Time Series Analysis

Discussion Section 00

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Organizational Issues

Axel Werwatz `axel.werwatz@tu-berlin.de`

Office hours: Tuesday 12:15 - 13:30 H 5103C

Lecture: Friday 12:15 - 13:45 H 0106

Franziska Plitzko `franziska.plitzko@tu-berlin.de`

Office hours: appointments via Mail

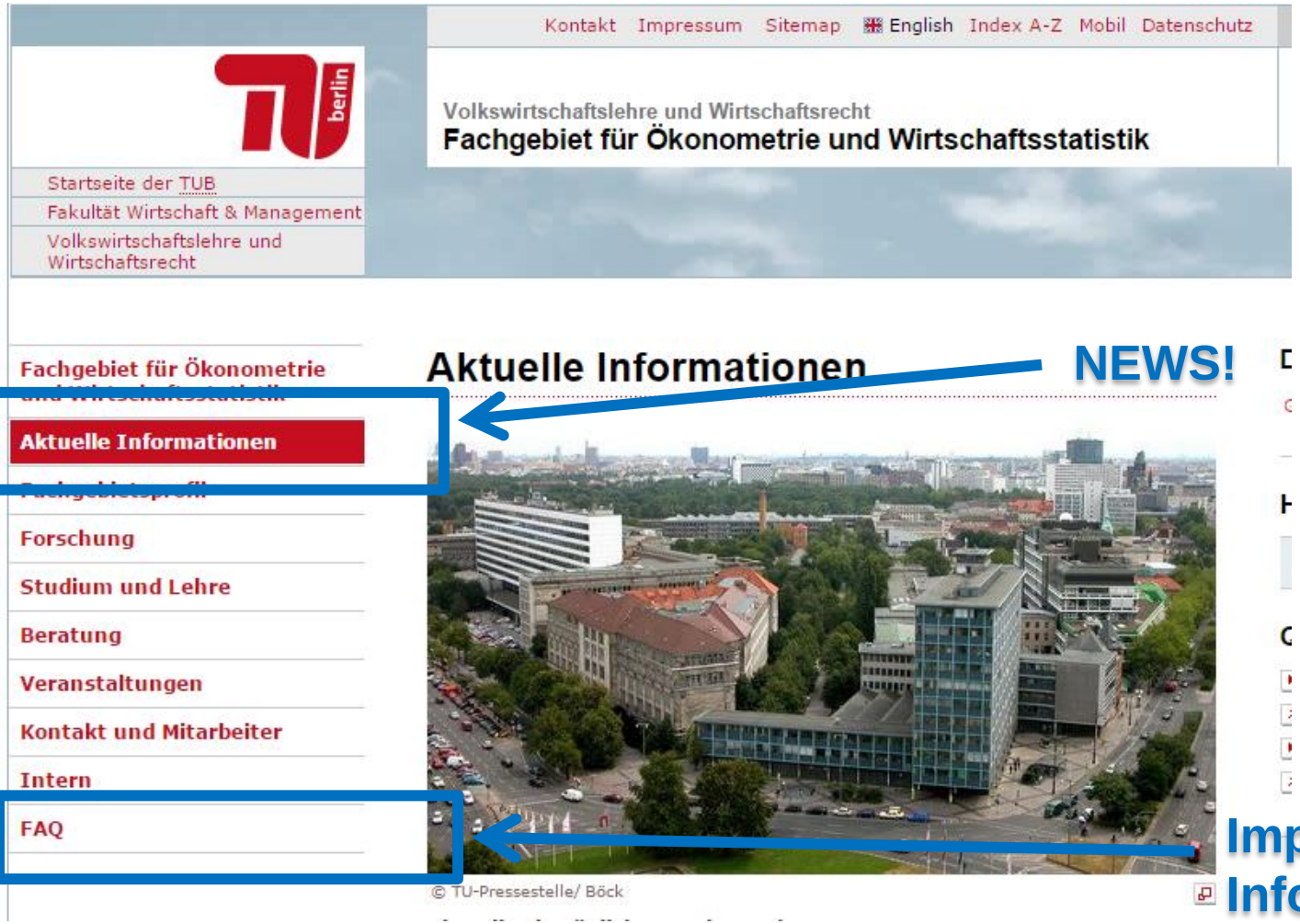
Tutorial (Ü): Thursday 8:30 - 10:00 **TEL 206_rechts**

occasionally EW 202

Next week (26.10.): Introduction to STATA

Check the homepage and the FAQ-Site!

