Quantitative Methods in Finance

Tutorial, Part 1:
Introduction to Stata.

Example 1: We have data available for variables y, x_1, x_2 and x_3. We observe each variable eight times, as shown in the table below. The data are provided in Stata Data file `basics_stata.dta`, while the programming code, needed for this exercise, is given in Stata Do file `basics_stata-commands.do`.

i	1	2	3	4	5	6	7	8
y_i	2	2	1	5	–4	1	4	1
x_{1i}	1	1	1	1	1	1	1	1
x_{2i}	1	2	0	–1	1	–1	–2	0
x_{3i}	–1	–1	2	–4	3	0	2	–1

a) Explore the data using different Stata commands. How would you edit the data manually for specific variables and specific observations in the data base?
b) Explore the data now using different Stata plots or diagrams. Use the scatter plot, line plot and histogram.
c) Based on the existing variables in the data base, generate new variables using different transformations. Use multiplication, absolute values, logarithms, exponential function (anti-logarithms), and standardisation.
d) Recall the results from Stata's memory for a simple command `summarize` and an extended command `regress`. How would you save them for later use?
e) Show the covariance and correlation matrix of variables y, x_2 and x_3. Also, establish the statistical significance of the calculated correlation coefficients.

Computer printout of the results in Stata:

```
a) Data exploration

. describe

Contains data
  obs:             8
 vars:             5
-------------------------------------------------------------------------------
              storage  display     value
variable name   type   format      label      variable label
-------------------------------------------------------------------------------
obs             float   %9.0g                 Observation
y               float   %9.0g                 Variable y
x1              float   %9.0g                 Variable x1
x2              float   %9.0g                 Variable x2
x3              float   %9.0g                 Variable x3
-------------------------------------------------------------------------------
Sorted by:
     Note:  dataset has changed since last saved
```

. inspect x2

```
x2:  Variable x2                              Number of Observations
--------------------                     ------------------------------
                                            Total   Integers   Nonintegers
|      #   #   #            Negative           3          3           -
|      #   #   #            Zero               2          2           -
|      #   #   #            Positive           3          3           -
|  #   #   #   #   #                       -----      -----       -----
|  #   #   #   #   #        Total              8          8           -
|  #   #   #   #   #        Missing            -
+----------------------                    -----
-2                    2                        8
   (5 unique values)
```

. sum y x1 x2 x3

```
    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
           y |         8         1.5    2.672612        -4          5
          x1 |         8           1           0         1          1
          x2 |         8           0    1.309307        -2          2
          x3 |         8           0    2.267787        -4          3
```

. sum y, detail

```
                          Variable y
-------------------------------------------------------------
      Percentiles      Smallest
 1%           -4             -4
 5%           -4              1
10%           -4              1       Obs                   8
25%            1              1       Sum of Wgt.           8

50%          1.5                      Mean                1.5
                        Largest       Std. Dev.       2.672612
75%            3              2
90%            5              2       Variance        7.142857
95%            5              4       Skewness           -.864
99%            5              5       Kurtosis         3.5344
```

. tabstat y x1 x2 x3, stat(N mean sd median sum min max)

```
   stats |         y        x1        x2        x3
---------+----------------------------------------
       N |         8         8         8         8
    mean |       1.5         1         0         0
      sd |  2.672612         0  1.309307  2.267787
     p50 |       1.5         1         0      -.5
     sum |        12         8         0         0
     min |        -4         1        -2        -4
     max |         5         1         2         3
------------------------------------------------
```

. tab y

```
   Variable y |      Freq.     Percent        Cum.
--------------+-----------------------------------
           -4 |          1       12.50       12.50
            1 |          3       37.50       50.00
            2 |          2       25.00       75.00
            4 |          1       12.50       87.50
            5 |          1       12.50      100.00
--------------+-----------------------------------
        Total |          8      100.00
```

. tab y x3

Variable y	Variable x3					
	-4	-1	0	2	3	Total
-4	0	0	0	0	1	1
1	0	1	1	1	0	3
2	0	2	0	0	0	2
4	0	0	0	1	0	1
5	1	0	0	0	0	1
Total	1	3	1	2	1	8

