

**Programs for Cyclical
Analysis: <F>, <G>,
and <FDESC>.
User's Guide**

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January 2004

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Introduction

The elaboration of the System of Cyclical Indicators (SCI) by the *Instituto Nacional de Estadística* (INE, 1994) required the development of a specific software for the detection of turning points of a high number of time series, as well as for its classification according to their cyclical behaviour into either coincident, lagged or acyclical with respect to a reference series.

The present document provides a detailed description of this software, which has been revised in order to comply with two main objectives: first, that of ensuing a more flexible use, thus making it possible for the analyst to fix the basic working parameters and, second, that of developing an interface which integrates all the components, enabling in this sense a more user-friendly and intuitive use. This new version is the result of the cumulated experience, comments and suggestions of its users, whom the authors wish to express their gratitude and, in particular, Juan Bógalo, Rafael Frutos, Leandro Navarro and Silvia Relloso who have carried out an exhaustive analysis of this program. An additional and warm acknowledgment should be made to Leandro Navarro, who has proficiently translated this *User's Guide* from Spanish to English.

Furthermore, the participation in the R&D program *Tools and Practices for Business Cycle Analysis in National Statistical Institutes of EU* (BUSY), in close collaboration with statisticians at the French and Italian National Statistical Institutes (INSEE and ISTAT respectively), and with the Joint Research Centre (JRC) of the European Commission, has proved an important stimulus for its further development and revision.

The programs developed enable an accurate and massive processing, and constitutes a completely objective decision-making and fully reproducible procedure, which remains coherent with robust signal-extraction methods based, on both, autoregressive low-pass filters (Melis, 1991; Cristóbal y Quilis, 1994), and cyclical band-pass filters (Bógalo y Quilis, 2003). Nonetheless, although the programs constitute a valuable complement, they **do not** provide a substitute for the analyst, who's critical analysis remains a must.

This document is a thorough exposition of the analysis performed by the aforementioned programs, whose technical background is described in Abad and Quilis (1994, 1996) and Abad et al. (2000). Applications of this methodology can be found, among others, in Abad and Quilis (1998), Bógalo (2001), Cabrero (2003), Cabrero et al. (2003), Márquez and Ramajo (2000) and Quilis (1999).

The software is divided into four programs, which have been fully developed in Pascal. This programming language was chosen because it offers an easy way of implementing a modular system which can be easily maintained, extended and revised. The four programs are:

- program for the detection and dating of turning-points: < F >
- Eviews code generating program: < PROLINK >
- supplementary program for the analysis of the results obtained by < F > : < FDESC >
- cyclical classification program: < G > .

These programs are executed by means of a common interface developed in Visual Basic (< FG >), which, in order to be operational, must be installed, as well as the four programs, in the common directory **C:\FG**.

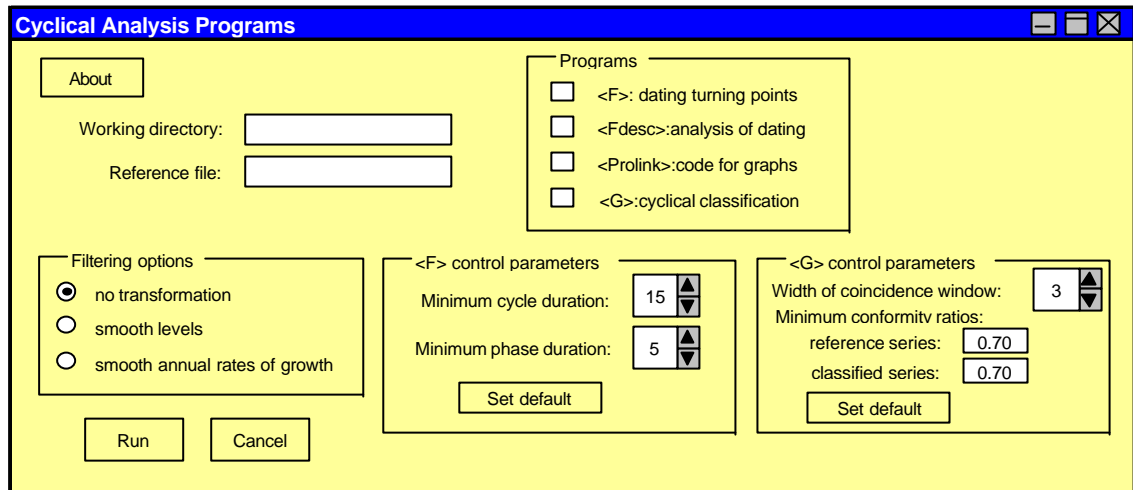
The decompression of the file FG.ZIP on the root directory (C:\) automatically creates the directory C:\FG, installing this way the programs and the user guide in this folder. Also, another sub-folder is created, C:\FG\EXAMPLE, which contains the data files (*.PRN) and the reference file (LIST.DAT) needed for replicating the example included in section 7.

The software described in this Guide is freely available upon request at www.ine.es/infoine.

1. Interface: <FG>

The interface of the cyclical analysis program allows the user to determine the programs to be executed and also setting the desired values of the optional parameters available for each program.

When activating the *interface*, this dialog-window will show up on the screen:



First, the user has to determine, both, the **working directory** (directory where all the input data can be found and where all output files will be stored), and the name of the **reference file**.

The reference file is a file in ASCII format, which has to be placed in the working directory, and which registers for each series to be processed the following items:

- the name of the file containing the time series (including its full extension),
- the name of the series, with a maximum of 50 characters,
- a sign indicating the behaviour with respect to the reference series, i.e. (+) when the series is procyclical, or (-) when anticyclical (the reference series has to be placed **in the first position** of this file),
- the initial year of the series (4 digits).

These data have to be stored (following the aforementioned order) columnwise, with a maximum of 100 time series. This file could have the following aspect:

```
x.prn
name of the series x
+
1965
y.prn
name of the series y
-
1965
z.prn
name of the series z
+
1965
```

In this hypothetical file (called, e.g. *LIST.DAT*), three series have been considered and stored in the files *x.prn*, *y.prn*, *z.prn*. The first one (*x*), is the reference series, and will always be procyclical with respect to itself (therefore the +); the second series (*y*) is anticyclical when compared to *x* (negative sign, -). The third one, (*z*), is procyclical (positive sign, +). In all three cases the beginning of the series has been set at January 1965.

