Faculty of economics, Commercial and Management Sciences
Department of commerce

Specialty: International Commerce & Finance
Module: Advanced Econometric
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Exercises series N°4

Exercise 1 *choose the correct answer for the following question*

1. **Which of the following is a key advantage of using panel data?**
   a. It reduces the number of observations
   b. It avoids the use of time series techniques
   c. It captures both individual and time variation in the data
   d. It requires fewer explanatory variables
2. **Why is panel data considered superior to purely cross-sectional data?**
   a. Because it assumes homogeneity across individuals
   b. Because it helps in identifying and controlling for individual-specific effects
   c. Because it eliminates the need for control variables
   d. Because it is always balanced
3. **Panel data models are especially useful because:**
   a. They ignore differences between individuals
   b. They are not influenced by time
   c. They allow us to study dynamic changes and control for hidden variables
   d. They are easier to estimate than OLS
4. **What is one reason researchers prefer panel data models?**
   a. They can observe the impact of variables across individuals and over time
   b. They avoid the use of econometric techniques
   c. They reduce the need for data cleaning
   d. They guarantee unbiased estimates in all cases
5. **In a fixed effects model, unobserved individual-specific effects are:**
   a. Assumed to be random and uncorrelated with the independent variables
   b. Assumed to be constant and correlated with the independent variables
   c. Time-varying and stochastic
   d. Ignored in the model
6. **Which of the following methods allows different intercepts for each cross-sectional unit?**
   a. Pooled OLS
   b. Random Effects Model
   c. Fixed Effects Model
   d. All the above
7. **In the Random Effects model, the individual-specific effect is:**
   a. Treated as a fixed unknown parameter
   b. Correlated with explanatory variables
   c. Treated as a random variable uncorrelated with regressors
   d. Eliminated through demeaning

8. **The Hausman test is used to:**
   a. Test if coefficients are statistically significant
   b. Choose between fixed effects and random effects models
   c. Test for serial correlation
   d. Determine the optimal lag length
9. **In a balanced panel dataset:**
   a. Each individual is observed in only one time period
   b. The number of individuals equals the number of time periods
   c. All individuals are observed in the same number of time periods
   d. Some individuals are missing in some time periods
10. **The Random Effects model is more efficient than Fixed Effects model only when:**
   a. There is autocorrelation
   a. The random effects are correlated with the explanatory variables
   b. The Hausman test rejects the null
   c. The random effects are uncorrelated with the explanatory variables
11. **Which of the following is a key assumption in the Random Effects model?**
   a. Errors are normally distributed
   b. Individual effects are fixed constants
   c. Random effects are uncorrelated with independent variable
   d. There is multicollinearity in the data

12. **What does the coefficient of** *advertising = 2.45* **in the Fixed Effects model mean?**
   a. For every 1 unit increase in *advertising, sales* increase by 2.45 units, controlling for firm-specific effects.
   b. SALES increase by 2.45 units each year regardless of advertising.
   c. The average advertising spending across firms is 2.45.
   d. Advertising does not significantly affect sales.

13. **Which model assumes that firm-specific effects are** uncorrelated **with the independent variables?**

   a. Fixed Effects
   b. Random Effects
   c. Pooled OLS
   d. All of the above

14. **What would be a reason to** prefer the Fixed Effects model **over Random Effects?**

   a. The t-statistic is larger in Fixed Effects.
   b. The Fixed Effects model has a higher R-squared.
   c. If a **Hausman test** shows that the unobserved effects are **correlated** with independent variable.
   d. The Random Effects model includes a constant term.

15. **Suppose you ran the** Hausman test **and the p-value was** 0.01**. Which model should you use?**

   a. Fixed Effects
   b. Random Effects
   c. Pooled OLS

d. Difference-in-Difference

Exercises 2

This study aims to investigate the relationship between **GDP and four key macroeconomic variables**—**exports, imports, exchange rate, and investment**—across **five countries** (China, USA, Russia, Italy and Algeria) over a **five-year period** (2010–2015). The data is

- **GDP** (in trillion national currency)
- **Exports** (in billion USD)
- **Imports** (in billion USD)
- **Exchange Rate** (National currency per 1 USD)
- **Investment** (in trillion national currency)

Tasks :

1. Import the dataset into Eviews, make the necessary transformations, open EViews software, go to import, import from file click ok; and the transformation you need make is to transform the data of GDP and Investment from local currency to US dollar
2. What kind of the data is this? The kind of the data is panel data, because we have a cross-section and time series variation.
3. Write the regression model? $GDP_{it} = \alpha_i + \beta_1 EXR_{it} + \beta_2 EXP_{it} + \beta_3 Inves_{it} + \beta_4 IMP_{it} + \varepsilon_{it}$
4. Estimate the model, we estimate the fixed effects model

