

```
# M3080 - 1 Treibergs Feb. 15, 2010
#
# Windmill data from Navidi 2008
#
# A windmill generates direct current. Record of daily readings.
# x = Wind Speed (mph)
# y = Curent (kA)
#
"x" "y"
4.2 1.9
1.4 0.7
6.6 2.2
4.7 2.0
2.6 1.1
5.8 2.6
1.8 0.3
5.8 2.3
7.3 2.6
7.1 2.7
6.4 2.4
4.6 2.2
1.6 1.1
2.3 1.5
4.2 1.5
3.7 2.1
5.9 2.2
6.0 2.6
10.7 3.2
5.3 2.3
5.1 1.9
4.9 2.3
8.3 3.1
7.1 2.3
9.2 2.9
4.4 1.8
8.0 2.6
10.5 3.0
5.1 2.1
5.8 2.5
2.6 1.4
7.7 2.8
6.1 2.4
5.5 2.2
4.7 2.3
4.0 2.0
2.3 1.2
11.9 3.0
8.6 2.5
5.6 2.1
```

4.2 1.7  
6.2 2.3  
7.7 2.6  
6.6 2.9  
6.9 2.6

```

R version 2.10.1 (2009-12-14)
> aa <- read.table("M3081dataWindmill.txt",header=TRUE);aa
  x y
1  4.2 1.9 2  1.4 0.7 3  6.6 2.2 4  4.7 2.0 5  2.6 1.1
6  5.8 2.6 7  1.8 0.3 8  5.8 2.3 9  7.3 2.6 10 7.1 2.7
11 6.4 2.4 12 4.6 2.2 13 1.6 1.1 14 2.3 1.5 15 4.2 1.5
16 3.7 2.1 17 5.9 2.2 18 6.0 2.6 19 10.7 3.2 20 5.3 2.3
21 5.1 1.9 22 4.9 2.3 23 8.3 3.1 24 7.1 2.3 25 9.2 2.9
26 4.4 1.8 27 8.0 2.6 28 10.5 3.0 29 5.1 2.1 30 5.8 2.5
31 2.6 1.4 32 7.7 2.8 33 6.1 2.4 34 5.5 2.2 35 4.7 2.3
36 4.0 2.0 37 2.3 1.2 38 11.9 3.0 39 8.6 2.5 40 5.6 2.1
41 4.2 1.7 42 6.2 2.3 43 7.7 2.6 44 6.6 2.9 45 6.9 2.6

> attach(aa); plot(x,y)
> f1 <- lm(y ~ x);summary(f1);anova(f1)

Call:  lm(formula = y ~ x)
Residuals:
      Min       1Q   Median       3Q      Max
-0.95701 -0.13391  0.04816  0.19525  0.51296

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.83325     0.11355   7.338 4.18e-09 ***
x            0.23542     0.01838  12.812 2.82e-16 ***
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1 1

Residual standard error: 0.291 on 43 degrees of freedom
Multiple R-squared: 0.7924, Adjusted R-squared: 0.7876
F-statistic: 164.2 on 1 and 43 DF, p-value: 2.819e-16

Analysis of Variance Table
Response: y
      Df Sum Sq Mean Sq F value    Pr(>F)
x       1 13.8973 13.8973  164.15 2.819e-16 ***
Residuals 43  3.6405  0.0847
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1 1

> layout(matrix(1:4, ncol=2))
> plot(x,y);abline(f1)
> plot(x,t1$residuals,ylab="Residuals");abline(h=0,lty=2)
> plot(x,f1$residuals,ylab="Residuals");abline(h=0,lty=2)
> plot(f1$fitted.values,f1$residuals,ylab="Residuals",xlab="Predicted");
> abline(h=0,lty=2)
> qqnorm(f1$residuals,ylab="Residuals");qqline(f1$residuals)

```

=====SECOND MODEL=====

```
> lx <- log(x);ly <- log(y)
> f2 <- lm( y~lx);summary(f2);anova(f2)
```

