Econometrics-Damodar N. Gujarati / Chapter 13

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22 08 2021

Econometric Modeling: Model Specification and Diagnostic Testing

Types of Specification Errors

$$Y_i = \beta_1 + \beta_2 X_i + \beta_3 X_i^2 + \beta_4 X_i^3 + u_{1i} \tag{13.2.1}$$

$$Y_i = \alpha_1 + \alpha_2 X_i + \alpha_3 X_i^2 + u_{2i} \tag{13.2.2}$$

$$u_{2i} = u_{1i} + \beta_4 X_i^3 \tag{13.2.3}$$

	$\text{Cov}(x_1,\, x_2) > 0$	$\text{Cov}(x_1,\, x_2) < 0$
$\beta_2 > 0$	Upward	Downward
$\beta_2 < 0$	Downward	Upward

This code Belongs to Edward Rubin: https://github.com/edrubin/EC421S20

```
library(tidyverse)
# Set seed
set.seed(12345)
# Sample size
n <- 1e3
# Parameters
beta0 <- 20; beta1 <- 0.5; beta2 <- 10
# Dataset
omit_df <- tibble(
  male = sample(x = c(F, T), size = n, replace = T),
  school = runif(n, 3, 9) - 3 * male,
  pay = beta0 + beta1 * school + beta2 * male + rnorm(n, sd = 7)
)
lm_bias <- lm(pay ~ school, data = omit_df)
bb0 <- lm_bias$coefficients[1] %>% round(1)
bb1 <- lm_bias$coefficients[2] %>% round(1)
lm_unbias <- lm(pay ~ school + male, data = omit_df)
bu0 <- lm_unbias$coefficients[1] %>% round(1)
bu1 <- lm_unbias$coefficients[2] %>% round(1)
bu2 <- lm_unbias$coefficients[3] %>% round(1)
```

```
ggplot(data = omit_df, aes(x = school, y = pay)) +
geom_point(size = 2.5, color = "black", alpha = 0.4, shape = 16) +
geom_hline(yintercept = 0) +
geom_vline(xintercept = 0) +
xlab("Schooling") +
ylab("Pay") +
theme(
  axis.title = element_text(size = 18),
  plot.margin = structure(c(0, 0, 0.1, 0), unit = "lines", valid.unit = 3L, class = "unit"),
)
```

```
ggplot(data = omit_df, aes(x = school, y = pay)) +
geom_point(size = 2.5, alpha = 0.8, aes(color = male, shape = male)) +
geom_hline(yintercept = 0) +
geom_vline(xintercept = 0) +
geom_line(stat = "smooth", color = "orange", method = lm, alpha = 0.5, size = 1) +
xlab("Schooling") +
ylab("Pay") +
theme(
  axis.title = element_text(size = 18),
  plot.margin = structure(c(0, 0, 0.1, 0), unit = "lines", valid.unit = 3L, class = "unit"),
) +
scale_color_manual("", values = c("red", "darkslategrey"), labels = c("Female", "Male")) +
scale_shape_manual("", values = c(16, 1), labels = c("Female", "Male"))
```

EXAMPLE 13.1

```
library(gujarati)

options(scipen = 999)

fix(Table6_4)

MODEL1 = lm(Table6_4$CM ~ Table6_4$FLR + Table6_4$PGNP) #Unbiased

summary(MODEL1)


MODEL1_1 = lm(Table6_4$CM ~ Table6_4$PGNP) # Biased

summary(MODEL1_1)




bb0 <- MODEL1_1$coefficients[1] %>% round(1)
bb1 <- MODEL1_1$coefficients[3] %>% round(1)

bu0 <- MODEL1$coefficients[1] %>% round(1)
bu1 <- MODEL1$coefficients[2] %>% round(1)
bu2 <- MODEL1$coefficients[3] %>% round(1)
```

```
ggplot(data = Table6_4, aes(x = Table6_4$PGNP, y = Table6_4$CM)) +
geom_point(size = 2.5, color = "red", alpha = 0.9, shape = 16) +
geom_hline(yintercept = 0) +
geom_vline(xintercept = 0) +
xlab("Income") +
ylab("Child Mortality") +
theme(
  axis.title = element_text(size = 18),
  plot.margin = structure(c(0, 0, 0.1, 0), unit = "lines", valid.unit = 3L, class = "unit"),
)
```

```
ggplot(data = Table6_4, aes(x = log(Table6_4$PGNP), y = Table6_4$CM)) +
geom_point(size = 2.5, alpha = 0.8, aes(color = Table6_4$FLR, Table6_4$FLR)) +
geom_hline(yintercept = 0) +
geom_vline(xintercept = 0)  +
xlab("Income") +
ylab("Child Mortality") +
theme(
  axis.title = element_text(size = 18),
  plot.margin = structure(c(0, 0, 0.1, 0), unit = "lines", valid.unit = 3L, class = "unit"),
)
```

