Estimating Annual Average Daily Traffic from Short-Term Traffic Counts

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The purpose of this study was to evaluate a method advocated by the U. S. Bureau of Public Roads for estimating annual average daily traffic from short-term traffic counts and to determine whether existing procedures could be improved with reduced annual cost. This study pertained to rural roads carrying 500 or more vehicles per day.

Some of the first tests were conducted for the purpose of determining the most satisfactory method of grouping continuous counting stations and the computation of mean monthly adjustment factors for each group.

One of the first conclusions was that continuous count stations should be grouped on the basis of average monthly adjustment factors of several consecutive years rather than on the basis of the factors for any single year. It was further concluded that division of the states' rural roadways into five groups would be sufficient stratification of annual patterns of traffic volume variation.

Tests were made to determine the relative efficiency of seasonal control counts repeated a various number of times per year per location for establishing group assignments of roadway sections and estimating AADT. Tests were made pertaining to seasonal control counts repeated four, six and twelve times a year per location. The standard deviations of the errors of estimated AADT from seasonal control counts of four, six and twelve times per year were 3.6, 3.1 and 1.7 percent, respectively. Comparisons of the results of using various seasonal control counts to indicate group assignment of roadway sections showed no significant difference.

The Missouri State Highway Department is considering the adoption of the Bureau's method of estimating AADT using a 7-day coverage count program and seasonal control counts repeated four times a year per location. It is believed that the eventual annual savings of this method would be approximately one-half the cost of the current program.

•EARLY in 1963 the Missouri State Highway Department began an investigation of the possible advantages of the method advocated by the U. S. Bureau of Public Roads for estimating annual average daily traffic (AADT) from short-term traffic counts for rural roads carrying 500 or more vehicles per day. The purpose of the investigation was to evaluate several variations of the Bureau's method and to determine whether the existing procedure could be improved with a possible reduction in annual cost.

In general, the Bureau's method involves: (a) stratifying continuous traffic counting stations into groups of similar annual patterns of monthly traffic adjustment factors; (b) determining average adjustment factors for each group; (c) assigning all sections of the rural highway system to one of these groups; and (d) applying the appropriate average adjustment factor to any short-term traffic count to produce an estimate of

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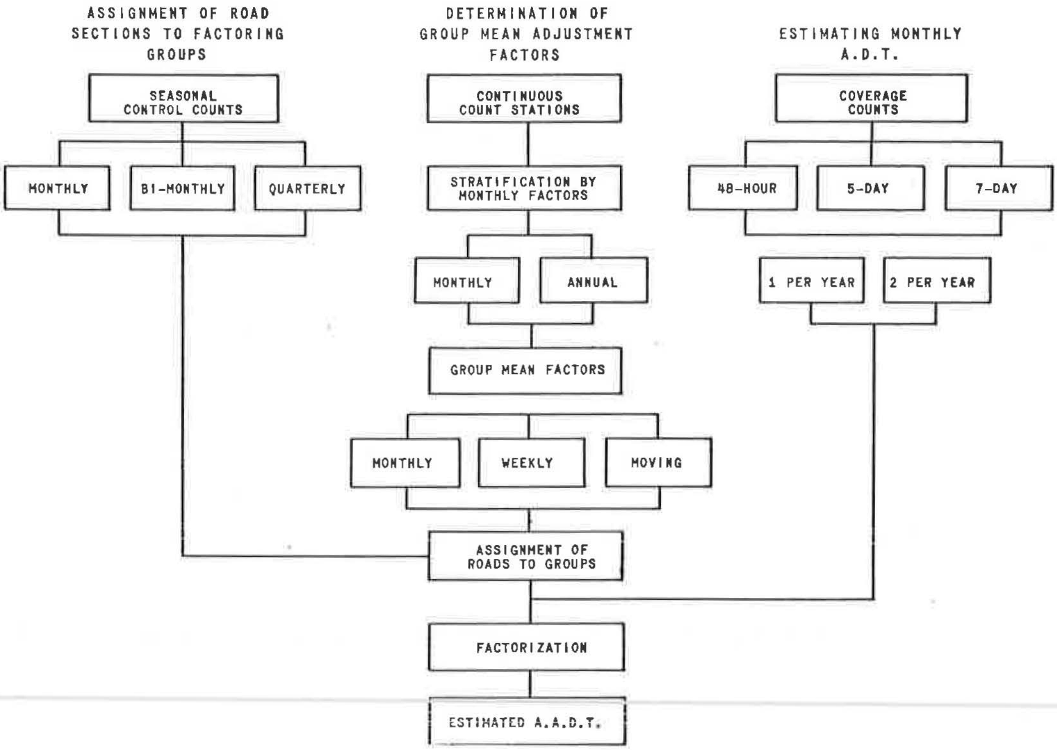