. list, N mean sum

	y	x1	x2	x3
1.	2	1	1	-1
2.	2	1	2	-1
3.	1	1	0	2
4.	5	1	-1	-4
5.	-4	1	1	3
6.	1	1	-1	0
7.	4	1	-2	2
8.	1	1	0	-1
Mean	1.5	1	0	0
Sum	12	8	0	0
N	8	8	8	8

. list in 4/8

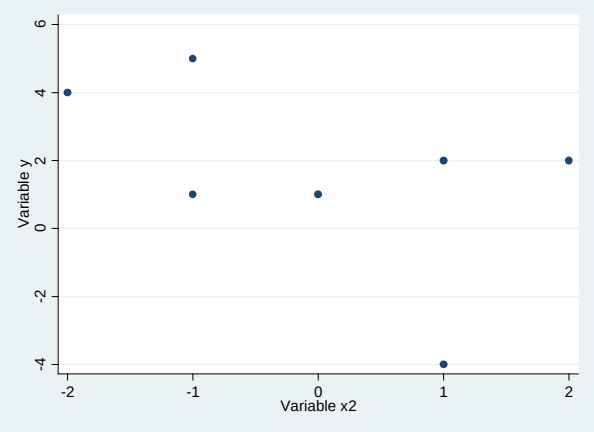
	y	x1	x2	x3
4.	5	1	-1	-4
5.	-4	1	1	3
6.	1	1	-1	0
7.	4	1	-2	2
8.	1	1	0	-1

. list x1 x2 if x2>=0

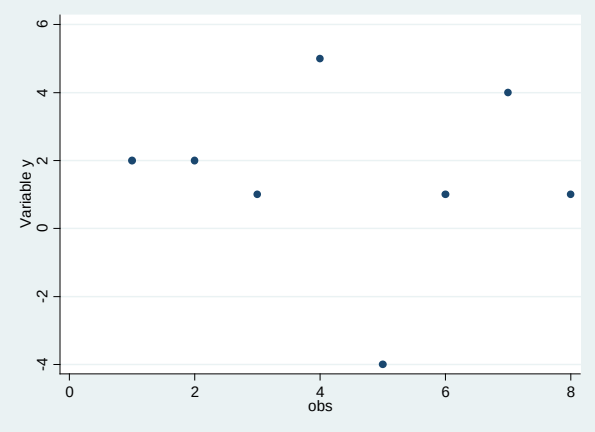
	x1	x2
1.	1	1
2.	1	2
3.	1	0
5.	1	1
8.	1	0

