UCINET IV: Network Analysis Software

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UCINET IV is a general purpose computer program for network analysis. It replaces UCINET 3.0 (MacEvoy and Freeman) and NETPAC (Borgatti), both of which are now unavailable. Like its predecessors, UCINET IV implements a diverse collection of network analysis techniques, in addition to traditional statistical procedures and data management facilities.

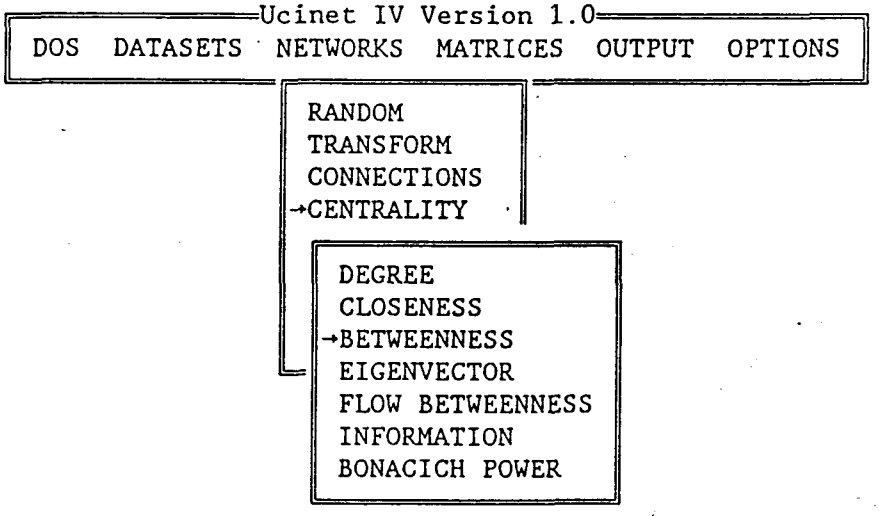

Figure 1. *Snapshot of UCINET IV menu.*

1.User Interface

UCINET IV is, for the most part, *menu-driven*. This means that instead of having to remember the spelling and syntax of hundreds of commands, you only have to choose an analysis from a menu. An exception is the matrix algebra package, which is command-driven. A snapshot of the menu system is shown in Figure 1.

The program is also *forms-driven*. This means that instead of having to choose options and parameter values by placing numbers in certain columns of a command file, you respond to fill-in-the-blank questions that appear on-screen. An example of a form – one that pops up when you choose to run the CLIQUE procedure – is shown in Figure 2.

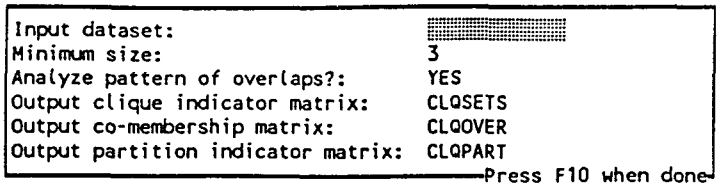

Figure 2. *Example of a UCINET IV form.*

The first line asks for the name of the UCINET IV dataset containing the data. For instance, if the dataset is called *samples*, and it is stored on the floppy disk in drive A:, you would type "a:sampes" to fill in the blank. The other lines already have default answers filled in. You can either accept them, or change them by moving the cursor to the spot and typing a new value over the old. In some cases, you can press a key (ctrl-enter) to bring up a list of choices. Additional information about each parameter is provided by a help line that appears at the bottom of the screen (not shown here).

Running a UCINET procedure results in both screen output and file output. The screen output from the CLIQUE procedure is shown in Figure 3. As you can see, the output gives the name of the input data file, as well as the values of all parameters. This makes it easy to reproduce results at a later time. Next are a list of cliques and their members, a node-by-node clique co-membership matrix, and a single-link hierarchical clustering of the co-membership matrix. The screen output is scrollable, which means you can use the cursor keys to re-examine any part of the output, no matter how long or wide it might be. The output can also be saved, printed, or appended to an ASCII file (presumably for inclusion in a word processing document).

