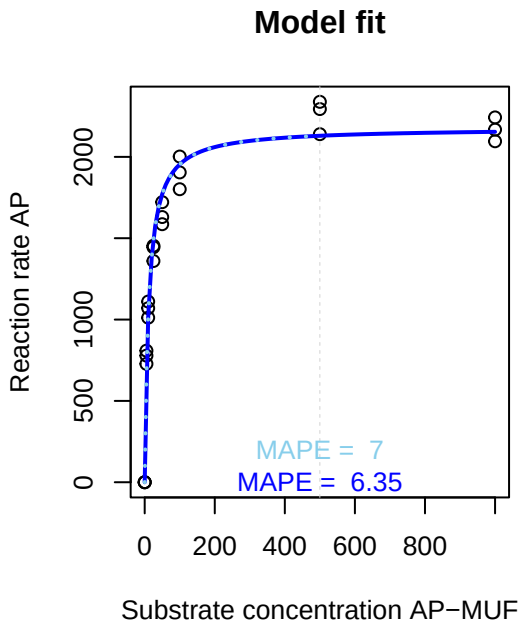

Model residuals
Residuals
−2
−1
0
1
0
2000
4000
6000
RMSE = 398.9
RMSE = 460.3
Fitted values

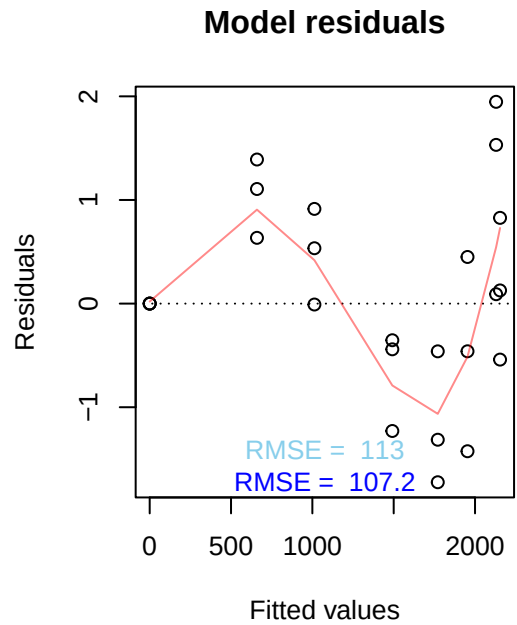

Model fit
Reaction rate AP
0
2000
4000
6000
0
200
400
600
800
MAPE = 7.061
MAPE = 7.542
Substrate concentration AP−MUF

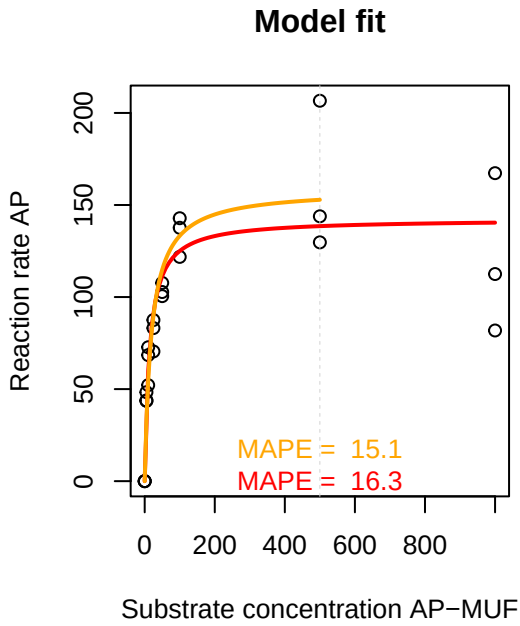

Model residuals
Residuals
−2
−1
0
1
0
2000
4000
6000
RMSE = 397.5
RMSE = 446.8
Fitted values

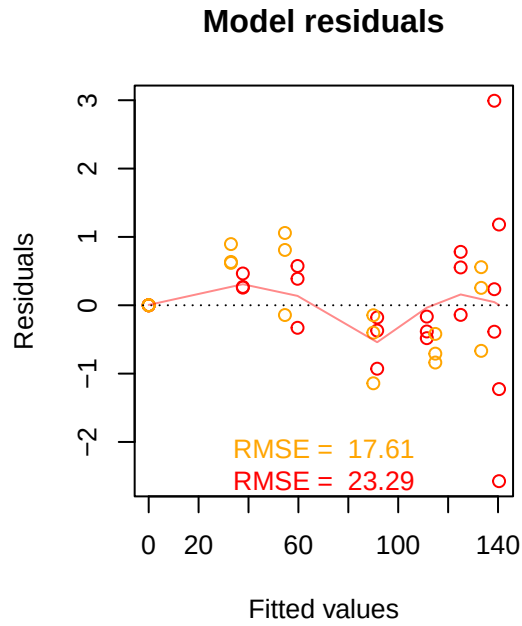

Model fit
Reaction rate AP
0
500
1000
2000
MAPE = 6.919
MAPE = 6.349
0
200
400
600
800
Substrate concentration AP−MUF

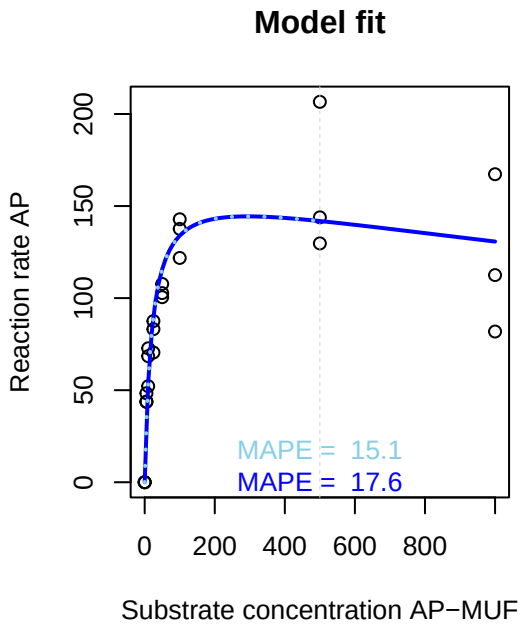

Model residuals
Residuals
−1
0
1
2
RMSE = 112.9
RMSE = 107.2
0
500
1000
2000
Fitted values

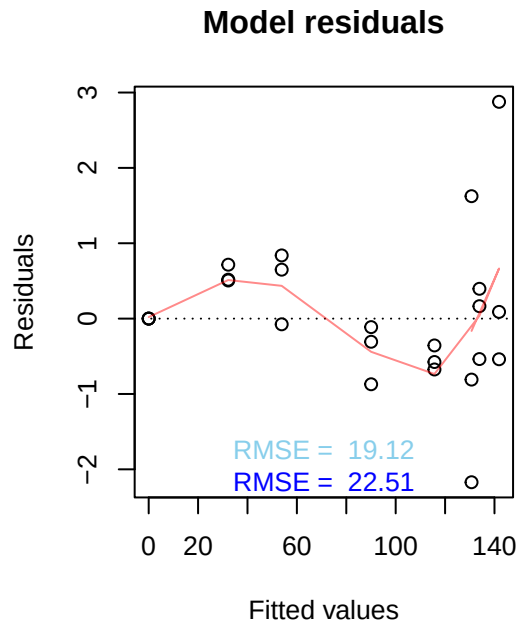

Model fit
Reaction rate AP
0
500
1000
2000
MAPE = 7
MAPE = 6.35
0
200
400
600
800
Substrate concentration AP−MUF

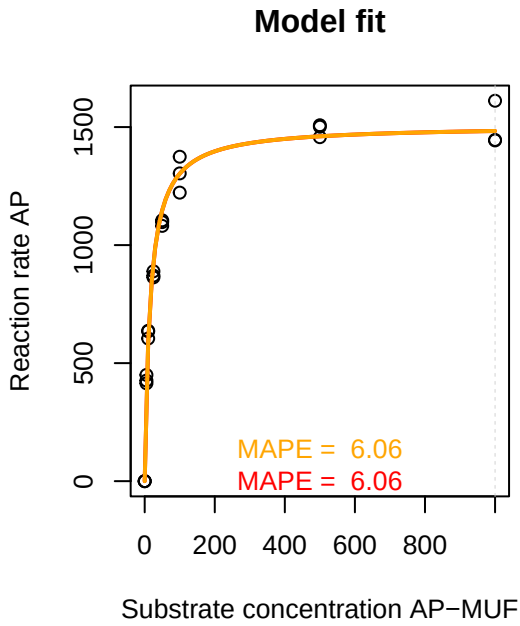

Model residuals
Residuals
−1
0
1
2
RMSE = 113
RMSE = 107.2
0
500
1000
2000
Fitted values

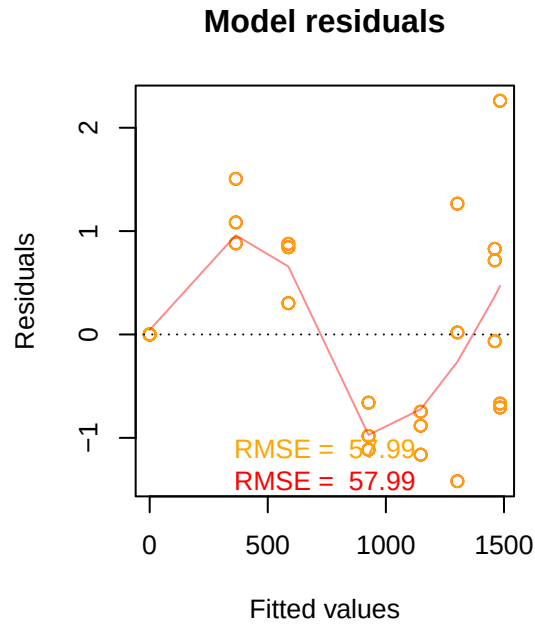

Model fit
Reaction rate AP
0
50
100
150
200
0
200
400
600
800
MAPE = 15.1
MAPE = 16.3
Substrate concentration AP−MUF

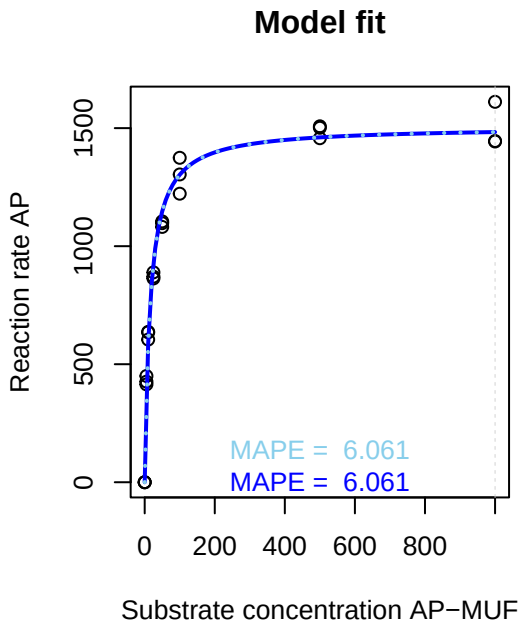

Model residuals
Residuals
−2
−1
0
1
2
3
0
20
60
100
140
RMSE = 17.61
RMSE = 23.29
Fitted values

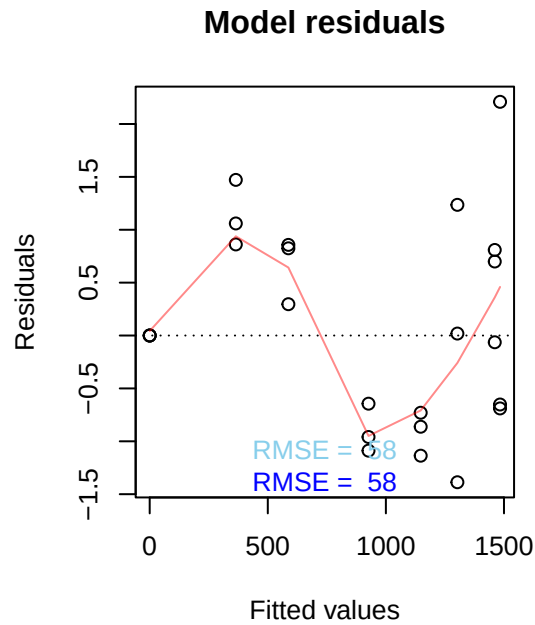

Model fit
Reaction rate AP
0
50
100
150
200
0
200
400
600
800
MAPE = 15.1
MAPE = 17.6
Substrate concentration AP−MUF

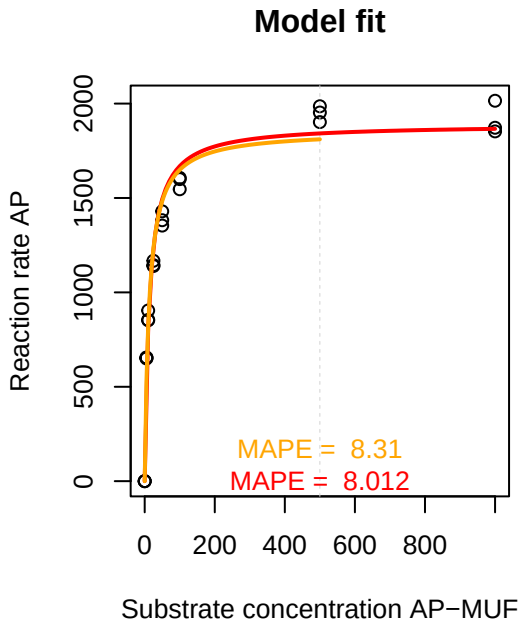

Model residuals
Residuals
−2
−1
0
1
2
3
0
20
60
100
140
RMSE = 19.12
RMSE = 22.51
Fitted values

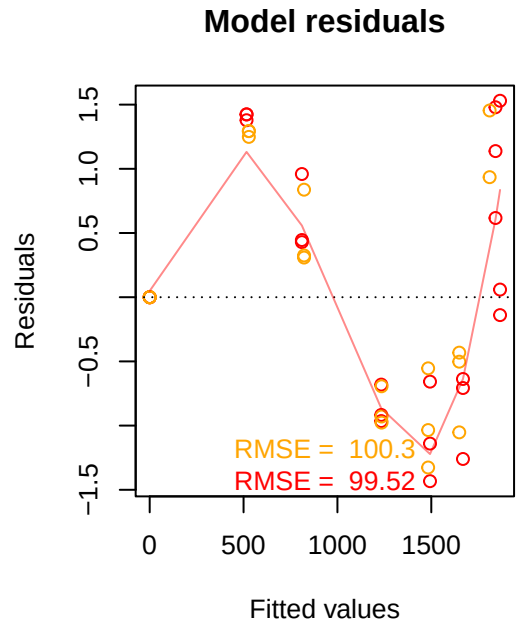

Model fit
Reaction rate AP
0
500
1000
1500
MAPE = 6.06
MAPE = 6.06
0
200
400
600
800
Substrate concentration AP−MUF

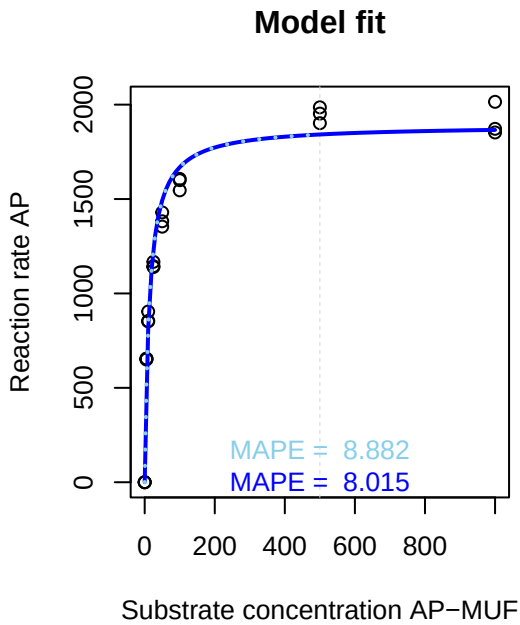

Model residuals
Residuals
−1
0
1
2
RMSE = 57.99
RMSE = 57.99
0
500
1000
1500
Fitted values

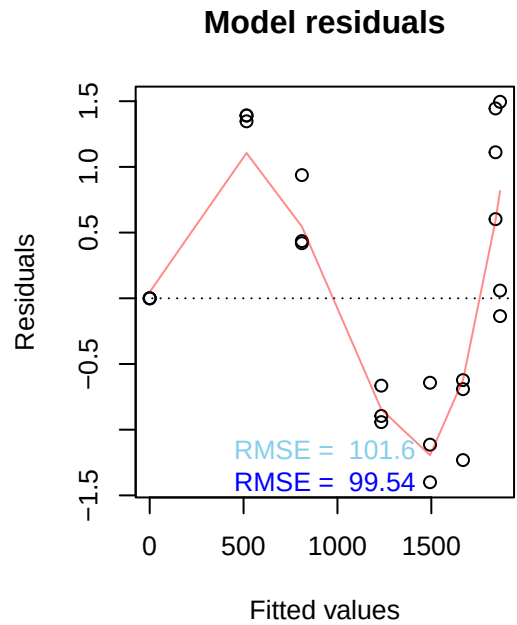

Model fit
Reaction rate AP
0
500
1000
1500
MAPE = 6.061
MAPE = 6.061
0
200
400
600
800
Substrate concentration AP−MUF

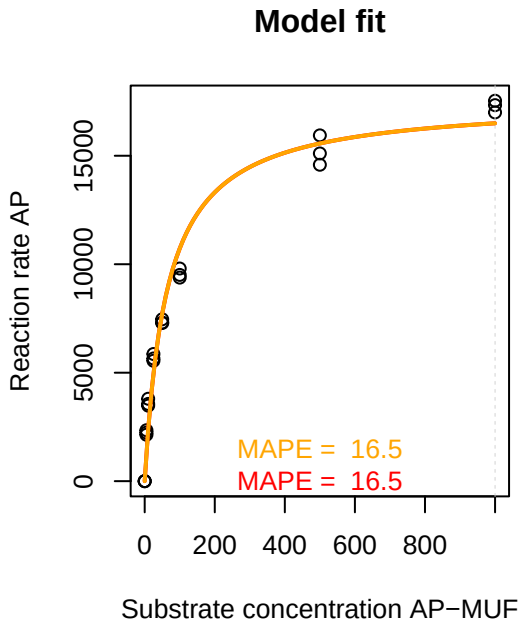

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
RMSE = 58
RMSE = 58
0
500
1000
1500
Fitted values

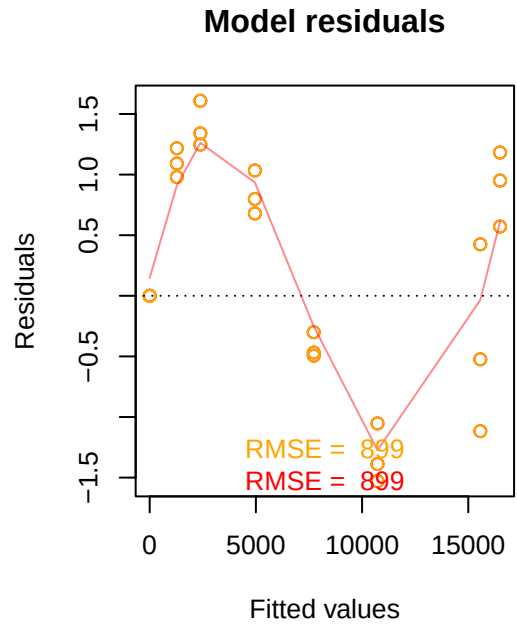

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 8.31
MAPE = 8.012
0
500
1000
1500
2000
0
200
400
600
800

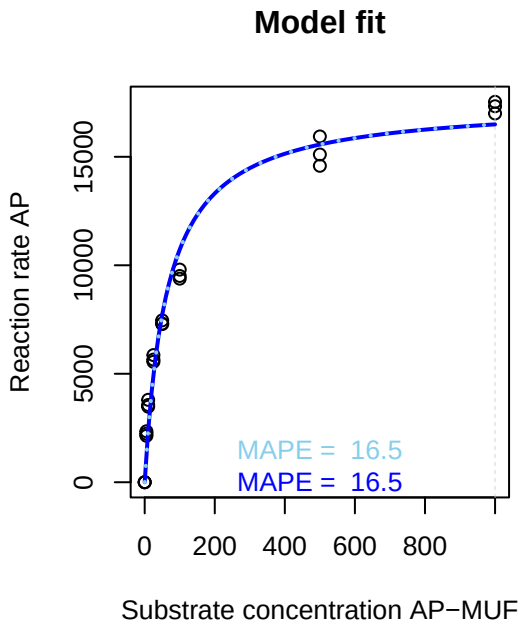

Model residuals
Residuals
Fitted values
RMSE = 100.3
RMSE = 99.52
−1.5
−0.5
0.5
1.0
1.5
0
500
1000
1500

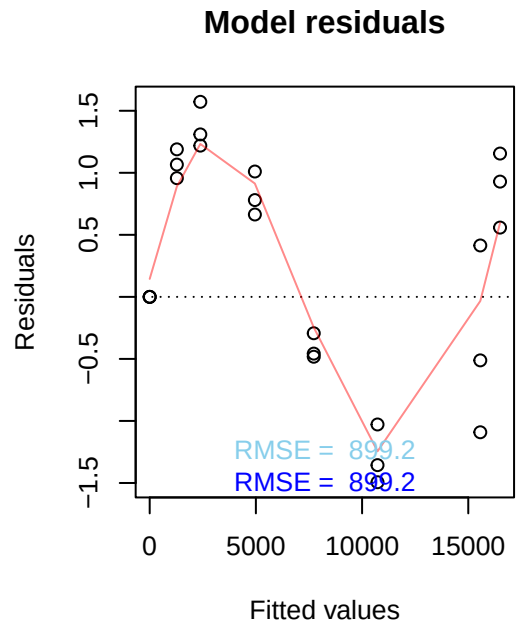

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 8.882
MAPE = 8.015
0
500
1000
1500
2000
0
200
400
600
800

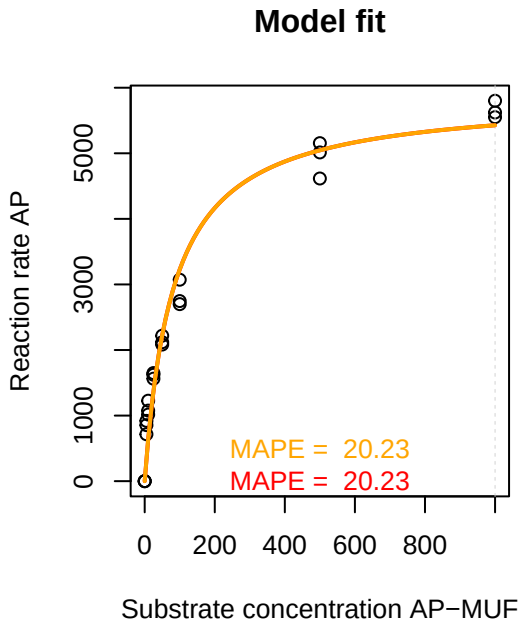

Model residuals
Residuals
Fitted values
RMSE = 101.6
RMSE = 99.54
−1.5
−0.5
0.5
1.0
1.5
0
500
1000
1500

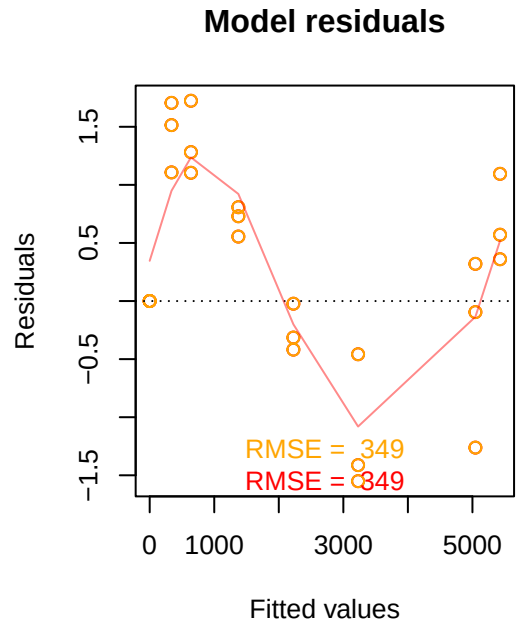

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
MAPE = 16.5
MAPE = 16.5
Substrate concentration AP−MUF

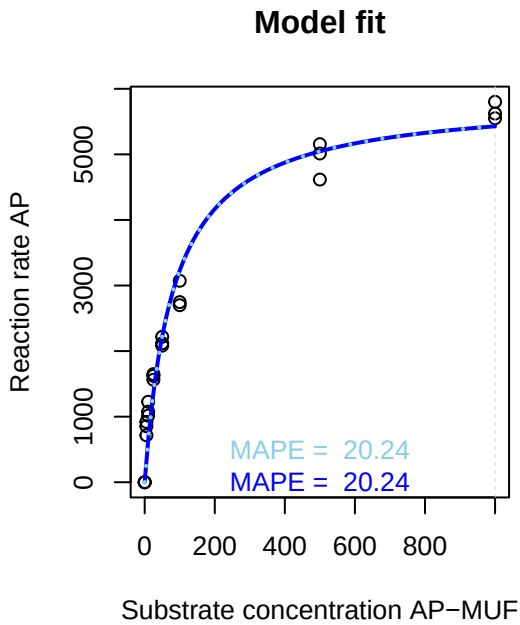

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
5000
10000
15000
RMSE = 899
RMSE = 899
Fitted values

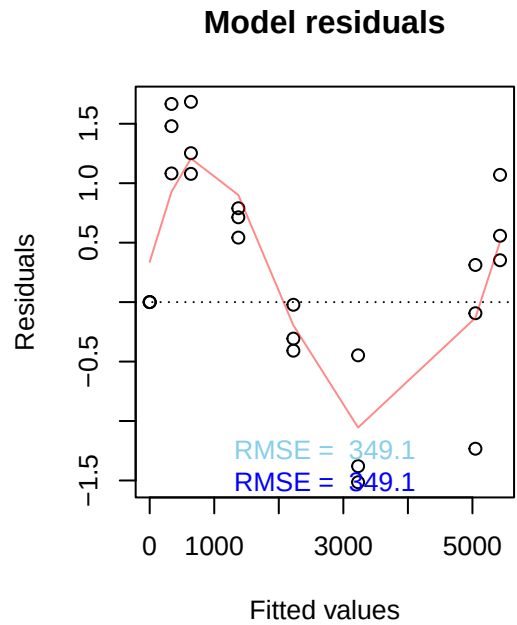

Model fit
Reaction rate AP
0
5000
10000
15000
0
200
400
600
800
MAPE = 16.5
MAPE = 16.5
Substrate concentration AP−MUF