b) Diagrams in Stata

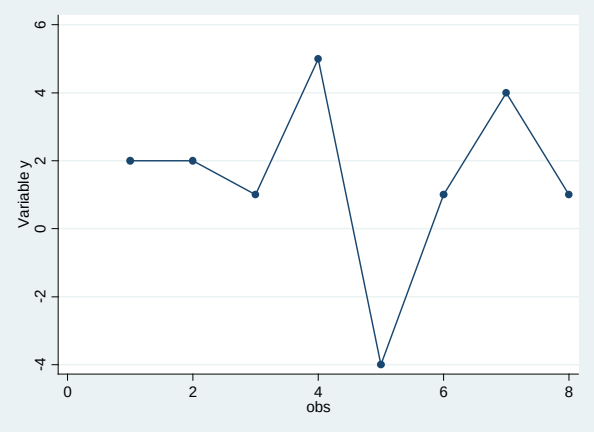
. twoway scatter y x2



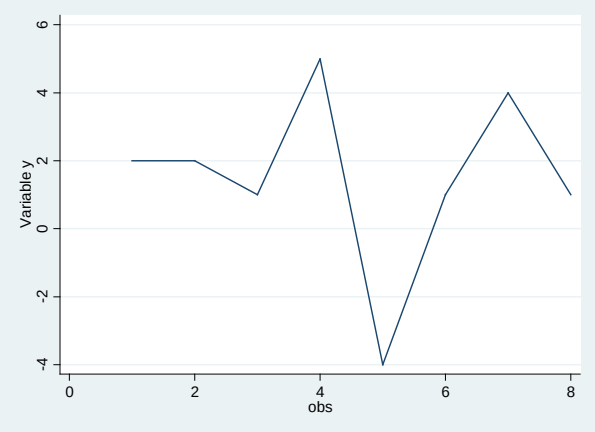
. twoway scatter y obs



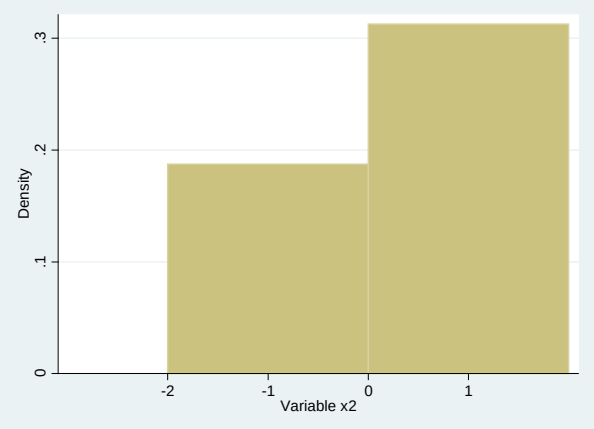
. twoway connected y obs



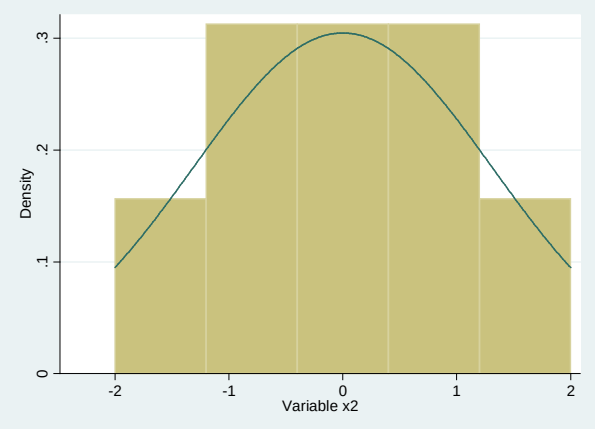
. twoway line y obs



. hist x2
(bin=2, start=-2, width=2)



. hist x2, bin(5) normal
(bin=5, start=-2, width=.8)



c) Generating new variables

```
. gen yx2=100*y*x2

. gen x2sq=x2^2

. gen x2a=abs(x2)

. gen lx2=log(x2)
(5 missing values generated)

. gen ex2=exp(lx2)
(5 missing values generated)

. list
```

	y	x1	x2	x3	obs	yx2	x2sq	x2a	lx2	ex2
1.	2	1	1	-1	1	200	1	1	0	1
2.	2	1	2	-1	2	400	4	2	.6931472	2
3.	1	1	0	2	3	0	0	0	.	.
4.	5	1	-1	-4	4	-500	1	1	.	.
5.	-4	1	1	3	5	-400	1	1	0	1
6.	1	1	-1	0	6	-100	1	1	.	.
7.	4	1	-2	2	7	-800	4	2	.	.
8.	1	1	0	-1	8	0	0	0	.	.

```
. replace lx2=0 if lx2==.
(5 real changes made)

. egen x2s=std(x2)

. list lx2 x2s
```

	lx2	x2s
1.	0	.7637626
2.	.6931472	1.527525
3.	0	0
4.	0	-.7637626
5.	0	.7637626
6.	0	-.7637626
7.	0	-1.527525
8.	0	0

```
. drop obs yx2 x2sq x2a lx2 ex2 x2s
```

