

This data is taken from Penner & Watts, Mining Information, *American Statistician* 1991, as quoted by Levine, Ramsey & Smidt, *Applied Statistics for Engineers and Scientists*, Prentice Hall, Upper Saddle River, NJ, 2001. The study wished to relate drilling depth to time to drill an additional five feet for dry holes.

Data Set Used in this Analysis :

```
# Math 3080 - 1    Drill Data          March 1, 2014
# Treibergs
#
# From Penner & Watts, "Mining Information," American Statistician 1991
# as quoted by levine, Ramsey & Smidt, Applied Statistics for Engineers and
# Scientists, Prentice Hall, Upper Saddle River, NJ, 2001.
# Relate drilling depth to time to drill an additional five feet for dry holes.
#
# Variables
#   Depth  in feet
#   Time   in minutes
"Depth" "Time"
5 4.90
10 5.07
15 6.77
20 6.65
25 6.99
30 7.41
35 6.07
40 7.04
45 5.49
50 6.03
55 6.19
60 6.43
65 6.27
70 6.03
75 6.34
80 5.57
85 5.70
90 6.23
95 6.60
100 5.84
105 5.17
110 6.03
115 6.84
120 6.58
125 7.03
130 6.89
135 7.27
140 6.92
145 7.15
```

150 7.25
155 7.05
160 6.95
165 6.76
170 5.97
175 7.75
180 7.11
185 7.07
190 7.17
195 6.91
200 6.15
205 6.19
210 6.29
215 5.58
220 7.22
225 7.62
230 8.28
235 7.59
240 6.42
245 7.12
250 6.62

R Session:

R version 2.10.1 (2009-12-14)
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'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[R.app GUI 1.31 (5538) powerpc-apple-darwin8.11.1]

[Workspace restored from /Users/andrejstreibergs/.RData]

```
> tt = read.table("M3082DataDrill.txt",header=T)
> attach(tt)
```

```
> tt
  Depth Time
1     5 4.90
2    10 5.07
3    15 6.77
4    20 6.65
5    25 6.99
6    30 7.41
7    35 6.07
8    40 7.04
9    45 5.49
10   50 6.03
11   55 6.19
12   60 6.43
13   65 6.27
14   70 6.03
15   75 6.34
16   80 5.57
17   85 5.70
18   90 6.23
19   95 6.60
20  100 5.84
21  105 5.17
22  110 6.03
23  115 6.84
24  120 6.58
25  125 7.03
26  130 6.89
27  135 7.27
28  140 6.92
29  145 7.15
30  150 7.25
31  155 7.05
32  160 6.95
33  165 6.76
34  170 5.97
35  175 7.75
36  180 7.11
37  185 7.07
38  190 7.17
39  195 6.91
40  200 6.15
41  205 6.19
42  210 6.29
43  215 5.58
44  220 7.22
45  225 7.62
46  230 8.28
47  235 7.59
48  240 6.42
49  245 7.12
50  250 6.62
```

```

> names(tt)
[1] "Depth" "Time"

> ##### SCATTERPLOT OF DATA WITH REGRESSION LINE #####
> plot(Time~Depth,
      main = "Scatter Plot of Drilling Depth v. Time to Drill next 5'")
> f1 = lm(Time~Depth); abline(f1,col=2)
> # M3082Drill1.pdf
>
> ##### PLOT STD. RESID. VS X #####
>
> plot(rstandard(f1)~Depth,ylab="Standardized Residuals of Time",
      main="Std. Resid. of Time vs. Depth",ylim=max(abs(rstandard(f1)))*c(-1,1))
> abline(h=c(0,2,-2),lty=c(5,2,2))
>
> ##### PLOT STD. RESID. VS FITTED #####
>
> plot(rstandard(f1)~fitted(f1), ylab="Standardized Residuals of Time",
      xlab="Fitted Values",main="Std. Resid. of Time vs. Fitted Values",
      ylim=max(abs(rstandard(f1)))*c(-1,1))
> abline(h=c(0,2,-2),lty=c(5,2,2))
>
> ##### PLOT FITTED VS OBSERVED #####
>
> plot(fitted(f1)~Time, ylab="Fitted values of Time",
      xlab = "Observed Time Values",
      main = "Fitted Values of Time vs. Observed Values of Time",
      xlim = c(mi,ma), ylim = c(mi,ma))
>
> ##### NORMAL Q-Q PLOT OF STD. RESID.#####
>
> qqnorm(rstandard(f1), ylab = "Standardized Residuals of Time",
      main = "QQ-Plot of Std. Resid. of Time",
      ylim = max(abs(rstandard(f1)))*c(-1,1))
> abline(h=c(0,2,-2), lty=c(5,2,2)); abline(0,1,col=2)
>
> ##### PLOT STANDARDIZED RESIDUALS VS INDEX: DATA ORDER #####
>
> plot(rstandard(f1), ylab = "Standardized Residuals of Time",
      xlab = "i = order of observation",
      main = "Std. Resid. of Time vs. i = Order of Observation",
      ylim = max(abs(rstandard(f1)))*c(-1,1))
> abline(h=c(0,2,-2),lty=c(5,2,2))
>
> ##### CANNED DIAGNOSTIC PLOTS #####
>
> layout(matrix(c(1,3,2,4),nrow=2))
> plot(f1)
> # M3082Drill7.pdf

