RESEARCH REPORT

Statistical graphics in SURVO 76 EDITOR

BY
Seppo Mustonen

No. 33 February 1982

DEPARTMENT OF STATISTICS
UNIVERSITY OF HELSINKI
SF 00100 HELSINKI 10 FINLAND

ISBN 951-45-2561-2
ISSN 0357-9778

1. Introduction

The interactive statistical system SURVO 76 provides several means for graphical representation of statistical data. There are modules like

DIAGRAM and PLOT for scatter diagrams and time series,
HISTO for histograms and frequency curves,
CURVE for analytic curves,
SURFACE for analytic surfaces in central projection,
SCURVE for Andrews' function plots,
FACES for Chernoff's faces,
CURVE2 for analytic curves in implicit form.

During SURVO 76 conversations the graphs are created by entering the parameters needed for plotting. The plots may be constructed gradually through several steps and various graphs (like scatter diagrams and curves) may be combined in the same picture.

SURVO 76 EDITOR is an extension of the system offering report generating and text processing activities. EDITOR also includes procedures for interactive numerical and statistical computing in editorial mode (Mustonen 1980,1981).

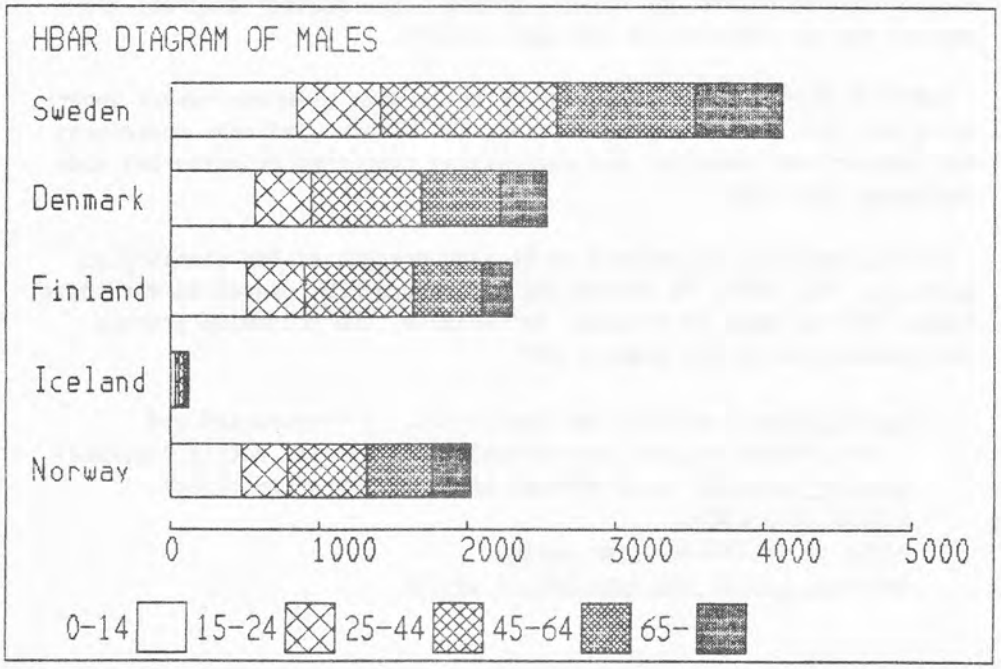
On this basis it is natural to develop procedures for statistical graphics, too. SURVO 76 EDITOR now includes a PLOT operation for these tasks. PLOT is able to produce, for example, the following graphic representations on the graphic CRT:

bar diagrams (vertical and horizontal, in frequencies and percentages, single and multiple, pie charts, matrix diagrams)
scatter diagrams (with several optional characteristics)
probability plots,
plots of (multiple) time series
analytic curves and families of curves

As an example let us consider the plotting of a bar diagram. In the upper half of the display 1.1 we have a data set and a PLOT operation typed in the edit field. In the lower part of the same display the graph created by activating the PLOT operation is presented. Activation of the PLOT operation takes place, as always in EDITOR operations, by first moving the cursor to the operation line and then pressing the key CONTINUE.

Disp.1.1

```
      1  SURVO 76 EDITOR    (C)1979 S.Mustonen    (100x100)
 1    *
 2    *Number of males (1000) in various age groups
 3    *
 4    *DATA MALES,A,B,M
 5    M          0-14 15-24 25-44 45-64   65-
 6    A Sweden    841   571  1188   930   585
 7    * Denmark   564   385   731   537   308
 8    * Finland   506   399   727   468   202
 9    * Iceland    32    22    29    20    10
10    B Norway    474   316   534   442   251
11    *
12    *PLOT MALES_
13    *
14    *
```



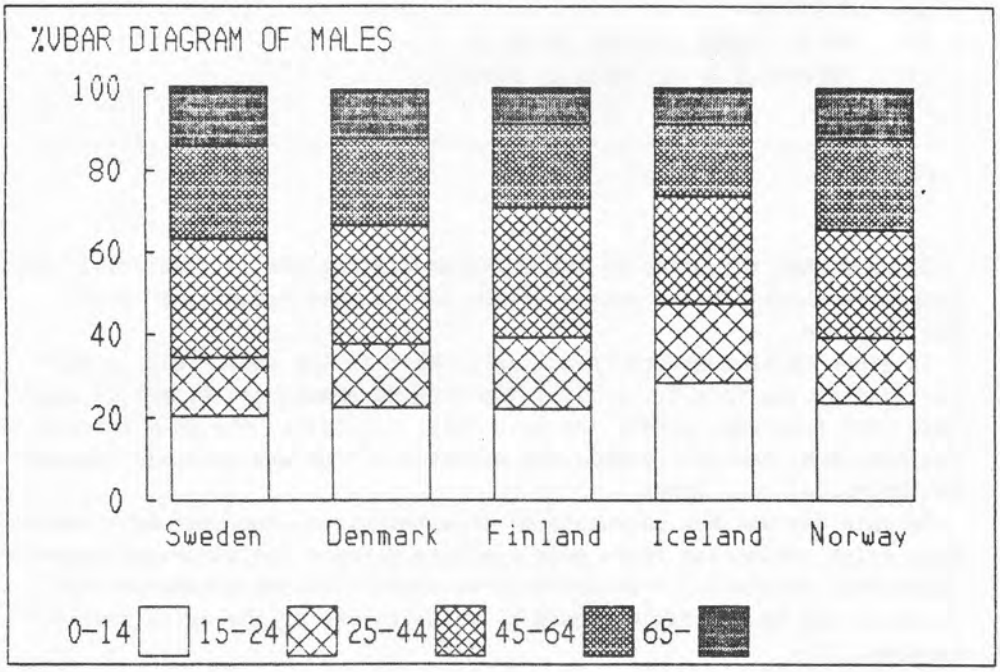
When plotting bar diagrams the PLOT operation has only one parameter, the name of the data set to be plotted (in this case MALES). The data set has to be defined by a DATA specification. DATA (on line 4) gives the name of the data set (MALES), the first and last line of observation values (A,B) and the line of the column labels (M).

In this case a plain PLOT operation produces the graph presented in the lower half of disp.1.1, but various features of the plot may easily be adjusted by means of extra specifications which are typed in the edit field prior to activation of the PLOT operation.

For instance, to make the same graph in vertical bars and in percentages, we add the specification TYPE=%VBAR in the edit field and after activation of the PLOT operation we have

Disp.1.2

```
      1  SURVO 76 EDITOR    (C)1979 S.Mustonen    (100x100)
 1    *
 2    *Number of males (1000) in various age groups
 3    *
 4    *DATA MALES,A,B,M
 5    M          0-14 15-24 25-44 45-64   65-
 6    A Sweden    841   571  1188   930   585
 7    * Denmark   564   385   731   537   308
 8    * Finland   506   399   727   468   202
 9    * Iceland    32    22    29    20    10
10    B Norway    474   316   534   442   251
11    *
12    *PLOT MALES_
13    *TYPE=%VBAR
14    *
```



Several extra specifications are available depending on the type of graph in question. Each specification has a default value which corresponds to some kind of a standard alternative. Thus even without any extra specifications a reasonable plot should be obtained, as already seen in Disp.1.1. In fact, in this case the default values of the extra specifications correspond to the following set up:

Disp.1.3

```
      1  SURVO 76 EDITOR   (C)1979 S.Mustonen   (100x100)
 1    *
 2    *Number of males (1000) in various age groups
 3    *
 4    *DATA MALES,A,B,M
 5    M          0-14 15-24 25-44 45-64   65-
 6    A Sweden    841   571  1188   930   585
 7    * Denmark   564   385   731   537   308
 8    * Finland   506   399   727   468   202
 9    * Iceland    32    22    29    20    10
10    B Norway    474   316   534   442   251
11    *
12    *PLOT MALES_
13    *TYPE=HBAR  DEVICE=G
14    *HOME=100,70  SIZE=600,400
15    *SCALE=0,1000,2000,3000,4000,5000
16    *SHADING=0,2,4,7,9
17    *LEGEND=-
18    *HEADER=HBAR DIAGRAM OF MALES
19    *XDIV=2,9,1  YDIV=2,5,1  PEN=1
20    *
21    *.....................................................
22    *
23    *
```

Observe that the order of the extra specifications is immaterial. If a specification appears several times in the edit field, the first will be used.

In order to have several plotting schemes in the same field, a border line of the form *.......... (as line 21 above) can be set to isolate them from each other. The data sets, defined by the DATA specifications, are, however, global and accessible from any subfield limited by the *.......... lines.

To gain the maximum advantage of this technique, the user may create edit files containing ready made plotting schemes for subsequent applications. Typically, from one well-designed plotting scheme several variants may be rapidly composed by editing some of the extra specifications.

At the end of this report an appendix including several ready-made plotting schemes together with the final output will be presented. Hence, the user may easily generate his own solutions on the basis of these examples.

The next chapter will be devoted to a more thorough account on the PLOT operation in various forms of plots. The plots in the appendix are also to be used as an illustration of the facts presented.

During the actual work at the computer information needed for plotting may be obtained by using the inquiry system of SURVO 76 EDITOR. The keyword PLOT? displays all the essentials related to the PLOT operation and to its extra specifications.

2. The PLOT operation and its extra specifications

The following chapters will cover the rules for using the PLOT operation in plotting various types of statistical graphs. Examples are given in the appendix.

All forms of the PLOT operation require that the data to be plotted is presented under a DATA specification.

DATA <name of the data set),L1,L2,L3
defines a data set on lines L1-L2. Each line includes one observation vector in the form <name of observation) X(1) X(2) ... X(M). Line L3 specifies the names of the variables X(1),...,X(M).

Note also that the line labels L1,L2,L3 may be either integers or symbolic (a character placed in the control column).

2.1 Bar and pie diagrams

PLOT <name of a data set)
plots a bar diagram of a data set defined by a DATA specification. Plotting is controlled by the following extra specifications typed in the edit field: TYPE, SCALE, SHADING, LEGEND, HEADER, TEXT, HOME, SIZE, XDIV, YDIV, GAP, SPACING, PLAN, LIMITS, PEN, FRAME.

2.1.1. TYPE

TYPE specifies the type of the bar diagram in the PLOT operation. Default is TYPE=HBAR (horizontal bar diagram). The alternatives are

TYPE=VBAR
    vertical bar diagram,
TYPE=%HBAR
    horizontal bar diagram in percentages,
TYPE=%VBAR
    vertical bar diagram in percentages,
TYPE=MHBAR
    multiple horizontal bar diagram,
TYPE=MVBAR
    multiple vertical bar diagram.
TYPE=PIE
    multiple pie diagram (total area proportional to column sum)
TYPE=%PIE
    multiple pie diagram (total area=constant)
TYPE=MATRIX
    matrix diagram with shaded cells according to the data values

2.1.2. SCALE

SCALE=<1st value),<2nd value),...,<max.value)
specifies the scale and the scale labels on the X-axis in HBAR diagrams and on the Y-axis in VBAR diagrams. If SCALE is not given, scaling and labelling is automatic and selected by using the values in the data set as a basis. Hence, when automatic scaling is used, no overflow of bars in the graph may occur.
SCALE=- means that the (automatic) scale will not be displayed.

2.1.3. SHADING

SHADING=<list of shading values 0,1,2,...,10>
or 0,-1,-2,...,-10
or 0,11,12,13,14

specifies a shading for each section of the bars. The values 0,1,2,... refer to tones from "white" to "black" (on paper).

If SHADING is not given, the shading values depend on the number g of variables (sections) to be plotted. Section i will then have shading value ROUND(11*(i-1)/g,0). For example, if g=5, the default corresponds to SHADING=0,2,4,7,9.

2.1.4. LEGEND

LEGEND=<string_without_spaces>

gives a declaration for the different shadings specified automatically or by SHADING. Default is an empty string (i.e. no declaration, but list of shadings is plotted). LEGEND=- means that all declarations are omitted.

2.1.5 HEADER

HEADER=<string_without_spaces>

gives a title to be plotted in the upper left corner of the picture area. Default is HEADER=<type>_DIAGRAM_OF_<data>
Since underlining is ignored in plotting, underline the whole text or use '_' in place of a blank.
HEADER=- means that no header is plotted.

More text may be plotted by a TEXT specification.

2.1.6. TEXT

TEXT=<list of text names>

lists the various text names. Each member of this list has to be defined in the edit field in the form

<text name>=<text_to_be_plotted>,x,y,<size>,<x spacing>,<y spacing>

where x,y are the coordinates (in plotting units) of the first character of the text, <size> (optional) is the letter size (default=1), and <x spacing>,<y spacing> (optional) are character spacing parameters (default=8,0).

<text_to_be_plotted> has to be a string without spaces. Since underlining is ignored in plotting, underline the whole text or use '_' in place of a blank.

2.1.7. HOME

HOME=<x coord.>,<y coord.>

specifies the location of the lower left corner of the graph with respect of the current home position of the pen. Coordinates are given in plotting units.
Default is HOME=100,70 for bar diagrams on the graphic CRT,
HOME=0,0 in other cases.

2.1.8. SIZE

SIZE=<width>,<height>
specifies the size of the graph in plotting units.
Default (on the graphic CRT) is SIZE=600,400 for bar diagrams,
SIZE=799,511 in other cases.

2.1.9. XDIV and YDIV

XDIV=<left margin>,<plot width>,<right margin>
specifies the division of the picture width. It is sufficient to use proportional values for the parameters. Default values are varying according to the size of the picture.

YDIV=<bottom margin>,<plot height>,<top margin>
specifies the division of the picture height. It is sufficient to use proportional values for the parameters. Default values are varying according to the size of the picture.

2.1.10. GAP

GAP=<ratio of the gap between the bars and the bar width>
Default is GAP=0.6666666

2.1.11. SPACING

SPACING=<x spacing>,<y spacing>
(for vertical bar diagrams) specifies the character spacing when plotting the bar labels (names of observations).
Default on the graphic CRT is SPACING=8,0.

2.1.12. PEN

PEN=<# of pen>
selects the pen. Default is PEN=1.

2.1.13. FRAME

FRAME=<integer>
controls plotting of frames (boxes) around the graph.
FRAME=2 is default and means that all frames are plotted.
FRAME=1 erases the outer frame
FRAME=0 erases all frames and coordinate axes notations.

2.1.14. PLAN

PLAN=R1,R2,...
(in PLOT operation for pie charts TYPE=PIE or %PIE) specifies the setup of charts in the plotting area so that R1 is the number of charts on the first row, R2 on the second etc.
Default values are determined by the total number of charts and the shape of the plotting area.

2.1.15. LIMITS=L1,L2,...

LIMITS=L1,L2,...
(in PLOT operation for matrix diagrams TYPE=MATRIX) specifies the upper limits for the classes of the data values so that the class i consists of values X: L(i-1)<X<=L(i).
When plotting the cells belonging to class i will be shaded according to the ith shading specified by SHADING.

2.2. Scatter diagrams

PLOT <data>,<image line>
where the image line has the form " XXX YYY SSS I " plots a scatter diagram of a data set defined by a DATA specification for the variables in the XXX and YYY columns.
SSS (optional) is a mask for the marks of the observations in the graph (like name of the observation or an indicator variable).
I (optional) is a mask for a missing value indicator. Characters 'space','0' and '-' are codes for the missing values.
Plotting is controlled by the following extra specifications typed in the edit field: XSCALE, YSCALE, XLABEL, YLABEL, POINT, LINE, GRID HEADER, TEXT, HOME, SIZE, XDIV, YDIV, PEN, FRAME, CONTOUR, TREND.

PLOT <data>,<x variable>,<y variable>
makes a scatter diagram of a data set defined by a DATA specification for the variables <x variable> and <y variable>.
The extra specification are the same as those for the previous form of PLOT for scatter diagrams.

2.2.1. XSCALE

XSCALE=<min.value>,<2nd value>,<3rd value>,...,<max.value>
specifies the scale on the X axis and the scale labels.
If XSCALE is not given, scaling and labelling is automatic.

XSCALE=<scale type>,<min.value>,<2nd value>,...,<max.value>
specifies a nonlinear scale on the X axis and the scale labels.
<scale type> is one of the alternatives LOG, LOGIT, PROBIT, SQR, EXP, ARCTAN.

2.2.2. YSCALE

YSCALE=<min.value>,<2nd value>,<3rd value>,...,<max.value>
specifies the scale on the Y axis and the scale labels.
If YSCALE is not given, scaling and labelling is automatic.

YSCALE=<scale type>,<min.value>,<2nd value>,...,<max.value>
specifies a nonlinear scale on the Y axis and the scale labels.
<scale type> is one of the alternatives LOG, LOGIT, PROBIT, SQR, EXP, ARCTAN.

2.2.3. XLABEL

XLABEL=<string_without_spaces>
gives a title for the X axis. Default is the name of the variable.
XLABEL=- means that the label is omitted.

2.2.4. YLABEL

YLABEL=<string_without_spaces>
gives a title for the Y axis. Default is the name of the variable.
YLABEL=- means that the label is omitted.

2.2.5. POINT

POINT=<character>
specifies the symbol for the observation points in the diagram.
Default is a small point. A more flexible way of marking is provided
by the SSS mask on the image line.

2.2.6. LINE

LINE=<line type>,<line thickness>,<line label>
specifies the line type especially in plotting time series but can
also be used in scatter diagrams to join consecutive points.
If LINE is missing, the points are not joined together when plotting
a scatter diagram.
<line type> is an integer n=0,1,2,...,12 indicating the brokeness of
the line (n=0 means a solid line).
<line thickness> (optional) is an integer 1,2,3,... Default=1.
<line label> (optional) is a string without spaces to be plotted
as a label at the end of the time series. Default=no label.

2.2.7. GRID

GRID=<X,Y or XY>
draws straight lines parallel to the x-axis (GRID=X) or the y-axis
(GRID=Y) or both (GRID=XY) through the points indicated by XSCALE
(TSCALE) and YSCALE, respectively.

GRID=<xstep,ystep>
works as the first GRID, but uses the steps <xstep>,<ystep> when
drawing the grid. If a step parameter is negative, only a small
tick is drawn instead of a line segment.

2.2.8. CONTOUR

CONTOUR=eps1,eps2,... BINORM=E(X),E(Y),S(X),S(Y),Corr(X,Y)
determines the contour ellipses to be plotted on levels eps1,eps2,...
on the basis of the two-dimensional normal distribution defined by a
BINORM specification. If BINORM is missing, the parameters are estim-
ated from the plotted data. The parameters eps1,eps2,... refer to the
probabilities of an observation lying inside the ellipse.
Particularly, eps1=0 causes the principal axes to be plotted.
Example: CONTOUR=0,0.5,0.9,0.99 BINORM=0,0,1,1,0.707

2.2.9. TREND

TREND=C1,C2,... (at most 5 parameters)
determines lines parallel to a linear trend to be plotted. If the trend is Y=aX+b and the residual variance is s↑2, then the lines Y=aX+b+Cs and Y=aX+b-Cs for C=C1,C2,.. will be plotted. For example, TREND=0 causes the trend itself to be drawn. The trend is estimated by the OLS method from the plotted data. However, if a BINORM specification is given (see 2.2.8), the trend will be computed according to the corresponding binormal distribution.

2.2.10. Other specifications

HEADER (see 2.1.5),
TEXT (see 2.1.6),
HOME (see 2.1.7),
SIZE (see 2.1.8),
XDIV (see 2.1.9),
YDIV (see 2.1.9),
PEN (see 2.1.12),
FRAME (see 2.1.13).

2.3. Time series

PLOT <data>,<image line>
where the image line has the form " TTT YYY SSS I "
plots the time series YYY from a data set defined by a DATA specification. The time axis will be labelled by texts appearing in the TTT column.
SSS (optional) is a mask for the marks of the observation points in the graph (like the names of the observations or the values of an indicator variable).
I (optional) is a mask for a missing value indicator. Characters 'space','0' and '-' are codes for the missing values.
Plotting is controlled by the following extra specifications typed in the edit field: TSTEP, TSCALE, YSCALE, XLABEL, YLABEL, POINT, LINE, GRID, HEADER, TEXT, HOME, SIZE, XDIV, YDIV, PEN, FRAME, TREND.

2.3.1. TSTEP

TSTEP=<labelling step),<marking step>
specifies the labels and the points to be marked on the time axis.
<labelling step> specifies the gap between the TTT labels and <marking step> (optional) the step for the small marks on the axis.

2.3.2. TSCALE

TSCALE=<list of TTT labels>
specifies the labels to be plotted on the time axis. TSCALE can be used jointly with TSTEP for additional markings.

2.3.3. Other specifications

The following specifications work as those for scatter diagrams.

YSCALE (see 2.2.2),
XLABEL (see 2.2.3), (default is XLABEL=TIME)
YLABEL (see 2.2.4),
POINT (see 2.2.5),
LINE (see 2.2.6), (default is LINE=0,1,_)
GRID (see 2.2.7),
TREND (see 2.2.9),
HEADER (see 2.1.5),
TEXT (see 2.1.6),
HOME (see 2.1.7),
SIZE (see 2.1.8),
XDIV (see 2.1.9),
YDIV (see 2.1.9),
PEN (see 2.1.12),
FRAME (see 2.1.13).

2.4. Plotting on normal probability paper

PLOT <data>,<image line>
where the image line has the form " PPP SSS " plots on normal probability paper the PPP variable from a data set defined by a DATA specification. The PPP column must be sorted in ascending order before plotting.

SSS (optional) is a mask for the marks of the observations in the graph.

Plotting may be controlled by the same extra specifications as in plotting scatter diagrams (see 2.2.)

Note also the possibility of using the probit transformation by the specifications XSCALE and YSCALE (see 2.2.1-2).

2.5. Plotting text

In addition to HEADER and TEXT specifications (see 2.1.5-6) text may be plotted freely on the graphic screen by using the PLOT operation in the form PLOT TEXT.

Activation of PLOT TEXT leads to the display:

```
COORDINATES:  X=    0, Y=   0

PLOTTING TEXT:
SELECT:  O=STARTING POINT,  T=ENTER THE TEXT,  RETURN(EXEC)=STOP
         C=CHARACTER SIZE,  S=CHARACTER SPACING,  P=PEN
```

On the graphic screen a cursor is blinking in the low-left corner (coordinates X=0,Y=0) and it can be moved in steps of 5 plotting units by the arrow-headed F-keys or directly to a specific point by pressing O and entering the new coordinates.

The text to be plotted is to be entered and edited by first pressing T then by typing and/or editing the text and finally the text is plotted by pressing RETURN(EXEC).

The character size (default 1) and spacing (default 10,0) may be set by C and S respectively.

All selections made by the user will be displayed on the normal screen as follows:

```
COORDINATES:  X=  100, Y= 400

PLOTTING TEXT:
SELECT:  O=STARTING POINT,  T=ENTER THE TEXT,  RETURN(EXEC)=STOP
         C=CHARACTER SIZE,  S=CHARACTER SPACING,  P=PEN

COORDINATES OF THE STARTING POINT (X,Y)? 100,400    0,0
text: Test 25.9.1981/SM
CHARACTER SIZE   1
HORIZONTAL SPACING?       10
VERTICAL SPACING?          0
PEN 1
```

Since all the parameters can be entered repeatedly, several texts may be plotted during the same activation of PLOT TEXT. Observe that PEN 2 may be used for erasing text previously plotted.

Return back to editorial mode takes place by RETURN(EXEC).

2.6. Curves and families of curves

As seen in 2.2.8-9 some curves, like contour ellipses and lines parallel to a linear trend, may be plotted directly in connection with scatter diagrams.

To produce more complicated graphs of analytic curves, a special form of the PLOT operation is available.

The equation of the curve can be written according to the user's own notation either in the form

```
PLOT Y(X)=function(X)
```

or in the parametric form

```
PLOT X(T)=f(T),Y(T)=g(T)
```

The functions appearing in the PLOT operation may include symbolic parameters (pi, rho, speed) whose values have to be given in the form <parameter>=<numeric value> (pi=3.1416, rho=0.99, speed=70) in the edit field.

In addition, at most two parameters can be given as cycling parameters in the form <parameter>=<first value),<last value),<step). Then a one- or two-parameter family of curves will be plotted in the same coordinate system.

The plotting area is specified by the XSCALE and YSCALE specifications (see 2.2.1-2). The default is XSCALE=-10,0,10 YSCALE=-10,0,10. The plotting range is given in the form X=<first value),<last value), <step). If <step) is not given, 1/100 of the plotting range is used as <step). If the plotting range is not given, the total range given by XSCALE will be used.

In the second form of PLOT above the range is given in the form T=<first value),<last value),<step).

In both forms X and T can be replaced by any other letter or word.

Some simple curve plotting schemes: (The plots are in the appendix.)

```
.....................................................................

PLOT Y(X)=10*SIN(X)

.....................................................................

HEADER=Functions y=x↑n for n=1,2,3,4   GRID=XY
PLOT Y(x)=x↑n   / n=1,4,1

.....................................................................

HEADER=Compound interest for P=5,6,...,15% XLABEL=Years GRID=XY
XSCALE=0,5,10,15,20,25,30 YSCALE=0,10,20,30,40,50,60,70
P=5,15,1  X=0,30,1
PLOT Y(X)=(1+P/100)↑X

.....................................................................

XSCALE=-10,0,10 YSCALE=-10,0,10 XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
X=-10,10,.025   HEADER=Y=100/(X-5)/(X+5)/X  GRID=XY
PLOT Y(X)=100/(X-5)/(X+5)/X

.....................................................................

HEADER=Contour ellipses
XSCALE=-10,0,10 YSCALE=-10,0,10 XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
s1=5 s2=3 rho=0.9  t=0,6.2832     GRID=XY
eps=0.5,0.9,0.1
PLOT X(t)=s1*sqr(-2*log(1-eps))*cos(t),
     Y(t)=s2*sqr(-2*log(1-eps))*sin(t+arcsin(rho))

.....................................................................

HEADER=Mixtures p*N(a,1)+(1-p)*N(3,.01) a=0(0.5)6, p=0.7
XSCALE=-3,0,3,6,9 YSCALE=0,0.5 SIZE=799,400
a=0,6,0.5    b=3 s=1 t=0.3 p=0.7  c=0.39894 (=1/sqr(2*pi))

PLOT Y(X)=p*c/s*exp(-.5*((X-a)/s)↑2)+(1-p)*c/s*exp(-.5*((X-b)/t)↑2)

.....................................................................

HEADER=Parabolic Steiner circles
XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
T=0,6.2832 R=-10,10,1 ind=0,1,1
PLOT X(T)=R*COS(T)+ind*R,Y(T)=R*SIN(T)+(1-ind)*R

.....................................................................
```

As seen from the preceding examples, the extra specifications of scatter diagrams (see 2.2.1-) can be used in curve plotting, too. Thus analytic curves may be plotted on an earlier scatter diagram or on a time series plot.

In curve plotting some additional specifications can also be employed.

2.6.1. FILL, YFILL, OFILL, IFILL

FILL=<density>,<intial value>,<final value>
draws line segments parallel to the Y axis from points on the curve to the X axis in the interval specified by <initial value> and <final value>. Default is the whole plotting range. <density> (an integer 1,2,3,..) gives the gap between the line segments using the curve plotting step as the unit.

YFILL=<density>,<initial value>,<final value>
works as FILL but joins points on the curve to the Y axis.

OFILL=<density>,<intial value>,<final value>
is an alternative form of the FILL specification for curves of the form X(T)=f(T),Y(T)=g(T) and joins the points on the curve to origo for values <initial value> < T < <final value>.

IFILL=<density>,<intial value>,<final value>
works as OFILL but joins the points on the curve to the intial point of the curve.

2.6.2. ROTATION

ROTATION=<angle in °),<x),<y>
rotates the graph by <angle in °) using the point <x),<y> as the center of rotation. Default is ROTATION=0,0,0.

2.6.3. INTEGRAL

INTEGRAL=<constant>
for curves of the form Y(X)=f(X) rescales the function before plotting so that the integral of f(X) is equal to <constant>. The range of integration is the same as that for plotting. By using INTEGRAL=1, for example, density functions can be plotted without giving the cumbersome constants appearing as coefficients in the function.

