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The Seasonality of Crime Victimization

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Introduction and highlights

Seasonality in the occurrence of crime has been noted by many observers over the years.[1] National Crime Survey (NCS) data have been analyzed from this perspective using the first 5 years of survey results.[2] This report is a further examination of seasonality in crime using NCS data from 1973 through 1984.

The National Crime Survey is a continuous survey of a nationally representative sample of households. Data for 1984, for example, were based on interviews with approximately 114,000 individuals age 12 and older living in 54,000 households. The NCS focuses on selected crimes, including those not reported to the police, that are of major concern to the general public and to law enforcement authorities: specifically, the personal crimes of rape, robbery, assault, and larceny and the household crimes of burglary, larceny, and motor vehicle theft.

The major findings on seasonality may be summarized as follows:

- **Based on total victimizations, the highly seasonal crimes are household larceny $50 or more, rape, household larceny less than $50, and unlawful entry. Those crimes exhibiting the least amount of seasonality are personal larceny without contact $50 or more, motor vehicle theft, robbery, forcible entry, and simple assault.**

- **In general, the amount of seasonality observed for a particular crime is similar for both those crimes that are reported to the police and those that are not. However, there are notable exceptions, such as simple assault and forcible entry.**

- Despite the general similarity between reported and nonreported crimes in the amount of seasonality, where there are differences, crimes reported to the police tend to be more seasonal.

[1]For a bibliography of analyses of seasonality in crime, see Block, Carolyn R., Is Crime Seasonal?, Statistical Analysis Center, Illinois Criminal Justice Information Authority, Chicago, Illinois, 1984, pp. 31-40.

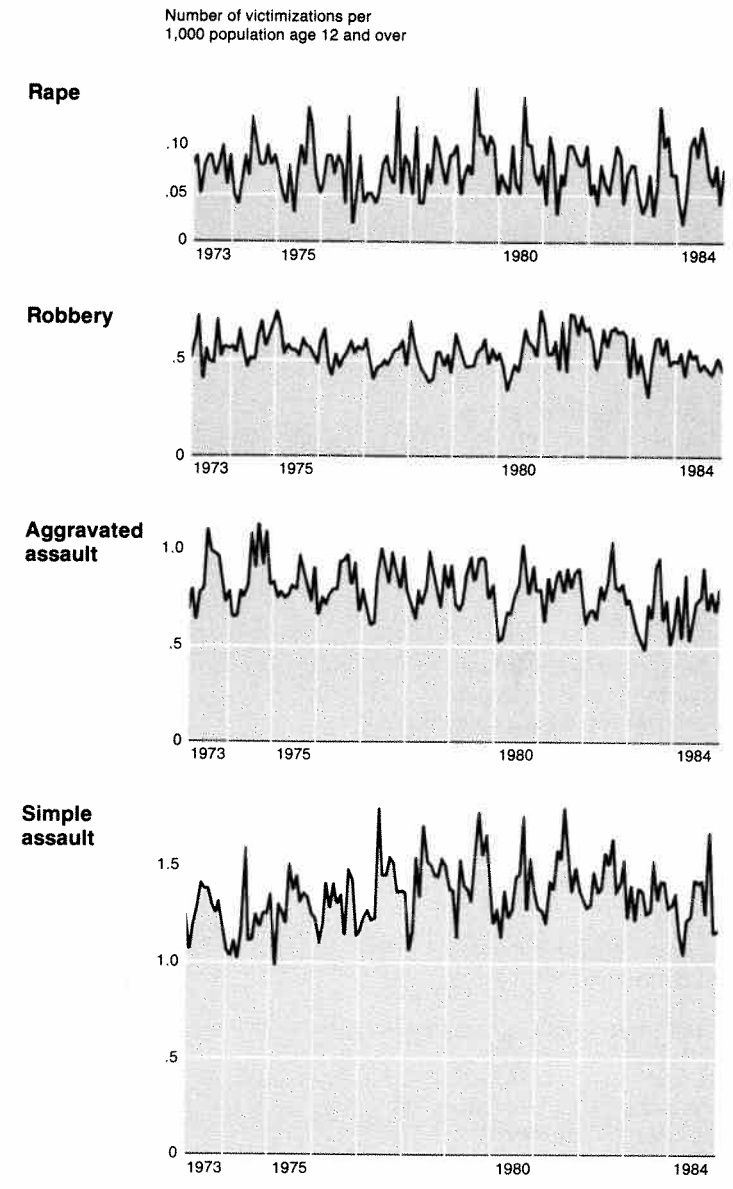
[2]Crime and Seasonality, Bureau of Justice Statistics, NCJ-64818, May 1980.

• The usual seasonal pattern is for the high-crime months to occur in the summer and the low-crime months in the winter. There are several significant exceptions to this pattern, such as robbery and personal larceny with contact, which peak in December.

• Crimes with the same amount of seasonality may have very different month-to-month patterns.

To provide a general context for the report, monthly victimization rates for each crime have been plotted for the 12 years covered by the study, 1973-84 (figures 1-3). These are the basic rates with no adjustment for trends or deletion of obvious outliers. The graphs indicate a great deal of variation in rates within crimes over the years. Some crimes can be seen by inspection to behave with more regularity from year to year than do others, for example, household larcenies amounting to $50 or more (figure 2) compared to robbery (figure 1). Although it is difficult to discern many trends, the effects of inflation are evident in the graphs of personal and household larceny (figure 2). Caution should be exercised in comparing one graph to another in terms of the amplitude of the movements in rates because the vertical scales are not constant, but vary depending upon whether the crime has a monthly victimization rate that is low (rape) or high (unlawful entry). Also, rates for the personal crimes (rape, robbery, assault, and larceny) are based on the number of persons age 12 and older. Those for the household crimes (burglary, larceny, and motor vehicle theft) are based on the number of households.

Violent crime victimization rates, 1973–84



Note: Victimization rates for rape are displayed on a different scale from the other crimes.

