

Report HSRI-335040-2

# DEVELOPMENT OF HIGHWAY SAFETY PROGRAM AND PROJECT EVALUATION CRITERIA: Accident Experience Characterization

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FINAL REPORT

Prepared for

*MICHIGAN OFFICE OF HIGHWAY SAFETY PLANNING  
and  
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION  
U. S. Department of Transportation*

The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the State or the U. S. Department of Transportation, National Highway Traffic Safety Administration.

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## PREFACE

This is the second of two reports prepared by the Highway Safety Research Institute (HSRI) for the Michigan Office of Highway Safety Planning (OHSP) under the contract resulting from HSRI Proposal ORA-71-399-B1(R-1). That contract effort, composed of two relatively independent tasks, was operated during the period October 15, 1970 - November 15, 1971, under the general title, "Development of Highway Safety Program and Project Evaluation Criteria."

Report of Task 1 of that contract was submitted on February 15, 1971, under the title, "Summary of Effort to Collect Data for AHSWP Effectiveness and Output Criteria." The number of that interim report is HSRI-335040-1. As the title suggests, that report identified the location and nature of data within State of Michigan agencies suitable for use with the quantitative evaluation measures for program sub-elements of the OHSP Annual Highway Safety Work Program (AHSWP).

The present report concerns the findings of Task 2, which was concerned with developing procedures for collating quantitative data on accidents, drivers, vehicles and roads to form normalized, areal indices of the State's accident experience.

While responsibility for the report must rest with its authors, the research reported here could not have proceeded without the assistance and advice of Mr. Noel C. Bufe, Executive Director of OHSP, and his staff.

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## 1.0 INTRODUCTION

Two of the major functions in the iterative process of accident countermeasure planning are, on the one hand, identification of the manifold nature of the accident problem and, on the other, gauging the success of countermeasure efforts. The first function might be called "problem evaluation" and the second, "program evaluation." The project of which this report is a part was involved with the search for practical techniques that could be used by OHSP in both those types of evaluation.

Our work with program evaluation was done in the context of the initial preparation by OHSP of the Michigan Annual Highway Safety Work Program (AHSWP). The AHSWP, as mandated by the National Highway Traffic Safety Administration, provides a formalized structure for planning, programming and evaluating the state's highway safety efforts. The structure is composed of countermeasure program elements and sub-elements, with each of the program sub-elements having effectiveness and output criteria measures. In a previous contract with OHSP, we assisted OHSP in developing that program element and sub-element structure and in defining appropriate, quantitative, effectiveness and output measures for each of the program sub-elements.\* As a follow-up to that "program evaluation" effort, the first

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\*Conclusions from that effort are contained in the report by D. K. Damkot and W. T. Pollock, "Highway Safety Project Evaluation System", Final HSRI Report to OHSP on ORA-70-1251-B1, October 15, 1970.

task of the current contract addressed the problem of locating and collecting the data required to vitalize the sub-element criteria. In the course of that data search, an overriding consideration was the need for channels of information and data flow that could be used iteratively for annual updating of the AHSWP. In addition, emphasis was placed on the need for objective data, rather than subjective estimates.

With those data conditions established, the search reduced to combing the many data files of state agencies and private organizations. The results of that data search were provided in an earlier interim report.\* While not all of the desired data were obtained, the original sub-element criteria were retained, in some instances without data, rather than revise individual criteria to use available, but less meaningful, data. Indeed, those missing data become goals of an extended, improved system of data banks and traffic information networks for the state.

The second major task of the present contract, and the principal subject of this report, was the beginning of a characterization of the State relative to its accident problems and highway safety needs. Development of any plan for attacking the highway accident problem, be it at a national, state, or local level, obviously requires the

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\*Damkot, D. K., "Summary of Effort to Collect Data for AHSWP Effectiveness and Output Criteria", Interim Report (HSRI-335040-1) to OHSP on ORA-71-399-B1(R1), February 15, 1971.

ability to designate where the "action" is. Thus, for Michigan, or any other state, it is important to determine those locations having the greatest need for financial and technical assistance to counteract a highway accident problem.

This effort dovetails in a sense with the AHSWP data to afford a systematic consideration of factors pertinent to planning and allocation of effort for a comprehensive highway safety program. The criteria measures for the AHSWP were designed to reflect, hopefully, the impact made by the varied 402 projects on specific highway safety problems. There is a great deal of question as to whether or not the relatively small projects can effect a large enough impact to be observable in changing statistics, but at least that is the basis for that effort at present. If this is effective, it will lend information useful in deciding which types of programs have the greatest potential benefit.

Concomitantly, a profile characterizing the State's accident experience is needed to determine where funds should be spent and projects established. Development of this tool entails a rather wide array of problems and choices. For example, how large should the areas and locations be which are to be considered? If one were interested only in determining where to place some new traffic signals one might narrow scope to intersections with the highest fatality rate. Obviously this is too specific when the dispersal



of funds for 402 projects is the prime concern. Conversely, initial attempts to compare the fourteen State planning regions showed that this cut was too broad and that differences tended to become hidden in the aggregates.

These considerations and the fact that data become very difficult to obtain for smaller areas resulted in the choice of counties as our basic comparative unit. Many statistics and demographic data are kept on a county basis which are extremely difficult or impossible to shake loose for smaller units such as cities, villages and townships.

Another basic consideration involves the choice of appropriate criteria measures. What are the relevant yardsticks to use when measuring the accident problem and comparing counties? Gross measures such as number of accidents, injuries, or fatalities are frequently used to characterize accident experience. Of course, these criteria are greatly affected by population and density factors so it is expected that populous urban areas will have more accidents than sparsely settled counties in the upper peninsula. These criteria may be normalized by relating the measure to some moderator variable such as population. Thus, one might consider number of accidents per unit of population of a county in order to control for county size. The measures we selected and the underlying rationale are explained in Sections 2.0 and 3.0 of this report.

After the unit has been chosen and appropriate criteria measures have been selected, one must determine how much of a difference is of practical significance for planning and programming purposes. For instance, if county X had 62 traffic fatalities last year while similar-sized county Y had 65, one questions whether or not the difference is large enough to justify varied levels of countermeasure funding for the two counties. Obviously that decision would be influenced by other factors such as personnel availability and interest, ability to more specifically pinpoint the problem locally, other funding, etc.

A related concern is the significance of the trends established by the counties on the criteria measures. If data are available for a number of years, trendlines can be an important consideration for predicting probable future experience. Of course this kind of prediction is needed before one can hope to measure the success of some program in altering the expected accident experience.

This report reflects these and other concerns in the development of a systematic characterization of Michigan's highway safety posture. Section 2.0 reflects the diversity and extent of the data gathered and the data manipulations performed. Some of the data did not afford useful insights and were not incorporated into the characterization profiles. Other data were essentially redundant and were also not used.

Most of the data, however, was retained and has become an essential part of the final profiles. Discussion of the use and relevance of the data incorporated into the county profiles is found in Section 3.0. Finally, Section 4.0 contains a brief description of the computerization of these profiles and some comments on further refinement of the characterization system.

## 2.0 SOURCE SPECIFICATION, DATA INPUTS, AND INITIAL PROCESSING

Data relevant to a characterization of the highway safety experience are diverse and extensive. Innumerable environmental, vehicular, roadway and driver variables are involved in the broad spectrum of potential causative factors of accidents. While these and other variables are relevant to highway safety, many are unmeasured except for very selected sampling for research purposes. While research results may be pertinent for ongoing programming, more comprehensive data are needed for a profile of the State's experience. Thus, from this population of variables, those that are most reflective of accident experience, accessible on an iterative basis, and unbiased, are to be extracted and included in a systematized characterization of Michigan's highway safety posture.

Functioning under these needs and guidelines, we took a broad approach to this task and attempted to gather those data which appeared to be of potential utility. Some data, such as number of drivers per unit area and number of vehicles in cities, proved to be unavailable. Some "data" were simply subjective estimations; with some other numbers, even those who use them warned that the figures were quite "dirty" (e.g., estimated vehicle miles). Other data are available only on a special study basis, without the continuity of measurement necessary to reflect change as it

occurs in the system. Thus, the data search was self-limiting to some extent.

The resultant collection of usable data is presented in this section along with their sources and the initial "massaging" of the numbers as meaningful profiles were sought.

## 2.1 GROSS DATA AND SOME PRELIMINARY MANIPULATION

Accident data available from the Michigan State Police accident file are the most obviously relevant information for the present effort. This file contains most of the raw data retrievable from accident forms compiled on all accidents throughout the State. Only Detroit still reports summary data rather than the individual accident forms, but that shall also soon change. As of January 1, 1972, all accidents will be encoded from each individual accident form. Hence, accident statistics included in this characterization are the most complete available in the State, and probably the most complete in the country.

Total accidents, personal injury accidents, fatal accidents, property damage accidents, number of injuries, and number of fatalities were extracted from the file. These data were obtained from "Accident Facts," a publication put out annually by the Michigan State Police, which is assembled from the data in the accident file. The accident file data can be obtained on a basis other than yearly so,

for instance, quarterly printouts of this information will be available when needed.

Also found in "Accident Facts" is information about the number of vehicles registered each year in Michigan. In addition to total vehicles registered, there is a breakout by passenger, commercial, farm vehicle, trailer, trailer coach, motorcycle, and municipal vehicle categories. A problem with the individual categories is that the class definitions have changed slightly since 1966 so there is not a one-to-one correspondence in the categories across this time span. In 1966 only total registered vehicles were published, while from 1967 on, categories of vehicle types were included. In 1967 and 1968, the fuller categorization noted above was adopted. However, in 1969 the classes were again changed to passenger, commercial, trailer, motorcycle, and municipal. These categories have been retained to the present. Thus, total number of vehicles registered per county per year was selected as the most practically usable information on number of vehicles available at present.

It would be desirable to be able to determine number of any given class of vehicles involved in accidents per total number of that particular type of vehicle registered in a county. Again, this is a case in which the vehicle type coded in an accident report does not coincide with the classifications of vehicle registrations. For example, all vehicles registered in the municipal category have tax-exempt "X" plates whether

they are passenger vehicles, dump trucks, or buses. If these are accident-involved, however, they will be coded by type. Consequently, it is not presently possible to cross-compare vehicle accidents and vehicles registered per county by type.

Miles of road were obtained from the Department of State Highway's annual reports. These data are also available on a county by county basis. While the data were being recorded, it became evident that there was very little change in the number of road miles in any given county from one year to the next. Comparison of years 1968 and 1969, for example, indicated that of 96,676.7 total miles, there was an addition of only 197 miles or .002% change. Consequently it was decided that it would be advantageous to use just one year of data for these profiles with updates required no more frequently than every five years.

We chose to utilize the data on number of road miles from 1968 and to include as much information as could be gleaned from that report. Therefore it was necessary to extract not only the mileage of county roads and rural trunkline data from the "County Road Commissions" section, but also the data available on state trunklines, city, and village local streets from the "Incorporated Cities and Villages" section. Four categories of data were recorded: (1) state and rural trunklines; (2) county and village primary, and cities and villages major streets data; (3) county and village

secondary, including the county local and the cities and villages local data; and (4) total road miles for the county, which included the summed totals of the county and the listed cities within that county. For example, Alcona County had the following road mileage: (1) state trunkline information from cities and villages was 1.46 miles from Harrisville and Lincoln, the two cities listed in the "Incorporated Cities and Villages" section which are in Alcona County, plus the rural trunkline figure for this county, as recorded in the "County Road Commission" tables, of 79.75 miles, equalling a rounded-off total of 81.2 miles of state and rural trunkline miles; (2) county and village primary roads totaled 193.8 miles, which include 188.43 county primary road miles and 5.4 city and village major roads for the two cities; (3) county and village secondary road mileage was derived from 560.26 miles of county local roads and 6.01 miles of city and village local streets for the two listed cities, for a total of 566.3 miles; and (4) summing to give the total mileage recorded for Alcona County in 1968 as 841 miles.

Combining the data in this way from the county road commissions and the cities and villages reports yields the most complete portrayal of a given county's road system available. Again, these data were derived for each county from the 1968 annual report of the Department of State Highways.



Population figures for each county are also given in the Department of State Highways' annual report, but these are from the 1960 census in the most recent reports. The census bureau has published 1970 data now and these figures were obtained for this project. Again, 1970 data were recorded and it is expected that only infrequent updates of these figures need be made. Since accurate data are collected only at ten-year intervals, it may be desirable to use the same population figures for the next ten-year period. On the other hand, if accurate estimates can be found, perhaps five year updates could be made in those years when the county road miles are made current.

Data were also sought which might reflect the level of emergency medical service available, again on a county basis if possible. The Department of Public Health (DPH) is able to supply information on the number of licensed ambulances owned by a company and the county in which the ambulance company is headquartered. Unfortunately this can be somewhat misleading since vehicles actually used in one county may be owned by a company headquartered in another county and consequently listed in the county having the headquarters. The latest report, however, dated October 12, 1971, included information about which city each vehicle is stationed in if in the same county as the company

headquarters and which county if different than the headquarters location. These ambulance licensing reports are updated and available approximately every six months.

Information on the number of licensed ambulance attendants is also available, but on a less regular basis. The latest report we have is dated September 30, 1970. This report lists the number of "temporary" and "regular" licensed attendants in each county. This list also suffers from noting attendants located in the county which headquarters a company rather than in the county where they are stationed.

It is apparent from these data that little informative value can be derived from them at present primarily due to their incompleteness. There are quite obviously many more ambulances and attendants involved in supplying emergency medical service to accident victims of our highway system than are listed in these reports. It would appear that the DPH does not yet have complete enough coverage to provide data reflecting the total picture. The DPH is gearing up to that level and will undoubtedly be exerting more complete control in the future. When that is a reality, the data will be more meaningful.

Other data which have obvious relevance to our

characterization problem are figures for the number of miles traveled in Michigan annually. Frequently accident statistics are displayed as relative to the total vehicle miles traveled in a given unit for a given time period. For example, Michigan's "Accident Facts" annually displays traffic trends for such statistics as numbers of registered vehicles, deaths, accidents, and vehicle miles traveled. Similar data were sought for each county.

Estimated vehicle miles traveled in each county were found to be calculated at the planning division of the Department of State Highways. For these estimations dollar figures are obtained for gasoline tax collected from wholesale gasoline distributors throughout the State on a county by county basis. Calculations made on these figures involve estimating 195 miles driven per dollar of tax monies collected, which is based on a 13.6 mile per gallon consumption estimate and allowance of 3% for evaporation. Obviously there is a gross estimate with many uncontrolled variables which could drastically affect the accuracy of these figures. Southeast Michigan has a considerable amount of commuting and it is quite possible to buy gasoline in one county to take advantage of price differentials while using most of it in another county. Similarly, the State has quite

a bit of tourism and many miles of freeways, making it likely that much gasoline purchased by travellers is combusted in another county or counties.

It should be noted that this problem is not unique to Michigan. Estimation of vehicle miles is no more accurate or reliable anywhere else at present. Indeed, the federal government is presently trying to improve on this problem through funding of "exposure" projects to more accurately assess time or miles spent in the system by the public.

These, then, are the data we initially collected. The next step, of course, was to determine how best to massage the numbers to reflect the accident problem. First cut was a comparison of the fourteen planning regions as used by the Michigan Office of Planning Coordination. Rank orderings of regions for the year 1968 were made for estimated vehicle miles, vehicle registrations, number of fatalities, and total accidents. These revealed a rather striking similarity in the orderings on each of the variables with little change of position between the demographic or the accident statistics. In other words, the more populous counties had more registered vehicles, more accidents, and more fatalities in general with much the same relative ranking for each of these variables.

Similarly, bivariate plots of accidents for the years 1966-1969 and fatalities versus 1966-1969 did not reveal any significant trends for the planning regions. Thus, the rather impressive drop in fatalities for Genesee County in 1970, to take just one example, was lost in the aggregation of these data with other counties of that region.

Small units such as townships and cities were found to be unacceptable analysis units because much of the demographic data were not available for areas smaller than counties. For example, number of registered vehicles is available on a county scale but are not obtainable for cities or townships.

Two things were evident from these initial manipulations: (1) normalization of the data is necessary to get a more accurate picture because of the great difference in population distribution throughout Michigan and (2) counties, rather than planning regions or smaller units, should be the unit basis of investigation for planning and programming.

## 2.2 NORMALIZING THE DATA

There appear to be at least three logical ways to normalize the accident statistics with the demographic data available. Estimated vehicle miles, although of dubious accuracy, is frequently used to normalize accident figures and is considered by many as the most relevant of the possible normalizers. In particular, the National Safety Council and the Michigan State Police both use these figures in their

respective "Accident Facts" booklets.

Population information is another potential normalizing parameter which is reasonably available and, since we are concerned with relative size of counties, has high face validity. However, it also has a number of inherent problems which cannot be ignored. For instance, arguments can be made that population figures include too many non-driving persons and hence do not accurately reflect the exposed population in the driving system. It can also be argued that these data create an inaccurate picture of counties that are losing populace, such as some of those in the upper peninsula, because those emigrating are young persons who have recently graduated from high school and are going elsewhere for work or further education. A population low in these "high risk" cases may well have a different accident experience than a similar populace with many young drivers.

A less philosophical criticism of population figures used as normalizing data is simply their infrequency of collection. Accurate updates are available only on a ten-year basis. Consequently the possibility exists that population shifts or change may go undetected for some time.

Number of registered vehicles is a third possibility for a normalizing statistic applicable to the accident data. As noted previously, number of registered vehicles per county are available on an annual basis in the "Accident Facts"

booklet as they are obtained by the Michigan State Police from the Department of State for reporting purposes. These data, unlike the census information, are available by actual count each year so are desirable from this standpoint. They also have potential for useful refinement in the future if accordance can be gained in registering vehicles by type and recording accident data by the same vehicle typology.

Incorporating each of these possible normalizing statistics, however, is redundant and undesirable. Tests on the correlations for population and registered vehicles in 1970, for population and estimated vehicle miles in 1969, and for estimated vehicle miles and registered vehicles for the years 1966 through 1969 revealed the lowest correlation coefficient obtained to be .93 for population and estimated vehicle miles in 1969. Thus, it is apparent that there is little uniqueness for any of these figures and that in fact any one of them could be used as a normalizing statistic, reflecting much the same profile as the others.

The choice then rests on availability and accuracy of the data. On this basis it was decided that number of registered vehicles would be the most desirable denominator for normalizing the accident data. This serves to reduce the influence of the county size (as measured by number of vehicles) in making county accident figure comparisons and also decreases the large variance existent in the gross data.

### 2.3 SECOND GENERATION NORMALIZATION

Normalization of the data can be carried a step further than suggested thus far. The normalization noted above provides for a common comparative base of the number of vehicles within counties, but it does not speak to differences in the density of the traffic on the highway system and certainly density of traffic affects accident experience. Inverted u-shaped functions relating accidents and fatalities to density might be expected with fatalities exhibiting a more compressed profile and more rapid drop-off at the higher density end. Thus, as traffic density increases, number of accidents and number of fatalities will also increase to some level after which these would decline as the system becomes increasingly saturated. For example, it might be expected that as the number of vehicles per mile of road increases, more accidents will occur simply because more possibilities exist for an accident, but at some level this will reverse so that increased traffic will decrease speed and opportunities to pass and consequently fewer accidents will occur. A similar effect on fatalities is expected, but the function is probably even more pronounced than for accidents.

In any case, it is very probable that differing traffic densities will be associated with some differences in the accident experience of a county or any other unit of comparison. Thus, it is desirable to utilize some density measure to normalize the accident statistics.



Originally it was hoped that something like actual count of number of vehicles per road section per year might be available as a density measure reflecting usage throughout Michigan. However, this kind of counting is a very large task and has not been done nor is it expected to be done in the near future. Another possibility might be the estimated vehicle miles per road mile per year for each county, but here again the questionable validity of the estimated vehicle miles makes this an undesirable choice.

On the other hand, number of registered vehicles per road mile for each county yields a usable density figure. Although this figure does not indicate the traffic density for any specific location at a specific time, it does offer a comparative base of one county with another and a conceptualization of saturation levels within each county. Indeed, the fact that vehicles are mostly driven within ten miles of their home base supports this density concept also.

### 3.0 COUNTY COMPARISONS

In Section 2.0 three types of traffic data were identified as key elements in a characterization of the State's highway safety posture. In the first case, gross accident data cannot be overlooked simply because it is desirable to institute countermeasures in those locations which have a very large number of accidents, injuries, or fatalities. Secondly, accident statistics normalized by number of registered vehicles are an important consideration since there is such a wide range of county sizes in Michigan. As a result the gross statistics are so weighted to the larger counties that smaller counties are completely overshadowed. Thus, a traffic problem in a small county would never be noted if some standardizing control for size were not employed. Thirdly, second generation normalization is desirable in order to produce some uniform index of traffic density between the counties. It is evident that if two counties have an equal number of vehicles but one has four times more road miles, they will likely experience different accident rates, types, and severity.

With that identification, then, of important data elements, how can these be used to characterize Michigan's highway safety posture and how can they best be interpreted? As noted previously, the decision was made to build our systematic characterization on a county basis with the obvious goal of identifying "good" and "bad" counties. That identification is the problem, of course. Just how does one designate

"good" and "bad" counties? Some absolute criteria would be desirable and in a sense we do have that. Everyone knows that any accident statistic above zero is "bad", at least philosophically. Quite obviously, however, system failure well above zero is an acceptable level when considering highway accidents.

Relative "goodness" is the real criterion. Both from a conceptual viewpoint and a realistic practitioner's point of observation it makes much more sense to think in terms of relative goodness and badness as a guide to better distribution of effort among all possible recipients. This was a developing feature as the characterization profiles took form.

### 3.1 PROFILES

It became increasingly evident that each county should be compared to some baseline of performance in order to judge its position on a theoretical "safeness" scale. Since it is virtually impossible to choose a typical county against which to compare the performance of other counties, the desirable technique is to statistically determine a representative conceptual county. The conceptualized county can then be viewed as "typical" and serves as a comparative yardstick against which others may be measured.

The mean, or average, was chosen as the comparative base derivable from the data. For each year of each variable, the mean and standard deviation of the 83-county distribution

were calculated to create a baseline and variance around this baseline. Each county, then, can be placed somewhere on these distributions to indicate its relation to the other counties. This technique yields essentially a "profile" for each county relative to the mean for all of the counties in aggregate. The "profiles" are composed of a number of variables, as designated previously and as shown in Appendix I.

Included in each county's profile are population and total number of road miles. These are presented primarily to assist in comparing similar sized counties. As a result, if it were desired to compare, say, Washtenaw County with other counties of approximately the same population and/or number of road miles, it would be reasonably simple to locate these counties for comparative purposes. As can be seen in Appendix I, the rest of the charted data consists of gross accident statistics, data normalized by registered vehicles, and density normalized data, for each of the years 1966 through 1970.

The utility of this type of analysis and descriptive presentation bears some notation and explanation. As was just mentioned, individual county profiles make it reasonably simple to compare two or more specific counties on one or more data points of interest. Take, for example, Washtenaw County and Jackson County. While these counties are quite similar in both population and number of road

miles, there are some rather striking differences in some of the accident statistics. Although Washtenaw County has slightly more accidents over the five year period, she exhibits a greater lead in the number of fatalities and injuries experienced. A rather similar relationship exists for accidents per registered vehicle, fatal accidents per registered vehicle and for the density, i.e., vehicles per road mile, normalized data. However, injury accidents per registered vehicle show a strikingly greater discrepancy between the two counties. This may serve as a flag or stimulus to consider possible reasons for the difference, search the accident data more specifically for these counties, and to develop effective countermeasures to apply to the differential factor. For instance, one may hypothesize that there are more injury accidents per registered vehicle in Washtenaw County because the pedestrian-vehicle ratio is higher and more pedestrians are being struck in the major towns, such as Ypsilanti and Ann Arbor, than there are in Jackson County. If a more detailed data search for these counties bears this hypothesis out, some reasonably specific countermeasures may be effective in Washtenaw County to control the problem.

More generally, this type of data display is also useful for broader looks at the relative experience of counties throughout the State. One might want to consider extending funds and aid only to those counties which are more than two standard deviations above the State mean for at least two of the three density normalized statistics. Obviously this

would rule out both Washtenaw and Jackson as potential fund recipients, but other things being equal, this might be one strategy for placing the bucks where the need appears greatest. Numerous strategies of this type are possible utilizing these data profiles.

One other important bit of information is available in these profiles due to the presentation of data over a time span, namely, five years. Availability of data for even such a relatively short time period permits consideration of trendlines. This also can be reasonably informative for program planning and fund allocation. Rapidly rising trendlines should warn of some problem while a rapidly falling trendline might signal a success which should be identified, dissected, and applied elsewhere.

Again, these data are plotted against the mean line for all the counties. Therefore, a rising trendline denotes not only an increase, but an increase that is either greater than the State average or perhaps even counter to the baseline if the mean is falling. Relative change over the five-year period, then, is a reasonably powerful indicator of where one might predict a given county is going.

### 3.2 KEYS

Some keys to the county profiles are shown in Appendices II and III. These were prepared to assist in the interpretation of the profiles and to more easily locate specific counties of interest.

It may be noted that two basic types of keys have been prepared. Appendix II contains those keys designed to show the counties which are one, two, or three standard deviations above or below the State average for every year of each variable.

Appendix III contains keys which utilize some trendline information. These were developed by calculating, for each county, the average of a given variable for years 1966, 1967, and 1968 and the average for years 1968, 1969, and 1970. Then, if the second average is greater than the first, an increasing trend is evident while if the first figure is greater, a decreasing trend exists. Also these keys indicate if the county was above, below, or crossing the baseline.

Both of these keys can be useful in interpreting the profiles and in pinpointing those counties of particular interest. For example, enquiry into counties that have been consistently above the state average but are beginning to show a declining trendline would find that Oakland County fits those criteria. Wayne County also has some of those characteristics, but the trendline keys indicate increasing numbers of injuries and fatalities.

Similarly, the trendline keys indicate that Van Buren and Wexford counties are exhibiting ascending trendlines which cross the baseline for some of the normalized data.

In other words, they are moving from the black side of the ledger to the red relative to the State Mean in their accident experience. Inspection of these counties' profiles, then, reveals that Van Buren County is a good deal larger, has higher gross accident figures, somewhat lower statistics normalized by registered vehicles and more stable density normalized characteristics than Wexford County. Based on this information one might be more apt to seek ways to assist Wexford rather than Van Buren if funds are limited and other considerations are equal. Again, a more specific data search may indicate unique problems for which counter-measures could be designed.

The unstable characteristics of the density normalized data for Wexford County reveal one of a number of characteristics of the profiles and keys that bear some notations. Wexford, like the other small counties, has extremely small numbers of accidents, fatalities, injuries, and registered vehicles, and as a result the normalized data may exhibit wide fluctuations, compared to other counties, when there has been rather small changes in the accident statistics. Looking again at Wexford as an example, it can be seen that they experienced 21 fatalities in 1969 compared to 6 and 9 in 1968 and 1970 respectively. Although 21 fatalities is quite small relative to statewide experience, this was a significant change for the county and is apparent in the normalized data profiles.



Another consideration when viewing these profiles is the fact that the large counties in Michigan are so overwhelming in their effect that most of the counties fall below the baseline average in their gross data characteristics. This is quite evident in the trendline key for accidents. It is recommended that when major concern is for counties which fall above or below the mean that primary consideration be given to the profiles normalized by vehicles registered and density. Conversely, when major interest is on trendline evidence, it is recommended that one note gross data characteristics rather than the normalized profiles in deference to the aforementioned large fluctuations apparent in the smaller counties.

Finally, it should be pointed out that a very broad criterion was used to determine if a trendline for any profile was rising or falling. As noted before, the 1966-1968 average was compared with the 1968-1970 average for each five year data group to determine if trend was up or down. Consequently, only if the 1966-68 mean was exactly the same as the 1968-1970 mean (rounded to the number of significant digits used in presenting the data) was a trend of "steady" recorded. This, of course, is quite rare and in fact a number of very minute changes were recorded as "ascending" or "descending" when a slightly broader criterion would yield no change. Also, it is quite evident from the profiles that a

significant decrement in 1970 for some data may well have not appeared in the profiles as a "descending" trendline because 1968 and 1969 were on the rise relative to the earlier years. This decrement, of course, may disappear or take on more weight as future years confirm or refute a descending trend or as the characterization system initiated here undergoes some refinement.

#### 4.0 SOME CONCLUDING COMMENTS

Computerization of this systematic characterization has been initiated with the Data Processing Division of the Michigan State Police (MSP) utilizing their Burroughs 5500 facilities. The processing of the data into the machine has been accomplished and a program has been written to make the appropriate calculations and analyses. Initial printouts of that effort were recently received and some minor changes are being made in the program to coincide the output with the displays we have devised.

A principal advantage of computerization of these data calculations is the speed with which a number of analyses can be made. We were unable in the contract time available to partial out the urban and the rural counties, for example, although it is felt that this could be most enlightening. As was noted previously, the large counties are overpowering in their effect and it is probably true that analyzing the urbanized counties separately would reflect Michigan's experience even more accurately. To this end, the Data Processing personnel are programming to analyze the data needed on a statewide basis and with the rural counties and the urban counties separated. Urban counties will be those listed as Standard Metropolitan Statistical Areas (SMSA) by the U. S. Census Bureau after the 1970 census.

Use of the computer in the MSP agency assures that more frequent updates can be made on these data and the profiles if necessary. Inasmuch as the MSP have the needed accident data available in the Traffic and Safety Division on a monthly basis and the program for this characterization is equally as available in the Data Processing section, it is recommended that the data be processed on a quarterly basis for all counties statewide. The quarterly data should be printed out and computerized maps should also be drawn for each variable utilizing the SYMMAP program available on the 5500. This SYMMAP program can print a map of Michigan with each county shaded to indicate the number of standard deviations it is above or below the State mean for any variable chosen. Thus, this coincides well with the characterization system and affords a very handy and meaningful "look" at the State on a quarterly basis.

Annually, then, the statewide analysis will be used to update the characterization profiles and keys presented in the appendices. Continuing trendlines can be maintained using the annual analysis. Also, it is expected that the partialing out of the urban and rural counties should be done with this annual data run if not on a quarterly basis.

Finally, it may be noted that this systematic characterization is not a mysterious model to designate how many dollars should go to which areas for what project. No such

magic formula exists. Rather, this is a tool which, it is hoped, will be useful in making the decisions necessary for good planning, programming, and management.

## ERRATUM

An error has been found in the population column of the county profiles of Appendix I which, although not affecting the information in the accident data shown in the profiles, should be noted. The State  $\mu$  and State  $\sigma$  for the population parameters are incorrect as shown in the graphs. The correct State  $\mu$  is 107,287 and the correct State  $\sigma$  is 332,015. The population data given for the counties are correct, except Kalamazoo county which should be 199,287. Thus, although the population of a given county is unchanged, the bar graphs showing its population relative to population of the average county will change radically. Given below are the corrected standard deviation values for each county population relative to the correct State  $\mu$  and State  $\sigma$ .

Alcona	-.30	Dickinson	-.25	Keweenaw	-.32	Oakland	+2.39
Alger	-.30	Eaton	-.12	Lake	-.31	Oceana	-.27
Allegan	-.13	Emmet	-.27	Lapeer	-.17	Ogemaw	-.29
Alpena	-.23	Genesee	+1.00	Leelanau	-.29	Ontonagon	-.29
Antrim	-.29	Gladwin	-.28	Lenawee	-.08	Osceola	-.28
Arenac	-.29	Gogebic	-.26	Livingston	-.15	Oscoda	-.31
Baraga	-.30	Grand		Luce	-.30	Otsego	-.29
Barry	-.21	Traverse	-.21	Mackinac	-.30	Ottawa	+0.06
Bay	+0.03	Gratiot	-.21	Macomb	+1.55	Presque	
Benzie	-.30	Hillsdale	-.21	Manistee	-.26	Isle	-.29
Berrien	+0.16	Houghton	-.22	Marquette	-.13	Roscommon	-.30
Branch	-.21	Huron	-.22	Mason	-.26	Saginaw	+0.33
Calhoun	+0.10	Ingham	+0.45	Mecosta	-.24	Sanilac	-.22
Cass	-.19	Ionia	-.19	Menominee	-.25	Schoolcraft	-.30
Charlevoix	-.30	Iosco	-.25	Midland	-.13	Shiawassee	-.14
Cheboygan	-.27	Iron	-.28	Missaukee	-.30	St. Clair	+0.03
Chippewa	-.23	Isabella	-.19	Monroe	+0.03	St. Joseph	-.18
Clare	-.28	Jackson	+0.11	Montcalm	-.21	Tuscola	-.18
Clinton	-.18	Kalamazoo	+0.28	Montmorency	-.31	Van Buren	-.16
Crawford	-.30	Kalkaska	-.31	Muskegon	+0.15	Washtenaw	+0.37
Delta	-.22	Kent	+0.91	Newaygo	-.24	Wayne	+7.81
						Wexford	-.27

Again, this correction does not alter the specific county population data nor will it change the interpretation of any of the other statistics shown.

## APPENDIX I

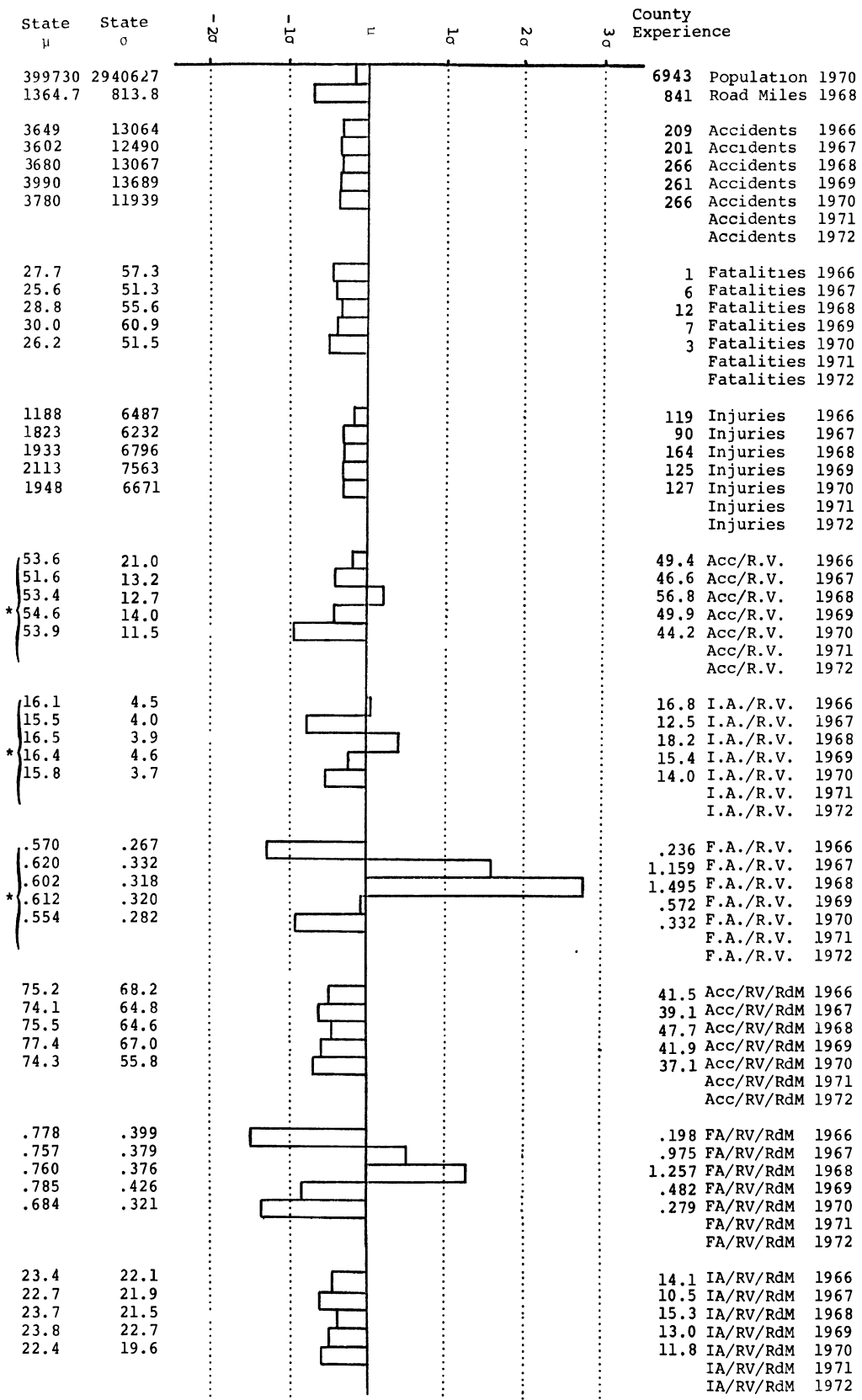
### COUNTY PROFILES

This appendix contains the profiles for each of Michigan's eighty-three counties. They can best be read by searching for the county or counties of interest with the pages in this attitude, then turning the graph 90° clockwise and reading each chart as a bar graph. Note that the heavy baseline for the charts is the State mean and the bars are drawn relative to it. Thus, it is easy to compare any county to the State average.

Arranged across the top of the graph (i.e., toward the binding) is a list of the variables and years. Directly beneath this are the data for each variable-year combination for the particular county represented by the graph. The graph itself shows the State mean and the standard deviations. Along the bottom of each chart are the data for State  $\mu$  (i.e., the average value for all 83 counties) and State  $\sigma$  (the variability of the counties around the State average). Thus, for each county a bar above the "mean" line indicates the county has a greater accident experience than the State average while a bar below this "mean" line indicates an experience "better" than the State average.

Alcona County, for example, exhibits accident experience which is below or better than the State mean for nearly every year and each criteria. In only a couple of instances is it worse than the State average.

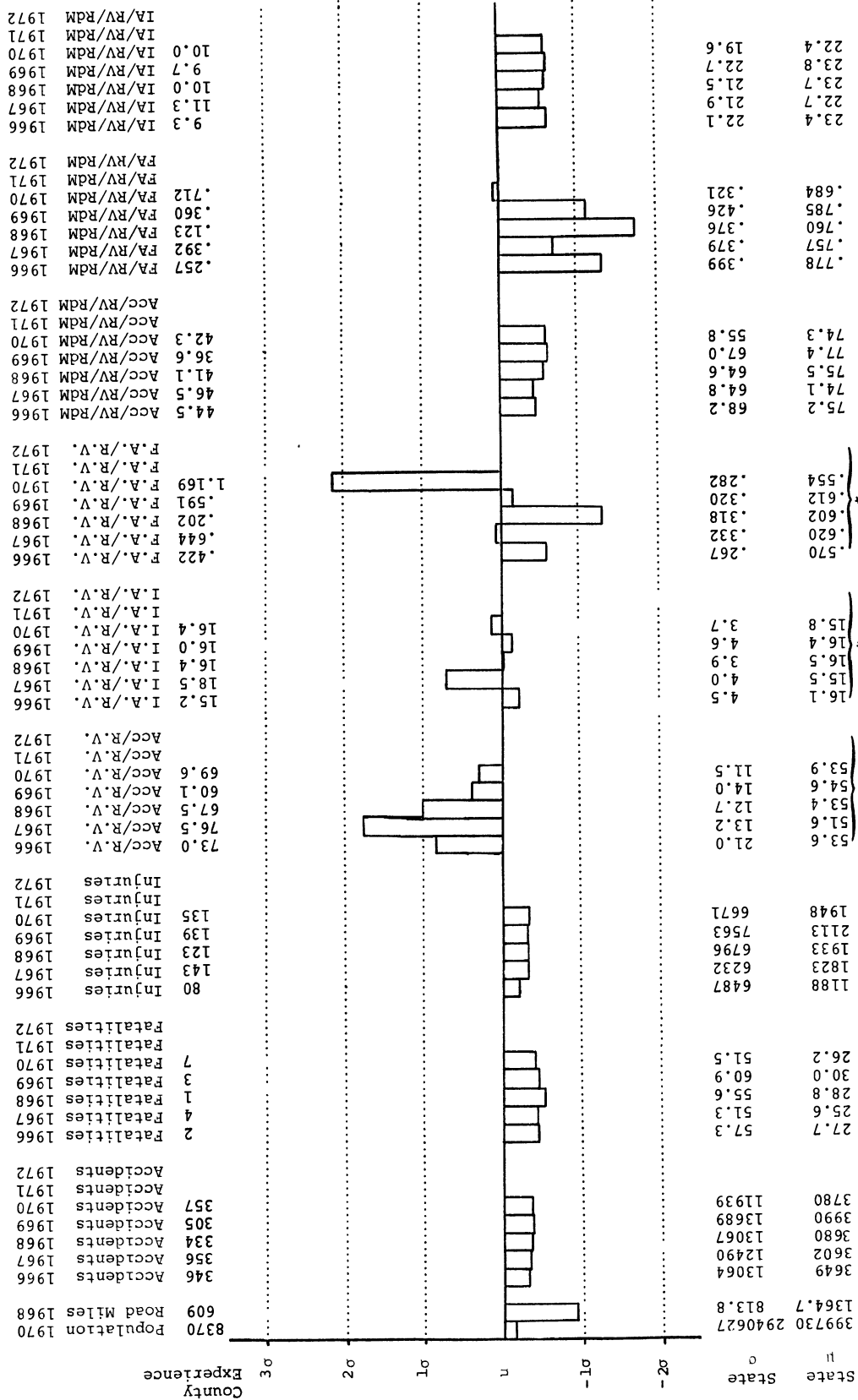
This brings up two warnings to bear in mind when interpreting these graphs. The large counties in Michigan so overpower the accident, injury accident, and fatal accident data that for these measures the vast majority of counties fall below the average. When considering the normalized data (i.e., those measures divided by registered vehicles or registered vehicles per road mile) the small counties exhibit large fluctuations with each small change in the accident data because they have few vehicles. Thus, interpretation must be made with care.