2.6.4. Plotting of an integral function

PLOT INTEGRAL Y(X)=f(X)

plots the integral function of f(X). The range for the integration and plotting is given in the form X=<lower limit),<upper limit), <step). If these limits are not given, XSCALE determines them and 1/100 of the the range is used as <step).
The extra specification INTEGRAL (see 2.6.3) can also be employed in connection with PLOT INTEGRAL thus permitting plotting of cumulative density functions of probability distributions, for example. Furthermore, by using YSCALE=PROBIT,...(scale values)... the cumulative functions may be plotted on normal probability paper.

REFERENCES

Mustonen, S. (1980), Interactive analysis in SURVO 76, Proceedings in Computational Statistics, ed.by M.M.Barritt and D.Wishart, 253-259, Physica-Verlag, Wien.

Mustonen, S. (1980), SURVO 76 EDITOR, a new tool for interactive statistical computing, text and data management, Research Report No. 19, Dept.of Statistics, University of Helsinki.

Mustonen, S. (1981), SURVO 76 EDITOR, a new tool for interactive statistical computing, text and data management, (RELEASE 2), Research Report No.24, Dept.of Statistics, University of Helsinki.

Mustonen, S. (1981), SURVO 76 EDITOR, Estimation of regression models, Research Report No.29, Dept. of Statistics, University of Helsinki

Mustonen, S. (1981), Statistical computing with a text editor, Computational Statistics, ed.by Herbert Büning and Peter Naeve, 327-348, Walter de Gruyter, Berlin.

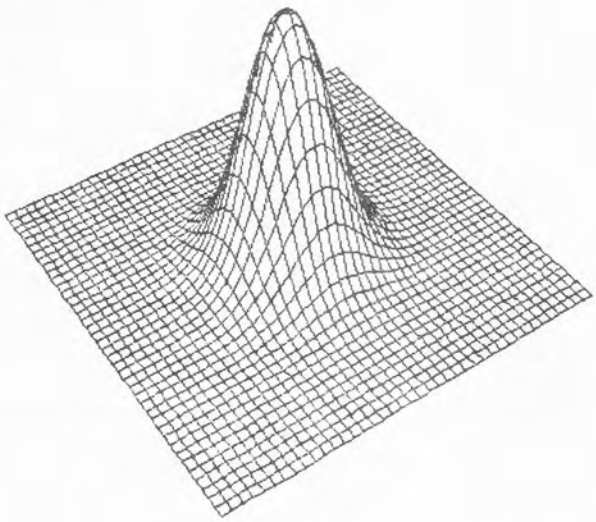
NOTE

The PLOT operation has now been extended to produce three dimensional graphs of analytic surfaces in central projection. The actual graph will consist of a projection on a plane orthogonal to the line from EYE to origo. The surface can be defined in the form

PLOT Z(X,Y)=function(X,Y) or

PLOT X(T,U)=f(T,U),Y(T,U)=g(T,U),Z(T,U)=h(T,U).

The space curves characterizing the surface are selected by CURVES specifications. The graph can be saved step by step in the edit field by using a PLOTLINE specification and it may be replotted by a PLOT FILE operation.
In replotting the specification EDIT may be used for editing of the graph. The plot will then appear step by step and the user may edit the plotting steps via the keyboard.



```
  1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (210x100)
 1 *SAVE EXP2
 2 *
 3 *
 4 *
 5 *PLOT Z(X,Y)=7*EXP((-X*X-Y*Y)/2)
 6 *
 7 *EYE=10,15,20
 8 *X=-5,5,.2                              PLOTLINE=B
 9 *Y=-5,5,.2
10 *X-CURVES=-5,5,.5
11 *Y-CURVES=-5,5,.5
12 *XDIV=0,1,0 YDIV=0,1,0 SIZE=511,511 FRAME=0
13 *.....................................................................
14 *PLOT FILE,EXP2,B_ /  HOME=1,400
15 B U,266,-123 D,-4,-2 D,-3,-1 U,-4,-2 U,-4,-1 U,-3,-2 U,-4,-2 U,-4,-
16 * U,-3,-2 U,-4,-1 U,-4,-2 U,-4,-1 U,-4,-2 U,-3,-2 D,-4,-1 D,-4,-2 D
17 * D,-4,-2 D,-4,-1 D,-4,-2 D,-4,-2 D,-4,-1 D,-4,-2 D,-4,-2 D,-4,-2 D
18 * D,-4,-2 D,-4,-2 D,-4,-1 D,-5,-2 D,-4,-2 D,-4,-2 D,-5,-2 D,-4,-2 D
19 * D,-4,-2 D,-5,-2 D,-4,-2 D,-5,-2  etc.
20 *
21 *          (plotting steps after editing.
22 *           hidden lines are removed semiautomatically)
23 *
```

APPENDIX: Graphs generated with SURVO 76 EDITOR

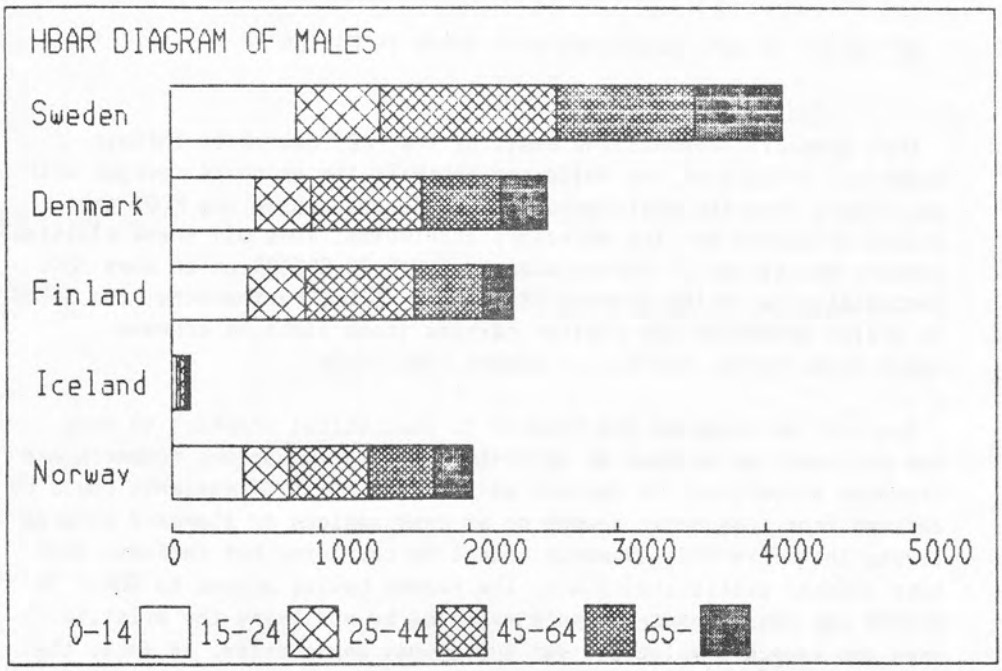
This appendix presents the usage of the PLOT operation through examples. In each of the following exhibits the graph is coupled with an extract from the edit field completely describing the PLOT operations activated and the necessary attributes. Thus all these plotting schemes may be easily regenerated by SURVO 76 EDITOR on an Wang 2200 installation with the graphic CRT plotter 2282. Furthermore, the SURVO 76 EDITOR DEMONSTRATION platter carries these plotting schemes (edit files PLOT1, PLOT2,...) almost completely.

Many of the examples are related to statistical graphics to show, how pictures can be used as an efficient tool in various research and teaching situations. Of course, an immense amount of variants could be derived from some basic graphs or as combinations of standard alternatives. Therefore this appendix cannot be complete, but includes only some typical statistical plots. The reader having access to SURVO 76 EDITOR can easily generate more examples by modifying the existing ones and save his solutions for subsequent application. In fact, the PLOT operation has now been succesfully employed from February 1981 on by several SURVO 76 users without written documents on the basis of a rather restricted sample of examples.

Also some purely mathematical curves and families of curves serve as illustration of how to use SURVO 76 EDITOR in non-statistical applications. The appendix finally contains more complicated 'artistic' plots displaying the power of the 'graphical language'.

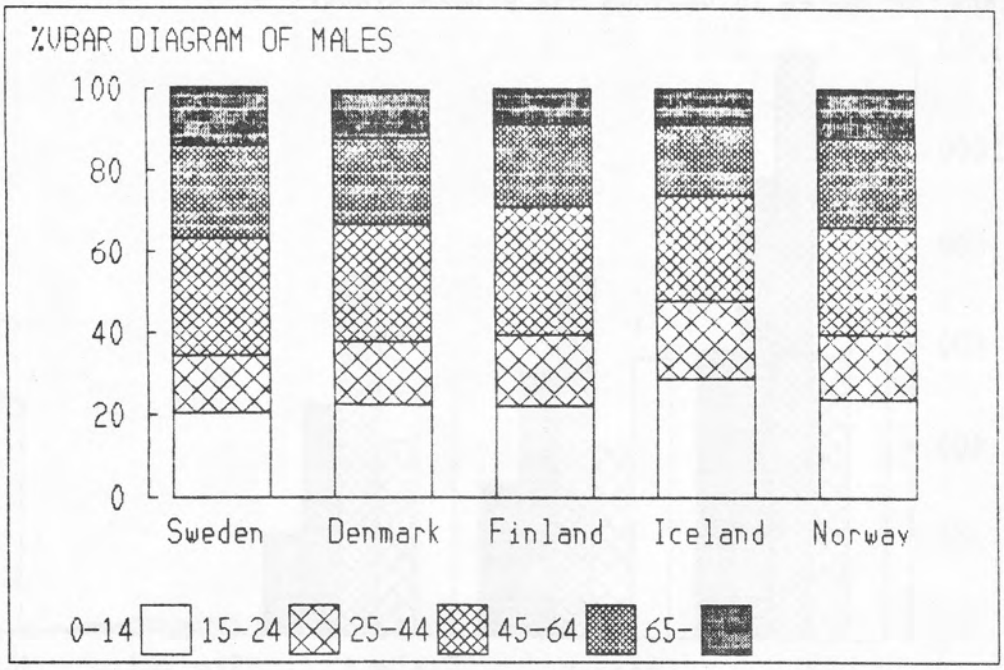
It is important to note that some of the dynamic aspects, which appear on the screen and are most interesting in many cases, cannot be detected from the final output on paper. Nevertheless we hope that even these ready-made graphs can give an impression of the possibilities available.

1



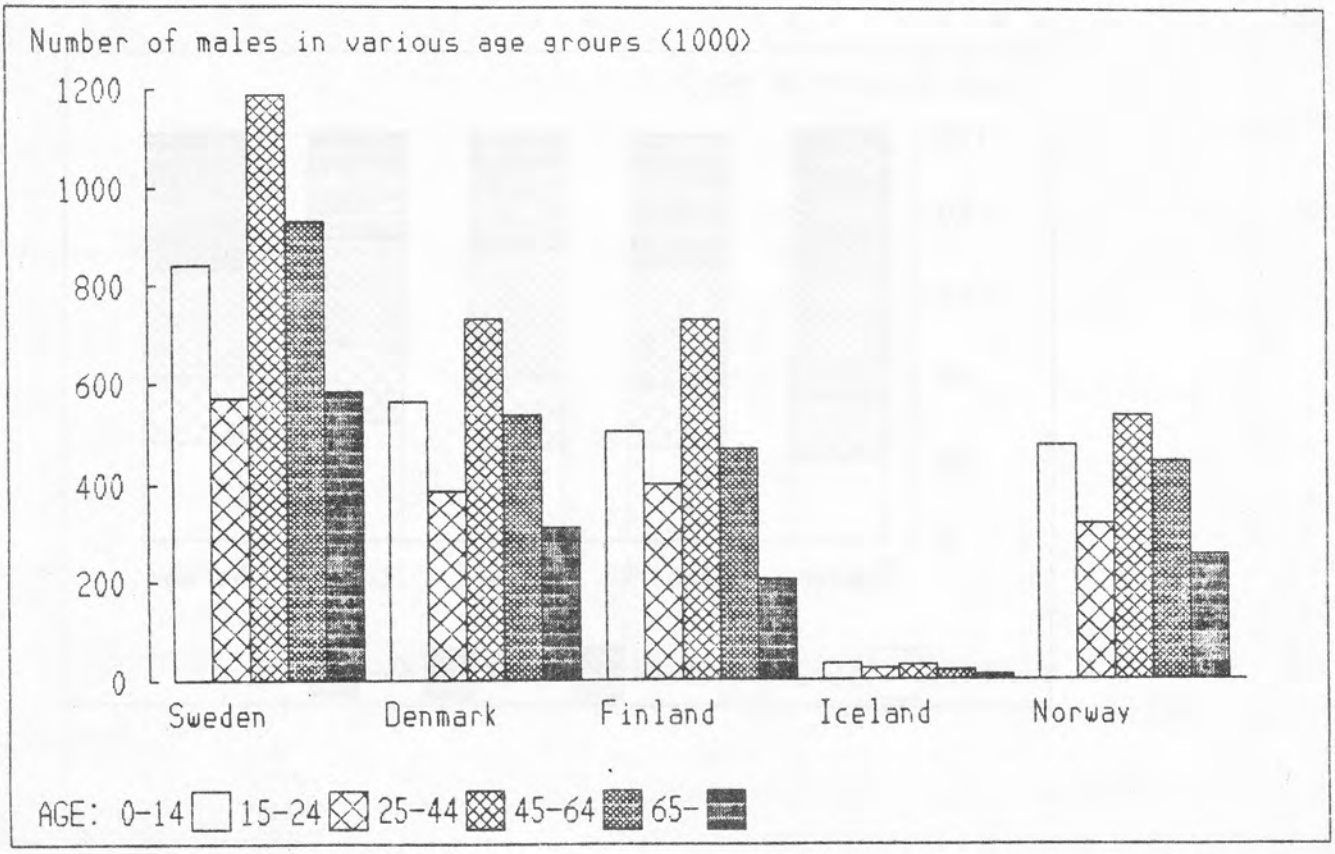

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
26 *     To plot a simple bar diagram of a data set defined by a DATA
27 *specification in the edit field, a mere PLOT <name of data set>
28 *is sufficient:
29 *
30 *            Number of males (1000) in various age groups
31 *
32 M                      0-14  15-24  25-44  45-64    65-
33 A              Sweden   841    571   1188    930    585
34 *              Denmark  564    385    731    537    308
35 *              Finland  506    399    727    468    202
36 *              Iceland   32     22     29     20     10
37 B              Norway   474    316    534    442    251
38 *
39 *DATA MALES,A,B,M
40 *PLOT MALES
41 *
42 *     Activate the PLOT operation on line 40!
43 *
44 *
```

2



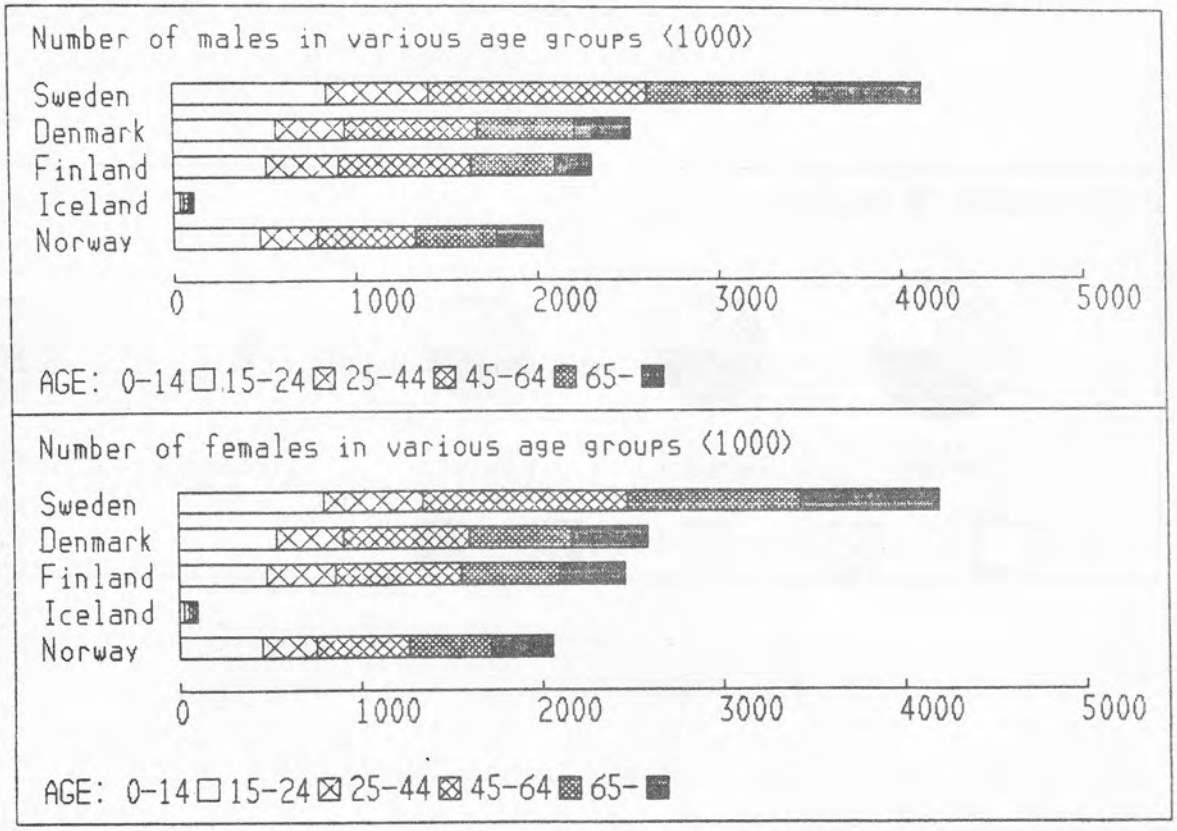

```
    1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
53 *
54 *TYPE=%VBAR
55 *PLOT MALES_
56 *
```

3



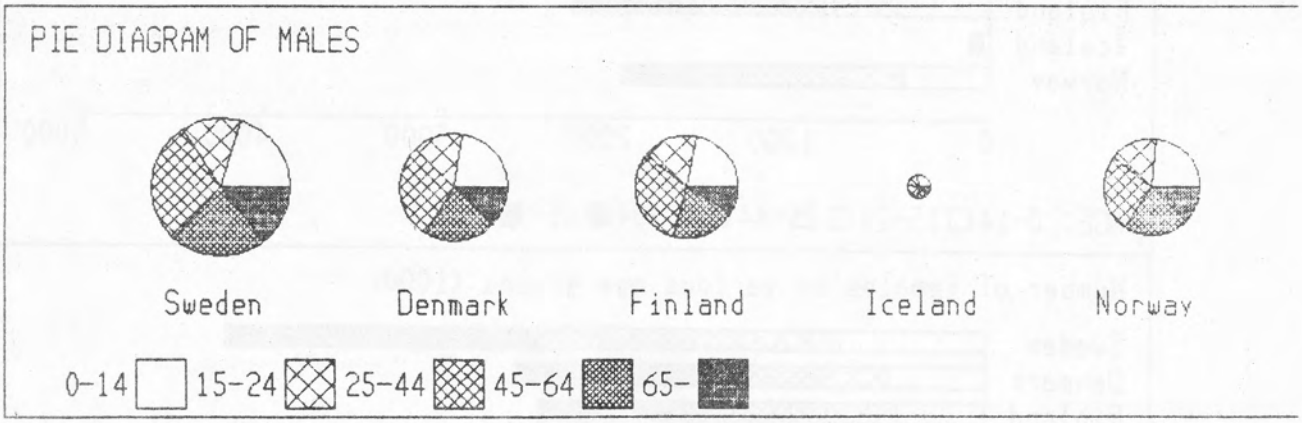

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
59 *
60 *PLOT MALES_
61 *TYPE=MVBAR
62 *HOME=0,0 SIZE=799,511
63 *LEGEND=AGE: HEADER=Number of males in various age groups (1000)
64 *
```

4



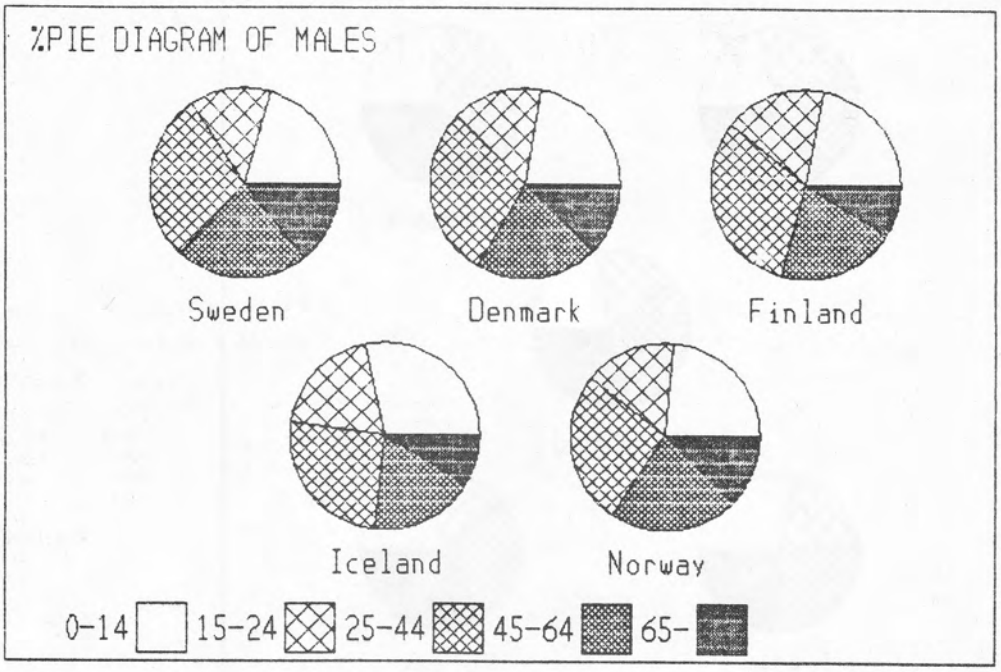

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
73 *
74 *PLOT MALES    / TYPE=HBAR HOME=50,250 SIZE=700,250
75 *                LEGEND=AGE:
76 *                HEADER=Number of males in various age groups (1000)
77 *-------------------------------------------------------------------
78 *PLOT FEMALES / TYPE=HBAR HOME=50,0   SIZE=700,250
79 *                LEGEND=AGE:
80 *                HEADER=Number of females in various age groups (100
81 *
82 *DATA FEMALES,C,D,F
83 *            Number of females (1000) in various age groups
84 F                      0-14  15-24  25-44  45-64    65-
85 C           Sweden     800    546   1128    953    760
86 *           Denmark    538    365    702    562    416
87 *           Finland    484    381    693    547    353
88 *           Iceland     31     21     28     20     12
89 D           Norway     451    301    507    453    337
90 *-------------------------------------------------------------------
91 *
```

5



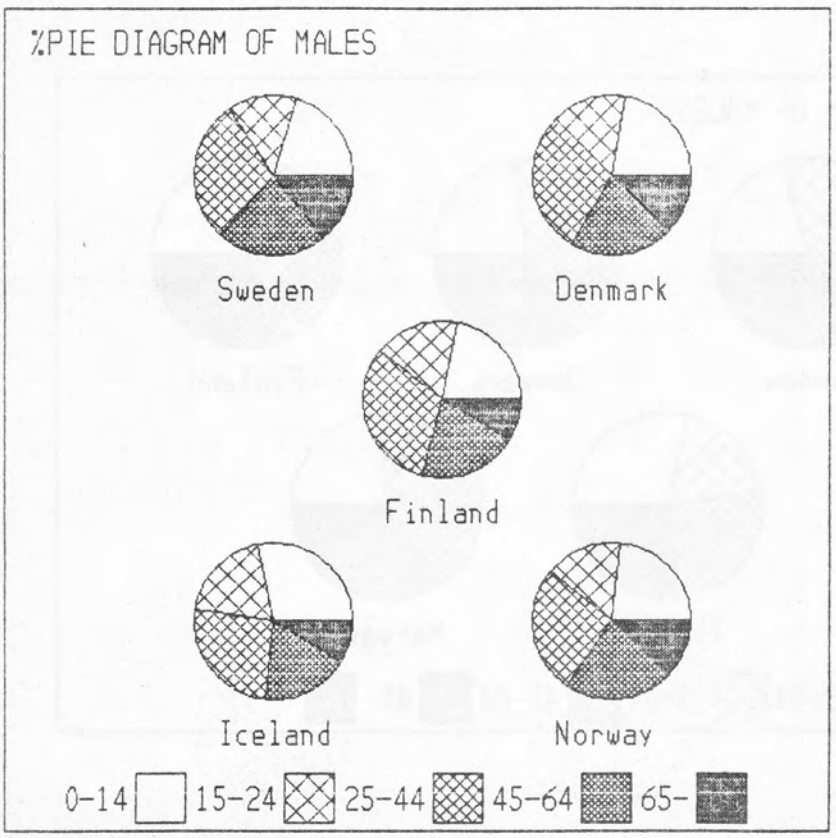

```
  1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (100x100)
  6 *
  7 *DATA MALES,A,B,M
  8 M             0-14  15-24  25-44  45-64    65-
  9 A Sweden       841    571   1188    930    585
 10 * Denmark      564    385    731    537    308
 11 * Finland      506    399    727    468    202
 12 * Iceland       32     22     29     20     10
 13 B Norway       474    316    534    442    251
 14 *
 15 *PLOT MALES_
 16 *TYPE=PIE
 17 *
 18 *SIZE=799,250  HOME=0,125
 19 *
 20 *
```

6



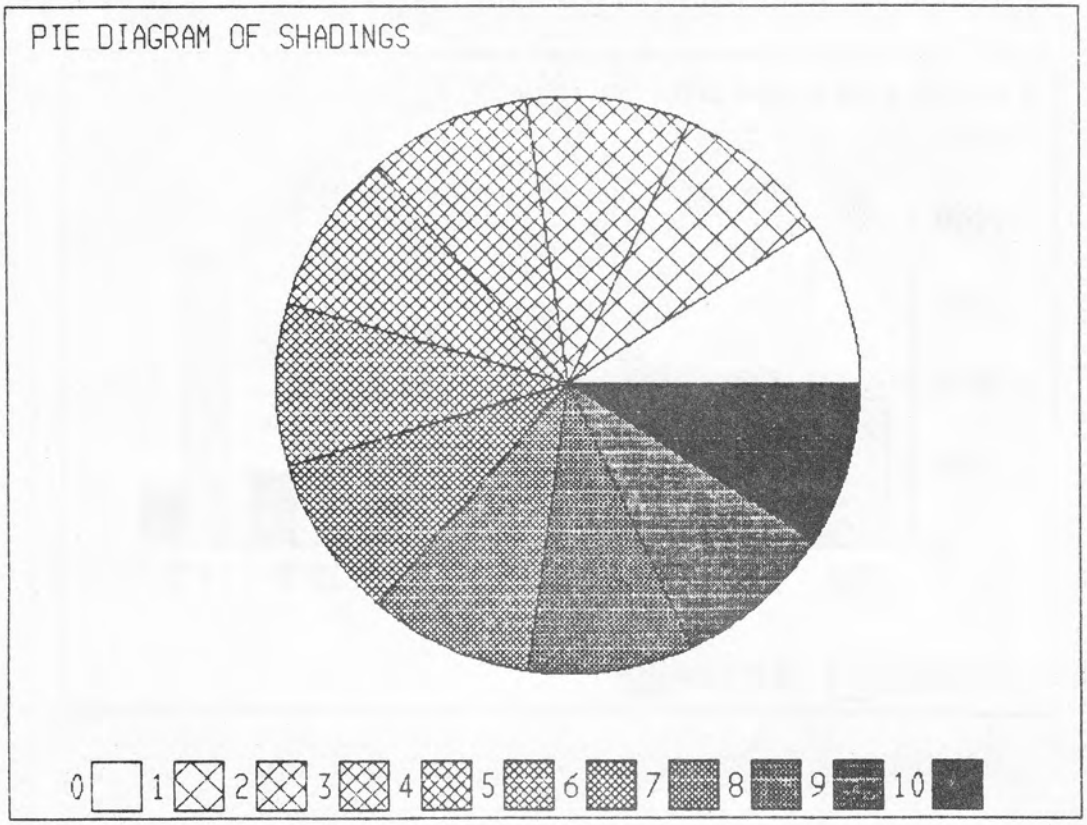

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (100x100)
 6 *
 7 *DATA MALES,A,B,M
 8 M              0-14  15-24  25-44  45-64    65-
 9 A Sweden        841    571   1188    930    585
10 * Denmark       564    385    731    537    308
11 * Finland       506    399    727    468    202
12 * Iceland        32     22     29     20     10
13 B Norway        474    316    534    442    251
14 *
15 *PLOT MALES_
16 *TYPE=%PIE
17 *
18 *
```

