Applied Statistics 20(1) 1971

Algorithm AS 37

Inversion of a Symmetric Matrix

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Language

Algol 60

Description and Purpose

To produce the negative of the upper triangle of the inverse of a square symmetric matrix in its own space by operating on only the upper triangle of the matrix.

Numerical method

The procedure is an adaptation of the Gauss–Jordan method (Garside, 1971). On each entry to the procedure a specified diagonal element is used for one pivot operation. To invert a kth order matrix the procedure must be called k times with p taking successive values $1, 2, \ldots, k$ in any order. The user should check, in the calling program, for a near zero pivot. The user must not change the values of A or E between calls.

Structure

procedure *pivot* (A, k, p, E)

Formal parameters

A	Real array $[1:k, 1:k]$	input:	any symmetric matrix at first call.
		output:	the submatrix of the upper triangle corresponding to those elements of E that are **true** contains the negative of the inverse of the original submatrix.
k	Integer	value:	the order of the matrix.
p	Integer	value:	pivot element at this step.
E	Boolean array $[1:k]$	input:	**false** at first call.
		output:	as input except that $E[p]$:= **not** $E[p]$.

Accuracy

Rounding errors will be of a similar order of magnitude to those obtained using the standard Gauss–Jordan method.

Reference

Garside, M. J. (1971). Some computational procedures for the best subset problem. *Appl. Statist.*, **20**, 8–15.

(*Coding overleaf*)

```
procedure pivot(A, k, p, E);

comment Algorithm AS 37 J.R.statist.Soc.C, (1971), Vol.20, No.1;

value k, p; integer k, p; array A; Boolean array E;

comment This procedure performs a single modified Gauss-Jordan
reduction of the matrix A[1:k,1:k] using A[p,p] as the pivot element.
The Boolean Array E[1:k] should be set false before the first
procedure call, on exit from the procedure the value of E[p] is
reversed. The action of the procedure is such that the upper triangle
of the matrix specified by the elements of E that have the value true
contains the negative of the inverse of the original matrix. It is
assumed that the calling program has checked for a near zero pivot;

 begin real aa, aip; integer i, j, p1;
 p1 := p - 1; aa := 1.0 / A[p, p];
 A[pp] := -aa;
 for i := 1 step 1 until p1 do
   begin
   aip := A[i, p] X aa;
   for j := i step 1 until p1 do A[i, j] := A[i, j] - aip X A[j, p];
   for j := p + 1 step 1 until k do
   A[i, j] := A[i, j] - aip X A[p, j];
   A[i, p] := if E[p] then aip else -aip
   end;
 for i := p + 1 step 1 until k do
   begin
   aip := A[p, i] X aa;
   for j := i step 1 until k do A[i, j] := A[i, j] - aip X A[p, j];
   A[p, i] := if E[p] then aip else -aip
   end;
 E[p] := ¬ E[p]
 end pivot
```

Algorithm AS 38

Best Subset Search

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Language

Algol 60

Description and Purpose

This algorithm provides a fast search through all possible subsets of a regression model to find those subsets with the largest coefficient of multiple correlation. The method is described fully in Garside (1971).

Numerical method

The procedure is an adaptation of the Gauss–Jordan method to operate on the upper triangle of the correlation matrix. The dependent variable must be identified with the last column of the correlation matrix. At each step in the calculation only the value of the coefficient of multiple correlation is of interest and thus efficiency can