Figure 1

Personal and household larceny victimization rates, 1973–84

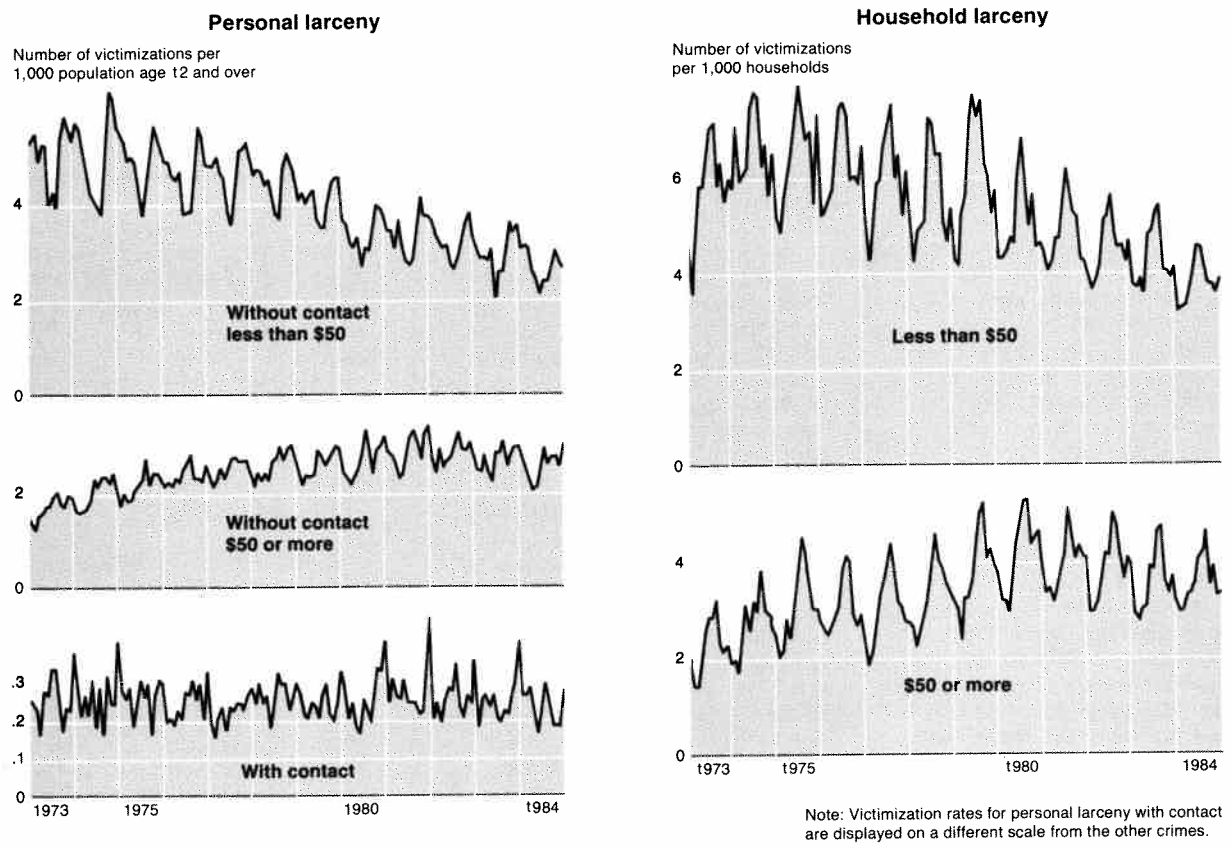


Figure 2

Burglary and motor vehicle theft victimization rates, 1973–84

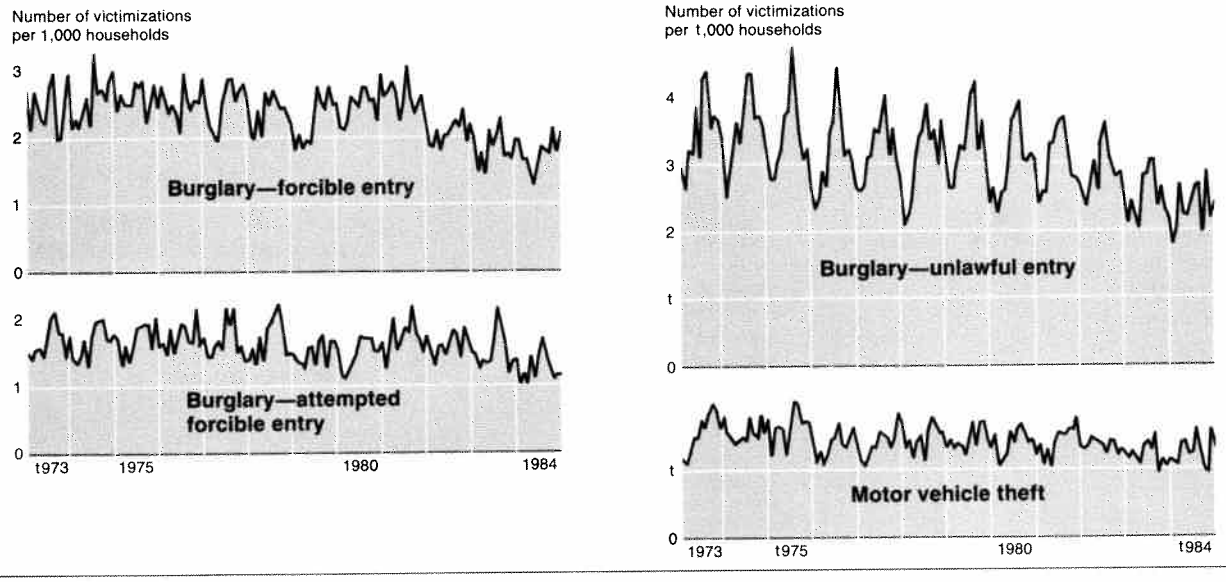


Figure 3

Definition of seasonality

Individual behavior patterns change with the seasons and with them the opportunity for crime to occur. For example, people spend more time outside in the warmer weather, increasing the number of potential targets for street crime. Doors and windows in homes are more apt to be open or left unlocked at these times and thus provide easier access to intruders. More household articles are likely to be left outside, serving as invitations to theft. Patterns of economic activity may also be related to ebbs and flows of crime, especially the purchase of retail goods and services. The data in this report attempt to describe seasonal patterns in crime and to speculate on the reasons behind them.

