IS CRIME SEASONAL?

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This report summarizes the analysis of many data sets obtained over the years through the help and cooperation of numerous people. A complete list is found in the introduction to the section, "Is Crime Seasonal?"

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INTRODUCTION

Researchers and policy makers often take for granted that seasonal fluctuation in crime is an established fact. To suggest otherwise goes against the grain of a long tradition in criminology. Indeed, Brearley (1932:161-199) begins his review of the literature on criminal seasonality with Hippocrates, and Wolfgang (1966) cites scholarly works dating from 1825.

Quetelet, a Belgian statistician and one of the earliest investigators of seasonal fluctuation in crime (1842:90;also see Sylvester,1982), states,

> The seasons, in their course, exercise a very marked influence: thus, during summer, the greatest number of crimes against persons are committed and the fewest against property; the contrary takes place during the winter.

The assumption that crime occurs seasonally continues to be made today. In heralding the "War on Crime" of the Johnson administration, the President's Commission on Law Enforcement and the Administration of Justice (1967:27) stated that

> Murder is a seasonal offense. Rates are generally higher in the summer, except for December, which is often the highest month and almost always 5 to 20 percent above the yearly average. In December, 1963, following the assassination of President Kennedy, murders were below the yearly average by 4 percent, one of the few years in the history of the UCR that this occurred.

The more recent Report to the Nation on Crime and Justice (BJS, 1983:11) states that, although personal larceny under $50 and robbery are exceptions,

> . . . almost all types of personal and household crimes are more likely to occur during the warmer months of the year.

One of the most influential basic criminology textbooks in the United States, Sutherland and Cressey (1978:82), states that

> statistical studies show very uniformly that crimes against property reach a maximum in winter months, and crimes against the person and against morals in the summer months.

The answer to the question, "Is crime seasonal?" is not as straightforward as these quotes suggest. Some types of crimes fluctuate with the seasons, while others do not. The same crime

may show seasonal fluctuation in one geographic area, but not in another. In addition, the decision as to whether or not a particular series is seasonal depends upon the conceptual and operational definition of seasonality the decision-maker uses.

This report first reviews some analytical issues that must be considered in decisions regarding the seasonal fluctuation of crime. Second, using analyses that the Statistical Analysis Center has conducted over the years, the report answers the question, "Is crime seasonal?" for specific crime types, geographic areas, and time periods.

The report ends with a review of analyses, published and unpublished, that address the question of seasonal fluctuation in crime. Studies were not selected for inclusion on the basis of methodology or any other quality criterion, but simply to provide a comprehensive review of the existing literature. The bibliographic review also includes a summary of the findings of a previously unpublished survey of seasonality analyses done by the states.

ISSUES IN THE SEASONALITY OF CRIME

The question, "Is crime seasonal?" is not easily answered with a yes or a no. The answer depends upon the statistical criteria used to make the decision (see Block,1983). Methods of seasonal analysis are not completely objective. Their results must be interpreted, and researchers using the same method may come to differing conclusions. There is even disagreement among statisticians on the very definition of seasonality.[1]

For the purpose of this report, we will use Kallek's (1978: 15) simple and straightforward definition of seasonality.

> Seasonality refers to regular periodic fluctuations which recur every year with about the same timing and with the same intensity and which, most importantly, can be mea-- sured and removed from the time series under review.

Not all analysts concur with this definition. A case in point is Warren, et al. (1981), who found homicide to have a seasonal pattern that changes from year to year. That is, a "peak month" in some years is a "trough month" in other years. The authors conclude that homicide is seasonal, but "inconsistent." Since year-to-year consistency is implied in Kallek's definition, if we accept that definition, "inconsistent seasonality" is a contradiction in terms.

This section reviews several methodological and analytical issues that affect an investigator's decision as to seasonality. These issues may explain the seemingly contradictory results of some studies of seasonal fluctuation in crime.

Length of Series

Generally, a number of years of data are necessary in order to answer the question, "Is this crime seasonal?" with confidence. A series shorter than seven years is considered too short for a definite decision about the presence of seasonality (see Block, 1983). The reason for this becomes clear if you consider that, in one year, you observe one instance of each month. In six years, you would have only six observations of Januaries, six observations of Februaries, and so on.

With an increasing number of observations (years), seasonal fluctuation can be described more accurately. A few extreme values will have less effect on the total analysis in a long

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[1]For a complete discussion of alternative conceptual and operational definitions, see Block (1983).

series than they will in a short series. Also, with a very short series, only strong seasonal fluctuation is likely to produce statistical significance. In general, the longer the series, the more likely that relatively weak seasonal fluctuation (that is, however, consistent over time) will be significant.

Table 1 shows the effect of length of series on a seasonal analysis, using the same method (Census X-11) and the same statistical criteria (F of stable seasonality and percent contributions of the seasonal and irregular components over a one-month span). The F value is an indicator of significance, while the percent contribution of the seasonal component is analogous to a measure of association.[2] The series, seven Index crimes in Illinois, begin in 1972, but extend either to 1977 (six years) or to 1981 (10 years).

Table 1

Census X-11 Results, Illinois Index Crimes

Index Crime	Six-Year Series (1972-1977)			Ten-Year Series (1972-1981)		
	Stable F	% Contribution Season.	Irreg.	Stable F	% Contribution Season.	Irreg.
Murder	1.5	30.5%	69.7%	2.8	29.0%	70.4%
Forcible Rape	8.1	27.2	72.2	10.0	20.5	79.0
Robbery	7.1	34.4	60.5	10.9	32.3	65.0
Agg. Assault	49.5	63.1	35.7	45.7	59.6	38.5
Burglary	10.8	52.8	43.2	19.3	55.9	41.7
Larceny/Theft	104.6	81.2	17.2	95.8	80.7	18.2
Motor Veh. Theft	16.2	51.9	46.8	13.0	39.1	59.6

[2]For a more complete discussion, see Block (1983) and the studies listed in its annotated bibliography. For a brief review of the statistics in Table 1, see the introduction to the Review Bibliography, page 32 below.

Because we cannot assume that observations in a time series are independent, the stable seasonality F should be interpreted as one indicator of the degree of seasonality, not as an exact measure of significance. The "Plewes rule-of-thumb" (Block,1983) uses the irregular contribution as a means of interpreting the F value. The Plewes criteria are: if the irregular contributes 30 percent or more of the total month-to-month variation, the decision should be "no stable seasonality," regardless of the F value; if the percent contribution is 25 to 29, the F value needs to be at least 15, and if the percent contribution is 15 to 24, the F value needs to be at least 2.41 for the series to be considered seasonal. An F value less than 2.41 indicates no stable seasonality, regardless of the irregular contribution.

In four cases, increasing the length of the series increased the F value. This happened for murder, forcible rape, robbery, and burglary. However, the stable seasonality F values of aggravated assault, larceny/theft, and motor vehicle theft were lower in the longer series.

The percent contribution of the seasonal component over a one-month span does not always increase when the length of the series increases. For example, for forcible rape, the seasonal contribution is 20.5 percent in the longer series, and 27.2 percent in the shorter series, although the F is higher in the longer series. This is also true of murder and robbery. Why should this be so?

It is, of course, possible that there is less seasonal fluctuation in the 1978-1981 years than in the previous six years. In that case, the addition of the 1978-1981 years to the series would decrease the seasonal fluctuation overall. However, if that were true, why would the F value increase? The answer to this apparent contradiction is that a longer series allows a more accurate description of seasonal activity. This more accurate description tells us that the seasonal contribution is less. Thus, it is possible that these violent crime series contain a weak degree of seasonal fluctuation, and that this weak fluctuation might produce high enough F values to be considered seasonal by the Plewes criteria in series that are even longer than these.

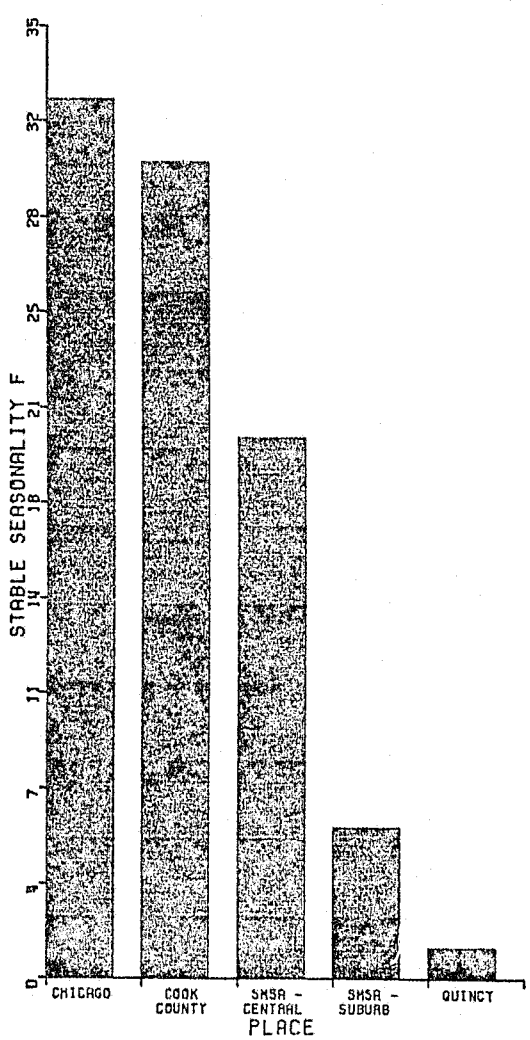
The literature of crime seasonality contains numerous examples of seasonal analyses based on very short series, sometimes only one year (see the Review Bibliography, below). It is not surprising that different analysts, analyzing the same crime but for varying time periods, would reach differing conclusions about the presence of seasonal fluctuation in that crime.