www.statistik.tu-berlin.de/menue/home/



Franziska Plitzko

Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Organizational Issues

Course web page:

https://www.isis.tu-berlin.de/

- Fakultät VII

- Institut für Volkswirtschaftslehre und Wirtschaftsrecht

- Time Series Analysis WS17/18

Password: Zeit1718

Proposed examination date:

23.2.2018 **A151** (first week of semester break)

12:00-14:00

Registration for the exam:

TU STUDENTS:

1. Write down the asked information into the JOURNAL ("Registration for exam at our institute") on the ISIS-System

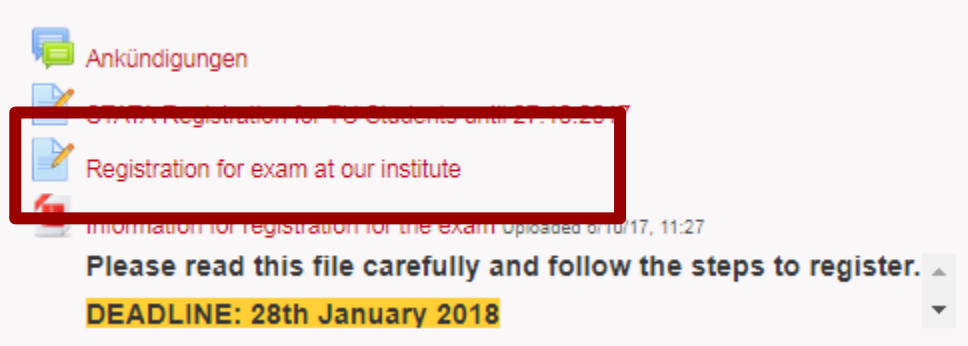
2. Register via QISPOS or "Prüfungsamt". QISPOS registration is possible from **16th October 2017 till 28th January 2018**. You can withdraw from the exam until the day before the actual exam via QISPOS.

   Yellow Sheets ("Gelbe Zettel") from the Prüfungsamt have to be given to our secretary Carola Haring (or the mailbox in front of our office H5103) until **28th January 2018**. We won´t accept those later on!

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Registration for the exam:

Follow the instruction in the Journal on ISIS!



Make-up exam:

There is (potentially) a make-upexam at the end of the semester break. It is **only for those**

• who failed the exam in February

• or who were sick at the first and have a **medical certificate** (Attest) – please sent the original to the Prüfungsamt within the given deadline of your field of study and a scan or copy to our secretary (carola.haring@tu-berlin.de).

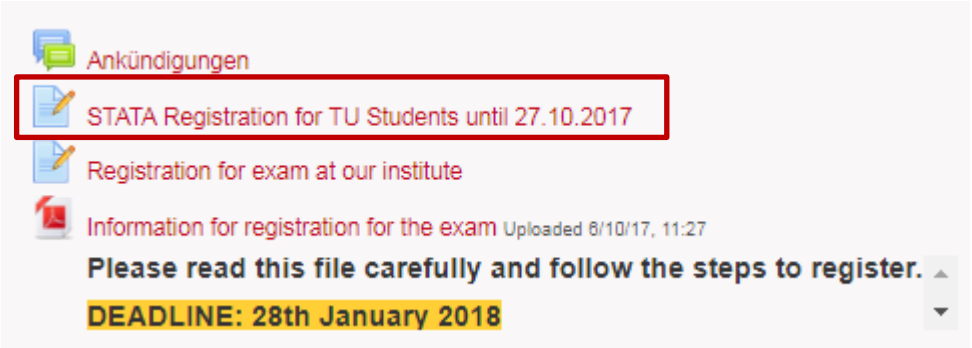
People who simply didn´t show up at the first exam are not eligible for the make-up exam.

