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# ALCOHOL AVAILABILITY, CONSUMPTION AND THE INCIDENCE OF ALCOHOL-RELATED SOCIAL AND HEALTH PROBLEMS IN MICHIGAN

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16. Abstract

Cross-correlation, time-series-modelling and multiple regression analyses were utilized with available Michigan data to explore causal relationships between beverage alcohol licensing actions of the Michigan Liquor Control Commission, alcohol beverage distribution, and a number of major social and health problems. While conclusions are not definitive because of limitations in the data, it was found that mortality due to traffic accidents, occupational accidents, and total reported accidents is strongly and consistently associated with increases in alcohol availability and with draught and packaged beer distribution.

Other analyses determined that beverage alcohol distribution is highly predictable by using time-series analysis techniques. Multiple regression analyses, interpreted in connection with the other findings, suggested that wine distribution is probably more vulnerable to changes in licensing activities than beer or liquor distribution. Implications of the findings and suggestions regarding data collection adequacy in Michigan are offered.

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# ALCOHOL AVAILABILITY, CONSUMPTION AND THE INCIDENCE OF ALCOHOL-RELATED SOCIAL AND HEALTH PROBLEMS IN MICHIGAN

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The regulation and control of alcoholic beverages has received considerable attention in recent years as a potentially viable means of reducing social problems related to alcohol use and abuse. The National Institute on Alcohol Abuse and Alcoholism reviewed the state of knowledge in 1974 and Bruun, et al. (1975) outlined a broadly based control policy perspective in 1975.

The retail availability of alcoholic beverages was shown by Douglass and Freedman (1977) to co-vary over time with both traffic casualties related to alcohol and with specific categories of alcohol consumption in Michigan. The age of legal purchase was found to be a major factor of alcohol availability while less radical modifications of retail licensure and control were also found to be associated with increases in the number of retail establishments.

The full range of social problems, of which a proportion are causally related to alcohol abuse, includes all forms of accidental injury and death, domestic and criminal violence, and several chronic disease mortalities, including the broadly defined alcoholism and narrowly defined alcoholic cirrhosis. These problems, of course, are accompanied by problems such as divorce, work absenteeism, child abuse and others which are not well reported and are inconsistently

recorded by public or private agencies, seldom are these problems reported as alcohol-related or unrelated.

The intention of this study is to learn more about the dynamics of alcohol availability, alcohol distribution, and several social and health problems which are, in part, associated with the abuse of beverage alcohol.

## Conceptual Framework

The availability of alcoholic beverages has assumed an increasingly promiment role in the literature on problem-related alcohol consumption, and yet it remains, to date, a concept whose precise theoretical definition has yet to be stated. Smart (1977) has outlined fragments of theories from differing disciplinary perspectives: Economic availability; subjective, or perceived availability; and social availability. The differing emphases of these and other notions of alcohol availability reflect differing views as to which aspects of alcohol control policies are most relevant to drinking behavior.

Economic availability has generally focussed on the aggregate relationship between the consumption of different types of alcoholic beverages, the prices of those beverages, and consumer income. Economic availability of alcohol, as it has been applied, does not differ appreciably from the economic availability of any other privately produced good. While estimates of aggregate alcohol demand undoubtedly constitute useful information, they provide no direct clues as to the possible effects on alcohol consumption that result from controllable changes in availability policy.

A closely related concept of availability, that of physical availability, provides a means by which to construct a more broadly defined theory of economic availability that can describe the process by which changes in availability policies (license issues, increased operating hours, etc.) are translated into changes in alcohol

consumption. In this study we examine the type of availability we believe to be most relevant to policy-making, that of physical availability. Physical availability is directly related to legal and policy dynamics which are associated with measurable variations in licensing activities of the Michigan Liquor Control Commission and, ultimately, the composition and size of the beverage alcohol marketplace. This study, an exploratory analysis, is intended to determine if there is a reasonable probability that fluctuations in aggregate consumption caused by modifications of availability policy are relevant in explaining the incidence of specific alcohol-related social and health problems.

## Alcohol and Social Problems

The consumption of beverage alcohol is widely acknowledged as a contributing factor in a variety of social and health problems. Although of uneven quality, there is a voluminous body of literature documenting the consequences of excessive consumption of alcohol. The present study dealt with several of the most important social problems related to alcohol use. Reviews of the literature supported the proposition that the following health and social problem areas were substantially associated with abusive alcohol consumption. Traffic accident mortality, total accident mortality, occupational accident mortality; certain kinds of family disorganization, including divorce; suicide mortality; reported child abuse and spouse abuse; violent assault and homicide, and cirrhosis mortality. Few of these social and health problems have been investigated in relation to alcohol availability, in fact, only traffic accidents related to alcohol abuse and alcoholism treatment enrollments have been directly linked to changes in physical, economic or legal availability, among the problems areas reviewed.

## Analysis Methods and Data

Data for secondary analysis were obtained from a variety of sources. Major datasets were obtained from the Michigan Liquor Control Commission, the Michigan Department of Social Services, the Michigan Department of Public Health, the Michigan Beer and Wine Wholesaler's Association, and the Michigan State Police.

Wholesale distilled spirits sales volumes were measured with data from the Michigan Liquor Control Commission. Also, changes in the frequency of a large number of licensing activities were measurable with data that monitoried the frequencies of all such events, by month, for the 1970-1977 time period. The frequency of reported child abuse was obtained from the Michigan Department of Social Services for the 1970 through 1977 time period, by month. Vital statistics of specific monthly mortality frequencies, divorce and completed suicides were obtained from the Michigan Department of Public Health. The monthly distribution volumes of wine, draught, and packaged beer for the analysis time period were supplied by the Michigan Beer and Wine Wholesaler's Association. Violent assault and homicide frequency data were provided by the Michigan State Police.

Reported alcohol involvement in any of the data were fully inadequate for analytic purposes. There was gross underreporting of the role of alcohol in vital statistics, domestic violence, and criminal violence frequencies. Therefore, aggregate monthly frequencies were not exclusively alcohol-related, which severely restricts the conclusions which can be derived from these analyses.

A major difficulty in the current analysis was the absence of any "natural experiment" to monitor the consequences of a change in alcohol availability in a controlled quasi-experimental design, such as the legal drinking age change and its effects on traffic crash involvement. The lack of manipulated changes in availability forced the analysis into regression and correlational designs. This non-experimental situation presents considerable limitations on the kinds of

interpretations that can be validly pursued regarding the direct, and defensably causal, relationships between levels of availability, levels of mortality, morbidity, and other reported problems, and alcohol distribution volumes.

The analysis designs are essentially descriptive. The main categories will include stationary time-series model constructions and assessing the predictive adequacy of derived models, and cross-correlation analyses to reveal time-related associations and to exploit the time-series data base to a fuller extent than static correlations alone can provide.

It is essential to mention here that these analysis approaches fall short of being adequate to demonstrate causal relationships. It is possible to measure covariation and in a few two-variable relationships, a degree of time-order. A full control over spurious correlations or competing explanations is not possible with the current dataset and no attempt is made to extend the interpretations beyond the legitimate boundaries of the analysis tools and data available.

