
Subject: Re: builtin simplex?

Posted by [Carsten Dominik](#) on Thu, 05 Dec 2002 11:18:45 GMT

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>>>> > "BS" == Bringfried Stecklum <stecklum@tls-tautenburg.de> writes:

BS> I recently realized that a piece of code which compiled fine
BS> with IDL5.4 failed under 5.5a because of
BS> "SIMPLEX: incorrect number of arguments."
BS> The reason for that is that there must be an IDL function of
BS> the same name which expects different arguments. I did not find
BS> any reference to it in the help system and it does not show
BS> up with help,/fun. Does anybody know more about it?
BS> The obvious solution was to rename my simplex.pro to
BS> my_simplex.pro.

Hallo Bringfried,

It seems to be a new builtin function:

- Carsten

SIMPLEX

The SIMPLEX function uses the simplex method to solve linear programming problems. Given a set of N independent variables X_i , where $i = 1, \dots, N$, the simplex method seeks to maximize the following function,

$$Z = a_1X_1 + a_2X_2 + \dots a_NX_N$$

with the assumption that $X_i \geq 0$. The X_i are further constrained by the following equations:

$$b_{j1}X_1 + b_{j2}X_2 + \dots b_{jN}X_N = c_j \quad j = 1, 2, \dots, M_1$$

$$b_{j1}X_1 + b_{j2}X_2 + \dots b_{jN}X_N = c_j \quad j = M_1 + 1, M_1 + 2, \dots, M_1 + M_2$$

$$b_{j1}X_1 + b_{j2}X_2 + \dots b_{jN}X_N = c_j \quad j = M_1 + M_2 + 1, M_1 + M_2 + 2, \dots, M$$

where $M = M_1 + M_2 + M_3$ is the total number of equations, and the constraint values c_j must all be positive.

To solve the above problem using the SIMPLEX function, the Z equation is rewritten as a vector:

$$Z_{\text{equation}} = a_1 \ a_2 \ \dots a_N$$

The constraint equations are rewritten as a matrix with N+1 columns and M rows, where all of the b coefficients have had their sign reversed:

$$\begin{array}{rcl} & c_1 & -b_{11} \quad -b_{12} \dots -b_{1N} \\ & c_2 & -b_{21} \quad -b_{22} \dots -b_{2N} \\ \text{Constraints} = & : & : \\ & : & : \\ & : & : \\ & c_M & -b_{M1} \quad -b_{M2} \dots -b_{MN} \end{array}$$

Note

The constraint matrix must be organized so that the coefficients for the less-than (<) equations come first, followed by the coefficients of the greater-than (>) equations, and then the coefficients of the equal (=) equations.

The Result is a vector of N+1 elements containing the maximum Z value and the values of the N independent X variables (the optimal feasible vector):

$$\text{Result} = Z_{\max} \quad X_1 \quad X_2 \dots X_N$$

The SIMPLEX function is based on the routine simplex described in section 10.8 of Numerical Recipes in C: The Art of Scientific Computing (Second Edition), published by Cambridge University Press, and is used by permission.

Syntax

```
Result = SIMPLEX( Zequation, Constraints, M1, M2, M3
[, Tableau [, Izrov [, Iposv] ] ] [, /DOUBLE]
[, EPS = value] [, STATUS = variable] )
```

Arguments

Zequation

A vector containing the N coefficients of the Zequation to be maximized.

Constraints

An array of N+1 columns by M rows containing the constraint values and coefficients for the constraint equations.

M1

An integer giving the number of less-than constraint equations contained in Constraints. M1 may be zero, indicating that there are no less than constraints.

M2

An integer giving the number of greater-than constraint equations contained in Constraints. M2 may be zero, indicating

that there are no greater than constraints.

M3

An integer giving the number of equal-to constraint equations contained in Constraints. M3 may be zero, indicating that there are no equal to constraints. The total of $M1 + M2 + M3$ should equal M, the number of constraint equations.

Tableau

Set this optional argument to a named variable in which to return the output array from the simplex algorithm. For more detailed discussion about this argument, see the write-up in section 10.8 of Numerical Recipes in C.

Izrov

Set this optional argument to a named variable in which to return the output izrov variable from the simplex algorithm.

For more detailed discussion about this argument, see the write-up in section 10.8 of Numerical Recipes in C.

Iposv

Set this optional argument to a named variable in which to return the output iposv variable from the simplex algorithm.

For more detailed discussion about this argument, see the write-up in section 10.8 of Numerical Recipes in C.

Keywords

DOUBLE

Set this keyword to use double-precision for computations and to return a double-precision result. Set DOUBLE to 0 to use single-precision for computations and to return a single-precision result. The default is /DOUBLE if any of the inputs are double-precision, otherwise the default is 0.

EPS

Set this keyword to a number close to machine accuracy, which is used to test for convergence at each iteration. The default is 10^{-16} .

STATUS

Set this keyword to a named variable to receive the status of the operation. Possible status values are:

Value	Description
-------	-------------

- 0 Successful completion.
- 1 The objective function is unbounded.
- 2 No solution satisfies the given constraints.
- 3 The routine did not converge.

Table 6-3: SIMPLEX Function Status Values

Example

The following example is taken from Numerical Recipes in C.

Find the Z value which maximizes the equation

$Z = X_1 + X_2 + 3 X_3 - 0.5 X_4$, with the

following constraints:

$$X_1 + 2X_3 \leq 740$$

$$2X_2 - \frac{1}{2} X_4 \leq 0$$

$$X_2 - \frac{1}{2} X_3 + 2X_4 \leq 0.5$$

$$X_1 + X_2 + X_3 + X_4 = 9$$

To find the solution, enter the

following code at the IDL command line:

```
; Set up the Zequation with the X coefficients.
```

```
Zequation = [1,1,3,-0.5]
```

```
; Set up the Constraints matrix.
```

```
Constraints = [ $
```

```
  [740, -1, 0, -2, 0], $
```

```
  [ 0, 0, -2, 0, 7], $
```

```
  [0.5, 0, -1, 1, -2], $
```

```
  [ 9, -1, -1, -1, -1] ]
```

```
; Number of less-than constraint equations.
```

```
m1 = 2
```

```
; Number of greater-than constraint equations.
```

```
m2 = 1
```

```
; Number of equal constraint equations.
```

```
m3 = 1
```

```
:: Call the function.
```

```
result = SIMPLEX(Zequation, Constraints, m1, m2, m3)
```

```
:: Print out the results.
```

```
PRINT, 'Maximum Z value is: ', result[0]
```

```
PRINT, 'X coefficients are: '
```

```
PRINT, result[1:*
```

IDL prints:

```
Maximum Z value is:      17.0250
```

```
X coefficients are:
```

```
    0.000000    3.32500    4.72500    0.950000
```

Therefore, the optimal feasible vector

is $X_1 = 0.0$, $X_2 = 3.325$, $X_3 = 4.725$, and

$X_4 = 0.95$.

See Also

AMOEBA, DFPMIN, POWELL