Registration for the exam for guests:

E-Mail to **Franziska Plitzko** (franziska.plitzko@tu-berlin.de) **not later than 28.01.2018** including:

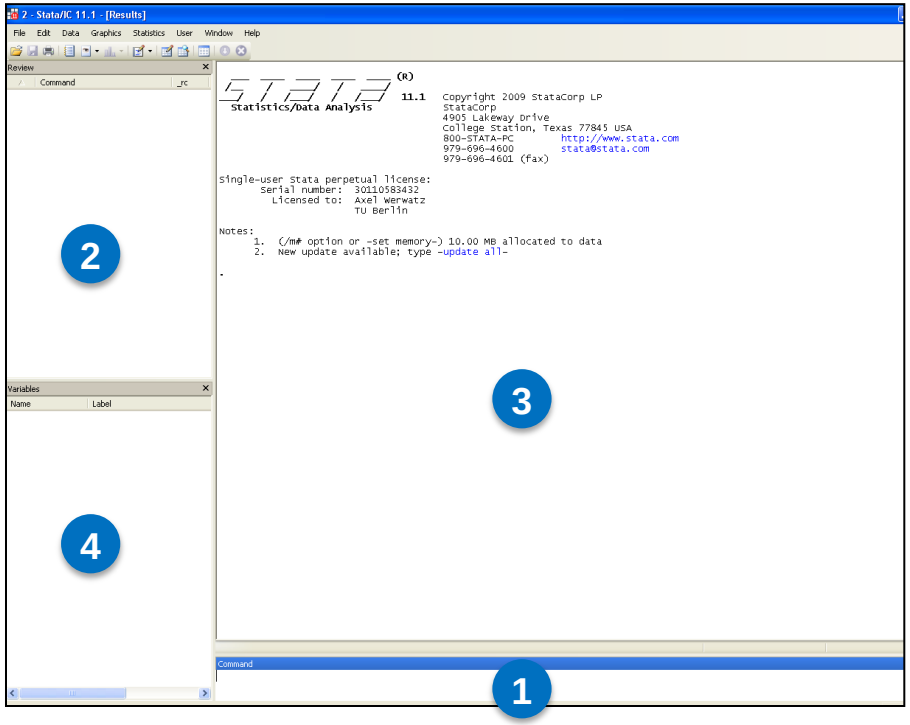
- course: Time Series Analysis
- last name,
- given name,
- student ID number (Msc. Statistics students **HU** and (if existent) TU no.),
- name of degree program (e.g. Wirtschaftsingenieurwesen, ...),
- aspired degree (e.g. Bachelor, Master, Diplom, PhD, ...),
- university

Please sign up for STATA!



Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

There are four **windows**:



- You enter your commands in the **Command Window** 1 .
- The **Review Window** 2 records your commands.
- The **Results Window** 3 displays your output.
- The **Variables Window** 4 lists the variables in the data set you are using.

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Syntax

```
[prefix :] command [varlist] [=exp] [if] [in] [weight]
[using filename] [, options]
```

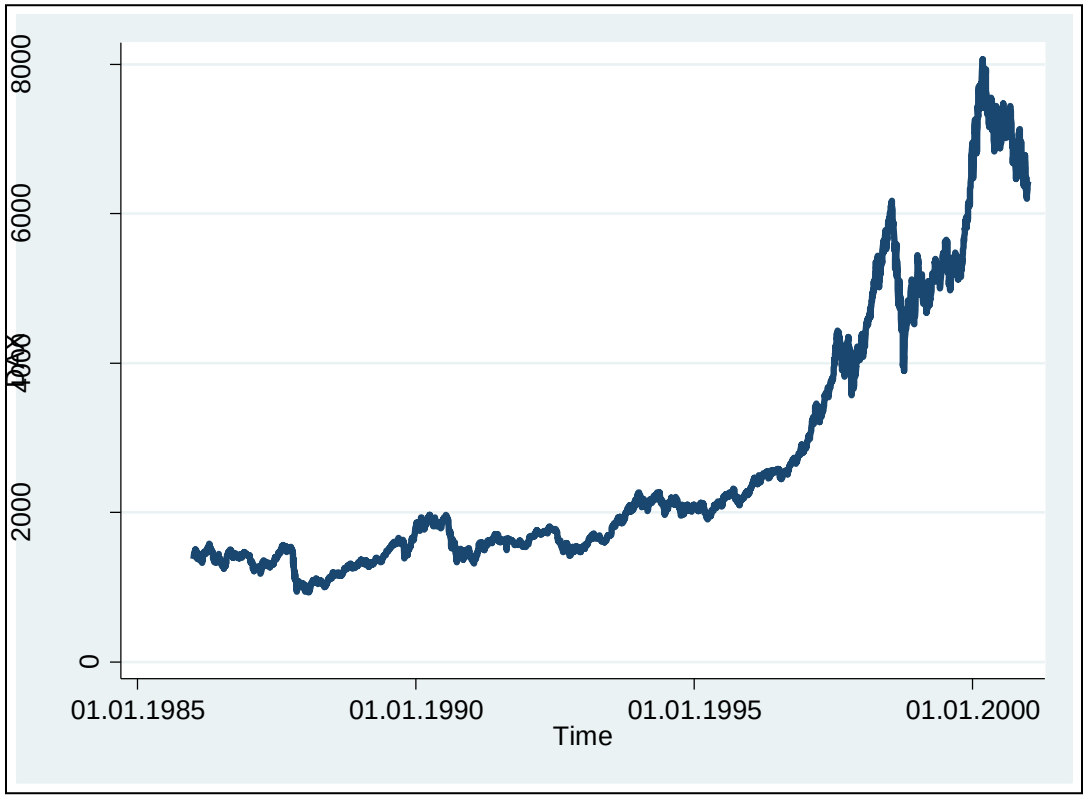
```
. list if dax>=7800, separator(10) mean(dax)
```

