

```
library(ISLR)
```

```
#9a
```

```
pairs(Auto)
```

```
#9b
```

```
> cor(subset(Auto, select=-name))
```

	mpg	cylinders	displacement	horsepower	weight	acceleration	year	origin
mpg	1.0000000	-0.7776175	-0.8051269	-0.7784268	-0.8322442	0.4233285	0.5805410	0.5652088
cylinders	-0.7776175	1.0000000	0.9508233	0.8429834	0.8975273	-0.5046834	-0.3456474	-0.5689316
displacement	-0.8051269	0.9508233	1.0000000	0.8972570	0.9329944	-0.5438005	-0.3698552	-0.6145351
horsepower	-0.7784268	0.8429834	0.8972570	1.0000000	0.8645377	-0.6891955	-0.4163615	-0.4551715
weight	-0.8322442	0.8975273	0.9329944	0.8645377	1.0000000	-0.4168392	-0.3091199	-0.5850054
acceleration	0.4233285	-0.5046834	-0.5438005	-0.6891955	-0.4168392	1.0000000	0.2903161	0.2127458
year	0.5805410	-0.3456474	-0.3698552	-0.4163615	-0.3091199	0.2903161	1.0000000	0.1815277
origin	0.5652088	-0.5689316	-0.6145351	-0.4551715	-0.5850054	0.2127458	0.1815277	1.0000000

```
#9c
```

```
> lm.fit1 = lm(mpg~.-name, data=Auto)
```

```
> summary(lm.fit1)
```

```
Call:
```

```
lm(formula = mpg ~ . - name, data = Auto)
```

```
Residuals:
```

Min	1Q	Median	3Q	Max
-9.5903	-2.1565	-0.1169	1.8690	13.0604

```
Coefficients:
```

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-17.218435	4.644294	-3.707	0.00024 ***
cylinders	-0.493376	0.323282	-1.526	0.12780

```

displacement 0.019896 0.007515 2.647 0.00844 **
horsepower   -0.016951 0.013787 -1.230 0.21963
weight       -0.006474 0.000652 -9.929 < 2e-16 ***
acceleration 0.080576 0.098845 0.815 0.41548
year         0.750773 0.050973 14.729 < 2e-16 ***
origin       1.426141 0.278136 5.127 4.67e-07 ***

```

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

Residual standard error: 3.328 on 384 degrees of freedom

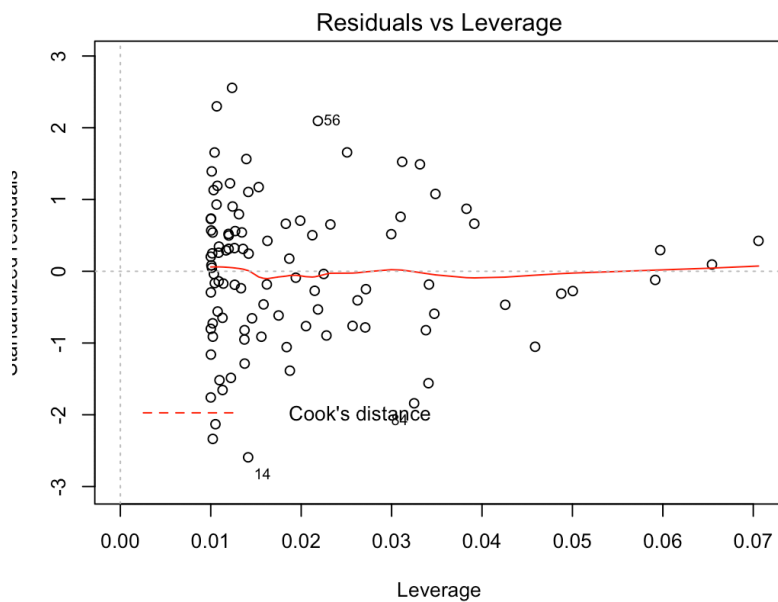
Multiple R-squared: 0.8215, Adjusted R-squared: 0.8182