\* Figures represent actual value times 10<sup>3</sup>

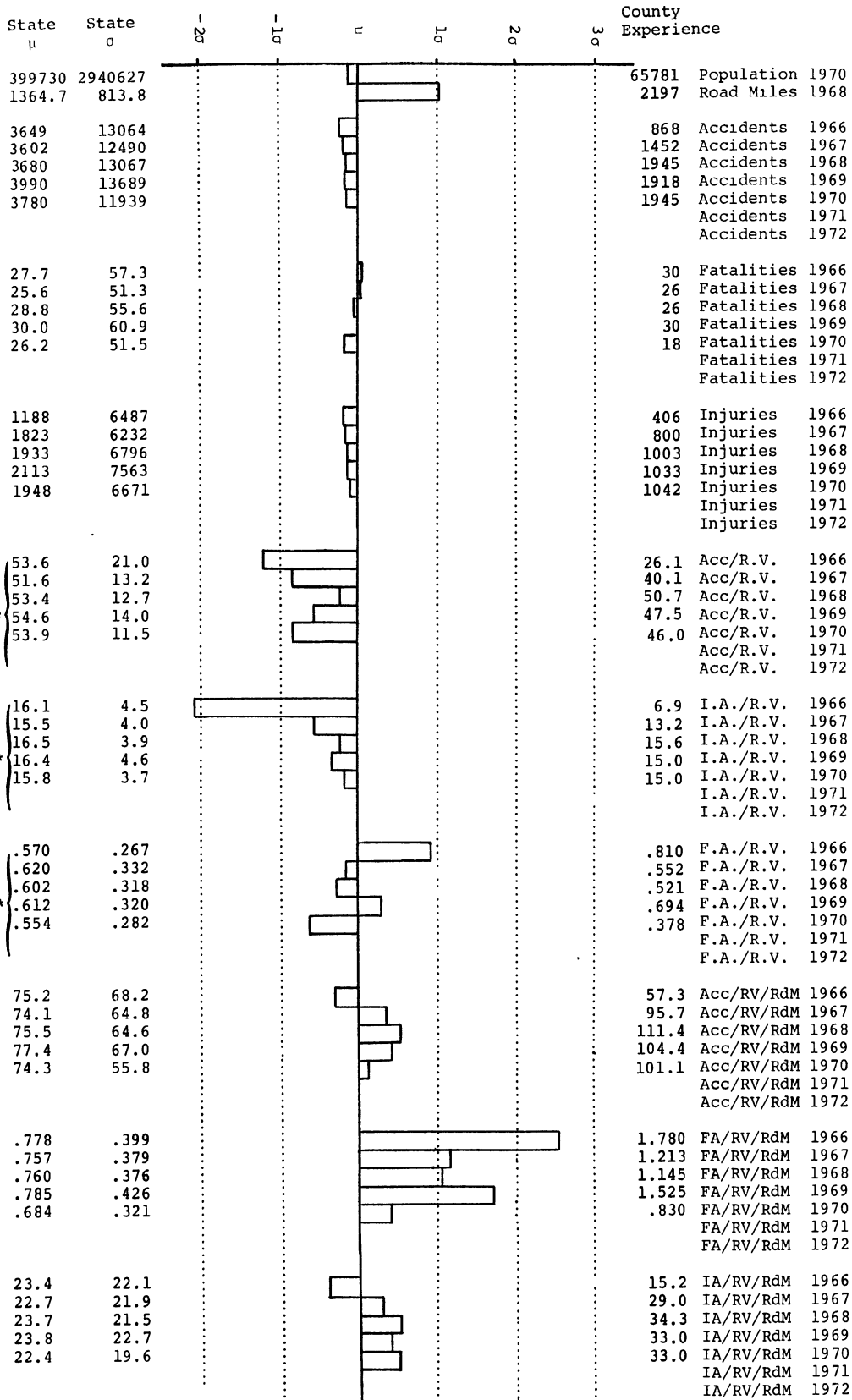


ALGER

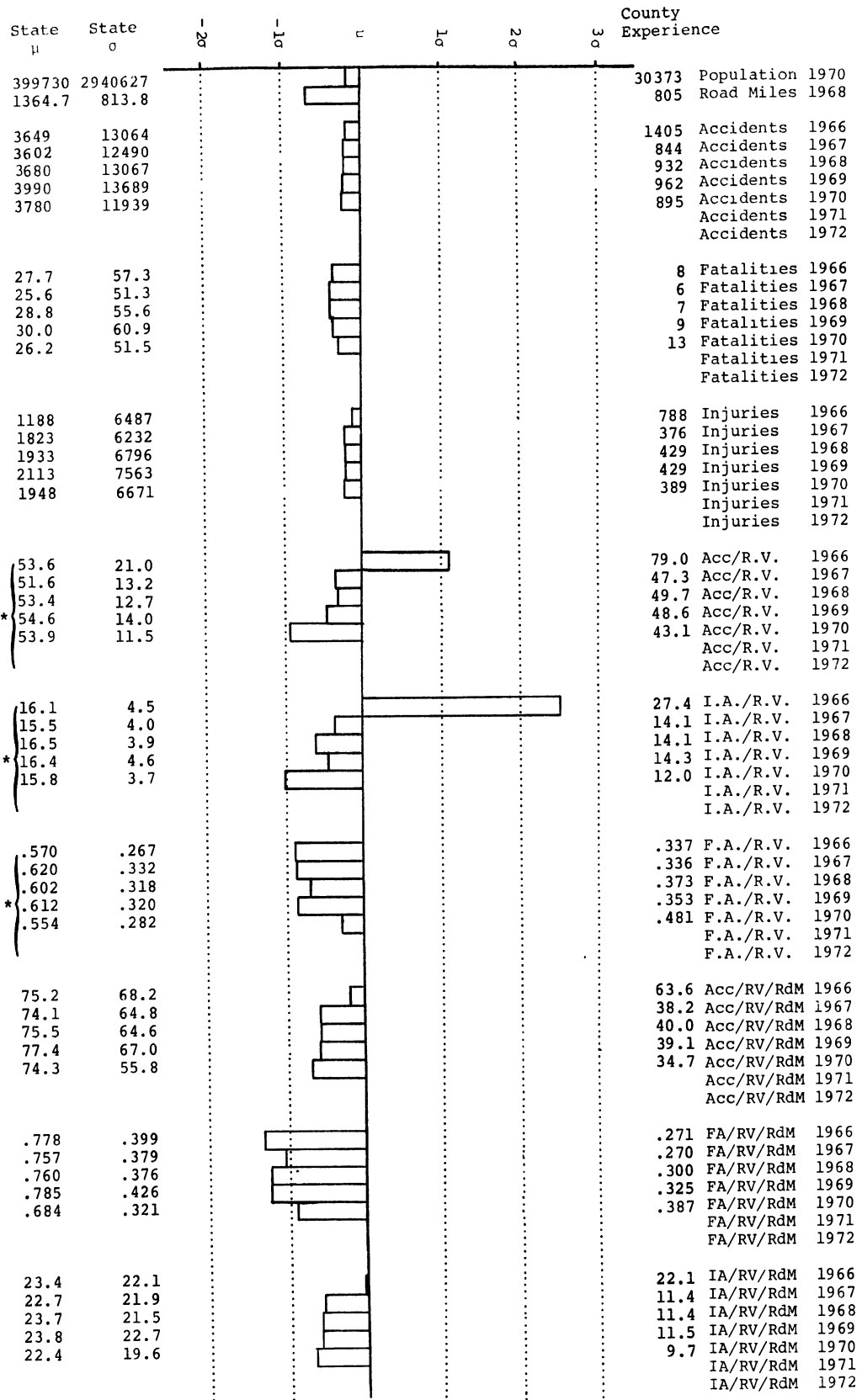


\*figures represent actual value times 10<sup>3</sup>

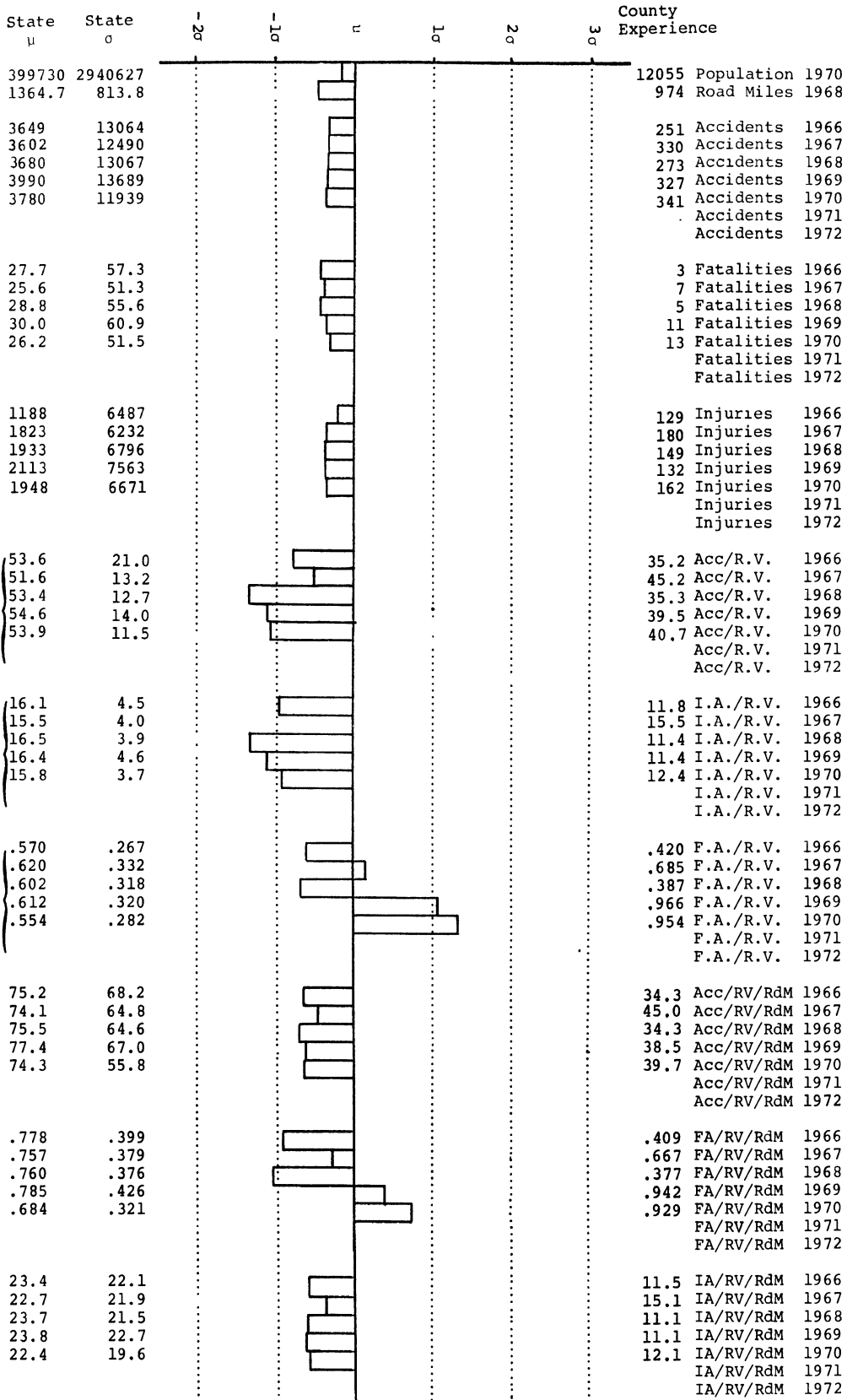
ALLEGAN



\*figures represent actual value times 10<sup>3</sup>

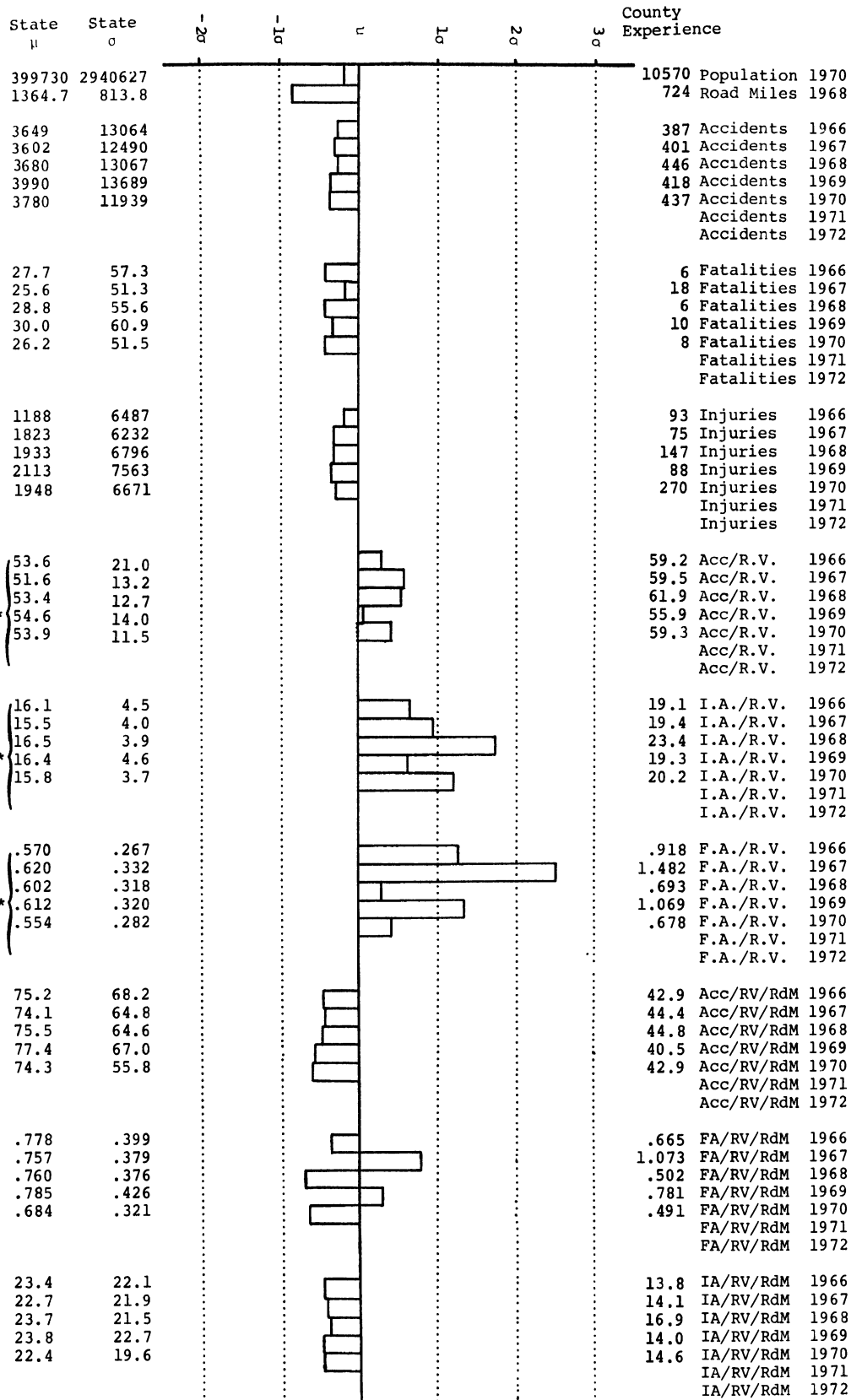


\*figures represent actual value times 10<sup>3</sup>



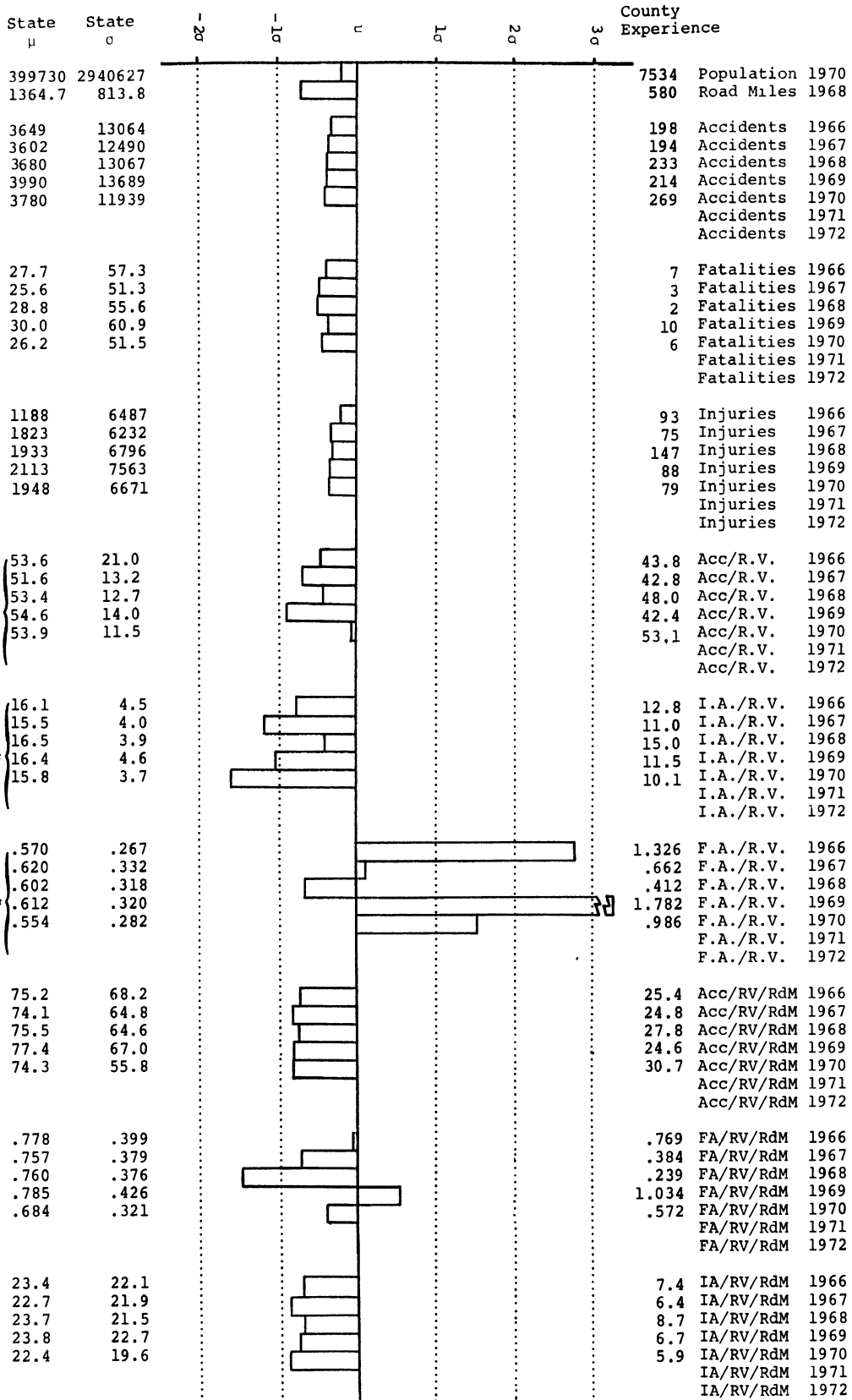
\*figures represent actual value times 10<sup>3</sup>

ARENAC



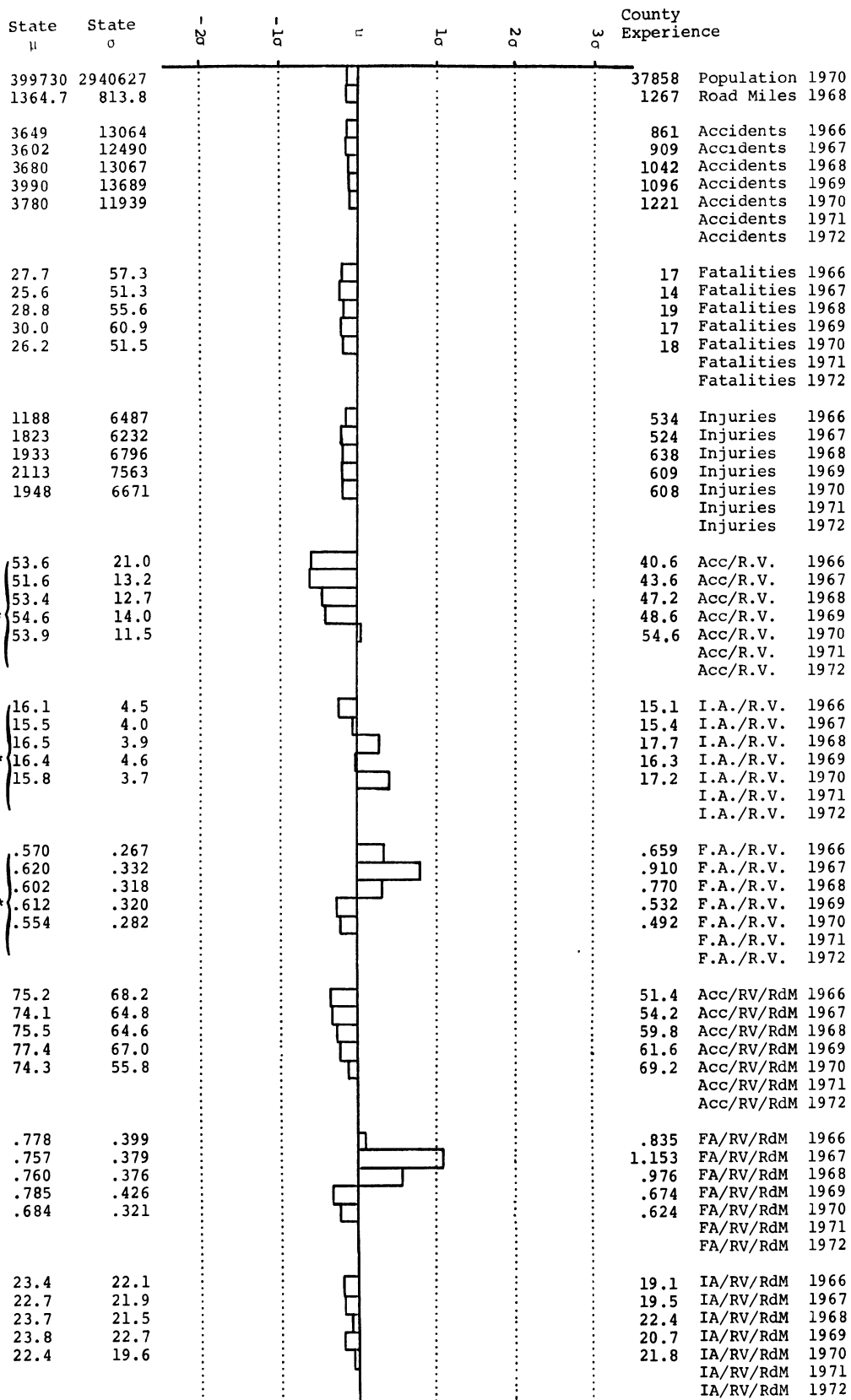
\*figures represent actual value times 10<sup>3</sup>

BARAGA

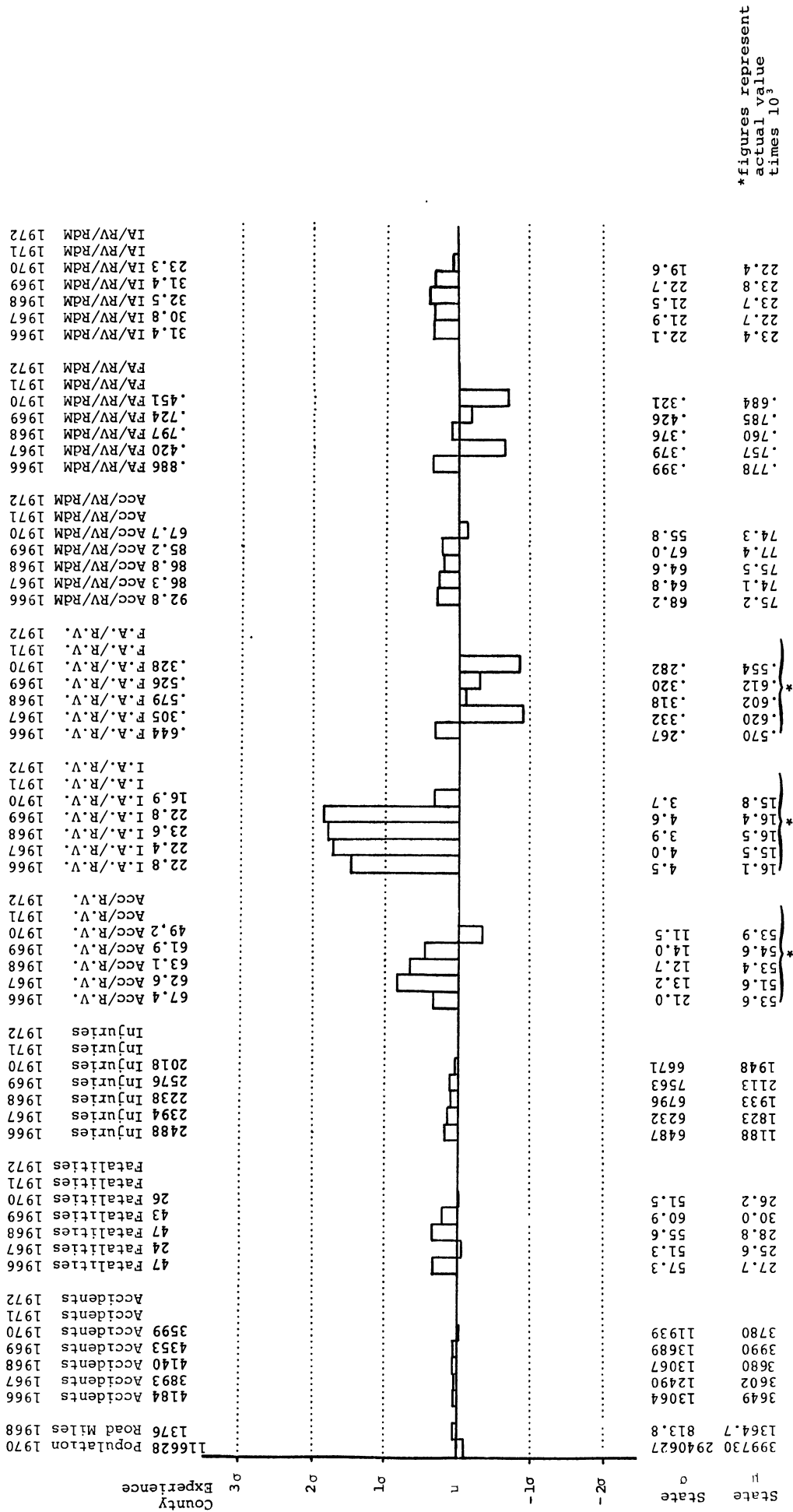


\*figures represent actual value times 10<sup>3</sup>

BARRY



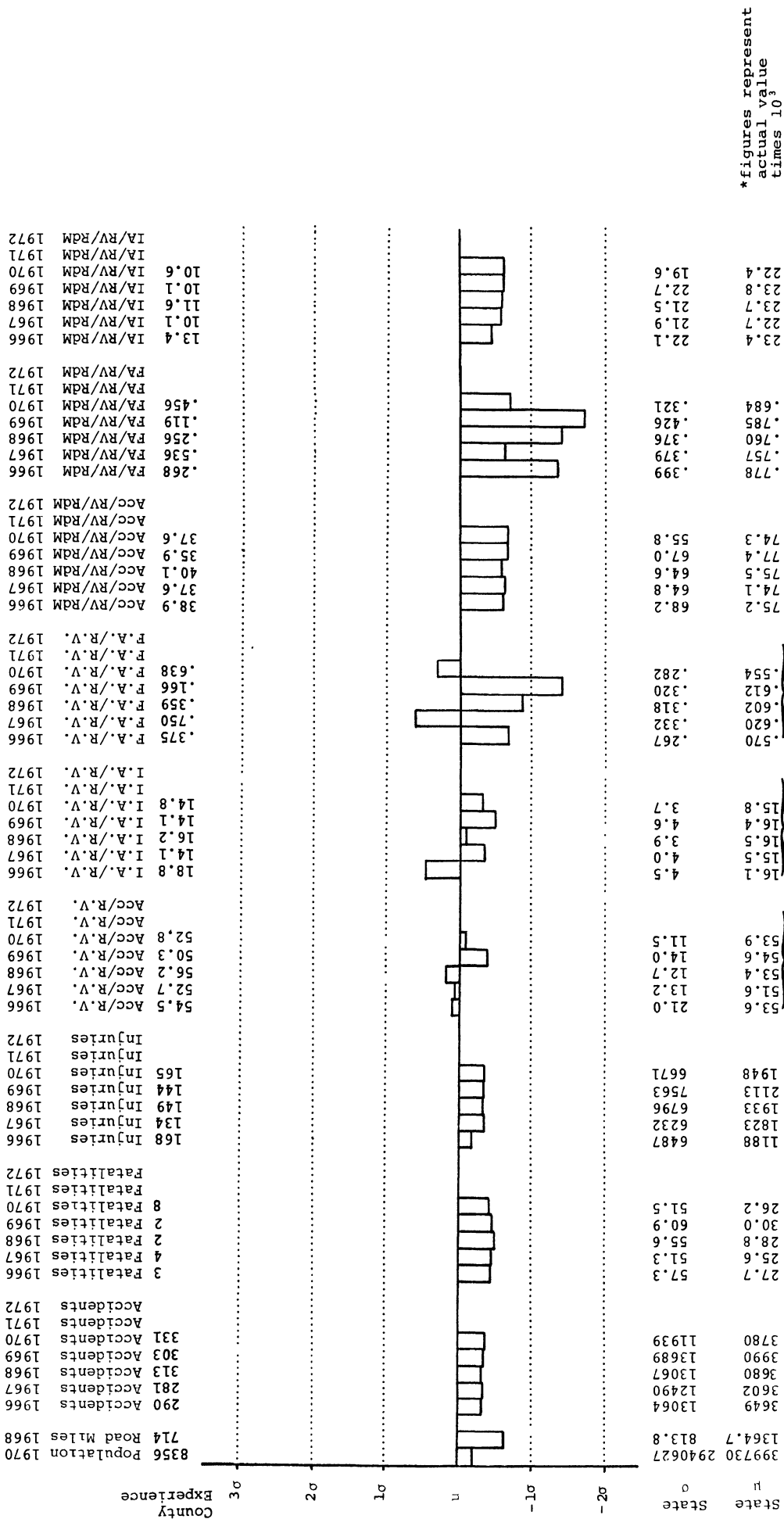
\*figures represent actual value times 10<sup>3</sup>



\*figures represent actual value times 10<sup>3</sup>

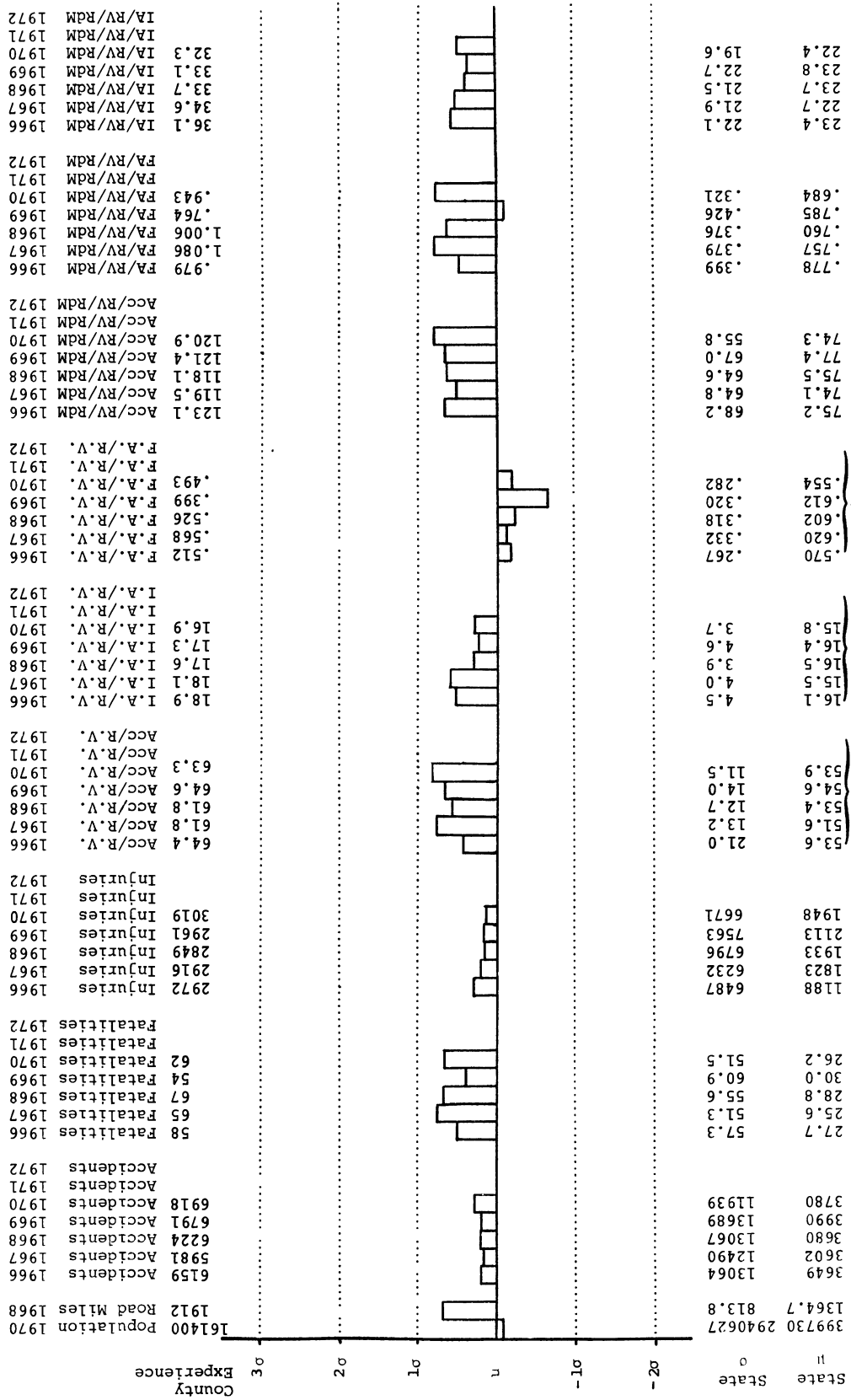


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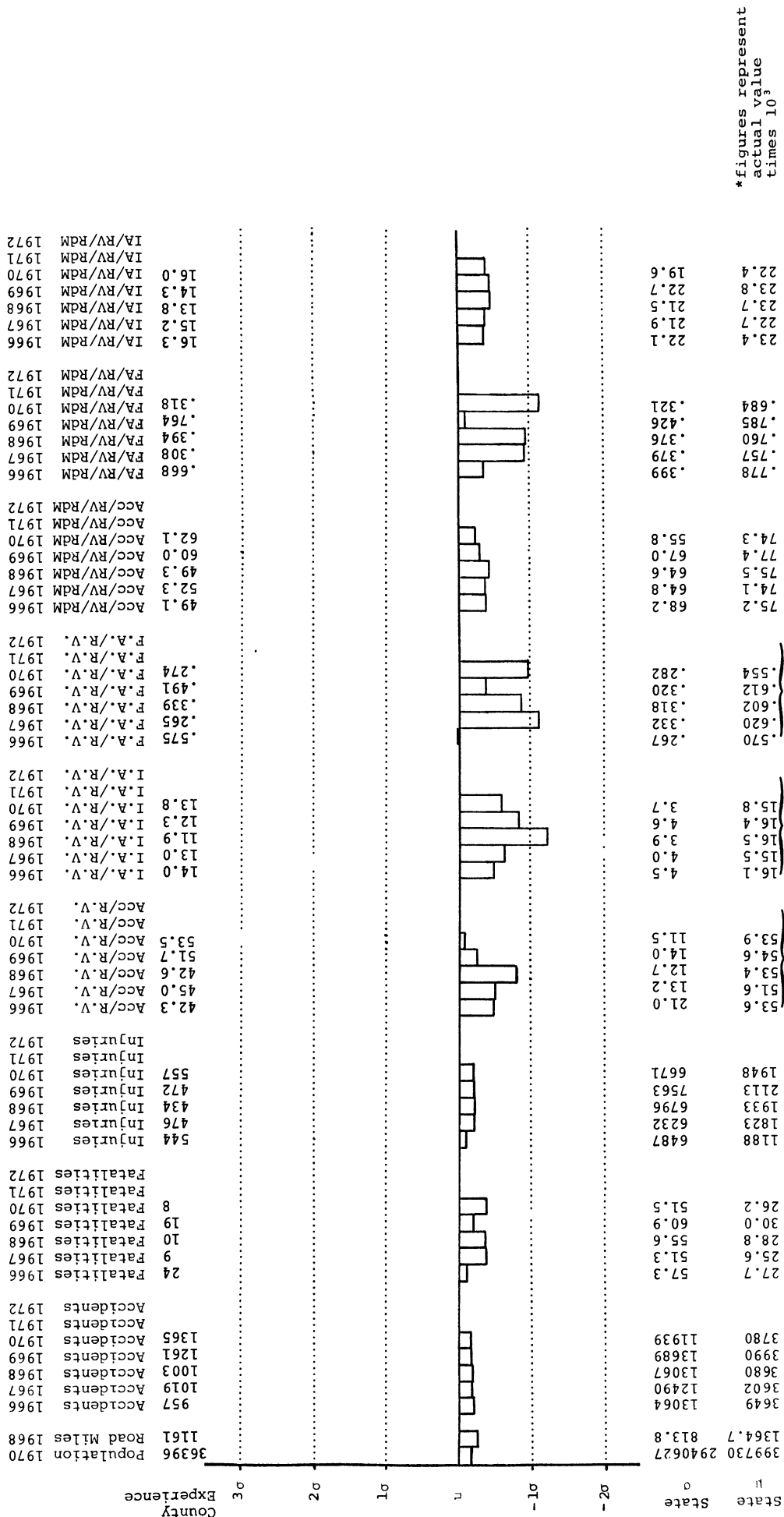


\*figures represent actual value times 10<sup>3</sup>

BERRIEN

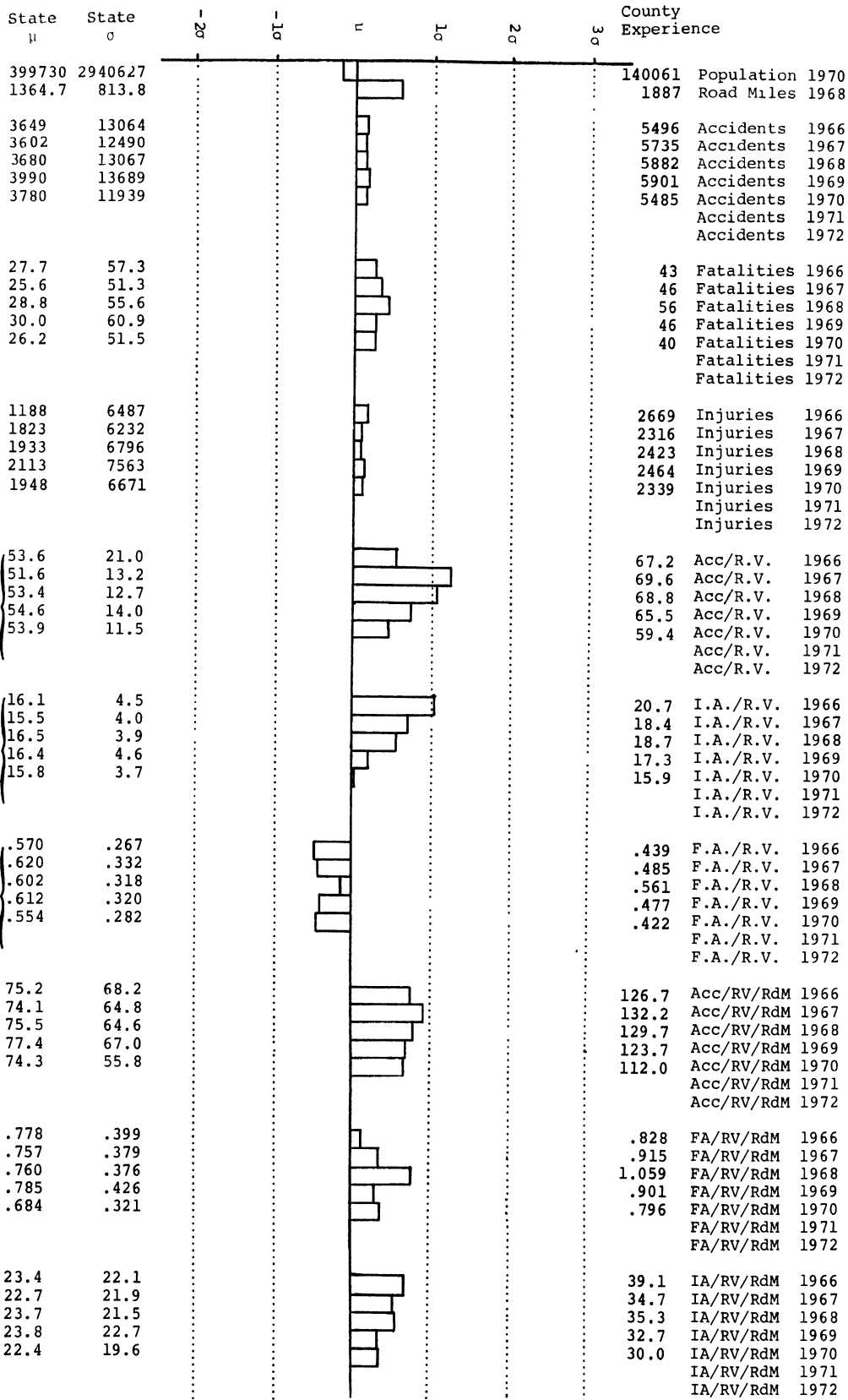


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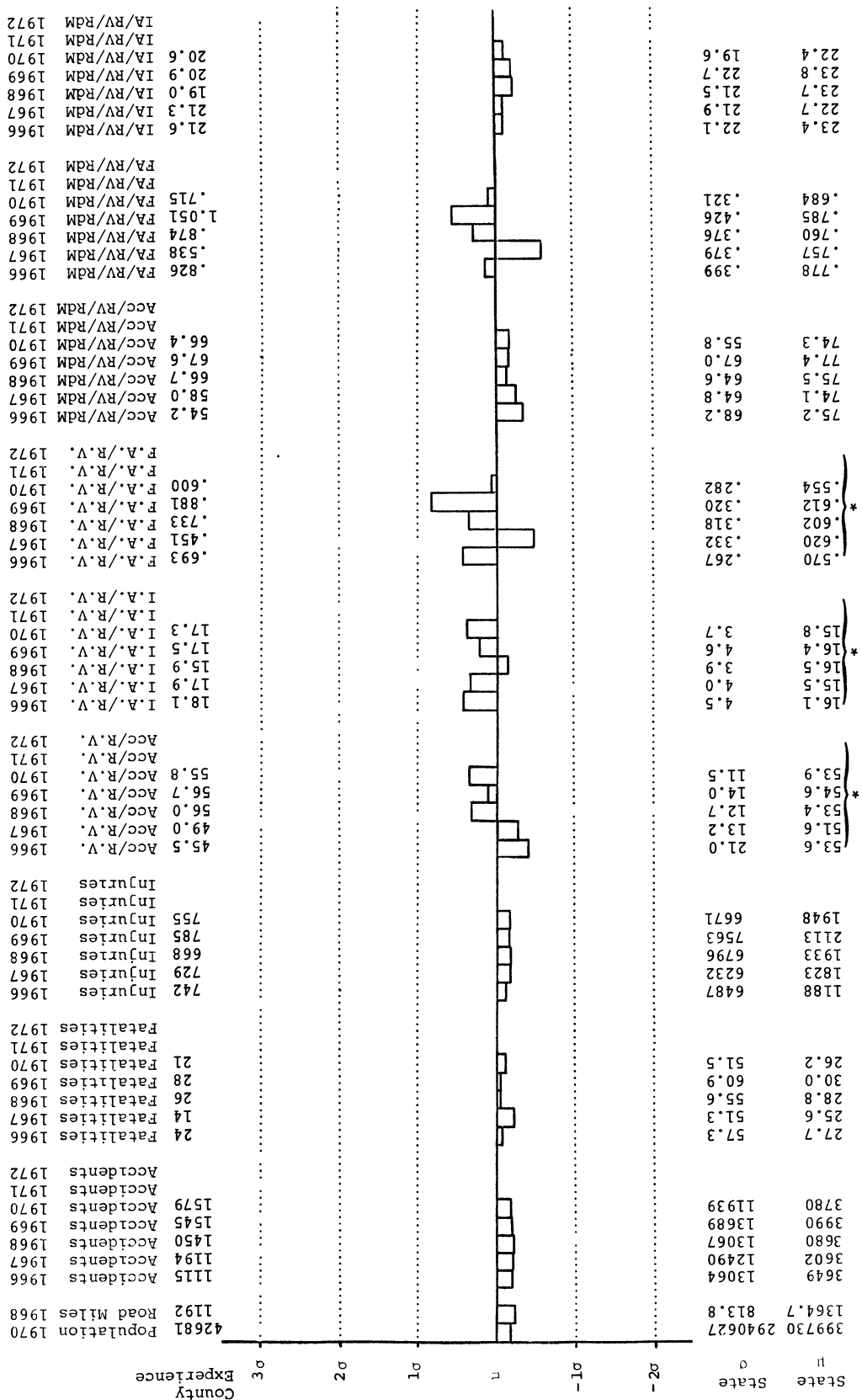


\*figures represent actual value times 10<sup>3</sup>

CALHOUN



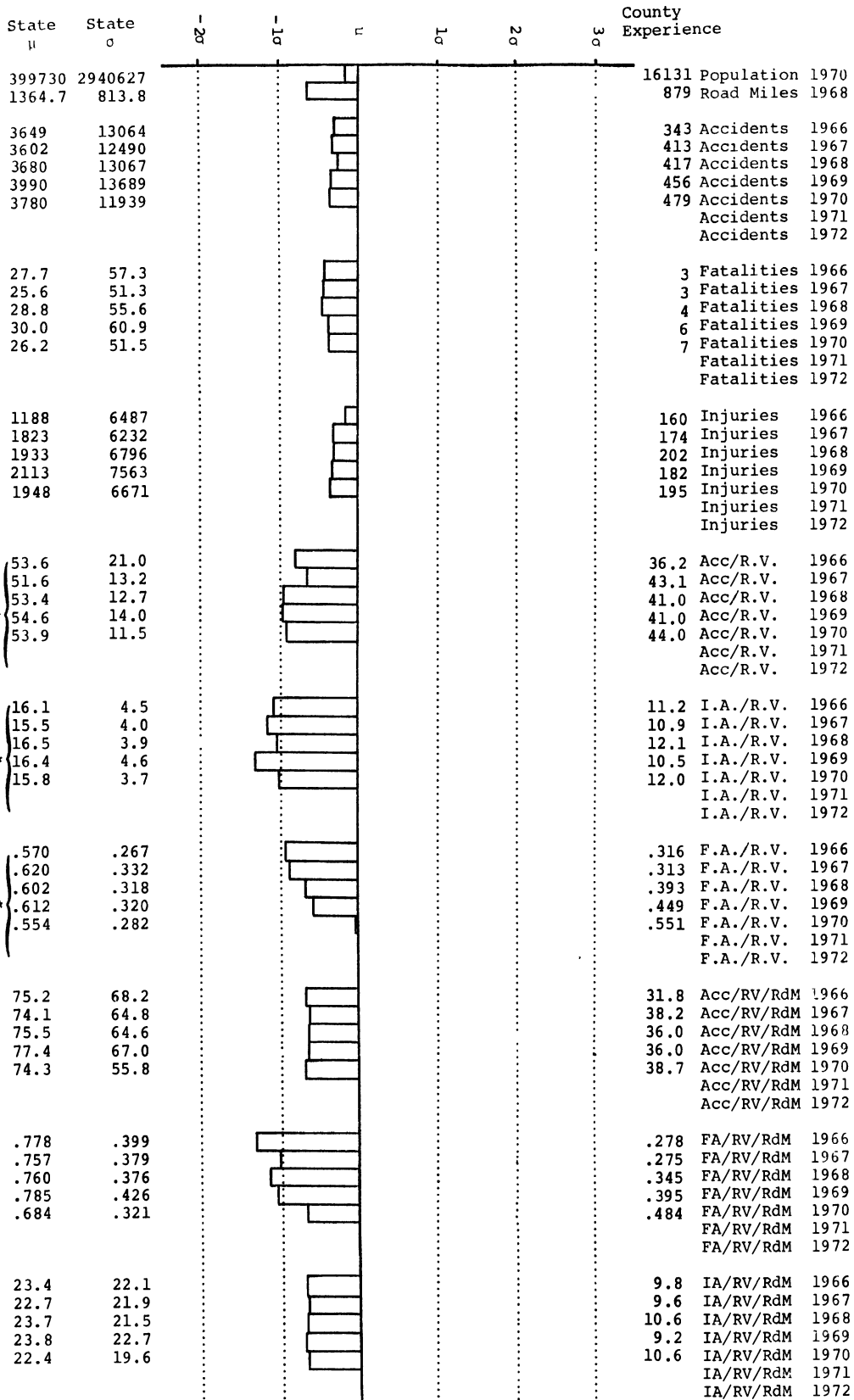
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\*figures represent actual value times 10<sup>3</sup>

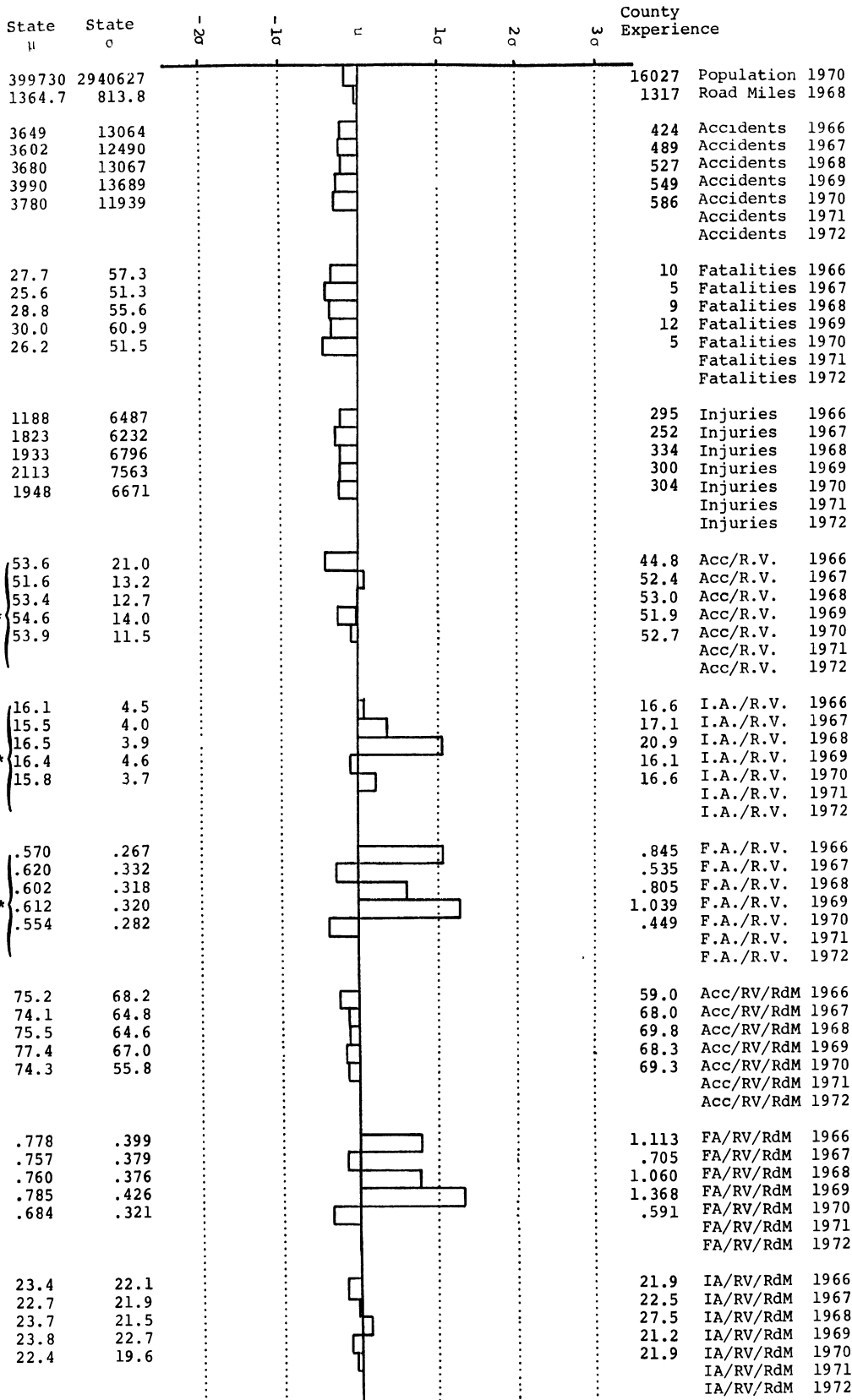
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CHARLEVOIX