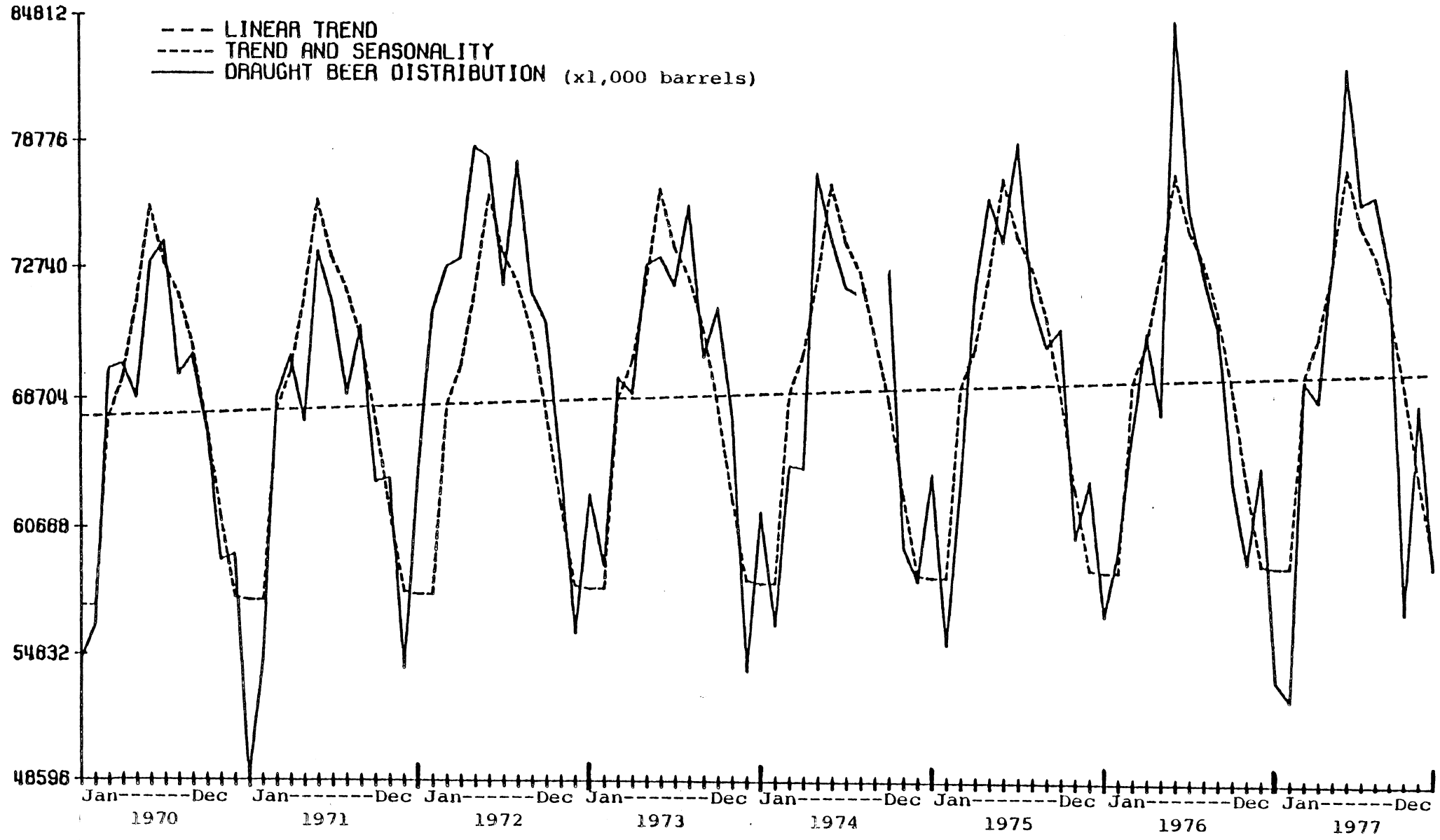
## Findings

Time Series Modelling. There are a variety of potential objectives for the analysis of time-series variables. One may wish to construct a model to describe the series. Another objective may be to explain the series in terms of other variables by constructing a multivariate model to account for the series. The value of the series at some future time point may be forecasted with the use of either a univariate or multivariate model. Finally, one may wish to manipulate the independent variables of a multivariate model and observe the impact of the manipulation on the series, using the time-series as a dependent variable in experimentation.

A time-series is usually conceptualized as a functional combination of four components (Douglass and Freedman, 1977): 1) trend, the long term movement, 2) cyclic component, a more or less regular fluctuation

FIGURE 1. WHOLESALE DRAUGHT BEER SALES DEMONSTRATING TREND AND SEASONAL COMPONENTS, STATE OF MICHIGAN, 1970-1977

Source: Michigan Beer and Wine Wholesalers Association



about the trend, 3) seasonality, a regular cyclic seasonal factor, and 4) a residual or irregular component. Since the time-series available for the present analysis are of insufficient length, no cyclic component was identifiable. Any cyclic component that might be present could not be estimated and therefore was included in the residual component for the remainder of this analysis.

The model used to describe the time-series variables considered in the present report conceptualizes each time-series as an additive composite of trend, seasonality, and an irregular component. Trend is defined as the linear growth component

$$Y = T + S + I$$

associated with economic and population growth. Seasonality is defined as the expected monthly value of the variable under consideration. It must be recognized that by viewing each time-series as an additive composite of the three components we are imposing a model on the situation. Multiplicative ($Y + T \cdot S \cdot I$) and other more complex models could also be proposed. The utility of any model is determined by the degree to which the data fit the model. In the interests of parsimony, the simplest model with which the data fit well is to be preferred. As shall be seen shortly, the simple additive model fit the data surprisingly well.

Each time-series was decomposed using the following procedure. First, a least squares linear regression was run on each time-series to estimate the variance explained by the linear trend. The residuals from this regression were used to compute the mean value of each month (i.e., average of all the Januarys, average of all the Februarys, etc.). The seasonal component was then removed from the residual series by subtracting from each month in the series its mean value. The resulting time-series represents the irregular component, the variation in the original time-series that is not explained by trend and seasonal components.

