DISPERSION OF HIGHWAY TRAFFIC BY TIME PERIODS

Medium and Small Stations in Farm Area

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SYNOPSIS

The dispersion of hourly volume of highway traffic for the hours from 9 to 10 in the morning to those from 5 to 6 in the afternoon is far less than for the remaining hours of the day This is true for rural stations of small traffic volume as well as for dense traffic Since roughly half of the traffic moves during the other hours, an increase in precision of estimate can be obtained by restricting sampling to the hours of small dispersion and by the use of traffic patterns, from which the error of estimate of the mean is less than for the hours of large scatter These results are presented in seven charts and ten tables of statistical measures

Most studies of time periods of highway traffic volume have been devoted largely to averages in the form of trends, or patterns, and have been confined to incomplete data A year ago I read a short paper[1] on the subject of dispersion by time periods based on finite sub-populations of hours but confined to Holland Tunnel and George Washington Bridge, two populations of large volume Since that time the analysis has been extended to a station on a State highway south of Ames, Iowa, and to one on a rural graveled road south of Churdan, Iowa, selected as typical of a strictly local farm traffic population As was true a year ago, this paper is limited to dispersion within sub-populations for two stations with, however, some averages and comparisons with the results of the preceding study of Holland Tunnel and George Washington Bridge

The three time periods considered are (1) hours of the day, (2) days of the week, and (3) months of the year If the dispersion in volume of traffic within certain of the hours of the day, days of the week, and months of the year is less than for others, samples may be drawn from these with a reduction in error of estimate

[1] Proceedings, Highway Research Board, Vol. 17, page 413 (1937)

HOURS OF THE DAY

The constancy of traffic is much greater from nine in the morning to six in the afternoon than for the remainder of the 24 hours, even for stations of moderate to small volume in agricultural areas as well as on highways in great population centers (Fig 1 and Tables 1–2) It is also shown (Fig 1) that traffic on a typical local farm highway, such as that passing Churdan, Iowa, has wider dispersion than that on a State highway on the edge of a State college town of an average annual daily traffic of 3,272 vehicles The dispersion is very wide from 11 at night to six in the morning for Churdan, while it increases only moderately for the same period for Ames It is well known that traffic on local farm roads is small during the night, and the very wide dispersion for Churdan for the same period indicates that small traffic and wide scatter are associated The converse that dense traffic and small dispersion are associated is likewise true

The best eight hours for Ames is from nine in the morning to five in the afternoon For Churdan the lowest dispersion is from 8 a m to 1, from 2 to 3, and from 4 to 6 p m (Tables 1–2) For Churdan the hours from 1 to 2 and 3 to 4 p m show slightly higher dispersion than the eight hours mentioned as best (Fig 1) The dispersion by hours

shows that any convenient work period from 8 a m to 6 p m can be used for these two stations, but that by choosing the best work period slightly lower dispersion is included (Table 8) This is also near the same periods that showed smallest dispersion for Holland Tunnel and George Washington Bridge Since the four stations here tested range from one of the largest to a very small local farm station, it seems that the law of

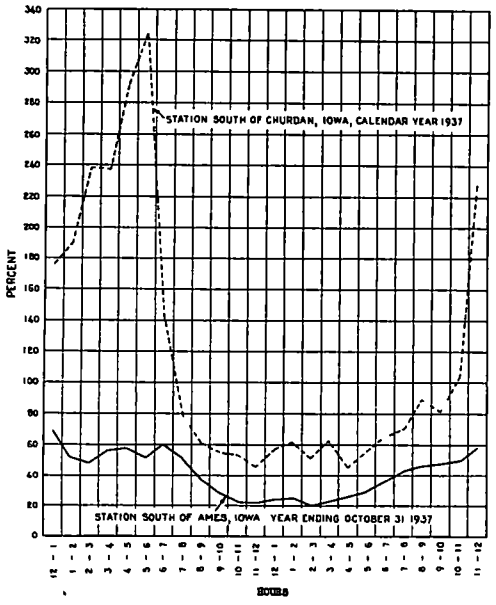

Figure 1. Dispersion of Number of Vehicles by Hours (in Chronological Order) for Stations and Years Specified on Figure, in Coefficient of Variation.

scatter is rather constant with the low period spreading from eight to 10 in the morning to five to six in the afternoon (Table 8)

The periods of greatest dispersion are from ten at night to seven in the morning From these periods it is likely that hourly patterns can be established for all hours except those used in the sample, and that from the sample and the pattern the estimate can be made with a higher degree of precision than if the widely scattered night hours had been included in the sample The traffic patterns can be computed from complete records or from large samples of a limited number of representative stations so that the error from the patterns may be small The error from the sample of the individual station may also be limited by confining the sample to the

