УКРАЇНСЬКИЙ ЦЕНТР ОЦІНЮВАННЯ ЯКОСТІ ОСВІТИ

PISA UKRAINE

OECD

Psychometric computing

PISA Data Analysis leveraging R:

pros and cons

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PISA

What is PISA?

PISA is the OECD's Programme for International Student Assessment

Goals:

- PISA measures 15-year-olds’ ability to use their reading, mathematics and science knowledge and skills to meet real-life challenges.
- PISA makes it possible to compare Educational systems of different countries.
- PISA gives us opportunity to define factors, which influences students achievements.

2000-2018:

PISA has involved more than 90 countries and economies and about 3 000 000 students worldwide

PISA-2018:

600 000 students representing about **32** million 15-year-olds in schools of **79** participating countries and economies sat the 2-hour PISA test in 2018

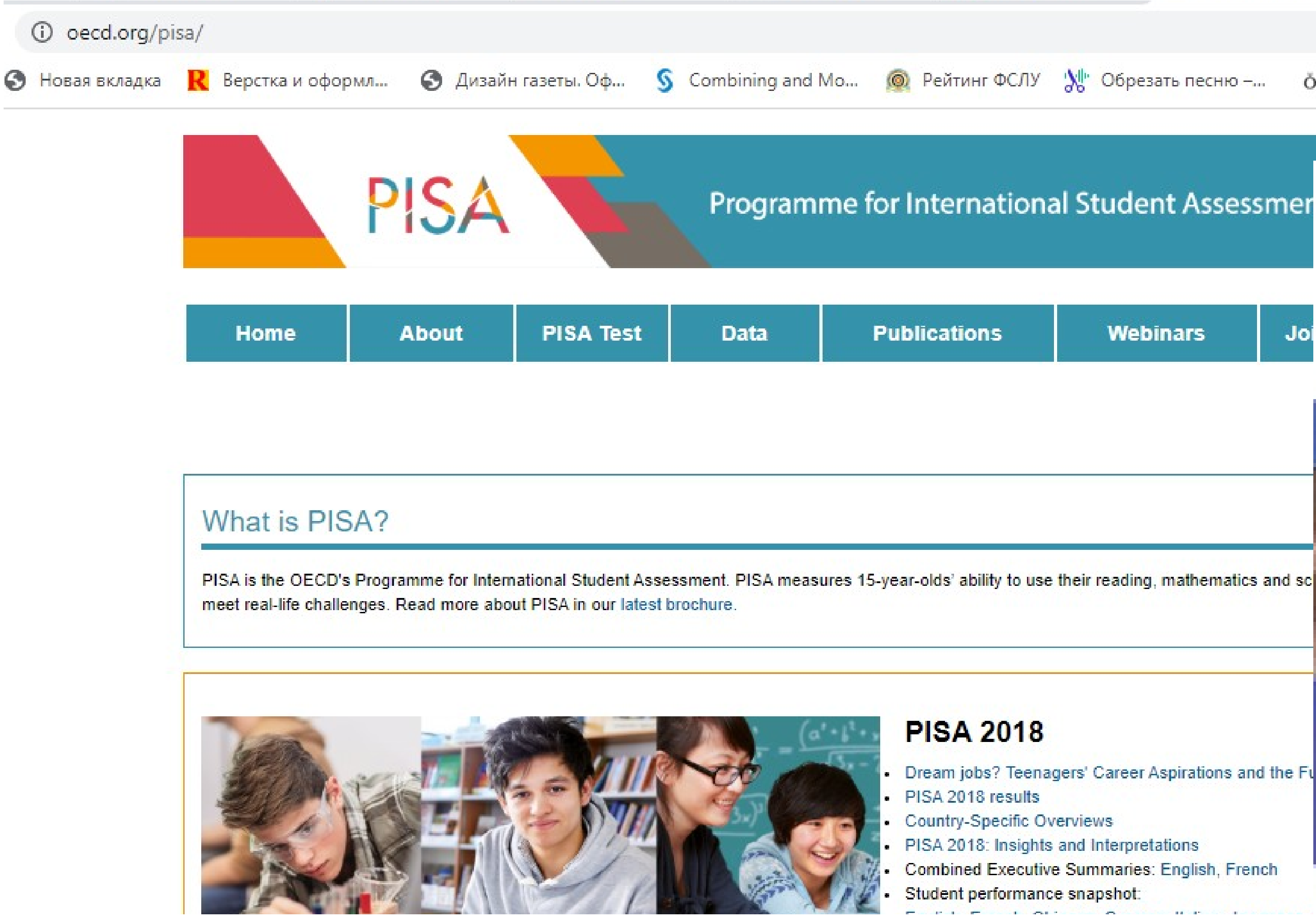
PISA Ukraine in PISA-2018

- Ukraine participated in PISA for the first time
- Over 6 000 students from 250 Ukrainian schools representing about 315 000 Ukrainian students sat the 2-hour PISA test and filled in questionnaires

Our goal: Ukraine PISA National report

Національний звіт за результатами міжнародного дослідження якості освіти PISA-2018

PISA https://www.oecd.org/pisa/



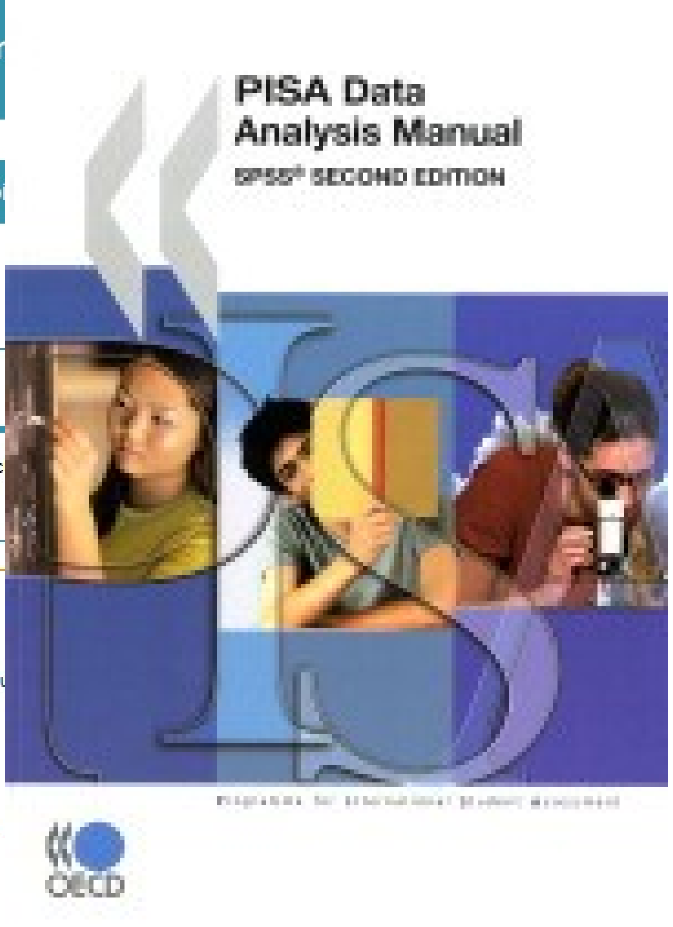
oecd.org/pisa/

What is PISA?