FIGURE 2. WHOLESALE PACKAGED BEER SALES (barrels), STATE OF MICHIGAN, 1970-1977

Source: Michigan Beer and Wine Wholesalers Association

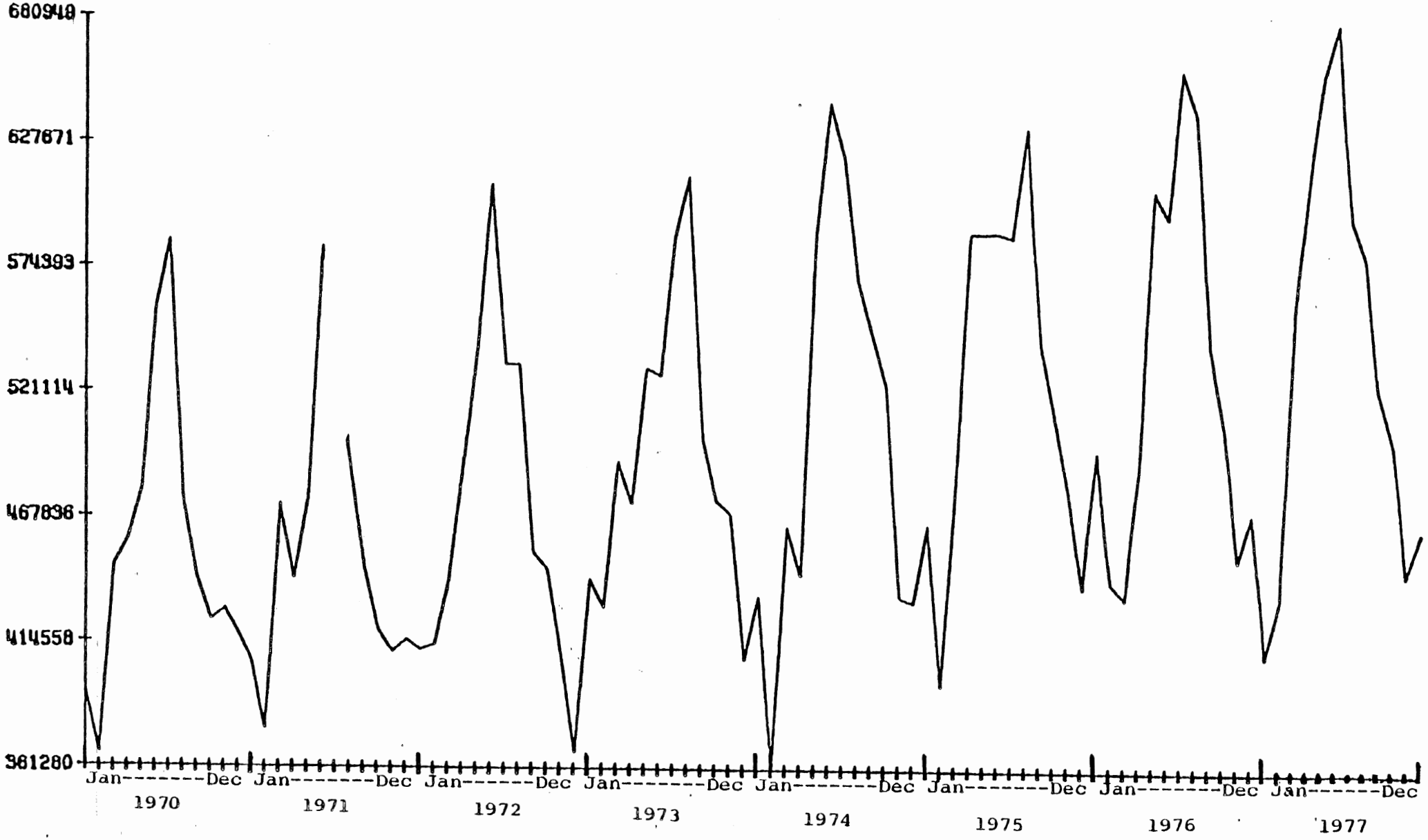
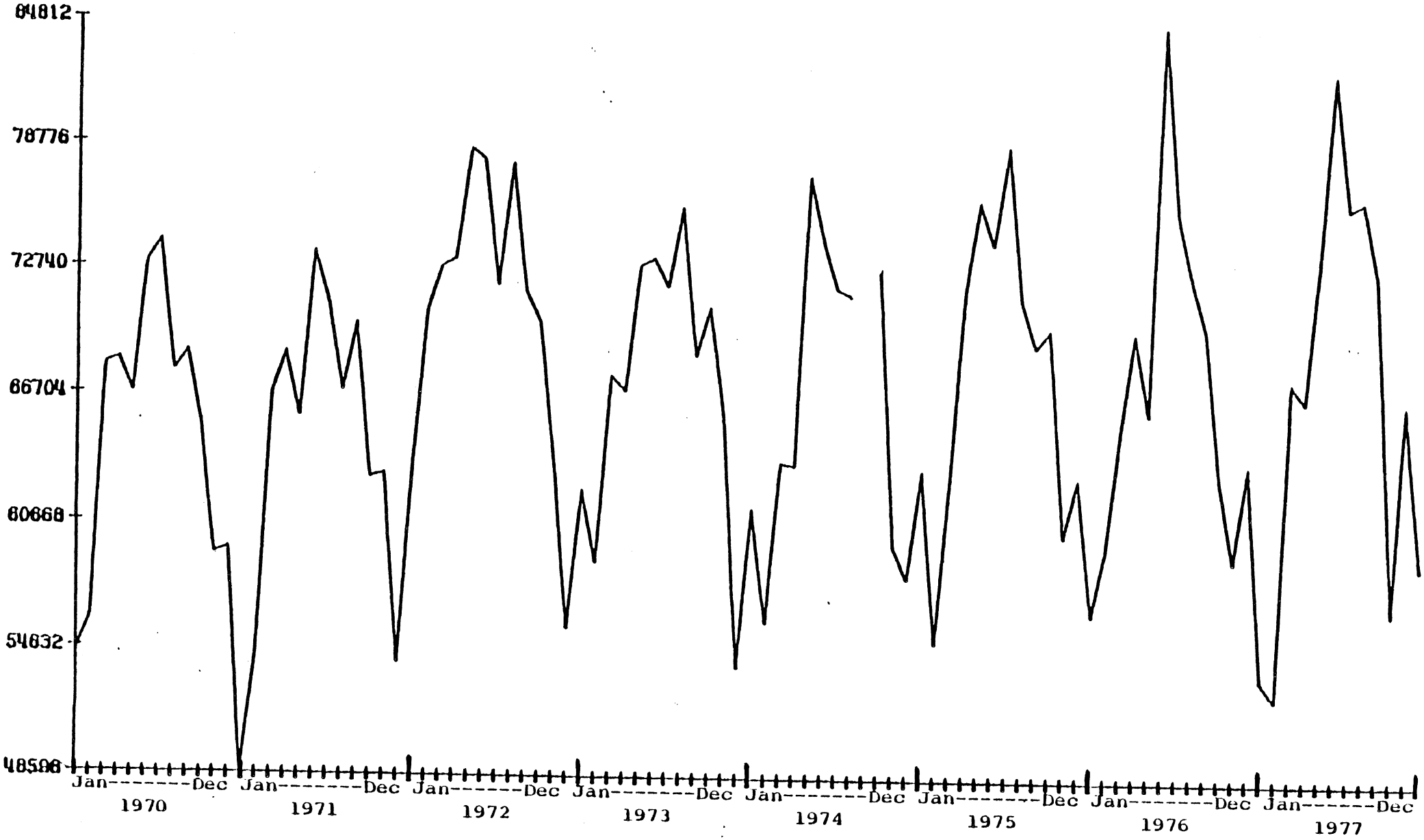


FIGURE 3. WHOLESALE DRAUGHT BEER SALES (x1,000 barrels), STATE OF MICHIGAN, 1970-1977

Source: Michigan Beer and Wine Wholesalers Association



Applying this simple additive model to the beverage alcohol distribution variables for which monthly time-series data are available, it was found that about three-fourths of the variance in these variables was explained by linear trend and cyclic seasonal factors. The high degree of fit between the data and the model can readily be seen in Figure 1, where both the actual draught beer consumption and its predicted values are plotted. As can be seen from Table 1, the relative contribution of trend or seasonality in explaining the variance in alcohol consumption varies with the type of beverage under consideration. Most of the variance in beverage alcohol consumption is a result of a dominant seasonal component in the series (see Figures 2, 3, and 5). This does not hold true for wine consumption, however; the variation in wine consumption is dominanted by a linear upward trend explaining 49% of the variance, with a moderate seasonal factor explaining an additional 20% of the variance (see Figure 4).

