TRAFFIC STREAM DATA, ROAD CATEGORIES, TRAFFIC COUNTING STRATEGIES

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EXECUTIVE SUMMARY

Traffic counting on a nationwide basis is a complex activity. Estimation of AADT for a road on the basis of a traffic count conducted over a particular week of the year, or even a particular day or hour clearly has uncertainty of outcome. The purpose of this analysis and report was to examine various strategies for traffic counting and their likely effect and related degree of precision on the estimation of AADT. The core data for this project were from the hourly traffic counts for several years from the Transit New Zealand telemetry sites. In addition to this, considerable continuous count data was available from local traffic authorities. The research was conducted in four major stages.

The primary focus in the first stage was examination the pattern of vehicle usage rather than simply on the count data in particular parts of the year. The endeavour was to find a method for segregating the various sites into groups which had common profiles as well as reasonable similarities from a traffic engineering viewpoint.

It was found after some early simple numerical summaries were performed that straightforward numerical methods were not providing any real insight into the nature of the data nor into possible methods for classification of roads and prediction of AADT.

The basic approach was to examine the weekly pattern, by day and by hour. Graphical methods of exploratory data analysis were used initially. Subsequently, median traffic usage patterns, were used as the basis for analysis. Medians were over the weeks of the year and constructed for each hour of the day, each day of the week for each site. Hierarchical cluster analysis using the median data provided a means of grouping (or segregating) individual sites. This first stage produced ten major groups of sites. Group daily traffic usage profiles were then developed.

The second stage concerned devising and evaluating several counting strategies for their effectiveness in estimating AADT for the groups determined from the first stage. The primary item produced, for each group, was a set of weekly multipliers together with associated standard errors of estimation. In addition, the comparison of counting strategies provided guidelines for sampling choice based on overall accuracy. All strategies relied upon full weeks of hourly count data.

The third stage of the project investigated variations to the general strategies examined in stage 2. These included examination of some directional traffic patterns as well as examining the effect of atypical traffic flow weeks such as Easter and other holidays. In addition, since the traffic flow groupings and variation estimates were produced for data covering many sites for multiple years, the effect of spatial (between sites) and temporal (within site) variation was examined. Estimates of weekly multipliers and associated standard errors for both spatial and temporal scales were produced. This allows for modified weekly factors for estimating AADT dependent on whether the sites being measured have previously been measured.

The final stage was an additional project which further simplified the practical application of the general method by an examination of the value of single day (full 24 hour) counts for estimating AADT. Clearly, the estimation of AADT from a single day count is less precise than that obtained from a full week of data, but the expended effort to obtain a reasonable estimate is considerably reduced. The first part of this task provided estimates of daily multipliers, for each group, which could be used for estimating Weekly ADT. The estimation of the accuracy of these multipliers was also produced. The second component of this final task was to evaluate simpler general characteristics of the usage pattern which do not require formal graphing.

An operational summary of the practical use of the project was produced by Transit New Zealand. [Traffic Count Guideline, April, 1994.] This provided an outline of the counting strategies and the associated weekly, daily and selected hourly multiplier factors to be used for estimating AADT. Tables of consequent accuracies were also produced.

ABSTRACT

The measurement of traffic volumes on an extensive nationwide road network is a very large task. It is not feasible to count all traffic on all roads all of the time. Considerable reduction or effort in the counting process can be achieved by identifying key factors which may allow for grouping of roads into similar groups. This project has determined ten major groups of roads by studying the hourly traffic patterns, over several years. The primary analytic method was that of hierarchical cluster analysis on the daily flows. The base data was obtained from hourly traffic counts for the permanent telemetry sites on New Zealand state highways as well as continuous count data available from local urban traffic authorities. Several strategies for estimating AADT using counting traffic flow volumes in selected periods were assessed for each of the ten groups. Comparison of the counting strategies is provided. A table of scalar multipliers is provided for each week of the year, for each of the road categories.

1. INTRODUCTION

This project was undertaken in four major stages, labelled as Tasks 1, 2, 3 and 4 which are summarised in this report, with samples of data from each Task presented in the appendices.

The primary focus for Task 1 was to find a useful grouping structure for those road sites which had yearly count data, by hour, and which were available to Transit New Zealand. Initially the effort concentrated on the Transpac sites labelled 01 to 42. The core files were for 1989, 1990 and 1991 and covering 42 sites. The primary aim of this first task was to examine the ***pattern*** of vehicle usage rather than simply the count data in particular parts of the file, to find a method for segregating the various sites into groups which had common profiles as well as reasonable similarities from a traffic engineering viewpoint.

The focus on numerical summaries and the search for some 'best' time for estimating AADT is at best a laborious exercise and at worst is likely to lead to simple information overload without clear understanding. It was found after some early summaries were performed that straightforward numerical methods were not providing any real insight into the nature of the data nor into possible methods for classification and prediction.

Task 2 concerned devising and evaluating several counting strategies for their effectiveness in estimating AADT for the groups determined from Task 1. The primary item produced, for each group, was the set of weekly multipliers together with associated standard errors of estimation. In addition, a comparison of counting strategies provided guidelines for sampling choice based on overall accuracy. All strategies relied upon full weeks of hourly count data.

Task 3 investigated variations to the general strategies covered in Task 2. These included examination of some directional traffic patterns as well as examining the effect of atypical traffic flow weeks, such as Easter and other holidays. In addition, since the traffic flow groupings and variation estimates were produced for data covering many sites for multiple years, the effect of spatial (between sites) and temporal (within site) variation was examined. Estimates of weekly multipliers and associated standard errors for both spatial and temporal scales were produced. This allows for modified weekly factors for estimating AADT dependent on whether the sites being measured have previously been measured.

Task 4, was an additional project which further simplified the practical application of the general method by an examination of the value of single day (full 24 hour) counts for estimating AADT. Clearly, the estimation of AADT from a single day count is less precise than that obtained from a full week of data, but the expended effort to obtain a reasonable estimate is considerably reduced. The first part of this task provided estimates of daily multipliers, for each group, which could be used for estimating Weekly ADT. The estimation of the accuracy of these multipliers was also produced. The second component of this final task was to evaluate simpler general characteristics of the usage pattern which do not require formal graphing.

