

THE IMPORTANCE OF FUZZY COMPUTER LOGIC FOR CLIENT DATA ANALYSIS

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Abstract

In an age where computers, rather than human beings, now compile client assessment data to produce conclusions about a client, it is imperative to understand the methods used to reach the conclusions. The computer is never working on the basis of the individual evaluator/client relationship. Rather, it works anonymously on a mass-production basis with a set number of variables. The traditional computer is set up to answer every problem variable with either yes or no: if the data input for a client meets or exceeds certain established requirements, a yes answer results; if any of the requirements are not met, a no answer results. The traditional computer, then, does not handle client data with the human flexibility of yes-but/no-but--or maybe--in reaching conclusions. It simply makes acceptance and denial statements. If fuzzy computer logic is used rather than traditional computer logic, however, client conclusions are made on a probability basis--more closely related to human decision-making procedures. Thus, the probability conclusions generated have (1) taken into account human nature's mix of high and low achievements and (2) predicted specific job performance in a ranking order, more like human decision-making. This paper is an explanation of how fuzzy computer logic reaches conclusions about a given set of client data.

This paper will concentrate on the most important aspect of computerized assessment: how the computer actually arrives at the client's vocational performance conclusions. This is not generally discussed, because apparently all computers function in the same general way: mysteriously, to the non-technician.

Let's take the case of the traditional computer, however. As you've heard, the equipment is called hardware; but what is inside doing the work is called software. We're speaking of the software when we say "traditional computer logic:" exactly what is happening to test data that's put into the computer's memory.

Traditional Logic and Vocational Decision Making

The traditional computer logic approach to vocational decision-making follows the rule that a person either is qualified or not qualified for specific vocations. Either the person passes all the criteria established for that occupation or he/she is denied access to that occupation. While this straight-line approach to job selection is easy to conceptualize, it assumes several factors:

- (1) That the minimum qualifications are an accurate statement of realistic demands on the job.
- (2) That all job requirements are equally important for successfully performing the job.
- (3) That the job has been measured in such detail that all requirements are accurately and fully described.
- (4) That the test(s) results provide a precise and accurate measurement of the factor(s) required for successful performance of the job.

In other words, the use of traditional logic assumes that all the variables have almost perfect validity and reliability derived from perfect job analysis data and assessed by perfect tests.

In vocational assessment most of us would look to the U.S. Department of Labor's occupational analysis publications (e.g., Dictionary of Occupational Titles) for the answers. Unfortunately, recently published criticisms of the DOL system inform us of many serious problems with past practices and, consequently, with the data obtained from these practices (Miller, et al, 1980).

Is it always necessary to meet all of the assumed minimum requirements for each and every job? Personal knowledge and common sense tell us that many people compensate for a lack of one skill or ability by using another. Indeed, much of the approach used to place handicapped persons is based on this concept.

What vocational test(s) has the needed degree of accuracy? Obviously, the GATB comes closest to meeting this need. Yet in spite of hundred of thousands of administrations, the GATB still

remains a poor measurement of some aptitudes (Christiansen, 1981).

Thus, when a totally accurate data base and a completely accurate assessment program do not exist, this pass-or-fail computer logic breaks down, and begins to misclassify persons into false positives and false negatives. It is our opinion that true dichotomies are not common in the real world; they exist even less in vocational assessment.

On the other hand, there is now an alternative to traditional computer logic decision-making. Career Evaluation Systems, Inc., uses a computer logic based on the fuzzy logic approach developed by Dr. Lofti Zadeh at the University of California at Berkeley.

What is Fuzzy Logic?

Basically, fuzzy logic allows computer decision-making that "considers all...factors simultaneously in a consistent way..." (Economist, 1983, p. 89). Many companies are using this approach to deal with large numbers of very complex variables; one company is:

In September, 1985, Tymshare, a California-based firm began marketing a decision-making software package called Reveal that uses fuzzy logic to sort through large data bases and find, for example, companies with high sales and large profit margins for possible acquisition. Without fuzzy logic it would be necessary to set arbitrary thresholds to define high and large, a firm that just failed the high sales criterion but had handsome profit margins would be passed over. (Ibid. p. 89)

The economic problem dealt with in this example is similar to problems in vocational assessment: some persons are "screened out" of jobs or training programs simply because one test score does not reach a pre-determined cutoff point; this happens even when his/her other test scores, etc. are high enough to qualify for the job or training program.

The major characteristic of fuzzy logic in vocational assessment is that it goes beyond the pass/fail dichotomy. It is realistic to assume that almost every person, at some level of competency, could hold virtually any job that is not totally beyond his/her mental and physical capacities. Recent years have seen the growth of numerous physical devices, electronic aids and environmental controls. Just as the devices make pass/fail thinking obsolete, Career Evaluation's fuzzy logic selects occupations that best fit the person in varying degrees of probability.

The central concept of fuzzy logic is probability; in this imperfect world, there is only probability. The best human decision-making realizes this truth and uses it as part of decision-making. If we admit the imperfections in tests and measurements, then we realize that we can only expect to select occupations on the basis of the most likely probability.

How Is Fuzzy Logic Used?

Career Evaluation Systems is a unique, integrated method of assessment. First of all, it tests for human factors and abilities rather than

for aptitudes--aptitudes being combinations of factors. These performance tests from widely-known and accepted suppliers, measure physical and mental/intellectual functioning over the full range of human ability, and the raw score results from these tests are entered into the computer for vocational decision-making.

During the test battery administration, it is possible that a client cannot take one or more tests because of an impairment. In this situation, a test score of "Could Not Take" is entered. The use of the "Could Not Take" category provides the flexibility needed when testing disabled persons, and this flexibility itself becomes a part of the fuzzy logic calculation. The test factor becomes the minimal value in the relevant equation(s), and allows the total combination of values (some of which could be quite high) to realistically evaluate the probability of the client's performance in the category.

All test results are then combined by fuzzy logic methods and converted to measure the client's level of functioning in each of the 24 Data-People-Things worker function categories. As many as 13 test scores are used in any one equation to satisfy the DOL's verbal definition for that category.

Therefore, the core of Career Evaluation Systems' computer methods for vocational conclusions about a client are based in:

- (1) The fuzzy logic structure of combining test score factors in their natural mixtures of high/medium/low's so that,
- (2) the person's level of vocational ability can be defined in each of the Data-People-Things criteria.

This is the same method that would be used by an evaluator's personal analysis of a client's functioning: "how do the mix of test scores on this client relate to vocational performance?"

Instead of test results one-for-one being forced to meet its matching requirement for a job, test results are being considered simultaneously in a consistent way to reveal the probably level of functioning in each of the 24 vocational requirements.

Once the level of functioning is stated for each of the 24 DPT categories, the computer then selects specific jobs matching the client's highest combinations of Data-People-Things categories first, and continues searching for the next highest until the search is exhausted. Thus, the job search portion of the printout will list jobs for the client in terms of probabilities--the highest probable match of client-to-job first, on down.

The job matching portion of the computer program also includes screening for GED levels and physical/environmental limitations if the evaluator requests, and there are also other major features about the printout, providing counseling guidance, which are not appropriate to today's presentation. A full technical paper is available for further information.

In conclusion, vocational decision-making with Career Evaluation Systems means selecting occupations that the client will most likely do best. The system both assumes and assures that the client's strengths will be balanced against some very low scores. The fuzzy logic approach ensures

a more humanistic and common sense approach to occupational selections than systems built on traditional logic.

References

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