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Snow + (X) = Use of Ski Slopes

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Introduction

What things, other than snow, attract skiers to ski areas? Various combinations of facilities, management practices, and a resort's distance from metropolitan centers are significantly related to total visitor-days per ski area at each of 26 ski resorts in northern New England and New York State. One visitor-day is one skier visiting an area during one day.

During a ski season of relatively poor snow accumulation (1964-65), total visitor-days per ski area were closely related to a resort's advertising program. The following winter, when snow was abundant, the total was related to a resort's length of intermediate trails, average driving time from metropolitan centers, percent of trails rolled and packed, and number of instructors employed. *Average* annual total visitor-days per ski area for both years were related to a resort's average total advertising budget, driving time from metropolitan centers, and average percent of the advertising budget used for broad coverage advertising (magazines, radio, and television).

How well the models developed in this study predict future use at ski resorts still needs to be tested in independent studies. Nonetheless, as descriptive devices that explain 71 to 89% of the variation in ski-area use, the models suggest relationships between management strategy and use patterns that may be helpful in planning and developing ski areas.

Procedure

Total visitor-days during the 1964-65 and 1965-66 ski seasons and measurement of 16 other variables (Table 1) assumed to affect use were obtained through personal interviews with managers of 26 ski resorts in northern New England and New York State. Each resort had at least one aerial lift facility in operation during both ski seasons. The resorts were distributed:

State	*Number studied*
Vermont	11
New Hampshire	9
New York	4
Maine	2

These procedures were used to analyze the data collected from each ski resort:

1. Factor analysis (1) was used to determine the interrelationship among the variables.
2. In each factor, the variable with the highest factor loading was used as a predictor variable in a multiple regression analysis (3) to explain total annual visitor-days (Y) per ski area. Initial regression functions included all linear and second degree terms for the predictor variables.

Three sets of analyses were made: 1964-65 (the poor snow year), 1965-66 (the good snow year), and the average for both years. All terms in the final equations are significant at the .05 level.

Results

The equation that explains 83% of the variation in use (Y_{65}) during the poor snow year is:

$$(1)\quad Y_{65} = 14.84 + .1006X_{10} + 14.48X_{16} + .1150X_{15}^2 - .5068X_{15}X_{16}$$

where:

X_{10} = Total advertising budget (dollars)
X_{15} = Percent of advertising budget spent on broad coverage advertising (radio, television, and magazines)
X_{16} = Percent of advertising budget spent on brochures and leaflets.

The following equation explains 71% of the variation in use (Y_{66}) during the good snow year:

$$(2)\quad Y_{66} = -4517 + 1649X_3 - 72.23X_3X_{11} - 13.59X_3X_{14} - 185.1X_{11}^2 + 3.108X_{11}X_{12} + 19.64X_{11}X_{14}$$

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where:

X_3 = Miles of intermediate trails

X_{11} = The average of the sum of the driving time (hours) from Boston, Hartford, New York, and Albany

X_{12} = Number of instructors

X_{14} = Percent of slopes rolled and/or packed.

The following equation explains 89% of the variation in use ($Y_{avg.}$) for the average of both seasons:

$$(3) \quad Y_{avg.} = -1681 + .3095X_{10} + 781.6X_{11} - .0030X_{10}X_{15} - 83.79X_{11}^2$$

where:

X_{10} = Average total advertising budget (dollars)

X_{11} = The average of the sum of driving time (hours) from Boston, Hartford, New York, and Albany

X_{15} = Average percent of advertising budget spent on broad coverage advertising (radio, television, and magazines).

Discussion of Results

The Poor Snow Season.—Three variables that dealt with advertising were significantly related to ski-area use during the poor snow year in (1). The findings are scarcely surprising, since advertising is important to the successful operation of most businesses. The surprising point is that the three advertising variables were able to explain so much of the variation in use during the poor year.

In the initial regression analyses for each season, one variable within each factor represented all other significant variables within that same factor (Table 2). For example, in (1), which describes use patterns during the 1964-65 season,

X_{10} represents X_1, X_2, X_5, X_{12}, and X_{14}—(Factor I)

X_{15} represents X_3, X_{13}, X_{14}—(Factor III)

X_{16} represents X_8, X_{11}—(Factor IV).

Although three advertising variables (X_{10}, X_{15}, and X_{16}) accounted for 83% of the variation in ski-area use, these same three variables, in effect, *represent* 10 of the other original 16 independent variables (Table 2).

