GRAP –

General Regression Analyses Program

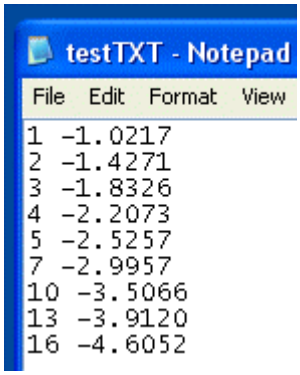
This program was developed around 1990 by Dr. Bjorn Teislev and has been used regularly to perform polynomial regressions on data sets (represented by *.TXT files) and curves, which are graphically available (represented by *.GIF files).

The data may be read from an ASCII text file (*.TXT) with up to 30 coordinates and subsequently polynomial regression is carried out interactively for polynomial degrees 1 to 8. The coefficients for the polynomial are calculated and may be saved to file (*.RPT files) or a report may be printed.

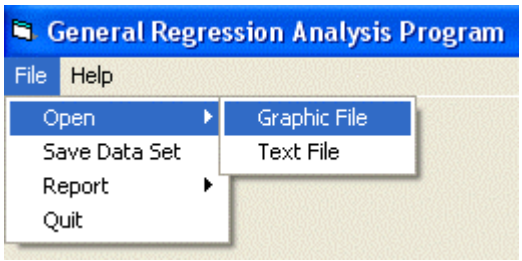
Another possibility is to pick the data (using the mouse) – up to 30 points are possible – along the curve, which is shown in a graphic field. This curve may originate from a scanned picture, a photo or a graph recovered from the screen using the PrtSc facility. The result is found interactively and reported similarly to the description above. You may also save the coordinate sets picked and generate a *.TXT file to be used as under the *TXT file input option

Text-File Option

A coordinate file might look like the picture below. If you want to find a polynomial regression representation, you should first prepare the file (in “Notepad”), which is subsequently saved with the extension *.TXT.

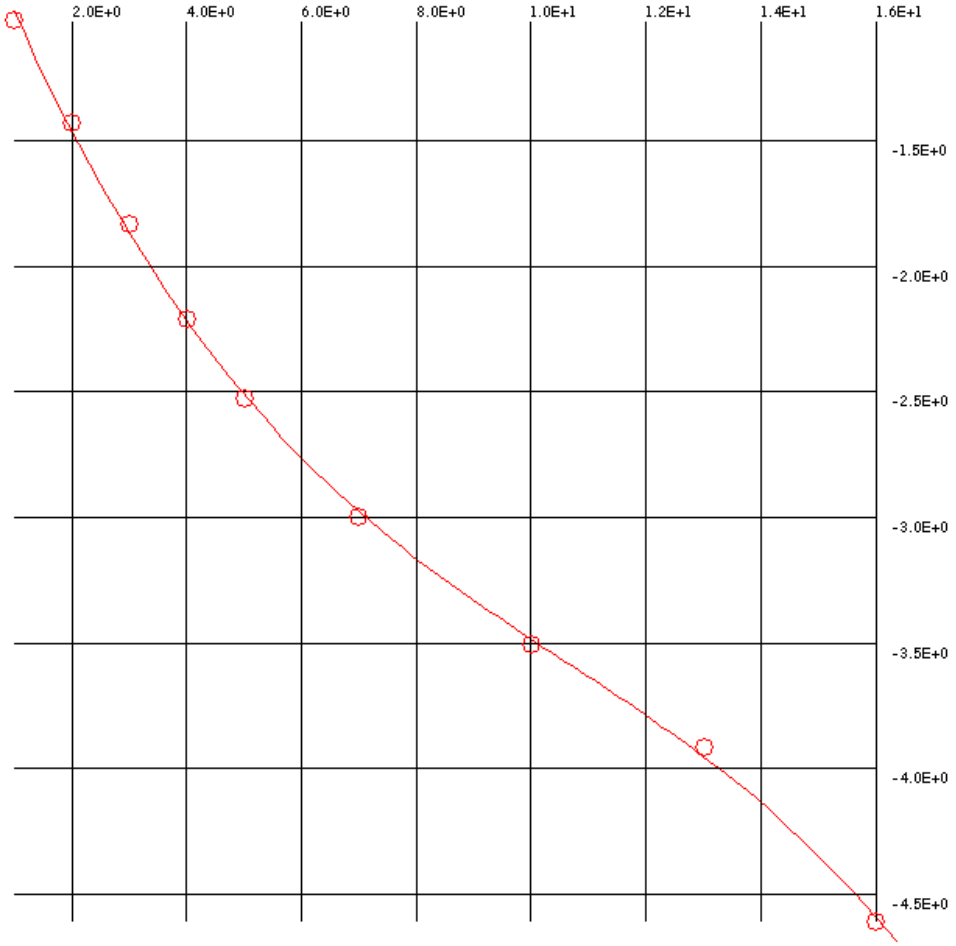


The file used here contains 9 coordinates, which are separated by (at least) one “blank”.



