Introduction to Data Exploration and Visualization[1]

Introductory remarks: The handout series are collections of (1) illustrative examples shown and discussed during the formal presentation, meant to be annotated (i.e. not always self-explanatory) (2) information on how to use the EDA software (3) additional examples and implicitely or explicitely suggested directions for your exploration, (4) background information ...

Example collection

Ex.1

```
26 cantons
 Stemleaf:ALPS(1) Initiative of the Alps (rail transit)
 Legend:  2|6 stands for 25.51;   8|8 for 87.54
    2|6
    3|668
    4|458
    5|122355567799
    6|000124
    7|
    8|8
```

Ex.2

```
183 countries
 Stemleaf:Pop93(3) Population 1993
 Legend:  0|0 stands for 2000.00;  11|9 for 1188628990.00
    0|000000000000000000000000000000000000+138
    1|2236
    2|06
    3|
    4|
    5|
    6|
    7|
    8|
    9|0
   10|
   11|9
```

Ex.3

```
Stemleaf:Pop93(3) Population 1993
 Legend:  0|0 stands for 2000.00;  34|2 for 35212000.00
    0|000000001111111111111222222222233344+27
    2|14445678912333557
    4|0113356601122369
    6|26955778
    8|5566779017899
   10|1457934
   12|007
   14|0028
   16|5688
   18|294
   20|16112
   22|736
   24|
   26|1334
   28|79
   30|
   32|4
   34|2

  hi |(*27)
```

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1. E. Horber, 13.12.98 : intro.mss

This example shows the default display for the same data shown in the previous example. Observations much bigger (or smaller) - relatively speaking - than the others appear on a separate high (labelled hi) or low (labelled lo) stem. As a principle these observations should be *identified* and named. In this case there is not enough room to do so on a single stem-line, therefore EDA simply informs you that there are 27 countries on that stem.[2]

In the next example there is enough room to show case identifiers[3], i.e. Swiss canton abreviations.

Ex.4

```
Stemleaf:ALPS(1) Initiative of the Alps (rail transit)
 Legend:  3|8 stands for 37.65;   6|4 for 63.78

  lo |VS FR VD

    3|8
    4|458
    5|122355567799
    6|000124

  hi |UR
```

Ex.5

```
30 countries
 Stemleaf:PGrow(4) Population Growth
 Legend: -4|0 stands for -0.30;  10|0 for 1.10
   -4|
   -2|00
   -0|0
    0|000
    2|00000000
    4|00000
    6|000
    8|00
   10|000

  hi |ALBA TURQ AND
```

Below you will find a stem-and-leaf plot as it is produced by SPSS.

Ex.6

```
AGE       Age of respondent

 Valid cases:   959.0   Missing cases:   2.0   Percent missing:      .2

 Frequency    Stem &  Leaf

     2.00        1 .  &
    98.00        2 *  00000001111111222222233333344444
   108.00        2 .  55555555556666667777788888889999999
   100.00        3 *  00000000001111222223333344444444
    97.00        3 .  55555555666667777778888888999999
    97.00        4 *  00000011111111222222333334444444
    99.00        4 .  55555555556666667777788888999999
    63.00        5 *  000011111222233333444
    77.00        5 .  55566666777788888889999999
    40.00        6 *  00011122233344
    53.00        6 .  555666777888889999
    35.00        7 *  000122233444
    56.00        7 .  5556666777888888999
    33.00        8 *  0001122344
     1.00        8 .  &

 Stem width:  10
 Each leaf:       3 case(s)
```

---

2. The parentheses and the star are used to signal that this is the count of observations on the stem and not some - strangely labelled- observation or a stem containing digit-leaves.

3. In the EDA Software these names are called CASIDs

```
  & denotes fractional leaves.
```

Stemleaf-plots can be adapted for other purposes, for instance comparison of the distributions of two variables on the same display, showing them back to back.

Ex.7

```
30 countries
 Stemleaf:LifeEM(6) Life Expectancy (men)
 with    :LifeEF(7) Life Expectancy  (women)
 Legend: 68|0 stands for 68.00;  82|0 for 83.00
          LifeEM                      LifeEF
                                |lo |TURQ

                           000000| 68|
                              00| 70|
                        000000000| 72|
                    00000000000000| 74|0
                                  | 76|0000
                                  | 78|00000000
                                  | 80|000000000000
                                  | 82|0000
```

or to study differences between groups...