These results suggest that additional research on the elements, design, and effectiveness of advertising campaigns may provide useful information for managers who want to promote greater use of ski resorts during periods of poor snowfall or, perhaps, during weekdays when use usually declines.

The Good Snow Season.—Most of the physical features at the 26 ski areas did not change noticeably between the two ski seasons (Table 1.). However, snowfall during the winter of 1965-66 was above average for most of Northern New England.

During the good snow year, miles of intermediate trails, driving time from metropolitan centers, number of instructors, and percent of slopes rolled and packed were significantly related to total visitors-days per ski area, (2). We did not measure one variable that may have influenced use in the good snow year: the skier's desire to ski. After the previous poor snow year, this desire may have increased.

TABLE 1

AVERAGE VALUE AND RANGE OF VALUES FOR TOTAL VISITOR DAYS AND 16 VARIABLES AT 26 SKI AREAS IN NORTHERN NEW ENGLAND—1964-1965 AND 1965-1966 SKI SEASONS

Variables	1964-65 Season		1965-66 Season		Average for both seasons	
	Average	Range	Average	Range	Average	Range
Y = Total visitor days	36,254	4,000–182,000	59,246	11,000–327,700	47,750	7,500–254,850
X_1 = Age of ski area (years)	10.6	1–29	11.6	2–30	11.15	1.5–29.5
X_2 = Miles of novice trails	3.2	0.2–8.0	3.7	0.2–8.0	13.6[a]	2.5–50.8[a]
X_3 = Miles of intermediate trails	5.7	0.9–27.8	6.3	0.9–27.8		
X_4 = Miles of expert trails	3.9	0.0–17.5	4.6	0.0–20.0		
X_5 = Lift capacity (skiers per hour)	3,253	900–6,290	3,622	900–7,530	3,437	900–6,400
X_6 = Slope exposure[b] (sine of angle)	.332	−1.000–+1.000	.332	−1.000–+1.000	.332	−1.000–+1.0
X_7 = Slope exposure[b] (cosine of angle)	.595	0.000–+1.000	.595	0.000–+1.000	.595	0.000–+1.000
X_8 = Snow making capacity (cubic feet per minute)	281	0–2,200	292	0–3,600	286.5	0–3,450
X_9 = Number of days operation	87	24–130	109	54–162	98	41–142
X_{10} = Total advertising budget (dollars)	23,070	500–175,000	25,130	1,700–200,000	24,100	1,600–187,500
X_{11} = Average driving time[c] (hours)	4.6	2.6–7.0	4.6	2.6–7.0	4.6	2.6–7.0
X_{12} = Number of instructors	23	5–126	25	6–126	24.5	5.5–126
X_{13} = Percent of slopes groomed	80	0–100	83	0–100	81.4	0–100
X_{14} = Percent of slopes rolled	94	60–100	95	70–100	94.5	65–100
X_{15} = Percent of advertisement budget for magazines, radio, and television	34	0–60	36	0–60	34.6	0–60
X_{16} = Percent of advertisement budget for brochures and leaflets	19	0–50	21	0–50	19.8	0–50

[a]Total miles of all types of ski trails were used in analysis of the average for both seasons.
[b]Slope exposure was expressed as a combination of the sine and cosine of the slope's angle from North.
[c]The average of the sum of the driving times from Boston, Hartford, New York, and Albany to each ski area (assuming 55 mph on expressways and 40 mph on primary roads).

Although managers would like to have uncomplicated explanations of recreation use patterns, such patterns simply may not operate in an uncomplicated manner. For example, significant second degree terms, like $-13.59X_3X_{14}$ in (2) are difficult to interpret—beyond reporting that they are significantly related to use. Herein lies a basic interpretation problem in many kinds of recreation research: to provide results that are accurate and *meaningful* to the manager. Yet, if second degree terms were not included in the initial regression functions, a significant proportion of variation in use could not have been explained.

According to the factor matrix (Table 2), the four independent variables in (2) represent all but one of the 16 variables measured. The length of intermediate trials was significant in (2); this agrees favorably with the results from a skier preference study in New York State: 54% of the skiers preferred intermediate rather than other types of slopes [2].

Average for Both Years.—Average use for both years was related to two variables significant in the bad snow year, and to one variable significant in the good snow year, (3). Advertising and accessibility appear to be the most important factors in the successful operation of a ski resort under various snow conditions.