```

```
> ##### SUMMARY AND ANOVA TABLE FOR REGRESSION #####
>
> summary(f1); anova(f1)
```

```
Call:
lm(formula = Time ~ Depth)
```

```
Residuals:
    Min       1Q   Median       3Q      Max
-1.38156 -0.58099  0.03983  0.44131  1.27335
```

```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 6.002882   0.186050  32.265 < 2e-16 ***
Depth       0.004459   0.001270   3.511 0.000982 ***
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1 1
```

```
Residual standard error: 0.6479 on 48 degrees of freedom
Multiple R-squared: 0.2043, Adjusted R-squared: 0.1878
F-statistic: 12.33 on 1 and 48 DF, p-value: 0.0009821
```

```
Analysis of Variance Table
```

```
Response: Time
      Df Sum Sq Mean Sq F value    Pr(>F)
Depth   1  5.1756   5.1756  12.328 0.0009821 ***
Residuals 48 20.1520   0.4198
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1 1
```

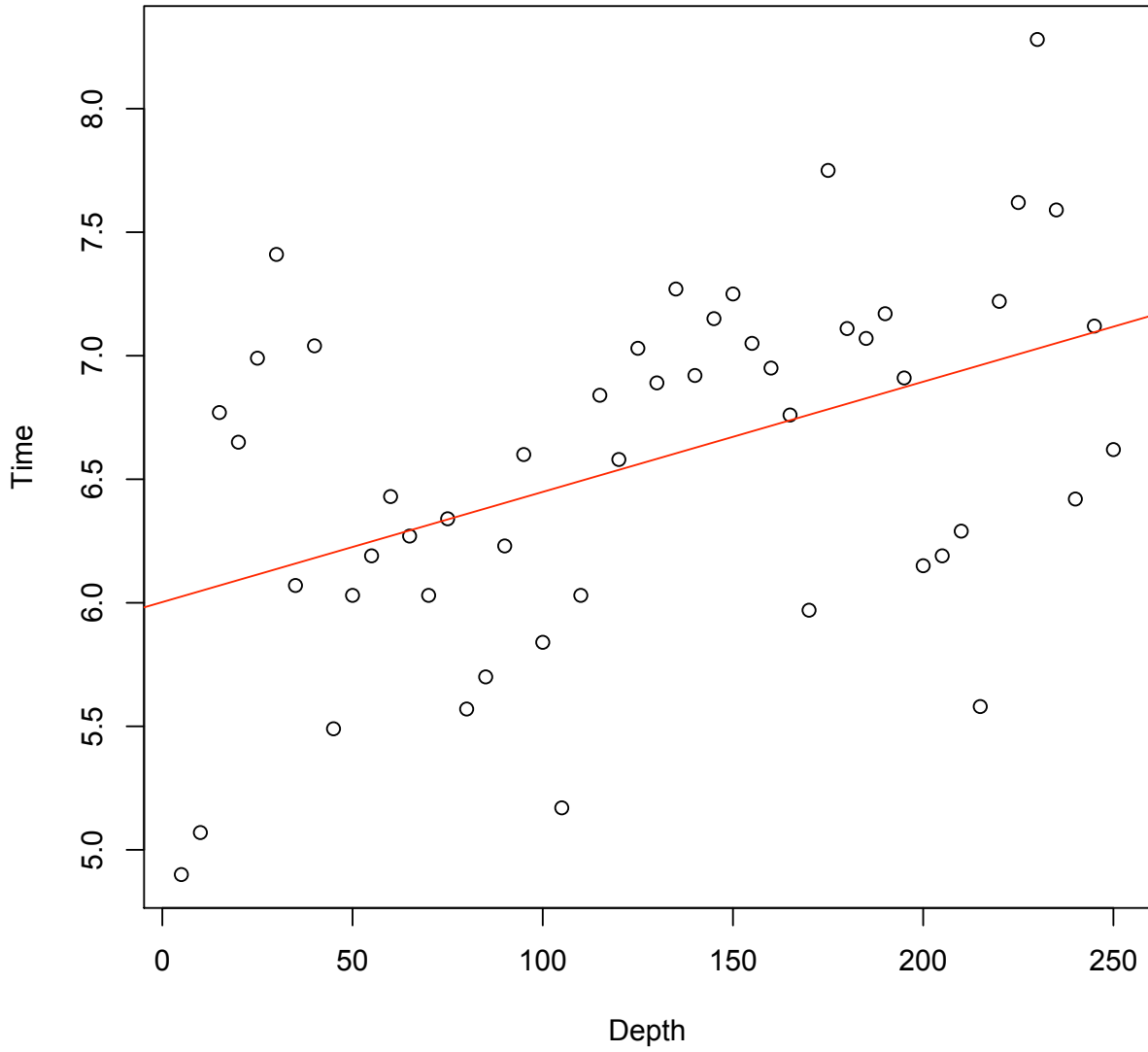
```
>
> ##### SHAPIRO WILK TEST FOR NORMALITY #####
>
> shapiro.test(rstandard(f1))
```

```
Shapiro-Wilk normality test
```