F-statistic: 252.4 on 7 and 384 DF, p-value: < 2.2e-16

#9d

```
> par(mfrow=c(2,2))
```

```
> plot(lm.fit1)
```



#9e

```
lm.fit2 = lm(mpg~cylinders*displacement+displacement*weight)
```

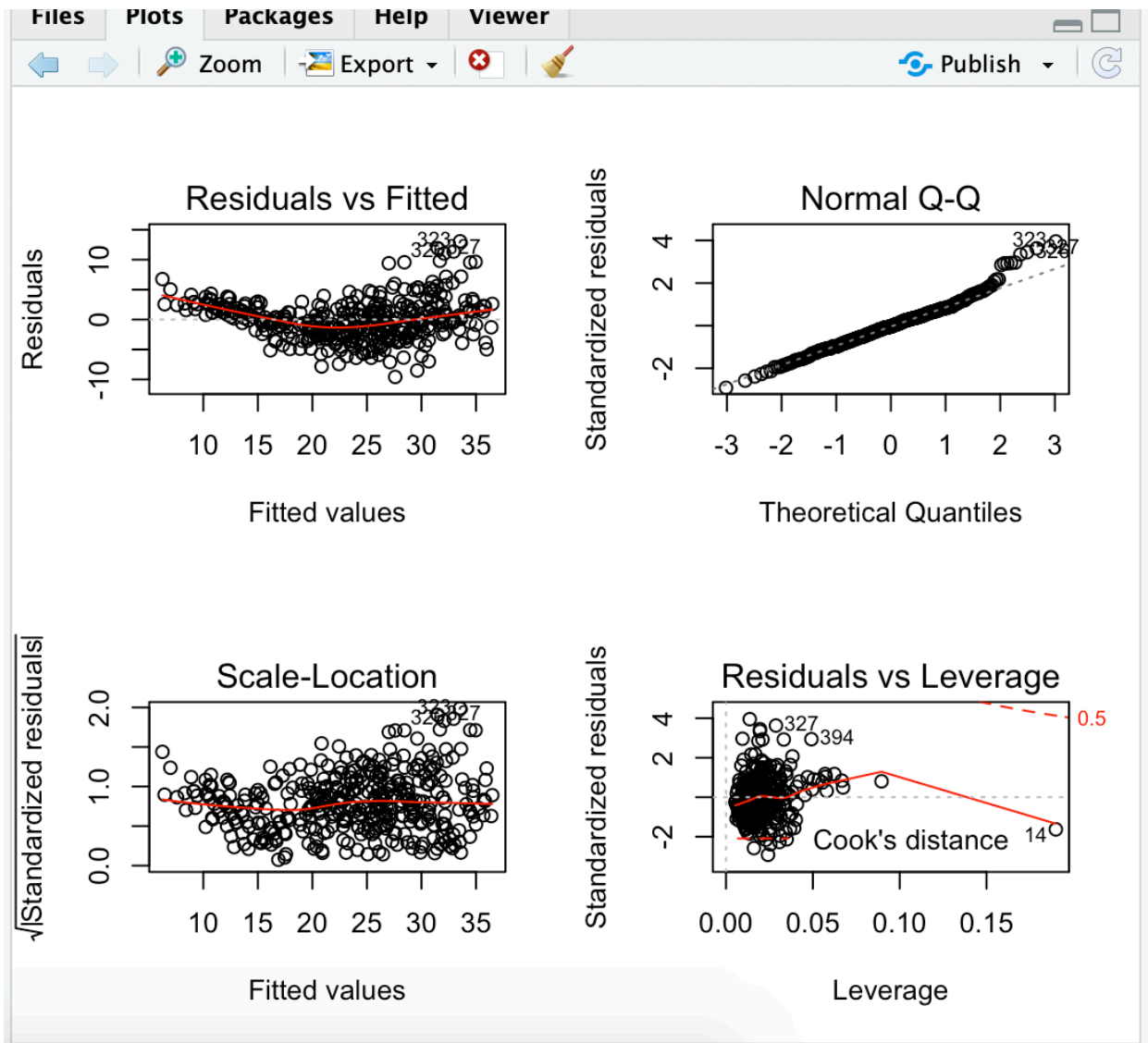
```
summary(lm.fit2)
```

#9f

```
lm.fit3 = lm(mpg~log(weight)+sqrt(horsepower)+acceleration+l(acceleration^2))
summary(lm.fit3)
par(mfrow=c(2,2))
plot(lm.fit3)
```

```
lm.fit2<-
lm(log(mpg)~cylinders+displacement+horsepower+weight+acceleration+year+origin,data=Auto
)
summary(lm.fit2)
```

```
par(mfrow=c(2,2))
plot(lm.fit2)
plot(predict(lm.fit2),rstudent(lm.fit2))
```