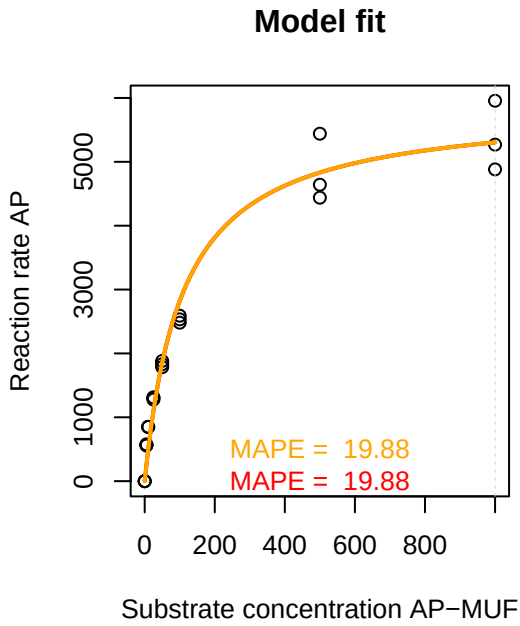

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
5000
10000
15000
RMSE = 899.2
RMSE = 899.2
Fitted values

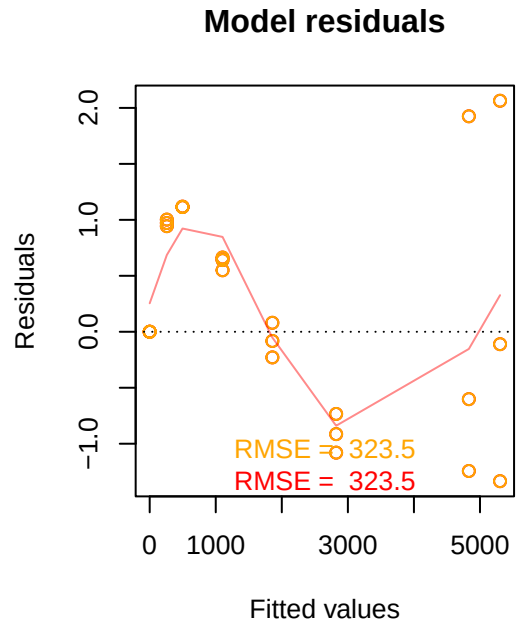

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
MAPE = 20.23
MAPE = 20.23
Substrate concentration AP−MUF

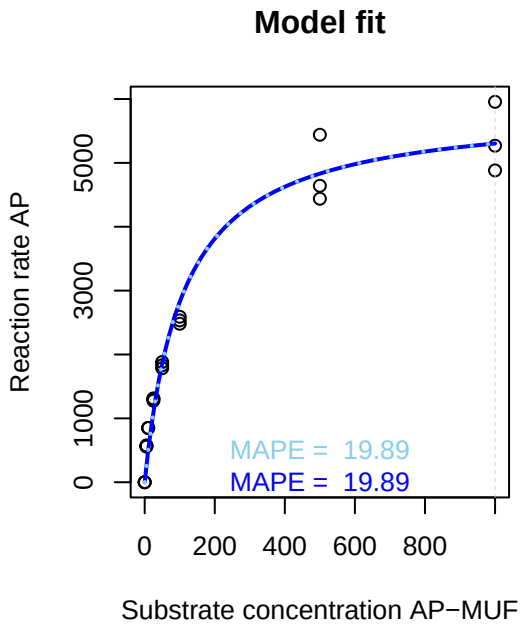

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
1000
3000
5000
RMSE = 349
RMSE = 349
Fitted values

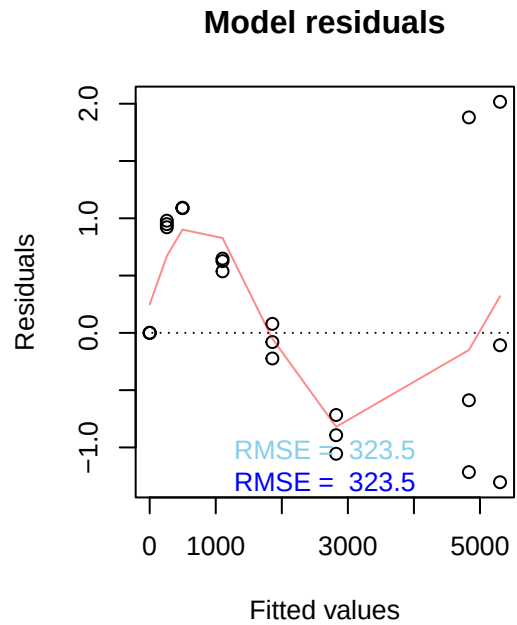

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
MAPE = 20.24
MAPE = 20.24
Substrate concentration AP−MUF

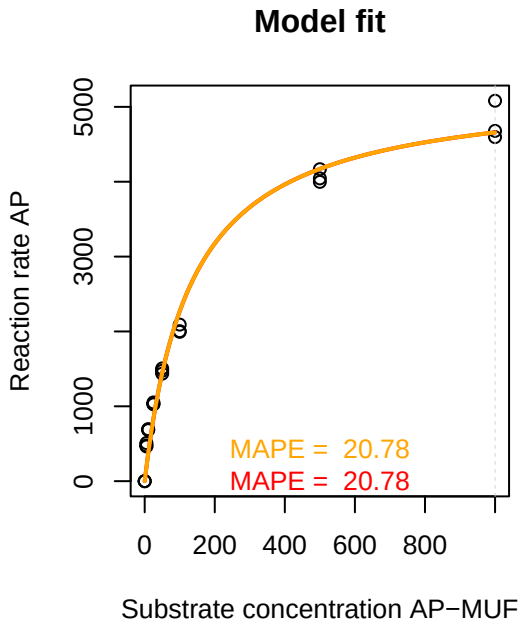

Model residuals
Residuals
−1.5
−0.5
0.5
1.0
1.5
0
1000
3000
5000
RMSE = 349.1
RMSE = 349.1
Fitted values

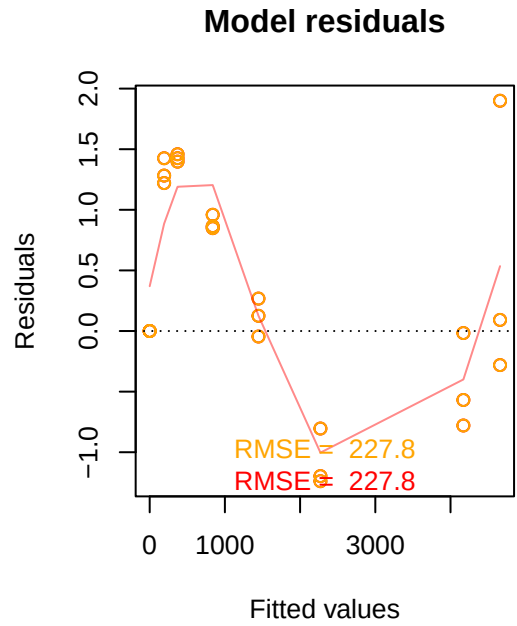

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
MAPE = 19.88
MAPE = 19.88
Substrate concentration AP−MUF

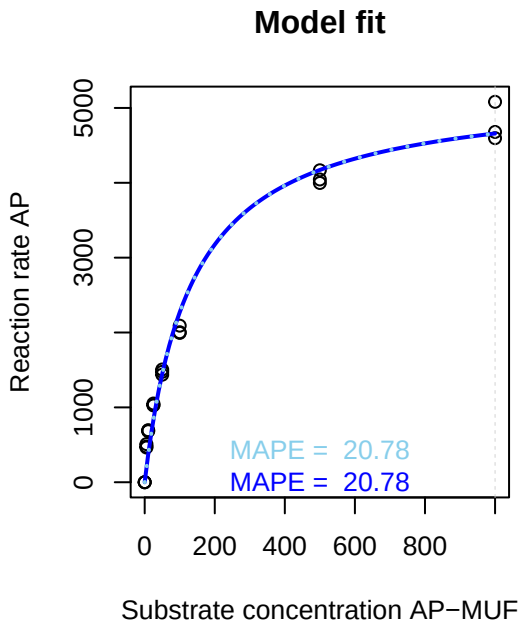

Model residuals
Residuals
−1.0
0.0
1.0
2.0
0
1000
3000
5000
RMSE = 323.5
RMSE = 323.5
Fitted values

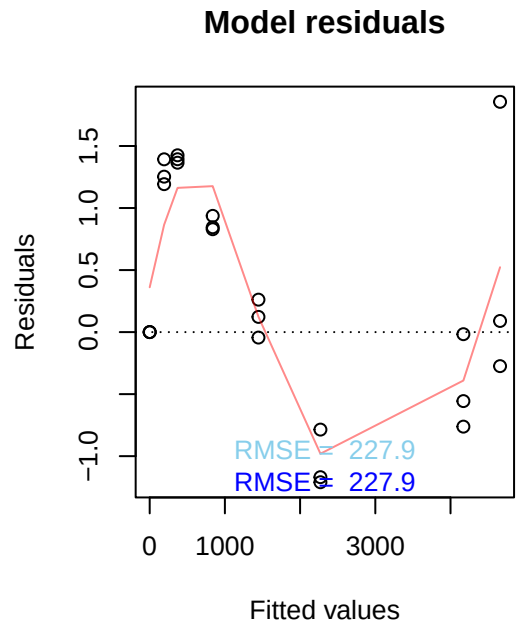

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
MAPE = 19.89
MAPE = 19.89
Substrate concentration AP−MUF

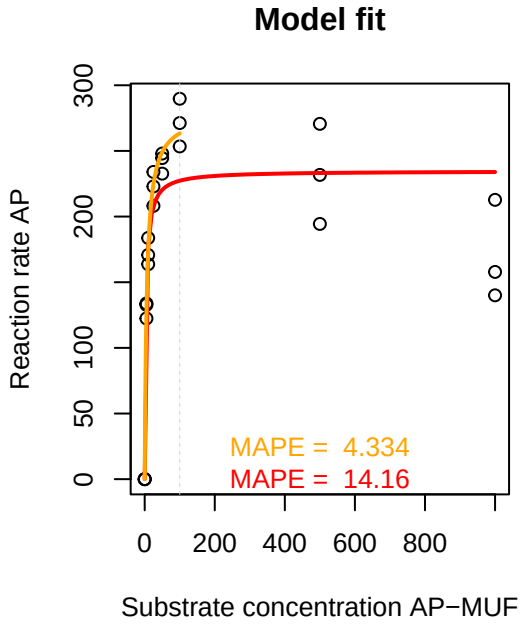

Model residuals
Residuals
−1.0
0.0
1.0
2.0
0
1000
3000
5000
RMSE = 323.5
RMSE = 323.5
Fitted values

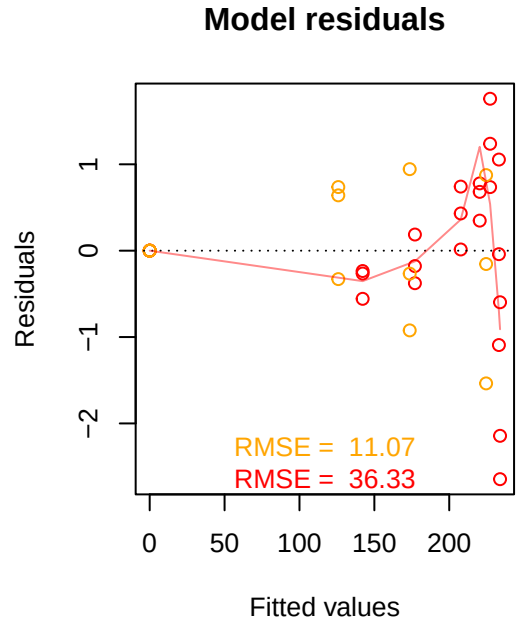

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 20.78
MAPE = 20.78

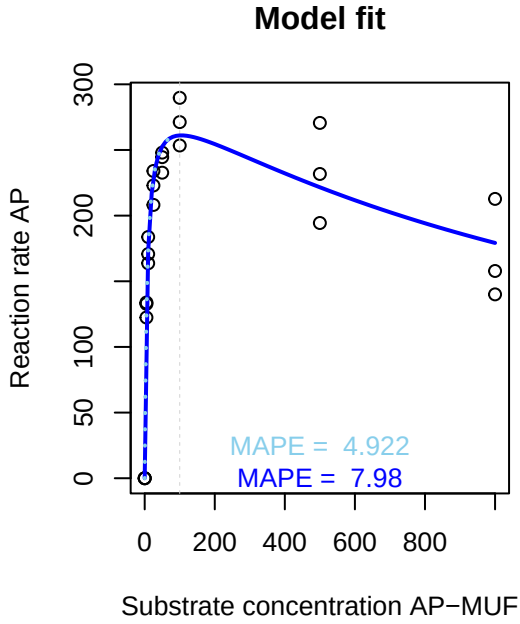

Model residuals
Residuals
−1.0
0.0
0.5
1.0
1.5
2.0
0
1000
3000
Fitted values
RMSE = 227.8
RMSE = 227.8

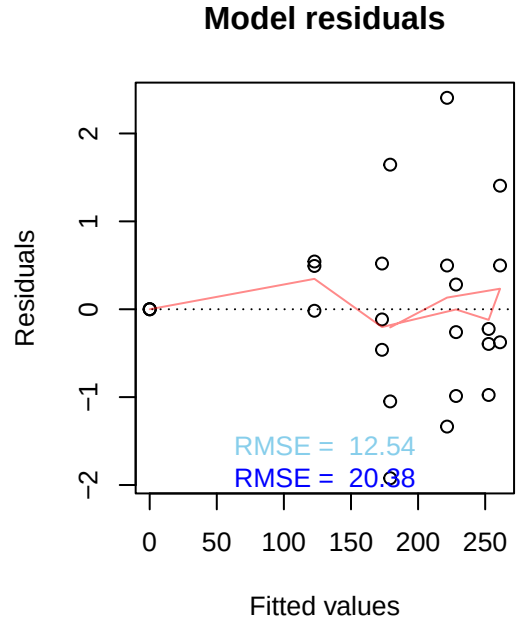

Model fit
Reaction rate AP
0
1000
3000
5000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 20.78
MAPE = 20.78

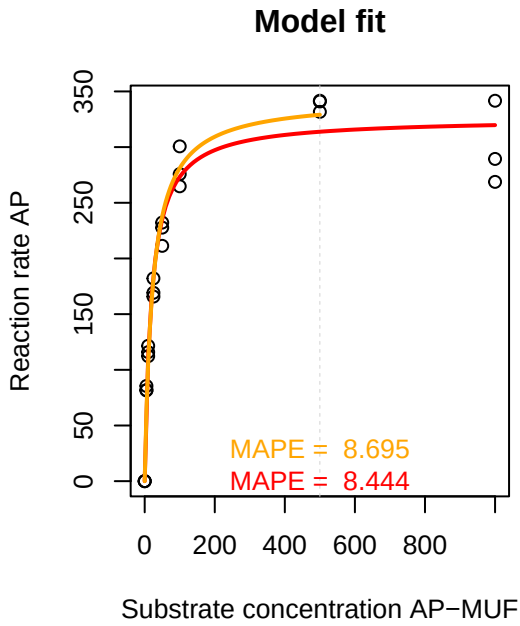

Model residuals
Residuals
−1.0
0.0
0.5
1.0
1.5
0
1000
3000
Fitted values
RMSE = 227.9
RMSE = 227.9

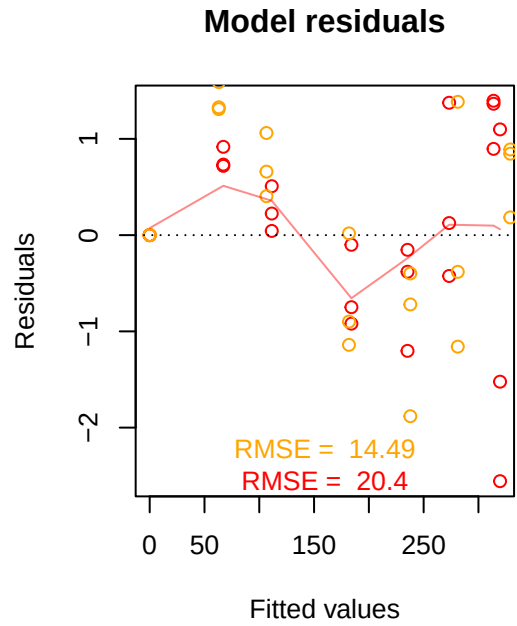

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 4.334
MAPE = 14.16

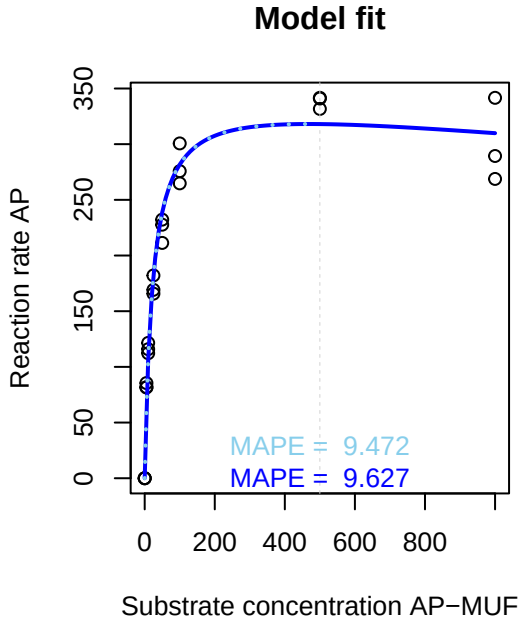

Model residuals
Residuals
Fitted values
RMSE = 11.07
RMSE = 36.33

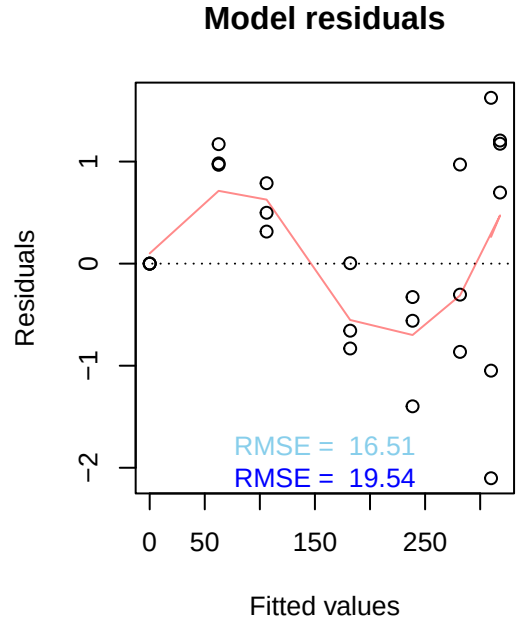

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 4.922
MAPE = 7.98

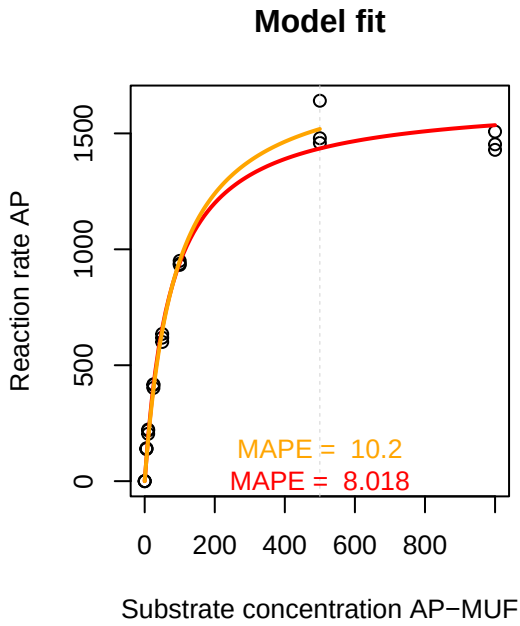

Model residuals
Residuals
Fitted values
RMSE = 12.54
RMSE = 20.38

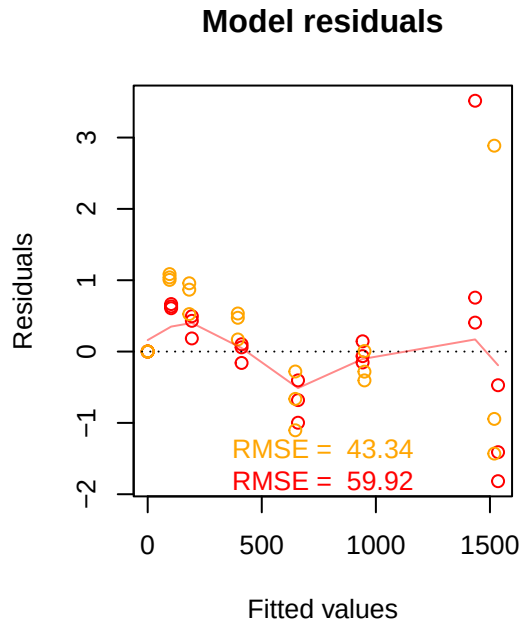

Model fit
Reaction rate AP
0
50
150
250
350
0
200
400
600
800
MAPE = 8.695
MAPE = 8.444
Substrate concentration AP−MUF

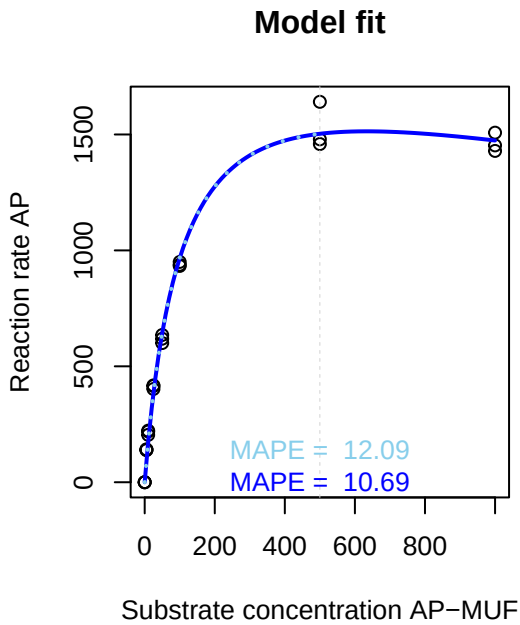

Model residuals
Residuals
−2
−1
0
1
0
50
150
250
RMSE = 14.49
RMSE = 20.4
Fitted values

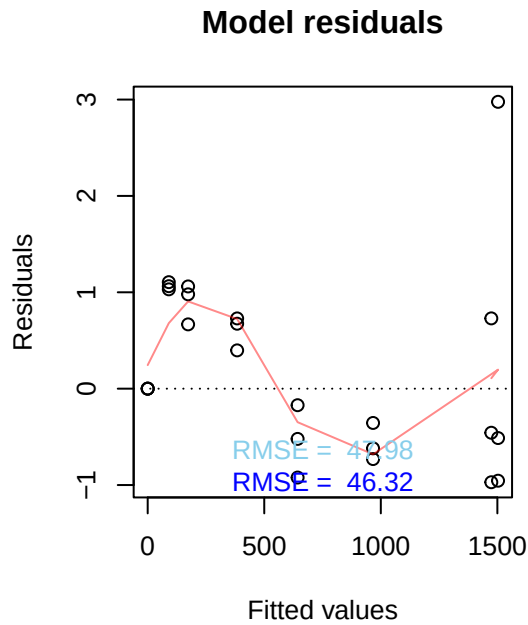

Model fit
Reaction rate AP
0
50
150
250
350
0
200
400
600
800
MAPE = 9.472
MAPE = 9.627
Substrate concentration AP−MUF

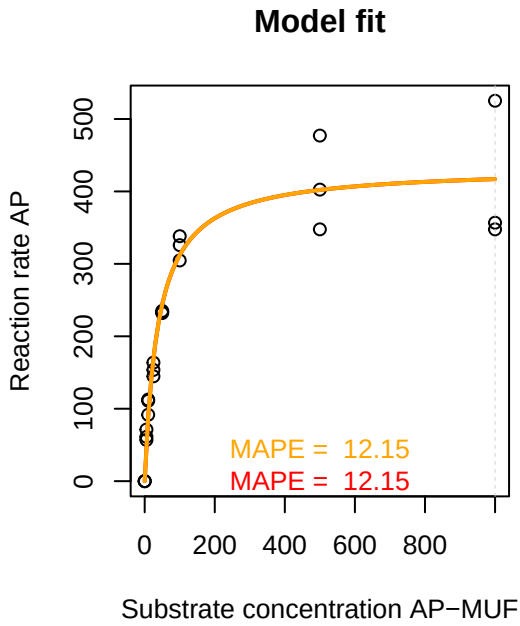

Model residuals
Residuals
−2
−1
0
1
0
50
150
250
RMSE = 16.51
RMSE = 19.54
Fitted values

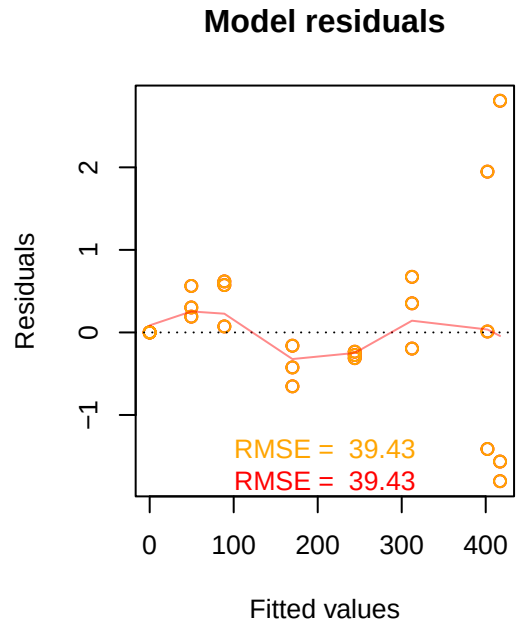

Model fit
Reaction rate AP
0
500
1000
1500
MAPE = 10.2
MAPE = 8.018
0
200
400
600
800
Substrate concentration AP−MUF