PISA is the OECD's Programme for International Student Assessment. PISA measures 15-year-olds' ability to use their reading, mathematics and sc meet real-life challenges. Read more about PISA in our latest brochure.

PISA 2018

- Dream jobs? Teenagers' Career Aspirations and the Fu
- PISA 2018 results
- Country-Specific Overviews
- PISA 2018: Insights and Interpretations
- Combined Executive Summaries: English, French
- Student performance snapshot:



PISA Data Analysis Manual

SPSS® SECOND EDITION

Content of technical report

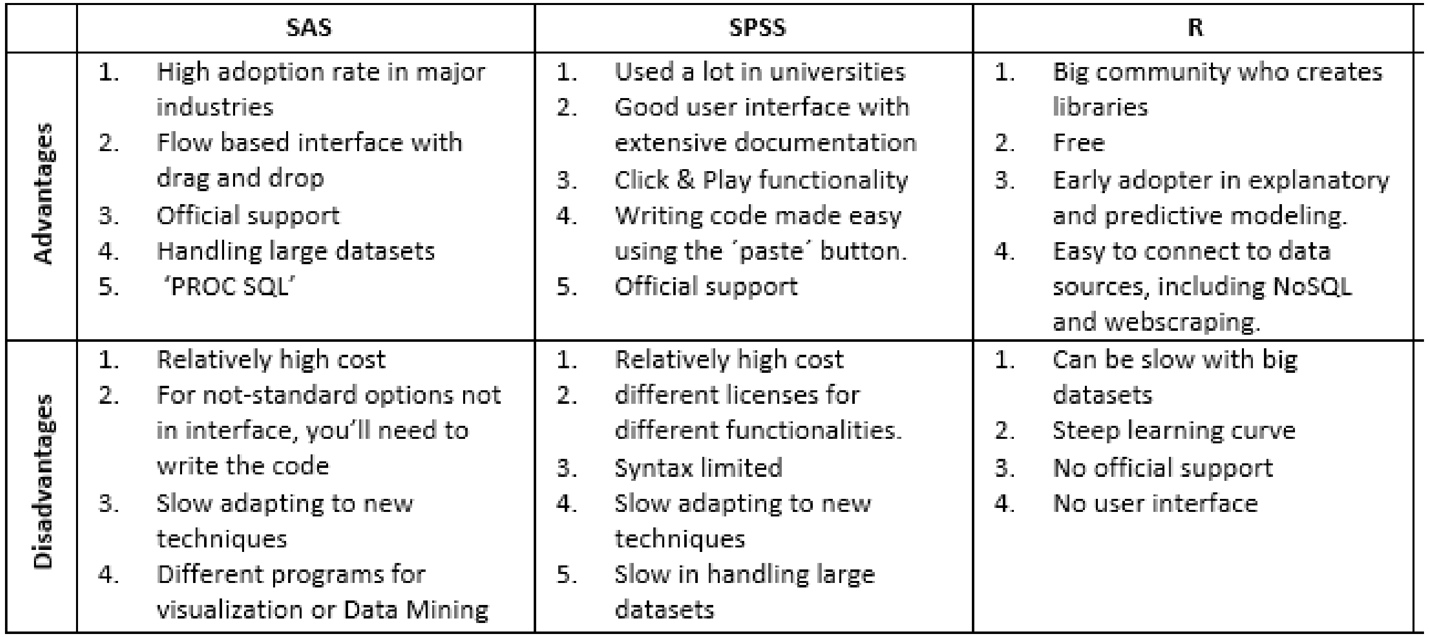
- Usefulness of PISA Data for Policy Makers, Researchers and Experts on Methodology
- Exploratory Analysis Procedures
- Sample Weights
- **Replicate Weights**
- **Computation of Standard Errors** (take into account the complex sample design)
- **Plausible Values**
- **Analyses with Plausible Values** (take into account rotated test forms)
- Use of Proficiency Levels
- The Rasch Model

Content of technical report

- Analyses with School-Level Variables
- Standard Error on a Difference
- **OECD Total and OECD Average**
- Trends
- **Studying the Relationship between Student Performance and Indices Derived from Contextual Questionnaires**
- Multilevel Analyses
- PISA and Policy Relevance – Three Examples of Analyses
- SPSS® Macro; SAS® Macro
- SAS Macro for 10 Plausible Values