In the future, gravity models and some index of a resort's advertising campaign may sufficiently explain variation in use intensity of ski areas. They should probably include more than the four population centers used in this study.

Limitations of the Models.— Inclusion of additional variables might have improved the descriptive capabilities of the use models. During the early phases of this study, we tried to measure additional variables for each ski area: number of ski rentals at local ski shops; number of private dwellings for rent; number of establishments with liquor licenses; sleeping capacity of surrounding hotels, motels, and tourist homes; and dining capacity of nearby restaurants. However, we were not able to obtain measurements of these additional variables at all 26 ski areas. Without data from all areas, the additional variables could not be used in the analysis.

TABLE 2

VARIMAX ROTATED FACTOR LOADINGS FOR 16 SKI-AREA VARIABLES DURING TWO SKI SEASONS, AND FOR BOTH SEASONS COMBINED[a]

Variable	1964-65 Ski season						1965-66 Ski season						Average for both seasons					
	Factor loadings				Communality		Factor loadings				Communality		Factor loadings				Communality	
	I	II	III	IV	Calcu-lated	Orig-inal	I	II	III	IV	Calcu-lated	Orig-inal	I	II	III	IV	Calcu-lated	Orig-inal
X_1	**.486**	—.002	.059	.310	.336	.478	.215	.069	**.530**	.131	.349	.383	**.461**	.126	—.391	—.084	.389	
X_2	**.435**	**.726**	—.086	.003	.725	.740	**.778**	—.169	—.063	—.204	.680	.694	.311	**—.447**	.301	**—.567**	.710	
X_3	.187	**.679**	**—.480**	—.103	.739	.845	**.434**	**—.763**[b]	—.005	—.045	.774	.791	[c]					
X_4	.232	**.922**[b]	—.256	—.046	.973	.845	**.643**	**—.569**	—.112	—.393	.906	.791	[c]					
X_5	**.684**	.128	.067	—.169	.518	.537	**.720**	.108	.162	.382	.703	.554	**.747**	.046	.137	—.079	.586	
X_6	—.045	.374	—.012	.054	.145	.330	.072	—.358	—.060	.023	.138	.282	0.000	—3.50	.038	—.004	.124	
X_7	—.196	—.005	.382	.293	.270	.423	—.010	**.409**	—.146	**—.418**	.364	.324	—.293	**.498**	—.060	—.221	.388	
X_8	.047	.386	.176	**—.582**[b]	.522	.461	**.438**	—.020	**—.521**	.092	.473	.423	.087	.168	**.655**[b]	—.105	.453	
X_9	.279	.129	—.314	—.134	.212	.434	**.509**	—.110	.161	**—.526**	.574	.620	.279	—.079	.088	**—.619**	.475	
X_{10}	**.790**[b]	.108	—.307	.032	.731	.727	**.511**	—.184	**.482**	.036	.529	.603	**.789**[b]	—.200	—.048	—.159	.691	
X_{11}	.080	.354	—.256	**.450**	.401	.470	.069	—.217	.182	**—.603**[b]	.448	.484	—.036	—.136	—.184	**—.668**[b]	.484	
X_{12}	**.720**	.296	.028	—.298	.696	.628	**.849**[b]	—.045	.054	—.107	.738	.622	**.646**	.101	.368	—.377	.706	
X_{13}	.244	—.159	**.558**	.088	.404	.439	.132	**.544**	.072	.305	.412	.488	.191	**.577**	—.046	.234	.426	
X_{14}	**—.684**	—.081	**.486**	—.278	.789	.727	**—.473**	.316	**—.602**[b]	.246	.747	.622	**—.647**	.208	.233	**.436**	.708	
X_{15}	.133	.154	**—.725**[b]	.247	.629	.439	.004	**—.529**	.383	—.197	.536	.488	.144	**—.661**[b]	—.335	—.345	.690	
X_{16}	.028	—.082	—.185	**—.564**[b]	.360	.331	.055	—.039	**—.443**	.081	.208	.298	—.003	—.074	**.548**	.135	.324	
Total	—	—	—	—	8.450	8.898	—	—	—	—	8.579	8.467	—	—	—	—	7.154	6
Variance contribution	2.797	2.447	1.855	1.339	—	—	3.459	2.090	1.625	1.397	—	—	2.555	1.469	1.345	1.773	—	
Percent of total original communality	31.4	27.5	20.9	15.1	94.9	—	40.8	24.7	19.2	16.5	101.2	—	38.2	21.9	20.1	26.5	106.7	

[a]Significant loadings (.40 or greater) are **boldface.**

[b]Indicates variables that were used in initial regression analysis because they had the highest loading of all variables within a factor. Note that for the 1964-65 season X_8 and X_{16} were both used to represent Factor IV because they are about the same size.