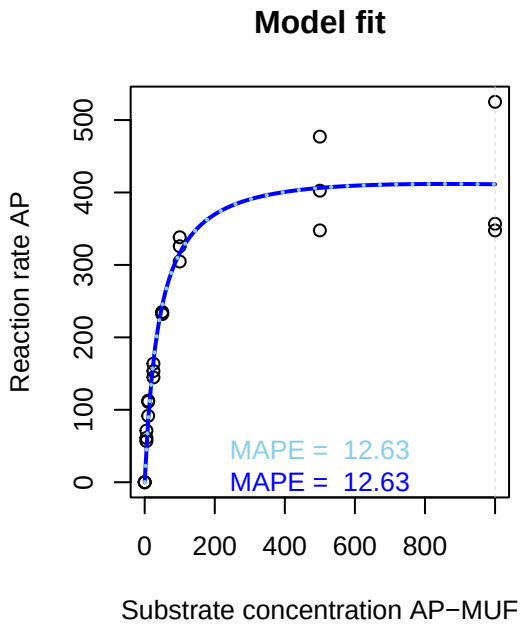

Model residuals
Residuals
−2
−1
0
1
2
3
RMSE = 43.34
RMSE = 59.92
0
500
1000
1500
Fitted values

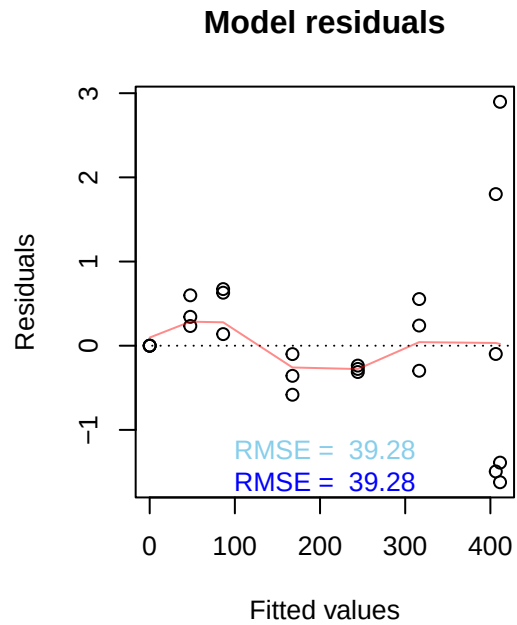

Model fit
Reaction rate AP
0
500
1000
1500
MAPE = 12.09
MAPE = 10.69
0
200
400
600
800
Substrate concentration AP−MUF

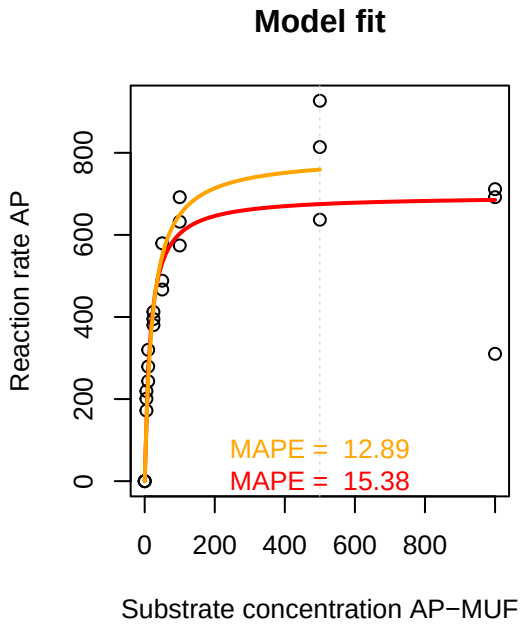

Model residuals
Residuals
−1
0
1
2
3
RMSE = 46.98
RMSE = 46.32
0
500
1000
1500
Fitted values

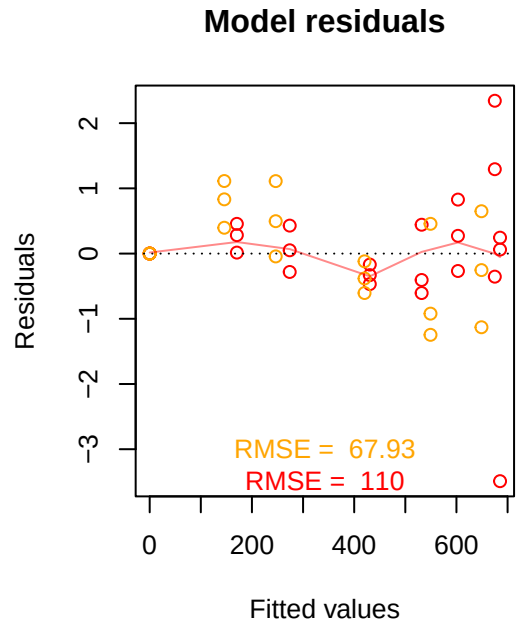

Model fit
Reaction rate AP
0
100
200
300
400
500
MAPE = 12.15
MAPE = 12.15
0
200
400
600
800
Substrate concentration AP−MUF

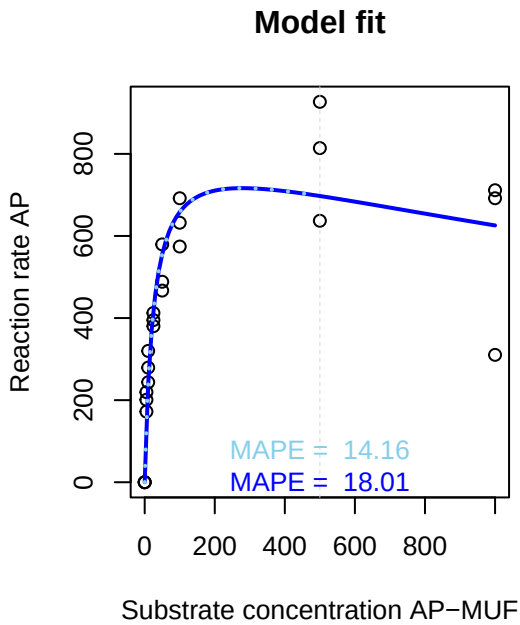

Model residuals
Residuals
−1
0
1
2
RMSE = 39.43
RMSE = 39.43
0
100
200
300
400
Fitted values

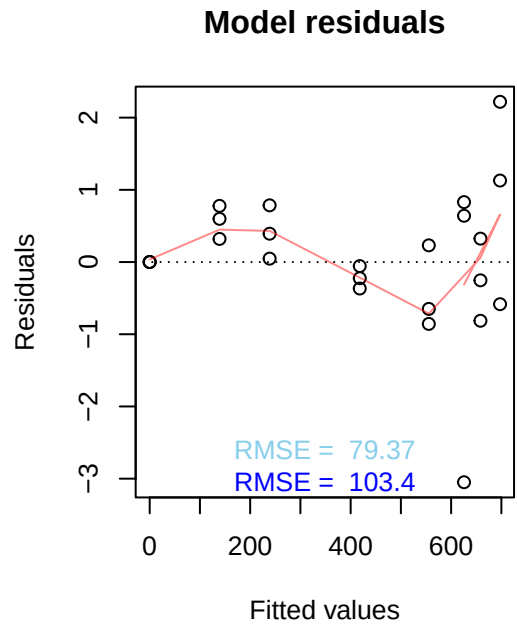

Model fit
Reaction rate AP
0
100
200
300
400
500
MAPE = 12.63
MAPE = 12.63
0
200
400
600
800
Substrate concentration AP−MUF


Model residuals
Residuals
−1
0
1
2
3
RMSE = 39.28
RMSE = 39.28
0
100
200
300
400
Fitted values

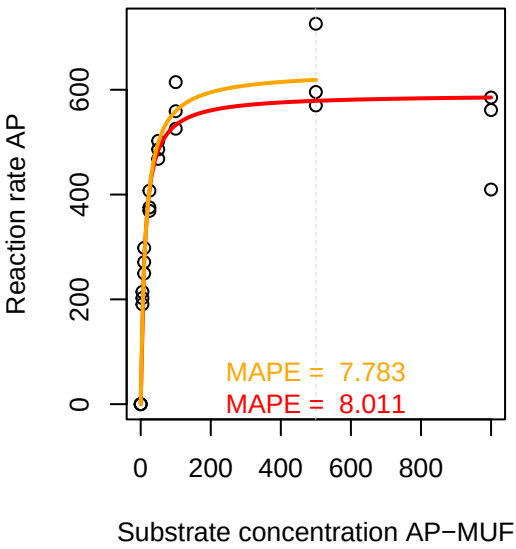

Model fit
Reaction rate AP
0
200
400
600
800
MAPE = 12.89
MAPE = 15.38
0
200
400
600
800
Substrate concentration AP−MUF


Model residuals
Residuals
−3
−2
−1
0
1
2
RMSE = 67.93
RMSE = 110
0
200
400
600
Fitted values

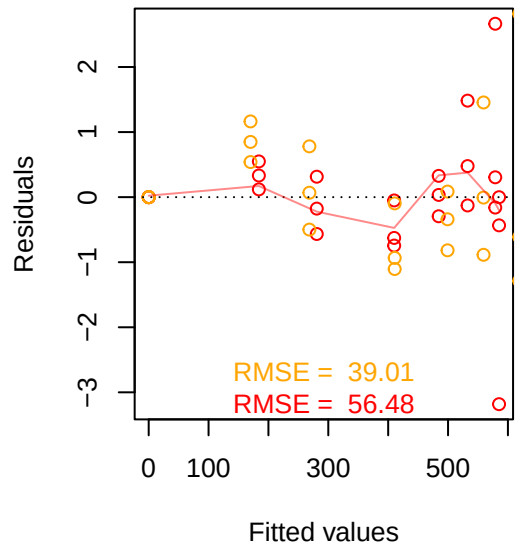

Model fit
Reaction rate AP
0
200
400
600
800
MAPE = 14.16
MAPE = 18.01
0
200
400
600
800
Substrate concentration AP−MUF


Model residuals
Residuals
−3
−2
−1
0
1
2
RMSE = 79.37
RMSE = 103.4
0
200
400
600
Fitted values

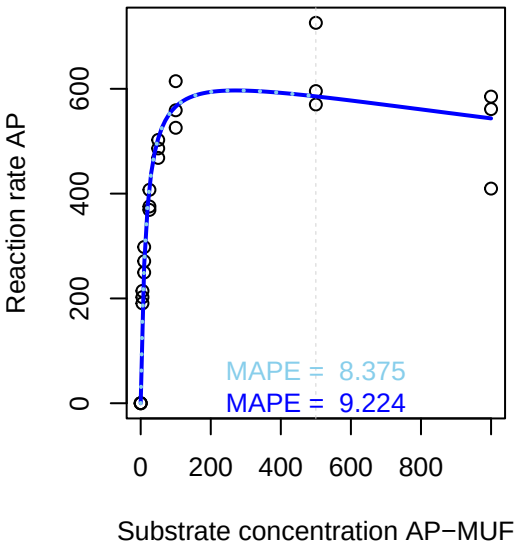
Model fit



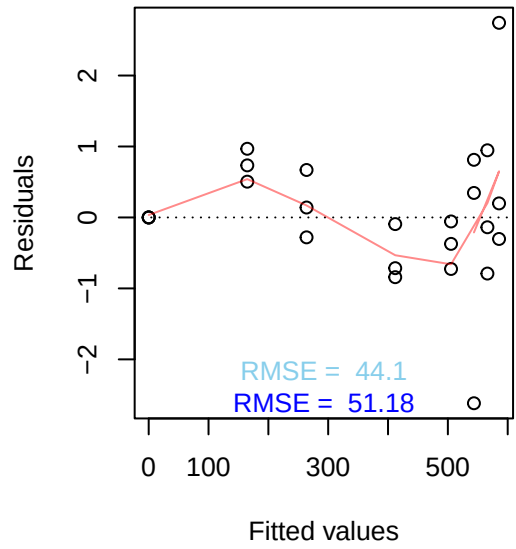
Model residuals

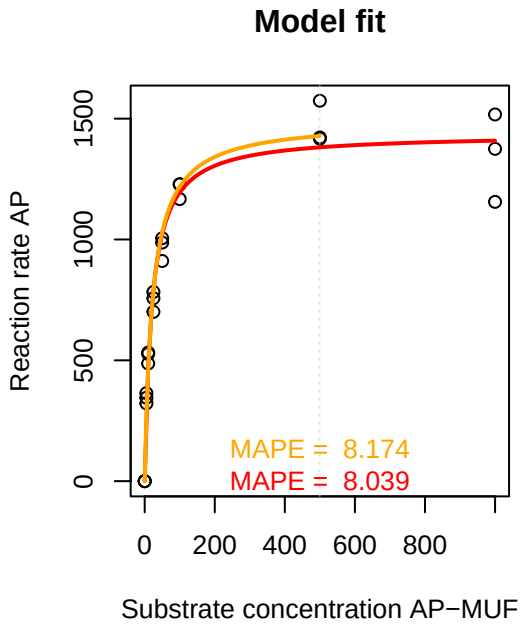


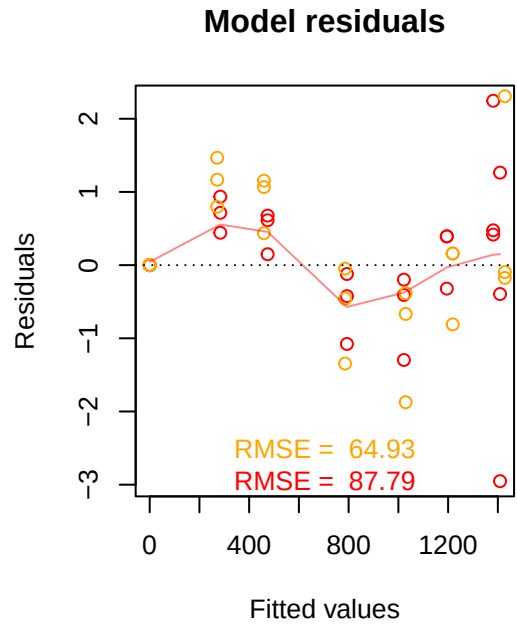
Model fit

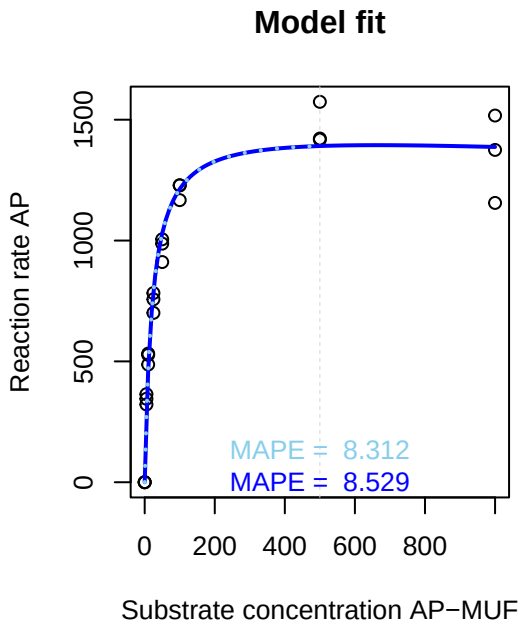


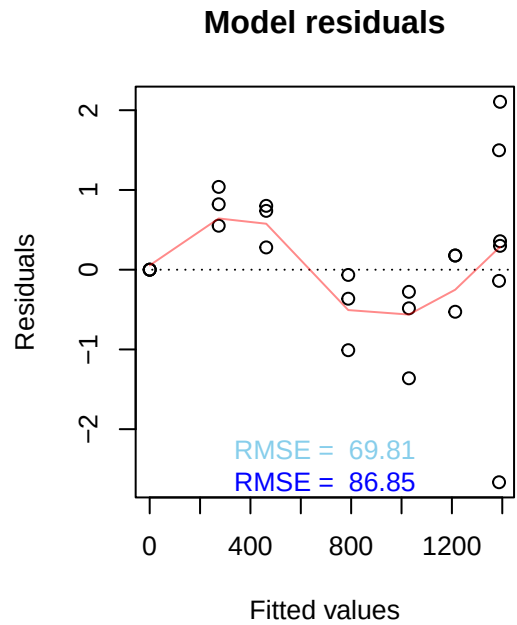
Model residuals



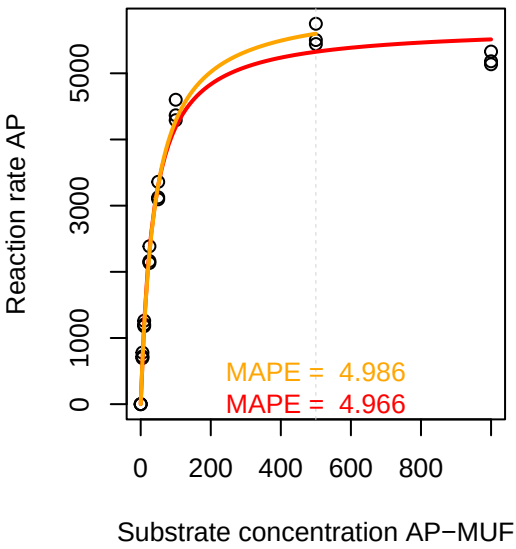

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 8.174
MAPE = 8.039
0
500
1000
1500
0
200
400
600
800


Model residuals
Residuals
Fitted values
RMSE = 64.93
RMSE = 87.79
−3
−2
−1
0
1
2
0
400
800
1200

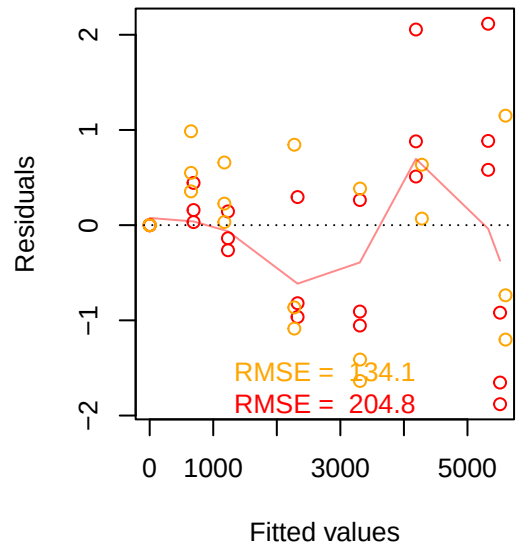

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 8.312
MAPE = 8.529
0
500
1000
1500
0
200
400
600
800


Model residuals
Residuals
Fitted values
RMSE = 69.81
RMSE = 86.85
−2
−1
0
1
2
0
400
800
1200

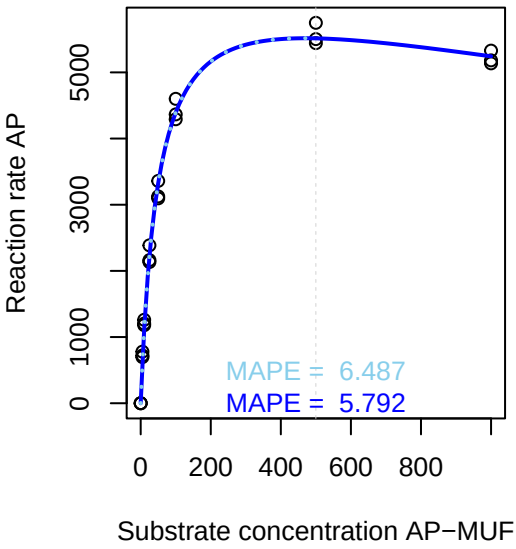
Model fit



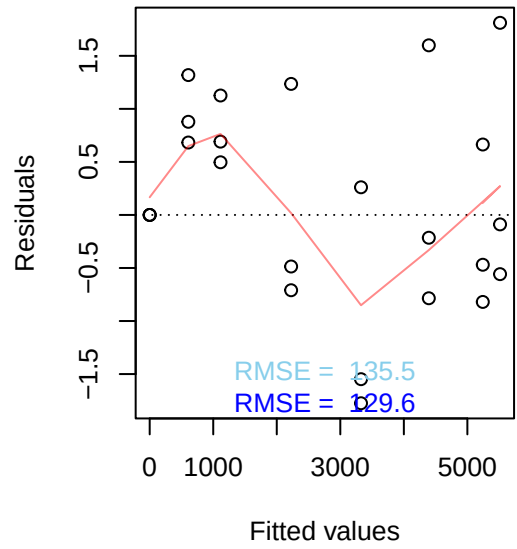
Model residuals

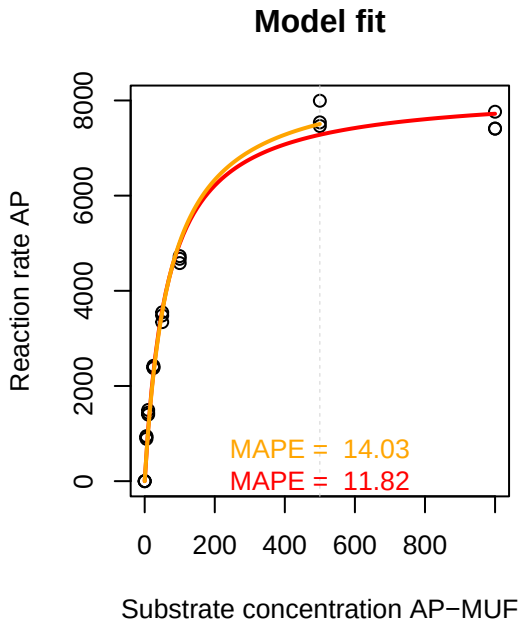


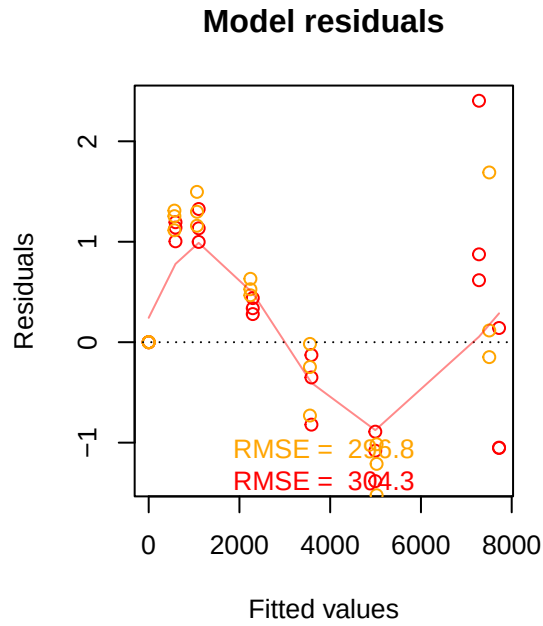
Model fit

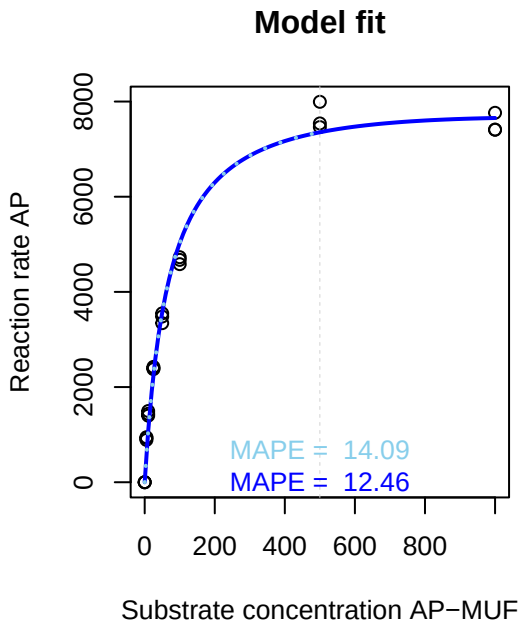


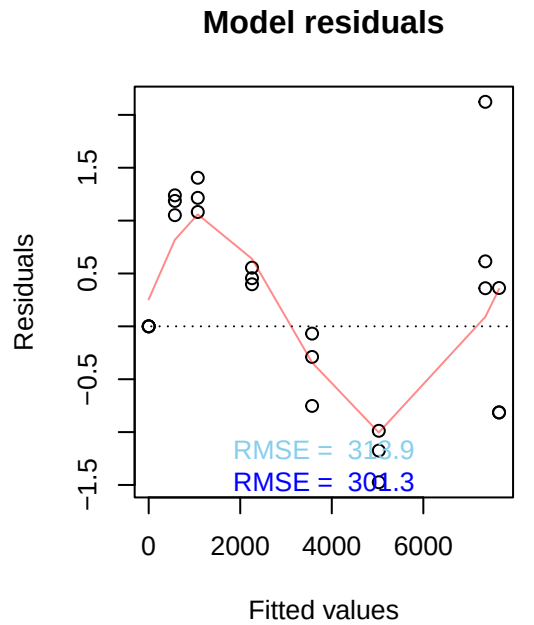
Model residuals

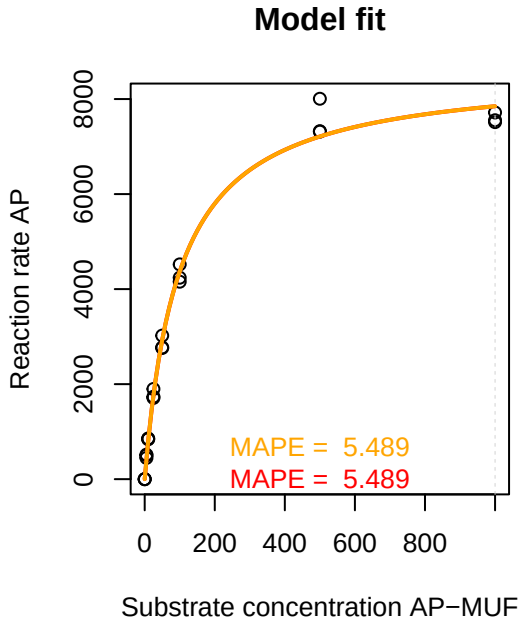


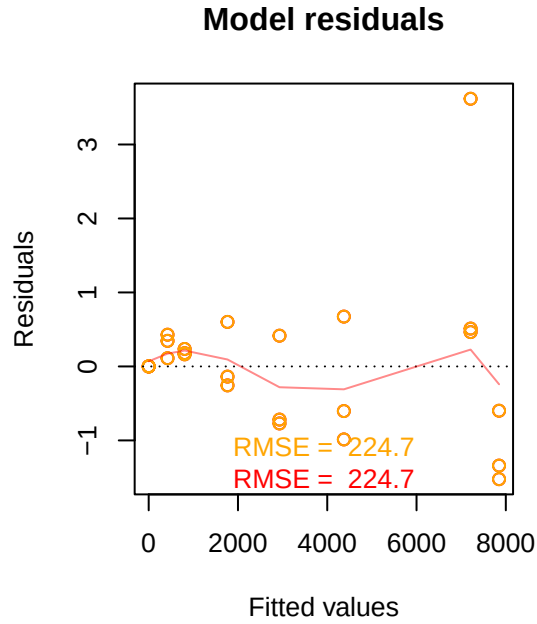

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 14.03
MAPE = 11.82
0
2000
4000
6000
8000
0
200
400
600
800