Table 1

Percentage of Variance in Michigan Beverage Alcohol Consumption Explained by Trend and Seasonal Components

| | Trend | Seasonality | Total |
|---|---|---|---|
| Packaged Beer Sales | 16% | 68% | 84% |
| Draught Beer Sales | 1 | 72 | 73 |
| Wine Sales | 49 | 20 | 69 |
| Table-top Liquor Sales | 11 | 58 | 69 |

Turning to the social problem variables, it is again observed that more than three-fourths of the variance in assault and divorce is accounted for by the additive time-series model (see Table 2 and Figures 6 and 7). However, an important difference in the two series is evident. Most of the variance explained by the model is a result

FIGURE 4. WHOLESALE WINE SALES (gallons), STATE OF MICHIGAN, 1970-1977

Source: Michigan Beer and Wine Wholesalers Association

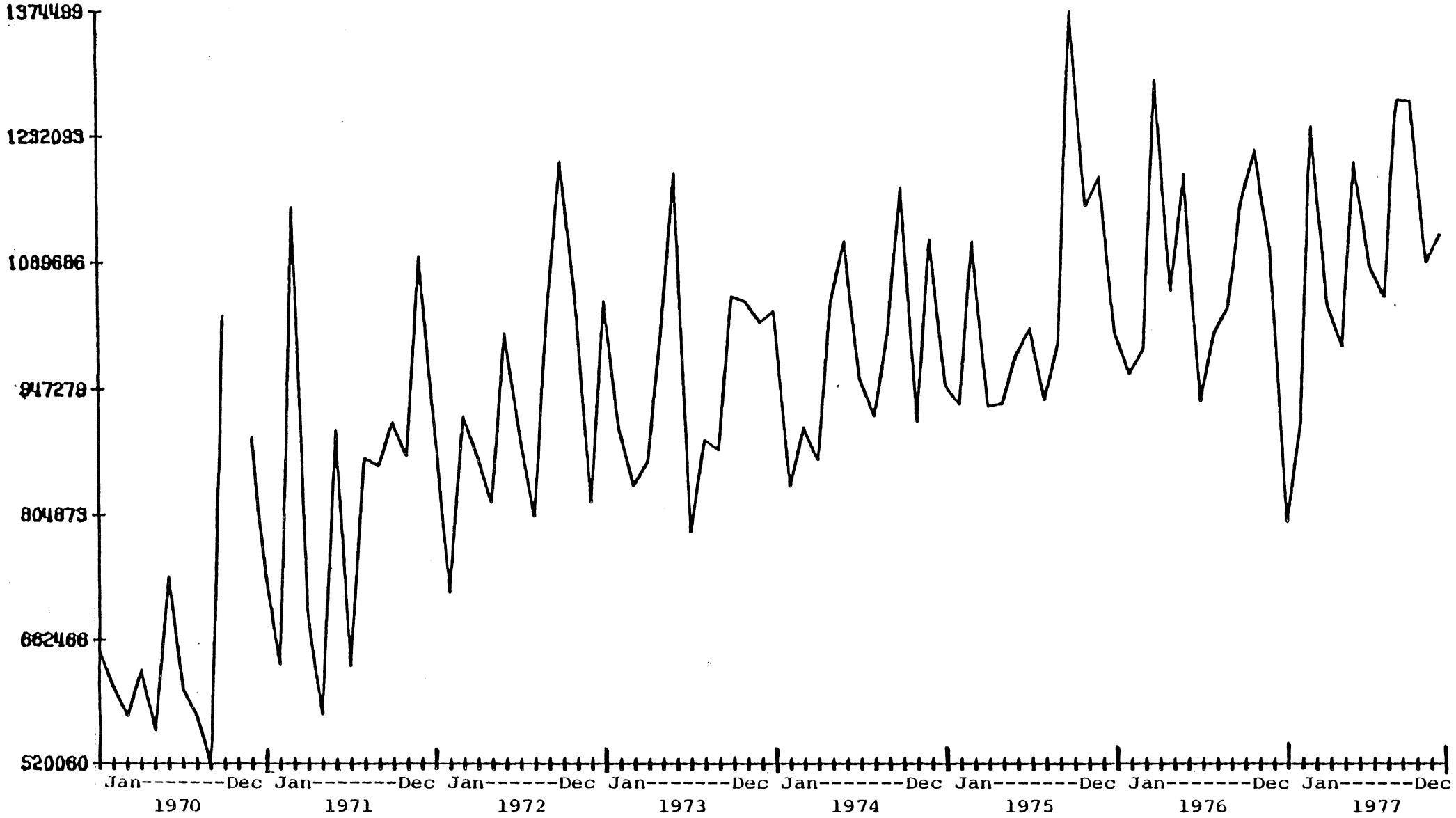


FIGURE 5. WHOLESALE DISTILLED SPIRITS TABLE-TOP SALES (dollars), STATE OF MICHIGAN, 1970-1977

Source: Michigan Liquor Control Commission

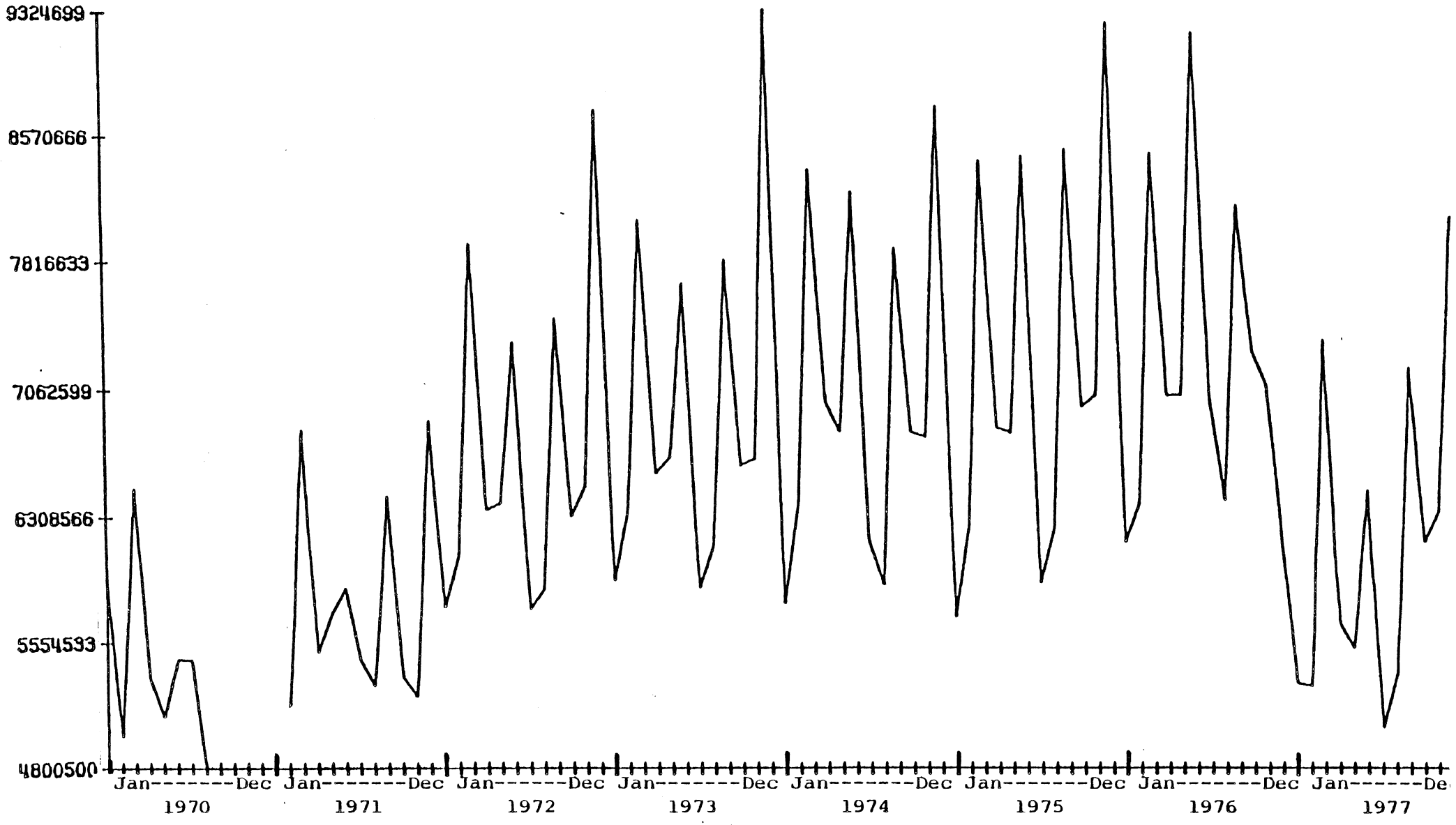


FIGURE 6. FREQUENCY OF AGGRAVATED ASSAULT, STATE OF MICHIGAN, 1974-1975
Source: Michigan State Police

