Stata Users Group Meeting

SDMXUSE

MODULE TO IMPORT DATA FROM STATISTICAL AGENCIES USING THE SDMX STANDARD

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Introduction

- `sdmxuse` is a user-written command available from the SSC archive since Sept. 2016
  - https://ideas.repec.org/c/boc/bocode/s458231.html

- The package allows users to
  - download and import statistical data from international organizations using the SDMX standard
    - The complex format of the datasets will be reviewed to show how users can send specific queries and import only the required time series
  - format the dataset into a panel or time series

- Motivation
  - It might prove useful for researchers who need frequently updated time series and wish to automate the downloading and formatting process
    - One can think of modern methods for forecasting economic series that exploit many predictors, often hundreds time series, which could be used as soon as they are released

Motivation

September 2016						
Mon	Tues	Wed	Thurs	Fri	Sat	Sun
29	30 ESTAT – B&C surveys	31 ESTAT – Unemployment	1	2	3	4
5 ESTAT – Serv. turnover	6 ESTAT – GDP	7	8 OECD – Lead. indicators	9	10	11
12 ECB – Interest rates	13 ESTAT – Employment	14 ESTAT – Indus. production	15 ESTAT – HICP	16 ECB – Car registrations	17	18
19	20	21	22 ESTAT – Flash consumer conf.	23	24	25
26	27 ECB – Monet. aggregates	28	29 ESTAT – B&C surveys	30 ESTAT – Unemployment	1	2

SDMX STANDARD

SDMX stands for Statistical Data and Metadata Exchange

- Initiative started in 2001 by 7 international organisations
  - Bank for International Settlements (BIS), European Central Bank (ECB), Eurostat (ESTAT), International Monetary Fund (IMF), Organisation for Economic Co-operation and Development (OECD), United Nations Statistics Division (UNSD) and the World Bank (WB)
    - More info at: https://sdmx.org/

- Their objective was to develop more efficient processes for sharing of statistical data and metadata
  - Metadata = data that provides information about other data
    - e.g. the data point 9.9 is not useful without the information that it is a measure of the total unemployment rate (according to ILO definition) for France, after seasonal adjustment but no calendar adjustment, in June 2016

SDMX STANDARD

- The initiative evolved around three axes:
  - setting technical standards
    - for compiling statistical data
      - the SDMX format (built around XML syntax) was created for this purpose
  - developing statistical guidelines
    - i.e. a common metadata vocabulary to make international comparisons meaningful (e.g. seasonal or price adjustments)
  - promoting tools to deploy web services
    - that facilitate the access to data and metadata (RESTful web services)