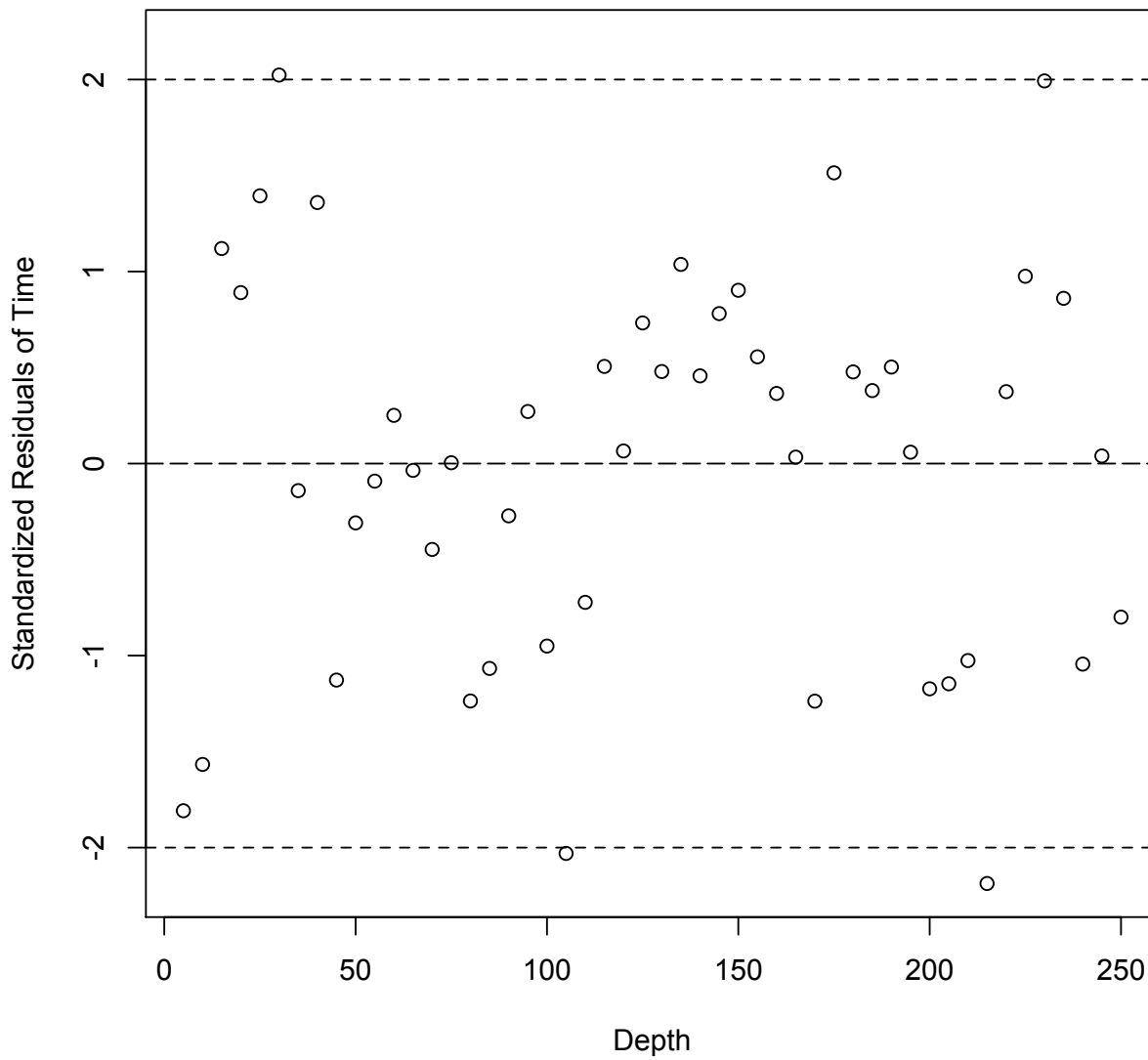
```
data:  rstandard(f1)
W = 0.977, p-value = 0.4323
```

```
>
>
>
```