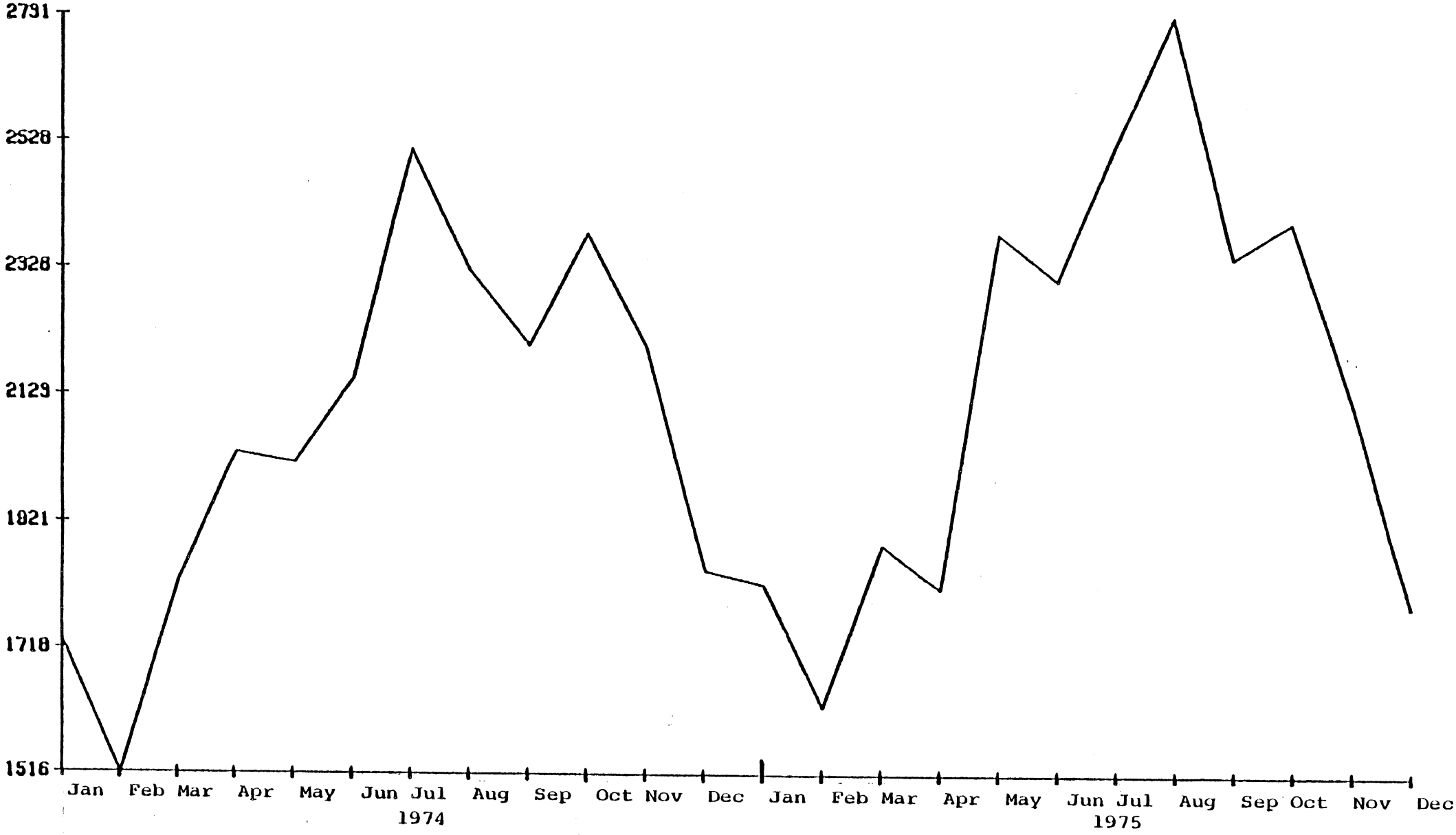
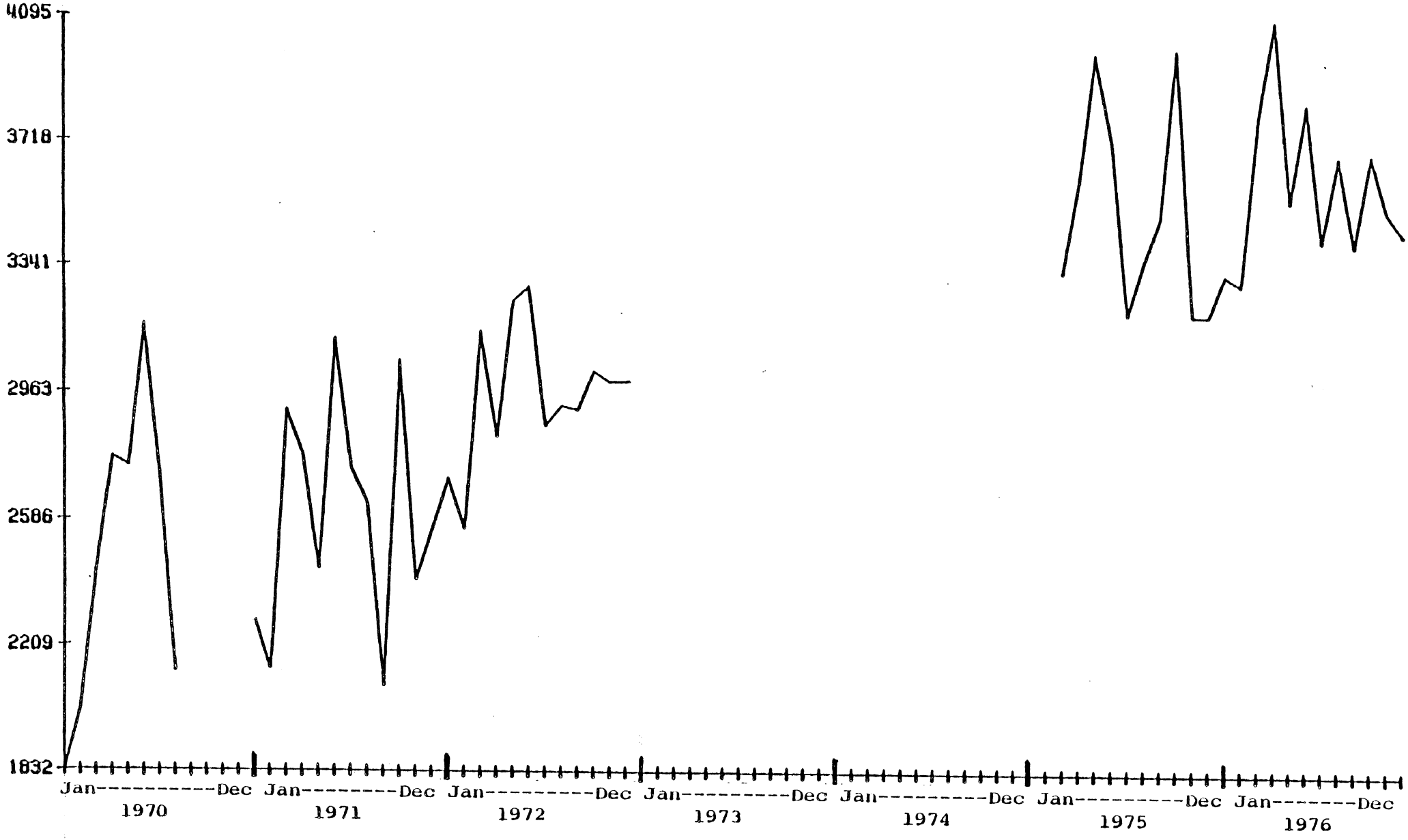