Figure 1. A plan for studying variations of the Bureau method of estimating AADT.

annual average daily traffic. The Bureau's method and procedures are described in detail in Guide for Traffic Volume Counting Manual.

The method now being used by the Missouri State Highway Department has produced useful results. This method, however, is highly subject to individual judgment. Basically, the method of estimating AADT at the location of a coverage count has been as follows:

1. Two 48-hr coverage counts, approximately 6 mo apart, are made at a particular location of interest.
2. The individual making the estimate selects a continuous count station which he believes to have a similar annual pattern of monthly traffic variations.
3. Using the data from the continuous count station, the ratios of AADT to the average daily traffic during the period of time in which each of the coverage counts were made are computed.
4. The two coverage counts are multiplied by the appropriate factors and the products averaged to produce an estimate of AADT for the particular location.

The Bureau's method as compared to the existing method has the following advantages:

1. Because of its objective nature, it can be presented in a manual of fixed procedures. With the aid of this manual, a wider range of individuals would be able to produce acceptable estimates of AADT.
2. It lends itself well to a statistical measure of accuracy.
3. It is readily adaptable to electronic data processing.

The plan for studying variations of the Bureau's method of estimating AADT is shown in Figure 1. The study was broken down into three parts:

1. Grouping of continuous count stations and the determination of group mean adjustment factors;
2. Estimating monthly average traffic using coverage counts of various lengths; and
3. Assignment of road sections to factoring groups by use of seasonal control counts.

Missouri has approximately 90 continuous traffic counting stations located throughout the state on rural roads having 500 or more AADT. Data from these stations for the fiscal year 1961-1962, and in some cases additional years, were used in performing the tests of the study.

GROUPING OF COUNT STATIONS AND DETERMINATION OF ADJUSTMENT FACTORS

The primary purpose of grouping continuous traffic counting stations, and eventually assigning most sections of roads in the state to one of these groups, is the establishment of a series of routes with consecutive road sections having similar patterns of monthly traffic volume variation.

If all roadways could be stratified into groups of identical annual patterns of traffic adjustment factors which correspond to the period of time of a coverage count, true AADT could be derived from coverage counts. It is also desirable to have the group assignment of a roadway section remain constant from year to year. These two conditions can be attained to a degree because of two fundamental characteristics of traffic patterns which have been established by many studies:

1. The pattern of monthly variations of traffic volumes persists over long stretches of highway.
2. The pattern of monthly variations of traffic volumes persists over long periods of time.

The Bureau's manual indicates that it is practical to group stations allowing a difference of 0.20 between the smallest and the largest values of factors within each month. It further indicates that by using this criterion, there should be little change in group assignment of roads from year to year.

Missouri's continuous count stations for the fiscal year 1961-1962 were grouped using the Bureau's criterion. This resulted in an excessive number of groups. When indicating the group assignment of continuous count stations on a map by the use of color codes, no reasonable pattern of continuous group assignments appeared. Other tests indicated that an appreciable number of stations would tend to change groups in the following year.