You recover the file from GRAP by clicking **File > Open > Text File**

A 3’rd degree polynomial will appear (default degree) – displaying a coordinate system – including a plot. You may subsequently adjust the polynomial degree and click “RUN REGRESSION ANALYSIS”.



File Help

01	X= 1.00000	Y= -1.02170	calculated = -0.98291
02	X= 2.00000	Y= -1.42710	calculated = -1.45839
03	X= 3.00000	Y= -1.83260	calculated = -1.86603
04	X= 4.00000	Y= -2.20730	calculated = -2.21373
05	X= 5.00000	Y= -2.52570	calculated = -2.50942
06	X= 7.00000	Y= -2.99570	calculated = -2.97636
07	X= 10.00000	Y= -3.50660	calculated = -3.48440
08	X= 13.00000	Y= -3.91200	calculated = -3.95147
09	X= 16.00000	Y= -4.60520	calculated = -4.59119

The coefficients in C(1) + C(2)*X + ... +C(n+1)*X^n are:

C(01) =	-4.3166e-01
C(02) =	-5.9176e-01
C(03) =	4.1835e-02
C(04) =	-1.3186e-03
RMS-error is:	2.8569e-02

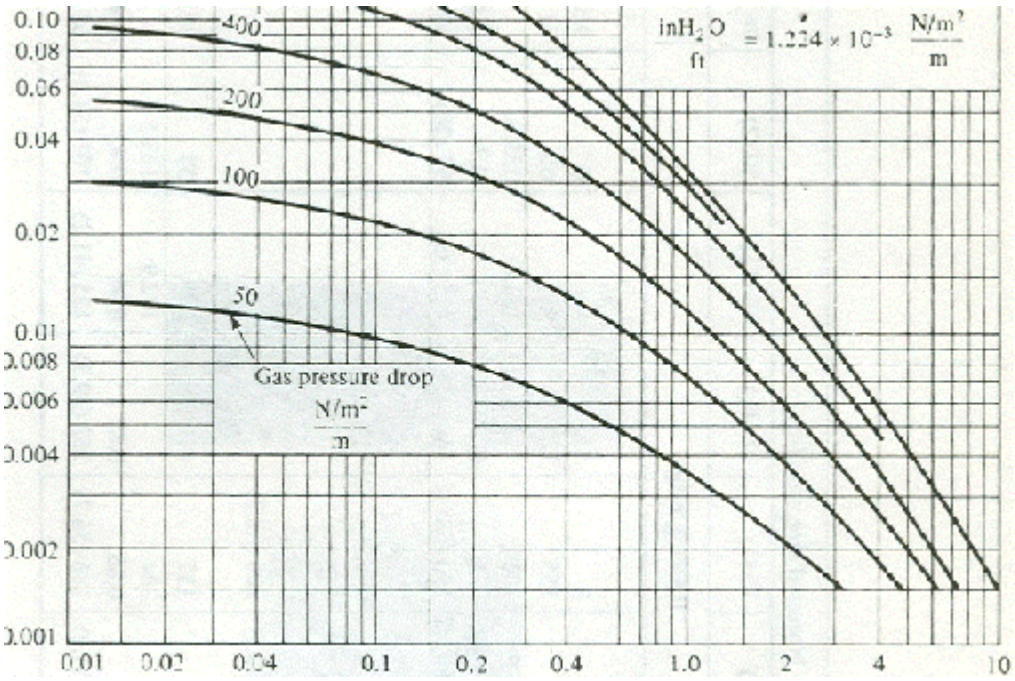
The regression coefficients are displayed in the upper left corner:

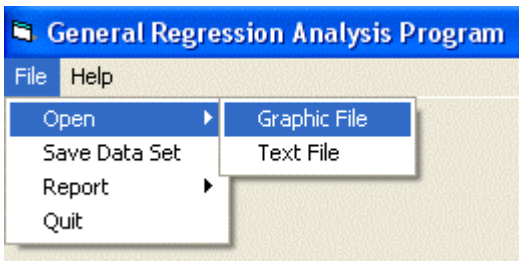
From here on the procedure is exactly like the one explained in paragraph “Graphic Option”.

Graphic Option

A graphic file including a curve might look like the picture below. If you want to find a polynomial regression representation, you should first prepare the file using the format *.gif, which means “Graphic Interchange File”.

The meaning of the graph shown here is actually not important (by the way, it describes the pressure drop gradient through a so-called scrubber bed) and you would naturally have to provide your own file.





You retrieve the file by clicking **File > Open > Graphic File**

If you only see part of the graph, you want to investigate or if it ought to fill out the frame better, you will have to go back to your favorite painting program (e.g. PaintShop Pro) and resize the picture until you are satisfied with the appearance.