TABLE 1

DISPERSION OF NUMBER OF VEHICLES BY HOURS OF THE DAY (IN CHRONOLOGICAL ORDER) FOR STATIONS AND YEARS SPECIFIED IN TABLE

Hour	Station south of Ames, Iowa Year ending October 31, 1937		Station south of Churdan, Iowa Calendar year 1937	
	Standard deviation[1]	Coefficient of variation[2]	Standard deviation[1]	Coefficient of variation[2]
a m	*vehicles*	*percent*	*vehicles*	*percent*
12– 1	42 82	68 50	2 34	177 33
1– 2	21 25	52 22	1 77	190 95
2– 3	12 20	47 82	1 18	238 55
3– 4	10 17	56 27	0 80	238 38
4– 5	10 64	57 53	0 73	288 30
5– 6	15 23	52 34	1 71	323 93
6– 7	32 76	60 21	2 41	141 78
7– 8	60 23	51 51	3 54	80 44
8– 9	61 38	38 93	4 06	60 53
9–10	55 73	28 79	4 06	55 81
10–11	47 67	23 12	4 65	54 15
11–12	43 07	22 33	3 81	45 72
12– 1	41 62	23 91	4 03	56 64
1– 2	51 82	24 65	5 25	61 89
2– 3	45 14	21 10	4 36	51 91
3– 4	50 85	22 94	5 16	62 88
4– 5	64 74	25 96	4 85	45 65
5– 6	74 56	29 20	4 79	56 41
6– 7	77 02	36 28	4 25	64 76
7– 8	77 26	43 13	4 89	70 42
8– 9	69 13	47 39	4 41	88 89
9–10	55 02	48 44	2 99	82 42
10–11	48 80	49 98	3 39	103 46
11–12	47 97	57 60	4 71	232 56

[1] Standard deviation of the 365 hours for each hour of the day for the year, for Ames computed by the group method, for Churdan, by items

[2] The coefficient of variation is the standard deviation divided by the mean of the 365 hours for each hour of the day

day hours of small dispersion It would also seem likely that the time required to collect the data might be reduced by restricting the number of observations in the sample and the number of stations included in the pattern While it may be difficult to apply the patterns to all stations, the error from this source is hardly likely to be as great as the sampling error from small samples of widely dispersed night hours

For Ames and Churdan combined (Table 7), the best nine hours are 9 a m to 6 p m , the best eight hours are the same, except 1 to 2, the best seven are 9 a m. to 6 p m , omitting 1 to 2 and 3 to 4 p m The hours of greatest dispersion are from 10 p m to 6 a m , and the very worst from 4 to 6 a m., the latter being due to Churdan (Table 7, column 2) The wide variation of the average coefficient of variation for the two stations, from 34 to 188 percent of the mean shows that the error of estimate would be greatly reduced by sampling from the hours of small scatter

TABLE 2

DISPERSION OF NUMBER OF VEHICLES BY HOURS OF THE DAY (IN ASCENDING ORDER OF THE COEFFICIENT OF VARIATION) FOR STATIONS AND YEARS SPECIFIED IN TABLE

Hour	Station south of Ames, Iowa Year ending Oct 31, 1937		Hour	Station south of Churdan, Iowa Calendar year 1937	
	Standard deviation	Coefficient of variation		Standard deviation	Coefficient of variation
	vehicles	*percent*		*vehicles*	*percent*
2- 3 p m	45 14	21 10	4- 5 p m	4 85	45 65
11-12 a m	43 07	22 33	11-12 a m	3 81	45 72
3- 4 p m	50 85	22 94	2- 3 p m	4 36	51 91
10-11 a m	47 67	23 12	10-11 a m	4 65	54 15
12- 1 p m	41 62	23 91	9-10 a m	4 06	55 81
1- 2 p m	51 82	24 65	5- 6 p m	4 79	56 41
4- 5 p m	64 74	25 96	12- 1 p m	4 03	56 64
9-10 a m	55 73	28 79	8- 9 a m	4 06	60 53
5- 6 p m	74 56	29 20	1- 2 p m	5 25	61 89
6- 7 p m	77 02	36 28	3- 4 p m	5 16	62 88
8- 9 a m	61 38	38 93	6- 7 p m	4 25	64 76
7- 8 p m	77 26	43 13	7- 8 p m	4 89	70 42
8- 9 p m	69 13	47 39	7- 8 a m	3 54	80 44
2- 3 a m	12 20	47 82	9-10 p m	2 99	82 42
9-10 p m	55 02	48 44	8- 9 p m	4 41	88 89
10-11 p m	48 80	49 98	10-11 p m	3 39	103 46
7- 8 a m	60 23	51 51	6- 7 a m	2 41	141 78
1- 2 a m	21 25	52 22	12- 1 a m	2 34	177 33
5- 6 a m	15 23	52 34	1- 2 a m	1 77	190.95
3- 4 a m	10 17	56 27	11-12 p m.	4 71	232 56
4- 5 a m	10 64	57 53	3- 4 a m	0 80	238 38
11-12 p m	47 97	57 60	2- 3 a m	1 18	238 55
6- 7 a m	32 76	60 21	4- 5 a m	0 73	288 30
12- 1 a m	42 82	68 50	5- 6 a m	1 71	323 93