In an attempt to reduce the number of groups and to stabilize group assignment of roadway sections from year to year, continuous traffic counting stations were classified on the basis of average monthly adjustment factors of several consecutive years. The average factors of 4 yr were used. It was assumed that a gradual change of roadways from one group to another would not be too significant over a period of 4 yr. Any station which had a tendency to change from one group to another in a period of less than 4 yr would probably be noticeable because of changing conditions in that area.

Grouping continuous traffic counting stations on this basis resulted in 5 different groups in the state. Three of these groups were classified as non-recreational and two as recreational. The two recreational groups were classified as such because of the high variation of monthly adjustment factors resulting from their locations near resort areas.

Each of the five groups was assigned a color code. All continuous traffic counting stations were then plotted on a map and what appeared a very reasonable series of group assignments resulted. Groups were numbered from one through five in the order of their increasing variation of average monthly adjustment factors. Stations belonging to group No. 1 were generally located near cities and on roads where a significant amount of the travel consisted of work trips. On these roads a smaller amount of traffic volume variation occurred throughout the year than on other roads where vacation and recreational travel are more prevalent.

Group No. 2 contained over fifty percent of all the continuous traffic counting stations in the state. The average pattern of this group was very similar to the average pattern of all stations within the state. Roadways belonging to this group were not limited to any particular area in the state.

Group No. 3 contained thirteen of the ninety continuous traffic counting stations. These stations were generally located on relatively high volume roads, which during the summer months are known to carry a high percentage of vacation trips. The roads assigned to this group were not necessarily located near the resort and recreational areas of the state.

Group No. 4, which contained four stations, was located near the resort areas of the state. The two stations in group No. 5 were located in resort areas in the state. The roadways assigned to groups Nos. 4 and 5 are known to carry large volumes of weekend recreational travel during the summer months. During the winter months, the volumes on these roads are relatively small.

The four-year average monthly adjustment factors of the continuous count stations were used only to determine the group assignment of the stations. The average adjustment factors of a group, to be applied to coverage counts of a particular year to estimate AADT, were determined by averaging the factors for that year of the stations assigned to that group. If the group mean adjustment factor of four years were applied to coverage counts in any one year to estimate AADT, additional error may result due to the variation of group mean factors between years.

The use of four-year average factors to stratify continuous count stations results in more variation about the group mean factors for those stations in any one particular year than if the Bureau's method were used. However, if the Bureau's method was used, there would be a larger number of groups and also a greater tendency for stations and roadways to change groups from year to year. Thus, at the end of any one year, there would be a substantial amount of roadway sections for which the group assignment would not be known. The group assignment for these sections would have to be estimated to factor coverage counts made along the sections during the year. To estimate these group assignments, the prevailing group assignment of a number of years would possibly be used. It is believed that this would result in approximately the same variation which would have been obtained if the average of a number of years had been used to group stations.

To this point, the grouping of continuous traffic counting stations has been based on the difference of annual patterns of monthly adjustment factors. This has been designated as the annual method of grouping. The Bureau manual indicates that when a computer is available, groupings can be made separately for every month during which vehicle coverage count stations are operated. Using this procedure, the continuous count stations would be grouped on the basis of the values of the monthly adjustment factors for that month. With this method, group assignments tend to vary from month to month. There is also a tendency for the number of groups to vary from month to month.

Missouri's continuous count stations were grouped using the monthly method. As in the annual method, the average monthly adjustment factors of four years were used. The number of groups per month varied from one in September to four in January.

A test was performed to find which method would yield the greater accuracy of estimates of AADT. Seven-day coverage counts were simulated from daily traffic volumes of continuous count stations selected at random. Sixty of these simulated counts were made for each month. Estimates of AADT were produced by applying the appropriate mean monthly adjustment factors derived by the annual method of grouping. The average factors of the groups from the monthly grouping of continuous count stations were applied to the same set of simulated coverage counts to compute another group of estimates of AADT. Comparisons by month and by year were made to test for a significant difference in the distributions of errors of estimated AADT. In no case was a significant difference found.