7



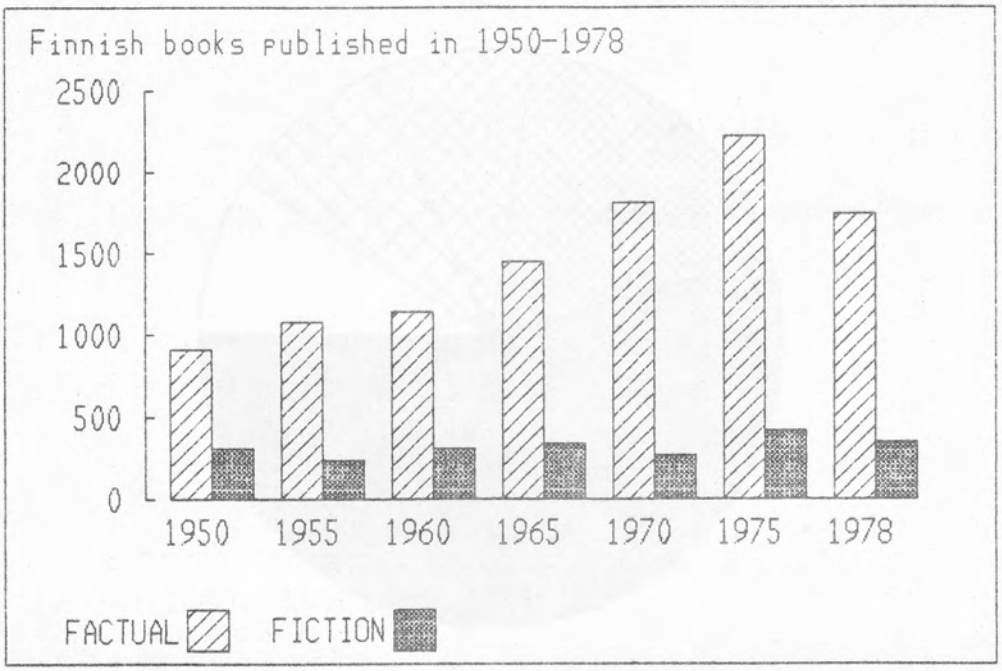

```
    1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (100x100)
 6 *
 7 *DATA MALES,A,B,M
 8 M              0-14 15-24 25-44 45-64    65-
 9 A Sweden        841   571  1188   930    585
10 * Denmark       564   385   731   537    308
11 * Finland       506   399   727   468    202
12 *  Iceland       32    22    29    20     10
13 B Norway        474   316   534   442    251
14 *
15 *PLOT MALES_
16 *TYPE=%PIE  PLAN=2,1,2
17 *HOME=0,0 SIZE=500,500
18 *
19 *
```

8

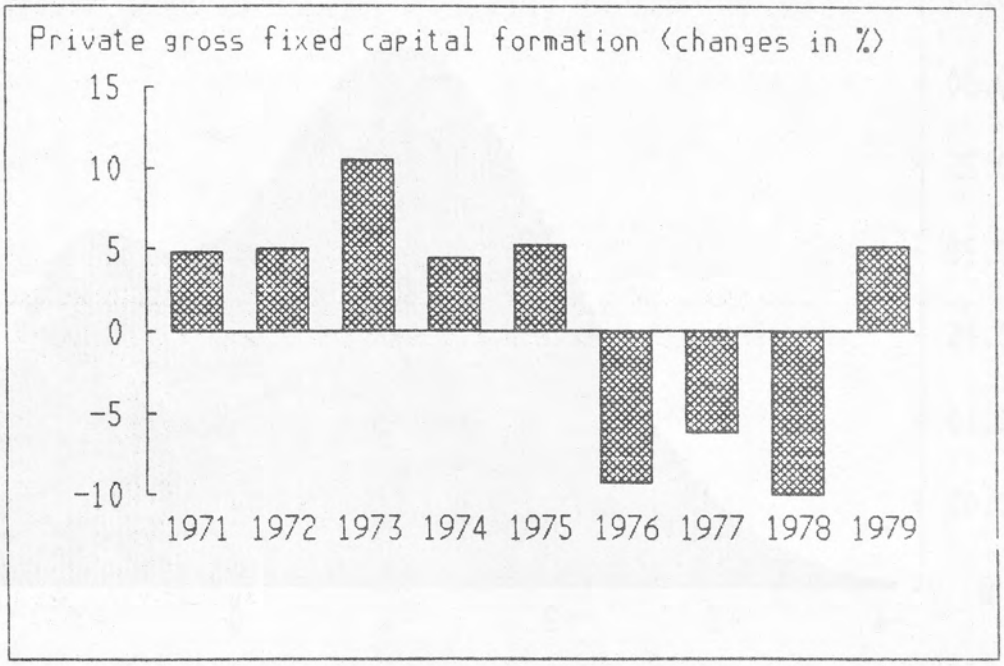



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (100x100)
57 *
58 *DATA SHADINGS,60,60,59
59 *     0 1 2 3 4 5 6 7 8 9 10
60 *_    1,1,1,1,1,1,1,1,1,1,1
61 *
62 *PLOT SHADINGS_
63 *TYPE=PIE
64 *SHADING=0,1,2,3,4,5,6,7,8,9,10
65 *HOME=0,0 SIZE=650,500
66 *
67 *
```

9

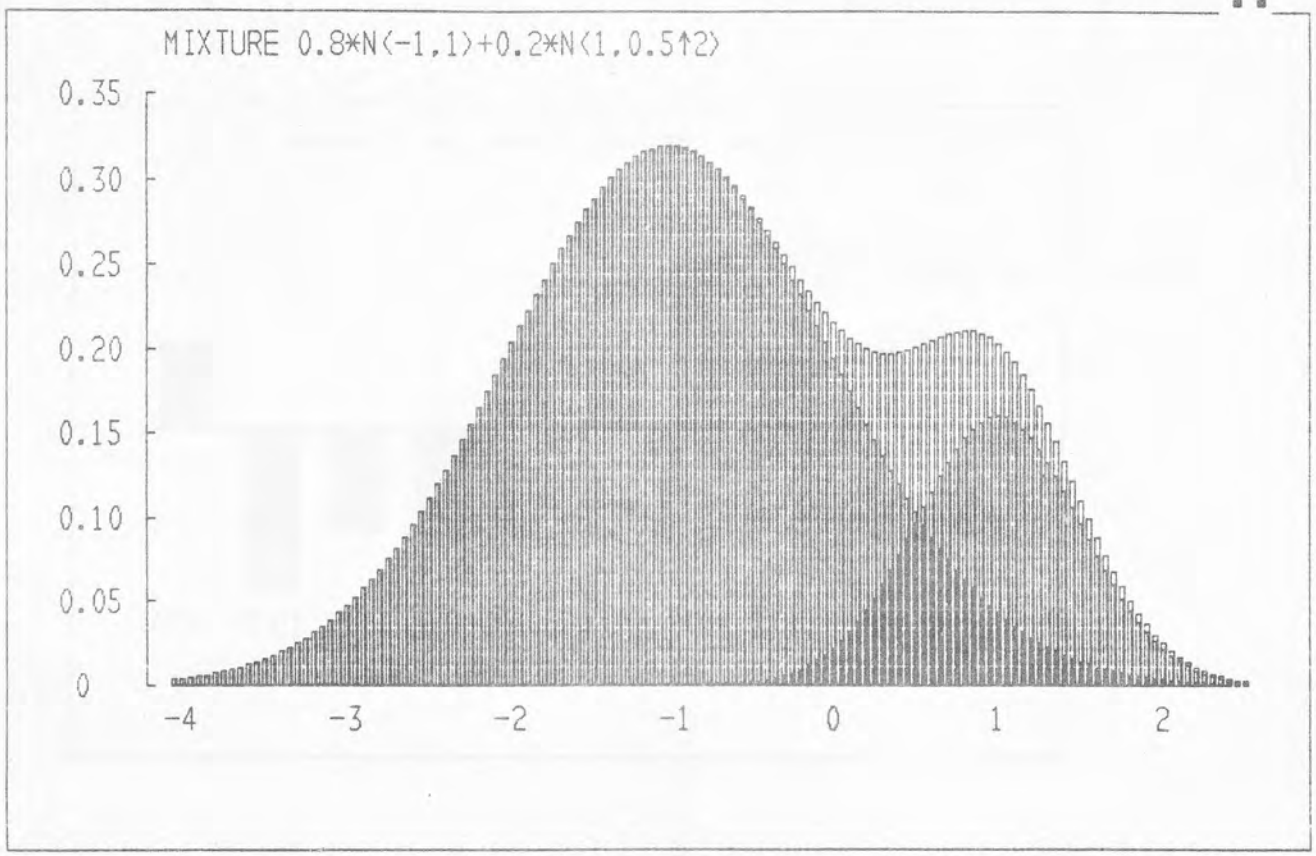



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (100x100)
68 *
69 *DATA BOOKS,X,Y,O
70 O         FACTUAL   FICTION
71 X1950       909       308
72 *1955      1078       241
73 *1960      1144       311
74 *1965      1451       336
75 *1970      1813       270
76 *1975      2222       421
77 Y1978      1740       345
78 *
79 *PLOT BOOKS_
80 *TYPE=MVBAR
81 *HEADER=Finnish books published in 1950-1978
82 *SHADING=-3,8
83 *
```



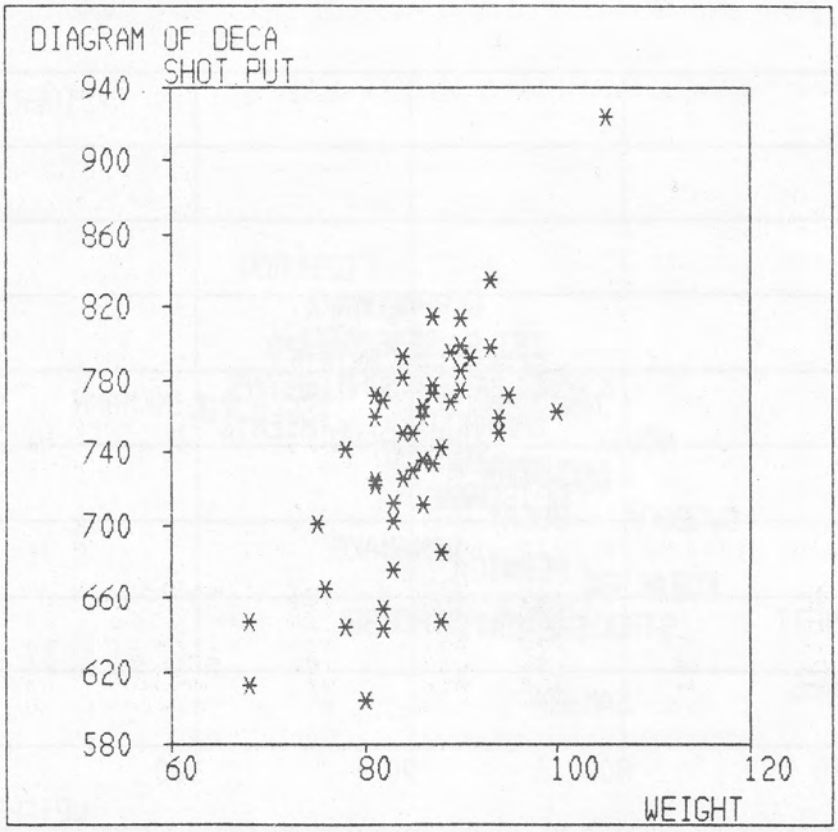

```
    1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
 96 *
 97 *HEADER=Private gross fixed capital formation (changes in %)
 98 *DATA FINLAND,I,J,K
 99 K              %DIFF
100 I 1971          4.8
101 * 1972          5.0
102 * 1973         10.5
103 * 1974          4.4
104 * 1975          5.2
105 * 1976         -9.3
106 * 1977         -6.2
107 * 1978        -10.0
108 J 1979          5.1
109 *
110 *TYPE=VBAR   SHADING=6
111 *PLOT FINLAND
112 *
```

11



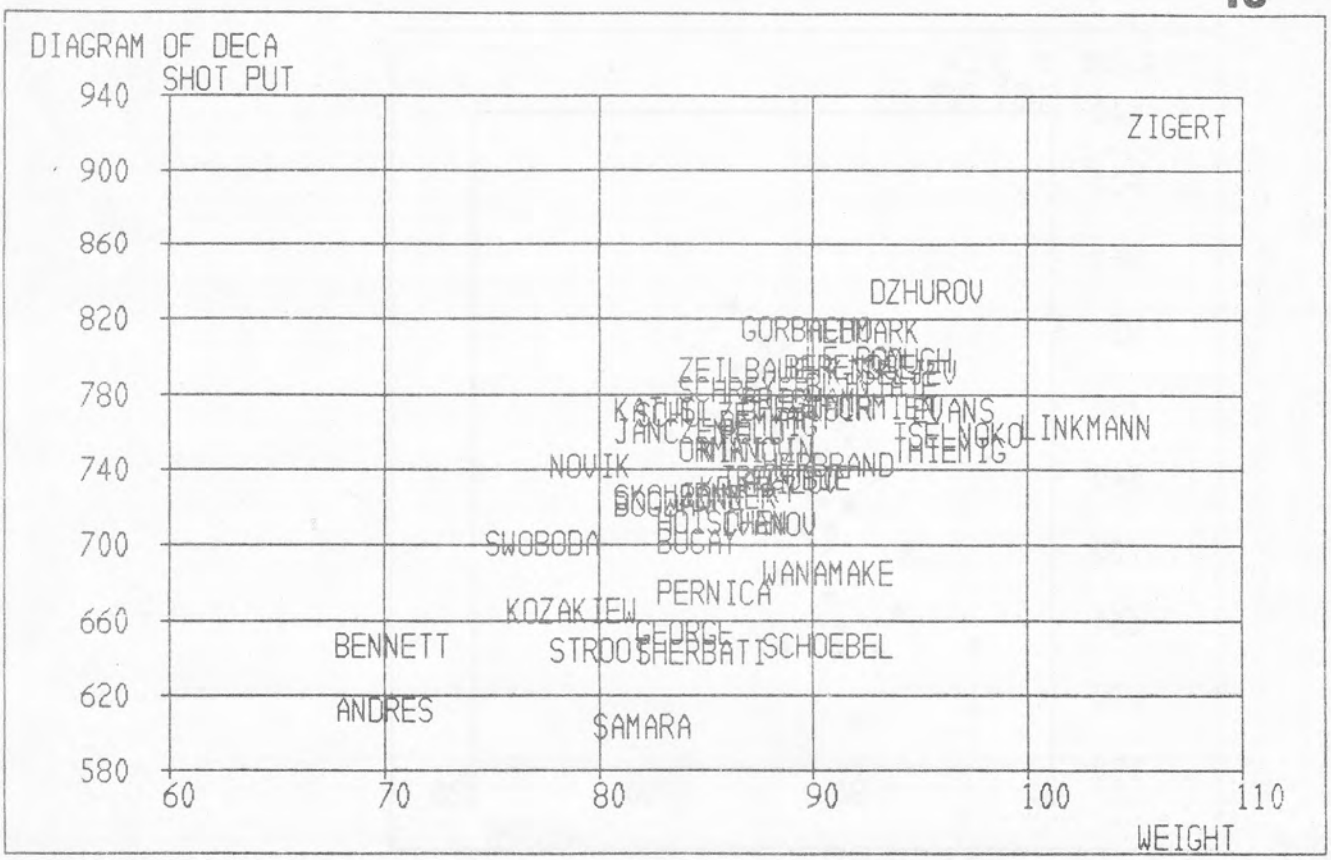

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (142x 70)
 1 *
 2 *
 3 *HEADER=          MIXTURE 0.8*N(-1,1)+0.2*N(1,0.5↑2)
 4 *LEGEND=-  SHADING=14,13,0  HOME=0,0  SIZE=790,511
 5 *TYPE=VBAR
 6 *PLOT BINORM_
 7 *          f=0.8*N.f(-1,1,x)  g=0.2*N.f(1,0.5↑2,x)
 8 *
 9 *DATA BINORM,11,141,10
10 *            min(f,g)    abs(f-g)    min(f,g)
11 *  -4_        0.0000      0.0035      0.0000
12 *    _        0.0000      0.0041      0.0000
13 *    _        0.0000      0.0048      0.0000
14 *    _        0.0000      0.0055      0.0000
15 *    _        0.0000      0.0063      0.0000
16 *    _        0.0000      0.0073      0.0000
17 *    _        0.0000      0.0083      0.0000
18 *    _        0.0000      0.0095      0.0000
19 *    _        0.0000      0.0109      0.0000
20 *    _        0.0000      0.0124      0.0000
21 *    _        0.0000      0.0140      0.0000
22 *    _        0.0000      0.0159      0.0000
23 *    _        0.0000      0.0179      0.0000
24 *    _        0.0000      0.0202      0.0000
25 *    _        0.0000      0.0227      0.0000
26 *    _        0.0000      0.0254      0.0000
27 *    _        0.0000      0.0284      0.0000
28 *    _        0.0000      0.0316      0.0000
29 *    _        0.0000      0.0352      0.0000
30 *    _        0.0000      0.0390      0.0000
31 *  -3_        0.0000      0.0432      0.0000
32 *    _        0.0000      0.0477      0.0000
33 *    _        0.0000      0.0525      0.0000
34 *    _        0.0000      0.0577      0.0000
35 *    _        0.0000      0.0632      0.0000
36 *    _        0.0000      0.0690      0.0000
37 *    _        0.0000      0.0752      0.0000
38 *    _        0.0000      0.0818      0.0000
39 *    _        0.0000      0.0887      0.0000
40 *    _        0.0000      0.0960      0.0000
```

12



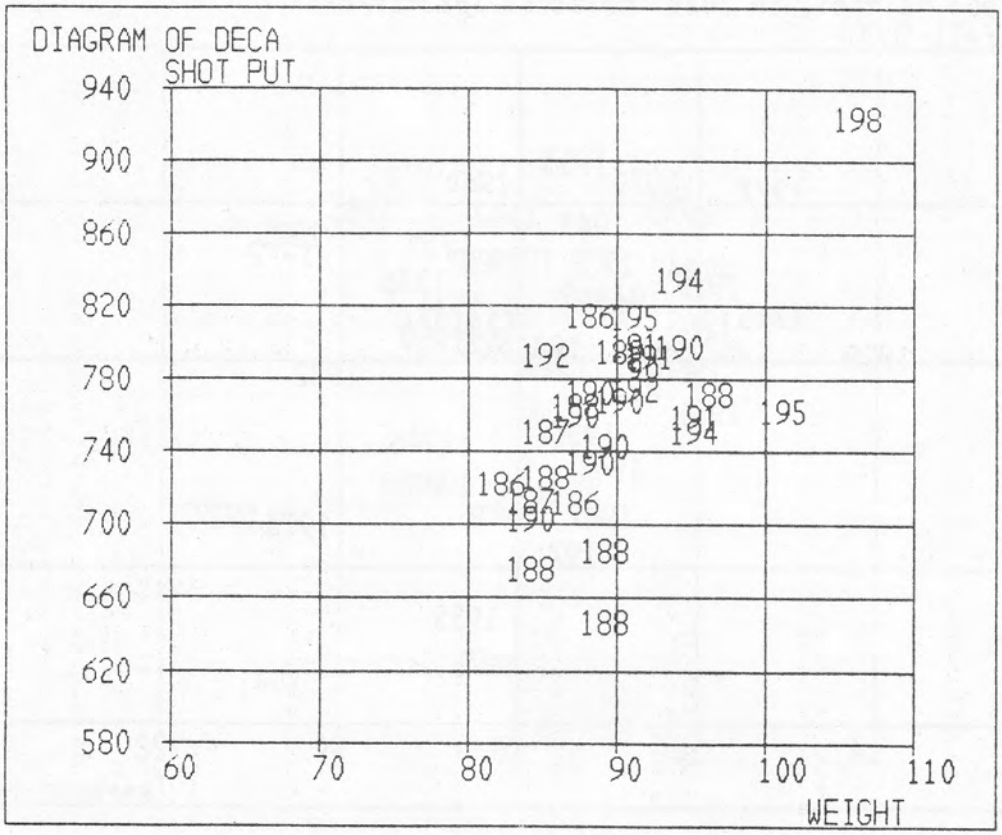

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (100x100)
35 *
36 *PLOT DECA,WEIGHT,SHOT_PUT_
37 *POINT=*   SIZE=500,500
38 *
39 *
40 *
41 *DATA DECA,X,Y,O
42 O            SHOT_PUT   400M   DISCUS   HEIGHT   WEIGHT
43 *
44 X SHERBATI     643       838     607      183       82
45 * GEORGE       654       866     626      184       82
46 * BENNETT      647       938     651      173       68
47 * KOZAKIEW     665       829     653      177       76
48 * NIKITIN      751       880     657      182       85
49 * BOGDAN       722       810     658      186       81
50 * ANDRES       612       880     671      180       68
```

13



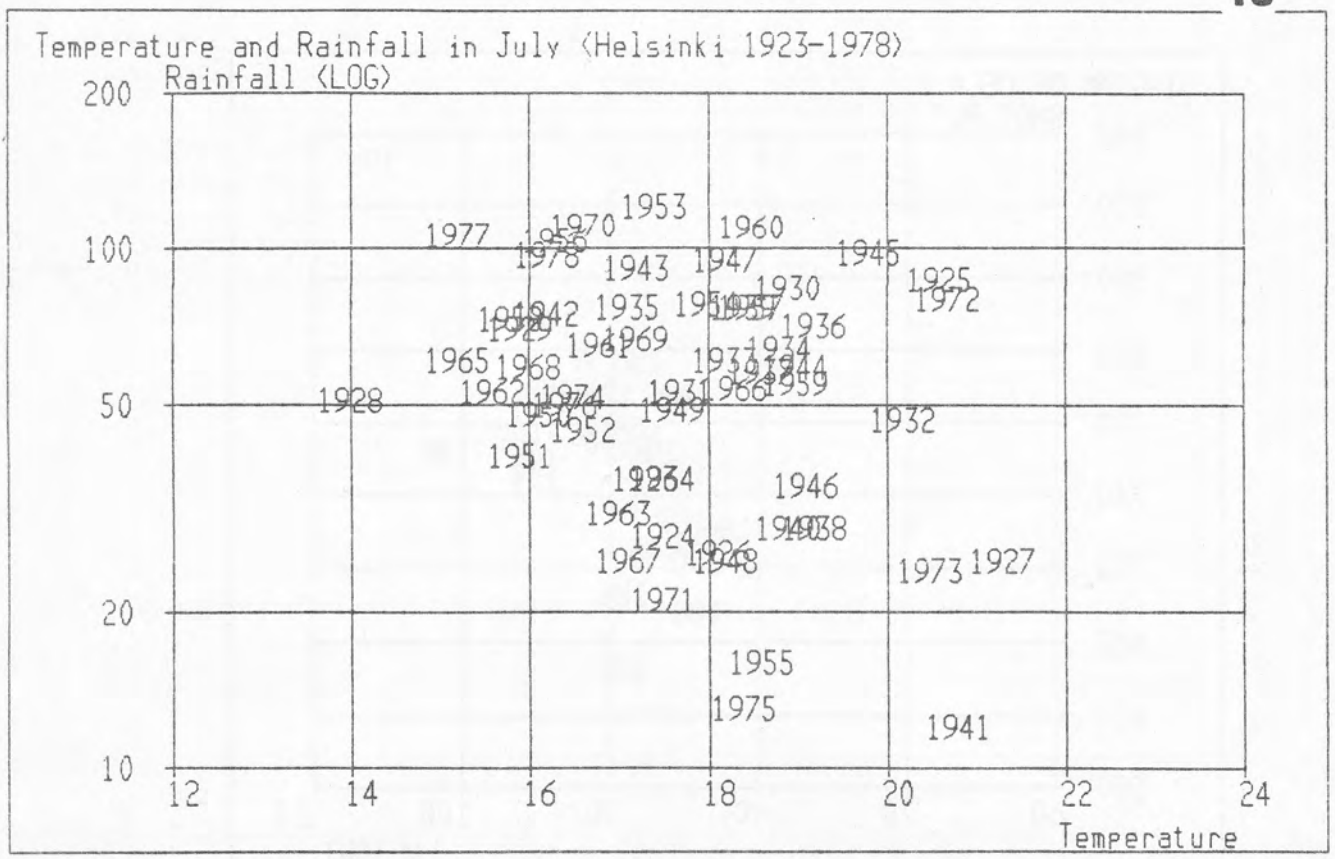

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (100x100)
35 *
36 *PLOT DECA,H_
37 *GRID=XY
38 *
39 *
40 *
41 *DATA DECA,X,Y,O
42 O           SHOT_PUT   400M   DISCUS   HEIGHT   WEIGHT
43 H SSSSSSSS     YYY                          XXX
44 X SHERBATI     643      838      607      183       82
45 * GEORGE       654      866      626      184       82
46 * BENNETT      647      938      651      173       68
47 * KOZAKIEW     665      829      653      177       76
48 * NIKITIN      751      880      657      182       85
49 * BOGDAN       722      810      658      186       81
50 * ANDRES       612      880      671      180       68
```

14



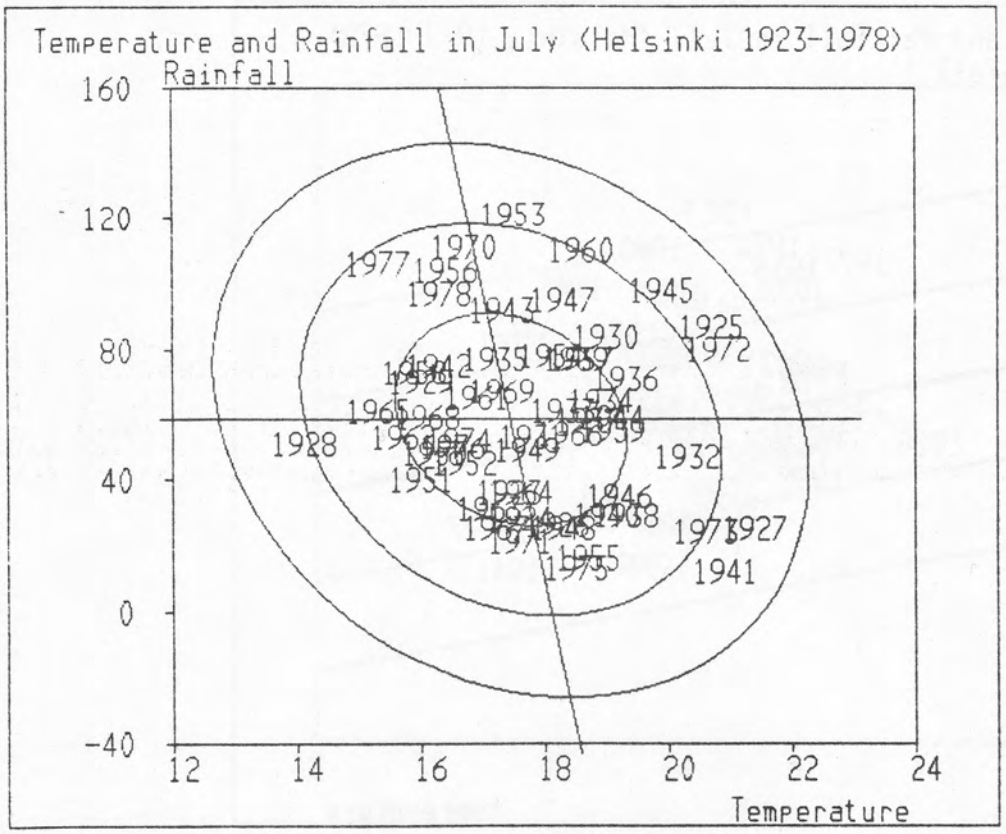