DAYS OF THE WEEK

The dispersion of the volume of traffic by hours of the day for each day of the week is shown in Table 3 in time order for both Ames and Churdan, Iowa The same measures are shown in ascending numerical order in Table 4 The spread of the coefficient for Ames is from 64 55 percent of the mean to 71 8

percent, and for Churdan it is not very much greater, extending from 88 75 percent of the mean to 105 4 percent For Ames the smallest coefficient is for Thursday, the second smallest is for Saturday, followed by the remainder of the weekdays and Sunday with the largest variation For Churdan, however, Thursday shows the largest scatter of hourly traffic, with Sunday second largest, Saturday third, and the remaining four days of the week with smaller dispersion While the scatter as a whole is not very great in view of the very small traffic at Churdan, the Thursday scatter is materially larger than even Sunday, while Wednesday has rather materially smaller dispersion than the other days of the week Saturday stands near the middle in dispersion and is not widely separated from the other weekdays The usual rule for traffic on State highways is likely more nearly represented by Ames than by the local farm station of Churdan This means that Thursday and Saturday usually have rather small dispersion while Sunday has rather large scatter For Churdan, however, Thursday is the day of largest dispersion This is probably due to the custom of marketing on the part of farmers on Thursday afternoons, resulting in something of a holiday for that period In the record here included, a homecoming of a large family caused the maximum traffic of the year to fall on Thursday, and most of the large hours of traffic fell on some Thursday of the year, including ball games and probably other institutional dates It is unusual, therefore, for Thursday to be the most widely dispersed day of the week Nevertheless, it is likely that this custom prevails among the farms of northern Iowa to

TABLE 3

DISPERSION OF NUMBER OF VEHICLES BY HOURS FOR EACH DAY OF THE WEEK (IN CHRONOLOGICAL ORDER) FOR STATIONS AND YEARS SPECIFIED IN TABLE

Day of week	Station south of Ames, Iowa Year ending Oct 31, 1937		Station south of Churdan, Iowa Calendar year 1937	
	Standard deviation[1]	Coefficient of variation	Standard deviation[1]	Coefficient of variation
	vehicles	*percent*	*vehicles*	*percent*
Sunday	116 20	71 75	5 28	99 18
Monday	84 28	65 16	5 09	97 51
Tuesday	82 89	66 88	4 55	97 36
Wednesday	88 18	68 26	4 28	88 75
Thursday	80 48	64 55	5 63	105 36
Friday	88 43	65 49	4 88	97 39
Saturday	97 20	64 87	4 40	98 56

[1] Standard deviation of the hours of each day of the week for the year

TABLE 4

DISPERSION OF NUMBER OF VEHICLES BY HOURS FOR EACH DAY OF THE WEEK (IN ASCENDING ORDER OF THE COEFFICIENT OF VARIATION) FOR STATIONS AND YEARS SPECIFIED IN TABLE

Day of week	Station south of Ames, Iowa Year ending Oct 31, 1937		Day of week	Station south of Churdan, Iowa Calendar year 1937	
	Standard deviation	Coefficient of variation		Standard deviation	Coefficient of variation
	vehicles	*percent*		*vehicles*	*percent*
Thursday	80 48	64 55	Wednesday	4 28	88 75
Saturday	97 20	64 87	Tuesday	4 55	97 36
Monday	84 28	65 16	Friday	4 88	97 39
Friday	88 43	65 49	Monday	5 09	97 51
Tuesday	82 89	66 88	Saturday	4 40	98 56
Wednesday	88 18	68 26	Sunday	5 28	99 18
Sunday	116 20	71 75	Thursday	5 63	105 36

some considerable extent, and that Thursdays and Sundays are, therefore, the worst days for sampling highway traffic in this farm region

Figure 2 shows that the coefficient of variation for days of the week is rather constant for Ames and not widely irregular for Churdan except for Thursday and Wednesday The scatter is materially greater, however, for Churdan