As Block has observed, whether a particular time series is seasonal depends to a great extent on how seasonality is defined.[3] In this study, the crimes are examined from two perspectives. One analyzes the total variation of the average monthly victimization rates from the mean for the 12-year period and constructs a standardized index that enables each crime to be ranked according to the amount of variation it exhibits. This statistic is designated as the Coefficient of Seasonal Variation (CSV), and the specific values are referred to as indicators of seasonality. The other measure is the Coefficient of Determination, more commonly known as R^2, and indicates the proportion of the variation in the monthly victimization rates that is explained by differences between months. The R^2 focuses on the consistency of the seasonal patterns from year to year and thus more nearly corresponds to the definition of seasonality as recurring patterns of similar timing and amplitude. In this report, R^2 values are referred to as measures of consistency.

[3]See footnote 1.

However, the R^2 is affected by sampling error, which may result in substantial variation in crime rates for a specific month over the 12-year period. For crimes that occur infrequently, and therefore have high relative sampling errors, the R^2 figure will be substantially depressed. In this circumstance it is impossible to know how much of this low rating is due to true variation of the victimization rates for that month and how much can be ascribed to sampling error. For crimes of high volume, the R^2 is a better measure of consistency because the effect of sampling error is minimal. The advantage of the CSV is that it is less sensitive to the effects of sampling error in the crimes of low frequency.

In the earlier NCS report on seasonality, the X-11 program, developed primarily for use in economic time series, was used to determine which crimes were seasonal. The R^2 measure produces results that are very similar to those from the X-11, but the R^2 is the preferred measure because its distributional properties are better known so that tests can be made to determine differences between crimes.

Both the CSV and the R^2 are expressed in numbers that, in this study, range from .115 to .728, with higher values indicating more seasonality or consistency in the series. Most effects of trend on the observed patterns over the 12-year period have been removed. Together, the CSV and R^2 statistics can provide a more complete picture of the seasonality in crime than either measure can by itself.

Table 1. Criteria for rating the seasonality and consistency of NCS crimes

Seasonality-Coefficient of Seasonal Variation (CSV)	
High seasonality	.440 or more
Moderate seasonality	.330 to .440
Little or no seasonality	Less than .330
Consistency-Coefficient of Determination (R^2)	
High consistency	.600 or more
Moderate consistency	.400 to .600
Little or no consistency	Less than .400

Background

The crimes included in this study will be discussed in terms of the two measures mentioned earlier--the amount of seasonality, indicated by the CSV, and the consistency of the seasonal pattern, indicated by the R^2. Crimes are classified as highly seasonal, moderately seasonal, or possessing little or no seasonality. Similarly, consistency of the seasonal pattern is divided into three groups--high, moderate, and low. Tests of significance have been computed to examine differences between crimes for both the CSV and R^2 measures. Unless otherwise indicated, crimes in any of these three groupings--whether by amount of seasonality or consistency--are statistically different from those in the other two groups. Frequently, there are meaningful differences within groups.

Specific criteria for determining the three CSV classifications were established by examining various patterns of crime seasonality (table 1). A deviation of at least 20% above and below the overall average was considered to indicate a high degree of seasonality, which translates into a CSV of .440 or more (figure 4). Highs and lows averaging between 15% and 20% from the mean, with CSV's between .330 and .440, were classified as moderately seasonal. Little or no seasonality was defined as variations of less than 15% from the average, which is indicated by a CSV less than .330.

For a crime to qualify as having a highly consistent pattern, the R^2 value must be .600 or more, which means that at least 60% of the variation remaining after the effect of the trend has been removed is due to differences between months. Moderate consistency is defined as an R^2 falling between .400 and .600, or from 40% to 60% of the variation ascribable to month-to-month differences. A value less than .400 indicates a pattern that is not consistent from year to year.

Seasonality and consistency for all NCS crimes

Considering crimes first from the standpoint of all victimizations, there are four crimes that exhibit a high degree of seasonality over the 12-year period: household larceny $50 or more, household larceny less than $50, unlawful entry, and rape (table 2). The first three also demonstrate substantial consistency over time, with R^2 values exceeding .600. Rape, on the other hand, shows very little consistency in its patterns from one year to the next. In fact, it ranks with robbery as having the lowest R^2 statistic of the crimes under consideration.[4] However, rape is the rarest crime measured by the NCS, averaging about 164,000 victimizations a year, and, consequently, has a high relative sampling error, which is reflected in the low R^2. The standardized monthly averages for rape show substantial variation about the overall mean when compared with those for robbery (figure 5).

Aggravated assault and attempted forcible entry are moderately seasonal, with highs and lows that deviate by approximately 15% to 20% from the average. These two crimes also fall into the middle category for consistency. Personal larceny with contact is at the high end of the moderately seasonal group, but is less consistent in general than the other moderately seasonal crimes. This crime is also one of small volume, averaging about 532,000 victimizations annually. Personal larceny without contact less than $50 is also moderately seasonal, but its pattern is highly consistent from year to year. In fact, this crime has the highest R^2 value of all the crimes examined.[5]

[4] Rape and robbery are significantly different from forcible entry at the .10 level.

[5] The difference between personal larceny less than $50 and unlawful entry is significant at the .10 level.

Analysis of the amount of seasonality as measured by the percent difference from the mean