```
    1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (100x100)
32  *
33  *
34  *
35  *PLOT DECA,H_
36  *GRID=XY SIZE=600,500
37  *
38  *
39  *
40  *DATA DECA,X,Y,O
41  O            SHOT_PUT   400M   DISCUS   HEIGHT   WEIGHT   IND(HEIGHT-185)
42  H                YYY                      SSS      XXX          I
43  X  SHERBATI      643     838      607      183       82          0
44  *  GEORGE        654     866      626      184       82          0
45  *  BENNETT       647     938      651      173       68          0
46  *  KOZAKIEW      665     829      653      177       76          0
47  *  NIKITIN       751     880      657      182       85          0
48  *  BOGDAN        722     810      658      186       81          1
49  *  ANDRES        612     880      671      180       68          0
50  *  HOISCHEN      712     716      688      187       83          1
51  *  PERNICA       675     819      695      188       83          1
52  *  SWOBODA       701     797      709      182       75          0
53  *  STROOT        644     898      710      182       78          0
54  *  IVANOV        711     784      715      186       86          1
```

15



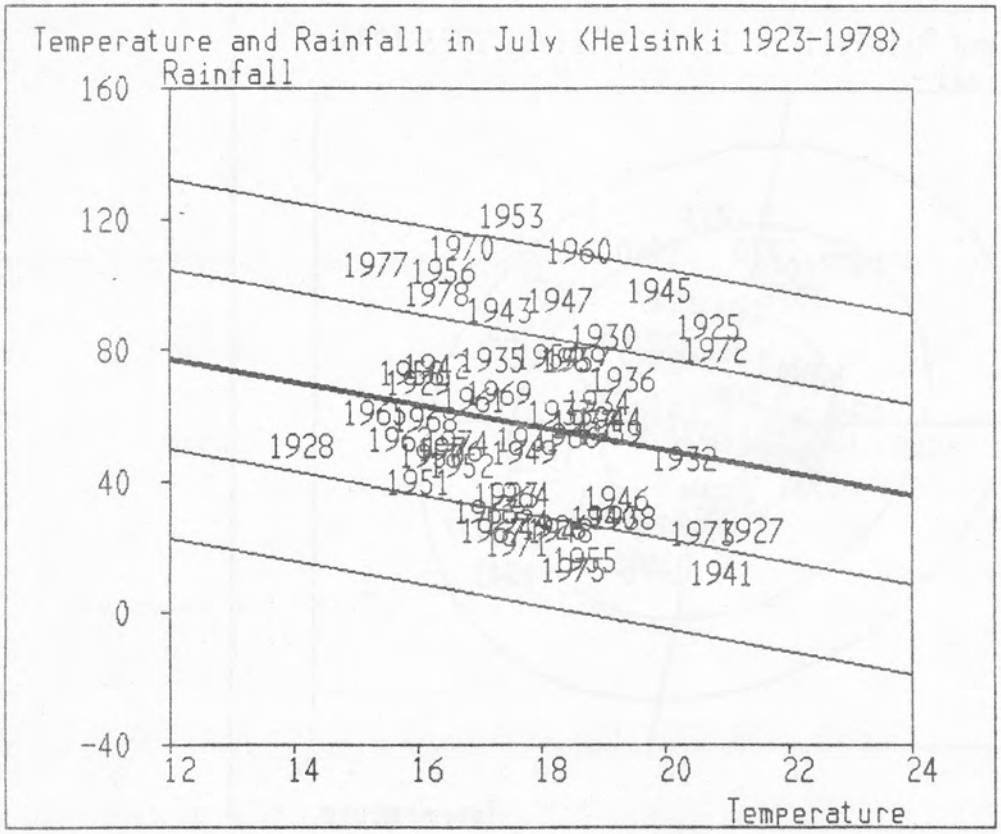

```
  1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
 9 *
10 *   _ PLOT HELSINKI "according to the masks on the image line" 20
11 *     GRID=XY HOME=0,0 SIZE=799,511
12 *     XSCALE=12,14,16,18,20,22,24
13 *     YSCALE=LOG,10,20,50,100,200
14 *     HEADER=Temperature and Rainfall in July (Helsinki 1923-1978)
15 *
16 *
17 *
18 *DATA HELSINKI,A,B,C
19 C              Temperature        Rainfall
20 *  SSSS           XXXX              YYY
21 A  1923           17.0               36
22 *  1924           17.2               28
23 *  1925           20.3               87
24 *  1926           17.8               26
25 *  1927           21.0               25
26 *  1928           13.7               51
27 *  1929           15.6               70
28 *  1930           18.6               84
29 *  1931           17.4               53
30 *  1932           19.9               47
31 *  1933           17.9               61
```

16



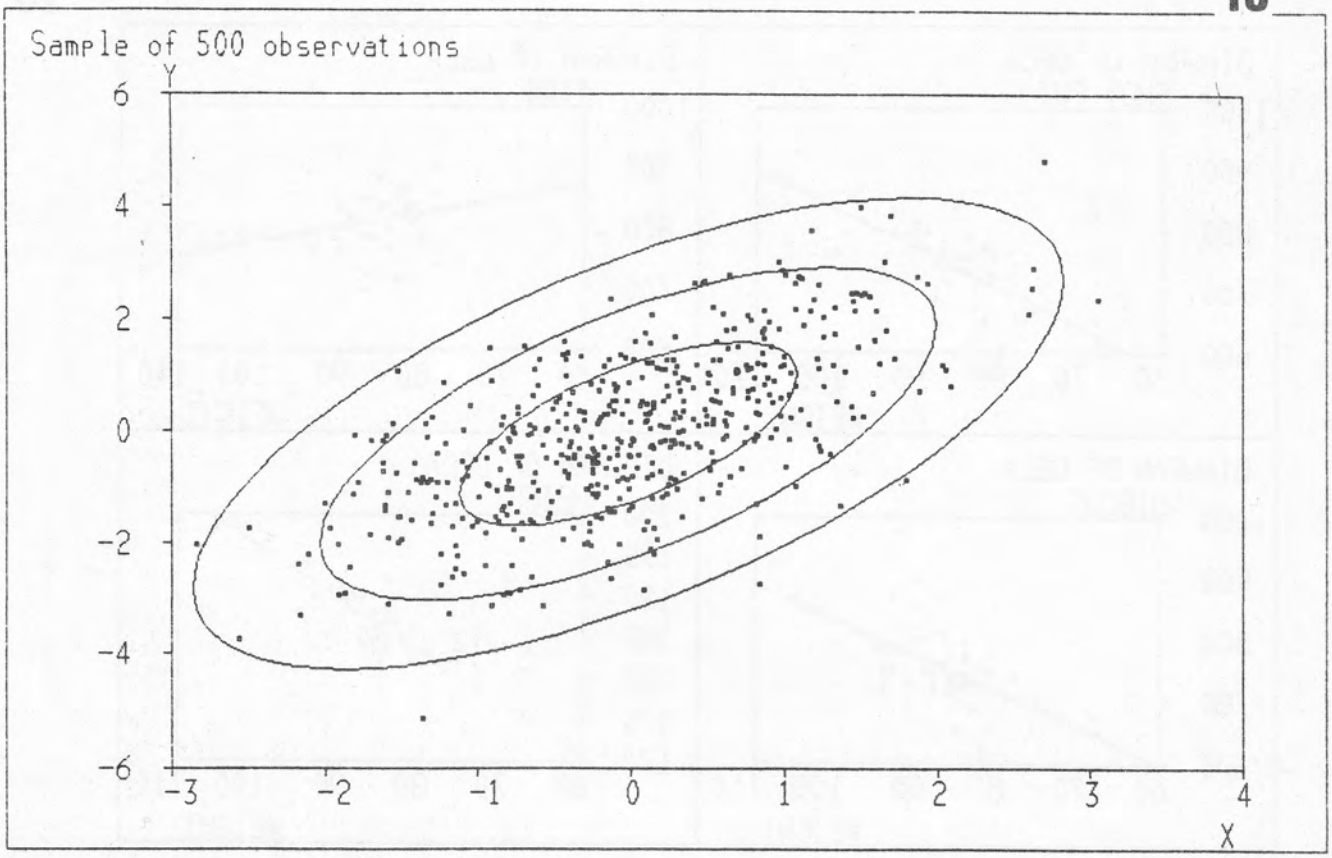

```
    1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
106 *
107 *PLOT HELSINKI,20_
108 *XSCALE=12,14,16,18,20,22,24 YSCALE=-40,0,40,80,120,160
109 *CONTOUR=0,0.5,0.9,0.99  SIZE=600,500
110 *HEADER=Temperature and Rainfall in July (Helsinki 1923-1978)
111 *
```

17



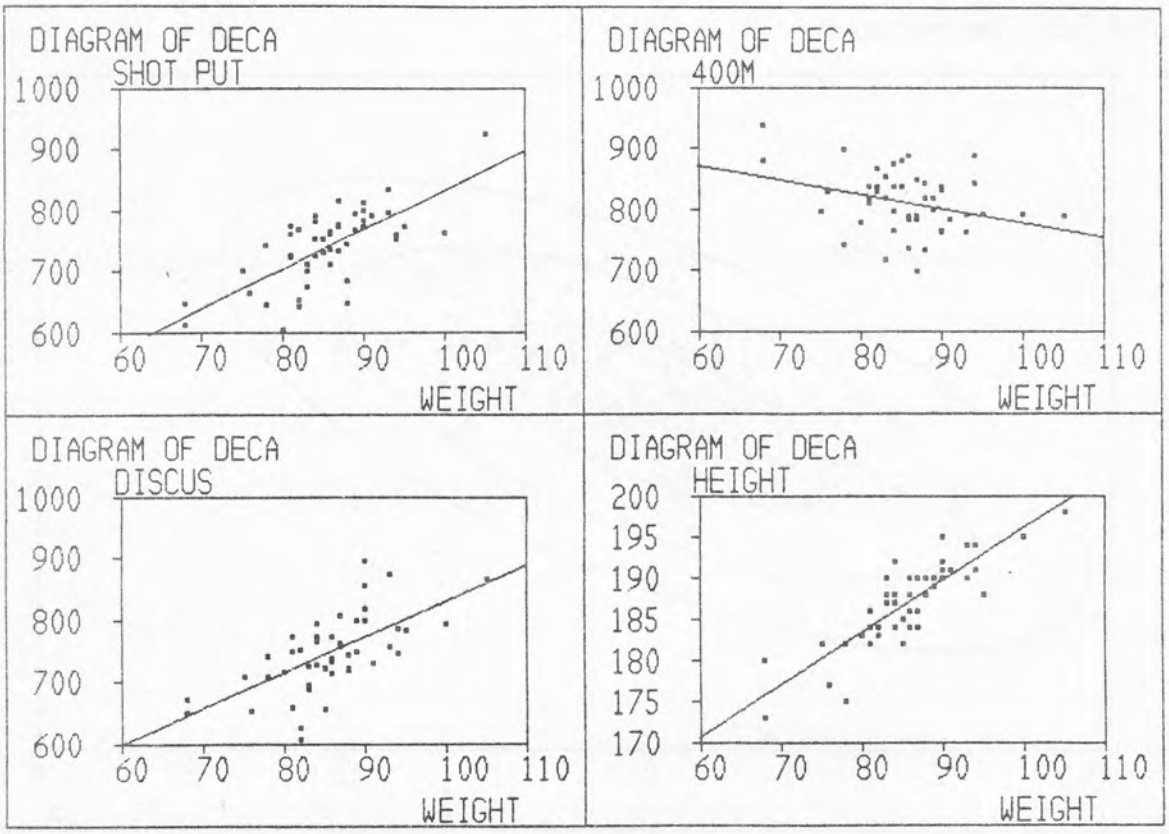

```
    1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
117 *
118 *PLOT HELSINKI,20_
119 *XSCALE=12,14,16,18,20,22,24 YSCALE=-40,0,40,80,120,160
120 *TREND=0,0.02,1,2      SIZE=600,500
121 *HEADER=Temperature and Rainfall in July (Helsinki 1923-1978)
122 *
```

18



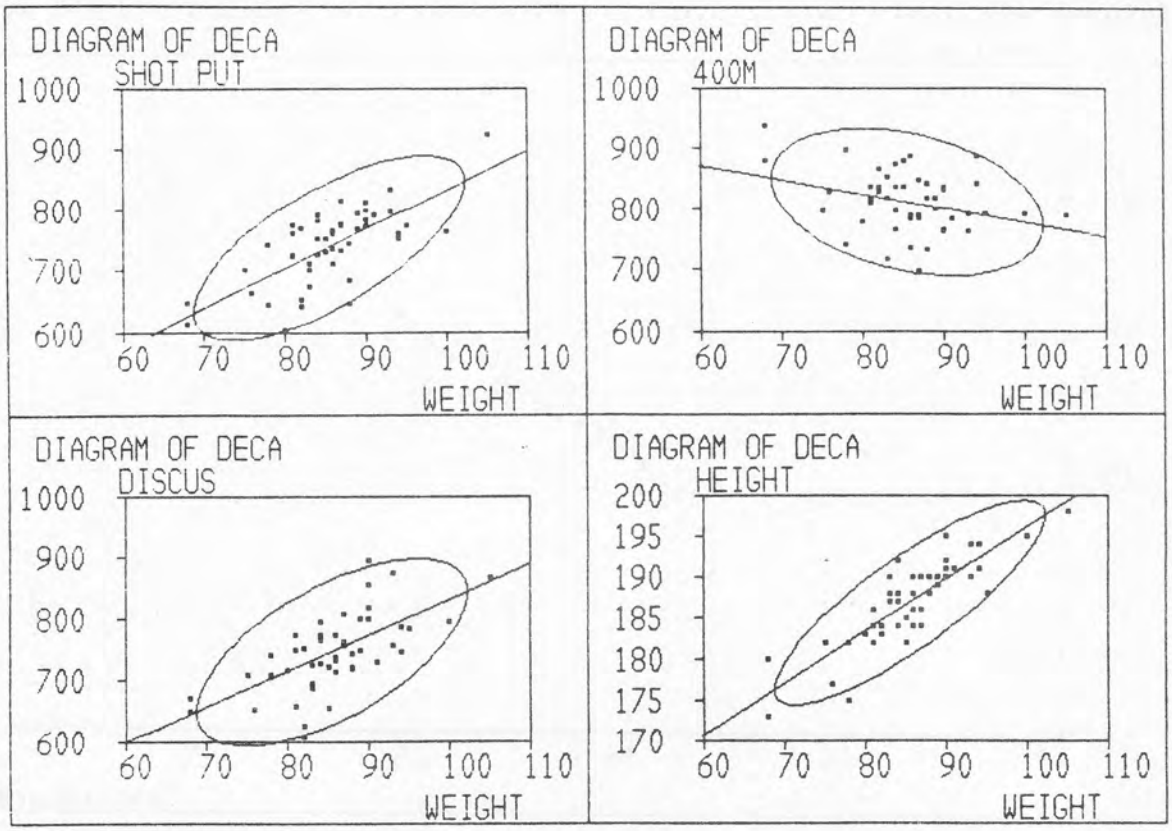

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen  U (517x 40)
 1 *
 2 *HEADER=Sample of 500 observations
 3 *
 4 *PLOT D,X,Y_
 5 *CONTOUR=0.5,0.9,0.99
 6 *
 7 *
 8 *DATA D,11,510,9
 9 *                      X         Y
10 *
11 * OBS0001   -1.36461 -0.82846
12 * OBS0002    0.54255  0.21492
13 * OBS0003    0.54080  1.25645
14 * OBS0004   -1.09976 -0.54924
15 * OBS0005   -0.36613 -0.48009
16 * OBS0006   -0.01055  0.85589
17 * OBS0007   -2.16692 -2.37393
18 * OBS0008    1.67211  1.79154
19 * OBS0009    0.08432 -1.76937
20 * OBS0010    0.87163  1.66212
21 * OBS0011    0.58090 -0.94937
22 * OBS0012    0.65213  0.31336
23 * OBS0013    0.10692  0.49461
```

19



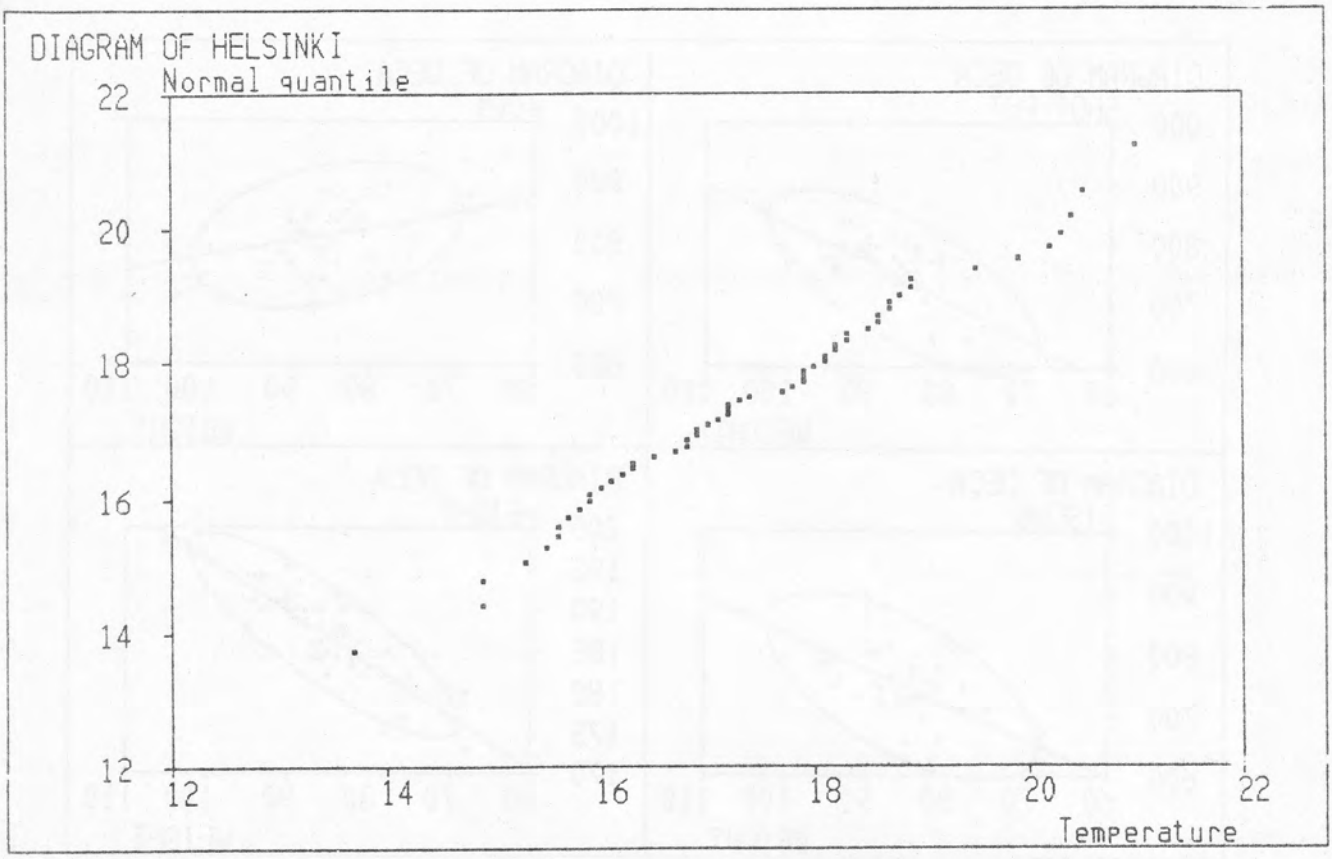

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (100x100)
16 *
17 *PLOT DECA,WEIGHT,SHOT_PUT   / TREND=0
18 *XSCALE=60,70,80,90,100,110  YSCALE=600,700,800,900,1000
19 *SIZE=350,250 HOME=0,250 XDIV=2,7,1 YDIV=2,6,2
20 *.....................................................................
21 *PLOT DECA,WEIGHT,400M        / TREND=0
22 *XSCALE=60,70,80,90,100,110  YSCALE=600,700,800,900,1000
23 *SIZE=350,250 HOME=350,250 XDIV=2,7,1 YDIV=2,6,2
24 *.....................................................................
25 *PLOT DECA,WEIGHT,DISCUS      / TREND=0
26 *XSCALE=60,70,80,90,100,110  YSCALE=600,700,800,900,1000
27 *SIZE=350,250 HOME=0,0 XDIV=2,7,1 YDIV=2,6,2
28 *.....................................................................
29 *PLOT DECA,WEIGHT,HEIGHT      / TREND=0
30 *XSCALE=60,70,80,90,100,110  YSCALE=170,175,180,185,190,195,200
31 *SIZE=350,250 HOME=350,0 XDIV=2,7,1 YDIV=2,6,2
32 *
```

20



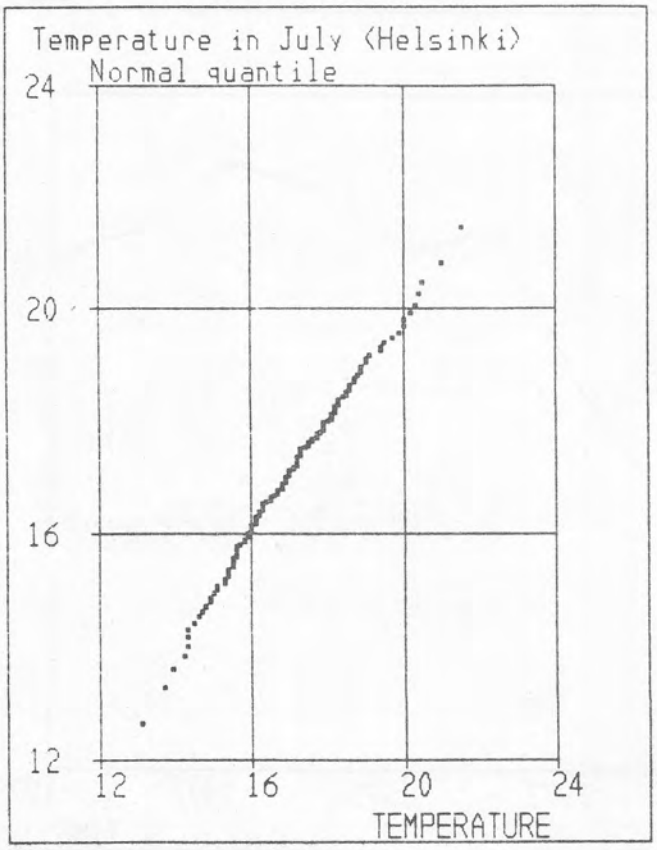

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (100x100)
16 *
17 *PLOT DECA,WEIGHT,SHOT_PUT  / TREND=0  CONTOUR=0.95
18 *XSCALE=60,70,80,90,100,110  YSCALE=600,700,800,900,1000
19 *SIZE=350,250 HOME=0,250 XDIV=2,7,1 YDIV=2,6,2
20 *.....................................................................
21 *PLOT DECA,WEIGHT,400M       / TREND=0  CONTOUR=0.95
22 *XSCALE=60,70,80,90,100,110  YSCALE=600,700,800,900,1000
23 *SIZE=350,250 HOME=350,250 XDIV=2,7,1 YDIV=2,6,2
24 *.....................................................................
25 *PLOT DECA,WEIGHT,DISCUS     / TREND=0  CONTOUR=0.95
26 *XSCALE=60,70,80,90,100,110  YSCALE=600,700,800,900,1000
27 *SIZE=350,250 HOME=0,0 XDIV=2,7,1 YDIV=2,6,2
28 *.....................................................................
29 *PLOT DECA,WEIGHT,HEIGHT     / TREND=0  CONTOUR=0.95
30 *XSCALE=60,70,80,90,100,110  YSCALE=170,175,180,185,190,195,200
31 *SIZE=350,250 HOME=350,0 XDIV=2,7,1 YDIV=2,6,2
32 *
```

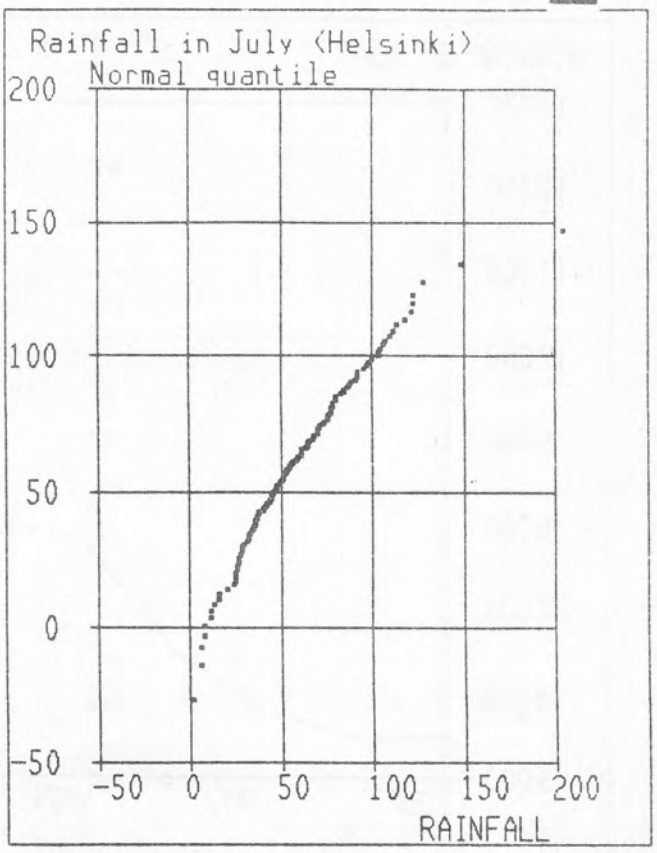
21




```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
68 * 1936          18.9                71
69 * 1938          18.9                29
70 * 1945          19.5                98
71 * 1932          19.9                47
72 * 1973          20.2                24
73 * 1925          20.3                87
74 * 1972          20.4                80
75 * 1941          20.5                12
76 B 1927          21.0                25
77 *-------------------------------------------------------------------
78 *               1111
79 *               PPPP
80 *                          PROBABILITY PLOTS
81 *     To test the normality of 'Temperature' a probability plot may
82 *generated in two steps:
83 *
84 *     1. Sort the observations in ascending order with respect to
85 *        'Temperature' by activating SORT on the next line:
86 *SORT HELSINKI,78
87 *
88 *     2. After sorting activate PLOT on the next line:
89 *PLOT HELSINKI,79_
90 *
```

22

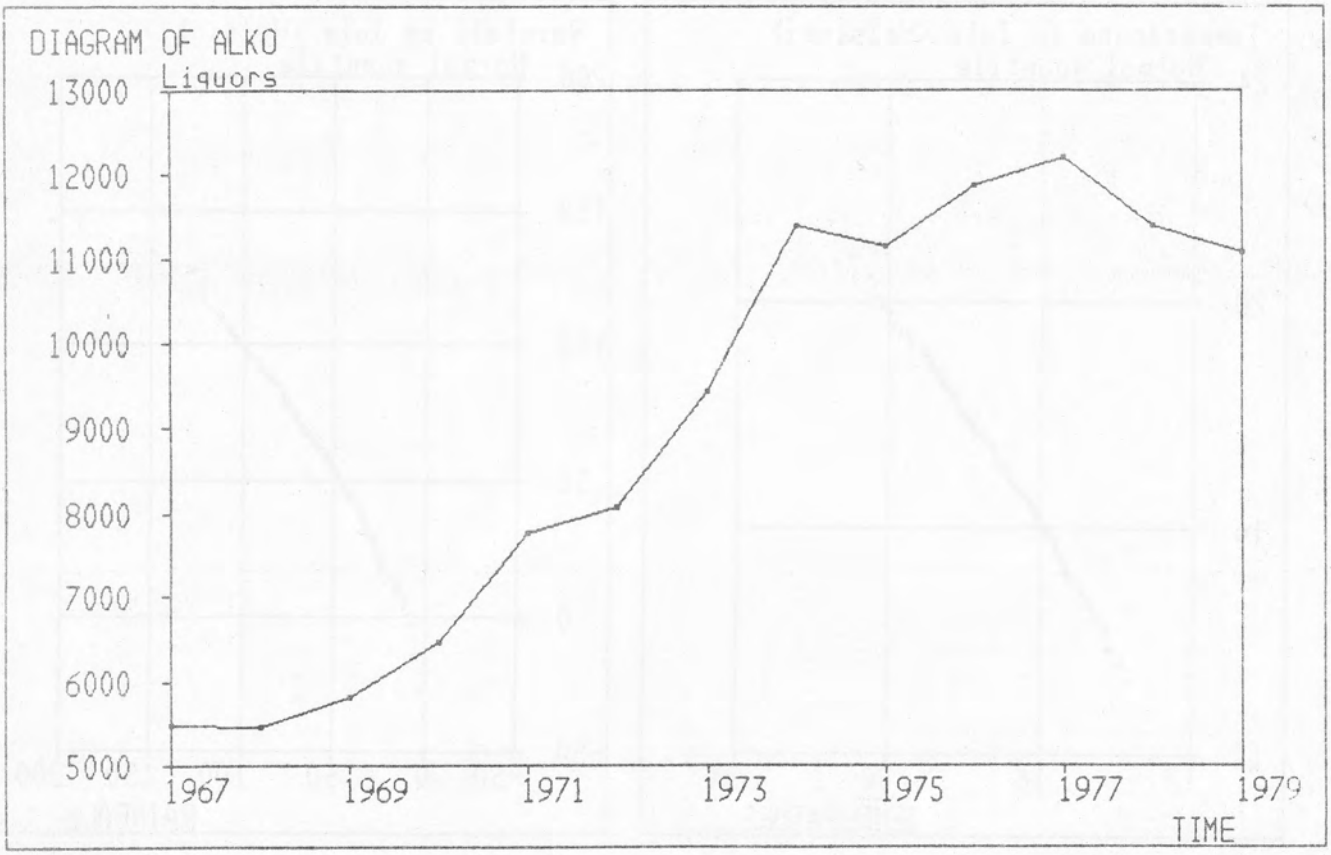





```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (150x 65)
 1 *
 2 *SORT HELSINKI,3
 3 *                1111
 4 *PLOT HELSINKI,5_
 5 *                PPPP
 6 *HEADER=Temperature in July (Helsinki)
 7 *HOME=0,0 SIZE=389,511 GRID=XY
 8 *XSCALE=12,16,20,24
 9 *XDIV=1,5,1
10 *
11 *DATA HELSINKI,14,148,12
12 *           TEMPERATURE   RAINFALL
13 *
14 * 1855          20.0            2
15 * 1868          18.4            6
16 * 1852          16.5            6
17 * 1912          18.1            8
18 * 1917          16.8            8
```

