ESTABLISHING PRIORITIES AMONG MULTIPLE MANAGEMENT GOALS

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If inferences from research are to be correct, economists, research workers and extension specialists should distinguish between adjustment recommendations for an individual farmer with his unique set of values as opposed to recommendations for a hypothetical group of farmers. Too often, economic analyses are based on the implied assumption that all individuals fit a general definition of the economic man whose one objective is to maximize profits. A single goal, such as profit maximization, is often used to derive the "otpimum" plan because the planning model is operational and is assumed to provide an analytical approximation of firm behavior [1]. Other goals may be relevant to the firm's decision-maker, and economists generally recognize that multiple goals are important in making business decisions. Consequently, single goal models are not always a realistic approach to the decision process and may not provide the farmer with an acceptable solution.

Progress in using multiple goals in decision models has been slowed by the difficulty of incorporating multiple goals into analytical models and by the inability to specify goals in ways that reflects their use in the actual decision process [3]. However, with the development of simulation routines, procedures became available that permit use of multiple goals.

Simulation models, designed to select the best combinations of managerial strategies for a farm over a given planning horizon, require that relevant goals be enumerated, how they change through time be known and how they are used in making decisions be specified [3]. Thus, for simulation to be a realistic planning technique, more information is needed about farmers' goals to more fully utilize its potential as a planning tool.

It may not be possible to obtain all necessary information about an individual's goals, how they change through time and how they are used in making decisions. Yet, it is important to gain information indicating the ranking and hierarchy of goals, and in what manner the hierarchy differs under different planning conditions. Such knowledge will provide a better basis for selecting organizational strategies for a given business. When using multiple goals in a planning framework, it may be assumed the decision-maker will try to satisfy as many of the specified goals as possible. Any given goal, or a less important one, will be pursued after satisfactory levels of the more dominant goals have been achieved.

The objectives of this study are: (1) to determine order of preference and relative weight farmers place on a given set of economically oriented goals, and (2) to determine if it is possible to predict the value an individual farmer might place on a given goal.

The "Paired-Comparison" format was used to obtain a ranking of goal preferences and determine scalar values for selected goals from a sample of 111 farmers interviewed in Northeast Arkansas during 1974-75. The "Method of Paired-Comparisons" refers to a number of analytical techniques which have been developed to measure "comparative-judgment." One of the more precise techniques is the method used in this study [4]. This method provides an ordinal ranking of preferences as well as an estimate of each item's numerical position on a ranking scale. It estimates the closeness or disparity of attitudes in the framework of scales by assigning a relative value of

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1.00 to the most preferred goal and a value of 0.00 to the least-preferred.

SELECTION OF GOALS

Goals considered are partially derived from previous research efforts [2]. Those selected for use in this study have been expanded and modified as a result of pretesting the schedule with farmers. The selected goals are:

1. Avoid being placed in situations where farmer could be forced out of business if several low income years should occur.
2. Organize farm to stabilize or reduce the uncertainty of income in order to avoid years of low profit or losses.
3. Increase efficiency and/or production on existing acreage through better farming methods such as leveling, irrigation, more efficient machinery, improved varieties and so forth.
4. Provide college or vocational education for children.
5. Increase or improve family's standard of living.
6. Reduce need for borrowing.
7. Organize and operate farm to realize the highest long-run profit possible, although yearly income may be variable or uncertain.
8. Increase amount of time off from farm business so as to devote more time to such things as family, personal, church and community needs.
9. Increase net worth with farm and off-farm investments.
10. Increase farm size by either renting or buying more land.

TEST FOR CONSISTENCY

The first procedure of analysis is to test the stated preferences of each respondent for consistency. Inconsistencies may occur because of lack of interest or inability of a respondent to understand alternative choices and simultaneously remain consistent in his choices.