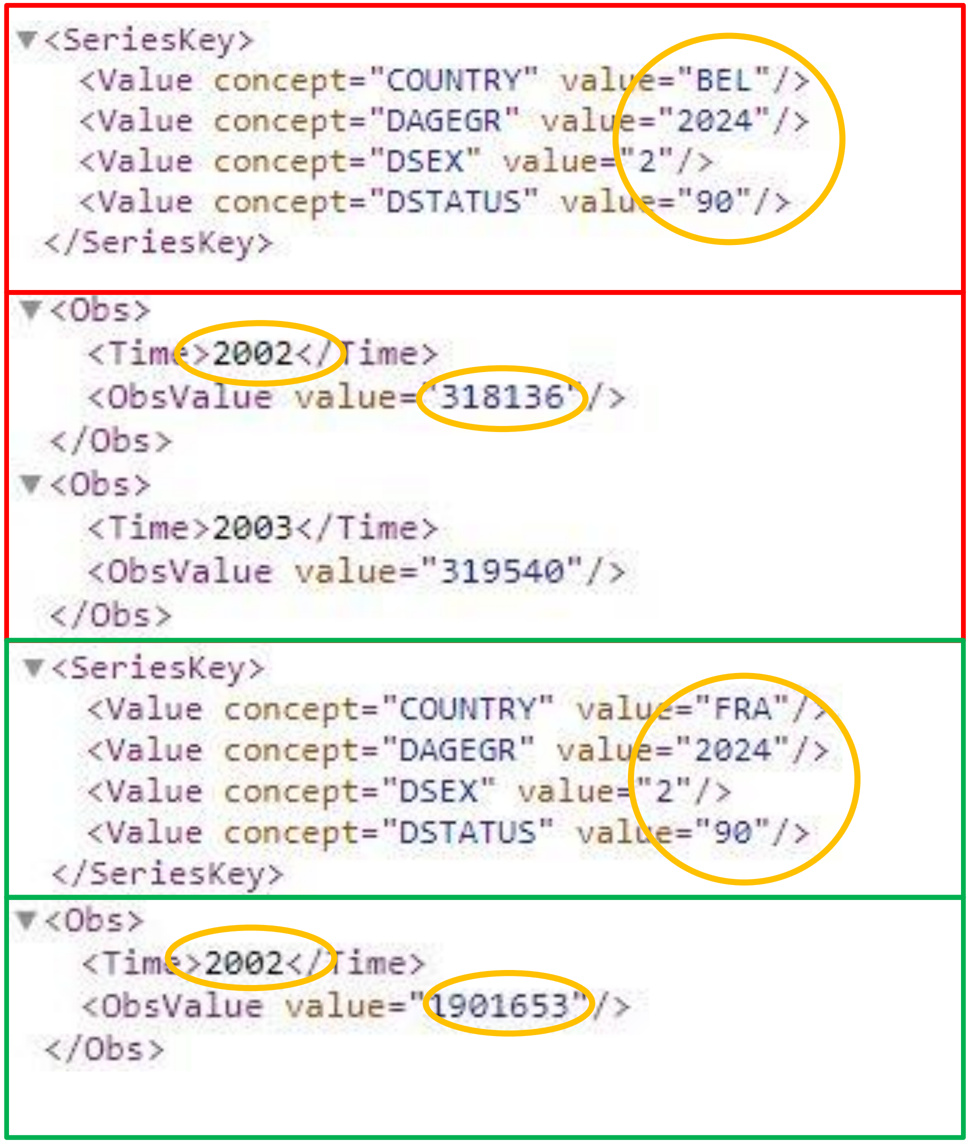
- The primary goal was to foster data sharing between participating organisations using a “pull” rather than a “push” reporting format
  - i.e. instead of sending formatted databases to each others, statistical agencies could directly pull data from another provider website
    - Dissemination of data to final users was somehow secondary even though the web services are accessible to the public

SDMX STANDARD

- Concretely, users can download a dataset (when they know its identifier) by sending a request to the URL of the service
  - The result is a structured (SDMX-ML) file
    - http://stats.oecd.org/restsdmx/sdmx.ashx//GetData/RPOP/BEL+FRA+CAN+USA.2024.2./all?
  - The output is really just a string of characters with text elements (data and metadata) and structural markers (called tags)
    - The tags are encapsulated between lower-than and greater-than symbols to distinguish them from the content

SDMX STANDARD

- In order to process the file in Stata, it is important to distinguish two types of tags:
  - <SeriesKey>, which contains the identification key of a given series
  - <Obs>, which contains a set of observations with a time element <ObsDimension> and a value element <ObsValue>



```
▼<SeriesKey>
   <Value concept="COUNTRY" value="BEL"/>
   <Value concept="DAGEGR" value="2024"/>
   <Value concept="DSEX" value="2"/>
   <Value concept="DSTATUS" value="90"/>
 </SeriesKey>
▼<Obs>
   <Time>2002</Time>
   <ObsValue value="318136"/>
 </Obs>
▼<Obs>
   <Time>2003</Time>
   <ObsValue value="319540"/>
 </Obs>
▼<SeriesKey>
   <Value concept="COUNTRY" value="FRA"/>
   <Value concept="DAGEGR" value="2024"/>
   <Value concept="DSEX" value="2"/>
   <Value concept="DSTATUS" value="90"/>
 </SeriesKey>
▼<Obs>
   <Time>2002</Time>
   <ObsValue value="1901653"/>
 </Obs>
```

SDMX STANDARD

How do we convert the file into a human-readable format

- Before importing the file into Stata, we add a carriage return to the <SeriesKey> and <Obs> tags (using the command **`filefilter`**)

```
. filefilter sdmxfile.txt sdmxfile2.txt, from("<Obs>") to ("\r\n<Obs>") replace
```