Call:

```
lm(formula = y ~ lx)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-0.607999	-0.140419	-0.003761	0.141309	0.424302

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.19878	0.11677	1.702	0.096 .
lx	1.20659	0.06827	17.673	<2e-16 ***

---

Signif. codes: 0 \*\*\* 0.001 \*\* 0.01 \* 0.05 . 0.1 1

Residual standard error: 0.2222 on 43 degrees of freedom

Multiple R-squared: 0.879, Adjusted R-squared: 0.8762

F-statistic: 312.3 on 1 and 43 DF, p-value: < 2.2e-16

Analysis of Variance Table

Response: y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
lx	1	15.4155	15.4155	312.34	< 2.2e-16 ***
Residuals	43	2.1222	0.0494		

---

Signif. codes: 0 \*\*\* 0.001 \*\* 0.01 \* 0.05 . 0.1 1

```
> layout(matrix(1:4, ncol=2))
```

```
> plot(lx,y,xlab = "log(x)");abline(f2)
```

```
> plot(lx,f2$residuals,ylab="Residuals",xlab="log(x)");abline(h=0,lty=2);
```

```
> plot(f2$fitted.values,f2$residuals,ylab="Residuals",xlab="Predicted");
```

```
> abline(h=0,lty=2)
```

```
> qqnorm(f2$residuals,ylab="Residuals");qqline(f2$residuals)
```

```

=====THIRD MODEL=====
> f3 <- lm(ly ~ x); summary(f3); anova(f3)
Call:    lm(formula = ly ~ x)
Residuals:
      Min       1Q   Median       3Q      Max
-1.38222 -0.06429  0.05304  0.13545  0.30390

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.06787    0.10758  -0.631   0.531
x             0.13673    0.01741   7.854 7.64e-10 ***

Residual standard error: 0.2757 on 43 degrees of freedom
Multiple R-squared: 0.5892, Adjusted R-squared: 0.5797
F-statistic: 61.68 on 1 and 43 DF,  p-value: 7.641e-10

Analysis of Variance Table

Response: ly
      Df Sum Sq Mean Sq F value    Pr(>F)
x       1  4.6878   4.6878  61.684 7.641e-10 ***
Residuals 43  3.2678   0.0760

> layout(matrix(1:4, ncol=2));
> plot(x,ly,ylab = "log(y)"); abline(f3);
> plot(x,f3$residuals,ylab="Residuals");abline(h=0,lty=2);
> plot(f3$fitted.values,f3$residuals,ylab="Residuals",xlab="Predicted");
> abline(h=0,lty=2);
> qqnorm(f3$residuals,ylab="Residuals");qqline(f3$residuals);
> qqline(f3$residuals)

```

=====FOURTH MODEL=====

```
> f4 <- lm(ly ~ lx); summary(f4); anova(f4)
```

```
Call: lm(formula = ly ~ lx)
```

```
Residuals:
```

	Min	1Q	Median	3Q	Max
	-1.12597	-0.08355	0.02349	0.11480	0.29922

```
Coefficients:
```

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	-0.51981	0.11260	-4.617	3.51e-05 ***
lx	0.75166	0.06583	11.418	1.33e-14 ***

```
Residual standard error: 0.2142 on 43 degrees of freedom
```

```
Multiple R-squared: 0.752, Adjusted R-squared: 0.7462
```

```
F-statistic: 130.4 on 1 and 43 DF, p-value: 1.328e-14
```

```
Analysis of Variance Table
```

```
Response: ly
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
lx	1	5.9824	5.9824	130.37	1.328e-14 ***
Residuals	43	1.9732	0.0459		

```
> layout(matrix(1:4, ncol=2));
```

```
> plot(lx,ly,ylab = "log(y)",xlab="log(x)");abline(f4);
```

```
> plot(lx,f4$residuals,ylab="Residuals",xlab="log(x)");abline(h=0,lty=2);
```

```
> plot(f4$fitted.values,f4$residuals,ylab="Residuals",xlab="Predicted");
```

```
> abline(h=0,lty=2)
```

```
> qqnorm(f4$residuals,ylab="Residuals");qqline(f4$residuals)
```

