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Estimating Past and Current Attendance at Winter Sports Areas . . . a pilot study

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ABSTRACT: Routine business records of tow-lift tickets or restaurant receipts provided estimates of total attendance over a 2-month period within 8 percent of true attendance, and attendance on an average day within 18 to 24 percent of true attendance. The chances were that estimates would fall within these limits 2 out of 3 times. Guides for field use can be worked out after further tests and model development.

Managers, planners, and researchers need better methods for estimating attendance on recreation areas--methods that will give estimates with specified precision and accuracy at low cost. They use estimates to inform the public or investors, to aid budget and design planning, or to determine markets. But present methods of estimating attendance are neither precise enough, nor uniform enough for this job.^{1, 2, 3} And with one notable exception,⁴ the precision of estimates made by current methods is usually not specified.

¹Clawson, Marion. Statistics on outdoor recreation. 165 pp., illus. Resources for the Future. Washington, D. C. 1958. (p. 1.)

²Outdoor Recreation Resources Review Commission. Outdoor recreation for America, a report to the President and to the Congress. 246 pp., illus. Washington, D. C. 1962. (p. 184.)

³Zivnuska, John, and Shideler, Ann. A projection of the recreational use of public forest areas in California to 1965. Forest Science 3:210-219. 1957. (pp. 217-218.)

⁴James, George A., and Ripley, Thomas H. Instructions for using traffic counters to estimate recreation visits and use. U.S. Forest Serv. Res. Paper SE-3, 12 pp., illus. U.S. Forest Serv., Southeast. Forest & Range Expt. Sta., Asheville, N.C. 1963.

Because an acceptable method must be cheap, and just precise enough for the job at hand, we wondered whether reliable estimates could be obtained from data collected routinely by businesses on winter sports areas; for example, total daily receipts or coffee shop sales.

THE STUDY

To check this idea, we ran a pilot study at the Dodge Ridge Winter Sports Site.⁵ This area lies on the west side of the central Sierra Nevada between 6,500 and 7,400 feet. The season runs from early December through Easter, and the area draws beginning and advanced skiers, spectators, and snow players from the Central Valley and the San Francisco Bay area.

For base data, we counted attendance on this area on consecutive days from December 30, 1961, through February 2, 1962. Each day was considered an observation. To determine the number of visitors arriving by auto, we counted the number of cars that entered the parking area and multiplied by the average number of persons per car; this figure came from an intensive sample on half the days of the study period. Bus drivers gave us the number of their passengers. Resort operators gave us their routinely collected figures on the number of lift and tow tickets issued, the restaurant receipts, and the receipts from equipment rental each day.

We then tested for correlation between the daily number of visits and the daily totals for each indicator--lift and tow tickets, restaurant receipts, and equipment rentals. Finally, from this "calibration sample" we worked out equations for estimating attendance.

⁵Bury, Richard L., Navon, Daniel I., and Hall, James W. Estimating past and current attendance on winter sports areas: details of 1962 test at Dodge Ridge. U.S. Forest Serv., Pacific SW. Forest & Range Expt. Sta. 1963. (Address requests for copies to Director, Pacific Southwest Forest & Range Expt. Sta., P.O. Box 245, Berkeley, Calif. 94701.)

RESULTS AND EVALUATION

We found that the relationship between number of visits and each indicator was different on weekdays than it was on weekend days. However, indicators showing close relationship to attendance on weekdays also showed close relationship on weekend days. Simple correlation coefficients ($r_{y \cdot x}$) were:

Indicator:	<u>Week Days</u>	<u>Weekend Days</u>
Lift & tow tickets (no.)	$\frac{1}{.96}$.83
Restaurant receipts (\$)	.88	$\frac{1}{.86}$
Rental receipts (\$)	$\frac{1}{.69}$.76

¹ Data were serially correlated.

The least-square linear regression equations for estimating daily attendance were:

Weekend days:

$$\hat{y} = 642.5233 + 1.7963X_1 \quad (1)$$

$$\hat{y} = 386.8442 + 2.4640X_2 \quad (2)$$

$$\hat{y} = 890.2073 + 3.0761X_3 \quad (3)$$

Week days:

$$\hat{y} = 72.4996 + 1.2273X_1 \quad (4)$$

$$\hat{y} = 18.6940 + 1.2827X_2 \quad (5)$$

$$\hat{y} = 134.6187 + 1.0540X_3 \quad (6)$$

in which \hat{y} = estimated number of visits, X_1 = number of lift and tow tickets, X_2 = restaurant receipts in dollars, and X_3 = equipment rental in dollars.

Daily attendance can be estimated simply by inserting the appropriate daily indicator value--for example, total restaurant receipts--in the proper equation and solving. Since estimates of seasonal attendance are a simple sum of the daily estimates, they may be determined by adding daily estimates or they may be computed by entering the average daily value of the indicator in the equation and multiplying the result by the number of days operated.

