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USER DEFINED FUNCTIONS AND OPERATORS

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Any Interactive Management of Time Series (IMTS)[*] user can create new functions, which cannot be reconstructed by means of existing functions, and use them as operators of the language.

As examples, a new method of estimation, or an operator executing cross-section analyses on time series data or a command to print both time series and particular values according to a certain format, can be considered. All the previous functions belong to the dynamic loading special functions category.

In order to define his new function, the user has to write a FORTRAN or Assembler program, whose file name must be equal to the name of the operator he wants to introduce in the language. The name of the new operator will be different from all the existing operators.

The program must have USER as entry point (in FORTRAN, therefore, the first statement must be SUBROUTINE USER (parameter 1, parameter 2, ...)) and have a standard list of parameters, among which, in particular, a double precision X vector, NSERIE, NVALUE, INANNO, INTERM, NFINAN, NFITER (integers), FLAG (logical). The selected data are put by IMTS in the X vector, starting from the first element, series by series, timewise (NVALUE is the number of values for each series, NSERIE is the number of selected series).

IMTS, transparently to the user, has previously performed the necessary compatibility controls which result in series with the same length, referred to a common period of which INANNO and INTERM are initial year and month (or quarter), NFINAN and NFITER the final ones.

In general, the user program will perform some elaborations on the X vector data. If the output of the program is only the printing of some results, without using these results with other operators in the same IMTS command, it is enough to specify FLAG = .TRUE. at the end of the program. If, on the contrary, the result of the program must be a series (or a constant) to be used in connection with other operators in the same IMTS command, the resulting series must be put at the beginning of the X vector and the statement FLAG = .FALSE. must be written.

Example of application: The user wants to introduce the ROWMAX operator which, when applied to a certain number of time series, gives back a new series having, for each period, the maximum among the values of the initial series (a simple example of cross-section analysis on the rows). By means of the EDIT subcommands of CMS, the user begins to

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write a file with identifier ROWMAX FORTRAN. By means of a GET subcommand the user copies inside his file the file USER FORTRAN available to all the users in a read-only disk. This file holds the statement SUBROUTINE USER with the correct list of the parameters and the comment cards with the necessary explanations.

After that, the user must finish his program with the statements which, starting from the X vector data, create, again in the X vector, the resultant series. Finally, the program must be compiled and eventually corrected. At this point, IMTS is able to use the ROWMAX operator, as any other already existent. For example, in the command:

```
'A' + LOG ROWMAX ('B'+ 'C', 'D', SIN'E', 'F' * 'G' * 'H' )
```

where A,B,C,D,E,F,G,H are private or public series.

The IMTS program works on the new operator as follows: When, analyzing the command, the ROWMAX.... characters string is found, it is not recognized as an already existing command. Then a check in the central or in the user disk for a TEXT (result of a compilation) file named "ROWMAX('" (8 characters) is performed. As this file does not exist, a check for a "ROWMAX(" (7 characters) TEXT file is performed until, finally, a "ROWMAX" (6 characters) TEXT file is looked for. This file is found and its name memorized. Then the remaining part of the command is analyzed, checked and, as it is correct, the related time series are looked for and loaded.

At this point the highest priority operations (SIN, * and + inside the parentheses) are performed. As the remaining highest priority operator is now the comma (corresponding to no operation), IMTS has to deal with the user-defined operator (internal function). To do that, the loading point of the dynamic routines is calculated, the number of series involved in the command (4 in this case) is computed and the LOAD of a main program called INTRFACE and of the ROWMAX program is executed with load point equal to the highest address of IMTS resident routines. After that, by means of the SVC 202, the START INTRFACE parameter 1, parameter 2, ... is performed, where parameter 1, parameter 2, ... are the addresses, in character format, of the parameters which will be received by the user-written program.

INTRFACE modifies these parameters from the character format, required by START, to the standard format required by the subroutines. Inside the INTRFACE main program there is the CALL USER (parameter 1, parameter 2, ...7 statement, so that the user program is executed.

After the execution of the program, IMTS controls for FLAG = .TRUE. (not the present case). If it is, another command is read. Otherwise, in the X vector (coincident with the working matrix described in the reference, starting from the position following the one occupied by the ROWMAX operator) the series result of the operation is found. At this point, the string is left justified as in any other case. The only

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difference is that it must be justified as many columns as the series involved in the operation (4 in the present case). After that, the remaining operations are executed according to their priority, i.e., LOG,*,+.

The result is a series which is printed or is put into a file if FILExxxx would have been specified at the end of the command.

If the new operator ROWMAX is used more than once, the LOAD and START phases are not repeated and the CALL USER is immediately executed, provided that, in the meantime, no user or system dynamic functions (like OLS, PLOT, TSLS, LISE, etc.) have been loaded.

[*] "Interactive Management of Time Series" by C. Bianchi, G. Calzolari and P. Corsi, IBM Technical Disclosure Bulletin, Vol. 17, No. 6, November 1974, pp. 1653-1657.