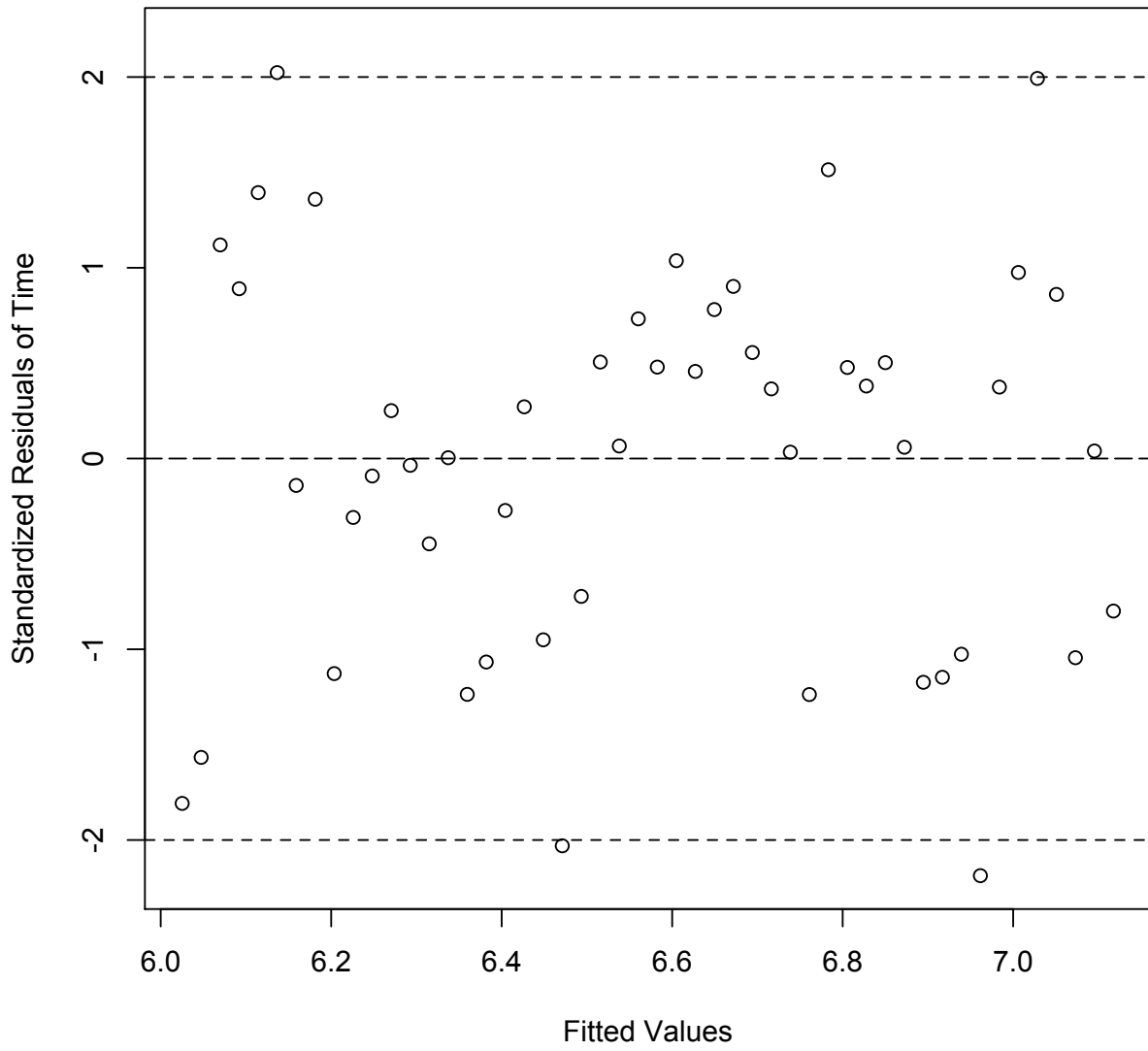
Scatter Plot of Drilling Depth v. Time to Drill next 5'