Local versus State or National

What is the appropriate level of geographic aggregation to answer the question, "Is crime seasonal?" Should we look for an answer at the local level, or at the state or national level? On one hand, "using local data may lead to erroneous conclusions about the seasonal pattern because of the small numbers involved and the possibility of local intervention or prevention efforts" (Michael and Zumpe, 1983). On the other hand, most administrative and policy decisions in law enforcement are made at the local level, and relate to local policy. If these decisions are based on information about seasonality at the national level, they may lead to erroneous local-level conclusions (Coldren, 1980).

Chart 1

SEASONAL FLUCTUATION OF AGGRAVATED ASSAULT
ILLINOIS, 1972 THROUGH 1981
CENSUS X-11 ADDITIVE ADJUSTMENT



The same phenomenon may vary seasonally in one place but not in another. Some geographic areas, such as a college town, a tourist mecca, or the home of the state fair, have an influx of population during certain seasons of the year. In addition, if the weather is an underlying cause of seasonal fluctuation, areas with different climates may experience differing patterns of seasonality. For examples, see the "Survey of the States" (Review Bibliography, below), especially Arizona, Delaware, and Maine.

The argument that the effect of local intervention or other "error" is "equalled out" in nationally aggregated data is spurious. Error never disappears, though it may be hidden. At the local level, with knowledge of the local situation, there is a better chance to discover and then control for local effects.

The case of aggravated assault demonstrates that conclusions about seasonal fluctuation in a crime may be very different, depending on the local area concerned. In Illinois, the F of stable seasonality in Index assault from 1972 to 1981 varies by jurisdiction: for example, Chicago, Cook County (excluding Chicago), SMSA counties containing a central city, suburban SMSA counties not containing a central city, and Quincy, a typical small city of less than 50,000 population (see Chart 1). The more urban the place, the more aggravated assault known to the police appears to fluctuate seasonally.

Such a change in the F, a measure of significance (see page 4, above), might be argued to be caused by a change in the number of observations. It is true that a longer series, or a series containing more observations, is more likely to produce a high F, other things being equal, and there are fewer reported assaults in Quincy than in Chicago. However, the lack of seasonal fluctuation in Quincy is evident not only in the F statistic, but also upon inspection of the graph (see Charts 2 and 3). Despite the difference in scale, there is a pattern of seasonal fluctuation in Chicago, but no discernible seasonality in Quincy.

Chart 2

CHICAGO INDEX AGGRAVATED ASSAULT, 1972 TO 1981

SOURCE: SAC EDITION, ILLINOIS UNIFORM CRIME REPORTS, OFFENSE DATA.

INDEX AGGRAVATED ASSAULT = AGGRAVATED ASSAULT, AGGRAVATED BATTERY, ATTEMPT MURDER.

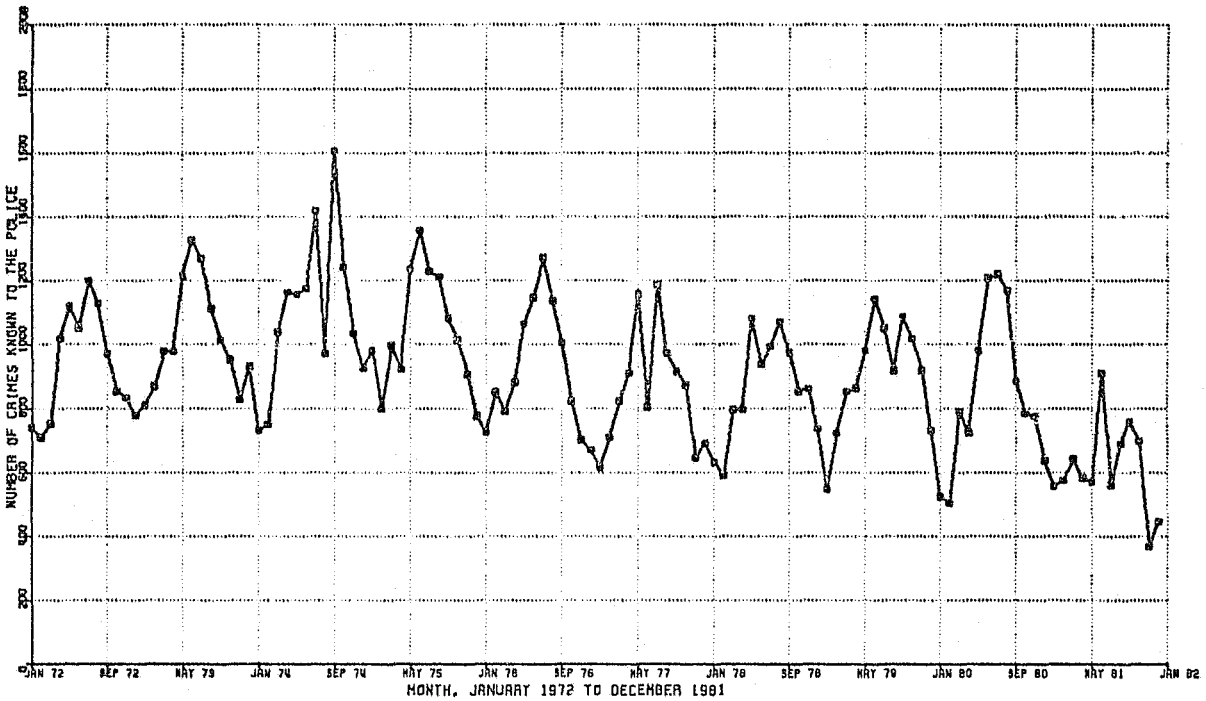
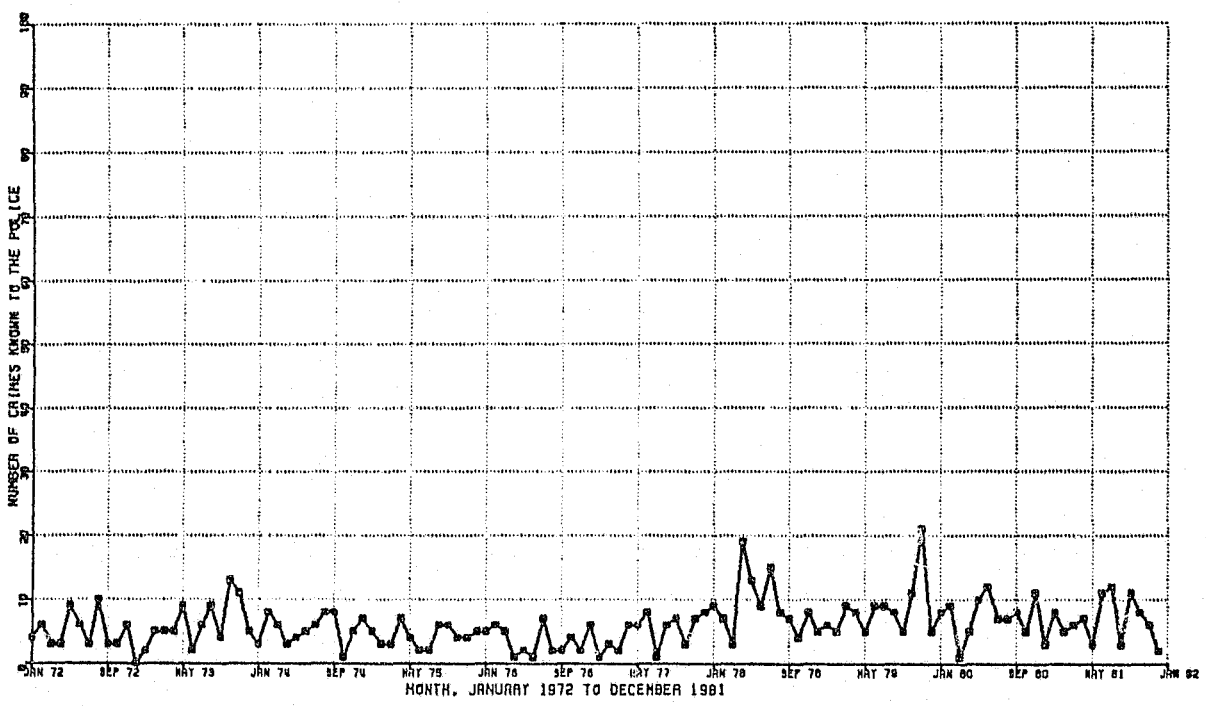


Chart 3

QUINCY INDEX AGGRAVATED ASSAULT, 1972 TO 1981

SOURCE: SAC EDITION, ILLINOIS UNIFORM CRIME REPORTS, OFFENSE DATA.

INDEX AGGRAVATED ASSAULT = AGGRAVATED ASSAULT, AGGRAVATED BATTERY, ATTEMPT MURDER.



Does Crime Occur Seasonally, or Is It Reported Seasonally?

Most homicides are, in their characteristics, a subset of another crime -- aggravated assault. They begin as a fight, brawl, or argument. Although some homicides are precipitated by a robbery, a rape, a gangland "hit," or another non-assault circumstance, the great majority begin as a fight, brawl, or argument, and escalate to murder (see Block, 1977; Zimring, 1979; Parker and Smith, 1979; Pierce and Bowers, 1981). In Chicago, for example, 68 percent of the homicides known to the police from 1965 to 1981 began as an assault, 17 percent began as a robbery, 2 percent began as a rape or burglary, and the rest involved other or unknown circumstances.[3]

Homicides that begin as fights or brawls differ from homicides that begin as robberies in a number of ways, including the weapon, the place and time of occurrence, the victim-offender relationship, and many other characteristics. In fact, homicides that begin as assaults are more similar in their characteristics to aggravated assaults than they are to homicides that begin as robberies (Block, 1977). They can almost be considered to be separate types of crime. A homicide that begins as a fight or assault can be thought of as a type of aggravated assault, one in which the victim was injured so seriously that death resulted.

Because assault homicides are similar in most of their characteristics to all aggravated assaults, we would expect them to be similar in another characteristic, seasonal fluctuation. If more assaults occur in the summer months, for example, we would expect more assault homicides to occur in the summer. However, Chicago data (Table 2) indicate that this is not necessarily true. Aggravated assaults known to the police fluctuate seasonally. Assault homicides do not. Why does this occur?