Ex.8

```
Stemleaf:GNPAgr(20) %GNP for Agriculture
 Groups defined by Continents
 Legend:  0|0 stands for 0.00;   5|5 for 55.00
     Asia              Africa            Europe             N&C.Am
    0|0111112234       |34               |1123333334444     |1122233444
    0|55778            |55567            |55666788          |5667899
    1|01               |1224444          |134               |134
    1|6899             |566              |667               |666999
    2|123              |111112           |03                |124
    2|5567             |577              |                  |
    3|24               |011344           |3                 |03
    3|9                |567              |                  |
    4|12               |3444             |                  |
    4|                 |5555677          |                  |
    5|11               |01123            |                  |
    5|                 |5                |                  |

 hi  |(* 4)            |GNEQ             |                  |
```

The next example is a histogram showing case ids as “leaves”.

Ex.9

```
30 countries
 Histogram:Urb(5) Urbanization
 midpoint
        32.50 | PORT
        37.50 | ALBA
        42.50 |
        47.50 |
        52.50 | ROUM
        57.50 | A    IRLA GREC HNGR
        62.50 | TURQ CH   POLO CHYP FI   AND
        67.50 | BULG
        72.50 | N    I    F
        77.50 | TCHE LUX
        82.50 | LIE  S
        87.50 | DK   MALT UK   NL
        92.50 | ISLA D    E
        97.50 | B    MONA
```

The next series of examples shows various numerical summaries

Ex.10

```
183 countries
 Summary:GNPCap(19) GNP per capita

          1622.00
    +-------------------+
 H  |   479.50  6491.50 |
 O  |    71.00 50000.00 |
```

This is a 5-number summary showing the median (1622), as well as the hinges labelled “H” (=letter value) and the minimum/maximum labelled “O” for “One” (=depth 1).

Ex.11

```
183 countries
 Summary:GNPCap(19) GNP per capita
          1622.00         spread    mid
    +-------------------------------------+
 H  |   479.50  6491.50 |  6012.00  3485.50 |
 O  |    71.00 50000.00 | 49929.00 25035.50 |
    Trimean= 2553.75
```

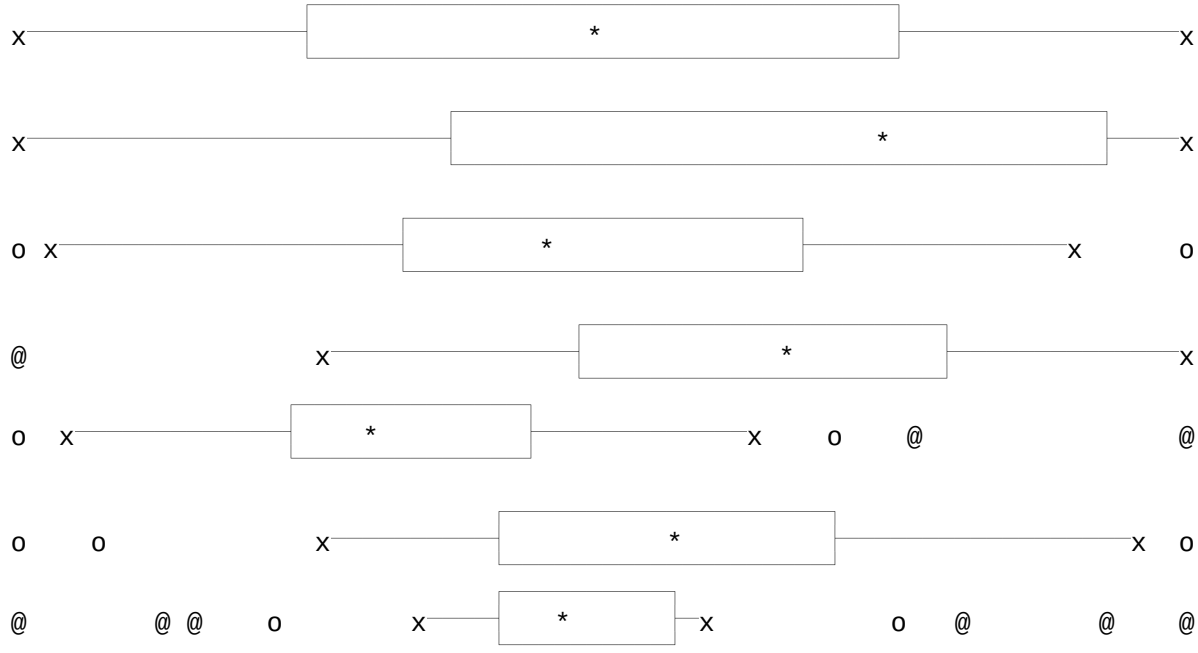
Ex.12

```
183 countries
 Summary:GNPCap(19) GNP per capita

          1622.00         spread    mid
    +-------------------------------------+
 H  |   479.50  6491.50 |  6012.00  3485.50 |
 E  |   283.50 15137.50 | 14854.00  7710.50 |
 D  |   191.00 21407.00 | 21216.00 10799.00 |
 C  |   172.00 23383.50 | 23211.50 11777.75 |
 B  |   117.00 25948.50 | 25831.50 13032.75 |
 A  |    84.00 30304.00 | 30220.00 15194.00 |
 O  |    71.00 50000.00 | 49929.00 25035.50 |
    Trimean= 2553.75
```

