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PERIODIC MOTOR VEHICLE INSPECTION IN NORTH CAROLINA: A DESCRIPTIVE STUDY

DONALD W. REINFURT and EDWARD A. PASCARELLA

NOVEMBER, 1969

CHAPEL HILL, NORTH CAROLINA

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Donald W. Reinfurt and Edward A. Pascarella

This report was partially sponsored by the office of the
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November 1969

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PERIODIC MOTOR VEHICLE INSPECTION IN NORTH CAROLINA: A Descriptive Study.

INTRODUCTION AND PROCEDURE

Beginning in February 1966 an annual motor vehicle inspection program was introduced in North Carolina with the intent of reducing the number of mechanically unsafe vehicles on North Carolina roads. Once each year, motor vehicle owners are required by law to have their vehicle inspected at one of the state-licensed inspection stations. Originally the items inspected consisted of the following:

Lights: headlights, parking lights, license plate light, tail lights, stop lights, clearance lights

Directional signals

Brakes: foot brake, emergency brake

Steering mechanism

Windshield wiper

Horn

Any items failing inspection must be repaired before a valid inspection sticker is granted.

The purpose of this report is to present statistics on failure rates and repair charges, and their relationship to vehicle age, mileage and presumed driving environment (i.e. rural or urban areas based on the owner's address). This amount of detailed data cannot be retrieved from the regular summary statistics compiled by the Department of Motor Vehicles which uses their information for other

purposes.

Through the wholehearted cooperation of the North Carolina Department of Motor Vehicles as well as literally thousands of inspection stations across the state, arrangements were made to collect the station copies of the vehicle inspection form for those vehicles inspected in December 1966. As seen in Figure 1 (a copy of the form currently in use), this form, upon completion, supplies the owner's name and address, identifies the vehicle, indicates the outcome of the inspection of each relevant item as well as repair charges assessed, and gives the date and place (i.e. station number) of the inspection. These forms were then converted onto computer tape for subsequent processing and analysis by the Highway Safety Research Center.

The present study is based on a sample of 47,402 privately-owned passenger cars. Omitted from the study were all trucks, trailers, buses and motorcycles and all vehicles for which the receipt information was incomplete. Since odometer reading was normally not recorded but was added to the document as a special part of this project, many cases were deleted due to missing odometer information. Finally, certain cases were deleted due to the likelihood of invalid odometer readings. (See the shaded area of Figure 2.) Relatively old cars with very low odometer readings were omitted since it was not possible to tell whether the true value was 15,950 miles (for example) as opposed to 115,950 miles representing a re-cycling of the odometer. Similarly, new cars with very high odometer readings were eliminated as it was impossible to know whether 6,520.7 miles (for example) was incorrectly recorded as 65,207 miles.

NORTH CAROLINA DEPARTMENT OF MOTOR VEHICLES

RECEIPT AND STATEMENT COVERING VEHICLE INSPECTION

OWNER JOHN THOMAS DOE

ADDRESS 111 FIRST STREET

CITY ANYWHERE, N.C.

LICENSE PLATE	MAKE OF VEHICLE	YEAR	VEHICLE IDENTIFICATION NUMBER
AK-1661	FORD	65	63K063665

MILEAGE: 43,731

TYPE OF VEHICLE: ☑ AUTO ☐ TRUCK ☐ TRAILER ☐ STA. WAGON ☐ BUS ☐ MOTORCYCLE

SAFETY EQUIPMENT	APPROVED INITIALLY	DISAPPROVED INITIALLY	CORRECTED DURING INSPECT.	REINSPECTED AND APPROVED
HEADLIGHTS		X	✓	
BEAM INDICATOR LIGHT	✓			
PARKING LIGHTS	✓			
LICENSE PLATE LIGHT	✓			
TAIL LIGHTS	✓			
STOP LIGHTS		X	✓	
CLEARANCE LIGHTS				
DIRECTIONAL SIGNALS	✓			
FOOT BRAKE	✓			
EMERGENCY BRAKE	✓			
STEERING MECHANISM	✓			
WINDSHIELD WIPER	✓			
HORN	✓			
TIRES	✓			

INSPECTION FEE COLLECTED $ 1.50 REPAIR CHARGE MADE $ 1.00

STATION NO.	DATE	MECHANIC'S SIGNATURE
6851	12-26-68	William J. Smith

INSPECTION NO. 2936147 CERTIFICATE

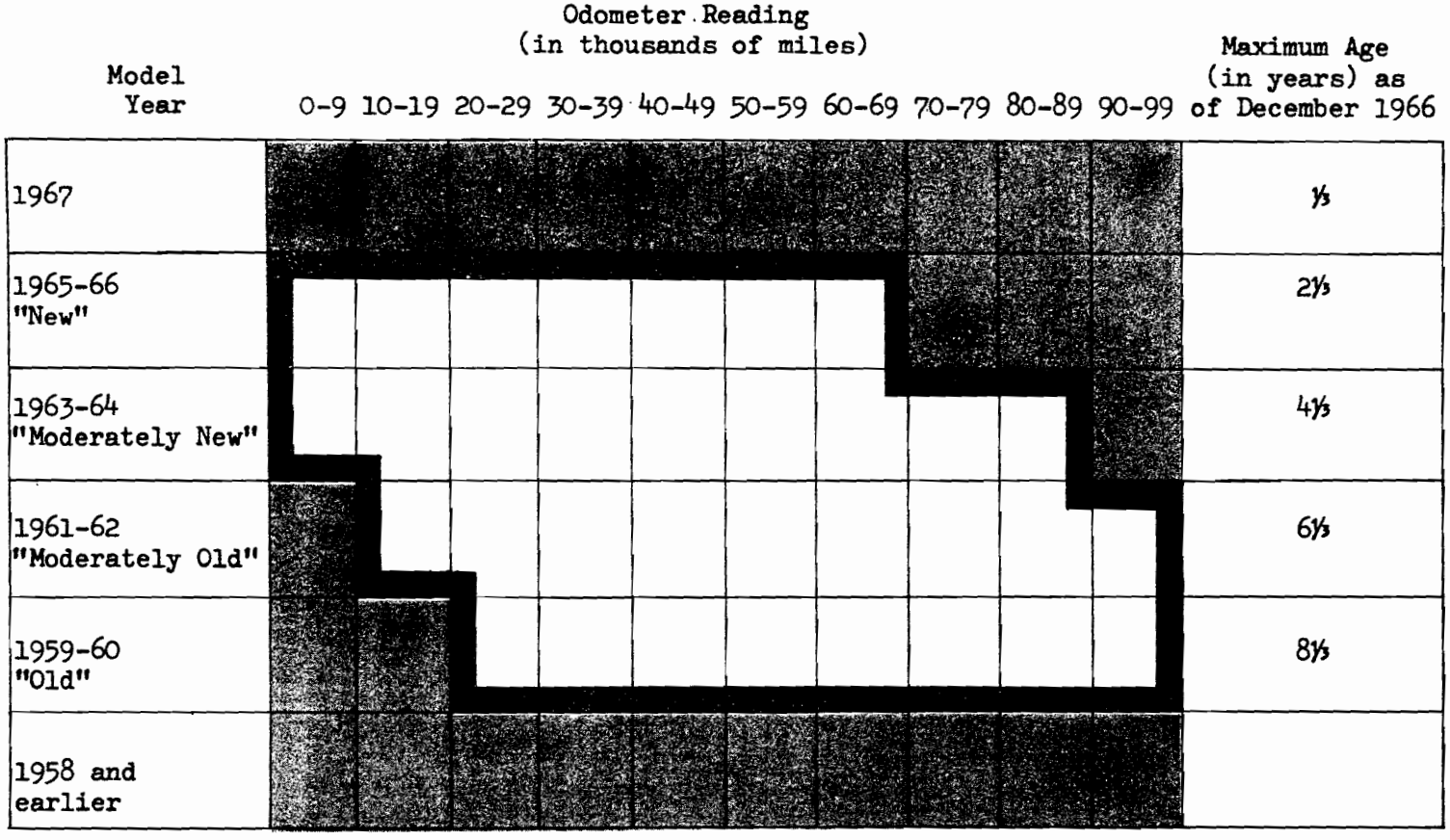
REINSPECTION DATE	MECHANIC'S SIGNATURE

DISAPPROVED EQUIPMENT MAY BE REPAIRED BY THE OWNER OR AT A FIRM OF THE OWNER'S CHOICE AND BE RE-INSPECTED FREE OF CHARGE WITHIN 90 DAYS UPON PRESENTATION OF THIS RECEIPT TO THE SAME STATION CONDUCTING THE ORIGINAL INSPECTION; HOWEVER, THE INSPECTION DEADLINE IS NOT EXTENDED. OPERATION WITHOUT CURRENT "INSPECTION CERTIFICATE" OR DEFECTIVE EQUIPMENT SUBJECTS THE OPERATOR TO ARREST ACTION. INSPECTION FEE $1.50

YOUR SAFETY IS ON THE LINE! A246513

MOORE BUSINESS FORMS, INC., RALEIGH, N. C. M

FIGURE 1. VEHICLE INSPECTION RECEIPT



(Shaded region omitted from study)

FIGURE 2. STUDY DESIGN

RESULTS

Annual Summary Results

The information presented in Table 1 was prepared by the North Carolina Department of Motor Vehicles. It shows a generally downward trend in failure percentages over the three-year period during which the program has been in operation. The most notable reduction occurs in the lights category dropping from over 60% failure to approximately 29%, with headlight failure constituting the vast majority of the light failures. The mandatory inspection fee of $1.50 for each vehicle inspected plus the repair charge per inspected vehicle (i.e. the total repair charges assessed divided by the total number of vehicles inspected) reflects the cost of motor vehicle inspection to the motoring population of North Carolina. The considerable reduction over the three-year period in the number of defects in each category (except windshield wipers) accounts for the reduction by over 50% in the repair charge per inspected vehicle. The sizable increase in windshield wiper defects is, in part, attributable to a change in the inspection requirements. The new regulation states that "If any vehicle is originally equipped by its manufacturer with wipers on both the right and left sides, both wipers shall be in good working order". Formerly only the wiper on the driver's side of the car was required to be in good working order.

At present, the Department of Motor Vehicles compiles monthly

Table 1. Annual Summary Statistics for the North Carolina Motor Vehicle Inspection Program

	1966	1967	1968
Total Number of Vehicles Inspected	2,206,553	2,331,124	2,497,797
Defective Items:			
Lights	1,341,154 (60.78%)*	821,891 (35.25%)	725,648 (29.05%)
Directional Signals	130,784 (5.92%)	121,706 (5.22%)	128,409 (5.14%)
Brakes	197,139 (8.93%)	142,613 (6.11%)	134,314 (5.38%)
Steering	55,199 (2.50%)	30,252 (1.29%)	27,224 (1.09%)
Windshield Wiper(s)	66,332 (3.00%)	61,940 (2.65%)	99,018 (3.96%)
Horn	36,890 (1.67%)	29,900 (1.28%)	31,107 (1.24%)
Repair Charge per Inspected Vehicle**	$1.85	$0.99	$0.87

*Item failure percentage = $\frac{\text{number of vehicles with defective item}}{\text{total number of vehicles inspected}}$

**Repair charge per inspected vehicle = $\frac{\text{total repair charges assesed}}{\text{total number of vehicles inspected}}$

tabulations by individual inspection station within each county in North Carolina for each of the entries in Table 1 with the addition of a tire failure category and with the lights category broken down into headlights versus other lights. However, failure rates as related to vehicle age and/or mileage remain unobtainable from these summary statistics.

Distribution of the Sample by Mileage and Model Year

It should be noted here that the vehicles subject to inspection in December 1966 were found to be representative of the motor vehicle population of North Carolina. Since the vehicles due for December inspections were those with a two as the terminal digit on their license plate, they could be compared with the "not twos"--vehicles not subject to inspection in December but still appearing for inspection. Upon doing this, it was seen that the age and mileage distributions as well as the various failure rates for the "twos" and "not twos" were most similar and hence the December sample was representative.

Figure 3 (see also Table A-1 in the Appendix) presents the mileage distributions for the 47,402 cars in the sample according to the model year of the vehicle. Two-year intervals were selected to contrast four different ages in the life of the vehicle and will be referred to as "New", "Moderately New", "Moderately Old", and "Old".