The appendices of this document contain sample pages from the more complete appendices for the individual Task reports. References to appendices which appear in this report apply to this document alone. The appendices for the individual Task reports are labelled separately.

2. THE GROUPING PROCESS

The traffic usage patterns were examined using commonly available exploratory data analytic methods. The basic approach was to examine the weekly pattern, by day and by hour. To avoid complications the odd days with some hourly flows missing were not analysed. After considerable exploratory searching via graphical methods, the decision was made to use the median usage patterns. Medians were over the weeks of the year and constructed for each hour of the day, each day of the week. The graphs for such median patterns are in the Appendix for Task 1. The measure relevant for each graph is the proportion of the AADT for the site for the 24 hours of the day. That is, if the height of the graph was, say, 0.10 then the traffic count within the corresponding hour on the horizontal axis is 10% of the average daily usage of the site. In most cases, the peak usage proportion for a single hour was less than 0.20.

The graphical information presented by these median patterns was highly useful for incorporation into a multivariate classification scheme. Any discrimination method requires the specification of a distance function. In this case the most straightforward, Euclidean Distance function was used. That is, for any two usage graphs the distance between them is given by:

$$\sum_{i=1}^{24} (x_{1i} - x_{2i})^2$$

where x_{1i} and x_{2i} are the hourly AADT proportions for sites 1 and 2 respectively, for i=1...24.

Overall, there were 82 sites available for this task. Most of the Transpac sites had relatively consistent and complete data available for several recent years of data (1989-1991). The most difficult sites to manage were some of the older (1982-1989) local body files.

The result of the classification process (hierarchical cluster analysis) gave, initially, a possible set of up to 15 separate groups derived from the classification dendogram. The threshold distance for separation into the groups was 0.12. The choice of this cut-off was a combination of interpretation of the dendogram as well as input from the Transit New Zealand manager for the project regarding the known characteristics of the sites.

Additional analysis was conducted using seasonal information. That is, the data for each site was split into a 'Winter' component and a 'Summer' component. Many of the sites did not exhibit a distinguishable seasonal split in usage. However, this analysis gave further insight into the nature of some individual sites which allowed for more refinement in the grouping process. This becomes evident in the recreational route sites.

Additional methods were evaluated. These included attempting a cluster analysis using the pattern of daily totals across a year. This produced some of the same information as the hourly by day median profiles, but were seen to be much less satisfactory. Furthermore, the implication for the AADT estimation process of using the annual graphs would be that counts for a substantial portion of the year would be required for sensible estimates. This was clearly impractical. A further method was to examine the top 10% of daily flows for each site. As before, some of the grouping structure was evident, but this method would not distinguish the seasonal sites in a clear way.

After review of the grouping arrangement the following characterisation was accepted as appropriate:

1a. ***Urban Arterial 'Major'***

Sites: 111, 115, 81, 4 [3b/4b], 61, 67, 3 [3a/4a], 83, 68, 79, 71, 55

1b. ***Urban Arterial 'Minor'***

Sites: 99, 72, 75, 77, 80, 112, 91, 93; 57, 58, 59, 60, 51 [61], 54 [64]

2. ***Urban Commercial***

Site: 65

3. ***Urban Industrial***

Sites: 100, 63, 64

4. ***Urban Other***

Site: 101

5. ***Rural Urban Fringe***

Sites: 1, 7, 2 [47 for 1991]

6a. ***Rural Strategic (a)***

Sites: 46, 45, 40, 22, 106, 107, 6, 103, 102, 92, 26, 94, 95, 41, 97, 96, 24, 39; 53 [Transpac site 65]

6b. ***Rural Strategic (b)***

Sites: 28, 52, 10, 36, 14, 13, 18, 5, 30, 38, 19, 15, 34, 20, 21, 16, 27, 31, 98, 23, 104, 12, 33, 8, 105, 25, 17, 110, 44; 56

7a. ***Rural Recreational 'Summer'***

Sites: 32, 35, 9

7b. ***Rural Recreational 'Winter'***

Sites: 29, 42, 37, 43, 11

Note the group names are labels only for easier reference. For example, the difference between *Urban Arterial 'Major'* and *Urban Arterial 'Minor'* is related not to the amount of traffic but to the traffic pattern, with *'Major'* exhibiting a more dramatic peak effect.

3. ESTIMATION OF WEEKLY MULTIPLIERS

Having settled on the grouping structure and the possibilities offered for reasonable classification, Task 1, the next step was to consider the process of predicting AADT of the sites and estimating the precision of such predictions.

Task 2 began with the inclusion of much more data into the project. All of the 1992 files for sites 01 to 46 (except 02) were added. Fortunately these files were reasonably complete with a standard format. Additionally nine new sites were added. A complete cluster analysis allocated the new sites to give one additional site for Group 1a; six new sites to Group 1b; one new site to Group 6a and one new site to Group 6b.

The primary aim of Task 2 was to evaluate several sampling strategies which were possibilities arising from the results of Task 1. The basic data files (by group) were as follows:

1a. Urban Arterial 'Major':	**12 sites;**	**29 site-years of data.**
1b. Urban Arterial 'Minor':	**14 sites;**	**36 site-years of data.**
2. Urban Commercial:	**1 site;**	**2 site-years of data.**
3. Urban Industrial:	**3 sites;**	**6 site-years of data.**
4. Urban Other:	**1 site;**	**3 site-years of data.**
5. Rural Urban Fringe:	**3 sites;**	**10 site-years of data.**
6a. Rural Strategic (a):	**19 sites;**	**57 site-years of data.**
6b. Rural Strategic (b):	**30 sites;**	**105 site-years of data.**
7a. Rural Recreational 'Summer':	**3 sites;**	**12 site-years of data.**
7b. Rural Recreational 'Winter':	**5 sites;**	**19 site-years of data.**

In all there were 91 sites and 279 site-years of data.

All strategies proposed and investigated in Task 2 required weekly count data. In order to compare strategies and groups on an equivalent basis, some standardisation was necessary.