Dependent Variable: GDP_IN_US$
Method: Panel Least Squares
Date: 04/26/25 Time: 19:26
Sample: 2010 2015
Periods included: 6
Cross-sections included: 5
Total panel (balanced) observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCHANGE_RATE	0.000342	0.017572	0.019444	0.9847
EXPORT	0.002080	0.016646	0.124981	0.9017
INVESTMENT_IN_US$	4.304745	0.476052	9.042595	0.0000
IMPORT	-0.001470	0.022279	-0.065964	0.9480
C	0.933002	1.194978	0.780769	0.4437

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.996752	Mean dependent var	5.743080
Adjusted R-squared	0.995515	S.D. dependent var	6.175276
S.E. of regression	0.413557	Akaike info criterion	1.315282
Sum squared resid	3.591615	Schwarz criterion	1.735641
Log likelihood	-10.72922	Hannan-Quinn criter.	1.449758
F-statistic	805.6335	Durbin-Watson stat	0.358058
Prob(F-statistic)	0.000000		

5. Interpret the signs and significance of the estimated coefficients.

$$GDP_{it} = 0.93 + 0.00034 EXR_{it} + 0.002 EXP_{it} + 4.3 Inves_{it} - 0.0014 IMP_{it}$$

- **Constant (0.93):** This is the intercept. It represents the baseline level of GDPGDP when all independent variables are equal to zero.
- **Exchange Rate (EXR): coefficient = 0.00034**, A **one-unit increase** in the exchange rate is associated with an **increase of 0.00034 units** in GDP, **holding all else constant**.
    - If exchange rate increases (say the local currency depreciates), GDP slightly increases, but the effect is very small.
- **Exports (EXP): coefficient = 0.002**, A **one-unit increase** in exports increases GDP by **0.002 units**, **ceteris paribus**.
    - Exports have a **positive but small effect** on GDP growth.
- **Investment (Inves): coefficient = 4.3**, A **one-unit increase** in investment leads to a **4.3 units increase** in GDP, **ceteris paribus**.
    - Investment has a **very strong positive impact** on GDP, much larger than exports or exchange rate.
- **Imports (IMP): coefficient = -0.0014**, A **one-unit increase** in imports is associated with a **0.0014 unit decrease** in GDP, **holding other variables constant**.
    - Imports have a **negative effect** on GDP, although the effect size is small.

6. Report and interpret the R-squared value.

- R^2 =99.67, this value indicate that 99.67% of the variation in GDP is explained by the variation in the independent variables Exchange rate, export, import, and investment, and the individual fixed effects.

7. Test for individual country effects. How do results vary across countries?

In a **Fixed Effects Model**, the intercept for each entity (here: individual) is calculated as:

$$Entity - specific\ intercept = average\ intercept + enttity\ effect$$

After you run the fixed effects model, you go view then choose fixed/random effects then choose cross-section effects, the EViews show the following results:

	COUNTRY	Effect
1	China	1.537495
2	Russia	-1.147646
3	Italy	-1.057805
4	Algeria	-1.034286
5	USA	1.702241

A**fter controlling for** the independent variables, China's GDP is, **on average, 1.5375 units higher** than the average of 0.93 (the overall intercept). Resulting an entity-specific intercept of **2.46, this indicates that China has GDP equal to 2.46 point when EXR and EXP investment and import are zero**.

Russia's GDP is, **on average, 1.1475 units lower** than the average of 0.93 (the overall intercept) that would have been predicted without considering country-specific effects. Resulting an entity-

specific intercept of **1.1475, this indicate that Russia has GDP equal to -0.21 point when EXR and EXP investment and import are zero**.

The number -**1.0578** represents the **individual intercept adjustment** for Italy in our fixed effects model. It means that, **after controlling for** the independent variables, Italy's GDP is, **on average, 1.0578 units lower** than the average of 0.93 (the overall intercept). Resulting in an entity-specific intercept of **-0.12 this indicate that Italy has GDP equal to -0.12 point when EXR and EXP investment and import are zero**.

The number -**1.0342** represents the **individual intercept for Algeria**. It means that, **after controlling for** the independent variables, Algeria's GDP is, **on average, 1.0342 units lower** than the average of 0.93 (the overall intercept). Resulting in an entity-specific intercept of **-0.10 this indicate that Algeria has GDP equal to -0.10 point when EXR and EXP investment and import are zero**.