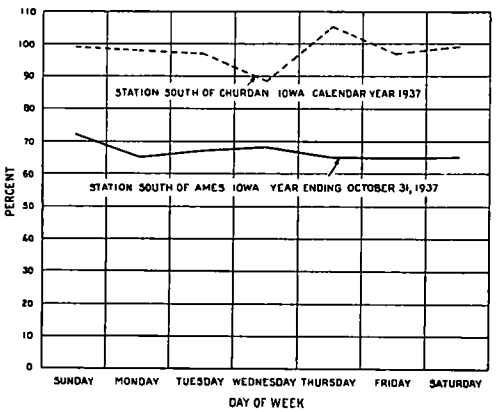

Figure 2 Dispersion of Number of Vehicles by Hours for Each Day of the Week (in Chronological Order) for Stations and Years Specified on Figure, in Coefficient of Variation.

for all days of the week than for the larger State highway station of Ames

MONTHLY DISPERSION OF HOURLY TRAFFIC

Dispersion of hourly traffic by months is shown in chronological order in Table 5, and the same measures are shown in ascending order of coefficient of variation in Table 6 For Ames the coefficient is not widely scattered among the months, varying from 56 3 percent for July to 74 2 percent for February For Churdan, however, the scatter of the coefficient ranges from 82 percent for September to 135 percent for January The three winter months are shown to have the greatest dispersion in hourly traffic for both stations, January having greater dispersion than February for Churdan, but February having greater scatter for Ames For Ames the four months of least dispersion are July, June, August, and May, but for Churdan the four of least scatter are September, August, July, and May. Some of the factors in the displacement of June are the very large traffic on the homecoming day of June 17 and the close confinement to farm operations during the month of June The latter factor leaves very small traffic as probable for most

TABLE 5

DISPERSION OF NUMBER OF VEHICLES BY HOURS FOR EACH MONTH OF THE YEAR (IN CHRONOLOGICAL ORDER) FOR STATIONS AND YEARS SPECIFIED IN TABLE

Month of year	Station south of Ames, Iowa Year ending October 31, 1937		Station south of Churdan, Iowa Calendar year 1937	
	Standard deviation	Coefficient of variation	Standard deviation	Coefficient of variation
	vehicles	*percent*	*vehicles*	*percent*
January	60 17	70 35	4 95	135 33
February	67 75	74 20	4 12	124 69
March	88 99	68 30	4 39	100 76
April	88 73	65 28	4 33	91 43
May	91 86	62 54	4 47	88 72
June	91 29	59 50	5 87	104 65
July	84 81	56 32	5 13	87 59
August	107 40	59 64	4 83	82 46
September	103 44	62 95	4 72	81 95
October	102 17	67 79	4 79	92 13
November	91 36	67 71	4 95	91 98
December	75 02	68 68	5 29	107 74

days of that month, while some special occasions furnish large hourly volumes causing the scatter to widen In general, however, the winter months have greatest dispersion, and the summer months are those of least scatter This indicates that sampling can best be done in the summer period, but the difference is not extremely great except for Churdan

The dispersion for Churdan is shown to be at the extreme for January, February, December, and June on Figure 3

The best period for sampling, however, for most stations ranges from May to September through the summer period with the exception of June for Churdan

TABLE 6

DISPERSION OF NUMBER OF VEHICLES BY HOURS FOR EACH MONTH OF THE YEAR (IN ASCENDING ORDER OF THE COEFFICIENT OF VARIATION) FOR THE STATIONS AND YEARS SPECIFIED IN TABLE

Month of year	Station south of Ames, Iowa Year ending October 31, 1937		Month of year	Station south of Churdan, Iowa Calendar year 1937	
	Standard deviation	Coefficient of variation		Standard deviation	Coefficient variation
	vehicles	*percent*		*vehicles*	*percent*
July	84 81	56 32	September	4 72	81 95
June	91 29	59 50	August	4 83	82 46
August	107 40	59 64	July	5 13	87 59
May	91 86	62 54	May	4 47	88 72
September	103 44	62 95	April	4 33	91 43
April	88 73	65 28	November	4 95	91 98
November	91 36	67 71	October	4 79	92 13
October	102 17	67 79	March	4 39	100 76
March	88 99	68 30	June	5 87	104 65
December	75 02	68 68	December	5 29	107 74
January	60 17	70 35	February	4 12	124 69
February	67 75	74 20	January	4 95	135 33

AVERAGE DISPERSION FOR TWO STATIONS AND FOR FOUR

The average dispersion for Ames and Churdan for the three time periods is indicated in Table 7, arranged in order of ascending coefficient of variation This table shows that the scatter is much wider among the hours of the day than among either the days of the week or the months of the year A considerable reduction in error of estimate can be obtained by combining the factors of constancy for hours of the day, for the summer months, and for weekdays