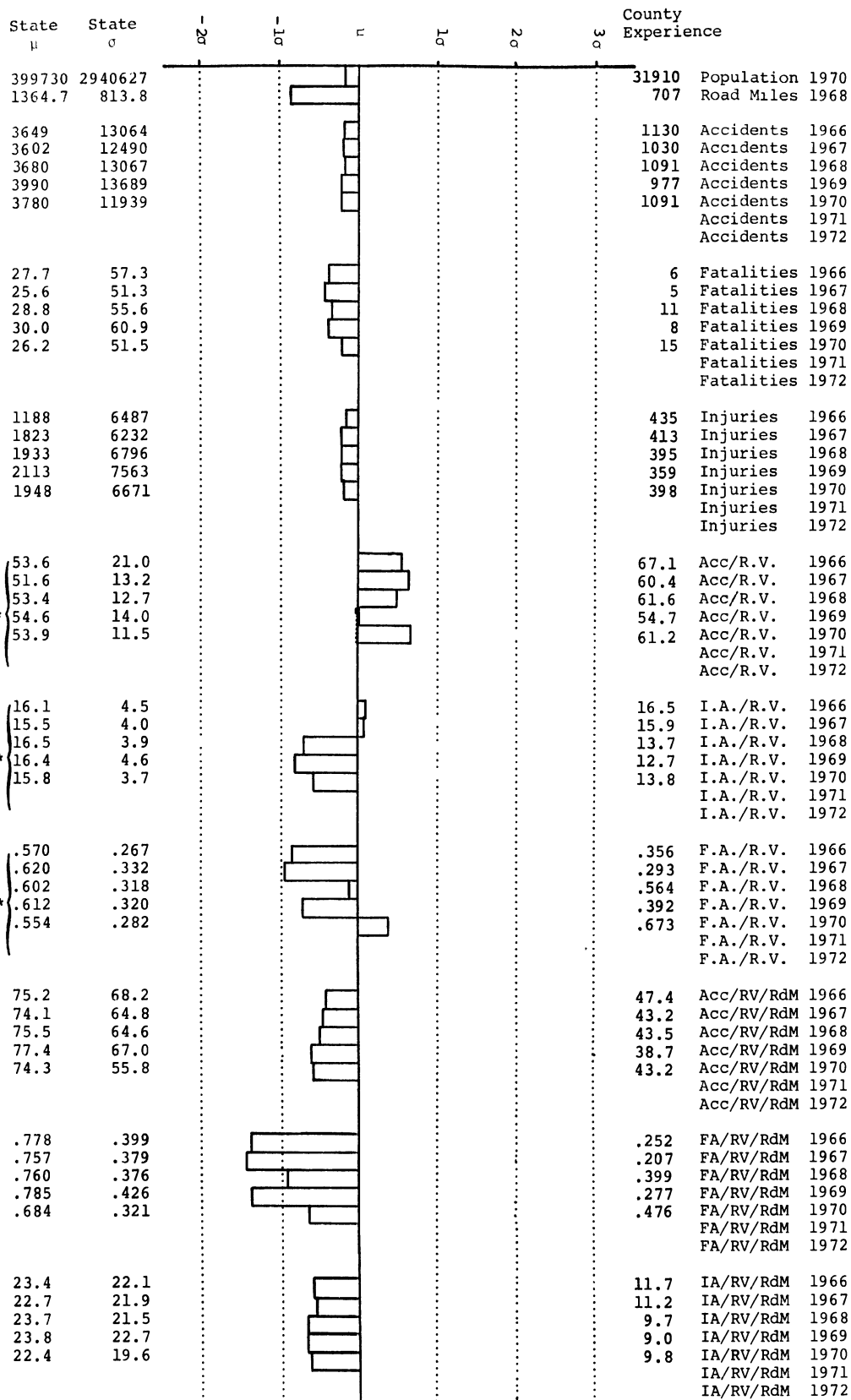


\*figures represent actual value times 10<sup>3</sup>

CHEBOYGAN



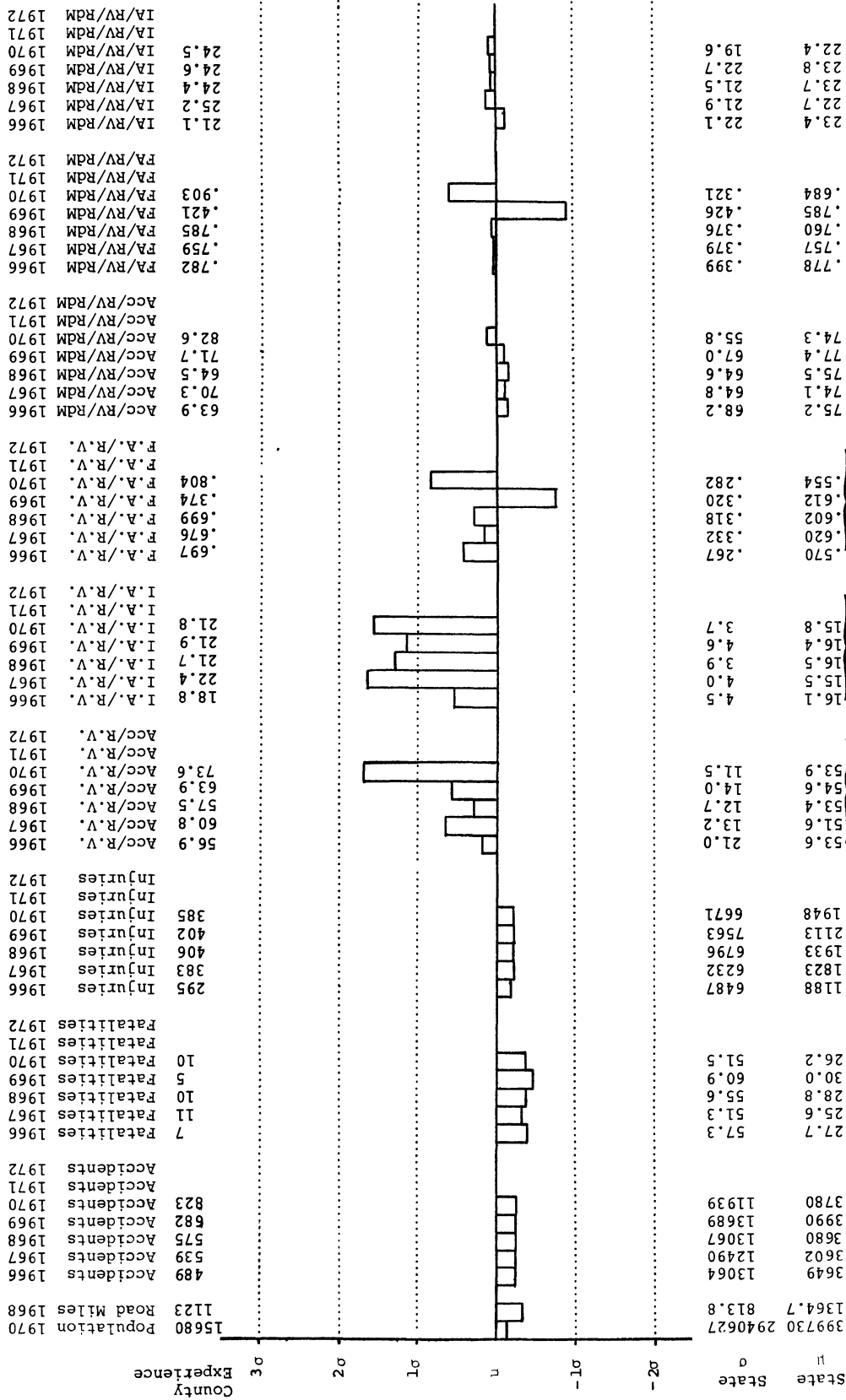
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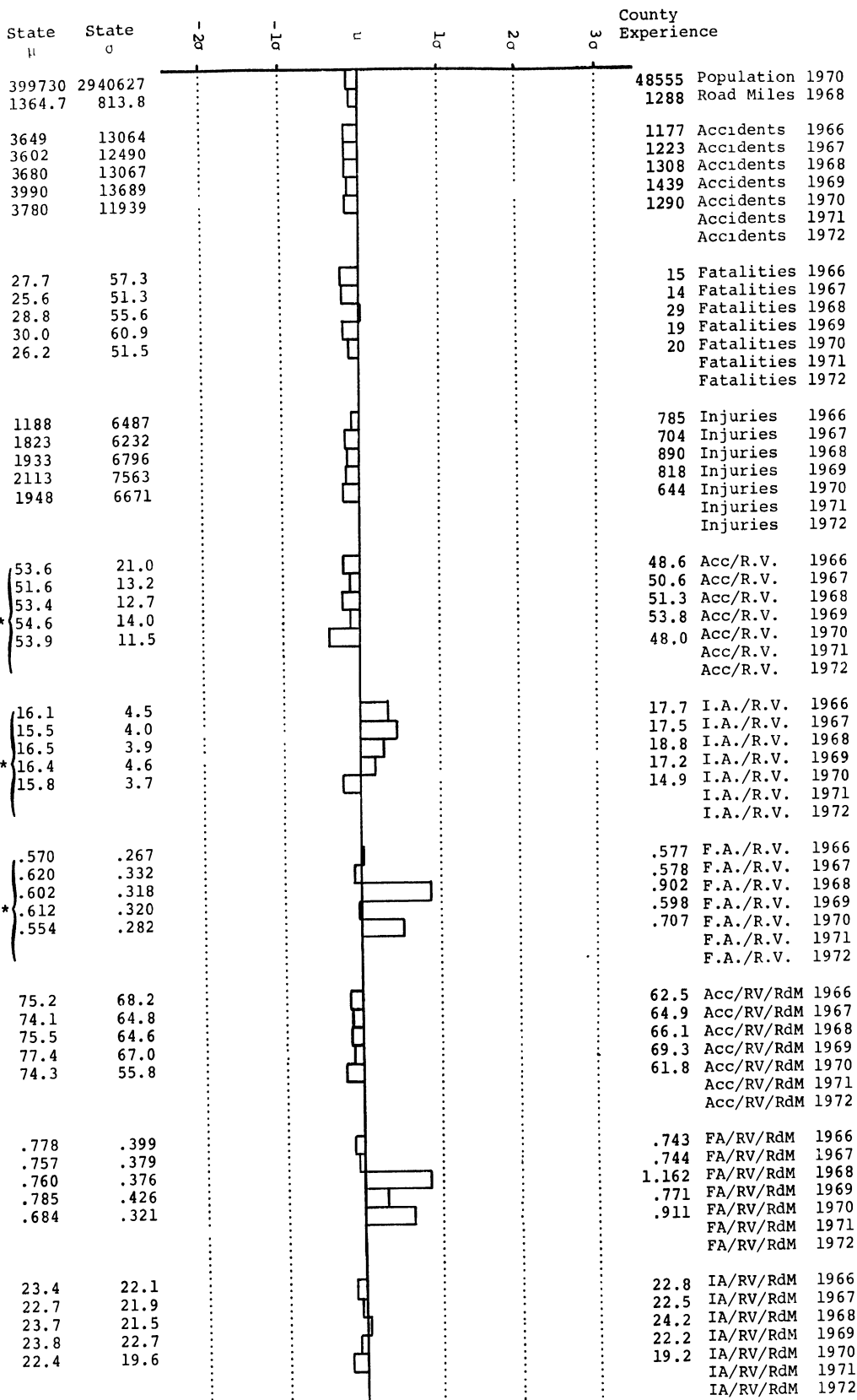
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CLARE

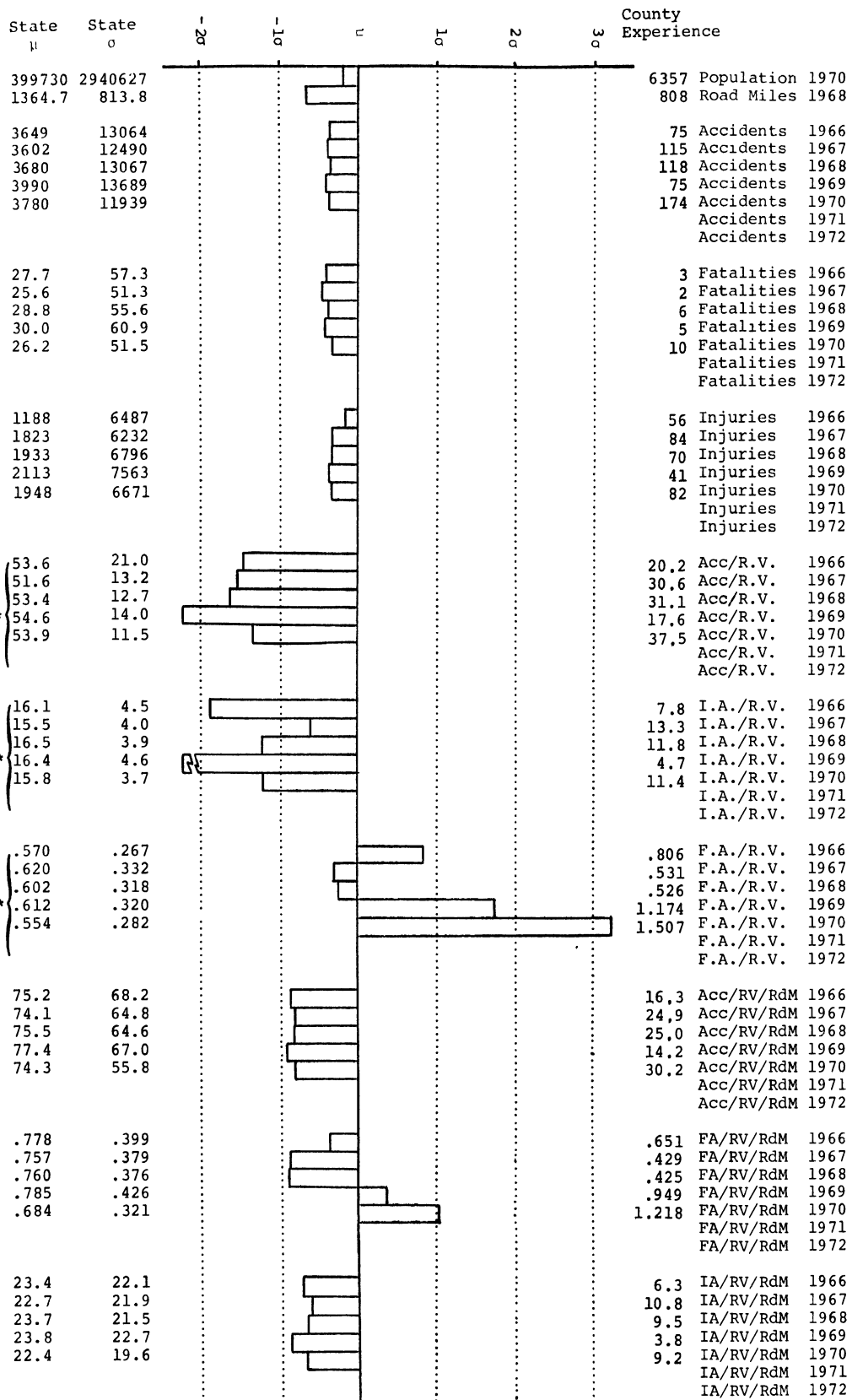


\*figures represent actual value times 10<sup>3</sup>



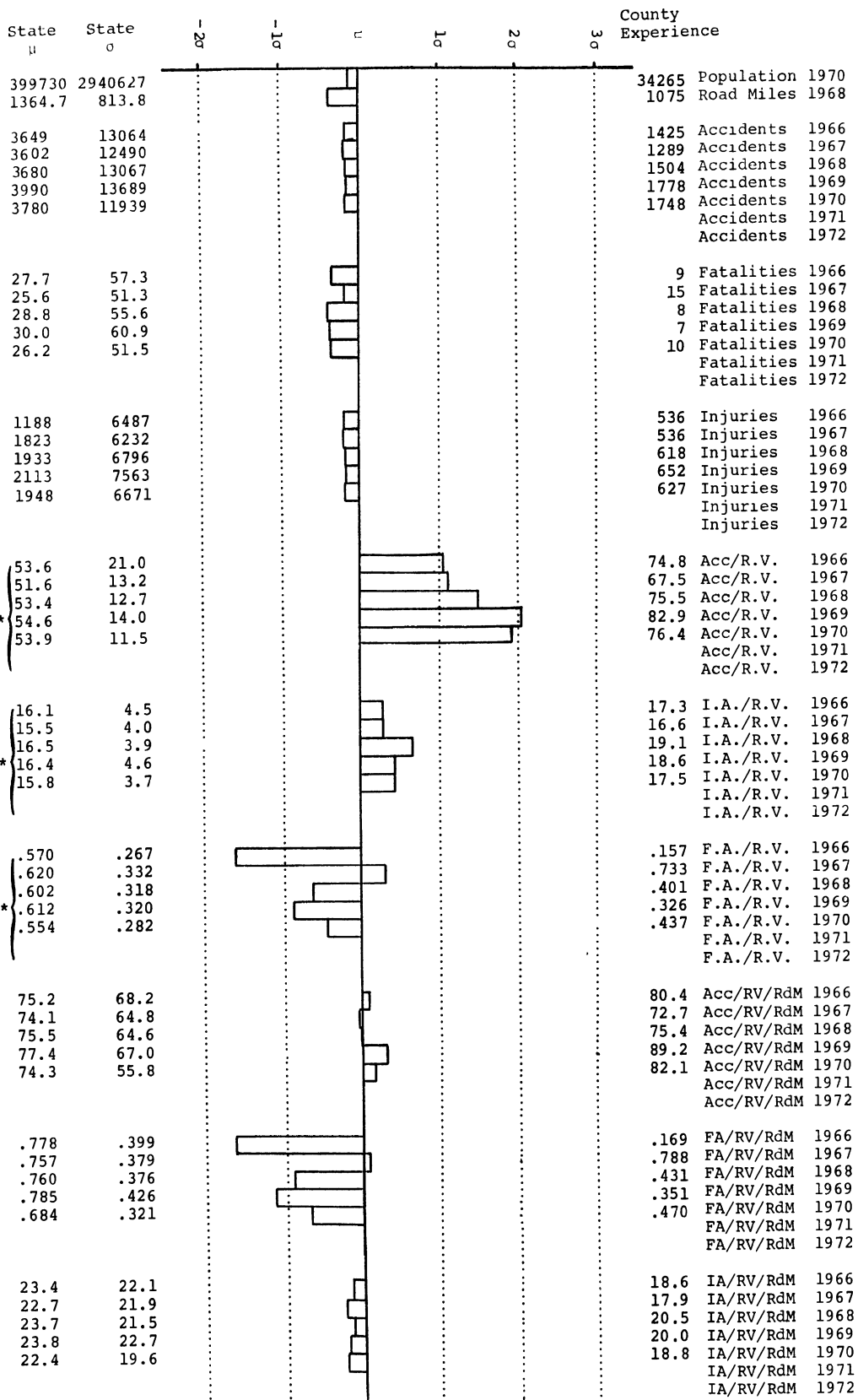
\*figures represent actual value times

CRAWFORD



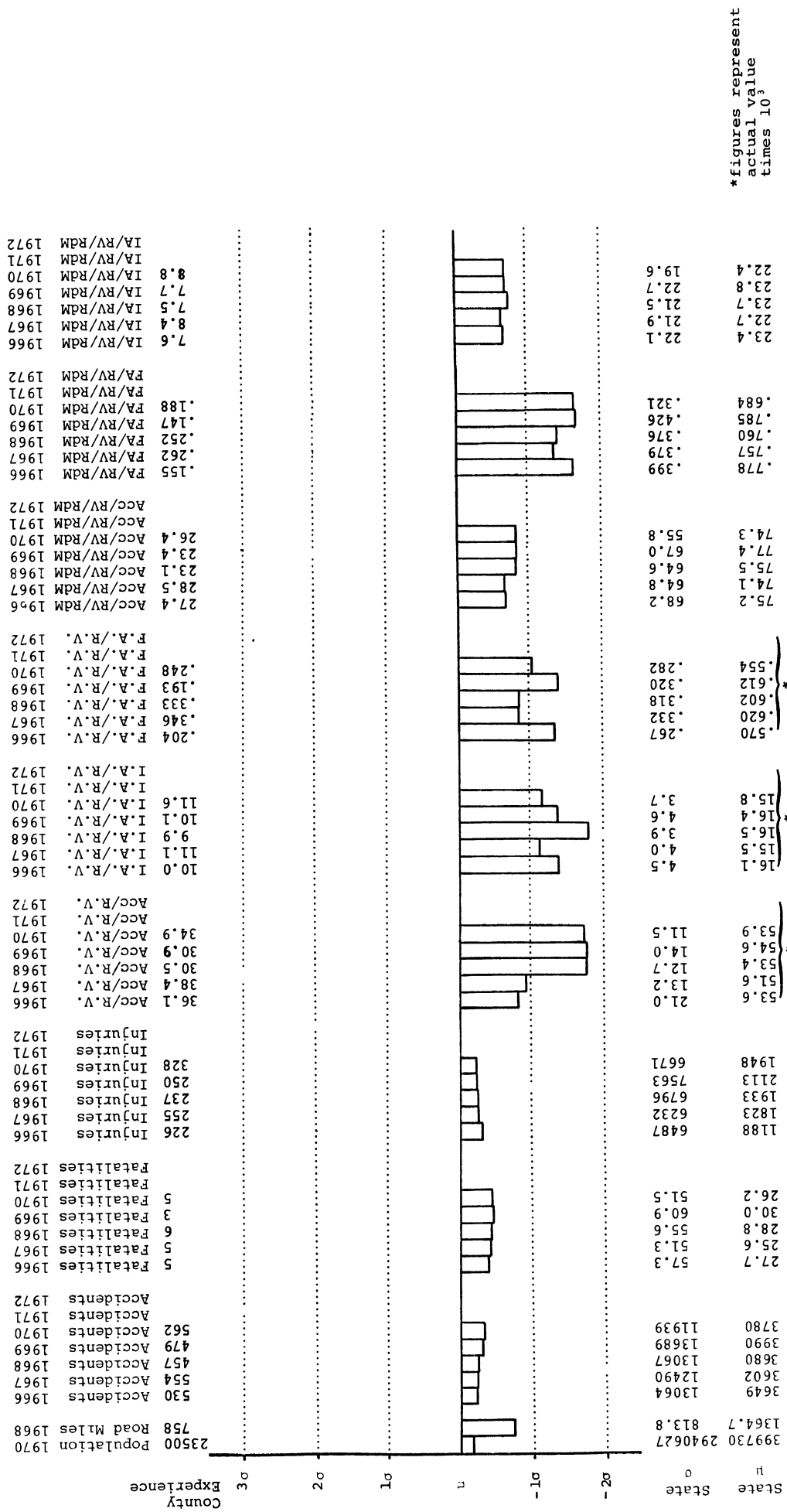
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DELTA



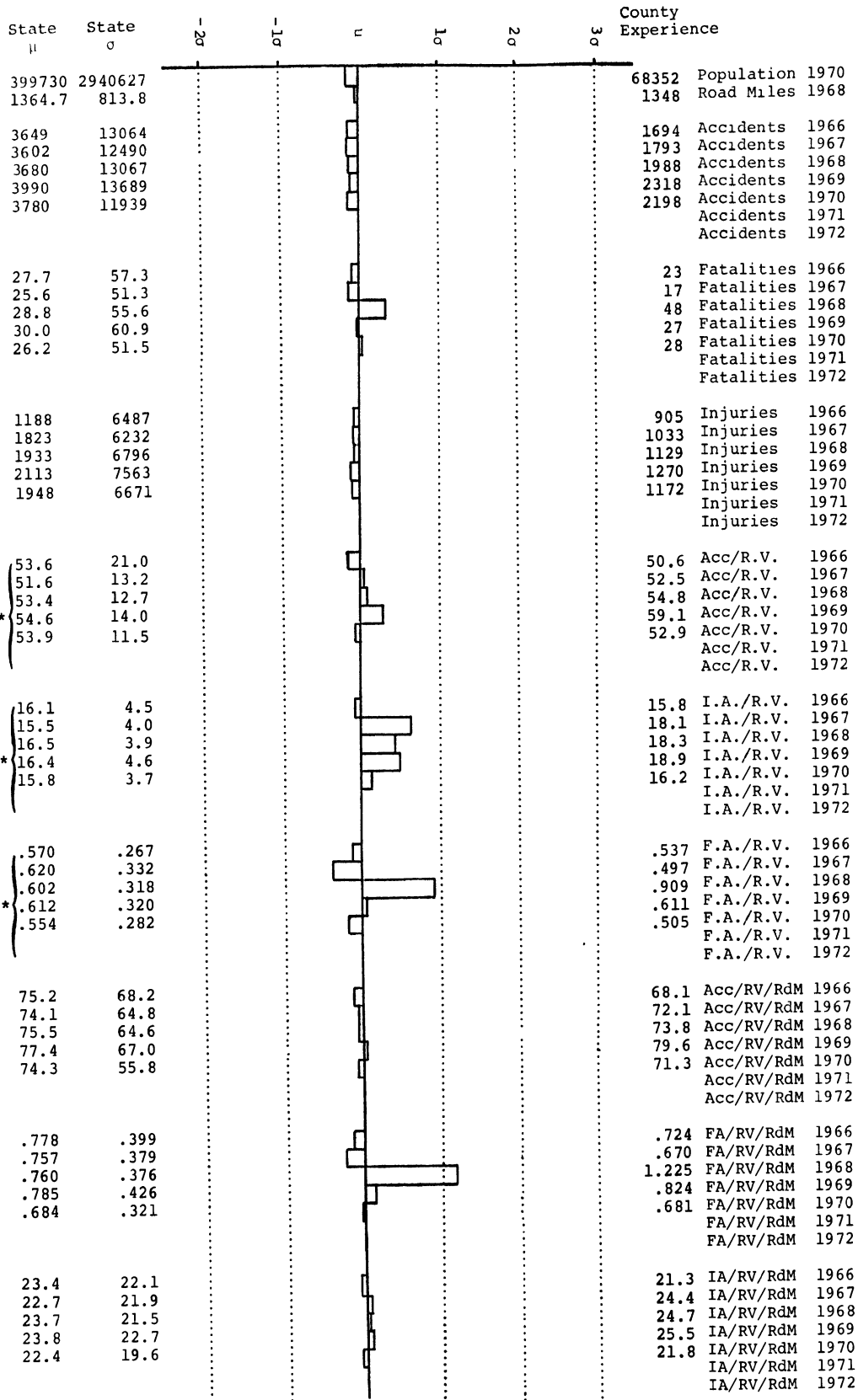
\* Figures represent actual value times 10<sup>3</sup>

DICKINSON



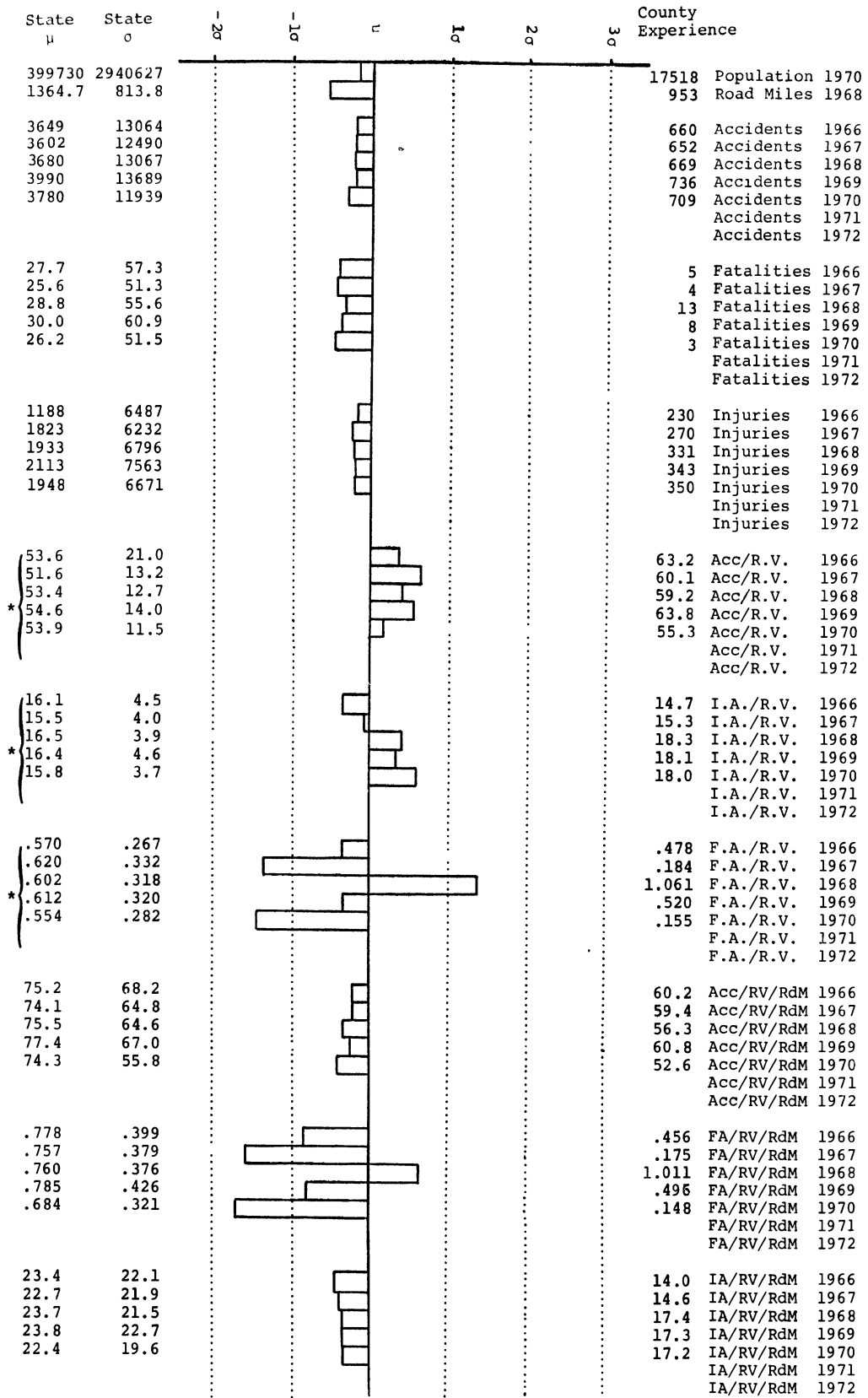
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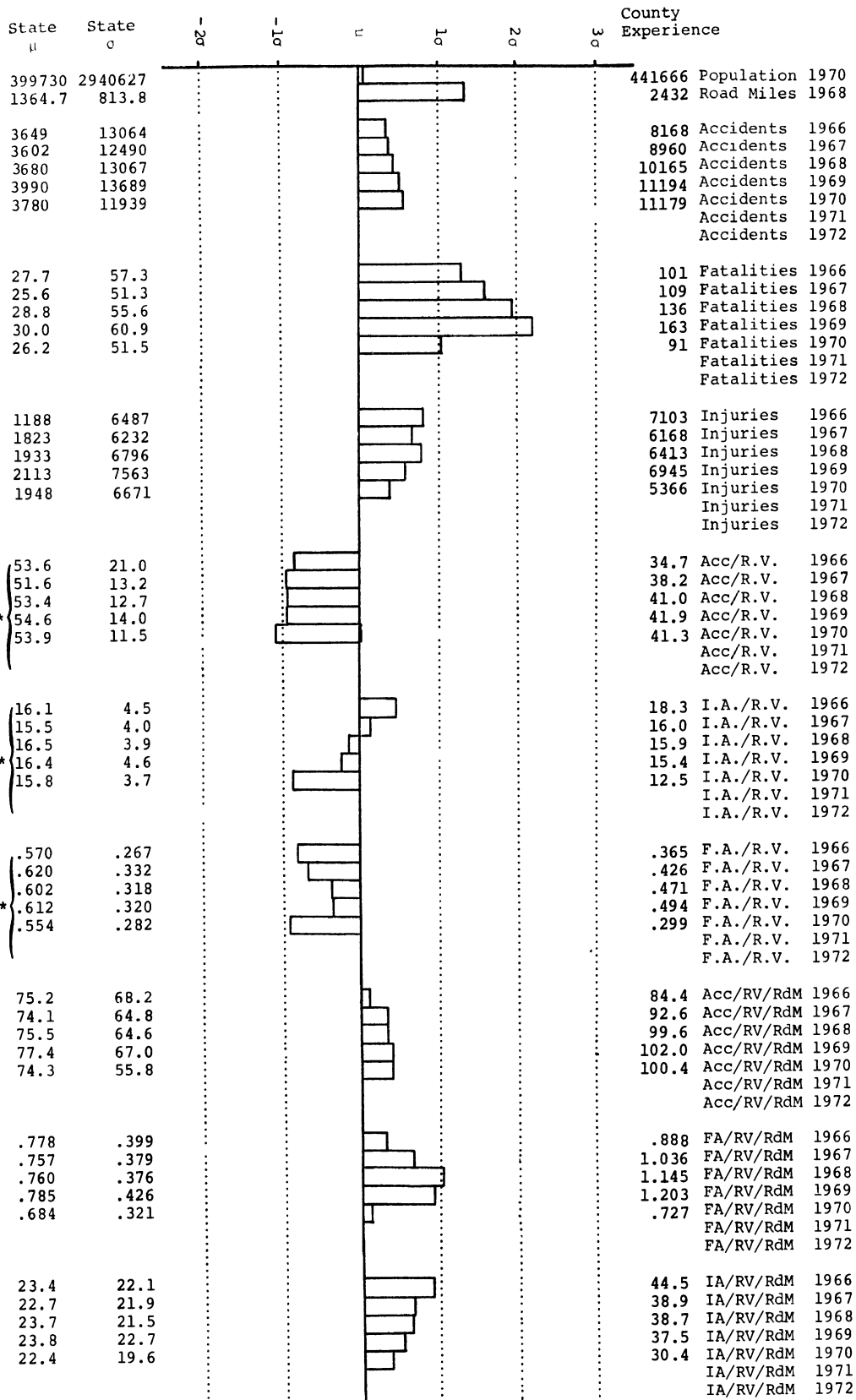


\* Figures represent actual value times 10<sup>3</sup>

EMMET



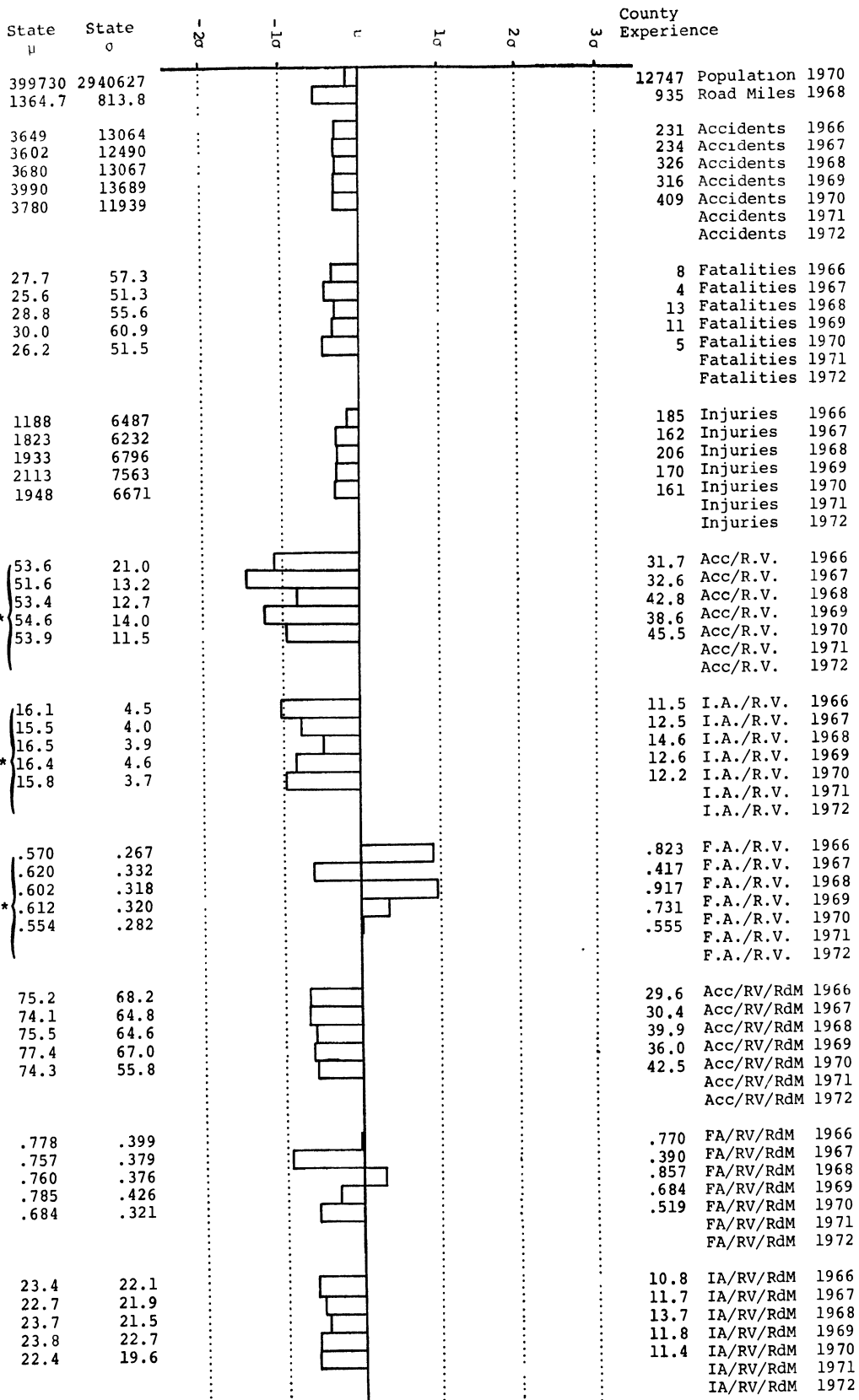
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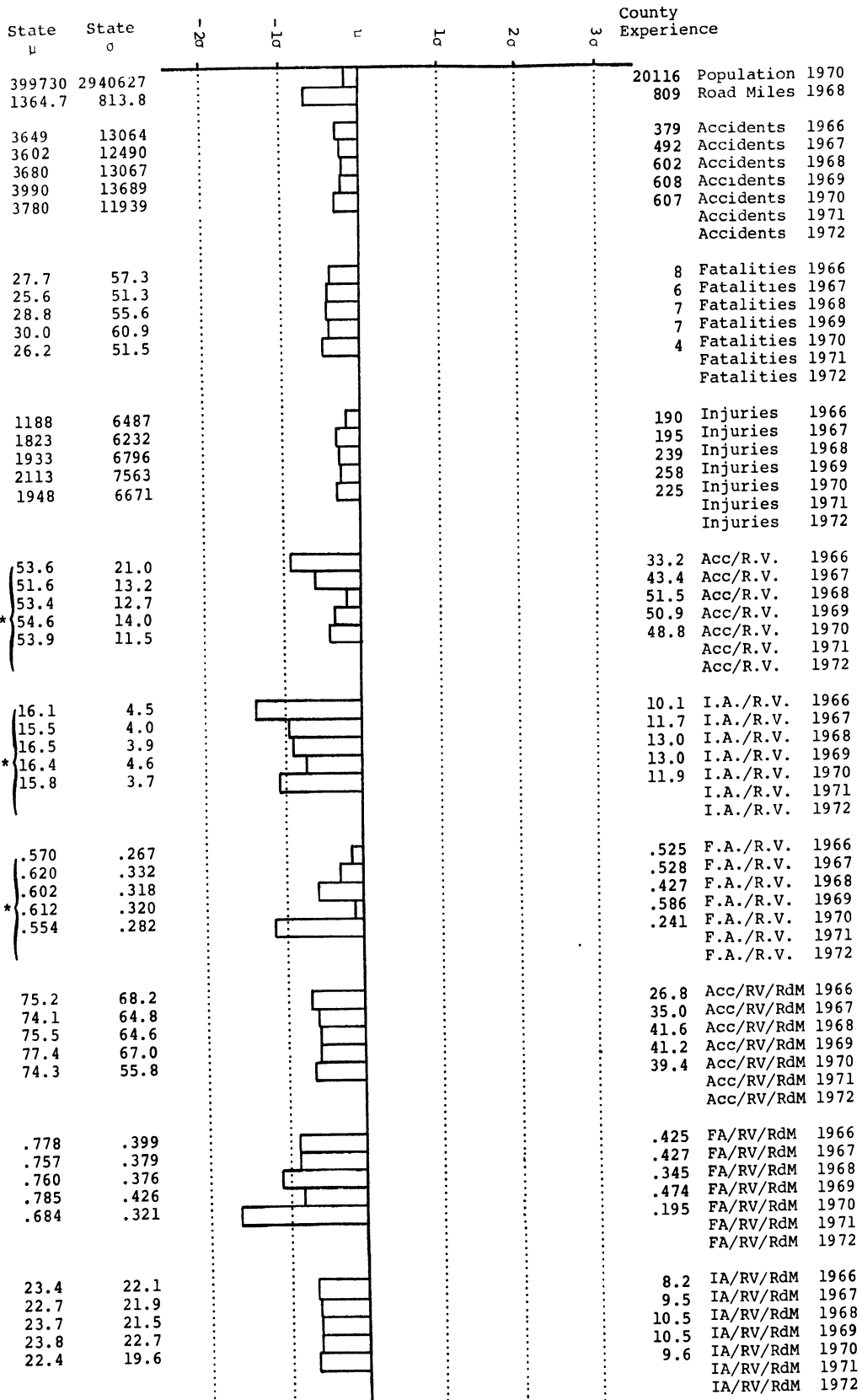
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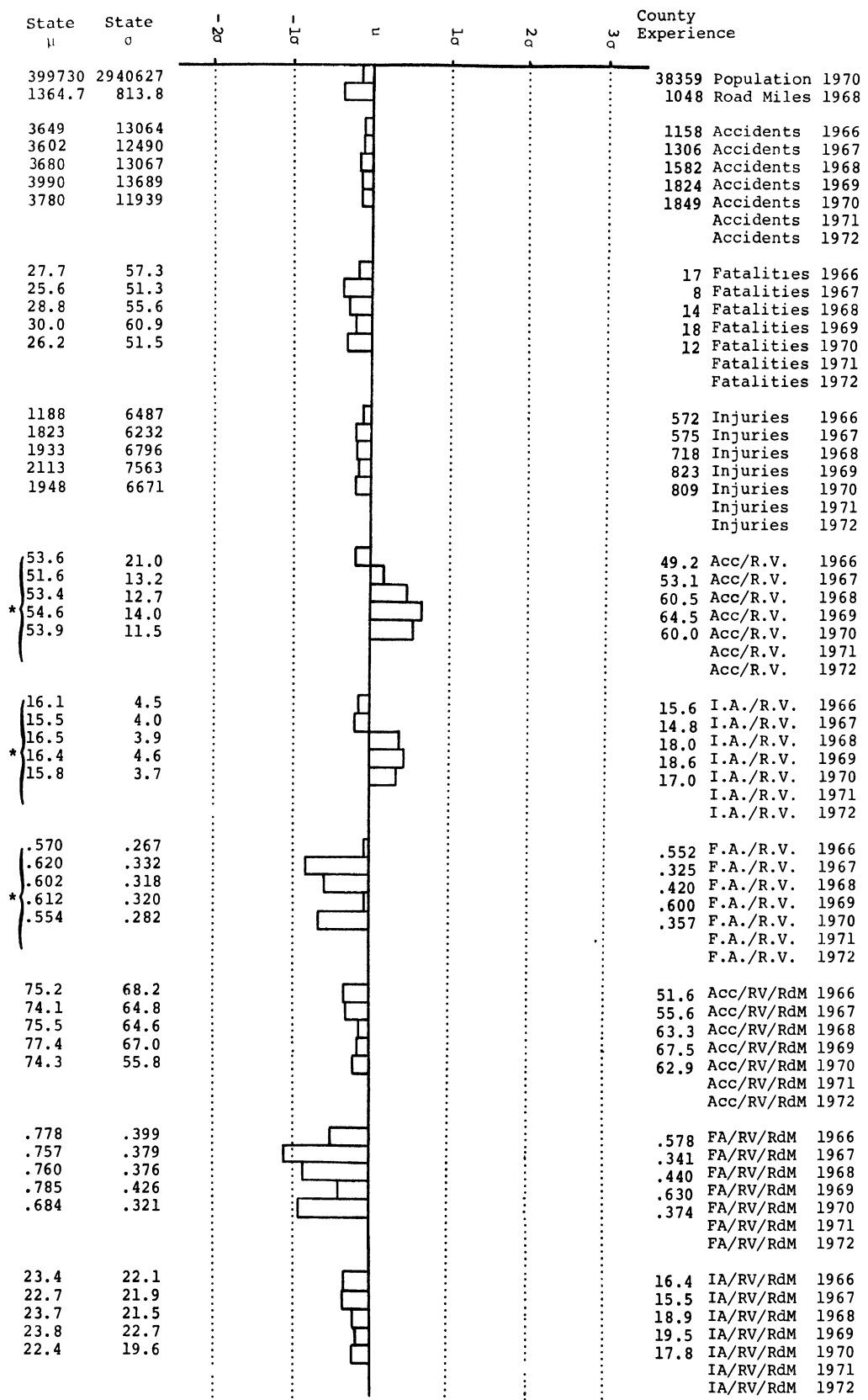


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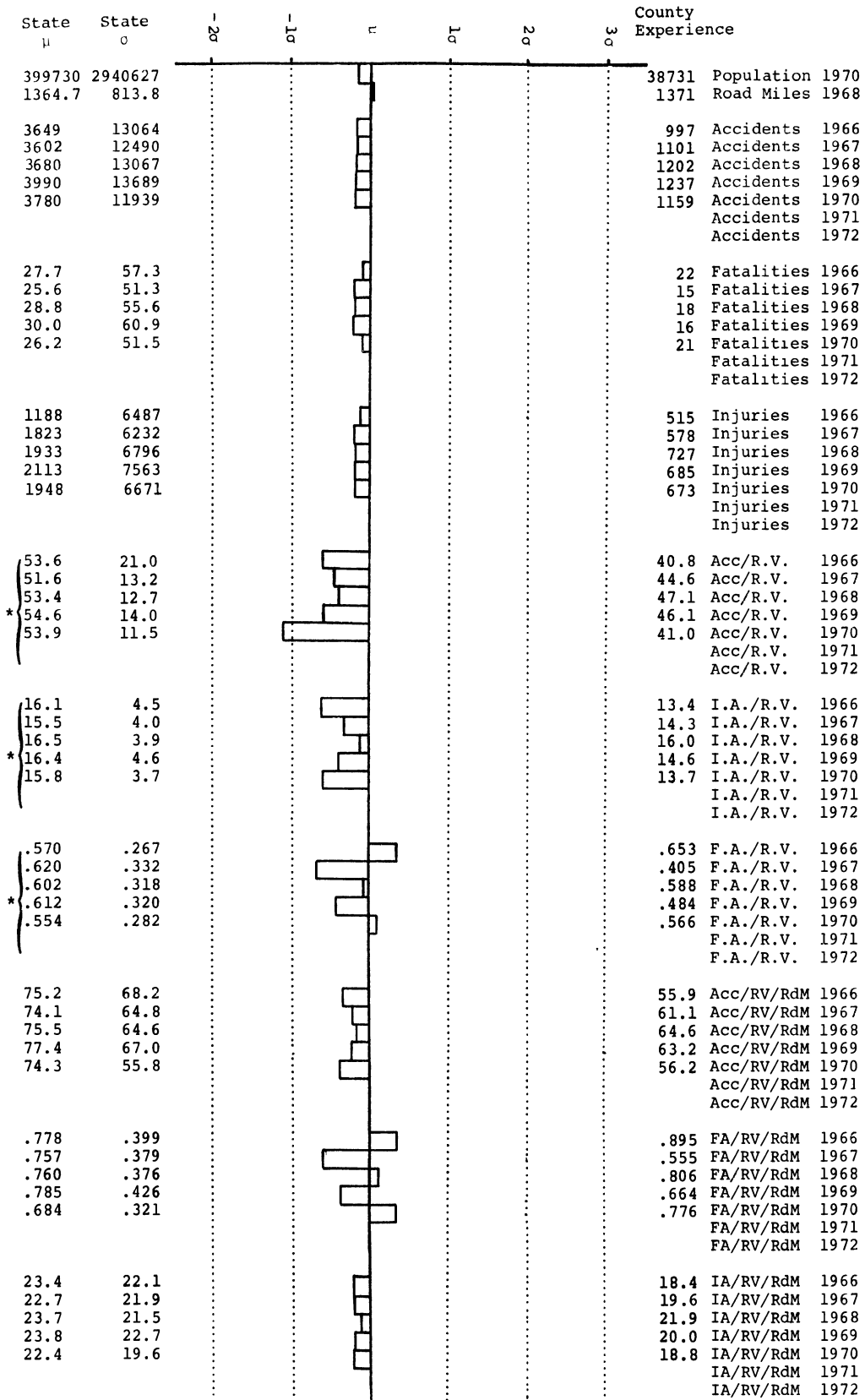


