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SUMMARIZING REMARKS: ESTIMATING RELATIVE ABUNDANCE (PART II)

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The papers presented in this session highlighted a variety of statistical problems needing attention from statisticians and biologists alike. Because there is neither time nor space to go into these problems in great detail, I shall confine my summary to some general comments on statistical contents of these papers.

In his interesting paper, Karr (1981) presents an excellent exposition of the use of mist nets as a tool for counting birds. In addition to noting advantages and disadvantages of using mist nets, Karr discusses several examples of data analysis and interpretation. The main thrust of his examples is that mist net count data can be used for studying spatial and temporal patterns in capture rates and species richness.

The methods of analysis found in Karr's paper provide good examples of techniques for handling data of the type considered. Use of binomial and regression models is certainly reasonable, but the following suggestions, if implemented, might improve the analysis further.

My first suggestion concerns the choice of binomial distribution to model the number of captures shown in his Tables 3 and 4. I have some reservations about this choice because: (1) these numbers represent counts over time intervals of different lengths; and (2) the total count is itself a random quantity. A more appropriate model in my view is a model which regards the number of captures as Poisson random variables. The expected number of captures would then represent the capture rate.

My second suggestion is to consider the model:

$$S = \frac{1}{S_{\max}} \exp(-K/T) \qquad (1)$$

for predicting species richness instead of the hyperbola used by Karr. Fitting this model does not cause any new problems because a logarithmic transformation will reduce the model into a simple linear regression model. Very often, exponential models, such as the one given by (1) are found to be effective in transforming count data to data suitable for regression analysis.

The papers by Johnson et al. (1981) and Marion et al. (1981) deal with play back recording as a technique for censusing avian population. The main point in both papers is that play back recording often increases sample size by eliciting responses from birds which are elusive and not easy to detect visually. Johnson et al. (1981) provide a general review of field techniques suitable for surveying with play back recording, while Marion et al. discuss the results of using play back recording to survey five species of birds in Texas and Florida.

Several sources of bias in estimates obtained from play back recording census are noted in the two papers. Most important among these is the failure of a certain proportion of the population to respond to auditory signals. Marion et al. (1981) provide an example of a survey of Plain Chachalacas in which they develop a correction factor to correct for bias due to non-response. Because a survey of two tracts of known density yielded 44% and 59% response rates, they assume an average response rate of 50% and adjust all density estimates by multiplying by 2.0.

Certainly, the idea of adjusting for bias using appropriate correction factors is a good one. Indeed the idea of Marion et al. (1981) can be extended a step further to establish an interval of plausible values of the correction factor. Such an interval may be preferable over the subjective method of selecting an average value to represent the observed values of 44% and 59% response rates.

An interval of appropriate values of the correction factor for the chachalaca data may be calculated as follows. First, use the fact that 22 + 10 = 32 out of 50 + 17 = 67 chachalacas responded to play back recording to calculate the estimated response rate as 32/67 = .48 with a standard error of $\sqrt{(.48)(.52)/67} = .06$. Thus the true response rate may be estimated to (at approximate 95% confidence level) lie between .36 (.48 − 2(.06)) and .60 (.48 + 2(.06)), yielding a range of 1.7 to 2.8 for the correction factor. This range of the correction factor, when applied to the observed response of 1.1 birds/ha in the April 18, 1972 survey, results in the approximate 95% confidence interval of 1.9 birds/ha to 3.1 birds/ha for the population density.

It is not clear why Marion et al. (1981) did not incorporate a correction factor in their calcula-

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tion of the density estimate for rails, but I am glad to see standard errors next to the estimates in their Table 1. Note the relatively large magnitudes of the standard errors, pointing out the need for more refinements in techniques of data collection and/or data analysis. Of course this last comment is not meant as a criticism of the excellent work accomplished thus far. Rather it is an expression of the fact that there are problems yet to be solved.

In his paper, Hussell (1981) describes how the multiple regression technique can be used to develop migration count indices to measure yearly bird population changes. His method is to regress the variable $Y = \text{Ln}\,(N + 1)$, where N is the number of birds observed, on independent variables such as year, site, date, etc. If $\hat{Y}$ denotes the adjusted estimate of Y for a given year, then the migration count index for that year is defined as $I = \exp(\hat{Y}) - 1$.

Hussell's paper provides yet another example of the power of multiple regression technique to solve practical data analysis problems. However, because of its popularity and availability of numerous computer packages for its implementation, there are many instances of improper use of regression analysis. Great care must be taken to insure the validity of assumptions underlying the model as well as to correctly interpret the model parameters. Hussell's model is more complicated than warranted by the situation, but I am pleased by his careful analysis of the underlying assumptions. In this connection, it is likely that the error structure in his data is more suitable for a time-series analysis.

The paper by Udvardy (1981) contains an overview of grid-based atlas as a tool for assessing spatial and temporal variation of avian population density.

Finally, because papers presented in this session contained several statistical tests of significance (e.g., t-tests, χ^2-tests), I would like to conclude this summary by making some comments on possible misinterpretation of such tests.

If a t-test shows statistically significant difference between two means, then all that one can conclude is that the population difference is not zero. It is quite possible that the real difference may be quite small to make it practically insignificant. If only the significance of a test is reported, there is the danger of interpreting it as indicating a practically significant difference.

A method to evaluate the practical significance of an observed difference is to construct a confidence interval. For example, the intervals (.01, .02) and (4.0, 6.0) both indicate statistically significant difference because both intervals exclude zero difference. Yet, the difference implied by the first could be considered practically unimportant in some situations.

To enable the user to examine confidence intervals, it is best to report the estimated difference and its standard error whenever possible. Indeed, as a general rule, it is important to report the standard error of every estimate. Without the standard error it is not possible to evaluate the reliability of the estimate.