When the average coefficient of variation for the four stations of Holland Tunnel, George Washington Bridge, Ames, and Churdan is made for the subpopulations, something of a representation of stations of all sizes is included, and the range of scatter is reduced for all three time periods. The hours of the day from 9 to 12 in the morning and from 2 to 6 in the afternoon are those of smallest dispersion, the coefficient of variation for these hours being less than 40 percent of the mean (Table 8, column 2)

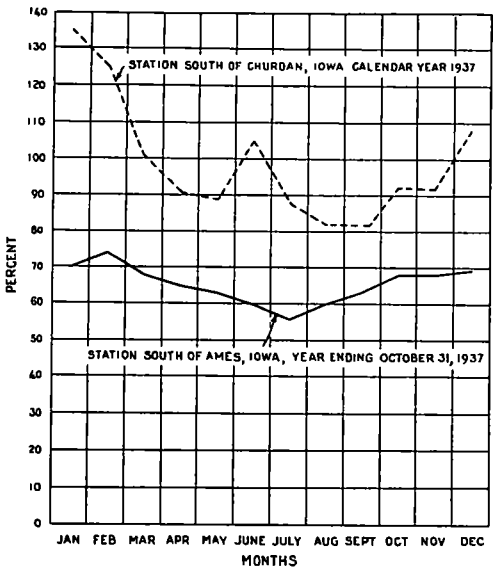

Figure 3. Dispersion of Number of Vehicles by Hours for Each Month of the Year (in Chronological Order) for Stations and Years Specified on Figure, in Coefficient of Variation

TABLE 7

AVERAGE COEFFICIENT OF VARIATION OF HOURS FOR SUB-POPULATIONS OF A STATION SOUTH OF AMES, IOWA, AND ONE SOUTH OF CHURDAN, IOWA, IN ASCENDING ORDER OF COEFFICIENT

Hour of day	Average coefficient	Day of week	Average coefficient	Month of year	Average coefficient
	percent		*percent*		*percent*
11–12 a m	34 02	Wednesday	78 50	August	71 05
4– 5 p m.	35 80	Monday	81 34	July	71 96
2– 3 p m	36 50	Friday	81 44	September	72 45
10–11 a m	38 64	Saturday	81 72	May	75 63
12– 1 p m	40 28	Tuesday	82 12	April	78 36
9–10 a m	42 30	Thursday	84 96	November	79 84
5– 6 p m	42 80	Sunday	85 46	October	79 96
3– 4 p m	42 91			June	82 08
1– 2 p m.	43 27			March	84 53
8– 9 a m	49 73			December	88 21
6– 7 p m	50 52			February	99 44
7– 8 p m	56 78			January	102 84
9–10 p m.	65 43				
7– 8 a m	65 98				
8– 9 p m	68 14				
10–11 p m	76 72				
6– 7 a m	101 00				
1– 2 a m	121 58				
12– 1 a m	122 92				
2– 3 a m	143 18				
11–12 p m	145 08				
3– 4 a m	147 32				
4– 5 a m	172 92				
5– 6 a m	188 14				

TABLE 8

AVERAGE COEFFICIENT OF VARIATION OF HOURS FOR SUB-POPULATIONS OF THE FOUR STATIONS OF HOLLAND TUNNEL, GEORGE WASHINGTON BRIDGE, A STATION SOUTH OF AMES, IOWA, AND ONE SOUTH OF CHURDAN, IOWA, IN ASCENDING ORDER OF THE COEFFICIENT

Hour of day	Average coefficient	Day of week	Average coefficient	Month of year	Average coefficient
	percent		*percent*		*percent*
4– 5 p m	32 85	Wednesday	68 24	July	64 54
10–11 a m	34 64	Saturday	70 64	August	65 39
11–12 a m	34 91	Friday	71 02	September	68 50
5– 6 p m	34 97	Thursday	71 44	May	69 62
9–10 a m	35 66	Monday	71 50	June	71 17
2– 3 p m	37 96	Tuesday	72 73	April	72 18
3– 4 p m	39 10	Sunday	73 30	March	72 90
12– 1 p m	39 50			November	72 94
1– 2 p m	40 28			October	73 84
8– 9 a m	41 36			December	78 20
6– 7 p m	42 14			February	81 80
7– 8 p m	49 56			January	83 46
7– 8 a m	54 35				
8– 9 p m	63 07				
9–10 p m	69 18				
10–11 p m	75 13				
6– 7 a m	76 02				
1– 2 a m	84 54				
12– 1 a m	86 39				
2– 3 a m	97 32				
3– 4 a m	103 98				
11–12 p m	104 15				
4– 5 a m	115 01				
5– 6 a m	121 90				