In searching for an explanation, we hypothesized that, in fact, assault does not occur more often in the summer than in the winter months. Rather, it <u>becomes known</u> to the police more often in the summer months. More serious assaults, involving serious injury and possibly hospitalization, become known to the police with greater likelihood than less serious assaults. They are reported by medical personnel and hospital staff, and are more likely to be reported by the victims themselves (LEAA, 1972;

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[3]Source: Data collected by the Authority, the Center for Studies in Criminal Justice of the University of Chicago Law School, and Loyola University from files maintained by the Chicago Police Department. Time series files maintained by the Authority.

Table 2

Assault Homicide and Aggravated Assault*
Chicago, 1967 to 1981

	Additive Assumption**			Multiplicative Assumption**		
	Stable F	% Contribution Season.	Irreg.	Stable F	% Contribution Season.	Irreg.
All Weapon Types						
Agg. assault	109.1	70.0%	27.3%	104.5	70.3%	27.4%
Assault homicide	6.2	25.1	74.3	6.2	25.7	73.7
Firearm						
Agg. assault	60.9	60.0%	35.4%	54.2	57.4%	38.7%
Assault homicide	4.3	24.2	75.2	4.2	24.1	75.3
Other Weapons						
Agg. assault	89.2	65.6%	31.5%	90.6	65.0%	32.4%
Assault homicide	3.8	29.3	70.3	3.8	24.2	75.5

*For a discussion of these statistics, see page 5, above. Data sources: Assault data set reconstructed by the Authority from two sources, each containing partial data: Chicago Police Department records, and the City of Chicago Municipal Reference Library. Time series data are in 13 "police periods" per year. To obtain estimates of months for the present analysis, we used a moving average. This probably decreased the amount of seasonal fluctuation. Assault homicide: see note 3, above.

**Under an additive assumption, the seasonal and irregular components are independent; under a multiplicative assumption, they are not. For more detail, see Block (1983).

Block and Block,1984). Less serious assaults, on the other hand, tend not to come to the attention of the police unless they are public. They are more likely to be public in the summertime. In the warm months, an assault is more likely to occur outside, and if it occurs inside, the windows are more likely to be open. Thus, we hypothesized that the explanation for the seasonality of assault and lack of seasonality of assault homicide is that neither, in fact, occurs seasonally, but that more assaults become known to the police in the summer months.

To test this hypothesis, we compared seasonal fluctuation in the number of aggravated assaults known to the police, and seasonal fluctuation in the number of aggravated assault victimizations, for the same place and time period: the United States from 1973 through 1979. The police data are Index aggravated assaults reported by police jurisdictions to the FBI through the Uniform Crime Reporting program.[4] The victimization data are aggravated assault victimizations (defined the same as Index aggravated assaults) estimated by the National Crime Survey.[5] We expected to find much more seasonal fluctuation in reported assaults than in assault victimizations. That is, in fact, what we found, as Table 3 shows.

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[4]These unweighted UCR data are the total offenses reported by those agencies that reported to the FBI in every month of the year in question. The number of reporting agencies increased during the 1973-1979 period from 7,106 (representing a population of 174,249,026) to 11,782 (representing 196,836,371). (Note that the added agencies were mostly small jurisdictions, serving cities and counties with smaller populations.) Thus, these data cannot be used to examine trends over time. However, because Census X-11 results indicate the behavior of the seasonal component of the series as opposed to the behavior of any "trend," whether real or artificial, the data can be used as one indicator of the presence of seasonal fluctuation. For another analysis of FBI/UCR data, see FBI (1981) in the Review Bibliography, below.

[5]These victimization estimates from the National Crime Survey were provided by Richard L. Block and Wesley Skogan. They represent the number of victimizations occurring in the NCS sample, corrected for underrepresentation of various population groups. The sample includes only noncommercial victims aged 12 and older. Victimizations in which the month of occurrence is unknown, such as "series" victimizations, are not included. These missing data account for fewer than 1 percent of the robberies or assaults in any month. Dodge and Lentzner conducted an analysis of NCS data for a shorter (five-year) period, but did not attempt to analyze crime categories comparable to police categories. See US/BJS in the Review Bibliography, below. As this report went to press, 1980 and 1981 NCS data became available. We plan to continue this analysis with more recent data, as they are available.

Table 3

Seasonality of Victimization and Reported Crime
United States, 1973 to 1979*

	Additive Assumption			Multiplicative Assumption		
	Stable F	% Contribution Season.	Irreg.	Stable F	% Contribution Season.	Irreg.
Aggravated Assault						
Known to Police	94.2	83.7%	15.0%	131.3	85.0%	13.7%
Victim Survey	7.5	31.0	68.4	7.4	29.9	69.5
Robbery						
Known to Police	100.4	86.9%	10.6%	107.6	86.9%	11.0%
Victim Survey	4.6	34.0	63.7	4.5	27.3	70.4

*For a discussion of these statistics, see page 5, above.

Having found that reported assault fluctuates with the seasons much more than assault victimization, at least for the United States as a whole, we looked at the same relationship for another violent crime -- robbery (Table 3). Robbery victimizations, like assault victimizations, do not fluctuate with the seasons, but robberies known to the police do. This suggests that less serious and less public robberies do not occur more often in the summer, but are more likely to become known to the police in the summer months.

Because the hypothesis is grounded on the issue of "public" crime, and the degree to which a crime is public may be related to whether it occurs in an urban area or not, a better test of the hypothesis would compare seasonal fluctuation in victim and police data in urban areas only. If this were done, we would expect that the difference in Census X-11 results would be even higher. However, data are not currently available to do this.[6]

[6]Victim survey data are not available for seven years in any city, and there are some problems in utilizing the NCS to examine metropolitan areas.

Partial support is found in the above analysis of assault data (see "Local versus State or National"). Aggravated assault series are more likely to be seasonal the more urban the place. It is also supported by the seasonality of Chicago assaults by type of weapon, in Table 2 above. The F of stable seasonality and the percent contribution of the seasonal component are higher for assaults without a gun than for assaults with a gun. Perhaps assaults without a gun are less serious, result in lesser or no injuries, and are thus more likely to become known to the police in public situations, especially in the summer months.

IS CRIME SEASONAL?

In this section, we summarize the findings of analyses of seasonality in crime that the Statistical Analysis Center of the Authority has conducted in the last few years, either in response to requests from users or in conjunction with a research project.

The reader's evaluation of the findings presented here, and indeed the evaluation of any analysis of seasonality, should take into account the method and criteria used, the place and time period, and the definition of the crime.

To facilitate comparison, all the analyses summarized here use the same method, the Census X-11, and the same criteria, F of stable seasonality and percent contributions of the seasonal and irregular components over a one-month span. However, we have repeated many of these analyses with a stochastic (ARIMA) model, and results are available on request from the author.

Crime definitions used also are consistent throughout the section: Index crimes, as defined by the Uniform Crime Reports. Even when we analyze victimization estimates from the National Crime Survey, we attempt to make NCS crime categories comparable to Index crime categories (see note 5, above, and Block and Block,1984). The section summarizes, in turn, findings for each of the four violent Index crimes and three property Index crimes. The eighth Index crime, arson, is not included, because, in general, consistently defined data have not been collected for the minimum seven-year period.

Although all other aspects are uniform, place and time change from analysis to analysis, and are noted for each.

Sources of the time series analyzed in this section are the following:

- United States 1970 to 1982: Uniform Crime Reports, FBI. See note 4, above.

- National Crime Survey: See note 5, above.

- Illinois, parts of Illinois: Authority edition of the Illinois Uniform Crime Reports offense data and supplementary homicide data. See Miller and Block (1983).

- Chicago aggravated assault: Data set reconstructed by the Authority from two sources, each containing partial data: Chicago Police Department records, and the City of Chicago Municipal Reference Library.

- Chicago homicide: Data collected from police homicide files, with the cooperation and assistance of the Chicago Police

Department over a number of years and changes in administration. See note 3, above.

- California, Los Angeles: Authority time series version of data obtained from the Bureau of Criminal Statistics and Special Services, state of California.

- New York City: Lily E. Christ, John Jay College of Criminal Justice, City University of New York.

- Boston: Deutsch and Alt (1977); see Review Bibliography.

- Canada, Ontario: Time series files created by Craig McKie, Statistics Canada, from homicide data collected by the Law Enforcement Section, Canadian Centre for Justice Statistics, Statistics Canada. See Block, et al. 1983.

Is Violent Crime Seasonal?

Homicide

The preponderance of the empirical literature finds that homicide does not vary seasonally.[7] In the Review Bibliography below, see Munford, et al. (1976:220), Deutsch and Alt (1977), Hay and McCleary (1979), Lamp (1982), and Michael and Zumpe (1983). However, the prevailing point of view in criminology seems to be that homicide *is* seasonal. See the quotes from the President's Commission and Sutherland and Cressey in the Introduction, above, and FBI (1981), Warren, et al. (1981).

As parts of various research projects and in response to user requests, the Authority has analyzed hundreds of homicide series for the presence of seasonal fluctuation. Most of these series were types of Chicago homicide or types of Canadian homicide; for example, homicide committed with a gun, homicide committed with a knife, and homicide committed with a blunt instrument. In addition to the Chicago and Canadian series, we have analyzed Boston homicide, California and types of California homicide, Index homicide in the United States, Index homicide in New York City, and homicide and types of homicide in Illinois jurisdictions outside of Chicago. Table 4 summarizes results for the major Chicago homicide component series.

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[7]Although suicide is not usually considered to be a crime, it is often discussed in conjunction with homicide. For a review of the literature on seasonal fluctuation in suicide, see Lester (1972). The Authority has analyzed Cook County suicides from 1963, and has found no evidence of seasonal fluctuation, either in suicides with a gun or without a gun. F values range from 0.5 to 1.8.

