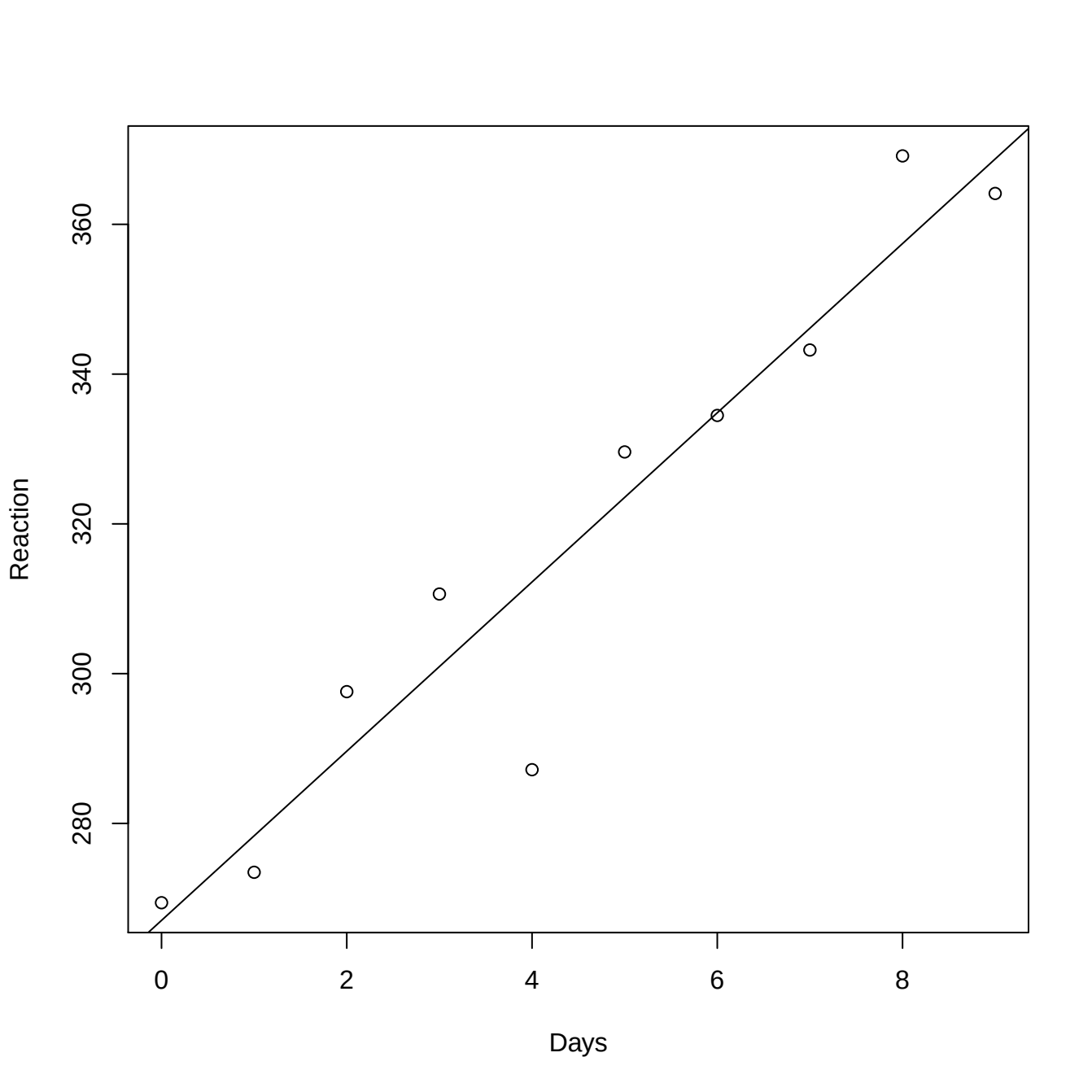
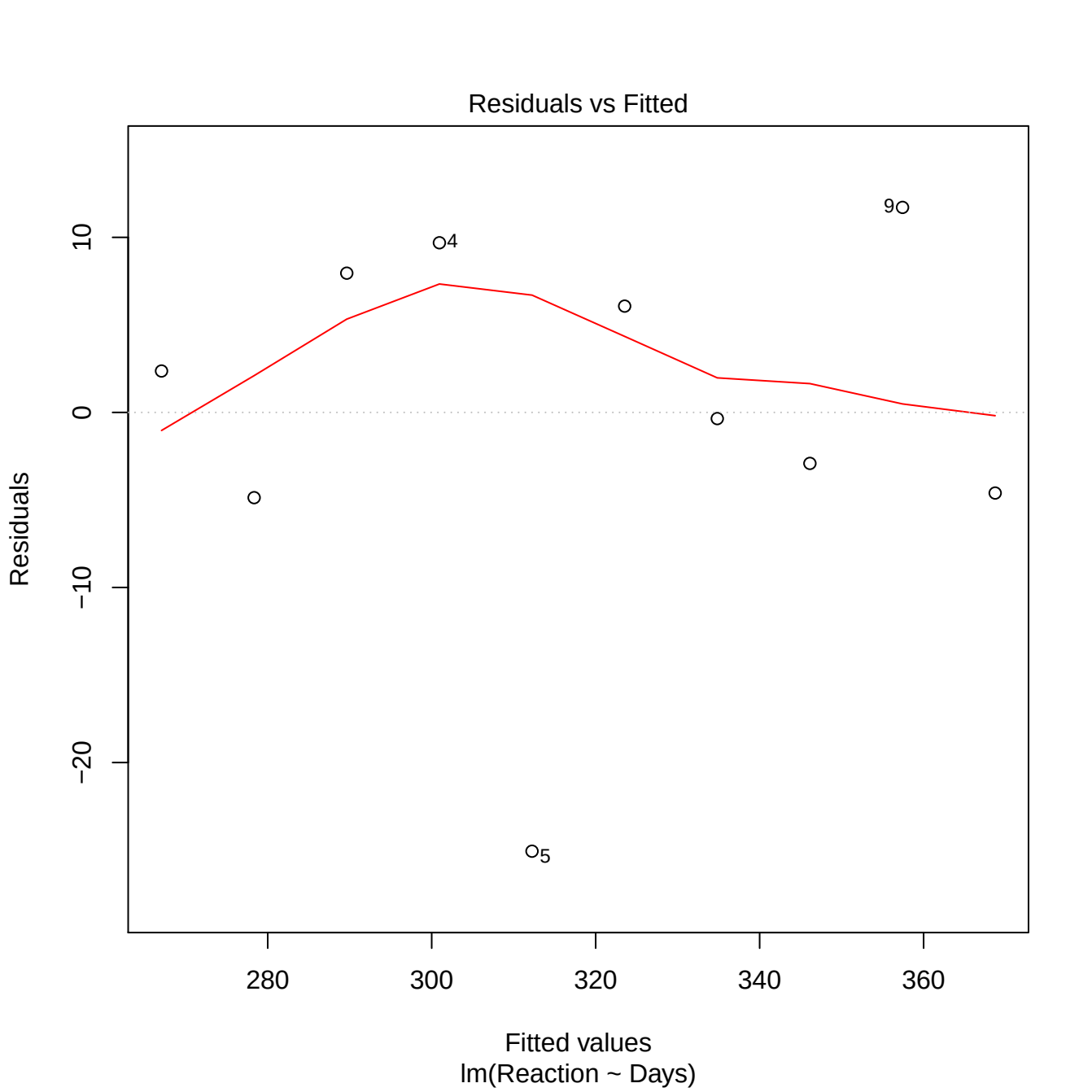
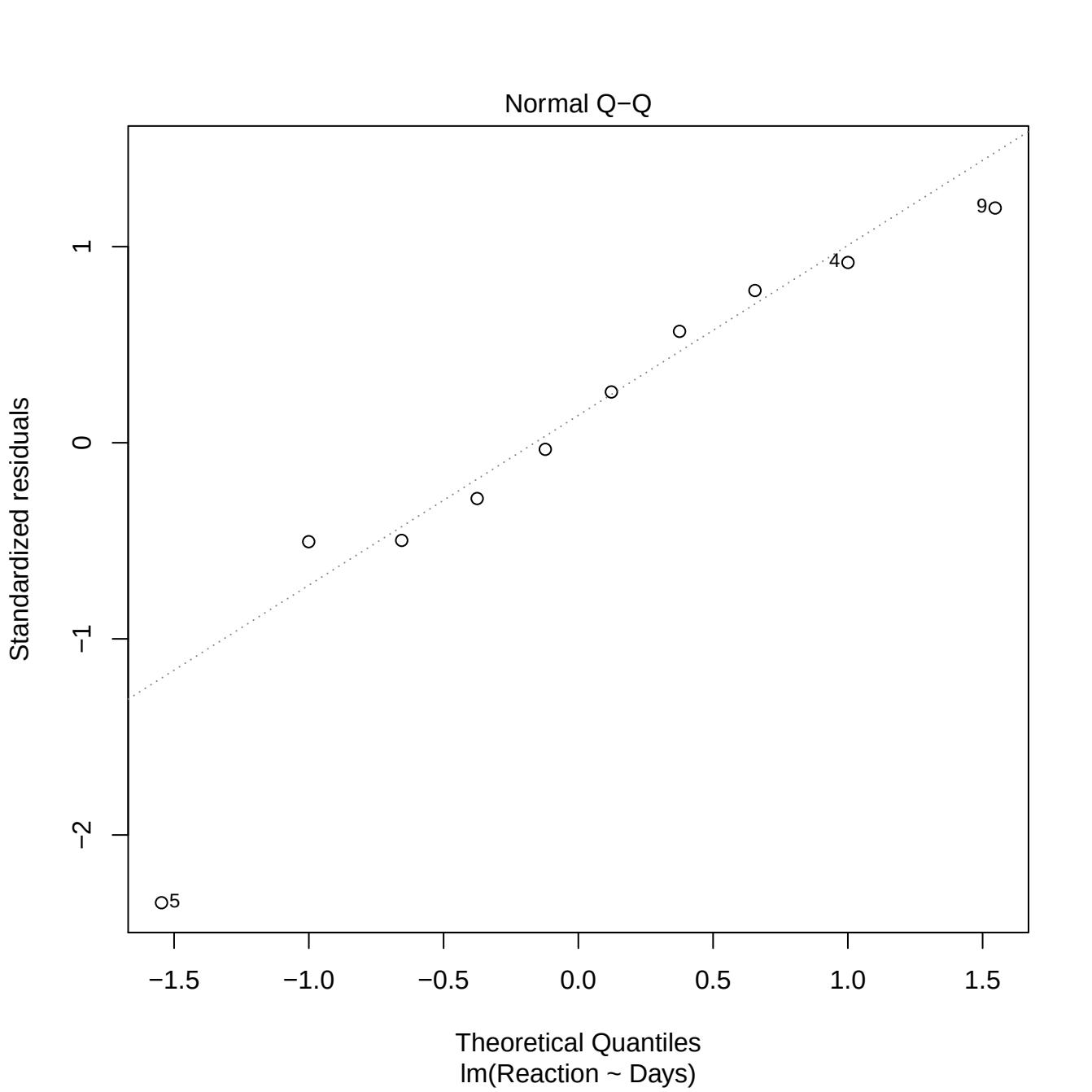
```
# Straight-line, constant rate of change fit
> sdat = subset(sleepstudy, Subject == "372")
> sdat
    Reaction Days Subject            > lm.sdat = lm(Reaction ~ Days) #OLS rate of 'decli
171 269.4117    0     372            > summary(lm.sdat)
172 273.4740    1     372            Call: lm(formula = Reaction ~ Days)
173 297.5968    2     372            Residuals:
174 310.6316    3     372                Min      1Q  Median      3Q     Max
175 287.1726    4     372            -25.064  -4.181   1.008   7.485  11.712
176 329.6076    5     372            Coefficients:
177 334.4818    6     372                        Estimate Std. Error t value Pr(>|t|)
178 343.2199    7     372            (Intercept)  267.045      6.632  40.265 1.59e-10 **
179 369.1417    8     372            Days          11.298      1.242   9.094 1.72e-05 **
180 364.1236    9     372            ---
                                     Residual standard error: 11.28 on 8 d freedom