From Table A-1 it can be determined that the overall median mileage is approximately 43,000 miles. The median for the New cars is approximately 20,000 miles, 40,000 miles for the Moderately New, 55,000 miles for the Moderately Old, and 65,000 for the Old cars. As

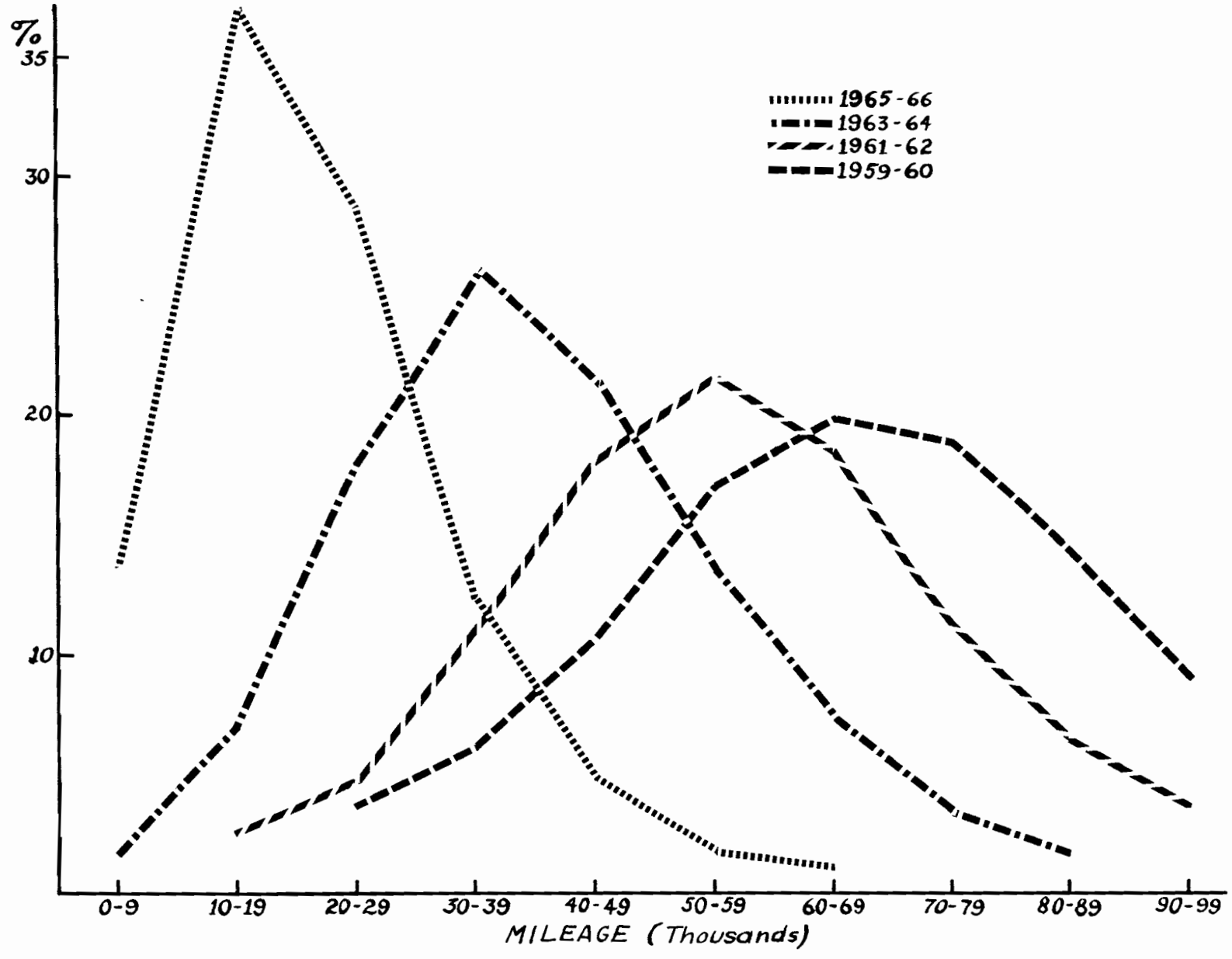


FIGURE 3, DISTRIBUTION OF THE SAMPLE BY MILEAGE AND MODEL YEAR

the latter two curves are symmetric, these approximations also represent the average (or mean) mileages for these two groups.

The 1963 model year represents the median age for these 48,684 vehicles inspected in December 1966; i.e., about 50% of these cars were at least three years old.

Proportions of Vehicles with Failures by Mileage and Model Year

An investigation of the proportion of cars which initially had one or more items failing inspection indicates that in the initial year of the program, less than one out of every three cars had all items in satisfactory condition. Figure 4 (and Table A-2) shows that even for the newest cars in the lowest mileage category only half of the cars passed the initial inspection.

The mean percentage of cars with at least one initial failure item rose steadily from a low of 59.5% for the New cars to a high of 78.8% for the Old cars. Similarly, failure rates increased from 50.9% for the lowest mileage vehicles to 81.0% for the highest mileage vehicles.

As can be seen from Figure 3, vehicle age and mileage are strongly associated. The older vehicles, for the most part, represent the higher mileage vehicles. Not unexpectedly, there is a joint effect (or interaction) of vehicle age and mileage on failure percentages with the greatest dispersion occurring in the lower mileage categories and a general convergence occurring in the higher mileage categories. As might be expected, there is a strong positive association between the increasing proportion of cars in the sample with initial failures and increasing vehicle age and/or mileage. More explicitly, the farther a car had traveled, and/or the older the car was, the more likely

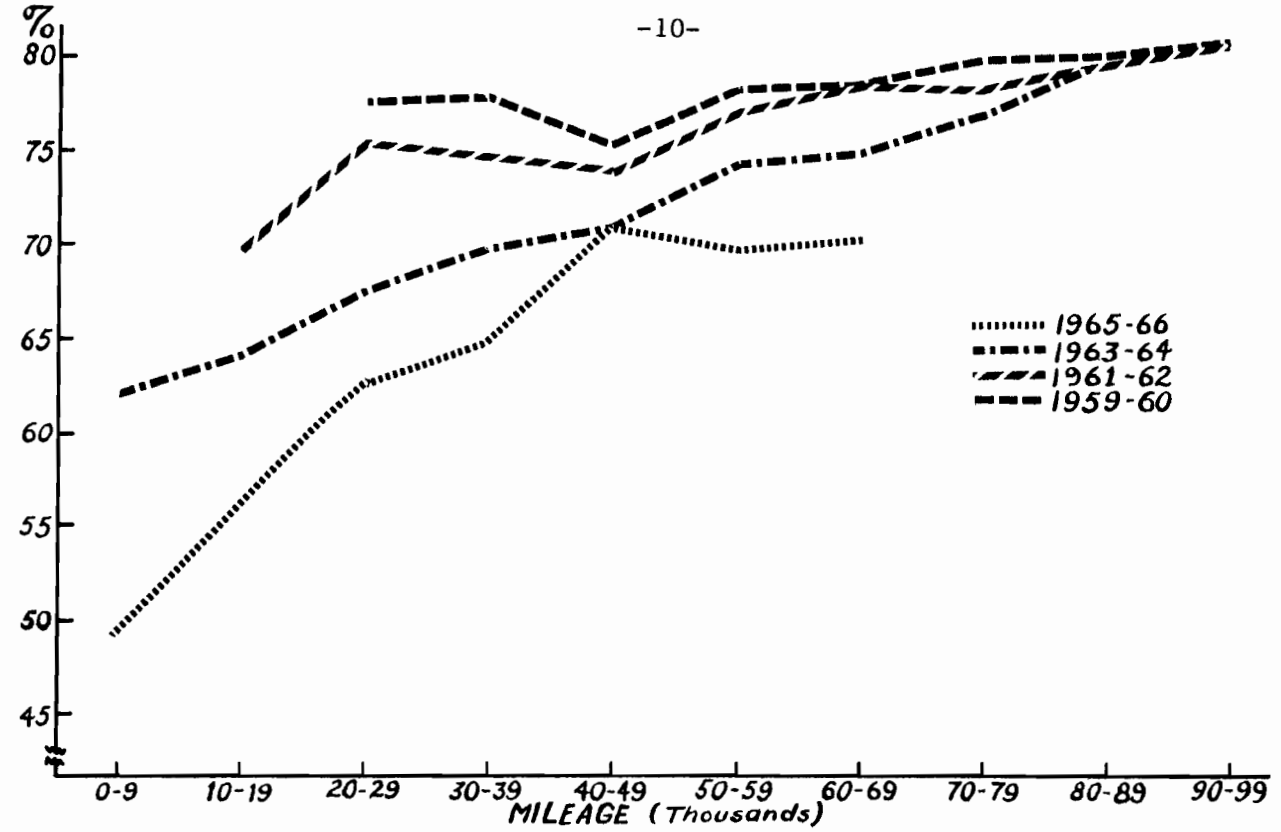


FIGURE 4, PROPORTION OF VEHICLES WITH FAILURES

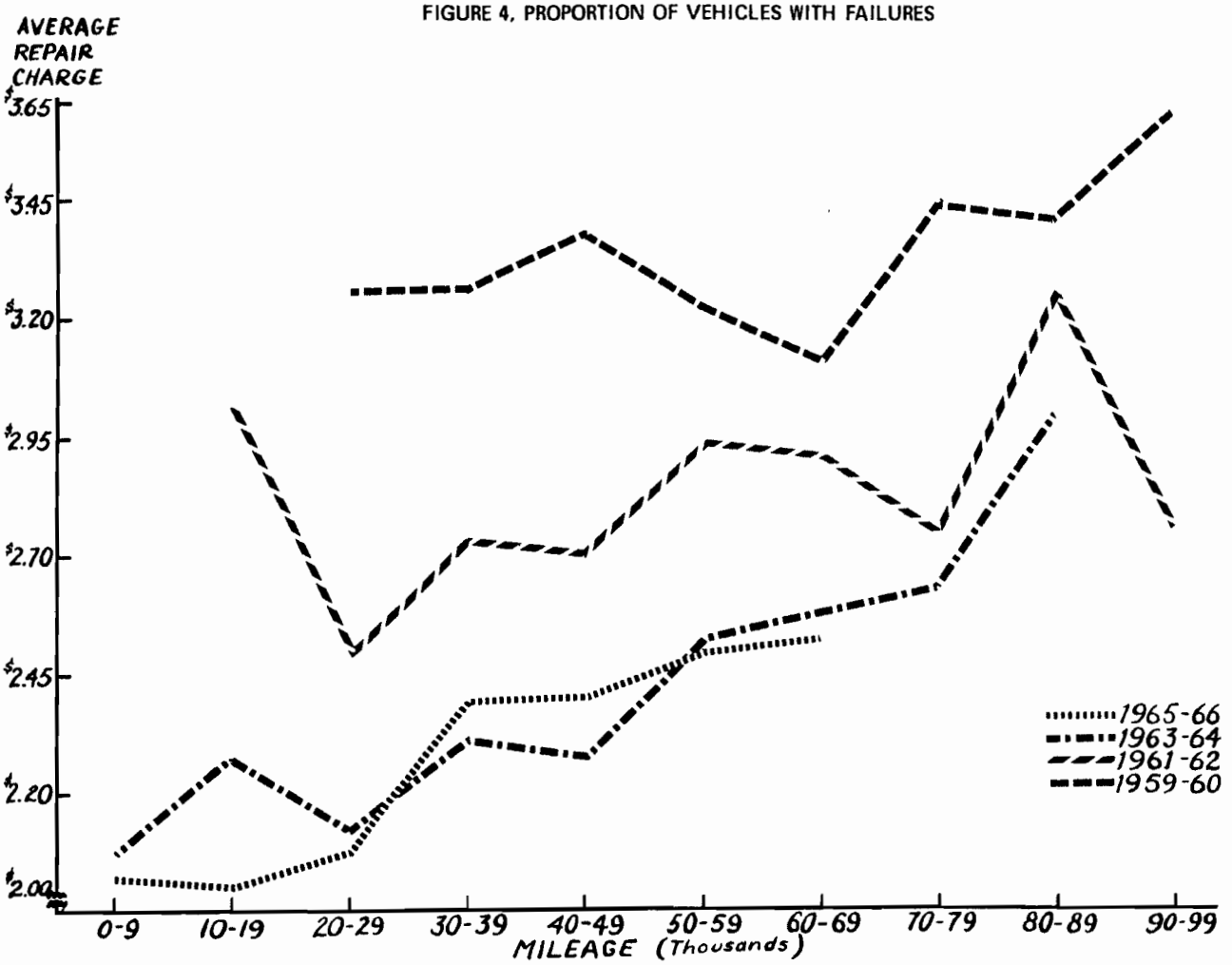


FIGURE 5, AVERAGE REPAIR CHARGE

it was that a failure would be recorded among the safety items inspected.

Average Repair Charge

A measure of the associated cost to the motor vehicle owners who have incurred repair charges is provided by the average repair charge (A.R.C.). For the purposes of this study, the A.R.C. is given by the ratio of the total repair charges made to the total number of vehicles for which repair charges were assessed. Figure 5 (Table A-3) shows the distribution of mean repair charges by mileage and by vehicle age. It may be informative to note that 6.37% of all vehicles which failed initial inspection (and eventually received an inspection sticker) had no repair charges recorded on the inspection ticket. If the repairs were not performed at this same inspection station, no repair charge would appear on the ticket. If the repairs were made at this inspection station, either the mechanic neglected to record the charge or the repairs were so minor that no charge was made.

From Table A-3, it can be seen that there is a definite linear trend of increasing mean costs with increasing vehicle age (ranging from a low of $2.05 to a high of $3.40) and with increasing vehicle mileage (ranging from a low of $2.03 to a high of $3.34). The overall A.R.C. is $2.62.

As was seen in the previous section (composite failure percentages by model year and mileage), there is a joint effect of vehicle age and mileage on the average repair charges. Inspection of the figures for failure percentages and A.R.C. will reveal that the convergence over mileage of the age curves is less orderly for average repair charges than for the failure percentages. This may be due to smaller

sample size (i.e. involving only those vehicles where repair charges were made). However, the same general trends are seen. The ranges of A.R.C. for the New and Moderately New vehicles are decidedly greater than those for the other two model year groups. In addition, the New and Moderately New vehicles exhibit most similar A.R.C.'s over the abbreviated mileage intervals.

The graph supports the common impression that as age and/or mileage increase, the cost increases also. Somewhat unexpected was the sizable rate at which A.R.C. increased with increasing mileage in the newer vehicles and the very slight increase for the older vehicles.

Overall Failure Rates for Individual Inspection Items

Overall failure rates for the eleven inspection items are presented both for mileage and model year. Figures 6a to 7d illustrate the failure percentages by intervals of 10,000 miles and also by model year. For these graphs, the proportion of cars within a given interval having incurred a particular failure gives the corresponding failure percentage. As each item is introduced, a brief description of the inspection specifications will be presented.

Headlights and License Plate Light

> Headlights will be inspected for their ability to generate a strong white or yellow beam capable of rendering discernable a person 200 feet ahead of the vehicle. Low beams must not dazzle or glare at oncoming cars and must render discernable a person 75 feet ahead of the vehicle. Reliability of the headlights will be determined from the condition of their component parts and the way the units are mounted in position and their alignment will be evaluated by one of several approved methods employing manual, mechanical or electronic devices. The lenses and reflectors will not be cracked or discolored and no foreign material will obstruct the beam. Vehicles not meeting these specifications will be approved for daylight use only. A separate lamp (License Plate Light) will be constructed and

> positioned to illuminate the number plate carried on the rear of the vehicle. It shall emit a white light which, under normal conditions, will permit the numbers to be read from a distance of 50 feet to the rear of the vehicle.

