

ANALYZING BIRD COUNT DATA USING ADVANCE-DECLINE METRICS

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Abstract

Advance-decline metrics are applied to field bird count data. Examples are taken from Christmas Bird Counts, from the 75th count to the present. The Sherburne NY count is used as an example of many species from a single site. Here the total number of individuals of all species is increasing while the advance-decline line is decreasing. The House Finch is used as an example of how the advance-decline line can be used with a single species being reported from multiple sites. The use of advance-decline metrics is advocated for all field bird count data as a way to represent every species equally.

Introduction

As a Christmas Bird Count (CBC) compiler I am often asked how the birds are doing. I used to give the standard answer, that some species are increasing while others are decreasing. But, rather than utter such a noncommittal reply, I sought a better one.

After all, stock market transaction data are very similar to bird count data and market analysts seem to have no problems telling up from down. The stock of each company is analogous to a species of bird. The closing market price is analogous to the number of individual birds of a species. Published CBC lists look remarkably similar to the stock market results in the daily newspapers.

Investors have devised many ingenious techniques for monitoring stocks (Zweig 1986). Most are too cumbersome to be practical and others reflect investor behavior too much to be applied elsewhere. However, a few Wall Street methods are simple and useful.

The advance-decline metric (Zweig 1986, pages 83-85; Siegel et al. 2000, pages 28-32) deserves consideration by birders. It is the number of stocks that increased, decreased, or remained the same in price since the previous close. It is printed daily in the newspapers and serves as a measure of the direction of the overall market, as well as how broad, or how narrow, the breadth is. When advancers outnumber decliners, the market direction is positive. When decliners outnumber advancers, the market direction is negative. The greater the difference, the greater the participation in the movement. It is just a simple subtraction for each stock, advancers minus decliners. Sometimes the numbers of stocks making new highs and new lows are also given. Sometimes the differences are correlated with market indexes, such as the Dow Jones Industrials, or with market volume (numbers of shares traded). Sometimes the advancers over decliners is expressed as a ratio (Siegel et al. 2000, page 32).

The advance-decline line is the cumulating sum of the daily advance-

decline numbers. Unchangers are ignored. The absolute value of the line is not important — its direction is. The advance-decline line enables investors to spot changes in the broad overall direction of the market. In its Business Day section, *The New York Times* prints the advance-decline line plot for the New York Stock Exchange, proclaiming it as a market gauge. The line is reset to zero on the first day of each year.

Methods

To use advance-decline metrics for bird counts, simply list the species followed by the number of individuals for each species. Place numbers for each count year in a separate column, forming a spreadsheet. The numbers in the rows for each species are then compared serially, each year to its previous, and designated as advancers, decliners, or unchangers. Then each of the three designations is tallied for each column. The differences are calculated as advancers minus decliners, retaining the signs. For example, $32 - 27 = 5$ and $22 - 28 = -6$. The unchangers are ignored. The differences are plotted on the ordinate (y axis) and the count years on the abscissa (x axis).

Because unchangers are ignored, advancing or declining is a binary phenomenon, like flipping coins. Therefore, up and down fluctuations in the advance-decline line are expected. Drastic or prolonged moves in one direction are tip-offs that important underlying changes are occurring. When the direction of the advance-decline line departs from other measures, a change in underlying fundamentals is suspected.

Results

The results are presented as examples of two different situations, many species at a single site and a single species at multiple sites.

Many Species at One Site

Figure 1 shows a plot of our Sherburne NY CBC from 1980 (81st count) to 2000 (101st count). The center of the Sherburne count is in the village of Sherburne in Chenango County. Both the advance-decline line and the total numbers of individual birds of all species are plotted. Note that even though the number of individual birds has been going up since the 90th count, the advance-decline line has recently been vacillating around a declining trend. The reason is that a few species have numbers way out of proportion to the others. A huge flock of Canada Geese is in, or partially in, our count circle, reaching a high of 3497 on the 100th count. We had a high of 1567 European Starlings on the 101st count. American Crows are another strong contributor.

The question may be posed as to why not just dissect out the few species responsible for the disproportionate increases in individual birds? To do so defeats the purpose of a count, which is to measure what is there — not to manipulate the data to suit biased notions. Here is where the advance-decline approach is valuable. It enables us to look at all the data objectively with all species being represented equally. So, when asked how our birds are doing, I can reply that over

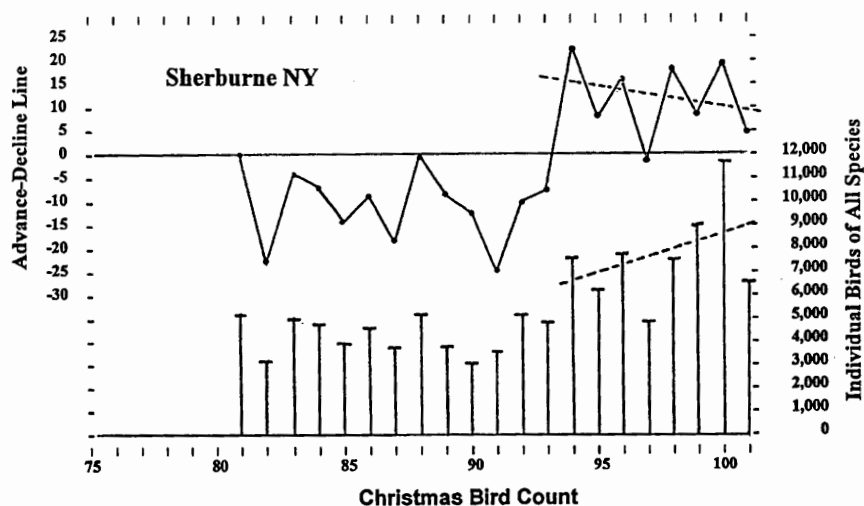


Figure 1. The Sherburne NY CBC. The upper graph (left axis) is the advance-decline line. The lower graph (right axis) is the total number of individual birds of all species. Note that for the past 8 counts (94th through 101st) the advance-decline line is declining while the numbers of individual birds is increasing. The dotted lines show the positive and negative regressions.