Table 4

Bell-Canada F* of Stable Seasonality, Chicago Homicide 1965-81

	Additive Assumption	Multiplicative Assumption
Total Homicide	4.25	4.13
Firearm	2.86	2.75
Knife	2.17	2.07
Blunt Instrument	3.15	**
Assault	5.38	5.20
Robbery	2.07	**
Family	1.23	1.26
Acquaintance	2.36	2.20
Stranger	2.58	**
Black victim	3.05	3.05
White victim	1.86	2.12
Male victim	5.34	5.00
Female victim	.39	.39
Offender age 15-19	1.43	**
Offender age 20-24	1.13	1.50
Offender other ages	4.15	4.10
Single offender	5.05	4.94
Multiple offenders	1.83	1.59
Inside a residence	1.28	.90
Inside a nonres.	3.03	3.24
Out of doors, vehicle	18.60	16.56

*The Bell-Canada is a quick screener for seasonality, similar to the Census X-11 but allowing no user options. The Bell-Canada F value can be interpreted as the Census X-11 F (see page 5, above).

**Because the series contains one or more zero values, a multiplicative adjustment is not applicable.

In addition to the types of homicide presented in Table 4, we analyzed more detailed Chicago homicide types, such as multiple offender assault homicide with a gun. We also conducted more detailed analyses, using the Census X-11, on any series having a Bell-Canada F value of 2.41 or over. After analyzing more than a hundred Chicago series, we finally found one that showed some seasonal fluctuation. This may be one of the few cases in which the maxim, "the exception proves the rule," is true. Of the

dozens of series, the only type of homicide that fluctuates with the seasons is homicide occurring out of doors or in a vehicle. This type of homicide tends to occur half as often in January and almost twice as often in August as in an average month.

Twenty years of Canadian homicide data were categorized into components comparable to those used in the Chicago analysis: age, sex, and ethnicity of victim; weapon; victim-offender relationship; and precipitating event (assault versus robbery). In addition, we analyzed each province separately. (For details, see Block,et al. 1983.) Consistently, each Canadian component showed a lower stable seasonality F value than the corresponding Chicago series (see Table 5). This difference was not due to more observations in the Chicago data. The Canadian series actually is longer, and contains about the same number of homicides per month as the Chicago series.

None of the California homicide series, nor the 20 component California series, was seasonal (however, note that these series are short). Neither the New York City series nor the Boston series was seasonal.

The only exception to the general finding of very low F values for homicide is United States homicide from 1970 through 1982. There are several possible reasons for this. First, the relatively high F value may reflect the high number of cases, which ranges from 1,087 to 1,866 per month. Second, it may reflect some artifact in the data. These data were collected by the FBI from reports from local jurisdictions, and the number of jurisdictions increases over time (see note 4, above). Third, it is possible that homicide fluctuates seasonally in some U.S. localities that we have not analyzed, Southern states for example. If so, seasonal fluctuation in these areas might override the lack of seasonal fluctuation in Illinois, New York City, Boston, and California to produce seasonality in the national aggregate.

Even though the United States Index murder series is significantly seasonal according to the Plewes criteria (page 5, above), the degree of seasonal fluctuation is very small. An indicator of this is the "final seasonal factors," a result of the Census X-11 analysis method. A seasonal factor can be interpreted as a monthly weight. If it is more than 1.00, then the month tends to be high; if it is less than 1.00, then the month tends to be low. For example, the January seasonal factors for Chicago homicides occurring outside or in a vehicle (see Table 4) are all less than 0.50 over the 17 years, and the August seasonal factors all approach 2.00. Twice as many outdoor homicides tend to occur in August, and half as many in January, as in a typical month.

Table 5

Census X-11 Results in Selected Homicide Series

	Additive Assumption			Multiplicative Assumption		
	Stable F	% Contribution Season	Irreg.	Stable F	% Contribution Season.	Irreg.
Total Homicide						
United States 1970-82	28.9	70.1%	28.2%	31.0	71.5%	27.1%
Canada 1961-80	1.4	13.7	86.0	1.4	16.7	83.0
Illinois 1972-81	2.8	29.0	70.4	2.8	29.4	70.0
California 1976-80*	4.3	44.0	53.8	7.8	49.2	48.7
Ontario 1961-80	0.8	18.7	81.0	0.8	16.6	83.2
Chicago 1965-81	5.6	30.5	67.2	5.3	27.1	70.7
Other Illinois 1973-82	0.5	9.7	90.0	0.5	5.4	94.5
New York City 1973-82	7.2	45.2	54.5	7.1	41.0	58.7
Los Angeles 1976-79*	2.7	39.1	60.4	2.4	35.8	63.7
Boston 1966-75	2.8	26.8	72.4	2.7	27.7	71.5
Homicide with a Gun						
Canada 1961-80	2.1	19.0%	80.6%	2.3	19.1%	80.7%
Illinois 1973-1982	2.0	26.9	72.5	2.1	9.0	90.3
California 1976-1979*	1.5	35.2	61.3	1.6	9.6	89.9
Ontario 1961-80	1.8	22.0	77.6	**	**	**
Chicago 1965-81	3.8	29.3	69.7	3.6	25.2	74.0
Other Illinois 1973-82	0.5	12.4	87.4	0.5	5.0	94.8
Los Angeles 1976-79*	1.4	41.8	57.7	1.3	31.4	67.7
Assault Homicide						
Canada 1961-80	1.9	22.0%	77.8%	1.7	26.6%	73.3%
Illinois 1973-1982	3.5	23.8	75.8	3.5	10.5	89.4
California 1976-79*	3.0	29.8	69.3	3.0	25.8	73.4
Chicago 1965-81	6.2	21.6	77.6	5.7	22.2	77.2
Other Illinois 1973-82	1.1	17.5	82.1	1.0	10.8	89.0
Robbery Homicide						
Canada 1961-80	1.9	25.1%	74.5%	**	**	**
Illinois 1973-82	1.3	19.8	77.3	**	**	**
California 1976-79*	0.5	9.0	90.4	0.5	9.6	89.8
Chicago 1965-81	2.4	9.1	80.5	2.4	19.1	80.5
Other Illinois 1973-82	0.7	13.6	86.0	**	**	**

*Note that this series contains fewer than seven years. See "Length of Series," above.

**Because the series contains one or more zero values, a multiplicative adjustment is not applicable.

In contrast, the seasonal factors for United States Index murder (multiplicative assumption) are close to 1.00 for all months. For 1982, they are the following:

January	.99	May	.99	September	1.03
February	.90	June	1.00	October	.99
March	.97	July	1.08	November	.98
April	.92	August	1.07	December	1.07

Seven to 8 percent more Index murders tend to occur in July, August, and December than in the typical month. About 10 percent fewer tend to occur in February.[8] Otherwise, no month tends to be particularly high or low. However, because this weak pattern is consistent throughout the 13 years of the series, and because the number of cases is so high, the F value is relatively high.

In summary, it is possible that certain types of homicide, such as those occurring out of doors or in certain parts of the country, vary with the season of the year. However, for most types of homicide in most places, seasonal fluctuation, if it exists, may be too weak to affect practical administrative or policy decisions.

Forcible Rape

Forcible rape, like homicide, is seasonal in the United States as a whole (Table 6). However, it is not seasonal, by the Plewes criteria, in New York City or in any of the Illinois jurisdictions we have analyzed, including three categories of counties: Cook County (which contains Chicago), small-city counties (nonmetropolitan counties with a city of 25,000 to 49,999 population), and rural counties (all other nonmetropolitan counties).

For other analyses of forcible rape, see, in the Review Bibliography below, Deutsch (1978), Edgerton et al. (1978), FBI (1981), Lamp (1983), Marshall (1977), Michael and Zumpe (1983). In the "Survey of the States," see California, Delaware, Kentucky, Maine, and North Carolina.

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[8]This is not surprising, given that February has about 7 percent fewer days than 30-day months and 10 percent fewer than 31-day months.

Table 6

Census X-11 Results in Selected Forcible Rape Series

	Additive Assumption			Multiplicative Assumption		
	Stable F	% Contribution Season.	Irreg.	Stable F	% Contribution Season.	Irreg.
U.S. 1970-82	110.8*	86.6%	12.1%	283.2	86.3%	12.6%
Illinois 1972-81	10.0	20.5	79.0	10.0	17.0	82.5
Cook County 1972-79	3.8	27.6	71.9	4.4	30.9	68.6
Chicago 1972-81	2.6	17.2	82.4	3.1	15.5	84.2
Small-city Coun. 72-79	1.7	27.6	72.1	**	**	**
Rural Coun. 1972-79	12.7	36.2	63.4	11.2	25.4	74.3
New York City 1973-82	10.9	40.3	59.4	10.8	28.1	71.8

*Moving seasonality present at the 1 percent level.
**Because the series contains one or more zero value, a multiplicative adjustment is not applicable.

Robbery

Robbery is a violent Index crime that also involves the taking of property. We have suggested above ("Does Crime Occur Seasonally, or Is It Reported Seasonally?") that the seasonal fluctuation found in some robbery series may reflect a tendency for less serious robberies (attempts, for example) to become known to the police more often in the summer months. The analyses of Index robbery conducted by the Authority do not offer much illimunination of this question (Tables 7 and 8).

We would expect that robberies known to the police, especially less serious robberies occurring in cities, to fluctuate seasonally. The number of Index robberies reported to the FBI in the United States as a whole does fluctuate seasonally (Table 8), as do Index robberies in New York City. In New York City, August and December have more robberies reported to the police than other months. In the United States as a whole, December is 16 percent to 18 percent higher, and April and May are 10 percent to 12 percent lower than the average month. If we consider armed robbery to be relatively serious, we would expect that it would not fluctuate seasonally, and that is what the 10-year Boston data indicate.

Robbery victimizations (occurring to noncommercial victims aged 12 and older) do not fluctuate seasonally (Table 8). Neither the weapon nor the relationship of the offender to the victim makes a difference in the seasonal fluctuation of robberies in the National Crime Survey.

