

Statistical Analysis, MSCA 31007, Lecture 3

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Simulation of 4 Linear Models

Understand common assumptions behind the linear model.

Set the values of slope (a) and intercept (b) parameters. Set the sample length to 1,000.

```
# Slope and Intercept
a <- 0.8; b <- 0.1
sample.n <- 1000

# Seeds
seed1 <- 111
seed2 <- 1112131415
```

Model 1.

Simulate and plot Model 1:

Input variable $X \sim \text{Norm}(\mu = 3, \sigma = 2.5)$; model residuals $Eps \sim \text{Norm}(\mu = 0, \sigma = 1.5)$

```
# Simulate the model using rnorm()
set.seed(seed1)
model1.x <- rnorm(sample.n, mean = 3, sd = 2.5)
set.seed(seed2)
model1.eps <- rnorm(sample.n, mean = 0, sd = 1.5)

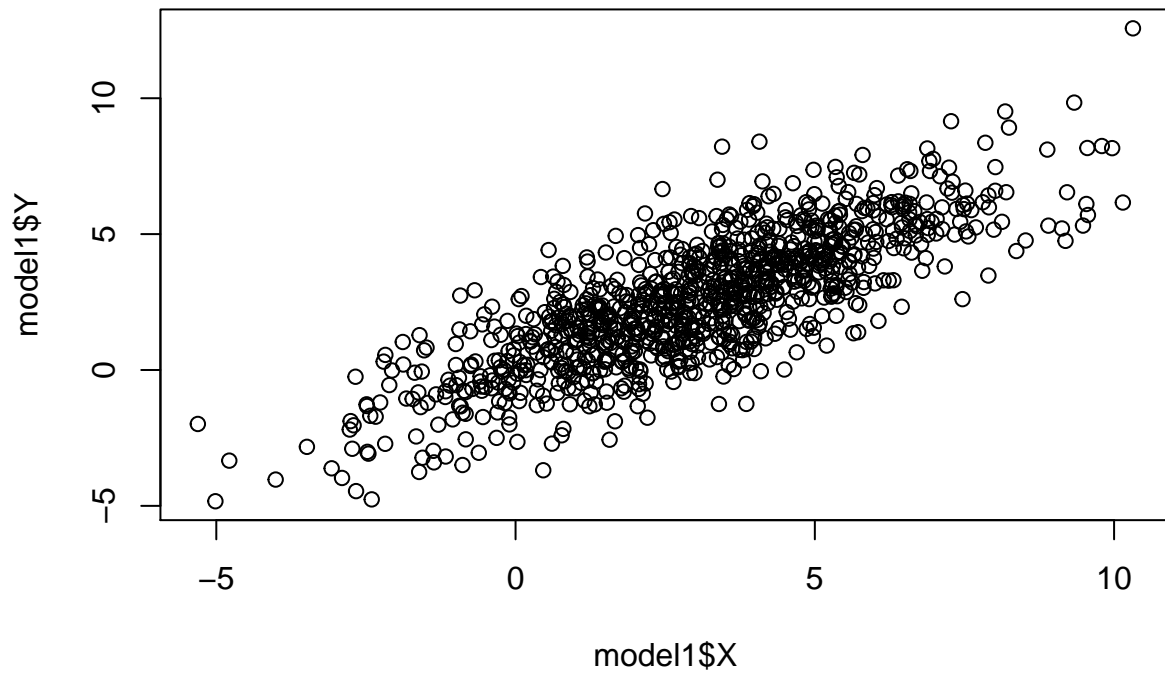
model1.y <- (a * model1.x + b) + model1.eps
model1 <- data.frame(Y=model1.y, X=model1.x, Eps=model1.eps)

# Inspect results
title <- "Model 1"
head(model1)
```

```
##           Y           X           Eps
## 1  1.3856455  3.588052 -1.5847959
## 2 -0.4957909  2.173160 -2.3343191
## 3  1.5640592  2.220940 -0.3126932
## 4 -1.8813610 -2.755864  0.2233303
## 5  5.4377138  2.572810  3.2794659
## 6  4.1192926  3.350696  1.3387362
```

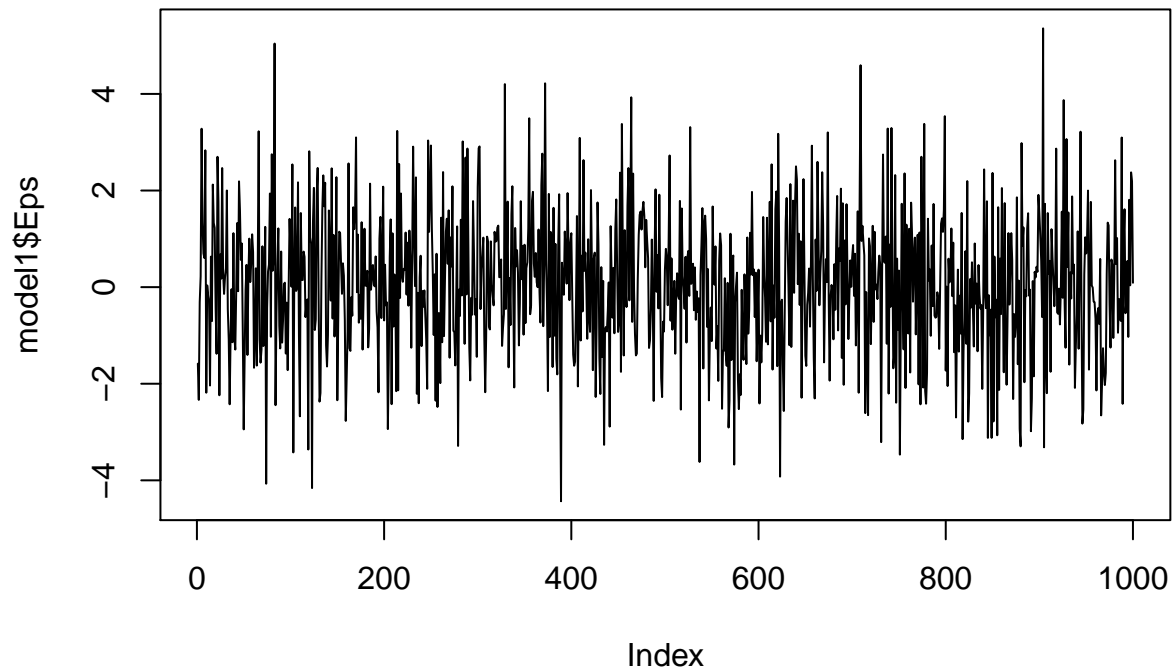
```
plot(model1$X, model1$Y, main = title)
```