- **Square brackets** distinguish optional from required options.
- **Underlining** is used to indicate the **shortest abbreviations** where abbreviations are allowed.
- **Options**, denoted as options in the generic syntax diagram above, are specified at the end of the command. A comma must precede the first option.
- **Type in the commands** which start with the Stata prompt (“.”). Do not type the . prompt - this is used to indicate a Stata command.
- **Note**: Stata distinguishes between upper and lower case letters.

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Data set

Daily closing prices of the German **DAX** index over the period 1986 to 2000



We can see a clear trend! Not linear, but maybe exponential. Fluctuations seem to increase over time

Schmitt (2002) “Stochastische Volatilität” in: Schröder (Hrsg.) “Finanzmarktökonometrie”, S. 301-358

Loading a Data File and Open a Log File

```
. use filename, clear
```

The use command copies a Stata data file into Stata's memory (clear will empty the current contents of memory).*

Alternatives:

- If you want to use a Stata-format (.dta) data set previously saved on your disk, select File – Open from the top menu bar, or click on  to receive a standard Windows dialog-box.
- When you double click on a *Stata data set*, Stata will automatically open for you.

```
. log using filename.log, replace
```

or click on 

A log is a file containing what you type and Stata's output.*

* Note that if your filename contains embedded spaces, remember to enclose it in double quotes.

Useful Commands for Describing the Data

. **describe** (list of all the variables with their labels)

```
Contains data from C:\...\dax.dta
  obs:         3,757
 vars:             2                          22 Apr 2009 11:18
 size:        45,084 (99.9% of memory free)
------------------------------------------------------------------------------
              storage  display     value
variable name   type   format      label      variable label
------------------------------------------------------------------------------
time            float  %tdD.N.CY              Time
dax             float  %9.0g                  DAX
------------------------------------------------------------------------------
Sorted by:  time
```

Format	Description
%td	daily
%tw	weekly
%tm	monthly
%tq	quarterly
%th	halfyearly
%ty	yearly

The default formats are a function of the type of the variable, here we have a general float variable. If we want to set a fixed number of decimal places (for example 2) the display format would be: %9.2f

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Date formats

Example: `%tdD.N.CY`

Format	Description
c and C	display the century without/with a leading 0
y and Y	display the two-digit year without/with a leading 0
m and M	display Month, first letter capitalized, in three-letter abbreviation (m), or spelled out (M)
l and L	display month, first letter not capitalized, in three-letter abbreviation (l), or spelled out (L)
n and N	display month number without/with a leading 0
d and D	display day-within-month without/with a leading 0
j and J	display day-within-year without/with leading 0s
h	display the half of year (1 or 2)
q	display quarter of year (1, 2, 3, or 4)
w and W	display week of year (1, 2, ... 52) without/with a leading 0
_	display a blank
.	display a period
,	display a comma
:	display a colon
-	display a dash
/	display a slash

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Useful Commands for Describing the Data

. **list** (listing the contents of memory)

```
     +----------------------+
     |       time       dax |
     |----------------------|
  1. | 02.01.1986   1374.47 |
  2. | 03.01.1986   1414.52 |
  3. | 06.01.1986   1425.56 |
  4. | 07.01.1986   1428.54 |
  5. | 08.01.1986   1474.24 |
     |----------------------|
  6. | 09.01.1986   1461.18 |
  7. | 10.01.1986   1448.97 |

[...]

--more--
```

If "**more**" appears at the bottom, press 'enter' to continue scrolling the results or press 'q' or  to quit.