Statistical software

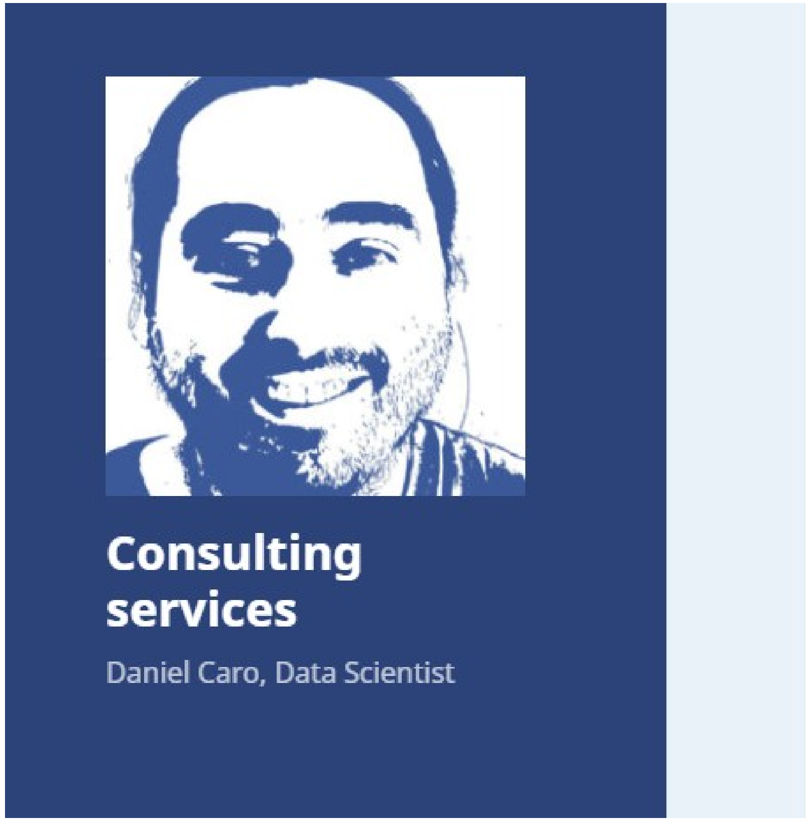
- SPSS
- STATA
- SAS
- R



	SAS	SPSS	R
Advantages	1. High adoption rate in major industries 2. Flow based interface with drag and drop 3. Official support 4. Handling large datasets 5. ‘PROC SQL’	1. Used a lot in universities 2. Good user interface with extensive documentation 3. Click & Play functionality 4. Writing code made easy using the ´paste´ button. 5. Official support	1. Big community who creates libraries 2. Free 3. Early adopter in explanatory and predictive modeling. 4. Easy to connect to data sources, including NoSQL and webscraping.
Disadvantages	1. Relatively high cost 2. For not-standard options not in interface, you’ll need to write the code 3. Slow adapting to new techniques 4. Different programs for visualization or Data Mining	1. Relatively high cost 2. different licenses for different functionalities. 3. Syntax limited 4. Slow adapting to new techniques 5. Slow in handling large datasets	1. Can be slow with big datasets 2. Steep learning curve 3. No official support 4. No user interface

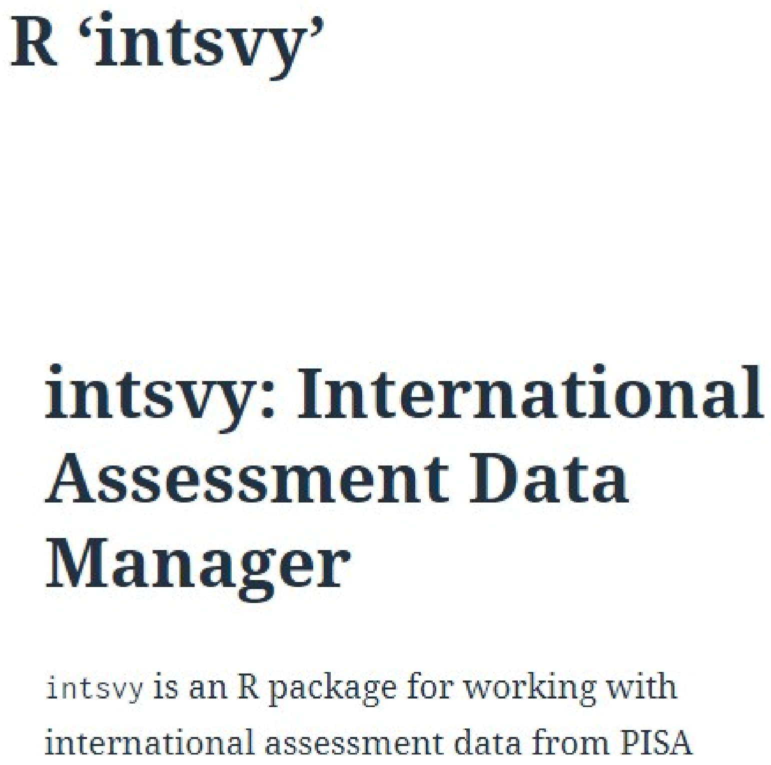
- IDB Analyzer (https://www.iea.nl/data-tools/tools#section-308)
- PISA Data Explorer (https://pisadataexplorer.oecd.org/ide/idepisa/)

intsvy package



Consulting services

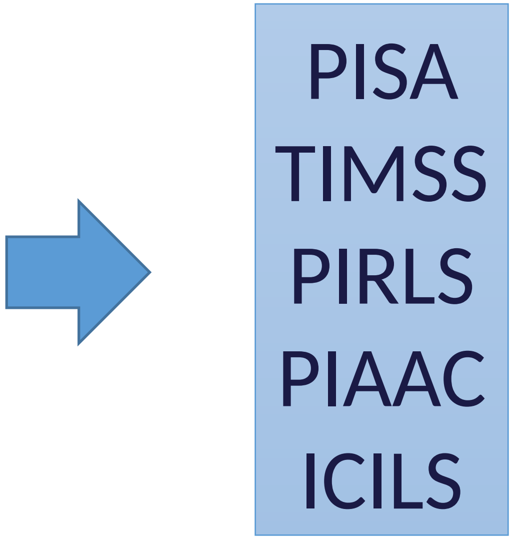
Daniel Caro, Data Scientist



R ‘intsvy’

intsvy: International Assessment Data Manager

intsvy is an R package for working with international assessment data from PISA



PISA
TIMSS
PIRLS
PIAAC
ICILS

https://cran.r-project.org/web/packages/intsvy/intsvy.pdf

http://danielcaro.net/r-intsvy/

Preparation of the PISA data files

- **Importing my data**
- **Merge the PISA data files**
- **Recode variables**
- **Creating new variables**

library(intsvy)

pisa.var.label

pisa.select.merge

library(survey)

svydesign

svyquantile

PISA Calculating main estimates

- **Average students performance**

```
pisa2015.mean.pv(pvlabel = "READ", data = pisa)
Freq      Mean   s.e.   SD      s.e
1 5998   465.95  3.5    93.34  1.7
```