An inconsistency exists if, for example, goal A is preferred to goal B, and goal B is preferred to goal C, but C is preferred to A rather than the consistent preference of A to C. An inconsistency of choice is termed a "circular triad" [2]. A coefficient of consistency is developed and statistically tested to determine if an excessive number of circular triads has been committed.

The number of circular triads is referred to as the "d" statistic [2]. If a large number of circular triads are committed by an individual, there is reason to suspect that selection of preferences is by random choice. A five percent level of confidence was used, as based on 20 degrees of freedom, which is relevant for a 10-goal matrix. If "d" observed is equal to or greater than "d" critical, the null hypothesis is not rejected and that individual's responses are removed from further analysis. Consequently, 28 schedules were rejected. The remaining 83 were analyzed according to age of the respondent. The classifications are 39 and younger, 40-49, 50-59 and 60 and older. For the first two age groups only 69 percent of the schedules were accepted. The 50-59 age group retained 78 percent of the schedules, while the 60 and older age groups retained 83 percent. The number of schedules retained in each age group, from youngest to oldest, are 18, 18, 28 and 19, respectively.

GROUP RESPONSE EVALUATION

Data revealed that individual farmers vary in ranking the selected goals. The goal "stay in business" is ranked most important by the total respondents; yet only 14.4 percent chose this goal in preference to all others (Table 1). These data also indicate the ordinal ranking of individual goals. That is, the highest percentage of responses indicating a goal preference will be ranked most important or number one. The lowest percentage will indicate the least important goal which will be ranked number ten. For the total sample, the least important goal is "increase farm size" with 7.1 percent of the respondents showing a preference for this goal above all others.

The rank of goals and scale values as determined by the "Paired-Comparison" procedure and tested by the Mosteller goodness-of-fit test are shown in

TABLE 1. PERCENTAGE OF RESPONSES PREFERRING A GIVEN GOAL TO ALL OTHERS, BY AGE GROUP

Preferred goal[a]	All ages combined	Age 39 or less	Age 40-49	Age 50-59	Age 60 or over
	(%)	(%)	(%)	(%)	(%)
Increase farm size	7.11	7.04	8.15	7.94	4.97
Increase net worth	7.19	6.67	7.41	7.42	7.13
Increase time off	8.00	6.98	7.28	9.72	7.13
Highest profit	8.72	8.21	7.78	9.17	9.42
Reduce borrowing	8.90	6.98	8.33	10.28	9.24
Standard of living	9.44	6.67	9.82	9.96	10.94
Provide a college ed.	11.26	15.68	12.47	8.41	10.12
Increase eff. & prod.	11.83	12.90	11.67	11.59	11.34
Stabilize income	13.15	14.14	12.96	12.30	13.63
Stay in business	14.40	14.75	14.14	13.21	16.08

[a]Goals are in shortened form.

Table 2 [5]. The analysis for each age group was accepted at the .05 level of significance or better.

The analysis indicated that the importance farmers place on individual goals shifts as the farm business progresses through its life cycle. Little disagreement appears among the four age groups with respect to the most preferred goal. Each of the three older age groups considered the objective "stay in business" to be the most important of the selected goals. Although the 39 or younger age group ranked the goal "provide a college education" most important, it still ranked "stay in business" second with a scale value of .87. This age group also ranked "stabilize income" as the third most important goal, with a scale value of .83. The other age groups ranked this goal second.

The goal "increase efficiency" ranked relatively high for all groups, with a rank of four for the two youngest age groups and a rank of three for the two oldest age groups.

Rank and scale values of goals remaining show considerably more disparity between age groups. For example, the goal "standard of living" is ranked ninth with a scale value of approximately zero by the youngest age group, whereas it is ranked fifth by the two middle age groups and fourth by the oldest. The scale value increases with an increase in age to .53 for the 60 and older age group. "Standard of living" appears to be relatively unimportant when compared with other relevant goals for beginning farmers who are in the initial phase of the life cycle of the farm business. This indicates they are more willing to sacrifice to get established in business and "increase farm size," which is ranked sixth in importance by this age group.

