

# Final Project 2131

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```
library(nlme)
library(orcutt)

## Loading required package: lmtest
## Loading required package: zoo
##
## Attaching package: 'zoo'
## The following objects are masked from 'package:base':
##
##      as.Date, as.Date.numeric

library(DescTools)
set.seed(1122214)
xt <- rep(NA, 50)
xt[1] <- 0
for (t in 1:length(xt)) {
  if (t == 1) {
    xt[t] <- 0
    next
  }
  xt[t] <- xt[t - 1] + 0.2
}
eps <- rep(NA, 50)
rho = 0.5
beta0 = 2
beta1 = 0.5
c <- matrix(nrow = 500, ncol = 2)
b <- matrix(nrow = 500, ncol = 2)
a <- matrix(nrow = 500, ncol = 1)
z <- matrix(nrow = 500, ncol = 1)
resi <- matrix(nrow = 500, ncol = 50)
dw <- matrix(nrow = 500, ncol = 4)
rho.hat.mle <- matrix(nrow = 500, ncol = 1)
rho.hat.reml <- matrix(nrow = 500, ncol = 1)
rhoyw <- matrix(nrow = 500)
segmle <- matrix(nrow = 500)
betagmle <- matrix(nrow = 500)
sereml <- matrix(nrow = 500)
betareml <- matrix(nrow = 500)
secoch <- matrix(nrow = 500)
betacoch <- matrix(nrow = 500)
```

```

gmleci <- matrix(nrow = 500, ncol = 2)
remlci <- matrix(nrow = 500, ncol = 2)
cochci <- matrix(nrow = 500, ncol = 2)
counter = 0
counter2 = 0
countergmle = 0
counterreml = 0
countercoch = 0
for (i in 1:500) {
  for (t in 1:length(eps)) {
    if (t == 1) {
      eps[t] <- rnorm(1) * sqrt(1/(1 - rho^2))
      next
    }
    eps[t] <- rnorm(1) + rho * eps[t - 1]
  }
  y0 = beta0 + beta1 * xt + eps
  fit1 <- lm(y0 ~ xt)
  conf <- confint(fit1)
  c[i, 1:2] <- conf[2, 1:2]
  b[i, 1:2] <- fit1$coefficients
  resi[i, ] <- fit1$residuals
  # (c2/3)
  gmle <- gls(y0 ~ xt, correlation = corAR1(form = ~1), method = "ML")
  a[i] <- as.numeric(gmle$modelStruct)
  rho.hat.mle[i] = (exp(a[i]) - 1)/(exp(a[i]) + 1)
  reml <- gls(y0 ~ xt, correlation = corAR1(form = ~1), method = "REML")
  z[i] <- as.numeric(reml$modelStruct)
  rho.hat.reml[i] = (exp(z[i]) - 1)/(exp(z[i]) + 1)
  coch <- cochrane.orcutt(fit1)
  rho.yw[i] <- coch$rho
  dwtemp <- DurbinWatsonTest(fit1, alternative = c("two.sided"))
  dw[i, 1] <- dwtemp$statistic
  dw[i, 2] <- dwtemp$method
  dw[i, 3] <- dwtemp$alternative
  dw[i, 4] <- dwtemp$p.value
  # Part (d)
  segmle[i] <- sqrt(gmle$varBeta[2, 2])
  betagmle[i] <- gmle$coefficients[2]
  sereml[i] <- sqrt(reml$varBeta[2, 2])
  betareml[i] <- reml$coefficients[2]
  secoch[i] <- coch$std.error[2]
  betacoch[i] <- coch$coefficients[2]
  gmleci[i, 1] <- betagmle[i] - (1.96 * segmle[i])
  gmleci[i, 2] <- betagmle[i] + (1.96 * segmle[i])
  remlci[i, 1] <- betareml[i] - (1.96 * sereml[i])
  remlci[i, 2] <- betareml[i] + (1.96 * sereml[i])
  cochci[i, 1] <- betacoch[i] - (1.96 * secoch[i])
  cochci[i, 2] <- betacoch[i] + (1.96 * secoch[i])
}
for (i in 1:500) {
  if (c[i, 1] < 0.5 && c[i, 2] > 0.5) {
    counter = counter + 1
  }
}