A very important feature is that the series to be processed should be defined at the monthly frequency and should have its initial value in January, totalling the maximum number of observations 600. Although the series can have different initial and ending dates, when dating them it is highly recommendable to set both values equal for all series from the beginning, in order to avoid possible inconveniences and misclassifications. Every series to be processed must be stored columnwise in an ASCII file.

Second, the **program** or programs to be executed have to be selected, taking into account that both <FDESC> as well as <G> need dating series before being run. That is why, before running them, the program <F> has to be executed (during the same or a previous session).

Finally, the values of the **optional parameters** of <F> and <G> have to be determined before running both programs. In the case of the <F> program, the type of filter applied to the series and the minimum distance between the phases of a cycle can be chosen. In the case of <G>, two options can be set: the width of the coincidence window (symmetric around zero), as well as the minimum limit of the conformity ratio between the reference series and the classified ones. By clicking on the button 'Set default' all values will be reset at their default values. For a detailed description on these parameters, please, refer to the section on each program of this guide.

After clicking on the button 'Run', a file containing the name of the reference file and the selected values for each parameter, called *PARAM.DAT* (in ASCII format), is generated in the working directory. (The values will be zero if a program has not been in use during the session). This file would, for example, have the following aspect:

```
list.dat  
1  
15  
5  
3  
0.70  
0.70
```

where the reference file would be *LIST.DAT*, the file would be processed without any initial transformation (filtering option = 1), and where the optional parameters of <F> and <G> would take its default values: minimum Peak-Through-Peak (PTP) duration = 15 months, minimum phase duration (PT or TP) = 5 months, coincidence window = 3 months around zero, and minimum conformity ratios = 0.70 for both, the reference and the classified series.

Finally, all programs are run sequentially and the output-files are stored in the working directory.

2. Automatic dating program: < F >

The automatic dating program, < F >, determines the behaviour of a set of time series, by means of dating its turning points (cyclical peaks and troughs).

The first filtering option of the program (no transformation of the input series) means that the analyst should have extracted previously an appropriate cyclical signal (from henceforth, CS), using specific filters like Hodrick-Prescott, Butterworth band-pass, etc. If this signal is too erratic, the second option may be chosen (the smoothed levels of the input). If the user wants to analyze a growth signal, the program will provide one if the third option is chosen (the annual rate of growth smoothed by means of a low-pass autoregressive filter).

The peaks and troughs of the CS, whose number can be very high due to small residual erraticities, are localised. In order to eliminate the turning points induced by these small perturbations, the program follows a sequential debugging procedure, so that the final turning points must comply with two basic restrictions:

- that the cycle duration (distance between two consecutive turning points of the same sign) is not less than L_1 months (the value of L_1 can be selected inside the range [13, 24], being 15 its default value),
- that the phase duration (distance between two consecutive turning points of opposite sign) is not less than L_2 months (L_2 can be selected to lie inside the range [3, 9], where 5 is the default value).

This way, an initial dating of the series is established. In the case of the most erratic series, it can be necessary to perform a manual correction of the dating, so that a final or definitive dating is established, which fully condenses all the relevant cyclical information of the variable.

Output

The results of the dating of each series are stored in an ASCII text file with the same name as the original series, but with a different extension (*.LOG). This output file contains the following information:

- a table with the cyclical signal, CS, which is the input for the dating procedure (the raw series, the smoothed levels of the series or its smoothed annual rates of growth, depending on the filtering option chosen in the first step). Missing data arising as a result of the second and third filtering options are symbolised by "-";
- a list with the initially detected turning points, accompanied by a detailed description of the number of observation, its exact date and the corresponding value of the CS series at this instant of time. In this list, like in posterior ones, the cyclical peaks will be marked by "1" and the troughs by "-1";
- a list using the same format as the previous one, but containing the final turning points estimated after using < F > ;
- the final number of turning points of each kind (peaks and troughs);

- a smoothness index of the series, which is measured by the means of a quotient of the final and the initial number of turning points detected: in the extreme case, if this ratio would equal the unity, i.e. that no turning point had been deleted during the internal debugging procedure, would imply that the series is already very smooth, lacking almost of any erratic oscillations.

- the time period analysed and the corresponding number of observations.

Additionally, the program generates two new files, both with the same name as the series, but with the extensions .TAS and .FEK. The first one contains the cyclical signal employed in the dating procedure, i.e. directly the original series (option 1), the smoothed series (option 2), or the smoothed annual rates of growth of the source series (option 3). The second file contains the dated series obtained by the means of < F >, and which is formed exclusively by "1" (if the observation is a cyclical peak), "-1" (if it is a through) and "0" (for the rest of observations).

Both files symbolise missing or non-available data by "-999.99", substituting automatically missing any data arising when applying, either, the annual rate of growth (the first 12 observations), and/or when smoothing them (the first and last 8 observations). The presence of such data does not pose any problem to the normal execution of the rest of programs, but the user should, in order to avoid distortions, exclude these when plotting them. Nonetheless, this problem can be bridged by using Eviews through the program generated by < PROLINK >, which automatically carries out a sample-range adequacy procedure.

Correction of the automatic dating

In case the CS series shows a slightly erratic behaviour, the program < F > might present difficulties in correctly assigning turning points. Under such circumstances it might prove necessary to manually correct the dating series.

This task can easily be fulfilled by means of a common graph, containing the cyclical signal (stored in the file with the extension .TAS) and the dating series (*.FEK), which allows determining, whether or not, a turning point should either be erased, shifted or added to the dating series computed by the program. These graphs can be done using the Eviews code generated by < PROLINK >. The exact dates for the turning points can be found in the initial and final listings of the output file (*.LOG)

Once the necessary changes have been clearly defined, the dating series can be edited (in the *.FEK file) on any editing program by substituting a 1 or a -1 by a 0 (to eliminate a peak or a through) or viceversa (to add a peak or a through); to shift a turning point from one date to another, both operations must be combined. The file for the modified series have to be stored in a file with the same name and extension as the original one, because it constitutes the input file for the rest of programs.

3. Eviews code generating program: <PROLINK>

This program generates source code readable by Eviews, which is stored in the working directory, in an ASCII file. The name of this file is the same as that of the reference file, but with extension .PRG (e.g. the corresponding <PROLINK> outcome of a reference file called LIST.DAT would be LIST.PRG).

