Using Recursion for More Convenient Macros

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Outline

Basic Idea

Suppose we want to make forecasts for flight 1542:

```
%makeForecasts( fnumber=1542 );
```

Now we want to make forecasts for all flights:

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%makeForecasts( fnumber=1542 );
%makeForecasts( fnumber=1543 );
%makeForecasts( fnumber=1544 );
%makeForecasts( fnumber=1545 );
%makeForecasts( fnumber=1546 );
```

Problems with above:

- We have to list them out individually.
- We have to find the right flight numbers.

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Better Idea

To make forecasts for flight 1542:

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%makeForecasts( fnumber=1542 );
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To make forecasts for all flights:

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%makeForecasts;
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Flight numbers are determined, listed automatically.

- Easy for testing (test for one before performing for all)
- Easy for drill-down (perform for all, then in depth for one)

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Step One

Define the macro for parameter:

%makeForecasts

```
%MACRO makeForecasts( fnumber );

  [Code for making forecasts]

%MEND makeForecasts;
```

Step One

Really easy example:

%makeForecasts

```
%MACRO makeForecasts( fnumber );

  %PUT fnumber=&fnumber;

%MEND makeForecasts;
```

Step Two

Step 2: Create auxiliary macro for getting flight numbers:

%getFlightNumbers

```
%MACRO getFlightNumbers;

  PROC SQL NOPRINT;
    SELECT DISTINCT flightnumber INTO :fnumbers
    SEPARATED BY ''
    FROM datasource
    WHERE orig="&orig" AND dest="&dest"
    ORDER BY by flightnumber;
  QUIT;

%MEND getFlightNumbers;
```

Step Three: Putting It All Together

%makeForecasts

```
%MACRO makeForecasts( fnumber=all );

  %LOCAL i n fnumbers;
  %IF &fnumber = all %THEN %DO;

    %getFlightNumbers;

    %LET i = 1;
    %DO %WHILE( %LENGTH( %SCAN( &fnumbers, &i ) ) > 0 );
     %LOCAL fnumber&i;
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    %DO i=1 %TO &n;
     %makeForecasts( fnumber=&&fnumber&i );
     %END;

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Does It Work?

Macro call		Log output

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		`fnumber=1543`
		`fnumber=1544`
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`%makeForecasts( fnumber=1542 );`	⇒	`fnumber=1542`

Two Parameters

%makeForecasts

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%MACRO makeForecasts( fnumber=all, method=all );

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    %LET i = 1;
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    %DO i=1 %TO &n2;
     %makeForecasts( fnumber=&fnumber, method=&&method&i );
     %END;

    %GOTO theend;
    %END;

   %PUT fnumber=&fnumber, method=&method;

  %theend:

%MEND makeForecasts;
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```

Two Parameters

Macro call		Log output
		`fnumber=1542, method=AddPick`
		`fnumber=1542, method=ExSm`
		`fnumber=1542, method=ARIMA`
		`fnumber=1543, method=AddPick`
		`fnumber=1543, method=ExSm`
		`fnumber=1543, method=ARIMA`
		`fnumber=1544, method=AddPick`
`%makeForecasts;`	⇒	`fnumber=1544, method=ExSm`
		`fnumber=1544, method=ARIMA`
		`fnumber=1545, method=AddPick`
		`fnumber=1545, method=ExSm`
		`fnumber=1545, method=ARIMA`
		`fnumber=1546, method=AddPick`
		`fnumber=1546, method=ExSm`
		`fnumber=1546, method=ARIMA`

Two Parameters

Macro call		Log output

`%makeForecasts( method=ARIMA );`	⇒	`fnumber=1542, method=ARIMA`
		`fnumber=1543, method=ARIMA`
		`fnumber=1544, method=ARIMA`
		`fnumber=1545, method=ARIMA`
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`%makeForecasts( fnumber=1542 );`	⇒	`fnumber=1542, method=AddPick`
		`fnumber=1542, method=ExSm`
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`%makeForecasts( fnumber=1542, method=ARIMA );`	⇒	`fnumber=1542, method=ARIMA`

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`%makeForecasts( fnumber=1542 );`	⇒	`fnumber=1542, method=AddPick`
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`%makeForecasts( fnumber=1542, method=ARIMA );`	⇒	`fnumber=1542, method=ARIMA`

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`%makeForecasts( fnumber=1542 );`	⇒	`fnumber=1542, method=AddPick`
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		`fnumber=1542, method=ARIMA`

`%makeForecasts( fnumber=1542, method=ARIMA );`	⇒	`fnumber=1542, method=ARIMA`

Conclusions

- A recursive definition can make a macro more convenient.
- Recursion can be applied to one or more parameters.
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Conclusions

- A recursive definition can make a macro more convenient.
- Recursion can be applied to one or more parameters.
- It can work especially well within a larger framework.

Further Resources


Art Carpenter.
Carpenter's Complete Guide to the SAS Macro Language.
SAS Press, 2004.


Nate Derby.
Suggestions for Organizing SAS Code and Project Files.
`http://nderby.org` (Publications → Manuscripts), 2010.

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