\*figures represent actual value times 10<sup>3</sup>

GRAND TRAVERSE

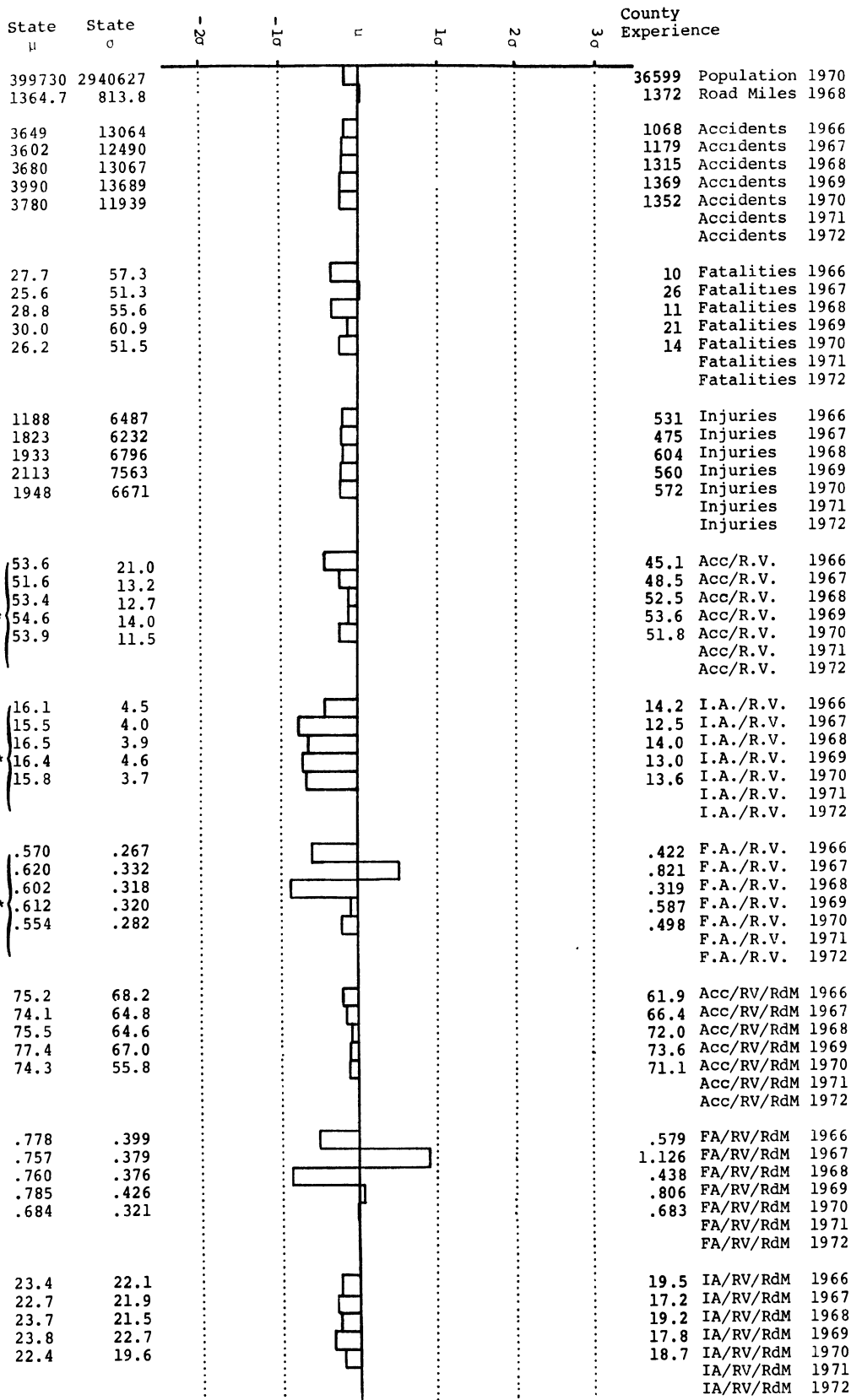


\* Figures represent actual value times 10<sup>3</sup>

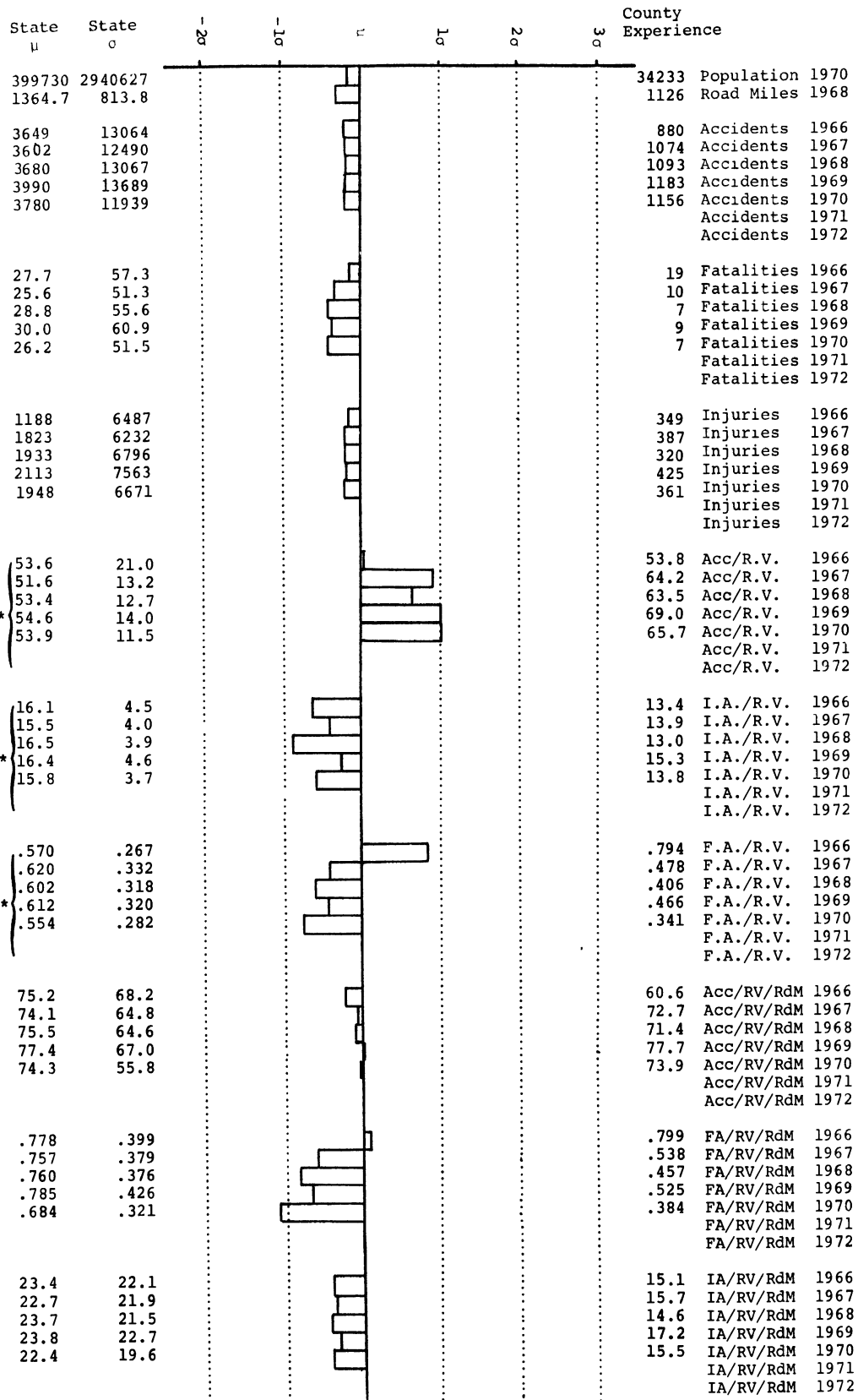


\*figures represent actual value times 10<sup>3</sup>

HILLSDALE

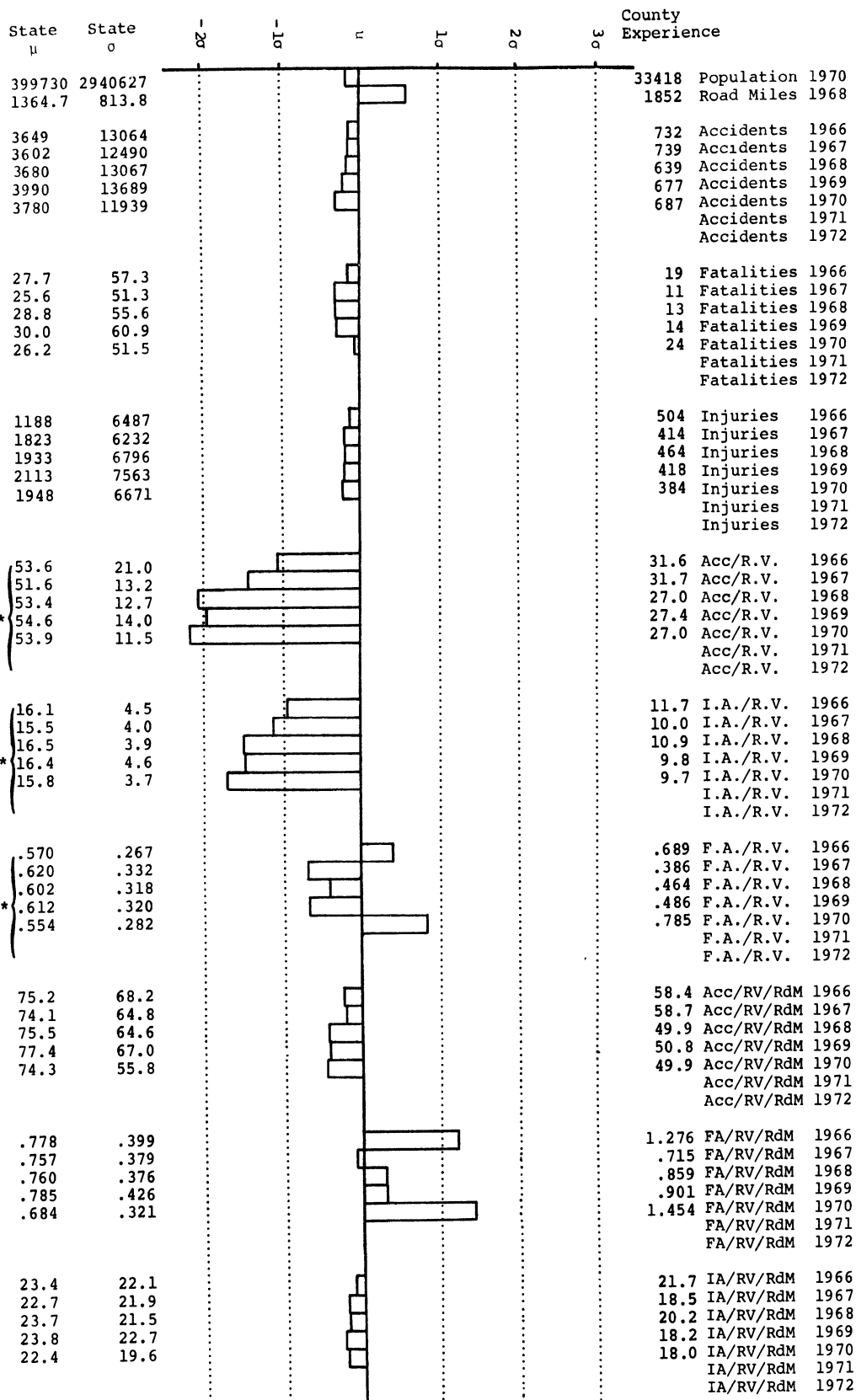


\*figures represent actual value times 10<sup>3</sup>



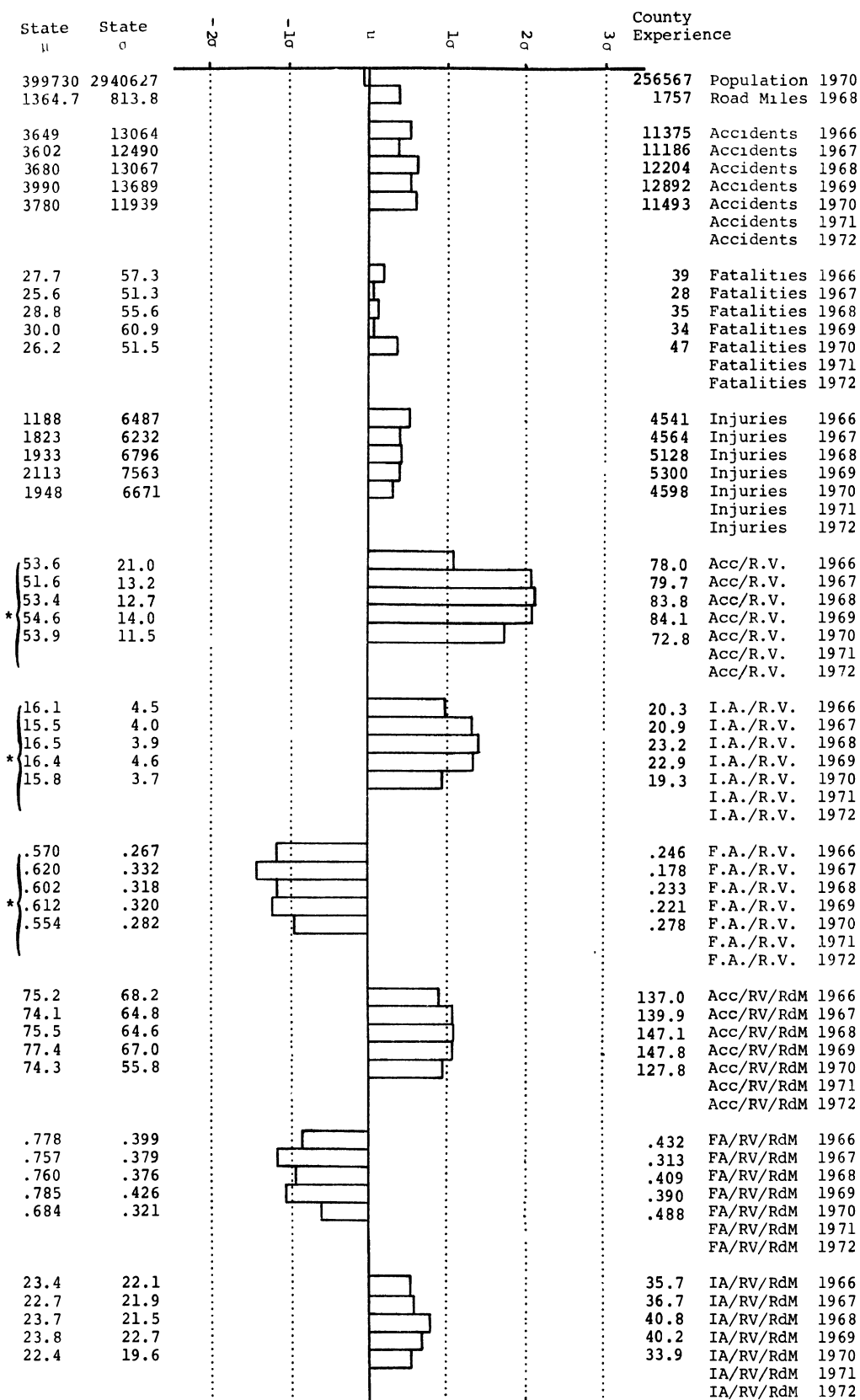
\* Figures represent actual value times 10<sup>3</sup>

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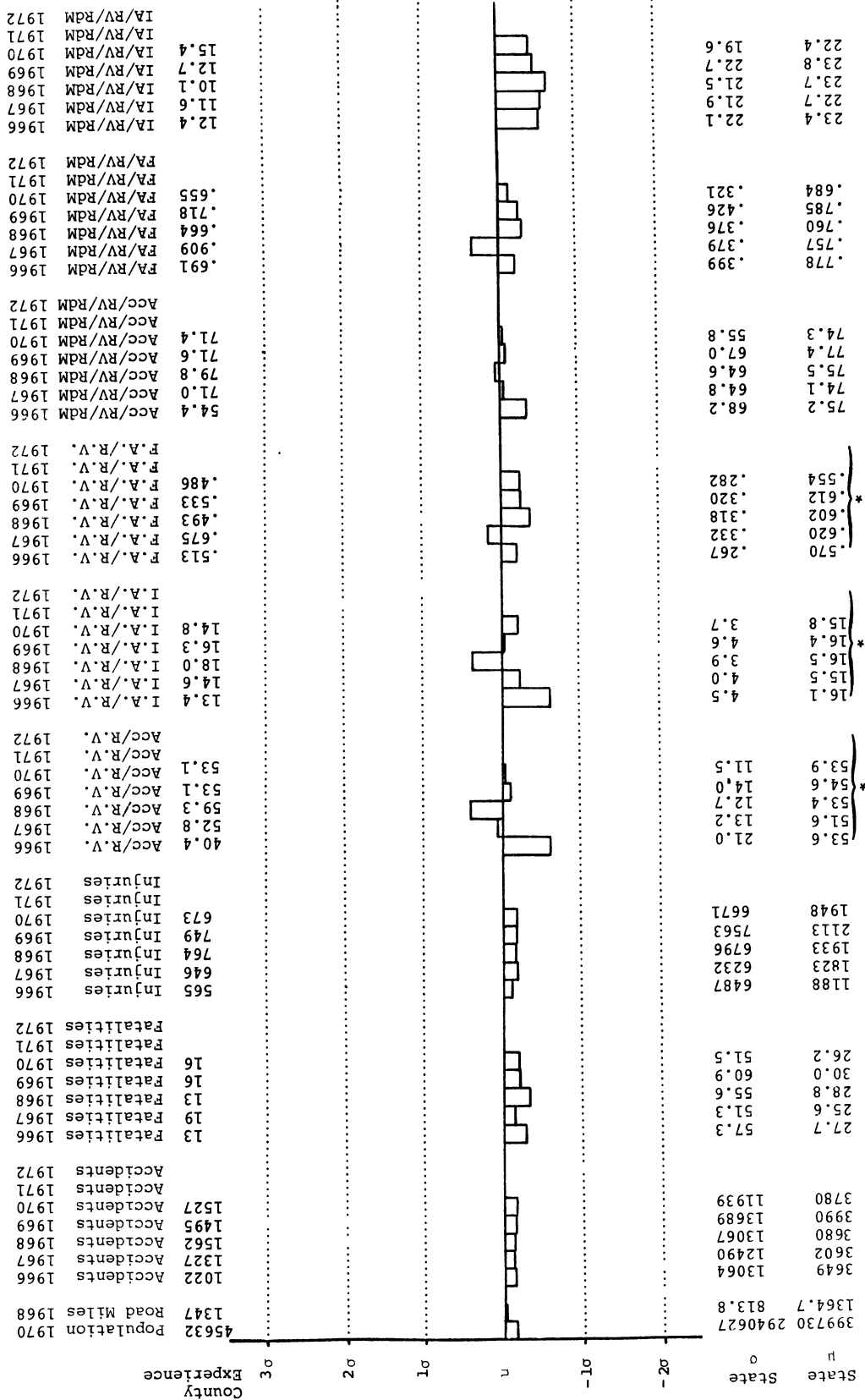
\* Figures represent actual value times 10<sup>3</sup>

INGHAM



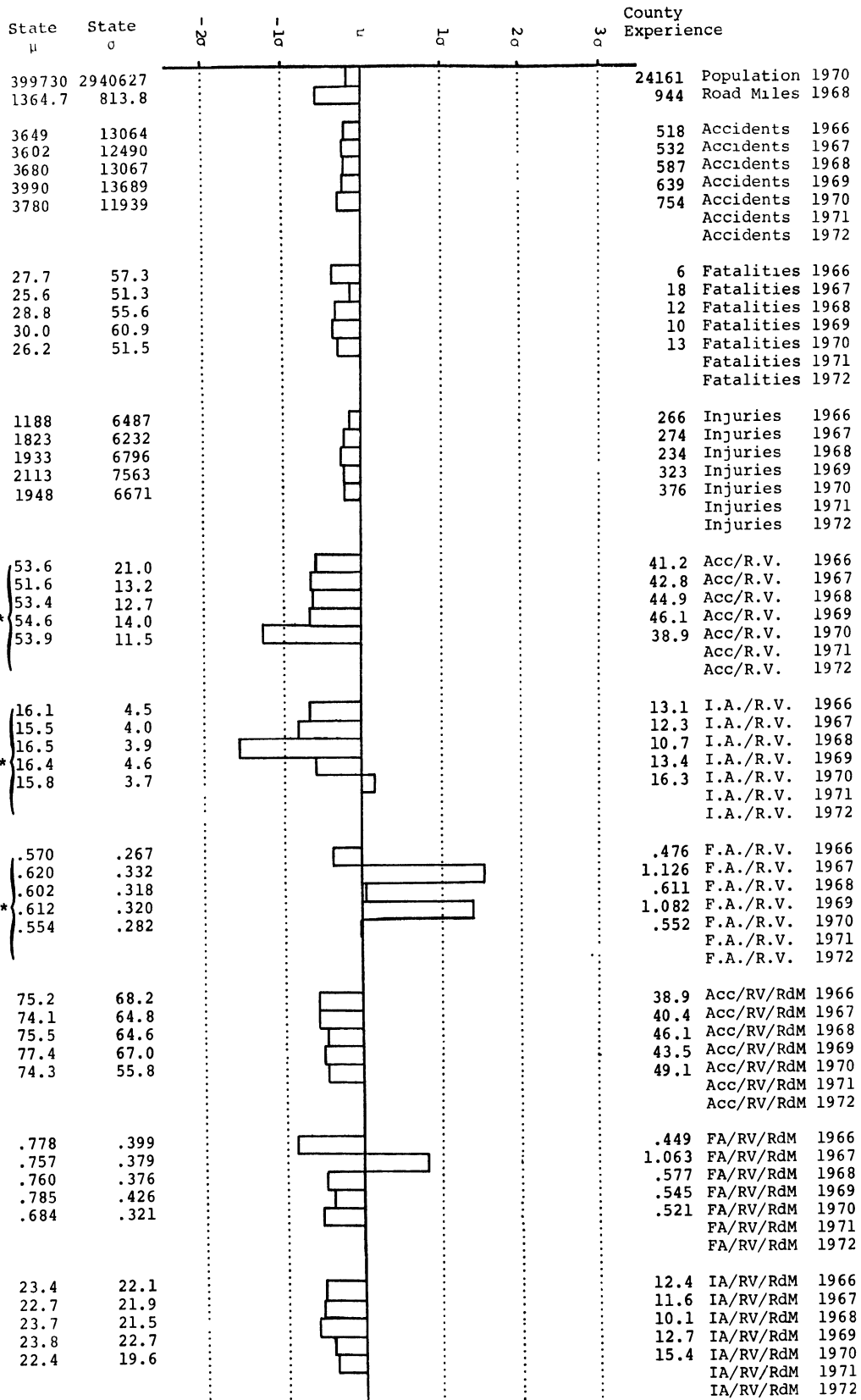
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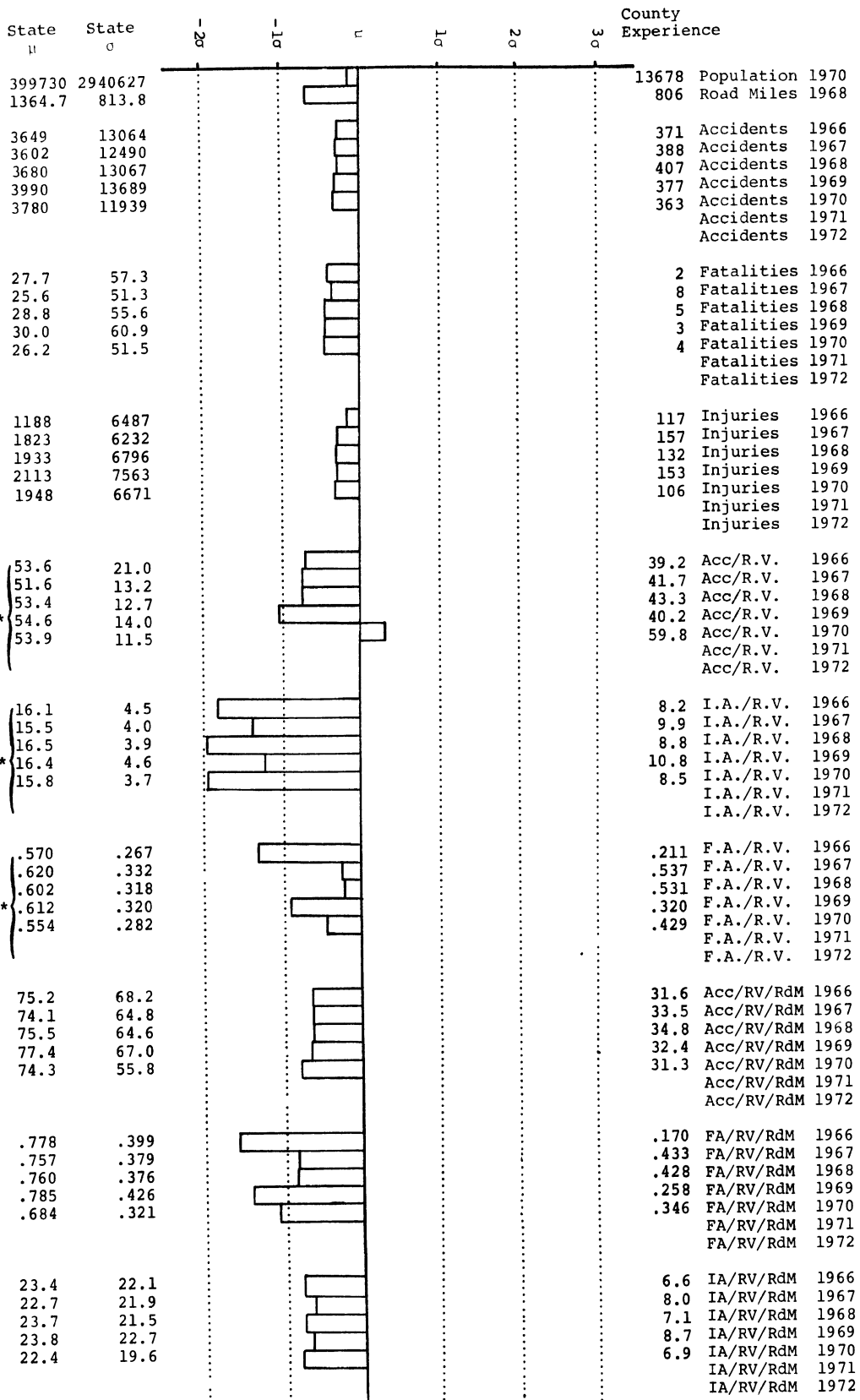


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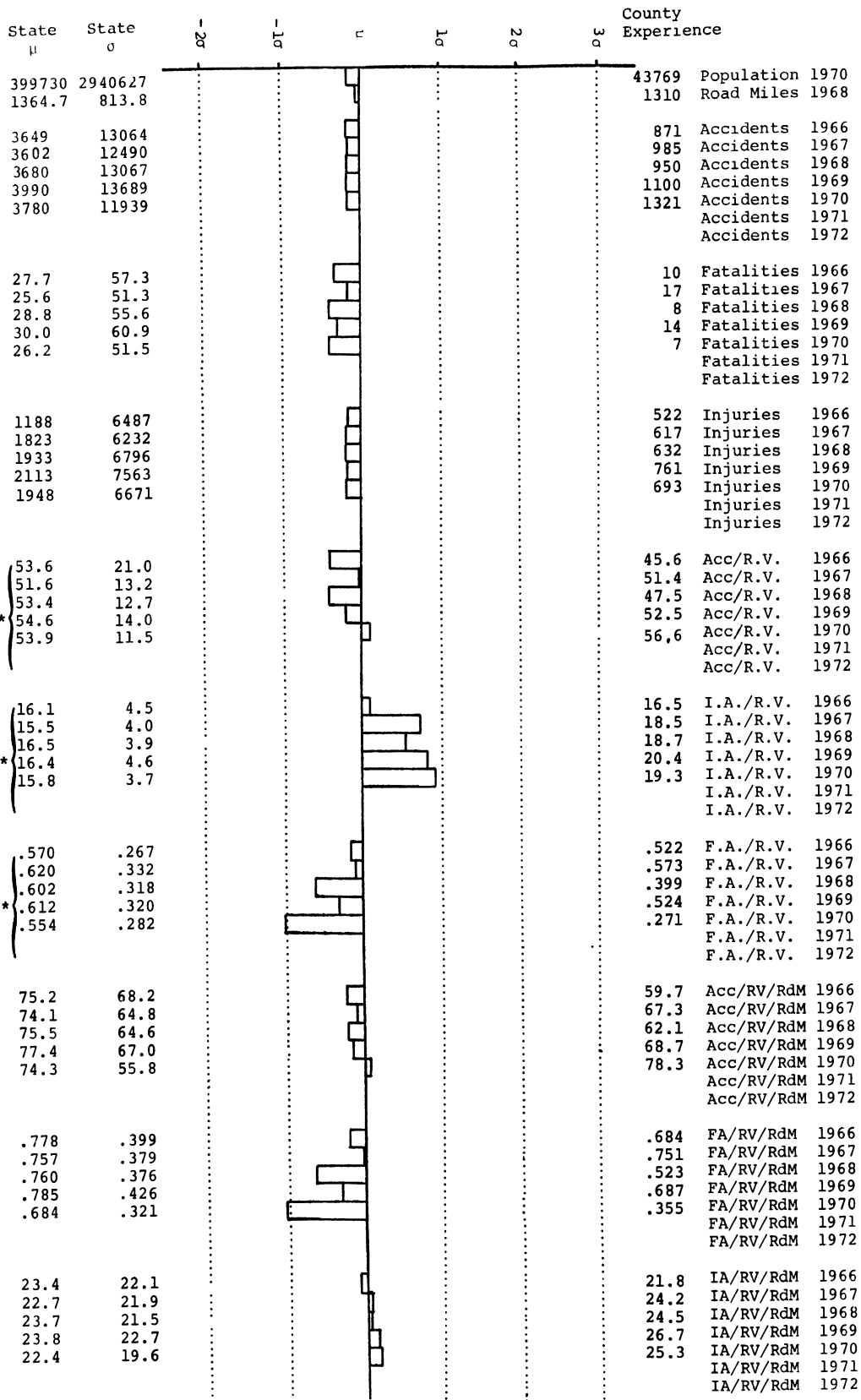
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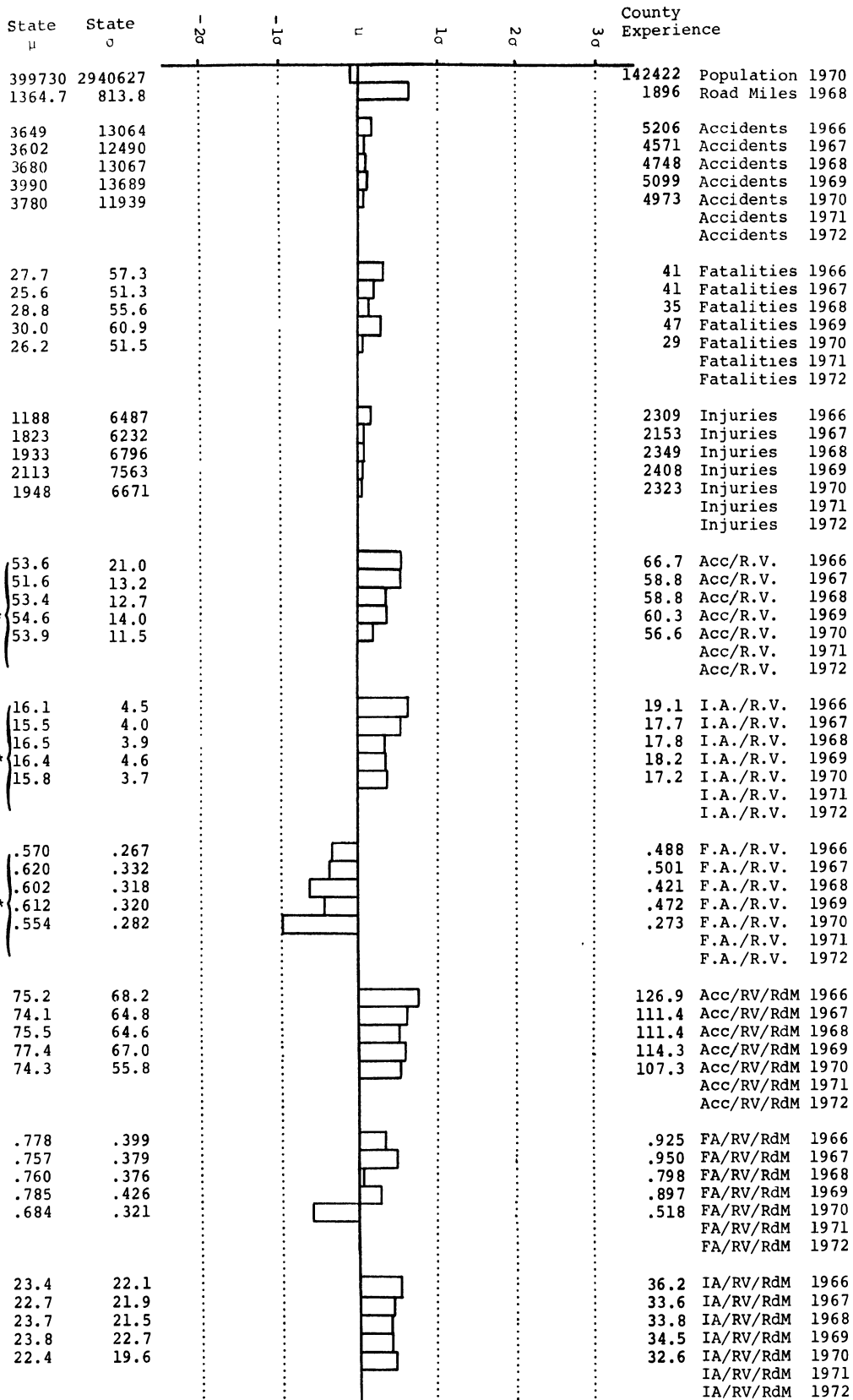
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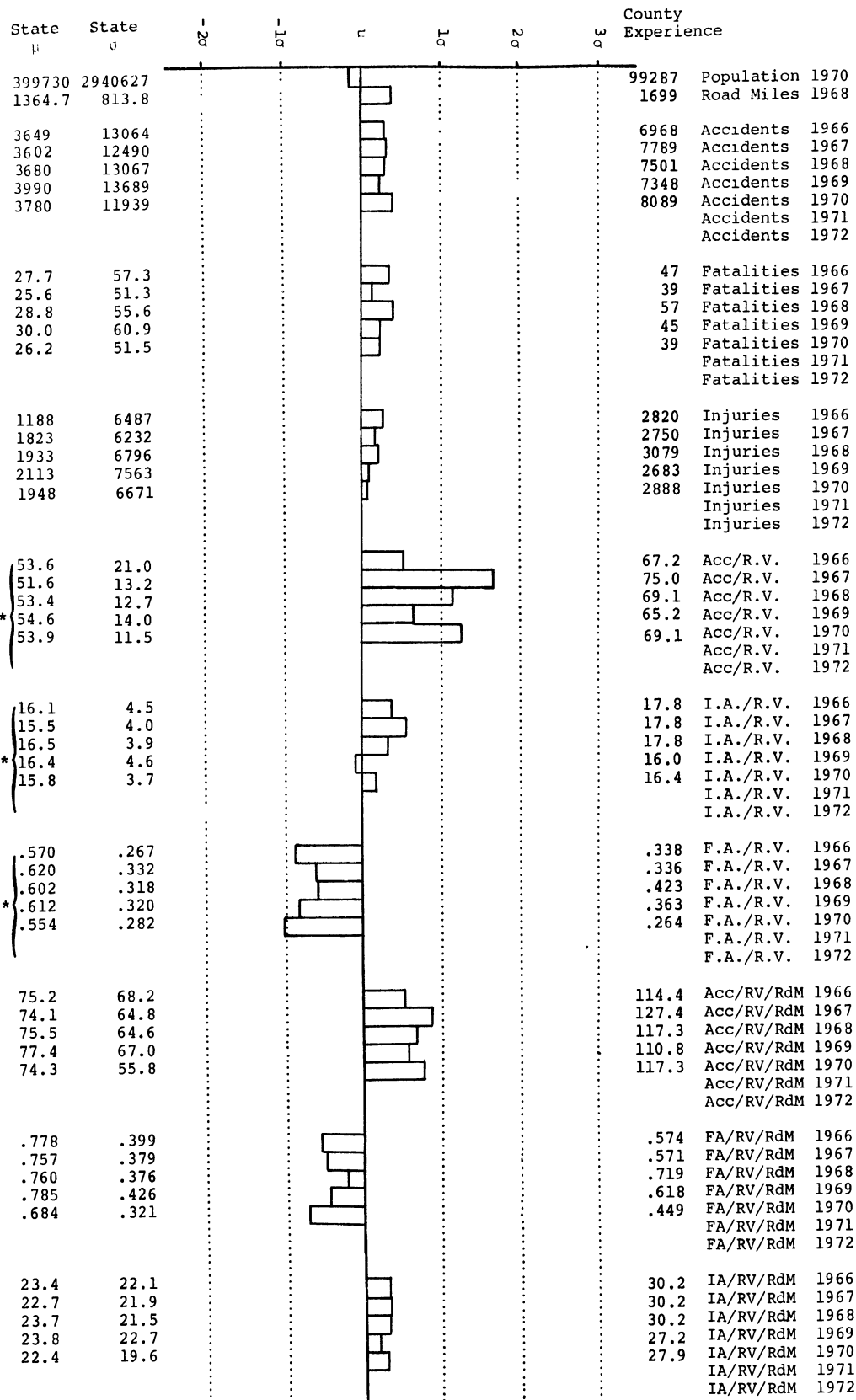
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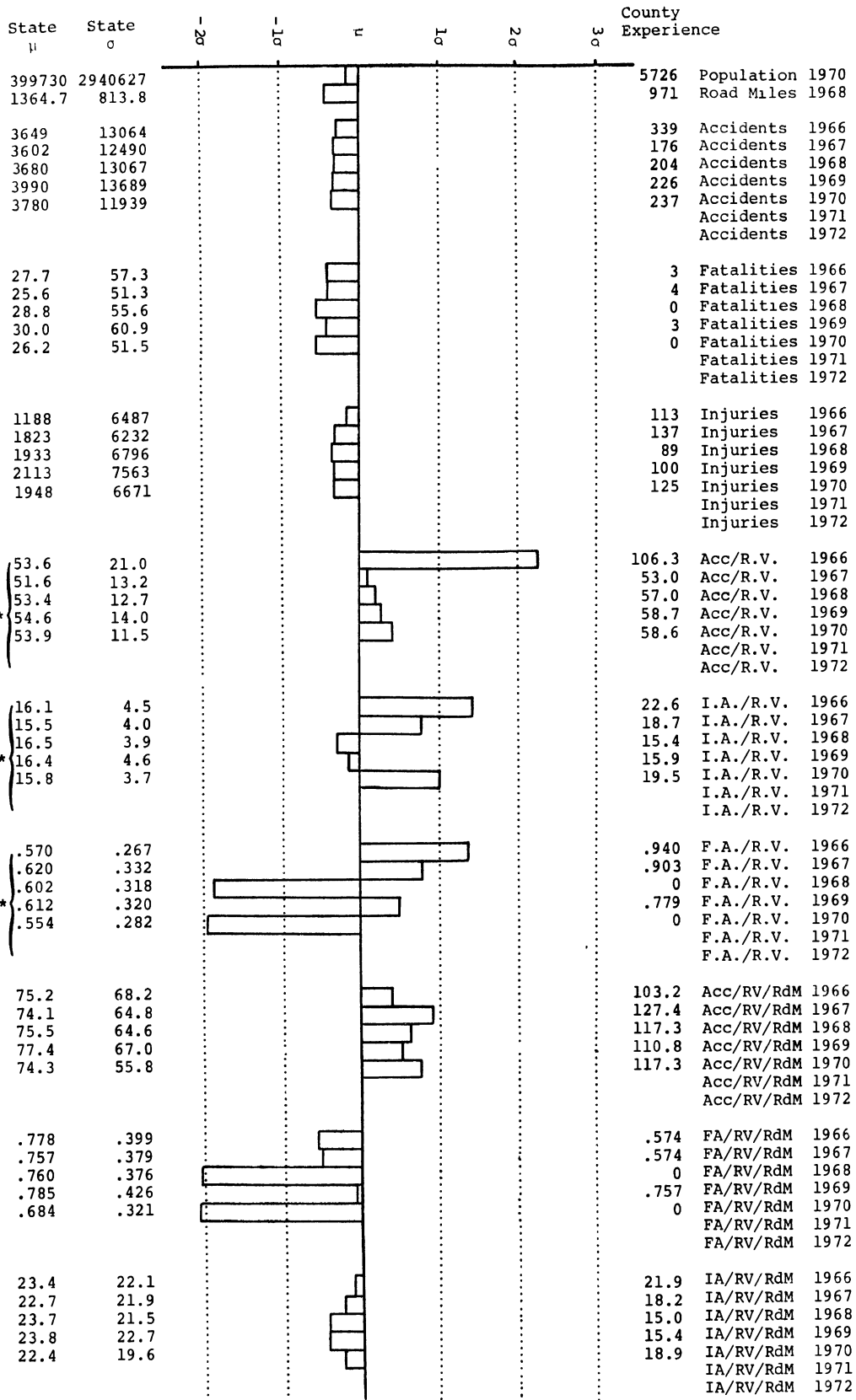
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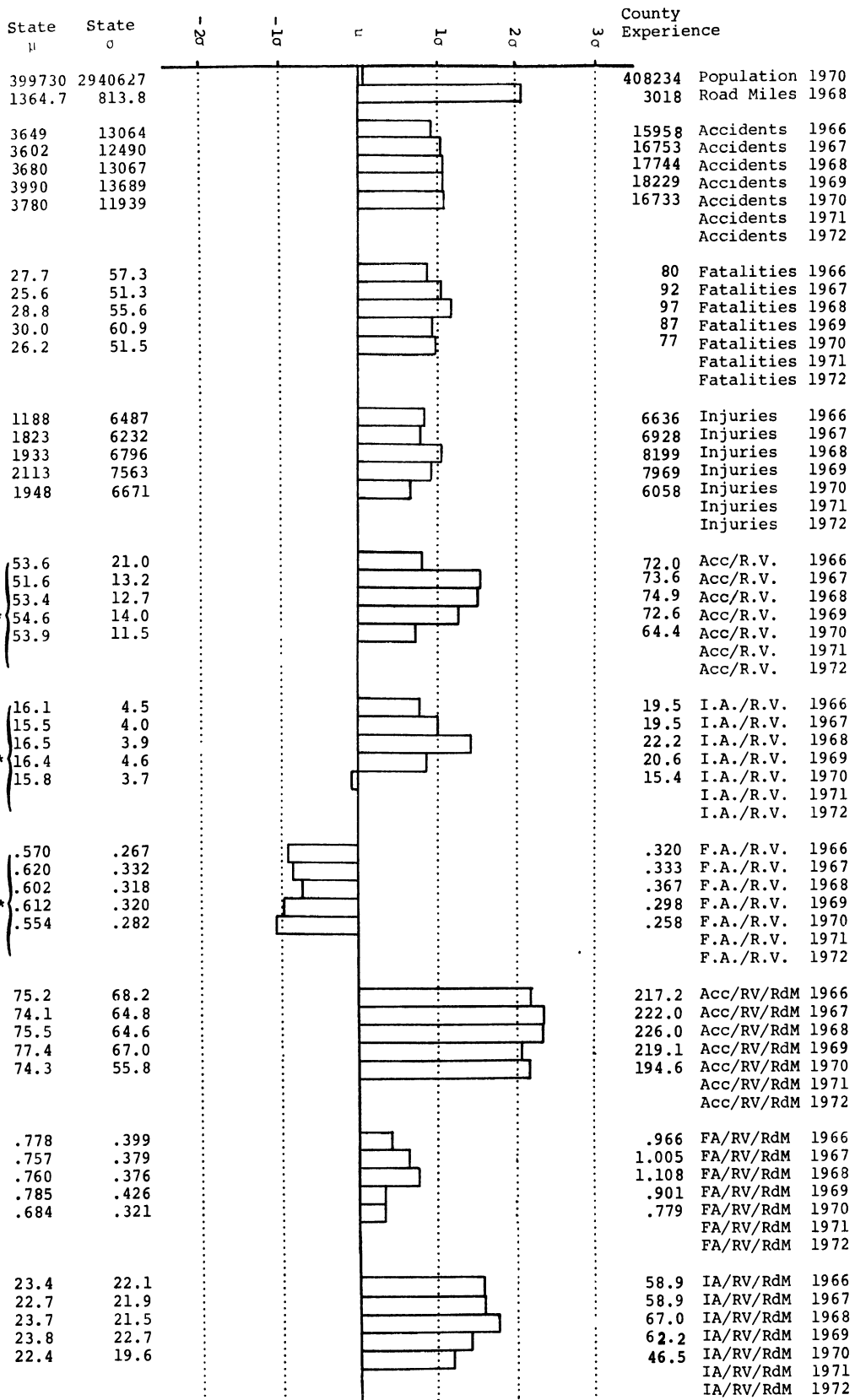
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\*figures represent actual value times 10<sup>3</sup>



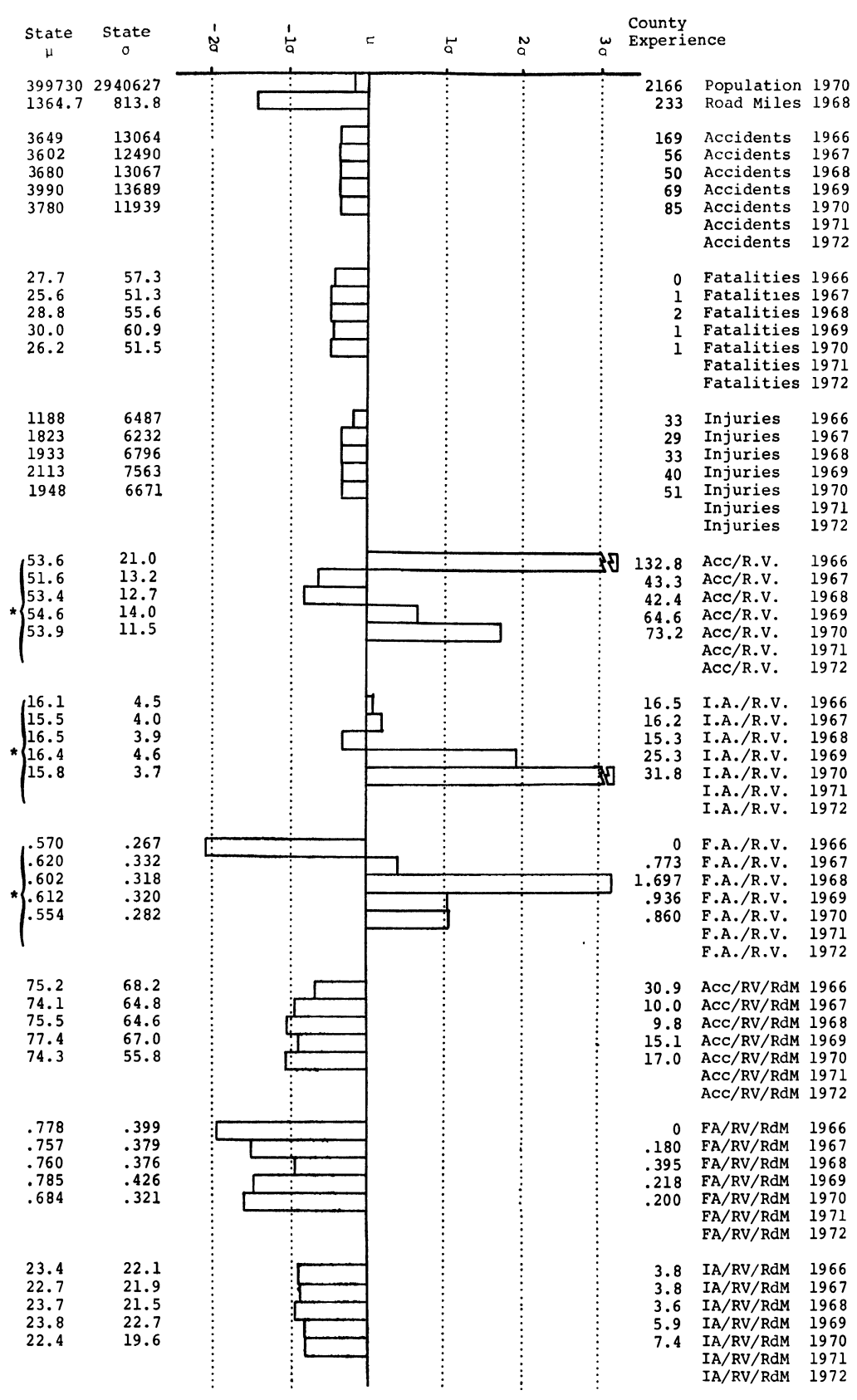
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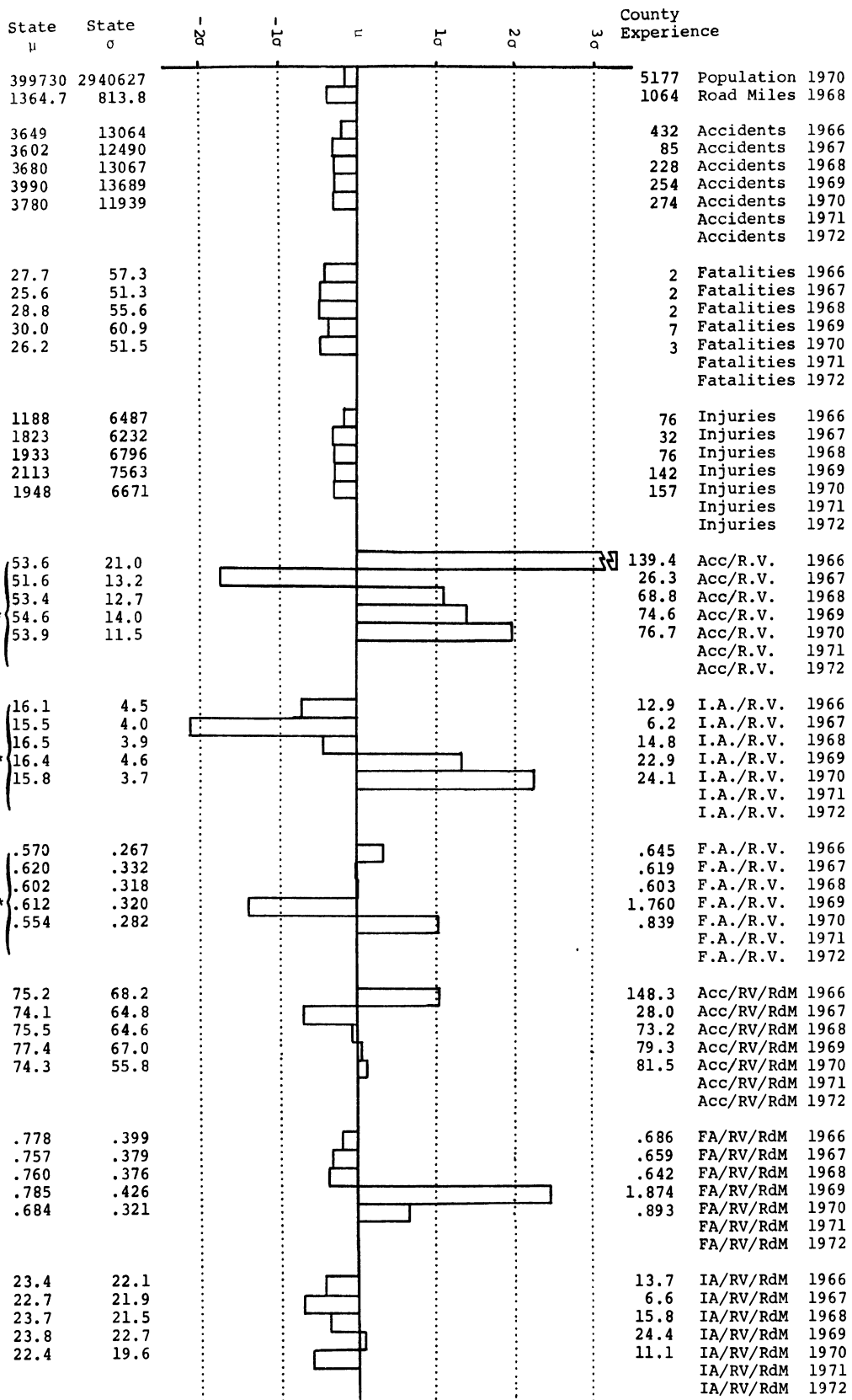
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KEMENAM