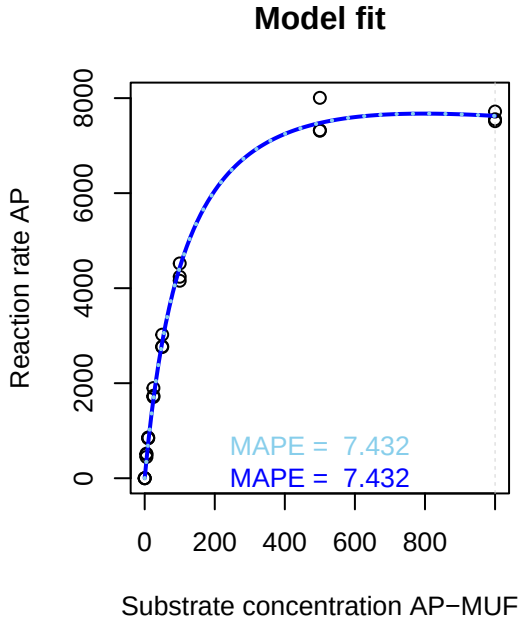

Model residuals
Residuals
Fitted values
RMSE = 296.8
RMSE = 304.3
−1
0
1
2
0
2000
4000
6000
8000

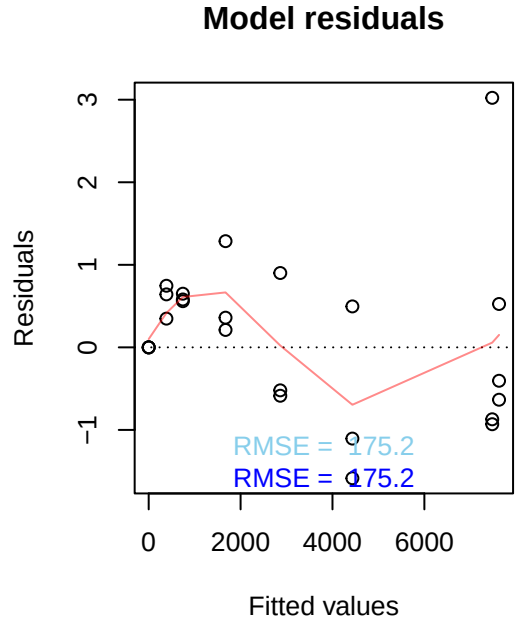

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 14.09
MAPE = 12.46
0
2000
4000
6000
8000
0
200
400
600
800

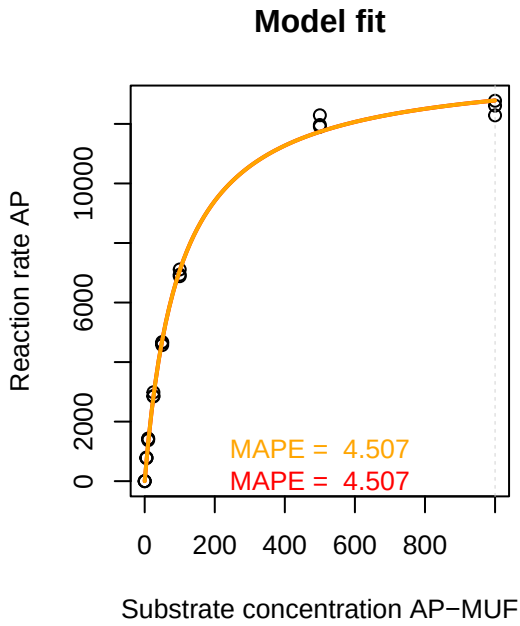

Model residuals
Residuals
Fitted values
RMSE = 301.3
−1.5
−0.5
0.5
1.5
0
2000
4000
6000

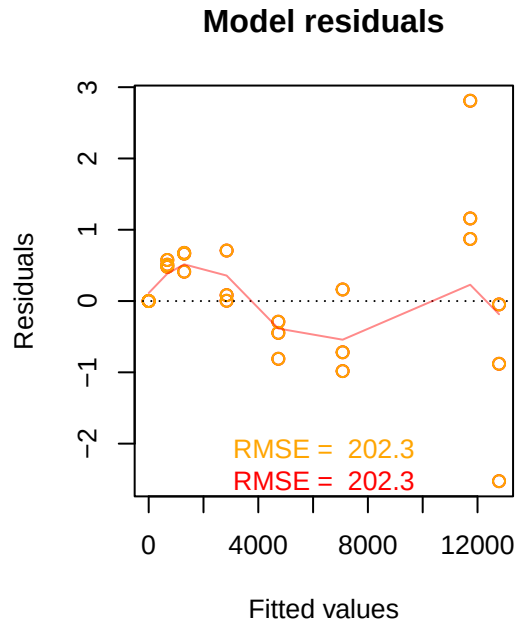

Model fit
Reaction rate AP
0
2000
4000
6000
8000
0
200
400
600
800
MAPE = 5.489
MAPE = 5.489
Substrate concentration AP−MUF

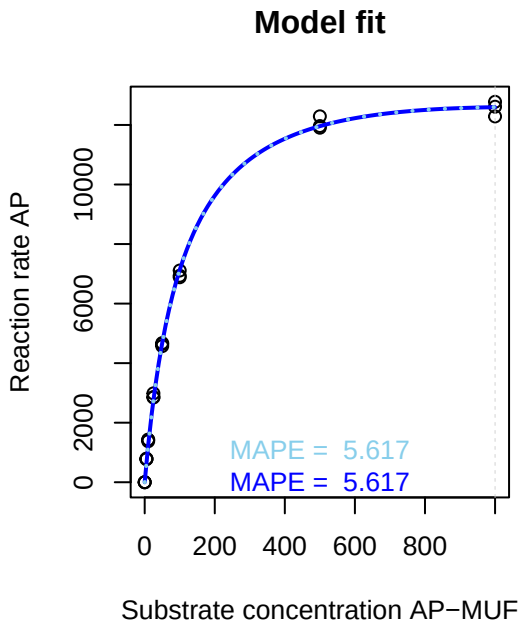

Model residuals
Residuals
−1
0
1
2
3
0
2000
4000
6000
8000
RMSE = 224.7
RMSE = 224.7
Fitted values

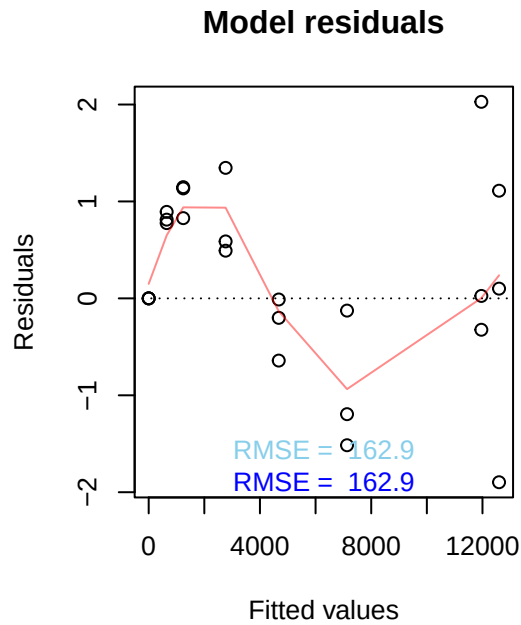

Model fit
Reaction rate AP
0
2000
4000
6000
8000
0
200
400
600
800
MAPE = 7.432
MAPE = 7.432
Substrate concentration AP−MUF

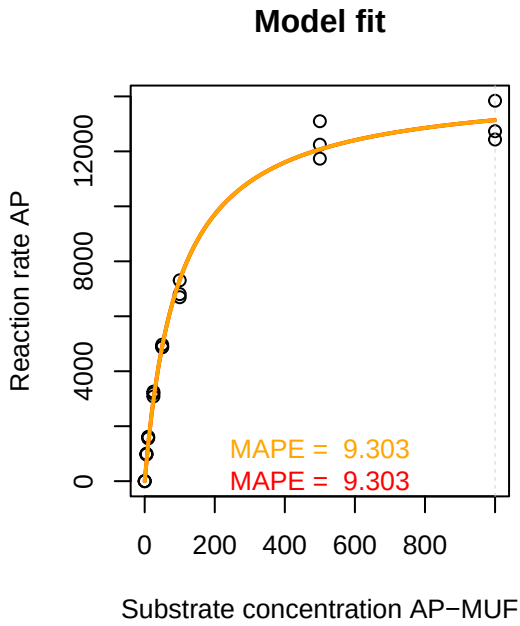

Model residuals
Residuals
−1
0
1
2
3
0
2000
4000
6000
RMSE = 175.2
RMSE = 175.2
Fitted values

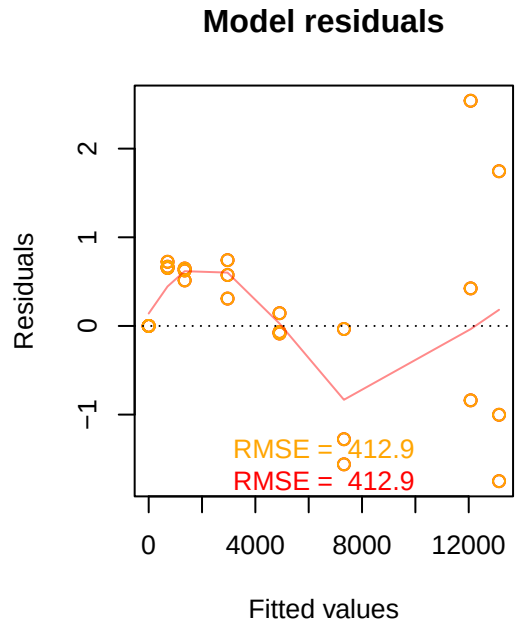

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 4.507
MAPE = 4.507

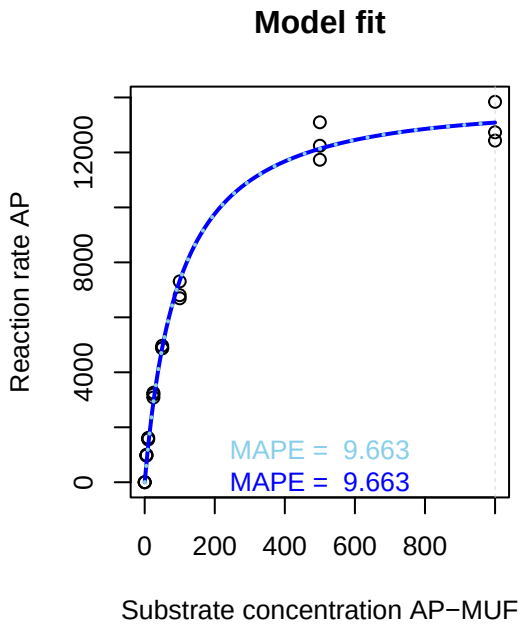

Model residuals
Residuals
−2
−1
0
1
2
3
0
4000
8000
12000
Fitted values
RMSE = 202.3
RMSE = 202.3

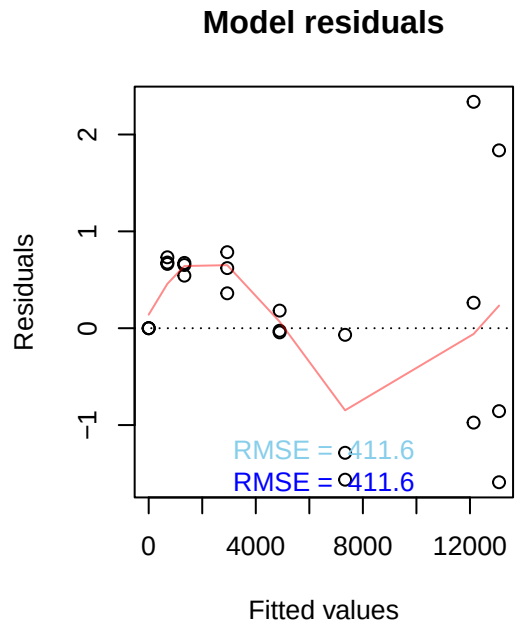

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 5.617
MAPE = 5.617

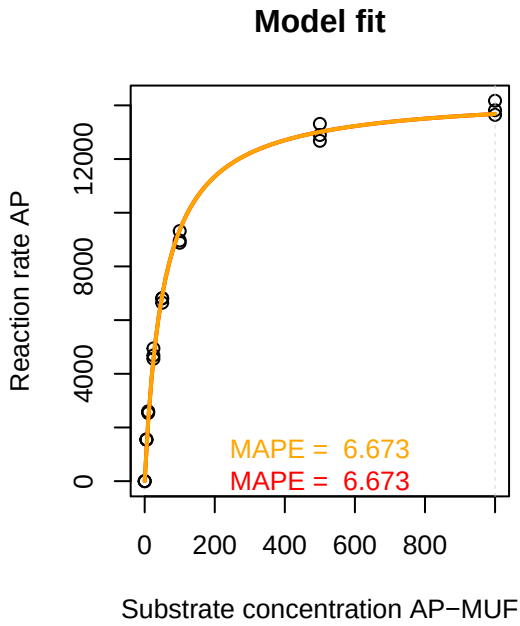

Model residuals
Residuals
−2
−1
0
1
2
0
4000
8000
12000
Fitted values
RMSE = 162.9
RMSE = 162.9

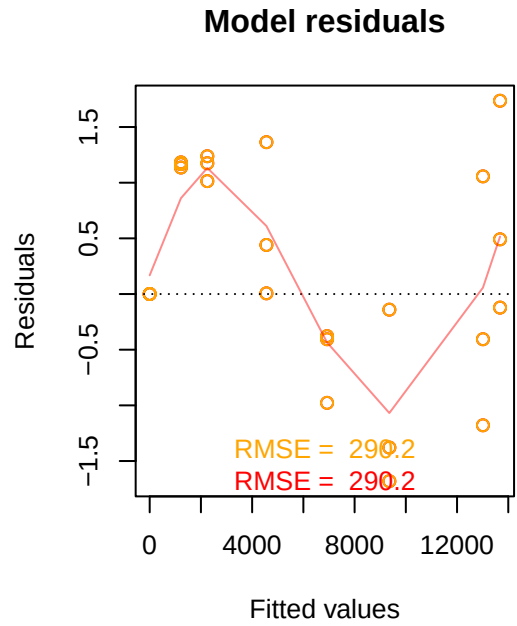

Model fit
Reaction rate AP
0
4000
8000
12000
0
200
400
600
800
MAPE = 9.303
MAPE = 9.303
Substrate concentration AP−MUF

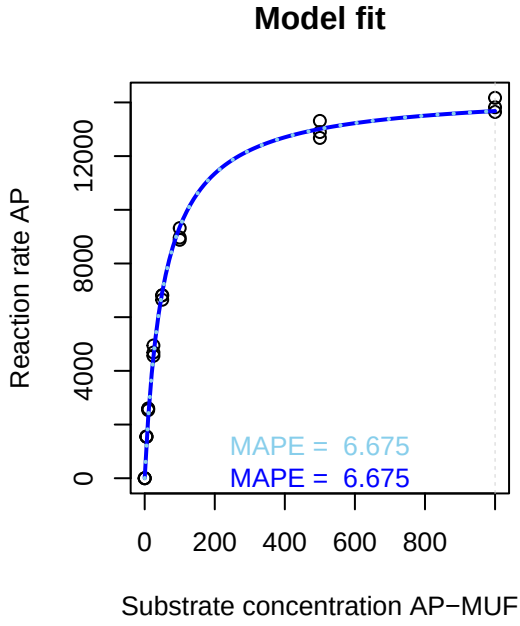

Model residuals
Residuals
−1
0
1
2
0
4000
8000
12000
RMSE = 412.9
RMSE = 412.9
Fitted values

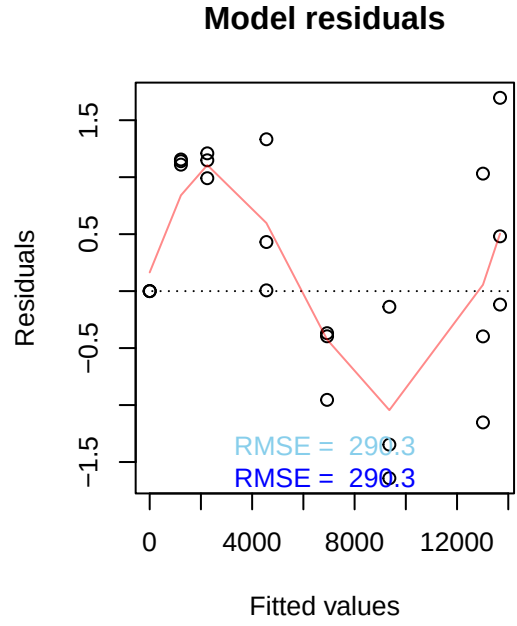

Model fit
Reaction rate AP
0
4000
8000
12000
0
200
400
600
800
MAPE = 9.663
MAPE = 9.663
Substrate concentration AP−MUF

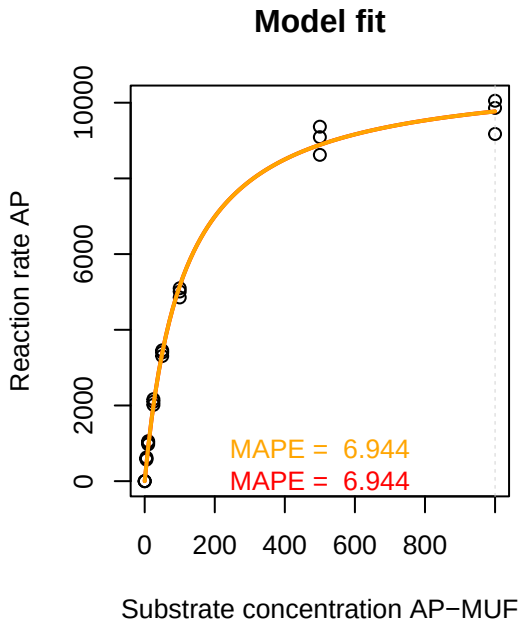

Model residuals
Residuals
−1
0
1
2
0
4000
8000
12000
RMSE = 411.6
RMSE = 411.6
Fitted values

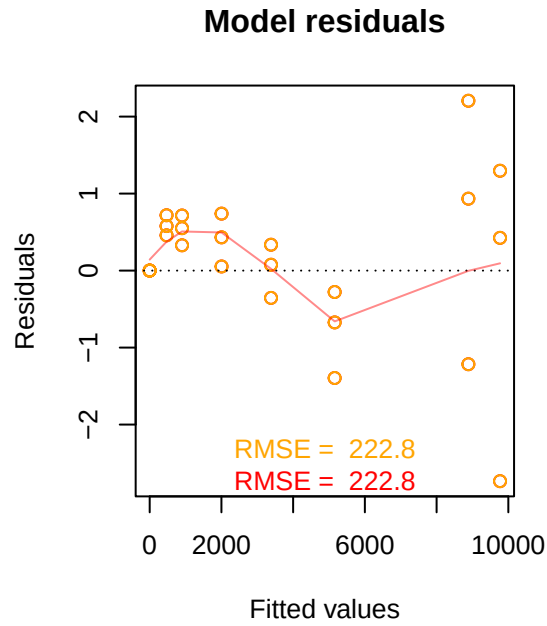

Model fit
Reaction rate AP
0
4000
8000
12000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 6.673
MAPE = 6.673

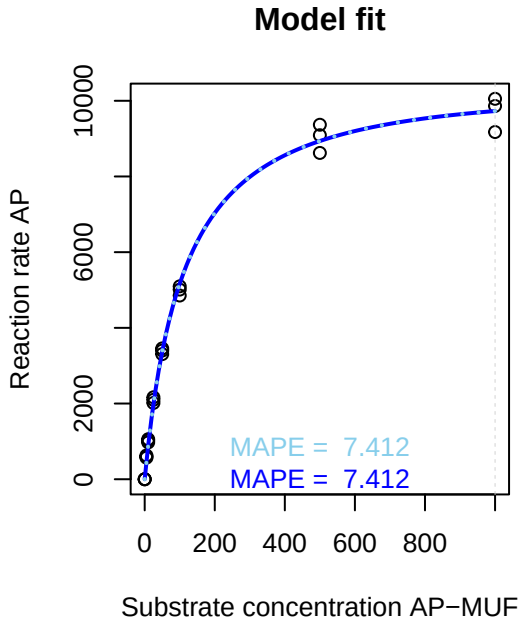

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
4000
8000
12000
Fitted values
RMSE = 290.2
RMSE = 290.2

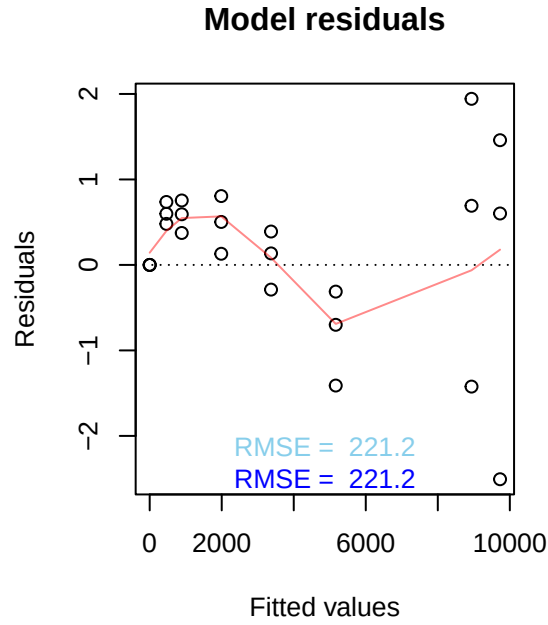

Model fit
Reaction rate AP
0
4000
8000
12000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 6.675
MAPE = 6.675

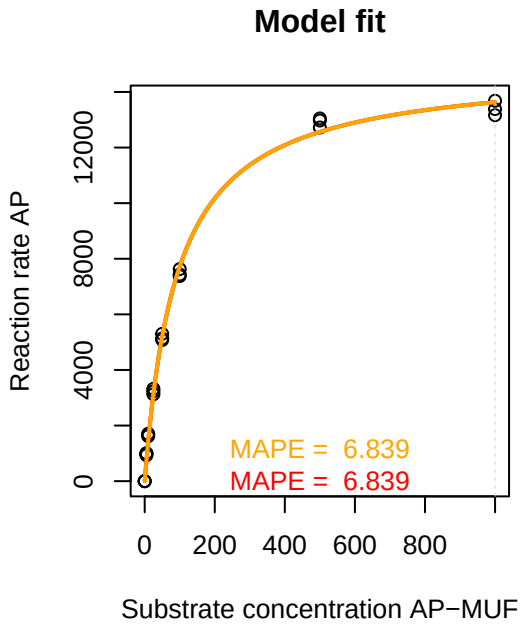

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
4000
8000
12000
Fitted values
RMSE = 290.3
RMSE = 290.3

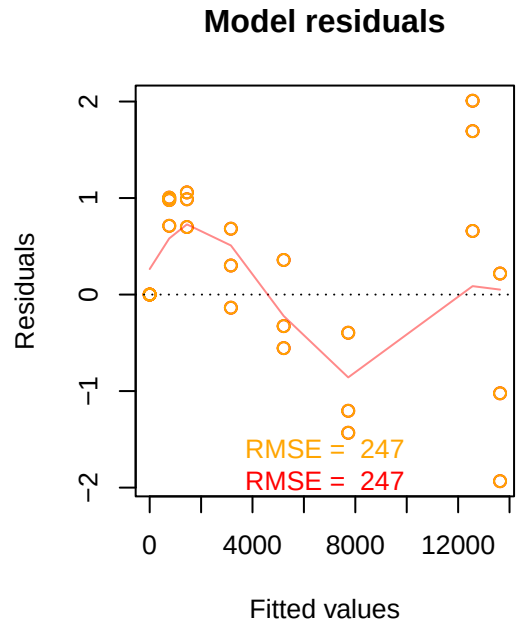

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
MAPE = 6.944
MAPE = 6.944
Substrate concentration AP−MUF

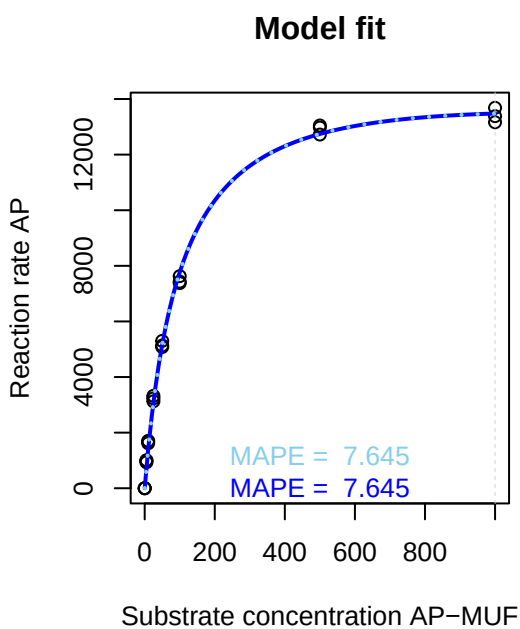

Model residuals
Residuals
−2
−1
0
1
2
0
2000
6000
10000
RMSE = 222.8
RMSE = 222.8
Fitted values

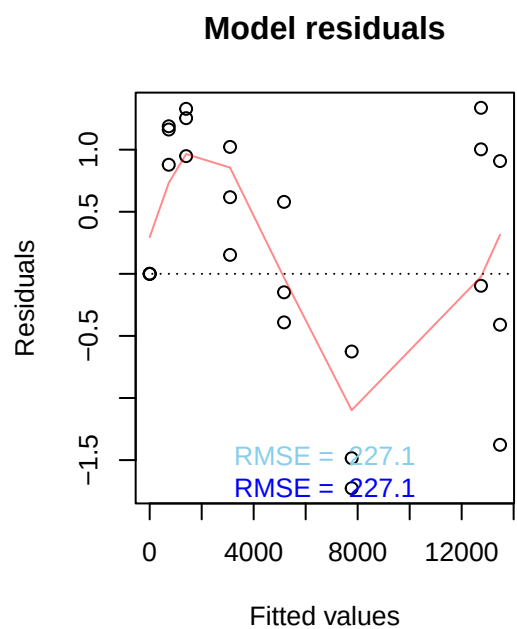

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
MAPE = 7.412
MAPE = 7.412
Substrate concentration AP−MUF