The following parameters were consistent throughout the strategy evaluation process:

a. Each week is considered as starting on Sunday, ending on Saturday.

b. A minimum of four complete daily counts within a week was required before a particular site-week was included. This was because the weekly-daily average count could be heavily biased by including a week which had, for example, only a single day of counts. Although the use of a minimum of four days is itself open to producing some bias, the overall effect is judged to be quite small given the number of site-years being examined.

c. All analysis dealt with weeks 2 through to 51 inclusive. This was considered appropriate given the likelihood of unusual patterns for many sites around the Christmas/New Year period.

d. Week 2 starts on the Sunday after the first Saturday of the year (for 1982 & 1989 week 2 starts on the second Sunday). That is, the first few days of the year, up to a maximum of seven, were discarded from the analysis.

The overall focus of this task was to examine the merits of several practical counting strategies rather than simply to find the 'best' combination of weeks, days or even hours which could be used to estimate the AADT for the sites. The base reference is the average daily count based on counting for a week. The full year's AADT can be estimated by multiplying the Weekly ADT by a factor. Since the AADT and the Weekly ADT vary according to the site and the year of measurement, the multiplier factor will also vary. It is vital to understand the nature of the variation of the computed factors in order to assess the reliability of the method.

The basic component of all strategies, listed in the Task 2 report, and given here for completeness, is as follows:

ESTIMATE:

$$WADT(i) = (\text{total count in week } i)/n(i) \qquad \text{for } i = 2 \text{ through } 51$$

where n(i) is the number of full daily counts used in constructing the week total. In almost all cases, n(i) = 7.

The AADT for the site is then found from:

$$AADT = k_i * WADT(i) \qquad \text{for } i = 2 \text{ through } 51$$

Since the AADT for each site-year in our groups is known, the major item of interest is the multiplier factors k_i across weeks and across sites and years.

For the purposes of estimating variability measures of the multiplier factors it was assumed that the extent of variation year by year is approximately the same as variation across the sites (at least within our groups).

The following computation method was developed during Task 2.

Average Weekly Factor for Week i: k_i

Estimated Standard Deviation: s_i

Number of site-years represented in week i: **n**

95% Interval for Week i factor: $(k_i - t_{n-1} * s_i \ , \ k_i + t_{n-1} * s_i)$

where t_{n-1} is the 95% value of the t distribution with n-1 degrees of freedom.

This yields some standardised basis for comparison of the counting strategies. The 95% range produced is simply the 95% range of the weekly multipliers for sites in the group concerned, centred on the average multiplier. It is **not** a 95% interval estimate for the average multiplier.

4. COUNTING STRATEGIES

There were four possible strategies investigated, described briefly below. Multiplier Factors were computed for each week and for each site-year on a group by group basis. Summaries of the computed factors were obtained on a week by week basis.

Strategy 1

Sample one full specific week during the year. Compute the WADT for that week. Estimate the site AADT by multiplying the WADT by the factor for that particular week.

Strategy 2

Sample two full weeks during the year; one week in the Summer period and one week in the Winter. The purpose behind this is to assess whether sampling a second week improves precision in the estimates of Strategy 1.

For the purposes of this computation, the seasonal split was defined as follows:

Winter:	Weeks 14 to 39 inclusive	(26 weeks)
Summer:	Weeks 2 to 13 and 40 to 51 inclusive	(24 weeks)

Strategy 3

Sample four full weeks during the year; one week in each three month period. The purpose behind this is to assess whether sampling a second week in each season improves precision in the estimates of strategy 2.
For the purposes of this computation, quarters were defined as follows:

Quarter 1:	Weeks 2 to 13 inclusive	(12 weeks)
Quarter 2:	Weeks 14 to 26 inclusive	(13 weeks)
Quarter 3:	Weeks 27 to 39 inclusive	(13 weeks)
Quarter 4:	Weeks 40 to 51 inclusive	(12 weeks)

This would give a total of 24336 combinations. It is neither practical nor appropriate to even try to compute all possibilities. Consequently, stratified random sampling was used. In each quarter, five weeks were selected at random. The four week factor was then computed. This gave 625 randomly chosen possible week combinations. Two samples were performed in this manner.

Strategy 4

Sample twelve full weeks during the year, approximately one week in each month. The purpose behind this is to assess whether the considerable extra sampling improves precision in the estimates of strategy 4, primarily for the rural recreational sites. The three groups investigated were 6b. *Rural Strategic (b)*, 7a. *Rural Recreational 'Summer'* and 7b. *Rural Recreational 'Winter'*. They were assessed with two samples each.

For the purposes of this computation, months were defined as follows:

Month 1:	Weeks 3 to 6 inclusive
Month 2:	Weeks 7 to 10 inclusive
Month 3:	Weeks 11 to 14 inclusive
Month 4:	Weeks 15 to 18 inclusive
Month 5:	Weeks 19 to 22 inclusive
Month 6:	Weeks 23 to 26 inclusive
Month 7:	Weeks 27 to 30 inclusive
Month 8:	Weeks 31 to 34 inclusive
Month 9:	Weeks 35 to 38 inclusive
Month 10:	Weeks 39 to 42 inclusive
Month 11:	Weeks 43 to 46 inclusive
Month 12:	Weeks 47 to 50 inclusive

This would give a total of in excess of 16 million combinations. As before, computing all possible combinations was not done. Stratified random sampling was used by randomly selecting one week out of the four in a 'month' for each of 12 months. Two samples were run, each being 500 random combinations.

Overall Results From the Comparison of Counting Strategies

Each weekly multiplier from each group was given as an estimate plus some description of the variability of the weekly estimates from which the average is drawn. For each estimated weekly multiplier, a 95% range was attached. The evaluation of the strategies was then done by considering the ranges (across weeks) of these 95% ranges. The measure chosen was the 80th percentile of the mean multipliers and the 95% relative ranges respectively. **That is, 80% of all weekly multiplier estimates have 95% relative errors less than this figure.**

An overall table of the 80% ranges for all strategies and groups investigated shown in Table 2.