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Useful Commands for Describing the Data

. **set more off** (Stata will spew all of the output to the screen directly)

Highlighting a command in the Review Window will make it appear in the Command Window.

If you push the Page Up key, the last command you typed (the last one in the Review Window) will appear in the Command Window.

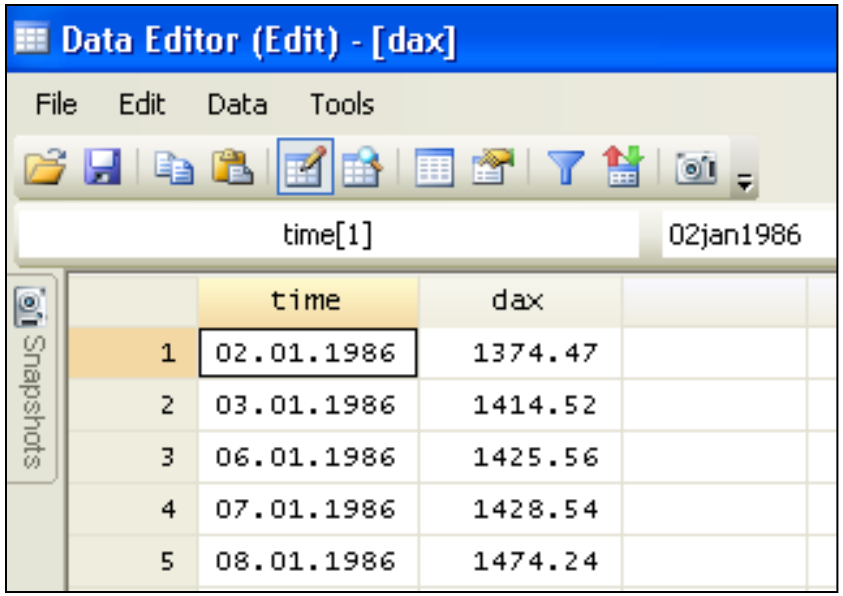
. **list**

```
     +----------------------+
     |       time       dax |
     |----------------------|
  1. | 02.01.1986   1374.47 |
  2. | 03.01.1986   1414.52 |

[...]

3756. | 28.12.2000   6371.64 |
3757. | 29.12.2000   6433.61 |
     +----------------------+
```

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Useful Commands for Describing the Data

. `edit` (or we can click on )



	time	dax
1	02.01.1986	1374.47
2	03.01.1986	1414.52
3	06.01.1986	1425.56
4	07.01.1986	1428.54
5	08.01.1986	1474.24

The Data Editor displays the current data set in spreadsheet format and can be used when cutting and pasting data to and from other spreadsheet applications. This window must be closed in order to issue commands.

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Useful Commands for Describing the Data

Changing the display format for dates:

```
. format time %tdd/M/Y

. list in 1/4

     +--------------------------+
     |             time       dax |
     |--------------------------|
  1. |    2/January/86   1374.47 |
  2. |    3/January/86   1414.52 |
  3. |    6/January/86   1425.56 |
  4. |    7/January/86   1428.54 |
     +--------------------------+
```

Format	Description
c and C	display the century without/with a leading 0
y and Y	display the two-digit year without/with a leading 0
m and M	display Month, first letter capitalized, in three-letter abbreviation (m), or spelled out (M)
l and L	display month, first letter not capitalized, in three-letter abbreviation (l), or spelled out (L)
n and N	display month number without/with a leading 0
d and D	display day-within-month without/with a leading 0
j and J	display day-within-year without/with leading 0s
h	display the half of year (1 or 2)
q	display quarter of year (1, 2, 3, or 4)
w and W	display week of year (1, 2, ... 52) without/with a leading 0
_	display a blank
.	display a period
,	display a comma
:	display a colon
-	display a dash
/	display a slash

Exercise 0.1: Change the display format to `-02 jan.1986-`

Solution 0.1:

```
. format time %td-D_l.CY-
```

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Time series dates

Format	Description	Coding
%td	daily	0 = 01jan1960, 1 = 02jan1960
%tw	weekly	0 = 1960w1, 1 = 1960w2
%tm	monthly	0 = 1960m1, 1 = 1960m2
%tq	quarterly	0 = 1960q1, 1 = 1960q2
%th	halfyearly	0 = 1960h1, 1 = 1960h2
%ty	yearly	1960 = 1960, 1961 = 1961

Note: Times before 1960 are allowed.