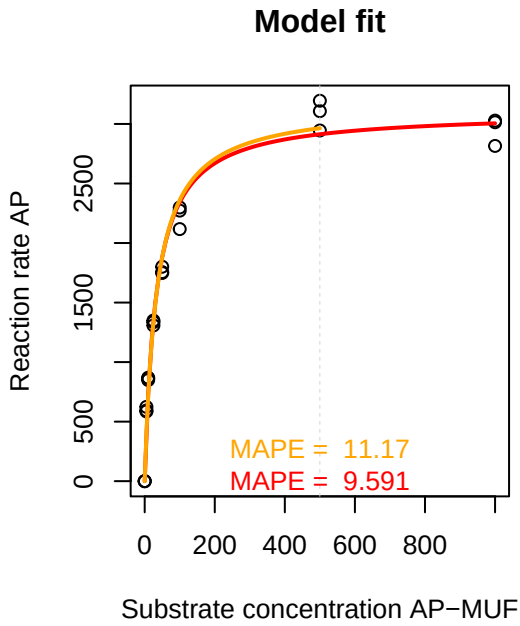

Model residuals
Residuals
−2
−1
0
1
2
0
2000
6000
10000
RMSE = 221.2
RMSE = 221.2
Fitted values

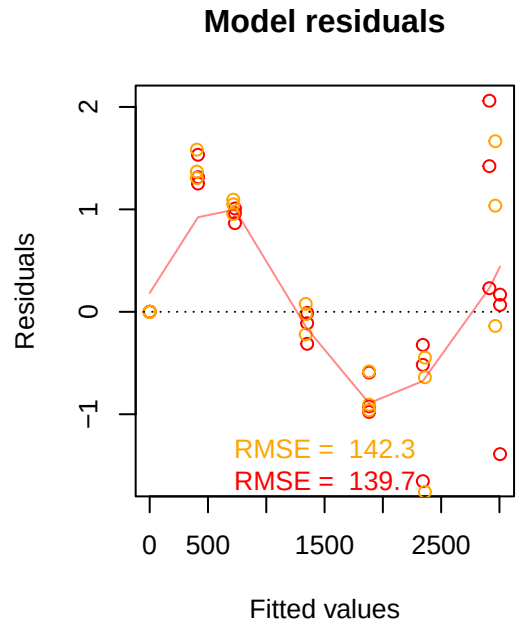

Model fit
Reaction rate AP
0
4000
8000
12000
0
200
400
600
800
MAPE = 6.839
MAPE = 6.839
Substrate concentration AP−MUF

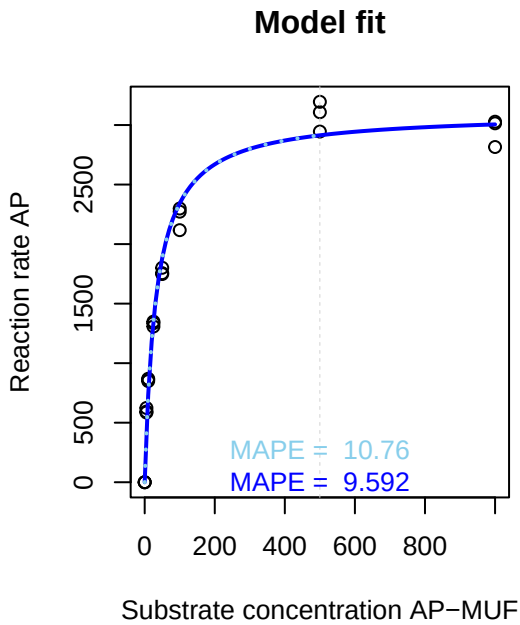

Model residuals
Residuals
2
1
0
−1
−2
0
4000
8000
12000
RMSE = 247
RMSE = 247
Fitted values

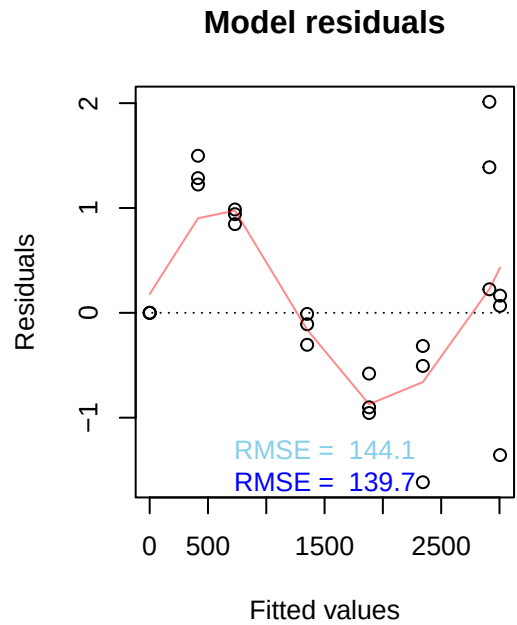

Model fit
Reaction rate AP
0
4000
8000
12000
0
200
400
600
800
MAPE = 7.645
MAPE = 7.645
Substrate concentration AP−MUF

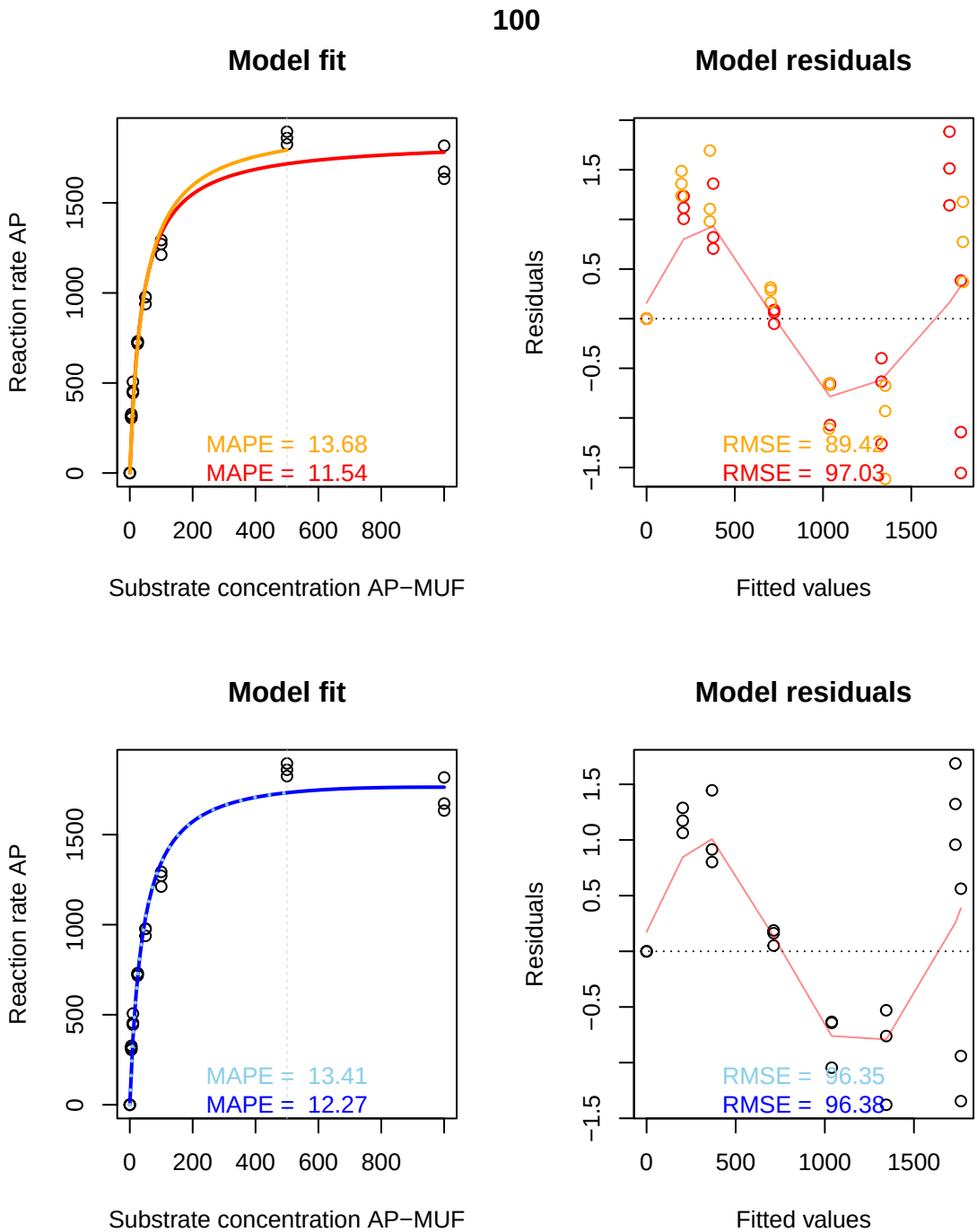

Model residuals
Residuals
1.0
0.5
−0.5
−1.5
0
4000
8000
12000
RMSE = 227.1
RMSE = 227.1
Fitted values

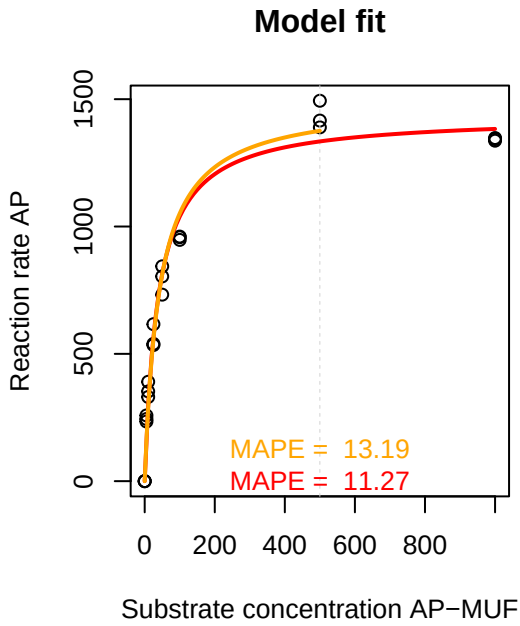

Model fit
Reaction rate AP
0
500
1500
2500
MAPE = 11.17
MAPE = 9.591
0
200
400
600
800
Substrate concentration AP−MUF

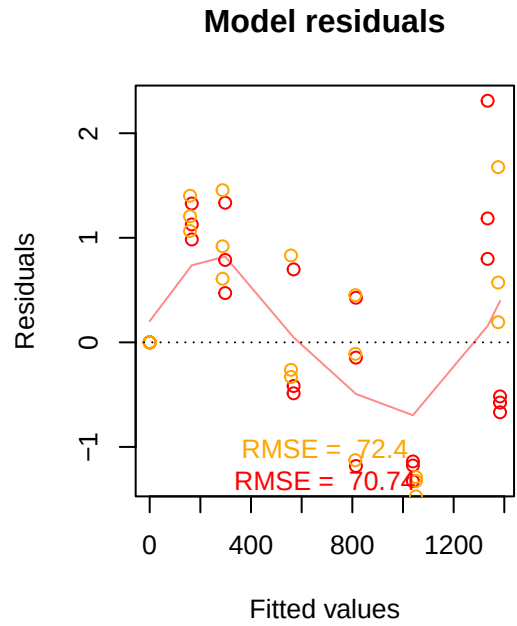

Model residuals
Residuals
−1
0
1
2
RMSE = 142.3
RMSE = 139.7
0
500
1500
2500
Fitted values

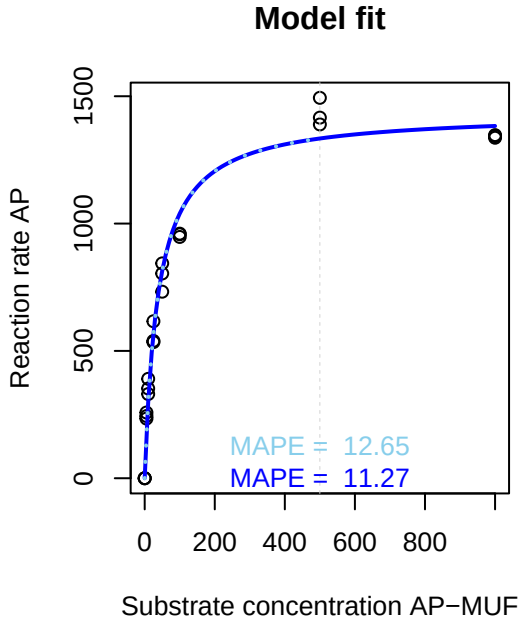

Model fit
Reaction rate AP
0
500
1500
2500
MAPE = 10.76
MAPE = 9.592
0
200
400
600
800
Substrate concentration AP−MUF

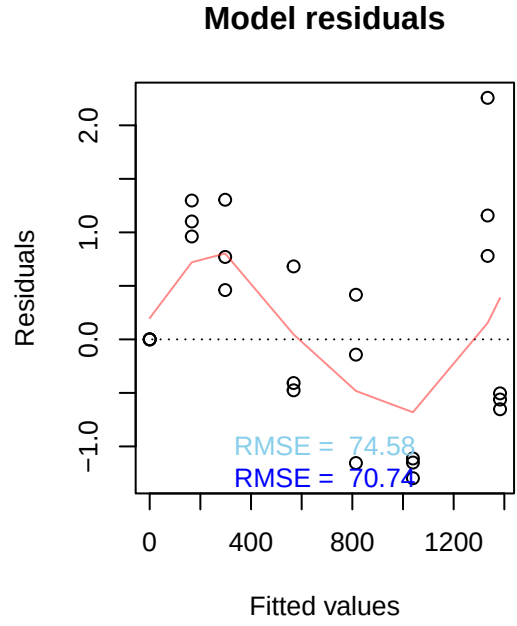

Model residuals
Residuals
−1
0
1
2
RMSE = 144.1
RMSE = 139.7
0
500
1500
2500
Fitted values


100
Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 13.68
MAPE = 11.54
Model residuals
Residuals
Fitted values
RMSE = 89.42
RMSE = 97.03
Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 13.41
MAPE = 12.27
Model residuals
Residuals
Fitted values
RMSE = 96.35
RMSE = 96.38

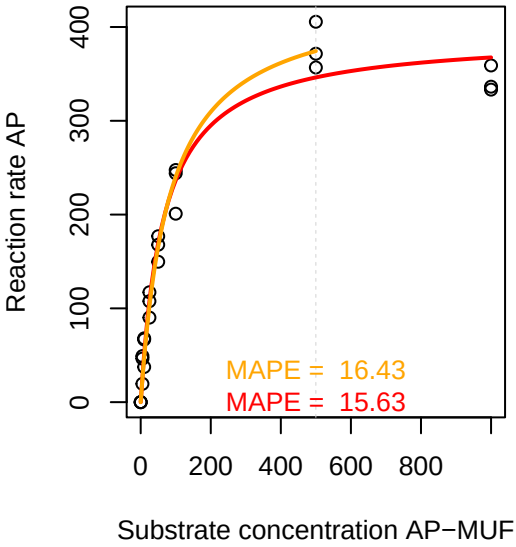

Model fit
Reaction rate AP
0
500
1000
1500
MAPE = 13.19
MAPE = 11.27
0
200
400
600
800
Substrate concentration AP−MUF


Model residuals
Residuals
−1
0
1
2
RMSE = 72.4
RMSE = 70.74
0
400
800
1200
Fitted values

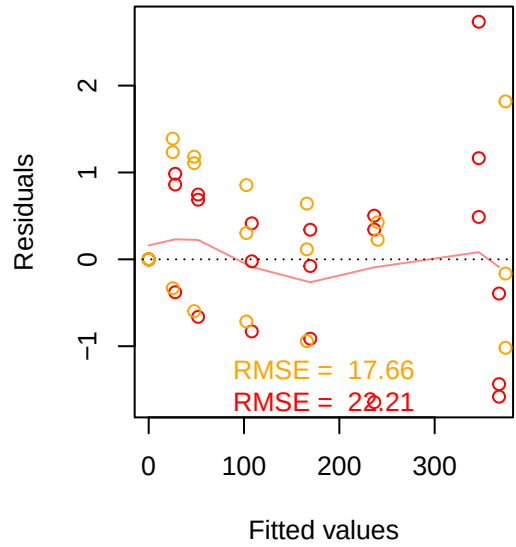

Model fit
Reaction rate AP
0
500
1000
1500
MAPE = 12.65
MAPE = 11.27
0
200
400
600
800
Substrate concentration AP−MUF


Model residuals
Residuals
−1.0
0.0
1.0
2.0
RMSE = 74.58
RMSE = 70.74
0
400
800
1200
Fitted values

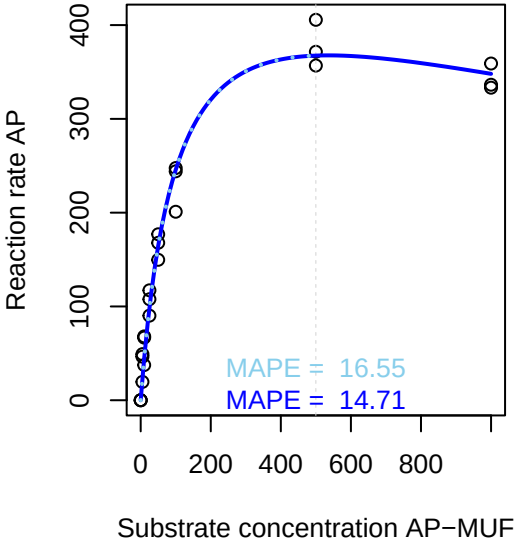
Model fit



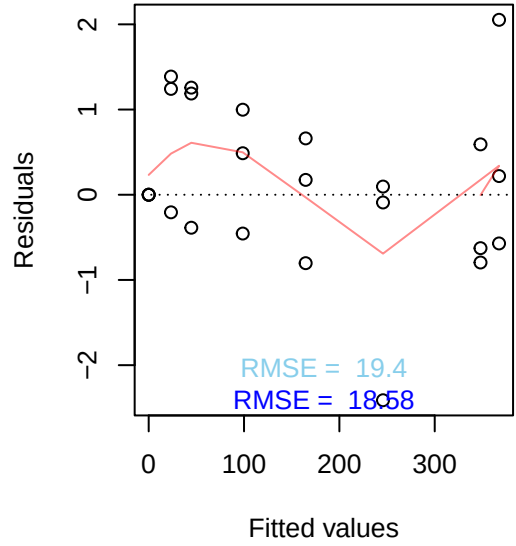
Model residuals



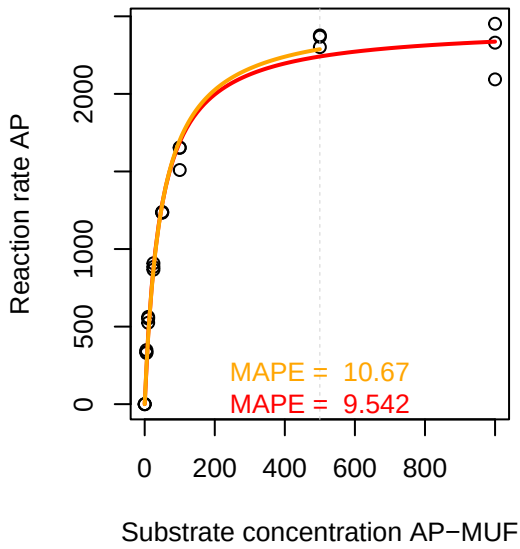
Model fit



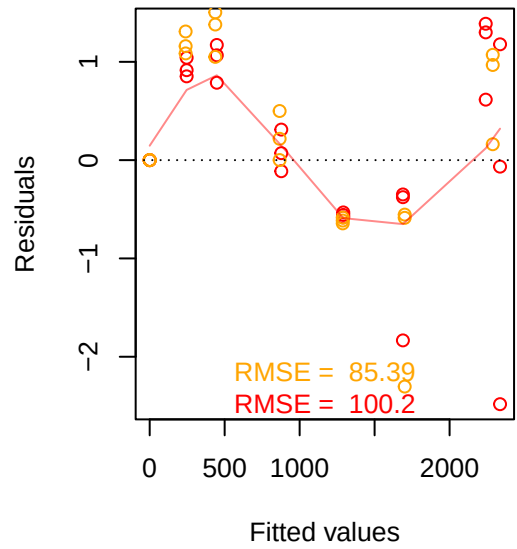
Model residuals



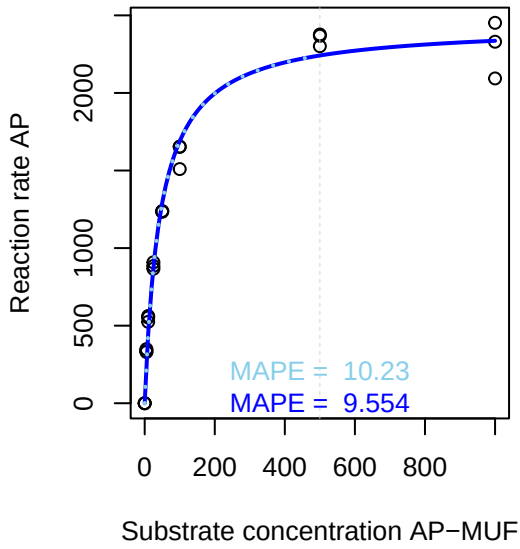
Model fit



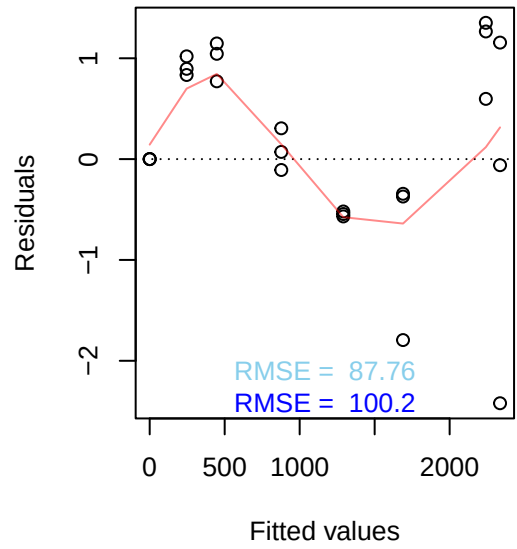
Model residuals

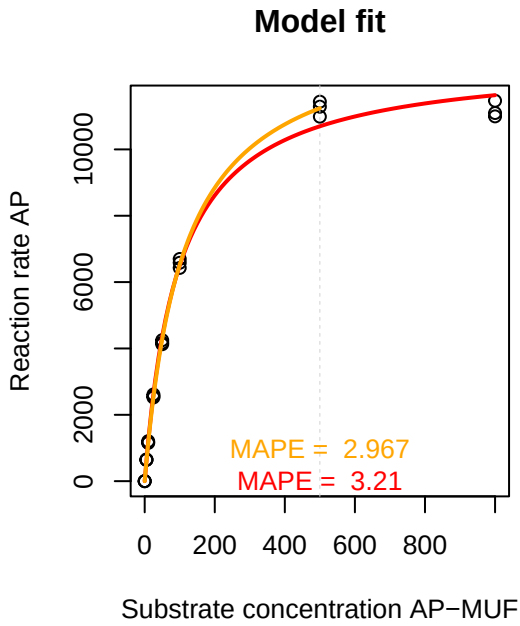


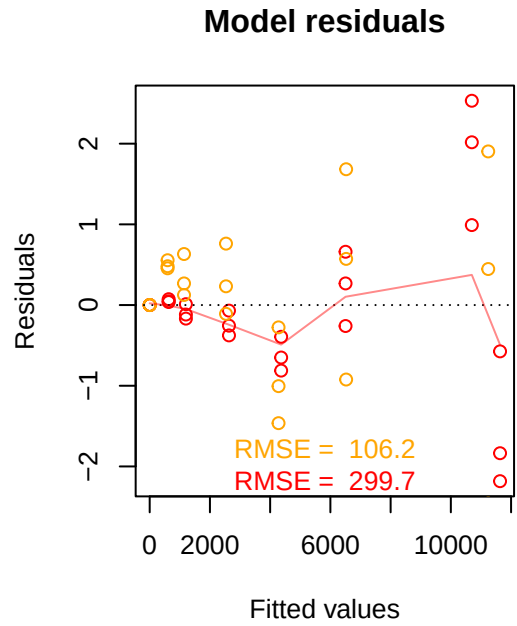
Model fit

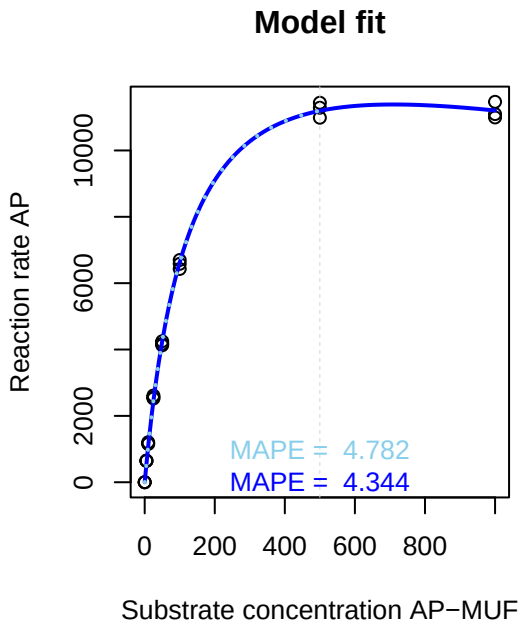


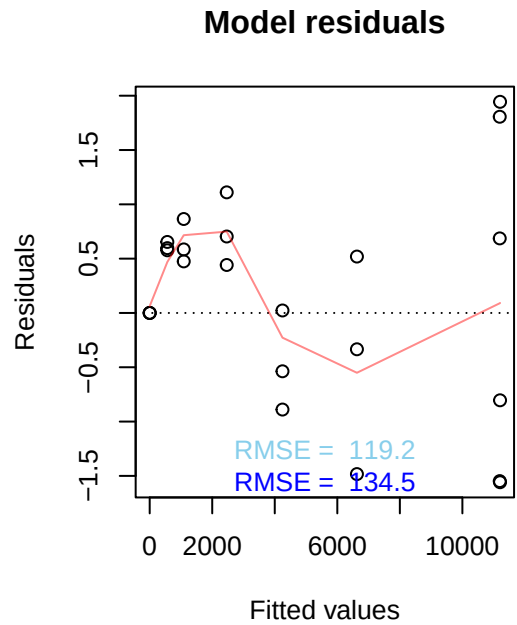
Model residuals



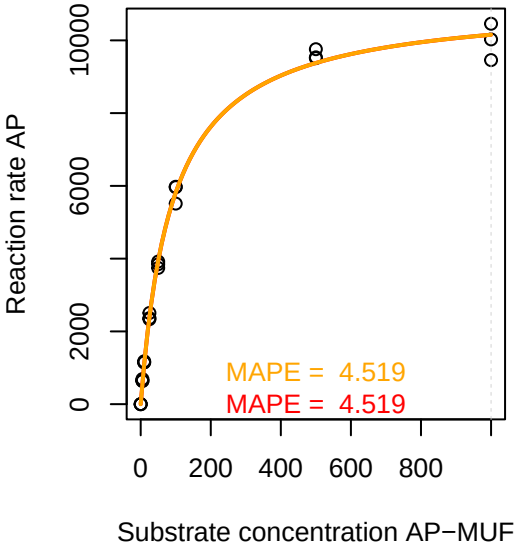

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
MAPE = 2.967
MAPE = 3.21
Substrate concentration AP−MUF