Table 7

Bell-Canada F of Stable Seasonality, Index Robbery
Selected Illinois Cities, 1972 to 1981

City	Population	Stable Seasonality F	
		Additive Assumption	Multiplicative Assumption
Chicago	3,005,072	6.4	6.6
Springfield	99,098	4.2	4.6
Joliet	78,165	1.2	1.1
Champaign	57,176	1.1	1.0
East St. Louis	54,966	1.1	1.2
Quincy	42,048	1.9	*

*Because there is one or more zero value in the series, a multiplicative adjustment is not applicable.

Table 8

Census X-11 Results in Selected Robbery Series

	Additive Assumption			Multiplicative Assumption		
	Stable F	% Contribution Season.	Irreg.	Stable F	% Contribution Season.	Irreg.
U.S. 1970-82	146.7	87.5%	10.4%	159.0	86.5%	11.4%
Nat. Crime Survey 1973-79						
Total Robbery	4.6	34.0	63.7	4.5	27.3	70.4
Robbery with a gun	4.3	38.4	61.2	4.6	30.8	68.9
Rob. without a gun	2.3	24.8	72.9	2.3	23.4	74.7
Rob. by a stranger	4.8	39.7	58.5	4.5	34.0	64.1
Rob. by acquaintance	0.4	31.6	68.0	0.5	25.8	73.8
Illinois 1972-81	10.9	32.3	65.0	10.9	28.9	69.0
Chicago 1972-81	6.4	26.3	71.6	6.6	21.7	76.8
New York City 1973-82	36.1*	74.0	23.2	35.1	72.7	24.3
Boston 1966-75, armed	6.0*	36.8	60.0	5.6	41.2	55.4

*Moving seasonality present at the 1 percent level.

On the other hand, none of the Illinois series we have analyzed is seasonal by the Plewes criteria, whether the series includes data from the state as a whole, Chicago (Table 8), or various large and small jurisdictions (Table 7).

For other analyses of robbery, see, in the Review Bibliography below, Block (1979), Deutsch (1978), Deutsch and Alt (1977), Hay and McCleary (1979), FBI (1981), Ku and Smith (1977,1978), Marshall (1977), Michael and Zumpe (1983), US/BJS (1980). In the "survey of the states," see California, Delaware, Kentucky, Maine, and North Carolina.

Aggravated Assault

Assault is repeatedly used as an example in "Issues in the Seasonality of Crime," above. We suggest there that assault victimization may not vary seasonally, but that less serious assault may become known to the police more frequently in the summer months because it tends to be more public. The findings for assault in the Authority's analysis (Tables 9 and 10) do not, generally, conflict with this interpretation. However, neither do they give it strong support.

Among the Illinois cities we have analyzed for the 1972 to 1981 period (Table 9), assault fluctuates with the seasons in Chicago, but not in the smaller cities. If we analyze 15 years of data for Chicago, the presence of seasonal fluctuation is even clearer (Table 10). For Cook County and for Illinois as a whole, the irregular contribution is too high to make any definitive statement about seasonality.

Boston data for firearm assaults over 10 years show no seasonal fluctuation at all. New York City Index assault data, which include aggravated assault by any weapon, have a high stable seasonality F value, but, like the Illinois data, also have an irregular that is too high for a definitive statement.

There seems to be no question, however, of seasonal fluctuation in assault victimization, whatever the weapon or the relationship of the offender to the victim (Table 10). For all components of assault, F values are low and the irregular contribution is high.

For other analyses of assault, see, in the Review Bibliography below, Deutsch (1978), Deutsch and Alt (1977), Hay and McCleary (1979), FBI (1981), Marshall (1977), Michael and Zumpe (1983), Pittman (1964), US/BJS (1980). In the "Survey of the States," see California, Delaware, Kentucky, Maine, and North Carolina.

Table 9

Bell-Canada F of Stable Seasonality, Index Aggravated Assault
Selected Illinois Cities, 1972 to 1981

City	Population	Stable Seasonality F	
		Additive Assumption	Multiplicative Assumption
Chicago	3,005,072	32.3	28.9
Springfield	99,098	6.0	7.0
Joliet	78,165	2.0	1.5
Evanston	73,278	4.6	5.6
Champaign	57,176	4.8	4.8
East St. Louis	54,966	4.6	*
Schaumburg	52.083	0.7	*
Quincy	42,048	1.2	*
Carbondale	26,144	0.9	*

*Because there is one or more zero value in the series, a multiplicative adjustment is not applicable.

Table 10

Census X-11 Results in Selected Assault Series

	Additive Assumption			Multiplicative Assumption		
	Stable F	% Contribution Season.	Irreg.	Stable F	% Contribution Season.	Irreg.
U.S. 1970-82	94.7*	83.2%	15.2%	237.8	83.9%	14.6%
Nat. Crime Survey 73-79						
Total Agg. Assault	7.5	31.0	68.4	7.4	29.9	69.5
Assault with a gun	1.8	22.8	76.8	1.7	16.3	83.4
Ass. without a gun	9.4	47.3	52.0	9.4	45.8	53.6
Ass. by a stranger	4.8	18.8	80.4	4.6	20.6	78.7
Ass. by acquaintance	6.2	29.2	70.4	6.4	34.9	64.6
Illinois 1972-81	45.7	59.6	38.5	42.9	58.9	39.5
Cook County 1972-82	46.5	52.4	45.7	44.6	52.6	45.8
Chicago 1967-81						
Total agg. assault	109.1*	70.0	27.3	104.5*	70.3	27.4
Ass. with a gun	60.9*	60.0	35.4	54.2*	57.4	38.7
Ass. without a gun	89.2*	65.6	31.5	90.6*	65.0	32.4
New York City 1973-82	58.1*	62.6	37.0	60.6*	59.4	40.1
Boston 1966-75, gun	2.8	24.3	74.8	2.9	12.8	86.6

*Moving seasonality present at the 1 percent level.

Is Property Crime Seasonal?

Burglary

In the jurisdictions we have analyzed, burglary generally has a low F of stable seasonality (though not usually as low as homicide) and a high percent contribution of the irregular component (Tables 11 and 12). However, it is strongly seasonal in the United States as a whole and in New York City.

The contrast between New York City and Chicago is striking. Chicago X-11 results contain no hint of seasonality, while the same measures indicate consistent (but weak) seasonality in New York.[9] This trend is the same for robbery (Table 8, above), and for motor vehicle theft (Table 15, below).[10] A possible explanation, and one that could be tested, is that certain types of burglary are more apt to become known to the police in New York City but not in Chicago during some seasons, either because they usually become known or because they usually do not become known to the police in Chicago, regardless of the season.

For other analyses of burglary, see, in the Review Bibliography below, Block (1979), Deutsch (1978), FBI (1981), Ku and Smith (1977,1978), Marshall (1977), Schneider and Sumi (1977), US/BJS (1980). In the "Survey of the States," see California, Delaware, Kentucky, Maine, and North Carolina.

Larceny/Theft

Of all the crime types we have analyzed over the years, Index larceny/theft seems to have the most consistently seasonal pattern. The F of stable seasonality is high not only in Chicago (Table 13), but also in smaller cities (although the irregular contributions are often high). The F value is extremely high in the United States as a whole and in Illinois as a whole. In the United States, Illinois and New York City, seasonality contributes 80 percent to 90 percent of the month-to-month variation in the number of offenses known to the police. Cook County and those Illinois nonmetropolitan counties containing a city of 25,000 to 49,999 population also show seasonal fluctuation in the number of larceny/thefts known to the police.

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[9] In New York City, July and August have 6 percent to 10 percent more burglaries than the typical month.

[10] It is difficult to compare the seasonality of assault in the two cities (Table 10), because the Chicago series is much longer, and the New York series contains moving seasonality in both the additive and multiplicative adjustment. Moving seasonality indicates that more detailed analysis is necessary. For larceny/theft (Table 14), even though New York City is seasonal and Chicago is not by the Plewes criteria, the contrast is not as striking as for burglary or motor vehicle theft.

Table 11

Bell-Canada F of Stable Seasonality, Index Burglary
Selected Illinois Cities, 1972 to 1981

City	Population	Stable Seasonality F	
		Additive Assumption	Multiplicative Assumption
Chicago	3,005,072	5.4	5.2
Springfield	99,098	1.3	0.9
Joliet	78,165	6.2	6.5
Evanston	73,278	3.6	3.4
Oak Lawn	60,358	3.2	*
Champaign	57,176	7.3	7.2
East St. Louis	54,966	3.1	*
Schaumburg	52.083	1.4	1.2
Quincy	42,048	2.2	2.2
Carbondale	26,144	1.3	1.3

*Because there is one or more zero value in the series, a multiplicative adjustment is not applicable.

Table 12

Census X-11 Results in Selected Burglary Series

	Additive Assumption			Multiplicative Assumption		
	Stable F	% Contribution Season.	Irreg.	Stable F	% Contribution Season.	Irreg.
United States 1970-82	99.6*	89.8%	8.1%	130.6	90.1%	7.8%
Illinois 1972-81	19.3	55.9	41.7	19.0	53.6	44.2
New York City 1973-82	46.6	78.0	18.4	42.7	78.5	18.5
Chicago 1972-81	5.4	32.0	65.7	5.2	28.8	69.4
Champaign Co. 1972-79	5.1	40.2	57.9	1.5	43.0	55.0
Kankakee Co. 1972-79	4.4	30.3	66.4	4.1	23.8	72.9
Macon Co. 1972-79	2.4	16.7	80.9	2.4	19.6	78.0

*Moving seasonality present at the 1 percent level.