- **Frequency tables**

```
pisa2015.table(variable="TFGender", data = pisa)
 TFGender  Freq Percentage Std.err.
1   Female   2857      47.37     1.02
2     Male    3141      52.63     1.02
```

```
library(intsvy)
```

pisa2015.mean.pv

pisa2015.mean

pisa2015.table

Calculating main estimates

- **Proficiency levels**

```
pisa2015.ben.pv(pvlabel="READ", cutoff = c(189.33, 262.04, 334.75, 407.47,
480.18, 552.89, 625.61, 698.32), data=pisa)
```

```
    Benchmarks    Percentage Std. err.
1           <= 189.33      0.17      0.08
2 (189.33, 262.04]       1.80      0.29
3 (262.04, 334.75]       7.21      0.69
4 (334.75, 407.47]      16.73      0.87
5 (407.47, 480.18]      27.73      0.81
6 (480.18, 552.89]      28.48      0.97
7 (552.89, 625.61]      14.47      0.82
8 (625.61, 698.32]       3.24      0.44
9             > 698.32      0.17      0.11
```

```
library(intsvy)
```

pisa2015.ben.pv

Regression models

- **Linear regression analysis**

```
pisa2015.reg.pv(pvlabel = "READ", x="TFGender", data = pisa)
```

```
                Estimate   Std. Error  t value
(Intercept)      483.56      3.63       133.30
TFGenderMale     -33.46      3.86        -8.67
R-squared          0.03     0.01          4.54
```

```
library(intsvy)
```

pisa2015.reg.pv

pisa2015.reg

Regression models

- **Logistic regression analysis**

```
fit1<-pisa2015.log.pv(pvlabel = "MATH", x="TFGender",cutoff=420, data=pisa)

                Coef. Std. Error t value   OR   CI95low  CI95up
(Intercept)      1.47      0.09    16.33   4.34   3.64     5.18
TFGenderMale    -0.72      0.09    -7.94   0.49   0.41     0.58

odds_female=exp(fit1$Coef.[1])
[1] 4.349235
odds_male=exp(fit1$Coef.[2])*exp(fit1$Coef.[1])
[1] 2.117
```

```
library(intsvy)
```