Model 1



```
plot(model1$Eps, type = "l", main = paste(title, "Residuals"))
```

Model 1 Residuals



Model 2.

Simulate and plot Model 1:

Input variable $X \sim \text{Norm}(\mu = 3, \sigma = 2.5)$; model residuals $Eps \sim \text{Unif}(\min = -4.33, \max = 4.33)$

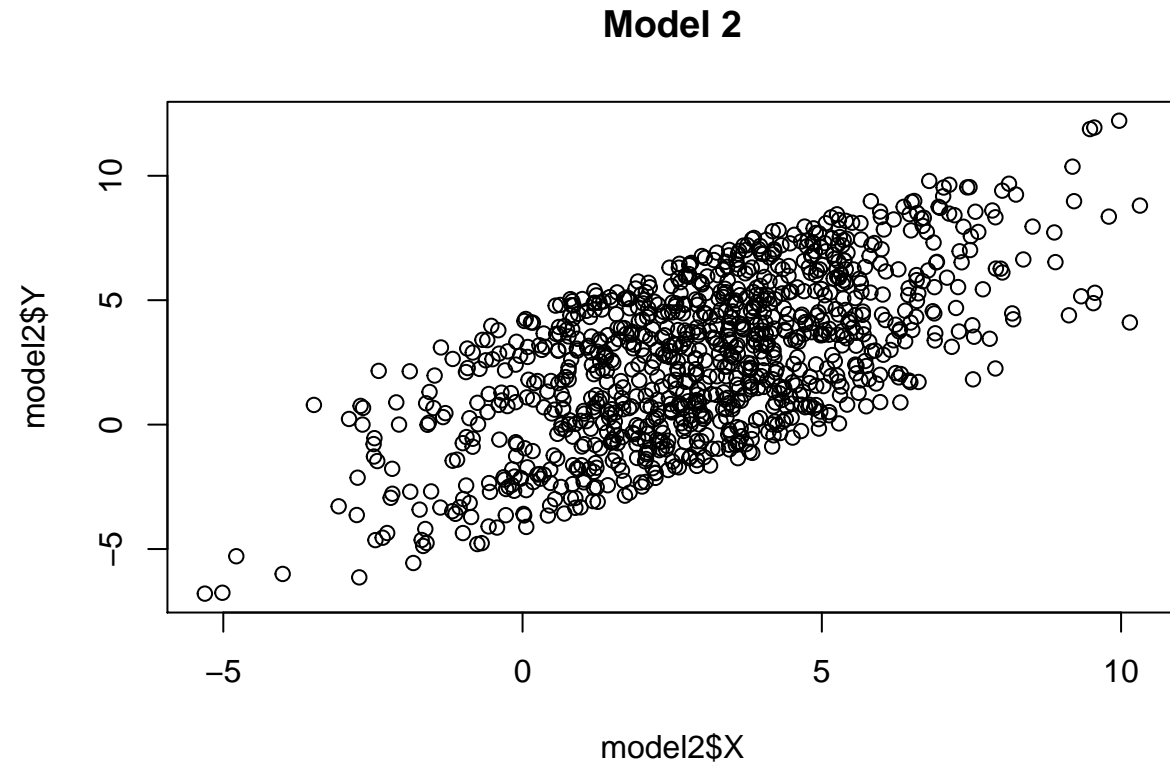
```
set.seed(seed2)
model2.eps <- runif(sample.n, min = -4.33, max = 4.33)

model2.y <- (a * model1.x + b) + model2.eps
model2 <- data.frame(Y=model2.y, X=model1.x, Eps=model2.eps)

# Inspect results
title <- "Model 2"
head(model2)
```

```
##           Y           X           Eps
## 1 -0.1007155  3.588052 -3.07115695
## 2 -1.7495480  2.173160 -3.58807627
## 3 -1.9351307  2.220940 -3.81188300
## 4 -2.1321719 -2.755864 -0.02748057
## 5  1.4432271  2.572810 -0.71502082
## 6  0.6424869  3.350696 -2.13806956
```

```
plot(model2$X, model2$Y, main = title)
```



```
plot(model2$Eps, type = "l", main = paste(title, "Residuals"))
```

Model 2 Residuals