#13a

```
> set.seed(1)
```

```
> x = rnorm(100)
```

#13b

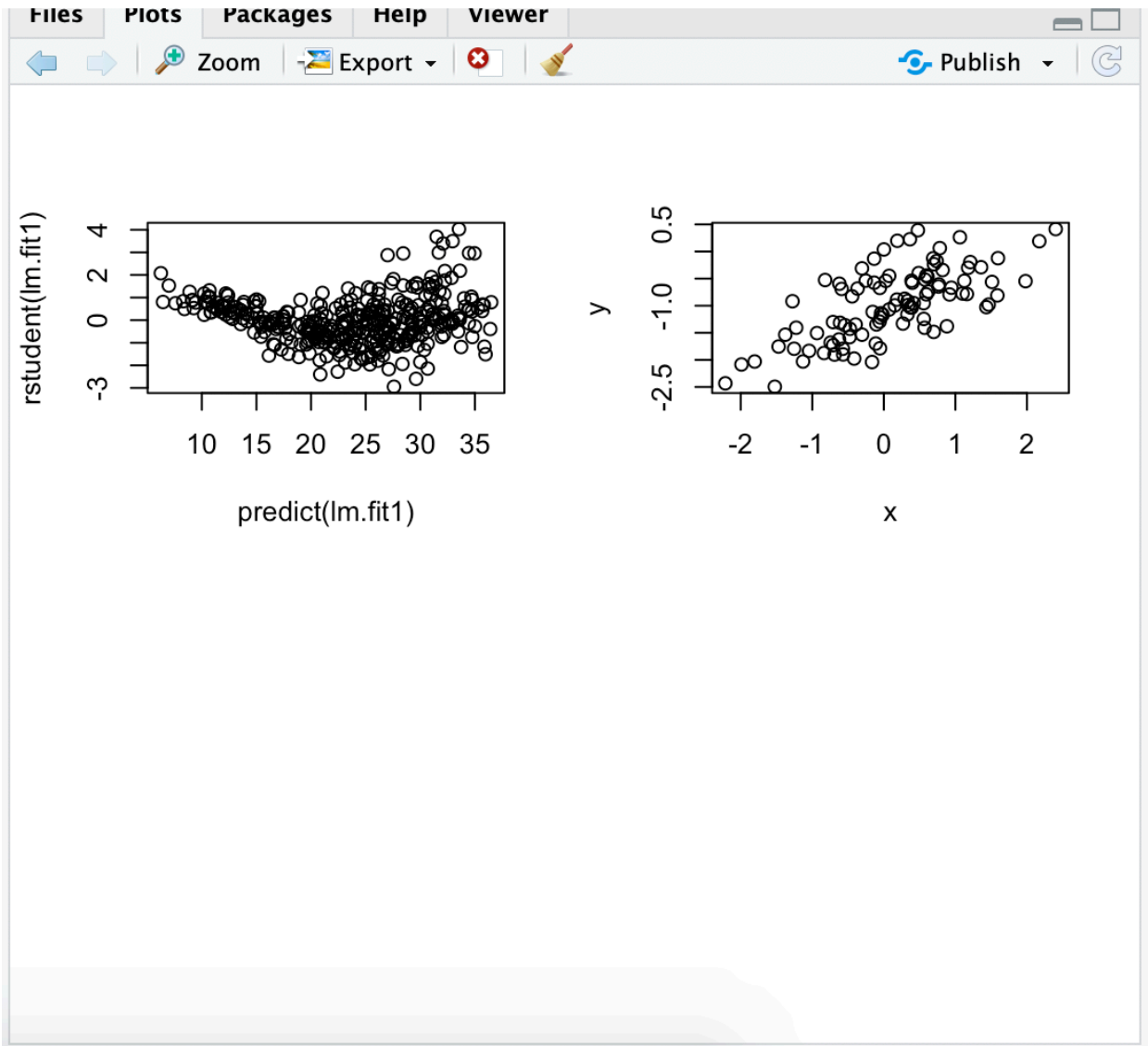
```
> eps = rnorm(100, 0, sqrt(0.25))
```

#13c

```
> y = -1 + 0.5*x + eps
```

#13d

```
> plot(x, y)
```



#13e

```
> lm.fit = lm(y~x)
> summary(lm.fit)
```

Call:

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

Residuals:

Min	1Q	Median	3Q	Max
-0.93842	-0.30688	-0.06975	0.26970	1.17309

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-1.01885	0.04849	-21.010	< 2e-16 ***
x	0.49947	0.05386	9.273	4.58e-15 ***

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

Residual standard error: 0.4814 on 98 degrees of freedom

Multiple R-squared: 0.4674, Adjusted R-squared: 0.4619

F-statistic: 85.99 on 1 and 98 DF, p-value: 4.583e-15

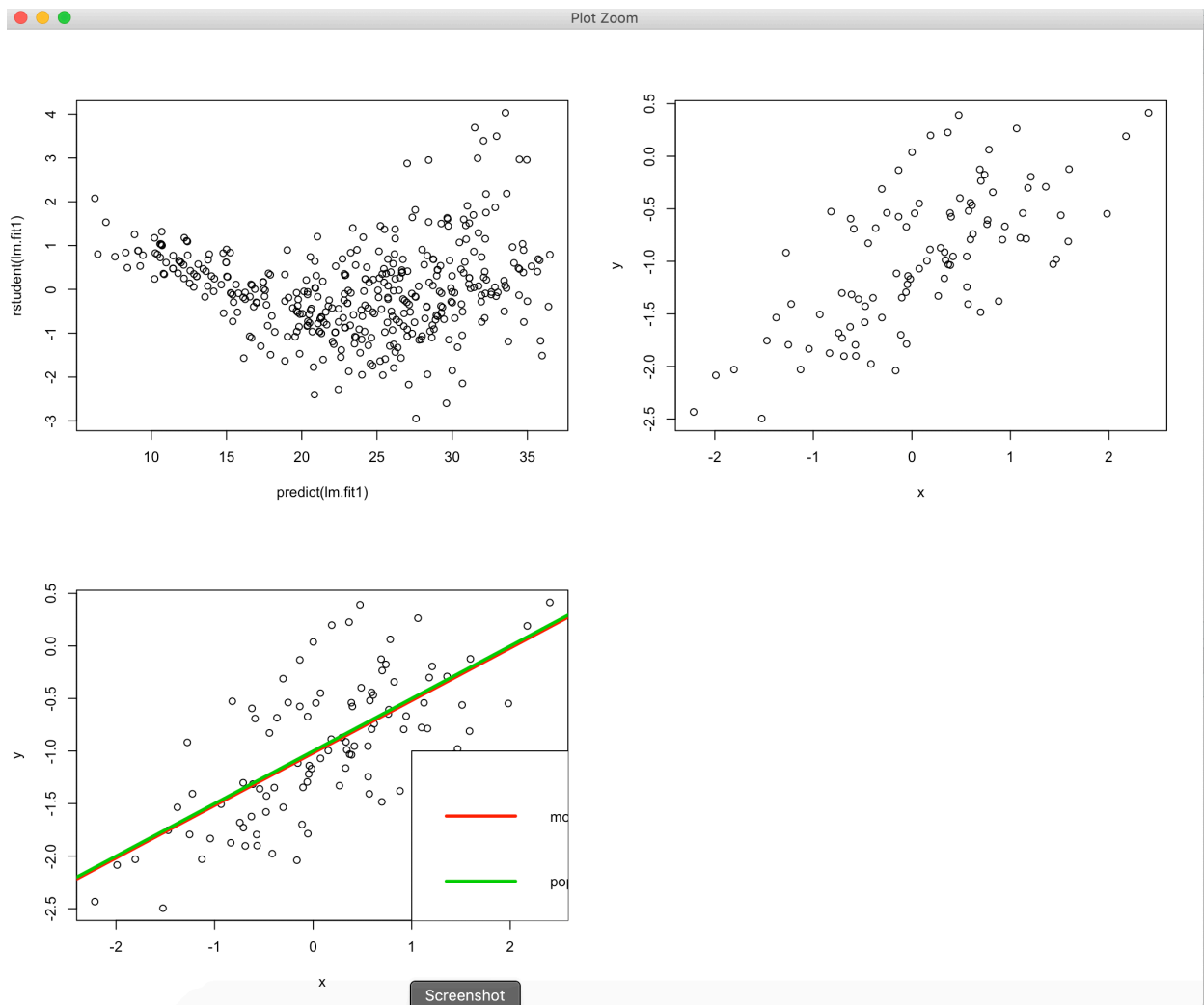
#13f

> plot(x, y)