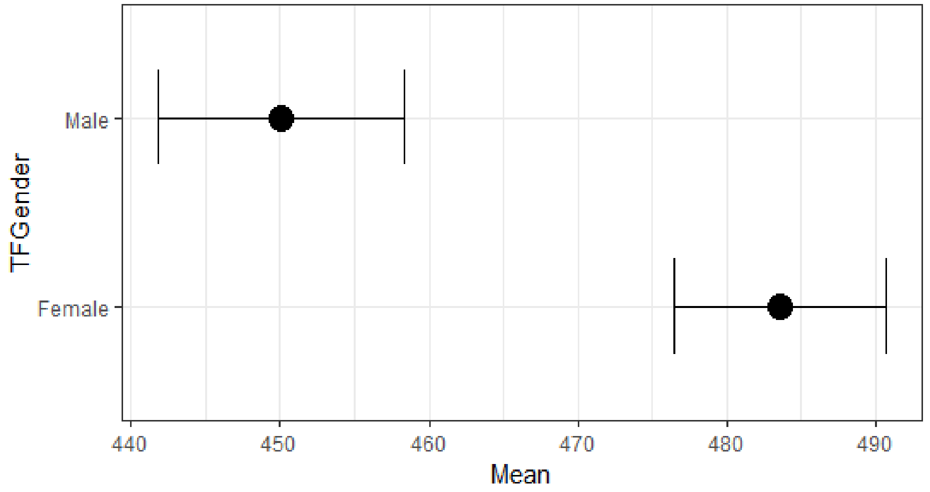
pisa2015.log.pv

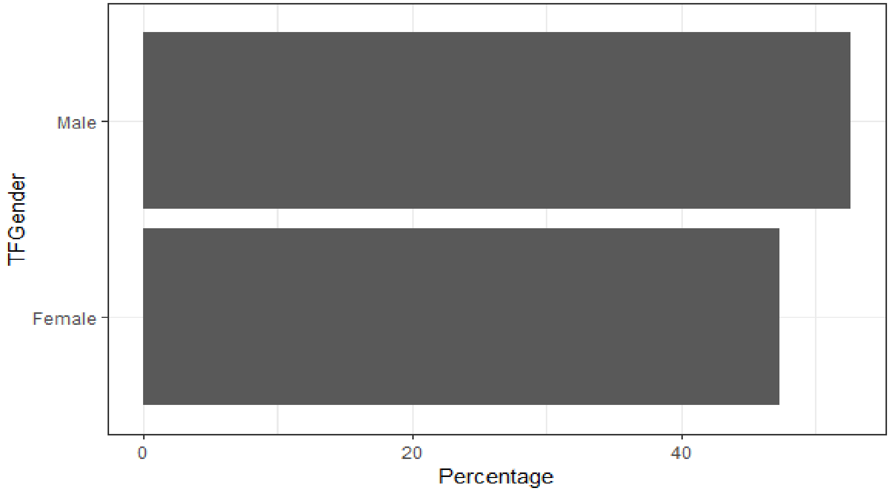
pisa2015.log

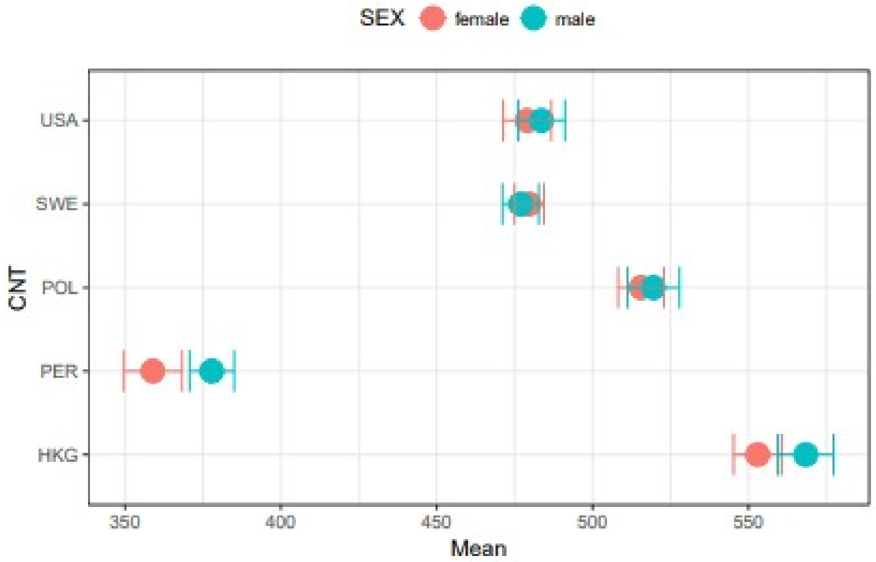
PISA Plots

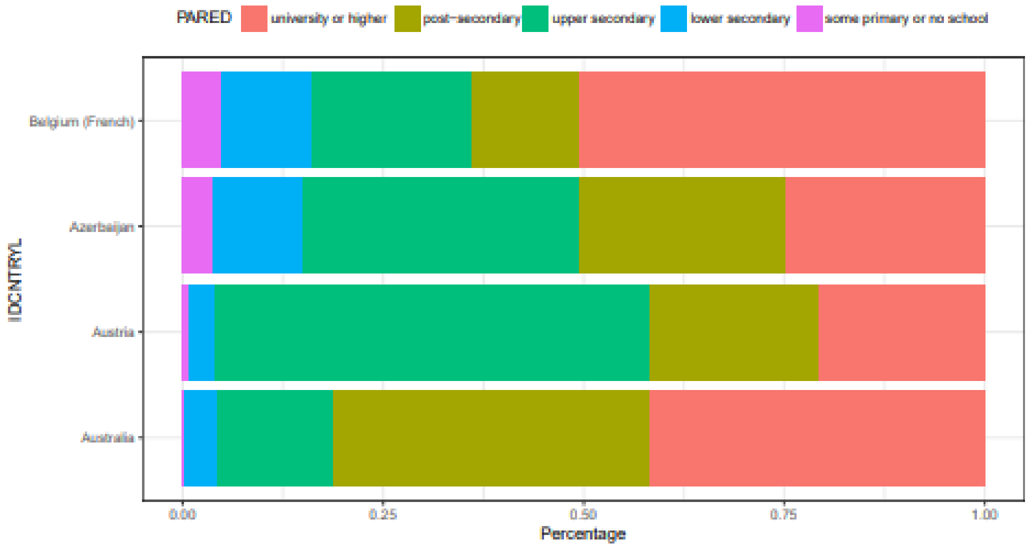
library(intsvy)