Table 13

Bell-Canada F of Stable Seasonality, Index Larceny/Theft
Selected Illinois Cities, 1972 to 1981

City	Population	Stable Seasonality F	
		Additive Assumption	Multiplicative Assumption
Chicago	3,005,072	39.9	36.9
Springfield	99,098	18.6	15.4
Joliet	78,165	10.9	12.1
Evanston	73,278	15.5	18.6
Oak Lawn	60,358	2.2	1.9
Champaign	57,176	7.4	6.2
East St. Louis	54,966	10.8	9.3
Schaumburg	52.083	7.9	8.0
Quincy	42,048	8.5	9.1
Carbondale	26,144	2.4	2.6

Table 14

Census X-11 Results in Selected Larceny/Theft Series

	Additive Assumption			Multiplicative Assumption		
	Stable F	% Contribution Season.	Irreg.	Stable F	% Contribution Season.	Irreg.
U.S. 1970-82	267.1	91.5%	6.7%	291.0	91.0%	7.0%
Illinois 1972-81	95.8	80.7	18.2	98.2	77.2	21.4
New York City 1973-82	59.1	80.2	17.1	65.3	79.5	18.0
Chicago 1972-81	39.9	60.1	38.3	36.9	54.4	44.1
Cook County 1972-79	75.1*	79.3	19.4	71.1	74.9	23.4
Small-city co. 72-79	46.5*	70.9	25.8	56.6	67.3	29.2
Rural counties 72-79	23.9*	53.6	43.2	29.3	50.5	46.9
Quincy 1972-81	8.6	32.3	65.4	9.0	32.3	64.8

*Moving seasonality present at the 1 percent level.

Such a strong seasonal pattern can be useful in practical situations. In our experience, a good prediction of larceny/theft can often be made by knowing the seasonal pattern and little else.[11]

For other analyses of larceny/theft, see, in the Review Bibliography below, Deutsch (1978), FBI (1981), Lamp (1983), US/BJS (1980). In the "Survey of the States," see California, Delaware, Kentucky, Maine, and North Carolina.

Motor Vehicle Theft

Index motor vehicle theft is seasonal in the United States as a whole and New York City, but not in any of the other jurisdictions we analyzed. In New York City and in the nation as a whole, the number of motor vehicle thefts known to the police tends to be high from July through October. As with burglary, the contrast between the lack of seasonal variation in Chicago and the strong seasonal variation in New York City is striking. As we suggested for burglary, this may be due to differences between the cities in reporting practices for certain types of motor vehicle theft.

For other analyses of motor vehicle theft, see, in the Review Bibliography below, Deutsch (1978), FBI (1981), and US/BJS (1980). In the "Survey of the States," see California, Delaware, Iowa, Kentucky, Maine, and North Carolina.

Table 15

Census X-11 Results in Selected Motor Vehicle Theft Series

	Additive Assumption			Multiplicative Assumption		
	Stable F	% Contribution Season.	Irreg.	Stable F	% Contribution Season.	Irreg.
U.S. 1970-82	167.9	90.0%	8.9%	172.5	90.4%	8.5%
Illinois 1972-81	13.0*	39.1	59.6	12.7*	38.1	60.5
New York City 73-82	46.0*	74.8	23.0	39.2*	72.6	25.1
Chicago 1972-81	5.0	17.9	81.8	5.0	17.2	82.5
Small-city co. 72-79	6.9	41.4	55.8	7.1	38.9	58.6
Rural co. 1972-81	12.8	38.0	59.3	10.7	30.7	68.6
Quincy 1972-81	4.0	21.5	78.0	4.5	9.3	90.4

[11]See the forthcoming Authority report, "The Predictability of Crime."

Summary

As we stated in the Introduction to this report, the answer to the question, "Is crime seasonal?" is not nearly as straightforward as is usually believed. However, with the accummulated knowledge from the seasonal analyses summarized in this section, and with knowledge derived from other studies of seasonality (see the Review Bibliography), perhaps we can, at least, define the question a little more carefully.

Any discussion of seasonal fluctuation in crime must be carefully qualified by several considerations: 1) the place (rural versus urban, Southern versus Northern); 2) the conceptual and operational definitions of the crime (victimizations versus crimes known to the police, attempts versus completed crimes); 3) circumstances relating to public or private crime (weapon, place of occurrence, injury, victim-offender relationship, property loss); and 4) numerical aspects of the series that would increase the likelihood of significant results (longer series and higher observations). Before anyone can make a definite statement as to the seasonality of crime, it is necessary to design a well-controlled study taking all these factors into account.

A working hypothesis for such a study, taking the totality of our knowledge of the seasonality of crime into account, might be the following: The direct effect of the seasons on the number of crimes occurring is small or nonexistent for most types of crime. Although this small effect may be unimportant for practical administrative or policy decisions, it may be important in a detailed explanatory or predictive analysis. However, the seasons are related to the likelihood that less serious crimes will become publicly known, in particular, known to the police.

The analysis of seasonal fluctuation in crime may have broader utility than providing a yes-or-no answer to the substantive question, "Is crime seasonal?" Several of the above analyses (seasonal fluctuation in New York City versus Chicago, and in assault versus assault homicide) suggest that seasonal fluctuation or lack of seasonal fluctuation in a data set may provide a clue as to the way in which the crime under discussion was defined, and the process by which the criminal justice agency collected and maintained records of the crime's occurrence. We suspect that seasonal analysis may be even more useful as an indicator of data definition and data quality than it is as an indicator of seasonal fluctuation in crime.

REVIEW BIBLIOGRAPHY

This is a comprehensive listing of analyses of seasonal fluctuation in crime, published and unpublished, concentrating on research from the 1960's to the present. (For earlier research, see Wolfgang's review, 1966.) Only analyses of crime incidents, reported or unreported to the police, are included in the review; analyses of arrests, court appearances or judgments, prison population, or other criminal justice data series are not included here. The review also includes a summary of the findings of a previously unpublished "Survey of the States," conducted in 1979, in which government officials from each state were asked to describe existing analyses of seasonal fluctuation of crime in their State.

The review does not include those unpublished analyses that the Authority has conducted over the years, and that have been covered earlier in this report: homicide in California, Canada, the United States, and Illinois; Index crime in the United States and New York City; certain crimes in Boston; National Crime Survey robbery and assault estimates for the United States; and Index crime in Illinois and cities within Illinois.

The studies have not been chosen for their quality, and are not necessarily methodologically sound. They have been chosen only because each addresses the question of seasonality in crime. The results given for each study represent the findings of its author or authors, not the opinion of the author of this review or the Authority.

For each study, the review specifies title and author, type of crime analyzed, time period and geographical area, method and criteria used, as well as the findings. The included studies vary greatly in method, crimes analyzed and their definitions, and even the author's definition of seasonal fluctuation. It is incumbent upon the reader, therefore, to take characteristics of each study into account when making a decision as to its contribution to our knowledge on the subject.

The reader should be especially cautious regarding the length of the time series analyzed in each study. As we discuss above (see "Length of Series"), the results of any analysis of fewer than seven years should be read with skepticism. Many of the studies in this section utilize fewer than seven years of data, and some base their conclusions on one year only.

The reader may not be familiar with some of the terms used in the Review Bibliography under the categories "method," "criteria," and "results." These terms are explained in the report, How to Handle Seasonality (Block, 1983), which also contains, for those who want more detail, an annotated bibliography of the seasonal analysis literature. For the purpose of understanding the present report, however, the following may be helpful:

ARIMA model	A stochastic model of the form (p,d,q)(sp,sd,sq) where p = degree of autoregressive process, d = degrees of differencing, q = degree of moving average process, and sp, sd, and sq indicate seasonal autoregressive, seasonal differencing, and seasonal moving average process, respectively. If the second term is not in the model, it is not a seasonal model.
Autocorrelation	Describes the relationship of observations within a series. In a seasonal series, observations 12 months apart are correlated. In a successful model, the residuals will not be autocorrelated.
Bell-Canada	A short version of the Census X-11, used as a screener.
Census X-11	A method of analyzing seasonality, developed by the U.S. Census, and widely used from the 1950's to the present. It divides a series into three components: seasonal, trend/cycle and irregular.
Contribution of the Irregular	A statistic generated by the X-11; the percent contribution of the irregular component to month-to-month variation in the series. Contributions of the three components add to 100 percent. See page 5, above.
Plewes rule-of-thumb	Criteria for the presence of seasonal fluctuation in a series. If the irregular contributes 30 percent or more of the total month-to-month variation, the decision should be "no stable seasonality," regardless of the F value. If the percent contribution is 25 to 29 the F value needs to be at least 15, and if the percent contribution is 15 to 24 the F value needs to be at least 2.41 for the series to be considered seasonal.
Stable Seasonality F	A statistic generated by the X-11: the ratio between the seasonal and irregular components. See page 5, above.
Stochastic model	An approach to seasonal analysis that emphasizes forecasts and the relationship of each observation to previous observations. The "Box/Jenkins" and "ARIMA" methods involve stochastic models.

Banks, Jerry and David Vatz
1976 Sinusoidal pattern analysis in criminal incidence. Criminology 14(2,August):241-250.

CRIME: "Serious offenses committed by juveniles." (No greater detail provided.)
TIME, PLACE: Fulton County, Georgia. January 1972 to March 1974 (two and one-half years).
METHOD: Multiple stepwise regression; trend and sine-cosine components.
CRITERIA: Regression components must exceed two times their standard error, and if one member of a sine-cosine pair is significant, the other is significant.
RESULTS: Two peaks and two valleys occur each year. June and December are low.

Block, Carolyn Rebecca
1979 Descriptive Time Series Analysis for Criminal Justice Decision Makers: Local Illinois Robbery and Burglary. Chicago: Statistical Analysis Center, Illinois Law Enforcement Commission.

CRIME: Index Burglary, Index Robbery.
TIME, PLACE: 77 Illinois jurisdictions (counties, cities with more than 25,000 population, planning regions) 1972-1977. Note: series are six years long.
METHOD: Bell-Canada screener; Census X-11.
CRITERIA: Plewes rule-of-thumb for stable seasonality F and percent contribution of irregular.
RESULTS: No seasonality in any series.

Block, Carolyn Rebecca and Richard L. Block
1980 Patterns of Change in Chicago Homicide: The Twenties, The Sixties, and the Seventies. Statistical Analysis Center, Illinois Criminal Justice Information Authority.