[c]Total miles of all types of ski trails are given for X_2 under **Average for both seasons.**

The reliability of the three models is affected by the accuracy of the use data. Some managers knew exactly how many tickets they sold each day, but others could only estimate this value. Furthermore, some managers had actual counts of the number of days season ticket holders skied, but other managers could only make educated guesses. We could not control these sources of error in use measurements. Therefore, the models contain an uncontrolled source of variation that cannot be explained mathematically.

Conclusions

It seems possible to develop mathematical models that describe a significant amount of variation in use of Northeastern Ski resorts. These models define more precisely than intuitive hunches what variables, besides snow accumulation, are related to use of a particular ski area. However, if managers want models that accurately *predict* use of ski developments, *two* requirements are necessary. First, for a given number of years, all variables that affect use must be measured; and, second, accurate measurements of annual total visitor-days must be supplied. In this respect, publicly financed research can assist the private sector only to the extent that the private sector is willing to cooperate. Sufficient and accurate data must be available to the researcher trying to predict demand for private recreation facilities. Gathering such data will always be difficult: in fact, the key items that account for the most profit may be the very ones that are the most difficult, or impossible, to obtain.

Our results also emphasize the extreme variablity that can be encountered in recreation behavior patterns. Models of ski-resort use patterns in two consecutive years contain entirely different variables. The model that explains average use across both seasons contains some variables from both of the previous models. Therefore, future studies of recreation behavior—not necessarily just in the ski market—probably should investigate measurements averaged over several years in order to account for significant yearly variations in weather conditions, management procedures, technology, and people's tastes.

References

1. Harry H. Harmon, *Modern Factor Analysis*, Chicago: The University of Chicago Press, 1960.
2. *Survey of Skier's Preferences*—1964-65 *Ski Season*, New York: State Department of Commerce Travel Bureau, 1966.
3. Helen Walker and J. Lev, *Statistical Inference*, New York: Henry Holt and Co., 1953.

Forest Recreation Symposium Scheduled for October 12-14

A Forest Recreation Symposium, devoted to solving planning and management problems in the densly-populated Northeast, will be sponsored in Syracuse, N.Y., October 12-14, by the U.S. Forest Service and the State University College of Forestry.

The objective will be to summarize progress in recreation research and management and to pass on results to recreation managers who can put them to use, according to co-chairman Warren T. Doolittle and Russell E. Getty. There will also be discussions of recreation management and planning problems that require further research. Approximately 200 natural resource managers and planners from the Northeast are expected to attend the three-day meeting at the Randolph House.

Edward E. Palmer, President of the College of Forestry at Syracuse, will open the symposium. The first technical session will be devoted to planning and developing the recreational resource, chaired by Rolland Handley, Director of the Northeast Office of the Bureau of Outdoor Recreation. Topics to be covered include forecasting recreation demand, design and lay-out of facilities, identification and inventory of the resource, impact of recreation on the economy, and private recreation enterprises.

George Hamilton, Special Assistant to the Governor of New Hampshire, will direct a session on managing the recreation resource. Speakers will present papers on preserving natural ecosystems, landscape management, extra-market values of natural environments, inventorying use, and multiple-use management.

A program entitled Characterizing the Recreation User, chaired by Conrad Lickel, Director of Pennsylvania State Parks, will cover campers, back country hikers, conservation groups, hunters and fishermen, and skiers.

William Everhart of the U.S. National Park Service is chairman of a session on specific managerial considerations related to users. The topics to be covered include unwelcome guests, crime, communicating with users, facility rehabilitation, and managing recreation saturation points.

Concluding the symposium is a session called A Look at the Research Task Ahead, directed by Richard J. Costley, Director of Recreation for the U.S. Forest Service. Presentations will be made on cultural considerations, management problems, organizational influences, financial considerations, and personal values. The symposium will be summarized by Paul F. Graves, Professor of Forest Administration at the College of Forestry.

For additional information and pre-registration forms, contact: Coordinator of Continuing Education, State University College of Forestry, Syracuse, N.Y. 13210.