=====SUPERIMPOSE FITTED LINES FROM ALL MODELS=====

```
> layout(matrix(1:1,ncol=1)); plot(x,y); abline(f1)
```

```
> xx <- seq(from = 1.3,to = 12, by = .05)
```

```
> a2 <- f2$coefficients[[1]];b2 <- f2$coefficients[[2]];a2;b2
```

```
[1] 0.1987821 [1] 1.206588
```

```
> a3 <- f3$coefficients[[1]];b3 <- f3$coefficients[[2]];a3;b3
```

```
[1] -0.06786883 [1] 0.1367314
```

```
> a4 <- f4$coefficients[[1]];b4 <- f4$coefficients[[2]];a4;b4
```

```
[1] -0.5198148 [1] 0.7516556
```

```
> y2 <- a2+b2*log(xx); y3 <- exp(a3+b3*xx)
```

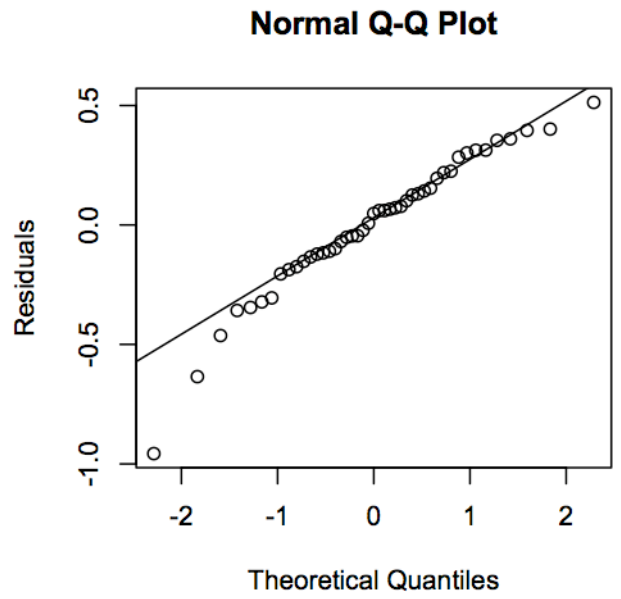
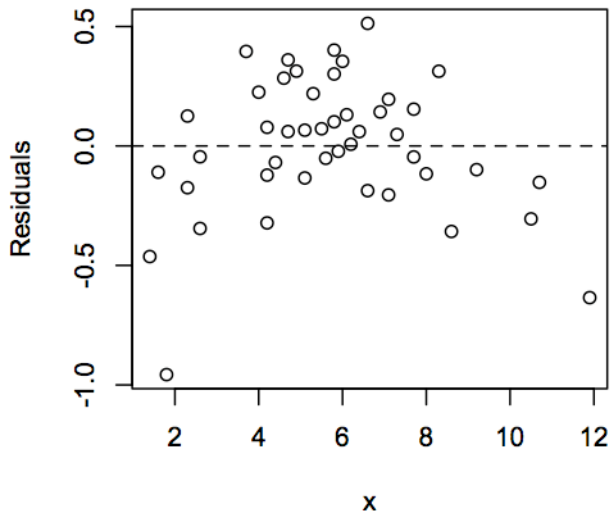
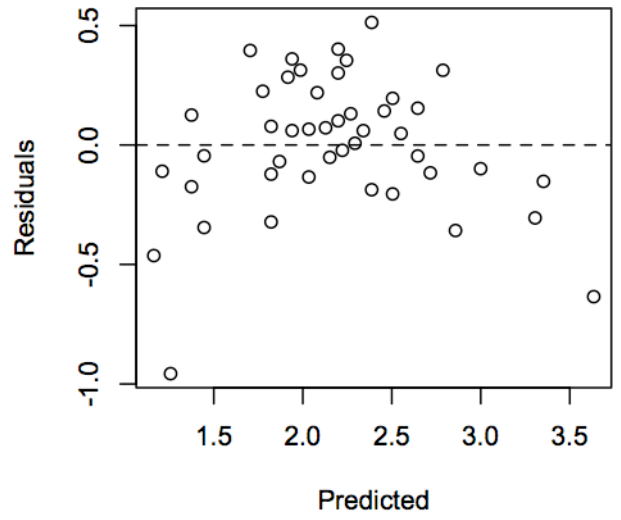
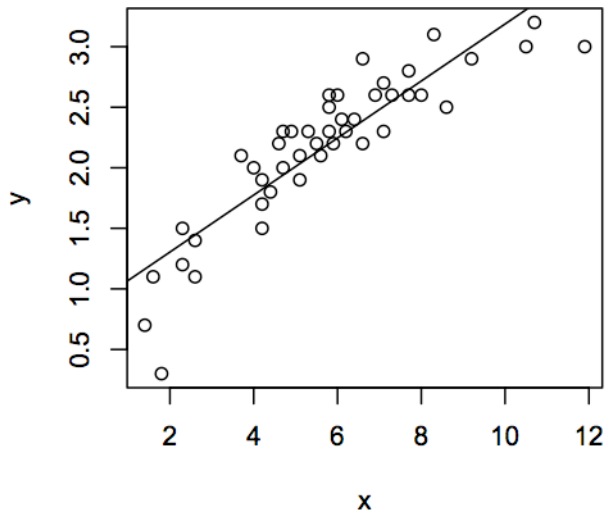
```
> ea4 <- exp(a4); y4 <- ea4*xx^b4
```