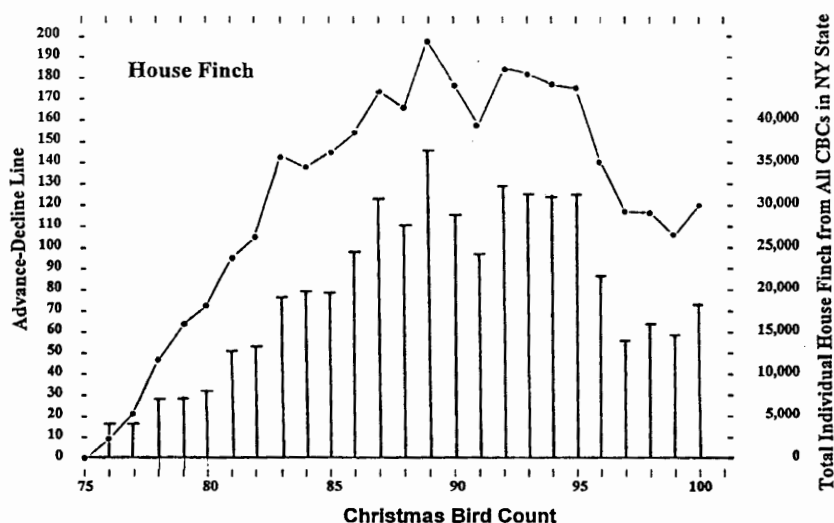


Figure 2. The House Finch in all CBCs in NY State. The upper graph (left axis) is the advance-decline line. The lower graph (right axis) is the total number of House Finch from all sites. Note how closely the two graphs resemble each other. This is because the advances and declines among the reporting sites were uniformly distributed.

the past 8 years they have been declining overall. For our most recent count, on 16 December 2000, we had 23 species advancing and 38 declining, so I can state that the birds have declined since last year, because decliners outnumbered advancers.

Note also that in counts 88 through 91, the direction of the advance-decline line was down. Something was going on, but we did not recognize it because we were looking at only the total numbers of individuals, which seemed to be fluctuating within a normal range. Had we been using advance-decline metrics back then, we could have sought an underlying cause. Now, we can only speculate.

One Species at Many Sites

The House Finch (*Carpodacus mexicanus*) was selected as an example because of its extraordinary rise (Windsor 1998) and its remarkable fall due to conjunctivitis (Hartup et al. 2000).

Figure 2 shows how well the advance-decline line tracks the total numbers of individual House Finches over the course of its invasion of New York State. Some CBC circles reported increases or decreases of hundreds of birds from one year to the next, while other circles reported small or no changes. Advance-decline metrics enabled each count circle to be equally represented. In the case of the House Finch, the changes among all the sites (approximately 60 count circles each year) were uniformly distributed.

Discussion

The inherent difficulty with bird field counts is that some species are seen in large numbers while many species appear in low numbers. Usually several species will be represented by only single individuals. Analyzing such disparate data is fraught with difficulties. Hundreds of European Starlings overwhelm a few Brown Creepers. Averages are useless and even misleading. The mean of 1500 starlings and 2 creepers is 751 birds. Even the median can be deceptive. The median of 900 Canada Geese, 2 Killdeers, and 1 Ring-billed Gull is 2 birds, a statistic of limited use. Whereas, the real concern is whether the birds seen are increasing or decreasing since the previous count. If last year the numbers were 1200 geese, 3 Killdeers, and no gulls, the advance-decline metric would be $(-1) + (-1) + (1) = -1$. That is, overall, the birds decreased since the last time.

The use of advance-decline metrics enables each species to be equally represented. A decrease in geese by 300 is given the same weight as a decrease in Killdeer by 1. This metric allows comparisons to be made when the species list includes high numbers of common species and low numbers of uncommon ones. The direction of change is being measured, not the magnitude.

The beauty of advance-decline metrics is that anyone can use them. No statistical knowledge is required; all it takes is simple arithmetic. However, for those who enjoy statistical rigor, there are the sign test, the signed-rank test, and various tests for runs (Dixon & Massey 1969).

Comparing one year's CBC with the previous year takes only a few min-

utes. The compiler can then confidently state that the count is up or down or unchanged from last year. Longer term trends can be readily spotted and, as with the stock market, predictions can be ventured.

Applicability

Advance-decline metrics can be used whenever there are widely disparate data from multiple sources. I have presented a use for many species from one CBC and for a single species from many CBCs. Other possible applications are for Breeding Bird Surveys, atlases, waterfowl counts, site specific surveys, migration counts, and even ordinary field trips.

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