A graph of the cyclical signal for each series (*.TAS) with its corresponding dating series (*.FEK) can be obtained by executing this command line in batch-mode, under the Eviews environment. This might, by following the process described in the previous section, help in correcting the automatic results obtained by <F> .

4. Supplementary program for cyclical analysis: < FDESC >

The supplementary program < FDESC > offers, through the analysis of the dating series computed by < F > , additional information on the univariate properties of the cycle of the analysed time series.

< FDESC > does not make use of the original data, but, instead, it uses directly the estimated cyclical signals (*.TAS files) and the dating series (*.FEK files). Therefore, it is **essential** to execute first the program < F > , so that the input file for < FDESC > is available before running it.

Output

The program < FDESC > generates an output file for every series specified in the reference file. These output files adopt the name as the files of the different series, but with the extension .SAL, containing the following information:

- a table with the turning points (separated by peaks and troughs, and ordered by complete cycles), with full detail on their duration (number of months between a turning point and the previous of opposite sign), their amplitude (the difference, in absolute terms, between its CS and the CS of the previous turning point of opposite sign), their intensity (its amplitude divided by its duration), as well as the total duration of each cycle and a measure of asymmetry (the duration of the peak divided by the one of the through, and the same formula for the amplitude);
- the median value of each variables listed on the previous table;
- the total and subtotal number of turning points, sorted by types;
- a smoothness index (the same as in the program < F >);
- the mean and standard deviation of the CS series;
- the sample analysed and the corresponding number of observations.

5. Cyclical classification program: < G >

The main aim of the program < G > is to classify a set of time series according to the behaviour of its cyclical signal with respect to a given reference series into either leading, lagged, coincident or acyclical. As before mentioned, the reference series has to be the first of the series listed on the reference file. The rest of the series of the file are thus classified with respect to the reference series.

In this process, the cyclical signal of each series is compared with that of the referent, computing the distance in months (**delay**) between the turning points of both. The median value of all delays allows assigning the series into any of the above mentioned categories. This procedure is carried out according to the following principle: if the median delay lies inside the interval $[-L, L]$ (symmetric around zero), the series is classified as **coincident**. In case the median delay does not lie inside this interval, the decisive factor is its sign: if it is negative, the series is classified as **leading** and **lagged** if it is positive. The value of the parameter L can adopt values inside the interval $[3, 6]$, being 3 its default value.

The delays are calculated for pairs of turning points, i.e. a turning point is paired off **with one and just one** of the series with which it is being compared. This implies that, given that usually the number of turning points is not equal in both series, some of them might have no correspondence.

Also, a **conformity ratio** is computed for both, the referent and the classified series. Both ratios are defined as the total number of paired turning points divided by the total number of turning points of each series, and have to achieve a minimum limit, which can be chosen by the analyst, constrained to lie inside the interval $[0, 1]$, being 0.70 the default value. If one or both ratios are outside the corresponding limit, it can be concluded that the cyclical signal of the series to be classified bears no cyclical correspondence with the reference series and therefore it can be catalogued as **acyclical or non-classifiable**.

On the one hand, the program < G > works exclusively with the dating series (files with extension .FEK), so that, in a similar way as mentioned when describing < FDESC >, it is a prerequisite to have previously executed < F > in order to obtain them. On the other hand, it is not indispensable to execute < FDESC > before executing < G >, because the former is just a descriptive program, which offers additional information to that provided by < F >, but does not modify the dating series.

A fundamental condition for the correct execution of < G > is, that **all the series must have the same date of beginning and ending**: the same month of the same year; and to be more precise, the initial month must be January. If this were not the case, the results provided by < G > would suffer a distortion and could therefore not be considered as valid, because all computations are carried out taking into account this prerequisite.

Output

The results of the series contained in the reference file (with the exception of the reference series, which, obviously, cannot be classified with respect to itself) are stored in an output file with the same name as the series, but with the extension .RES. This file contains the following information:

- a list with the peaks of the reference series and their delay with the corresponding peaks of the series to be classified;
- a similar list, but with the troughs;
- an index of cyclical coincidence between both series;
- the conformity ratios of both series and their troughs values;
- the median delay between the turning points of the two series;
- the result of the classification of the series according to their cyclical behaviour, i.e. if the series is leading, coincident, lagged or non-classifiable with respect to the reference series, which is a function of the conformity ratios and the median delay;
- box-plot diagrams showing the delays (this sort of graphic tool is analysed in Tukey, 1977), for the peaks and troughs;
- a table with measures of position and range of the delays, divided by troughs and peaks.

When a series is classified as **anticyclical** (and, therefore, carries a negative sign in the reference file), the program changes the sign of its turning points before computing the delays, thus the correspondences between the turning points of the two series can be carried out correctly. In this case, these series will appear as **inverted** in the output file.

Besides, the < G > program offers a table summarising the cyclical classification of all the series of the reference file (excepting the first one). This table is comprised in a file with the same name as the reference file, but with the extension .TAG and includes the following information for all the series:

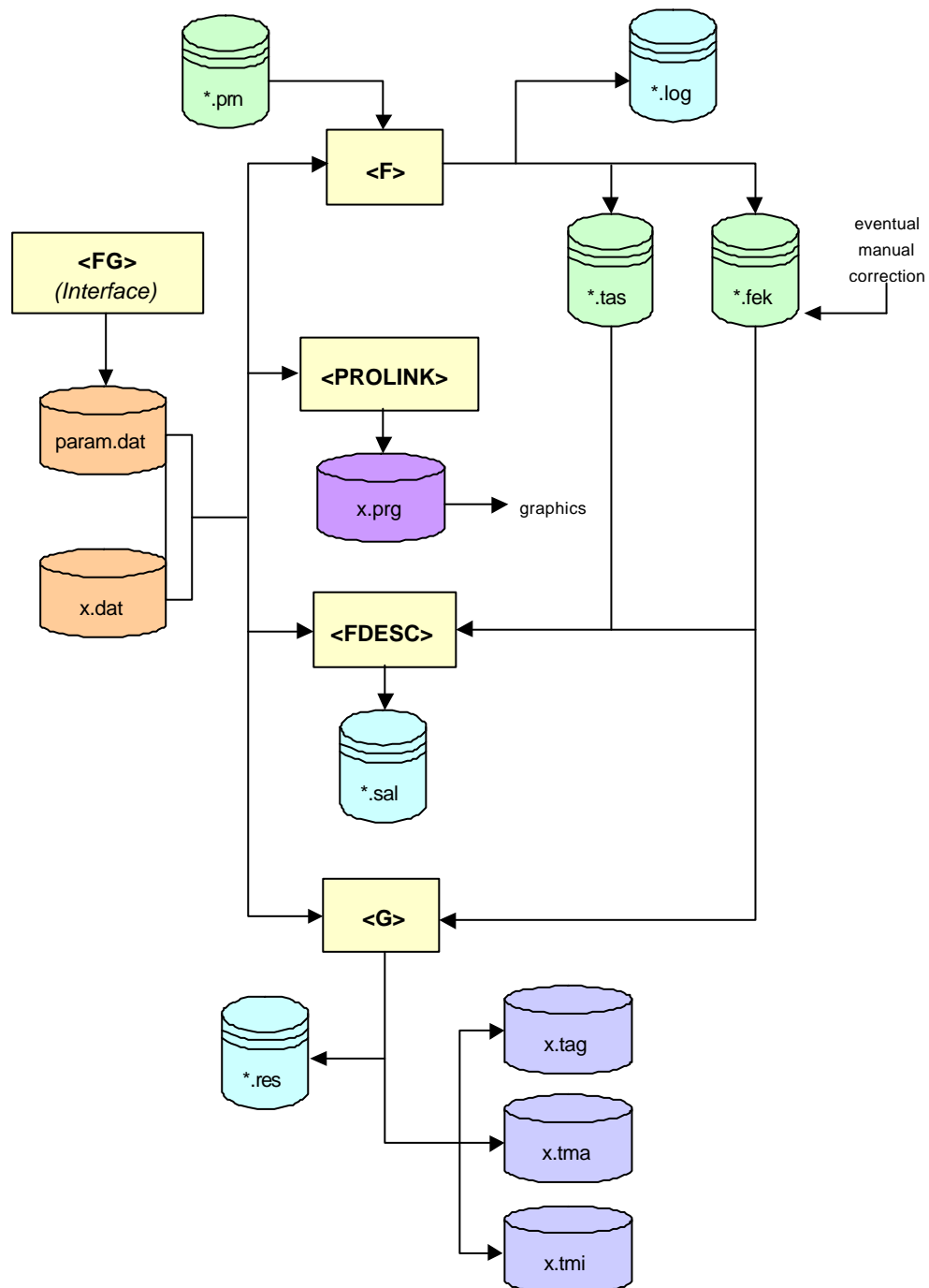
- the classification with respect to the reference series (CLASS);
- the conformity ratio of the reference series (Ry);
- the conformity ratio of the analysed series (Rx);
- the median delay for all the turning points (GMD);
- the cyclical coincidence index (COINC);
- a sign indicating the procyclical (+) or anticyclical (-) behaviour of the series with respect to the reference series.

Finally, the program provides two additional tables (distinguishing peaks and troughs), giving the punctual delay between every turning point of the reference series (represented by its chronological order number) and the corresponding turning points of all the classified series, following the assignation given by the program. These tables are stored in two files, coinciding their names with that of the reference file, but with the extensions .TMA (table for the peaks) and .TMI (for the troughs).

6. Overall working scheme

In the current section, a diagram of the overall computation and working process is presented, showing the links, as well as input and output files required or generated by each program.

The reference file, that contains the specifications of the n series to be processed, has been named *X.DAT*. The original series are found in the corresponding **.PRN* files.



7. Practical example

This section constitutes a practical exercise of how to use these programs. The data used can be found in the folder in which the programs are stored: the series are the Indices of Industrial Production (IIP) for the United States (USA), Spain (SPA), France (FRA), Italy (ITA), Great Britain (GRB) and Germany (GER). The sample ranges from 1970.01 until 2002.09.

The reference file used in this example, also enclosed with the programs, has been named *LIST.DAT*. The reader will notice that all the series to be processed are procyclical with respect to the first series (USA), our **reference series**.

First, making use of the six original series in levels (the enclosed *.PRN files) we proceeded to an automatic dating. In this process the third filtering option, the **smoothed annual rates of growth**, has been selected. The optional parameters of < F > stay at their **default values**.

Table 1 shows a standard output of the program < F > . This table, as well as the following ones, differ slightly from the ones directly provided by the programs. This is so, because the text has been edited in order to adapt the outputs to the present guide, remaining the contents identical with those of the original files.

TABLE 1: Output of <F> for IIP USA (file USA.LOG)