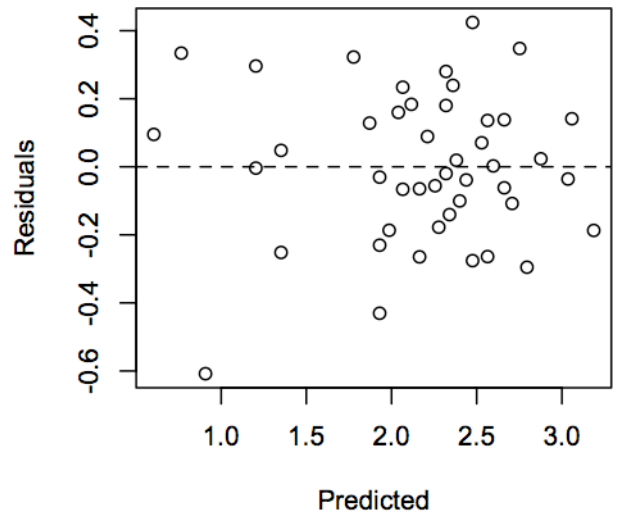
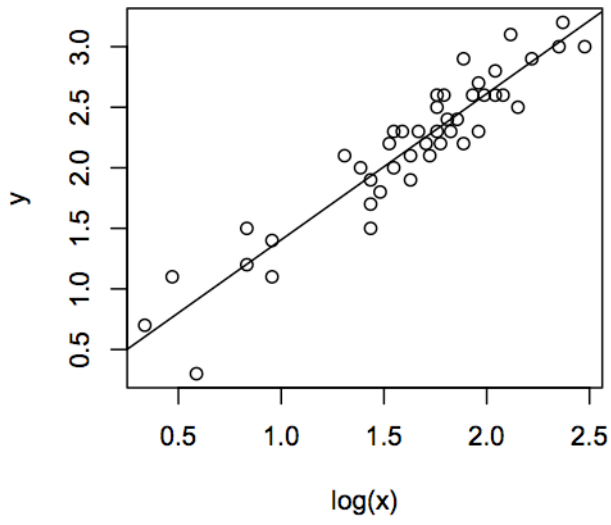
```
> plot(x,y);abline(f1)
```

```
> lines(xx,y2,lty=2); lines(xx,y3,lty=3); lines(xx,y4,lty=4)
```