FIGURE 7. FREQUENCY OF DIVORCE, STATE OF MICHIGAN, 1970-1976

Source: Michigan Department of Public Health



of the seasonal variation in assault but most of the variation in frequency of divorce is a result of the upward linear trend.*

In conclusion, it is clear that the time-series variables analyzed are characterized by a high degree of fit to the additive time-series model $Y = T + S + I$. The predictive power of the model is particularly high for package beer sales and frequency of assault; in each case over 80% of the variance was accounted for. Important differences were noted in the relative contribution to explained variance of trend and seasonality.

Table 2

Percentage of Variance in Frequency of Assault and Divorce in Michigan Explained by Trend and Seasonal Components

| | Trend | Seasonality | Total |
|---|---|---|---|
| Assault | 13% | 77% | 90% |
| Divorce | 69 | 7 | 76 |

With regard to the objectives of time-series analysis discussed earlier, it is clear that the additive model functions very well as a description of the time-series. This is important not only for an understanding of the event but also because the tested model can be used to forecast future values of the variable under consideration. In using a model such as the one described here for forecasting, it is assumed that there is sufficient momentum in the system to ensure that future events will occur as they have in the past. As a result, forecasting can be done without knowledge of the specific causal system operating to bring about the event. Obviously, such a forecast could be seriously in error if a major occurrence (such as a significant

*The percent of variance in assault accounted for by the model should be interpreted with caution since only 24 data points were used.

change in beverage control laws or a war) were to impact on the causal system during the period to which the forecast applied.

Another use of a highly predictive time-series model is to eliminate the variation accounted for by the model prior to further analysis of relationships between time-series variables. However, the elimination of variation due to trend and seasonality prior to further analysis assumes that the determinants of the trend and seasonal variation are clearly known. Since the causes of trend and seasonal variation in Liquor Control Commission licensing actions, beverage alcohol consumption variables, and social/health problem variables are not fully known at this time, analysis of the relationship between these variables were conducted using the original time-series variables, including trend and seasonal components, rather than the irregular component only. It is possible that the trend and seasonal components of Liquor Control Commission licensing actions, alcohol consumption, and social problems are related. Since our knowledge is limited concerning the causal mechanisms that bring about trend and seasonal variation in these variables, all the components of variance are included in the subsequent analysis of cross-correlations among the variables.

## Cross-Correlation Analyses

Time-series data present opportunities for examining relationships among variables which are not possible when observations are made only at singular or irregular points in time. The availability of time-series data permit analyses which, while not totally conclusive, are capable of indicating relationships which exhibit strong probabilities of causality, that are not possible with other techniques.

Determination of a causal relationship between one social factor, such as a new law, a change in a regulation, an increase in alcohol consumption, an increase in alcohol consumption, or an increase in the number of beverage outlets in a jurisdiction, and an outcome or

consequence variable, such as increased numbers of traffic accidents, was the central focus of the current study of the impacts of changes in alcohol availability. There are four basic requirements which must be met if a causal X-Y relationship is to be substantiated. First, there must be covariation, or systematic change, in both terms. The number of package liquor outlets in Michigan could hardly be deemed responsible for a sudden surge in package liquor sales if there was no associated increase in the numbers of outlets with SDD licenses. Secondly, the causal X variable must preceed the outcome Y. The argument that X causes Y could not be supported if changes in Y were followed by changes in X. Third, the X-Y relationship must hold even when other factors are held constant. This means that alternative, or spurious, competing independent terms ($X_i$) must be tested for their grouped or independent influences on Y. Finally, the presumed causal relationship must make sense. Even with covariation, proper time sequence, and an apparent absence of competing causal influences, no increase in alcohol consumption would be attributed to a conceptually unrelated social change.

The measurement, over time, of the frequencies of retail alcohol outlet licensing, marketing changes (changes in permits held), beverage distribution (consumption by beverage type), and a range of reported social and health problems and mortalities, allowed analyses of covariation and time ordering sequences. Full control over spurious sources of influence on outcome measures (consumption, problems, and mortalities) was not possible. Some analytic techniques, however, are possible which can determine the strength of covariation, the probability of covariation and the direction of the relationships; use of these techniques aids the analyst in a preliminary interpretation of X-Y relationships which are most likely to be truly causal. Cross-correlation analysis is the technique we chose to employ. The interpretive power of these analyses is that the strength of the associations of bivariate processes and the time-dimensions are both

inherently part of the analysis. It is possible, therefore to screen all potential bivariate processes for the possibility of relationships which are meaningful and then to determine the possibility of causality in regard to proper time ordering of changes in the variables.

Results of Cross-Correlation Analyses. Table 3 displays all important cross-correlation results for the full set of licensing and alcohol distribution independent variables and the alcohol distribution, health and social problem dependent measures. Although the police data on homicide and assault generated impressive cross-correlation coefficients (although with negative k lags) the data are limited to a 24 month series which greatly inflates the values of r. These analyses, however can be considered against the public health homicide mortality data, which are more satisfactory, and a reasonable interpretation of the relationships between availability, distribution and homicide can be made. There appears to be weak, positive relationships between new SDM licenses and homicide, and between draught beer sales and homicide.

The most striking result of these statewide tests is the dominant interactions between accidental mortality measures, both categories of beer volumes, and the independent test variables. Those coefficients which explain the greatest amount of variance are exclusively interactions testing the relationships of accident mortality and beer. New SDM licensing is consistently and strongly associated with traffic accident and work accident mortality; both package and draught beer distributions are associated with total accident mortality.

Coefficients explaining between 10 and 20% of variance were found when correlating licensing activities and alcohol distribution. Of the seven interactions which produced 10 or more percent of variance explained, only those between licensing changes and wine or table-top spirits were noteworthy. This may reflect a stable beer distribution pattern over time which is not as easily influenced as sales of spirits or wine.