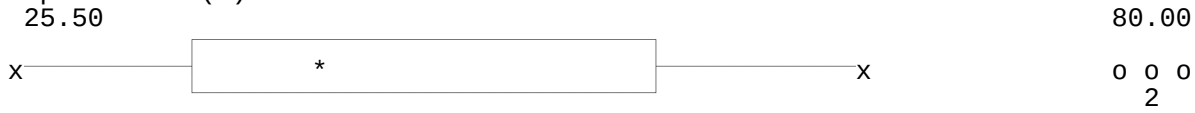
The next series shows boxplots, starting with an example illustrating the various forms boxplots can take....

Ex.13



Ex.14

Boxplot :EEE (1)



Extreme values (LO,HI): UR NE adjacent(LO,HI): UR FR
Hi outliers:JU GE VD NE

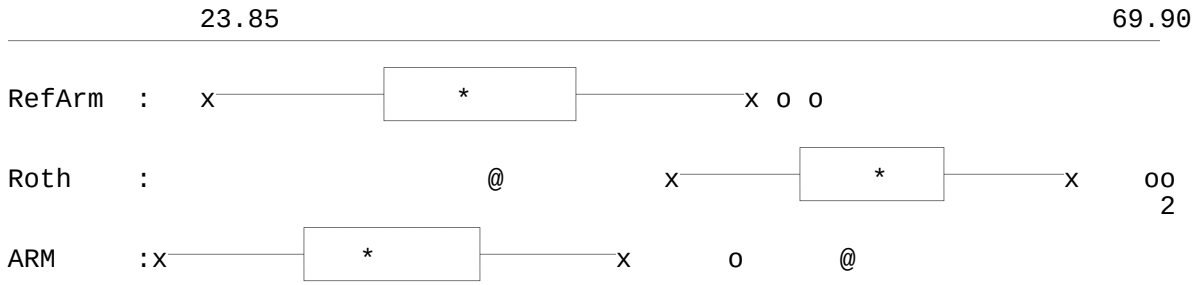
Ex.15

Boxplot :Part90 (4) Participation avril 1990 Tot=40.5

Extreme values (LO,HI): GE SH adjacent(LO,HI): TI SO
Lo outliers:GE
Hi outliers:NW ZG SH

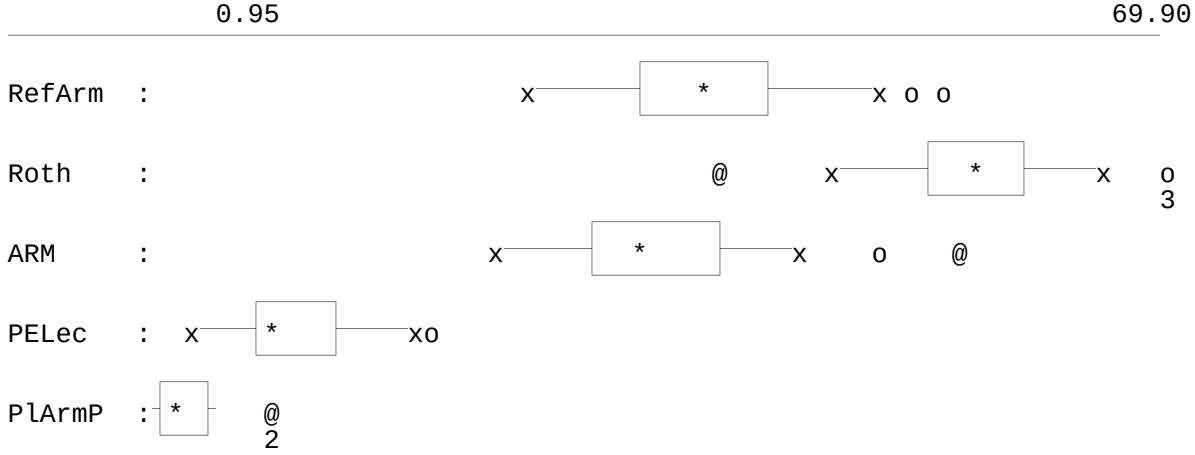
Ex.16

Parallel Boxplots



Ex.17

Parallel Boxplots



Ex.18

Boxplot :divison (9)