The goal "reduce borrowing" is ranked as being less important with the youngest age group, which gave it a rank order of eighth with a scale value of only .006. This goal increases to fourth for the 50-59 age group with a scale value of .496. However, it decreases to seventh with a scale value of .374 for the 60 and older age group. It might be suggested that beginning operators accept the fact that they are dependent upon borrowed funds to become established in farming and achieve firm growth. As the firm advances through its life cycle, it achieves a greater capability for independence from borrowed funds.

The goal "highest profits" shows a disparity between age groups without revealing a definite trend. This goal is ranked highest by the 39 or younger age group, with a rank of five, but has a relatively low scale value of .17. Its lowest rank occurs with the 40-49 age group with a rank of eighth and a scale value of .06. Its importance increases for the 50-59 and 60 and older age groups, with ranks of seven and six and scale values of .31 and .40, respectively.

The goal "increase time off" is ranked highest by the 50-59 age group at sixth and lowest by the 40-49 age group at ninth. The goal "increase net worth" is ranked tenth by all groups except the 60 and older

TABLE 2. A COMPARISON OF GOAL RANK ORDERS AND COMMON SCALE VALUES BY AGE GROUPS[a]

	All Ages Combined[b]		Age 39 or Less[c]		Age 40 to 49[d]		Age 50 to 59[e]		Age 60 or Over[f]	
	Rank Order	Common Scale	Rank Order	Common Scale	Rank Order	Common Scale	Rank Order	Common Scale	Rank Order	Common Scale
Stay in Business	1	1.0000	2	.8654	1	1.0000	1	1.0000	1	1.0000
Stabilize Income	2	.8320	3	.8325	2	.8610	2	.8462	2	.7654
Increase Efficiency	3	.6490	4	.6768	4	.6463	3	.7331	3	.5735
Provide an Education	4	.5611	1	1.0000	3	.7460	8	.1820	5	.4560
Standard of Living	5	.3202	9	.0001	5	.3794	5	.4434	4	.5309
Reduce Borrowing	6	.2505	8	.0065	6	.1795	4	.4963	7	.3744
Highest Profit	7	.2177	5	.1716	8	.0614	7	.3124	6	.4020
Increase Time Off	8	.1330	7	.0362	9	.0318	6	.4024	8	.2112
Increase Net Worth	9	.0102	10	.0000	10	.0000	10	.0000	9	.1979
Increase Farm Size	10	.0000	6	.0547	7	.1550	9	.0855	10	.0000

[a]The null hypothesis (H_o) being that the paired-comparison model is valid. Each model was found to be accepted at the .05 level or better.

[b]Sample size of 83 and X_2 observed value of 43.7014 with 36 degrees of freedom.

[c]Sample size of 18 and X_2 observed value of 30.4111 with 36 degrees of freedom.

[d]Sample size of 18 and X_2 observed value of 27.3084 with 36 degrees of freedom.

[e]Sample size of 28 and X_2 observed value of 35.0534 with 36 degrees of freedom.

[f]Sample size of 19 and X_2 observed value of 25.8700 with 36 degrees of freedom.

age group which ranked it ninth. "Increase farm size" is ranked sixth by the 39 and younger age group, seventh by the 40-49 age group, ninth by the 50-59 age group and tenth by the 60 and older age group.

The trend shown in the ranking for "increase farm size" appears to be associated with life cycle of the firm. The beginning operator, by necessity, may need to increase farm size in order to remain in business and attain other goals.

PREDICTIVE EQUATIONS

The second objective of the study was to determine if selected characteristics of the firm and operator could be used to estimate rank and scale value of individual goals. The "maximum R^2 improvement" technique was employed to derive predictive equations. Each respondent's scalar value for each goal was used as the dependent variable. Dependent variables are: Y_1—stay in business, Y_2—stabilize income, Y_3—increase efficiency, Y_4—provide an education, Y_5—standard of living, Y_6—reduce borrowing, Y_7—highest profits, Y_8—increase time off, Y_9—increase net worth and Y_{10}—increase farm size.