The file output from the CLIQUE procedure consists of three UCINET datasets that can be used as input to other procedures. One contains a clique-by-node binary matrix which indicates which nodes belong to which cliques. Another contains the co-membership frequency matrix. The third contains the partition information resulting from a hierarchical clustering of the frequency matrix. Any of these can be input to other procedures for further processing. For example, the co-membership matrix could be submitted to multidimensional scaling, or to a different kind of clustering.

2.Network Analysis Techniques

The network-theoretic capabilities of the program can be divided into six basic areas: transformations, connectivity, centrality, subgroups, positions, and hypothesis testing. This division corresponds to the UCINET IV menu structure.

Network Transformations. Most of the routines classified as network transformations are concerned with graph-theoretic concepts such as linegraphs, multiplex graphs, multigraphs, image graphs, density tables, subgraphs, permutations, and so forth. Others concern the creation of graphs from other kinds of data, such as person-by-attribute matrices. Still others concern the derivation of other mathematical objects from graphs, such as semigroups and hypergraphs.

Connectivity. While almost all of network analysis can be viewed as studying connectivity, what we mean here is the calculation of such things as distance between nodes, reachability, maximum flows, volume of paths and walks, and other measures of proximity or cohesion. In many cases, the program is able to compute these measures not only for binary adjacency data, but also for various kinds of valued data, including costs, strengths, and probabilities. Also included here are global measures of transitivity and density.

Centrality. Centrality is an attribute of nodes that reflects how important the node is to the structure of the network. A number of standard measures of centrality can be computed, including Freeman's degree, closeness and betweenness measures, Bonacich's eigenvector and power measures, and several others. Some of the measures can be computed on both directed and undirected data.

Subgroups. Dozens of definitions, algorithms, and criteria have been proposed for identifying cohesive subgroups within social networks. UCINET IV computes cliques, n-cliques, n-clans, lambda sets, factions, and k-plexes. In addition, the program computes "regions" which contain cohesive subgroups, such as k-cores, components, and graph-theoretic blocks.

```
CLIQUES

Minimum Set Size:   3
Input dataset:      C:\UCI3\SAMPES

WARNING: Valued graph. All values > 0 treated as 1
WARNING: Directed graph. Direction of arcs ignored.


14 cliques found.

   1:  8 9 10 11
   2:  9 10 11 12
   3:  2 7 9 10
   4:  10 12 13 14
   5:  8 10 13 14
   6:  10 17 18
   7:  2 3 5 6
   8:  2 3 5 7
   9:  2 3 7 9
  10:  4 5 6
  11:  4 5 7
  12:  2 6 15
  13:  15 16 17
  14:  16 17 18


HIERARCHICAL CLUSTERING

                          1 1 1 1 1 1 1 1 1
Level   1 4 5 6 3 2 7 8 9 0 1 2 3 4 5 6 7 8
-----   - - - - - - - - - - - - - - - - - -
    3   . . . . XXXXX . XXX . . . . . . . .
    2   . XXXXXXXXXXXXXXXXXXXXXXXX . XXXXX
    1   . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    0   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Group indicator matrix saved as dataset CLQSETS
Clique co-membership matrix saved as dataset CLQOVER
Clique co-membership partition-by-actor indicator matrix saved as dataset CLQPART

Elapsed time:  1 second. 12/10/1991 11:07 AM.
UCINET IV 0.41 Copyright 1991 by Analytic Technologies.
```

Co-Membership Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	5	3	0	2	2	3	0	2	1	0	0	0	0	1	0	0	0
3	0	3	3	0	2	1	2	0	1	0	0	0	0	0	0	0	0	0
4	0	0	0	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0
5	0	2	2	2	4	2	2	0	0	0	0	0	0	0	0	0	0	0
6	0	2	1	1	2	3	0	0	0	0	0	0	0	0	1	0	0	0
7	0	3	2	1	2	0	4	0	2	1	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	2	1	2	1	0	1	1	0	0	0	0
9	0	2	1	0	0	0	2	1	4	3	2	1	0	0	0	0	0	0
10	0	1	0	0	0	0	1	2	3	6	2	2	2	2	0	0	1	1
11	0	0	0	0	0	0	0	1	2	2	2	1	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	1	2	1	2	1	1	0	0	0	0
13	0	0	0	0	0	0	0	1	0	2	0	1	2	2	0	0	0	0
14	0	0	0	0	0	0	0	1	0	2	0	1	2	2	0	0	0	0
15	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2	1	1	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	1
17	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	3	2
18	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	2	

