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Scalogram Analysis of Farmers' Attitudes Toward Use of Credit\*

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Agricultural Economists concerned with the human factor are sometimes faced with the problem of assigning quantitative values to qualitative attributes. This paper describes how a scaling method was used to differentiate a sample of farmers according to their degree of favorableness or unfavorableness toward the use of credit in a farm business.

The study was an investigation of use and management of credit by farmers in central Indiana. One objective was to determine what factors can be associated with farmers' reluctance to use (more) credit when apparently it is available, especially when the operator expresses a desire to increase the investment in his business.

It was hypothesized that, among other things, a farmer's attitude toward the use of credit can be associated with the use, or nonuse, of credit in his business. Thus, an objective means of assigning a farmer to a point on an attitude continuum was desired.

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Although an attitude is complex and cannot be described completely by any single numerical index, recent developments in scale analysis indicate that there are ways of determining whether a person is higher or lower on the continuum; that is, whether he is more favorable or less favorable than other persons with regard to a single issue.

Scalogram analysis, a mathematical scaling technique developed by Louis Guttman,<sup>1/</sup> was used to test the hypothesis that farmers' attitudes toward the use of credit are scalable.

#### Definition of Scale

Psychologists have pointed out that no scale can really be called a scale unless one can tell from a given attitude than an individual will maintain each attitude falling to the right or to the left of the point assigned.<sup>2/</sup> That is, if the statements are to be considered a scale,<sup>3/</sup> a person who endorses a more extreme statement should also endorse all less extreme statements.

J. W. Riley, Jr., proffers an example of scale:

"Although simplified examples are sometimes dangerous, an analogue of the Guttman scale might order a sample of boys according to their ability to scale barriers of varying heights. If there are five barriers arranged from the lowest to the highest and if we give

<sup>1/</sup> The technique is described in each of the following:

S. A. Stouffer, et al, Measurement and Prediction, Vol. IV of Studies in Social Psychology in World War II (Princeton University Press, Princeton, New Jersey, 1950).

Louis Guttman, "The Cornell Technique for Scale and Intensity Analysis", Educational and Psychological Measurement, Vol. 7, No. 2, Summer 1947.

M. W. Riley, J. W. Riley, Jr., and J. Tobey, Scale Analysis (Rutgers University Press, New Brunswick, N.J., 1954).

<sup>2/</sup> G. Murphy, L. B. Murphy, and T. M. Newcomb, Experimental Social Psychology (Harper and Bros., New York, 1937), p. 897.

<sup>3/</sup> S. A. Stouffers, op. cit., p. 62.



all the boys who get over all the barriers a score of 5, then a score of 4 goes to the boys who fail only the highest barrier, 3 to those who fail the highest and next to the highest, 2 for those who get over only the first two barriers, 1 for getting over only the lowest, and 0 for failing all five barriers. The important thing to note about this example is that, given a boy's score, one is able to say precisely not only how many, but also which barriers the boy succeeded in surmounting. And finally, to exploit the obvious double-entendre, each boy in the example has been given a highly meaningful scale score of scaling ability.

"This cumulative model, like all mathematical models, is an abstraction. Guttman and others have used it widely in the study of attitudes, substituting for the barriers a series of statements which are successively harder to endorse."<sup>4/</sup>

The results of scale analysis are sometimes presented in a picture, or "scalogram". For example, if four statements constitute a scale, there are five possible scores, 0 through 4. In scalogram 1, the statements are ranked according to favorableness, with statement 4 the "most favorable". Ignoring errors, if a person makes a score of 3, he has a more favorable attitude than a person with a score of 2, because he endorsed all statements that "2" endorsed plus the next most favorable statement. However, "3" has a less favorable attitude than the person who endorses all four statements.

Psychologists recognize that a perfect scale does not, in fact, exist. For instance, it is inevitable that a few boys in a large sample will successfully surmount one barrier while failing to hurdle a less difficult barrier.

<sup>4/</sup> M. W. Riley, et al, op. cit., p. 18.

## Scalogram No. 1

Scale Score	Favorable answers to statements:				Unfavorable answers to statements:			
	4	3	2	1	4	3	2	1
4	x	x	x	x				
3		x	x	x	x			
2			x	x	x	x		
1				x	x	x	x	
0					x	x	x	x

In scalogram analysis, the deviation from a perfect scale is measured by what Guttman calls a "coefficient of reproducibility". It is a measure of the degree to which a given scale conforms to the perfect pattern. In practice, a coefficient of 90 percent or better is considered satisfactory (provided the scale meets other stipulated criteria),<sup>5/</sup> although it is recognized to be arbitrary. Jardine<sup>6/</sup> has developed a test of significance for the null hypothesis that there is a random association of scale scores. The test can be adapted to scalogram analysis.

## A Practical Application

It is not the purpose of this paper to discuss the theory and the mechanics of scalogram analysis. They are given comprehensive treatment in the works cited. The purpose here is to show briefly how the technique was used in a particular study, and to suggest implications to agricultural economics research.

<sup>5/</sup> These criteria are outlined in Stouffer, pp. 78-79.

<sup>6/</sup> R. Jardine, "Ranking Methods and the Measurement of Attitudes", Journal of American Statistical Association, Vol. 53, September, 1958.



The first step is to determine the universe of content, or the general content of the statements to be used in testing the hypothesis that the universe of content is scalable. The selecting of statements that the research worker "thinks" covers the universe of content is recognized by psychologists to be somewhat arbitrary. There is no known way of overcoming this by any scaling technique. Yet the scalogram analysis technique does assure unidimensionality, or singular meaning of each statement within a scale to all respondents.