Fifty independent variables were used in deriving the predictive equations (Table 3). Fifteen variables which showed no influence in the statistical results are omitted from the list. The regression model is $Y_i = b_o + b_1 X_1 + b_2 X_2 + ... + b_{50} X_{50}$. Results of the selected predictive models are shown in Table 4 which includes the number of independent variables, F—values, probability of a greater F value and coefficient of variation.

The R^2 values for the 10 estimating equations range from a low of .70 for Y_6, "reduce borrowing," to .97 for Y_7, "highest profits." Not all of the 50 independent variables are included in each of the ten estimating equations. Only one variable, X_{17}, the number of acres of cropland owned, appears in each of the estimating equations (Table 5). To derive the high levels of R^2 a considerable number of variables

TABLE 3. LIST OF INDEPENDENT VARIABLES

Variable	Identification	Variable	Identification	Variable	Identification
X_1	Operator's age in years	X_{19}	Acres inherited by either operator or spouse	X_{36}	Is any type of land leveling normally practiced where 0 = no and 1 = yes
X_2	Farming experience in years	X_{20}	Proportion of owned land inherited	X_{37}	Is any crop insurance being carried where 0 = no and 1 = yes
X_3	Operator qualified for work other than farming where 0 = no and 1 = yes	X_{21}	Value per acre of owned cropland	X_{38}	Was the sale of any of last year's cotton crop contracted where 0 = no and 1 = yes
X_4	Reason for choosing farming as an occupation where 1 = because of personal preference and 0 = any other reason	X_{22}	Value per acre of rented cropland	X_{39}	Was the sale of any of this year's cotton crop contracted where 0 = no and 1 = yes
X_5	Family size including children, operator and spouse	X_{23}	Total value of owned land	X_{40}	Was the sale of any of last year's or this year's soybean crop contracted where 0 = no and 1 = yes
X_6	Number of dependents living at home	X_{24}	Is the farm larger now than five years ago where 0 = no and 1 = yes	X_{41}	Was the sale of any of last year's or this year's wheat crops contracted where 0 = no and 1 = yes
X_7	Number of children who have attended college or vocational school beyond high school	X_{25}	Is the farm smaller now than five years ago where 0 = no and 1 = yes	X_{42}	Estimated value of farm machinery, tools and shop equipment
X_8	Number of years of public school the operator completed	X_{26}	Is any change in farm size anticipated within the next five years where 0 = no and 1 = yes	X_{43}	Amount presently owed on land
X_9	Has any vocational school been attended by the operator where 0 = no and 1 = yes	X_{27}	Is an increase in farm size anticipated within the next five years where 0 = no and 1 = yes	X_{44}	Is any custom work performed where 0 = no and 1 = yes
X_{10}	Number of years of college completed where each semester = 0.5 years	X_{28}	Is a decrease in farm size anticipated within the next five years, where 0 = no and 1 = yes	X_{45}	Number of full-time hired laborers employed
X_{11}	Tenure of operator where 1 = part owner-part renter and 0 = other	X_{29}	Type of rental arrangement where 1 = both cash and crop share rent and 0 = other	X_{46}	Last year's gross income
X_{12}	Tenure of operator where 1 = renter only and 0 = otherwise	X_{30}	Type of rental arrangement where 1 = crop share only and 0 = other	X_{47}	Value of all owned assets
X_{13}	Number of acres in the farm operation	X_{31}	Acres of cotton produced last season	X_{48}	Net worth
X_{14}	Number of acres in cropland	X_{32}	Acres of soybeans produced last season	X_{49}	Debt to asset ratio
X_{15}	Number of acres owned	X_{33}	Acres of wheat produced last season	X_{50}	Is the farm operation a partnership where 0 = no and 1 = yes
X_{16}	Proportion of land owned	X_{34}	Proportion of cropland planted to wheat last season		
X_{17}	Number of acres of cropland owned	X_{35}	Proportion of cropland planted to any other crop last season		
X_{18}	Proportion of cropland owned				