CRIME: Eighteen types of homicide (homicides attributed to white, black or Latin offenders, to young or older offenders, to male or females; homicides of victims by age, sex, and race categories; homicide with a gun or another weapon; homicides precipitated by a fight or robbery; and combinations of these).
TIME, PLACE: Chicago, 1965-1976.
METHOD: Bell-Canada screener, Census X11, stochastic model.
CRITERIA: Plewes rule-of-thumb for stable seasonality F and percent contribution of the irregular; simplest model with no significant autocorrelations in residuals.
RESULTS: No seasonality in any series.

Block, Carolyn Rebecca, Craig McKie, and Louise S. Miller
1983 Patterns of change over time in Canadian and United States Homicide. Policy Perspectives 3(2):121-180.

CRIME: Thirteen types of homicide (gun vs. not gun; offender age 15-24 vs. other; fight vs. robbery; family vs. acquaintance vs. stranger; "native" vs. other for Canada; black vs. other for Chicago; female vs. male victim).
TIME, PLACE: Chicago, 1965-1981; Canada 1961-1980, also each Canadian province for same time period.
METHOD: Bell-Canada screener, Census X-11.
CRITERIA: Plewes rule-of-thumb for F of stable seasonality and percent contribution of irregular.
RESULTS: No seasonality in any series. Highest F of Canadian series, 2.18. Highest F of Chicago series, 4.23 (irregular contribution 60 percent).

Block, Carolyn Rebecca, Louise S. Miller, Richard Block, Douglas Hudson
1981 Explaining patterns of change over time in Chicago homicides with a gun. Manuscript. Statistical Analysis Center, Illinois Law Enforcement Commission.

CRIME: Homicide with a firearm (same types as above), handgun, rifle, and shotgun registrations, gun and not-gun suicides, gun and not-gun aggravated assaults; also number of general assistance (GA) and aid to dependent children (ADC) cases.
TIME, PLACE: Homicide, Chicago 1965-1978; registrations, Chicago 1969-1980; suicide, Cook County 1963-1979; assault, Chicago, 1965-1978; GA and ADC, Cook County 1965-79.
METHOD: Bell-Canada screener, Census X-11.
CRITERIA: Plewes rule-of-thumb for stable seasonality F and percent contribution of irregular.
RESULTS: No homicide series was seasonal. Rifle and shotgun but not handgun registrations seasonal. Assault seasonal. Neither gun nor not-gun suicide seasonal. ADC seasonal after 1975, not before. GA not seasonal.

Deutsch, Stuart Jay
1978 Stochastic models of crime rates. International Journal of Comparative and Applied Criminal Justice 2(2):127-151.

CRIME: Seven Index crimes: homicide, forcible rape, robbery, aggravated assault, burglary, larceny/theft, and motor vehicle theft.
TIME, PLACE: Ten cities: Jan. 1966 to July 1975 for St. Louis, Portland, Los Angeles, Kansas City, Atlanta, Cleveland, Boston and Denver. Jan. 1970 to July 1975 (five and one-half years) for Dallas and Cincinnati.

METHOD: Stochastic modelling.
CRITERIA: Simplest model with no significant autocorrelations in residuals.
RESULTS: Homicide and rape not seasonal in any city. ARIMA model for all other crimes in all cities was (0,1,1)(0,1,1).

Deutsch, Stuart Jay and Francis B. Alt
1977 The effect of Massachusetts' gun control law on gun-related crime in the city of Boston. Evaluation Quarterly 1(4, November):543-568.
Deutsch, Stuart Jay and Lu Ann Sims
1978 An identification algorithm for dynamic intervention modeling with application to gun control. Series no. J-78-29, Georgia Institute of Technology, Atlanta 30332. Mimeographed.
Hay, Richard A., Jr. and Richard McCleary
1979 Box-Tiao time series models for impact assessment: A comment on the recent work of Deutsch and Alt. Evaluation Quarterly 3(2,May):277-314.
Deutsch, Stuart Jay
1979 Lies, damn lies and statistics: A rejoinder to the comment by Hay and McCleary. Evaluation Quarterly 3(2, May):315-328.

CRIME: Homicide, assault with a gun, armed robbery.
TIME, PLACE: Boston, Jan. 1966 to Oct. 1975 for Deutsch and Alt and Hay and McCleary; Jan. 1966 to Sept. 1977 for Deutsch and Sims.
METHOD: Stochastic modelling.
CRITERIA: Simplest model with no significant autocorrelation in residuals.
RESULTS: All analysts agree that homicide is not seasonal. ARIMA models for assault and robbery found by Deutsch and Alt and Deutsch and Sims:(0,1,1)(0,1,1) Hay and McCleary, using the same method and data, find a (0,1,1)(0,0,1) model for assault, and log (0,1,1)(0,0,1) for robbery.

Edgerton, Julie, Linda Phelps,Karen Boley-Chang,Constance Osgood
1978 Ecology of Rape, Kansas City Metropolitan Area: Summary Report of the Rape Data Bank. Institute for Community Studies, University of Missouri, Kansas City. Report prepared for the Metropolitan Organization to Counter Sexual Assault.

CRIME: Rapes known to the police.
TIME, PLACE: Kansas City, Missouri, Kansas City, Kansas, and Independence, Missouri, 1971 and 1975 (two years).
METHOD: Inspection of monthly data.
CRITERIA: Not specified.
RESULTS: "No definite seasonal pattern."

Federal Bureau of Investigation
1981 Crime in the United States: Uniform Crime Reports 1980. U.S. Department of Justice, Washington, D.C. 20525.

CRIME: Index offense rates, agencies reporting all 12 months of each year.
TIME, PLACE: 1971-1980, United States.
METHOD: Quarterly data, expressed as a relative crime rate (proportion of the first quarter, 1971). Ratio-to-moving average for each quarter, averaged over 10 years into a "seasonal index."
CRITERIA: Not specified.
RESULTS: Seasonal indices (see method), by quarter, are:

	Q1	Q2	Q3	Q4
Murder:	95.0	95.4	104.2	105.5
Forcible Rape:	85.9	101.5	116.8	95.8
Robbery:	97.5	89.7	101.0	111.7
Agg. Assault:	88.6	103.4	110.8	97.2
Burglary:	96.1	94.6	104.8	104.4
Larceny/Theft:	88.5	102.5	109.1	99.9
Motor Veh. Theft:	91.7	98.0	106.6	103.8

Ku, Richard and Bradford Smith
1977 First Year Evaluation of the Illinois Urban High Crime Reduction Program: Final Report. Manuscript. Abt Associates, Inc., Cambridge, Massachusetts.
1978 Second Year Evaluation of the Illinois Urban High Crime Reduction Program: Final report. Manuscript. Abt Associates, Inc., Cambridge, Massachusetts.

CRIME: Residential burglaries and robberies known to the police.
TIME, PLACE: Jan. 1972 to June 1978 in three Illinois cities: Peoria, Champaign, and Joliet.
METHOD: Ratio-to-moving-average.
CRITERIA: Not specified.
RESULTS: Not specified, but subsequent analysis uses seasonally adjusted data.

Lamp, Rainer
1983 Jahreszeit und Kriminalitat. (Time of year and criminality) Paper presented at the International Congress on Criminology, Vienna. Max-Planck-Institut, Freiburg.

CRIME: Total crime, theft, rape, murder.
TIME, PLACE: Federal Republic of Germany, 1971-1980.
METHOD: Census X-11, stochastic modelling.
CRITERIA: Percent contributions of three components, accuracy of 1981 forecasts, simplest model with no significant autocorrelations in residuals.
RESULTS: Both methods agree: Murder not seasonal, but theft, rape, and total crime are seasonal (strong moving average effect).

Marshall, Clifford W.
1977a Application of Time Series Methodology to Crime Analysis. The Polytechnic Institute, 33 Jay St. Brooklyn, 11201. Law Enforcement Assistance Administration Grant #76-TA-99-0028
1977b The State Space Forecasting Technique Applied to Reported Crime Data. Supplement to 1977a, above.

CRIME: Robbery, aggravated assault, burglary, rape.
TIME, PLACE: "District 1" of Cincinnati, 1968-1974.
METHOD: Census X-11.
CRITERIA: Stable seasonality F of 2.41, "reasonable" graphs of three components.
RESULTS: Robbery seasonal with December consistently high. Aggravated assault seasonal (F = 2.78). Burglary and rape show no seasonal effects.

Michael, Richard P. and Doris Zumpe
1983 Sexual violence in the United States and the role of season. The American Journal of Psychiatry 140(7,July): 883-886.

CRIME: Rates of forcible rape, aggravated assault, robbery, murder.
TIME, PLACE: 1975-1979 (five years): Alabama, Arizona, Georgia, Honolulu, Illinois, Los Angeles, Maine, New Mexico, North Carolina, Oregon, Puerto Rico, San Francisco, South Carolina, Tennessee, Texas, Utah.
METHOD: Harmonic analysis of crime rates and monthly mean temperature, separate analyses for each crime and place. Locations ranked by latitude.
CRITERIA: Significance of relationships between crime, latitude, and temperature, Spearman rank correlation.
RESULTS: Assault seasonal in 12 locations, rape in 14, robbery in five, murder in one. Latitude had no effect, but temperature was significant for assault and rape.

Munford, Robert S., Ross S. Kazer, Roger A. Feldman, and Robert R. Stivers
1976 Homicide trends in Atlanta. Criminology 14(2,August):213-232.

CRIME: Criminal homicide, as determined by investigating authorities. Justifiables not included.
TIME, PLACE: Residents of Atlanta killed in Atlanta or in DeKalb County, 1961-1962, 1971-1972 (four years.)
METHOD: Crosstabulations.
CRITERIA: Chi square; $p < .01$.
RESULTS: "No seasonal trend in the occurrence of homicide was observed in either time period."

Pittman, David J. and William Handy
1964 Patterns in criminal aggravated assault. Journal of Criminal Law, Criminology, and Police Science 55:462-470.