The number **1.7022** represents the **individual intercept** for USA. It means that, **after controlling for** the independent variables, USA's GDP is, **on average, 1.7022 units higher** than the average of 0.93. Resulting in an entity-specific intercept of **2.632, this indicate that USA has GDP equal to 2.632 point when EXR and EXP investment and import are zero**.

8. Discuss whether a fixed or random effects model is more appropriate using the Hausman test.

To test which is the appropriate model in EViews: we go `View → Fixed/Random Effects Testing → Correlated Random Effects - Hausman Test ;`

`we get the result`

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	3.114001	4	0.5389

Null hypothesis: Random Effects is appropriate.

- **If p-value < 0.05** → Reject RE → Use **Fixed Effects**.

- **If p-value > 0.05** → Fail to reject RE → **Random Effects is OK**.

According to our value, the **p-value > 0.05** the radom effect is appropriate

Exercise 3

You want to estimate the effect of **education** and **experience** on **productivity**, while controlling for **unobserved, time-invariant traits** like personality or family background (which are not measured but may influence productivity).

Dependent Variable: PRODUCTIVITY
Method: Panel Least Squares (Fixed Effects)
Sample: 2010 2019
Periods included: 10
Cross-sections included: 5
Total panel (balanced) observations: 50

Variable	***Coefficient***	***Std. Error***	***t-Statistic***	***Prob.***
EDUCATION	*1.800000*	*0.300000*	*6.000000*	*0.0000*
EXPERIENCE	*0.600000*	*0.150000*	*4.000000*	*0.0002*
C	*12.2025*	*0.210*		*0.0000*

R-squared *0.850000*
Adjusted R-squared *0.820000*
F-statistic *28.00000*
Prob(F-statistic) *0.000000*

cross-section id	fixed effect
individual_1	+2.50
INDIVIDUAL_2	-1.00
INDIVIDUAL_3	+0.80
INDIVIDUAL_4	-0.70
INDIVIDUAL_5	-1.60

Tasks

1. Which model is appropriate to estimate this relationship, write the regression model?
2. Based on the table, interpret the results of regression?
3. What does the R-squared tell about the model fit?
4. Interpret the cross-section effect?

Answer

1. Since the problem specifies that **there are unobserved, time-invariant traits** like personality or family background (which don't change over time), so, the appropriate model is the **Fixed Effects Model**.

Model: $Prod_{it} = \alpha_i + \beta_1 Educ_{it} + \beta_2 Exper_{it} + \varepsilon_{it}$

$$Prod_{it} = 12.2 + 1.8 Educ_{it} + 0.6\ Exper_{it}$$

2. Interpret the results of the regression

- **EDUCATION coefficient (1.8):** Each additional year of education is associated with an **increase of 1.8 points in productivity**, holding experience constant.
- **EXPERIENCE coefficient (0.6):** Each additional year of experience is associated with an **increase of 0.6 points in productivity**, holding education constant.
- **Constant (12.2):** The base productivity level when education and experience are zero for all sample.

  - Both education and experience **positively and significantly** affect productivity.

3. What does R-squared tell about the model fit?

- **R-squared = 0.85**
  This means that **85% of the variation** in productivity **is explained** by education, experience, and the individual fixed effects.
- **Conclusion:** The model has a **very good fit**.

4. Interpret the cross-section effects : The cross-section effects capture **individual-specific characteristics** that are constant over time but affect productivity.

- **Individual 1 (+2.50):** Individual 1 has a productivity level **2.5 points higher** than the base due to unobserved personal characteristics. This means that the individual 1 intercept is 12.2+2.50 = 14.7 point, the individual 1 productivity is 14.7 when the education and experience equal zero
- **Individual 2 (−1.00):** Individual 2 has a productivity level **1 point lower** than the base due to unobserved factors. This means that the individual 2 intercept is 12.2+ (-1) = 11.2 point, the individual 2 productivity is 11.1 when the education and experience equal zero
- **Individual 3 (+0.80) :**Individual 3 has a productivity level **0.8 points higher** than the average productivity of sample, due to unobserved personnel characteristics. This means that the individual 3 intercept is 12.2+0.8 = 13 point, the individual 2 productivity is 13 when the education and experience equal zero
- **Individual 4 (−0.70):** Individual 4 has a productivity level **0.7 points lower** than the base productivity of the sample. This means that the individual 4 intercept is 12.2+ (-0.7) = 11.5 point, the individual 4 productivity is 11.5 when the education and experience equal zero
- **Individual 5 (−1.60):** Individual 5 has a productivity level **1.6 points lower** than the base productivity of the sample. This means that the individual 5 intercept is 12.2+(-1.6) = 10.6 point, the individual 5 productivity is 10.6 when the education and experience equal zero