Figures 6a and 6b (Tables A-4 and A-10) illustrate failure rates for these two items of lighting equipment: headlights and license plate light. The first figure describes failure by mileage and the second in terms of model year. Headlights have the highest failure rates of any equipment component subject to periodic inspection. Examination of Figure 6a discloses a steadily increasing failure rate. Failure rates start at 46.6% and gradually increase to a maximum of approximately 69.0% for the highest mileage category. For failure by model year (Figure 6b) there is a similar relationship in that the headlight failure percentages rise consistently with increasing vehicle age. Headlights, it may be stated, are perhaps uniquely subject to "failure". This may be due, in part, to their location on the vehicle, mechanical and structural features associated with the alignment (headlight aiming) process and instruments employed in assessing the alignment of each "sealed-beam" unit. Objectively, then, headlights have more ways and perhaps more likelihood for failure than other components of inspection.

License plate light failures describe a curve which is similar to that of headlights. The same comments as to shape and direction of the curve apply with but a difference in magnitude of rates to differentiate them. The shape of the curve for model years is somewhat irregular when compared with the smooth, continuous ascent of the mileage curve. Mileage, in general, seems to exert a "smoothing out" influence upon the graphed data when contrasted with model year

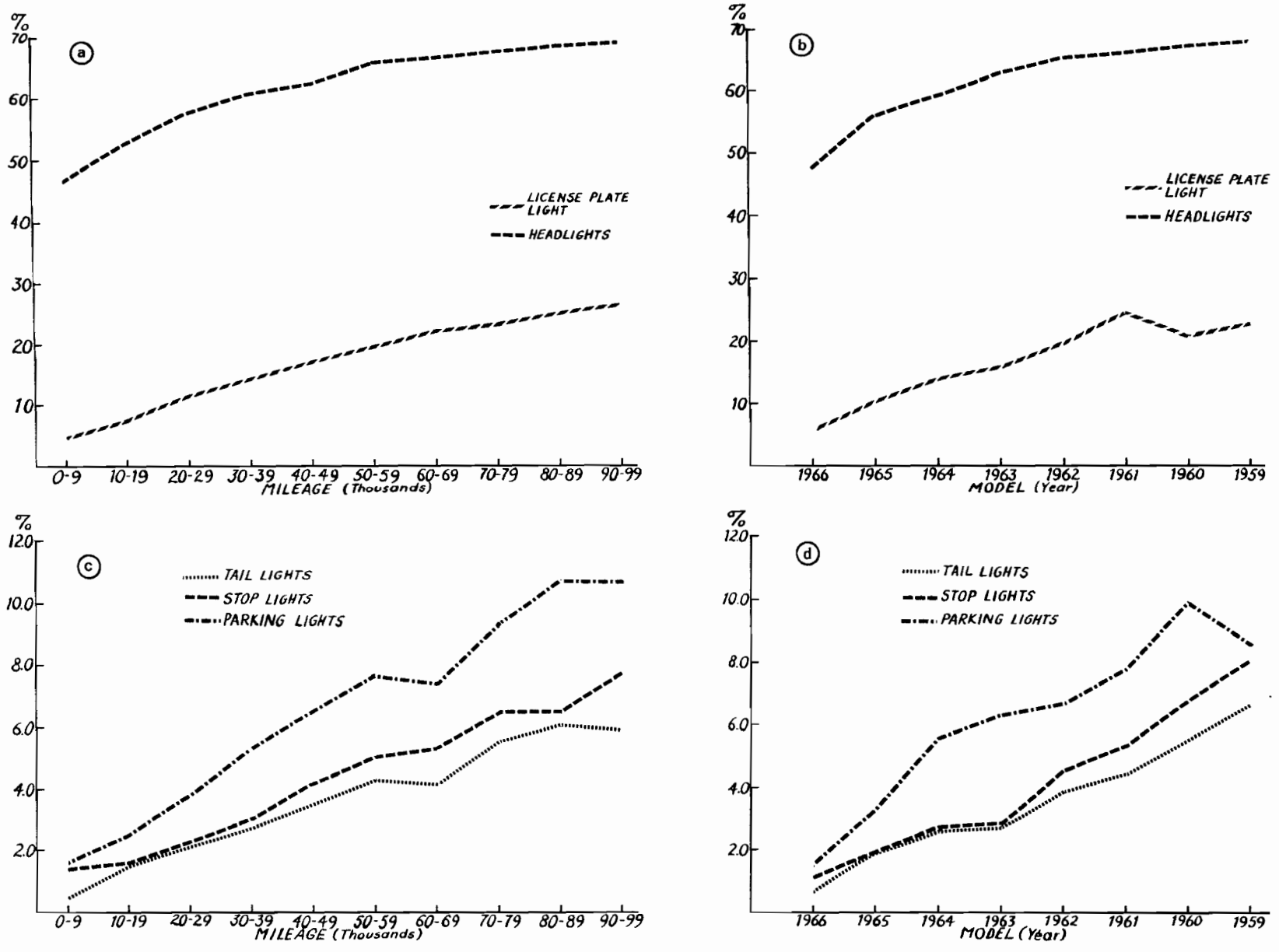


FIGURE 6a-d FAILURE RATES BY MILEAGE AND BY MODEL YEAR FOR HEADLIGHTS, LICENSE PLATE LIGHT, PARKING LIGHTS, STOP LIGHTS, AND TAIL LIGHTS

curves.

Parking Lights, Stop Lights, and Tail Lights

> Parking lights must have white or amber lenses in the front and red lenses in the rear. Stop lights must have lenses of red, yellow or amber and they must not be cracked or discolored. The light must come on when the foot brake pedal is depressed and they must be securely mounted to project a light to the rear of the vehicle. Tail lights shall exhibit a red light visible some 500 feet to the rear of the vehicle. (Lights similar to original equipment and of an approved type when in good working order will meet these requirements.) They will be securely mounted and have red lenses which are not cracked or discolored.

This group of lighting equipment features three curves which are remarkably similar in overall shape, direction and size of failure rates (see Figures 6c and 6d and Tables A-5, A-8, and A-11). There is a generally increasing trend of failure rates for each item noted for both mileage and model year figures. In this group of comparatively low failure rate items (maximum 11.0%), parking light failure exceeds the others with stop lights and tail lights following in order.

Foot Brake, Emergency Brake and Steering Mechanism

> Every vehicle will have brakes adequate to control movement and to stop and hold the vehicle. Each vehicle will have two separate means of applying the brakes. The foot brake must distribute braking force evenly to all wheels without audible indication of brake lining wear. The pedal reserve must be not less than one-third of the total possible travel and power brakes must meet manufacturers specifications for those units. The reservoir of the master cylinder must be full and there must be no audible or visible leakage or seepage from the lines, cylinders and hoses of the intact braking system. The emergency brake (or parking or hand brake) must have a lever reserve travel when it is fully set. Cables must not be visibly frayed or frozen. There must be no defective parts, missing or broken retractor springs or worn rods or couplings. With the vehicles wheels in the straight ahead position there will be no more than 3 inches of free play in steering wheels up to 18 inches in diameter or more than 4 inches of free play in steering wheels over 18 inches in diameter. Rejection will occur if either front or rear springs are sagging or

> broken and the front end assembly is bent or twisted and bolts, nuts or rivets are loose or missing. Power steering units must have no visible leaks and the power system drive belt must not be loose or worn.

Of these three items, two of them, foot brake and steering, provide the vehicle operator with control over highly critical systems of vehicle guidance. The overall impression obtained from the graphs (see Figures 7a and 7b and Tables A-6, A-7, and A-9) is one of low to moderate failure rates increasing fairly constantly over age and mileage. The foot brake with failure rates from approximately 1.0% to 9.0% is located in the same general failure class with directional signals, parking lights, and stop lights. Failure by mileage exposes a curve having an essentially constant rate of increase over miles. After 1961 the essentially level curve suggests an equilibrium of failure rates at approximately 9.0%. The other curves, emergency brake and steering, have features similar to that of the foot brake but with perceptibly lower failure rates. Emergency brake failure rates occupy the middle position of these three items. Steering mechanism shares with the horn possession of the lowest failure rates of the eleven equipment items tested with a range extending from 0.25% to 3.4%.

Directional Signals, Windshield Wipers and Horn

> All motor vehicles starting with the 1954 model must be equipped with electrical or mechanical directional signals. All vehicles will be rejected if directional signals are not present and of an approved type. All lights must operate properly and all lenses must be intact and properly fitted. Lenses must be of white or amber color on the front and red or amber on the rear and must be well mounted to be visible from the front or rear. Switches must be accessible to driver and not obstruct other controls necessary for operation of the vehicle. All motor vehicles equipped with a permanent windshield shall be equipped with a device (windshield wiper) for cleaning rain, snow and other

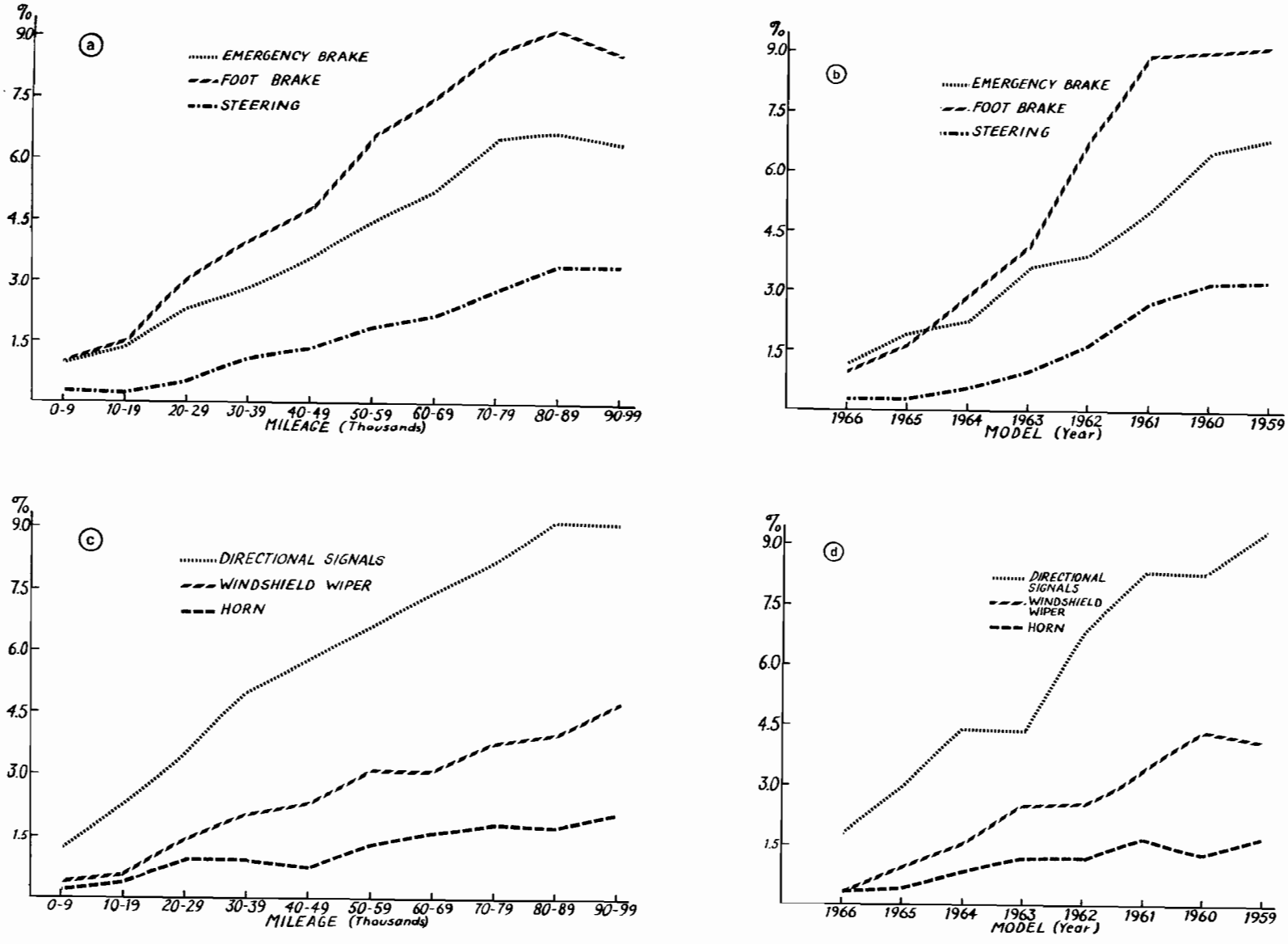


FIGURE 7a-d, FAILURE RATES BY MILEAGE AND BY MODEL YEAR FOR FOOT BRAKE, EMERGENCY BRAKE, STEERING, DIRECTIONAL SIGNALS, WINDSHIELD WIPER, AND HORN

materials from the windshield. It shall be in good working order and be so located that the driver may operate it. Every self-propelled motor vehicle will be equipped with a horn capable of emitting sound audible for a distance of 200 feet under normal conditions. (Horns similar to original equipment will, if in good operating condition, meet these requirements.) The sound must not be unusually loud or harsh, wiring and horn button shall be intact and securely mounted and operation of the horn should not interfere with any other mechanism.

As in the previous section, the results of inspecting directional signals, the windshield wiper, and horn prescribe three curves with relatively low failure rates when plotted by mileage or by model year (see Figures 7c and 7d and Tables A-12, A-13 and A-14). The range of failures by mileage extends from 0.2% (horn) to 9.2% (directional signals). A similar range of failure rates can be observed by model year. Once again the mileage curves are smoother and somewhat more consistent than those for model year. Of these three low-failure-rate items, directional signal failure rates double the failure rates of the second highest (windshield wiper) and more than quadruple the failure rates of the horn. The horn appears to be an equipment item which is subject to minimal but fairly constant failure rates.

Failure Rates for Individual Inspection Items by Mileage and Model Year

Headlights

Figure 8a (Table A-4) delineates the experience of headlight failure percentages when considered jointly by age and mileage. Each of the other items will be treated in a similar manner within this section.

Differentiation of the four curves generally follows an expected

pattern in that the older vehicles exhibit somewhat higher failure proportions. This effect is not constant across all of the mileage intervals. Greatest separation of model year curves occurs at the lowest mileage intervals and progressively decreases. For mileage intervals starting with the 60-69 thousand mile interval, the curves for vehicles older than 2 years 3 months become amalgamated into one broad-banded line. This reflects the joint influence of age and mileage on headlight failure.