Step 1: Calibrate the picture
First you must create a connection between your graph and GRAP and following the instructions by clicking on 3 fix-points and entering the real coordinates does this. These points – which have known coordinates – are:

- A point in the lower left part of the graph, which is the origin of the coordinate system. This graph is (clearly) logarithmic and you select the point with the

abscissa “0,01” and the ordinate “0,001”. When prompted for the abscissa, you write “-2”, which is the logarithm of 0,01 and for the ordinate, you write “-3”, which is the logarithm of 0,001

- A point in the lower right part of the graph on the x-axis and you select the point with the abscissa “10” and the ordinate “0,001”. When prompted for the abscissa, you write “1”, which is the logarithm of 10 and for the ordinate, you write “-3”, which is the logarithm of 0,001
- A point in the upper left part of the graph on the y-axis and you select the point with the abscissa “0,01” and the ordinate “0,1”. When prompted for the abscissa, you write “-2”, which is the logarithm of 0,01 and for the ordinate, you write “-1”, which is the logarithm of 0,1

You are asked, if you are satisfied with this calibration (displayed in the upper left corner of the screen). Click “Yes” or “No” – if you want to repeat the calibration. This calibration is kept in memory (when the program runs) and if you want to recover the same graphic file again, you are asked if you want to retain the previous calibration. This saves you for the work of repeating the 3-step calibration.

Step 2: Select points on the graph
We assume, that you want to find a representation for the curve marked “200”. You now trace the curve with the mouse pointer and select points along the curve (you may select up to 30 points and the values found are displayed in the list at the upper left hand of the screen.

Step 3: Run the regression analysis
Next we assume, that you have selected e.g. 10 points and you start the regression program by clicking “RUN REGRESSION ANALYSIS”. The result is something like this – the program uses a 3’rd degree polynomial as default. The values selected, the calculated values and the regression coefficients are shown:

File Help

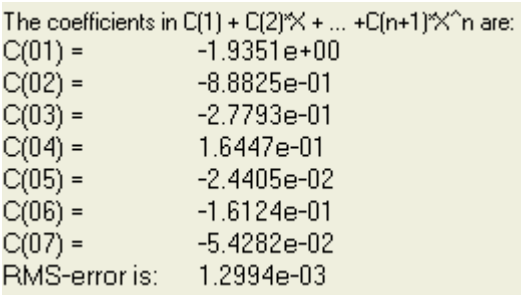
01	X= -1.91536	Y= -1.27165	calculated = -1.27564
02	X= -1.43075	Y= -1.31185	calculated = -1.30436
03	X= -1.00276	Y= -1.40343	calculated = -1.39716
04	X= -0.55919	Y= -1.56164	calculated = -1.57683
05	X= -0.14119	Y= -1.83272	calculated = -1.83870
06	X= 0.14791	Y= -2.08864	calculated = -2.07988
07	X= 0.40609	Y= -2.34973	calculated = -2.34112
08	X= 0.79350	Y= -2.81574	calculated = -2.82173

The coefficients in C(1) + C(2)*X + ... +C(n+1)*X^n are:

C(01) =	-1.9500e+00
C(02) =	-8.3146e-01
C(03) =	-3.1138e-01
C(04) =	-3.1898e-02
RMS-error is:	8.9802e-03

The RMS (Root Mean Square) error is about 0,009.

You may then adjust the regression degree by using the slider – and if you e.g. adjust the value to “6” and click “RUN REGRESSION ANALYSIS”, you will get the coefficients for a 6’th degree approximation. Something like this (only the coefficients are shown):

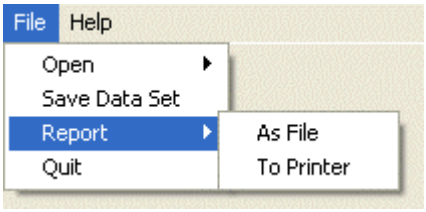


Now the RMS error is reduced to about 0,001 and therefore, this is apparently a better approximation.

Step 4: Save the coordinates selected

You may save the coordinates, you selected along the graph by clicking **File > Save Data Set**, where you are prompted for a name – e.g. "curve200" – following which a text-file named "curve200.txt" will be created in the GRAP directory. This file can subsequently be used like any other coordinate file as described in the paragraph "Text-File Option".

Step 5: Report the Result



By clicking **File > Report > To Printer**, the result (selected data points, regression coefficients and RMS error) is sent to the printer.

You may also create a report file (with the extension *.RPT – if at the first time using GRAP, the program does not recognize the extension you are prompted to choose from list: Select "Notepad").

You may use this option to integrate the result into other reports (Words, etc.) and also you may "stack" several results in the same *.RPT file by saving to the same file. This will "append" the data and this is useful if you in your session want to have results for different regression degrees in the same file and/or if you want e.g. the curves for 50, 100, 200 and 400 together.