TABLE 2: 80th PERCENTILE OF THE 95% INTERVAL ESTIMATE RANGES

Group	Strategy 1: 1 week/yr	Strategy 2: 2 weeks/yr	Strategy 3: 4 weeks/yr	Strategy 4: 12 weeks/yr
1a	0.2857	0.1848	NA	NA
1b	0.2891	0.2129	0.1179	NA
2	NA	NA	NA	NA
3	0.8195	0.5540	0.3297	NA
4	0.3978	NA	NA	NA
5	0.2818	0.2093	NA	NA
6a	0.3984	0.2693	NA	NA
6b	0.3559	0.2546	0.1622	0.0940
7a	0.5626	0.4991	0.3696	0.2192
7b	0.6784	0.5187	0.2862	0.1895

Table 2 is useful for comparing strategies. [**It is not the reference table for obtaining errors or interval estimates for a particular strategy.** The base source for that must be Appendix B3.1 of the Task 2 Report (1993). Discussion on the detailed interpretation of the table and some examples are in this Report.] Overall, the following offers some guidelines:

If we chose to have a margin of error figure of at most say +/- 10% for 80% of possible multiplier (and thus AADT) estimates then:

Group 1a: Choose Strategy 2 (9.2%)
Group 1b: Choose Strategy 2 (10.6%)
Group 2: Choose Strategy Not Known
Group 3: Choose Strategy 3 (16.5%) * estimate unreliable due to small sample sizes
Group 4: Choose Strategy 1 (19.9%) * so the next strategy might be needed
Group 5: Choose Strategy 2 (10.5%)
Group 6a: Choose Strategy 2 (13.5%)
Group 6b: Choose Strategy 2 (12.7%)
Group 7a: Choose Strategy 4 (11.0%)
Group 7b: Choose Strategy 4 (10.5%)

The table of ranges provides a means for determining which strategy is most useful for a pre-determined required level of accuracy. Alternatively, given the measurement effort which is most practicable, a measure of the achieved level of accuracy can be found.

The major item for reference for estimating AADT using any of the above strategies is the table of weekly multipliers for each group provided in Appendix B3 for Task 2. The report for Task 2 also produced an approximate method for estimation of the multipliers for any combination of weeks.

The last component of Task 2 was the discussion of predictive intervals for the AADT multipliers for sites not currently included in the base analysis. The basic formula is:

predictive 95% range = base 95% range *(n +1)/n

where the base 95% range is the 95% range of the multipliers for the particular week in question. The range is centred on the average multiplier for the week and is obtained from Appendix B3.

5. ADDITIONAL RESULTS

5.1 Standardised Pattern Graphs

While there is complete information on the chosen strategies in the Appendices for Task 2, the Steering Group identified other areas for investigation which could lead to additional flexibility in the traffic counting practice. Five separate items were included in Task 3.

The first sub-task simply took the basic hourly median graphs, by day, for each group and enlarged these (incorporating all new files) to a standard scale, namely 5 mm to 1% of the AADT. This gave not only a standard comparison for all groups but also a means of consistently comparing new sites against group averages. In addition, part of this task consisted of aggregating the regular weekday (Monday-Thursday) patterns to a single pattern. The basic rationale for this was the similarity of usage patterns for these days within all groups.

5.2 Directional Patterns

Since all of the analysis and the resulting classification procedures in the project had concentrated on the total vehicle flows, some examination of the directional patterns was considered appropriate to determine whether this additional information could aid the classification process. Not all sites were represented in this task. However, there was a total of 460 site-years of available directional data (directions a & b) as follows:

1987: Sites 01-04, 08, 10, 11, 15	[108+109 = 111 not used]
1988: Sites 01-04, 06, 07, 08, 10, 11, 13-18, 21-23, 25-30	
1989: Sites 01-42	
1990: Sites 01-46	
1991: Sites 01, 03-47 (site 47 = renamed site 02)	[112, 115 not used]
1992: Sites 01, 03-46, 51-54, 56-60, 112, 115	
1993: Sites 01, 07, 51, 54, 57-60 (partial year up to end April)	

This meant that the following groups were represented: 1a, 1b, 5, 6a, 6b, 7a, 7b. In general terms the directional patterns did provide some additional pattern information which could be useful in the allocation of a new site. The most interesting exception was a Christchurch site (112), Curletts Road where the directional patterns did not match the patterns typical of the remainder of sites in the same group (1b, *Urban Arterial 'Minor'*). In fact the Curletts Road directions were essentially the same, exhibiting both morning and afternoon peaks. The fact that this was the only major exception to the pattern indicates that any more detailed analysis of the directional flows, either producing a classification dendogram or table of multipliers, would be unlikely to yield a significantly better process.

5.3 Multipliers Excluding Easter Counts

A major issue for all of the classification and especially estimation procedures is the level of variability inherent in the weekly multipliers. The effect of removing the count data for the Easter week was assessed. The data used here was the total flow files as for Task 2. This involved removing 1 week of data surrounding Easter Sunday (a separate process for each year). The weekly multipliers were produced in the same way as those derived in Task 2. This time the item being estimated was the AADT for 51 weeks (ie excluding Easter). Consequently, a multiplicative adjustment was necessary for the ex-Easter figure to give the full year AADT. In most of the urban groups this adjustment was a downwards correction. For the rural groups, the adjustment was upwards. Overall estimating weekly multipliers and AADT by means of this process did not appear to significantly improve the precision of the estimates. In fact the highest correction adjustment was only 1.2% of AADT.

In order to assess any improvement in the accuracy of using the Easter-excluded multipliers (as opposed to the full year multipliers in Appendix B3) it is appropriate to consider the comparisons in interval widths (or by implication, standard deviations) of the multipliers under the two methods. A week by week comparison is possible, but it must be remembered that we are always dealing only with sample information, not whole population information. The implication from this is that any comparison between the Easter-excluded variability and the full year variability is best considered on an overall basis. In addition, for this sub-Task, several site-years were added to the full list creating some changes in week by week variability estimates.

Table 3 contains the average standard deviations (average over weeks) for each group for the two methods.