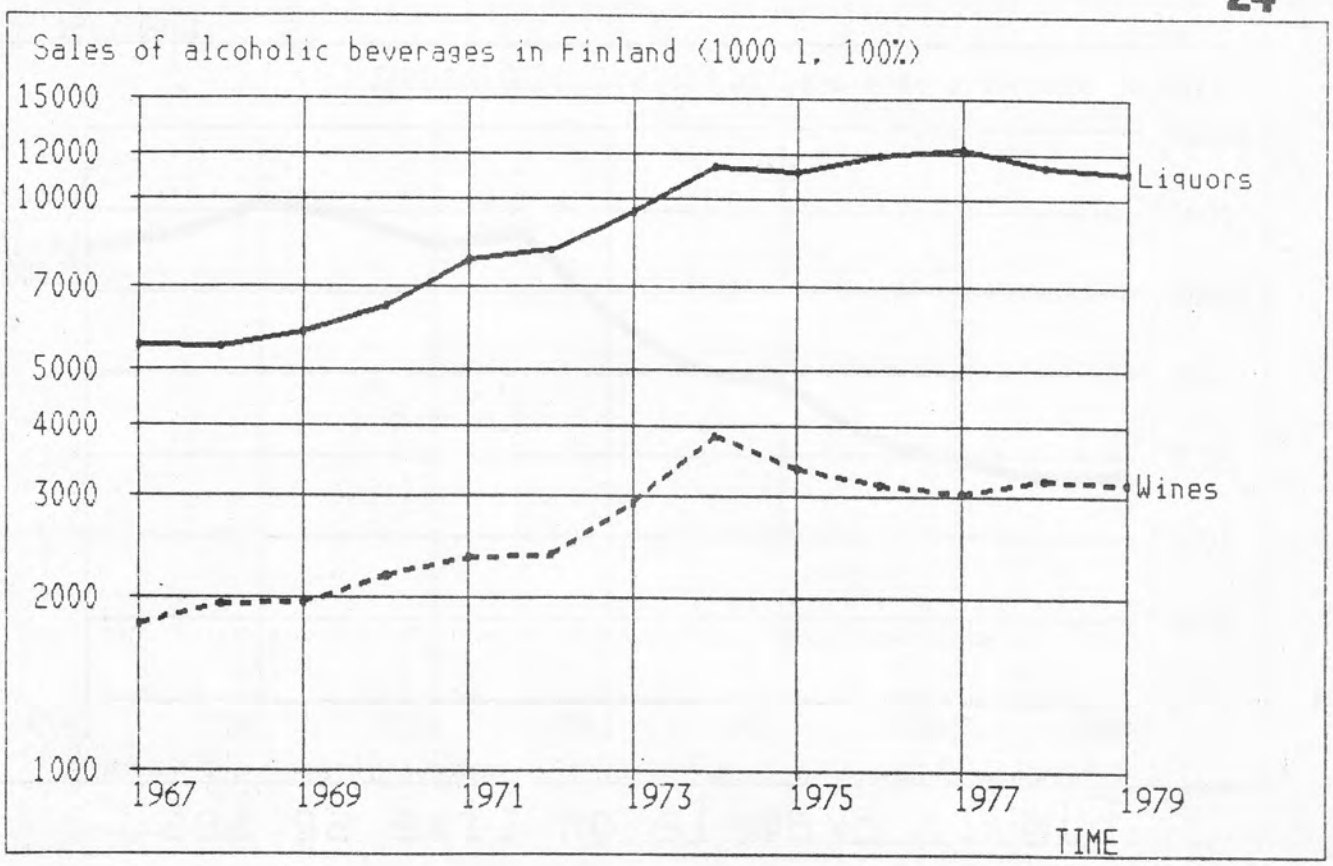
```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (150x 65)
 1 *
 2 *SORT HELSINKI,3
 3 *                          1111
 4 *PLOT HELSINKI,5_
 5 *                          PPPP
 6 *HEADER=Rainfall in July (Helsinki)
 7 *HOME=410,0 SIZE=389,511 GRID=XY
 8 *XSCALE=-50,0,50,100,150,200
 9 *XDIV=1,5,1
10 *
11 *DATA HELSINKI,14,148,12
12 *           TEMPERATURE   RAINFALL
13 *
14 * 1855          20.0            2
15 * 1868          18.4            6
16 * 1852          16.5            6
17 * 1912          18.1            8
18 * 1917          16.8            8
```

23




```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen    (124x 80)
27 *
28 *PLOT ALKO,L_
29 *
30 L       TTTT        YYYYY
31 *DATA ALKO,A,B,N
32 N                  Liquors     Wines
33 A       1967       5492720    1801882
34 *       1968       5464000    1950321
35 *       1969       5822810    1955832
36 *       1970       6464055    2178778
37 *       1971       7763558    2336811
38 *       1972       8083891    2363498
39 *       1973       9433061    2929823
40 *       1974      11384323    3836223
41 *       1975      11131258    3361426
42 *       1976      11880317    3146010
43 *       1977      12209625    3043773
44 *       1978      11389732    3209680
45 B       1979      11051050    3163677
46 *
```

24




```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
39 *       1973         9433061    2929823
40 *       1974        11384323    3836223
41 *       1975        11131258    3361426
42 *       1976        11880317    3146010
43 *       1977        12209625    3043773
44 *       1978        11389732    3209680
45 B       1979        11051050    3163677
46 W       TTTT                    YYYY
47 L       TTTT        YYYYY
48 *
49 *PLOT ALKO,L
50 *YSCALE=LOG,1000,2000,3000,4000,5000,7000,10000,12000,15000
51 *LINE=0,3,Liquors  YLABEL=-
52 *GRID=XY  XDIV=2,15,3
53 *HEADER=Sales of alcoholic beverages in Finland (1000 l, 100%)
54 *-----------------------------------------------------------------------
55 *
56 *PLOT ALKO,W
57 *YSCALE=LOG,1000,2000,3000,4000,5000,7000,10000,12000,15000
58 *LINE=6,3,Wines     YLABEL=-
59 *GRID=XY  XDIV=2,15,3
60 *HEADER=Sales of alcoholic beverages in Finland (1000 l, 100%)
61 *
```

25

13.5.1981/SM

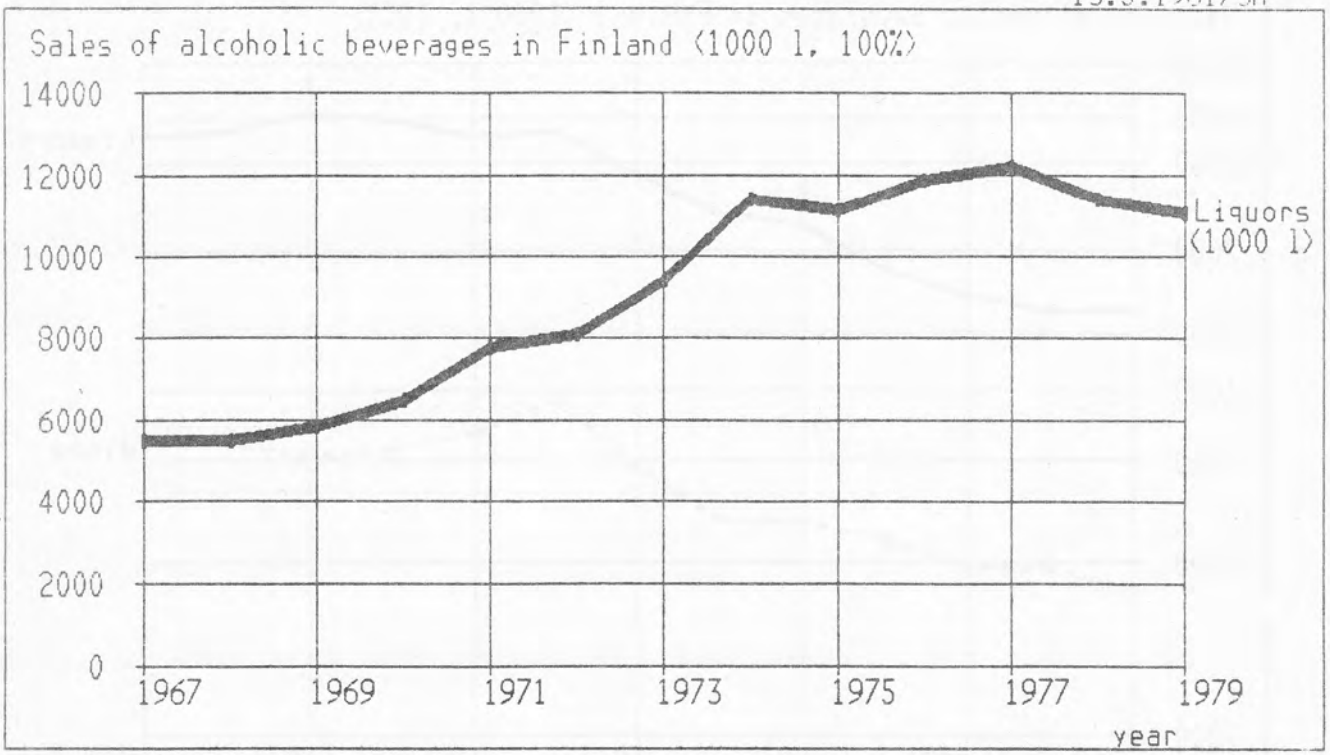
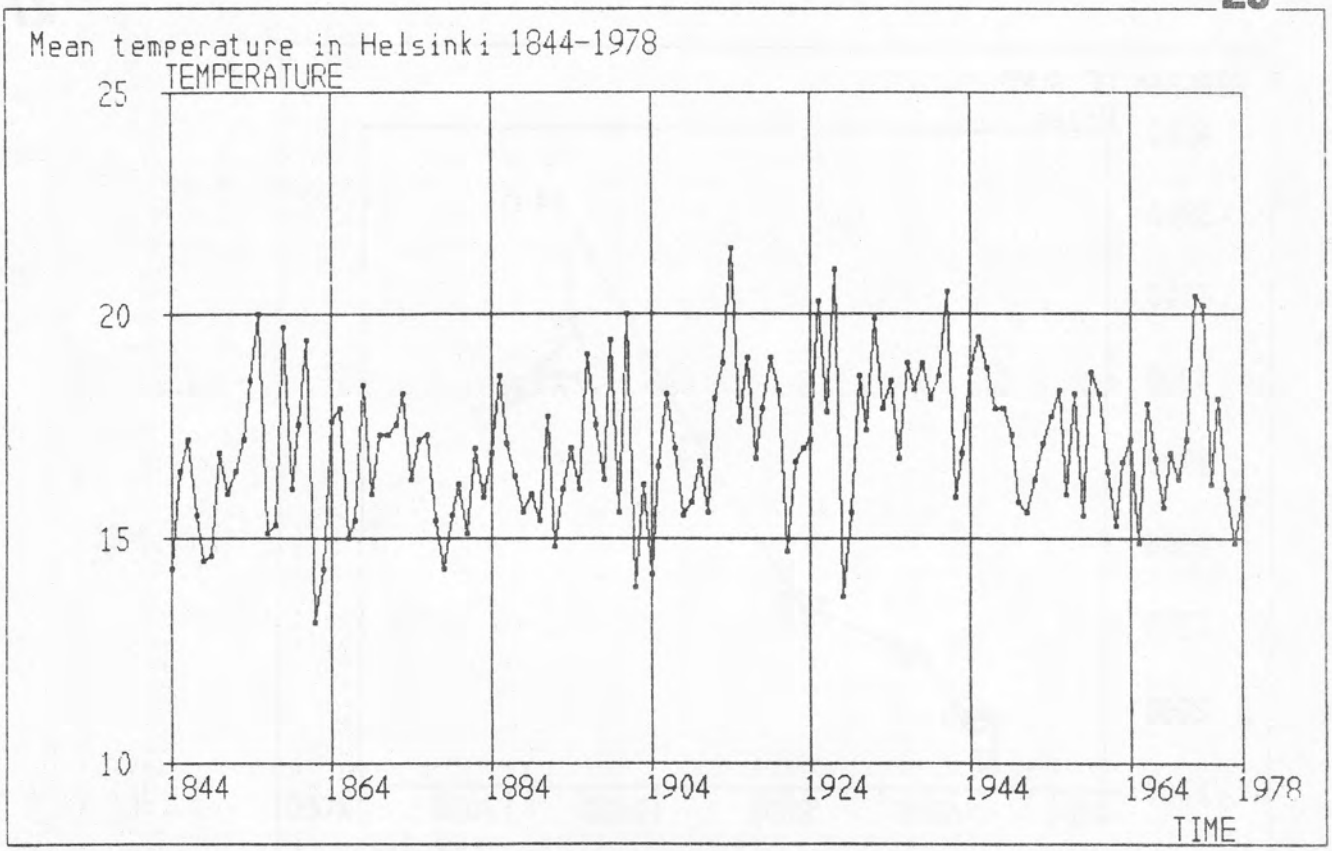


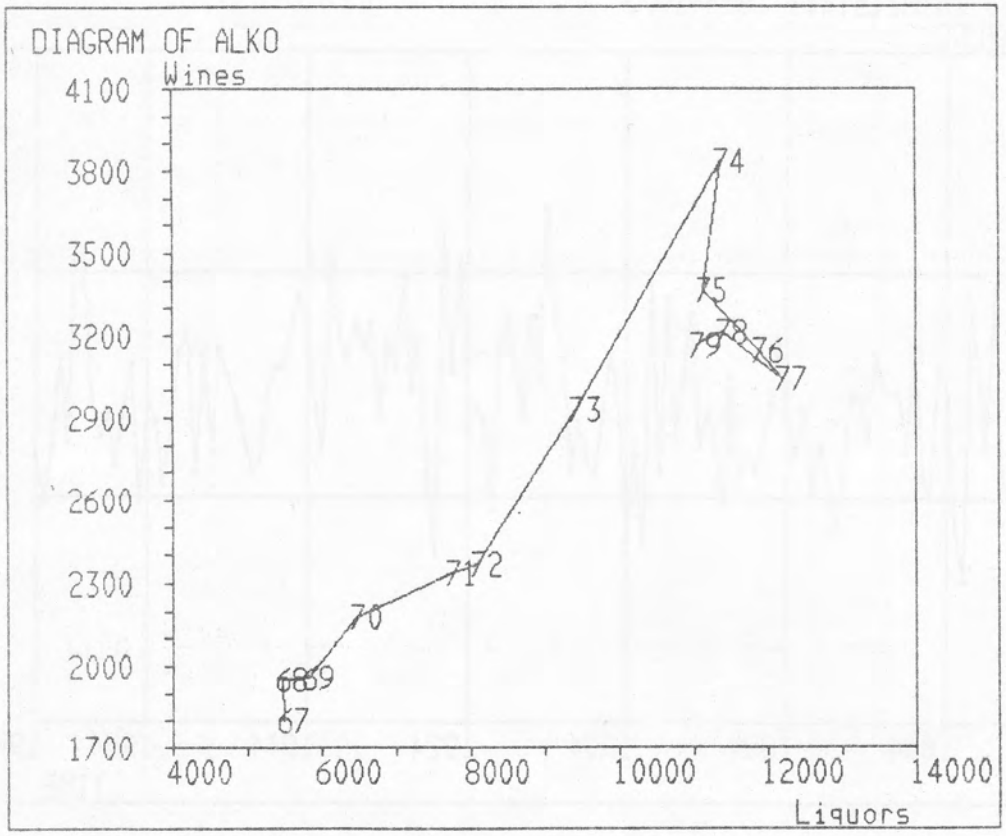
Fig.1: Example on time series

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
30 *
31 *DATA ALKO,A,B,N
32 N                    Liquors     Wines
33 A       1967         5492720    1801882
34 *       1968         5464000    1950321
35 *       1969         5822810    1955832
36 *       1970         6464055    2178778
37 *       1971         7763558    2336811
38 *       1972         8083891    2363498
39 *       1973         9433061    2929823
40 *       1974        11384323    3836223
41 *       1975        11131258    3361426
42 *       1976        11880317    3146010
43 *       1977        12209625    3043773
44 *       1978        11389732    3209680
45 B       1979        11051050    3163677
46 L       TTTT        YYYYY
47 *PLOT ALKO,L_
48 *YSCALE=0,2000,4000,6000,8000,10000,12000,14000
49 *GRID=XY  XLABEL=year  YLABEL=- TSTEP=2,1 LAG=0
50 *LINE=0,7,Liquors XDIV=4,30,4  TSCALE=1967,1979,1981
51 *HEADER=Sales of alcoholic beverages in Finland (1000 l, 100%)
52 *SIZE=799,450 HOME=0,40
53 *TEXT=Title,M1,M2   Title=Fig.1: Example on time series,100,20,2
54 *            M1=(1000 l),720,350  M2=13.5.1981/SM,650,500
55 *
```

26

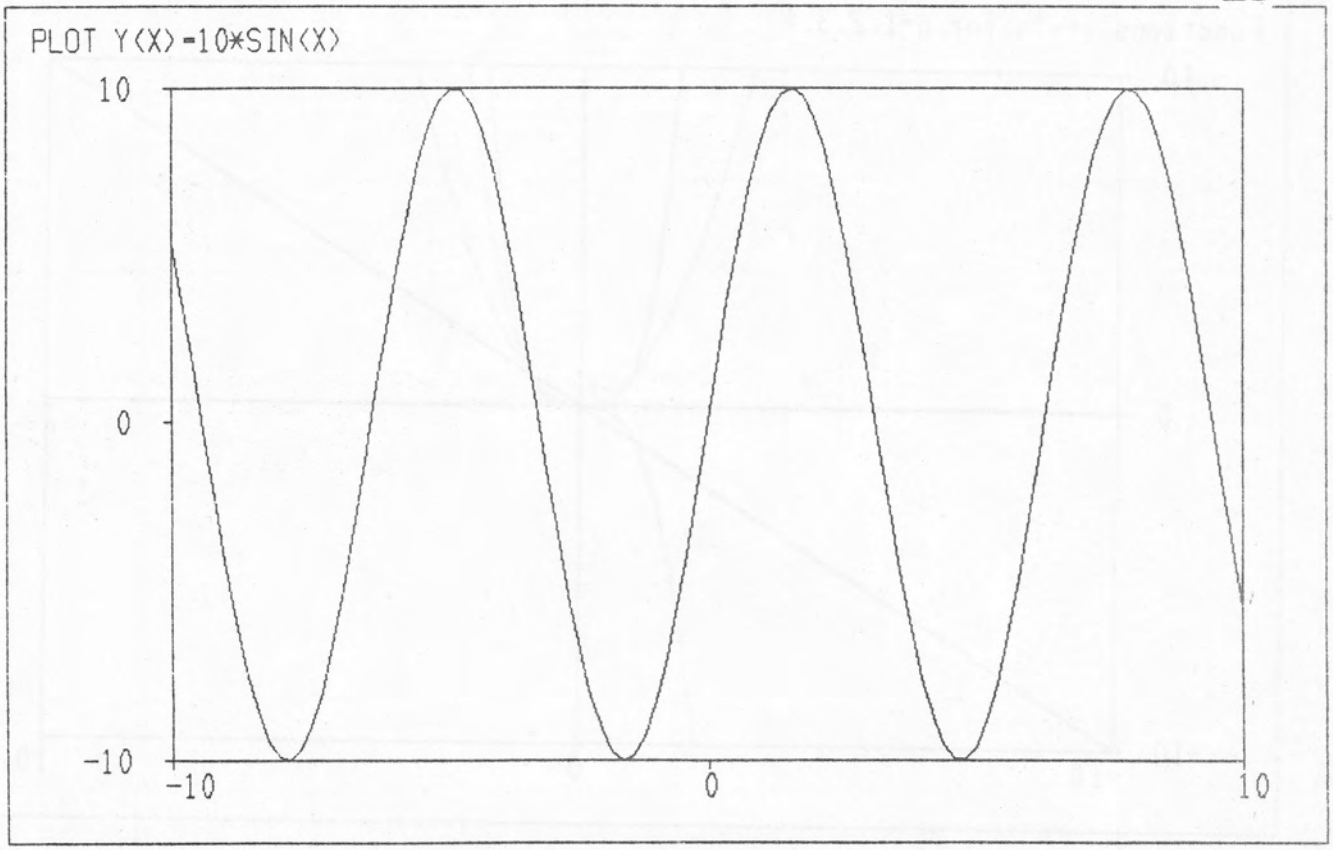



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (150x 65)
 1 *
 2 *
 3 *
 4 *PLOT HELSINKI,13_
 5 *
 6 *HEADER=Mean temperature in Helsinki 1844-1978
 7 *TSTEP=20,1   TSCALE=1978
 8 *YSCALE=10,15,20,25
 9 *GRID=XY
10 *
11 *DATA HELSINKI,14,148,12
12 *            TEMPERATURE   RAINFALL
13 * TTTT           YYYY
14 * 1844           14.3           65
15 * 1845           16.5           30
16 * 1846           17.2           32
17 * 1847           15.5           32
18 * 1848           14.5           44
19 * 1849           14.6           86
20 * 1850           16.9           27
21 * 1851           16.0           48
22 * 1852           16.5            6
23 * 1853           17.2           16
```



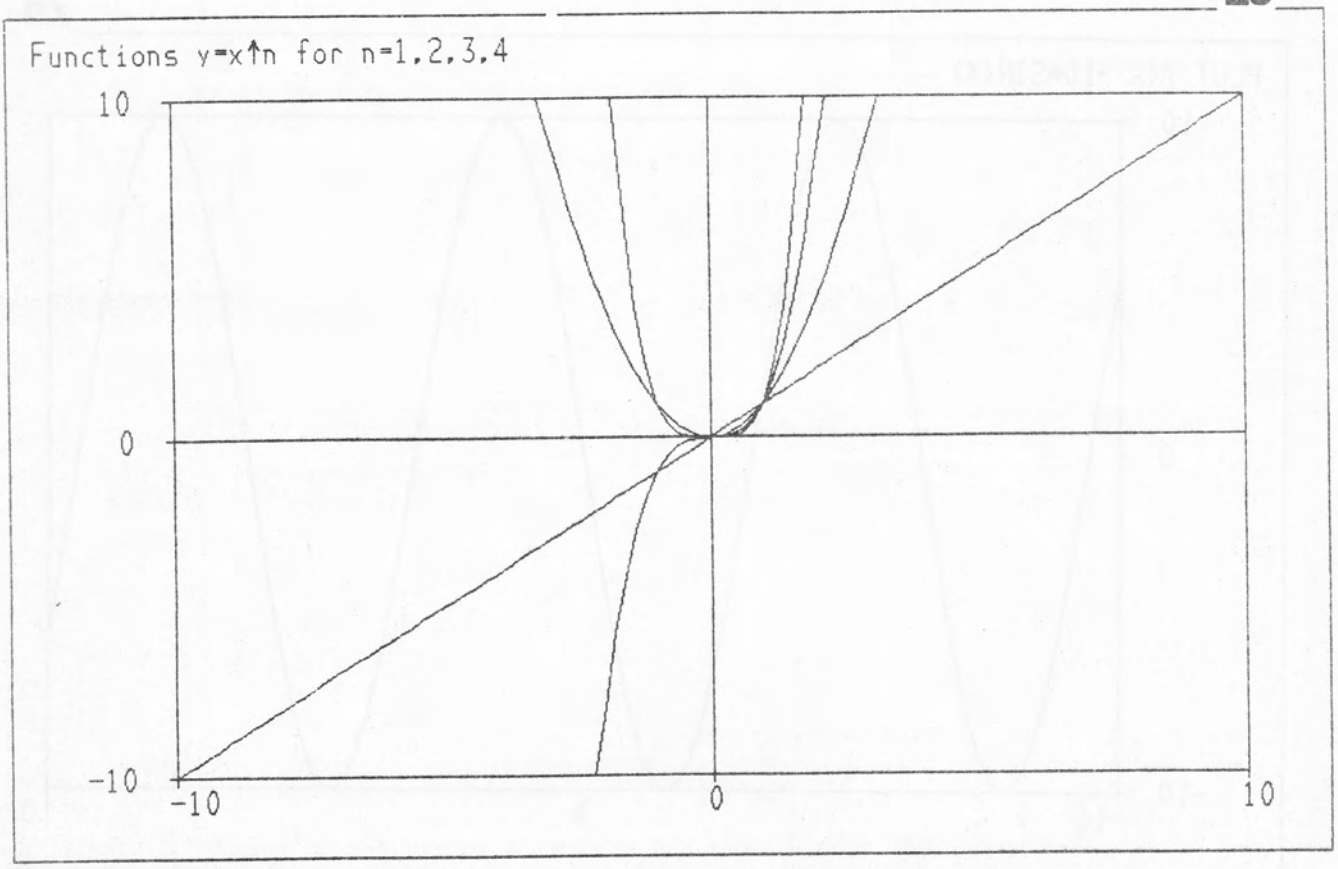

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
30 *
31 *DATA ALKO,A,B,N
32 N                    Liquors     Wines
33 A        1967        5492720    1801882
34 *        1968        5464000    1950321
35 *        1969        5822810    1955832
36 *        1970        6464055    2178778
37 *        1971        7763558    2336811
38 *        1972        8083891    2363498
39 *        1973        9433061    2929823
40 *        1974       11384323    3836223
41 *        1975       11131258    3361426
42 *        1976       11880317    3146010
43 *        1977       12209625    3043773
44 *        1978       11389732    3209680
45 B        1979       11051050    3163677
46 S          S8       XXXXX       YYYY
47 *
48 *LINE=0,1    SIZE=600,500   GRID=-1000,-100
49 *PLOT ALKO,S_
50 *
51 *
```

28



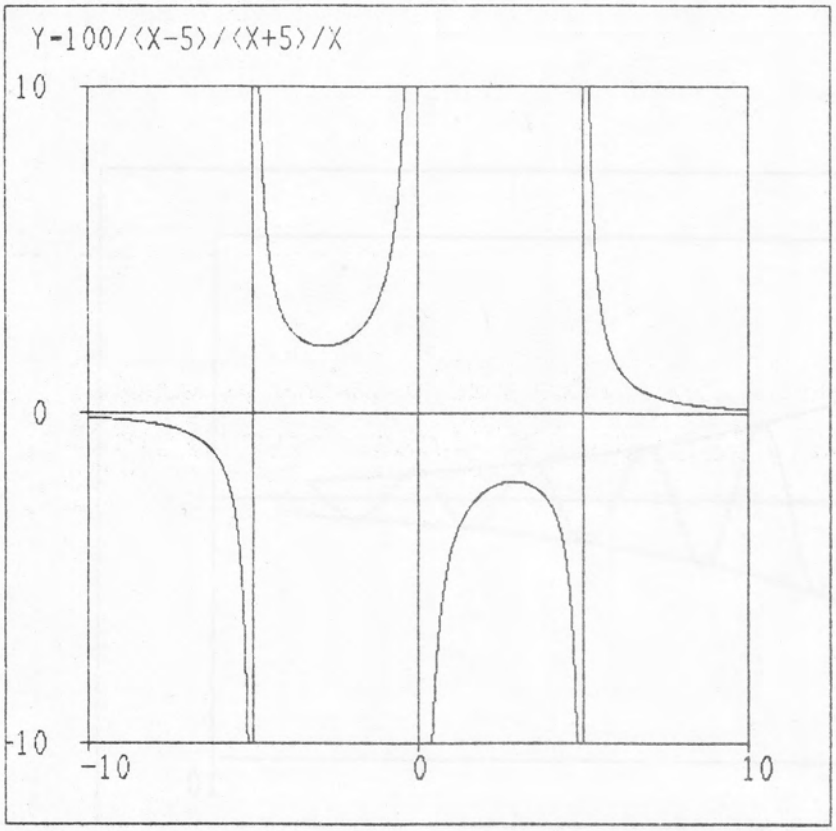

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
25 *
26 *
27 *PLOT Y(X)=10*SIN(X)_
28 *
29 *
```

