

Algorithm AS 14

Printing the Minimum Spanning Tree

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LANGUAGE

Algol 60.

DESCRIPTION AND PURPOSE

This procedure prints the links of the Minimum Spanning Tree in an order which is helpful in preparing it for display. The method is described by Gower and Ross (1969). The procedure assumes that the output of Algorithm AS 13 (Printree) is available.

STRUCTURE

The procedure call is *mintreeprint* (*n*, *B*, *C*, *xprint*).

Formal parameters

Input:

<i>n</i>	integer	} The number of points. As defined in AS 13.
<i>B</i>	integer array	
<i>C</i>	real array	

Auxiliary procedure

Procedure *xprint*(*j*, *k*, *m*, *dkm*) prints a new line, *j* spaces, the integers *k* and *m* and the real number *dkm*.

This procedure must be written according to local output conventions.

TIME

Time depends on n^2 .

RESTRICTIONS

None.

REFERENCES

As Algorithm AS 13.

procedure *mintreeprint*(*n*, *B*, *C*, *xprint*);

comment Algorithm AS 14, J.R.statist.Soc. C, (1969), Vol.18, No.1;

value *n*, *B*; integer *n*; array *C*; integer array *B*; procedure *xprint*;
begin

comment This procedure enables the minimum spanning tree to be drawn rapidly without having to search for end points, and is especially useful when $n > 100$. The computer cannot draw any adequate tree on the printed page, and the user must therefore decide how to accommodate the various branches. The output of Printree is used;

```

integer array hist, route[1:n]; integer i, j, k, m;
for i := 1 step 1 until n do hist[i] := 0;
for i := 2 step 1 until n do hist[B[i]] := hist[B[i]] + 1;
route[1] := j := k := 1;

comment route[j] is the current end point and if hist[route[i]] ≠ 0
a further line can be found. hist[1] must be non-zero initially
because the tree is connected;

for i := 2 step 1 until n do
L1:
  if hist[k] = 0 then
    begin
      j := j - 1; k := route[j];
      goto L1
    end
  else
    begin
      hist[k] := hist[k] - 1;
      for m := 2 step 1 until n do
        if k = B[m] then goto L2;
      L2: xprint(j, k, m, C[m]); j := j + 1;
          route[j] := k := m; E[m] := - E[m]
    end
  end
end mintreeprint

```

Algorithm AS 15

Single Linkage Cluster Analysis

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LANGUAGE

Algol 60.

DESCRIPTION AND PURPOSE

This procedure uses the minimum spanning tree to compute a single linkage cluster analysis as described by Gower and Ross (1969). Two forms of output are provided, (i) a list of the members of each group at each level of clustering and (ii) a dendrogram which summarizes the information in (i).

STRUCTURE

The procedure call is *singlelinkage* (*n*, *delta*, *B*, *C*, *dlarge*, *groupprint*, *topprint*, *sideprint*, *printx*).

Formal parameters

Input:

<i>n</i>	integer	} The number of points.
<i>delta</i>	real	
<i>dlarge</i>	real	} The amount by which the clustering threshold is raised at each iteration.
<i>B</i>	integer array	
<i>C</i>	real array	

As defined in AS 13.