TABLE 4. MODELS JUDGED TO BE BEST REPRESENTATIVE OF EACH DEPENDENT VARIABLE[a]

Dependent Variable Number	Number of Variables in Model	F-Value	Probability of > F[b]	R^2 [c]	C.V. Percent
Y_1	36	4.958	.0003	.8992	39.286
Y_2	31	4.755	.0002	.8550	44.803
Y_3	31	2.554	.0095	.7600	43.300
Y_4	32	5.351	.0001	.8771	50.184
Y_5	37	2.312	.0270	.8182	33.602
Y_6	30	1.988	.0392	.6964	46.936
Y_7	41	13.910	.0001	.9744	24.313
Y_8	37	8.902	.0001	.9455	32.998
Y_9	34	3.839	.0001	.8558	23.788
Y_{10}	35	2.195	.0300	.7853	26.036

[a]Selection of the "best" model for each dependent variable was made by the following criteria:

1. A high R^2 value was preferred.
2. A low C.V. (coefficient of variance) was preferred.
3. The R^2 value must be significant at the .05 level or better.
4. The fewest number of variables which did not significantly alter the above criteria was preferred.

[b]May be interpreted as the level of significance.

[c]May be converted to the "percentage of variance accounted for" by multiplying by a factor of 100.

are utilized. The equation with fewest independent variables is Y_6 with 30, and Y_7 has the most at 41 (Table 4).

The relation of R^2 to the number of independent variables is shown in Figures 1 and 2. Generally, little or no improvement in R^2 is realized after from 30 to 35 variables are included in the estimating equations.

SUMMARY AND CONCLUSIONS

Results of this study indicate that decision-makers have multiple goals which can be ranked in a hierarchy of importance. Further, personal and business characteristics have considerable bearing on an individual's hierarchy of goals.

To use multiple goals in a decision-making framework, it is important (1) to determine relevant goals, (2) know how they change through time and (3) know how they are used in the decision-making process. This study gives some insight into the first two areas of knowledge, but the analysis does not indicate methods or procedures employed by farm operators in using multiple goals.