- Then, we separate the data and metadata from the structural markers
  - This is facilitated by the use of the package **`moss`** created by Nicholas J. Cox and Robert Picard that allows for finding substrings matching complex patterns of text using regular expressions
    - This package must be installed for `sdmxuse` to work properly

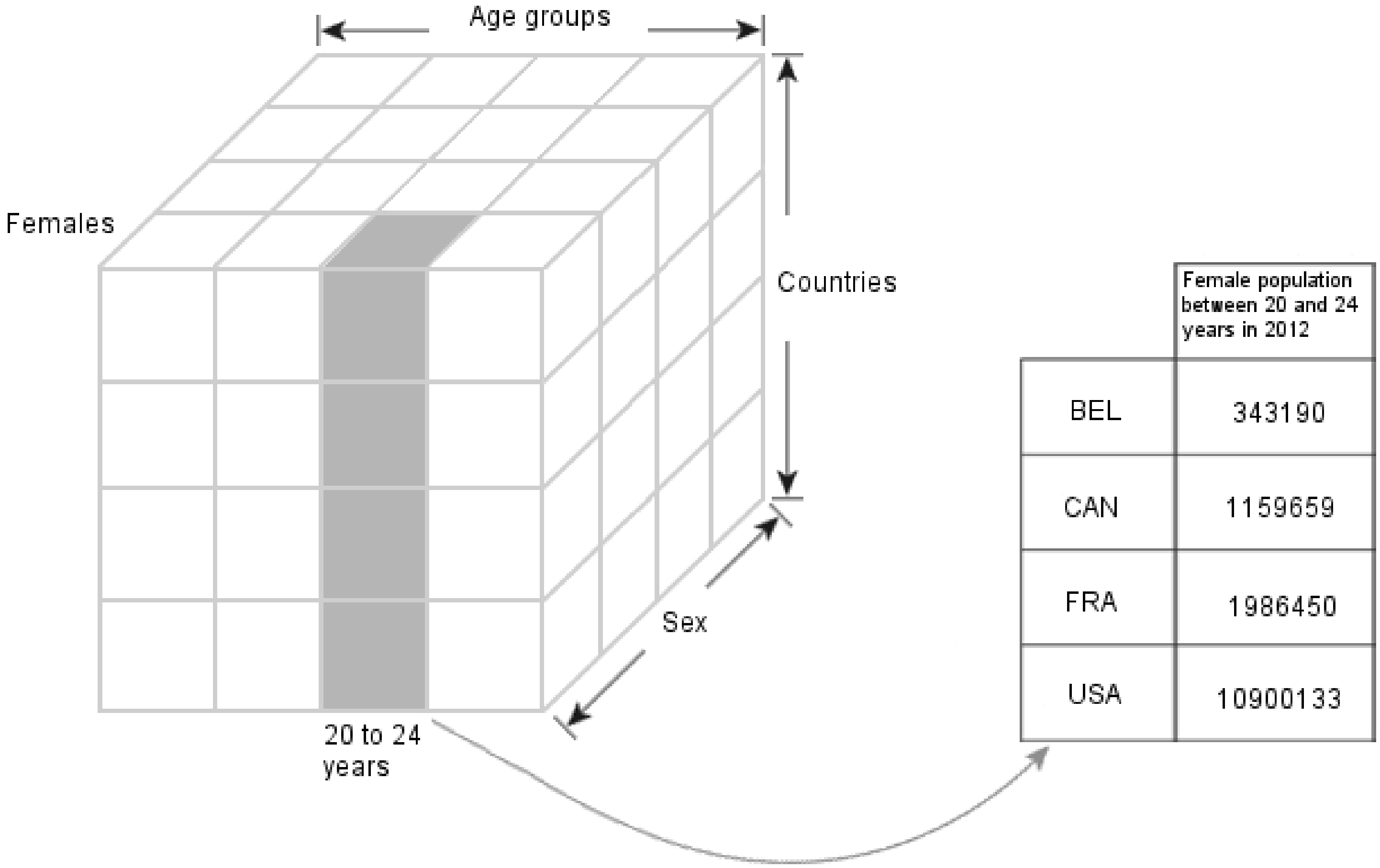
```
. moss v1, match(`"value="([a-zA-Z0-9_-]+)"') regex
```