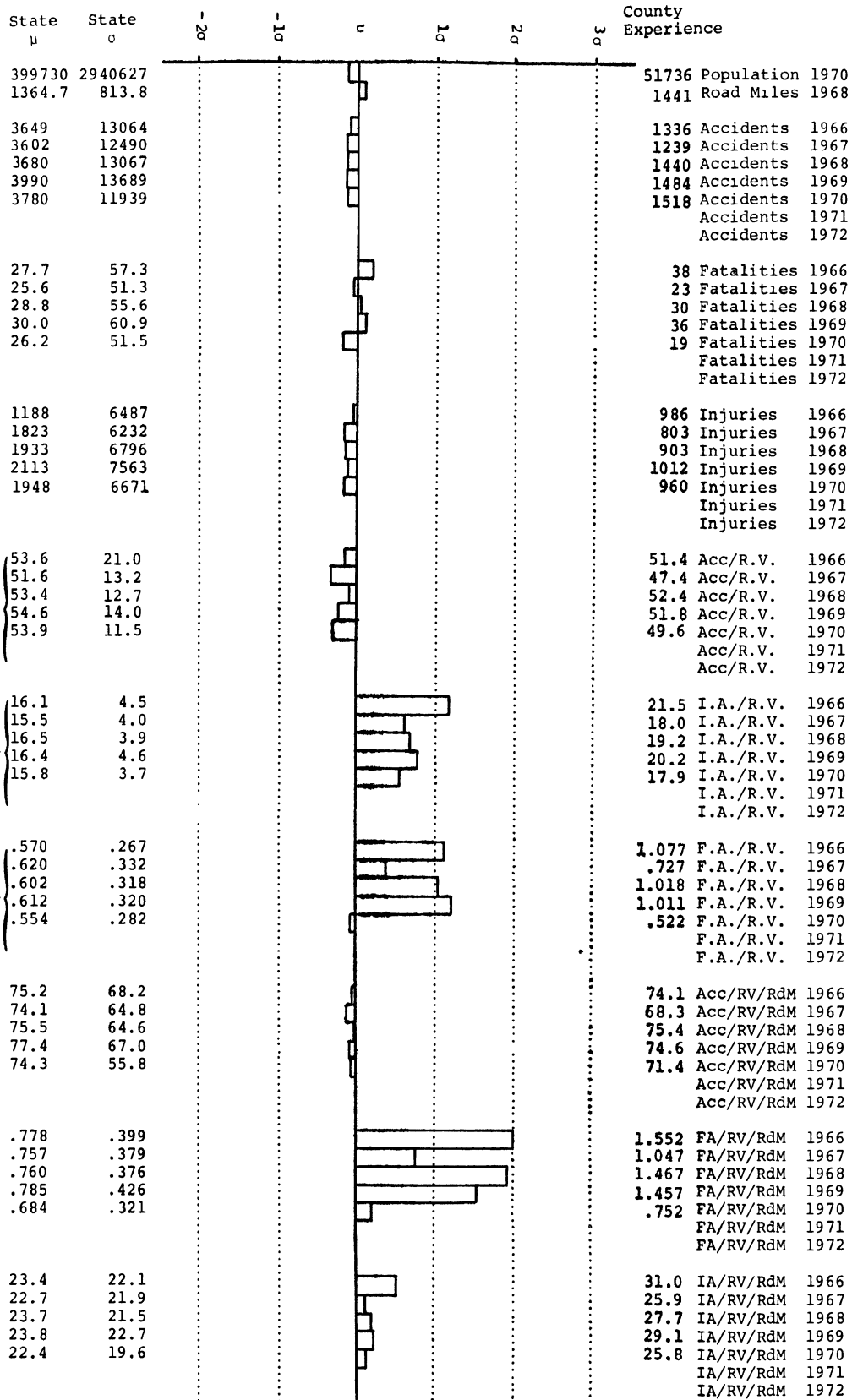


\* Figures represent actual value times 10<sup>3</sup>



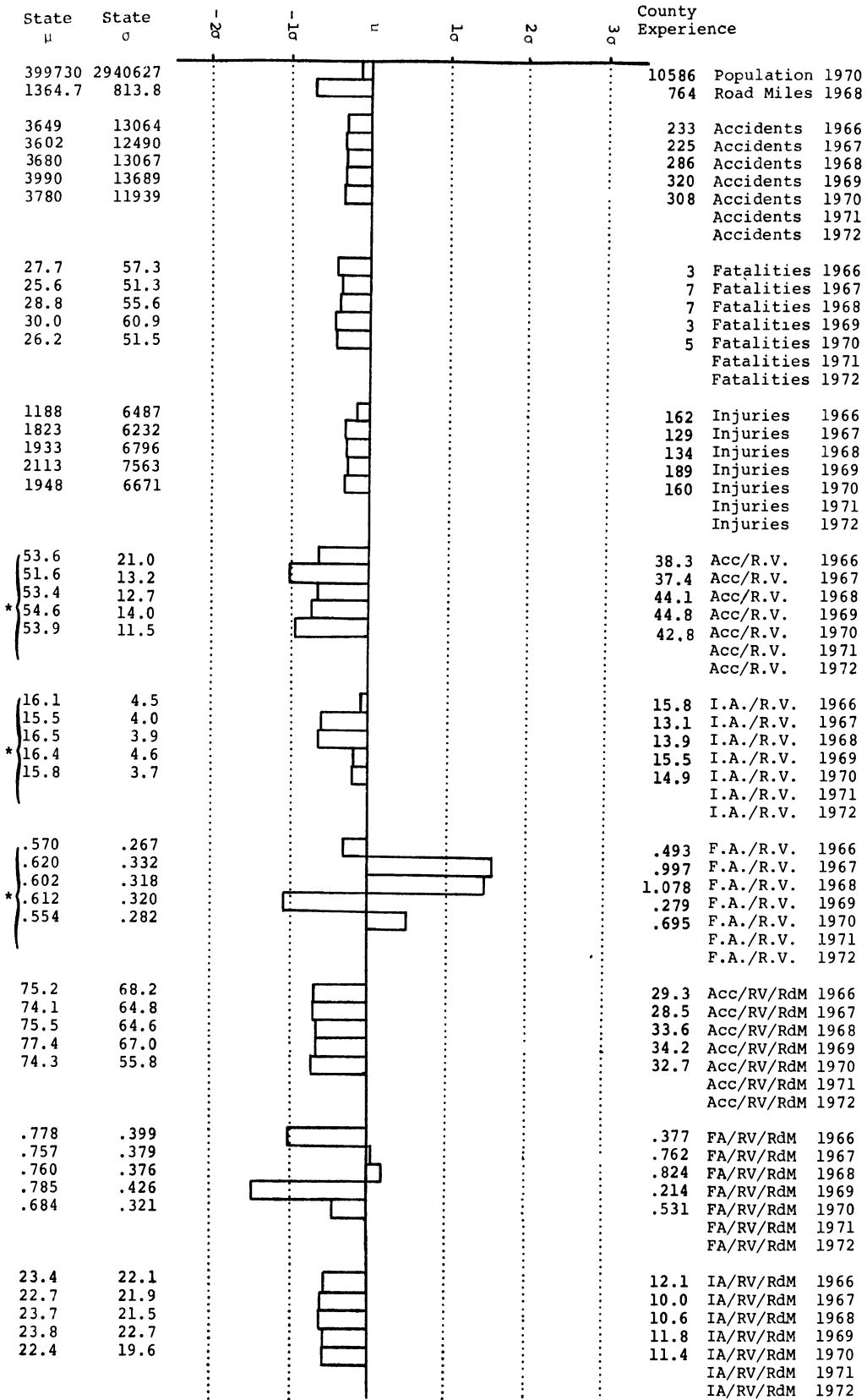
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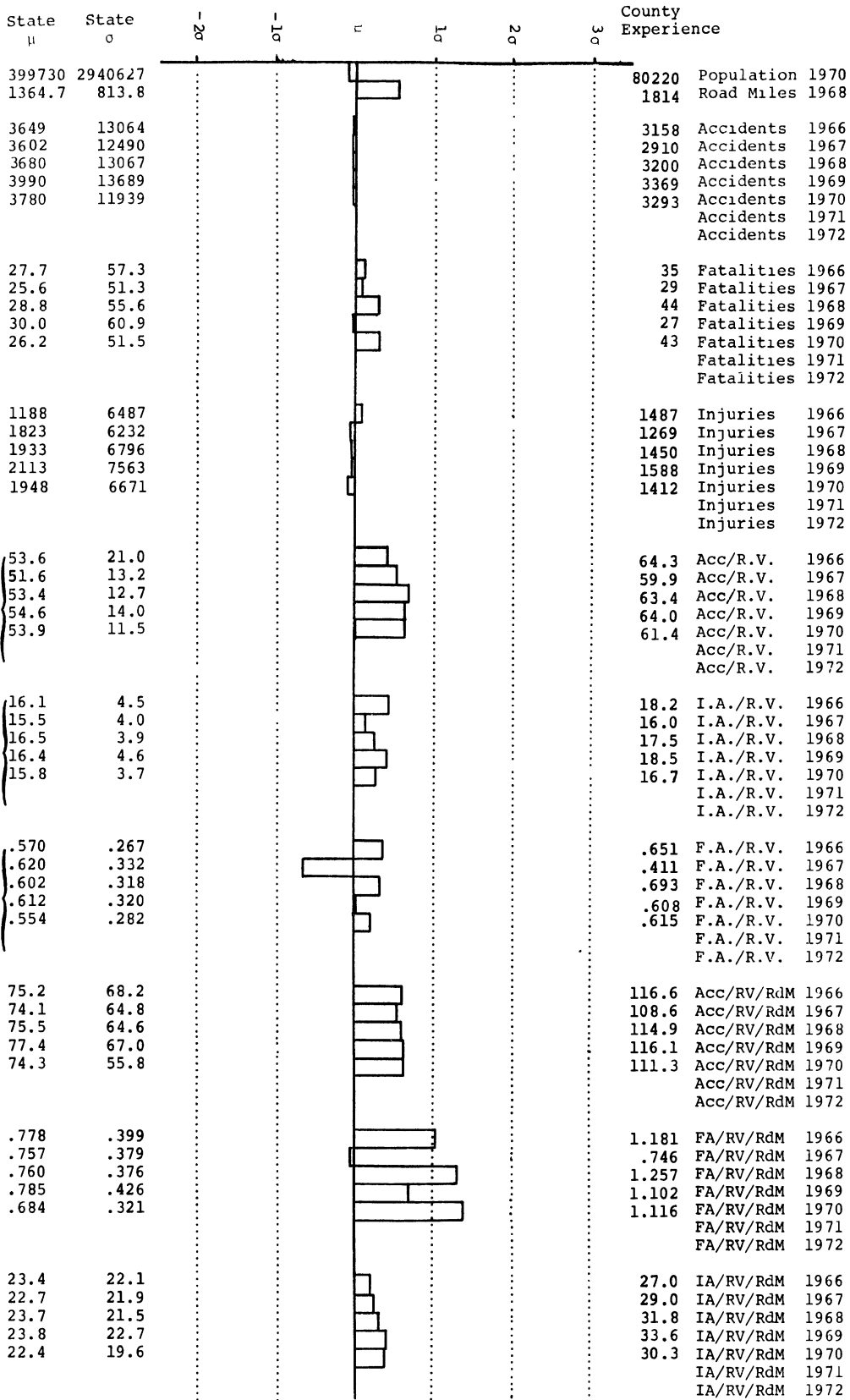
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LEELANAU



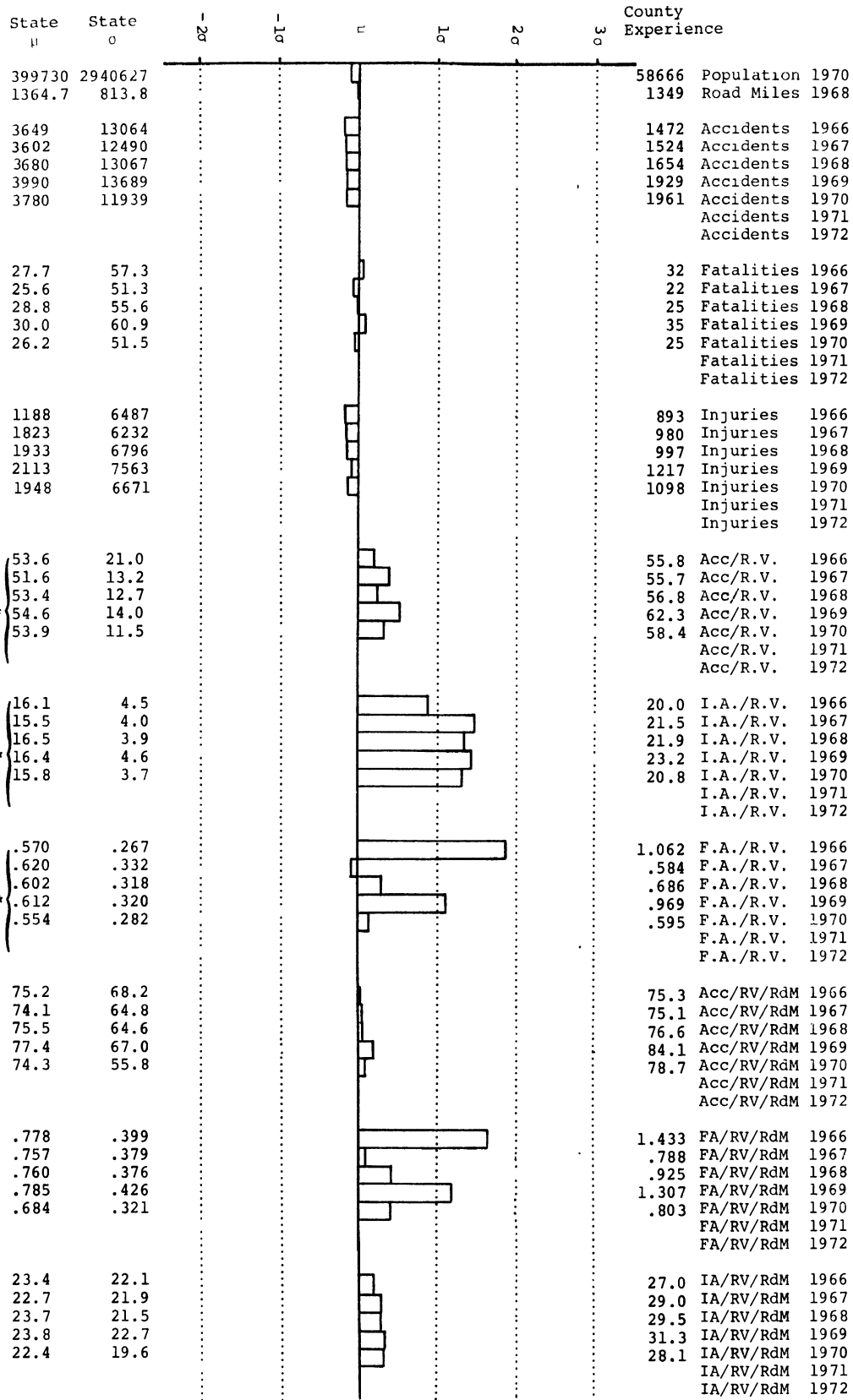
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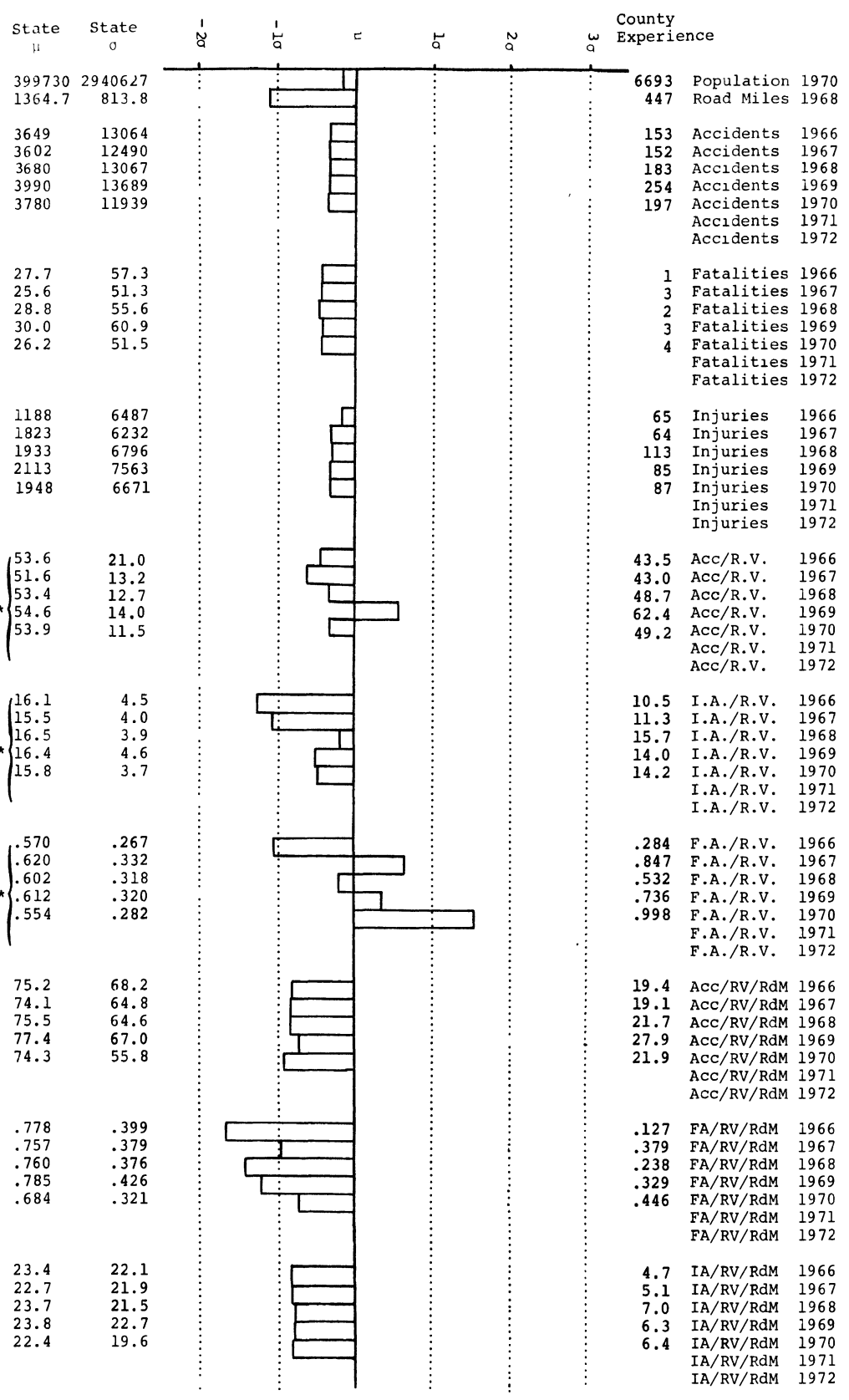


\*Figures represent actual value times 10<sup>3</sup>

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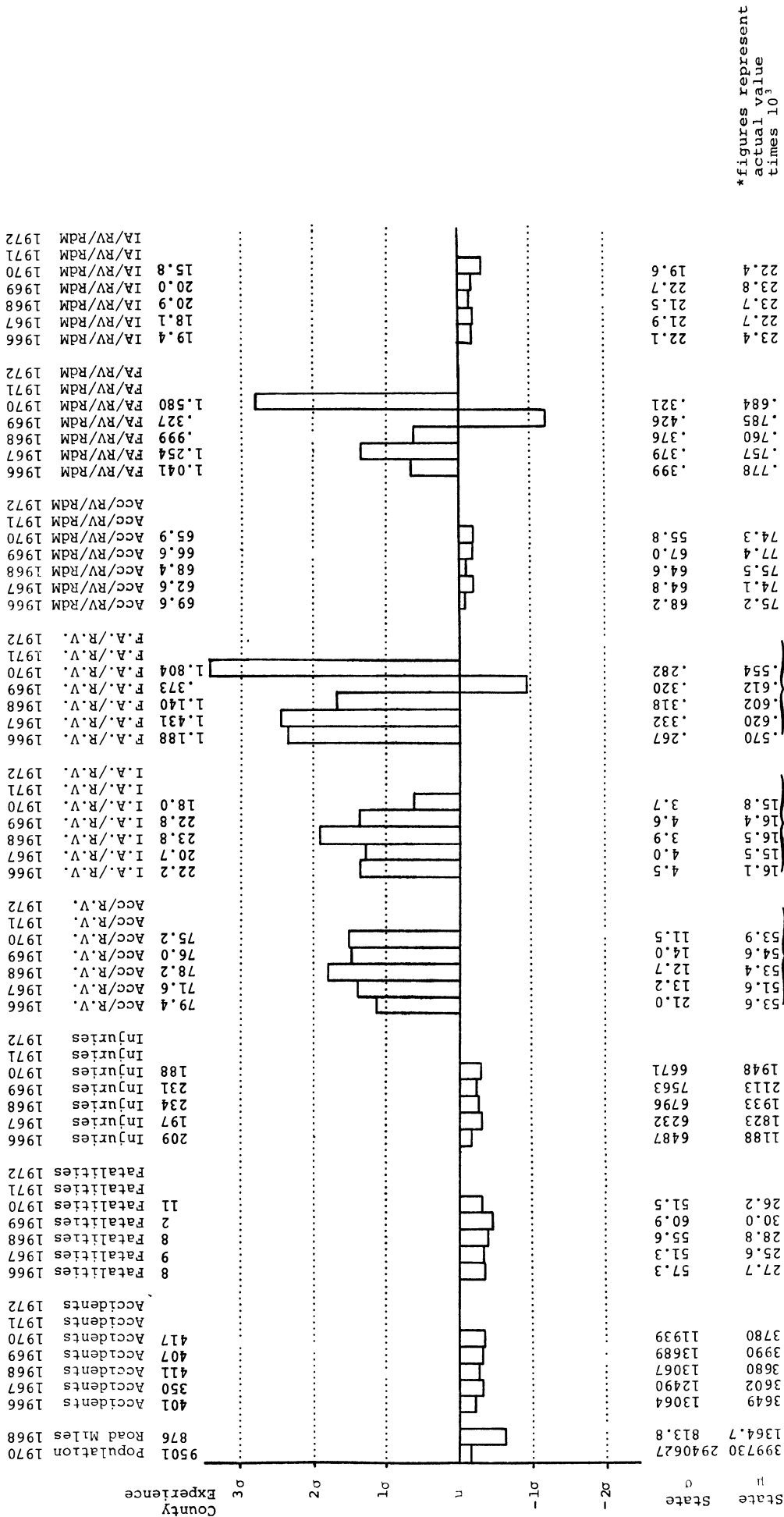


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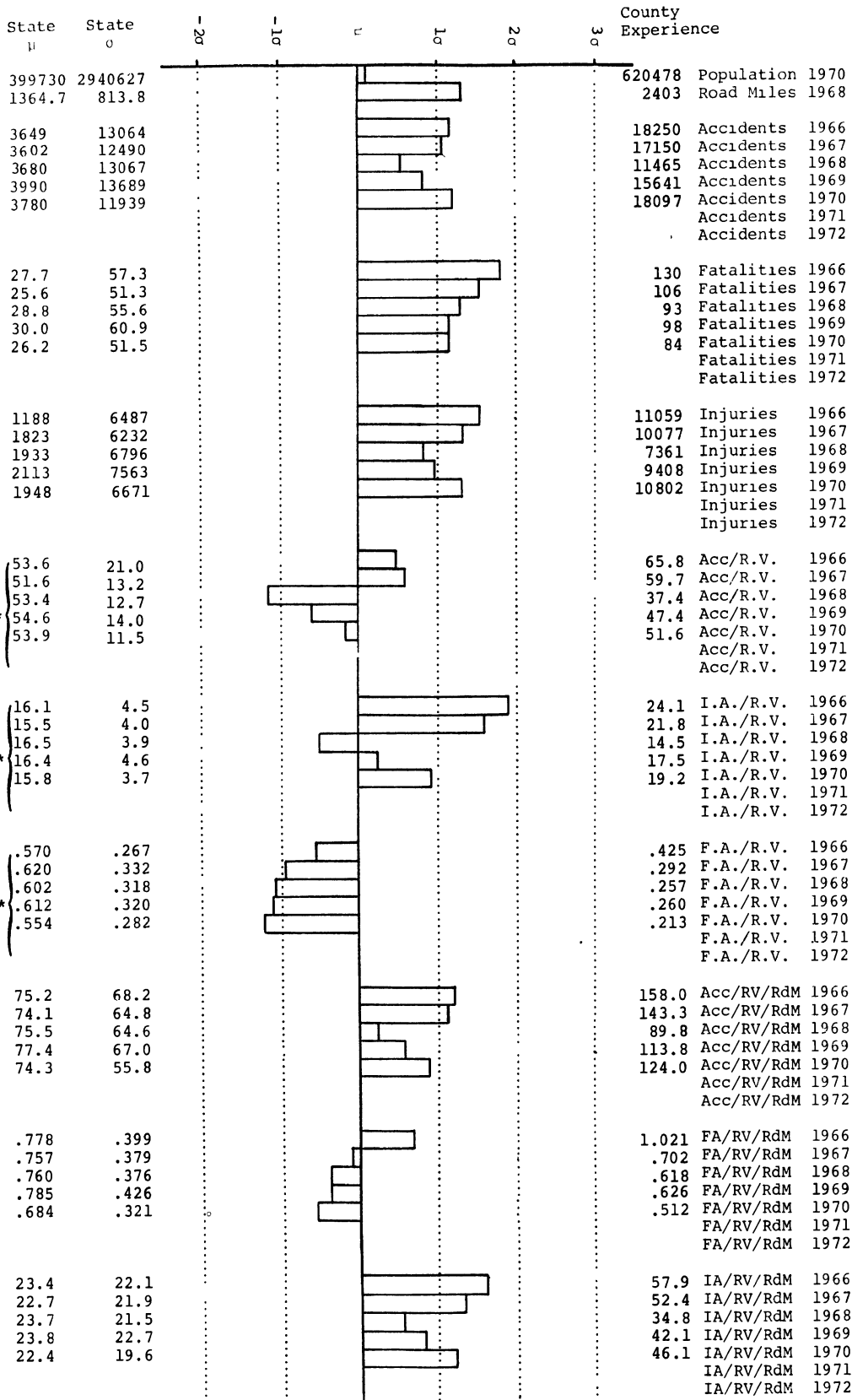
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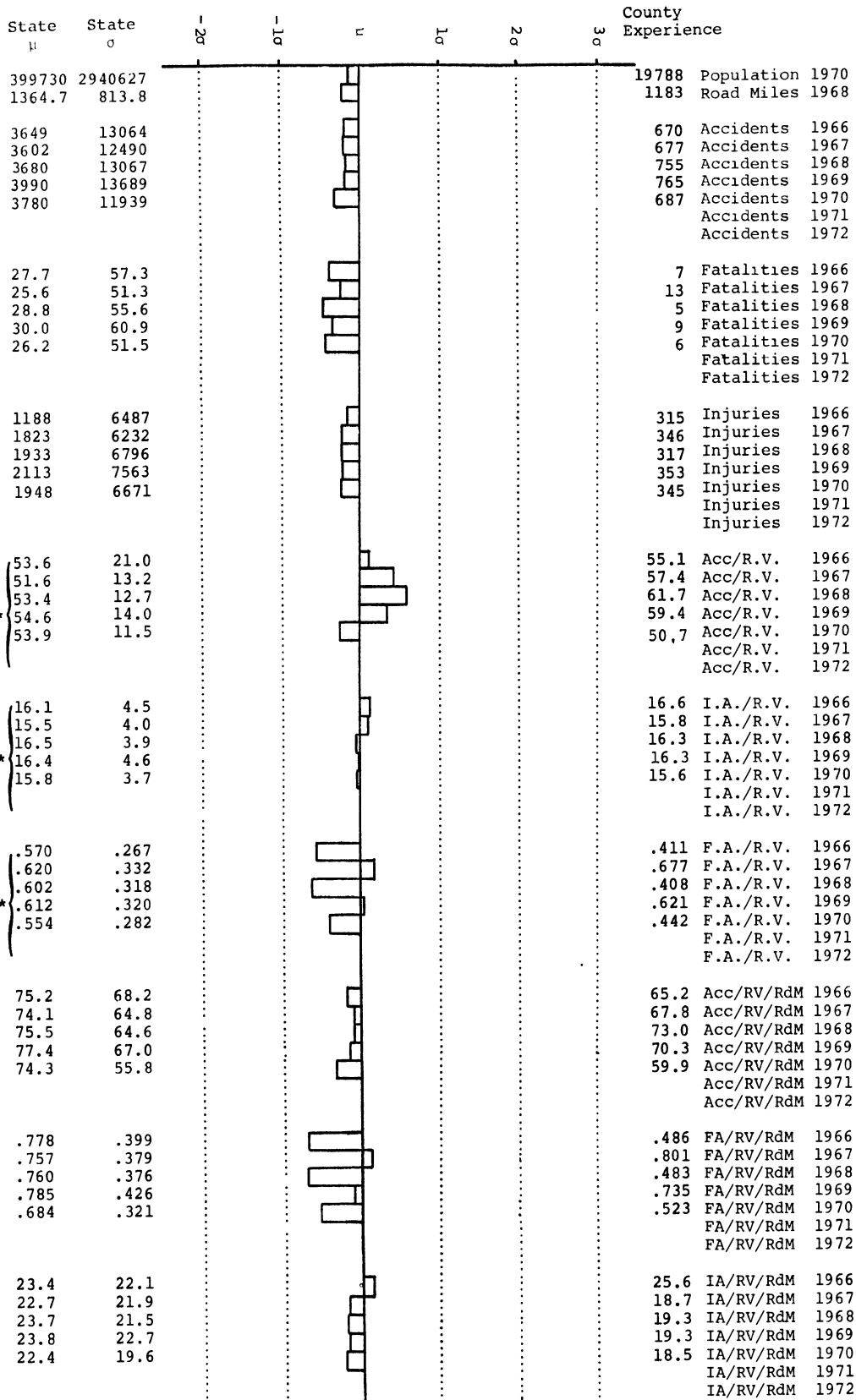


\* figures represent actual value times 10<sup>3</sup>



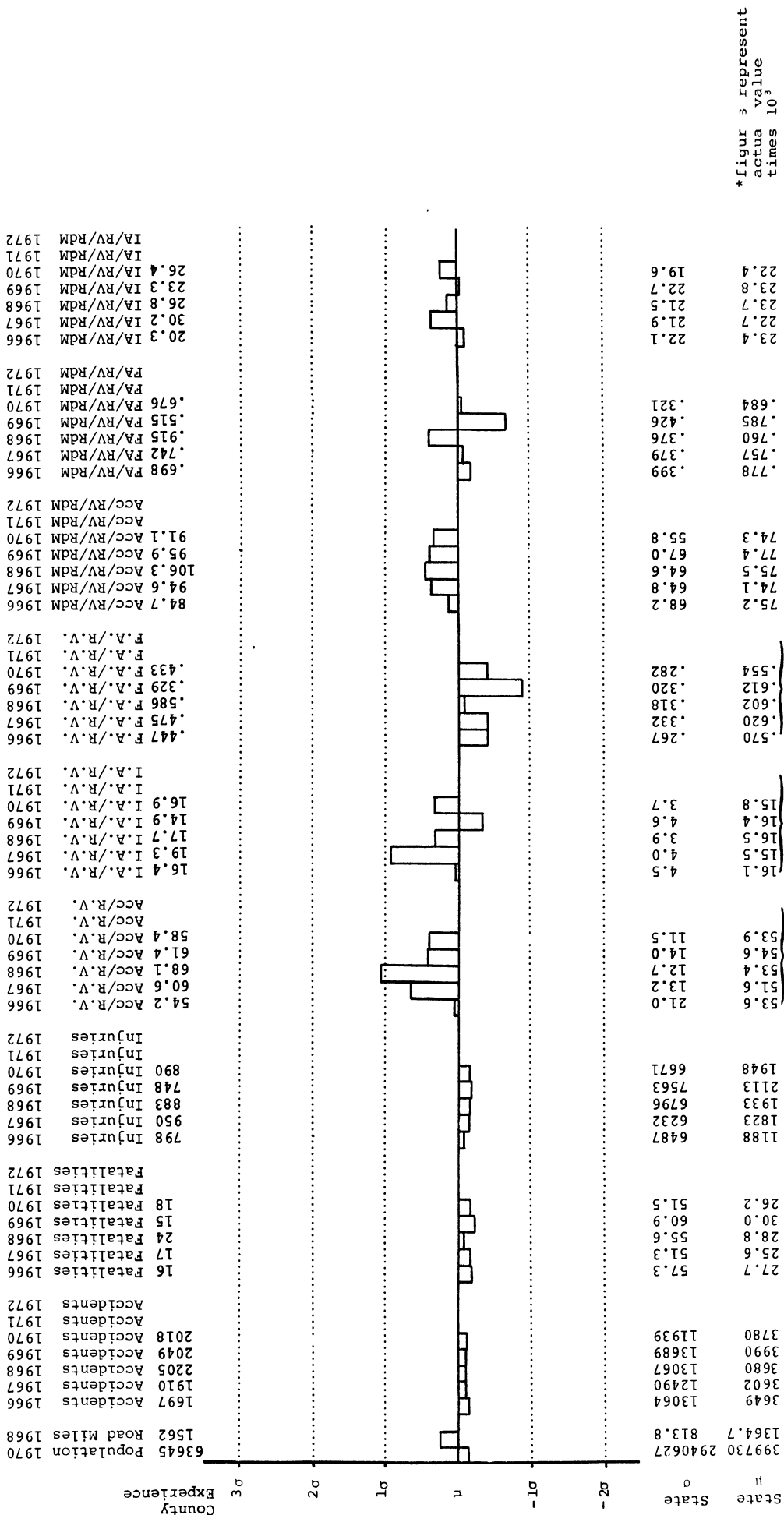


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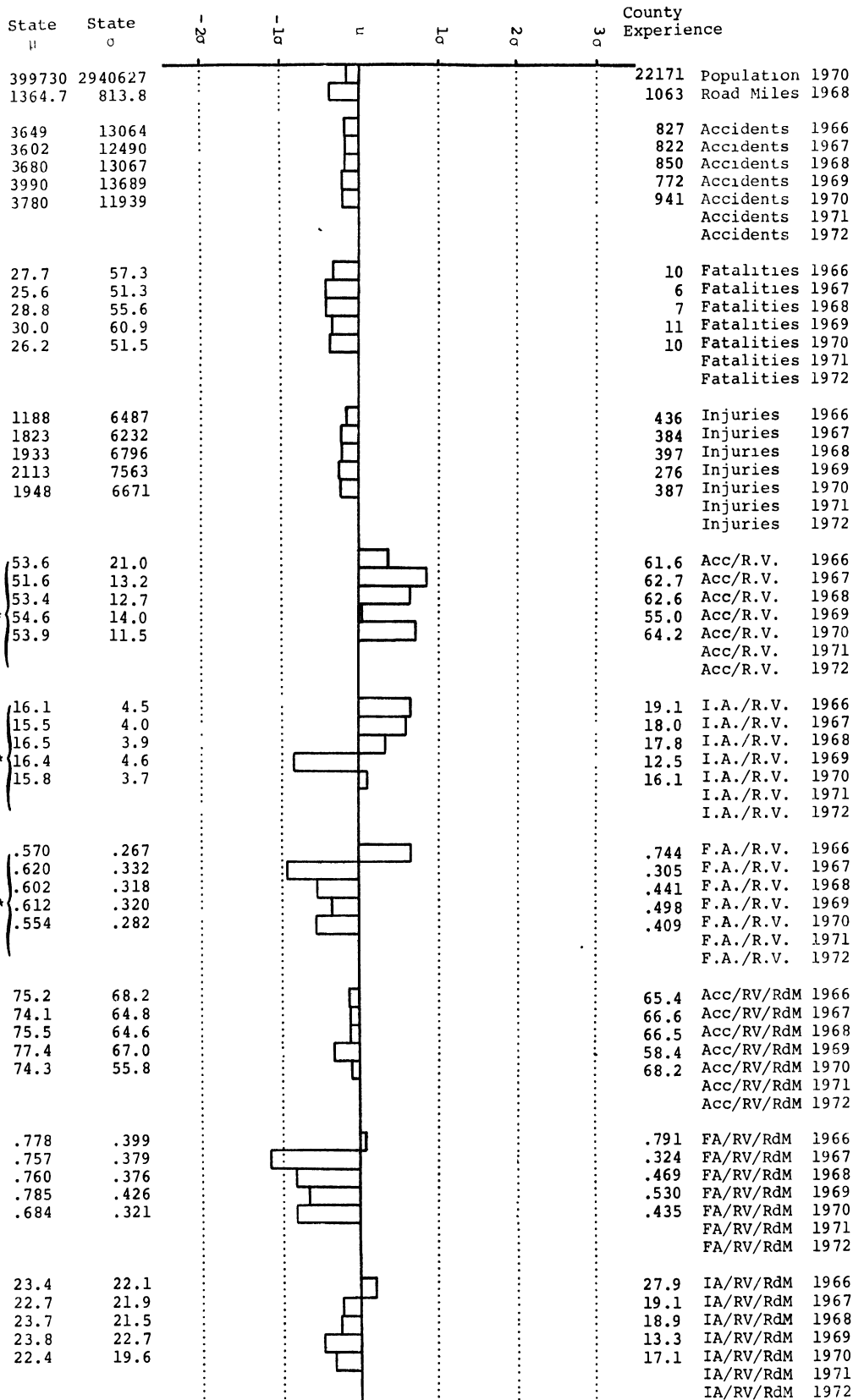


\*figures represent actual value times 10<sup>3</sup>

MARQUETTE

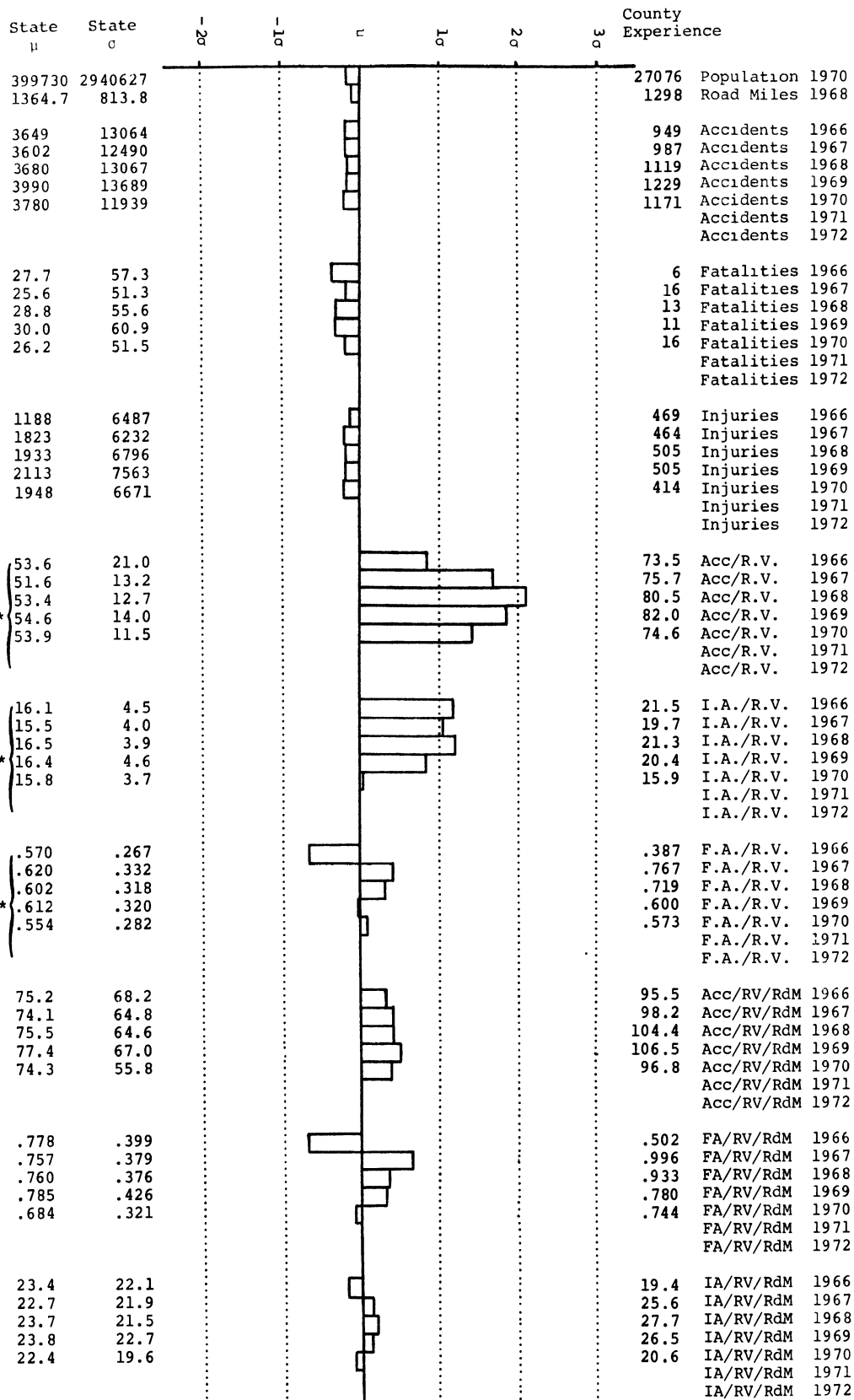


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times 10<sup>3</sup>



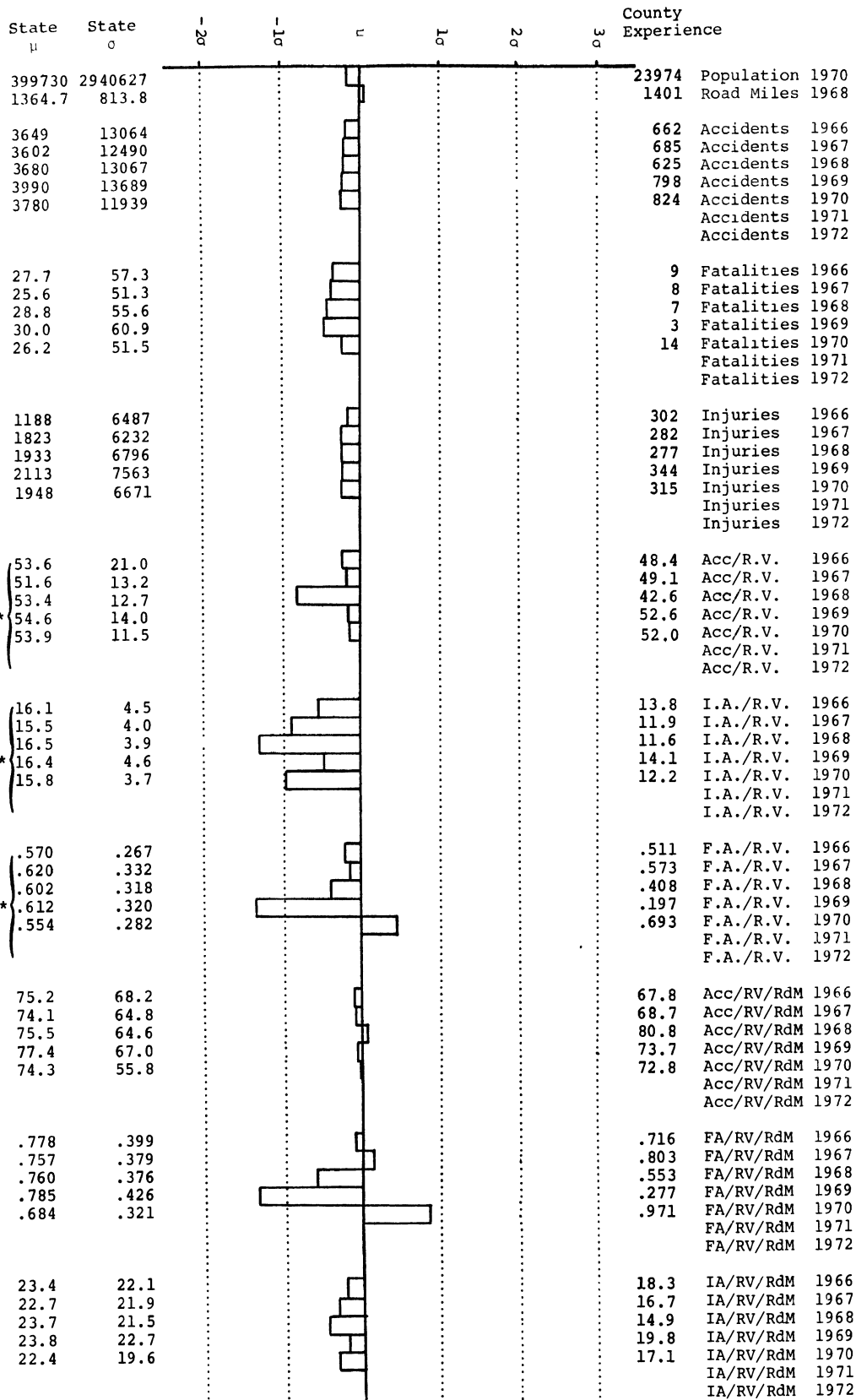
\*figures represent actual value times 10<sup>3</sup>