d) Recall of data from Stata's memory

```
. sum y
```

Variable	Obs	Mean	Std. Dev.	Min	Max
y	8	1.5	2.672612	-4	5

```
. return list

scalars:
                  r(N) =  8
              r(sum_w) =  8
               r(mean) =  1.5
                r(Var) =  7.142857142857143
                 r(sd) =  2.672612419124244
                r(min) =  -4
                r(max) =  5
                r(sum) =  12

. regress y x2 x3

      Source |       SS       df       MS              Number of obs =       8
-------------+------------------------------           F(  2,     5) =    4.54
       Model |       32.25     2      16.125           Prob > F      =  0.0751
    Residual |       17.75     5        3.55           R-squared     =  0.6450
-------------+------------------------------           Adj R-squared =  0.5030
       Total |          50     7  7.14285714           Root MSE      =  1.8841

------------------------------------------------------------------------------
           y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          x2 |         -1   .5439056    -1.84   0.125    -2.398154    .3981539
          x3 |       -.75   .3140241    -2.39   0.063    -1.557225    .0572245
       _cons |        1.5   .6661456     2.25   0.074    -.2123819    3.212382
------------------------------------------------------------------------------

. ereturn list

scalars:
                  e(N) =  8
               e(df_m) =  2
               e(df_r) =  5
                  e(F) =  4.542253521126761
                 e(r2) =  .645
               e(rmse) =  1.884144368141677
                e(mss) =  32.25
                e(rss) =  17.75
               e(r2_a) =  .503
                 e(ll) =  -14.53928416260374
               e(ll_0) =  -18.68183412063062
               e(rank) =  3

macros:
            e(cmdline) : "regress y x2 x3"
              e(title) : "Linear regression"
          e(marginsok) : "XB default"
                e(vce) : "ols"
              e(depvar) : "y"
                e(cmd) : "regress"
         e(properties) : "b V"
            e(predict) : "regres_p"
              e(model) : "ols"
          e(estat_cmd) : "regress_estat"

matrices:
                  e(b) :  1 x 3
                  e(V) :  3 x 3

functions:
             e(sample)
```

```
. scalar r2=e(r2)
. display r2
.645

. matrix varcov=e(V)
. matrix list varcov

symmetric varcov[3,3]
              x2         x3      _cons
   x2  .29583333
   x3          0  .09861111
_cons          0          0     .44375

. scalar varcov22=varcov[2,2]
. display varcov22
.09861111
```

e) Covariances and correlations

```
. correlate y x2 x3, covariance
(obs=8)

             |        y       x2       x3
-------------+---------------------------
           y |  7.14286
          x2 | -1.71429  1.71429
          x3 | -3.85714        0  5.14286


. correlate y x2 x3
(obs=8)

             |        y       x2       x3
-------------+---------------------------
           y |   1.0000
          x2 |  -0.4899   1.0000
          x3 |  -0.6364   0.0000   1.0000


. pwcorr y x2 x3, sig

             |        y       x2       x3
-------------+---------------------------
           y |   1.0000
             |
             |
          x2 |  -0.4899   1.0000
             |   0.2178
             |
          x3 |  -0.6364   0.0000   1.0000
             |   0.0898   1.0000
             |

. clear all
```

■

Example 2: The enclosed Stata Data file `basics_time_series.dta` contains a time series starting in year 1950. The programming code, needed for this exercise, is given in Stata Do file `basics_time_series-commands.do`.

a) Open the Stata data file. Explore the data using different Stata commands.
b) Set the time dimension of the data. Then sort the data base with respect to the time variable and change the order of variables. Generate a linear trend, dummy variables for seasons, and the cyclical component.
c) Generate a dummy variable that takes the value 1 for values of our time series variable higher than 80% of its median or lower than two thirds of its mean, and 0 otherwise.
d) Generate first and fourth lags of our time series variable, and second forward lags (leads). Also, generate first differences of the variable.

Computer printout of the results in Stata:

a) Data exploration

```
. inspect spr

spr: Time variable (in units of measurement)     Number of Observations
------------------------------------------------ ------------------------------
                                                    Total   Integers   Nonintegers
|  #                          Negative                  -          -             -
|  #                          Zero                      -          -             -
|  #   #                      Positive                204         18           186
|  #   #   #   #                                      -----      -----        -----
|  #   #   #   #              Total                   204         18           186
|  #   #   #   #   #          Missing                   -
+----------------------                               -----
1610.5           9303.9                               204
(More than 99 unique values)

. tabstat spr, stat(N mean sd median sum min max)

    variable |        N      mean        sd       p50       sum       min       max
-------------+--------------------------------------------------------------------
         spr |      204  4562.646  2113.962    4142.2  930779.7    1610.5    9303.9
----------------------------------------------------------------------------------
```