TABLE 3: AVERAGE MULTIPLIER STANDARD DEVIATION

Group	using all weeks		using weeks 14-16 only	
	Easter included	Easter excluded	Easter included	Easter excluded
1a	0.0530	0.0457	0.0352	0.0503
1b	0.0617	0.0585	0.0542	0.0345
2	0.0254	0.0246	0.0323	0.0405
3	0.1178	0.1102	0.1827	0.0796
4	0.0371	0.0334	0.0529	0.0298
5	0.0468	0.0493	0.0896	0.0442
6a	0.0882	0.0834	0.0868	0.0488
6b	0.0755	0.0706	0.1208	0.0532
7a	0.1093	0.0936	0.2107	0.0855
7b	0.1410	0.1298	0.2368	0.0898
Average	0.0756	0.0699	0.1104	0.0556

Note: The results for Groups 2, 3 and 4 are not fully reliable for the simple reason, as before, of low numbers of site-years in the groups.

Clearly there is some improvement in the precision of the weekly multiplier estimates by excluding Easter from the calculations.

When considering the multipliers for weeks 14, 15, and 16, which are the weeks most affected by the Easter week removal, the effect is more substantial. (These weeks were used as being the most common Easter weeks over the years in the data files.)

5.4 Within Site and Between Site Variation

Many of the groups identified from Task 1 were composed of files from different sites as well as repeated years from the same sites. In terms of the basic classification, these were regarded as equivalent. However, for the purposes of the estimation process, estimating AADT for a new year for a site already in a group (based on the analysis in Tasks 1 and 2) is different from estimating AADT for a site not included in the base analysis but identified as a member of the group.

The possible virtue of this split is derived from the likelihood that the temporal variation is lower than the spatial variation. The extent of any improvement will be dependent on the group under consideration. In all groups, there was an improvement in precision when estimating multipliers for sites already in the base analysis. Appendices C1-C6 give tables of the relative 'between' and 'within' precision for each week and each group.

5.5 Estimation for a Single Site

Since the Transpac data offered several years of count data for at least 42 sites, the possibility of even further refinement of the estimating precision arose.

This task required the creation of individual summary file for each of the Transpac sites. The basic regression formula is the simple linear equation:

Multiplier = a * Year + b (+ error)

The 42 Transpac sites were analysed separately in this way to give fifty weekly equations.

This task produced the least rewarding results. No group produced results which could consistently provide improved multiplier estimation precision.

5.6 Hourly Estimates

Although the classification scheme and the Multiplier Tables, examples of which are in Appendix B3.1, provide a comprehensive basis for estimating AADT, there was considerable interest in the value of short term count data. In many practical situations it is only the short term counts which are available. Consequently, it is appropriate to have some knowledge of the value of such counts in determining AADT. It must be stressed that these short term counts will provide little, if any, benefit in the process of allocating a new site to an existing group. However, one hour counts can obviously be used for estimation of AADT. The main issue is the reliability of such estimates.

Three specific hours were chosen for this task:

- Friday am peak 8am - 9am
- Friday pm peak 4pm - 5pm
- Saturday peak 11am - 12pm

The files used for this analysis were the same as for Task 2 with several 1993 files added. The report for Task 3 gives more detail on the methods and the reported results. The Appendix for Task 3 contains the set of multipliers, by week for each group, for each of the three selected hours. The variability in the estimated multipliers is high throughout sites in a group. However, there is, with some exceptions, a reasonably low variability in average factors across weeks of the year. The clear exceptions are the seasonal Groups 7a and 7b. This means that, provided certain 'odd' weeks are not used for counting, the choice of week is not critical. (Examination of the results in the Appendix indicate that the 'odd' weeks are those with long weekends or around holiday periods. This will of course vary according to the year and the nature of the group.)

6. DAY FACTOR ESTIMATION PROCESS

6.1 Day Factor Estimation and Evaluation

For each day of the week, the daily factor was estimated as the average, across weeks of the year and across sites within the groups, of the day count as a proportion of the week count.

Special account was taken of holidays (especially Mondays) to avoid significant bias in the day multipliers. In those weeks where Monday was coded as a holiday, the day identifier was re-coded to that of a Sunday.

6.1.1 Calculation of Weekly ADT

The minimum requirement of the Weekly ADT estimation was that at least four full days of hourly counts were available for any week. For the purposes of estimating individual day multipliers, an additional restriction was imposed in order to avoid significant bias in the estimates. The restriction, suggested by Transit NZ, was that both weekend days were present. If this condition was not met for a particular week, its contribution was zero.

When some days are missing from a week, the computation of WADT is not simply the (unweighted) average of the daily totals. The estimate of the WADT was produced as a weighted average of the counts present for the week. Weights were determined by the number of weekend and weekday days present.

For those days which are present in the week, the day factor is the weekly average ADT as a proportion of the daily total. Symbolically, this is:

$$\mathbf{F_i = WADT/DT_i}$$

where i = 1...7 are the days of the week; DT_i is the total count for day i.

That is, consistent with the overall estimation of AADT, the daily count is multiplied by the day factor to produce an estimate of WADT which in turn is multiplied by the week factor (for the sampled week of the year, appropriate to the group) to provide an estimate of AADT.

As with the weekly factors, the 7 day factors were produced for each of the 10 groups. The summary results table, together with the standard deviation of the estimates is given in Appendix D1.

6.1.2 Comments

In all groups it is Sundays and Holidays which exhibit the greatest imprecision. (The exception is Group 3, Monday).

Both the winter and summer rural recreational groups exhibit somewhat more variation than most other groups for all days of the week.

Care must be taken in strict use of the factors for Groups 2, 3 and 4. In each case the number of sites and years is limited, so the estimate of both the average day factors as well as the corresponding variations is subject to error. In the case of Group 4 (Urban Other), it should be remembered that this group has only a single site, which may indicate the relatively low standard deviations.

6.1.3 Rural Recreational Groups

An investigation of the summer/winter split in the day factors for rural recreation groups was performed. The tables are in Appendix D2.

6.2 Assessment of Different Allocation Rules

The formal application of the grouping and allocation method given in this project requires the assessment of the 'nearness' of an individual site to the graph pattern of the identified groups. In strict terms, this would require the calculation of the Euclidean distance between the site and all group centroids for each day of the week. This is not a process which will work in practical field applications.