After examining the results of the comparison between the annual method and the monthly method, it was decided to adopt the annual method. Generally, the annual method is more easily understood. Unusual variations of monthly traffic volumes are more obvious when the annual pattern is examined. The annual method also lends itself better to the use of seasonal control counts.

The determination of group mean adjustment factors was related to the grouping of continuous traffic counting stations. Tests were made to determine whether group mean adjustment factors should be computed on a monthly, weekly or moving base corresponding to the length of coverage counts. In no case were the differences of the distributions of errors of estimated AADT highly significant, but all indications were that increased accuracy could be gained by using a moving base as opposed to a monthly base. A somewhat limited analysis of variance test indicated that over a year's time, the standard deviation of the percent errors of estimated AADT could possibly be reduced by approximately five-tenths of one percent by using the moving base. This, however, is assuming that coverage counts would be made during all twelve months of the year. If the winter months were not used, the difference of the accuracies would possibly not be as great. Differences in accuracies appear significant only during the winter months. It was concluded that if average adjustment factors were determined by use of an electronic computer, the additional cost of computing factors from a moving base would not be excessive. If the adjustment factors are computed manually, however, the cost of the additional possible accuracy would be too great.

ESTIMATION OF MONTHLY AVERAGE TRAFFIC

Considerable time was given to determining the probable accuracy of estimated AADT when using short-term coverage counts of various lengths. Tests were made using 7-day, 5-day, 48-hr and 24-hr coverage counts. Estimates of AADT were made for continuous count stations from simulated coverage counts. These estimates were compared to the true AADT's and a frequency distribution of errors of estimation formulated. The probable occurrence of errors within the limits of various magnitudes was stated by statistically measuring the dispersion of this frequency distribution.

The standard deviation was used to measure the probable occurrence of errors in estimates of AADT which would result from the factoring of coverage counts of various lengths. The formula for computing the standard deviation is as follows:

$$\text{Standard deviation} = \sqrt{\frac{\Sigma X^2}{N - 1}}$$

where

X = percent error of estimated AADT; and
N = number of observations in sample.

This formula varies from the conventional formula for the standard deviation, which is as follows:

$$\text{Standard deviation} = \sqrt{\frac{(X - \bar{X})^2}{N - 1}}$$

where

X = percent error of estimated AADT;
$\bar{X}$ = average percentage error of estimated AADT; and
N - 1 = number of observations, less one degree of freedom.

The formula used for this study was based on the experience in other states and in the U. S. Bureau of Public Roads that the average of percent errors differs from zero by such a small amount as to be negligible.

In actual application of the Bureau's method of estimating AADT, it is believed that the average estimated percentage errors would not be significantly different from zero in most cases. If some year-end simulation of coverage counts would possibly indicate a significant average error, all estimates of AADT could be adjusted in the appropriate direction to reduce this average error to near zero. Unless this adjustment is made, however, it is desirable to know the expected dispersion of errors from zero and the modified equation provides such an estimate.

Assuming a normal distribution of errors and a zero average error, approximately 68 percent of all errors could be expected to be within the range of plus and minus one standard deviation; 95 percent within two standard deviations; and 99.7 percent within three standard deviations.

The following outline describes the steps used to produce simulated distributions of errors of estimated AADT which could be expected from coverage counts of various lengths and types.

1. Continuous traffic counting stations were grouped using the annual method.
2. Group mean monthly adjustment factors were computed.
3. Coverage counts were simulated at continuous count stations.
4. The average 24-hr traffic volume of each coverage count was expanded to an estimate of AADT by applying the appropriate group mean monthly adjustment factor.
5. Each estimated AADT was compared to the true AADT of the particular continuous count station and the plus or minus error of estimate as a percent of true AADT was computed.
6. The standard deviation of the resulting distribution of directional percentage errors was computed using the previously mentioned formula.