plot





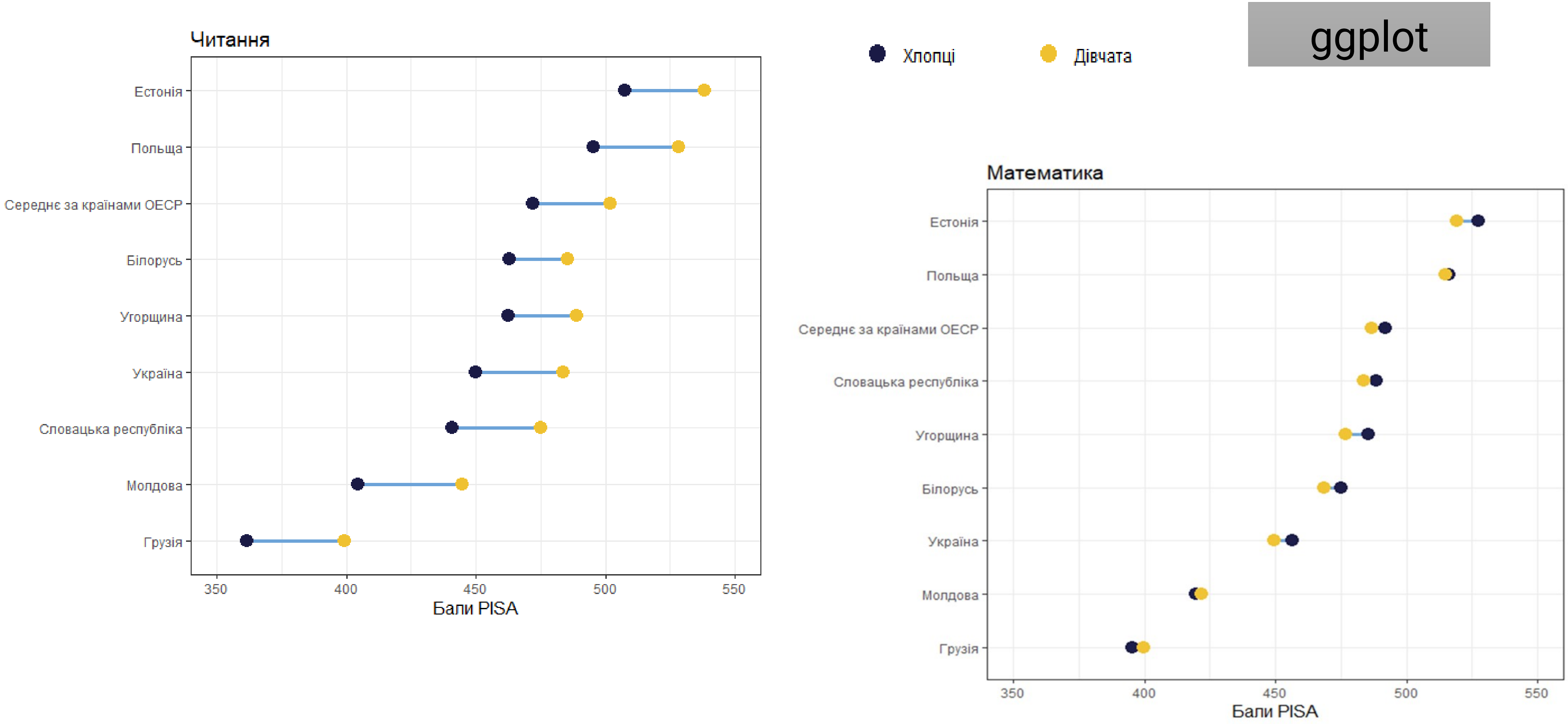




PISA Plots

```
library(ggplot2)
```

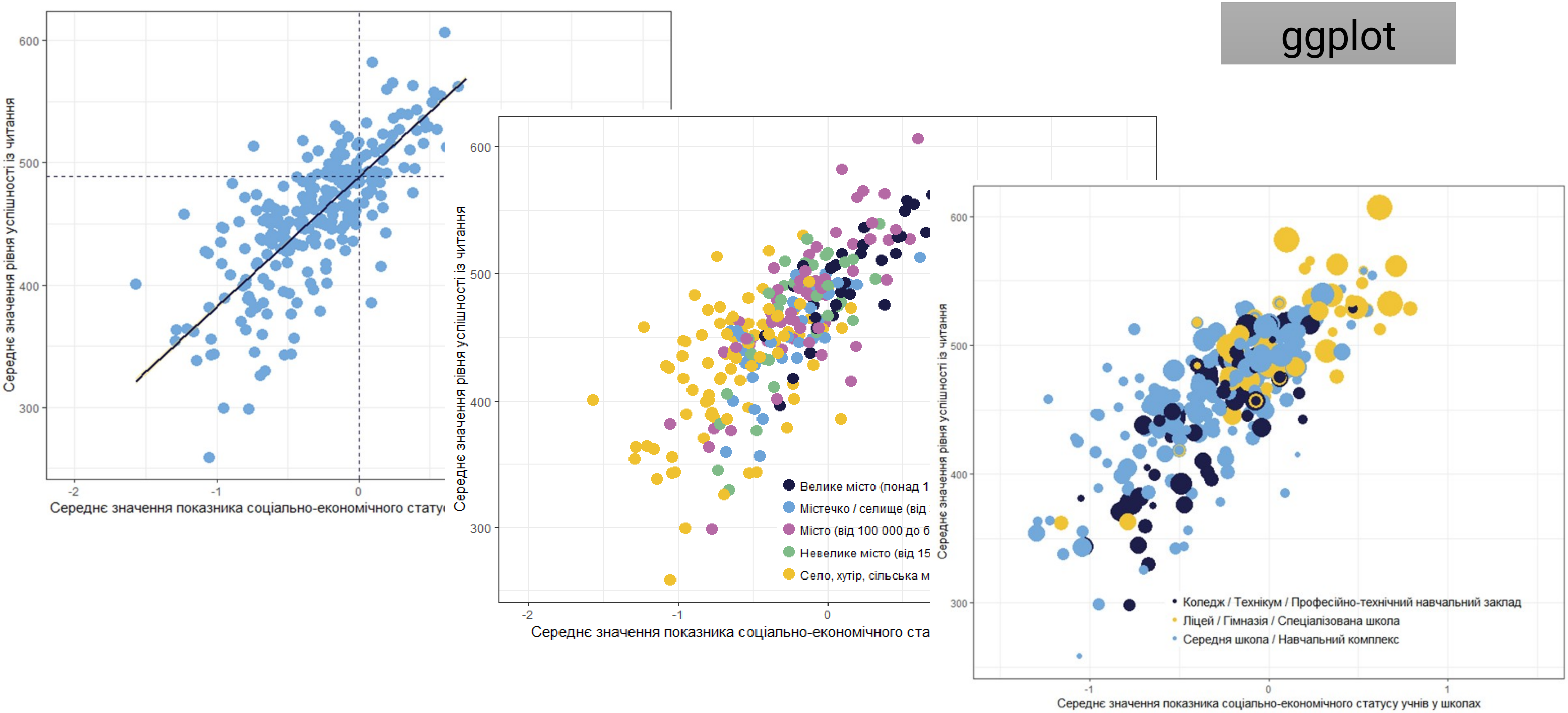
ggplot



PISA Plots

```
library(ggplot2)
```

ggplot



Additional PISA data analysis

- **Multilevel regression models**

```
fm2<-lmer(stud484$PV1READ~1+stud484$ESCS +(1+stud484$Mean|
stud484$CNTSCHID),weights=stud484$norm_weight, stud484)
summary(fm2)
```

```
        Random effects:
Groups                    Name         Variance Std.Dev. Corr
 stud484$CNTSCHID (Intercept)        631.9     25.14
                       stud484$Mean      8047.4     89.71    0.44
                              Residual       5799.9    76.16
Number of obs: 5998, groups:  stud484$CNTSCHID, 250
          Fixed effects:
                    Estimate Std. Error t value
(Intercept)       473.445    2.423    195.43
stud484$ESCS   24.111      1.481    16.28
Correlation of Fixed Effects:
          (Intr) std484$ESCS 0.110
```

library(lme4)

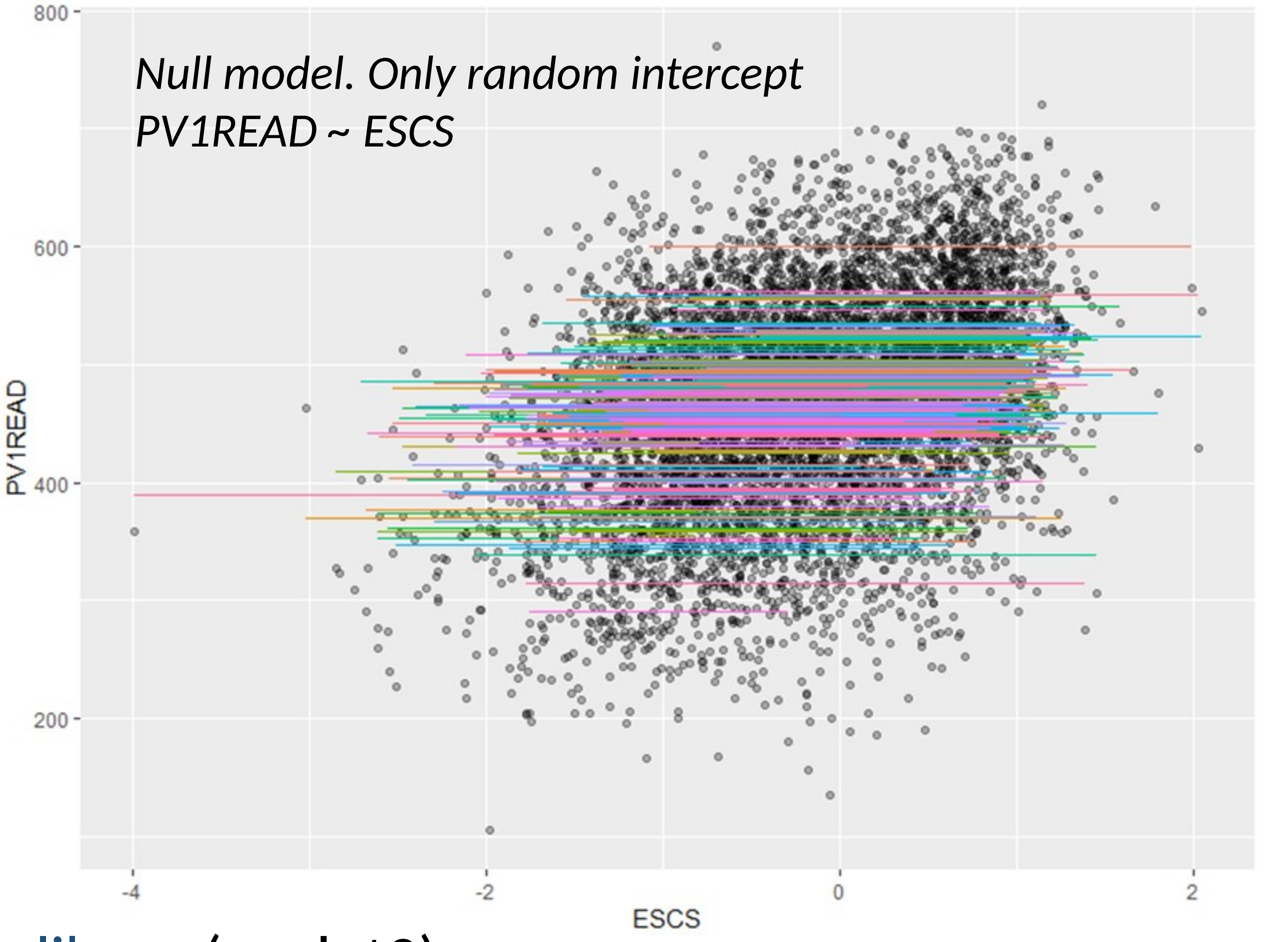
lmer

library(survey)