Model residuals
Residuals
−2
−1
0
1
2
0
2000
6000
10000
RMSE = 106.2
RMSE = 299.7
Fitted values

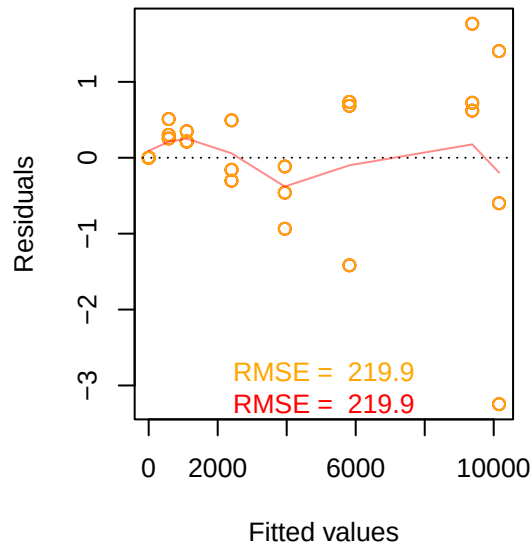

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
MAPE = 4.782
MAPE = 4.344
Substrate concentration AP−MUF


Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
2000
6000
10000
RMSE = 119.2
RMSE = 134.5
Fitted values

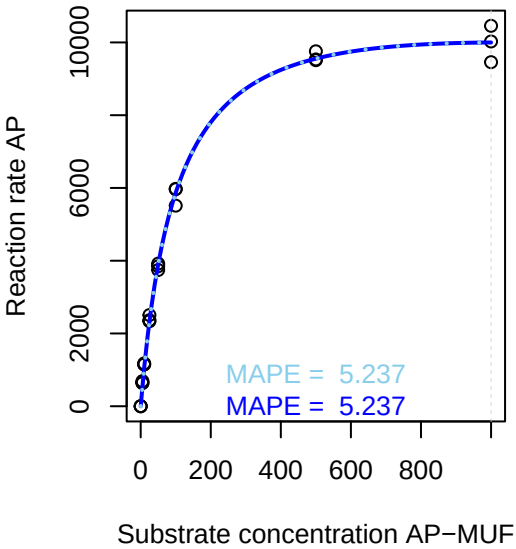
Model fit



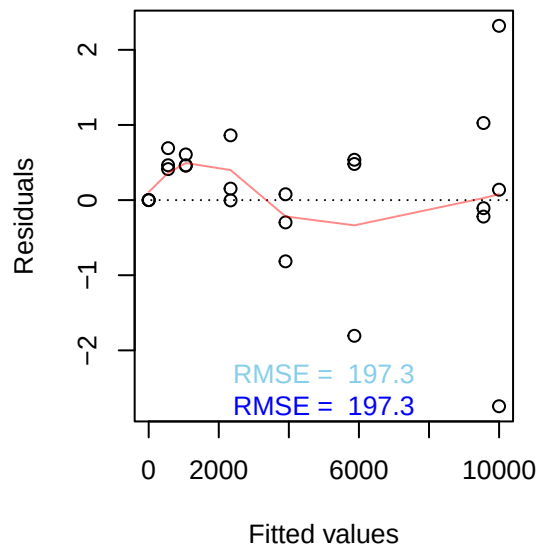
Model residuals

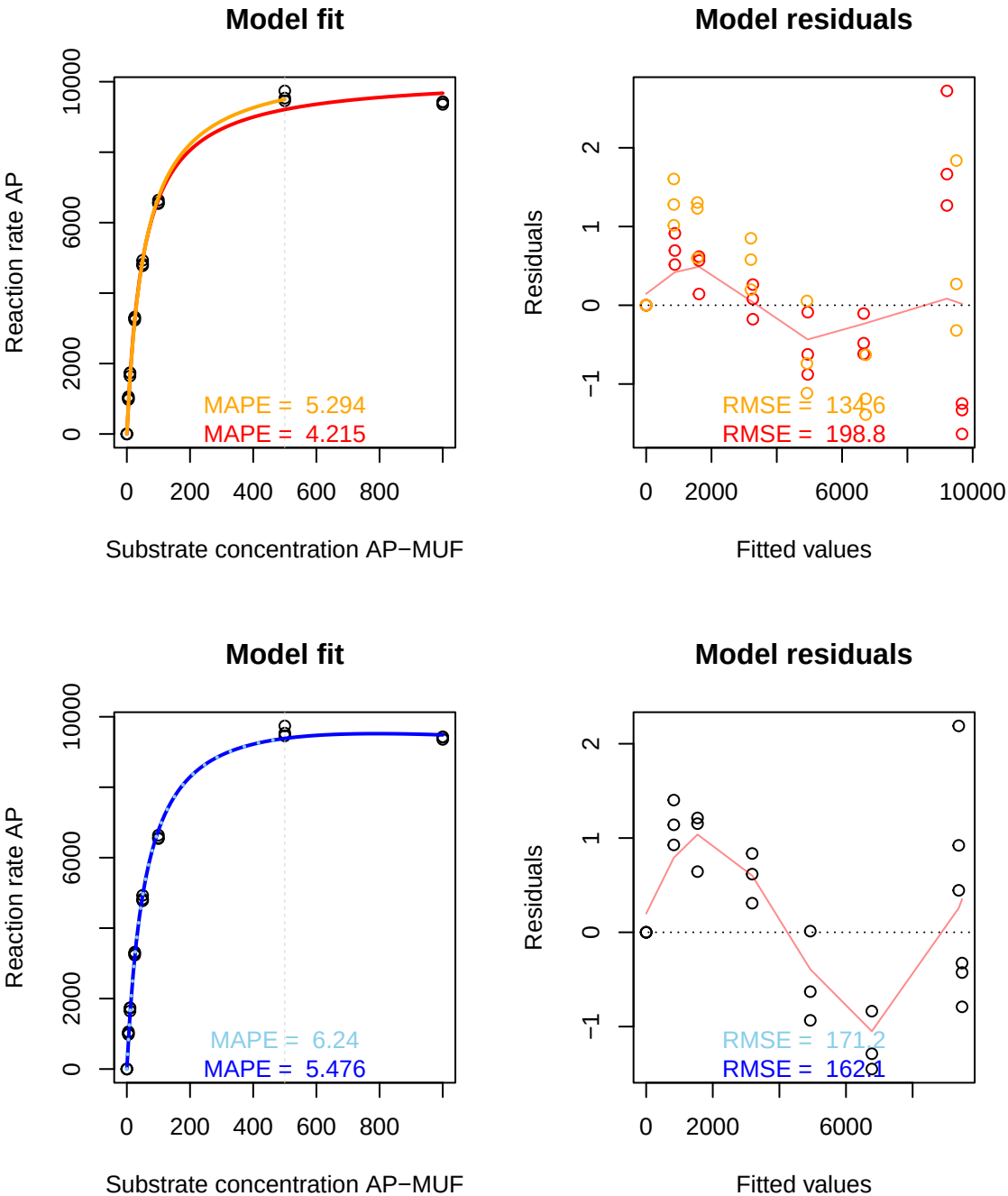


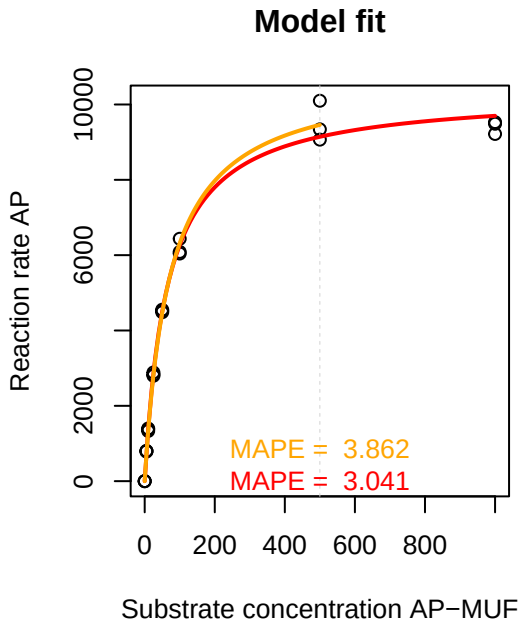
Model fit

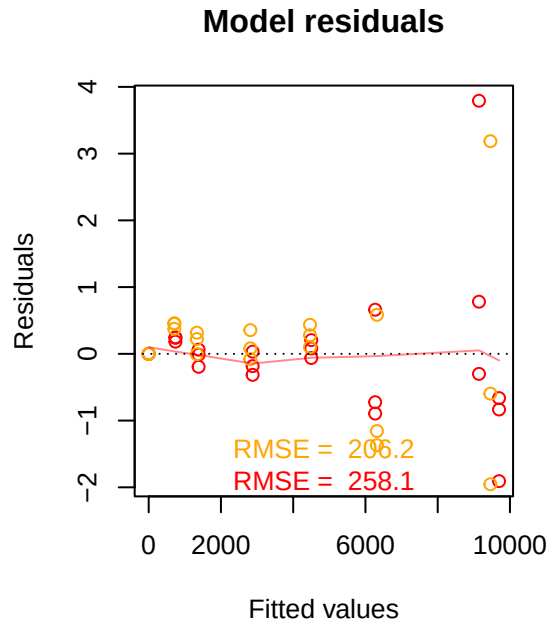


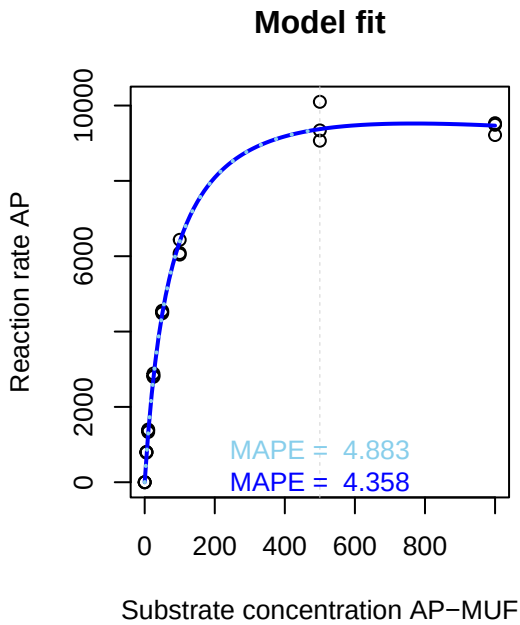
Model residuals

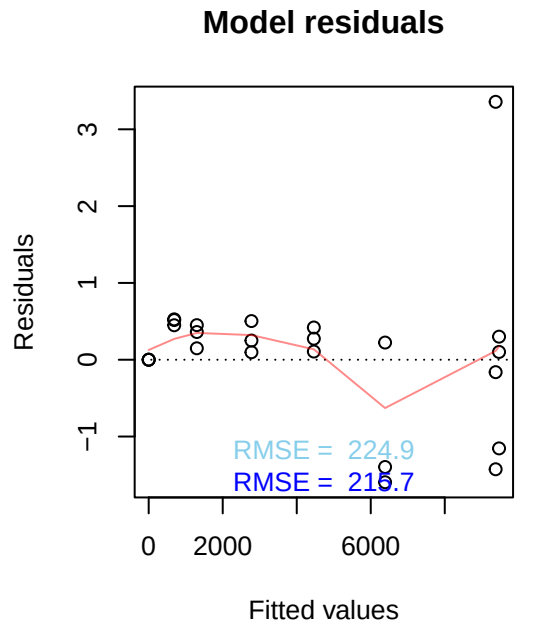


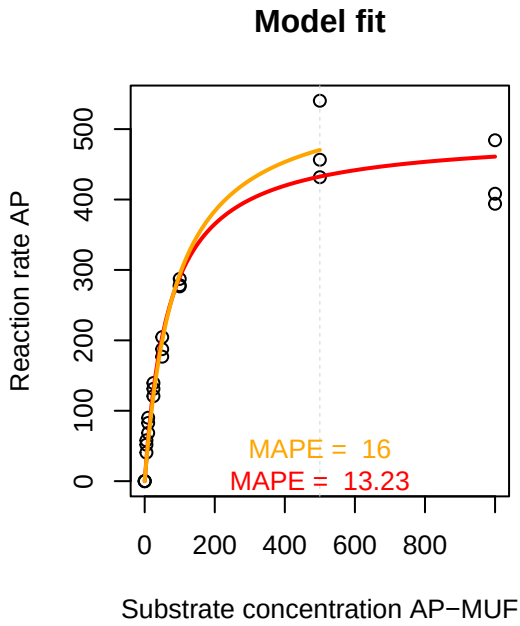

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 5.294
MAPE = 4.215
Model residuals
Residuals
Fitted values
RMSE = 134.6
RMSE = 198.8
Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 6.24
MAPE = 5.476
Model residuals
Residuals
Fitted values
RMSE = 171.2
RMSE = 162.1

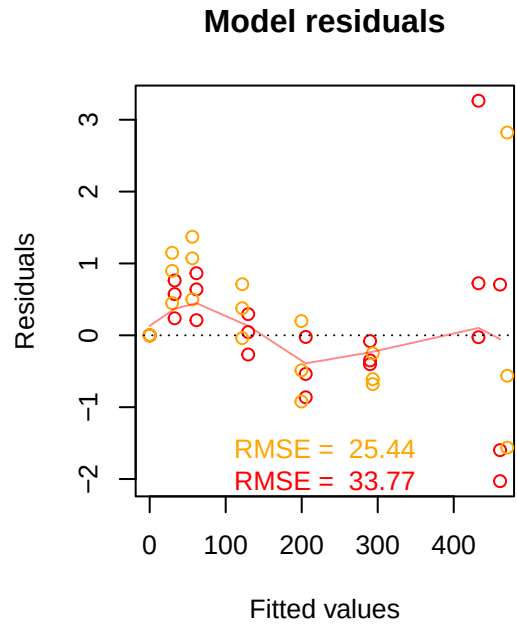

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
MAPE = 3.862
MAPE = 3.041
Substrate concentration AP−MUF

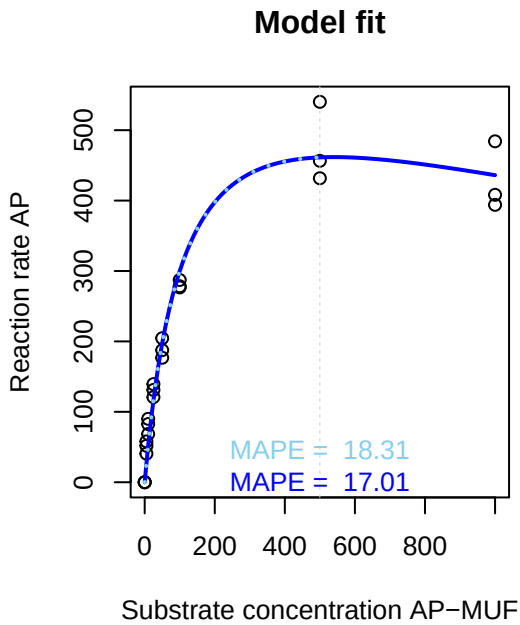

Model residuals
Residuals
−2
−1
0
1
2
3
4
0
2000
6000
10000
RMSE = 206.2
RMSE = 258.1
Fitted values

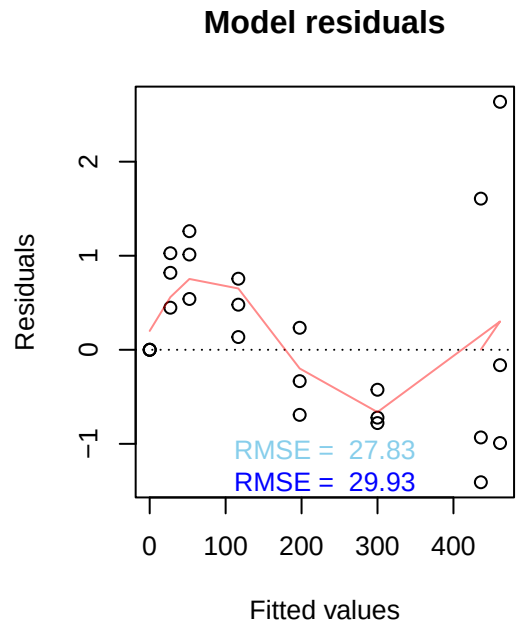

Model fit
Reaction rate AP
0
2000
6000
10000
0
200
400
600
800
MAPE = 4.883
MAPE = 4.358
Substrate concentration AP−MUF


Model residuals
Residuals
−1
0
1
2
3
0
2000
6000
RMSE = 224.9
RMSE = 215.7
Fitted values

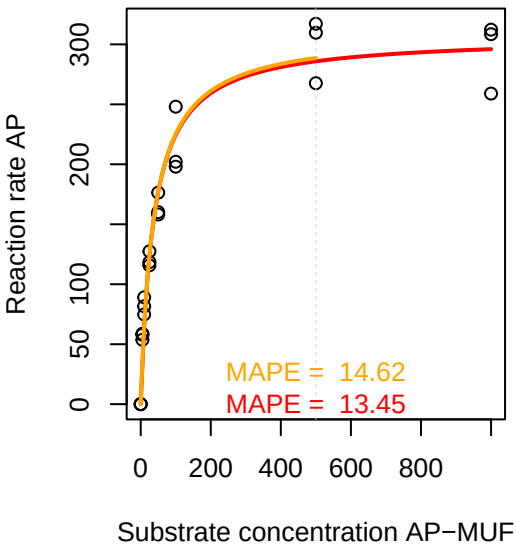

Model fit
Reaction rate AP
0
100
200
300
400
500
MAPE = 16
MAPE = 13.23
0
200
400
600
800
Substrate concentration AP−MUF


Model residuals
Residuals
−2
−1
0
1
2
3
RMSE = 25.44
RMSE = 33.77
0
100
200
300
400
Fitted values

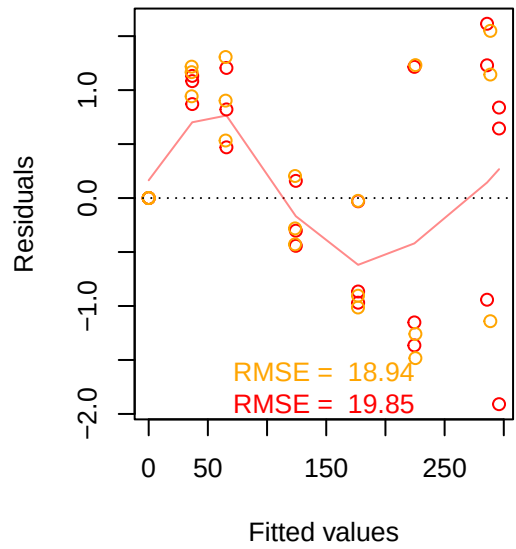

Model fit
Reaction rate AP
0
100
200
300
400
500
MAPE = 18.31
MAPE = 17.01
0
200
400
600
800
Substrate concentration AP−MUF


Model residuals
Residuals
−1
0
1
2
RMSE = 27.83
RMSE = 29.93
0
100
200
300
400
Fitted values