Figure 3. *Output from the CLIQUE procedure.*

Positions and Roles. UCINET IV implements algorithms for computing three positional concepts: structural equivalence, regular equivalence, and automorphic equivalence. Options available for structural equivalence are CONCOR, CATIJ, profile similarity, and tabu search blockmodeling. For regular equivalence, UCINET implements the REGE and CATREGE algorithms, plus a tabu search method. For automorphic equivalence, UCINET implements three algorithms, including a tabu search approach.

Hypothesis Testing. Suppose you believe that people who have similar values are more friendly with each other than people with different values. If you have measured both friendship and similarity-in-values (e.g. correlations across attitude variables), you can test the hypothesis using the QAP procedure, which essentially correlates one matrix with the other. There is also an analog to multiple regression called MRQAP. This can be used to predict ties in one social relation, given information on other relations.

3.Statistics and Multivariate Analysis

This category is a hodge-podge of numerical procedures which are not peculiar to network analysis, but are often used in this context.

For describing the rows, columns, or all values in a data matrix, UCINET provides a variety of univariate statistics, such as means, standard deviations, sums, norms, etc. For scaling rows and columns, UCINET performs correspondence analysis and singular value decomposition (which can be used for factor analysis and MDPREF). And for modeling variables, UCINET includes a standard OLS multiple regression procedure.

UCINET also includes a number of procedures for creating and analyzing proximity matrices, such as correlations, euclidean distances, perceived similarities, etc. For creating proximity matrices from rectangular data, UCINET computes a variety of measures of similarity and distance. For analyzing proximity matrices, UCINET provides metric and non-metric multidimensional scaling, and various forms of cluster analysis.

4. Data Manipulation and Transformation

One of the strongest features of UCINET is the ability to transform, edit, normalize and otherwise massage data matrices. As any data analyst knows, this is where the most "analysis" time is usually spent. UCINET has routines for symmetrizing, dichotomizing, recoding, reversing, transposing, standardizing, reshaping, sorting, permuting, collapsing and subsetting matrices.

A spreadsheet-like editor allows you to enter or change individual matrix values.

UCINET also contains a command-driven matrix algebra language with functions for element-wise arithmetic (add, subtract, multiply, divide), matrix multiplication, element transformations (e.g., log, absolute value, sine), determinants, inverses and generalized inverses. Also included are functions for performing within-matrix arithmetic, such as taking sums, averages, minimums and maximums of matrix values, either across all values in the matrix, or separately for each row or column.

5. Dataset Management

UCINET datasets consist of a pair of physical files (a data file and a header file) which, within the UCINET environment, are treated as a single object. In order to minimize human error in copying, renaming or other housekeeping of datasets, the program provides a series of functions to replace ordinary DOS commands (e.g., rename, copy, delete, dir) which operate simultaneously on both physical files. Also provided are routines for displaying the contents of datasets, for merging datasets, and for editing datasets.

Import and export routines allow you to read and write ASCII files in order to exchange data with other programs, such as SYSTAT, NEGOPY, and STRUCTURE. A full-screen editor based on the WordStar command set is provided for editing ASCII files. A browser is provided for examining very large ASCII files.

Other miscellaneous file-related facilities including changing the default directory, printing files, and changing printer settings (e.g., switching to compressed font).

6.Purchasing the Program

UCINET IV is distributed by Analytic Technologies, which also publishes ANTHROPAC and the *World Cultures* electronic journal. Two versions of the UCINET IV are available: a professional and a student edition. The professional edition is currently priced at $75 plus shipping ($5 for the Americas, $10 for Europe, and $14 otherwise). The student edition is $29, plus shipping. The student edition comes in a shrink-wrapped package which can be ordered through a university bookstore, like a textbook. In addition, there are extremely inexpensive instructional and site licenses available. All quoted prices are guaranteed until the end of 1992. Personal checks, credit cards (Visa and MasterCard only), and university purchase orders are accepted.

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