Precision of Estimates

Daily attendance on weekdays was estimated best by the number of lift and tow tickets issued. On weekends, restaurant receipts produced slightly better estimates than the tickets. Rental receipts yielded the least precise estimates on both weekdays and weekends. Confidence intervals⁶ for seasonal estimates may be calculated without particular difficulty if only one regression equation is used. But if seasonal attendance is estimated with separate equations for weekdays and weekend days, serious handicaps arise in specifying precision.

Our sample indicated that total attendance over a 2-month period could be estimated within 8 percent of true attendance, with 2/3 probability. In addition, attendance on an average single day could be estimated within 18 percent for weekdays and 24 percent for weekend days, again with 2/3 probability. When taken as a percentage of true attendance, estimates were more precise when crowds were larger than average and less precise when crowds were smaller than average. Precision also improved with length of period for which the estimate was desired.

Discussion

This method of estimating attendance may be simplified by combining data from weekdays and weekend days. Then, both the attendance and the precision of seasonal estimates can be more readily calculated. The resulting estimates will probably be less precise than if separate equations had been used for weekdays and weekend days, but they may be within acceptable limits.

The main costs are for personnel and data processing. If precision of each estimate must be determined, calculation of confidence intervals could require several hours on a desk calculator.

Calibration--correlating counted attendance with selected indicators and computing estimating equations--is a key element in this method,

⁶The precision of daily and seasonal estimates may be judged by associated confidence intervals, which are discussed in Bury, Navon, and Hall (op. cit.), as are several simulations of seasonal and subseasonal attendance.

and the most expensive step. Those in charge of the work must have enough statistical knowledge to design and supervise the sampling, to perform the statistical test, and to interpret the results. The calibration count of attendance requires at least one full-time person at each entrance and exit to the study area on calibration days unless a precise count can be obtained by other means. Then, too, calculation of the estimating equations is laborious unless electronic computers are used. Further study of this approach to estimating attendance could reduce these difficulties. Also, a specially trained calibration team might lower the total expense if several areas are to be calibrated by a single agency.

We recognize, too, that the equations and precision characteristics reported here apply only to Dodge Ridge. Separate relationships must be worked out for each site until we find the degree of agreement in equations for sites with similar recreation businesses. The relationship between attendance and indicators at any area must be checked periodically and after every change that might alter such relationships, such as adding a new type of facility at the site. Nor can we say at this time whether the equations or the precision obtained would be similar throughout a season or through several years. Consequently, our numerical findings are useful primarily to illustrate the form of results, identify problems, and suggest general levels of attainable precision.

On the plus side, attendance can be estimated very cheaply after the estimating equations are derived. Required data can be copied quickly if business records are accessible, and estimating equations can be solved in a few minutes.

Indicator data for this method of estimating will probably be accurate, since cash registers and other machines used as data sources are not subject to disturbance by visitors. Proper sample design should result in accurate data from the calibration count of attendance.

Estimates of attendance may be readily converted among the standard units of attendance. In our test, for example, we converted car counts to estimated number of visits by sampling for average number of persons per car and applying an expansion factor. If we had also sampled

for average length of stay and proportion of repeaters, we could have converted number of visits to man-hours of use and to number of visitors.⁷

CONCLUSION

This approach to estimating attendance looks feasible, and standard procedures could be worked out for managers and planners. Once the relationships between attendance and routinely collected business data are established, estimating equations can be obtained through simple regression techniques. Either daily or seasonal attendance may be established by inserting business data into the estimating equation, but the relationships should be checked periodically for revision in response to changes in the character of use.

The precision of estimates obtained with the method seems reasonable, and the method can be applied on any recreation area where data on volume of business are available. Either dollar receipts or units sold may be used as data, and confidential treatment of the information can be guaranteed. Unlike periodic sampling, this method records the presence of visitors whenever they are on the area. Attendance may be estimated in any of the common units desired--visitor-days, man-hours, etc.

Other indicators or data series might be tested; for example, parking lot receipts, ski rentals, or samples of cars in the parking lot. Non-business factors such as weather or snow conditions could be introduced although we are not sure that such items would add enough precision to justify the added cost and effort.

Operational procedures for applying this method have not yet been devised. The statistical models we used require at least 30 random

⁷A 100 percent sample of persons per car, estimated activity, length of stay, and proportion of repeat visitors was conducted at Dodge Ridge during several days of early 1961. Field workers found that group size and estimated activity are easily sampled, but length of stay and proportion of repeaters must be determined by either (a) interviewing visitors as they leave the area or (b) recording both time and license number of each vehicle as it enters and leaves the area, and subsequent matching of license numbers. Details are reported in Bury, Richard L. Characteristics of visitors and use at Dodge Ridge winter sports site. U.S. Forest Serv. Pacific SW. Forest & Range Expt. Sta. 1961. (Address requests to Director, Pacific Southwest Forest & Range Expt. Sta., P. O. Box 245, Berkeley, Calif. 94701.)

observations throughout the season to specify the precision of attendance estimates, but refinement of the models may allow a smaller sample and lower the cost. Refinement will require information on levels of precision acceptable to potential users, the period for which estimates are desired, the area to be covered by the estimate, and how much can be spent on the job.

Readers wishing to learn more about the statistical models, field procedures, and results are referred to the report by Bury, Navon, and Hall (see footnote 5).