Certain deviations from increasing failure rates with increasing age and mileage (e.g. the decrease to 59.4% in the 60-69 thousand mile interval for the "New" cars) are most likely merely random fluctuations; the general trend is the main feature of interest.

A noteworthy feature of the headlight graph is the elevated failure rates. From a low of 45% they increase to almost 70% for the oldest vehicles. Interpretative comments referable to this observation are to be found in the previous section dealing with overall headlight failure rates.

Foot Brake

Model year curves for foot brake failures (see Figure 8b and Table A-6) appear essentially to be somewhat irregular horizontal lines. Vertically the difference in rates for the 20-29 thousand interval (the first interval with all four points present) is about 8.5% while the largest difference between the extremes of any one curve is about 4.1% (for the 1963-64 model year). In the 1959-60 curve the highest failure rate (10.29%) appears in the 20-29 thousand mile interval. It may be conjectured that this high rate is due largely to vehicles exhibiting the "re-cycling effect" which was described in an earlier

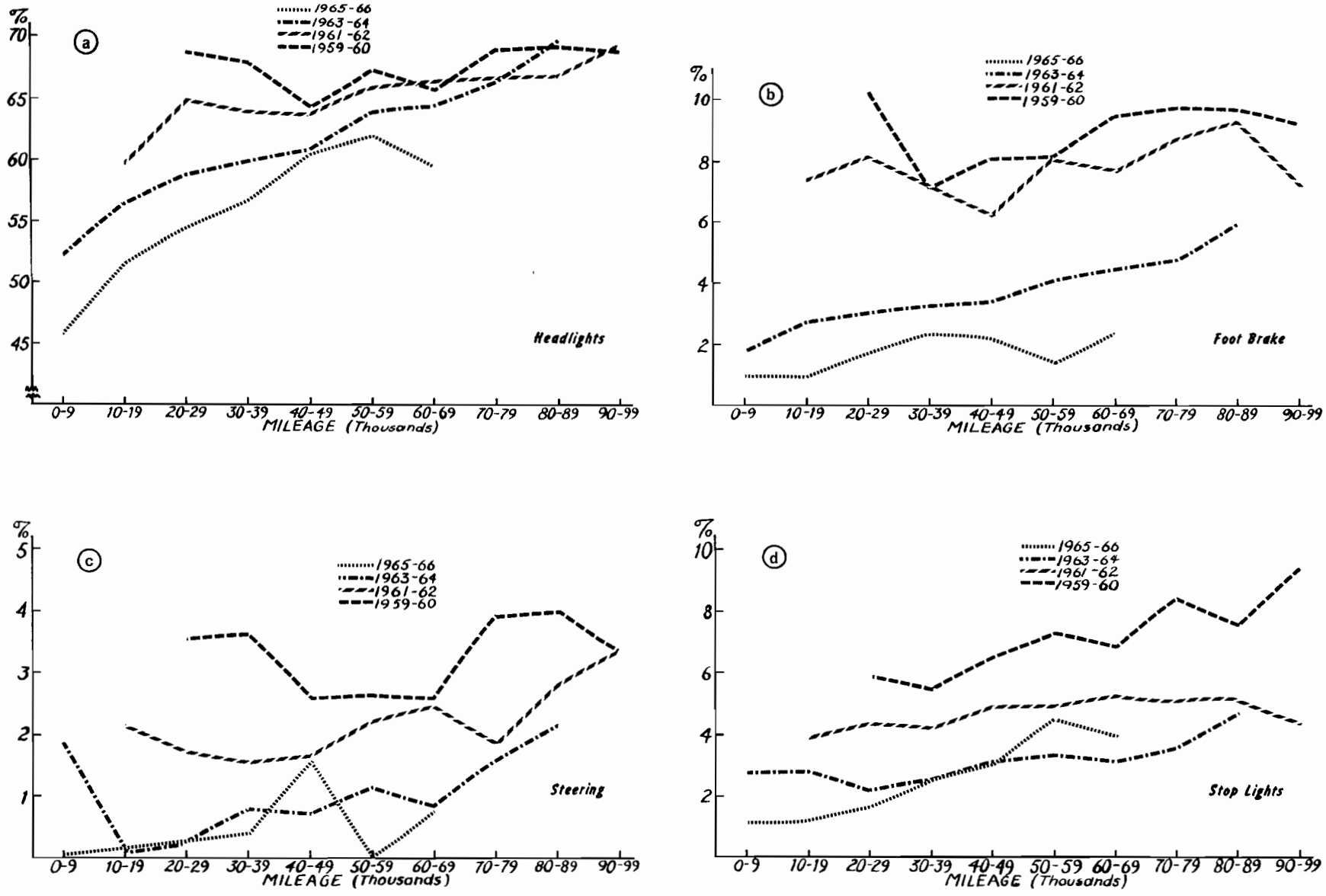


FIGURE 8a-d, FAILURE RATES BY MILEAGE AND MODEL YEAR FOR HEADLIGHTS, FOOT BRAKE, STEERING, AND STOP LIGHTS

section.

Failure rates for foot brakes, on the basis of these data, ostensibly respond to age-related influences. Moderately Old and Old vehicles demonstrate largely the same failure experience. Mileage effects are generally of a low order of magnitude.

Steering

Percentages of steering failure are among the lowest recorded for all items inspected, and the lowest for the "major"[1] items inspected (see Figure 8c and Table A-7). The range of failures extends from 0.06% to 3.98% with the New and Moderately New vehicles producing fairly similar curves. As was noted earlier for foot brakes, there is but a slight tendency towards an increase in failure with increasing mileage. Failure rates do not reach a sustained level over 1.0% until the 1961-62 model year curve; even then the mean failure rate for that model year is only 2.08%. The greatest failure rates are shown by the 1959-60 curve where the maximum is 3.98%.

Stop Lights

The stop light failure rates range from a low of 1.17% to a high of 9.34% (see Figure 8d and Table A-5). The New and Moderately New (1965-66 and 1963-64 respectively) curves cross, due mainly to a rather sharp increase in failure in the New vehicles (possibly only a random phenomenon). The 1961-62 curve is almost horizontal in character and is intermediate among the four curves graphed. The Old cars are

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[1]For purposes of this report "major" items of equipment may be defined as: steering, foot brakes, headlights.

clearly the highest in failure rates and sustain that relationship throughout the full range of mileage.

Emergency Brake

The curves for this item present the most plausible evidence of a "re-cycling effect" of any graph presented thus far (see Figure 9a and Table A-9). In three curves (1959-60, 1961-62 and 1963-64) there is a sharp decrease in failure percentage after the first interval plotted. If some conjecture may be permitted, the higher initial failure percentages presumably result mainly from vehicles with "re-cycled" odometers.

Curves for New, Moderately New and Moderately Old vehicles all demonstrate steadily increasing failure rates with increasing mileage (after the initial decrease). Somewhat greater rates of increase by the newer vehicles cause an eventual convergence of the three curves. Clearly higher is the curve for the Old vehicles, which shows a decline after the 70-79 thousand mile interval.

License Plate Light

From a low failure rate of 3.7% (1965-66 curve), the rates increase fairly consistently to a high of 28.4% (1961-62 curve). See Figure 9b and Table A-10. The increase of failure rates over mileage is quite similar for each of the four age groups with the oldest cars exhibiting the smallest increase. Considering the simplicity of the license plate light unit, the magnitude of the failure rates suggests that this item is one which is often ignored by the motoring public.

Tail Lights

Evidence of the presumed presence of some "re-cycled" vehicles

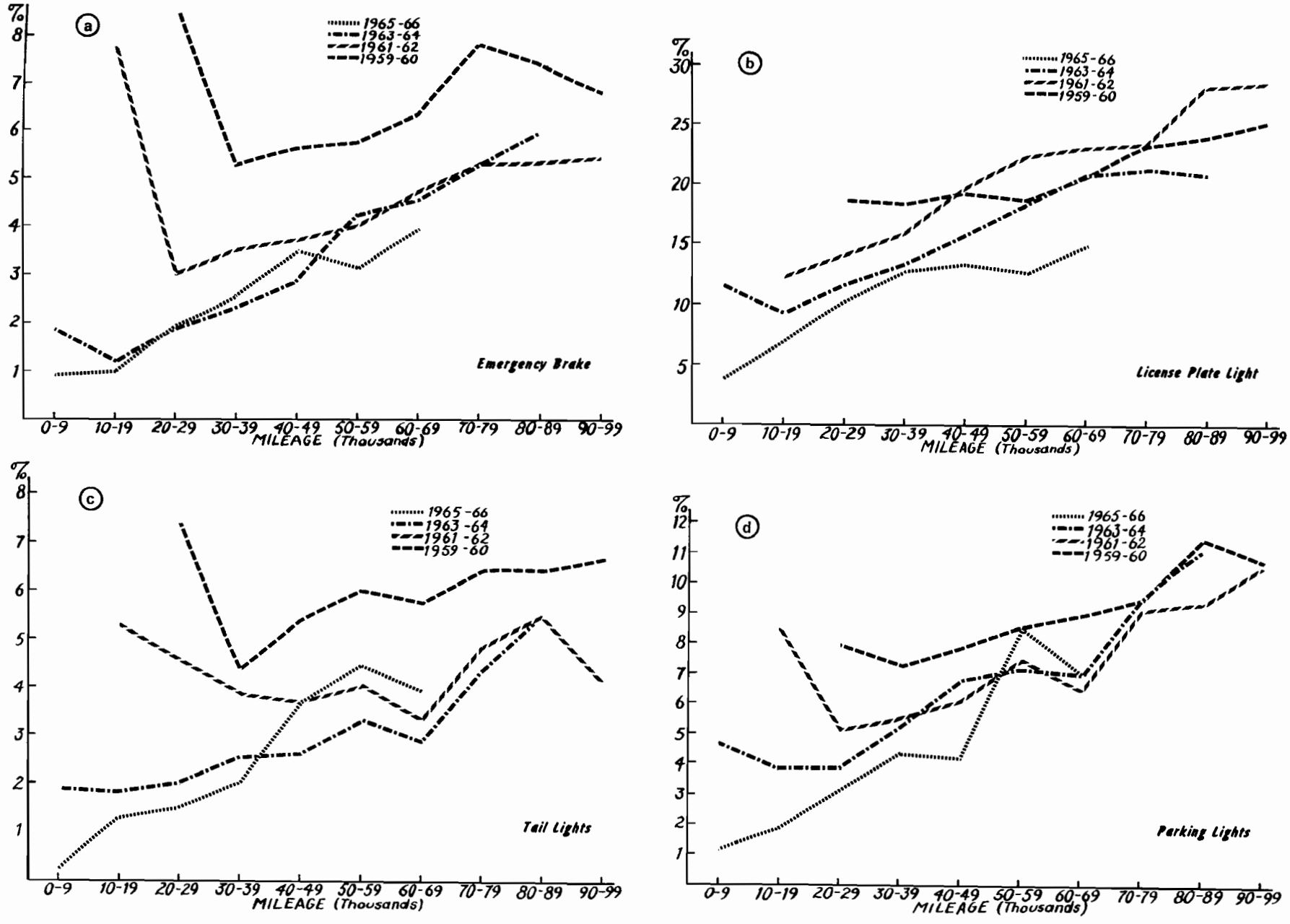


FIGURE 9a-d, FAILURE RATES BY MILEAGE AND MODEL YEAR FOR EMERGENCY BRAKE, LICENSE PLATE LIGHT, TAIL LIGHTS, AND PARKING LIGHTS

may be seen in the initial points of the 1959-60 and 1961-62 model year curves (see Figure 9c and Table A-11). After some initial decreases, there are generally increasing tail light failure rates over mileage and age, with the most notable occuring for the New cars. As with the emergency brake there is a distinct "upper strata" of failure rates formed by the 1959-60 model year curve.

Parking Lights

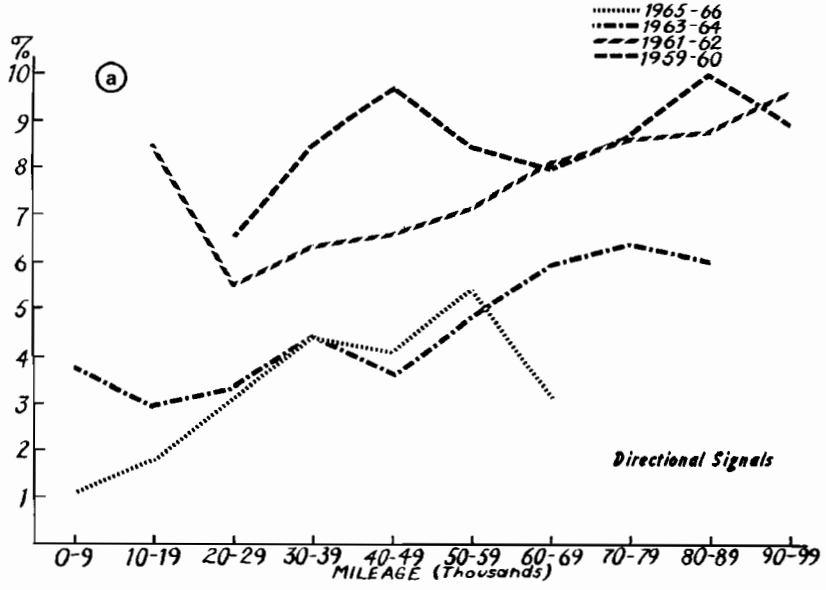
Parking light failures delineate a set of curves which bear considerable resemblance to those for license plate light failures although only half as large, with a range of 1.2% to 11.5% (see Figure 9d and Table A-8). There is, however, poorer differentiation by model year.