> abline(lm.fit, lwd=3, col=2)

> abline(-1, 0.5, lwd=3, col=3)

> legend(-1, legend = c("model fit", "pop. regression"), col=2:3, lwd=3)



#13g

```
> lm.fit_sq = lm(y~x+l(x^2))
> summary(lm.fit_sq)
```

Call:

```
lm(formula = y ~ x + l(x^2))
```

Residuals:

Min	1Q	Median	3Q	Max
-0.98252	-0.31270	-0.06441	0.29014	1.13500

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.97164	0.05883	-16.517	< 2e-16 ***
x	0.50858	0.05399	9.420	2.4e-15 ***
l(x^2)	-0.05946	0.04238	-1.403	0.164

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

Residual standard error: 0.479 on 97 degrees of freedom

Multiple R-squared: 0.4779, Adjusted R-squared: 0.4672

F-statistic: 44.4 on 2 and 97 DF, p-value: 2.038e-14

#13h

```
> set.seed(1)
```

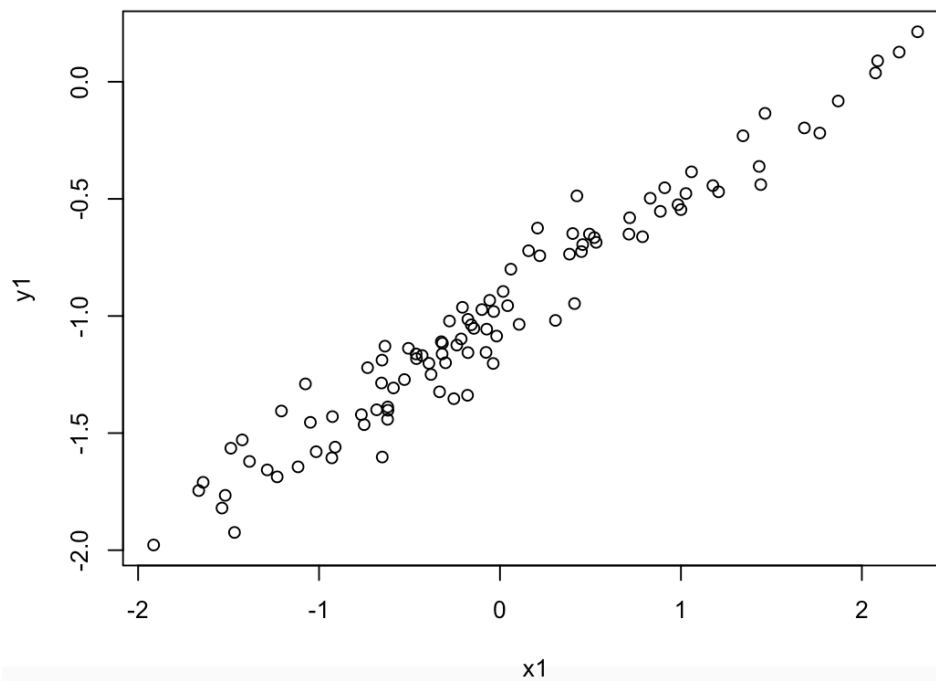
```
> eps1 = rnorm(100, 0, 0.125)
```

```
> x1 = rnorm(100)
```

```
> y1 = -1 + 0.5*x1 + eps1
```

```
> plot(x1, y1)
```

```
> lm.fit1 = lm(y1~x1)
```



```
> summary(lm.fit1)
```

Call:

```
lm(formula = y1 ~ x1)
```


Residuals:

Min	1Q	Median	3Q	Max
-0.29052	-0.07545	0.00067	0.07288	0.28664

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.98639	0.01129	-87.34	<2e-16 ***
x1	0.49988	0.01184	42.22	<2e-16 ***