The wide scatter of hours for Thursday at Churdan has changed the rank of that day in dispersion to the middle one of the week for the four stations, while Sunday remains with the widest scatter The combination of the four stations leaves the summer months and September, May, and April as the six months of smallest scatter, and the three winter months and October, November, and March as the six months of greatest

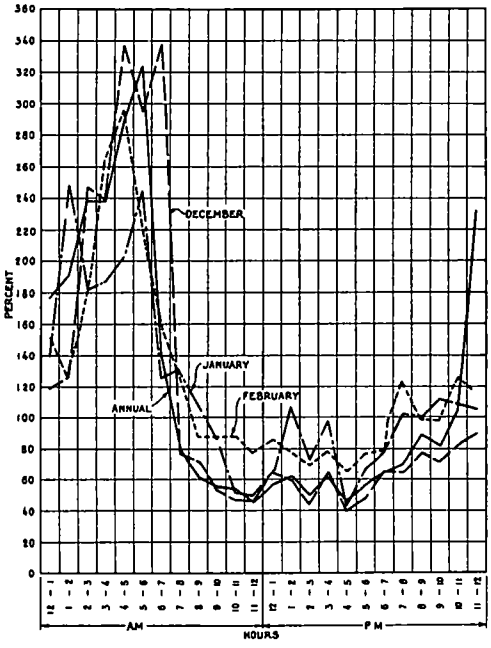

Figure 4. Dispersion of Number of Vehicles by Hours (in Chronological Order) for Winter Months, 1937, in Coefficient of Variation, Compared with the Annual Dispersion.

scatter From these average coefficients of variation and the other measures discussed in this paper, it is rather clear that sampling may be confined to the hours from 9 to 6 in the day period, to the weekdays, and to the summer months with considerable saving of error of estimate The elimination of extremes will also aid in the same direction, but this subject must be presented in a later section of this series

This short discussion has been confined to indicating the hours, days, and months, in which dispersion is least The design of a sample and of a pattern must be left for future consideration, but it is clear that a work program for a year, a month, or any number of months can be fitted to the day period from 9 or 10 in the morning to 5 or 6 in the afternoon when the dispersion of the hourly traffic is least Likewise, some reduction in scatter can be obtained by the elimination of holidays and week-end days from samples, but all surveys cannot be restricted to summer months, nor can winter months be entirely excluded It is important that the daylight hours of least dispersion can be counted throughout the year, and that surveys of any necessary length can be based on these hours

DISPERSION OF VOLUME OF HIGHWAY TRAFFIC BY HOURS FOR EACH MONTH COMPARED WITH THE ANNUAL DISPERSION

In the previous sections of this paper the dispersion of hourly volume of traffic through the year has been presented In this section the results of an investigation of the dispersion for each hour of the day for each month are set forth in comparison with the dispersion for the year

In brief, the figures and tables show that the dispersion, or scatter, in volume is much less for the day period from nine or ten o'clock in the morning to five or six in the afternoon This is true with some variation for each month of the year, as well as for the year as a whole, and it indicates that the error in estimating traffic volume from hourly records of the period stated is far less than from other hours of the 24 It follows from this that traffic surveys may

be confined largely to the more pleasant part of the day and need not be extended to an entire year, and that they may be restricted to any one or several of the months with adequate precision of estimate

Even the winter months show much smaller dispersion, or scatter, during the day period than during the remainder of the 24 hours (Fig 4 and Table 9) The curve of the coefficient of variation for December corresponds surprisingly close to that for the year The curves for even January and February, the two winter months of worst weather, also conform fairly well to that for the year, and show only moderate scatter for the day period The curve for February shows slightly wider dispersion than that for the year quite uniformly for the day period described, and that for January conforms very closely to the annual dispersion except for a moderate expansion for the hours one to two and three to four in the afternoon While this irregularity is not large and is due to a few hours of irregular volume, it could be overcome by an increase in the number of observations or by the elimination of those hours Since there are at least six hours of small dispersion for each of the days of a month, there is no narrow limit to the number of hours that can be included in a sample

For each of the spring, summer, and fall months the dispersion trends are very

TABLE 9

DISPERSION OF NUMBER OF VEHICLES BY HOURS PASSING CHURDAN, IOWA, FOR EACH OF THE WINTER AND SPRING MONTHS COMPARED WITH THE CALENDAR YEAR 1937