It is possible to visually assess the nearness of the site to each group provided the daily traffic pattern of the site has been graphed on the same scale graphs as that provided by Transit NZ for the groups. This too is difficult to implement in practice.

Furthermore, it may be reasonable to suppose that many sites, once counted, will clearly fit one particular group pattern without significant formal allocation procedures. This may be readily verified by more simple computation than is necessary for the formal method. Where the simple computed measure (or measures) fails to provide very clear allocation, the more rigorous use of the group pattern graphs may be required.

This section deals with assessment of the usefulness of several, easily computed, traffic measures.

The measures examined are:

Inter-Peak Distance: Weekday (Monday-Thursday); Friday.

Peak Hour: Weekday (Monday-Thursday); Friday; Saturday; Sunday.

Peak Volume: Weekday (Monday-Thursday); Friday; Saturday; Sunday.

Inter-Peak to Peak Ratio: Weekday (Monday-Thursday); Friday.

For the purpose of standardising definitions:

Inter-Peak Distance is the difference between the morning (pre 12pm) peak flow and the afternoon (post 12pm) peak flow; and

Inter-Peak to Peak Ratio is the ratio of the midday (12-1pm) flow to the peak hourly flow.

All flows are determined as the proportion of the daily flow, thus standardising comparisons regardless of actual ADT.

For each of the computed measures, the reference points are the group measures.

A cross-validation method is employed to determine the efficacy of the measures to characterise each group. For every site, the measure under examination is computed. The allocation to a group is done on a nearest neighbour basis.

Using the 'known' information, about the group to which the sites belong and the allocation table, enables an assessment of the accuracy of the allocation scheme provided by the measure under examination.

6.2.1 Inter-Peak Distance

TABLE 4: INTER-PEAK DISTANCE FIRST GROUP PARAMETERS (HOURS)

GROUP	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1a	10	10	10	10	8	1	5
1b	8	8	8	8	8	1	5
2	1	1	1	8	1	1	1
3	9	5	9	9	3	2	1
4	6	6	9	9	6	5	5
5	10	10	10	10	10	6	5
6a	6	7	7	7	6	3	5
6b	6	6	6	6	5	2	5
7a	1	4	2	2	4	2	4
7b	3	4	4	4	4	2	4

The Allocation Rule for a site was determined as:

Monday - Thursday

1a: IPDist >9
1b: 7.75<IPDist<9
2: 2.5<IPDist<3.25
3: Same as 1b (ie inability to discriminate)
4: 7.125<IPDist<7.75
5: Same as 1a (ie inability to discriminate)
6a: 6.25<IPDist<7.125
6b: 4.875<IPDist<6.25
7a: IPDist<2.875
7b: 3.25<IPDist<4.875

Friday

1a: 7<IPDist <9
1b: Same as 1a (ie inability to discriminate)
2: IPDist<2.0
3: 2.0<IPDist<3.5
4: Same as 6a (ie inability to discriminate)
5: IPDist>9
6a: 5.5<IPDist<7
6b: 4.5<IPDist<5.5
7a: 3.5<IPDist<4.5
7b: Same as 7a (ie inability to discriminate)

This method allows complete allocation (no gaps or duplicates) which permits assessment of not only the 'correct' allocation by group, but also the groups into which mis-allocations occur. The resulting allocation table is given in Appendix D3.

6.2.2 Peak Hour

This measure has proved the least valuable of all.

Monday-Thursday:	Cannot Distinguish Groups 1a, 4, 5 (Peak 6pm) Cannot Distinguish Groups 1b, 3, 6a, 6b (Peak 5pm)
Friday:	Cannot Distinguish Groups 1a, 1b, 6a, 6b, 7b (Peak 5pm)
Saturday:	Cannot Distinguish Groups 1a, 1b, 4, 7a, 7b (Peak 12pm) Cannot Distinguish Groups 3, 5, 6a, 6b (Peak 11am)
Sunday:	Cannot Distinguish Groups 1a, 1b, 5, 6a, 6b (Peak 5pm) Cannot Distinguish Groups 2, 4 (Peak 1pm) Cannot Distinguish Groups 7a, 7b (Peak 12pm)

6.2.3 Peak Volume

The allocation process also followed a nearest neighbour rule.
The table in Appendix D4.1 gives the allocation thresholds for the groups.

Interpretation: Monday-Thursday, if the Peak Value for the site is <0.07121 allocate to Group 7b, if the Peak Value is greater than 0.07121 but less than 0.07824, allocate to 6b; etc. Similar interpretation follows for Fridays; Saturdays and Sundays.

The tables in Appendix D5.1 give the group summaries for the peak values. Appendix D6 gives histograms of the peaks for all sites, all groups for each day. The allocation results for this appear in Appendix D3.

6.2.4 Inter-Peak:Peak Ratio

The allocation process also followed a nearest neighbour rule.
The table in Appendix D4.2 gives the allocation thresholds for the groups.

Interpretation of this table is as for the table in Appendix D4.1. The tables in Appendix D5 give the group summaries for the peak values. Appendix D6 gives histograms of the peaks for all sites, all groups for each day.

6.2.5 Comments

The percentage of correct allocations are given in the lower right corners of the actual versus allocated matrices in Appendix D3. The best allocation methods are: Monday-Thursday Inter-Peak Distance (44%); Monday-Thursday Peak (43%); Saturday Peak (43%); Monday-Thursday Inter-Peak:Peak ratio (35%).

It is clear that some allocation methods work well for some groups but less so for others. In particular, Monday-Thursday and Friday Peaks; Inter-Peak distance and Inter-Peak:Peak ratios appear to work well for the urban arterial sites. However, rural-urban fringe sites are often difficult to distinguish from the urban arterials. Saturday Peak seems to perform best on the rural strategic groups - although even here the success rate is only 40-50%.

Some care must also be taken in balancing the overall percentage of correct allocations versus the group size effect.