For instance:

`-1` means `31dec1959` in %td format and `1959q4` in %tq format.

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Exercise 0.2: Find the Stata code for the **first Monday in year 2000**

Format	Description	Coding
%td	daily	0 = 01jan1960, 1 = 02jan1960
%tw	weekly	0 = 1960w1, 1 = 1960w2
%tm	monthly	0 = 1960m1, 1 = 1960m2
%tq	quarterly	0 = 1960q1, 1 = 1960q2
%th	halfyearly	0 = 1960h1, 1 = 1960h2
%ty	yearly	1960 = 1960, 1961 = 1961

Leap years (Schaltjahre)

1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000

Calendar January 2000

Mo	Di	Mi	Do	Fr	Sa	So
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Note: . **`display`** can be used as a substitute for a hand calculator

```
. display 2+2
4
```

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Solution 0.2: Find the Stata code for the **first Monday in year 2000**

- 0 = 01jan1960
- 40 years into the future (each year with 365 days)
- 10 leap years (10 extra days)
- 3rd of January (2 extra days)

```
. display 365*40+10+2
14612

. list if time == 14612
     +-------------------------+
     |          time       dax |
     |-------------------------|
3504. | -03 jan.2000-   6750.76 |
     +-------------------------+
```

Alternative:

```
. list if time == td(3jan2000)
```

The Stata command **if** restricts the observations to meet certain criteria using logical operators. Logical operators:

< less than	**==** equal	**>** greater than	**&** and
<= less than or equal	**>=** greater than or equal	**~=** not equal	**|** or

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Useful Commands for Describing the Data

. **summarize** (table with number of observations, mean, standard deviation, minimum value, and maximum value of variables)

```
    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
        time |      3757     12241.8    1582.182      9498      14973
         dax |      3757    2682.192    1761.047    931.18    8064.97
```

. **sum dax**

```
    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
         dax |      3757    2682.192    1761.047    931.18    8064.97
```

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad s = \sqrt{s^2} \qquad s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$$

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Time series operators

Operator	Meaning
L.	lag x_{t-1}
L2.	2-period lag x_{t-2}
...	...
F.	lead x_{t+1}
F2.	2-period lead x_{t+2}
...	...
D.	difference $x_t - x_{t-1}$
D2.	difference of difference $x_t - x_{t-1} - (x_{t-1} - x_{t-2}) = x_t - 2x_{t-1} - x_{t-2}$
...	...
S.	"seasonal" difference $x_t - x_{t-1}$
S2.	lag-2 (seasonal) difference $x_t - x_{t-2}$
...	...

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Creating New Variables

```
. generate L_dax=L.dax
```

Generate allows you to create a new variable that is an algebraic expression of other variables.