MECOSTA



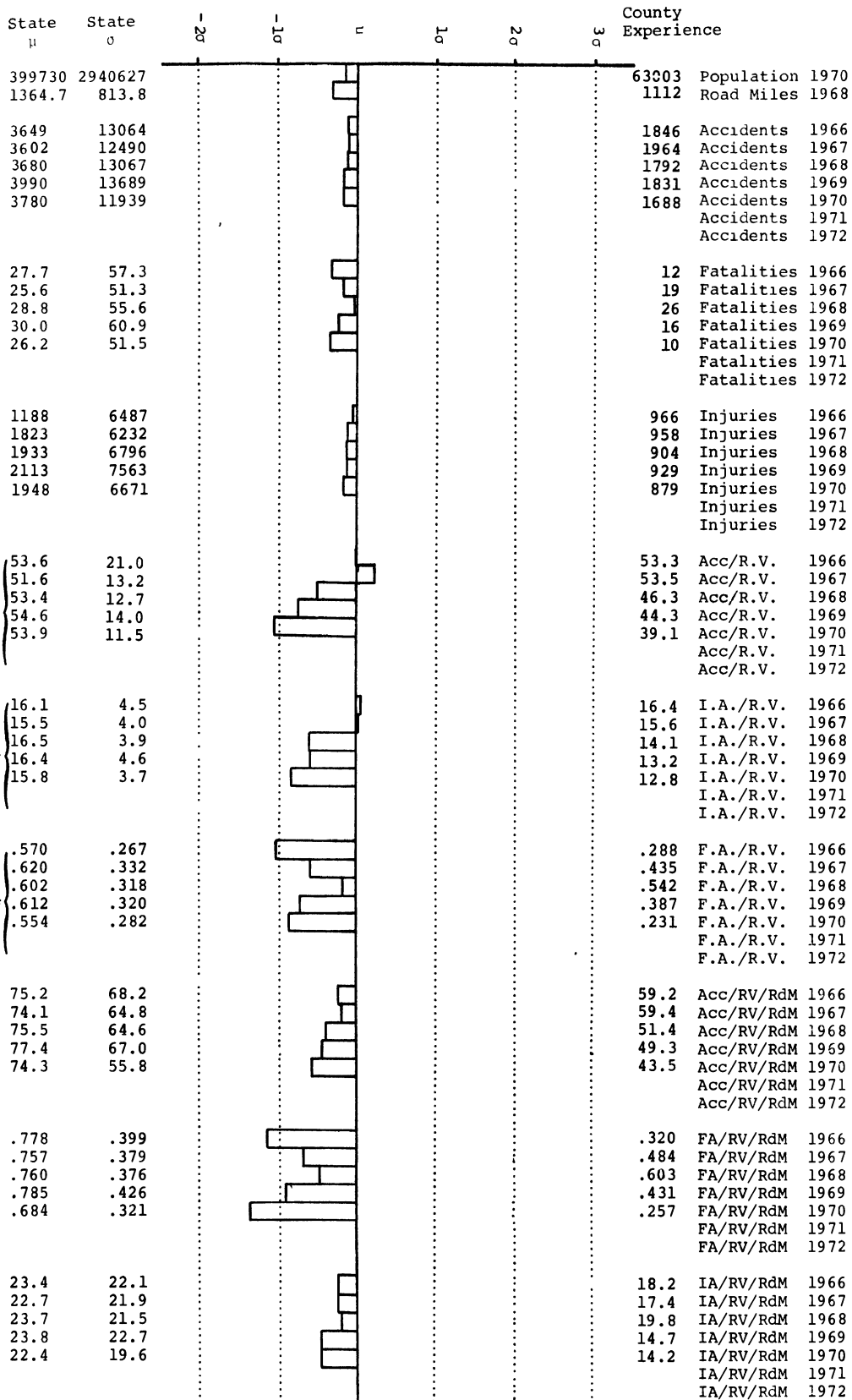
\*Figures represent  
actual value  
times 10<sup>3</sup>

MEMORINEE



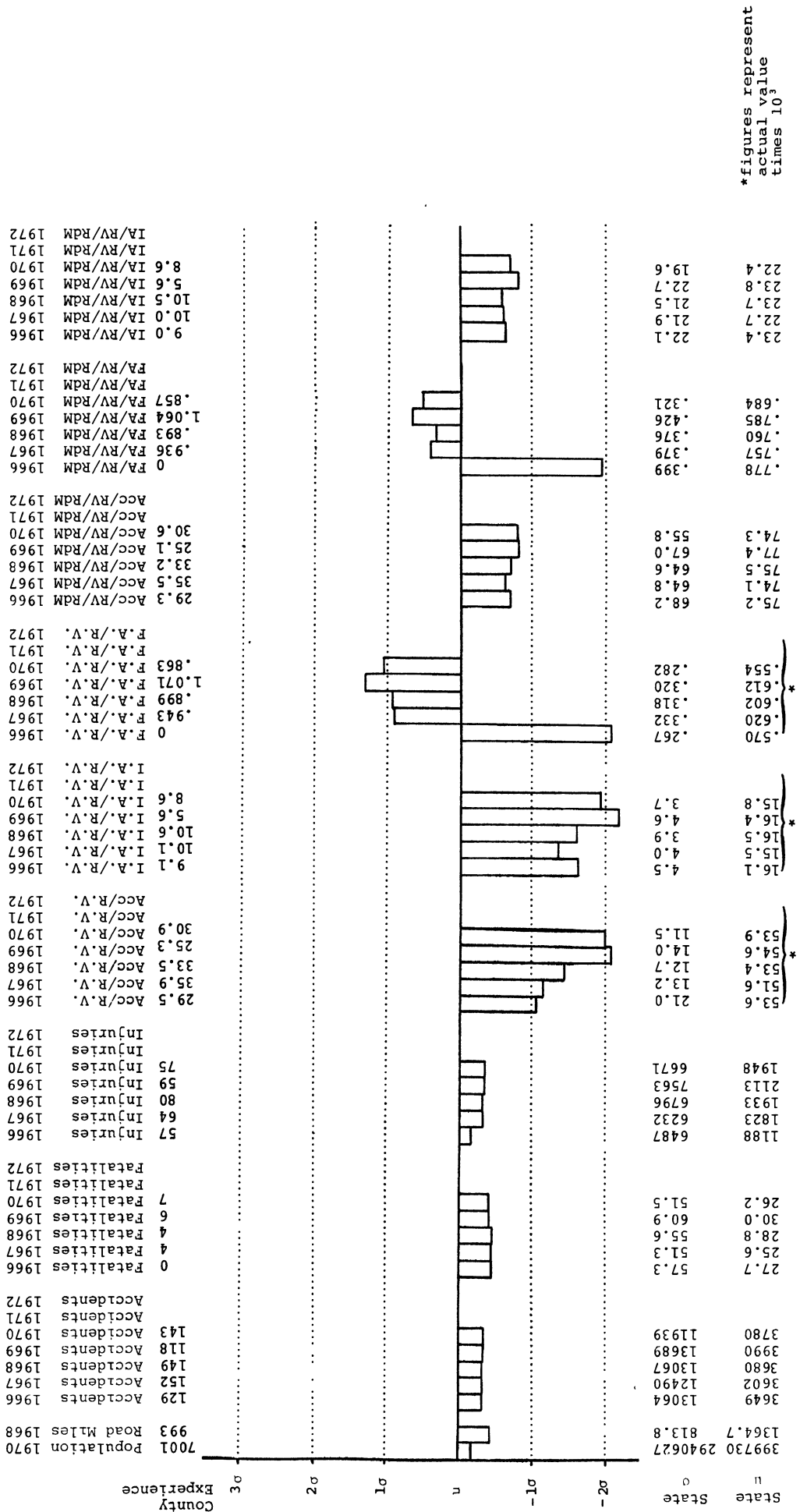
\*figures represent actual value times 10<sup>3</sup>

MIDLAND



\*figures represent actual value times 10<sup>3</sup>

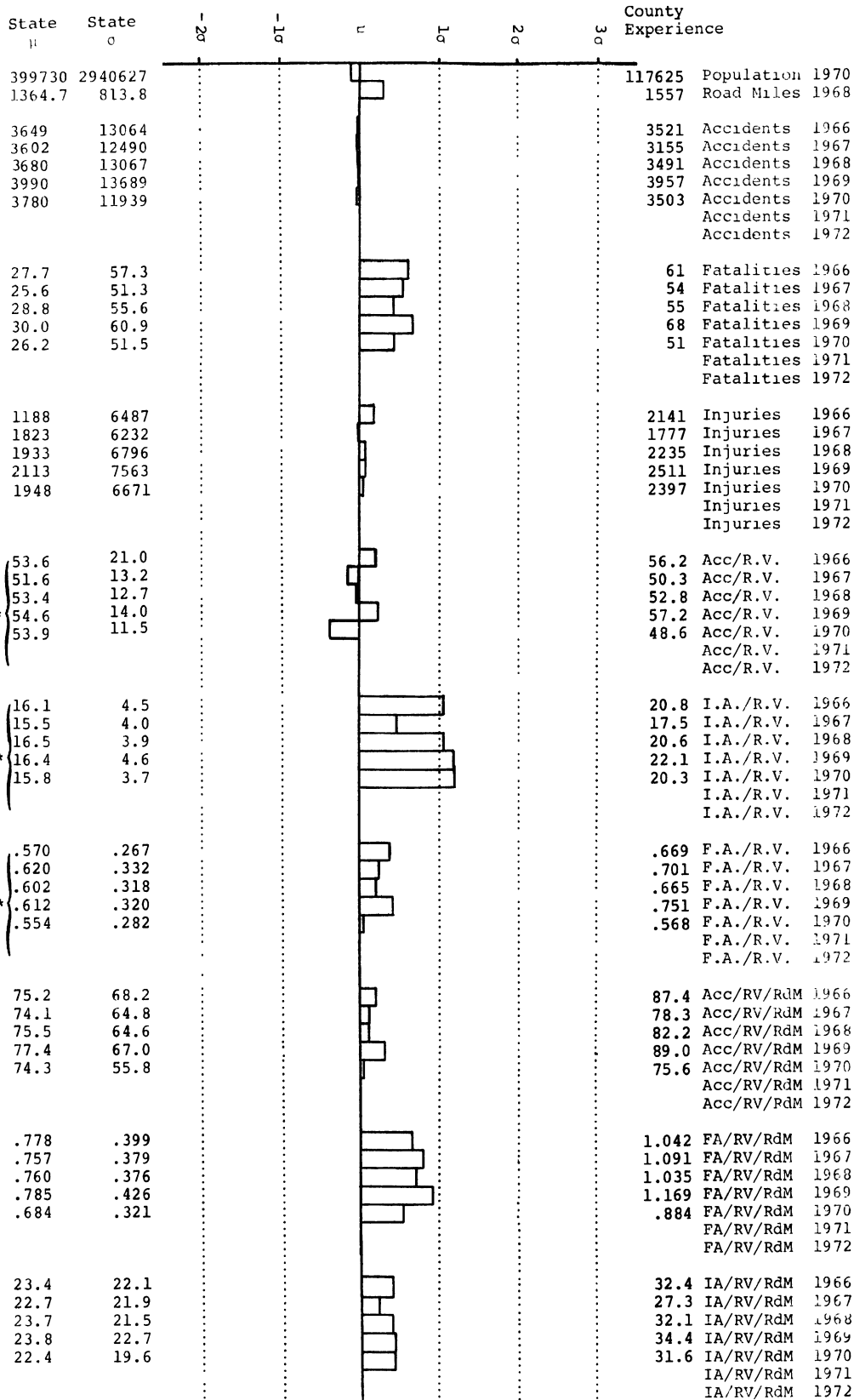
MISSAUKEE



\*figures represent actual value times 10<sup>3</sup>

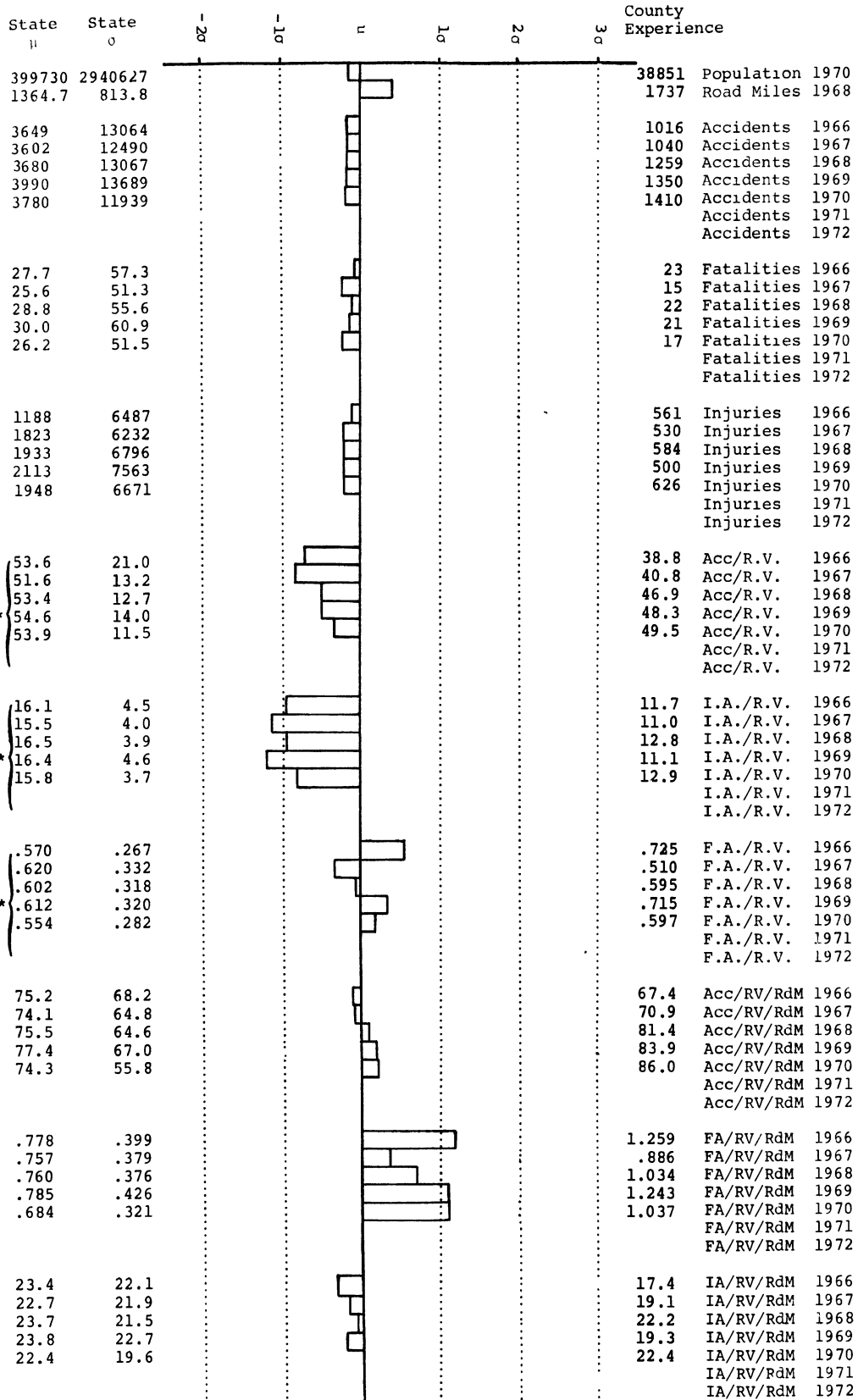


MONROE



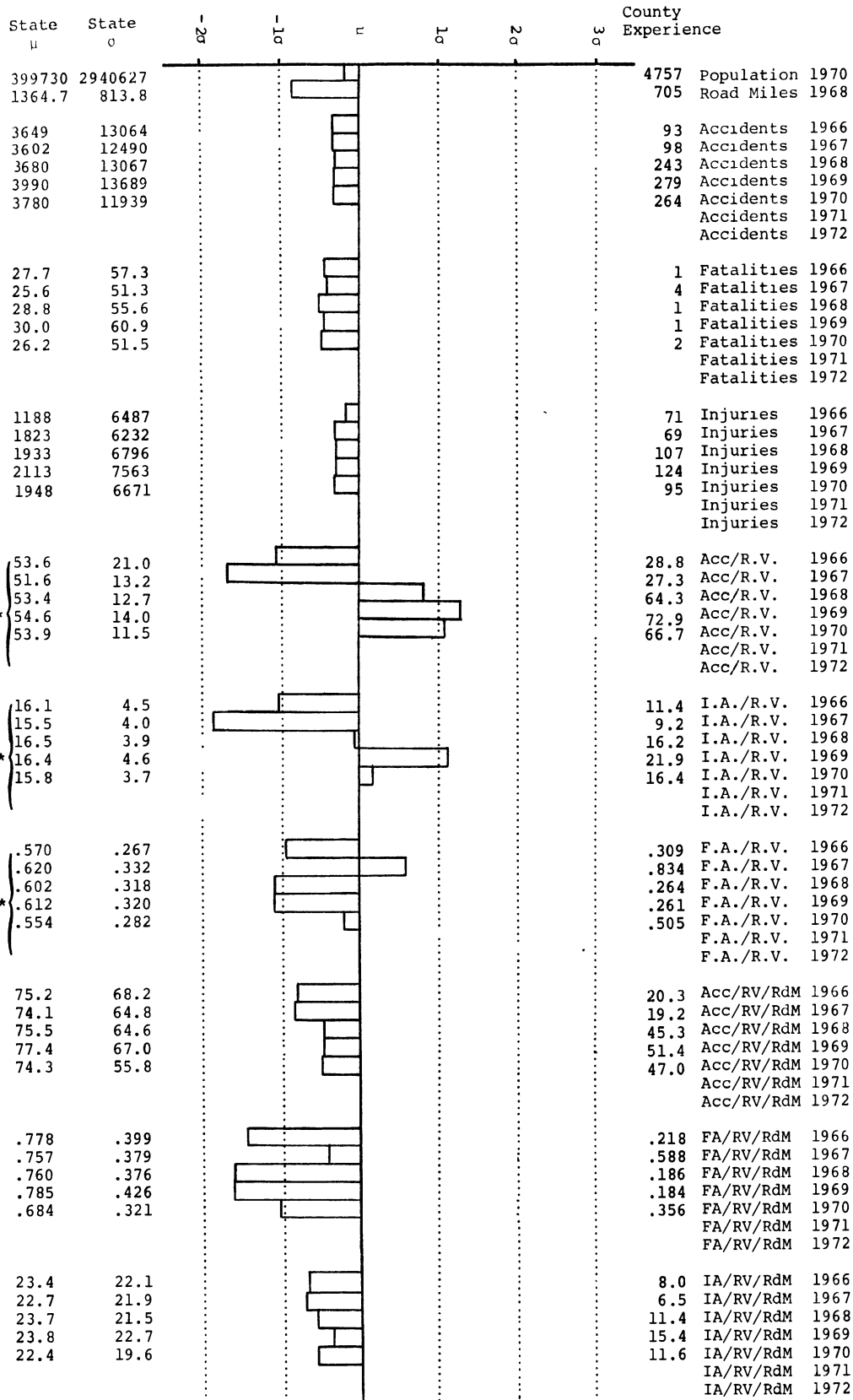
\*figures represent actual value times 10<sup>3</sup>

MONTCALM



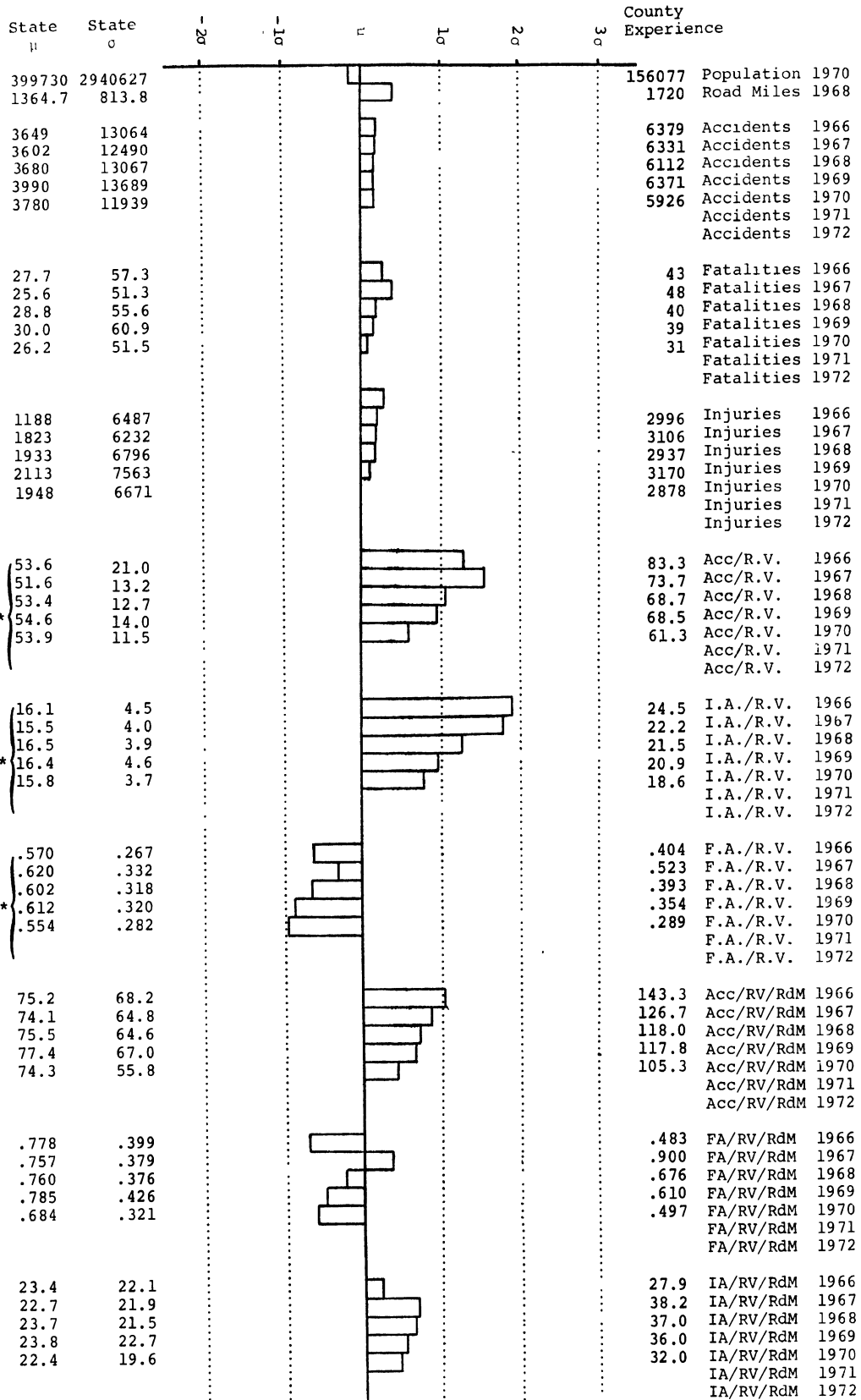
\*Figures represent actual value times 10<sup>3</sup>

MONTMORENCY



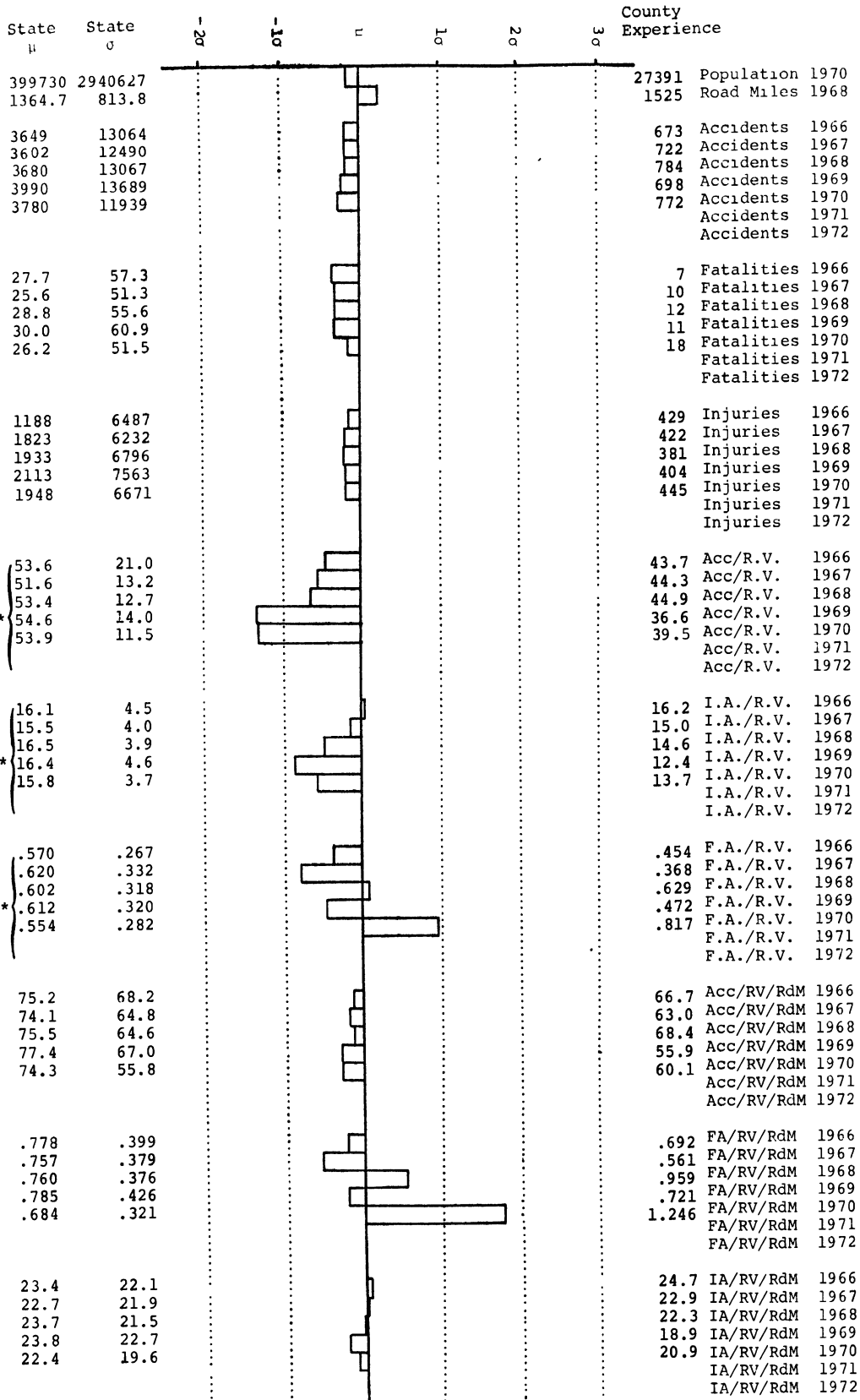
\* Figures represent actual value times 10<sup>3</sup>

MUSKIEGON



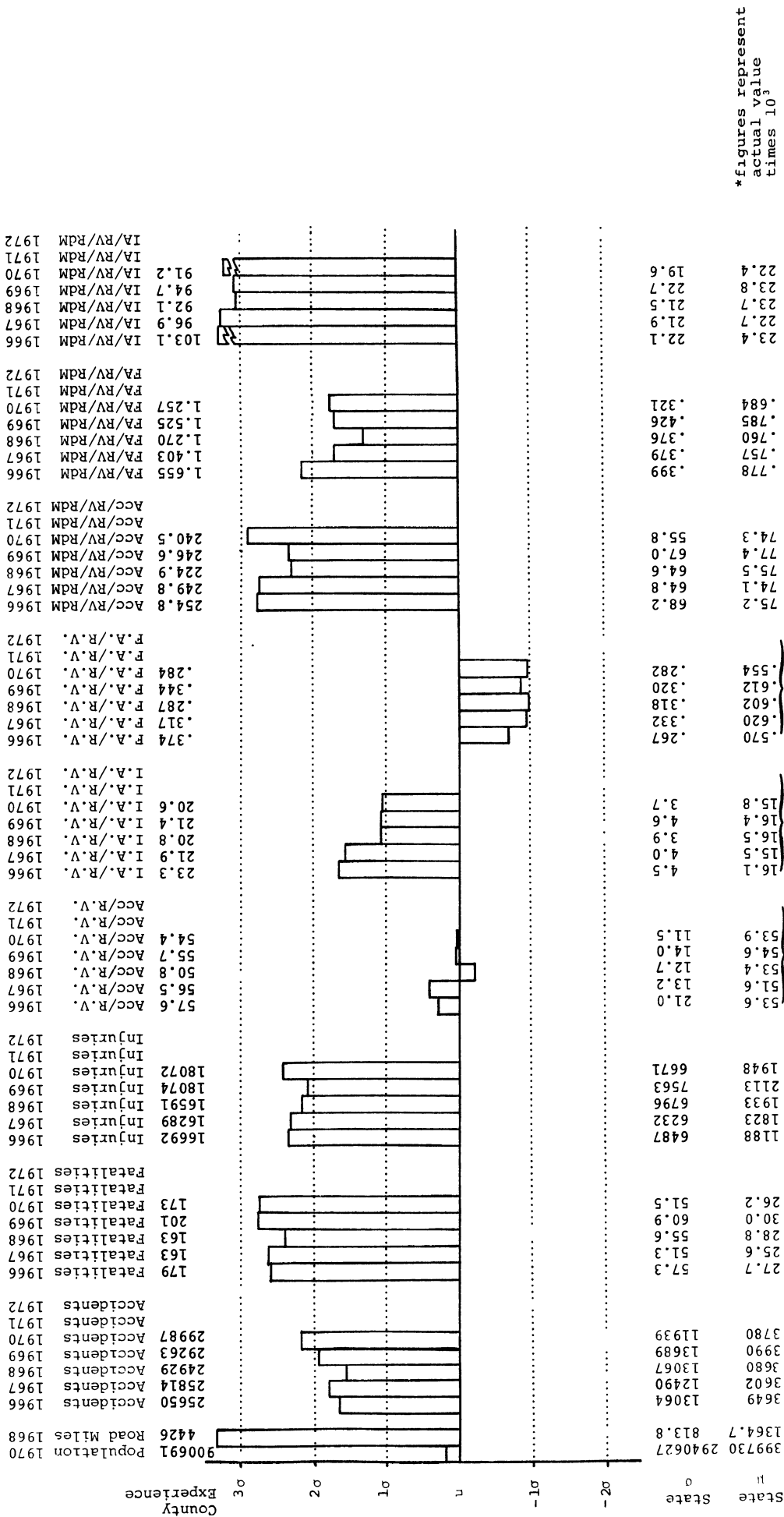
\* Figures represent actual value times 10<sup>3</sup>

NEWAYGO

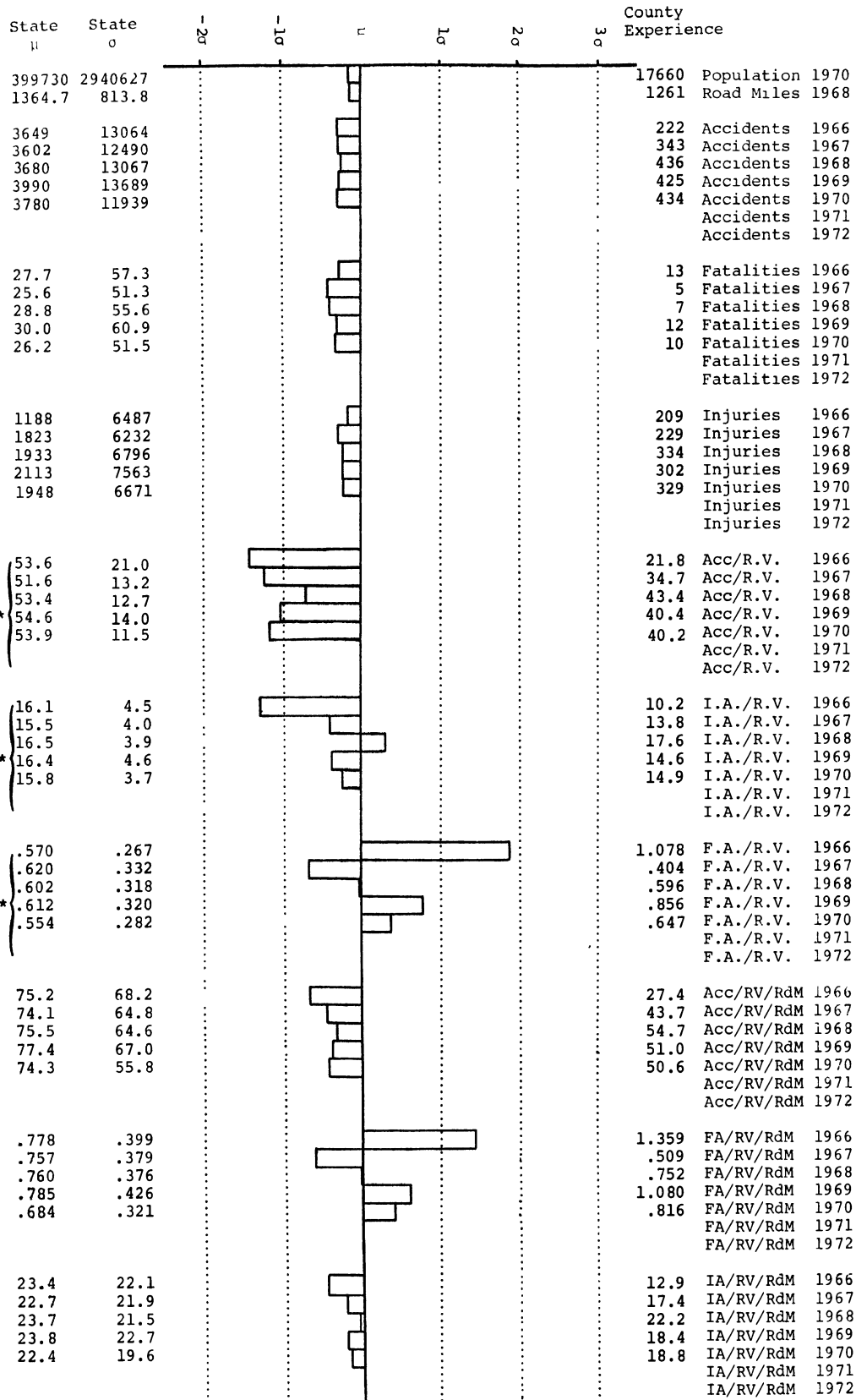


\* Figures represent actual value times .03

OAKLAND

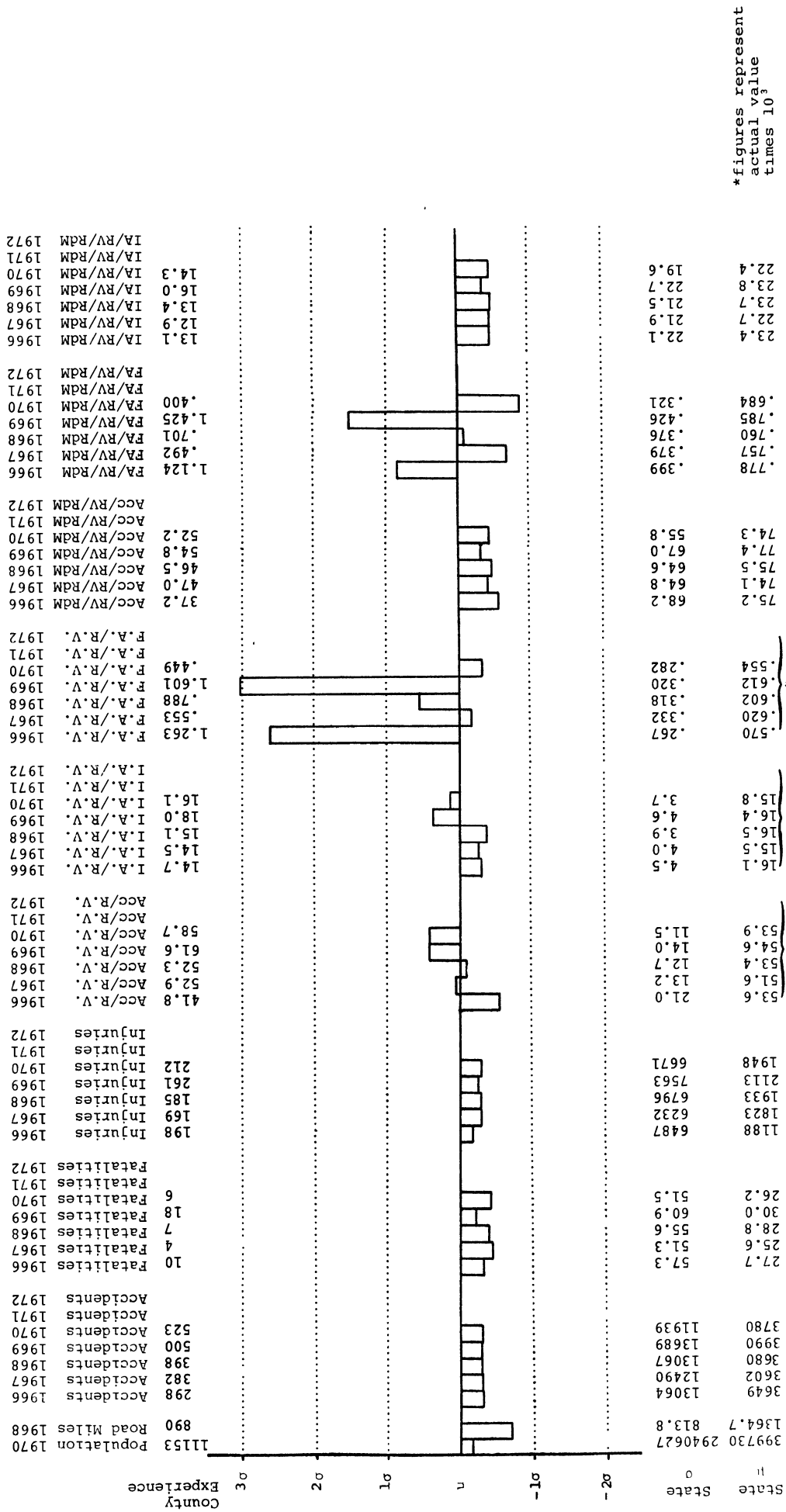


\* figures represent actual value times 10<sup>3</sup>



\* figures represent actual value times 10<sup>3</sup>

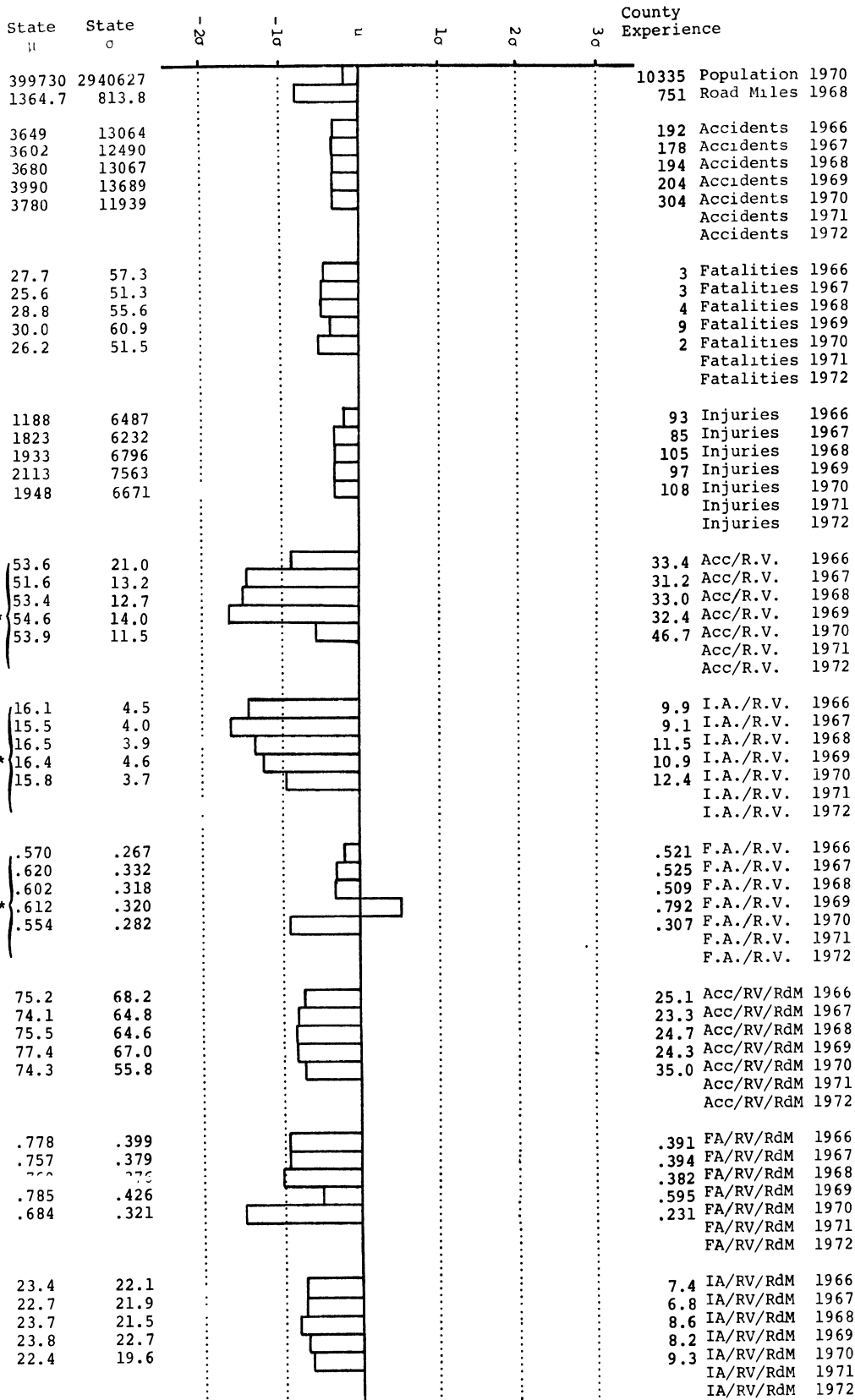
OGEMAW



\* figures represent actual value times 10<sup>3</sup>

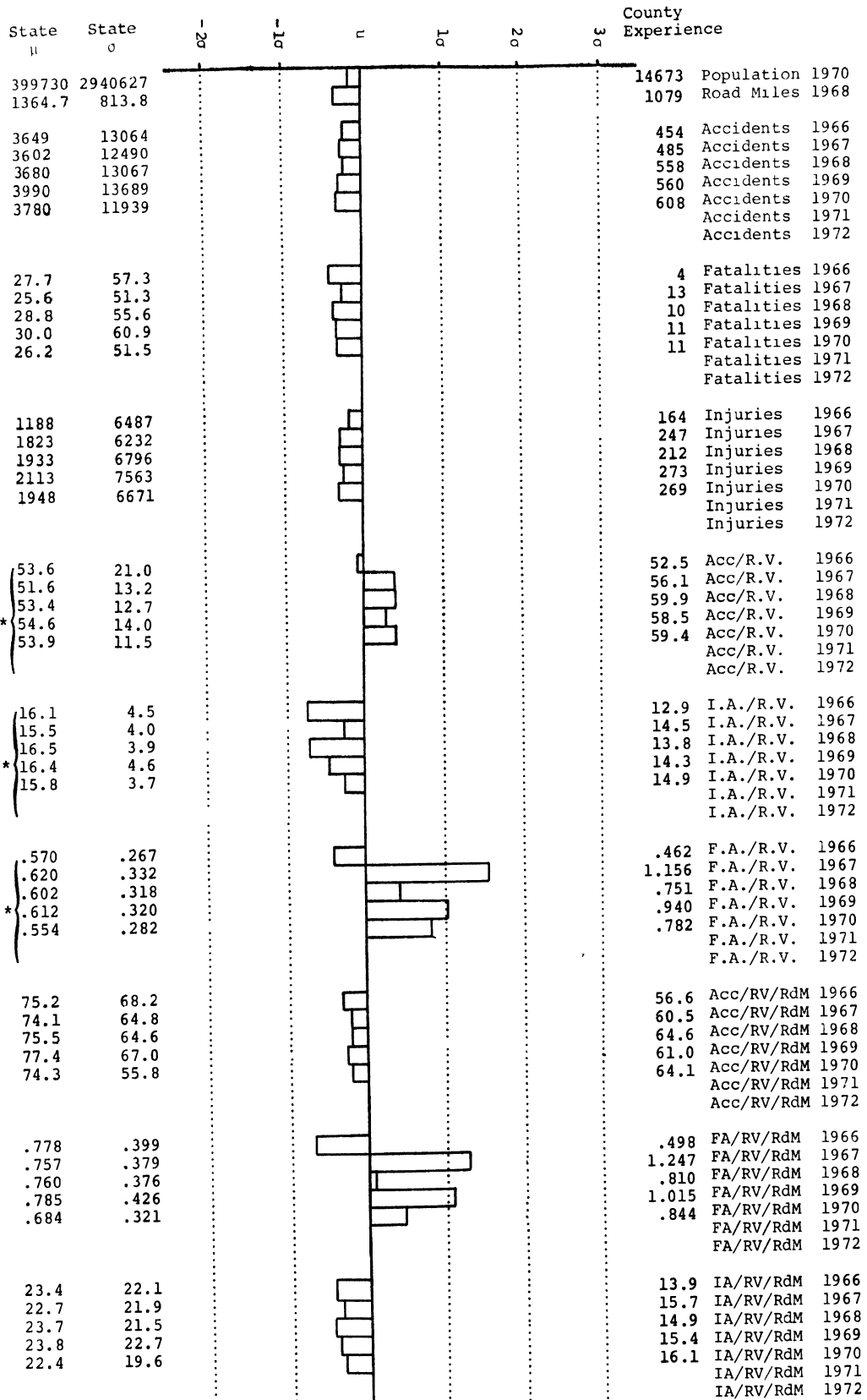


ONTONAGON



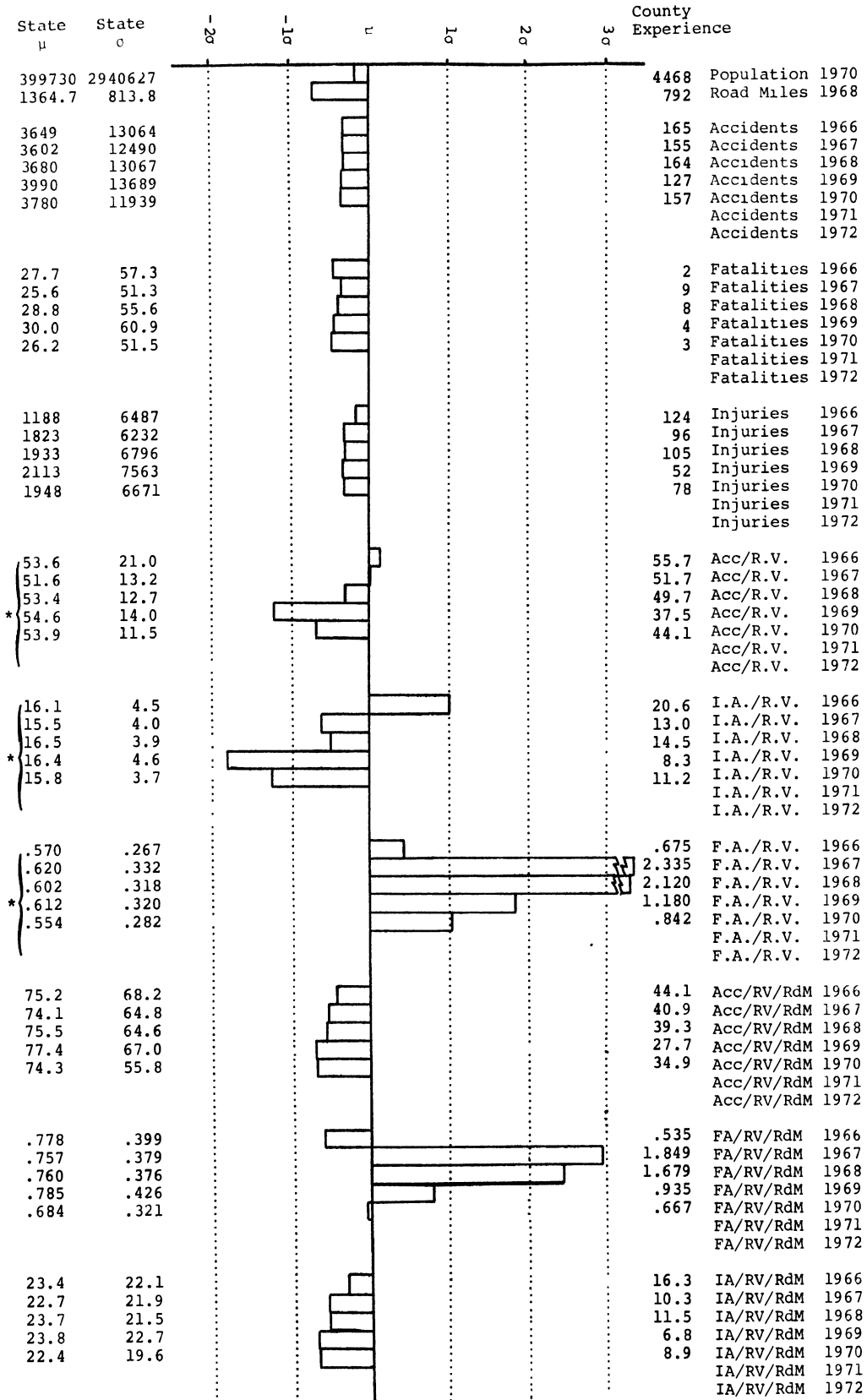
\*Figures represent actual value times 10<sup>3</sup>