Monday-Thursday Inter-Peak Distance works best for: 1a, 1b, 6a, 6b, 7b

Saturday Peak works best for: 1a, 3, 4, 6a, 6b, 7a, 7b

Monday-Thursday Peak works best for: 1a, 2, 3, 7b, 6b

Monday-Thursday Inter-Peak:Peak ratio works best for: 1a, 1b, 2, 6b, 7a, 7b.

Sunday Peak has the best success with Group 5 (Rural Urban Fringe) sites; not with others. In fact, most of the other measures have little success with sites in Group 5. In practice, if other characteristics of a site (eg physical location, local knowledge) initially indicate that Group 5 is a possibility, specific sampling on weekends may allow verification.

In summary, it would appear that these measures do have something to offer in the way of rapid identification some of the time. It is not uniformly effective however.

6.3 Combination Measures

Investigation of a combination of two of the above measures cannot simply be conducted by the union of the two allocation rules without modification. Each individual rule in 3.1-3.4 is complete in itself - that is, a definite allocation is made for each site. There is no complement to the rule.

Consequently the following was performed:

The two measures chosen were Monday-Thursday Inter-Peak distance and the Monday-Thursday Inter-Peak:Peak Ratio. The purpose is to define general characteristics of the groups which may lend themselves to an effective allocation. The limits for each group for each individual measure were chosen from the distributions (from 10th and 90th percentiles) of the measures. These are as follows:

Group	Mon-Thu Inter-Peak Distance	Mon-Thu Inter-Peak:Peak Ratio
1a	8.5-10.0	0.45-0.60
1b	6.0-9.0	0.60-0.85
2	2.5-3.0	0.80-0.85
3	4.0-9.0	0.65-0.90
4	7.0-9.0	0.55-0.60
5	8.0-10.0	0.50-0.75
6a	3.0-8.0	0.65-0.90
6b	3.0-7.0	0.80-0.95
7a	2.0-4.0	0.85-1.0
7b	2.0-4.0	0.90-1.0

The resulting allocation scheme (only for correct allocations - no grid is possible) is as follows:

Group	Number	Percentage
1a	24	73
1b	32	80
2	2	100
3	4	67
4	1	33
5	15	94
6a	49	73
6b	97	73
7a	6	40
7b	16	64

The resulting allocation accuracy is quite high, but this is not surprising since the rule was almost designed that way. The consequence is that, the allocation works well for known sites. It is not possible to tell whether the characterisation of the group by this combined method will produce the same efficacy with other sites.

6.4 Assessment of Published Guide

The Traffic Count Guideline (Transit NZ Publication, 29 April 1994) uses the Friday Inter-Peak:Peak Ratio and the Sunday Peak with the following limits:

Group	Friday Inter-Peak:Peak Ratio	Sunday Peak
1a	0.45-0.70	0.055-0.75
1b	0.65-0.85	0.05-0.09
2	0.85-1.00	0.05-0.09
3	0.70-1.00	0.00-0.05
4	0.50-0.70	0.05-0.09
5	0.40-0.65	0.10-0.14
6a	0.50-0.85	0.07-0.14
6b	0.50-0.85	0.09-0.17
7a	0.60-1.00	0.10-0.19
7b	0.50-0.95	0.10-0.30

The results of that allocation are:

Group	Number	Percentage
1a	31	94
1b	27	68
2	2	100
3	6	100
4	2	66
5	16	100
6a	64	95
6b	128	96
7a	15	100
7b	25	100

There is a difficulty of interpretation here. The 'correct' allocations apply to known sites. In principle, it is possible to obtain a 100% correct allocation simply by making the parameter intervals sufficiently wide to cover all known cases. What we do not know is the allocation efficiency with previously non-identified sites.

In terms of developing some information on the correct allocation efficiency, it may be appropriate to allocate new sites accurately (at least as far as the graphical method) then to determine which group is indicated by the various peak parameters above. This method would, however, be slow and dependent upon the rate of addition of new sites into the classification scheme. The estimates of accuracy could be progressively updated.

7. SUMMARY AND RECOMMENDATIONS

This project has been a substantial undertaking. Each raw data file is a matrix whose dimension is approximately 365 by 29. There were 306 total flow files and 462 directional flow files of this size used for the project. For the purposes of reference, all analysis for the project has been carried out using either a Sun workstation or PC 80486/DX2 66MHz with 20 MB RAM. The statistical software used was SPlus (Copyright, Statistical Sciences).

Overall the analysis and methods used and described for this project have provided two major results which should offer significant insight into a very complex issue.

The first is a classification protocol. This offers a clear, systematic means of classifying various sites and consequently a sensible set of groups. Whether or not the groups identified from Task 1 are the final set is certainly influenced by the representativeness of the site files included in the analysis.

The second is the estimation of AADT. The tables of multipliers derived from Task 2 provide a very extensive means of estimating AADT for any site which can be allocated to one of the groups, based on the count information from one week. In addition the precision of such estimates is obtainable from those tables. The selection of the best strategy (sampling one week or several weeks in a structured way) is made on the basis of the desired precision.

The next challenge is to make the procedures operational in the field. The large scaled graphs produced in Task 3 could be used as templates for field classification without the need for substantial computation.

The most substantial drawback is that, for classification purpose at least, a weekly pattern is required. That is the counts, every hour for one full week, are needed to determine the best match to one of the existing group graphs. As determined from Task 3, a full week is not necessary for the purposes of estimating AADT provided that the site being examined is known to belong to a particular group. The issue at this point is the variability of the estimators. If the site being measured is not previously classified, then the process does require the full week.

Where only partial information is available, the results of Task 3 certainly indicate that some progress can be made. For example, if only a single direction is counted, then the directional graphs do provide a reasonable means of allocation. In terms of estimating AADT, the directional data was not used to obtain multipliers. While it is possible to simply scale by some multiplicative factor to compensate for the missing direction, this process would require clear judgement as to the balance between the two directions. Of course, any such process would be inherently more variable than that based on total flows.

If the required AADT is from a site which is already included in the base analysis, then further thought could be given to the use of the 'within' and 'between' variability's estimated in Task 3. This requires the same average weekly multiplier as for the full group but it is clear that in most cases, some improvement in accuracy is obtained by extracting the temporal variation from the spatial variation.

