FRACTAL TYPE

PURPOSE
Specifies the format of the input data for a fractal plot command.

DESCRIPTION
DATAPLOT generates Iterated Function Systems fractals as defined by Michael Barnsley. Barnsley defines an affine transformation as follows:

$$w(x) = w\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} e \\ f \end{bmatrix} \qquad \textbf{(EQ 5-61)}$$

Fractal plots are generated by applying one or more affine transformations in an iterative fashion to an initial starting point (DATAPLOT uses (0,0) as the starting point). The points a, b, c, and d define rotation and scaling operations to be applied to the point. The e and f points define a translation to be applied to the point. An additional value is the probability weighting. These weights are applied to a uniform random number generator to determine which of the affine transformations (if there is more than one) to apply at a given step. The a, b, c, and d points are commonly expressed as follows:

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} r_1\cos\alpha_1 & -r_2\sin\alpha_2 \\ r_1\sin\alpha_1 & r_2\cos\alpha_2 \end{bmatrix} \qquad \textbf{(EQ 5-62)}$$

This form makes the nature of the scaling and rotation more explicit. In addition, DATAPLOT also supports an alternate form for specifying the rotation and scaling (this algorithm is due to William Whithers of the US Naval Academy). It performs the following rotation and scaling to obtain the a, b, c, and d points:

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}\begin{bmatrix} p & 0 \\ 0 & q \end{bmatrix}\begin{bmatrix} \cos\beta & \sin\beta \\ \sin\beta & \cos\beta \end{bmatrix} \qquad \textbf{(EQ 5-63)}$$

This form specifies an initial rotation, a scaling, then a final rotation.

DATAPLOT currently supports each of these methods for specifying fractals (earlier versions only supported the Whithers method).

SYNTAX
FRACTAL TYPE <BARNSLEY/ANGLE/WHITHERS>
where BARNSLEY specifies the Barnsley definition (i.e., specify the a, b, c, d in the above equations), ANGLE specifies the Barnsley definition transformed to explicit scale and rotation factors (i.e., specify the r1, r2, alpha1, and alpha2 in the above equations), and WHITHERS specifies the Whithers format.

EXAMPLES
FRACTAL TYPE BARNSLEY
FRACTAL TYPE ANGLE
FRACTAL TYPE WHITHERS

DEFAULT
The default format is the Barnsley format (i.e., BARNSLEY). Earlier versions of DATAPLOT only support the Whithers format.

SYNONYMS
None

RELATED COMMANDS
FRACTAL PLOT	=	Generate a fractal plot.
FRACTAL ITERATIONS	=	Specify the number of points generated by the FRACTAL PLOT command.
FRACTAL (LET)	=	Generate fractal data (of the kind used to create Koch snowflakes).

REFERENCE
"Fractals Everywhere," Michael Barnsley, Academic Press, 1988.

APPLICATIONS
Fractals

IMPLEMENTATION DATE
88/12

PROGRAM
. Generate a fractal fern
READ Y1 TO Y7
180.000 0.160 0.001 180.000 0.000 0.000 1
 0.000 0.850 0.850 -2.500 1.600 0.000 15
180.000 0.340 0.300 229.000 1.600 0.000 2
109.709 -0.288 0.379 235.233 0.440 0.000 2
END OF DATA
FRAME OFF
FRAME COORDINATES 5 5 95 95
ANGLE UNITS DEGREES
CHARACTER JUSTIFICATION LEBO
CHARACTER .
LINE BLANK
FRACTAL TYPE WHITHERS
FRACTAL PLOT Y1 Y2 Y3 Y4 Y5 Y6 Y7