In grouping continuous traffic counting stations, the four-year average monthly adjustment factors were used as previously indicated. If coverage counts are made during all twelve months of the year, it is best to group stations based on the adjustment factors of all twelve months. If coverage counts are made only during a particular part of the year, it is best to group the continuous count stations on the basis of the factors of the months involved. During this portion of the study, continuous count stations were first grouped using all twelve months and later grouped using only nine months, omitting December, January and February. Although some stations tended to change groups, the number was very small and the difference in group mean adjustment factors per month was insignificant. When 7-day coverage counts, including Saturday and Sunday, were tested, the continuous count stations were grouped on the basis of the ratio of AADT to monthly average daily traffic. When 5-day coverage counts, excluding weekend days, were simulated, the continuous count stations were grouped on the basis of the ratio of AADT to monthly average weekday traffic. There was an obvious difference between the group assignment of stations when these two methods were compared. The differences of the average monthly adjustment factors were also significant.

In the tests concerning lengths of coverage counts, the value of the standard deviation of the errors of estimated AADT is of primary importance. To measure the relative accuracy of estimated AADT's between months, separate distributions of errors by month were derived from simulated coverage counts. The standard deviations of the months were combined statistically to produce the expected overall standard deviation for the coverage count season.

A pilot sample of 25 simulated 7-day coverage counts for the month of January was used to estimate a standard deviation of the errors of estimated AADT. Based on this sample, it was estimated that 60 simulated coverage counts per month would yield a standard error of the standard deviation of one percent or less. The estimated standard deviation of a counting season would have a standard error of the standard deviation of less than one-half of 1 percent. To attain approximately the same degree of accuracy for standard deviations of 5-day and 48-hr counts, it was estimated that approximately 100 samples of simulated coverage counts would be needed in each month. One hundred samples in each month were also used for 24-hr coverage counts.

Tables 1, 2 and 3 give the standard deviations of the various distributions of simulated errors expressed as a percent of true AADT. Table 1 indicates, for various coverage count seasons, the standard deviations of errors of estimated AADT for 7-day, 5-day, 48-hr and 24-hr coverage counts. These distributions are based on the assumption that only one coverage count per year per station would be made. Table 2 gives the standard deviations, by month, for the various length coverage counts. Table 3 in-

TABLE 1

STANDARD DEVIATIONS OF PERCENT ERRORS OF ESTIMATED AADT[a]

Counting Season	Length of Coverage Counts			
	7 Day	5 Day	48 Hr	24 Hr
12 Months	10.1 (0.27)[b]	10.1 (0.21)	12.6 (0.26)	14.7 (0.30)
Mar. - Nov.	8.8 (0.27)	9.3 (0.22)	11.5 (0.27)	13.5 (0.32)
Apr. - Nov.	8.7 (0.28)	9.2 (0.23)	11.5 (0.29)	13.5 (0.34)

[a]Based on one count per station per year.
[b]Standard error of standard deviation.

TABLE 2

STANDARD DEVIATIONS OF PERCENT ERRORS OF ESTIMATED AADT BY MONTHS

Month	Length of Coverage Counts			
	7 Day	5 Day	48 Hr	24 Hr
July	7.6 (0.69)[a]	8.1 (0.57)	9.5 (0.67)	12.2 (0.86)
Aug.	7.7 (0.70)	8.6 (0.61)	9.8 (0.69)	13.1 (0.93)
Sept.	9.0 (0.82)	10.6 (0.75)	13.9 (0.98)	15.2 (1.08)
Oct.	7.1 (0.65)	8.1 (0.57)	10.7 (0.76)	10.9 (0.77)
Nov.	9.7 (0.88)	10.4 (0.74)	12.7 (0.90)	13.7 (0.97)
Dec.	12.8 (1.17)	11.9 (0.84)	15.4 (1.09)	17.9 (1.27)
Jan.	17.3 (1.58)	13.7 (0.97)	17.4 (1.23)	20.2 (1.43)
Feb.	8.4 (0.77)	9.4 (0.66)	12.2 (0.86)	15.6 (1.10)
Mar.	9.7 (0.88)	9.9 (0.70)	11.3 (0.80)	13.1 (0.93)
Apr.	9.6 (0.88)	11.1 (0.78)	13.3 (0.94)	15.6 (1.10)
May	9.0 (0.82)	9.3 (0.66)	12.6 (0.89)	14.4 (1.02)
June	9.3 (0.85)	8.1 (0.57)	9.6 (0.68)	12.4 (0.88)