TABLE 3. SUMMARY OF SIGNIFICANT CROSS CORRELATION ANALYSES BY JURISDICTION LEAD/LAG DESIGNATION, STATE OF MICHIGAN

| Variable Match | r | Lead/ Lag* |
|---|---|---|
| New C License vs (Police) Homicide† | .52 | -6 |
| New Tavern License vs (Police) Homicide | .35 | -1 |
| New Sunday Sales Permit vs (Police) Homicide | .58 | -5 |
| Transfer of SDD vs (Police) Homicide | .57 | -4 |
| Transfer of SDM vs (Police) Homicide | .63 | -4 |
| New C License vs (Police) Assault† | .53 | -6 |
| New Tavern License vs (Police) Assault | .36 | -1 |
| New Sunday Sales Permit vs (Police) Assault | .56 | -5 |
| Transfer SDD vs (Police) Assault | .56 | -4 |
| Transfer SDM vs (Police) Assault | .63 | -4 |
| Transfer C vs (Police) Assault | .36 | -4 |
| New SDM Licenses vs Total Accident Mortality | .51 | 0 |
| New SDM Licenses vs Total Accident Mortality | .60 | +1 |
| New SDM Licenses vs Total Accident Mortality | .57 | +2 |
| New SDM Licenses vs Traffic Mortality | .58 | 0 |
| New SDM Licenses vs Traffic Mortality | .60 | +1 |
| New SDM Licenses vs Work-Related Fatal Accidents | .46 | 0 |
| New SDM Licenses vs Public Health Homicide Mortality | .32 | +3 |
| New Tavern Licenses vs Total Accident Mortality | .32 | +1 |
| New Tavern Licenses vs Total Accident Mortality | .38 | +2 |
| New Tavern Licenses vs Traffic Mortality | .34 | +1 |
| New Tavern Licenses vs Work-Related Fatal Accidents | .42 | +2 |
| New Tavern Licenses vs Work-Related Fatal Accidents | .35 | +2 |
| New Sunday Sales Permits vs Total Accident Mortality | .40 | +1 |
| New Sunday Sales Permits vs Total Accident Mortality | .53 | +2 |
| New Sunday Sales Permits vs Total Accident Mortality | .50 | +3 |
| New Sunday Sales Permits vs Traffic Mortality | .40 | +1 |
| New Sunday Sales Permits vs Traffic Mortality | .48 | +2 |
| New Sunday Sales Permits vs Traffic Mortality | .52 | +3 |
| New Sunday Sales Permits vs Traffic Mortality | .38 | +4 |
| New Sunday vs Work-Related Fatal Accidents | .44 | +1 |
| New Sunday vs Work-Related Fatal Accidents | .33 | +2 |
| New Sunday vs Cirrhosis Mortality | .37 | 0 |
| New Sunday vs Cirrhosis Mortality | .38 | -1 |
| Transfer of C Licenses vs Work-Related Fatal Accidents | .37 | -3 |
| Transfer of Tavern Licenses vs Work-Related Fatal Accidents | .30 | +1 |
| New C Licenses vs Table Top Spirits Distribution | .25 | 0 |
| New C Licenses vs Table Top Spirits Distribution | .26 | +4 |
| Transfer of C Licenses vs Table Top Spirits Distribution | .20 | 0 |
| Transfer of C Licenses vs Table Top Spirits Distribution | .22 | +6 |
| New SDD Licenses vs Wine | .43 | 0 |
| New SDD Licenses vs Wine | .39 | +1 |
| New C Licenses vs Wine | .46 | 0 |
| Transfer SDD Licenses vs Wine | .33 | 0 |
| Transfer SDD Licenses vs Wine | .33 | +2 |
| Transfer SDM Licenses vs Wine | .32 | 0 |

† Police data have only 23 monthly observations which greatly inflates values of r.

*Lead/Lag in Months

TABLE 3. SUMMARY OF SIGNIFICANT CROSS CORRELATION ANALYSES BY JURISDICTION LEAD/LAG DESIGNATION, STATE OF MICHIGAN (continued)

| Variable Match | r | Lead/ Lag* |
|---|---|---|
| Package Beer vs (Police) Homicide | .30 | -6 |
| Package Beer vs Total Accident Mortality | .42 | 0 |
| Package Beer vs Total Accident Mortality | .55 | +1 |
| Package Beer vs Total Accident Mortality | .45 | +2 |
| Package Beer vs Traffic Mortality | .35 | 0 |
| Package Beer vs Traffic Mortality | .55 | +1 |
| Package Beer vs Traffic Mortality | .45 | +2 |
| Draught Beer vs Total Accident Mortality | .49 | 0 |
| Draught Beer vs Traffic Mortality | .48 | 0 |
| Draught Beer vs Traffic Mortality | .68 | +1 |
| Draught Beer vs Traffic Mortality | .67 | +2 |
| Draught Beer vs Traffic Mortality | .47 | +3 |
| Draught Beer vs Work-Related Fatal Accidents | .35 | 0 |
| Draught Beer vs Work-Related Fatal Accidents | .45 | +1 |
| Draught Beer vs Work-Related Fatal Accidents | .42 | +2 |
| Draught Beer vs Work-Related Fatal Accidents | .37 | +3 |
| Draught Beer vs Public Health Homicide | .32 | +1 |
| Wine vs Suicide Mortality | .30 | 0 |
| Table Top Spirits Sales vs (Police) Homicide | .40 | 0 |
| Table Top Spirits Sales vs (Police) Assault | .38 | 0 |

Few consistent relationships were identified between cirrhosis or suicide mortality and the licensing data. Only the relationship between wine dis-ribution and suicide mortality even approached importance; furthermore, this relationship was at the k=0 paired observations in which no time ordering is evident.

The most important bivariate relationships involved package and draught beer, as mentioned above. On Table 4, it is clearly shown that the strength of the relationships between beer distribution and all three categories of accident mortality, and the direction of these relationships (k=0 to k=+3) strongly suggest causality. It is apparent that increases in beer distribution are consistently followed by increases in total accident mortality, traffic accident mortality, and accidental deaths in the working place. The lag between the maximum alcohol distribution increases and mortality increases is generally one or two months (k=+1,+2) which would be an appropriate time sequence if these relationships are truly causal.

Discussion of Cross-Correlation Analyses. If one were to construct an hypothetical continuum based on the social and medical etiologies of each of the social and health dependent variables used in these analyses, it would be possible to rank-order the problem areas and mortality categories along a "most simple" to "most complex", or most acute to most chronic, scale. If this were done the three categories of accident mortality, assault, and homicide would probably be classified as relatively acute, while divorce, child abuse, and suicide would be more complex and more chronic. Cirrhosis mortality would certainly be listed as the most chronic. The general impression that emerges from the cross-correlation analyses is that the most acute social and health problems, particularly the acute accident mortality measures, are most likely to be statistically associated and appropriately time ordered which suggests causal relationships with increased alcohol availability. Further, increases in the distribution of draught beer and package beer appears to be associated with acute

TABLE 4. ALCOHOL AVAILABILITY, CONSUMPTION AND THE INCIDENCE OF ALCOHOL-RELATED SOCIAL AND HEALTH PROBLEMS IN MICHIGAN

Cross-correlation Analysis of Alcohol Licensing, Alcohol Distribution, and Selected Social and Health Problems, State of Michigan, 1970-1976

| | Wholesale Distributions | | | | Frequency | | | | Mortality | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Package Beer | Draught Beer | Wine | Table Top | Divorce | Child Abuse | Homicide (Police)* | Assault (Police)* | Accidents All | Motor Accidents | Work Accidents | Cirrhosis | Suicide | Homicide |
| New SDD Licences | | | .43(0) | | | | | | | | | | | |
| New SDM Licences | | | | | | | | | .60(+1) | .60(+1) | .46(0) | | | .32(+3 |
| New C Licences | | | .46(0) | .25(0) | | | .52(-6) | .53(-6) | | | | | | |
| New Tavern Licences | | | | | | | .35(-1) | .36(-1) | .38(+2) | .34(+1) | .42(+2) | | | |
| New Sunday Sales Permits | | | | | | | .58(-5) | .56(-5) | .53(+2) | .52(+3) | .44(+1) | .38(-1) | | |
| Transfer SDD Licences | | | .33(0,+2) | | | | .57(-4) | .56(-4) | | | | | | |
| Transfer SDM Licences | | | .32(0) | | | | .63(-4) | .63(-4) | | | | | | |
| Transfer C Licences | | | | | | | | .36(-4) | | | .37(-3) | | | |
| Transfer Tavern Licences | | | | | | | | | | | .30(+1) | | | |
| Package Beer | | | | | | | .30(-6) | | .55(+1) | .55(+1) | | | | |
| Draught Beer | | | | | | | | | .49(0) | .68(+1) | .45(+1) | | | .32(+1) |
| Wine | | | | | | | | | | | | | .30(0) | |
| Table Top Spirits | | | | | | | .40(0) | .38(0) | | | | | | |

Note: Coefficients are product-moment correlations; Values in parentheses indicate positive lead or negative lag for the coefficient.