It was planned to develop a scale of four or five statements that could be used to rank farmers according to their attitudes toward the use of credit. These statements could then be attached to a field questionnaire used to obtain detailed credit data from each of a random sample of farmers. Farmers' use and nonuse of credit could then be associated with their attitude scores.

For the pretest, a list of 18 statements that were believed to cover the universe of content were mailed to a sample of 300 farmers in central Indiana, with the expectation of receiving 100 usable responses. A total of 114 were returned, of which 99 were usable. Analysis of the 99 responses revealed that there were four statements that formed a scale with 92.7 percent reproducibility.<sup>7/</sup> Because of space limitations, only the four statements constituting the scale are listed as an example of the type of statements used in the pretest.

1. Most farmers who enlarge their	Definitely agree	<u>+</u>
operations by borrowing make	Agree somewhat	<u>+</u>
more profit than farmers who	No opinion	<u>0</u>
have small operations free of	Disagree somewhat	<u>0</u>
debt.	Definitely disagree	<u>0</u>

<sup>7/</sup> Jardine's test of significance was employed. The scale was significantly different from 0 at the 1 percent level.

2. Farmers should wait until they can accumulate their own capital rather than borrow for farm production purposes.	Definitely agree	<u>0</u>
	Agree somewhat	<u>0</u>
	No opinion	<u>0</u>
	Disagree somewhat	<u>0</u>
	Definitely disagree	<u>+</u>
3. A farmer should strive to increase the size of his business rather than get out of debt on a small unit.	Definitely agree	<u>+</u>
	Agree somewhat	<u>+</u>
	No opinion	<u>0</u>
	Disagree somewhat	<u>0</u>
	Definitely disagree	<u>0</u>
4. A farmer should borrow enough money to have as much equipment and livestock as he needs, regardless of how much he is in debt.	Definitely agree	<u>+</u>
	Agree somewhat	<u>+</u>
	No opinion	<u>+</u>
	Disagree somewhat	<u>0</u>
	Definitely disagree	<u>0</u>

Best results are usually obtained in scalogram analysis if answers to the statement, or questions, are dichotomous (although in some cases trichotomies work very well). Note that the statements listed have five answer categories. Therefore, it was necessary to determine a unique cutting point in the answer categories for each statement so that the statements would form the best scale. Determination of the cutting points is less arbitrary than might be expected, as a separate analysis may be made for each of several cutting points with the best dichotomies used in the final scale. Cutting points for the four statements are indicated by positive and negative signs, positive being "favorable". (Of course, the positive and negative signs were not included in the field schedule.)



Scalogram 2 shows the final rank of farmers in the pretest. Only a third of the original scalogram - every third respondent - is shown, because of space limitations. The scalogram pattern is evident, as are random errors. The rank order of respondents within a scale score is arbitrary.

Respondents whose answers deviate from the true scale pattern are assigned scores that minimize error. For example, respondent 98 has only one error (question 2) if he is assigned to scale type 4, but two errors (questions 2 and 4) if he is assigned to scale type 3.

#### Implications to Agricultural Economists

Apparently, farmers' attitudes toward the use of credit constitute a scalable universe of content. Many other attitudes, opinions, and personal qualities form a universe of content that is scalable for some populations. Possible areas in which agricultural economists might want to scale a population, or a sample thereof, are: (1) consumer attitudes or studies of product acceptance, in marketing research, and (2) farmers' attitudes, knowledge or managerial qualities, in farm management research.

The particular attribute, or universe of content, to be analyzed must be narrowly defined - must contain a single dimension - if a scale is to evolve. Scalogram analysis is a practical method of testing the scalability of a set of questions or statements that are thought to define the universe of content. The research worker must use logical judgment, as in other types of analysis, as to what defines content. One should be cautioned that it is possible for a set of questions or statements to form a scale for one population and not for another. Therefore, the pretest sample should represent the population from which the ultimate study is to be made.



## Scalogram No. 2. Pretest of Farmers' Attitudes Toward Use of Credit\*

Respondent Number	Scale Score	Favorable answers to statements:				Unfavorable answers to statements:			
		4	3	2	1	4	3	2	1
8	4	x	x	x	x				
104	4	x	x	x	x				
98	4	x	x		x				
102	4	x	x	x	x				
108	4	x	x	x	x				
45	3		x	x	x	x			
26	3		x	x	x	x			
15	3		x	x	x	x			
3	3		x	x	x	x			
46	3		x	x	x	x			
51	3		x	x	x	x			
39	3		x	x	x	x			
90	3		x	x		x			
31	3		x	x	x	x			x
91	3		x	x	x	x			
9	2			x	x	x	x		
80	2			x		x	x		x
101	2			x	x	x	x		
33	2			x		x	x		x
94	2			x	x	x	x		
47	2	x		x			x		x
55	1	x			x		x	x	
21	1				x	x	x	x	
48	1		x		x	x		x	
109	1				x	x	x	x	
112	0		x			x		x	x
29	0	x					x	x	x
10	0					x	x	x	x
113	0					x	x	x	x
19	0					x	x	x	x
11	0					x	x	x	x
95	0					x	x	x	x
4	0					x	x	x	x

\* Because of space limitations, only 1/3 of the original scalogram (every third respondent) is shown. Coefficient of reproducibility for the entire pretest sample was 0.927.

Many alternative techniques of "measuring" attitudes and opinions are less rigorous than the scalogram analysis in this respect: Analyses are based on questions or statements that the research worker thought referred to the problem, with no test of internal consistency or reliability. Perhaps the statements meant different things to different people. Scalogram analysis gives assurance, with a degree of reliability, that statements or questions have the same meaning to all respondents.