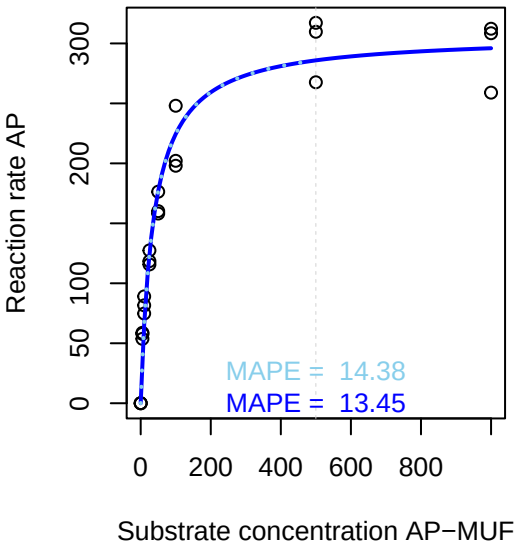
Model fit



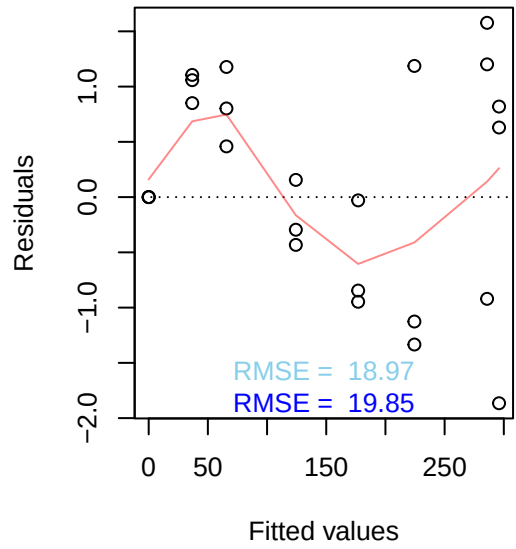
Model residuals



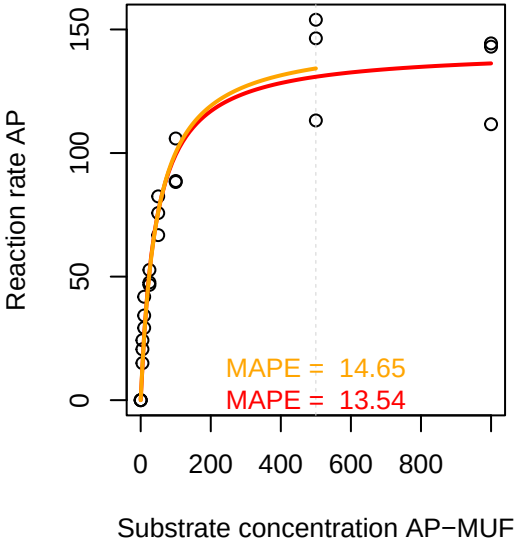
Model fit



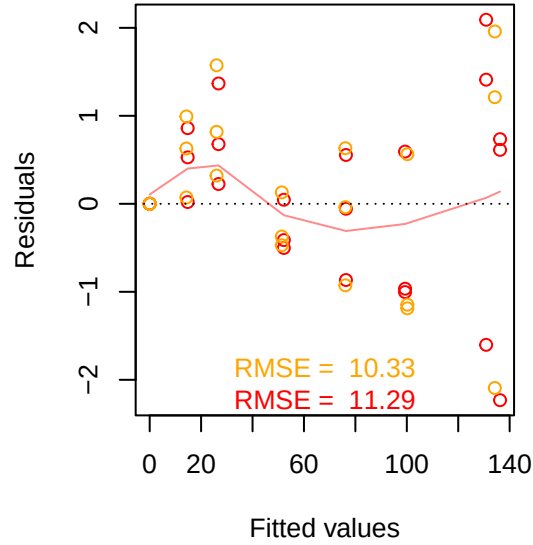
Model residuals



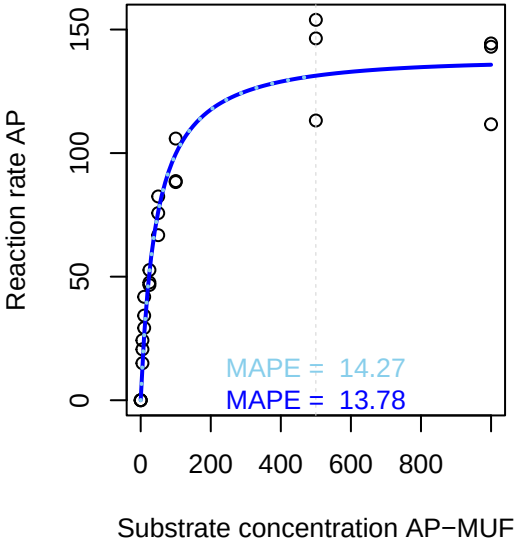
Model fit



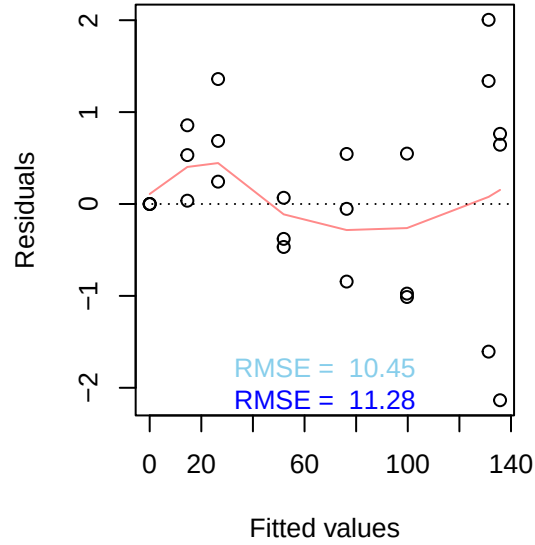
Model residuals

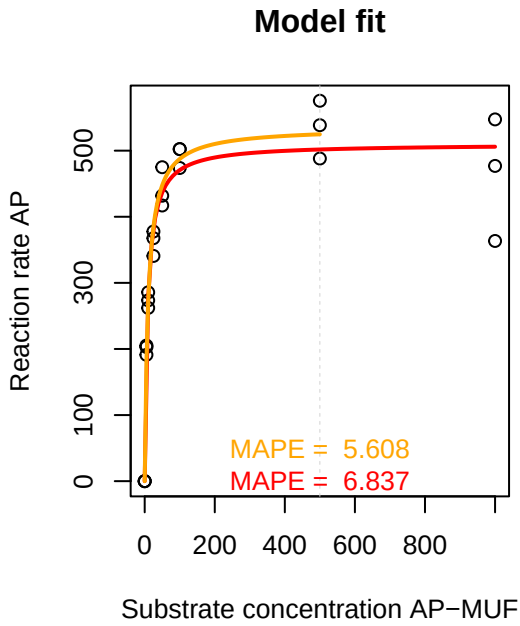


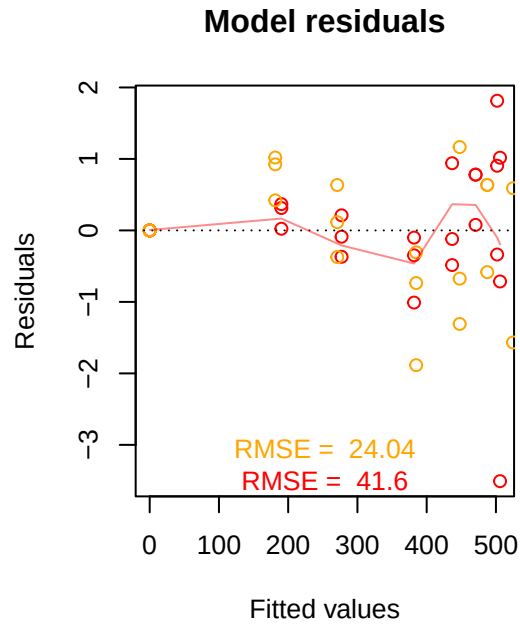
Model fit

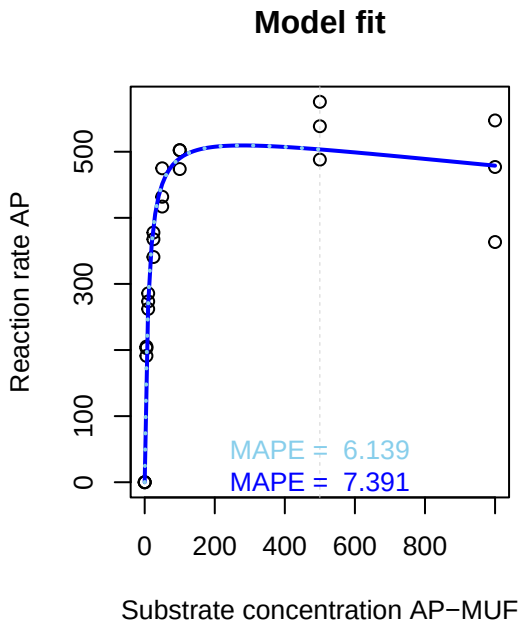


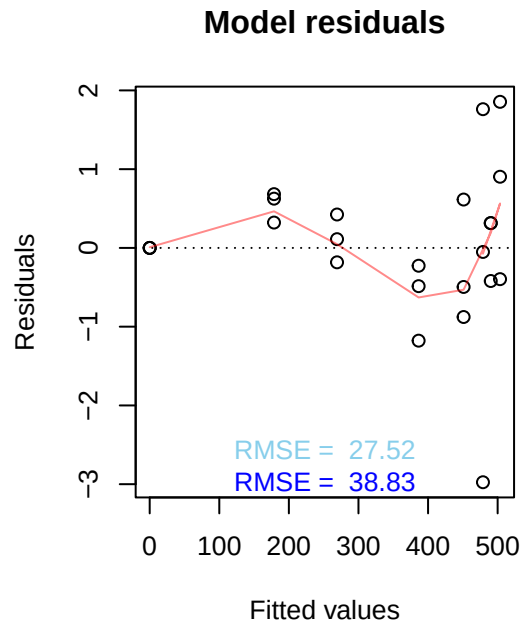
Model residuals

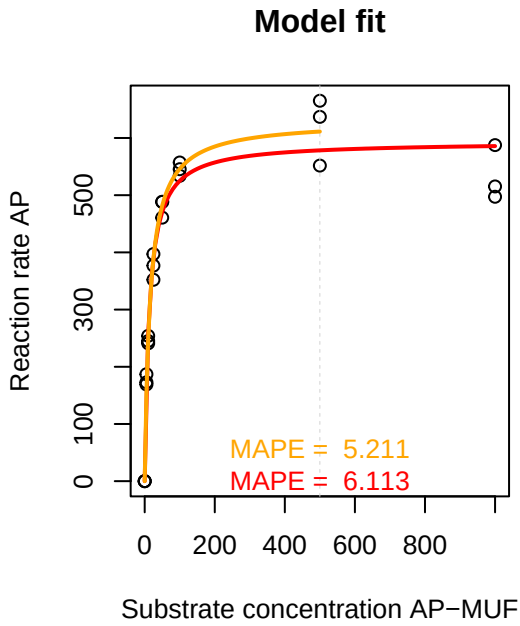


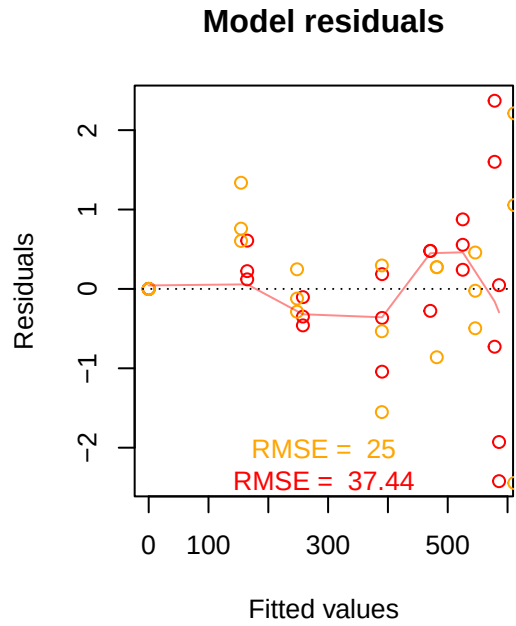

Model fit
Reaction rate AP
0
100
300
500
0
200
400
600
800
MAPE = 5.608
MAPE = 6.837
Substrate concentration AP−MUF

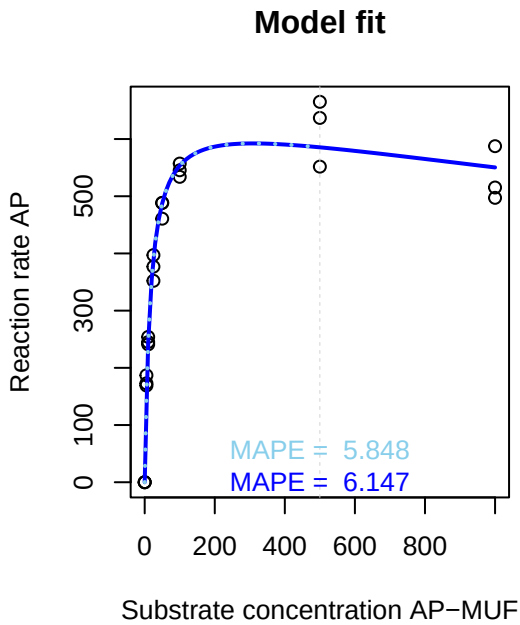

Model residuals
Residuals
−3
−2
−1
0
1
2
0
100
200
300
400
500
RMSE = 24.04
RMSE = 41.6
Fitted values

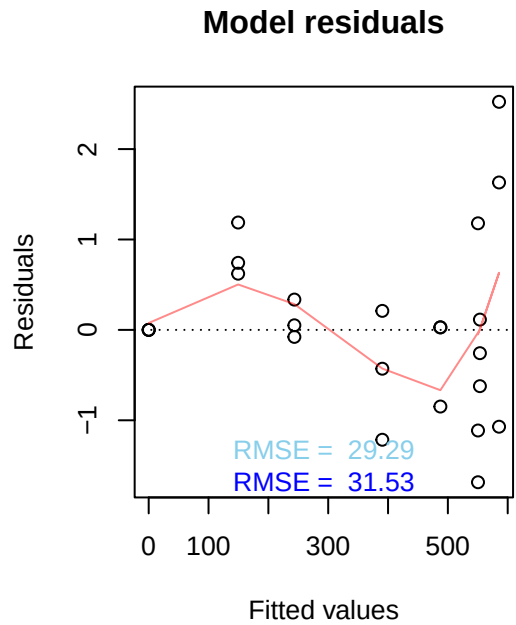

Model fit
Reaction rate AP
0
100
300
500
0
200
400
600
800
MAPE = 6.139
MAPE = 7.391
Substrate concentration AP−MUF


Model residuals
Residuals
−3
−2
−1
0
1
2
0
100
200
300
400
500
RMSE = 27.52
RMSE = 38.83
Fitted values

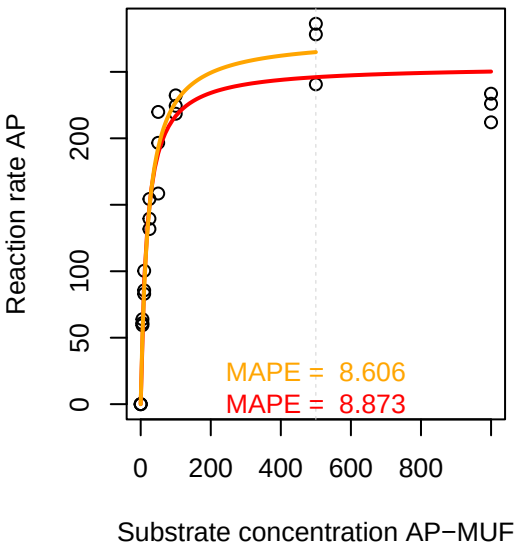

Model fit
Reaction rate AP
0
100
300
500
0
200
400
600
800
MAPE = 5.211
MAPE = 6.113
Substrate concentration AP−MUF


Model residuals
Residuals
−2
−1
0
1
2
0
100
300
500
RMSE = 25
RMSE = 37.44
Fitted values

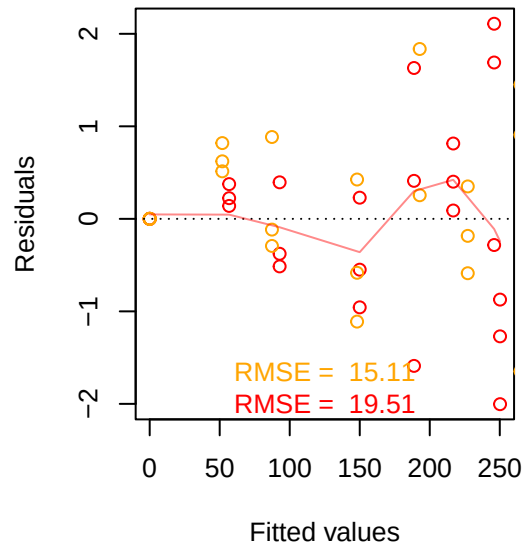

Model fit
Reaction rate AP
0
100
300
500
0
200
400
600
800
MAPE = 5.848
MAPE = 6.147
Substrate concentration AP−MUF


Model residuals
Residuals
−1
0
1
2
0
100
300
500
RMSE = 29.29
RMSE = 31.53
Fitted values

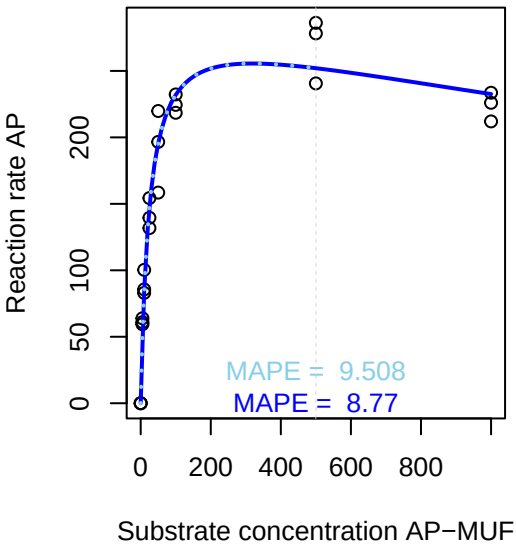
Model fit



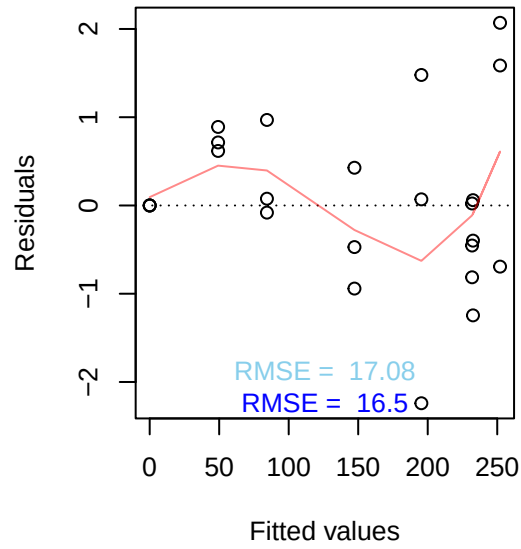
Model residuals

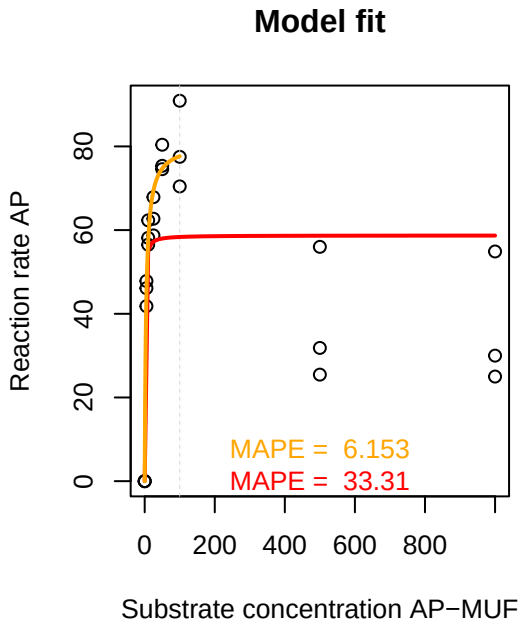


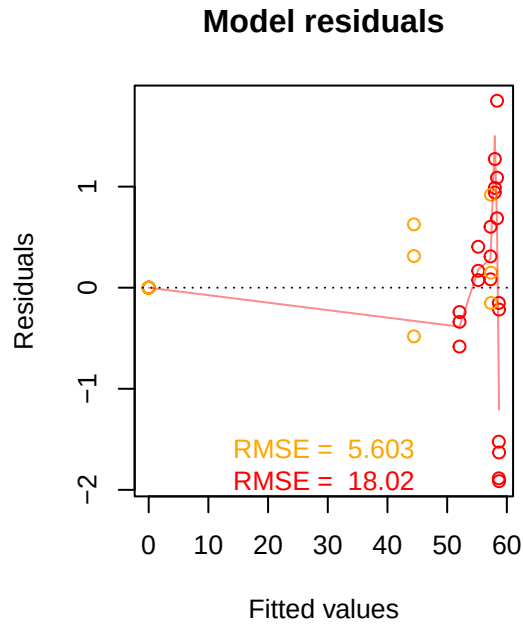
Model fit

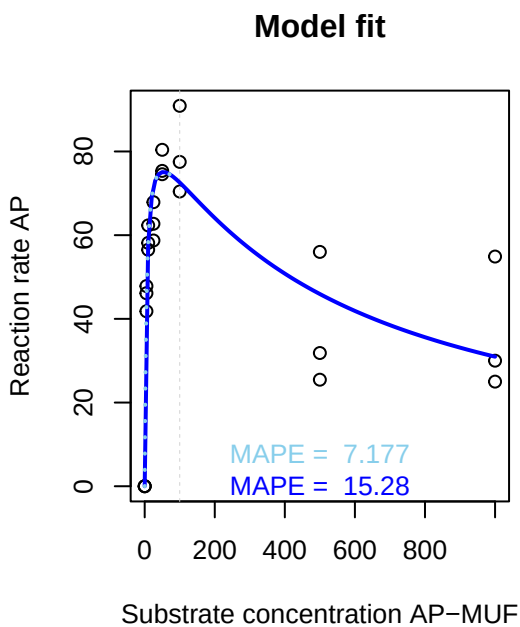


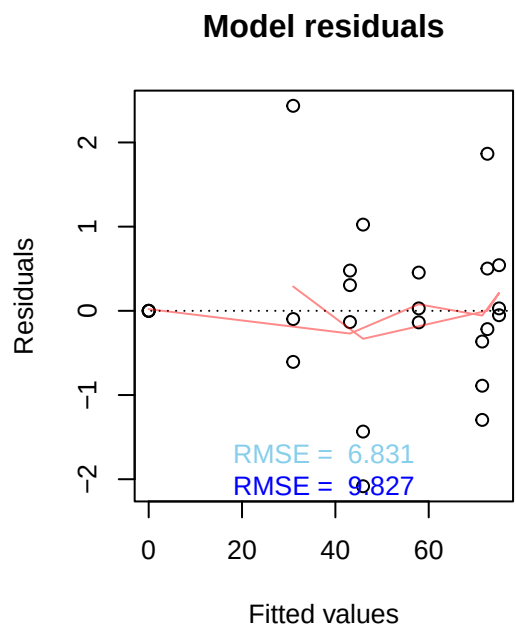
Model residuals

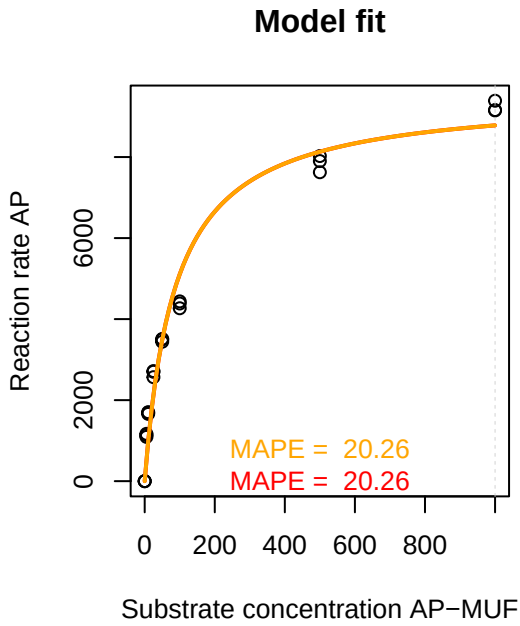


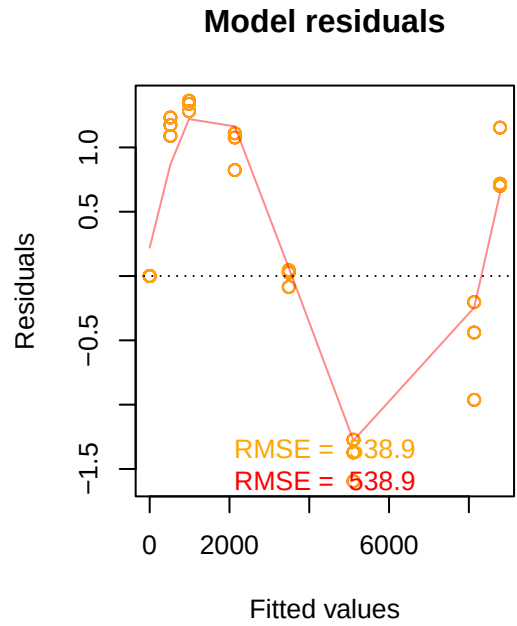

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 6.153
MAPE = 33.31
0
20
40
60
80
0
200
400
600
800

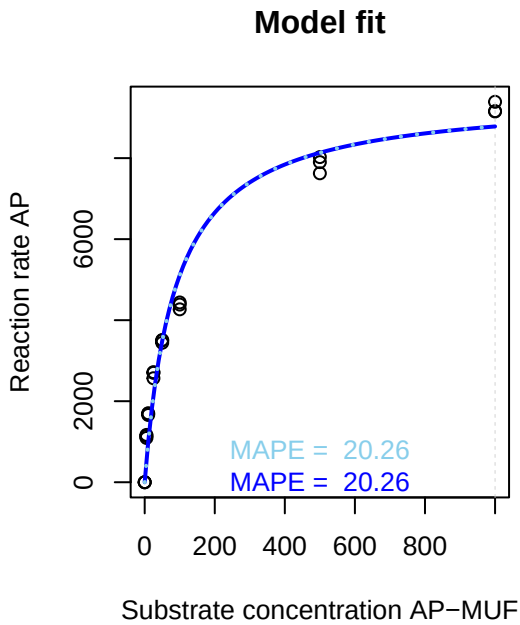

Model residuals
Residuals
Fitted values
RMSE = 5.603
RMSE = 18.02
−2
−1
0
1
0
10
20
30
40
50
60

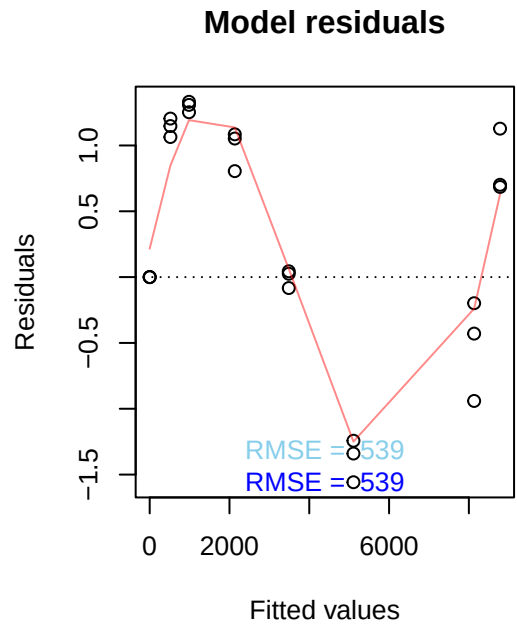

Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 7.177
MAPE = 15.28
0
20
40
60
80
0
200
400
600
800


Model residuals
Residuals
Fitted values
RMSE = 6.831
RMSE = 9.827
−2
−1
0
1
2
0
20
40
60

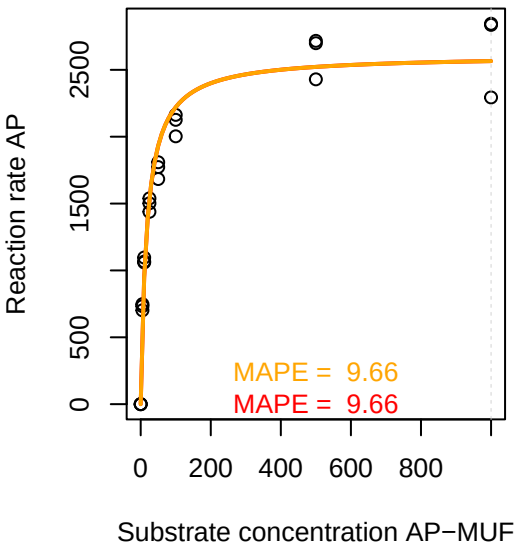

Model fit
Reaction rate AP
0
2000
6000
0
200
400
600
800
MAPE = 20.26
MAPE = 20.26
Substrate concentration AP−MUF


Model residuals
Residuals
−1.5
−0.5
0.5
1.0
0
2000
6000
RMSE = 538.9
RMSE = 538.9
Fitted values

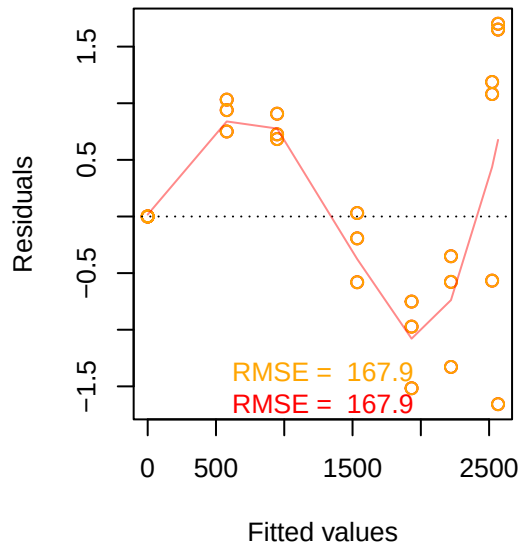

Model fit
Reaction rate AP
0
2000
6000
0
200
400
600
800
MAPE = 20.26
MAPE = 20.26
Substrate concentration AP−MUF


Model residuals
Residuals
−1.5
−0.5
0.5
1.0
0
2000
6000
RMSE = 539
RMSE = 539
Fitted values