b) Identification of time dimension and generating periodic components

```
. tsset quarter
        time variable:  quarter, 1950q1 to 2000q4
                delta:  1 quarter

. sort quarter
. order quarter, last
. order quarter, first

. gen t=_n

. gen q=quarter(dofq(quarter))

. tabulate q, gen(d)

          q |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |         51       25.00       25.00
          2 |         51       25.00       50.00
```

```
          3 |         51       25.00       75.00
          4 |         51       25.00      100.00
------------+-----------------------------------
      Total |        204      100.00
```

```
. drop q

. gen t2=t^2
. gen t3=t^3

. list
```

	quarter	spr	t	d1	d2	d3	d4	t2	t3
1.	1950q1	1610.5	1	1	0	0	0	1	1
2.	1950q2	1658.8	2	0	1	0	0	4	8
3.	1950q3	1723	3	0	0	1	0	9	27
4.	1950q4	1753.9	4	0	0	0	1	16	64
5.	1951q1	1773.5	5	1	0	0	0	25	125
6.	1951q2	1803.7	6	0	1	0	0	36	216
7.	1951q3	1839.8	7	0	0	1	0	49	343
8.	1951q4	1843.3	8	0	0	0	1	64	512
9.	1952q1	1864.7	9	1	0	0	0	81	729
10.	1952q2	1866.2	10	0	1	0	0	100	1000
11.	1952q3	1878	11	0	0	1	0	121	1331
12.	1952q4	1940.2	12	0	0	0	1	144	1728
13.	1953q1	1976	13	1	0	0	0	169	2197
14.	1953q2	1992.2	14	0	1	0	0	196	2744
15.	1953q3	1979.5	15	0	0	1	0	225	3375
16.	1953q4	1947.8	16	0	0	0	1	256	4096
17.	1954q1	1938.1	17	1	0	0	0	289	4913
18.	1954q2	1941	18	0	1	0	0	324	5832
19.	1954q3	1962	19	0	0	1	0	361	6859
20.	1954q4	2000.9	20	0	0	0	1	400	8000
21.	1955q1	2058.1	21	1	0	0	0	441	9261
22.	1955q2	2091	22	0	1	0	0	484	10648
23.	1955q3	2118.9	23	0	0	1	0	529	12167
24.	1955q4	2130.1	24	0	0	0	1	576	13824
25.	1956q1	2121	25	1	0	0	0	625	15625
26.	1956q2	2137.7	26	0	1	0	0	676	17576

...

195.	1998q3	8528.5	195	0	0	1	0	38025	7414875
196.	1998q4	8667.9	196	0	0	0	1	38416	7529536
197.	1999q1	8733.5	197	1	0	0	0	38809	7645373
198.	1999q2	8771.2	198	0	1	0	0	39204	7762392
199.	1999q3	8871.5	199	0	0	1	0	39601	7880599
200.	1999q4	9049.9	200	0	0	0	1	40000	8000000
201.	2000q1	9102.5	201	1	0	0	0	40401	8120601
202.	2000q2	9229.4	202	0	1	0	0	40804	8242408
203.	2000q3	9260.1	203	0	0	1	0	41209	8365427
204.	2000q4	9303.9	204	0	0	0	1	41616	8489664

```
. keep quarter spr
```