CRIME: Aggravated assaults known to police.
TIME, PLACE: St. Louis, 1961. Note: one year only.
METHOD: Crosstabulations.
CRITERIA: Chi square.
RESULTS: No seasonal pattern in zero-level tables, no relation between indoor-outdoor location and season.

Schneider, Anne L. and David Sumi
1977 Patterns of Forgetting and Telescoping in LEAA Survey Victimization Data. Institute of Policy Analysis, 777 High Street, Suite 222, Eugene, Oregon 97401.

CRIME: Burglary victimization, National Crime Survey.
TIME, PLACE: Eighteen cities (all available cities), 10 months of 1972, 1973, or 1974 (one year per city).
METHOD: "Seasonal Distinctiveness" (range of mean monthly temperature for year of survey), recall patterns (telescoping and forgetting), and season in which survey was fielded.
CRITERIA: Correlations, inspection of graphs.
RESULTS: Seasons influence memory. More crimes are reported to victim survey interviewers in the summer. This is especially true of crimes that the victim had not reported to the police.

Stein, Donald P., Jay-Louise Crawshaw and Algrid R. Barskis
1967 Computer-Aided Crime Prediction in a Metropolitan Area. Technical Reports 1-202 and 1-202-A, The Franklin Institute Research Laboratories, Philadelphia.

CRIME: Part I Index offenses, 5 percent sample.
TIME, PLACE: Philadelphia SMSA, 1966. Note: one year only.
METHOD: Multiple regression. Other variables: weather, time of day, day of week, phase of the moon.
CRITERIA: Probability that a certain type of crime would occur, given that some crime did occur.
RESULTS: Criteria render results irrelevant.

United States, Bureau of Justice Statistics
1980 Crime and Seasonality. National Crime Survey Report SD-NCS-N-15,NCJ-64818. Report written by Richard W. Dodge and Harold R. Lentzner, Crime Statistics Analysis staff, Center for Demographic Studies, U.S. Bureau of the Census.

CRIME: Household larceny (total, and more and less than $50), personal larceny without contact (total, and more and less than $50), residential burglary (total, forcible entry, and unlawful entry), motor vehicle theft, assault (total, aggravated and simple), noncommercial robbery. Crimes occurring in "series" (recurring offenses) not included. National Crime Survey incident-level data.

TIME, PLACE: United States, 1973-1977 (five years), persons aged 12 and older.

METHOD: Census X-11.

CRITERIA: Stable seasonality F of 10 or more. F 2.34 - 9.99 considered "merely indicative of seasonality." Percent contribution of seasonal component, and seasonal factors.

RESULTS: Household larceny F=51.75 (less than $50, F=22.61; more than $50, F=27.65); personal larceny F=25.08 less than $50, F=43.50; more than $50, F=15.36); residential burglary F=22.98 (forcible entry F=7.04; unlawful entry F=35.96); motor vehicle theft F=7.09; assault F=7.52 (aggravated F=5.80; simple F=4.79); robbery F=2.15.

Warren, Charles W., Jack C. Smith and Carl W. Tyler
1981 Seasonal variation in suicide and homicide: A question of consistency. Unpublished manuscript. Public Health Service, U.S. Centers for Disease Control, Atlanta, 30333.

CRIME: Homicides, except for deaths resulting from legal intervention, and suicides of people over age 14, National Vital Statistics Mortality files.

TIME, PLACE: United States, 1969-1978.

METHOD: Periodic regression analysis (PRA). See Bliss (1958, 1970).

CRITERIA: Goodness of fit of PRA model.

RESULTS: Both homicide and suicide have significant monthly patterns within each year. For homicide, however, the pattern differs from year to year. December, for example, is a "peak month" in some years and a "trough month" in other years. Suicide is consistently high in the spring and low in the winter.

Wolfgang, Marvin E.
1966 Patterns in Criminal Homicide. New York: John Wiley & Sons

CRIME: Homicide, by race and sex of victim. Number of multiple suspects arrested for criminal homicide.

TIME, PLACE: Philadelphia, 1948-1952 (five years); United States, 1930 and 1950.

METHOD: Proportion of total homicides, aggregated over the five years, occurring in each month.

CRITERIA: Inspection of table.

RESULTS: Rejected "hypothesis (of) a relationship between monthly or seasonal changes and variations in criminal homicide." For the United States, 1930 and 1950 September is a high month. Arrests of multiple suspects show greater seasonal fluctuation.

Survey of the States, 1979

In late 1979, the Illinois Law Enforcement Commission (predecessor to the Authority) surveyed each state, asking the director of each criminal justice planning agency the following:

> Has anyone analyzed reported Index crimes in your state to determine whether they increase and decrease with the seasons? If so, we would appreciate a copy of the publication, or a summary of the findings if they have not been published.

We received responses from 17 states and the District of Columbia. Six of these states said that they had not analyzed seasonality. The findings of the other respondents appear below.

Arizona

CRIME:	Property crimes (burglary, larceny/theft, and motor vehicle theft).
TIME, PLACE:	Arizona, by county, 1975 to 1977 (three years).
METHOD:	Mean across three years of number occurring in each month. Northern counties and Maricopa and Pima Counties analyzed separately.
CRITERIA:	Inspection of graph.
RESULTS:	Number of property offenses varies with the tourist season (northern counties high in summer months, Maricopa and Pima high in winter months).

California

CRIME:	Each Index crime (willful homicide, forcible rape, robbery, aggravated assault, burglary, theft, motor vehicle theft).
TIME, PLACE:	California, 1974-1978 (five years).
METHOD:	Graphs of number of offenses known to police each month over the five-year period.
CRITERIA:	Inspection.
RESULTS:	Homicide: decreases each February, many fluctuations from month to month. Rape: high July-October, low January-February. Robbery: high December, low May-June. Assault: peak in summer or fall. Burglary: high in fall and winter, lowest in June. Theft: September low in all years, but pattern inconsistent for other months. Motor vehicle theft: no consistent pattern for all years.

Delaware

CRIME: Each Index crime.
TIME, PLACE: Total Delaware, and Sussex County, 1976-1978 (three years).
METHOD: Ratio-to-moving-average.
CRITERIA: Not given.
RESULTS: Homicide, burglary, and motor vehicle theft not seasonal. Rape, robbery, assault, and larceny seasonal. Sussex County, which has a lot of tourism, has large seasonal fluctuations.

Iowa

CRIME: Motor vehicle theft, by type of vehicle.
TIME, PLACE: Iowa, 1975-1978 (four years).
METHOD: Graph of each type of motor vehicle theft.
CRITERIA: Inspection of graph.
RESULTS: Decrease of total motor vehicle theft in winter, due entirely to a decrease in theft of motorcycles.

Kentucky

CRIME: Each Index crime.
TIME, PLACE: Total state, 1973-1978 (six years). For homicide, 1978 only.
METHOD: Comparison of high and low months.
CRITERIA: Inspection.
RESULTS: 1978 homicide high in late spring and summer. Rape consistently high in summer, low in January. Robbery highest in final quarter of year. Assault high May to September, low January, February. Breaking and entering slightly more frequent in second half of year. Larceny consistently high June to August. Auto theft high July to August, low January-February.

Maine

CRIME: Each Index crime.
TIME, PLACE: Maine, 1975-1978 (four years).
METHOD: Graphs of number of offenses known to police per month.
CRITERIA: Inspection.
RESULTS: Homicide, rape, robbery not seasonal. Assault high May-October. Burglary high October-November. Larceny/theft strongly seasonal, high June-October. Motor vehicle theft high July-October. Seasonality may be an artifact of population fluctuation. Total Index crime rates, counting residents plus transients in the denominator, is not seasonal.

New Jersey

CRIME: Violent Index crime (homicide, rape, robbery, assault); nonviolent Index crime (burglary, larceny/theft, motor vehicle theft)
TIME, PLACE: New Jersey, 1975-1977 (three years).
METHOD: Graphs of crimes known to the police.
CRITERIA: Inspection.
RESULTS: Violent crime not seasonal. Nonviolent crime high June-September, low January-February.

North Carolina

CRIME: Each Index crime.
TIME, PLACE: North Carolina, 1977-1978 (two years).
METHOD: Graphs of crimes known to the police.
CRITERIA: Inspection.
RESULTS: Murder and motor vehicle theft are not seasonal. Rape and aggravated assault: high in summer. Robbery, burglary high in December; larceny/theft high in August.

Virginia

CRIME: Personal Index crime (homicide, rape, assault); property Index crime (robbery, burglary, larceny/theft, motor vehicle theft).
TIME, PLACE: Virginia, 1975-1978 (four years).
METHOD: Graphs of crimes known to the police.
CRITERIA: Inspection.
RESULTS: Personal crimes high June-August; property crimes high July-August.

Washington

CRIME: Homicide.
TIME, PLACE: Washington, 1958-1962 (five years).
METHOD: Graph.
CRITERIA: Inspection.
RESULTS: No seasonal pattern.

Washington, D.C.

CRIME: Violent and property Index crime.
TIME, PLACE: District of Columbia, 1977 and 1978 (two years).
METHOD: Graphs.
CRITERIA: Inspection.
RESULTS: Violent crime not seasonal. Property crime peaks in August.

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1932 Homicide in the United States. Chapel Hill: The University of North Carolina Press.

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1980 Aggregation problems in the analysis of Illinois statewide data. Statistical Analysis Center, Illinois Criminal Justice Information Authority.

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1978 An overview of the objectives and framework of seasonal adjustment. Pp. 3-25 in Zellner (ed) Seasonal Analysis of Economic Time Series. Proceedings of the Conference on the Seasonal Analysis of Economic Time Series, September 9-10, 1976, U.S. Department of Commerce, Bureau of the Census, Economic Research Report ER-1.

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1981 The Bartley-Fox gun law's short-term impact on crime in Boston. The Annals of the American Academy of Political and Social Science 455(May):120-137.

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