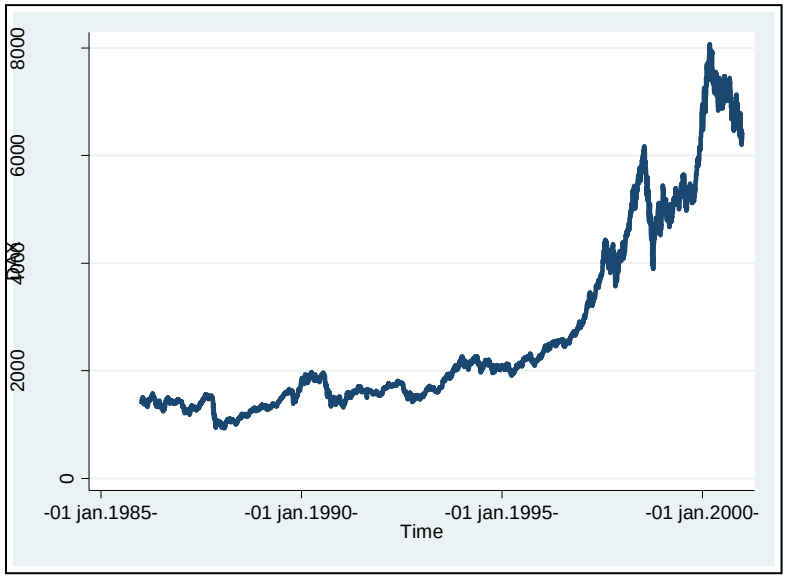
```
. list in 1/10
```

	time	dax	L_dax
1.	-02 jan.1986-	1374.47	.
2.	-03 jan.1986-	1414.52	1374.47
3.	-06 jan.1986-	1425.56	.
4.	-07 jan.1986-	1428.54	1425.56
5.	-08 jan.1986-	1474.24	1428.54
6.	-09 jan.1986-	1461.18	1474.24
7.	-10 jan.1986-	1448.97	1461.18
8.	-13 jan.1986-	1451.64	.
9.	-14 jan.1986-	1472.09	1451.64
10.	-15 jan.1986-	1507.77	1472.09

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Graphing Data

```
. graph twoway line dax time
. tsset time
time variable:  time, -02 jan.1986- to -29 dec.2000-, but with gaps
                delta:  1 day
. tsline dax
```



Exercise 0.3: winesales.dta

- Generate the appropriate `time` variable (from Jan. 1980 - Oct. 1991).

Recall:

- Creating New Variables: `generate` *`newvar`* `= exp`
- **System variables** (`_variables`)

  `_n` contains the number of the current observation. It is useful for indexing observations or generating sequences of numbers and can be used with mathematical operators.
- Time series dates:

Format (`%fmt`)	**Description**	**Coding**
%td	daily	0 = 01jan1960, 1 = 02jan1960
%tw	weekly	0 = 1960w1, 1 = 1960w2
%tm	monthly	0 = 1960m1, 1 = 1960m2
%tq	quarterly	0 = 1960q1, 1 = 1960q2
%th	halfyearly	0 = 1960h1, 1 = 1960h2
%ty	yearly	1960 = 1960, 1961 = 1961

`format` *`varlist`* `%tm`

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Solution 0.3: winesales.dta

- 0 = 1960m1
- 20 years into the future (each year with 12 month)
- minus 1 because _n adds 1 for the first observation

```
. display 12*20-1
239

. generate time = _n+239

. format time %tm

. list in 1/3
     +-------------------+
     | winesa~s     time |
     |-------------------|
  1. |      464   1980m1 |
  2. |      675   1980m2 |
  3. |      703   1980m3 |
     +-------------------+
```

Alternative

```
. generate time=_n+239
. format time %tm
. generate time_2=tm(1980m1)+_n-1
. format  time_2 %tm
. list time time_2 in 1/5

     +-------------------+
     |   time     time_2 |
     |-------------------|
  1. | 1980m1     1980m1 |
  2. | 1980m2     1980m2 |
  3. | 1980m3     1980m3 |
  4. | 1980m4     1980m4 |
  5. | 1980m5     1980m5 |
     +-------------------+
```

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de

Exit Stata

- Close your log-file by typing: `. log close`

  The results of all of your commands will be saved in the log file (e.g. *C:\Dokumente und Einstellungen\Desktop\test.log*).
- Right click in the Review window. A menu will appear. You can use the menu to highlight the entire contents of the review window ("select all") and send the highlighted commands to the do-file editor ("send to do-file editor"). The do-file editor will open up and contain all the commands that you have executed. Edit your do-file (e.g. delete your mistakes). Save your do-file. You can execute your do-file by clicking on the execute do-file button from the Stata do-file editor  .
- To save your data set click:  .

Save your files for the next discussion section by using an USB flash drive or by sending an email to your account.

Excursus: Warning regarding different formats!

Although you may store your numeric variables as `byte`, `int`, `long`, `float` or `double`, Stata converts all numbers to `double` before performing any calculations. Consequently, difficulties can arise in comparing numbers that have no finite binary representations.

For example, if the variable x is stored as a float and contains the value `1.1` (a repeating "decimal" in binary), the expression `x==1.1` will evaluate to false because the literal `1.1` is the double representation of `1.1`, which is different from the float representation stored in x. (They differ by 2.384 x 10^(-8).) The expression `x==float(1.1)` will evaluate to true because the float() function converts the literal `1.1` to its float representation before it is compared with x.

Franziska Plitzko
Raum: H 5103 D, **Tel.:** 314-78734, **E-Mail:** franziska.plitzko@tu-berlin.de