| DATING OF THE SERIES ----> IIP United States | | | | | | | | | | | | |
|--|--------|--------|--------|---------|---------|---------|--------|--------|--------|--------|--------|--------|
| File name ----> usa.prn | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1970 | - | - | - | - | - | - | - | - | - | - | - | - |
| 1971 | - | - | - | - | - | - | - | - | 3.293 | 4.187 | 5.081 | 5.953 |
| 1972 | 6.783 | 7.557 | 8.263 | 8.898 | 9.455 | 9.929 | 10.315 | 10.604 | 10.789 | 10.869 | 10.853 | 10.752 |
| 1973 | 10.583 | 10.357 | 10.086 | 9.768 | 9.395 | 8.950 | 8.414 | 7.775 | 7.030 | 6.189 | 5.274 | 4.313 |
| 1974 | 3.338 | 2.380 | 1.461 | 0.587 | -0.247 | -1.060 | -1.878 | -2.728 | -3.629 | -4.590 | -5.604 | -6.644 |
| 1975 | -7.667 | -8.620 | -9.444 | -10.067 | -10.416 | -10.414 | -9.997 | -9.123 | -7.786 | -6.018 | -3.893 | -1.517 |
| 1976 | 0.978 | 3.450 | 5.761 | 7.797 | 9.473 | 10.736 | 11.569 | 11.985 | 12.028 | 11.762 | 11.265 | 10.623 |
| 1977 | 9.914 | 9.211 | 8.568 | 8.024 | 7.596 | 7.281 | 7.060 | 6.908 | 6.802 | 6.716 | 6.634 | 6.542 |
| 1978 | 6.436 | 6.316 | 6.192 | 6.075 | 5.984 | 5.934 | 5.939 | 5.998 | 6.096 | 6.207 | 6.298 | 6.337 |
| 1979 | 6.293 | 6.141 | 5.868 | 5.469 | 4.953 | 4.339 | 3.652 | 2.922 | 2.170 | 1.408 | 0.641 | -0.126 |
| 1980 | -0.884 | -1.615 | -2.294 | -2.890 | -3.371 | -3.713 | -3.900 | -3.928 | -3.794 | -3.496 | -3.032 | -2.404 |
| 1981 | -1.628 | -0.743 | 0.196 | 1.113 | 1.929 | 2.570 | 2.981 | 3.126 | 2.990 | 2.581 | 1.920 | 1.047 |
| 1982 | 0.009 | -1.136 | -2.328 | -3.504 | -4.598 | -5.551 | -6.314 | -6.850 | -7.128 | -7.132 | -6.854 | -6.296 |
| 1983 | -5.465 | -4.375 | -3.049 | -1.519 | 0.172 | 1.974 | 3.825 | 5.661 | 7.412 | 9.011 | 10.401 | 11.529 |
| 1984 | 12.356 | 12.851 | 13.002 | 12.813 | 12.305 | 11.517 | 10.503 | 9.326 | 8.053 | 6.751 | 5.478 | 4.286 |
| 1985 | 3.215 | 2.296 | 1.548 | 0.980 | 0.597 | 0.390 | 0.338 | 0.408 | 0.564 | 0.765 | 0.978 | 1.174 |
| 1986 | 1.331 | 1.439 | 1.493 | 1.500 | 1.467 | 1.406 | 1.337 | 1.280 | 1.257 | 1.293 | 1.405 | 1.609 |
| 1987 | 1.907 | 2.295 | 2.759 | 3.276 | 3.822 | 4.366 | 4.878 | 5.334 | 5.711 | 5.993 | 6.169 | 6.236 |
| 1988 | 6.198 | 6.065 | 5.853 | 5.579 | 5.263 | 4.926 | 4.585 | 4.258 | 3.958 | 3.694 | 3.467 | 3.271 |
| 1989 | 3.095 | 2.927 | 2.752 | 2.560 | 2.339 | 2.085 | 1.800 | 1.485 | 1.148 | 0.801 | 0.462 | 0.151 |
| 1990 | -0.114 | -0.314 | -0.441 | -0.498 | -0.500 | -0.470 | -0.439 | -0.439 | -0.495 | -0.619 | -0.813 | -1.065 |
| 1991 | -1.355 | -1.655 | -1.935 | -2.164 | -2.314 | -2.363 | -2.289 | -2.080 | -1.730 | -1.249 | -0.659 | 0.007 |
| 1992 | 0.709 | 1.402 | 2.050 | 2.625 | 3.110 | 3.498 | 3.793 | 4.003 | 4.135 | 4.200 | 4.206 | 4.160 |
| 1993 | 4.072 | 3.952 | 3.809 | 3.655 | 3.502 | 3.360 | 3.241 | 3.155 | 3.112 | 3.122 | 3.192 | 3.325 |
| 1994 | 3.521 | 3.777 | 4.082 | 4.425 | 4.791 | 5.165 | 5.531 | 5.869 | 6.159 | 6.381 | 6.519 | 6.566 |
| 1995 | 6.521 | 6.391 | 6.186 | 5.920 | 5.608 | 5.261 | 4.895 | 4.527 | 4.177 | 3.866 | 3.615 | 3.441 |
| 1996 | 3.354 | 3.358 | 3.449 | 3.619 | 3.856 | 4.146 | 4.473 | 4.824 | 5.182 | 5.533 | 5.860 | 6.150 |
| 1997 | 6.395 | 6.593 | 6.747 | 6.864 | 6.952 | 7.018 | 7.067 | 7.098 | 7.110 | 7.100 | 7.061 | 6.987 |
| 1998 | 6.874 | 6.718 | 6.518 | 6.271 | 5.979 | 5.647 | 5.285 | 4.908 | 4.530 | 4.171 | 3.848 | 3.574 |
| 1999 | 3.358 | 3.205 | 3.114 | 3.086 | 3.116 | 3.199 | 3.331 | 3.502 | 3.705 | 3.934 | 4.178 | 4.425 |
| 2000 | 4.662 | 4.873 | 5.041 | 5.147 | 5.174 | 5.106 | 4.927 | 4.624 | 4.190 | 3.622 | 2.924 | 2.112 |
| 2001 | 1.209 | 0.241 | -0.759 | -1.760 | -2.725 | -3.619 | -4.406 | -5.048 | -5.514 | -5.778 | -5.825 | -5.654 |
| 2002 | -5.275 | - | - | - | - | - | - | - | - | - | - | - |

TABLE 1 (continued)