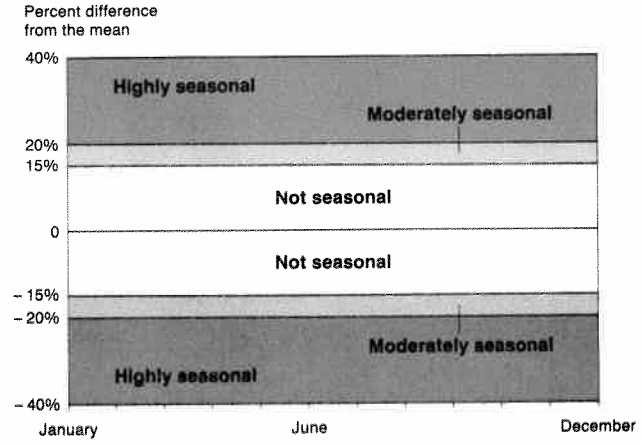


Figure 4

Differences in the amount of seasonality for rape and robbery

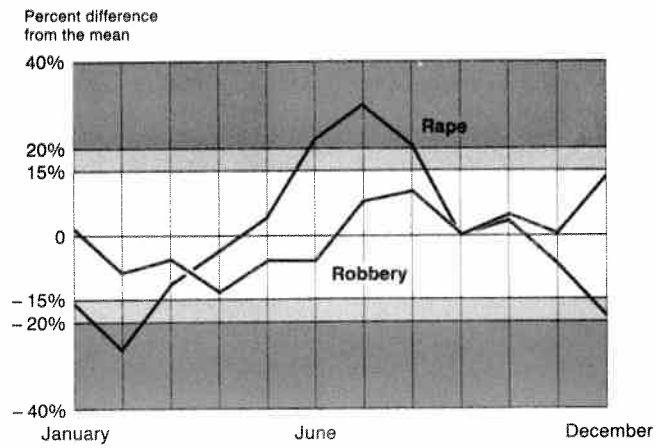


Figure 5

Table 2. Seasonality and consistency for all NCS crimes

Seasonality	Coefficient of Seasonal Variation (CSV)
High seasonality	
Household larceny $50 or more	.585
Rape	.579
Household larceny less than $50	.483
Unlawful entry	.476
Moderate seasonality	
Personal larceny with contact	.430
Personal larceny without contact less than $50	.396
Aggravated assault	.374
Attempted forcible entry	.363
Little or no seasonality	
Personal larceny without contact $50 or more	.291
Motor vehicle theft	.281
Robbery	.264
Forcible entry	.257
Simple assault	.239

Consistency	Coefficient of Determination (R^2)
High consistency	
Personal larceny without contact less than $50	.715
Unlawful entry	.704
Household larceny $50 or more	.670
Household larceny less than $50	.669
Moderate consistency	
Aggravated assault	.488
Attempted forcible entry	.450
Personal larceny without contact $50 or more	.432
Little or no consistency	
Personal larceny with contact	.357
Simple assault	.344
Motor vehicle theft	.320
Forcible entry	.288
Robbery	.219
Rape	.218

Seasonality and consistency for all NCS crimes

Any crime with monthly values that deviate less than 15% from its overall average is considered as not having a meaningful seasonal pattern. Motor vehicle theft, robbery, forcible entry, and simple assault fall into this category. These four crimes also rank toward the bottom of the consistency scale with, at most, about one-third of the total variation explained by differences between months. Personal larcenies with losses of $50 or more also show evidence of little seasonality, but their behavior is more predictable than the other four crimes.

Table 3. Seasonality and consistency for NCS crimes reported to the police

Seasonality	Coefficient of Seasonal Variation (CSV)
High seasonality	
Household larceny $50 or more	.725
Personal larceny with contact	.563
Rape	.542
Unlawful entry	.514
Household larceny less than $50	.506
Simple assault	.468
Aggravated assault	.455
Moderate seasonality	
Personal larceny without contact $50 or more	.379
Attempted forcible entry	.377
Little or no seasonality	
Robbery	.280
Motor vehicle theft	.262
Personal larceny without contact less than $50	.243
Forcible entry	.238

Consistency	Coefficient of Determination (R^2)
High consistency	
Household larceny $50 or more	.705
Moderate consistency	
Unlawful entry	.559
Simple assault	.488
Personal larceny without contact $50 or more	.462
Aggravated assault	.443
Household larceny less than $50	.439
Little or no consistency	
Attempted forcible entry	.262
Personal larceny with contact	.252
Motor vehicle theft	.241
Forcible entry	.200
Personal larceny without contact less than $50	.188
Robbery	.154
Rape	.115

Crimes reported to the police

Seasonal patterns can be examined for those crimes that are reported to the police and those that are not. Although for many crimes the amount of seasonality is similar whether or not the police were notified, there are some significant exceptions.

Considering crimes reported to the police, there are more crimes that rank as highly seasonal (seven) than was true for the total victimization category (table 3). Four are the same crimes that ranked high on total victimizations: household larceny $50 or more, household larceny less than $50, unlawful entry, and rape.[6] In addition, both aggravated and simple assault and personal larceny with contact display highly seasonal patterns. One crime, household larceny of $50 or more, is extremely seasonal, with a CSV of .725, or an average deviation from the mean of more than 30%. It also ranks at the top among crimes reported to the police in the consistency of its seasonal pattern from year to year. Personal larceny with contact and rape, despite high seasonality, rank low on the measure of consistent patterns. The other highly seasonal crimes demonstrate a moderate amount of consistency, with unlawful entry second only to the more costly household larcenies.

Personal larcenies with losses of $50 or more and attempted forcible entry display a moderate amount of seasonality in their rates of crimes reported to the police. For the larcenies, this is a fairly consistent pattern, but attempted forcible entry ranks low on this measure.

[6]However, rape is not significantly different from the two crimes in the moderate category.

In the little or no seasonality category are 3 of the 4 crimes that were also low on total victimizations: motor vehicle theft, robbery, and forcible entry. The fourth crime is personal larceny less than $50. All four crimes rank near the bottom in the consistency of their patterns.

Table 4. Seasonality and consistency for NCS crimes not reported to the police

Seasonality	Coefficient of Seasonal Variation (CSV)
High seasonality	
Rape	.701
Household larceny less than $50	.485
Household larceny $50 or more	.478
Unlawful entry	.458
Personal larceny with contact	.452
Personal larceny without contact less than $50	.445
Forcible entry	.443
Moderate seasonality	
Attempted forcible entry	.380
Motor vehicle theft	.353
Little or no seasonality	
Robbery	.306
Aggravated assault	.305
Personal larceny without contact $50 or more	.253
Simple assault	.144

Consistency	Coefficient of Determination (R^2)
High consistency	
Personal larceny without contact less than $50	.728
Household larceny less than $50	.660
Moderate consistency	
Unlawful entry	.584
Household larceny $50 or more	.459
Attempted forcible entry	.409
Little or no consistency	
Forcible entry	.338
Personal larceny with contact	.300
Personal larceny without contact $50 or more	.277
Aggravated assault	.229
Motor vehicle theft	.194
Rape	.175
Robbery	.161
Simple assault	.115

Crimes not reported to the police

There are also seven crimes that meet the test of high seasonality for those victimizations not reported to the police (table 4). Five were among those rated highly seasonal as reported crimes: rape, household larceny more and less than $50, unlawful entry, and personal larceny with contact. The two additions are forcible entry and personal larcenies without contact with losses less than $50. Although rape is at the top of the CSV rankings, it again falls into the low group for year-to-year consistency. Forcible entry and personal larceny with contact also are characterized by little consistency, but they both rank higher on this measure than rape. The two noncontact larcenies with losses less than $50 are not only highly seasonal, but consistently so, especially personal larceny, which has the highest R^2 value. Unlawful entry and household larceny of $50 or more place in the middle category on consistency.