c) Generating a dummy variable

```
. sum spr, detail

           Time variable (in units of measurement)
-------------------------------------------------------------
      Percentiles      Smallest
 1%         1723         1610.5
 5%         1878         1658.8
10%       2058.1           1723       Obs                 204
25%      2600.05         1753.9       Sum of wgt.         204

50%       4142.2                      Mean           4562.646
                        Largest       Std. dev.      2113.962
75%      6312.85         9102.5
90%       7621.9         9229.4       Variance        4468837
95%       8442.9         9260.1       Skewness       .4680201
99%       9229.4         9303.9       Kurtosis       2.133958

. return list

scalars:
                  r(N) =  204
              r(sum_w) =  204
               r(mean) =  4562.645581413718
                r(Var) =  4468836.741843408
                 r(sd) =  2113.962332172314
           r(skewness) =  .4680200721224719
           r(kurtosis) =  2.133957959862034
                r(sum) =  930779.6986083984
                r(min) =  1610.5
                r(max) =  9303.900390625
                 r(p1) =  1723
                 r(p5) =  1878
                r(p10) =  2058.10009765625
                r(p25) =  2600.050048828125
                r(p50) =  4142.199951171875
                r(p75) =  6312.849853515625
                r(p90) =  7621.89990234375
                r(p95) =  8442.900390625
                r(p99) =  9229.400390625

. gen d=0
. replace d=1 if spr>=0.8*r(p50) | spr<(2/3)*r(mean)
(195 real changes made)

. tab d

          d |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |          9        4.41        4.41
          1 |        195       95.59      100.00
------------+-----------------------------------
      Total |        204      100.00

. drop d
```

d) Generating lags and differences

```
. sort quarter

. gen spr_lag1=l.spr
(1 missing value generated)
```

```
. gen spr_lag4=l4.spr
(4 missing values generated)

. gen spr_lead2=f2.spr
(2 missing values generated)

. gen spr_diff1=d.spr
(1 missing value generated)

. list
```

	quarter	spr	spr_lag1	spr_lag4	spr_lead2	spr_diff1
1.	1950q1	1610.5	.	.	1723	.
2.	1950q2	1658.8	1610.5	.	1753.9	48.30005
3.	1950q3	1723	1658.8	.	1773.5	64.19995
4.	1950q4	1753.9	1723	.	1803.7	30.90002
5.	1951q1	1773.5	1753.9	1610.5	1839.8	19.59998
6.	1951q2	1803.7	1773.5	1658.8	1843.3	30.19995
7.	1951q3	1839.8	1803.7	1723	1864.7	36.1001
8.	1951q4	1843.3	1839.8	1753.9	1866.2	3.5
9.	1952q1	1864.7	1843.3	1773.5	1878	21.3999
10.	1952q2	1866.2	1864.7	1803.7	1940.2	1.5
11.	1952q3	1878	1866.2	1839.8	1976	11.80005
12.	1952q4	1940.2	1878	1843.3	1992.2	62.19995
13.	1953q1	1976	1940.2	1864.7	1979.5	35.80005
14.	1953q2	1992.2	1976	1866.2	1947.8	16.19995
15.	1953q3	1979.5	1992.2	1878	1938.1	-12.69995
16.	1953q4	1947.8	1979.5	1940.2	1941	-31.69995
17.	1954q1	1938.1	1947.8	1976	1962	-9.700073
18.	1954q2	1941	1938.1	1992.2	2000.9	2.900024
19.	1954q3	1962	1941	1979.5	2058.1	21
20.	1954q4	2000.9	1962	1947.8	2091	38.90002
21.	1955q1	2058.1	2000.9	1938.1	2118.9	57.20007
22.	1955q2	2091	2058.1	1941	2130.1	32.8999

...

193.	1998q1	8396.3	8272.9	8016.4	8528.5	123.3994
194.	1998q2	8442.9	8396.3	8131.9	8667.9	46.60059
195.	1998q3	8528.5	8442.9	8216.6	8733.5	85.59961
196.	1998q4	8667.9	8528.5	8272.9	8771.2	139.4004
197.	1999q1	8733.5	8667.9	8396.3	8871.5	65.59961
198.	1999q2	8771.2	8733.5	8442.9	9049.9	37.7002
199.	1999q3	8871.5	8771.2	8528.5	9102.5	100.2998
200.	1999q4	9049.9	8871.5	8667.9	9229.4	178.4004
201.	2000q1	9102.5	9049.9	8733.5	9260.1	52.59961
202.	2000q2	9229.4	9102.5	8771.2	9303.9	126.9004
203.	2000q3	9260.1	9229.4	8871.5	.	30.69922
204.	2000q4	9303.9	9260.1	9049.9	.	43.80078

```
. clear all
```

■