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

Residual standard error: 0.1128 on 98 degrees of freedom

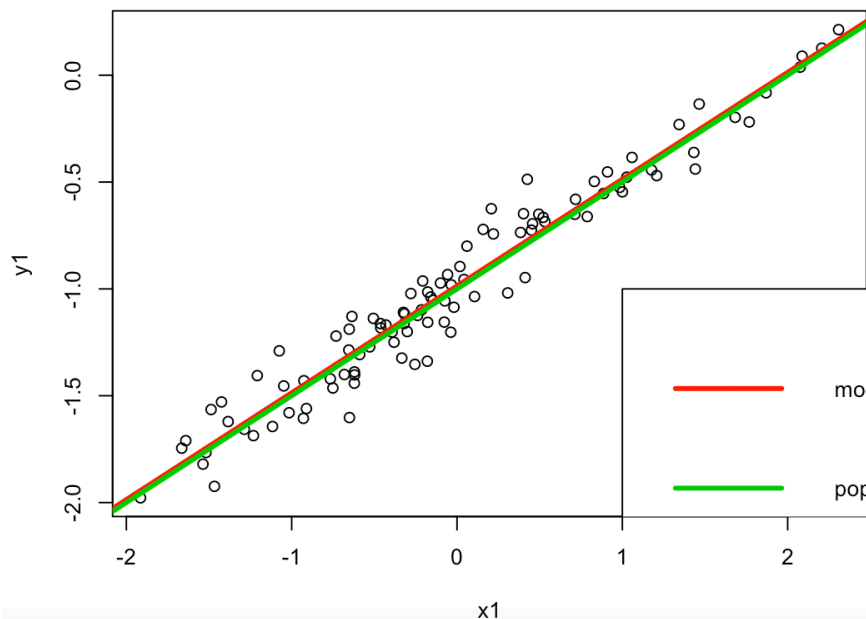
Multiple R-squared: 0.9479, Adjusted R-squared: 0.9474

F-statistic: 1782 on 1 and 98 DF, p-value: < 2.2e-16

```
> abline(lm.fit1, lwd=3, col=2)
```

```
> abline(-1, 0.5, lwd=3, col=3)
```

```
> legend(-1, legend = c("model fit", "pop. regression"), col=2:3, lwd=3)
```



#13i

```
> set.seed(1)
```

```
> eps2 = rnorm(100, 0, 0.5)
```

```
> x2 = rnorm(100)
```

```
> y2 = -1 + 0.5*x2 + eps2
```

```
> plot(x2, y2)
> lm.fit2 = lm(y2~x2)
> summary(lm.fit2)
```

Call:

```
lm(formula = y2 ~ x2)
```

Residuals:

Min	1Q	Median	3Q	Max
-1.16208	-0.30181	0.00268	0.29152	1.14658

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-0.94557	0.04517	-20.93	<2e-16 ***
x2	0.49953	0.04736	10.55	<2e-16 ***

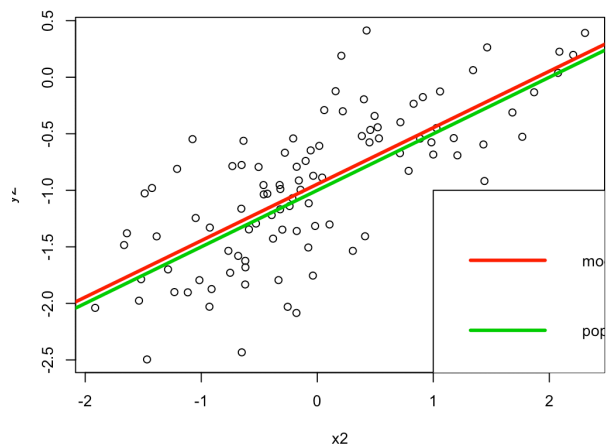
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4514 on 98 degrees of freedom

Multiple R-squared: 0.5317, Adjusted R-squared: 0.5269

F-statistic: 111.2 on 1 and 98 DF, p-value: < 2.2e-16

```
> abline(lm.fit2, lwd=3, col=2)
> abline(-1, 0.5, lwd=3, col=3)
> legend(-1, legend = c("model fit", "pop. regression"), col=2:3, lwd=3)
```



#13j

```
> confint(lm.fit)
      2.5 %   97.5 %
(Intercept) -1.1150804 -0.9226122
x           0.3925794  0.6063602
```

```
> confint(lm.fit1)
      2.5 %   97.5 %
(Intercept) -1.008805 -0.9639819
x1          0.476387 0.5233799
> confint(lm.fit2)
      2.5 %   97.5 %
(Intercept) -1.0352203 -0.8559276
x2          0.4055479 0.5935197
```