There are only two crimes in the moderately seasonal range, according to the CSV, attempted forcible entry and motor vehicle theft.[7] The former crime falls in the moderately consistent category, but the latter displays very little consistency.

Personal larcenies without contact of $50 or more and simple assault, in addition to robbery and aggravated assault, display little or no seasonality as well as a low degree of consistency from year to year.

[7] Motor vehicle theft does not differ significantly from robbery and aggravated assault in the lowest category.

Comparison of seasonality and consistency in crimes reported and not reported to the police

In 7 of the 13 crimes under study, those incidents reported to the police and those not reported have similar amounts of seasonality; that is, they both fall into the same category--high, moderate, or low. Where there are significant differences in the amount of seasonality, crimes reported to the police are more seasonal in six instances, and nonreported crimes are more seasonal in three (table 5). For the remaining crimes, there was no difference in the amount of seasonality. The sharpest contrasts in the amount of seasonality occur for aggravated and simple assault, both of which are highly seasonal for those incidents reported to the police and exhibit little or no seasonality in nonreported crimes. Two crimes, personal larceny without contact less than $50 and forcible entry, behave in opposite fashion, with crimes not reported to the police displaying high seasonality when compared with reported crimes.

For 8 of the 13 crimes, the measure of consistency follows a similar pattern to that for seasonality in distinguishing between reported and nonreported crimes. For example, in four cases, reported crimes that are more seasonal are also more consistent than nonreported crimes. The category of crimes with no difference in consistency contains 4 of the 5 crimes with the fewest number of incidents as measured by the NCS.

There appear to be varying reasons for the differences in the amount of seasonality between reported and nonreported victimizations. In general, crimes that are reported to the police tend to be more serious, either in terms of injury to the victim or in the amount of economic loss. This is true between types of crime and also within a single crime. Some of the crimes studied are by definition more serious than others, for example, larcenies of $50 or more compared to those less than $50 and aggravated versus simple assaults. However, there can be considerable variation within one crime in the degree of seriousness and thus in the likelihood of its being reported to the police. Forcible entry with a loss of $1,000 or more is much more likely to be reported than the same crime when nothing is taken, 95% vs. 48%, respectively, in 1984. Similarly, simple assault can range from a casual verbal threat to an attack involving minor injury, with the latter more likely to be reported to the police.

Although degrees of seriousness within crimes have not been examined for this report, the evidence

Table 5. Relative amount of seasonality and consistency in crimes reported to the police, compared with crimes not reported to the police

	Are reported or nonreported crimes more:	
	Seasonal (CSV)	Consistent (R^2)
Personal crimes		
Rape	No difference	No difference
Robbery	No difference	No difference
Aggravated assault	Reported	Reported
Simple assault	Reported	Reported
Personal larceny		
With contact	Reported	No difference
Without contact		
Less than $50	Not reported	Not reported
$50 or more	Reported	Reported
Household crimes		
Burglary		
Forcible entry	Not reported	Not reported
Unlawful entry	Reported	Not reported
Attempted forcible entry	No difference	Not reported
Household larceny		
Less than $50	No difference	Not reported
$50 or more	Reported	Reported
Motor vehicle theft	Not reported	No difference

Note: Significant differences were determined by a t test. All differences are significant at the .05 level except the R^2 for unlawful entry, which is significant at the .10 level.

Comparison of seasonality and consistency in crimes reported and not reported to the police

indicates that the more serious kinds of both aggravated and simple assault occur in a seasonal pattern, whereas the less serious forms of these crimes, especially simple assault, are spread relatively evenly throughout the year. Both aggravated and simple assault occur more frequently in the warmer months when people spend more time outdoors. The data suggest that a disproportionately large share of these warm-weather incidents are of the more serious (that is, reportable) kind.

The only difference between personal and household larceny in the NCS is a definitional one--whether the incidents occurred in or near the victim's home or elsewhere. Household larcenies, regardless of the amount of loss or whether or not they are reported to the police, exhibit more seasonality than personal larcenies (figure 6). Approximately five-sixths of household larcenies occur in the vicinity of the victim's home rather than inside it. Because it is more likely for property to be left outside the home in the warmer months, this may explain the high incidence of stolen household goods at that time of year. Weather apparently plays less of a role in personal larcenies, which can occur in a diverse array of settings, such as at workplaces, inside commercial buildings, in parking lots or garages, in association with leisure activities, on the way to or from any of these activities, and so forth. Thus, personal larcenies $50 or more display a moderate amount of seasonality for those incidents reported to the police. Those not reported are apparently less memorable, possibly because they cluster toward the lower end of the category, and show little evidence of seasonal variation. Personal larcenies less than $50 are a special case. They are 1 of the 3 crimes where the incidents not reported to the police are more seasonal than those that are reported. The explanation appears to lie in the large number of such victimizations that are never brought to police

