

EDS241: Assignment 4

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1 Read in Sardines Data

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

2 Homework Questions

- 2.1 a.) Estimate a bivariate regression of $\log(\text{volume_sold_kg})$ on $\log(\text{price_euro_kg})$. What is the price elasticity of demand for sardines? Test the null hypothesis that the price elasticity is equal to -1.

```
#transform variables to generate log values
sardines <- sardines %>%
  mutate(log_vol_sold_kg = log(volume_sold_kg),
         log_price_euro_kg = log(price_euro_kg))

vol_on_price <- lm_robust(log_vol_sold_kg ~ log_price_euro_kg, data = sardines)

vol_on_price_table <- tidy(vol_on_price)

vol_on_price_table %>%
  select(term, estimate, std.error, p.value, conf.low, conf.high) %>%
  kable()
```

term	estimate	std.error	p.value	conf.low	conf.high
(Intercept)	7.759061	0.0430246	0	7.674709	7.843413
log_price_euro_kg	-1.545335	0.0781254	0	-1.698505	-1.392166

Based on the confidence interval for the linear regression, we can say with 95% confidence that the coefficient on volume sold in kilograms price elasticity, β_1 (?) is contained by the range -1.69 and -1.39. This means we can reject the null hypothesis that price elasticity is equal to -1.

- 2.2 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? Also test for the relevance of the instrument and whether it is a “weak” instrument by reporting the proper F-statistic.

```
#first stage regression
wind_price_mod <- lm_robust(log_price_euro_kg ~ wind_m_s, data = sardines)

wind_price_table <- tidy(wind_price_mod)

wind_price_table %>%
  select(term, estimate, std.error, p.value, conf.low, conf.high) %>%
  kable()
```

term	estimate	std.error	p.value	conf.low	conf.high
(Intercept)	-0.3048875	0.0273093	0	-0.3584290	-0.2513461
wind_m_s	0.0673459	0.0055995	0	0.0563677	0.0783240

The estimated coefficient on wind speed is 0.07, which tells us that for each 1 m/s increase in wind speed, the price of sardines in euros per kilogram increases by .7 euros.

I think that this does have the expected sign (positive) because I would expect demand for sardines to increase as wind speed increases which would negatively impacting supply. Wind speed does not impact demand for sardines, but the supply (ie demand is the same, but there are fewer sardines, and the price is driven up).

```
# F-test for non-weak and relevant instruments (Lecture 9, slides 13-14)
wind_hypothesis <- linearHypothesis(wind_price_mod,
  c("wind_m_s = 0"),
  white.adjust = "hc2")

wind_hypothesis_table <- tidy(wind_hypothesis)

wind_hypothesis_table %>%
  kable()
```

res.df	df	statistic	p.value
3987	NA	NA	NA
3986	1	144.6526	0

The F statistic is 144.65 in the case of this first stage regression. This means that the instrument is not weak because it is greater than 10.

- 2.3 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?

```
tsls1 <- ivreg(log_vol_sold_kg ~ log_price_euro_kg | wind_m_s, data = sardines)
summary(tsls1)
```

```
##
## Call:
## ivreg(formula = log_vol_sold_kg ~ log_price_euro_kg | wind_m_s,
##       data = sardines)
##
## 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 ***
## log_price_euro_kg -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
```

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

2.4 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(log_vol_sold_kg ~ log_price_euro_kg + as.factor(country) + as.factor(year) + as.factor(month) |
              wind_m_s, data = sardines)
summary(tsls2)
```

```
##
## Call:
## ivreg(formula = log_vol_sold_kg ~ log_price_euro_kg + as.factor(country) +
##       as.factor(year) + as.factor(month) | as.factor(country) +
##       as.factor(year) + as.factor(month) + wind_m_s, data = sardines)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -9.2940 -1.8317 -0.1353  1.9969  6.2894
##
## Coefficients:
##              Estimate Std. Error t value      Pr(>|t|)
## (Intercept)    7.33742    0.20781  35.309 <0.0000000000000002 ***
## log_price_euro_kg -1.25004    0.46393  -2.694    0.0076 **
## as.factor(country)Italy -0.68925    0.12970  -5.314 <0.0000000000000002 ***
## as.factor(country)Portugal  1.71563    0.34614   4.957 <0.0000000000000002 ***
## as.factor(country)United Kingdom -0.07422    0.31428  -0.236    0.8167
## as.factor(year)2014    0.14610    0.15281   0.956    0.3371
## as.factor(year)2015    0.18487    0.15221   1.215    0.2241
## as.factor(year)2016    0.21335    0.15320   1.393    0.1621
## as.factor(year)2017    0.07400    0.15224   0.486    0.6271
## as.factor(year)2018   -0.09137    0.15508  -0.589    0.5541
```

```
## as.factor(year)2019      0.03602      0.19688      0.183
## as.factor(month)2        0.06866      0.20972      0.327
## as.factor(month)3        0.51583      0.20489      2.518
## as.factor(month)4        0.91433      0.20297      4.505
## as.factor(month)5        1.14887      0.20370      5.640
## as.factor(month)6        1.14474      0.20164      5.677
## as.factor(month)7        1.40047      0.21047      6.654
## as.factor(month)8        1.26382      0.21692      5.826
## as.factor(month)9        1.31072      0.21298      6.154
## as.factor(month)10       0.72059      0.22958      3.139
## as.factor(month)11       0.48128      0.22575      2.132
## as.factor(month)12       0.06683      0.21920      0.305
##                               Pr(>|t|)
## (Intercept)              < 0.0000000000000002 ***
## log_price_euro_kg         0.00708 **
## as.factor(country)Italy    0.0000001129314 ***
## as.factor(country)Portugal 0.0000007476568 ***
## as.factor(country)United Kingdom 0.81332
## as.factor(year)2014        0.33909
## as.factor(year)2015        0.22461
## as.factor(year)2016        0.16382
## as.factor(year)2017        0.62692
## as.factor(year)2018        0.55580
## as.factor(year)2019        0.85483
## as.factor(month)2          0.74339
## as.factor(month)3          0.01185 *
## as.factor(month)4          0.0000068372477 ***
## as.factor(month)5          0.0000000181902 ***
## as.factor(month)6          0.0000000146801 ***
## as.factor(month)7          0.0000000000324 ***
## as.factor(month)8          0.0000000061221 ***
## as.factor(month)9          0.0000000008287 ***
## as.factor(month)10         0.00171 **
## as.factor(month)11         0.03308 *
## as.factor(month)12         0.76049
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.648 on 3966 degrees of freedom
## Multiple R-Squared:  0.1522, Adjusted R-squared:  0.1477
## Wald test: 9.963 on 21 and 3966 DF, p-value: < 0.00000000000000022
```

The estimated price elasticity of demand is is -1.25.

```
fs2 <- lm_robust(log_price_euro_kg ~ wind_m_s + as.factor(country) + as.factor(year) + as.factor(month)

fs2_hypothesis <- linearHypothesis(fs2,
                                   c("wind_m_s = 0"),
                                   white.adjust = "hc2")

fs2_hypothesis_table <- tidy(fs2_hypothesis)

fs2_hypothesis_table %>%
  kable()
```

res.df	df	statistic	p.value
3967	NA	NA	NA
3966	1	77.65815	0

The f statistic for the instrument of wind speed is 77.66.