DATASET STRUCTURE

- But datasets are often very large and users may be seeking to download only a few series
  - This is the reason why the statistical agencies have decided to offer a genuine database service that is capable of processing specific queries
- The organisation of this database relies on a **cube structure** commonly used for data warehousing
  - The dataset is organised along dimensions and a particular series (stored in a cell) takes distinct values for each dimension (the combination of these values is called a key and it uniquely identities this cell)

DATASET STRUCTURE

- “Slicing” a data cube by processing a specific query
  - To obtain only the total female population aged between 20 and 24 years in four OECD countries



	Female population between 20 and 24 years in 2012
BEL	343190
CAN	1159659
FRA	1986450
USA	10900133

Dataset structure

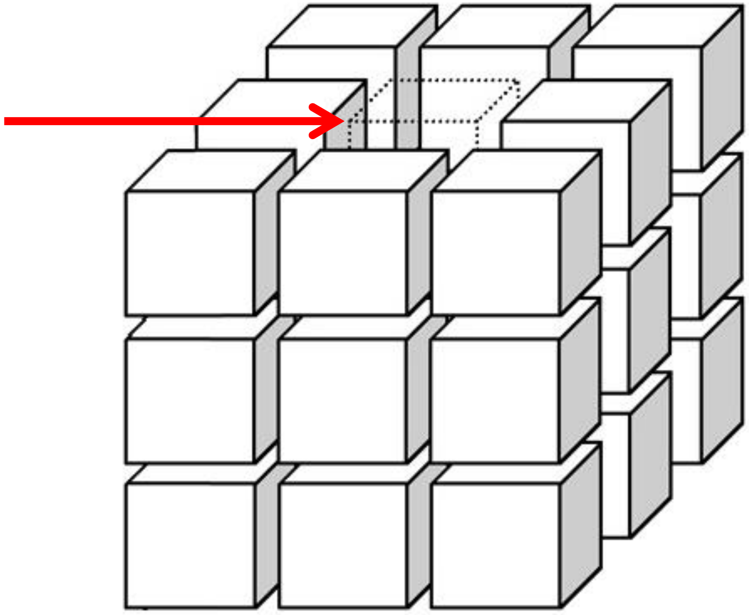
- The total number of cells of the cube in the example above is 6498
  - corresponding to all possible crossings of the dimensions
    - age groups (38) * countries (57) * sex (3)
      - But new dimensions could be added - In fact, even though it is called a cube, it is actually multi-dimensional (i.e. it allows more than three dimensions)

- The user should therefore identify the dimensions to be able to make a specific query
  - This is the reason why the SDMX standard provides structural metadata describing the organization of a dataset in the form of a Data Structure Definition (DSD) file
    - giving information about the number of dimensions of the dataset, the order of the dimensions, as well as the values for each dimension

DATASET STRUCTURE

- The DSD gives the user enough detail to write a query for data, but it does not make any guarantees about the presence of data
  - It is quite possible that the dataset is a sparse cube (i.e. there may not be data for every possible key permutation)

```
. sdmxuse data IMF, dataset(PGI) dimensions(A1.AIPMA...)
The query did not match any time series - check again the dimensions' values or
download the full dataset
```