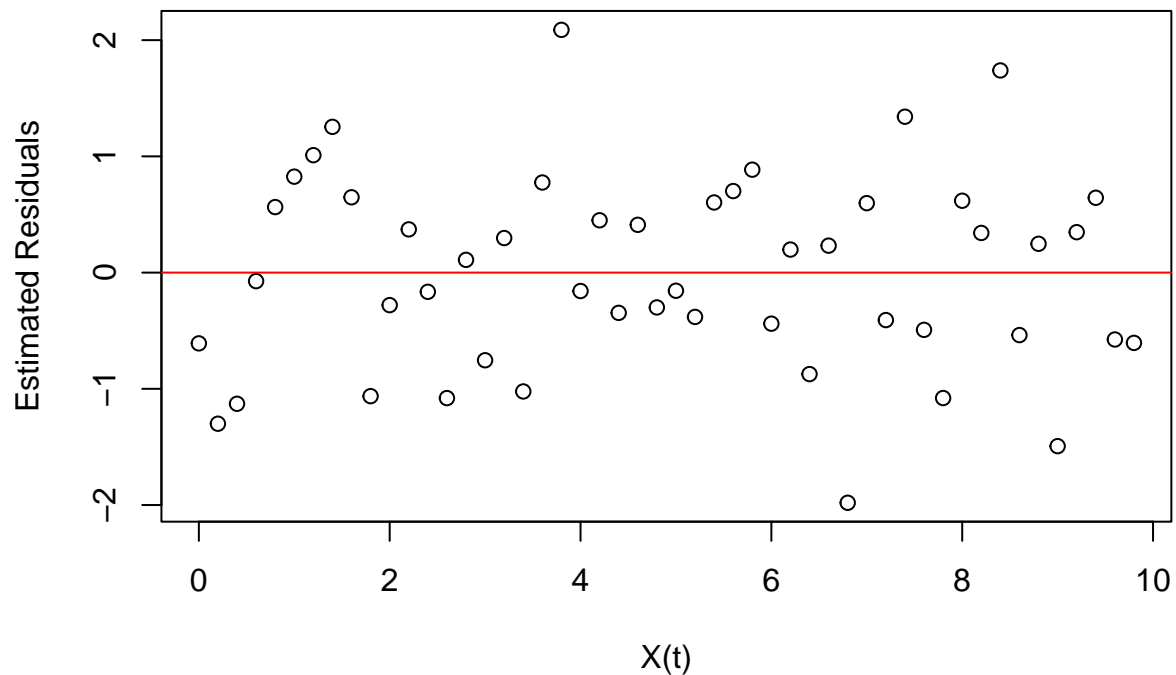
```

```

}
if (dw[i, 1] < 1.5) {
  counter2 = counter2 + 1
}
if (gmleci[i, 1] < 0.5 && gmleci[i, 2] > 0.5) {
  countergmle = countergmle + 1
}
if (remlci[i, 1] < 0.5 && remlci[i, 2] > 0.5) {
  counterreml = counterreml + 1
}
if (cochci[i, 1] < 0.5 && cochci[i, 2] > 0.5) {
  countercoch = countercoch + 1
}
}
plot(xt, resi[24, ], main = "Simulation 24, Correlation Check", xlab = "X(t)", ylab = "Estimated Residuals",
abline(h = 0, col = "red")

```

### Simulation 24, Correlation Check

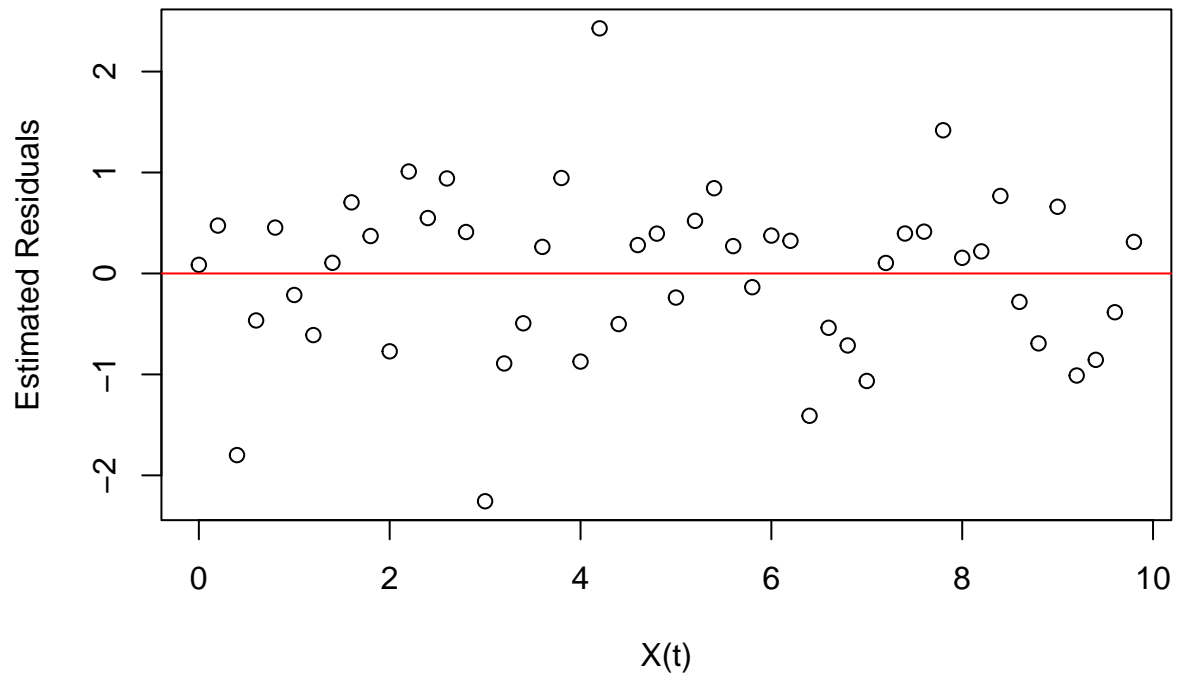