[a]Standard error of standard deviation.

TABLE 3

STANDARD DEVIATIONS OF PERCENT ERRORS OF ESTIMATED AADT[a]

Months	Length of Coverage Counts			
	7 Day	5 Day	48 Hr	24 Hr
July & Jan.	9.0 (0.82)[b]	8.1 (0.57)	9.8 (0.69)	12.1 (0.86)
Aug. & Feb.	4.6 (0.42)	6.4 (0.45)	7.6 (0.54)	10.2 (0.72)
Sept. & Mar.	5.0 (0.46)	5.2 (0.37)	8.0 (0.57)	8.8 (0.62)
Oct. & Apr.	5.8 (0.53)	7.5 (0.53)	9.1 (0.64)	9.9 (0.70)
Nov. & May	5.8 (0.53)	6.5 (0.46)	8.9 (0.63)	10.0 (0.71)
Dec. & June	7.1 (0.65)	7.1 (0.50)	9.2 (0.65)	10.7 (0.76)
Year	6.4 (0.24)	6.8 (0.20)	8.8 (0.25)	10.3 (0.30)

[a]Based on average of two estimates per year per station made six months apart.
[b]Standard error of standard deviation.

dicates the expected standard deviations of the percent error if two counts per station per year, spaced approximately six months apart, were used to estimate AADT.

The tables include the values of the estimated standard error of the standard deviation. The standard error of the standard deviation is an indicator of the accuracy of the estimated standard deviations when considering their values and the size of sample from which they were computed. If the range of plus and minus one standard error from the standard deviation is established about the estimated standard deviation, the fiducial probability is approximately 68 times out of 100 that the true standard deviation falls within this range. If the range of plus and minus two standard errors from the standard deviation is established, the fiducial probability is approximately 95 chances out of 100. Using plus and minus three standard errors of the standard deviations, the fiducial probability would be approximately 997 chances out of 1,000.

The standard error of the standard deviation is also used in testing for a significant difference between two standard deviations. The formula for the standard error of the standard deviation is as follows:

$$\text{Standard error of standard deviation} = \frac{\text{Estimated standard deviation}}{\sqrt{2\,N}}$$

where N = sample size used in estimating the standard deviation.

A statistical comparison of the standard deviations of Table 1 for a 12-mo coverage count season indicated that no significant difference between the accuracy of 7-day and 5-day coverage counts could be expected. The values shown, however, do indicate that a significant increase in accuracy of estimates of AADT would be gained by using 7-day or 5-day coverage counts rather than 48-hr or 24-hr coverage counts. The difference of the standard deviations shown for 48-hr and 24-hr coverage counts is also significant.

If December, January and February are eliminated from the coverage count season, there tends to be a difference between the accuracy which can be expected from 7-day and 5-day coverage counts. Although the difference between the two standard deviations is not highly significant, there is an indication that an improved accuracy would be gained from the use of 7-day coverage counts. A comparison of the values in Table 2 indicates that in most months a 7-day coverage count produces a lower standard deviation of the errors of estimated AADT. In December, January and June, the standard deviation of the errors of 7-day counts is greater than for the 5-day counts. Based on the sample size used to determine the monthly standard deviations, the differences of the standard deviations in December and June cannot be regarded as significant. The difference between the standard deviations of January, however, is significant.