*r values are inflated for police data because of the small number of cases available for analysis.

mortality including total accident deaths, accident deaths in the working place, and traffic accident mortality. Although explaining only a small percent of the variance, changes in the licensing of beverage alcohol sales outlets does appear to be consistently related to wine and distilled spirits distribution. Beer distribution, in the form of package sales or draught beer, is apparently unaffected by changes in the licensing actions of the Liquor Control Commission.

These findings suggest, from a public health perspective, prevention of a portion (alcohol-related) of accident mortality might be accomplished through changes in certain licensing actions. It is also clear that, while package and draught beer distribution are more strongly associated with accident mortality than wine or distilled spirits, beer distribution is probably more resistant to influences of licensing activities than other alcoholic beverages. Thus we are faced with a dilemma; the availability of beer is the most strongly related to accident mortality but it is the category of alcoholic beverages least effectively regulated by the state.

## Conclusions

In many respects this study has been exploratory. Regarding hypothesis testing, the clear intention was to clarify potentially testable hypotheses as well as to raise new research issues from which new hypotheses might be developed in the future. Also exploratory were our many efforts to find and utilize data resources which might aid in the research process; in a practical sense we suspect that, in the short run, our discoveries of widespread data collection and the strengths and weaknesses of those data will have the largest benefit to the State of Michigan.

Analyses of several datasets were designed to provide empirical guidance for future, more definitive, research regarding the fundamental relationships between beverage alcohol availability, consumption and distribution, and alcohol-related morbidity, mortality and social

problems. In each of the analyses both design and data restrictions were significant and the results should be viewed as suggestive regarding the continuing study of the phenomenon or for policy development.

Data Availability for Research Analysis. The major strength with regard to data on alcohol availability, consumption, and social and health problems is that in Michigan a variety of systems exist that collect data relevant to alcohol availability, consumption and alcohol-related social and health problems. The Office of Vital and Health Statistics routinely processes data on a wide variety of causes of death and on other social problems (such as divorce) which are potentially related to alcohol availability and consumption. These data are easily accessible in machine readable format facilitating their use for research and monitoring efforts. Similarly, the Liquor Control Commission maintains a large dataset that is potentially relevant to public health policy monitoring and evaluation. Other state or local government units, such as the Department of Social Services and the Michigan Department of State Police, keep regular records that are useful for monitoring the impacts of public policy on alcohol-related problems. These existing data collection systems could be effectively used to compile a continually up-dated data file which would be appropriate for the monitoring of the effect of a wide variety of state policy changes on alcohol availability, consumption and social and health problems. If the existing data resources are to be fully exploited for the purpose of policy evaluation, significant deficiencies in the quality and comprehensiveness of data collected shoudl be corrected.

Alcohol Availability and Alcohol Distribution. It is apparent that, singularly and in combination, licensing activities which increase the numbers of licensees and which change the mix of existing licenses and permits are associated with increased distribution of alcoholic beverages. Wine distribution is the most consistently

affected beverage category followed by draught and package beer and distrilled spirits sold by the drink. No adequate data were available to test the association of alcohol licensing activities with the distribution of packaged distilled spirits.

Except in combination, licensing activities have a less pronounced effect on beer distribution than on wine or distilled spirits (table-top sales). The relative lack of responsiveness of beer distribution to licensing activity, compared to wine and distilled spirits, might be due to the size of the beer market or the strong seasonal cycles of that market. The general influence of the Michigan Liquor Control Commission's licensing activities appears to be substantial regarding the volumes of wine and distilled spirits and to a lesser degree with beer, which are distributed for sale throughout the state.

Other exogenous factors have not been analyzed which might contribute to a more thorough understanding of the association of licensing and distribution. Population changes and economic variations were not tested. We do not believe that the statistical associations relating availability and distribution would be totally negated with the inclusion of appropriate test variables (population, economic growth, etc.), however this is somewhat speculative and suggests that further research is required.

Another set of analyses investigated the predictability of alcoholic beverage distribution as a time-ordered process. Utilizing additive time-series models it was found that alcohol distribution, over time, is highly regular and predictable. Draught beer distribution is remarkably consistent with stable and dominant seasonal cycles. The time-series models of wine and distilled spirits demonstrated relatively less seasonal dominance, yet linear trend (growth) was stable and predictable. These findings are of importance because such stability in the data on beverage distribution accomodates analytic requirements to evaluate the impact of specific changes in licensing rules and regulations on the distribution of alcoholic beverages. The

relative effectiveness of legal, regulatory or administrative changes can be evaluated if it is possible to predict beverage distribution into the future with reasonable confidence. It is very clear that highly accurate predictions of beer, wine and distrilled spirits distribution levels can be made with straightforward time-series modelling. Therefore, rigorous and scientifically satisfactory impact analyses are feasible.

Alcohol Distribution and the Frequency of Health and Social Problems. Certain categories of beverage alcohol distribution are associated with increases in the frequency of specific acute health and social problems. Distribution of package and draught beer are associated jointly with licensing and certain mortality frequencies. While not definitive, these associations support the hypotheses that licensing (availability) is associated with consumption (beverage distribution) which directly results in certain increases in specific kinds of social and health problems. Much more analysis, however, is required before a full understanding of these relationships is known.

All categories of accidental mortality were found to be consistently associated with several kinds of licensing and permit actions by the Liquor Control Commission. Neither the consistency nor the strength of statistical associations were found between most other social and health problems and licensing and regulatory activities. Total accident mortality, occupational accident mortality and traffic accident deaths were consistently related to beer distribution in both package and draught categories.

In general the more acute (from our set of mortality, morbidity and frequency of reported social problems) social or health problems are predicted better by alcohol distribution than "chronic" problems such as cirrhosis mortality, suicide, divorce or reported child abuse, where "chronic" refers to problems with long, time-ordered and complex etiologies.

Two remarks should be made in interpreting these results. First, we note that variations in beer consumption are, by a large margin, dominant in explaining subsequent variation in the incidence of social problems. The seasonal variation in beer consumption was examined and it was found that the seasonal and trend components accounted for nearly all of the fluctuations in consumption that were observed. With beer consumption having such a pronounced seasonal pattern when plotted against time, we must be aware that to the extent that other, causally unrelated variables covary with time, they will appear to be related to beer consumption. Secondly, the finding that chronic problems do not covary greatly with aggregate consumption need not mean that the two are independent - it may simply indicate that they are tied together in a more complicated way.

These analyses refer to one jurisdiction and the dynamics, mostly increases, in beverage distribution and reported frequency-of-events over time. The limitations of our analyses, therefore, do not preclude the validity of findings which are based on comparative analyses of different jurisdictions and the effects of different kinds and levels of availability and alcohol distribution on the public health. Such a finding was recently reported by Parker, Wolz and Harford (1978) regarding the effects of population based limits on the number of sales outlets upon alcoholism rates. The authors concluded that "alcohol availability should become a public health issue"; a conclusion that is supported by our analyses of Michigan data.

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