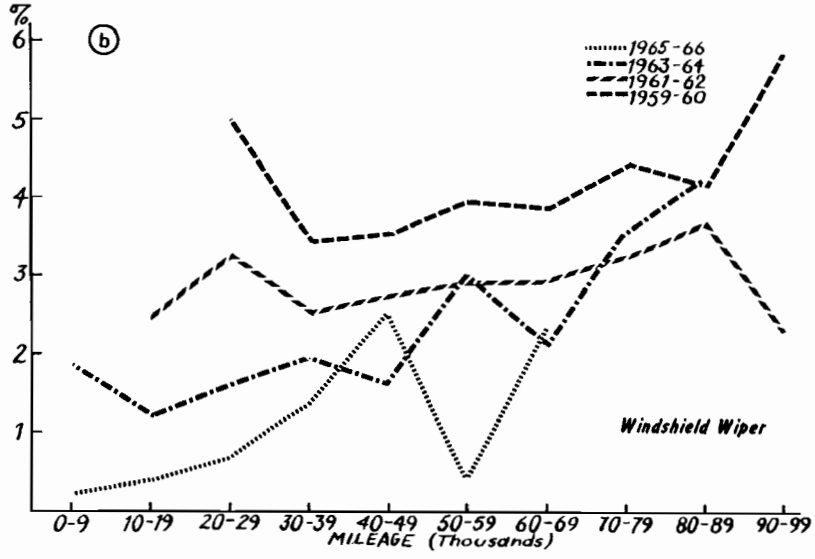
Directional Signals

The curves for directional signal failures form two rather distinct strata, each consisting of two adjacent age groups (see Figure 10a and Table A-12). The failure rates for the lower strata (model years 1965-66 and 1963-64) range from 1.1% to 6.3%; for the upper strata (for model years 1959-60 and 1961-62) they range from 5.5% to 10.0%. The rates of increase appear to be roughly similar for the two strata.

Windshield Wiper

The curves which describe the failures for this item are characterized by particularly low failure rates (see Figure 10b and Table A-13). The dispersion of these rates is considerable (0.22% to 5.86%) with perhaps a slight increase in failures over age and mileage.





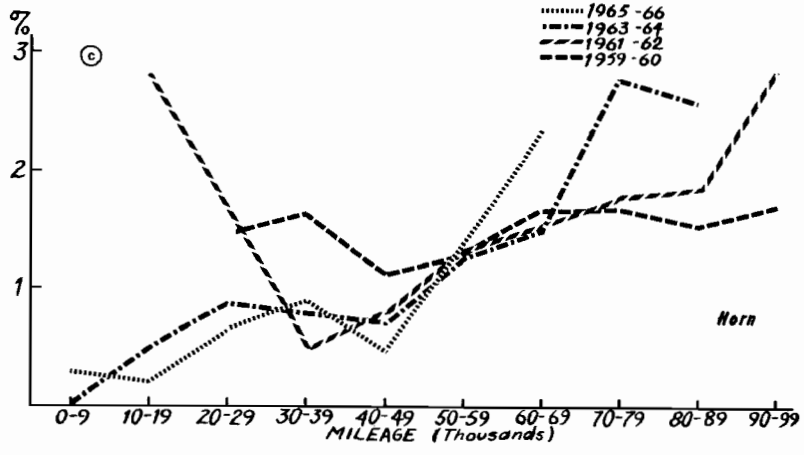


FIGURE 10a-c, FAILURE RATES BY MILEAGE AND MODEL YEAR FOR DIRECTIONAL SIGNALS, WINDSHIELD WIPER, AND HORN.

Horn

This equipment item has the lowest failure rate (1.0%) of any mechanical feature subject to inspection. The curves for horn failures are not readily distinguishable but, considering the low rates of failure, this is not at all unexpected (see Figure 10c and Table A-14).

Comparisons by Place of Residence

Distribution of Mileage, Age, Failure Rates, and Average Repair Charge

For the purpose of investigating possible rural-urban differences, a car was assigned to the urban category if the driver listed either a street address or a post office box number in a North Carolina community with a population of at least 2,500 at the time of the 1960 census. Otherwise it was considered a rural vehicle. Thus, vehicles are assigned to a category comprised of vehicles which would appear to be relatively homogeneous with respect to the environment in which presumably the bulk of the driving is done. Figure 11 (Table A-1) displays the mileage distributions for these two groups. In general, the urban vehicles have accumulated less mileage than the rural vehicles. The apparent median mileage for the urban vehicles in this study is slightly under 40,000 miles while for the rural vehicles it is over 44,000 miles. If the residual "re-cycled" vehicles could be placed in their correct mileage categories, the rural-urban mileage differences would be even greater. Since mileage and age are associated (see Figure 3), it is not surprising that the urban cars are also newer than the rural cars as can be seen from Figure 12 (Table A-1).

There is a trend for a slightly higher percentage of urban cars

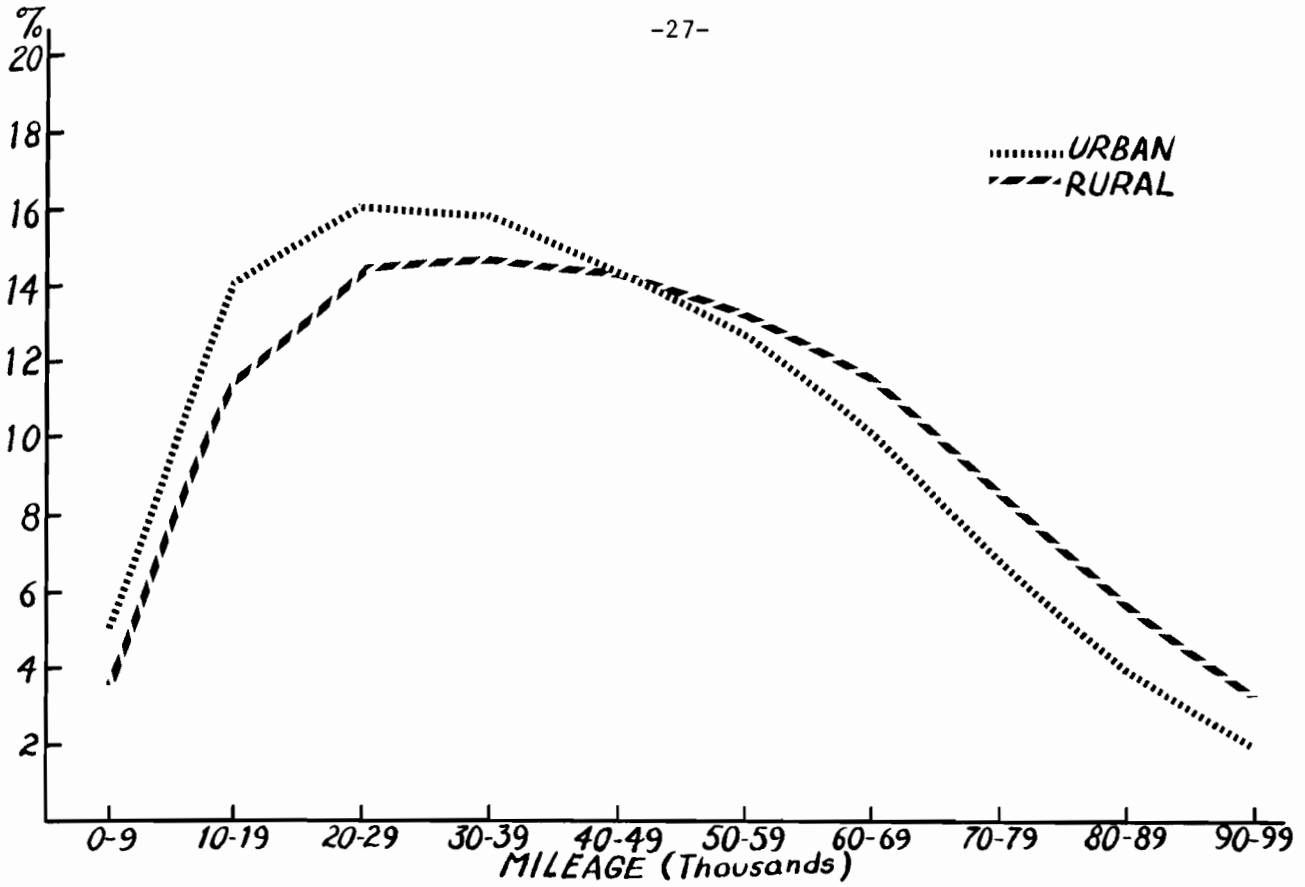


FIGURE 11, MILEAGE DISTRIBUTION OF THE SAMPLE BY PLACE OF RESIDENCE

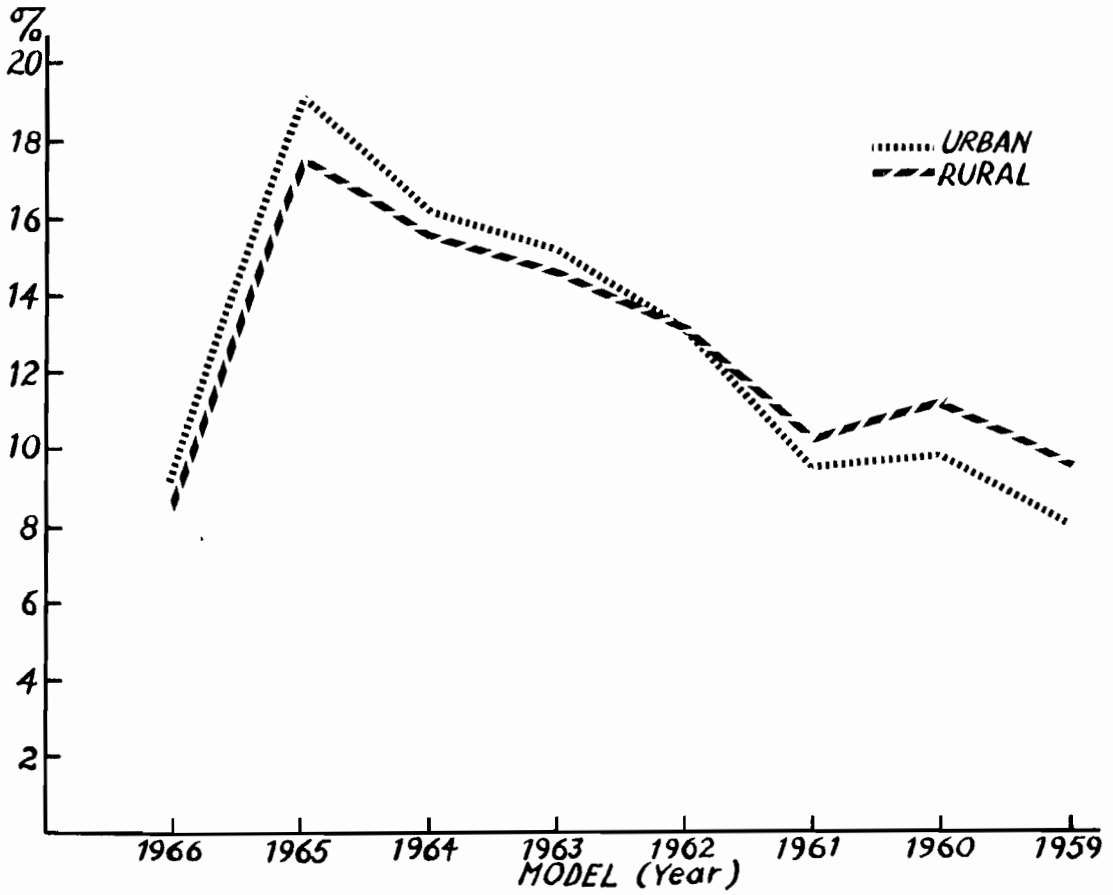


FIGURE 12, MODEL YEAR DISTRIBUTION OF THE SAMPLE BY PLACE OF RESIDENCE

failing inspection in the lower mileage categories with the reverse being true for the higher mileage cars (see Figure 13 and Table A-2).

Whatever the reasons may have been, the urban vehicles owners experienced repair charges that were consistently about 25 cents higher than those for the rural owners (see Figure 14 and Table A-3).

Failure Rates for Individual Inspection Items

Failure rates for headlights (see Figure 15a and Table A-4) on urban vehicles slightly exceed those for rural vehicles through the 50-59 thousand mile interval; after 60,000 miles, the rural failure rates are considerably greater than those for urban vehicles.

In general, the failure rates for stop lights, foot brake, and steering (see Figures 15b, 15c, and 16a and Tables A-5, A-6, and A-7) are higher for the urban vehicles than for the rural vehicles. The opposite is true for the parking light and emergency brake (see Figures 16b and 16c and Tables A-8 and A-9). For the remaining five items, there were no consistent rural-urban differences noted.