Differences in the amount of seasonality for personal and household larceny

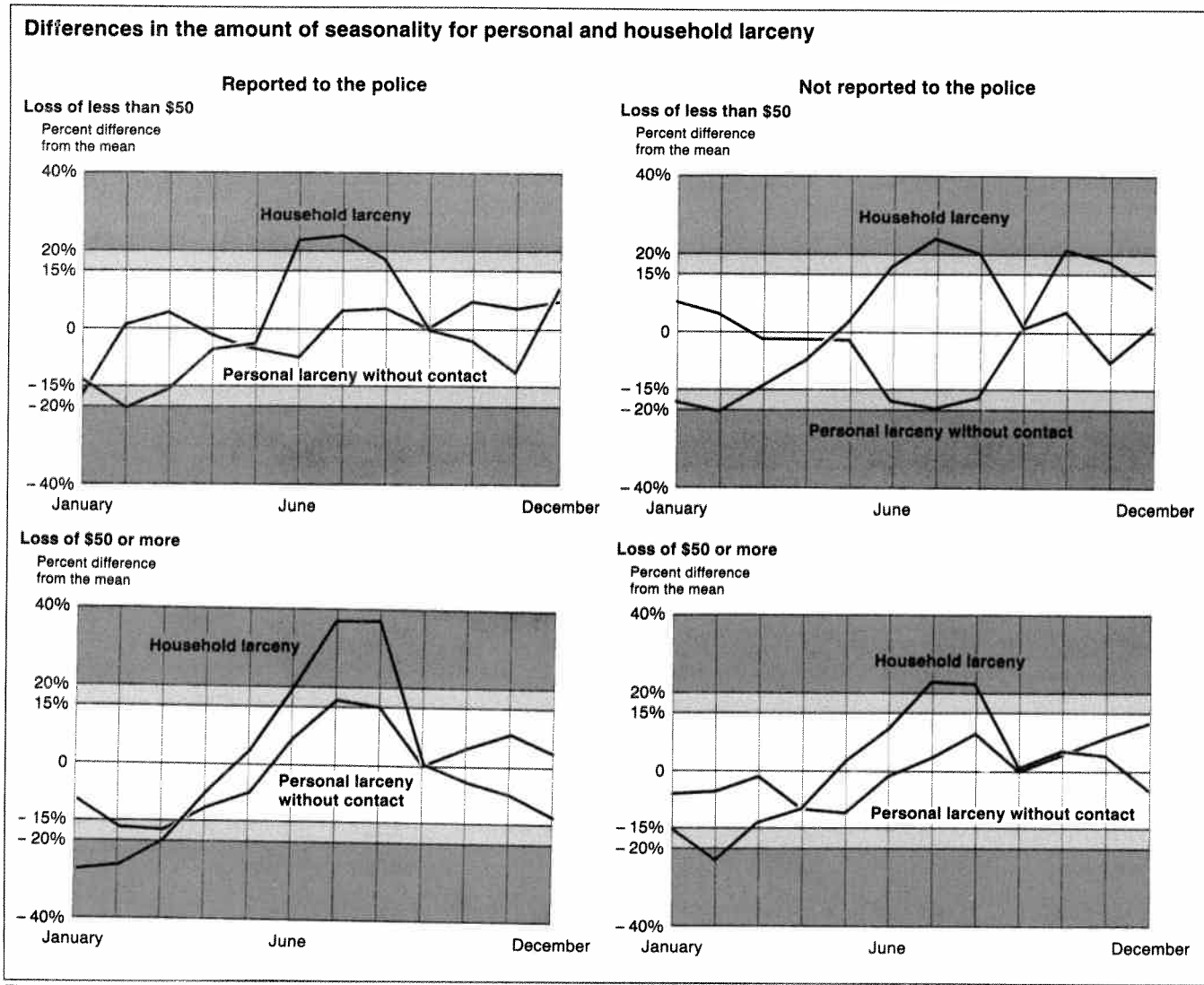


Figure 6

attention and in the locations where the greatest number of such crimes occurs. Approximately 7 out of 8 of these thefts are not reported to the police, and roughly one-third occur inside schools or on school property (compared to 10% for personal larcenies of $50 or more). Thefts occurring on school property are frequently reported to school authorities, but seldom become matters of police concern. Unlike other larcenies, the peak months for personal larcenies less than $50 are in the fall at the start of the school year. The R^2 statistic of .728 demonstrates that this pattern is highly consistent from year to year.

The other two crimes that display more seasonality in incidents not reported to the police are forcible entry and motor vehicle theft. Of the 13 crimes included in this report, these are the 2 with the highest police reporting rates, 73% and 69%, respectively, in 1984. These are obviously considered by victims to be serious crimes, and most will be reported whenever they occur throughout the year. In the case of motor vehicle theft, 86% of completed thefts were reported to the police in 1984, but only 40% of attempted thefts became part of the police record. Attempted thefts, which dominate nonreported motor vehicle thefts, are apparently more seasonal, but the pattern from year to year is highly variable. Nonreported forcible entries, which are largely situations where little or nothing of value is taken, are in the highly seasonal category.