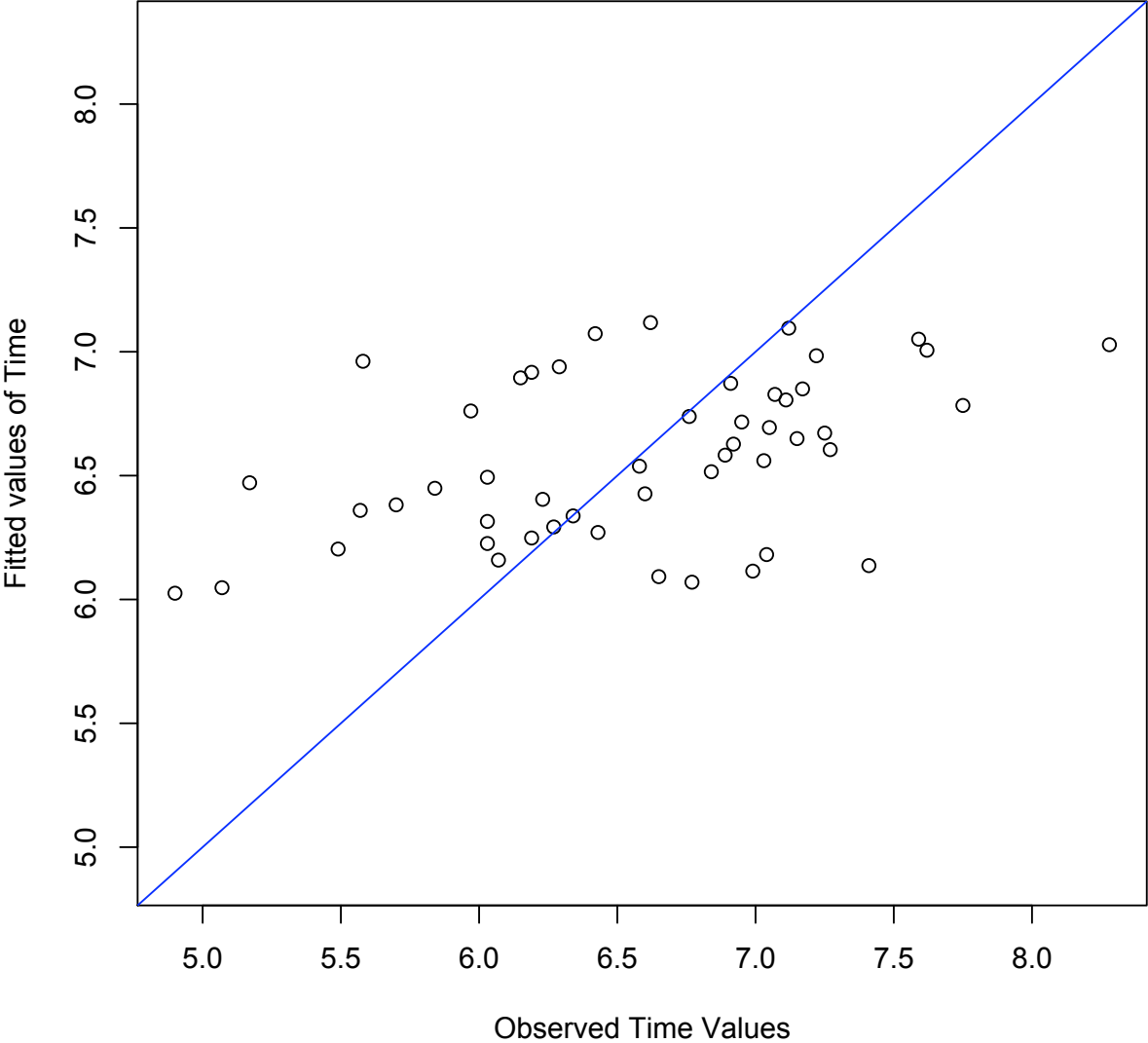
Std. Resid. of Time vs. Depth



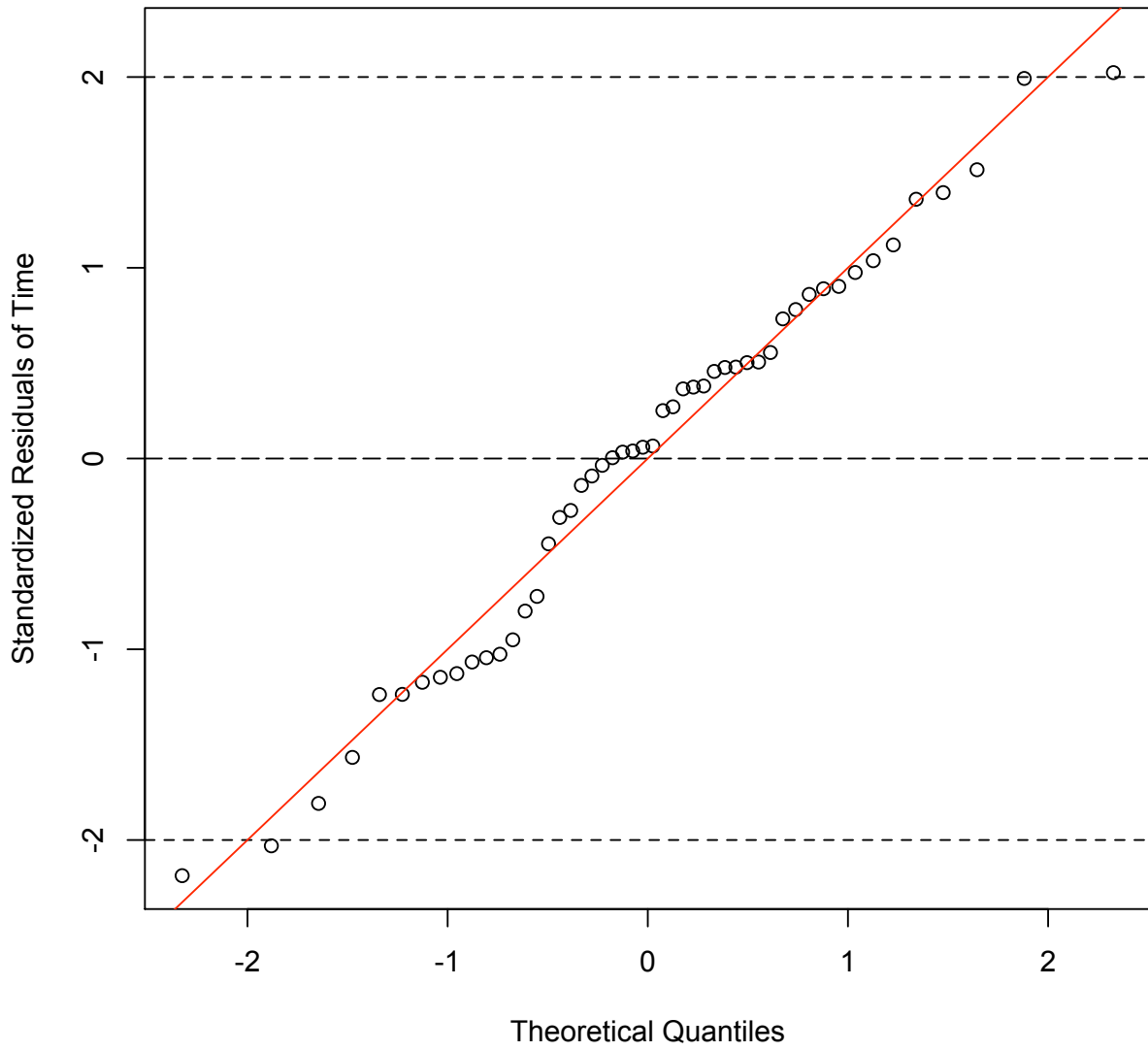
Std. Resid. of Time vs. Fitted Values



Fitted Values of Time vs. Observed Values of Time



QQ-Plot of Std. Resid. of Time



Std. Resid. of Time vs. i = Order of Observation