29



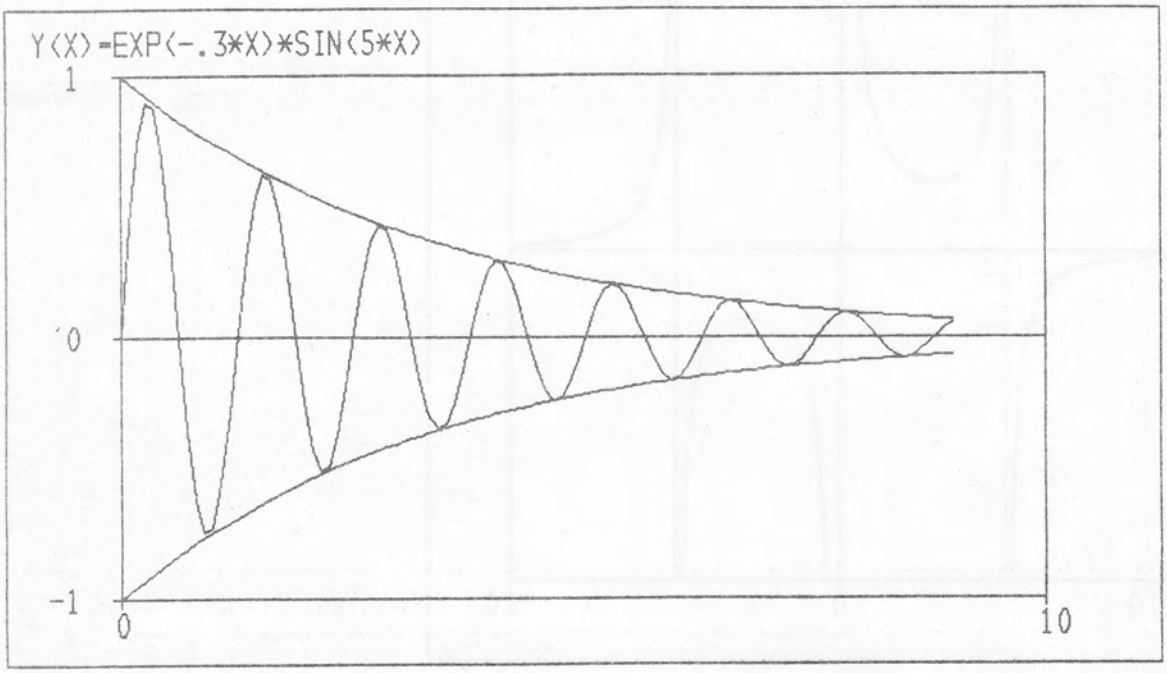

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
30 *
31 *HEADER=Functions y=x↑n for n=1,2,3,4    GRID=XY
32 *PLOT Y(x)=x↑n_   / n=1,4,1
33 *
```

30



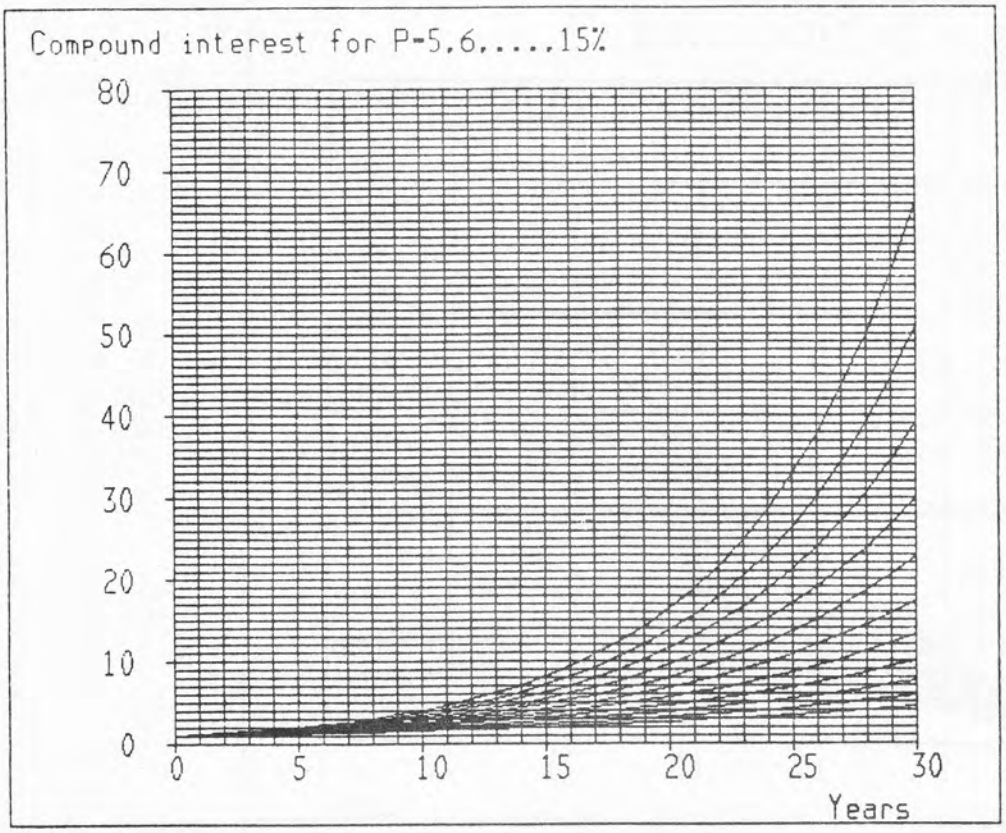

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
44 *
45 *XSCALE=-10,0,10 YSCALE=-10,0,10 XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
46 *X=-10,10,.025   HEADER=Y=100/(X-5)/(X+5)/X  GRID=XY
47 *PLOT Y(X)=100/(X-5)/(X+5)/X_
48 *
49 *
```

31



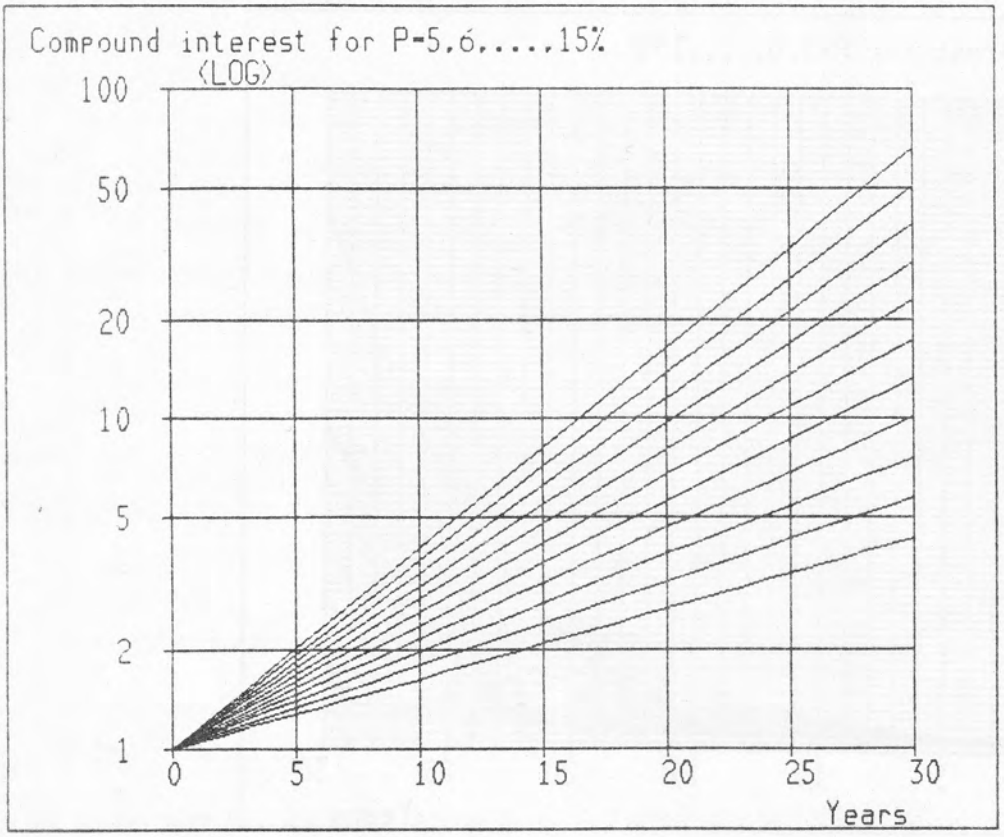

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
35 *
36 *XSCALE=0,10 YSCALE=-1,0,1 XDIV=1,8,1 YDIV=1,8,1 SIZE=700,400
37 *GRID=XY HEADER=Y(X)=EXP(-.3*X)*SIN(5*X)
38 *X=0,9
39 *PLOT Y(X)=EXP(-.3*X)*SIN(5*X)_
40 *PLOT Y(X)=EXP(-.3*X)
41 *PLOT Y(X)=-EXP(-.3*X)
42 *
```

32



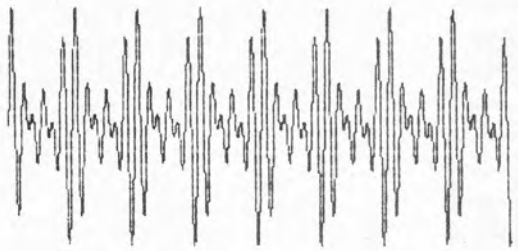

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
10 *
11 *HEADER=Compound interest for P=5,6,....,15% XLABEL=Years GRID=1,1
12 *XSCALE=0,5,10,15,20,25,30 YSCALE=0,10,20,30,40,50,60,70,80
13 *P=5,15,1  X=0,30,1    SIZE=600,500  YDIV=50,400,50
14 *PLOT Y(X)=(1+P/100)↑X_
15 *
```

33

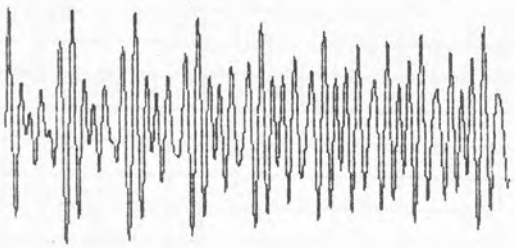



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
10 *
11 *HEADER=Compound interest for P=5,6,...,15% XLABEL=Years GRID=XY
12 *XSCALE=0,5,10,15,20,25,30 YSCALE=LOG,1,2,5,10,20,50,100
13 *P=5,15,1  X=0,30,1   SIZE=600,500  YDIV=50,400,50
14 *PLOT Y(X)=(1+P/100)↑X_
15 *
```

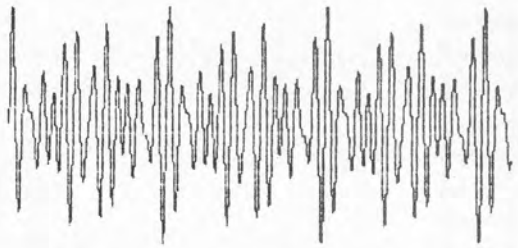
Pure major triad 4:5:6



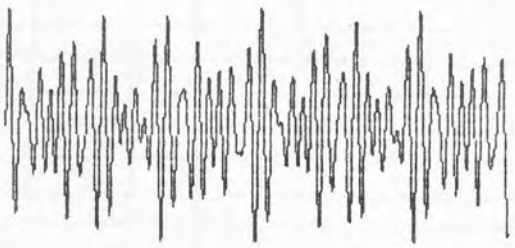
Tempered major triad 4:5:6



Pure minor triad 10:12:15

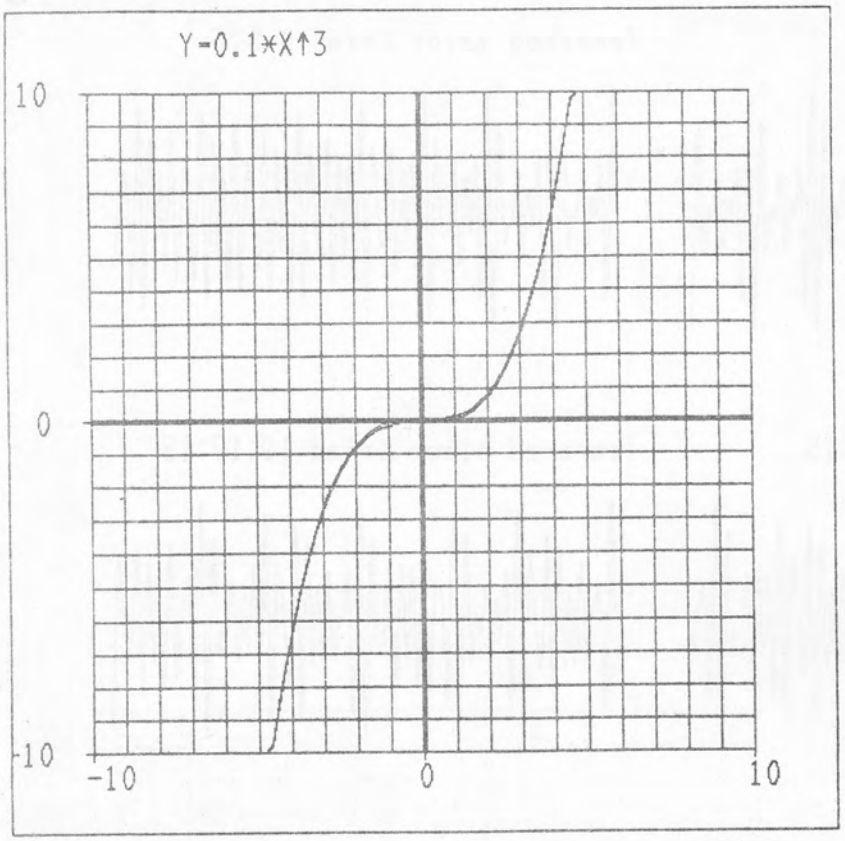


Tempered minor triad 10:12:15

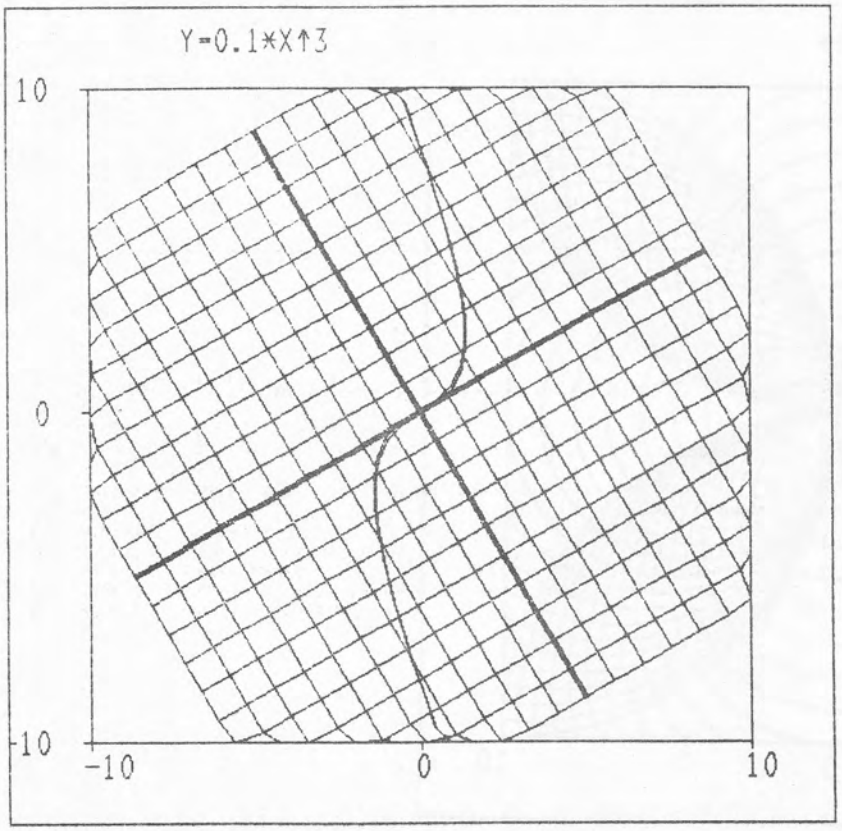


```
    1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
100 *
101 *                  PURE AND TEMPERED TRIADS IN MUSIC
102 *HEADER=Pure major triad 4:5:6  SIZE=350,250 HOME=0,250
103 *CLEARG XDIV=2,20,1 FRAME=0      XSCALE=0,10 YSCALE=-3,0,3 X=0,10,.0
104 *PLOT Y(X)=SIN(20*X)+SIN(25*X)+SIN(30*X)_
105 *
106 *.....................................................................
107 *HEADER=Pure minor triad 10:12:15 SIZE=350,250 HOME=0,0
108 *        XDIV=2,20,1 FRAME=0      XSCALE=0,10 YSCALE=-3,0,3 X=0,10,.0
109 *PLOT Y(X)=SIN(20*X)+SIN(24*X)+SIN(30*X)
110 *
111 *.....................................................................
112 *HEADER=Tempered major triad 4:5:6 SIZE=350,250 HOME=350,250
113 *                  20*2↑(4/12)=25.1984209979 20*2↑(7/12)=29.966141537
114 *        XDIV=2,20,1 FRAME=0      XSCALE=0,10 YSCALE=-3,0,3 X=0,10,.0
115 *PLOT Y(X)=SIN(20*X)+SIN(25.198*X)+SIN(29.966*X)
116 *
117 *.....................................................................
118 *HEADER=Tempered minor triad 10:12:15 SIZE=350,250 HOME=350,0
119 *                  20*2↑(3/12)=23.7841423
120 *        XDIV=2,20,1 FRAME=0      XSCALE=0,10 YSCALE=-3,0,3 X=0,10,.0
121 *PLOT Y(X)=SIN(20*X)+SIN(23.784*X)+SIN(29.966*X)
122 *
```

35

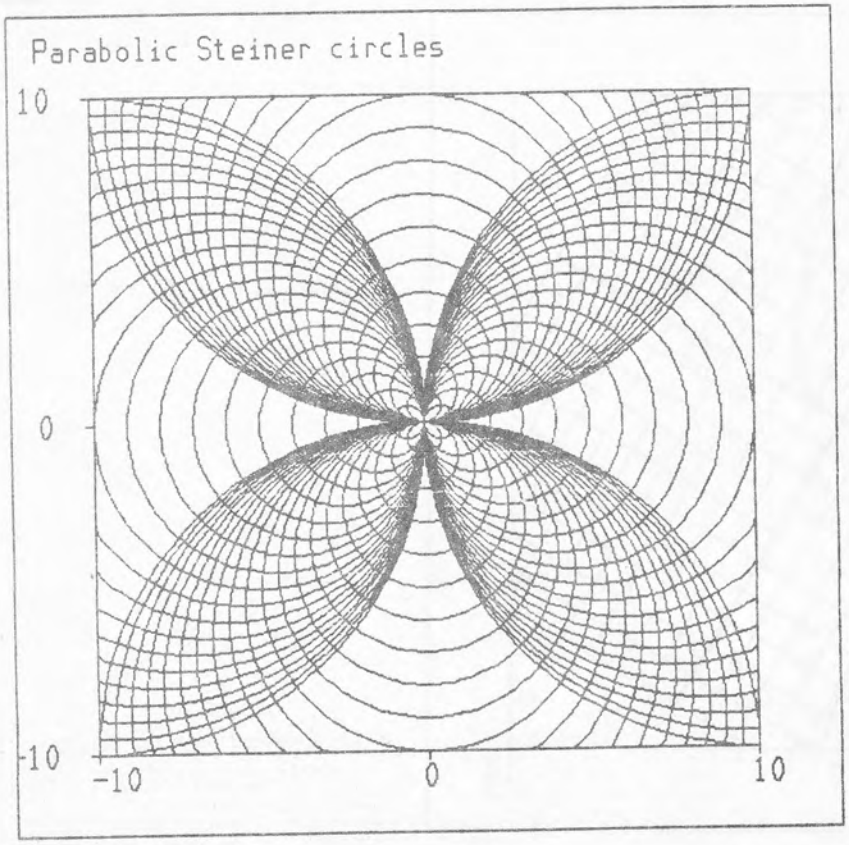



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen      (124x 80)
77 *
78 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
79 *t=-10,10,1     HEADER=          Y=0.1*X↑3
80 *u=-10,10,1
81 *eps=-.05,.05,.1
82 *                                  Comments:
83 *PLOT Y(u)=t_                    / lines parallel to X axis
84 *PLOT X(t)=u,Y(t)=t              / lines parallel to Y axis
85 *PLOT Y(u)=eps                   / thicker X axis
86 *PLOT X(t)=eps,Y(t)=t           / thicker Y axis
87 *PLOT Y(X)=.1*X↑3+eps           / curve
88 *
89 *
```



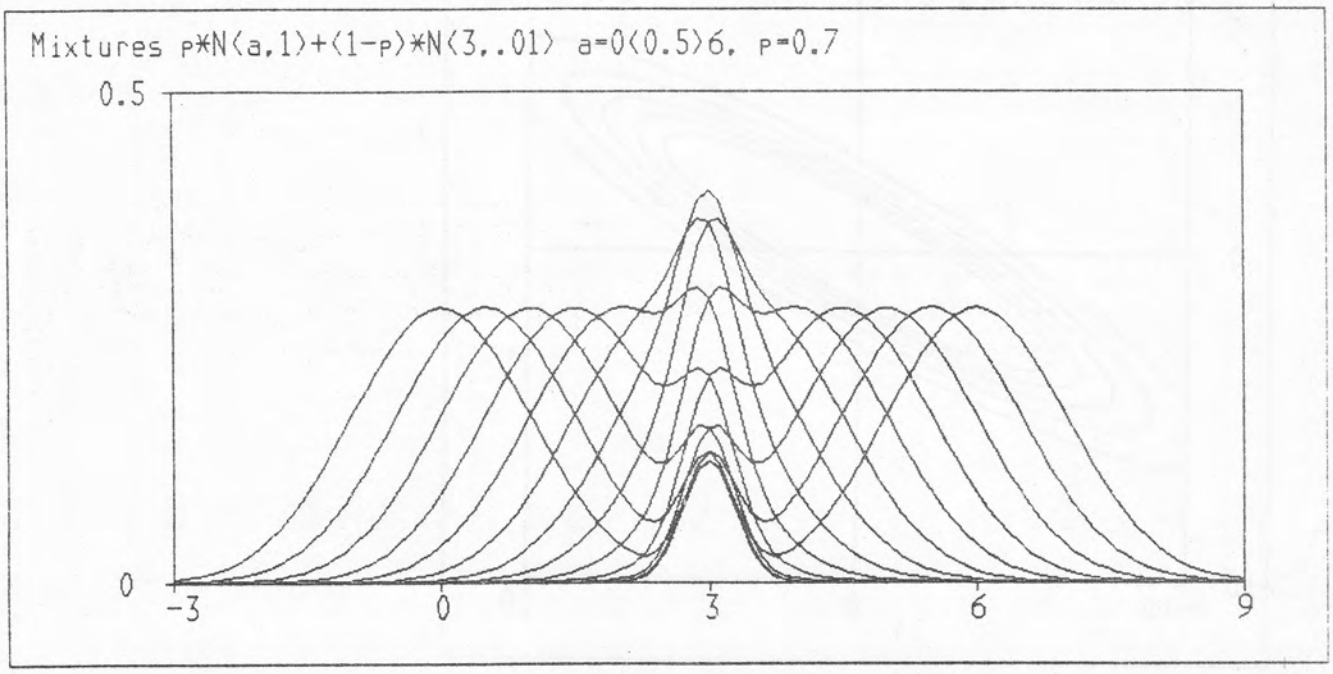

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
77 *
78 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
79 *t=-10,10,1     HEADER=          Y=0.1*X↑3
80 *u=-10,10,1
81 *eps=-.05,.05,.1  ROTATION=30
82 *                                  Comments:
83 *PLOT Y(u)=t_                     / lines parallel to X axis
84 *PLOT X(t)=u,Y(t)=t               / lines parallel to Y axis
85 *PLOT Y(u)=eps                    / thicker X axis
86 *PLOT X(t)=eps,Y(t)=t             / thicker Y axis
87 *PLOT Y(X)=.1*X↑3+eps             / curve
88 *
89 *
```

37



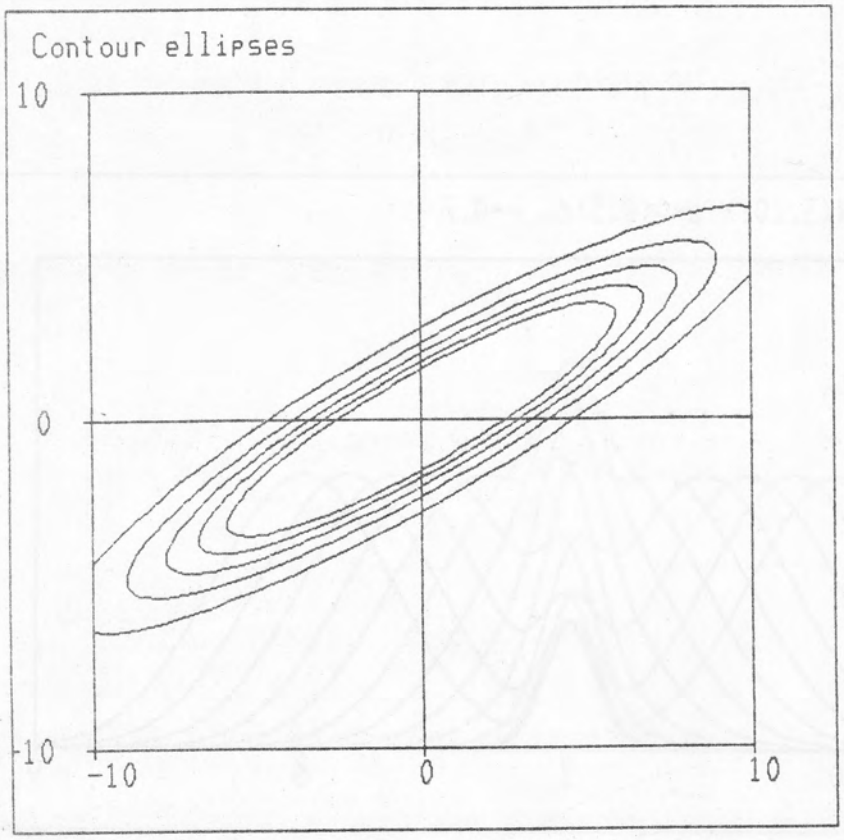

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
69 *
70 *HEADER=Parabolic Steiner circles
71 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
72 *T=0,6.2832 R=-10,10,0.5 ind=0,1,1
73 *PLOT X(T)=R*COS(T)+ind*R,Y(T)=R*SIN(T)+(1-ind)*R_
74 *
75 *
```