Hour	Coefficient of variation						
	Year	Dec	Jan	Feb	March	April	May
a m	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*
12- 1	177 3	119 1	139 1	151 0	159 4	101 4	106 9
1- 2	191 0	125 8	246 7	127 7	184 3	127 7	117 0
2- 3	238 5	246 7	182 1	176 4	146 0	305 1	146 0
3- 4	238 4	238 5	186 3	265 1	167 6	341 1	158 9
4- 5	288 3	338 1	202 3	294 1	310 6	380 4	231 8
5- 6	323 9	293 9	244 4	224 9	409 3	291 0	221 3
6- 7	141 8	337 5	125 7	160 1	163 4	97 1	101 6
7- 8	80 4	76 7	131 0	127 6	68 4	66 4	80 4
8- 9	60 5	72 2	105 5	88 3	62 1	51 1	49 4
9-10	55 8	53 0	86 1	85 9	62 8	47 4	54 9
10-11	54 2	46 7	51 9	87 6	55 7	44 9	56 0
11-12	45 7	46 3	50 1	78 0	42 4	31 6	37 3
p m							
12- 1	56 6	64 3	63 7	85 0	62 2	53 9	57 1
1- 2	61 9	58 8	106 2	77 4	63 1	45 8	55 7
2- 3	51 9	43 8	73 1	69 6	35 9	42 4	50 6
3- 4	62 9	63 7	98 3	77 7	47 0	47 8	50 9
4- 5	45 6	40 4	41 3	65 3	45 7	39 0	51 5
5- 6	56 4	48 4	65 5	76 3	52 9	52 6	51 6
6- 7	64 8	64 5	76 9	79 4	67 6	82 7	64 2
7- 8	70 4	65 1	102 2	123 3	60 6	75 1	54 8
8- 9	88 9	76 8	99 6	98 3	79 4	61 8	51 6
9-10	82 4	72 4	111 2	98 4	82 0	76 8	75 4
10-11	103 5	81 8	109 1	124 7	101 7	75 6	64 1
11-12	232 6	90 3	104 5	115 0	101 5	89 2	110 0

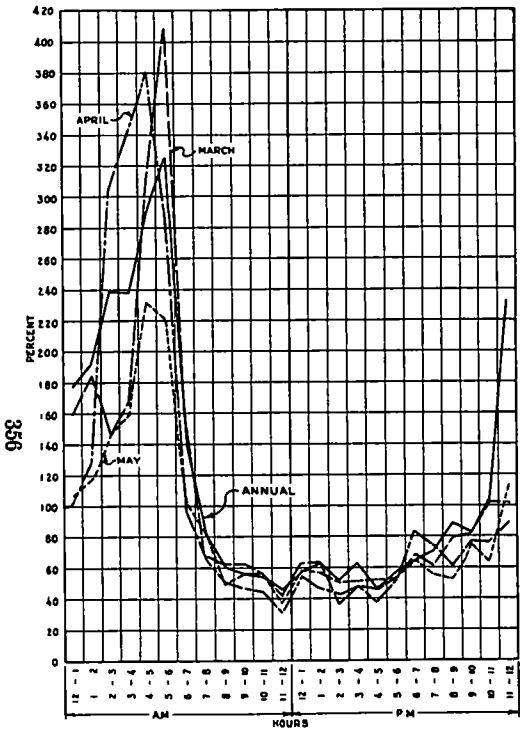

Figure 5. Dispersion of Number of Vehicles by Hours (in Chronological Order) for Spring Months, 1937, in Coefficient of Variation, Compared with the Annual Dispersion.

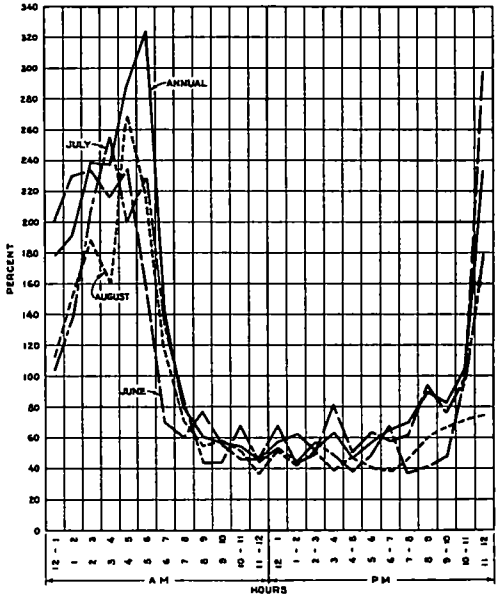

Figure 6. Dispersion of Number of Vehicles by Hours (in Chronological Order) for the Summer Months, 1937, in Coefficient of Variation, Compared with the Annual Dispersion.