TABLE 5. REGRESSION COEFFICIENTS FOR PREDICTIVE EQUATIONS FOR ESTIMATING SCALE VALUES OF MANAGEMENT GOALS

Independent Variable	Dependent Variable Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8	Y_9	Y_{10}
b_0	1.3216	1.1276	1.9220	3.0063	-.5298	.6242	-.2397	.6003	.3664	-1.6318
X_1	-.0125	-.0106		.0109	.0248	-.0213	.0067	.0112	.0083	
X_2	.0106		.0186		-.0131	.0195		-.0065	-.0035	
X_3		.0605				-.4342	.0684	.3462		-.3895
X_4		-.1985	.4522	-.2345	-.2104		.2724	.1198		
X_5	.0160	-.0598	.0520	-.1596	.0514	.0823	.1023			.1283
X_6		.1236	-.1460	.0993	-.0509	-.0844		-.0338		
X_7	-.1669	-.0410	-.2011	.0889	-.2089		-.1349	.0753	-.0283	.3271
X_8	-.0085	-.0292			.0440	.0304		-.0149		-.0328
X_9	.1749			-.0847	-.1378	.1259		-.0975		.2396
X_{10}	-.0622	.0608		.0902	-.0514	.0404			.0611	.2174
X_{11}	-.2266		-.7732	-1.2774	-.5055	.5206		-.4070		1.2494
X_{12}	-.3594		-2.6604	-3.9974	.1727	.5569	-.3229	-.3973		2.1104
X_{13}	-.0004	.0031	.0066			-.0009	.0027		.0004	-.0116
X_{14}			-.0124	.0011	-.0003		-.0049		.0008	.0113
X_{15}		-.0020	-.0083	.0028	-.0005		-.0040		-.0011	.0059
X_{16}	3.7282	-1.0784	-.6560	-15.5987	1.6465		7.4412	-1.7090	2.2142	.9643
X_{17}	-.0013	-.0003	.0095	-.0027	.0028	-.0018	.0028	.0012	.0016	-.0089
X_{18}	-4.1221	1.4256		15.4184	1.7421		-7.4155	1.8463	-.25892	
X_{19}	-.0007	-.0012	.0014		.0011	-.0008		.0012	.0005	.0035
X_{20}		.1538	-.1199	.5203	-.4062	.5566	.2563		-.2502	.1870
X_{21}			-.0030	-.0034	.0012		-.0006		.0001	.0012
X_{22}	-.0005		.0016	.0021		-.0009		.0005	-.0004	-.0015
X_{23}	.0020	-.0243	.0510	.0423	-.0277		.0067		.0092	-.0127
X_{24}	-.1936	-.1029	-.2365			.0954	-.1701		-.0859	.5660
X_{25}	.1063	-.0572	.2587	.0866	-.1766	-.3899	.0904			.1874
X_{26}		.1308	-.2620		.0705					
X_{27}	.3734				-.4113		.1929	-.2122	-.1034	.2010
X_{28}		.1377				-.1747			.0986	-.2538
X_{29}		.0817		.4136	.1666		-.0975			.2205
X_{30}		-.0473	.2234	.5695	.5092			-.0550		
X_{31}	-.0006	-.0020	.0066				.0025			-.0007
X_{32}		-.0023	.0051	-.0026		-.0005	.0027			
X_{33}	.0027	.0023			.0024				.0010	.0021

TABLE 5. REGRESSION COEFFICIENTS FOR PREDICTIVE EQUATIONS FOR ESTIMATING SCALE VALUES OF MANAGEMENT GOALS (CONT'D)

Independent Variable	Dependent Variable									
	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8	Y_9	Y_{10}
X_{34}	-2.2505	-1.2993	-.7781	-2.6304	-.9574	.7013	.7795	-1.6019		.9501
X_{35}		.3032			-1.4425	1.1324	.3299	-.7759	-1.0544	
X_{36}	.0734	-.0315	-.3736	-.1038		.0897	-1.908	-.0749	.0708	.2966
X_{37}	.1890	.2561	.1152	-.2079	-.1245		.1241	-.1284		-.1686
X_{38}	.4363		-.2543	-.7159	-.1162	.4009		-.5215	.1359	
X_{39}	-.0639		-.1382	-.2365		-.5556		.3579	.0869	.4603
X_{40}	-.0886		.0741		-.1536	.2096		.2314	.0972	
X_{41}	.1565			.3116	.0628			-.2193	-.2616	.2730
X_{42}	.0035	-.0322	.0473	.0457	-.0218	.0080		.0065	.0116	
X_{43}	-.0025	-.0037	.0079	.0035	.0051	-.0076			-.0024	-.0188
X_{44}	-.4100		.3870	.5147	.2179	-.4240	-.1172		-.0693	-.4153
X_{45}			.2704		.0507		.0762	-.1401	-.0355	-.3787
X_{46}		-.0050	-.0053	.0081	-.0017		-.0036	.0046		
X_{47}		.0281	-.0464	-.0489	.0178	.0077		-.0031	-.0102	.0210
X_{48}	.0010		-.0013	.0058	.0060	-.0050	-.0027	-.0021		-.0086
X_{49}	.3017	.0677	.3858	.4221	.2010			-.4163		-.4228
X_{50}	.1216	.3091		-.3224	.0566	-.5114	.1725	-.1577	.1085	-.4150