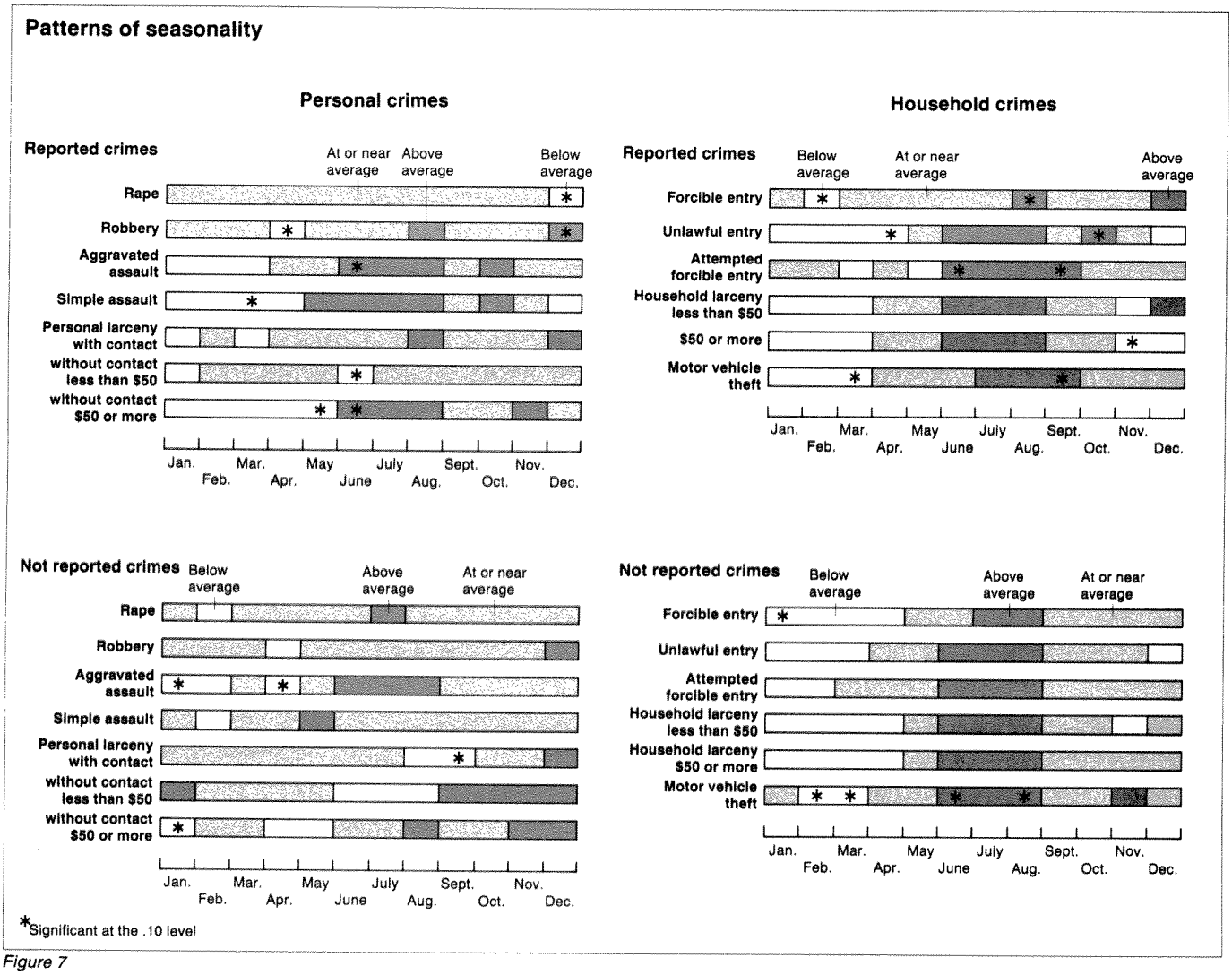


Figure 7

Patterns of seasonality

Similar amounts of seasonality with different seasonal patterns for reported personal larceny with contact and unlawful entry and for not reported personal larceny without contact of less than $50 and forcible entry

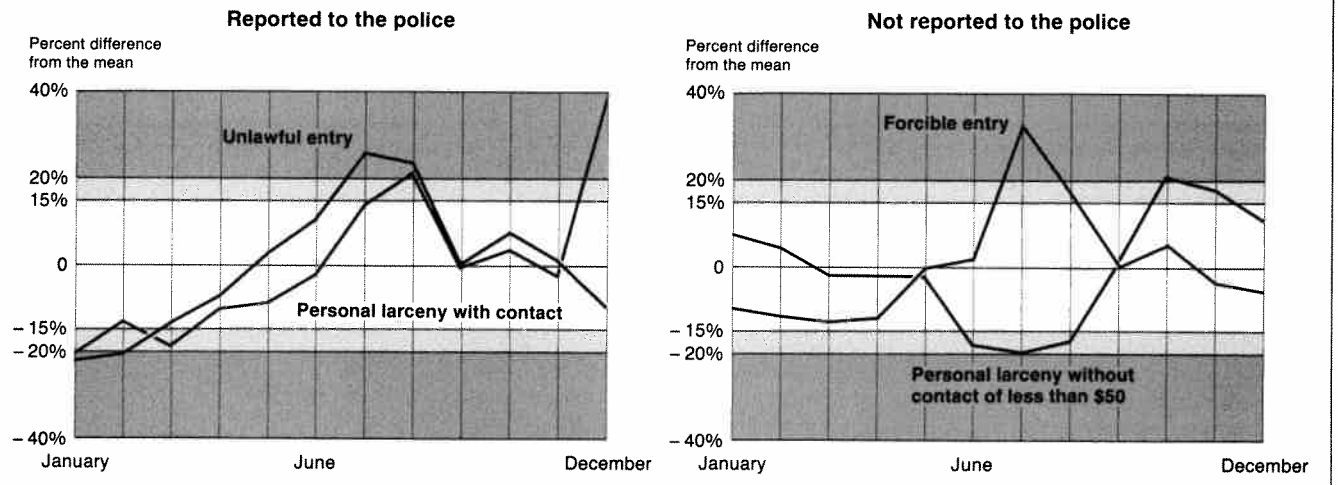


Figure 8

The seasonal variations in crime rates—those months that are significantly above and below the overall average--are not the same for all crimes. However, the most common pattern is for rates to be highest in one or more of the summer months (June, July, and August) and lowest in January, February, and March.[8] This is generally true for both crimes reported to the police and those not reported and is particularly evident in crimes against households (figure 7). Household crimes not reported to the police adhere most closely to this pattern, with 85% of the months that differ significantly from the average registering peaks in the summer and lows in the winter. At the opposite end of the spectrum, only about one-third of nonreported personal crimes fit this configuration.

The most striking exception to the conventional pattern is personal larcenies without contact less than $50 that are not reported to the police, where, as noted earlier, the highest rates coincide with the first part of the school year, September through January, and the low months occur in the summer when most schools are not in session. Other departures from the norm among nonreported crimes are robbery and personal larceny with contact, which both peak in December, with the latter having lows in August and September. Personal larcenies of $50 or more are characterized by highs and lows in nonconsecutive months; highs in August, November, and December; and lows in January, April, and May.

Reported personal crimes are more likely to follow the usual pattern, although rape and personal larceny less than $50 have no months that significantly exceed the overall average. Rape's only low month is December, whereas larceny registers lows in January and June. Robbery and personal larceny with contact have peaks in August and December, and the more expensive personal larcenies without contact show a high in November, in addition to the usual summer highs. The substantial amount of seasonality in December displayed by robbery and personal larceny with contact for both reported and nonreported crimes is undoubtedly related to the heavy volume of shopping that occurs during the holiday season.