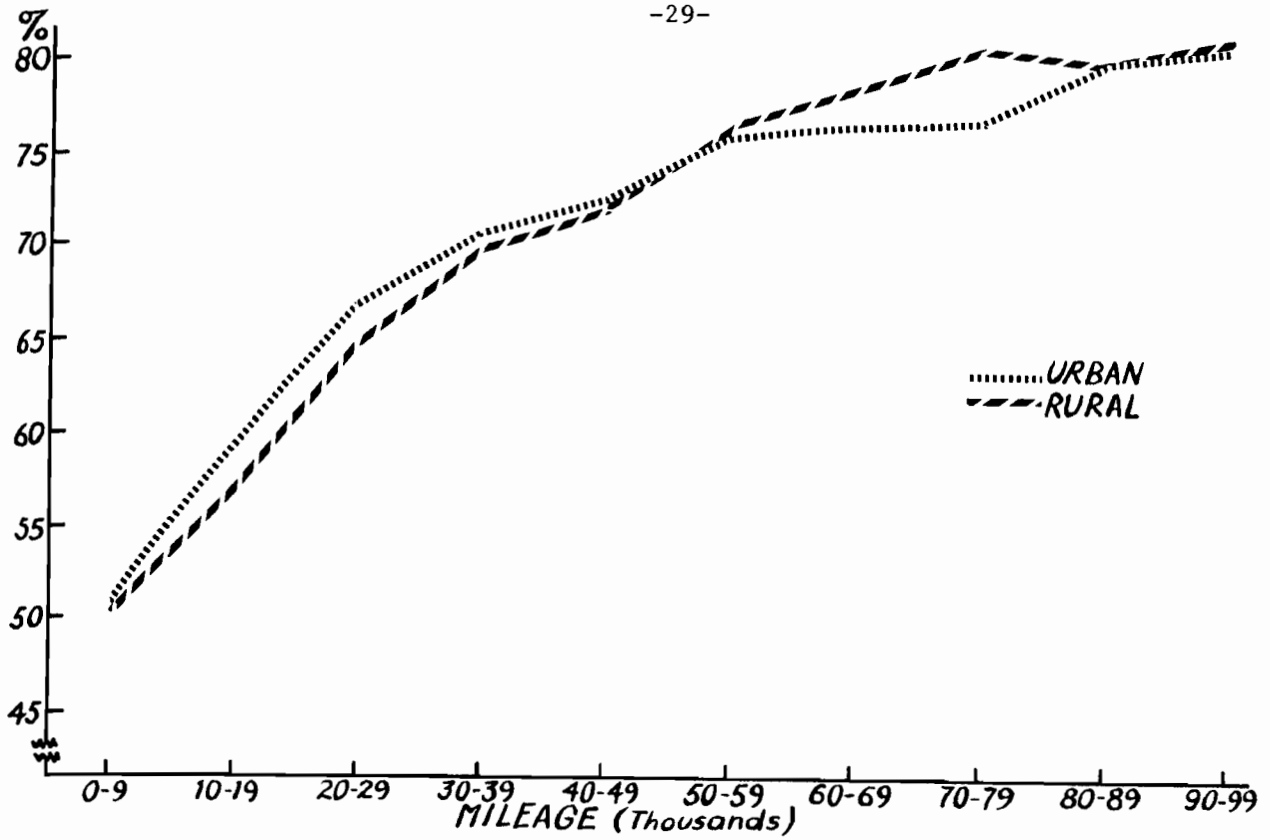


FIGURE 13, PROPORTION OF VEHICLES WITH FAILURES BY PLACE OF RESIDENCE

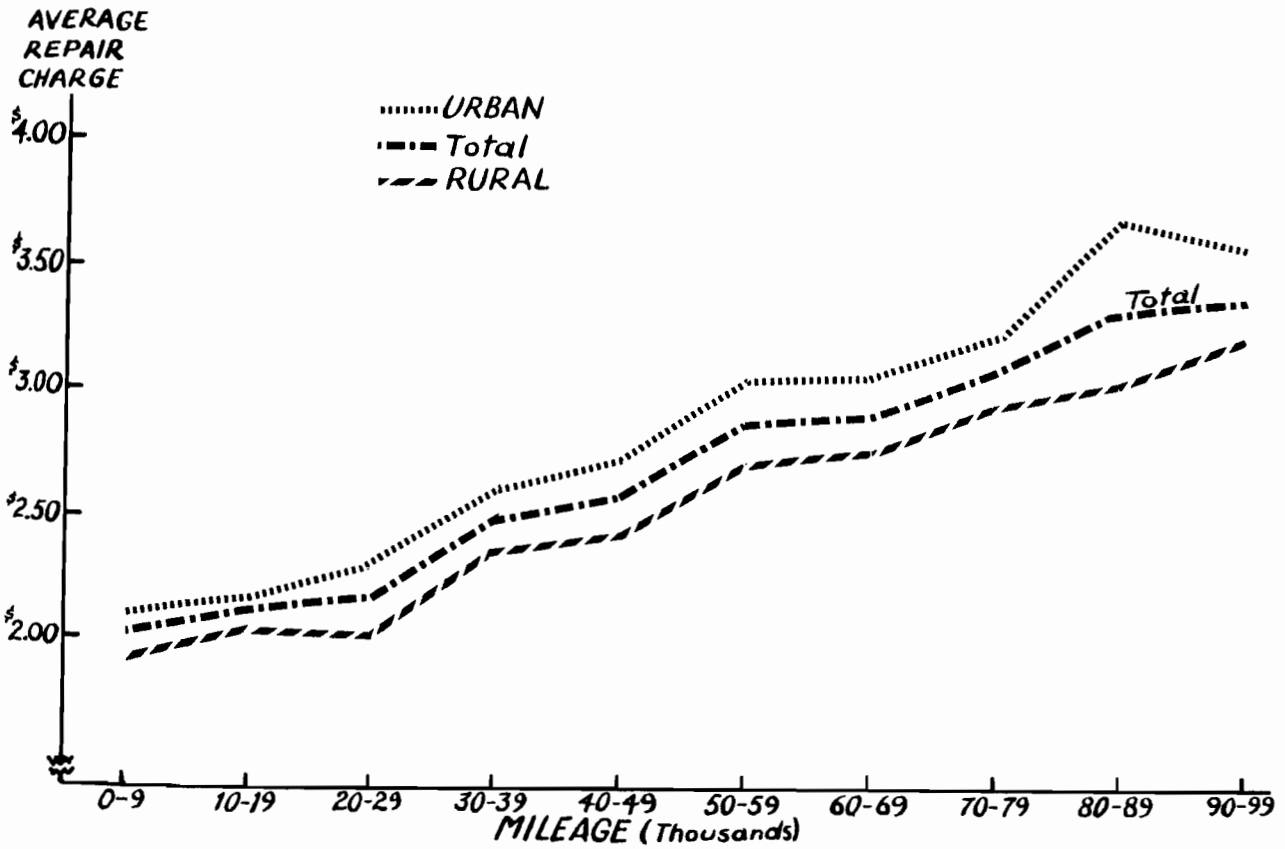


FIGURE 14, AVERAGE REPAIR CHARGE BY PLACE OF RESIDENCE

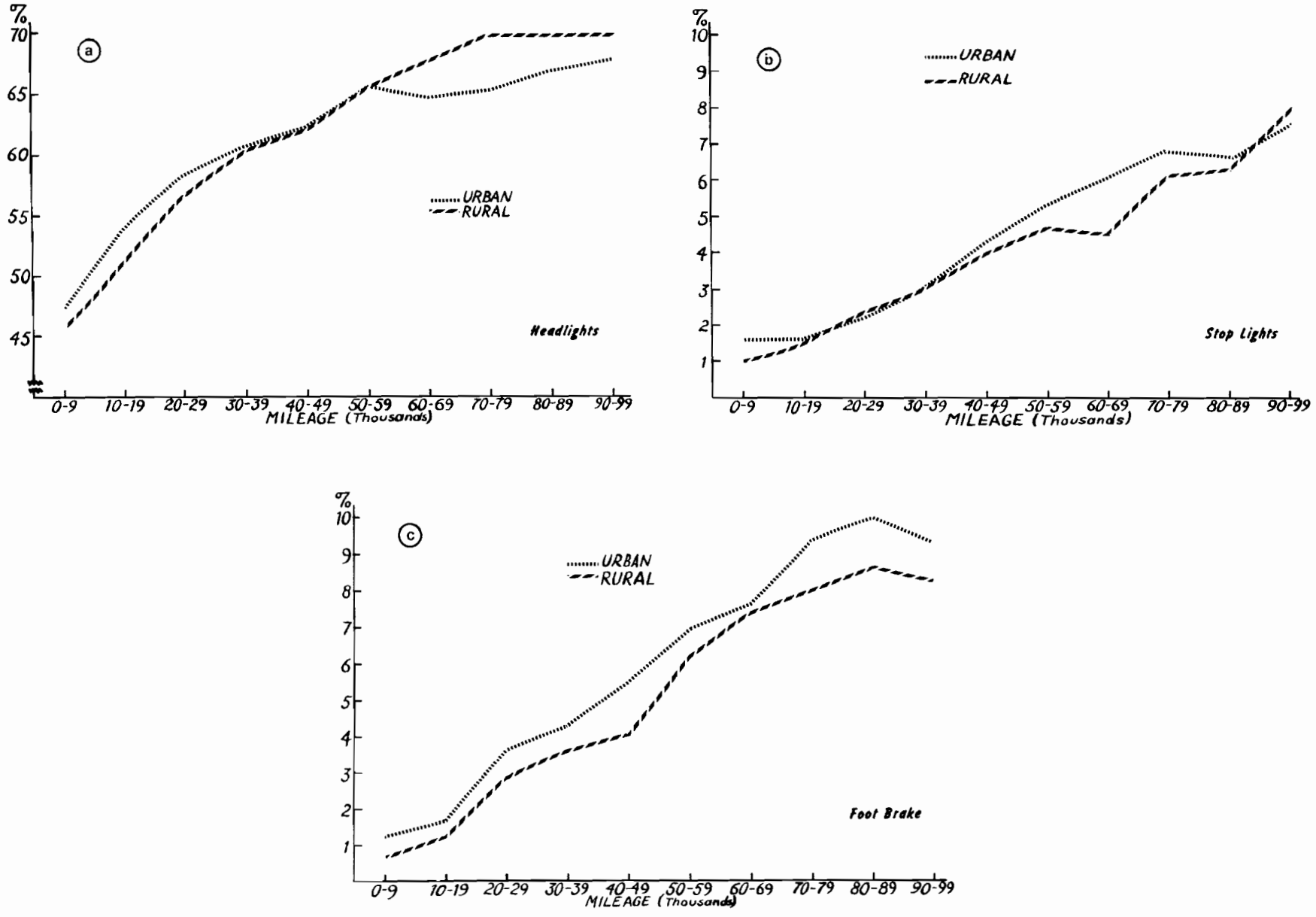


FIGURE 15a-c. FAILURE RATES BY PLACE OF RESIDENCE FOR HEADLIGHTS, STOP LIGHTS, AND FOOT BRAKE

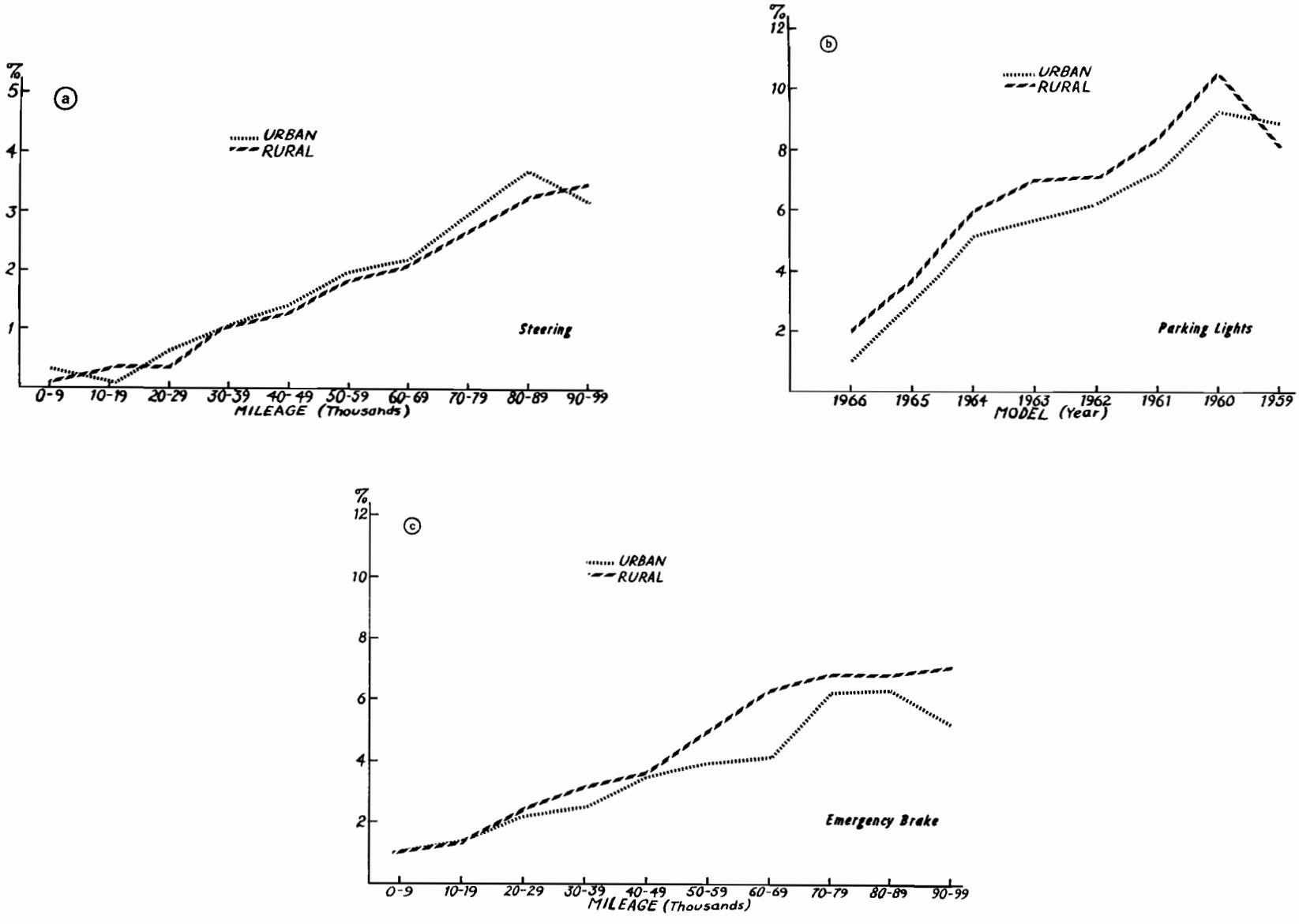


FIGURE 16a-c FAILURE RATES BY PLACE OF RESIDENCE FOR STEERING, PARKING LIGHTS, AND EMERGENCY BRAKE

DISCUSSION AND SUMMARY

Over the first three years of compulsory motor vehicle inspection in North Carolina, the overall item failure rates have, in general, shown a notable downward trend with a corresponding reduction in the associated repair costs. The most significant reduction is seen in headlight failures, dropping from about 60% failures to less than 30%.

For the special sample of privately-owned passenger cars inspected in December 1966, there is a positive association of both age and mileage of vehicle with the percentage of cars failing inspection (i.e. the higher mileage cars and/or the older cars had the higher proportions of initial failures). The failure rates ranged from nearly 50% for new, low mileage cars to over 80% for old, high mileage cars with an overall failure rate of approximately 70%. As would be expected, the average repair charges reflected the same general trends.

In terms of magnitude of failure rates, headlights clearly topped the list with an overall failure rate of 61% followed by the license plate light at 16%; steering and horn failures were at the bottom at 1.4% and 1.0% respectively with the remaining items intermediate (ranging from 2.3% to 5.9%). The failure rates for each of the eleven inspection items were positively associated with the mileage and model year of the vehicle; i.e. the failure rates increased with increasing vehicle mileage and/or age.