001  
OSCEOLA

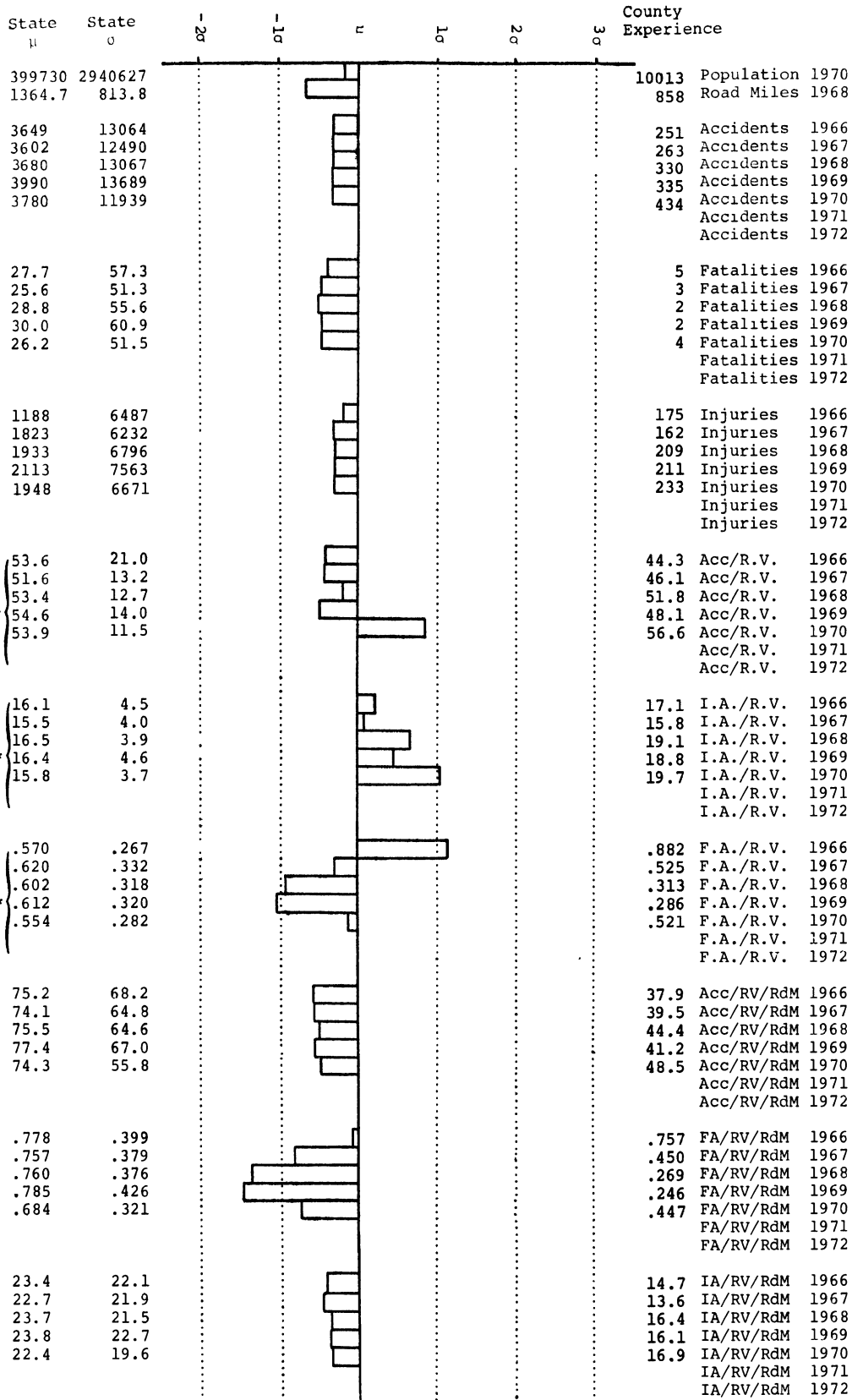


\* figures represent actual value times 10<sup>3</sup>

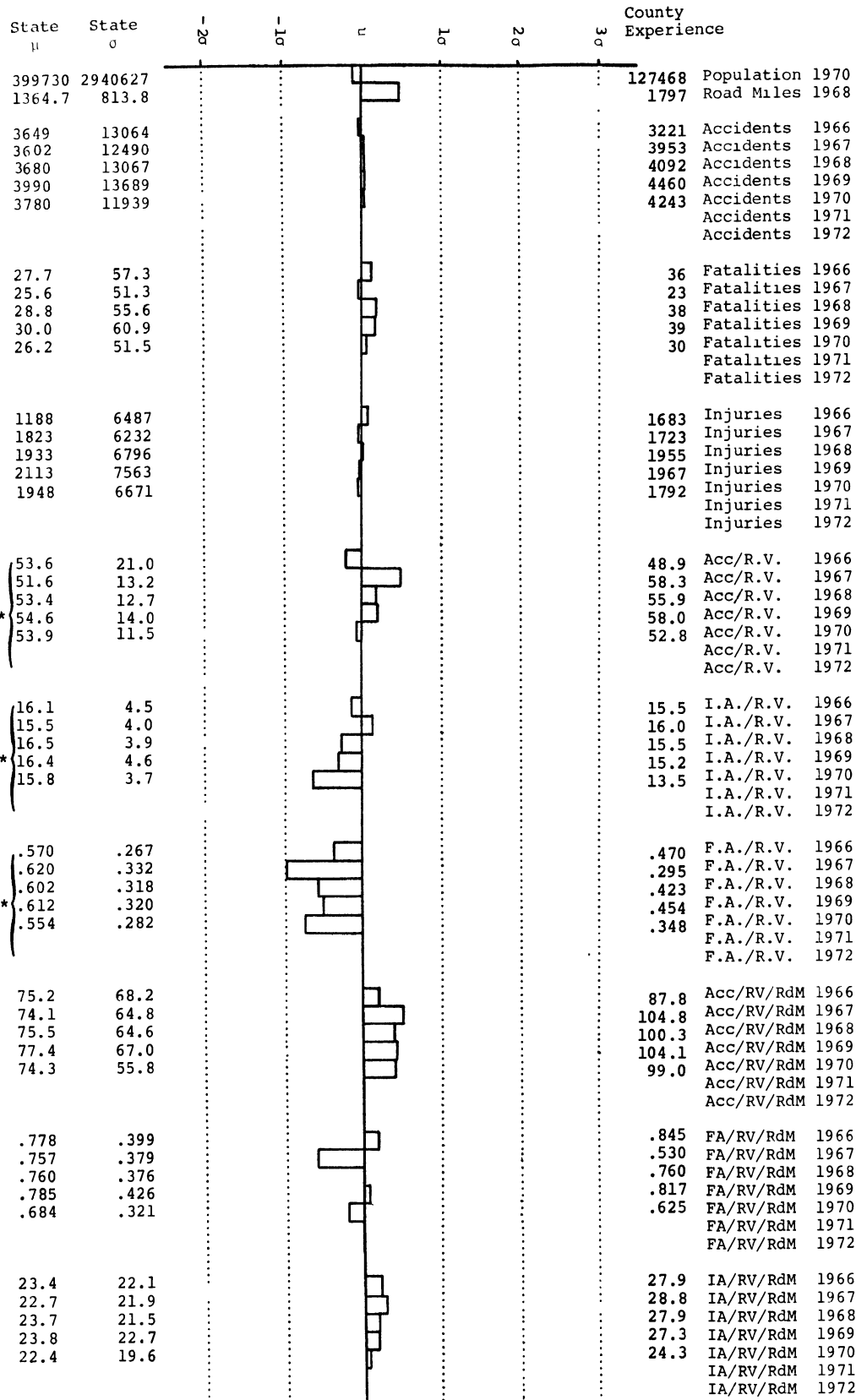
TOT  
ADDCSO



\*figures represent  
actual value  
times 10<sup>3</sup>

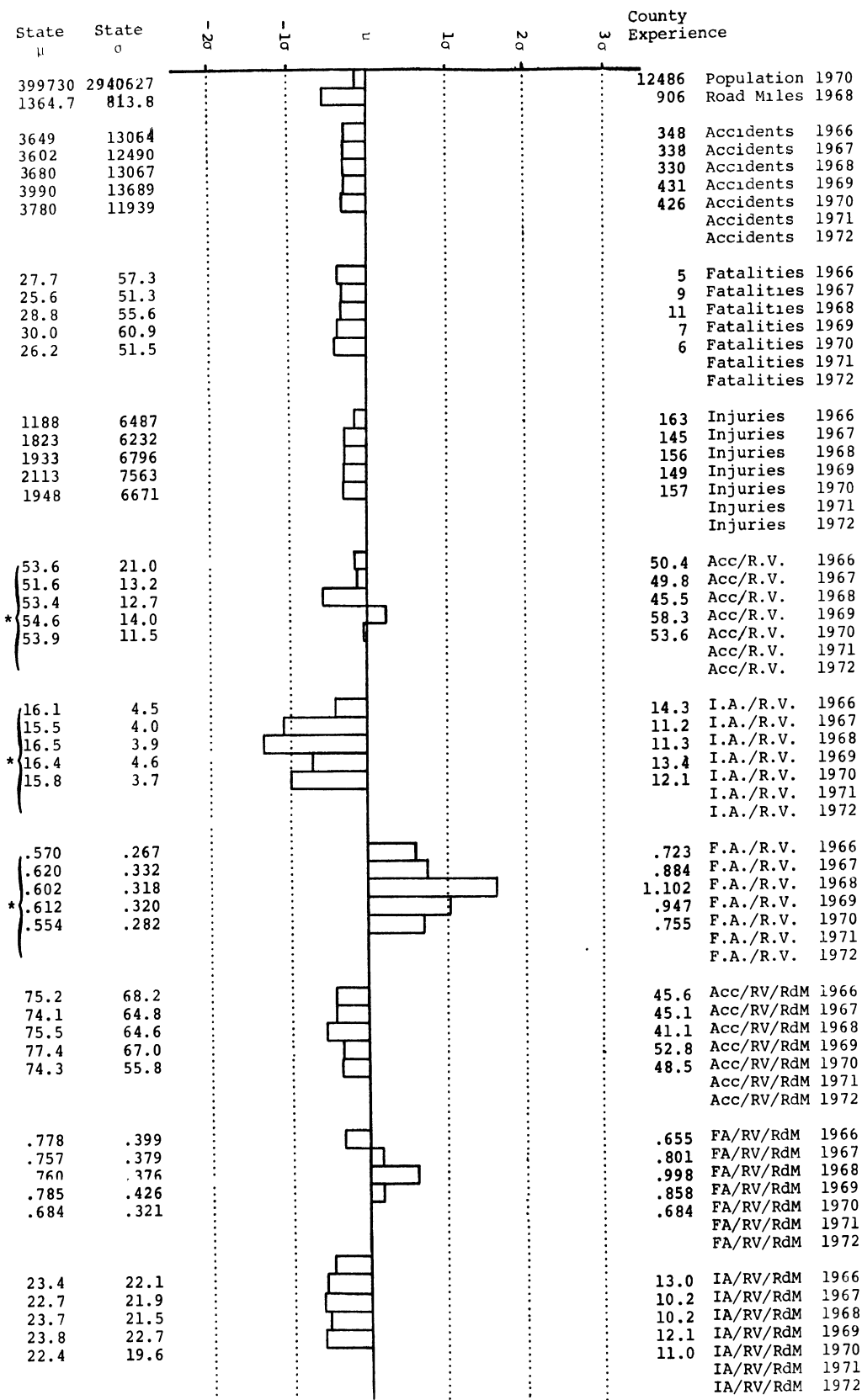


\* Figures represent actual value times 10<sup>3</sup>



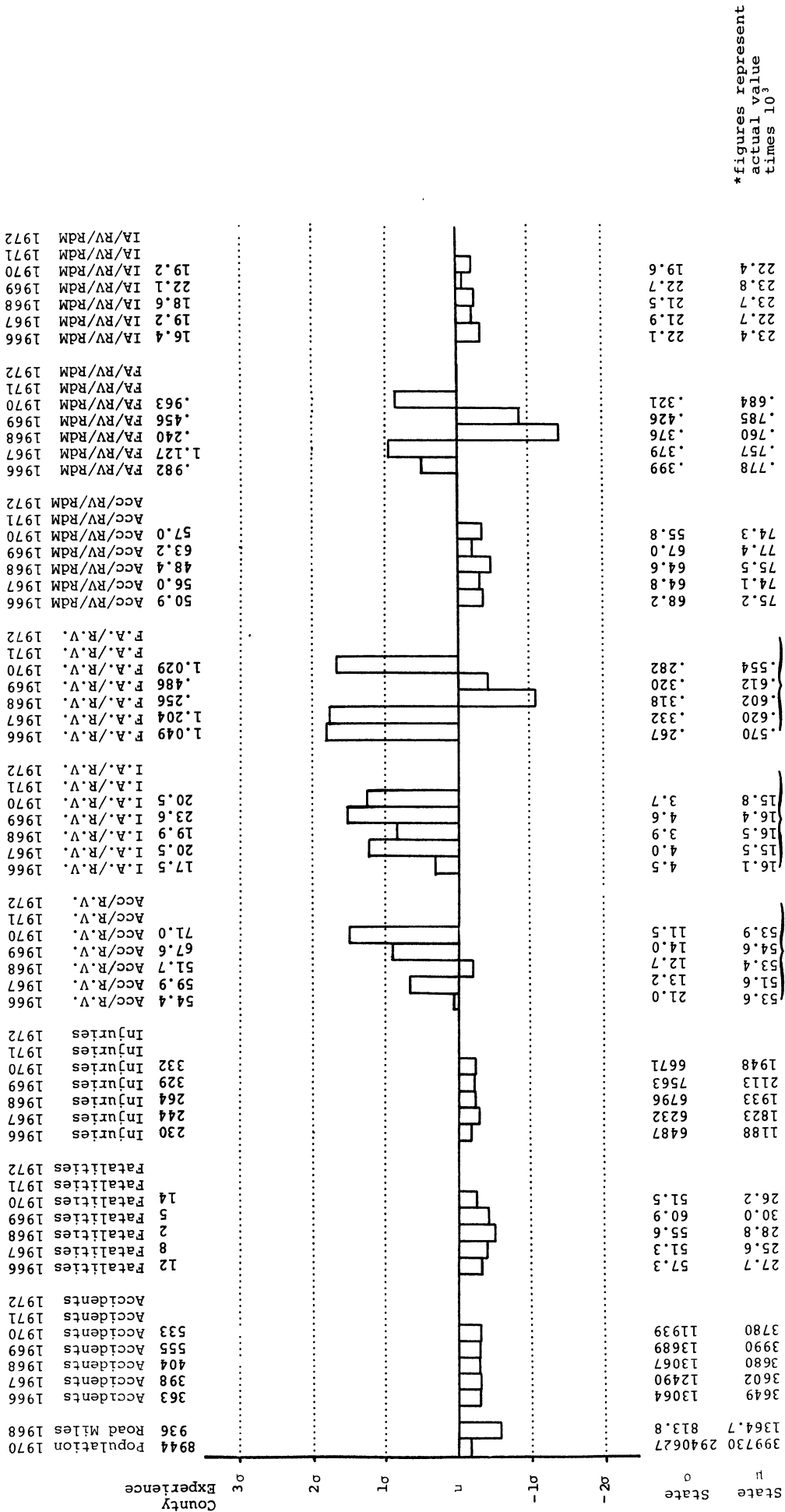
\*figures represent actual value times 10<sup>3</sup>

104  
PRESQUE ISLE



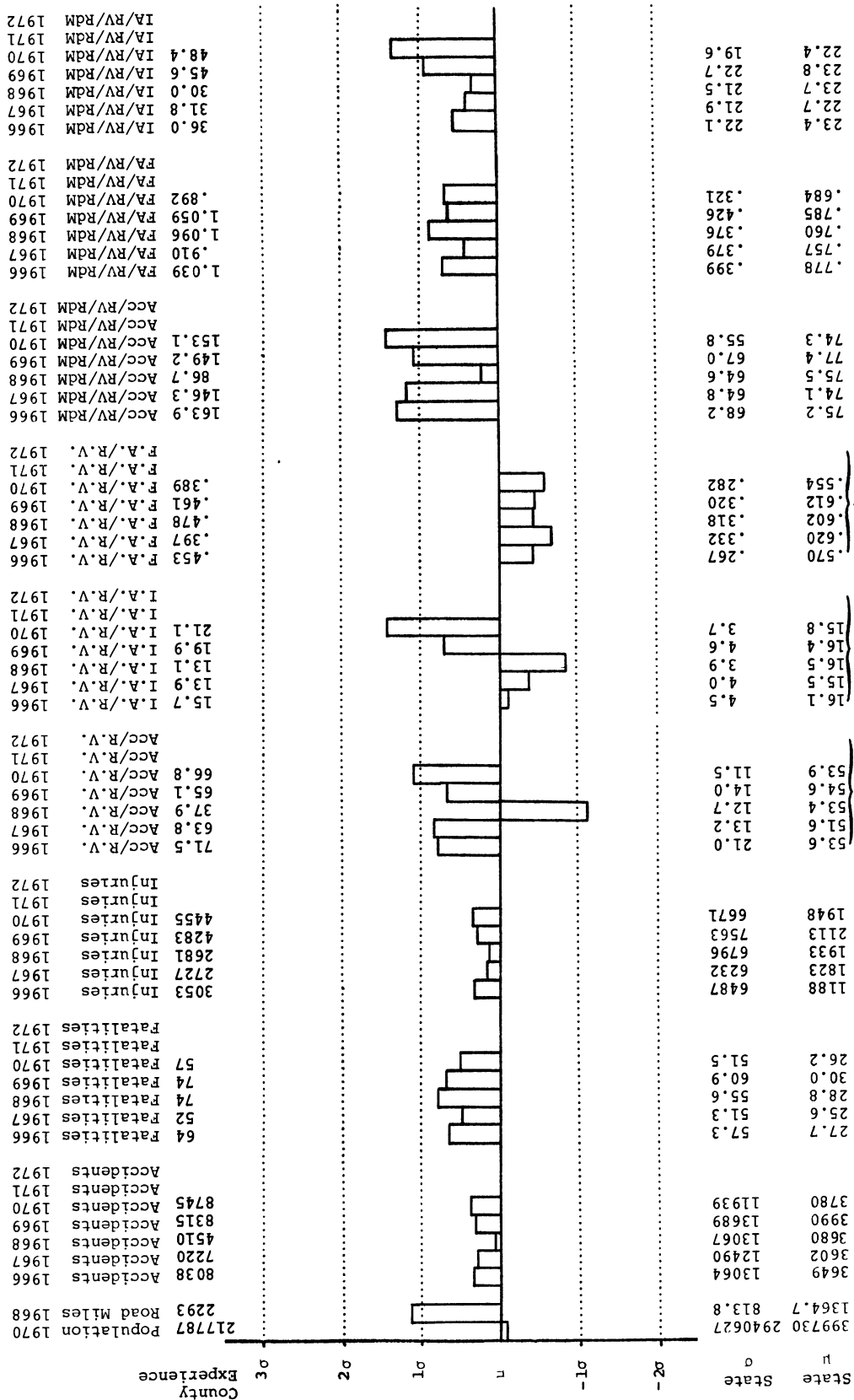
\* Figures represent actual value times 10<sup>3</sup>

ROSCOMMON



\* figures represent actual value times 10<sup>3</sup>

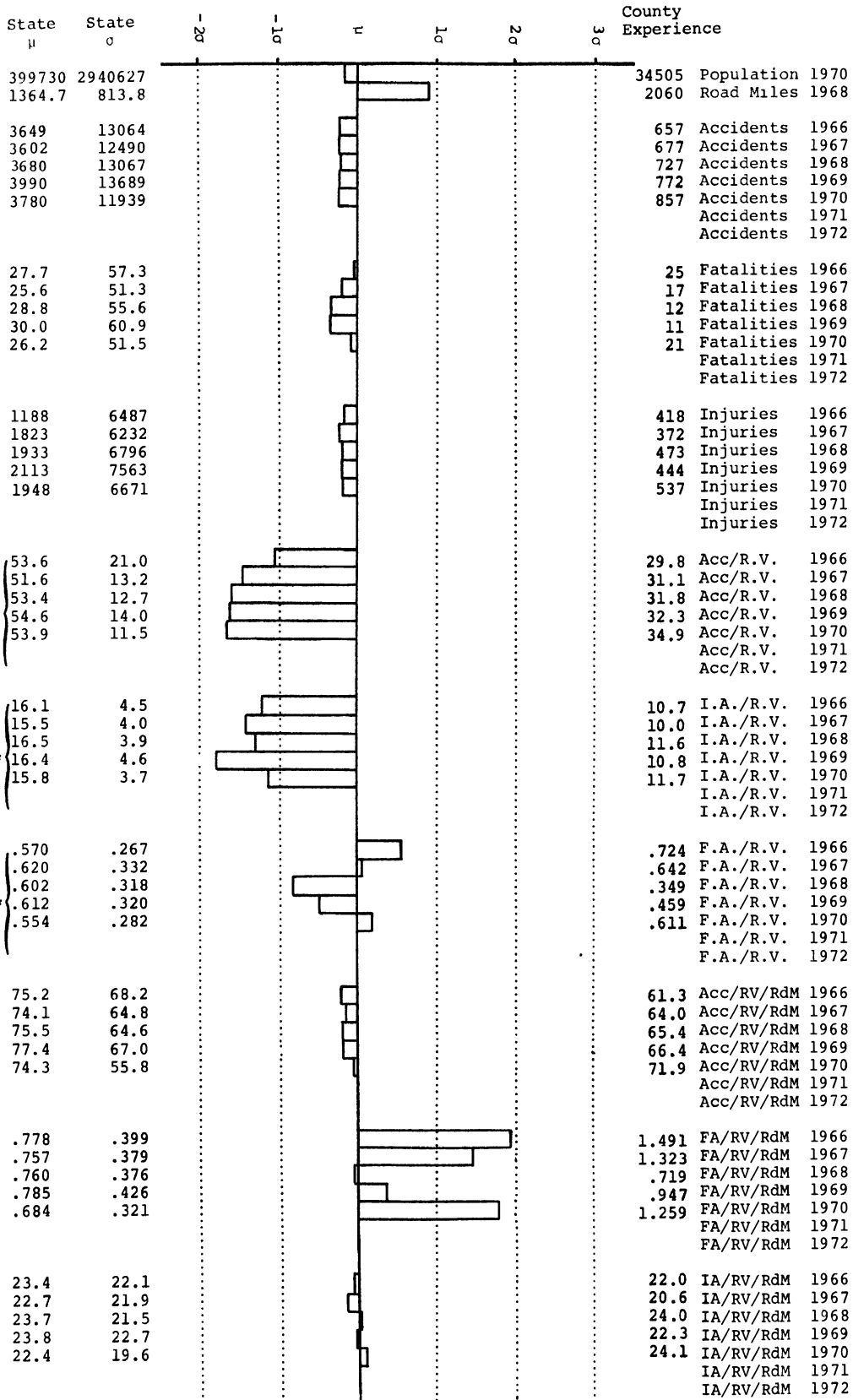
SAGINAW



\* figures represent actual value times 10<sup>3</sup>

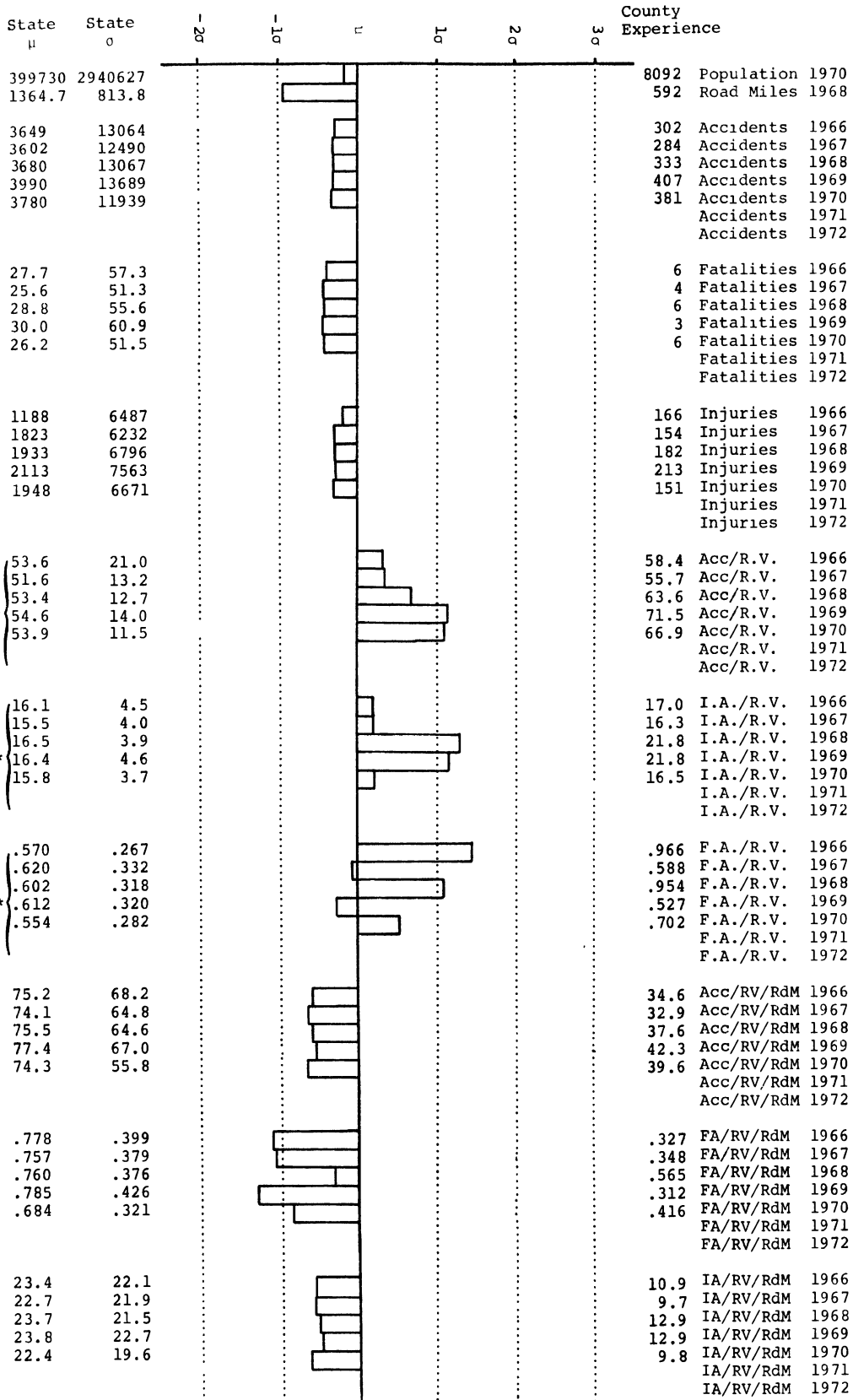


SANILAC



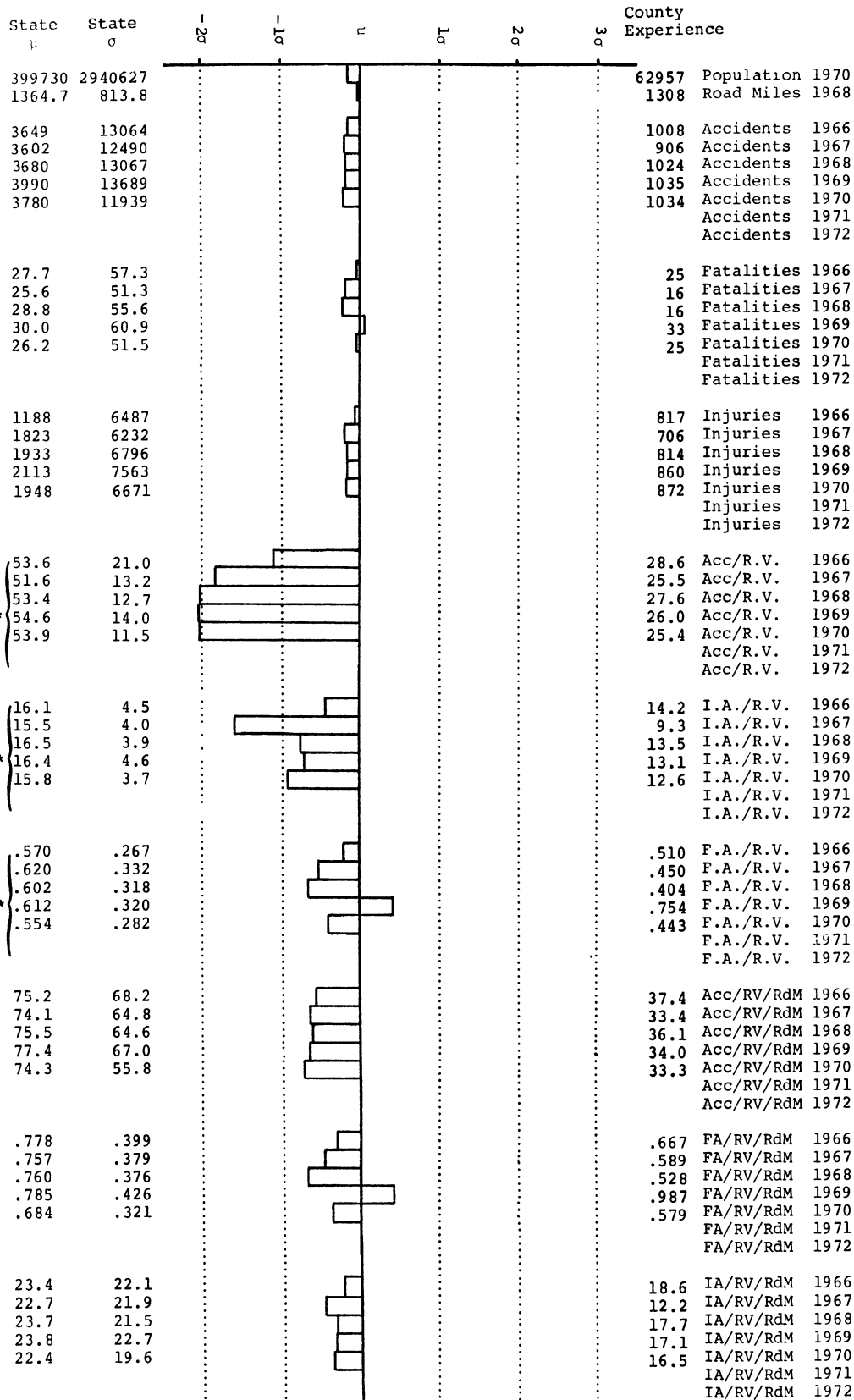
\*figures represent actual value times 10<sup>3</sup>

SCHOOLCRAFT



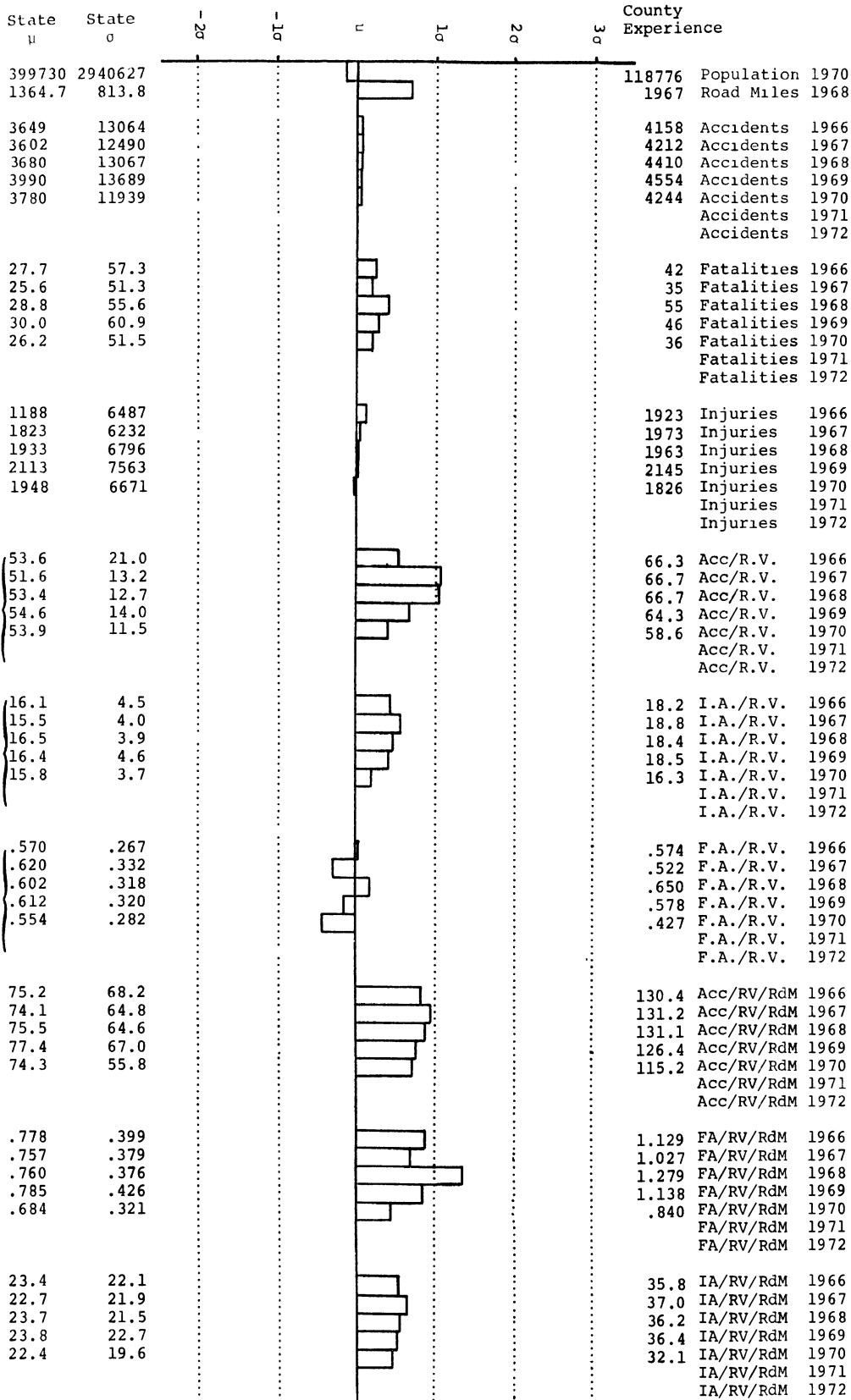
\*figures represent actual value times 10<sup>3</sup>

## SHAWASSEE



\*figures represent  
actual value  
times 10<sup>3</sup>

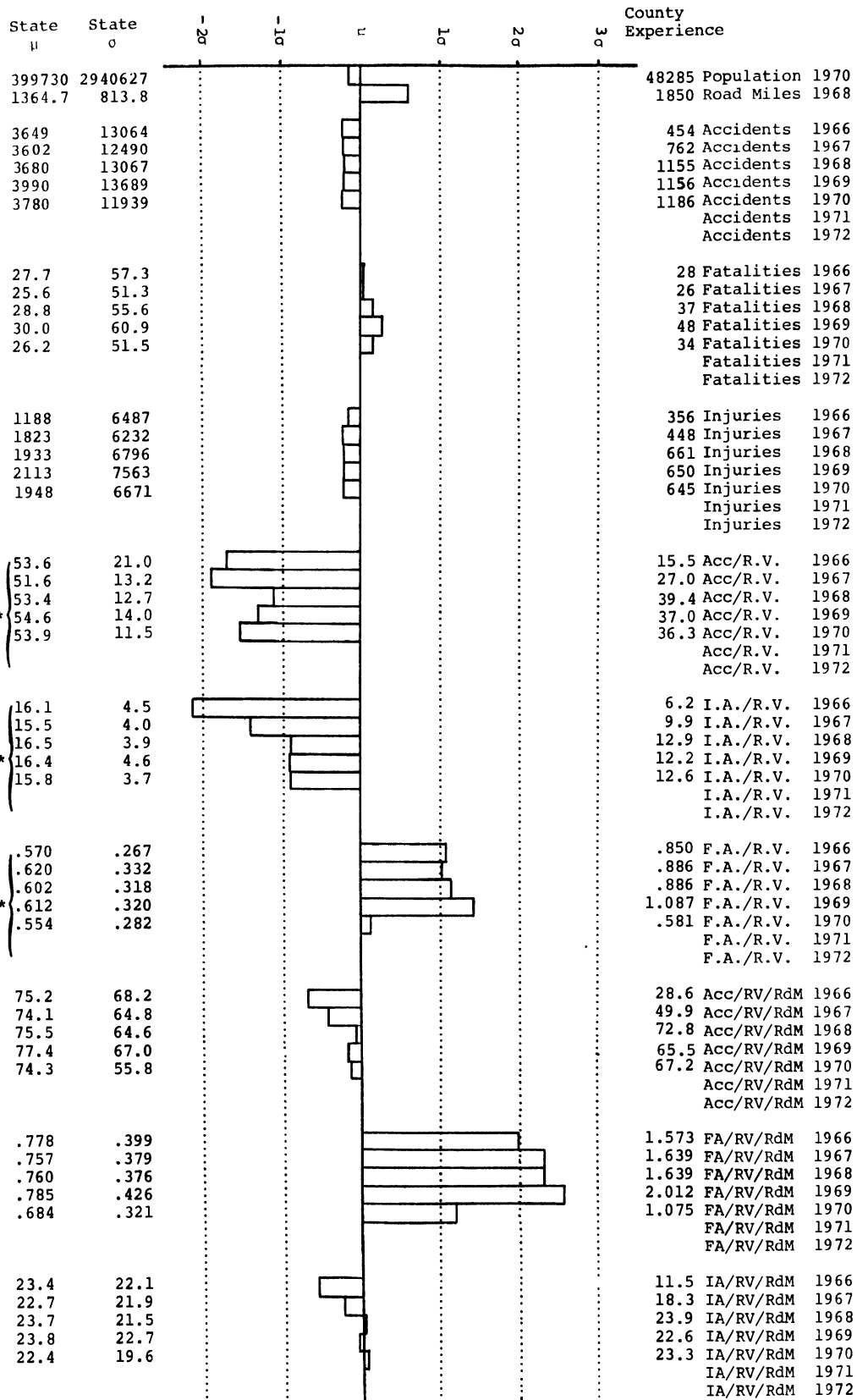
ST. CLAIR



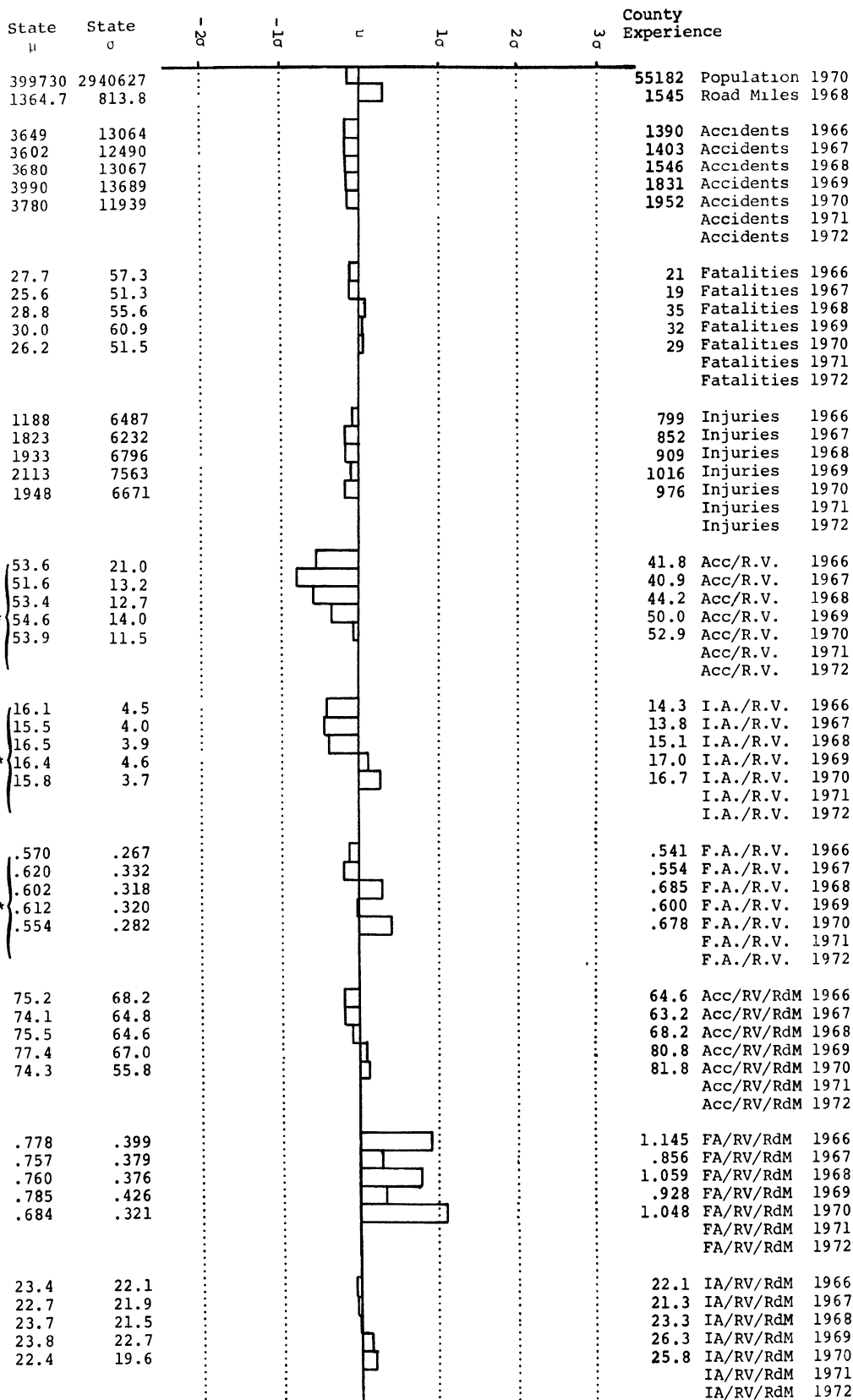
\* Figures represent actual value times 10<sup>3</sup>

State u	State o	-2σ	-1σ	u	1σ	2σ	3σ	County Experience
399730	2940627							46713 Population 1970
1364.7	813.8							1280 Road Miles 1968
3649	13064							1379 Accidents 1966
3602	12490							1447 Accidents 1967
3680	13067							1703 Accidents 1968
3990	13689							1857 Accidents 1969
3780	11939							1848 Accidents 1970
								Accidents 1971
								Accidents 1972
27.7	57.3							13 Fatalities 1966
25.6	51.3							26 Fatalities 1967
28.8	55.6							32 Fatalities 1968
30.0	60.9							14 Fatalities 1969
26.2	51.5							23 Fatalities 1970
								Fatalities 1971
								Fatalities 1972
1188	6487							626 Injuries 1966
1823	6232							661 Injuries 1967
1933	6796							849 Injuries 1968
2113	7563							829 Injuries 1969
1948	6671							859 Injuries 1970
								Injuries 1971
								Injuries 1972
53.6	21.0							45.5 Acc/R.V. 1966
51.6	13.2							47.3 Acc/R.V. 1967
53.4	12.7							54.1 Acc/R.V. 1968
* 54.6	14.0							57.2 Acc/R.V. 1969
53.9	11.5							55.3 Acc/R.V. 1970
								Acc/R.V. 1971
								Acc/R.V. 1972
16.1	4.5							12.5 I.A./R.V. 1966
15.5	4.0							13.2 I.A./R.V. 1967
16.5	3.9							15.6 I.A./R.V. 1968
* 16.4	4.6							16.2 I.A./R.V. 1969
15.8	3.7							15.7 I.A./R.V. 1970
								I.A./R.V. 1971
								I.A./R.V. 1972
.570	.267							.396 F.A./R.V. 1966
.620	.332							.752 F.A./R.V. 1967
.602	.318							.794 F.A./R.V. 1968
* .612	.320							.400 F.A./R.V. 1969
.554	.282							.538 F.A./R.V. 1970
								F.A./R.V. 1971
								F.A./R.V. 1972
75.2	68.2							58.3 Acc/RV/RdM 1966
74.1	64.8							60.5 Acc/RV/RdM 1967
75.5	64.6							69.3 Acc/RV/RdM 1968
77.4	67.0							73.3 Acc/RV/RdM 1969
74.3	55.8							70.8 Acc/RV/RdM 1970
								Acc/RV/RdM 1971
								Acc/RV/RdM 1972
.778	.399							.507 FA/RV/RdM 1966
.757	.379							.963 FA/RV/RdM 1967
.760	.376							1.016 FA/RV/RdM 1968
.785	.426							.513 FA/RV/RdM 1969
.684	.321							.689 FA/RV/RdM 1970
								FA/RV/RdM 1971
								FA/RV/RdM 1972
23.4	22.1							16.0 IA/RV/RdM 1966
22.7	21.9							16.9 IA/RV/RdM 1967
23.7	21.5							20.0 IA/RV/RdM 1968
23.8	22.7							20.7 IA/RV/RdM 1969
22.4	19.6							20.1 IA/RV/RdM 1970
								IA/RV/RdM 1971
								IA/RV/RdM 1972