The six household crimes, especially those not reported to the police, follow the high in summer, low in winter pattern rather closely. What few deviations there are tend to be in adjoining months. However, reported forcible entry burglaries and larcenies less than $50 have December highs, in addition to at least one high month in the summer. Nonreported motor vehicle thefts peak in November as well as in June, July, and August.

Crimes with the same amount of seasonality may have very different seasonal patterns (figure 8). Among crimes reported to the police, personal larceny with contact and unlawful entry are both highly seasonal, but where the latter crime follows the conventional pattern, contact larcenies peak in December as well as in August. Two crimes not reported to the police, personal larceny without contact less than $50 and forcible entry, have almost identical amounts of seasonality, but differ sharply in their high and low months.

[8]The determination of which months are above or below the overall average is obtained from a t test. See the further discussion in the Technical Appendix.

Technical appendix

This report on seasonality in crime differs in a number of ways from the 1980 report, Crime and Seasonality. Twelve years of data were used instead of 5. Rape, personal larceny with contact, and attempted forcible entry were added to the crimes studied. Four crimes, whose subcategories have been separately analyzed in this report, were eliminated (assault, personal larceny without contact, burglary, and household larceny). In addition to examining the seasonal movement of all victimizations for a particular crime, separate analyses were made of crimes reported to the police and those not reported. Two analytical techniques were used that, in addition to describing seasonal patterns, made it possible to determine differences in the amount of seasonality among the various crimes and in the consistency of seasonal patterns over time.

The two measures of seasonality used in this report, the Coefficient of Seasonal Variation (CSV) and the Coefficient of Determination (R^2), are both derived from a multiple regression model and assume a linear relationship between the independent and dependent variables. The months of the year and a trend variable constitute the independent variables in the regression equation. Month is expressed as a dummy variable, with September left out of the equation because for most crimes it is the month with victimization rates that are closest to the annual average. The dependent variable is the monthly victimization rate for each crime over the 12-year period 1973 through 1984. Thus, the model represents each month's effect on the victimization rate for a given crime, with an adjustment for any trend that may be present in the series.

The R^2 statistic is part of the output of the regression model. It indicates the proportion of the variation in the dependent variable that is explained by the model. In this case, R^2 expresses how much of the total variation in the monthly victimization rates is explained (or accounted for) by differences between months. The residue (or unexplained variation) is the variation about the average within a specific month.

A high R^2 value on a scale from 0 to 1 means that the 12 values for each month tend to cluster around the average value for that month, indicating little variation around the seasonal pattern. If graphs of the monthly victimization rates for such a crime for each of the 12 years were to be superimposed on one another, there would be a high degree of similarity in the yearly patterns. In this sense, the R^2 statistic indicates the consistency of whatever seasonal pattern exists. As mentioned earlier, one difficulty with this measure is that crimes with low victimization rates generally have high relative sampling errors. These sampling errors may result in victimization rates that vary substantially from the average value, thus lowering the R^2 figure. For crimes with low R^2 values, one cannot be sure how much variation may be due to genuine differences and how much results from sampling error.

The formula for computing the R^2 value for a crime is the following:

$$R^2 = \frac{\text{Regression sum of squares (RSS)}}{\text{Total sum of squares (TSS)}}$$

The regression sum of squares is that part of the variation in the dependent variable (the monthly victimization rate) accounted for by the model. The total sum of squares is the total variation, both the portion accounted for by the model and that not accounted for. The variation due to the trend only was separately calculated and subtracted from both the numerator and denominator of the fraction.

The Coefficient of Seasonal Variation is an alternative way of looking at month-to-month variation, which minimizes the problem of sampling error that affects the R^2 calculation. It measures the deviation of the average victimization rates for each month, adjusted for trend, from the overall 12-year average. The formula for the expected victimization rate for a particular month i is:

$$S_i = a + 72.5(c) + b_i$$

where a is the constant from the regression
c is the regression coefficien for the trend varia le
72.5 is the midp t of the 144 months 'ata used in the i ure
b_i is the regres coefficient fc nth i

To compute the CSV, the dif ce between the S values for eacl ıth and the overall mean ($\bar{S}$) is de\ mined, and then these monthly values are standardized by divi each of them by the mean. The results are then squared, the 12 products are summed, and the square root of this result is the CSV. Following the notation above, the formula is:

$$CSV = \sqrt{\sum_{i=1}^{12} \left[\frac{S_i - \bar{S}}{\bar{S}}\right]^2}$$

Technical appendix

Significant differences between both R^2 and CSV values, in the degrees of consistency and seasonality, respectively, can be ascertained from t tests. The formula for determining differences between R^2 values for crimes A and B is:

$$T = \frac{F(A) - F(B)}{\sqrt{\left(SE\left[F(A)\right]\right)^2 + \left(SE\left[F(B)\right]\right)^2}}$$

where $F = \frac{R^2 \times 131}{\left(1 - R^2\right) \times 11}$

131 and 11 are the appropriate degrees of freedom for calculating the F statistic

$SE\left[F(A)\right]$ = standard error of the F value for crime A

The procedure for calculating differences between CSV values for crimes A and B is:

$$T = \frac{CSV^2(A) - CSV^2(B)}{\sqrt{VAR\left(CSV^2(A)\right) + VAR\left(CSV^2(B)\right)}}$$

where $VAR\left(CSV^2\right) = \left[\frac{MSE / 12}{\overline{S}^2}\right]^2 \times 22$

MSE is the mean square error from the regression

The identification of specific months above and below the overall average for a particular crime is obtained from a t test that is part of the output of the SPSS-X multiple regression program. Significant differences for all t tests in this report assume a two-tailed test with 11 degrees of freedom.

The fact that the months vary slightly in length might be expected to have some impact on the measures of seasonality and consistency. Although the data have not been adjusted for this factor, an independent examination of this issue revealed that the effect on the results was negligible.

The derivations of the formulas in this report and the assumptions on which they are based are contained in an internal Census Bureau memorandum that is available from the author at (202) 724-6100.

The CSV has been developed by the Census Bureau as an alternative way of looking at seasonality. It is recognized that some of the underlying assumptions need further study and refinement. However, because the NCS series exhibits considerable stability over time, it is believed that this approach reflects with reasonable accuracy varying amounts of seasonality among the crimes measured by the survey.