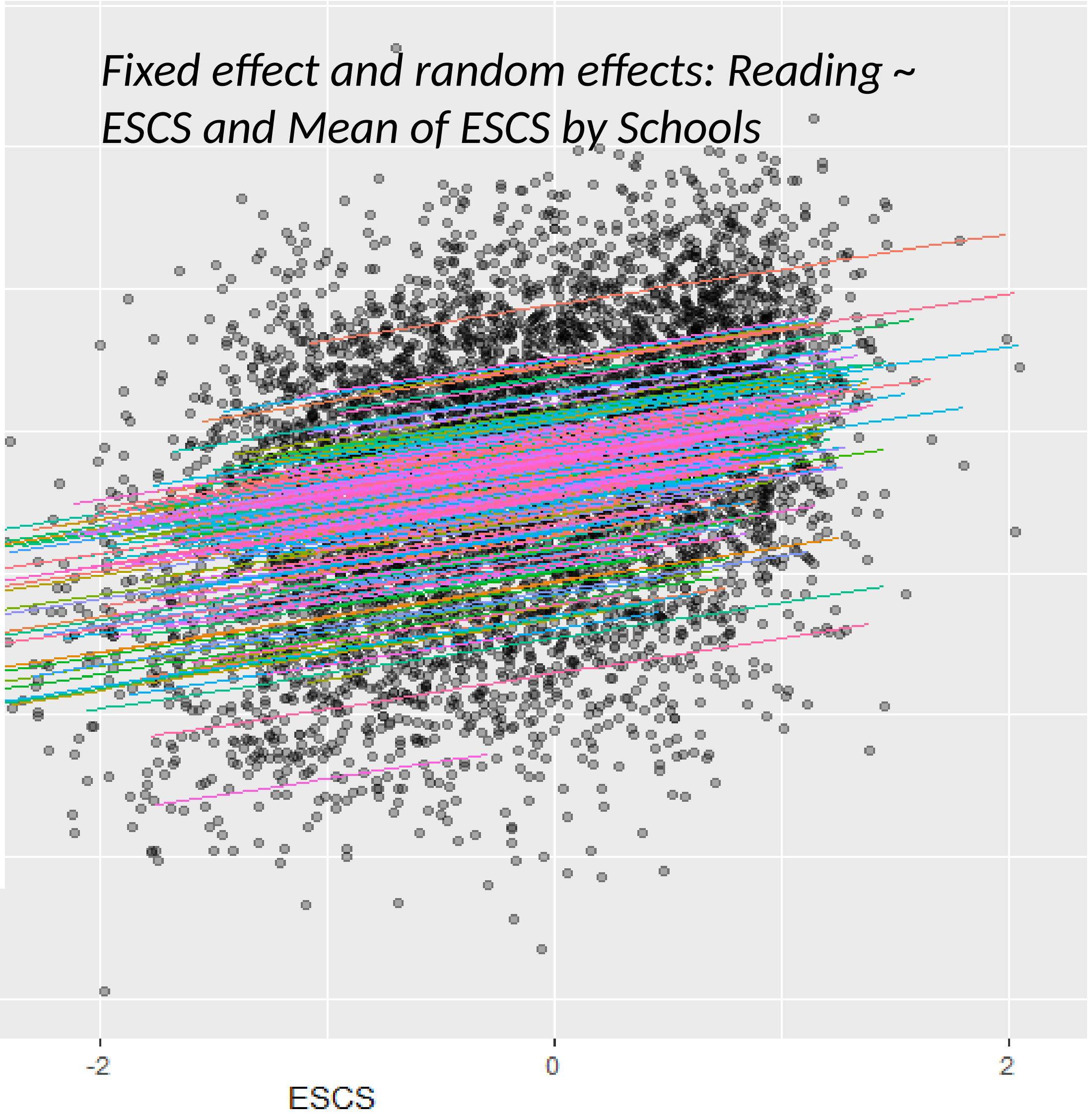
svydesign

Only for one PV !

Additional PISA data analysis



Null model. Only random intercept
PV1READ ~ ESCS

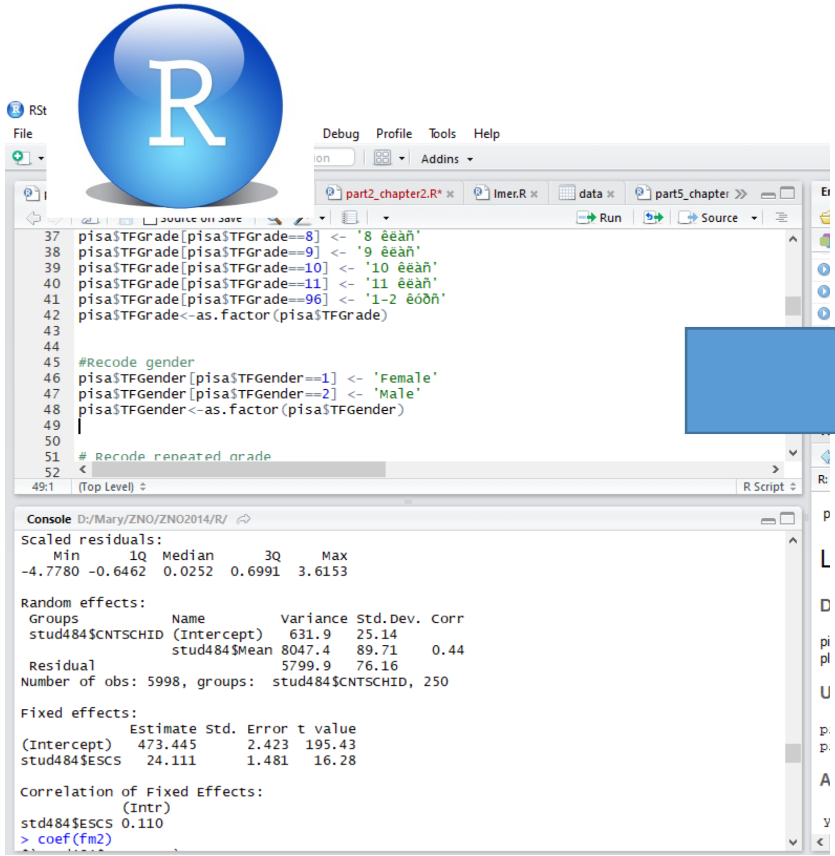


Fixed effect and random effects: Reading ~ ESCS and Mean of ESCS by Schools

library(ggplot2)