38



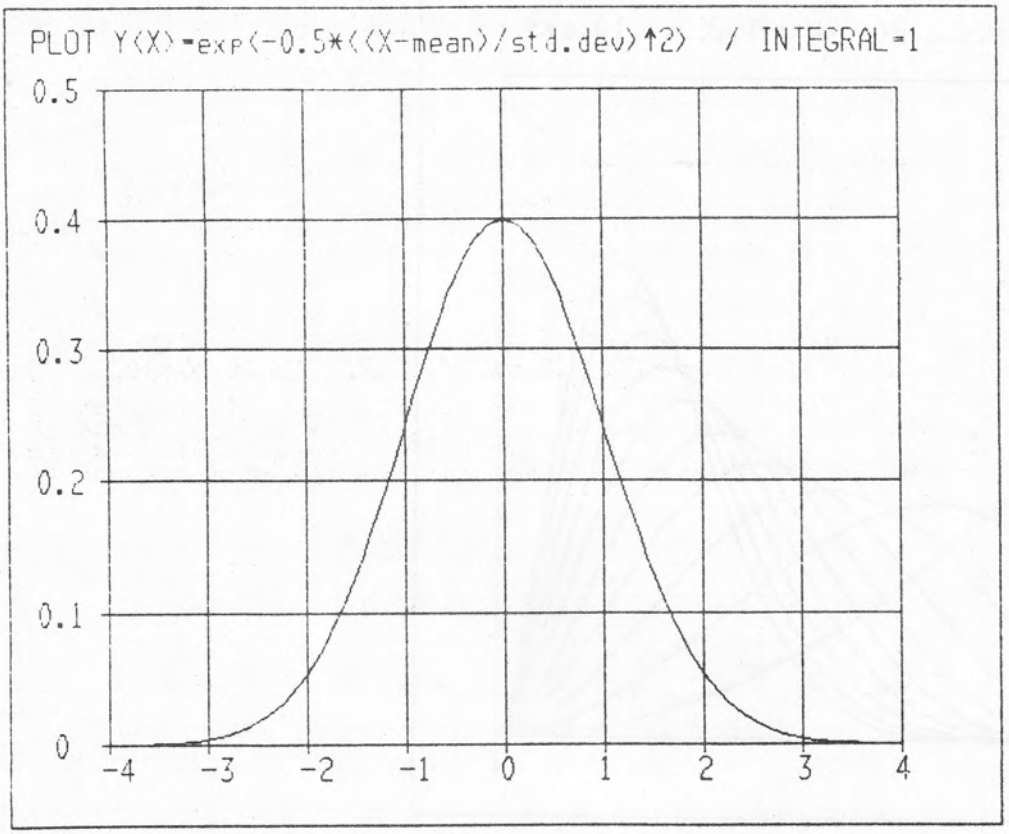

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
60 *
61 *HEADER=Mixtures p*N(a,1)+(1-p)*N(3,.01) a=0(0.5)6, p=0.7
62 *XSCALE=-3,0,3,6,9 YSCALE=0,0.5 SIZE=799,400
63 *a=0,6,0.5     b=3 s=1 t=0.3 p=0.7  c=0.39894 (=1/sqr(2*pi))
64 *
65 *PLOT Y(X)=p*c/s*exp(-.5*((X-a)/s)↑2)+(1-p)*c/s*exp(-.5*((X-b)/t)↑2
66 *
67 *
```

39



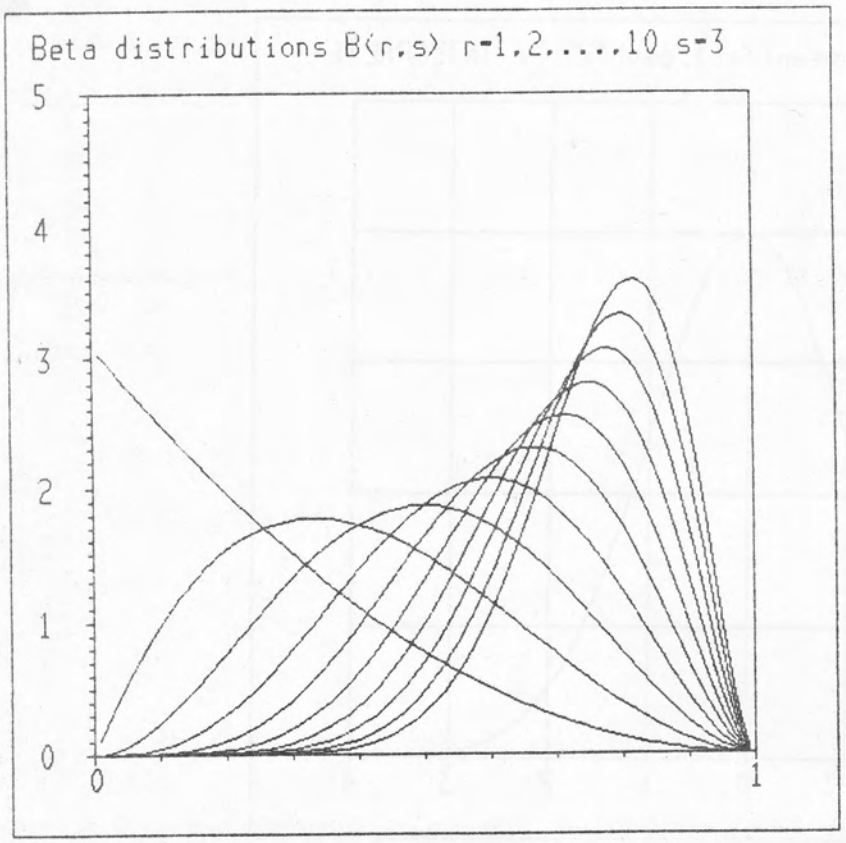

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
51 *
52 *HEADER=Contour ellipses
53 *XSCALE=-10,0,10 YSCALE=-10,0,10 XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
54 *s1=5 s2=3 rho=0.9  t=0,6.2832       GRID=XY
55 *eps=0.5,0.9,0.1
56 *PLOT X(t)=s1*sqr(-2*log(1-eps))*cos(t),
57 *      Y(t)=s2*sqr(-2*log(1-eps))*sin(t+arcsin(rho))
58 *
```

40



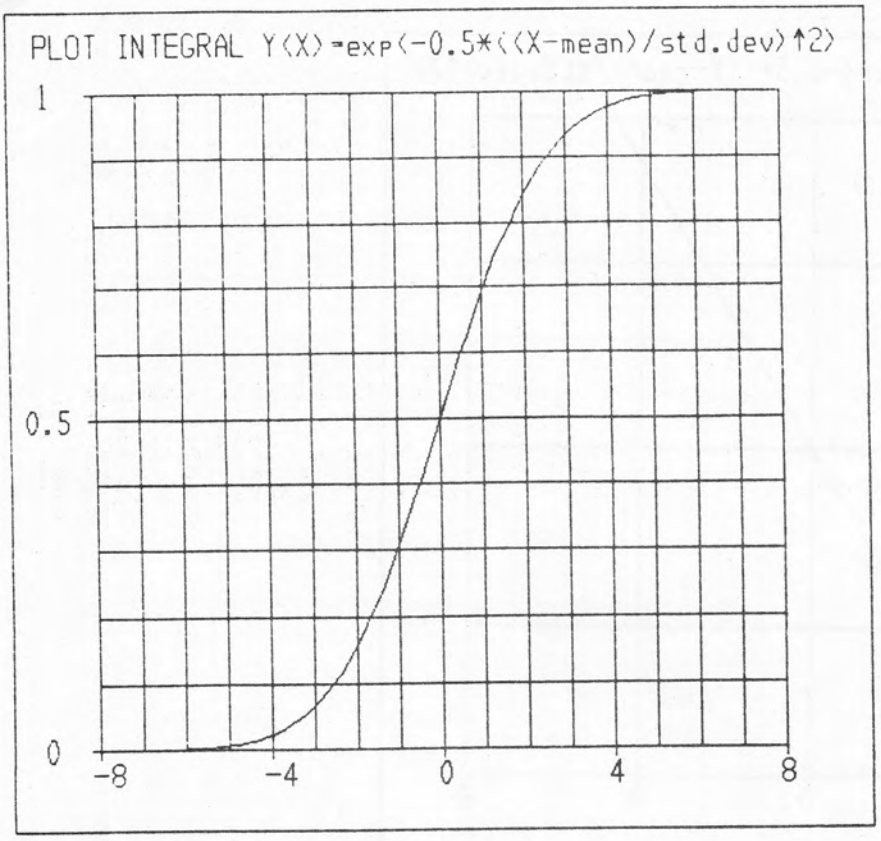

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
48 *
49 *XDIV=1,8,1 YDIV=1,8,1 SIZE=600,500
50 *XSCALE=-4,-3,-2,-1,0,1,2,3,4 YSCALE=0,0.1,0.2,0.3,0.4,0.5
51 *mean=0 std.dev=1    GRID=XY
52 *PLOT Y(X)=exp(-0.5*((X-mean)/std.dev)↑2)  / INTEGRAL=1
53 *
```

41

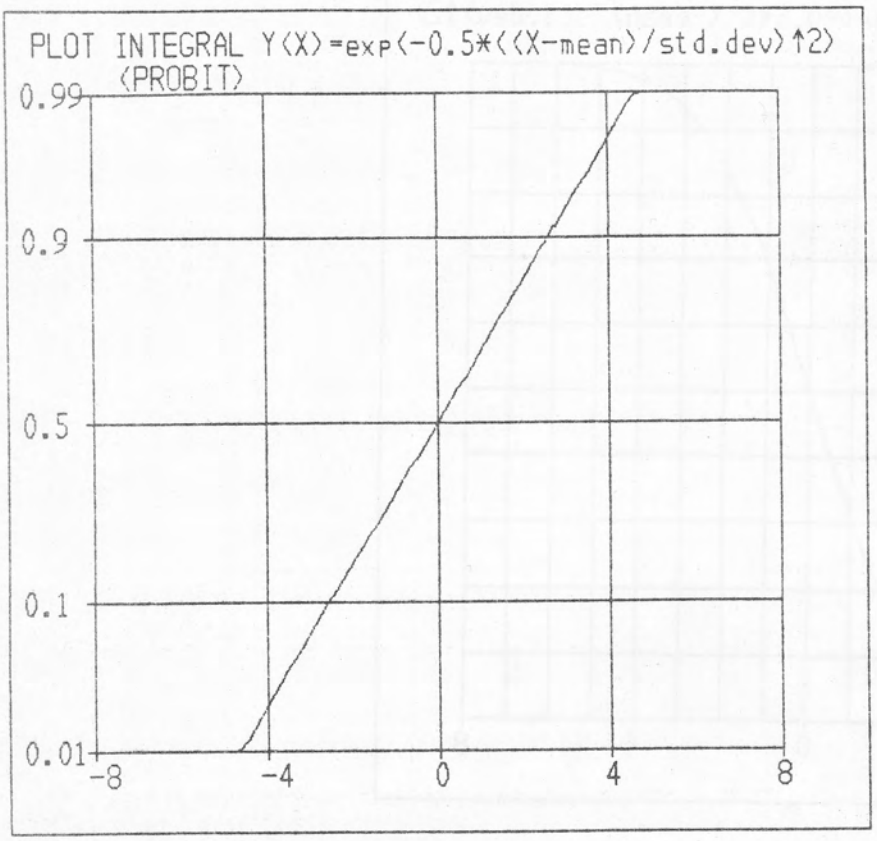



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
55 *
56 *HEADER=Beta distributions B(r,s) r=1,2,....,10 s=3
57 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500 GRID=-0.1,-0.1
58 *INTEGRAL=1    XSCALE=0,1 YSCALE=0,1,2,3,4,5
59 *r=1,10,1    s=3  X=0.01,0.99,0.01
60 *PLOT Y(X)=X↑(r-1)*(1-X)↑(s-1)
61 *
```

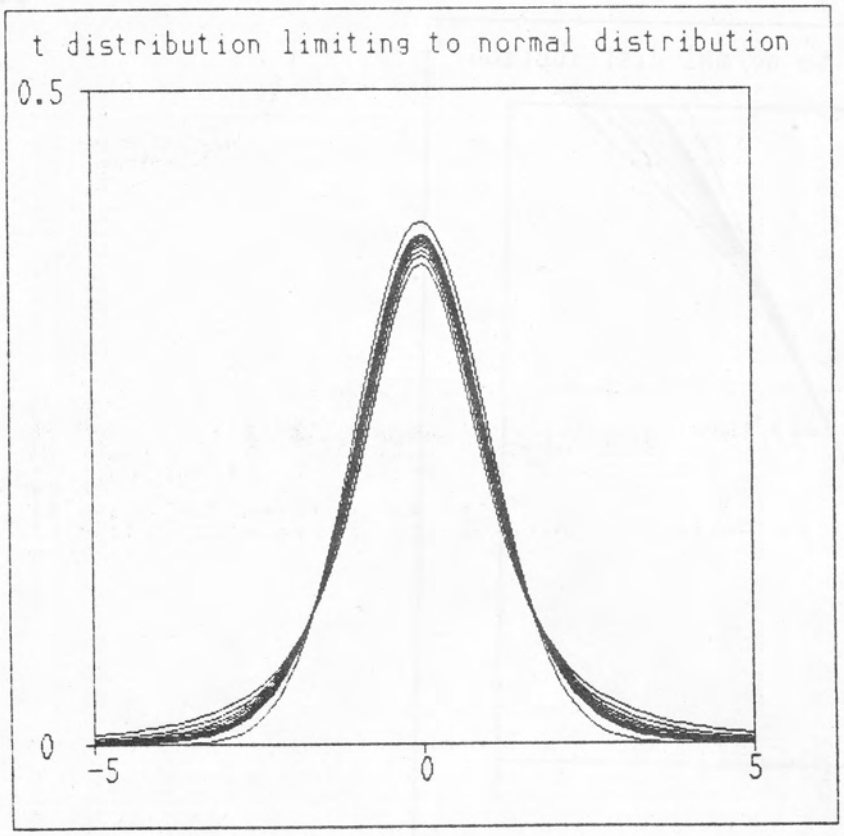
42



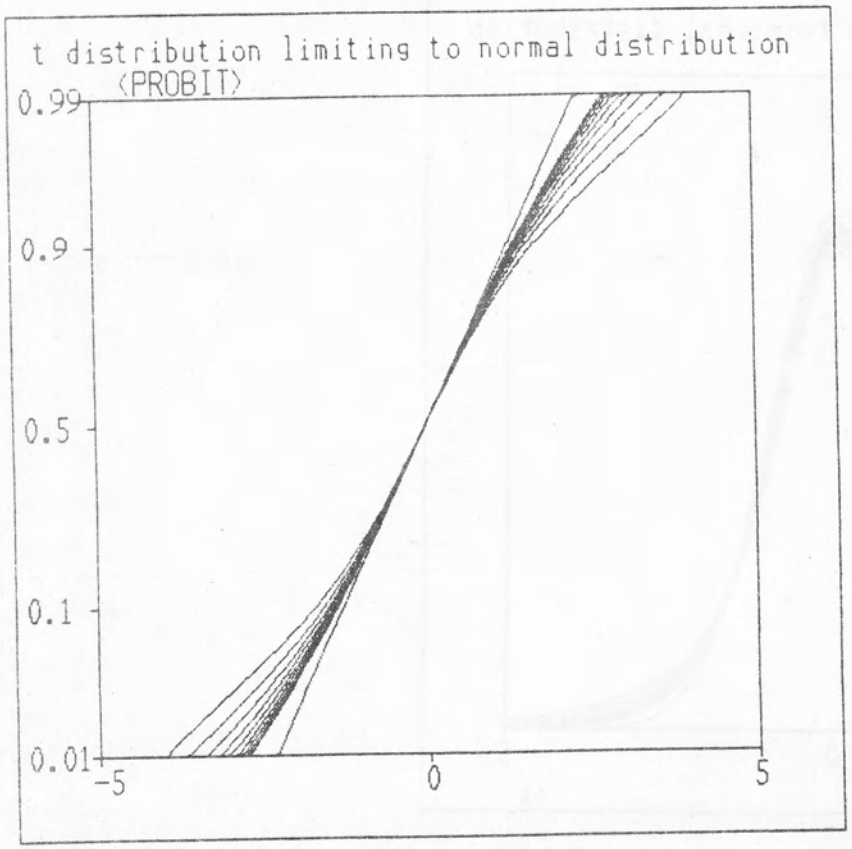

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
74 *
75 *XDIV=1,8,1 YDIV=1,8,1 SIZE=520,500
76 *INTEGRAL=1    XSCALE=-8,-4,0,4,8  YSCALE=0,0.5,1
77 *mean=0 std.dev=2            GRID=1,0.1
78 *PLOT INTEGRAL Y(X)=exp(-0.5*((X-mean)/std.dev)↑2)
79 *
```




```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
81 *
82 *XDIV=1,8,1 YDIV=1,8,1 SIZE=520,500
83 *INTEGRAL=1    XSCALE=-8,-4,0,4,8 GRID=XY mean=0 std.dev=2
84 *              YSCALE=PROBIT,0.01,0.1,0.5,0.9,0.99
85 *PLOT INTEGRAL Y(X)=exp(-0.5*((X-mean)/std.dev)↑2)
86 *
```

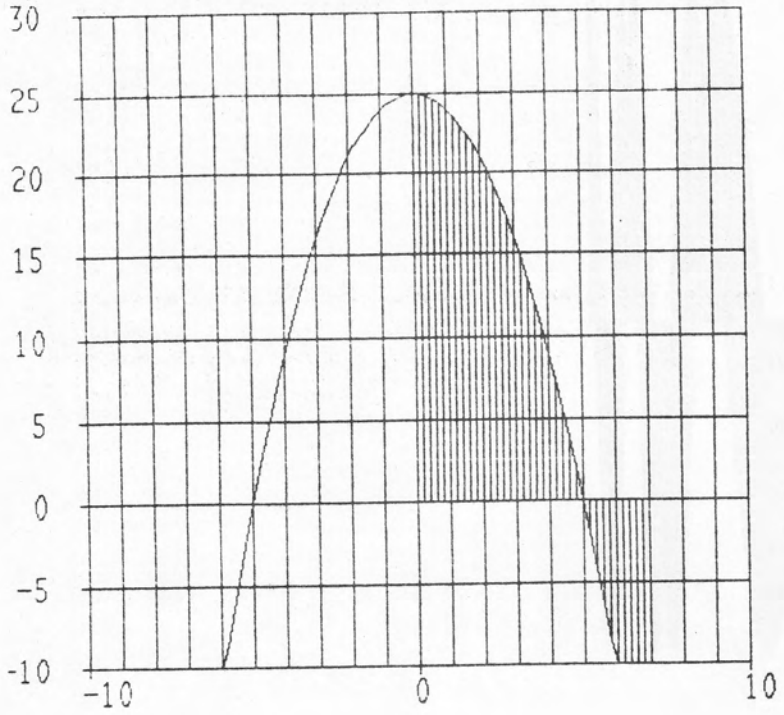



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
63 *
64 *HEADER=t distribution limiting to normal distribution
65 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
66 *INTEGRAL=1  XSCALE=-5,0,5 YSCALE=0,0.5
67 *
68 *PLOT Y(X)=exp(-0.5*X↑2)_
69 *PLOT Y(X)=(1+X↑2/n)↑(-(n+1)/2)   / n=2,10,1
70 *
```



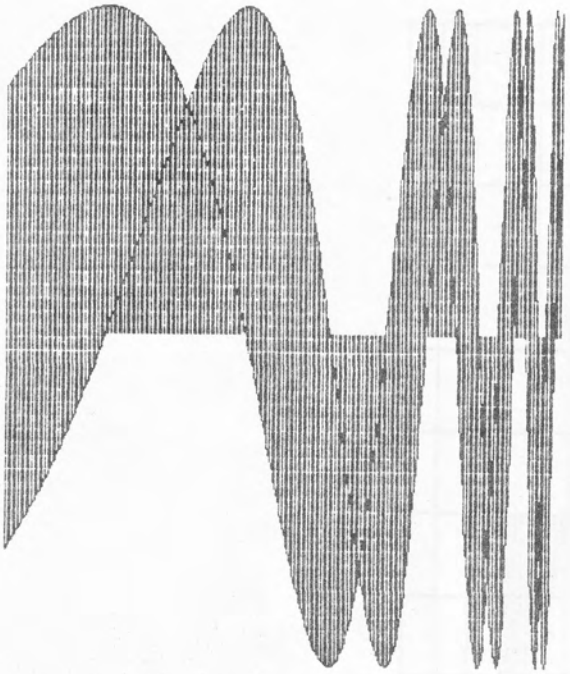

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
88 *
89 *HEADER=t distribution limiting to normal distribution
90 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
91 *INTEGRAL=1  XSCALE=-5,0,5 YSCALE=PROBIT,0.01,0.1,0.5,0.9,0.99
92 *
93 *
94 *PLOT INTEGRAL Y(X)=exp(-0.5*X↑2)_
95 *PLOT INTEGRAL Y(X)=(1+X↑2/n)↑(-(n+1)/2)  / n=2,10,1
96 *
```

PLOT Y(X)=-X↑2+25



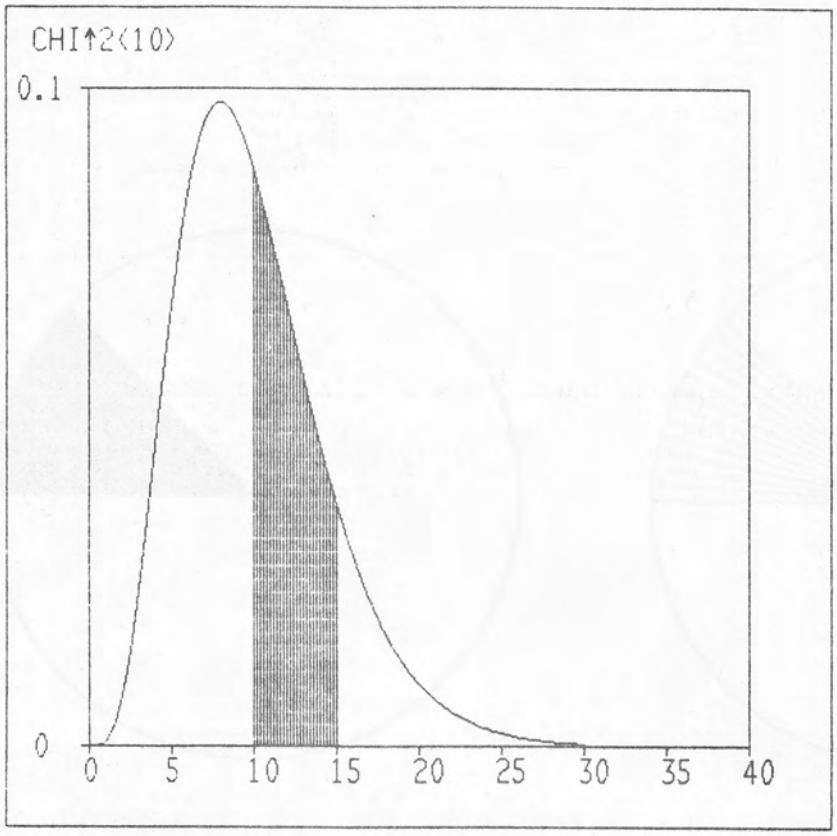

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen      (124x 80)
 5 *
 6 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
 7 *YSCALE=-10,-5,0,5,10,15,20,25,30
 8 *FILL=1,0,7    FRAME=1   GRID=1,5
 9 *PLOT Y(X)=-X↑2+25_
10 *
```

47



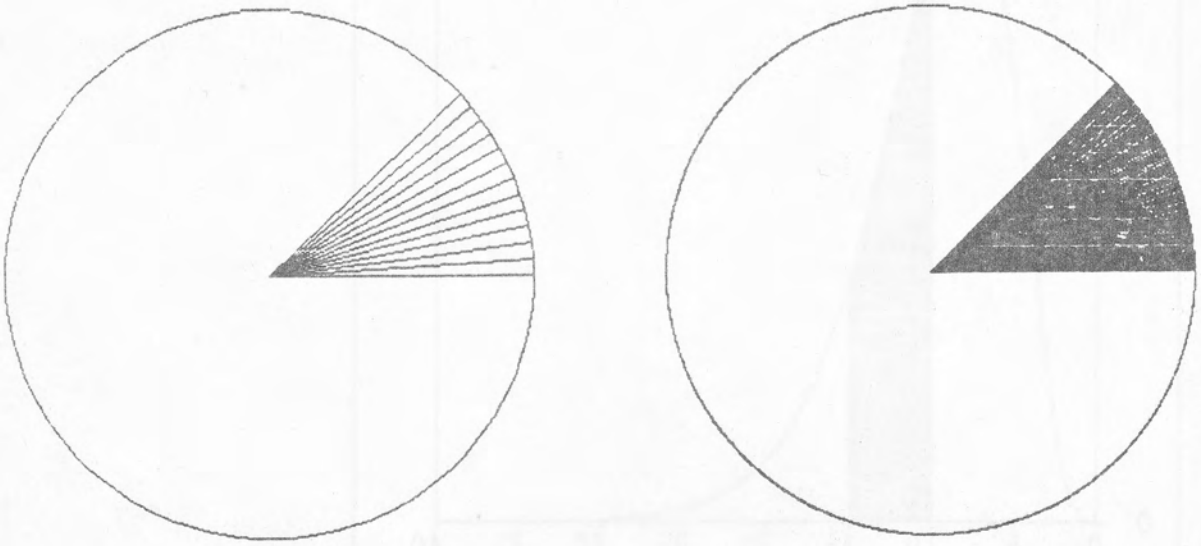
```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
12 *
13 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500  HEADER=_
14 *YSCALE=-1,0,1 XSCALE=0,1,2,3,4,5
15 *              FRAME=0  FILL=2    X=0,4.2,0.01
16 *PLOT Y(X)=SIN(20/(X-5))_
17 *PLOT Y(X)=COS(20/(X-5))
18 *
```

48



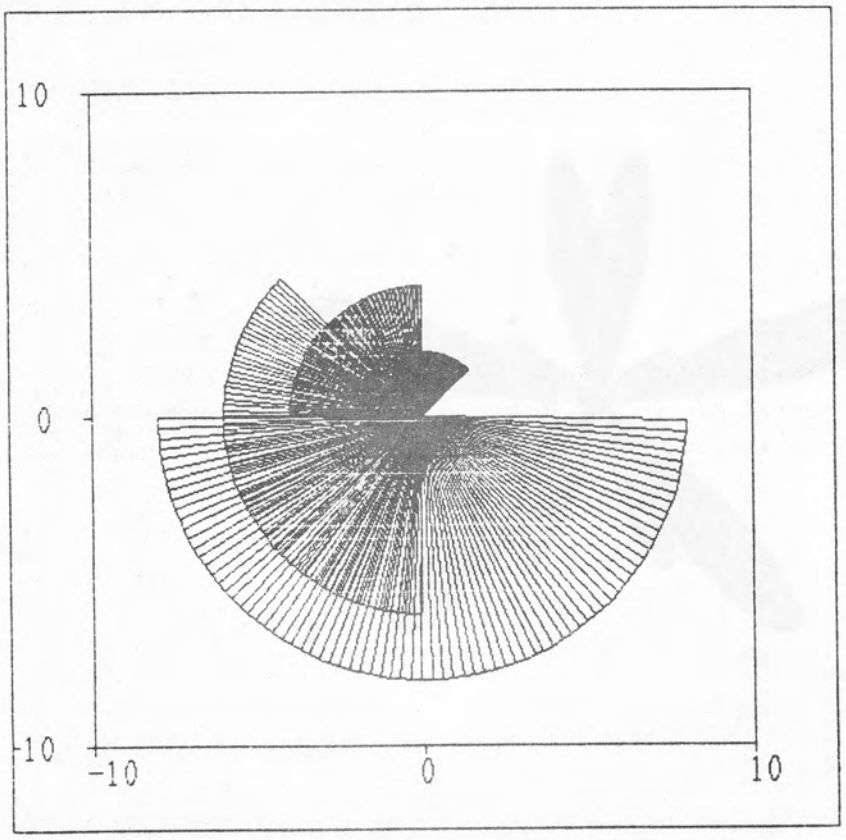

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
20 *
21 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500  HEADER=CHI↑2⟨10⟩
22 *XSCALE=0,5,10,15,20,25,30,35,40 YSCALE=0,0.1
23 *n=10 FILL=1,10,15  INTEGRAL=1  X=0,30,.2
24 *PLOT Y(X)=X↑(n/2-1)*exp(-X/2)_
25 *
```

49



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
25 *
26 *XDIV=1,8,1 YDIV=1,8,1 SIZE=400,400  HEADER=_
27 *r=10 t=0,6.2832          OFILL=1,0,0.7854 FRAME=0
28 *PLOT X(t)=r*cos(t),Y(t)=r*sin(t)_
29 *
30 *.....................................................................
31 *XDIV=1,8,1 YDIV=1,8,1 SIZE=400,400  HOME=400,0   HEADER=_
32 *r=10 t=0,6.2832,.002     OFILL=1,0,0.7854 FRAME=0
33 *PLOT X(t)=r*cos(t),Y(t)=r*sin(t)
34 *
```

50

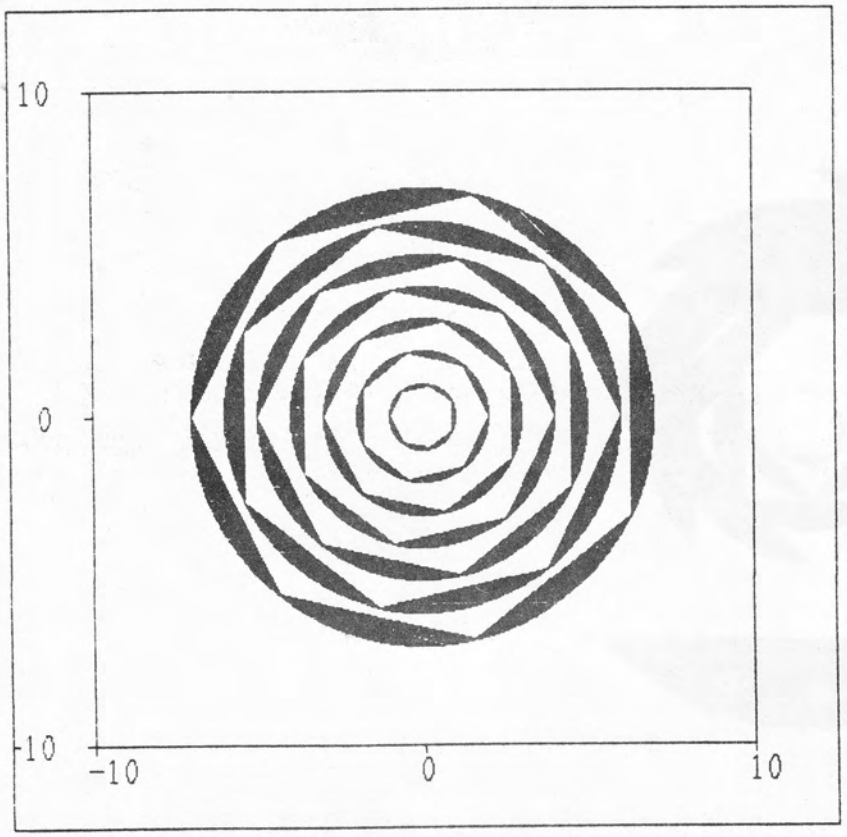



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
33 *
34 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500  HEADER=_
35 *t=0,0.7854,.01      OFILL=1,0,0.7854   a=1,4,1        pi=3.1416
36 *PLOT X(t)=2*a*cos(a*t+a*pi/4),Y(t)=2*a*sin(a*t+a*pi/4)_
37 *
```

51

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
43 *
44 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500 HOME=150,0  HEADER=_
45 *r=5   t=0,6.2832,.01  OFILL=1    a=5 b=6    FRAME=0
46 *PLOT X(t)=r*(sin(a*t)+sin(b*t))*cos(t),
47 *      Y(t)=r*(sin(a*t)+sin(b*t))*sin(t)
48 *
```

