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

hypothesis <- linearHypothesis(mdl, c("price_log=-1"), white.adjust = "hc2")
hypothesis_p <- hypothesis$`Pr(>Chisq)`[2]
```

The price elasticity of demand, or the slope of the demand curve, for sardines is approximately -1.545. We also reject the null hypothesis that the price elasticity is equal to -1 (p-value 0.05).

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)	-1.545^{***}
	(0.078)
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. This coefficient has the expected sign because wind makes it more difficult to catch fish, decreases the supply of fish, and thus drives up the price of fish sold.

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)
```

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()`

```
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: Fish price and volume with wind speed instrument

	Dependent variable:		
	Log(Volume)	Log(Price)	Log(Volume)
	OLS	*OLS*	*instrumental variable*
	(1)	(2)	(3)
Log(Price)	-1.545^{***}		-1.088^{***}
	(0.078)		(0.372)
Wind Speed (m/s)		0.067^{***}	
		(0.006)	
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.

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

The estimated price elasticity of demand is approximately -1.09.

```
fs2 <- lm(formula = price_log ~ wind_m_s + as.factor(country) + as.factor(year) + as.factor(month), dat
hypothesis2 <- linearHypothesis(fs2, c("wind_m_s=0"), white.adjust = "hc2")
f2 <- round(hypothesis2$F[2], digits = 2)
```

The F-statistic for the wind speed instrument is approximately 77.66, which is still above the threshold of 10. So even when controlling for country, year, and month, wind speed is still a strong and relevant instrument.