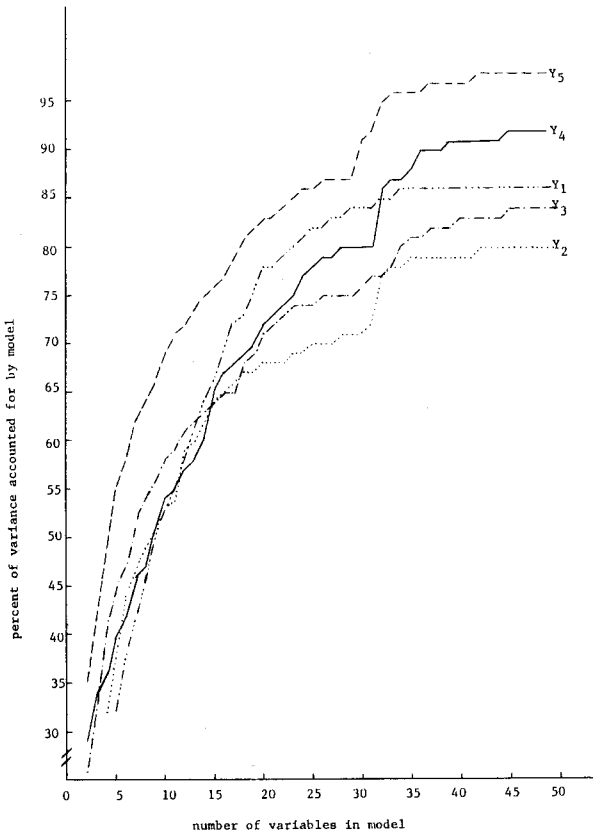

FIGURE 1. REGRESSION MODELS PROVIDED FOR GOALS Y_1 THROUGH Y_5 BY THE MAXIMUM R^2 IMPROVEMENT TECHNIQUE

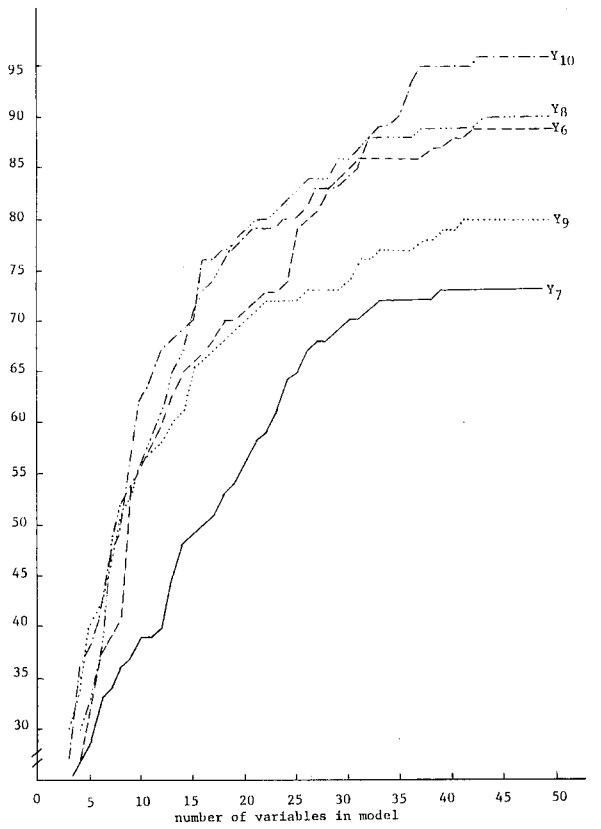

FIGURE 2. REGRESSION MODELS PROVIDED FOR GOALS Y_6 THROUGH Y_{10} BY THE MAXIMUM R^2 IMPROVEMENT TECHNIQUE

A further weakness of the study is that the respondents were presented a given set of objectives. All relevant goals may not have been considered. Also, goals presented may not have been worded correctly to avoid undue bias. Some of the goals are not completely independent of others and it may not be possible to quantify all of the goals to permit their use in a decision model.

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