Urban cars appeared to be newer with corresponding lower mileages than the rural cars but were subject to repair charges that were

consistently approximately 25 cents higher. Also, the urban cars appeared to have slightly higher failure rates for stop lights, foot brake and steering while the rural cars showed higher failure rates for parking lights and emergency brakes. However, for headlights there is a reversal in that the low mileage urban cars and the high mileage rural cars had the higher failure rates.

The existence of substantially higher rejection percentages for older, high mileage cars raises the possibility of trying a new inspection procedure. Under such a procedure, the content and depth of the inspection process would be based on car mileage and perhaps age. Thus, for example, for cars with more than 30,000 miles the brake examination might require pulling the wheel to inspect the linings, whereas for cars with fewer miles a less rigid brake inspection would suffice.

This "variable requirement" procedure as an alternative to an across-the-board stiffening of all inspection raises the problem of an additional cost to the vehicle owner. If the uniform inspection fee is dropped, the added burden would fall on the owners of the oldest cars--a group perhaps less able to pay. On the other hand, if the uniform inspection fee is retained, the owners of the newer, low mileage cars would be paying more than their share for the inspection program. At any rate, this procedure would allow for stiffening the procedure for the most logical group of cars--the ones driven longest and hardest.

APPENDIX: Supplementary Tables

(Note: For Table A-1, the figures in parentheses represent the percentage distribution of the sample by model year; for Table A-2, they represent the percentage of the sample failing initial inspection; for Table A-3, they represent the average repair charges in dollars; for Tables A-4 through A-14, they represent the percentage of the sample incurring the indicated safety equipment failures.)

Table A-1. Distribution of Sample by Mileage and Model Year

MODEL YEAR	ODOMETER READING (in thousands) 0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	(by single years) TOTAL	RURAL	URBAN
1965-66	1793	4809	3716	1607	633	223	128	*	*	*	12,909	4237	1941	2296
	(13.89)	(37.25)	(28.79)	(12.45)	(4.90)	(1.73)	(0.99)				(27.23)	(8.93)	(8.57)	(9.28)
												8672	3950	4722
												(18.29)	(17.43)	(19.08)
1963-64	216	997	2629	3777	3120	1971	1084	505	235	*	14,534	7487	3492	3995
	(1.49)	(6.86)	(18.09)	(25.99)	(21.47)	(13.56)	(7.46)	(3.47)	(1.62)		(30.66)	(15.79)	(15.41)	(16.14)
												7047	3308	3739
												(14.86)	(14.60)	(15.11)
1961-62	*	284	529	1228	2012	2349	2038	1354	709	387	10,890	6247	2999	3248
		(2.61)	(4.86)	(11.28)	(18.48)	(21.57)	(18.71)	(12.43)	(6.51)	(3.55)	(22.97)	(13.17)	(13.24)	(13.13)
												4643	2301	2342
												(9.79)	(10.16)	(9.46)
1959-60	*	*	340	553	960	1547	1811	1717	1306	835	9069	4924	2510	2414
			(3.75)	(6.10)	(10.59)	(17.06)	(19.97)	(18.93)	(14.40)	(9.21)	(19.13)	(10.38)	(11.08)	(9.76)
												4145	2157	1988
												(8.74)	(9.52)	(8.03)
TOTAL	2009	6090	7214	7165	6725	6090	5061	3576	2250	1222		47,402	22,658	24,744
	(4.23)	(12.84)	(15.21)	(15.11)	(14.18)	(12.84)	(10.67)	(7.54)	(4.74)	(2.57)			(47.80)	(52.20)
RURAL	806	2606	3260	3277	3223	2980	2591	1903	1268	744				
	(3.56)	(11.50)	(14.39)	(14.46)	(14.22)	(13.15)	(11.44)	(8.40)	(5.60)	(3.28)				
URBAN	1203	3484	3954	3888	3502	3110	2470	1673	982	478				
	(4.86)	(14.08)	(15.98)	(15.71)	(14.15)	(12.57)	(9.98)	(6.76)	(3.97)	(1.93)				

Table A-2. Distribution of Vehicles with Failures

MODEL YEAR	ODOMETER READING (in thousands) 0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	(by single years) TOTAL	RURAL	URBAN
1965-66	888	2721	2321	1055	450	156	90	*	*	*	7681	2215	1010	1205
	(49.53)	(56.58)	(62.46)	(65.65)	(71.09)	(69.96)	(70.31)				(59.50)	(52.28)	(52.04)	(52.48)
												5466	2482	2984
												(63.03)	(62.84)	(63.19)
1963-64	134	638	1774	2638	2212	1466	814	390	188	*	10,254	5117	2378	2739
	(62.04)	(63.99)	(67.48)	(69.84)	(70.90)	(74.38)	(75.09)	(77.23)	(80.00)		(70.55)	(68.35)	(68.10)	(68.56)
												5137	2423	2714
												(72.90)	(73.25)	(72.59)
1961-62	*	198	399	920	1484	1813	1600	1060	564	313	8351	4739	2291	2448
		(69.72)	(75.43)	(74.92)	(73.76)	(77.18)	(78.51)	(78.29)	(79.55)	(80.88)	(76.68)	(75.86)	(76.39)	(75.37)
												3612	1824	1788
												(77.79)	(79.27)	(76.35)
1959-60	*	*	264	430	723	1211	1422	1373	1049	677	7149	3850	1969	1881
			(77.65)	(77.76)	(75.31)	(78.28)	(78.52)	(79.97)	(80.32)	(81.08)	(78.82)	(78.19)	(78.45)	(77.92)
												3299	1711	1588
												(79.59)	(79.32)	(79.88)
TOTAL	1022	3557	4758	5043	4869	4646	3926	2823	1801	990		33,435	16,088	17,347
	(50.87)	(58.40)	(65.95)	(70.38)	(72.40)	(76.28)	(77.57)	(78.94)	(80.04)	(81.01)		(70.53)	(33.94)	(36.60)
RURAL	409	1481	2113	2290	2327	2281	2033	1535	1015	604				
	(50.74)	(56.83)	(64.82)	(69.88)	(72.20)	(76.54)	(78.46)	(80.66)	(80.05)	(81.18)				
URBAN	613	2076	2645	2753	2542	2365	1893	1288	786	386				
	(50.96)	(59.59)	(66.89)	(70.81)	(72.59)	(76.05)	(76.64)	(76.99)	(80.04)	(80.75)				

Table A-3. Average Repair Charge

MODEL YEAR	ODOMETER READING (in thousands) 0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	(by single years) TOTAL	RURAL	URBAN
1965-66	825 (2.02)	2526 (2.00)	2173 (2.04)	983 (2.38)	417 (2.38)	152 (2.49)	83 (2.52)	*	*	*	7159 (2.11)	2038 (2.05)	924 (1.97)	1114 (2.11)
												5121 (2.13)	2341 (1.98)	2780 (2.25)
1963-64	123 (2.07)	603 (2.28)	1668 (2.12)	2480 (2.31)	2069 (2.27)	1380 (2.52)	765 (2.57)	365 (2.63)	178 (2.99)	*	9631 (2.34)	4799 (2.23)	2218 (2.09)	2581 (2.35)
												4832 (2.45)	2285 (2.36)	2547 (2.52)
1961-62	*	191 (3.02)	366 (2.48)	864 (2.73)	1387 (2.70)	1711 (2.93)	1505 (2.90)	1002 (2.74)	539 (3.24)	297 (2.75)	7862 (2.83)	4467 (2.67)	2163 (2.53)	2304 (2.81)
												3395 (3.04)	1725 (2.84)	1670 (3.26)
1959-60	*	*	241 (3.26)	403 (3.26)	686 (3.37)	1124 (3.22)	1306 (3.10)	1284 (3.43)	977 (3.40)	632 (3.62)	6653 (3.32)	3593 (3.25)	1854 (3.18)	1739 (3.33)
												3060 (3.40)	1597 (3.19)	1463 (3.64)
TOTAL	948 (2.03)	3320 (2.11)	4448 (2.17)	4730 (2.48)	4559 (2.57)	4367 (2.86)	3659 (2.89)	2651 (3.06)	1694 (3.31)	929 (3.34)		31,305 (2.62)	15,107 (2.50)	16,198 (2.72)
RURAL	374 (1.92)	1388 (2.03)	1981 (2.01)	2157 (2.35)	2170 (2.41)	2158 (2.69)	1891 (2.75)	1445 (2.93)	965 (3.02)	578 (3.20)				
URBAN	574 (2.10)	1932 (2.17)	2467 (2.30)	2573 (2.59)	2389 (2.72)	2209 (3.03)	1768 (3.05)	1206 (3.21)	729 (3.68)	351 (3.57)				

Table A-4. Headlight Failure

ODOMETER READING (in thousands)

MODEL YEAR	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	(by single years) TOTAL	RURAL	URBAN
1965-66	823 (45.90)	2477 (51.51)	2024 (54.47)	912 (56.75)	382 (60.35)	138 (61.88)	76 (59.37)	*	*	*	6832 (52.92)	2007 (47.37)	908 (46.78)	1099 (47.87)
												4825 (55.64)	2191 (55.47)	2634 (55.78)
1963-64	113 (52.31)	563 (56.47)	1541 (58.62)	2257 (59.76)	1894 (60.71)	1260 (63.93)	704 (64.94)	335 (66.34)	164 (69.79)	*	8831 (60.76)	4412 (58.93)	2050 (58.71)	2362 (59.12)
												4419 (62.71)	2095 (63.33)	2324 (62.16)
1961-62	*	169 (59.51)	343 (64.84)	785 (63.93)	1280 (63.62)	1545 (65.77)	1382 (66.35)	902 (66.62)	473 (66.71)	268 (69.25)	7147 (65.63)	4076 (65.25)	1965 (65.52)	2111 (64.99)
												3071 (66.14)	1555 (67.58)	1516 (64.73)
1959-60	*	*	233 (68.52)	375 (67.81)	617 (64.27)	1040 (67.23)	1187 (65.54)	1182 (68.84)	903 (69.14)	575 (68.86)	6112 (67.39)	3302 (67.06)	1708 (68.05)	1594 (66.03)
												2810 (67.79)	1473 (68.29)	1337 (67.25)
TOTAL	936 (46.59)	3209 (52.69)	4141 (57.40)	4329 (60.42)	4173 (62.05)	3983 (65.40)	3349 (66.17)	2419 (67.64)	1540 (68.44)	843 (68.99)		28,922 (61.01)	13,945 (29.42)	14,977 (31.60)
RURAL	369 (45.78)	1330 (51.04)	1846 (56.63)	1975 (60.27)	1996 (61.93)	1946 (65.30)	1753 (67.66)	1327 (69.73)	884 (69.72)	519 (69.76)				
URBAN	567 (47.13)	1879 (53.93)	2295 (58.04)	2354 (60.55)	2177 (62.16)	2037 (65.50)	1596 (64.62)	1092 (65.27)	656 (66.80)	324 (67.78)				

Table A-5. Stop Light Failure

MODEL YEAR	ODOMETER READING (in thousands) 0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	(by single years) TOTAL	RURAL	URBAN
1965-66	21 (1.17)	57 (1.19)	62 (1.67)	40 (2.49)	19 (3.00)	10 (4.48)	5 (3.91)	*	*	*	214 (1.65)	45 (1.06)	22 (1.13)	23 (1.00)
												169 (1.94)	81 (2.05)	88 (1.86)
1963-64	6 (2.78)	28 (2.81)	58 (2.21)	93 (2.46)	98 (3.14)	67 (3.40)	33 (3.04)	18 (3.56)	11 (4.68)	*	412 (2.83)	201 (2.68)	81 (2.32)	120 (3.00)
												211 (2.99)	95 (2.87)	116 (3.10)
1961-62	*	11 (3.87)	23 (4.35)	51 (4.15)	97 (4.82)	115 (4.90)	106 (5.20)	68 (5.02)	36 (5.08)	17 (4.39)	524 (4.81)	280 (4.48)	123 (4.10)	157 (4.83)
												244 (5.25)	128 (5.56)	116 (4.95)
1959-60	*	*	20 (5.88)	30 (5.42)	62 (6.46)	112 (7.24)	123 (6.79)	144 (8.39)	98 (7.50)	78 (9.34)	667 (7.35)	334 (6.78)	166 (6.61)	168 (6.96)
												333 (8.03)	163 (7.56)	170 (8.55)
TOTAL	27 (1.34)	96 (1.58)	163 (2.26)	214 (2.99)	276 (4.10)	304 (4.99)	267 (5.28)	230 (6.43)	145 (6.44)	95 (7.77)		1817 (3.83)	859 (1.81)	958 (2.02)
RURAL	8 (0.99)	39 (1.50)	77 (2.36)	97 (2.96)	126 (3.91)	139 (4.66)	118 (4.55)	116 (6.10)	80 (6.31)	59 (7.93)				
URBAN	19 (1.58)	57 (1.64)	86 (2.18)	117 (3.01)	150 (4.28)	165 (5.31)	149 (6.03)	114 (6.81)	65 (6.62)	36 (7.53)				

Table A-6. Foot Brake Failure

ODOMETER READING (in thousands)

MODEL YEAR	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	(by single years) TOTAL	RURAL	URBAN
1965-66	16 (0.89)	42 (0.87)	63 (1.70)	37 (2.30)	14 (2.21)	3 (1.35)	3 (2.34)	*	*	*	178 (1.38)	40 (0.94)	13 (0.67)	27 (1.18)
												138 (1.59)	54 (1.37)	84 (1.78)
1963-64	4 (1.85)	27 (2.71)	79 (3.00)	120 (3.18)	105 (3.37)	79 (4.01)	48 (4.43)	24 (4.75)	14 (5.96)	*	500 (3.44)	214 (2.86)	83 (2.38)	131 (3.28)
												286 (4.06)	128 (3.87)	158 (4.23)
1961-62	*	21 (7.39)	43 (8.13)	87 (7.08)	125 (6.21)	192 (8.17)	156 (7.65)	118 (8.71)	66 (9.31)	28 (7.24)	836 (7.68)	424 (6.79)	181 (6.04)	243 (7.48)
												412 (8.87)	198 (8.60)	214 (9.14)
1959-60	*	*	35 (10.29)	39 (7.05)	77 (8.02)	126 (8.14)	172 (9.50)	167 (9.73)	127 (9.72)	77 (9.22)	820 (9.04)	442 (8.98)	222 (8.84)	220 (9.11)
												378 (9.12)	194 (8.99)	184 (9.26)
TOTAL	20 (1.00)	90 (1.48)	220 (3.05)	283 (3.95)	321 (4.77)	400 (6.57)	379 (7.49)	309 (8.64)	207 (9.20)	105 (8.59)		2334 (4.92)	1073 (2.26)	1261 (2.66)
RURAL	5 (0.62)	32 (1.23)	92 (2.82)	117 (3.57)	129 (4.00)	184 (6.17)	191 (7.37)	153 (8.04)	109 (8.60)	61 (8.20)				
URBAN	15 (1.25)	58 (1.66)	128 (3.24)	166 (4.27)	192 (5.48)	216 (6.95)	188 (7.61)	156 (9.32)	98 (9.98)	44 (9.21)				