Some small tests were made to determine why a 7-day coverage count produced less accuracy in January than a 5-day coverage count and seemingly more accuracy in other months. The results of the tests indicated that it is better to assume an average relationship of daily traffic in January between weekdays and weekend days rather than using a sample of only one weekend which is included when a 7-day coverage count is taken. It was concluded, that in the winter months there tends to be a significant uniform variation of weekend daily traffic from the average weekend daily traffic of the month among the various roadways of the state. If for January average group adjustment factors had been determined on the basis of the period of time in which the coverage counts were made, it is believed that the accuracy of 7-day coverage counts would have been better than 5-day coverage counts. Uniform variation between weeks of the month of all stations in the group would have been accounted for in the adjustment factor. As the summer season approaches, the variation between weekend traffic volumes within a month is not as significant as in the winter months and a sample of one weekend tends to be better than using an overall average relationship, which is assumed when a 5-day coverage count is expanded to an estimate of AADT.

Assuming that the present method used in Missouri of estimating AADT has an accuracy somewhat comparable to the value shown for 48-hr counts in Table 3, it was concluded that the same approximate accuracy could be obtained if 7-day coverage counts were made once a year per location for a 9-mo count season. The eventual cost of this procedure should be approximately one-half the cost of the present method.

ASSIGNMENT OF ROAD SECTIONS TO FACTORING GROUPS

Seasonal control counts are a necessity when using the procedure of estimating AADT recommended by the U. S. Bureau of Public Roads. The primary purpose of seasonal control counts is to assign roadways to groups of similar seasonal traffic patterns when continuous traffic counts are not available. They can also be used to estimate AADT for a particular location when a greater degree of accuracy is desired than may be expected from regular coverage counts.

Seasonal control counts at a location provide an estimate of the annual pattern of monthly adjustment factors for that particular location. The U. S. Bureau of Public Roads recommends that seasonal control counts be made either four, six or twelve times a year per location. These seasonal control counts, of seven consecutive days duration, should be spaced at approximately equal intervals throughout the year.

When seasonal control counts are made twelve times a year, an estimate of the adjustment factor for each month can be computed. If seasonal control counts are made only six or four times a year, the estimated annual pattern of monthly adjustment factors is not complete, but a sketch of the estimated monthly variation is provided.

Knowing that the cost of seasonal control counts per location increases with the number of times the location is counted per year, it was decided to investigate the difference between the results obtained when using the various types of seasonal control counts. The tests were performed in the following manner:

1. Twenty-six of Missouri's continuous traffic counting stations were used in this test. Some of the 90 previously used continuous count stations had a substantial number of days missing in some months due to various reasons making it inadvisable to use these stations in this particular test. The 26 stations provided a good proportional representation of the five groupings of stations in the state.
2. A 7-day simulated seasonal control count was made for each month for each of the 26 stations.
3. The twelve simulated 7-day seasonal control counts of each station were grouped to form six samples of various type seasonal control counts. There were three ways of simulating four control counts per year, two ways of simulating six counts per year, and one way of simulating twelve counts per year. The total sample sizes of the four, six and twelve repetitions per year were 78, 52 and 26, respectively.
4. The first test consisted of comparing the accuracies of estimated AADT's of the various types of seasonal control counts. The standard deviations of the errors of estimated AADT resulting from seasonal control counts of four, six and twelve times a year were 3.6, 3.1 and 1.7 percent, respectively. Based on the sample sizes, there proved to be no significant difference between the standard deviation of four counts a year and six counts a year. There is, however, a significant difference between the standard deviations of four counts a year and twelve counts a year, and between six counts a year and twelve counts a year.
5. For each sample of simulated seasonal control counts, the estimated annual pattern of monthly adjustment factors was computed. Monthly adjustment factors were computed by dividing the estimated AADT by the average five weekdays of each 7-day simulated seasonal control count of each month. This produced estimated ratios of annual average daily traffic to monthly average weekday traffic.
6. Each sample of simulated seasonal control counts per station was assumed to be on a road section of which the group assignment was not known. The station was then assigned to one of the five predetermined groups. These assignments were based on the similarity of the estimated annual pattern of monthly adjustment factors compared to the group mean patterns of the five groups. A least squares criterion was used to assign stations to one of these groups. This least squares method is different from the one recommended in the Bureau's manual. An example of assigning a seasonal control station to a group using the least squares method is as follows: (a) The individ-