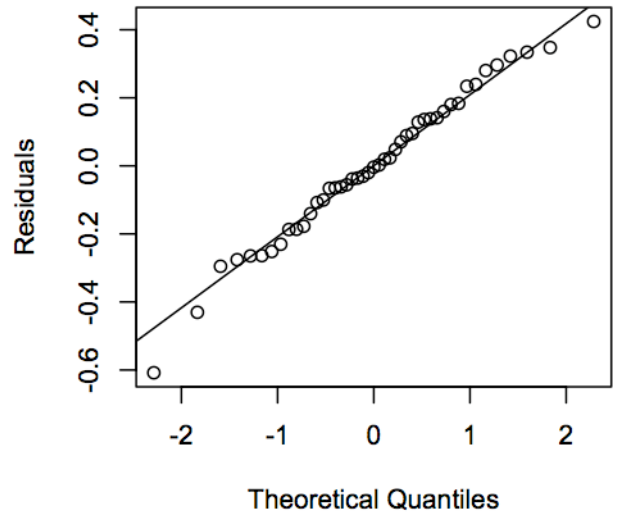
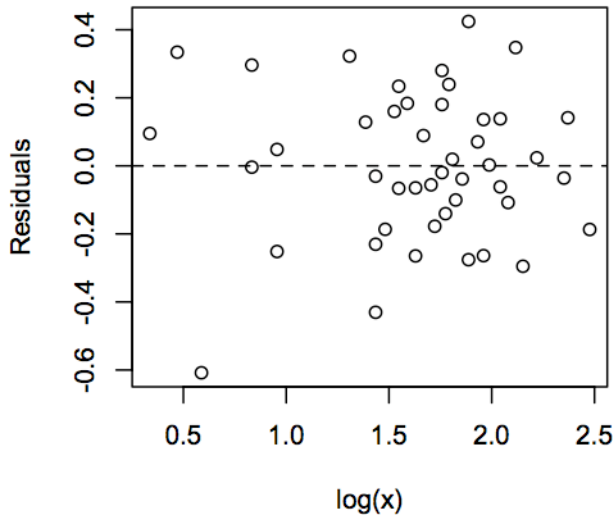
```
> legend(7,1.8,legend=c("y~x","y~log(x)","log(y)~x",
```

```
+ "log(y)~log(x)",lty=1:4,title="Fitted Curves", bty="n")
```

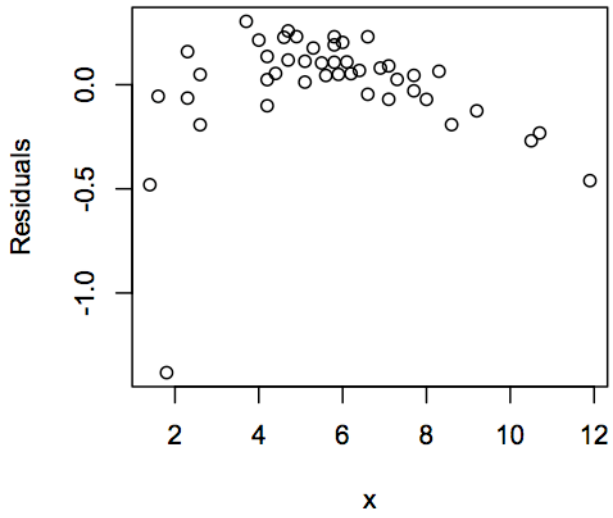
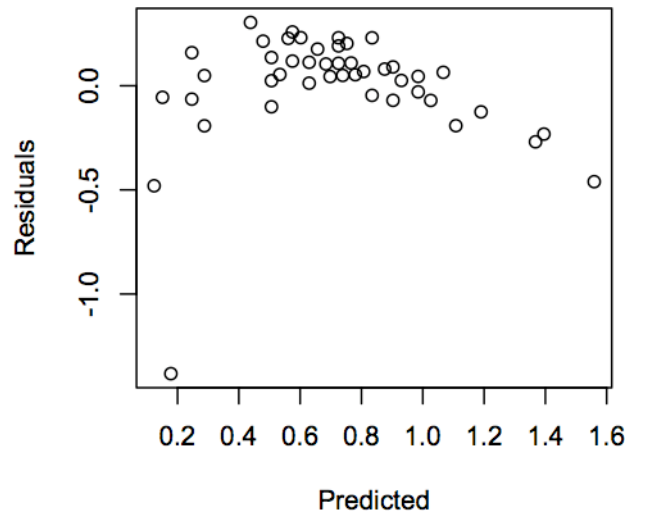
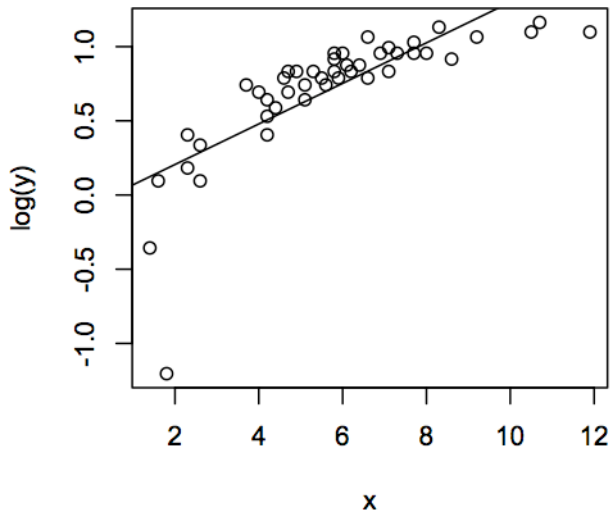