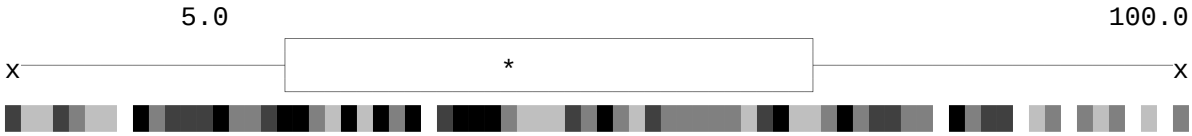
```
Extreme values (LO,HI): PA   WY   adjacent(LO,HI): PA   WY
Stemleaf:divison (  9)
Legend:  1|0 stands for      1.00;   4|0 for      4.00
   1|000000000
   1|
   2|0000000000000000
   2|
   3|000000000000
   3|
   4|0000000000000
Density line for :divison (  9)
```

A density line is a kind of one-line histogram showing concentrations.

Let us examine another density line, shown together with a boxplot of the same variable.

Ex.19

```
177 countries
 Boxplot :Urb     ( 11) Urbanization
```




```
A ‘ ’ symbol corresponds approx. to 1.0 occurrence(s).
```

This is a coded density line: the four symbols shown code frequencies at specific locations; as the legend says the lightest symbols corresponds here to more or less one occurrence, i.e. one country.

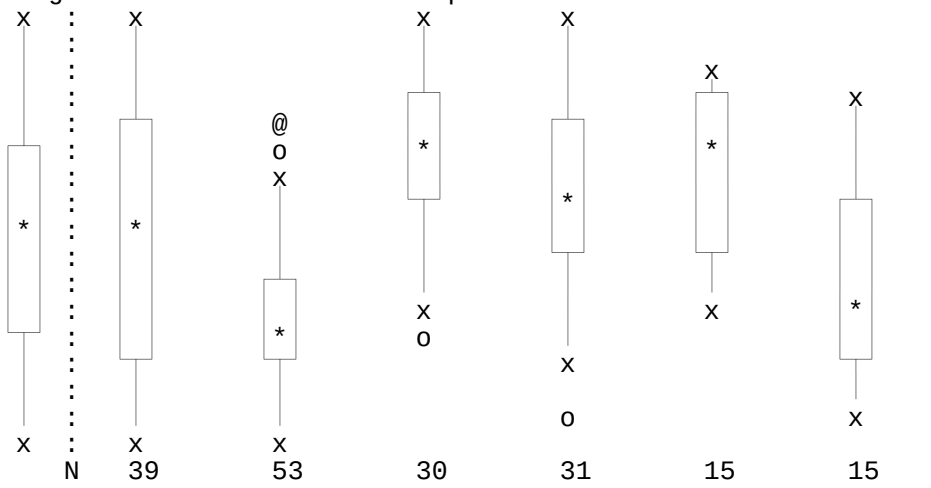
Ex.20

```
3113211 523336223442141624 3446211132621322222135112523332252233 12 212 1 2
```

This is another form of the density line, showing the same information using single digits for every location, i.e. a ‘3’ means 3 countries. A star is shown if more than 9 observations are found at the same location.

Ex.21

```
183 countries
 Trace of :Urb(5) Urbanization
 Range: 5.00 - 100.00 ; Groups: Continents
```



EDA Software: First steps

Before starting to work with the EDA package you need to know how to call EDA on your computer and how to write EDA commands.

How to write EDA commands

You interact with EDA using simple commands. There is no difference between commands written in lower or upper case letters.[4] In the various examples and in the manual however we will always use *upper case* letters for commands and options. Lower case letters will be used for parts of commands you should supply (variable names etc.)

For clarity all command line examples will be preceded by the > symbol. This symbol is *not* part of the command and should never be typed.