SDMXUSE

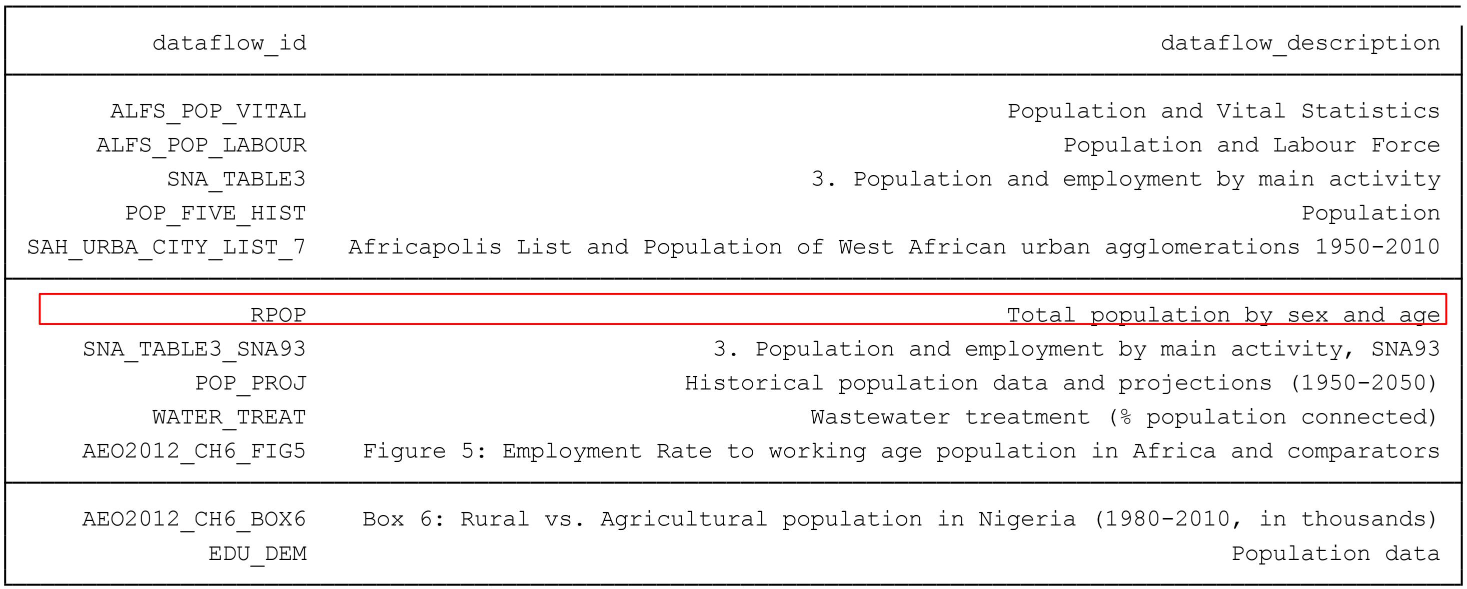
- The program `sdmxuse` allows for retrieving three types of resources:
  - Data flows
    - complete list of publicly available datasets with their identifiers and a description
  - Data Structure Definition
    - metadata describing the structure of a dataset, the order of dimensions for the query and the distinct values for each dimension
  - Time series data

- The syntax varies accordingly
  - `sdmxuse` **`dataflow`** *`provider`*
  - `sdmxuse` **`datastructure`** *`provider`*`, dataset(`*`identifier`*`)`
  - `sdmxuse` **`data`** *`provider`*`, dataset(`*`identifier`*`)`

- 6 providers are currently available
  - European Central Bank (ECB), Eurostat (ESTAT), International Monetary Fund (IMF), Organisation for Economic Co-operation and Development (OECD), United Nations Statistics Division (UNSD) and World Bank (WB)
    - Their acronym should be written in capital letters

WALK-THROUGH

- The following example uses `sdmxuse` to import and format population data in OECD countries
  - **Step 1**: find all publicly available datasets from OECD and search for those whose description contains the word “population”