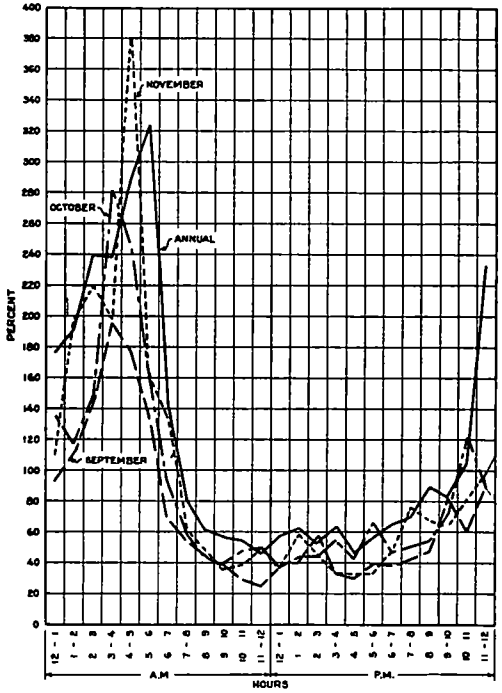

Figure 7. Dispersion of Number of Vehicles by Hours (in Chronological Order) for the Fall Months, 1937, in Coefficient of Variation, Compared with the Annual Dispersion

close to that for the year, and all show small scatter for the day period as defined above (Figs 5 to 7 and Tables 9 and 10) These results for each month are based on small sub-populations of 30 or 31 hours for each month for each of the 24 hours of the day, while the annual curve includes 365 hours for each hour of the day The number of hours for each month is in the small sample field, while that for the year is in the scope of a moderately large sample with far less sampling error. In both cases the entire sub-population is included, which means that there are no additional hours of wider variation not included in the sub-populations of either the month or the year. This is the surprise in the conformity of the monthly curves with the annual one The explanation is that in the small sub-population for each hour of the day for the month is included the function of variation of a single month, while in the larger one of the year the entire function of variation for the year is embraced

The importance of the small dispersion of the monthly records in comparison with the annual one is that a traffic survey can be made within a short period of time for any month of the year (though there are preferred months) by means of a small sample at small cost and with satisfactory precision of estimate These results are due to the restriction of the function of variation to a period of a month

If traffic records are confined to the

TABLE 10

DISPERSION OF NUMBER OF VEHICLES BY HOURS PASSING CHURDAN, IOWA, FOR EACH OF THE SUMMER AND FALL MONTHS COMPARED WITH THE CALENDAR YEAR 1937

Hour	Coefficient of variation						
	Year	June	July	Aug	Sept	Oct	Nov
a m	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*
12- 1	177 3	200 1	102 6	113 4	93 1	135 1	110 3
1- 2	191 0	229 6	138 2	151 3	109 9	117 0	198 3
2- 3	238 5	233 4	206 7	186 9	144 2	147 3	218 7
3- 4	238 4	216 0	254 5	160 2	195 3	280 5	198 3
4- 5	288 3	234 1	199 9	268 7	178 3	245 2	380 4
5- 6	323 9	155 4	227 9	219 4	133 7	162 0	161 3
6- 7	141 8	70 1	133 0	118 3	69 2	92 9	132 7
7- 8	80 4	59 6	83 4	70 8	54 2	59 3	57 6
8- 9	60 5	76 0	42 9	53 5	44 4	43 2	48 2
9-10	55 8	56 6	44 2	57 6	38 9	38 6	35 1
10-11	54 2	45 8	66 6	50 7	29 2	47 1	38 2
11-12	45 7	46 3	45 0	35 6	24 8	49 0	47 5
p m							
12- 1	56 6	66 8	52 1	50 9	37.4	37 9	35 7
1- 2	61 9	43 4	44 3	40 7	39 9	42 8	56 5
2- 3	51 9	46 7	56 4	49 8	57 5	44 2	43 8
3- 4	62 9	81 2	47 8	38 5	33 4	53 9	32 9
4- 5	45 6	49 8	38 8	46 2	29 9	42 3	32 5
5- 6	56 4	63 0	48 1	39 7	39 3	65 2	32 9
6- 7	64 8	57 5	67 1	37 5	37 7	46 9	46 1
7- 8	70 4	61 7	37 2	46 6	42 3	49 5	75 1
8- 9	88 9	93 0	41 0	59 7	46 5	53 7	67 2
9-10	82 4	76 4	47 1	65 6	81 7	71 8	62 9
10-11	103 5	99 2	98 9	70 6	61 1	120 4	79 3
11-12	232 6	298 0	178 5	73 7	92 4	89 1	97 1

hours of least dispersion and to short periods of time (one or more months, e g), it is necessary to establish hourly and monthly patterns at typical stations, which patterns are applicable to the stations to be covered in a survey The curves of dispersion make it clear that more observations should be taken at night than during the day, which is not in accord with the usage of the past. The use of a group of typical stations for the establishment of patterns for application to a larger number of stations has become the common method of increasing the number of observations in the highly variable night period