Polynomial regression

mcycle dataset from MASS

Fitted models

In-sample adjusted $R^2$ and BIC

Cross-validation: training and testing

Cross-validation: leave-one-out

Cross-validation: 10-fold

Bootstrap
mcycle dataset from MASS

A data frame giving a series of measurements of head acceleration in a simulated motorcycle accident, used to test crash helmets.

\( x \): time in milliseconds after impact  
\( y \): head acceleration (in g)


```r
library(MASS)
n = nrow(mcycle)
x = mcycle$times
y = mcycle$accel
x = x/max(x)
y = y/max(y)
x = -1+2*x
xt = x
yt = y
xt = x[1:132]
yt = y[1:132]
n = length(xt)
xt = (xt-mean(xt))/sqrt(var(xt))
yt = (yt-mean(yt))/sqrt(var(yt))
```
The data

![Graph](image-url)
Polynomial regressions

- **d=1**
  
  ![Graph](image1)
  
  \( R^2 = 0.0769 \)

- **d=2**
  
  ![Graph](image2)
  
  \( R^2 = 0.1323 \)

- **d=5**
  
  ![Graph](image3)
  
  \( R^2 = 0.5259 \)

- **d=8**
  
  ![Graph](image4)
  
  \( R^2 = 0.6941 \)

- **d=10**
  
  ![Graph](image5)
  
  \( R^2 = 0.769 \)

- **d=11**
  
  ![Graph](image6)
  
  \( R^2 = 0.7686 \)

- **d=12**
  
  ![Graph](image7)
  
  \( R^2 = 0.7798 \)

- **d=20**
  
  ![Graph](image8)
  
  \( R^2 = 0.7688 \)
In-sample adjusted $R^2$ and BIC

In-sample Adjusted R2

In-sample BIC

Order of polynomial

Adjusted R2

BIC
Cross-validation: training and testing
Cross-validation: training and testing - 100 replications
Cross-validation: leave-one-out

Leave-one-out cross validation

Root MSE

Order of polynomial

0.5 0.6 0.7 0.8 0.9

1 2 3 4 5 6 7 8 9 10 11 12 13 14
Cross-validation: 10-fold

10-fold cross validation

Order of polynomial
Root MSE

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Root MSE
0.5 0.6 0.7 0.8 0.9
Cross-validation: 10-fold - 100 replications
“Best” fitted model (and bootstrap replications)

Polynomial regression of order 12

Head acceleration (in g)

Time in milliseconds after impact