EDS 241 Assignment 4

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Introduction

We plan to estimate the price elasticity of demand for fresh sardines across 56 points in 4 European countries. We will be using monthly data from 2013 - 2019.

Data description

Variables include:

- `country`
- `port`: where the fish is landed and sold
- `year`
- `month`
- `price_euro_kg`: price per kg in Euros
- `volume_sold_kg`: quantity of sardines sold in kg
- `wind_m_s`

Set up

Read in and clean the data

```
data <- read_csv(here("data", "EU_sardines.csv"))

data_clean <- data %>%
  clean_names() %>%
  mutate(year = as.factor(year),
         month = as.factor(month),
         price_euro_kg = as.numeric(price_euro_kg),
         volume_sold_kg = as.numeric(volume_sold_kg),
         wind_m_s = as.numeric(wind_m_s)
  )
```

(a) Estimate a bivariate regression of log(volume_sold_kg) on log(price euro_kg). What is the price elasticity of demand for sardines? Test the null hypothesis that the price elasticity is equal to -1.

```
data_log <- data_clean %>%
  mutate(volume_log = log(volume_sold_kg),
         price_log = log(price_euro_kg))

mdl <- lm_robust(price_log ~ volume_log, data = data_log)
price_elasticity <- round(mdl$coefficients[[2]], digits = 3)

#linearHypothesis(mdl, c("volume_log=-1"), white.adjust = "hc2")
```

The price elasticity of demand, or the slope of the demand curve, for sardines is approximately -0.068.

Table 1 shows the results of a bivariate regression of log-transformed volume sold and log-transformed price per kg of fresh sardines across 56 ports in 4 European contries from 2013 - 2019.

Table 1: Sardine volume significantly impacts price in Europe

	Dependent variable:
	Log(Price)
Log(Volume)	-0.068^{***}
	(0.003)
Observations	3,988
R^2	0.104
Note:	*p<0.1; **p<0.05; ***p<0.01

(b) Like in Lecture 8 (see the IV.R script), we will use wind_m_s as an instrument for log(price_euro_kg). To begin, estimate the first-stage regression relating log(price_euro_kg) to wind_m_s. Interpret the estimated coefficient on wind speed. Does it have the expected sign?

First-stage regression

```
fs1 <- lm(formula = price_log ~ wind_m_s, data=data_log)
#summary(fs1)
wind_coef <- round(fs1$coefficients[[2]], digits = 3)
```

The coefficient on wind speed is approximately 0.067. In other words, on average, when wind speed increases by 1 m/sec, the log price of of sardines per kg increases by 0.067 Euros.

Table 2 shows the results of a first-stage regression of wind speed (m/s) and log-transformed price per kg of fresh sardines across 56 ports in 4 European contries from 2013 - 2019.

Table 2: Wind speed significantly impacts sardine price in Europe

	Dependent variable:
	Log(Price)
Wind Speed (m/s)	0.067***
	(0.006)
Observations	3,988
R^2	0.038
Note:	*p<0.1; **p<0.05; ***p<0.01

(b) Also test for the relevance of the instrument and whether it is a "weak" instrument by reporting the proper F-statistic.

F-test for non-weak and relevant instruments

```
f <- linearHypothesis(fs1, c("wind_m_s=0"), white.adjust = "hc2")
f_coef <- round(f$F[2], digits = 2)
```

Wind speed is not a weak instrument because the F-test value of 144.65 is well above our threshold of 10.

(c) Estimate the TSLS estimator of the price elasticity of demand for sardines using wind_m_s as an instrument for log(price_euro_kg). What is the estimated price elasticity of demand for sardines?

Two-stage least square regresion

```
tsls1 <- ivreg(volume_log ~ price_log | wind_m_s, data = data_log)
price_elasticity2 <- round(tsls1$coefficients[[2]], digits = 2)
#summary(tsls1)
```

The estimated price elasticity of demand for sardines is approximately -1.09.

Calculate robust standard errors

- use `starprep()`to calculate OLS standard errors
- use `coeftest()` to calculate TSLS standard erros
- display standard errors using `stargazer()`

```r
se_ols_fs1 <- starprep(mdl2,fs1, stat = c("std.error"), se_type = "HC2", alpha = 0.05)

se_tsls1 <- coeftest(tsls1, vcov = vcovHC(tsls1, type = "HC2"))[, "Std. Error"]

se_models <- append(se_ols_fs1,list(se_tsls1))
```

Table 3 shows the two-stage least square regression of the price elasticity of demand for sardines using wind speed (m/s) as an instrument for the log of sardine price per kg.

Table 3: Title

	Dependent variable:		
	price_log		volume_log
	OLS		*instrumental variable*
	(1)	(2)	(3)
volume_log	-0.068^{***}		
	(0.003)		
wind_m_s		0.067^{***}	
		(0.006)	
price_log			-1.088^{***}
			(0.372)
Observations	3,988	3,988	3,988
R^2	0.104	0.038	0.095
Note:			*p<0.1; **p<0.05; ***p<0.01

(d) Repeat the exercise in (c), but include fixed effects for each year, month, and country. [Hint: you can use the command "as.factor(country) + as.factor(year) +as.factor(month)" to the ivreg function in R]. Report the estimated price elasticity of demand and the F-statistic testing for relevant and non-weak instruments.

```r
tsls2 <- ivreg(volume_log ~ price_log + as.factor(country) + as.factor(year) + as.factor(month) | wind_m
price_elasticity2 <- round(tsls1$coefficients[[2]], digits = 2)

summary(tsls2)
```

```
##
## Call:
## ivreg(formula = volume_log ~ price_log + as.factor(country) +
##     as.factor(year) + as.factor(month) | wind_m_s, data = data_log)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
```

```
## -8.8626 -1.9790 -0.2333  2.0950  6.2354
##
## Coefficients:
##             Estimate Std. Error t value            Pr(>|t|)
## (Intercept)  7.75534    0.04331  179.08 <0.0000000000000002 ***
## price_log   -1.08802    0.37003   -2.94              0.0033 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.728 on 3986 degrees of freedom
## Multiple R-Squared: 0.09529, Adjusted R-squared: 0.09506
## Wald test: 8.646 on 1 and 3986 DF,  p-value: 0.003297
```