\*figures represent actual value times 10<sup>3</sup>

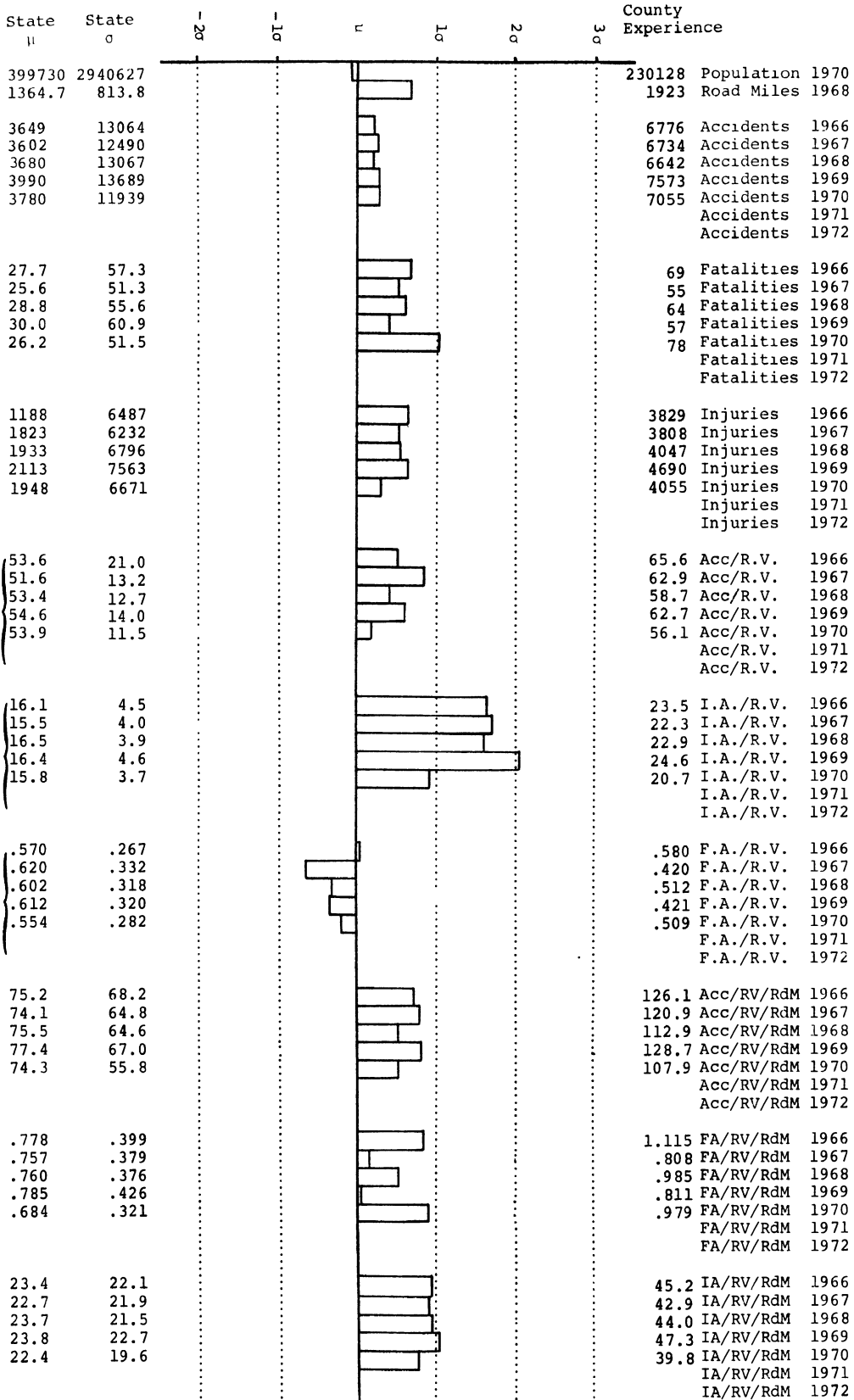


\* Figures represent actual value times 10<sup>3</sup>



\* Figures represent actual value times 10<sup>3</sup>

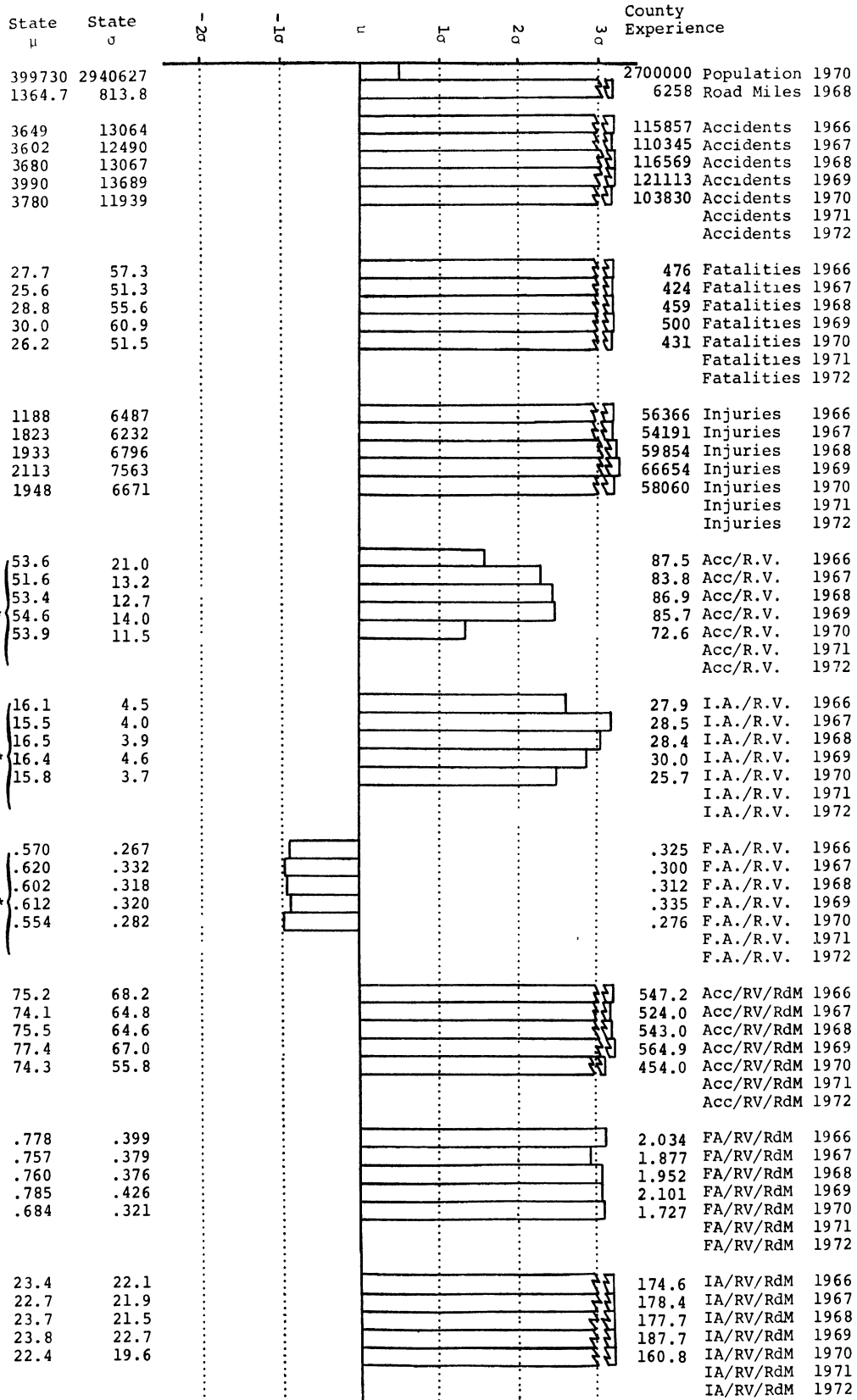
WASHTEANM



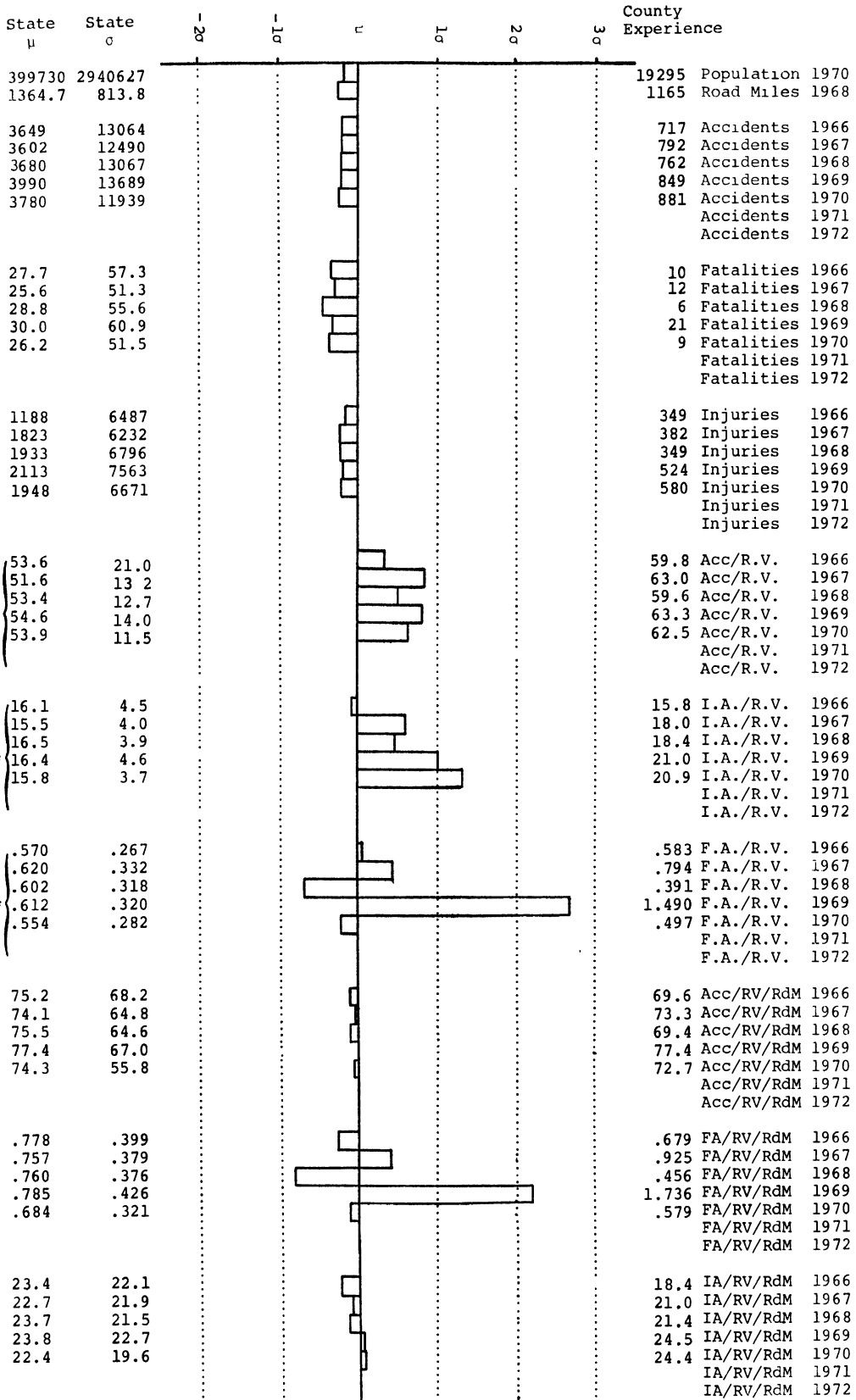
\*figures represent actual value times 10<sup>3</sup>



WAYNE



\*figures represent actual value times 10<sup>3</sup>



\*figures represent actual value times 10<sup>3</sup>

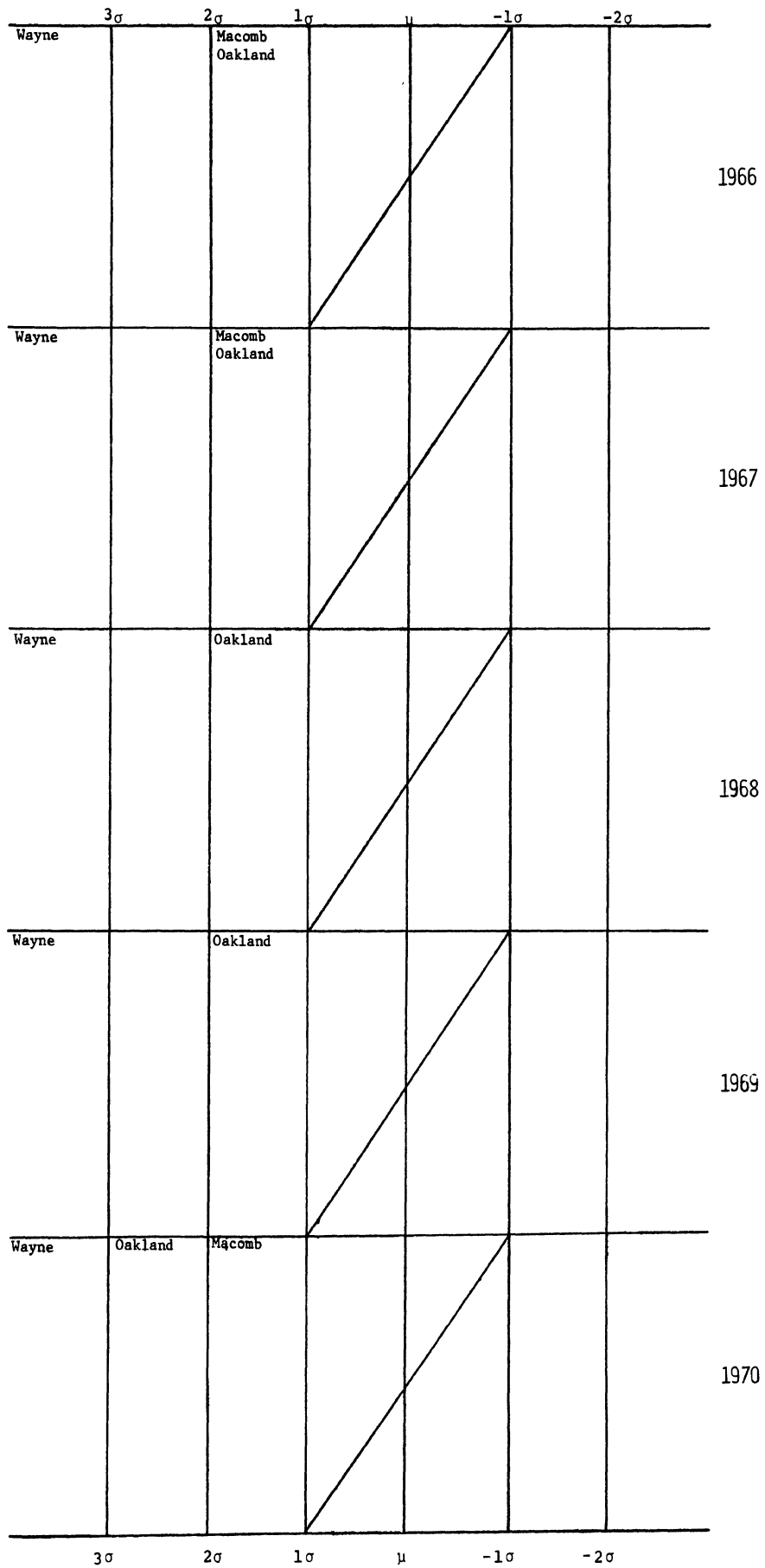
## APPENDIX II

### KEYS FOR COUNTIES DEVIATING FROM THE STATE MEAN

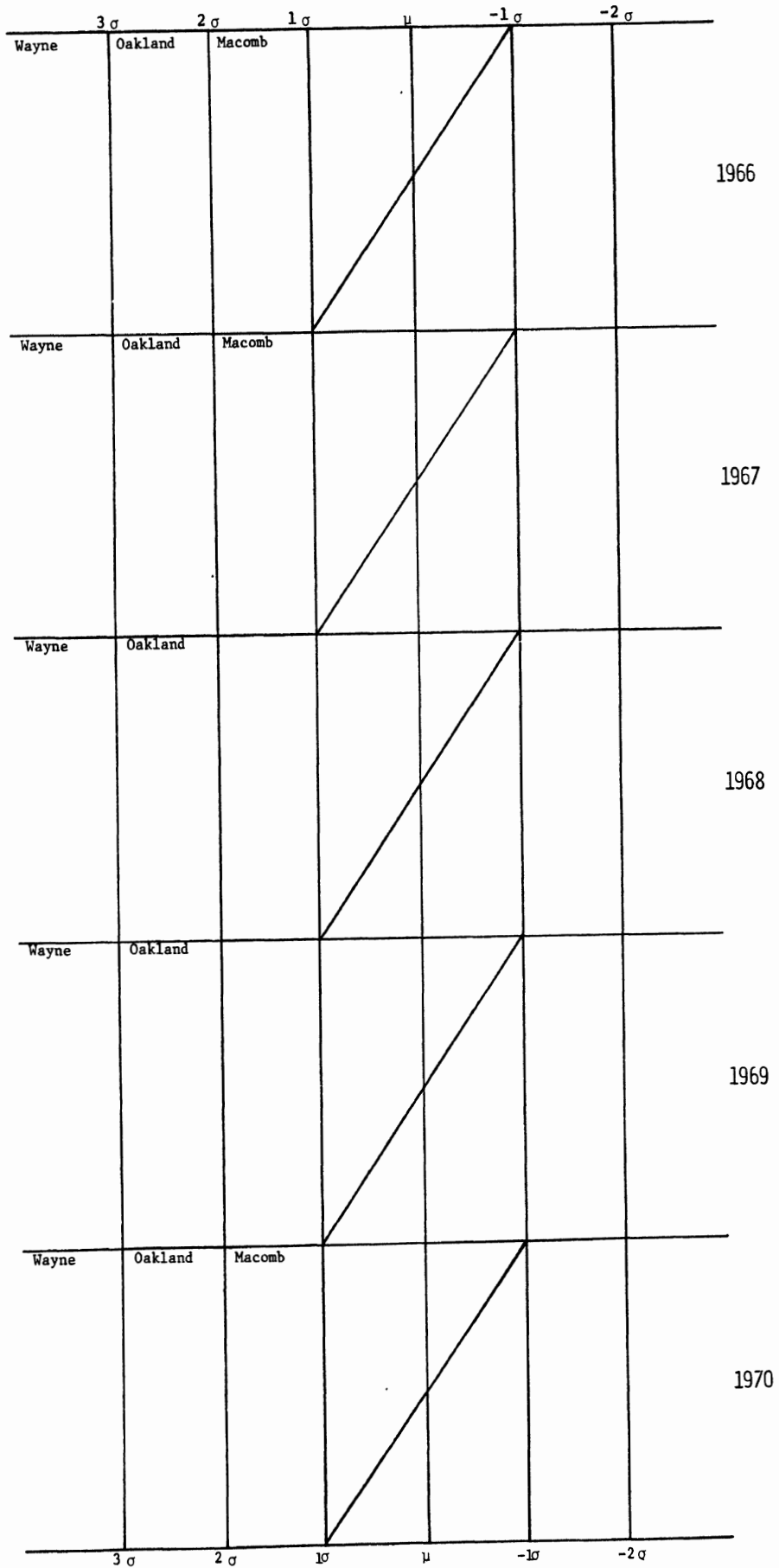
Included in this appendix are keys for each of the plotted variables listing counties above and below one standard deviation from the State mean. Those counties that lie within one standard deviation of the mean are not included since these are not of principal interest for discerning the "good" and "bad" counties. These keys simply list counties based on the profiles of Appendix I to assist in interpreting those graphs. For example, if one were interested in those counties that have significantly more accidents than the average for the State one could look in Appendix I at each and every county graph or simply turn to the key herein for that variable and find Wayne, Oakland, and Macomb counties have more accidents than other counties. Examination of this key shows Wayne is the "worst" county for this criterion, while Oakland and Macomb are better but still above the State  $\mu$ .

In general, then, going from left to right on these keys reveals counties distributed from "worst" to "best." Also, how a county shifts in position from top to bottom on the time dimension gives an indication of experience trend over the five years covered. Appendix III shows that trend information more explicitly.

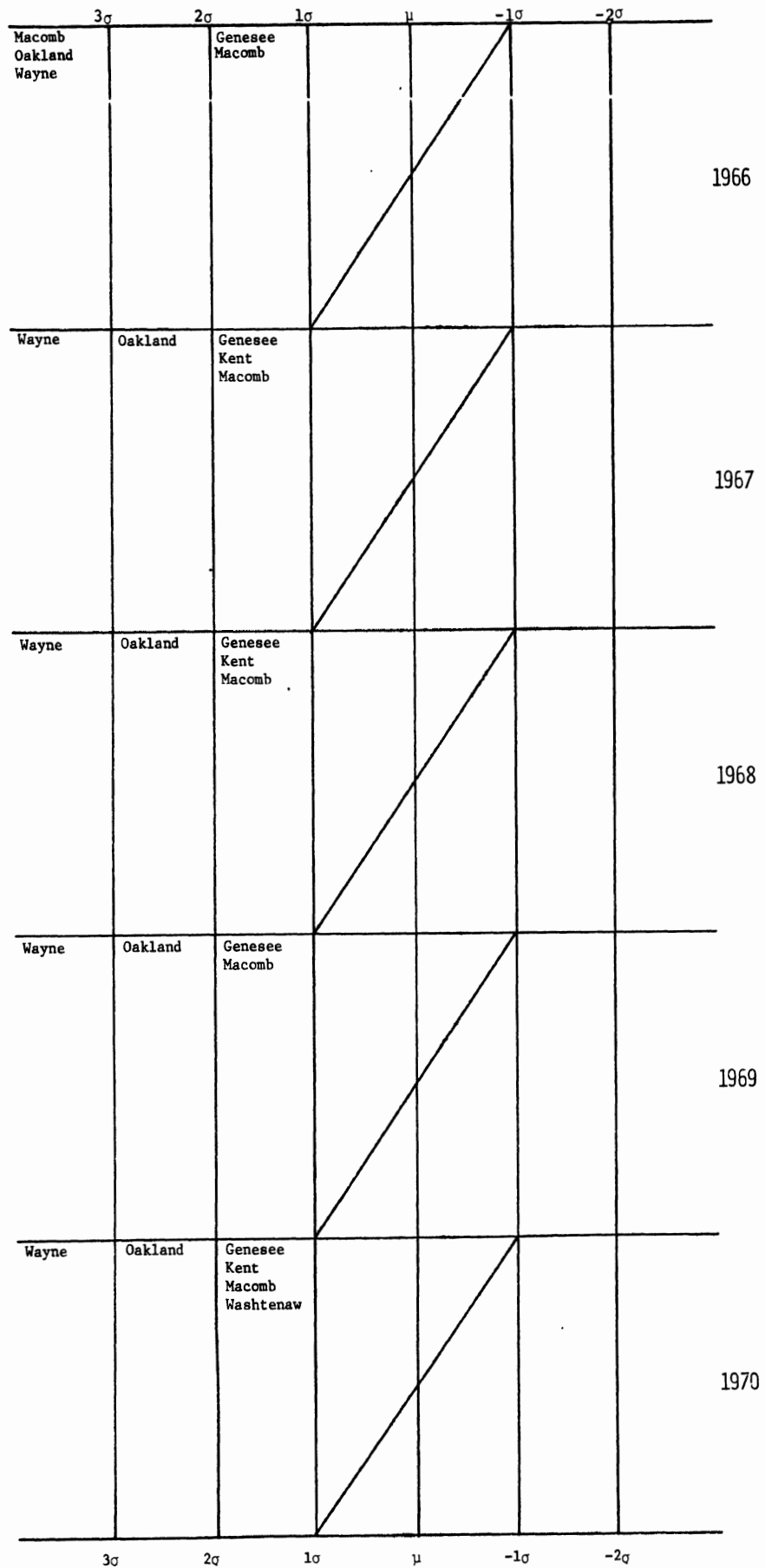
# ACCIDENTS



# INJURIES



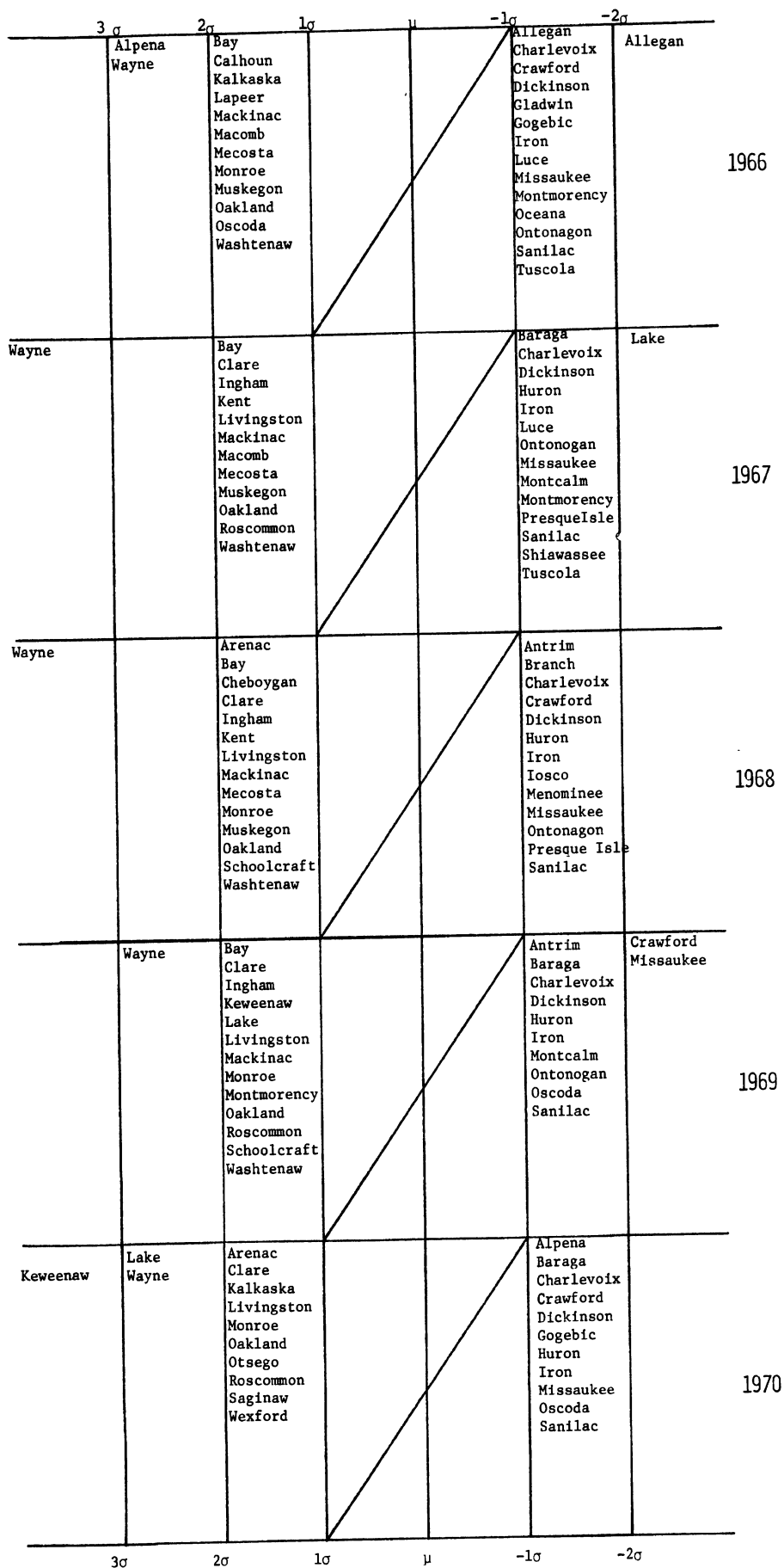
# FATALITIES



ACCIDENTS/REGISTERED VEHICLE

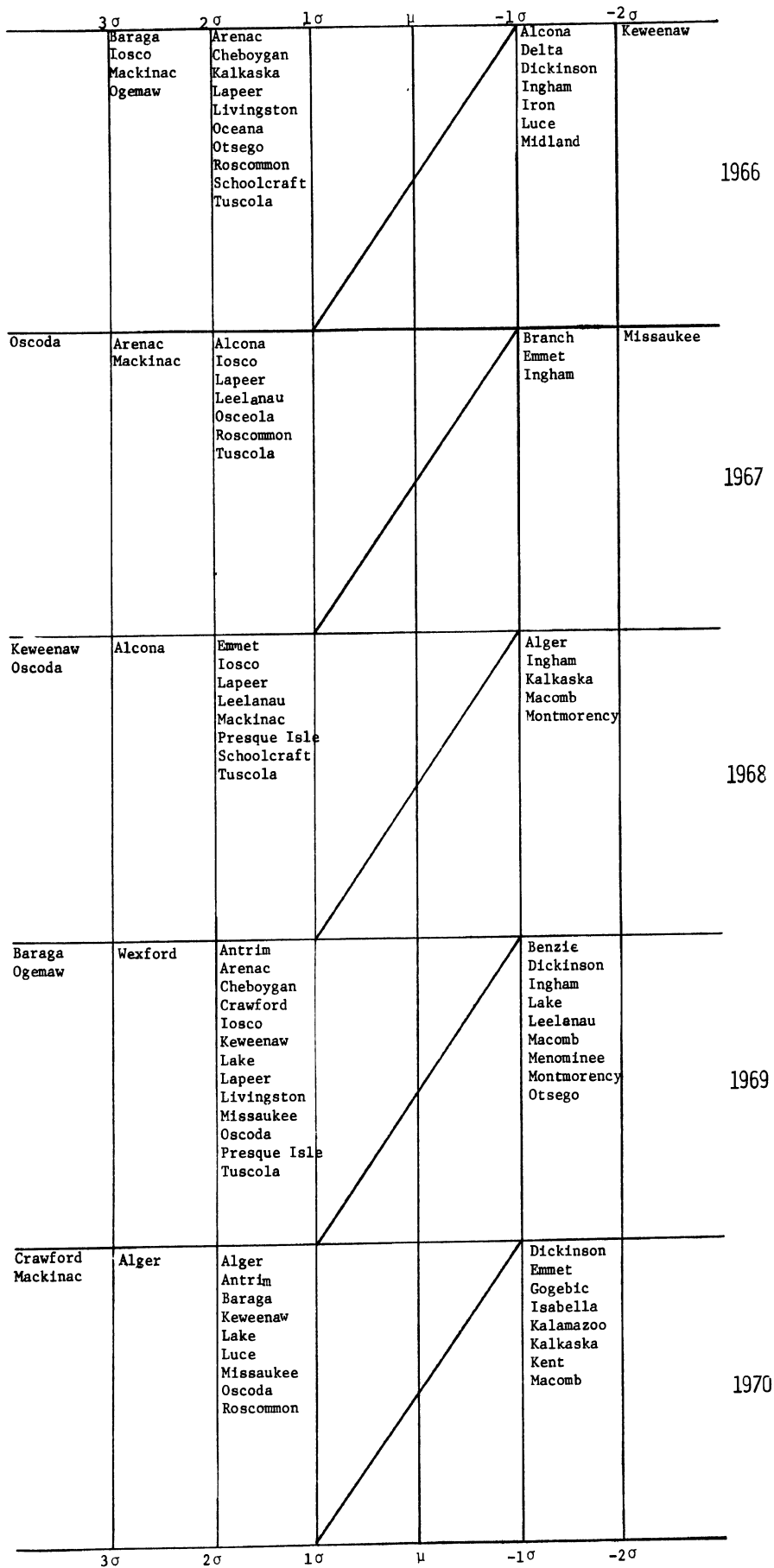
	$3\sigma$	$2\sigma$	$1\sigma$	$\mu$	$-1\sigma$	$-2\sigma$	
Lake Keweenaw	Kalkaska	Alpena Delta Ingham Mackinac Muskegon Wayne				Allegan Crawford Gladwin Huron Missaukee Montmorency Oceana Sanilac Shiawassee Tuscola	1966
	Wayne Ingham	Alger Calhoun Delta Kalamazoo Kent Mackinac Mecosta Muskegon St. Clair				Crawford Gladwin Huron Lake Leelanau Missaukee Montmorency Oceana Ontonagon Sanilac Shiawassee Tuscola	1967
	Wayne Ingham Mecosta	Calhoun Delta Kalamazoo Kent Lake Mackinac Marquette Muskegon St. Clair				Antrim Crawford Dickinson Huron Macomb Missaukee Ontonagon Saginaw Sanilac Shiawassee Tuscola	1968
	Wayne Ingham Delta	Houghton Kent Lake Mackinac Mecosta Montmorency Schoolcraft				Antrim Dickinson Gladwin Iron Newaygo Oceana Ontonagon Oscoda Sanilac Tuscola	1969
		Clare Delta Houghton Kalamazoo Keweenaw Lake Mackinac Mecosta Montmorency Saginaw Schoolcraft Wayne				Antrim Clare Crawford Dickinson Genesee Gratiot Huron Iosco Midland Newaygo Sanilac Tuscola	1970
						Missaukee Shiawassee	

### INJURY ACCIDENTS/REGISTERED VEHICLE

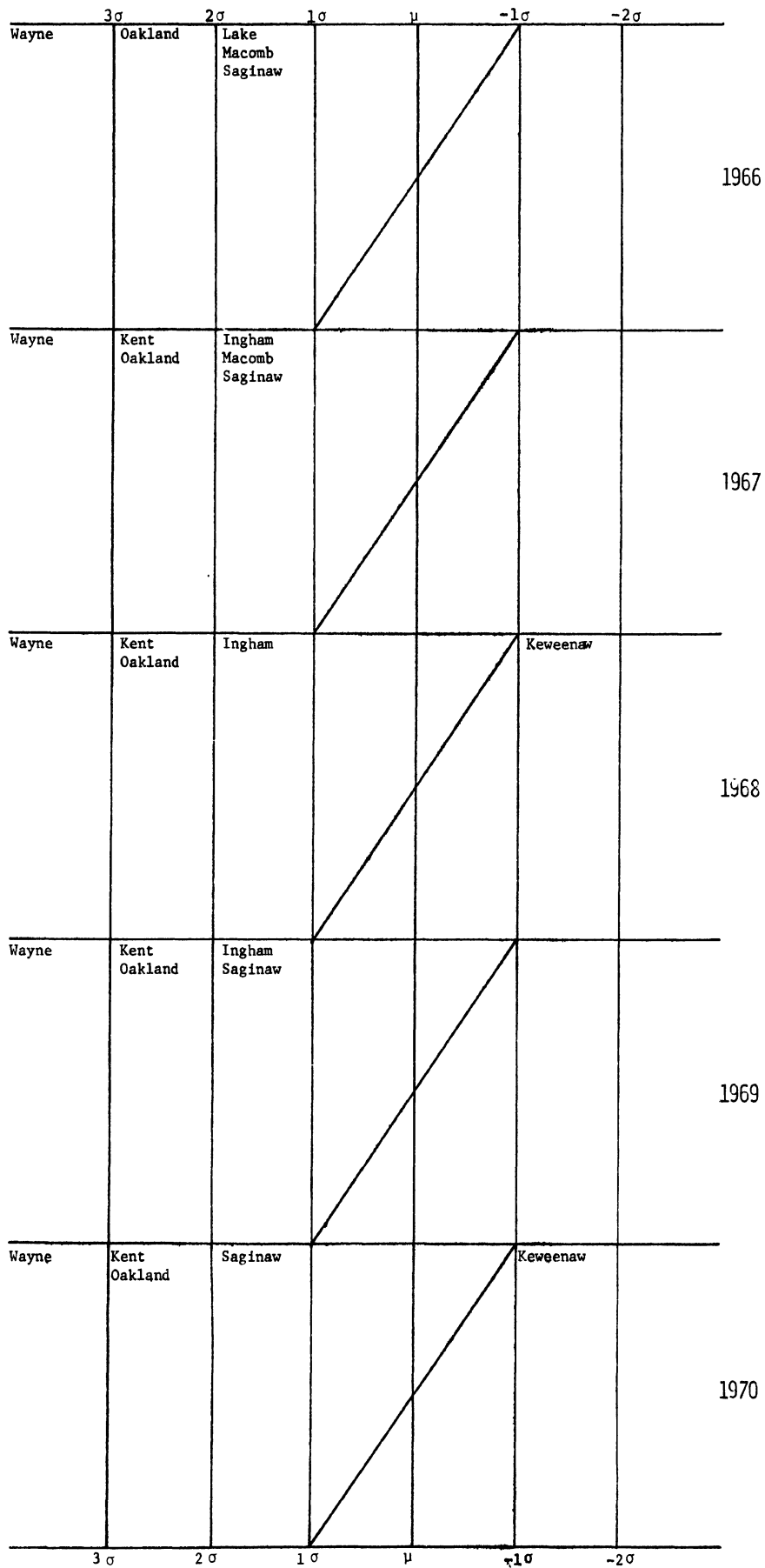




FATAL ACCIDENTS/REGISTERED VEHICLE



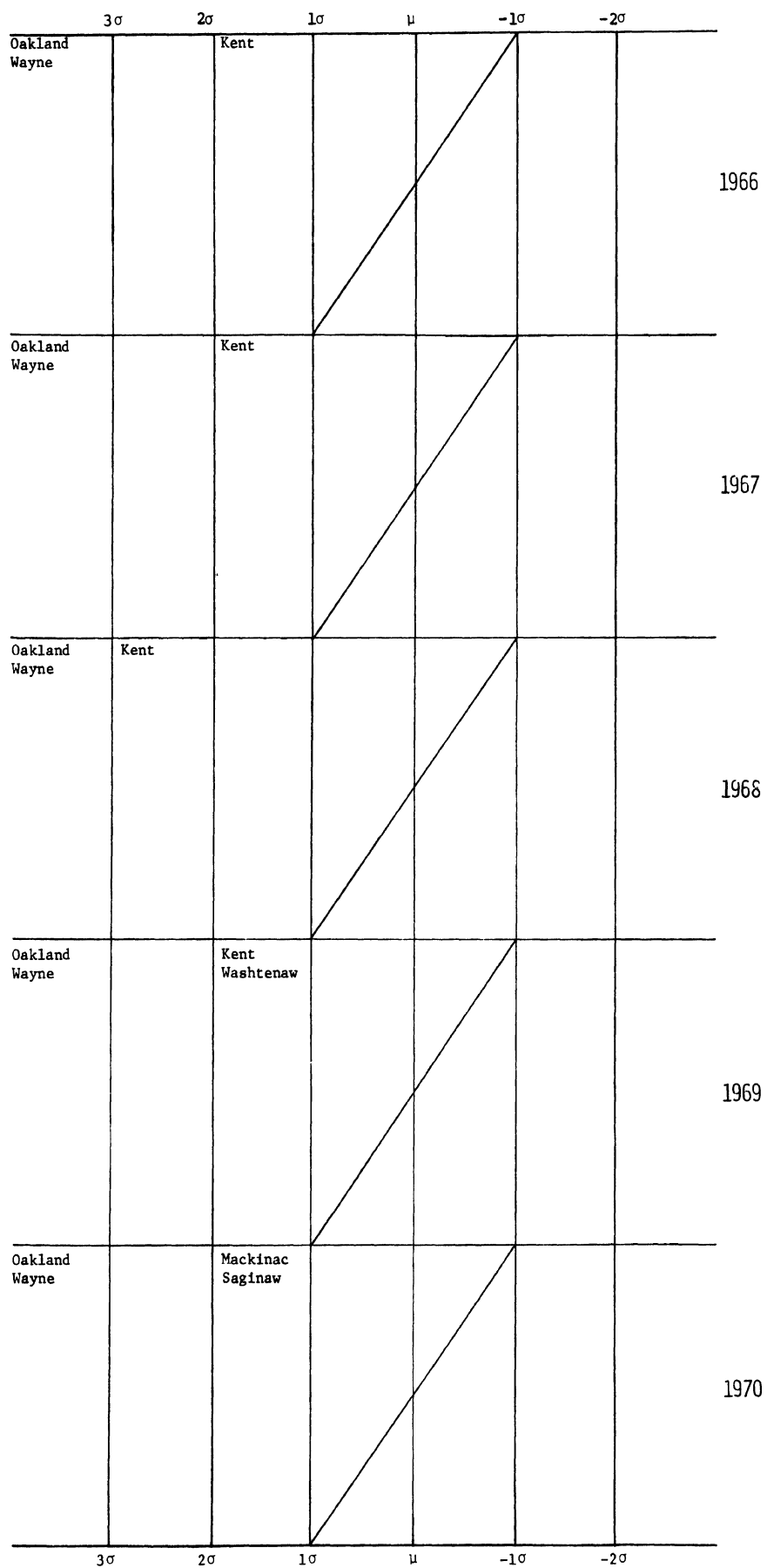
ACCIDENTS/REGISTERED VEHICLE/ROAD MILE



FATAL ACCIDENTS/REGISTERED VEHICLE/ROAD MILE

	$3\sigma$	$2\sigma$	$1\sigma$	$\mu$	$-1\sigma$	$-2\sigma$	
Wayne	Allegan Oakland	Huron Lapeer Lenawee Livingston Montcalm Oceana Sanilac Tuscola			Alcona Alger Alpena Benzie Charlevoix Chippewa Delta Dickinson Iron Keweenaw Leelanau Luce Mason Midland Missaukee Montmorency Schoolcraft		1966
	Oscoda Tuscola Wayne	Allegan Barry Mackinac Oakland Osceola Sanilac			Alpena Charlevoix Chippewa Dickinson Emmet Gd.Traverse Ingham Keweenaw Otsego Roscommon Schoolcraft		1967
Wayne	Oscoda Tuscola	Alcona Allegan Eaton Genesee Lapeer Lenawee Oakland St. Clair			Alger Alpena Antrim Baraga Benzie Charlevoix Dickinson Gogebic Luce Montmorency Ontonagon Otsego	Kalkaska	1968
Wayne	Lake Tuscola Wexford	Allegan Cheboygan Lapeer Livingston Montcalm Oakland Ogemaw Osceola			Alger Alpena Benzie Charlevoix Chippewa Delta Dickinson Ingham Iron Keweenaw Leelanau Luce Mackinac Menominee Montmorency Schoolcraft		1969
Wayne	Mackinac	Crawford Huron Lenawee Montcalm Newaygo Oakland Sanilac Tuscola Van Buren			Alcona Branch Dickinson Emmet Gogebic Houghton Iron Isabella Keweenaw Midland Montmorency Ontonagon	Kalkaska	1970
	$3\sigma$	$2\sigma$	$1\sigma$	$\mu$	$-1\sigma$	$-2\sigma$	

INJURY ACCIDENTS/REGISTERED VEHICLE/ROAD MILE



## APPENDIX III

### TRENDLINE KEYS

The keys included in this section indicate the trendline for counties on each variable and the counties' relation to the State baseline. These keys simply list the placement of each county as above, below, or crossing the State mean line as shown in the profiles of Appendix I. They also indicate whether the county experience is rising (worsening), falling (improving) or stable for each of the variables. This is based on each county's average for 1966-1968 compared with its average for 1968-1970. Also indicated by the left hand margin of the keys is whether each county's placement is above, below, or crossing the State average for each of the variables. Thus, for example, examination of the "Accidents" key shows Berrien County with more accidents than the State average and a general increase in this experience over the five years of our county profiles.

# ACCIDENTS

## TRENDLINE

		Ascending	Steady	Descending
<u>RELATION TO BASELINE</u>	Above	Berrien Calhoun Genesee Ingham Jackson Kalamazoo Kent Oakland Ottawa Saginaw St. Clair Washtenaw		Bay Macomb Muskegon Wayne
	Cross			
	Below	Alcona      Lenawee Allegan      Livingston Antrim      Luce Arenac      Mackinac Baraga      Manistee Barry      Marquette Benzie      Mason Branch      Mecosta Cass      Menominee Charlevoix      Monroe Cheboygan      Montcalm Clare      Montmorency Clinton      Newaygo Crawford      Oceana Delta      Ogemaw Eaton      Ontonagon Emmet      Osceola Gladwin      Otsego Gogebic      Presque Isle Gd.Traverse      Roscommon Gratiot      Sanilac Hillsdale      Schoolcraft Houghton      Shiawassee Ionia      Tuscola Iosco      Van Buren Lake      Wexford Lapeer Leelanau		Alger Alpena Chippewa Dickinson Huron Iron Isabella Kalkaska Keweenaw Midland Missaukee Oscoda St. Joseph

# INJURIES

## TRENDLINE

		Ascending	Steady	Descending
RELATION TO BASELINE	Above	Berrien Ingham Kent Oakland Ottawa Saginaw Washtenaw Wayne	Kalamazoo	Calhoun Genesee Jackson Macomb Monroe Muskegon
	Cross			St. Clair
	Below	Alcona      Lenawee Alger        Livingston Allegan      Luce Arenac       Mackinac Barry        Manistee Benzie       Menominee Branch       Missaukee Cass          Montcalm Charlevoix   Montmorency Cheboygan   Oceana Clare        Ogemaw Delta        Ontonagon Dickinson   Osceola Eaton       Otsego Emmet       St. Joseph Gogebic      Sanilac Gd.Traverse   Schoolcraft Gratiot       Shiawassee Hillsdale    Tuscola Houghton    Wexford Huron Ionia Iosco Isabella Keweenaw Lake Lapeer Leelanau	Baraga	Alpena Antrim Bay Chippewa Clinton Crawford Gladwin Iron Kalkaska Marquette Mason Mecosta Midland Newaygo Oscoda Presque Isle Roscommon Van Buren

# FATALITIES

## TRENDLINE

		Ascending	Steady	Descending
<u>RELATION TO BASELINE</u>	Above	Eaton Genesee Ingham Lenawee Monroe Oakland Ottawa Saginaw St. Clair Washtenaw Wayne		Bay Berrien Calhoun Jackson Kalamazoo Kent Lapeer Macomb Muskegon
	Cross	Livingston		
	Below	Alcona Alger Alpena Antrim Baraga Barry Benzie Cass Charlevoix Cheboygan Chippewa Clinton Crawford Emmet Gladwin Gd. Traverse Huron Keweenaw Lake Luce Mason Mecosta Missaukee Newaygo Oceana Ogemaw Ontonagon Osceola	Shiawassee Tuscola Van Buren Wexford	Gratiot Ionia Iosco Marquette Menominee Montcalm Schoolcraft



ACCIDENTS/REGISTERED VEHICLE

TRENDLINE

		Ascending	Steady	Descending
<u>RELATION TO BASELINE</u>	Above	Berrien Clare Delta Gd.Traverse Houghton Lenawee Livingston Mackinac Marquette Mecosta Osceola Ottawa Roscommon Schoolcraft Wexford		Alger Bay Benzie Calhoun Cass Chippewa Emmet Ingham Jackson Kalamazoo Kalkaska Kent Keweenaw Lake Manistee Mason Monroe Muskegon Oakland Saginaw St. Clair Washtenaw Wayne
	Cross	Allegan Cass Eaton Ionia Luce Montmorency Ogemaw St. Joseph		Alpena Arenac Macomb
	Below	Baraga Barry Branch Charlevoix Cheboygan Clinton Crawford Genesee Gladwin Gogebic Gratiot Hillsdale Iosco Iron Isabella Lapeer Leelanau Menominee Montcalm Oceana Ontonagon Otsego Presque Isle Sanilac Tuscola Van Buren		Alcona Antrim Dickinson Huron Midland Missaukee Newaygo Oscoda Shiawassee

INJURY ACCIDENTS/REGISTERED VEHICLE

TRENDLINE

		Ascending	Steady	Descending
<u>RELATION TO BASELINE</u>	Above	Arenac Barry Cass Clare Delta Eaton Emmet Gd.Traverse Ingham Keweenaw Lenawee Livingston Monroe Otsego Roscommon Schoolcraft Wexford		Bay Benzie Berrien Calhoun Crawford Clinton Jackson Kalamazoo Kalkaska Kent Lapeer Mackinac Macomb Marquette Mecosta Muskegon Oakland St. Clair Washtenaw Wayne
	Cross	Ionia Lake Montmorency Ogemaw Saginaw Van Buren		Alger Alpena Genesee Manistee Mason
	Below	Alcona Allegan Cheboygan Dickinson Gladwin Gogebic Gratiot Houghton Iosco Iron Isabella Leelanau Luce Menominee Montcalm Oceana Ontonagon Osceola St. Joseph Sanilac Shiawassee Tuscola	Presque Isle	Antrim Baraga Branch Chippewa Crawford Hillsdale Huron Midland Missaukee Newaygo Oscoda Ottawa

FATAL ACCIDENTS/REGISTERED VEHICLE

TRENDLINE

		Ascending	Steady	Descending
<u>RELATION TO BASELINE</u>	Above	Baraga Cheboygan Clinton Crawford Eaton Iosco Keweenaw Lake Mecosta Montcalm Oceana Ogemaw Osceola Presque Isle	Saginaw	Alcona Arenac Barry Bay Clare Lapeer Leelanau Livingston Mackinac Missaukee Monroe Oscoda Roscommon Tuscola
	Cross	Alger Antrim Lenawee Luce Newaygo Van Buren Wexford		Allegan Kalkaska St. Joseph Schoolcraft
	Below	Alpena Cass Charlevoix Chippewa Emmet Genesee Gladwin Gd.Traverse Huron Ingham Iron Ontonagon Ottawa Shiawassee		Benzie Berrien Branch Calhoun Delta Dickinson Gogebic Gratiot Hillsdale Houghton Ionia Isabella Jackson Kalamazoo Kent Macomb Manistee Marquette Mason Menominee Midland Montmorency Muskegon Oakland Otsego St. Clair Sanilac Washtenaw Wayne

ACCIDENTS/REGISTERED VEHICLE/ROAD MILE

TRENDLINE

		Ascending	Steady	Descending
<u>RELATION TO BASELINE</u>	Above	Allegan Delta Genesee Lenawee Livingston Marquette Mecosta Ottawa		Bay Berrien Calhoun Ingham Jackson Kalamazoo Kalkaska Kent Lake Macomb Monroe Muskegon Oakland Saginaw St. Clair Washtenaw Wayne
	Cross	Menominee Montcalm Van Buren		
	Below	Baraga Barry Branch Cass Charlevoix Cheboygan Clare Clinton Crawford Eaton Gladwin Gogebic Gd.Traverse Gratiot Hillsdale Houghton Ionia Iosco Isabella Lapeer Leelanau Luce Mackinac Montmorency Oceana Ogemaw Ontonagon Osceola	Otsego Presque Isle Roscommon St. Joseph Sanilac Schoolcraft Tuscola Wexford	Alcona Alger Alpena Antrim Arenac Benzie Chippewa Dickinson Emmet Huron Iron Keweenaw Manistee Mason Midland Missaukee Newaygo Oscoda Shiawassee

FATAL ACCIDENTS/REGISTERED VEHICLE/ROAD MILE

TRENDLINE

		Ascending	Steady	Descending
RELATION TO BASELINE	Above	Cheboygan Clinton Eaton Genesee Huron Lenawee Mecosta Montcalm Oceana Ogemaw Osceola Presque Isle	Saginaw	Allegan Barry Berrien Calhoun Gratiot Kent Lapeer Livingston Mackinac Monroe Oakland Oscoda St. Clair Sanilac Tuscola Van Buren Washtenaw Wayne
	Cross	Cass Crawford Lake Missaukee Newaygo Ottawa Wexford		Alcona Clare Jackson Macomb Marquette Roscommon St. Joseph
	Below	Alger Alpena Antrim Baraga Branch Charlevoix Chippewa Emmet Gladwin Gd. Traverse Ingham Keweenaw Luce Ontonagon Schoolcraft Shiawassee	Iron	Arenac Bay Benzie Delta Dickinson Gogebic Hillsdale Houghton Ionia Iosco Isabella Kalamazoo Kalkaska Leelanau Manistee Mason Menominee Midland Montmorency Muskegon Otsego

INJURY ACCIDENTS/REGISTERED VEHICLE/ROAD MILE

TRENDLINE

		Ascending	Steady	Descending
<u>RELATION TO BASELINE</u>	Above	Allegan Clare Eaton Ingham Lenawee Livingston Mecosta Monroe Muskegon Saginaw		Berrien Calhoun Cheboygan Genesee Jackson Kalamazoo Kent Lapeer Macomb Marquette Oakland Ottawa St. Clair Washtenaw Wayne
	Cross	Sanilac Van Buren Wexford		
	Below	Alcona Arenac Barry Cass Charlevoix Delta Dickinson Emmet Gladwin Gogebic Gd.Traverse Gratiot Houghton Ionia Iosco Iron Isabella Keweenaw Lake Leelanau Luce Menominee Montcalm Montmorency Oceana Ogemaw Ontonagon	Osceola Otsego Roscommon St. Joseph Schoolcraft Shiawassee Tuscola	Hillsdale Presque Isle