```

plot(xt, resi[154, ], main = "Simulation 154, Correlation Check", xlab = "X(t)",
      ylab = "Estimated Residuals")
abline(h = 0, col = "red")

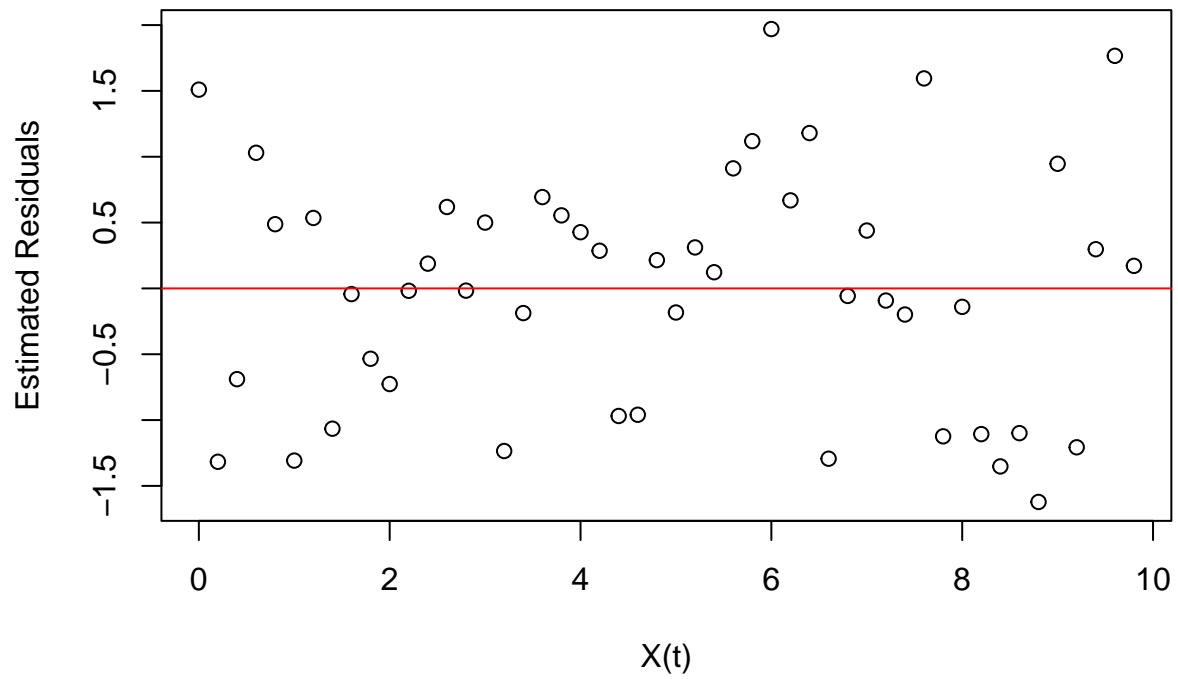
```

### Simulation 154, Correlation Check



```
plot(xt, resi[338, ], main = "Simulation 338, Correlation Check", xlab = "X(t)",  
     ylab = "Estimated Residuals")  
abline(h = 0, col = "red")
```

### Simulation 338, Correlation Check



```
betahat0 <- mean(b[1:500, 1])
betahat1 <- mean(b[1:500, 2])
rhothmle <- mean(rho.hat.mle[1:500])
rhothreml <- mean(rho.hat.reml[1:500])
rhothyw <- mean(rho.yw[1:500])
print(counter)
```

```
## [1] 363
```

```
print(counter2)
```

```
## [1] 449
```

```
print(countergmle)
```

```
## [1] 448
```

```
print(rhothmle)
```

```
## [1] 0.4197968
```

```
print(counterreml)
```

```
## [1] 459
```

```
print(rhothreml)
```

```
## [1] 0.4825033
```

```
print(countercoch)
```

```
## [1] 443
```

```
print(rhothyw)
```

```
## [1] 0.418544
```