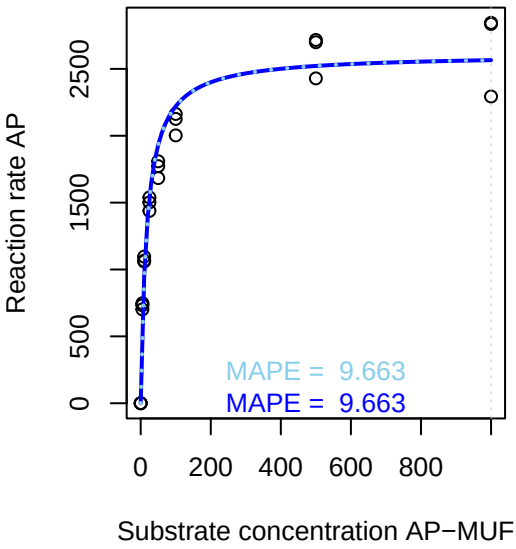
Model fit



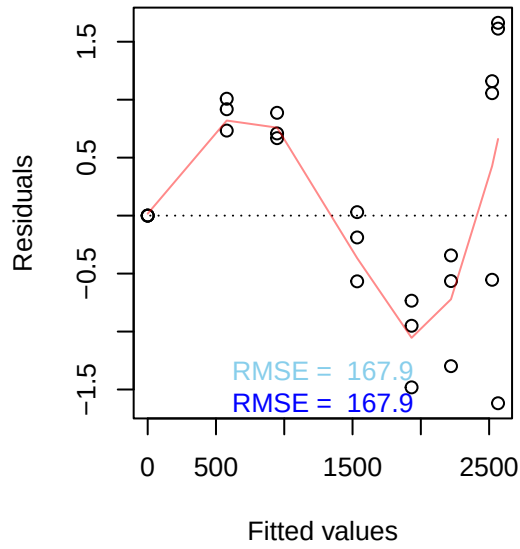
Model residuals

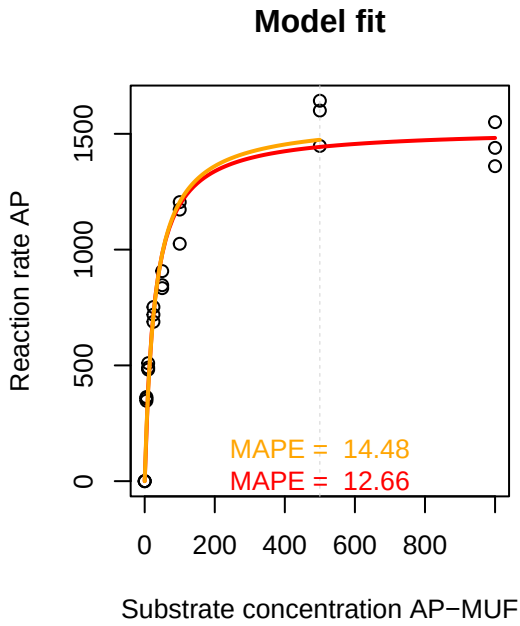


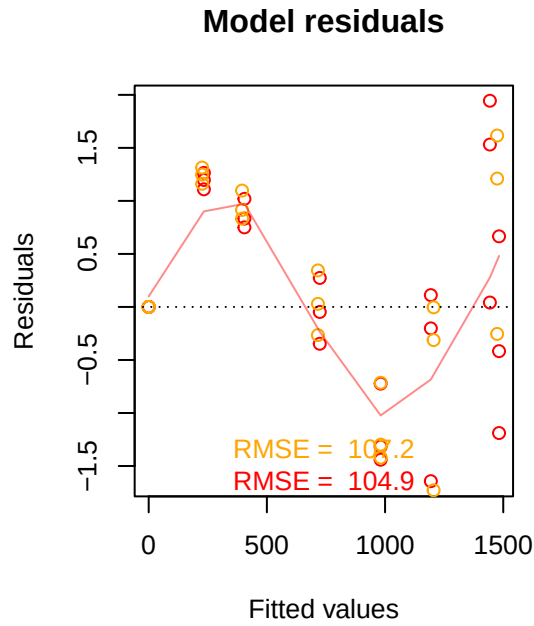
Model fit

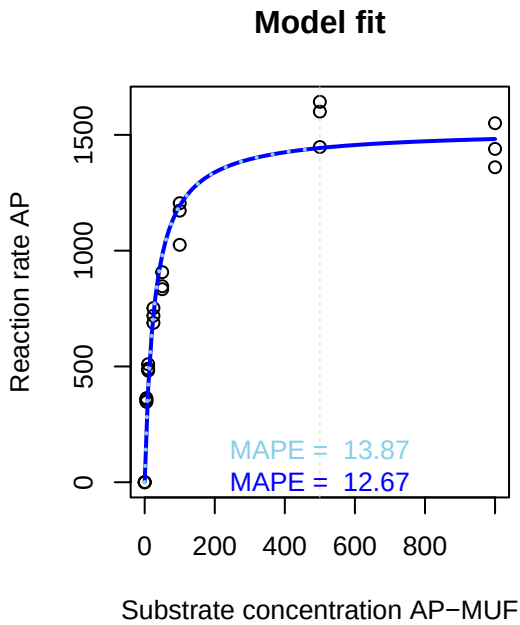


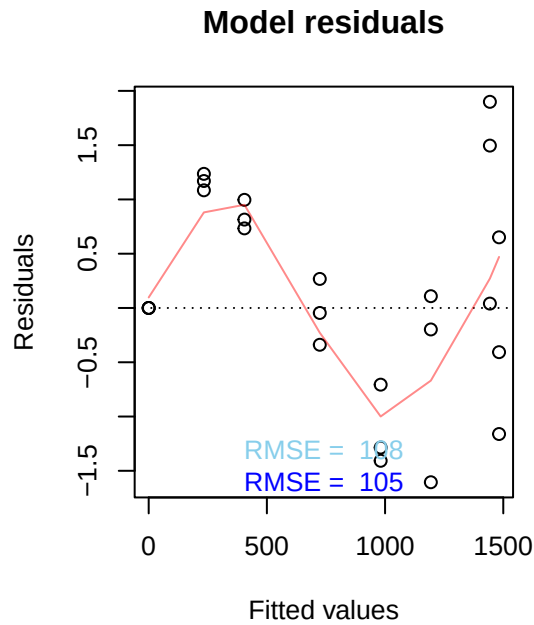
Model residuals

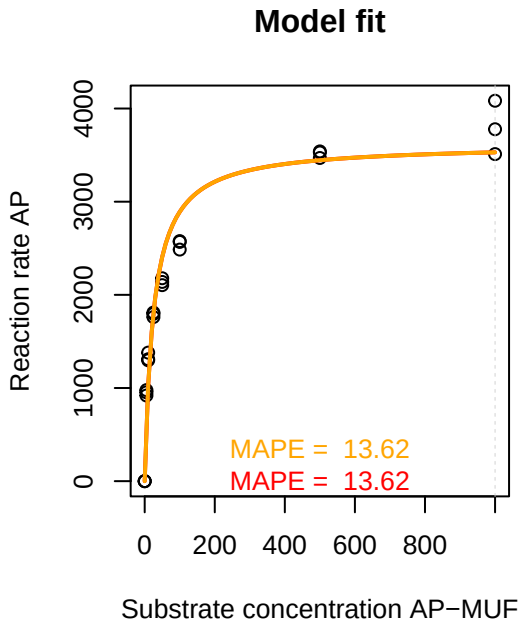


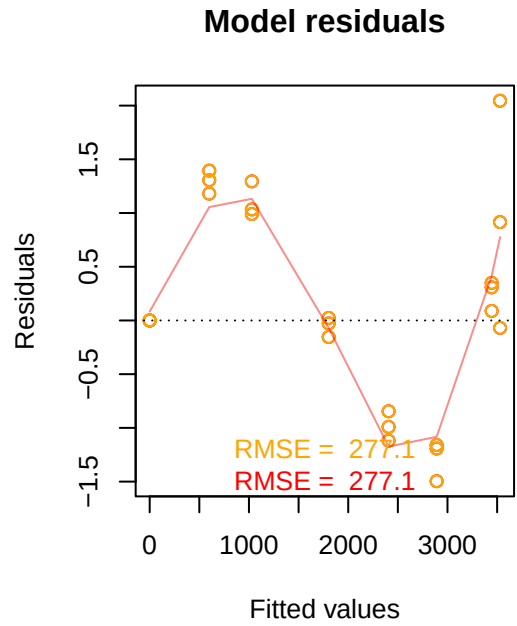

Model fit
Reaction rate AP
0
500
1000
1500
0
200
400
600
800
MAPE = 14.48
MAPE = 12.66
Substrate concentration AP−MUF

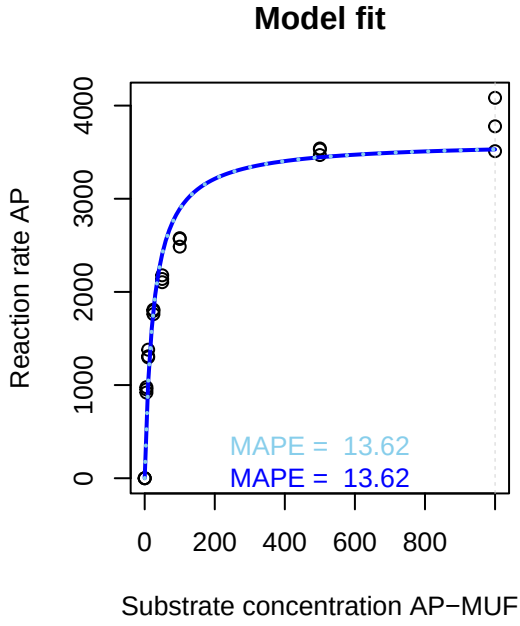

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
500
1000
1500
RMSE = 104.9
Fitted values

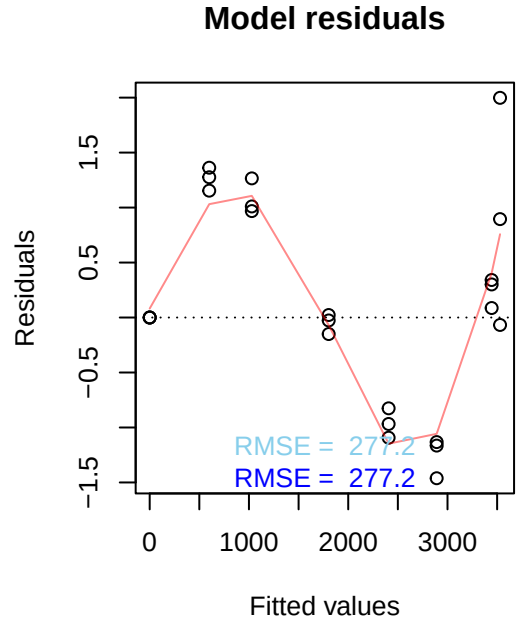

Model fit
Reaction rate AP
0
500
1000
1500
0
200
400
600
800
MAPE = 13.87
MAPE = 12.67
Substrate concentration AP−MUF

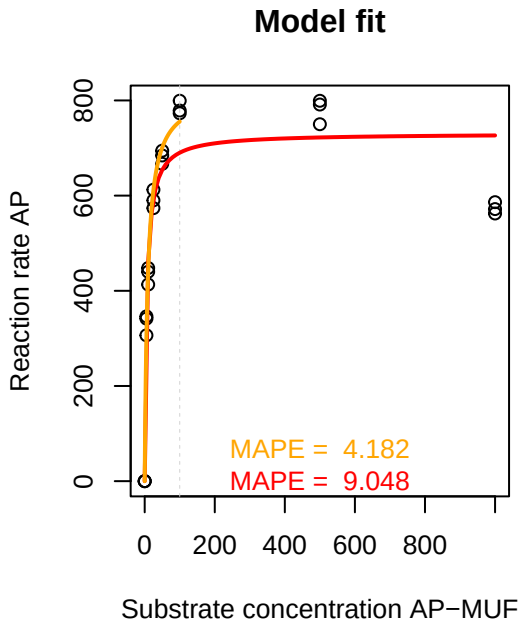

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
500
1000
1500
RMSE = 105
Fitted values

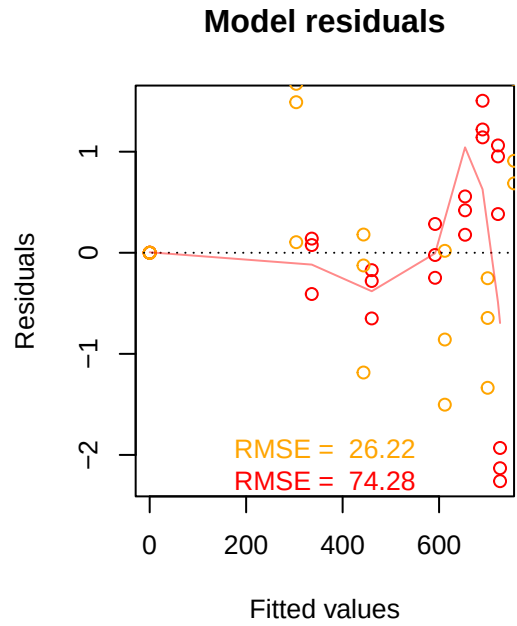

Model fit
Reaction rate AP
0
1000
2000
3000
4000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 13.62
MAPE = 13.62

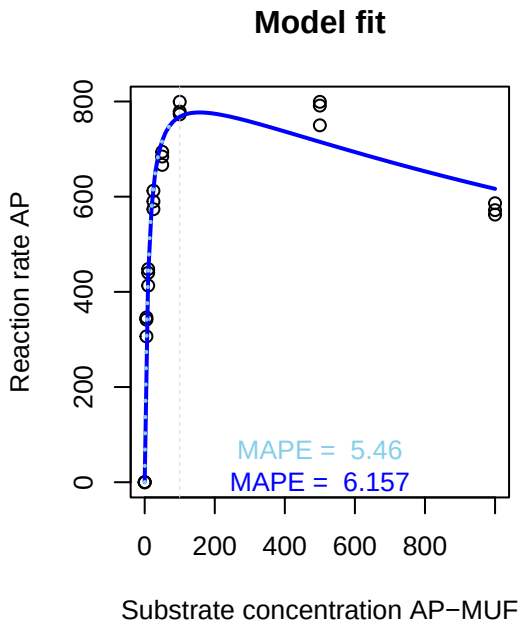

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
1000
2000
3000
Fitted values
RMSE = 277.1
RMSE = 277.1

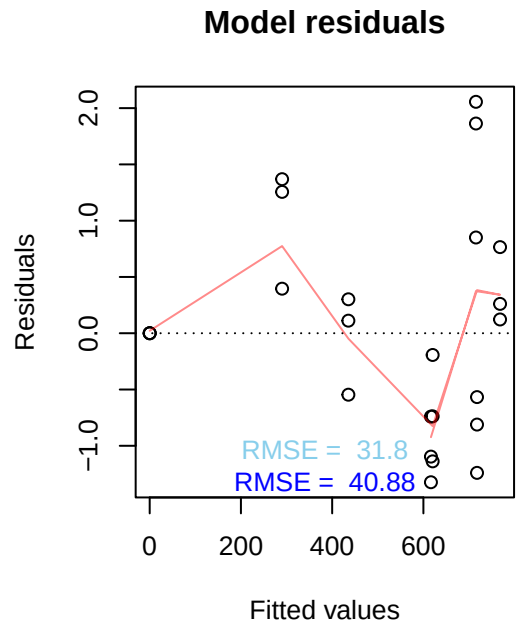

Model fit
Reaction rate AP
0
1000
2000
3000
4000
0
200
400
600
800
Substrate concentration AP−MUF
MAPE = 13.62
MAPE = 13.62

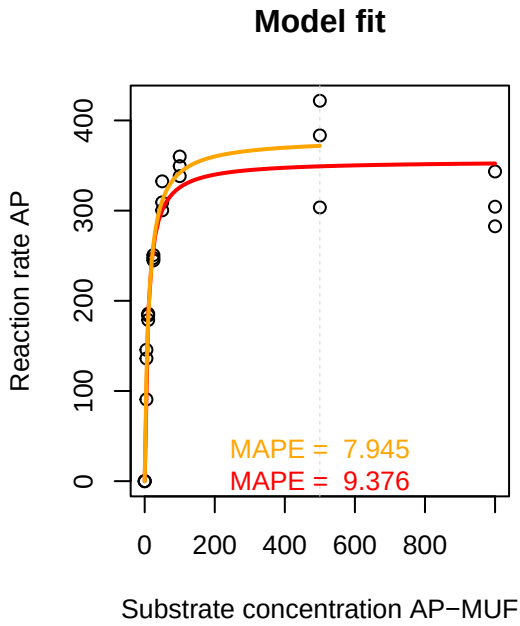

Model residuals
Residuals
−1.5
−0.5
0.5
1.5
0
1000
2000
3000
Fitted values
RMSE = 277.2
RMSE = 277.2

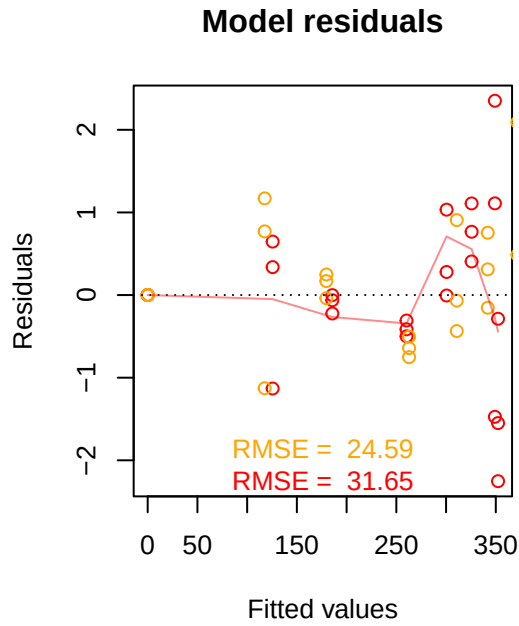

Model fit
Reaction rate AP
0
200
400
600
800
MAPE = 4.182
MAPE = 9.048
0
200
400
600
800
Substrate concentration AP−MUF

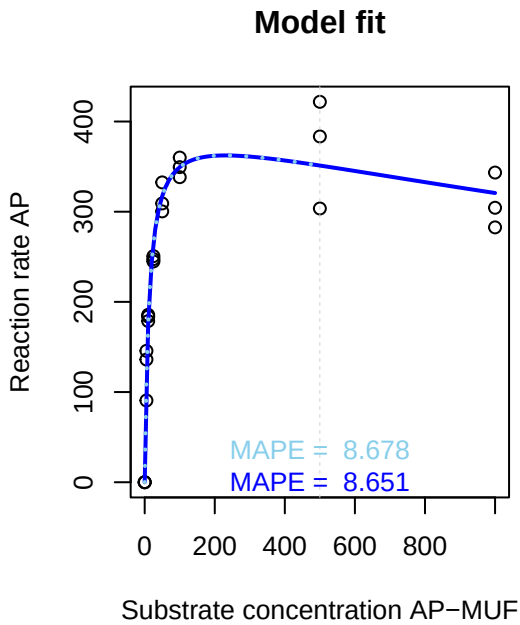

Model residuals
Residuals
−2
−1
0
1
RMSE = 26.22
RMSE = 74.28
0
200
400
600
Fitted values

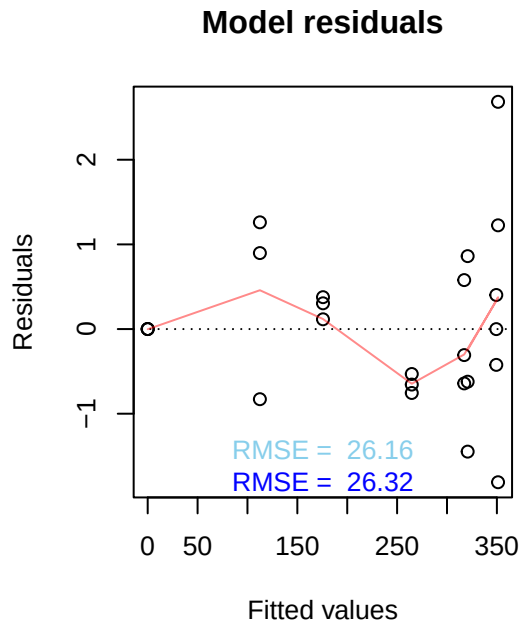

Model fit
Reaction rate AP
0
200
400
600
800
MAPE = 5.46
MAPE = 6.157
0
200
400
600
800
Substrate concentration AP−MUF


Model residuals
Residuals
−1.0
0.0
1.0
2.0
RMSE = 31.8
RMSE = 40.88
0
200
400
600
Fitted values

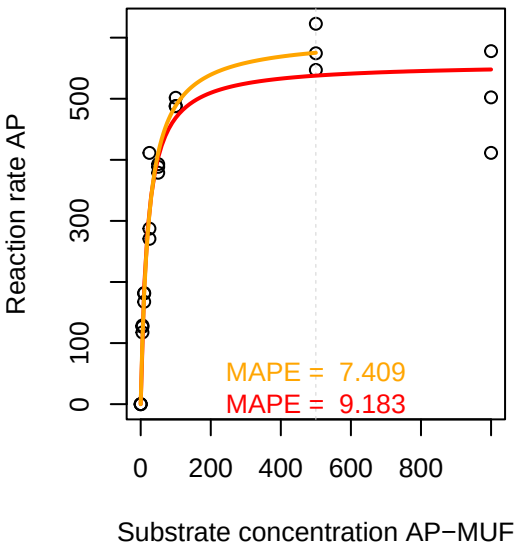

Model fit
Reaction rate AP
0
100
200
300
400
0
200
400
600
800
MAPE = 7.945
MAPE = 9.376
Substrate concentration AP−MUF


Model residuals
Residuals
−2
−1
0
1
2
0
50
150
250
350
RMSE = 24.59
RMSE = 31.65
Fitted values

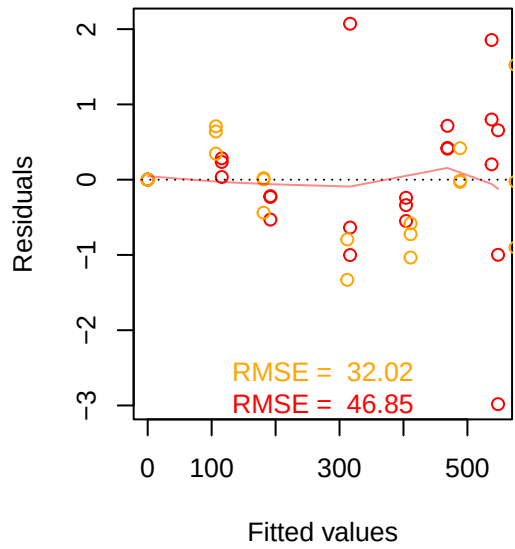

Model fit
Reaction rate AP
0
100
200
300
400
0
200
400
600
800
MAPE = 8.678
MAPE = 8.651
Substrate concentration AP−MUF


Model residuals
Residuals
−1
0
1
2
0
50
150
250
350
RMSE = 26.16
RMSE = 26.32
Fitted values

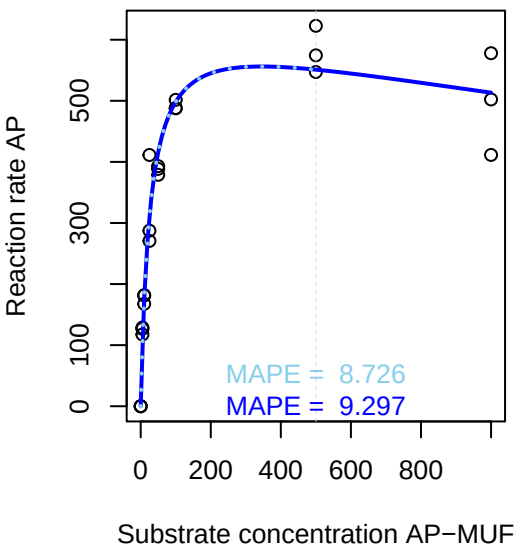
Model fit



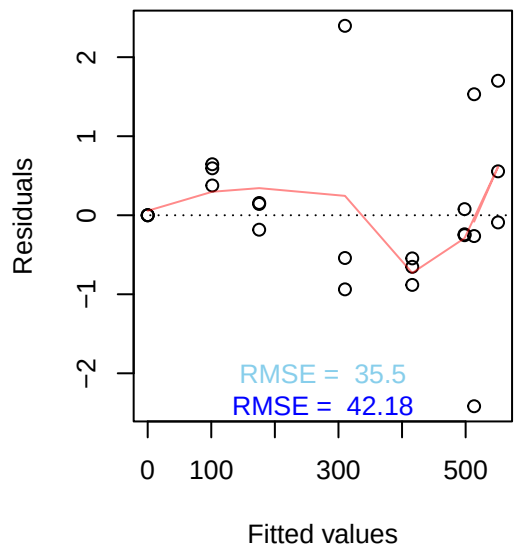
Model residuals

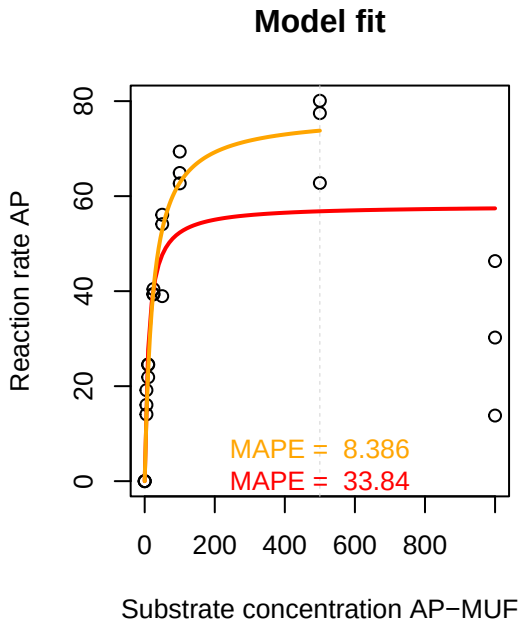


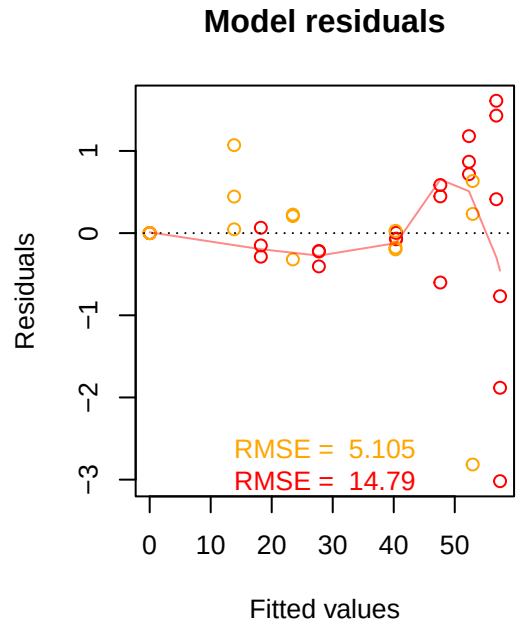
Model fit

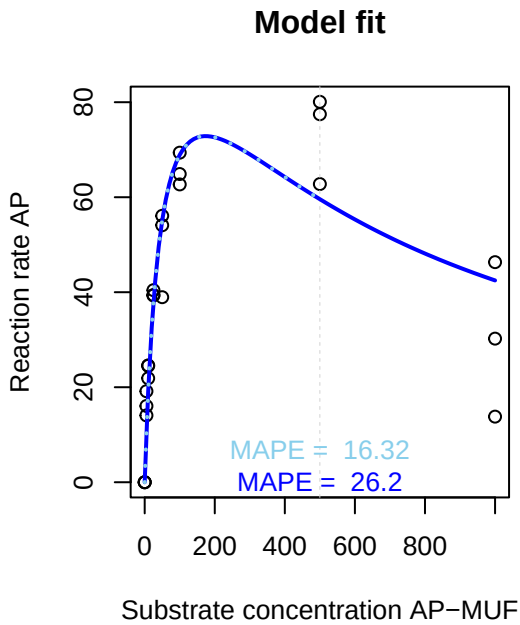


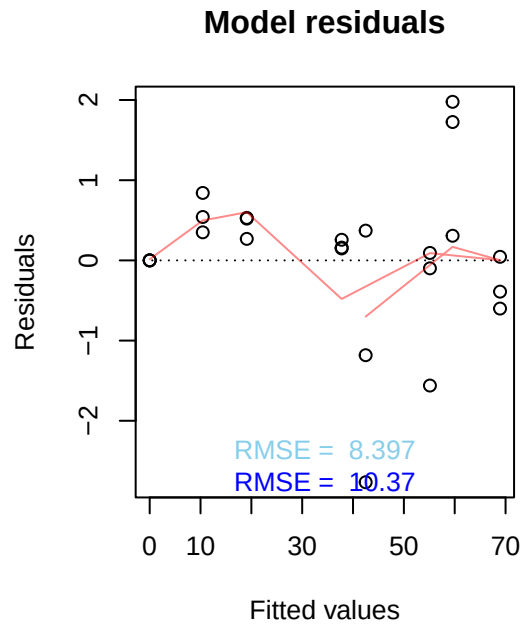
Model residuals




Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 8.386
MAPE = 33.84
0
20
40
60
80
0
200
400
600
800


Model residuals
Residuals
Fitted values
RMSE = 5.105
RMSE = 14.79
−3
−2
−1
0
1
0
10
20
30
40
50


Model fit
Reaction rate AP
Substrate concentration AP−MUF
MAPE = 16.32
MAPE = 26.2
0
20
40
60
80
0
200
400
600
800


Model residuals
Residuals
Fitted values
RMSE = 8.397
RMSE = 10.37
−2
−1
0
1
2
0
10
30
50
70