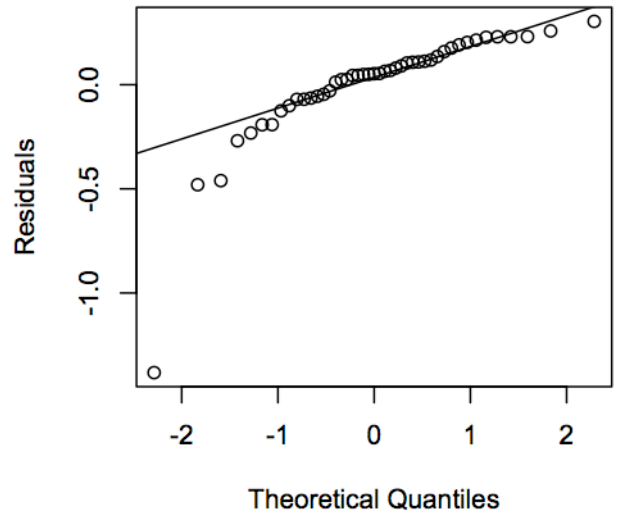
**Normal Q-Q Plot**

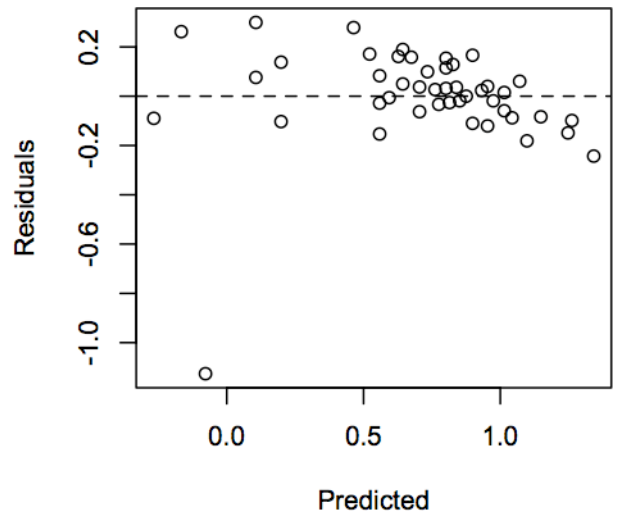
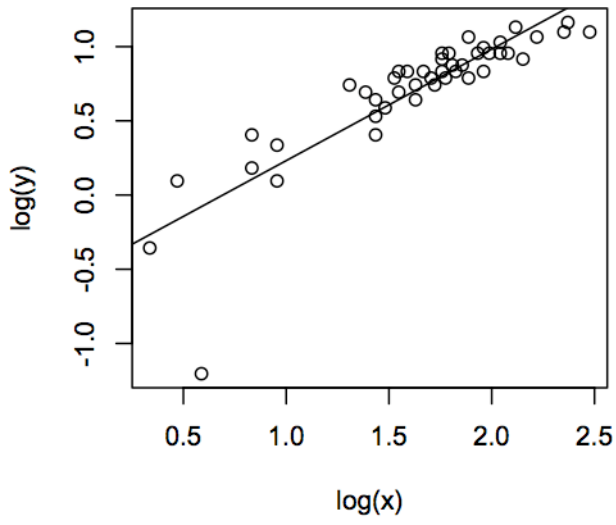






**Normal Q-Q Plot**





**Normal Q-Q Plot**

