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COMPUTER PROGRAM/PROGRAM EXCHANGE
(edited by M.J. Hodgson):
FEATURE LOCATION-ALLOCATION FOR SMALL COMPUTERS

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The following article continues *TOG's* computer feature by describing a computer program which can be obtained directly from the authors. Dr. Hodgson welcomes submissions from readers for future issues of *TOG*. *TOG* does not publish program listings but welcomes instead descriptions which have generic applicability and are not machine specific. This feature also allows readers to publicize requests for programs, and to communicate their needs for computer hardware and software to accomplish specific objectives. *TOG* also can publicize programs which readers have obtained from third parties and which may interest other geographers. Please direct all your communications (except those pertaining to the program described below) to Dr. Hodgson and adhere to the deadlines for submissions listed elsewhere in this issue of *TOG*.

TOG's computer features editor, Dr. M.J. Hodgson, writes:

> I have received an MS-DOS (Interpreted or compiled Microsoft BASIC) version of *Location-Allocation for Small Computers* from Dr. Goodchild. The system was written originally for mini-computer and documented in a University of Iowa publication (Goodchild and Noronha, 1983). I quote extensively from that publication which is an excellent location-allocation primer as well as program documentation:

M.F. Goodchild and V.T. Noronha (1983), *Location-Allocation for Small Computers*, Monograph 8, Department of Geography, The University of Iowa, Iowa City, Iowa, 52242.

THE LOCATION-ALLOCATION PROGRAM

The aim of location-allocation is to determine the best, or optimal locations for one or more facilities from which some service is to be provided to a spatially dispersed population. The location problem is the question of where to locate, given knowledge of which people are to be served from each facility: the allocation problem is to decide which people should be served from which facility. . . . A large number of applications have been modeled in this way since the earliest work on location-allocation in the 1960s, including retail stores, schools, recreation facilities, emergency services such as fire and ambulance stations, government offices, gas stations and restaurants. . . .

Two largely independent literatures have developed in location-allocation, taking different approaches to the treatment of space and thus to strategies for problem solution. The continuous space approach assumes that all points in the plane are feasible locations for facilities, that travel is possible in all directions, and that distance is measured by some simple rule, usually along straight lines. The discrete space approach assumes that travel is limited to a network, that distances are measured on the network, and that locations are feasible only at a limited set of locations on the network, usually at the nodes (clearly this is more realistic). Many examples exist, however, for which the scale of the problem makes continuous space an acceptable approximation; continuous space is cheaper in terms of both data collection and computer time, and may be appropriate when the cost of evaluating discrete space cannot be justified by the increased accuracy. The program offered here deals with discrete space methods.

The general location-allocation problem may be formulated as:

$$\text{MIN } Z = \Sigma_{i,j}\, x_{ij}\, c_{ij} \qquad (1)$$

where x_{ij} is the proportion of demand at i served by a facility at j (the allocation) and c_{ij} is a demand-weighted distance function which may take one of several forms. The program can produce c_{ij} appropriate to solving any of the following problems.

1. *The P-Median problem* — aggregate weighted distance is minimized.
2. *The P-Median problem* — with a maximum distance constraint.
3. *Minimize* — the number of centers required to bring all demand within a certain distance of a facility.
4. *Maximal covering problem* — maximize the number of persons within a certain distance of a facility.
5. *Maximal covering problem* — with maximum distance constraint.
6. *Maximize attendance* — on the assumption that attendance falls off linearly with distance.
7. *Minimize* — total weighted powered distance.

The program offers a choice of shortest path algorithms and provides a subroutine which generates random test data. The location-allocation algorithm is the Tietz and Bart substitution heuristic. The program incorporates Hillsman's node ordering and maximum distance factor, allowing high efficiency both in terms of computing time and storage.

Two test problems are included—one a ten-node example and the other a problem dealing with site location in London, Ontario with 150 nodes and 9 fire halls to be located. The latter example requires about 180k.

For further information or to obtain the diskette and documentation, please contact the authors.