$$\mathrm{Var}(\hat{\alpha}_2) = \frac{\sigma^2}{\sum x_{2i}^2} \qquad (13.3.3 \text{ and } 13.3.4)$$

$$\mathrm{Var}(\hat{\beta}_2) = \frac{\sigma^2}{\sum x_{2i}^2}\mathrm{VIF}$$

```
MODEL1 = lm(Table6_4$CM ~ Table6_4$FLR + Table6_4$PGNP) #Unbiased

summary(MODEL1)

library(car)

vif(MODEL1)
```

Tests of Specification Errors

Residuals and Durbin Watson

```
fix(Table7_4)

x1 = Table7_4$X
x2 = (Table7_4$X)^2
x3 = (Table7_4$X)^3


MODEL2 = lm(Table7_4$Y ~ x1 + x2 +x3)

MODEL2_1 = lm(Table7_4$Y ~ x1 + x2)

MODEL2_2 = lm(Table7_4$Y ~ x1)


RES1 = resid(MODEL2)
RES1_1 = resid(MODEL2_1)
RES1_2 = resid(MODEL2_2)

par(mfrow=c(2,2))
plot(RES1,type = "l")
plot(RES1_1,type = "l")
plot(RES1_2,type = "l")

library(lmtest)

dwtest(MODEL2)

dwtest(MODEL2_1)

dwtest(MODEL2_2)
```

Ramsey's RESET Test

```
library(fRegression)
lmTest(MODEL2,method = "reset")

resettest(MODEL2,order = 2:3,type = "fitted")
```

Errors of Measurement

$$Y_i = \alpha + \beta X_i^* + u_i \implies \text{Correct Model}$$

$$X_i = X_i^* + w_i \quad \text{where wi represents errors of measurement in}$$

$$\text{cov}(z_i, X_i) = -\beta\sigma_w^2$$

(z_i) is a compound of equation and measurement errors.

$$\text{plim}\hat{\beta} = \beta \left[\frac{1}{1 + \dfrac{\sigma_w^2}{\sigma_X^2}} \right]$$

```
fix(Table13_2)

MODEL3 = lm(Table13_2$Y. ~Table13_2$X.)
summary(MODEL3)

MODEL3_1 = lm(Table13_2$Y ~Table13_2$X)
summary(MODEL3_1)
```

Davidson–MacKinnon J Test

$$

	Hypothesis : $\alpha_4 = 0$	
Hypothesis : $\beta_4 = 0$	**Do not Reject**	**Reject**
Do not Reject	Accept Both C and D	Accept D, Reject C
Reject	Accept C, Reject D	Reject Both C and D

$$

```
fix(Table13_3)

library(dynlm)

NEW1 = ts()

MODEL4 = dynlm(ts(Table13_3$PPCE) ~ ts(Table13_3$PDPI) + L(ts(Table13_3$PDPI))
               ,data = Table13_3)

summary(MODEL4)

MODEL5 = dynlm(ts(Table13_3$PPCE) ~ ts(Table13_3$PDPI) + L(ts(Table13_3$PPCE))
               ,data = Table13_3)

summary(MODEL5)

library(stargazer)

stargazer(list(MODEL4,MODEL5),type = "text")

Fit1 = fitted(MODEL4)

Fit2 = fitted(MODEL5)


MODEL4_1 = dynlm(ts(Table13_3$PPCE) ~ ts(Table13_3$PDPI) + L(ts(Table13_3$PDPI))+
                   Fit2)

summary(MODEL4_1)

model5_1 = dynlm(ts(Table13_3$PPCE) ~ ts(Table13_3$PDPI) + L(ts(Table13_3$PPCE))+
                   Fit1)
summary(model5_1)
```

```
fix(Table10_7)

MODEL6 = lm(log(Table10_7$C) ~ log(Table10_7$Yd) + log(Table10_7$W) + Table10_7$I)

summary(MODEL6)

dwtest(MODEL6)

MODEL7 = lm(log(Table10_7$C) ~ log(Table10_7$Yd) + log(Table10_7$W) + Table10_7$I +
            log(Table10_7$Yd)*log(Table10_7$W))

summary(MODEL7)

dwtest(MODEL7)

bgtest(MODEL7)

library(sandwich)

NW <- NeweyWest(MODEL7,
 lag = 4)
coeftest(MODEL7, vcov = NW)

library(strucchange)

sctest(MODEL6, data = Table10_7,
  type = "Chow", point = 44)
```