[A New Look at an Old Problem: Finding Temporal Patterns in Homicide Series: The Canadian Case]: Discussion
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Discussion

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The analysis of seasonality presented by Dagum, Huot, and Morry follows the traditional X-11-ARIMA approach. The major limitation of the X-11 approach and its variants is that the test for seasonality is based mainly on the empirical experience of X-11 practioners. Statements about significant seasonality and the measures of goodness of fit are based mainly on empiricism. Furthermore, no confidence intervals for the seasonal adjustment are available. As has been emphasized by Box (1981), theory and empiricism should interact in the development of good statistical models.

The Regression-ARIMA model suggested by McLeod, MacNeill, and Bhattacharyya (1985) is a step in the direction of a more theory-based seasonal-adjustment model. As pointed out by Dagum, Huot, and Morry, the method should be modified to constrain the sum of the seasonal effects to zero. In fact, such a modification is only necessary when there is a deterministic trend component present. The necessary modification is then simply to subtract the mean from the differenced or seasonally differenced series. Further work on the Regression-ARIMA seasonal adjustment approach will be reported in a future article.

The X-11-ARIMA procedures test for seasonality and for moving seasonality using standard F-tests. However, recent studies of time-series-valued experimental design show that autocorrelation in the series used to define the numerator and denominator of the F-ratios invalidate the standard distribution theory. There are two reasons for this: first, the numerator and denominator are correlated; and second and more importantly, the autocorrelation in the series can cause the mean sums of squares to be badly biased as estimators of the residual variance. The effects of these biases are discussed by Sutradhar, MacNeill, and Sahrmann (1987), particularly in the case of time-series-valued experimental design with AR(P) errors. For the one-way classification with AR(1) errors, appropriate modifications are suggested for the degrees of freedom to account for the reduction in information conveyed by the autocorrelated errors. The overall effect on the F-ratio depends upon sample size, but for a wide range of sample size, this effect can be approximately compensated for by multiplying the F-ratio by $(1-\phi)/(1+\phi)$, $|\phi| < 0.9$, where ϕ is the AR(1) parameter. Hence, for large values of ϕ, the effect of autocorrelation is substantial enough to make the standard F-tables of little practical use for hypothesis testing. The theory of time-series-valued experimental designs is being extended to seasonal models.

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Granger (1984, p.335) states:

> The most obvious approach to modelling this [seasonal] component [of the monthly demand for electricity] is to consider why the seasonal component exists and why it has its particular shape and thus consider the explanatory variables, which themselves will be seasonal, such as temperature, humidity, and the timing of public and school vacations. A regression procedure will then model the seasonal component, and adjustment or removal of this component is straight forward.

Nakamura and Nakamura (1985) applied such a regression procedure in an effort to relate monthly fluctuations in Canadian homicide activity to monthly variations in the numbers of Fridays and Saturdays, the unemployment rate, and the average temperature. Regression equations were estimated for eleven cities as well as for the whole of Canada. Nakamura and Nakamura found monthly fluctuations in homicide activities to be associated with the number of Fridays in the month and with variations in below-zero average temperatures. They conclude their analysis by suggesting that better empirical results could be obtained if information on the day of occurrence of each homicide, as well as the outside temperature at the time of occurrence, were added to the information Statistics Canada currently compiles on homicides. U.S. evidence suggests a sharp rise in homicide activity on Fridays and Saturdays, and there has been persistent interest in possible associations between homicide activity and climatic factors such as the temperature. Addition of the suggested variables would permit more rigorous testing of hypotheses concerning these factors. If it were possible to control more adequately for day of the week and temperature-related patterns, it might also be easier to identify fluctuations associated with other variables such as the unemployment rate. Adding information about the day (and even the time) of occurrence would entail very little extra expense, since this information is available in the original crime reports which are the primary data source.

While promoting causally based regression adjustments for seasonality of the sort used by Nakamura and Nakamura, Granger (1984, p.335) acknowledges that these methods are rarely used, probably because of the expense, and that the methods used are almost exclusively autoadjustments. The latter have been traditionally used in economic statistics as well (see for example, Bell and Hillmer 1984). In particular, the U.S. Bureau of Census Method II X-11 and its Statistics Canada modification X-11-ARIMA, although developed to analyze seasonality in economic time series, can also be applied to noneconomic series. For example, Sakamoto-Momiyama (1977, Chapter 6) has applied the Census X-11 method to analyze seasonal patterns in mortality in Tokyo, London, and New York, and attributes the smaller seasonal variations in New York to the effects of central heating in that city.

Dagum, Huot, and Morry use the X-11-ARIMA method in their analysis of seasonality in Canadian homicide activity. They find that the quarterly time series for All Murders, All Victims, and All Suspects for the period of 1974 through 1980 display a well-defined, common seasonal pattern. In particular they are able to accept the hypothesis that the murder rate is highest in summer (July, August, and September). This clear-cut result is in contrast to earlier findings (McKie 1985; and McLeod, MacNeill, and Bhattacharyya 1985). Dagum, Huot, and Morry suggest that their finding that the murder rate is highest in summer "should be a consideration when planning manpower allocation, holiday scheduling, etc."

Dagum, Huot, and Morry's analysis is carefully executed and thought-provoking. Nevertheless it seems premature to recommend using their findings (or any other Canadian findings, including our own) as a basis for allocation of law-enforcement personnel, holiday planning, and so forth. Planning of this sort would only be affected in a substantial way by pronounced and regular seasonal variations, yet Dagum, Huot, and Morry note the lack of conclusive evidence of seasonality. This is a compelling reason, as they suggest, for using "other tools. . .to determine if the series are affected by seasonal forces." It also suggests, however, that the seasonal fluctuations may not be pronounced and regular enough to have important planning implications of the sort suggested above.

Nevertheless the seasonal pattern that Dagum, Huot, and Morry identify could provide important clues concerning causal factors affecting homicide activity. This is the direction in which we believe research attention should be focussed, in the hopes that an improved understanding of various sorts of homicidal behavior will point the way towards effective means of curbing this behavior. The finding that the murder rate rises in the summer raises a series of questions. Are Canadian summers really hot enough, for instance, for this pattern to be attributable to "irritability due to excessive heat" as Dagum, Huot, and Morry suggest? Could it be caused in part by work-related factors such as the seasonal migration patterns of itinerant labourers? Could seasonal changes in social behavior be part of the explanation, as Dagum, Huot, and Morry also suggest?

Dagum, Huot, and Morry (p.5) contend that "a finer disaggregation of the data. . .leads to less reliable or inconclusive results." This finding is probably an inherent limitation of their methodology in dealing with a fairly rare event like murder. Yet it is precisely such a disaggregation by city and type of homicide which might permit Dagum, Huot, and Morry to build on their present results by relating city-specific seasonal patterns for particular types of homicides to city-specific climatic, economic, social, and demographic patterns, following the example set by Sakamoto-Momiyama in her mortality study. Such an extension, if feasible, would complement the behaviorally oriented regression approach adopted by Nakamura and Nakamura. Moreover, the addition of information about the day of the week as well as the month of occurrence to the homicide information compiled by Statistics Canada would probably enhance the potential effectiveness of both approaches.

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