| Initial turning points | | | | Final turning points | | | |
|------------------------|----------------|-----------|----------------|----------------------|----------------|-----------|----------------|
| Obs. | Date | Type | CS | Obs. | Date | Type | CS |
| 34 | 1972.10 | 1 | 10.8693 | 34 | 1972.10 | 1 | 10.8693 |
| 65 | 1975. 5 | -1 | -10.4162 | 65 | 1975. 5 | -1 | -10.4162 |
| 81 | 1976. 9 | 1 | 12.0278 | 81 | 1976. 9 | 1 | 12.0278 |
| 102 | 1978. 6 | -1 | 5.9343 | 102 | 1978. 6 | -1 | 5.9343 |
| 108 | 1978.12 | 1 | 6.3374 | 108 | 1978.12 | 1 | 6.3374 |
| 128 | 1980. 8 | -1 | -3.9277 | 128 | 1980. 8 | -1 | -3.9277 |
| 140 | 1981. 8 | 1 | 3.1260 | 140 | 1981. 8 | 1 | 3.1260 |
| 154 | 1982.10 | -1 | -7.1317 | 154 | 1982.10 | -1 | -7.1317 |
| 171 | 1984. 3 | 1 | 13.0021 | 171 | 1984. 3 | 1 | 13.0021 |
| 187 | 1985. 7 | -1 | 0.3381 | 187 | 1985. 7 | -1 | 0.3381 |
| 196 | 1986. 4 | 1 | 1.4996 | 196 | 1986. 4 | 1 | 1.4996 |
| 201 | 1986. 9 | -1 | 1.2573 | 203 | 1986.11 | -1 | 1.4052 |
| 216 | 1987.12 | 1 | 6.2357 | 216 | 1987.12 | 1 | 6.2357 |
| 245 | 1990. 5 | -1 | -0.5001 | 258 | 1991. 6 | -1 | -2.3626 |
| 247 | 1990. 7 | 1 | -0.4393 | 275 | 1992.11 | 1 | 4.2059 |
| 258 | 1991. 6 | -1 | -2.3626 | 285 | 1993. 9 | -1 | 3.1119 |
| 275 | 1992.11 | 1 | 4.2059 | 300 | 1994.12 | 1 | 6.5664 |
| 285 | 1993. 9 | -1 | 3.1119 | 313 | 1996. 1 | -1 | 3.3543 |
| 300 | 1994.12 | 1 | 6.5664 | 333 | 1997. 9 | 1 | 7.1104 |
| 313 | 1996. 1 | -1 | 3.3543 | 352 | 1999. 4 | -1 | 3.0855 |
| 333 | 1997. 9 | 1 | 7.1104 | 365 | 2000. 5 | 1 | 5.1744 |
| 352 | 1999. 4 | -1 | 3.0855 | <u>383</u> | <u>2001.11</u> | <u>-1</u> | <u>-5.8254</u> |
| 365 | 2000. 5 | 1 | 5.1744 | | | | |
| <u>383</u> | <u>2001.11</u> | <u>-1</u> | <u>-5.8254</u> | | | | |

Final number of peaks = 11

Final number of troughs = 11

Smoothness index ---> 0.9167

Time interval ---> 1970.01 - 2002.09

Number of observations ---> 393

When executing <PROLINK> a file called *LIST.PRG* will be obtained. This file contains the code needed for generating in EViews the comparative graphs of the cyclical signal and their corresponding dating. The code obtained for the first two series of the example file is as follows:

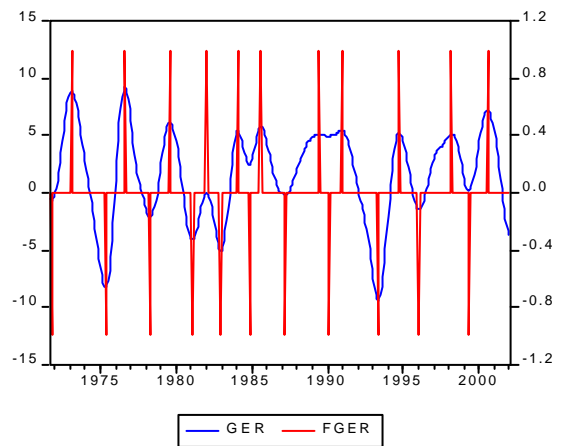
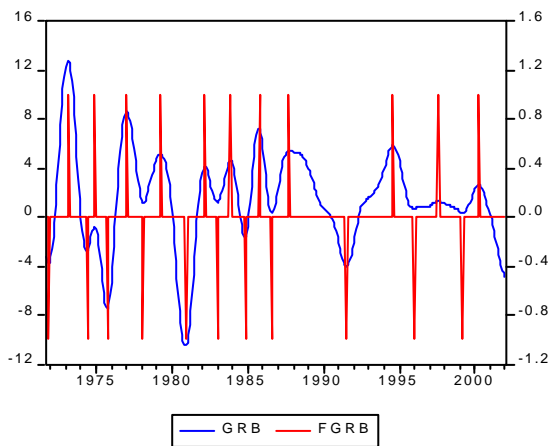
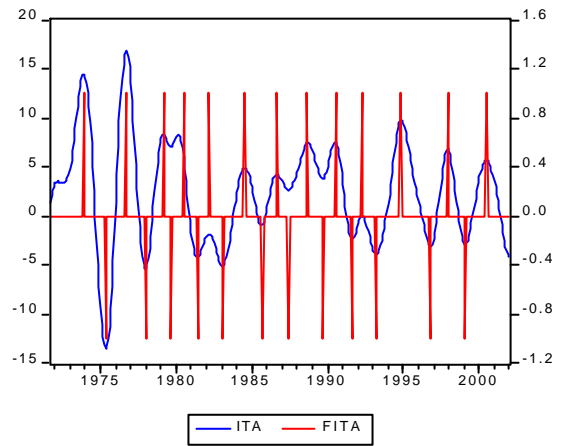
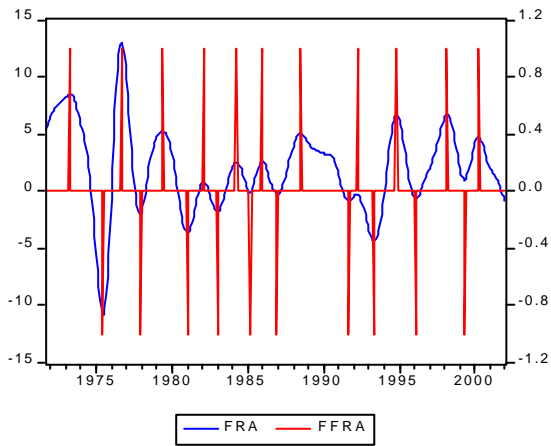
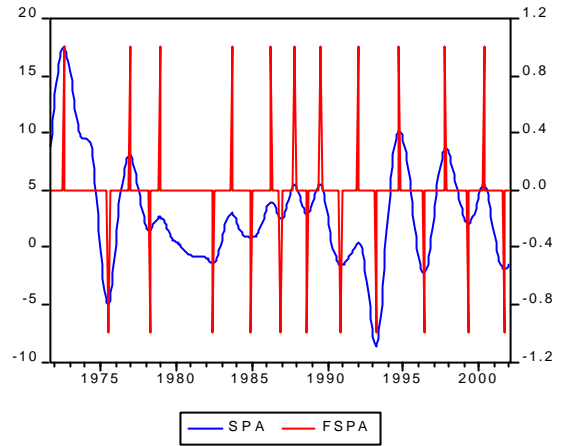
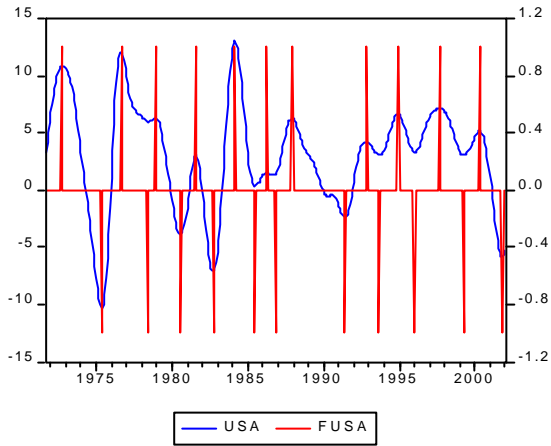
```
cd c:\fg\example
create m 1970.01 2002.09
```

```
smpl 1970.01 2002.09
read(c) usa.tas usa
read(c) usa.fek fusa
smpl 1971.09 2002.01
plot(x) usa fusa
```

```
smpl 1970.01 2002.09
read(c) spa.tas spa
read(c) spa.fek fspa
smpl 1971.09 2002.01
plot(x) spa fspa
```