52

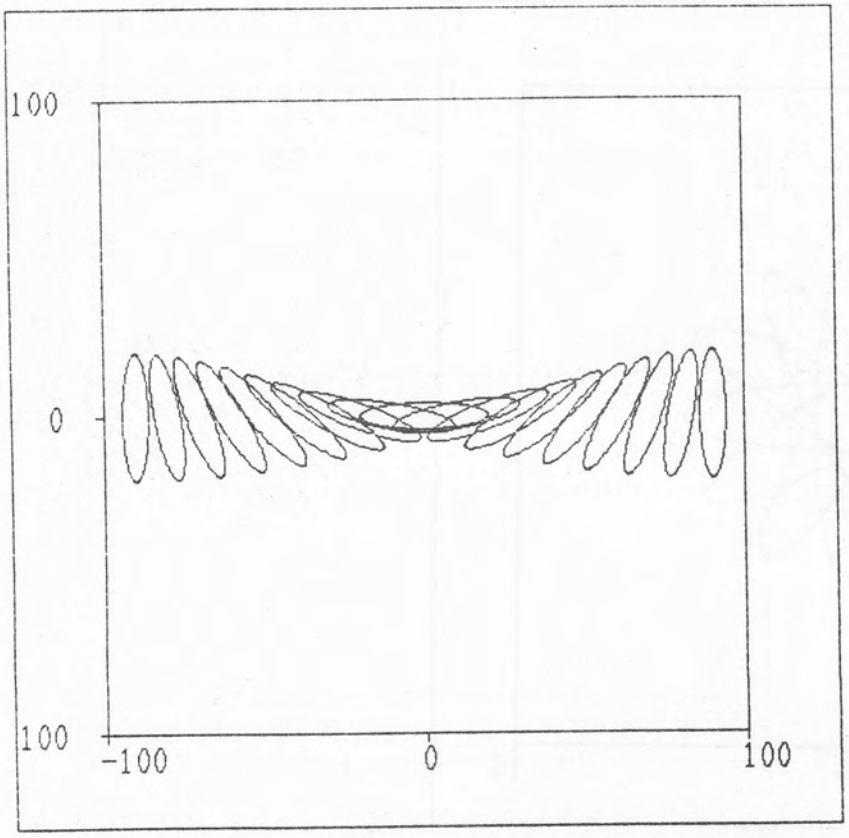



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
55 *
56 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500  HEADER=_
57 *T=0,0.8976  R=1,7,1  IFILL=1   A=1,7,1   pi=3.1416
58 *PLOT X(T)=R*COS(T+2*A*pi/7+R*pi/7),Y(T)=R*SIN(T+2*A*pi/7+R*pi/7)
59 *
```

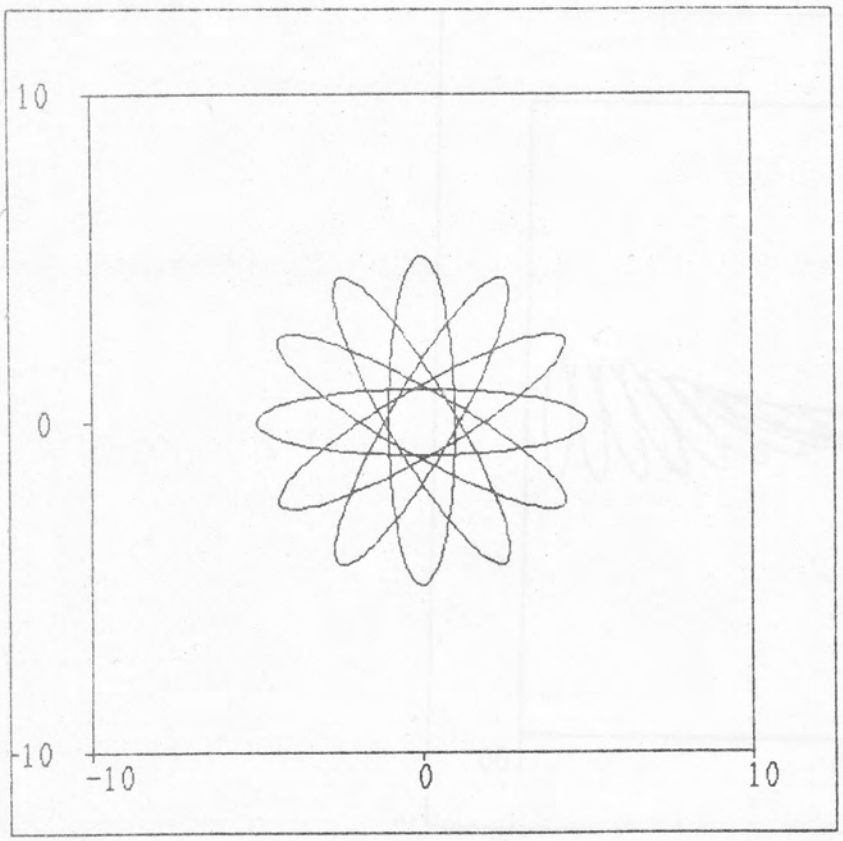
53

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
50 *
51 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500  HEADER=_  FRAME=0
52 *T=0,1.5708  R=1,9,1  IFILL=1   A=1,4,1   pi=3.1416
53 *PLOT X(T)=R*COS(T+A*pi/2+R*pi/4),Y(T)=R*SIN(T+A*pi/2+R*pi/4)
54 *
```

54

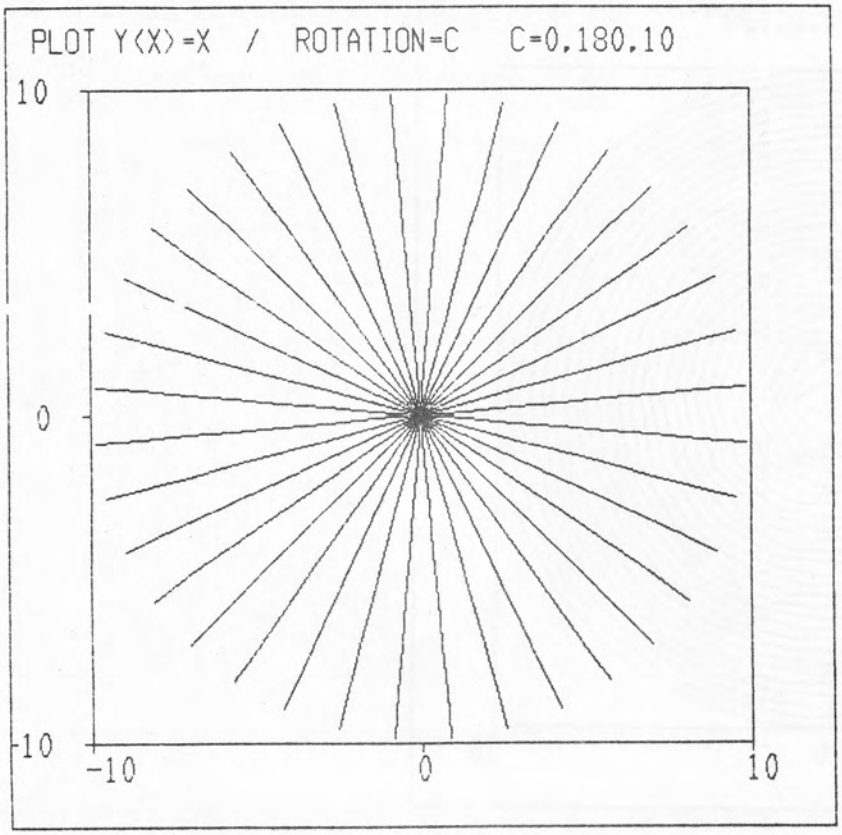



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
73 *
74 *XDIV=1,7,1 YDIV=1,7,1 SIZE=500,500  HEADER=_
75 *A=20 B=4   T=0,6.2832
76 *XSCALE=-100,0,100 YSCALE=-100,0,100
77 *ROTATION=C,C,0      C=-90,90,10
78 *PLOT X(T)=A*COS(T)+C,Y(T)=B*SIN(T)_
79 *
```



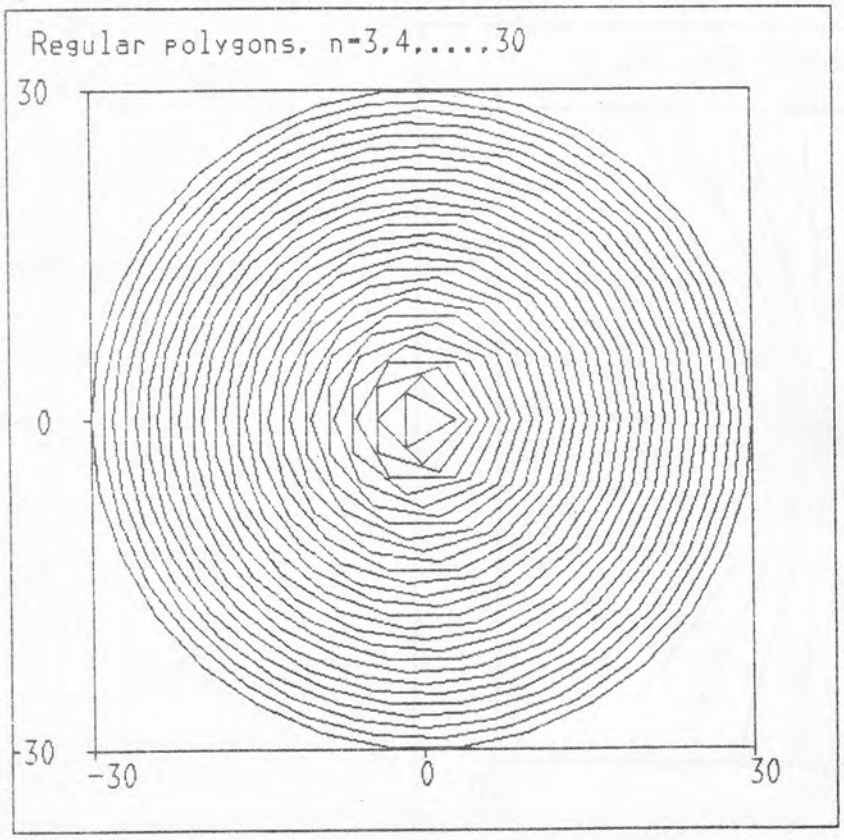

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
64 *
65 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500  HEADER=_
66 *A=5 B=1   T=0,6.2832
67 *ROTATION=C     C=-90,90,30
68 *PLOT X(T)=A*COS(T),Y(T)=B*SIN(T)_
69 *
```

56



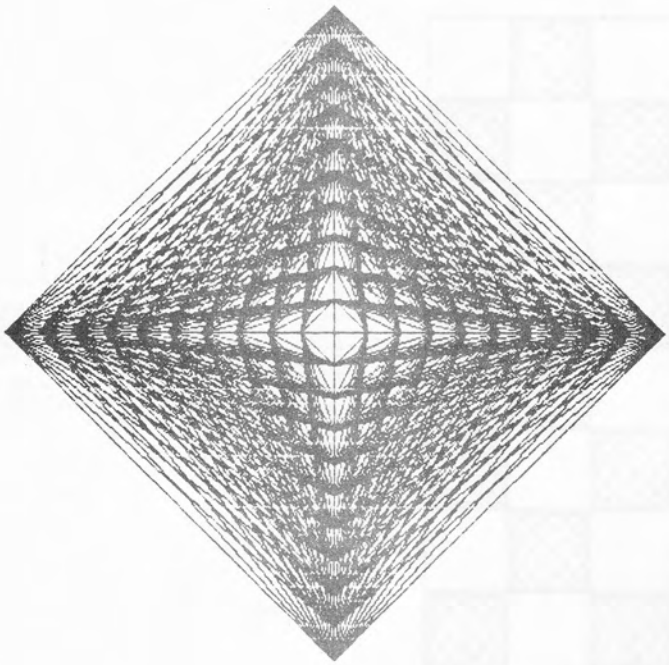

```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
58 *
59 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
60 *X=-7,7,1
61 *PLOT Y(X)=X_ /  ROTATION=C    C=0,180,10
62 *
```

57




```
    1  SURVO 76 EDITOR  (C)1979 S.Mustonen  U (124x 80)
106 *
107 *HEADER=Regular polygons, n=3,4,....,30
108 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500  HEADER=_
109 *XSCALE=-30,0,30  YSCALE=-30,0,30
110 *t=0,30,1 n=3,30,1     pi=3.1416
111 *PLOT X(t)=n*cos(2*pi*t/n),Y(t)=n*sin(2*pi*t/n)_
112 *
```

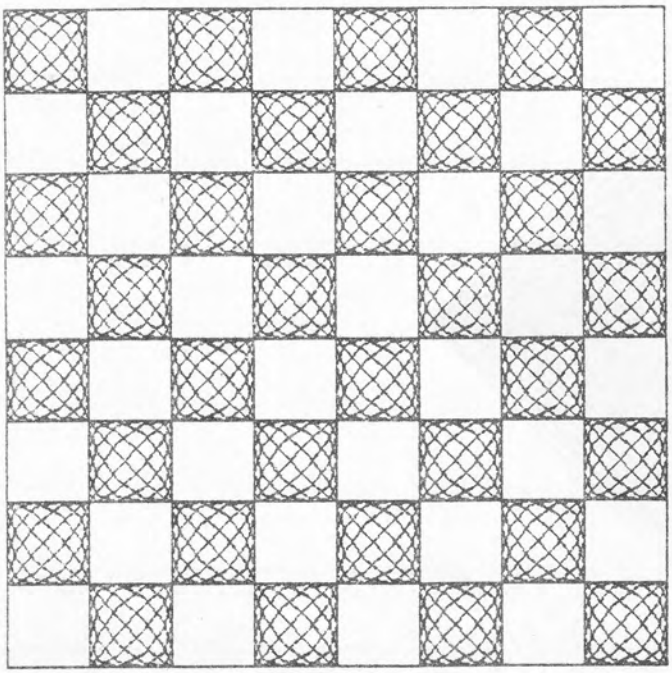
58



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
 97 *
 98 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500  HEADER=_
 99 *FRAME=0
100 *X1=-10,10,1 Y1=0 X2=0  Y2=-10,10,1
101 *T=0,1,1
102 *PLOT X(T)=X1+(X2-X1)*T,
103 *      Y(T)=Y1+(Y2-Y1)*T
104 *
```

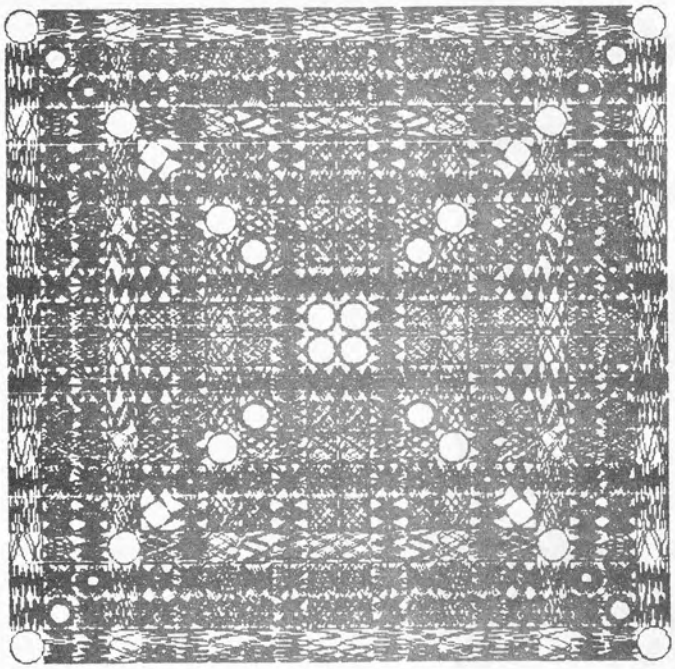
59

"Chess board"



```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
14 *
15 *HEADER="Chess board"
16 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500
17 *XSCALE=0,8 YSCALE=0,8
18 *x=0,8,1 y=0,8,1 x1=1,8,1 y1=1,8,1 t=0,6.2832
19 *FRAME=0
20 *PLOT Y(y)=x
21 *PLOT X(x)=y,Y(x)=x
22 *PLOT X(t)=x1-0.5+0.5*sgn(x1+y1-2*int((x1+y1)/2))*cos(10*t),
23 *      Y(t)=y1-0.5+0.5*sgn(x1+y1-2*int((x1+y1)/2))*sin(11*t)
24 *
```

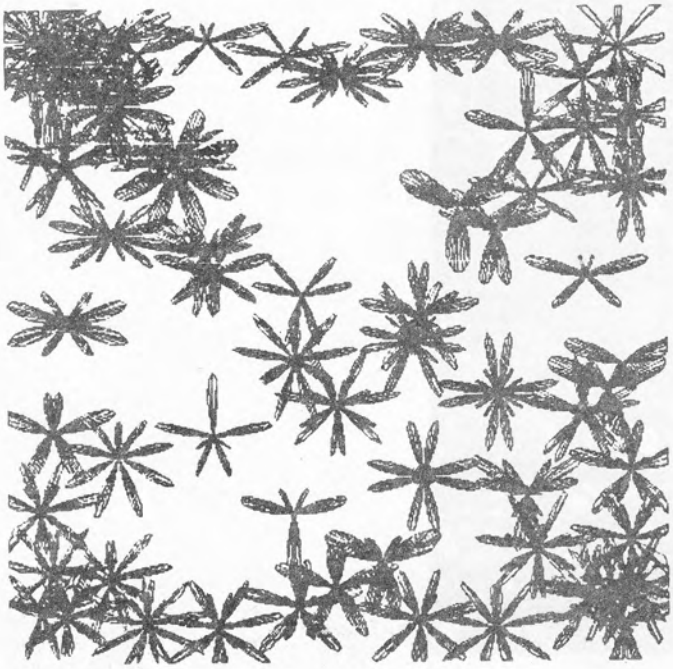
60



```
  1  SURVO 76 EDITOR  (C)1979 S.Mustonen      (124x 80)
 5 *
 6 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500  HEADER=_
 7 *x=-20,20,2 y=-20,20,2 x1=-19,19,2  y1=-19,19,2  t=0,62.832,1
 8 *FRAME=0  XSCALE=-20,20 YSCALE=-20,20
 9 *PLOT X(t)=x1+cos(x1*t),Y(t)=y1+sin(y1*t)_
10 *
11 *
```

61

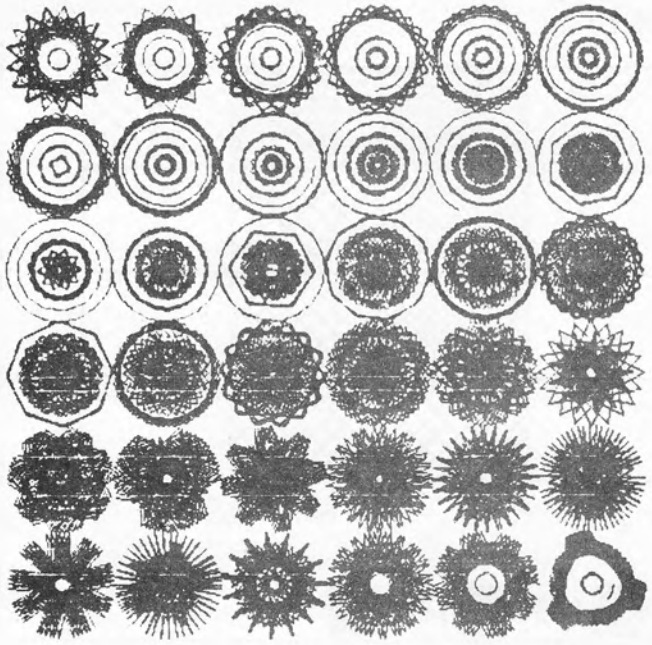
"Bugs and flowers"



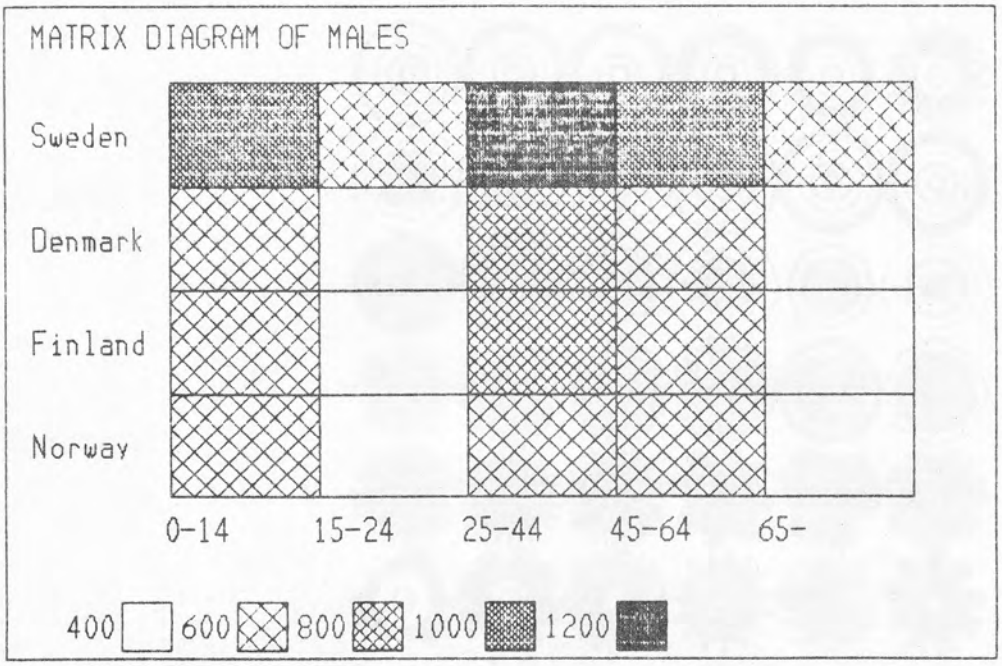
```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen      (124x 80)
38 *
39 *XDIV=1,8,1 YDIV=1,8,1 SIZE=500,500  HEADER="Bugs and flowers"
40 *a=3,10,1  b=3,10,1      t=0,6.2832
41 *FRAME=0 IFILL=1
42 *PLOT X(t)=9*sin(10*a-7*b)+(sin(a*t)+sin(b*t))*cos(t),
43 *      Y(t)=9*sin(28*b-9*a)+(sin(a*t)+sin(b*t))*sin(t)
44 *
45 *
```

62

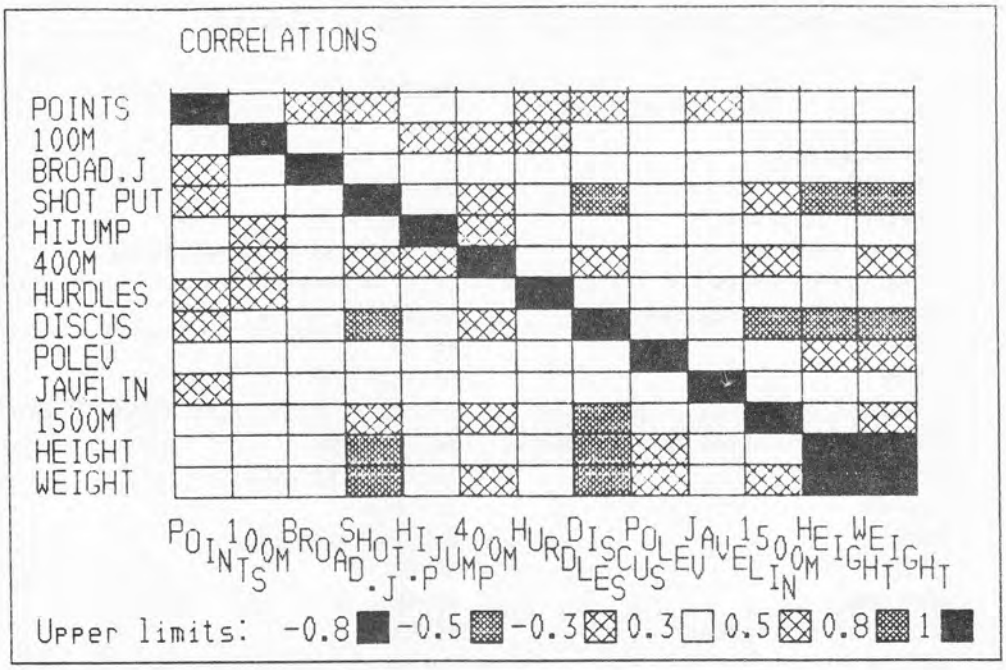
"Badges"



```
    1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (124x 80)
106 *
107 *XDIV=1,18,1 YDIV=1,18,1 SIZE=500,500  HEADER="Badges"
108 *XSCALE=0,7 YSCALE=0,7
109 *t=0,50,1 r=.1,.5,.1 n=0,35,1 FRAME=0
110 *PLOT X(t)=int(n/6)+1+r*cos((7*r+n)*t),
111 *      Y(t)=n+1-6*int(n/6)+r*sin((7*r+n)*t)
112 *
```




```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     (100x100)
 5 *
 6 *DATA MALES,A,B,M
 7 M              0-14 15-24 25-44 45-64   65-
 8 A Sweden        841   571  1188   930   585
 9 * Denmark       564   385   731   537   308
10 * Finland       506   399   727   468   202
11 B Norway        474   316   534   442   251
12 *
13 *PLOT MALES_
14 *TYPE=MATRIX
15 *LIMITS=400,600,800,1000,1200
16 *
17 *
```




```
   1  SURVO 76 EDITOR  (C)1979 S.Mustonen     ( 50x100)
26 *
27 *HEADER=          CORRELATIONS
28 *
29 *DATA DECATHLON,31,43,30
30 *           POINTS 100M    BROAD.J SHOT.P HIJUMP 400M   HURDLES DISCUS
31 *POINTS      1.000  0.294   0.499   0.364  0.221  0.295  0.445   0.386
32 *100M        0.294  1.000   0.172  -0.028 -0.412  0.456  0.316   0.014
33 *BROAD.J     0.499  0.172   1.000  -0.034 -0.003  0.133  0.298   0.021
34 *SHOT_PUT    0.364 -0.028  -0.034   1.000  0.163 -0.304  0.086   0.727 -
35 *HIJUMP      0.221 -0.412  -0.003   0.163  1.000 -0.339 -0.039   0.217 -
36 *400M        0.295  0.456   0.133  -0.304 -0.339  1.000  0.176  -0.345
37 *HURDLES     0.445  0.316   0.298   0.086 -0.039  0.176  1.000   0.048 -
38 *DISCUS      0.386  0.014   0.021   0.727  0.217 -0.345  0.048   1.000 -
39 *POLEV       0.160  0.055   0.061  -0.204 -0.118  0.007 -0.073  -0.182
40 *JAVELIN     0.321 -0.221   0.154   0.023  0.150 -0.105 -0.148   0.136 -
41 *1500M      -0.153 -0.298  -0.207  -0.446 -0.146  0.302 -0.225  -0.574
42 *HEIGHT      0.224 -0.110  -0.049   0.617  0.125 -0.165  0.225   0.588 -
43 *WEIGHT      0.143 -0.082  -0.055   0.708  0.161 -0.323  0.130   0.635 -
44 *
45 *PLOT DECATHLON_ / TYPE=MATRIX
46 *LIMITS=-0.8,-0.5,-0.3,0.3,0.5,0.8,1
47 *SHADING=10,7,3,0,3,7,10          LEGEND=Upper limits:
48 *SPACING=10,-6
49 *
50 *
```

EXTRA SPECIFICATIONS AND PLOT TYPES USED IN EXAMPLES

	Exhibit no.
Bar diagrams	1-4,9-11
CONTOUR	16,18,20
Contour ellipses	16,18,20,39
Curves (simple)	28,30,31,34-36,40-43,46-51
Density functions	38,40,41,44,48
Distribution functions	42,43,45
FILL	46-48
FRAME	34,46,47,58
Families of curves (1 parameter)	29,32,33,38,39,41,44,45,54,55,56
Families of curves (2 parameters)	52,53,57-62
GRID	13-15,32,41 etc.
HEADER	3,4 etc.
HOME	3-5,15,19,34 etc.
IFILL	52,53
INTEGRAL	40-45
Integral functions	42,43,45
LEGEND	3,4,64
LIMITS	63,64
LINE	24,27
Matrix diagrams	63-64
OFILL	49-51
PLAN	7
POINT	12
Pie charts	5-8
Polygons	52,57
Probability plots	21,22
ROTATION	36,54,55,56
SHADING	8,9,11,64
SIZE	3-5,14,15,19,34 etc.
SPACING	64
Scatter diagrams	12-20,27
TEXT	25
TREND	17,19,20
TSCALE	26
TSTEP	25,26
TYPE	2-11,63,64
Time series	23-27
XDIV	24,30