ual monthly deviations of the estimated annual pattern from each group mean annual pattern is determined; (b) the individual deviations of each group mean pattern comparison are squared and the sum of squares determined; and (c) the road section is assigned to the group whose summation of squared deviations is the least. Because the summation of the squared deviations from a particular measurement is directly related to the magnitude of the expected distribution of errors, this method should hold errors of group assignment to a minimum. Although this method may be more accurate than a straight deviation comparison as recommended by the Bureau, it is not believed that the increased accuracy would be too significant. The least squares method, however, is relatively simple to program on a computer.

7. The percentage of wrong group assignments was computed based on the assumption that the group assignments from the original 90 continuous count stations were correct. Of the 78 samples counted four times per year, 44 percent of the assignments were made to the wrong group. For the 52 samples of six counts per year, 54 percent of the group assignments were wrong. For the 26 samples of twelve counts per year, 46 percent of the group assignments were incorrect. Based on these percentages, it can be expected that approximately 50 percent of the time a wrong group assignment will be indicated by any type seasonal control count. However, in every case where a wrong group assignment was made, it was made to a group adjacent to the true group. For example, the five group mean patterns were numbered consecutively in order of increasing variation of monthly adjustment factors. If a station had been assigned to group No. 1, and this assignment was in error, the true group assignment would be No. 2. If a station had been incorrectly assigned to group No. 3, the true group assignment would be either group No. 2 or group No. 4. The probability of the true group assignment being either one or five, in this case, is very small. Approximately 95 percent of the time incorrect group assignments were made, the true group assignment was the group which had the next least total squared deviations. Thus, when the least squares method is used, it is highly probable that the roadway involved belongs to one of two particular groups.

8. Five-day coverage counts were simulated at the test stations for the months of March through November. These coverage counts were expanded to estimates of AADT using the average factors of the true group assignment. A standard deviation of the resulting errors of estimated AADT was determined. This produced an expected range of errors which would result if group assignments from the use of seasonal control counts had been entirely correct. AADT was then estimated based on the group assignments resulting from the seasonal control counts of the various types. The standard deviations of the errors of estimated AADT were then computed and compared to the standard deviation resulting from the use of the true group assignments. The differences of the various standard deviations were not significant and in no case did a difference exceed one-half of one percent.

It has been concluded that the increased accuracy of estimated AADT from a twelve times per year seasonal control count program does not warrant the extra cost over programs of four or six counts per year. Because the difference between the accuracies of the six and four counts per year programs are not deemed significant, the four times per year seasonal control count program is being considered for adoption by Missouri.

Although group assignments resulting from seasonal control counts may be incorrect at times, the true group assignment might be determined in a number of cases when a preponderance of one group assignment is found along a length of roadway. This is assuming that a very high percentage of the other estimated group assignments are made to groups adjacent to the group which has the preponderance.

CONCLUSIONS

The Missouri State Highway Department is considering the adoption of a 7-day coverage count program. Each coverage count location would be counted once a year and the coverage count season would be for nine months, omitting December, January and February.

Initially, a rather extensive seasonal control count program may be used. After what is believed to be sufficient coverage, approximately two to three years, the seasonal count program would be greatly reduced. An insignificant amount of control counts would then be handled as special counts as they are deemed necessary, such as an indication that a significant change in the annual pattern of a particular roadway section has taken place.

In comparing estimated annual costs of the proposed program to the existing program, the eventual savings should be approximately one-half the current annual cost.