.....

As a result, after running this program on Eviews, we obtain a set of graphs for all the series analyzed:



The results herein presented constitute a mere demonstration of the working procedure with the set of programs of this guide. Because of this, the outputs of the programs have not been manually corrected, adopting the raw results of the dating provided by <F> as a final result. Nonetheless, in some cases and in line on the analyst's judgement, it might be reasonable to undertake diverse modifications of the turning point series (see *Correction of the automatic dating*, in section 2).

<FDESC> affords a complementary and more in-depth analysis of the dating than that originated when running the automatic procedure of <F> (or of the definitive dating in case it has been manually corrected). A standard output of this program is shown on table 2.

TABLE 2: Output of <FDESC> for IIP USA (file USA.SAL)

ANALYSIS OF THE DATING OF ---> IIP United States
File name ---> usa.prn

| DATE | | DURATION | | | AMPLITUDE | | STRENGTH | | ASYMMETRY | |
|---------|---------|----------|--------|-------|-----------|--------|----------|--------|-----------|-----------|
| PEAK | TROUGH | PEAK | TROUGH | CYCLE | PEAK | TROUGH | PEAK | TROUGH | DURATION | AMPLITUDE |
| 1972.10 | 1975.05 | - | 31.00 | - | - | 21.29 | - | 0.69 | - | - |
| 1976.09 | 1978.06 | 16.00 | 21.00 | 37.00 | 22.44 | 6.09 | 1.40 | 0.29 | 0.76 | 3.68 |
| 1978.12 | 1980.08 | 6.00 | 20.00 | 26.00 | 0.40 | 10.27 | 0.07 | 0.51 | 0.30 | 0.04 |
| 1981.08 | 1982.10 | 12.00 | 14.00 | 26.00 | 7.05 | 10.26 | 0.59 | 0.73 | 0.86 | 0.69 |
| 1984.03 | 1985.07 | 17.00 | 16.00 | 33.00 | 20.13 | 12.66 | 1.18 | 0.79 | 1.06 | 1.59 |
| 1986.04 | 1986.11 | 9.00 | 7.00 | 16.00 | 1.16 | 0.09 | 0.13 | 0.01 | 1.29 | 12.30 |
| 1987.12 | 1991.06 | 13.00 | 42.00 | 55.00 | 4.83 | 8.60 | 0.37 | 0.20 | 0.31 | 0.56 |
| 1992.11 | 1993.09 | 17.00 | 10.00 | 27.00 | 6.57 | 1.09 | 0.39 | 0.11 | 1.70 | 6.00 |
| 1994.12 | 1996.01 | 15.00 | 13.00 | 28.00 | 3.45 | 3.21 | 0.23 | 0.25 | 1.15 | 1.08 |
| 1997.09 | 1999.04 | 20.00 | 19.00 | 39.00 | 3.76 | 4.02 | 0.19 | 0.21 | 1.05 | 0.93 |
| 2000.05 | 2001.11 | 13.00 | 18.00 | 31.00 | 2.09 | 11.00 | 0.16 | 0.61 | 0.72 | 0.19 |
| MEDIAN | | 14.00 | 18.00 | 29.50 | 4.29 | 8.60 | 0.30 | 0.29 | 0.95 | 1.00 |

Number of peaks ---> 11
Number of troughs ---> 11
Total number of turning points ---> 22
Smoothness index ---> 0.9167
CS average ---> 3.0223
CS std. deviation ---> 4.6574
Time interval ---> 1970.01 - 2002.09
Number of observations ---> 393

This table comprehends a list with the durations and amplitudes for the peaks and troughs and makes it possible for the analyst to perform a detailed study of the time-path of both parameters, as well as detecting the possible asymmetries between the two types of turning points. This table also is very useful in establishing comparisons between the cycles of different series.

< G > has been employed in order to obtain a dynamic classification of the series with respect to a reference series which is, in this case, the IIP for the United States (*USA.PRN*). On that ground, it holds the first place on the file *LIST.DAT*. The control parameters have been set at their **default values**.

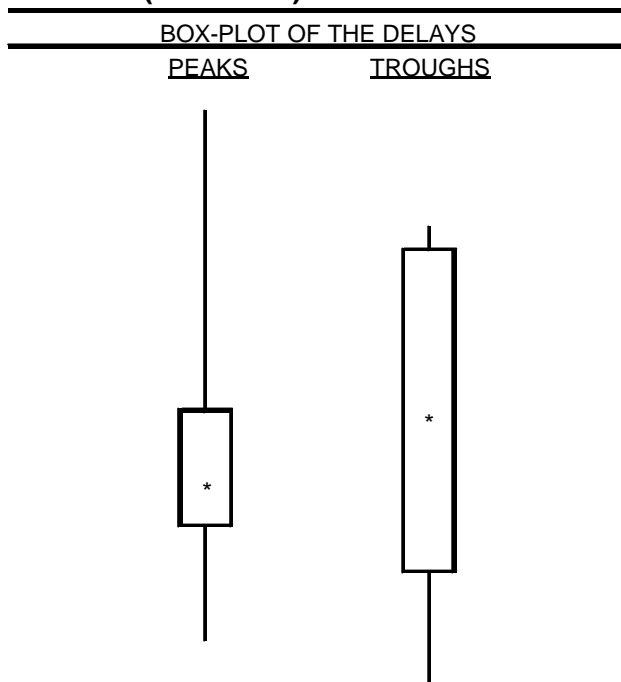
Table 3 shows the output of < G > concerning Spain's IIP. The conformity ratios of both, referent and classified series, exceed the minimum limits and can therefore be classified. To be more specific, the series can be classified as coincident, given that the median delay turns out to lie inside the selected interval (3 months around 0)

Besides, through a visual inspection of the box-plot of the delays, it can be noticed: (i) that those corresponding to the troughs show a higher dispersion than those of the peaks, (ii) a slight asymmetry in both distributions.