Table A-7. Steering Failure

ODOMETER READING (in thousands)

MODEL YEAR	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	(by single years) TOTAL	RURAL	URBAN
1965-66	1 (0.06)	6 (0.12)	9 (0.24)	7 (0.44)	10 (1.58)	0 (0.00)	1 (0.78)	*	*	*	34 (0.26)	10 (0.24)	3 (0.15)	7 (0.30)
												24 (0.28)	15 (0.38)	9 (0.19)
1963-64	4 (1.86)	1 (0.10)	6 (0.23)	30 (0.79)	22 (0.71)	22 (1.12)	9 (0.83)	8 (1.58)	5 (2.13)	*	107 (0.74)	39 (0.52)	17 (0.49)	22 (0.55)
												68 (0.96)	29 (0.88)	39 (1.04)
1961-62	*	6 (2.11)	9 (1.70)	19 (1.55)	33 (1.64)	52 (2.21)	50 (2.46)	25 (1.85)	20 (2.82)	13 (3.36)	227 (2.08)	101 (1.62)	44 (1.47)	57 (1.75)
												126 (2.71)	69 (3.00)	57 (2.43)
1959-60	*	*	12 (3.53)	20 (3.62)	25 (2.60)	41 (2.65)	47 (2.60)	67 (3.90)	52 (3.98)	28 (3.35)	292 (3.22)	157 (3.19)	74 (2.95)	83 (3.44)
												135 (3.26)	72 (3.34)	63 (3.17)
TOTAL	5 (0.25)	13 (0.21)	36 (0.50)	76 (1.06)	90 (1.34)	115 (1.89)	107 (2.11)	100 (2.80)	77 (3.42)	41 (3.36)		660 (1.39)	323 (0.68)	337 (0.71)
RURAL	1 (0.12)	10 (0.38)	11 (0.34)	35 (1.07)	41 (1.27)	54 (1.81)	53 (2.05)	51 (2.68)	41 (3.23)	26 (3.49)				
URBAN	4 (0.33)	3 (0.09)	25 (0.63)	41 (1.05)	49 (1.40)	61 (1.96)	54 (2.19)	49 (2.93)	36 (3.67)	15 (3.14)				

Table A-8. Parking Light Failure

MODEL YEAR	ODOMETER READING (in thousands) 0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	(by single years) TOTAL	RURAL	URBAN
1965-66	21 (1.17)	88 (1.82)	116 (3.12)	69 (4.29)	26 (4.10)	19 (8.52)	9 (7.03)	*	*	*	348 (2.69)	64 (1.51)	40 (2.06)	24 (1.05)
												284 (3.27)	144 (3.65)	140 (2.96)
1963-64	10 (4.62)	38 (3.81)	100 (3.80)	207 (5.48)	212 (6.79)	141 (7.15)	75 (6.91)	48 (9.50)	26 (11.06)	*	857 (5.89)	413 (5.51)	207 (5.93)	206 (5.16)
												444 (6.30)	230 (6.95)	214 (5.72)
1961-62	*	24 (8.45)	27 (5.10)	67 (5.45)	121 (6.01)	175 (7.44)	131 (6.42)	123 (9.08)	66 (9.30)	41 (10.59)	775 (7.11)	415 (6.64)	212 (7.07)	203 (6.25)
												360 (7.75)	191 (8.30)	169 (7.22)
1959-60	*	*	27 (7.94)	40 (7.23)	75 (7.81)	133 (8.59)	161 (8.89)	163 (9.49)	150 (11.48)	90 (10.77)	839 (9.25)	488 (9.91)	264 (10.52)	224 (9.28)
												351 (8.46)	175 (8.11)	176 (8.85)
TOTAL	31 (1.54)	150 (2.46)	270 (3.74)	383 (5.34)	434 (6.45)	468 (7.68)	376 (7.42)	334 (9.34)	242 (10.75)	131 (10.72)		2819 (5.94)	1463 (3.09)	1356 (2.86)
RURAL	19 (2.36)	69 (2.65)	117 (3.59)	188 (5.74)	207 (6.42)	258 (8.66)	193 (7.45)	200 (10.51)	130 (10.25)	82 (11.02)				
URBAN	12 (1.00)	81 (2.54)	153 (3.87)	195 (5.02)	227 (6.48)	210 (6.75)	183 (7.41)	134 (8.01)	112 (11.41)	49 (10.25)				

Table A-9. Emergency Brake Failure

MODEL YEAR	ODOMETER READING (in thousands) 0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	(by single years) TOTAL	RURAL	URBAN
1965-66	16 (0.89)	47 (0.97)	72 (1.93)	41 (2.55)	22 (3.47)	7 (3.13)	5 (3.90)	*	*	*	210 (1.62)	47 (1.10) 163 (1.87)	18 (0.93) 88 (2.23)	29 (1.26) 75 (1.59)
1963-64	4 (1.85)	12 (1.20)	49 (1.86)	88 (2.32)	89 (2.85)	83 (4.21)	49 (4.52)	27 (5.34)	14 (5.95)	*	415 (2.85)	165 (2.20) 250 (3.54)	80 (2.29) 134 (4.05)	85 (2.13) 116 (3.10)
1961-62	*	22 (7.74)	16 (3.02)	43 (3.50)	74 (3.67)	94 (4.00)	96 (4.71)	72 (5.31)	38 (5.35)	21 (5.42)	476 (4.37)	244 (3.90) 232 (4.99)	126 (4.20) 133 (5.78)	118 (3.63) 99 (4.23)
1959-60	*	*	29 (8.52)	29 (5.24)	54 (5.62)	89 (5.75)	115 (6.35)	134 (7.80)	97 (7.42)	57 (6.82)	604 (6.66)	321 (6.51) 283 (6.82)	174 (6.93) 169 (7.83)	147 (6.09) 114 (5.73)
TOTAL	20 (0.99)	81 (1.33)	166 (2.30)	201 (2.80)	239 (3.55)	273 (4.48)	265 (5.23)	233 (6.51)	149 (6.62)	78 (6.38)		1705 (3.59)	922 (1.95)	783 (1.65)
RURAL	8 (0.99)	33 (1.27)	79 (2.42)	103 (3.14)	118 (3.66)	149 (5.00)	163 (6.29)	129 (6.78)	87 (6.86)	53 (7.12)				
URBAN	12 (1.00)	48 (1.38)	87 (2.20)	98 (2.52)	121 (3.46)	124 (3.99)	102 (4.13)	104 (6.22)	62 (6.32)	25 (5.23)				

Table A-10. License Plate Light Failure

MODEL YEAR	ODOMETER READING (in thousands) 0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	TOTAL (by single years)
1965-66	67	324	373	206	86	28	19	*	*	*	1103	235
	(3.73)	(6.73)	(10.03)	(12.81)	(13.42)	(12.55)	(14.84)				(8.54)	(5.54) 868 (10.00)
1963-64	25	94	304	505	489	356	226	107	49	*	2155	1036 (13.83)
	(11.57)	(9.42)	(11.56)	(13.37)	(15.67)	(18.06)	(20.84)	(21.18)	(20.85)		(14.82)	1119 (15.87)
1961-62	*	35	74	195	397	528	475	318	201	110	2333	1208 (19.33)
		(12.32)	(13.98)	(15.87)	(19.73)	(22.47)	(23.30)	(23.48)	(28.34)	(28.42)	(21.42)	1125 (24.23)
1959-60	*	*	63	101	185	288	393	400	312	210	1952	1014 (20.59)
			(18.52)	(18.26)	(19.27)	(18.61)	(20.56)	(23.29)	(23.88)	(25.14)	(21.52)	938 (22.62)
TOTAL	92	453	814	1007	1157	1200	1113	825	562	320	7543	
	(4.57)	(7.43)	(11.28)	(14.05)	(17.20)	(19.70)	(21.99)	(23.07)	(24.97)	(26.18)	(15.91)	

Table A-11. Tail Light Failure

MODEL YEAR	ODOMETER READING (in thousands) 0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	TOTAL (by single years)
1965-66	5	61	55	32	23	10	5	*	*	*	191	29 (0.68)
	(0.28)	(1.27)	(1.48)	(1.99)	(3.63)	(4.48)	(3.91)				(1.47)	162 (1.86)
1963-64	4	18	52	95	85	65	31	22	13	*	385	195 (2.60)
	(1.85)	(1.81)	(1.98)	(2.52)	(2.72)	(3.30)	(2.86)	(4.36)	(5.53)		(2.64)	190 (2.69)
1961-62	*	15	24	47	74	95	68	66	39	16	444	240 (3.84)
		(5.28)	(4.54)	(3.83)	(3.68)	(4.04)	(3.34)	(4.87)	(5.50)	(4.13)	(4.07)	204 (4.39)
1959-60	*	*	25	24	52	93	104	111	84	56	549	274 (5.56)
			(7.35)	(4.34)	(5.42)	(6.01)	(5.74)	(6.46)	(6.43)	(6.71)	(6.05)	275 (6.63)
TOTAL	9 (0.45)	94 (1.54)	156 (2.16)	198 (2.76)	234 (3.48)	263 (4.32)	208 (4.11)	199 (5.56)	136 (6.04)	72 (5.89)	1569 (3.30)	

Table A-12. Directional Signal Failure

MODEL YEAR	ODOMETER READING (in thousands) 0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	TOTAL (by single years)
1965-66	19	86	115	70	26	12	4	*	*	*	332	75 (1.77)
	(1.05)	(1.78)	(3.09)	(4.35)	(4.10)	(5.38)	(3.12)				(2.57)	257 (2.96)
1963-64	8	29	87	166	139	94	64	32	14	*	633	329 (4.39)
	(3.70)	(2.90)	(3.30)	(4.39)	(3.54)	(4.76)	(5.90)	(6.33)	(5.95)		(4.35)	304 (4.31)
1961-62	*	24	29	78	132	167	165	116	62	37	810	424 (6.78)
		(8.45)	(5.48)	(6.35)	(6.56)	(7.10)	(8.09)	(8.56)	(8.74)	(9.56)	(7.43)	386 (8.31)
1959-60	*	*	22	47	93	130	144	149	131	74	790	405 (8.22)
			(6.47)	(8.49)	(9.68)	(8.40)	(7.95)	(8.67)	(10.03)	(8.86)	(8.71)	385 (9.28)
TOTAL	27 (1.34)	139 (2.28)	253 (3.50)	361 (5.03)	390 (5.79)	403 (6.61)	377 (7.44)	297 (8.30)	207 (9.20)	111 (9.08)	2565 (5.41)	

Table A-13. Windshield Wiper Failure

MODEL YEAR	ODOMETER READING (in thousands) 0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	TOTAL (by single years)
1965-66	4	18	26	22	16	1	3	*	*	*	90	11 (0.25)
	(0.22)	(0.37)	(0.69)	(1.36)	(2.52)	(0.44)	(2.34)				(0.69)	79 (0.91)
1963-64	4	12	41	73	50	59	23	18	10	*	290	110 (1.46)
	(1.85)	(1.20)	(1.55)	(1.93)	(1.60)	(2.99)	(2.12)	(3.56)	(4.25)		(1.99)	180 (2.55)
1961-62	*	7	17	31	55	68	60	44	26	9	317	158 (2.52)
		(2.46)	(3.21)	(2.52)	(2.73)	(2.89)	(2.94)	(3.24)	(3.66)	(2.32)	(2.91)	159 (3.42)
1959-60	*	*	17	19	34	61	70	76	54	49	363	211 (4.28)
			(5.00)	(3.43)	(3.54)	(3.94)	(3.86)	(4.42)	(4.13)	(5.86)	(4.00)	169 (4.07)
TOTAL	8 (0.39)	37 (0.60)	101 (1.40)	145 (2.02)	155 (2.30)	189 (3.10)	156 (3.08)	138 (3.85)	90 (4.00)	58 (4.74)	1077 (2.27)	

Table A-14. Horn Failure

MODEL YEAR	ODOMETER READING (in thousands) 0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOTAL	TOTAL (by single years)
1965-66	5	10	24	14	3	3	3	*	*	*	62	15 (0.35)
	(0.28)	(0.21)	(0.65)	(0.87)	(0.47)	(1.35)	(2.34)				(0.48)	47 (0.54)
1963-64	0	5	23	30	22	25	16	14	6	*	141	60 (0.80)
	(0.00)	(0.50)	(0.87)	(0.79)	(0.71)	(1.27)	(1.48)	(2.77)	(2.55)		(0.97)	81 (1.14)
1961-62	*	8	9	6	16	31	31	24	13	11	149	72 (1.15)
		(2.82)	(1.70)	(0.49)	(0.80)	(1.32)	(1.52)	(1.77)	(1.83)	(2.84)	(1.36)	77 (1.65)
1959-60	*	*	5	9	11	20	30	28	20	14	137	67 (1.36)
			(1.47)	(1.63)	(1.15)	(1.29)	(1.66)	(1.63)	(1.53)	(1.68)	(1.51)	70 (1.68)
TOTAL	5 (0.24)	23 (0.38)	61 (0.85)	59 (0.82)	52 (0.77)	79 (1.30)	80 (1.58)	66 (1.85)	39 (1.73)	25 (2.05)	489 (1.03)	