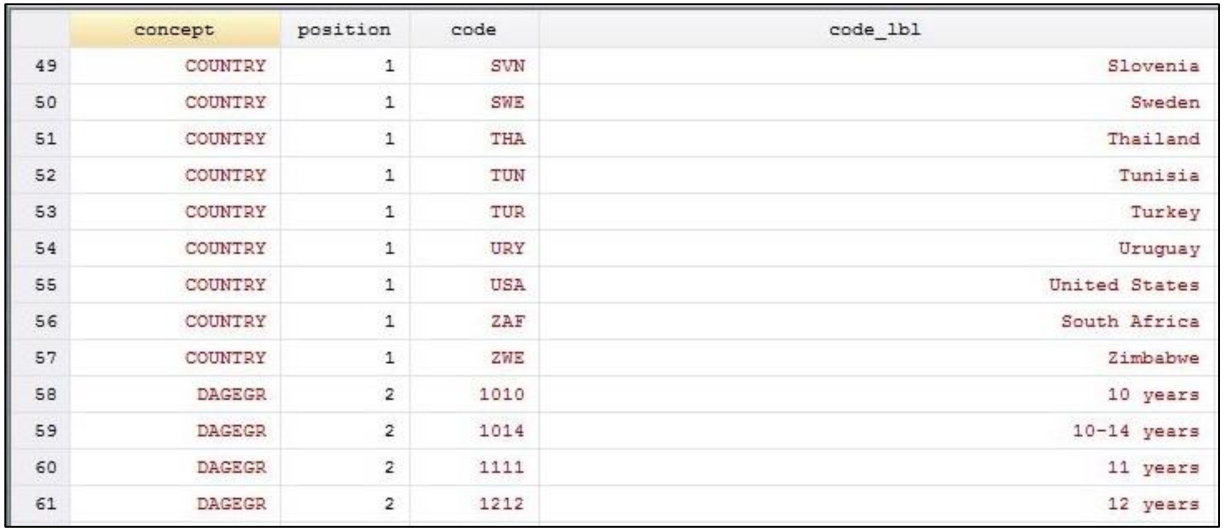
```
          dataflow_id                                                  dataflow_description
  ---------------------------------------------------------------------------------------------
       ALFS_POP_VITAL                                     Population and Vital Statistics
      ALFS_POP_LABOUR                                         Population and Labour Force
           SNA_TABLE3                                3. Population and employment by main activity
        POP_FIVE_HIST                                                          Population
  SAH_URBA_CITY_LIST_7   Africapolis List and Population of West African urban agglomerations 1950-2010
  ---------------------------------------------------------------------------------------------
                 RPOP                                          Total population by sex and age
     SNA_TABLE3_SNA93                      3. Population and employment by main activity, SNA93
             POP_PROJ                        Historical population data and projections (1950-2050)
          WATER_TREAT                                   Wastewater treatment (% population connected)
       AEO2012_CH6_FIG5    Figure 5: Employment Rate to working age population in Africa and comparators
  ---------------------------------------------------------------------------------------------
      AEO2012_CH6_BOX6    Box 6: Rural vs. Agricultural population in Nigeria (1980-2010, in thousands)
               EDU_DEM                                                    Population data
```

```
. sdmxuse dataflow OECD, clear
. list if regexm(lower(dataflow_description), "population"), noobs
```

WALK-THROUGH

- **Step 2**: find the Data Structure Definition of the RPOP dataset
  - The command also returns a message to indicate the names and order of the dimensions:

```
Order of dimensions: (COUNTRY.DAGEGR.DSEX.DSTATUS)
```