TABLE 3: Output of <G> for IIP Spain (file SPA.RES)

| | | |
|--|--|---------|
| REFERENCE SERIES | ---> IIP United States | |
| initial date | ---> 1970 | |
| CLASSIFIED SERIES | ---> IIP Spain | |
| initial date | ---> 1970 | |
| classified series file | ---> spa.prn | |
| <hr/> | | |
| FINAL PEAKS OF IIP United States AND THEIR DELAYS IN RELATION TO IIP Spain * MEANS NO CORRESPONDENCE | FINAL TROUGHS OF IIP United States AND THEIR DELAYS IN RELATION TO IIP Spain * MEANS NO CORRESPONDENCE | |
| 1972.10 | -2 | 1972. 8 |
| 1976. 9 | 3 | 1976.12 |
| 1978.12 | 0 | 1978.12 |
| 1981. 8 | * | -- |
| 1984. 3 | -6 | 1983. 9 |
| 1986. 4 | 0 | 1986. 4 |
| 1987.12 | -1 | 1987.11 |
| 1992.11 | -10 | 1992. 1 |
| 1994.12 | -2 | 1994.10 |
| 1997. 9 | 1 | 1997.10 |
| 2000. 5 | 0 | 2000. 5 |
| 1975. 5 | 2 | 1975. 7 |
| 1978. 6 | -2 | 1978. 4 |
| 1980. 8 | * | -- |
| 1982.10 | -4 | 1982. 6 |
| 1985. 7 | -7 | 1984.12 |
| 1986.11 | 1 | 1986.12 |
| 1991. 6 | -7 | 1990.11 |
| 1993. 9 | -6 | 1993. 3 |
| 1996. 1 | 4 | 1996. 5 |
| 1999. 4 | 0 | 1999. 4 |
| 2001.11 | -2 | 2001. 9 |
| <hr/> | | |
| Coincidence index | ---> 0.5507 | |
| MINIMUM LIMITS OF CONFORMITY: | | |
| Reference series | ---> 0.70 | |
| Classified series | ---> 0.70 | |
| CONFORMITY RATIOS: | | |
| Reference series | ---> 0.9091 | |
| Classified series | ---> 0.9091 | |
| MEDIAN DELAY | ---> -1.5 | |
| CLASSIFICATION | ---> COINCIDENT | |

TABLE 3 (continued)



| RANK AND DISPERSION STATISTICS OF THE DELAYS | | |
|--|-------|----------|
| | PEAKS | TROUGHES |
| min | -10.0 | -7.0 |
| q1 | -2.0 | -6.0 |
| median | -0.5 | -2.0 |
| q3 | 0.0 | 1.0 |
| max | 3.0 | 4.0 |
| max-min | 13.0 | 11.0 |
| q3-q1 | 2.0 | 7.0 |

Finally, < G > also generates a summary table with the main results available. It condenses the information contained in all the *.RES files, easing the comparisons between a high number of series.

While table 4 shows the final results of the cyclical classification, tables 5 and 6 provide additional details (for the peaks and troughs, respectively) on the delays of the turning points of the classified series with respect to the ones of the referent series, represented by its chronological order number. (the corresponding listings with the exact dates can be found in the *.RES files). The symbol '*' means absence of correspondence.

TABLE 4: Summary output of <G> (file LIST.TAG)

| SERIES | CLASS | Ry | Rx | GMD | COINC | SIGN |
|--------|-------|--------|--------|------|--------|------|
| spa | C | 0.9091 | 0.9091 | -1.5 | 0.5507 | + |
| fra | C | 0.9545 | 1.0000 | 1.0 | 0.5836 | + |
| ita | C | 0.9545 | 0.8400 | 3.0 | 0.3205 | + |
| grb | C | 0.8636 | 0.8636 | -1.0 | 0.5178 | + |
| ger | C | 0.9091 | 0.9091 | 0.5 | 0.3753 | + |

TABLE 5: Summary output of <G>: delays of the peaks (file LIST.TMA)

| DELAYS IN RELATION TO THE PEAKS OF ---> IIP United States | | | | | | | | | | | |
|---|----|----|---|---|----|----|----|-----|----|----|----|
| SERIES | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| spa | -2 | 3 | 0 | * | -6 | 0 | -1 | -10 | -2 | 1 | 0 |
| fra | 6 | 0 | 6 | 6 | 1 | -4 | 7 | -7 | -1 | 6 | -1 |
| ita | 14 | 0 | 3 | 7 | 4 | 5 | 9 | -7 | -1 | 3 | 2 |
| grb | 5 | 4 | 4 | 7 | -4 | -6 | -2 | * | -4 | -1 | -1 |
| ger | 4 | -1 | 8 | 5 | -1 | -8 | 18 | * | -2 | 6 | 3 |

TABLE 6: Summary output of <G>: delays of the troughs (file LIST.TMI)

| DELAYS IN RELATION TO THE TROUGHS OF ---> IIP United States | | | | | | | | | | | |
|---|---|----|----|----|----|----|-----|----|---|----|----|
| SERIES | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| spa | 2 | -2 | * | -4 | -7 | 1 | -7 | -6 | 4 | 0 | -2 |
| fra | 1 | -6 | 5 | 3 | -4 | 1 | 3 | -4 | 1 | 1 | * |
| ita | 0 | -5 | 10 | 4 | 2 | 7 | 2 | -6 | 9 | -2 | * |
| grb | 5 | -4 | 4 | 3 | -8 | -3 | 1 | * | 0 | -1 | * |
| ger | 0 | -2 | 6 | 2 | -8 | 4 | -16 | -4 | 0 | 1 | * |

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