For instance

```
>GET name
```

GET is the name of the command to be typed (in upper or lower case letters). *name*: you should supply a valid name (name of a work area = data set).

```
>GET SET2
```

is an command as you might type it, i.e. SET2 is a work area name. (Uppercase because this is an acutal command line example).

```
>BOXPLOT 1
>BOXPLOT 1,2,4
>BOXPLOT 1-10 PARALLEL
>BOXP 1-10 PAR
```

The four examples produce boxplots. The first example displays a boxplot for variable number 1; the second three boxplots for variables 1,2 and 4. Thee third example produces parallel boxplots for all variables from 1 to 10; PARALLEL is an option. The last example is identical to the third, except that it shows that you need not type all letters. 1; 1,2,4 and 1-10 show various forms of variable lists. Variable lists are always specified immediately after the command name (before any option).

Data in EDA

Data you want to analyse has to be brought into the EDA work area, i.e. the active data matrix (data sheet). The GET command reads a data-set[5] into the EDA Work Area (WA), i.e. the data matrix to be analysed.

Use the DIR[6] command to see a list of available datasets. This command will show the name and a short description of all datasets in the EDA library, i.e. the data sets available with a GET command.

Syntax conventions

The user's manual and the on-line help use a number of syntactical conventions. If you type:

```
>?STEMLEAF
```

you will see the syntax of the STEMLEAF command: *Do not worry if you do not understand all the details of the command itself, concentrate on the syntactical constructs used.*

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4. Later we will learn that case and variable names are case-sensitive.

5. The data sets read by GET are EDA specific system files, i.e. the only software package that can read and produce them is EDA. Of course EDA has a number of commands to bring in data from the "outside world", namely the *READ command and its many options. But start to learn how to work with EDA using the various data sets which are readily available.

6. Note that this is an EDA command, and NOT the DOS DIR command.

```
STEMLEAF v <opt>
STEMLEAF v  BYGVAR{=gvar#} [NGROUPS=ng] <opt>
STEMLAEF v  SPLIT (log-expression) [PARALLEL] <opt>
STEMLEAF v1,v2 <opt>

<opt> [SCALE=value] [WIDTH=chars]
      [NOLINE] [NOHILOSTEM]
      [ASCENDING|DESCENDING]
```

There are four different forms (producing variations of the stem and leaf-plot) of the command each of them sharing a number of common options. A number of *metasymbols*[7] are used:

```
v       Refers to a single variable
[]      Used to indicate an option
{}      Options within options
|       Select one (alternatives). In the [ASC|DESCENDING] example
        select either ASC or DESC, if you use this option ([]= option)
<opt>   see definition of <opt> elsewhere, usually below
```

Even though syntax diagrams might look complex, sometimes frightening, make sure to understand that, the actual command you are typing will often be very simple, e.g. STEMLEAF 1, sometimes with an option or two.

A first list of commands

These commands perform common tasks and are useful to learn about exploratory tools. All of them are straightforward to use and to understand (from the output they produce). You are invited to try them out.

```
GET  name          Gets a work area from the archive library
DIR                Shows the work areas in the archive library

DESCRIBE  vlist    display variable info. (labels and descriptors)
DESCRIBE  ALL      display variable info for all variables in the WA


STEMLEAF           produces a stem and leaf plot
HISTOGRAM          shows a histogram
HISTOGRAM vlist BAR  “classical” histogram
LIST               listing variables, many options (coded etc)
SHOW               conditional lists SHOW FAR shows only outliers
BOXPLOT            displays a box-and-whisker plot
  PARALLEL            parallel boxplot
SUMMARY            numerical summaries (5-number summaries etc)
DISPLAY            numerical summaries (MEDIAN MEAN etc)
QSUMMARY           quick summaries
DLINE              density lines (single line histograms)
  CODED              coded density lines
PLOT               plot two or more variables (many forms)
  PI                 plot inspect module
```

Controlling screen output

Most commands produce output in a way that you can see all information on a single screen. There are however exceptions: output from commands producing lists usually does not fit on a single screen. Commands like the LIST or DIR command will, by default, automatically page the output, i.e. after a screenfull of output, the display stops and you are invited to hit the return key to see the next screenfull[8]

The are some situations however where the information quickly scrolls off the screen and when the screen stops you are looking at the bottom of the display. In this situation you might use the <PAUSE> or <SCROLL-LOCK> keys on your PC to stop scrolling or you might tell EDA to stop after each screenfull of information: this is done with the SET PAGE ON command (turns paging on; SET PAGE OFF turns it off).

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7. Metasymbols are symbols used to explain the syntax and are not used in actual commands

8. You are also offered the choice to stop at that point.

Additional information

Type INFO INFO to see what other course specific on-line information is available.

Basic information (command lists, general concepts etc) can be obtained from the HELP command; syntactical information on a specific command is produced by ?<name>, where name is the name of a valid EDA command.