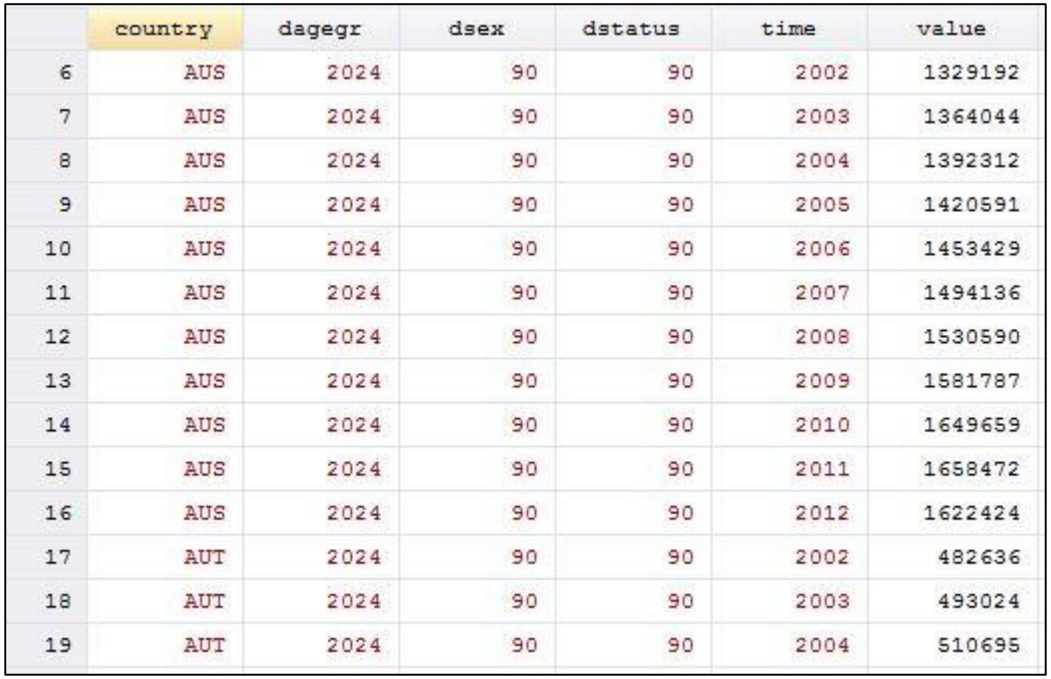


	concept	position	code	code_lbl
49	COUNTRY	1	SVN	Slovenia
50	COUNTRY	1	SWE	Sweden
51	COUNTRY	1	THA	Thailand
52	COUNTRY	1	TUN	Tunisia
53	COUNTRY	1	TUR	Turkey
54	COUNTRY	1	URY	Uruguay
55	COUNTRY	1	USA	United States
56	COUNTRY	1	ZAF	South Africa
57	COUNTRY	1	ZWE	Zimbabwe
58	DAGEGR	2	1010	10 years
59	DAGEGR	2	1014	10-14 years
60	DAGEGR	2	1111	11 years
61	DAGEGR	2	1212	12 years

```
. sdmxuse datastructure OECD, clear dataset(RPOP)
```

WALK-THROUGH

- **Step 3**: Customized request to obtain total population aged between 20 and 24 years
  - We leave the first and last dimensions empty, meaning that we want all values for those dimensions



	country	dagegr	dsex	dstatus	time	value
6	AUS	2024	90	90	2002	1329192
7	AUS	2024	90	90	2003	1364044
8	AUS	2024	90	90	2004	1392312
9	AUS	2024	90	90	2005	1420591
10	AUS	2024	90	90	2006	1453429
11	AUS	2024	90	90	2007	1494136
12	AUS	2024	90	90	2008	1530590
13	AUS	2024	90	90	2009	1581787
14	AUS	2024	90	90	2010	1649659
15	AUS	2024	90	90	2011	1658472
16	AUS	2024	90	90	2012	1622424
17	AUT	2024	90	90	2002	482636
18	AUT	2024	90	90	2003	493024
19	AUT	2024	90	90	2004	510695

```
. sdmxuse data OECD, clear dataset(RPOP) dimensions(.2024.90.)
```

WALK-THROUGH

- We can reshape the dataset to get all time series in separate variables or build a panel dataset
  - Here, we ask separated series for men and women by specifying the values “1+2” in the dimension DSEX

    - [, timeseries]
      - reshapes the dataset so that each series is stored in a single variable - variables' names are made of the values of the series for each dimension

```
. sdmxuse data OECD, clear dataset(RPOP) dimensions(.2024.1+2.) timeseries
```

    - [, panel(*panelvar*)]
      - reshapes the dataset into a panel - *panelvar* must be specified, it will often be the geographical dimension

```
. sdmxuse data OECD, clear dataset(RPOP) dimensions(.2024.1+2.) panel(COUNTRY)
```

WALK-THROUGH

More options are available

- Filtering the time dimension
  - [, start()] or [, end()]
    - defines the start/end period by specifying the exact value (e.g. 2010-01) or just the year (e.g. 2010)

- Attributes
  - [, attributes]
    - downloads attributes that give additional information about the series or the observations, but do not affect the dataset structure itself (e.g. observations' flags)

- Merge dataset and Data Structure Definition
  - [, mergedsd]
    - adds new variables with labels for dimensions’ values – useful if the meaning of a specific value is not transparent (e.g. ZAF for South Africa)

CONCLUDING REMARKS

- Many thanks to Robert Picard & Nicholas J. Cox for their program `moss`
- I believe that SDMX is an initiative that is worth investing in because it is sponsored by leading international statistical agencies
  - Joined by more and more national organizations
    - INSEE: https://www.insee.fr/en/information/2868055
- Some initiatives have already been implemented to facilitate the use of SDMX data for external users but they rely on the Java programming language
  - Formatting the data directly within Stata has proved to be quicker for large datasets
- `sdmxuse` could become an alternative to private data providers
  - e.g. Thomson Reuters Datastream, Macrobond
- Stata 15 integrates a module to import data from the Federal Reserve Economic Database (FRED)
  - built after the package **`freduse`** by David Drukker
    - http://www.stata.com/new-in-stata/import-fred/