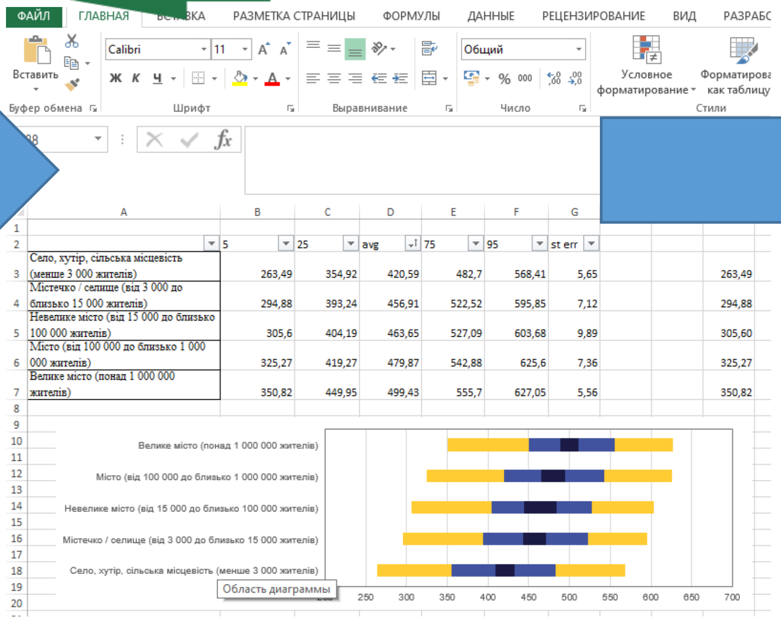
ggplot

Writing report



```
pisa$TFGrade[pisa$TFGrade==8] <- '8 êëàñ'
pisa$TFGrade[pisa$TFGrade==9] <- '9 êëàñ'
pisa$TFGrade[pisa$TFGrade==10] <- '10 êëàñ'
pisa$TFGrade[pisa$TFGrade==11] <- '11 êëàñ'
pisa$TFGrade[pisa$TFGrade==96] <- '1-2 êóðñ'
pisa$TFGrade<-as.factor(pisa$TFGrade)


#Recode gender
pisa$TFGender[pisa$TFGender==1] <- 'Female'
pisa$TFGender[pisa$TFGender==2] <- 'Male'
pisa$TFGender<-as.factor(pisa$TFGender)


# Recode repeated grade
```

```
Scaled residuals:
    Min      1Q  Median      3Q     Max
-4.7780 -0.6462  0.0252  0.6991  3.6153

Random effects:
 Groups           Name        Variance Std.Dev. Corr
 stud484$CNTSCHID (Intercept)  631.9   25.14
                  stud484$Mean 8047.4   89.71    0.44
 Residual                     5799.9   76.16
Number of obs: 5998, groups:  stud484$CNTSCHID, 250

Fixed effects:
             Estimate Std. Error t value
(Intercept)   473.445      2.423  195.43
stud484$ESCS   24.111      1.481   16.28

Correlation of Fixed Effects:
            (Intr)
std484$ESCS 0.110
> coef(fm2)
```


ФАЙЛ
ГЛАВНАЯ
ВСТАВКА
РАЗМЕТКА СТРАНИЦЫ
ФОРМУЛЫ
ДАННЫЕ
РЕЦЕНЗИРОВАНИЕ
ВИД
РАЗРАБ
Вставить
Буфер обмена
Calibri
11
Шрифт
Выравнивание
Общий
Число
Условное форматирование
Форматировать как таблицу
Стили
Велике місто (понад 1 000 000 жителів)
Місто (від 100 000 до близько 1 000 000 жителів)
Невелике місто (від 15 000 до близько 100 000 жителів)
Містечко / селище (від 3 000 до близько 15 000 жителів)
Село, хутір, сільська місцевість (менше 3 000 жителів)
Область диаграммы
250
300
350
400
450
500
550
600
650
700

	5	25	avg	75	95	st err		
Село, хутір, сільська місцевість (менше 3 000 жителів)	263,49	354,92	420,59	482,7	568,41	5,65		263,49
Містечко / селище (від 3 000 до близько 15 000 жителів)	294,88	393,24	456,91	522,52	595,85	7,12		294,88
Невелике місто (від 15 000 до близько 100 000 жителів)	305,6	404,19	463,65	527,09	603,68	9,89		305,60
Місто (від 100 000 до близько 1 000 000 жителів)	325,27	419,27	479,87	542,88	625,6	7,36		325,27
Велике місто (понад 1 000 000 жителів)	350,82	449,95	499,43	555,7	627,05	5,56		350,82

Національний звіт за результатами міжнародного дослідження якості освіти PISA-2018

… from OECD!

Pros and cons

⊕

- R is a free open source package.
- You can create a flexible script and repeat calculation process.
- You can use effective functions for calculating estimates taking into account the complex sample design and rotated test form of PISA data (using **intsvy** package).

⊖

- A major drawback of R is that most of its functions have to load all the data into memory before execution, which sets a **limit** to the volumes that can be handled.
- R requires some programming skills.
- The process of graph creating sometimes is very complex.

Results and discussion

We have published a Ukrainian National report, where the results of our work have been shown.
You can look them up in the reference: http://pisa.testportal.gov.ua/wp-content/uploads/2019/12/PISA_2018_Report_UKR.pdf

We don’t have a unified system for all calculations and for forming reports.
There aren’t a lot of functions for calculating different indicators. We want to extend intsvy package.

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PISA UKRAINE

OECD

Psycho metric co mputing

Thank you!

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