> plot(Days, Reaction)               Multiple R-squared: 0.9118, Adj R-squared: 0.9008
> abline(coef(lm.sdat)[1],           F-statistic: 82.71 on 1 and 8 DF,p-val:1.716e-05
         coef(lm.sdat)[2])
#see plot

# Autocorrelation worries
> # AR(1) with standard Durbin-Watson test from package lmtest
> install.packages("lmtest")
> dwtest(lm.sdat, alternative = "two.sided")
        Durbin-Watson test
data:  lm.sdat DW = 2.8718, p-value = 0.2599         # approx DW = 2(1 - r)
alternative hypothesis: true autocorrelation is not 0
> acf(sdat)
=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=
# Polynomial (Quadratic, Cubic) Trajectories; Berkeley Growth Data
> bgsdat = read.table(file="D:\\drr13\\stat222\\week1\\BGSdata", header = T)
> attach(bgsdat)   > plot(age, cog)  #see plot    #Data from the Berkeley Growth Study
> lm.bgsQ = lm(cog ~ age + I(age^2))              #(Nancy Bailey). Data are for Child
> lm.bgsC = lm(cog ~ age + I(age^2) + I(age^3))   ##8 in the BGS study with age in mont
> anova(lm.bgsQ, lm.bgsC)                         #(ranging from 1 to 60) and intellect
Analysis of Variance Table                        #performance "cog".
Model 1: cog ~ age + I(age^2)                                      cog  age
Model 2: cog ~ age + I(age^2) + I(age^3)                             4    1
  Res.Df     RSS Df Sum of Sq      F    Pr(>F)                      10    2
1     18 1303.17                                                    17    3
2     17  524.88  1    778.28 25.207 0.0001049 ***                  37    5
---                                                                 65    7
> summary(lm.bgsC)                                                  85    9
Call: lm(formula = cog ~ age + I(age^2) + I(age^3))                 88   10
Residuals:                                                          95   11
     Min       1Q   Median       3Q      Max                       101   12
-11.2620  -3.2718  -0.5045   4.0831   9.6681                       103   13
Coefficients:                                                      107   14
             Estimate Std. Error t value Pr(>|t|)                  113   15
(Intercept) -7.766229   3.675075  -2.113 0.049671 *                121   18
age         10.911380   0.583345  18.705 8.91e-13 ***              148   21
I(age^2)    -0.198944   0.024207  -8.219 2.52e-07 ***              161   24
I(age^3)     0.001386   0.000276   5.021 0.000105 ***              165   27
                                                                   187   36
Residual standard error: 5.557 on 17 degrees of freedom            205   42
Multiple R-squared: 0.9946, Adjusted R-squared: 0.9936             218   48
F-statistic:  1039 on 3 and 17 DF,  p-value: < 2.2e-16             218   54
                                                                   228   60
```


Reaction
280
300
320
340
360
0
2
4
6
8
Days


Residuals vs Fitted
Residuals
10
0
−10
−20
9
4
5
280
300
320
340
360
Fitted values
lm(Reaction ~ Days)


Normal Q−Q
Standardized residuals
Theoretical Quantiles
lm(Reaction ~ Days)
1
0
−1
−2
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
9
4
5