When the required AADT is from a new, but allocated, site then the overall variation estimates of Appendix B3 is the best available for determining precision.

It may be possible, over a long measuring period, to obtain more precise estimates of the AADT for a specific site. However, the requirement to obtain better reliability would be a longer time period than is currently available. In some circumstances it may be appropriate simply to estimate AADT for a site by means of regression of the actual AADT over time rather than attempting to rely on actual weekly counts. This may be appropriate for very stable sites, but as a general rule it would not be sensitive to changes in usage patterns.

Using short term samples such as one hour counts certainly enables estimation of AADT. Task 3 has given some insight into the extent of the variation in multiplier (and thus AADT) estimates based on counts at certain peak periods. If other hours were to be used, this would require the same process and result in a vast array of multiplier tables. While this is feasible, it seems unlikely that a rational counting strategy would emerge. It would certainly be possible to identify a combination of hours which is best in some sense, but given the extent of the variation in the hourly multipliers, the best may be hard to identify and may not be particularly good in any case. As a very quick means of obtaining 'ball-park' estimates of volume for a site already allocated to one of the groups, it may serve a useful purpose. However, if the aim is to identify annual estimates of traffic volumes for the purpose of obtaining Transit New Zealand funding for example, it is likely to be quite inadequate.

The results and general approach used in this project should be published, at least within New Zealand.

8. ISSUES FOR FUTURE INVESTIGATION

8.1 Small Groups

This project has identified seven major groupings of traffic sites, with further subdivision into subgroups in three of the groups. In four of these groups, namely 1a, 1b, 6a, 6b there are many sites. This gives considerable weight to the validity of the derived estimates. In the recreational sites 7a and 7b there are fewer sites but sufficient replicates of yearly counts for each site to confirm the nature of the groups and thus the allocation and estimation process. There must remain some questions over the smaller groups. In particular, Group 2 *Urban Commercial* and Group 4 *Urban Other* have only a single site each. The results of the hierarchical cluster analysis and other traffic engineering information has clearly separated these sites from each other and from the rest.

It is highly appropriate that other sites, which may be identified as potential members of these small groups, should be measured to determine the reliability of both the usage pattern and the weekly multiplier estimates. The current data does not allow appropriate assessment of variability for the estimators in these groups.

8.2 Urban Sites

The basic set of files did contain a number of urban sites. However, most of these sites were identified as primarily arterial. In addition, many of the urban sites were relatively old, so the question must arise as to the consistency of the patterns they exhibited.

It is recommended that further urban sites of varying usage (based on general engineering and location indicators) be incorporated into a classification analysis. It is possible that the usage patterns which have emerged from this project do not cover all urban or urban/commercial sites. Clearly this requires the collection of data on a systematic basis from local and regional authorities.

It is the view of this researcher that including such sites into the overall scheme would provide a very thorough method for assessing the whole demography of New Zealand road traffic usage. This in turn would offer a consistent, data-based approach to assist Transit New Zealand and other appropriate authorities in the development of planning policies and strategies as well as improving the assessment of urban roading/traffic scheme appraisals.

8.3 Vehicle Types

The base data for this project has been simply the vehicle counts per hour. While this is clearly a critical factor in categorising a site, it is unlikely to be the only influence. In terms of understanding further the structure of traffic usage, particularly for the purposes of economic appraisal, vehicle type should be included as a factor in the analysis. This may not require a re-definition of the basic grouping structure, but may lead to a sub-division of the existing groups.

8.4 Updating Multipliers

The weekly multipliers produced for this project are the best possible, given the current set of site-year data. However, all such multipliers are in fact only estimates. These estimates will change with the inclusion of new sites or years into the existing groups. In particular, the multipliers for the small groups may be sensitive to new data. Consequently it is appropriate to consider a programme for deriving the most up to date estimates. The most consistent set of data is that from the Transit New Zealand sites. Many of the rural sites have exhibited a reasonable stability from year to year. As a result, inclusion of a new year's data is not likely to alter the multipliers in a substantial way. Updating the multipliers for groups 6a and 6b may be useful every 2-3 years. The multipliers for other groups should be updated more frequently. In particular, given the highly seasonal and variable nature of the sites in Groups 7a and 7b, updating may be necessary at least every two years.

In practical terms, updating the multipliers is relatively easy. It is simply a matter of producing a weighted average of the current multiplier with the most recent week factors. The more difficult part is updating the variability estimates, particularly if the new data includes a new site which has been allocated to the group. The inclusion of new sites is likely to have the most substantial impact on variability estimates.

It is recommended that a review is conducted every two years to determine how much additional data is available and the extent of that data (new sites/new years). An updating exercise could be appropriate at that point. Any such update should not include a reformation of groups or a new allocation process. New sites should have been allocated according to one of the ten group patterns, unless the new site pattern is not identified as clearly belonging to any existing group.

8.5 Further Refinements

The overall approach in this project has been to focus attention on the general traffic pattern of site usage. There are additional variables which could have been examined for site allocation. For example factors such as the size of the daily peaks and troughs; the relativity of the peaks and troughs to the remaining hourly counts; the actual hours of the hourly peaks and troughs. These are unlikely to alter the basic group structure, but knowledge and analysis of these factors may be very useful at a local planning level. That is, once the group of the site under examination is known, further specific analysis may be appropriate to refine any planning or management programme.

Overall the results of this project have been very rewarding in terms of providing a systematic basis for developing an objective, operational traffic counting and estimation procedure. Incorporation of the additional recommendations relating to small groups and urban sites would make it more comprehensive.

9. REFERENCES

Transit New Zealand 1994. Traffic Count Guideline.

Mara, M.K., 1993-1997. Traffic Stream Data Tasks 1, 2, 3 and 4 Reports. Transit New Zealand (unpublished).

SAMPLES of APPENDICES

for

TRAFFIC STREAM DATA PROJECT

TASK 1 : Appendices 1-12

TASK 2 : Appendices B1-B8

TASK 3 : Appendices C1-C6

TASK 4 : Appendices D1-D6

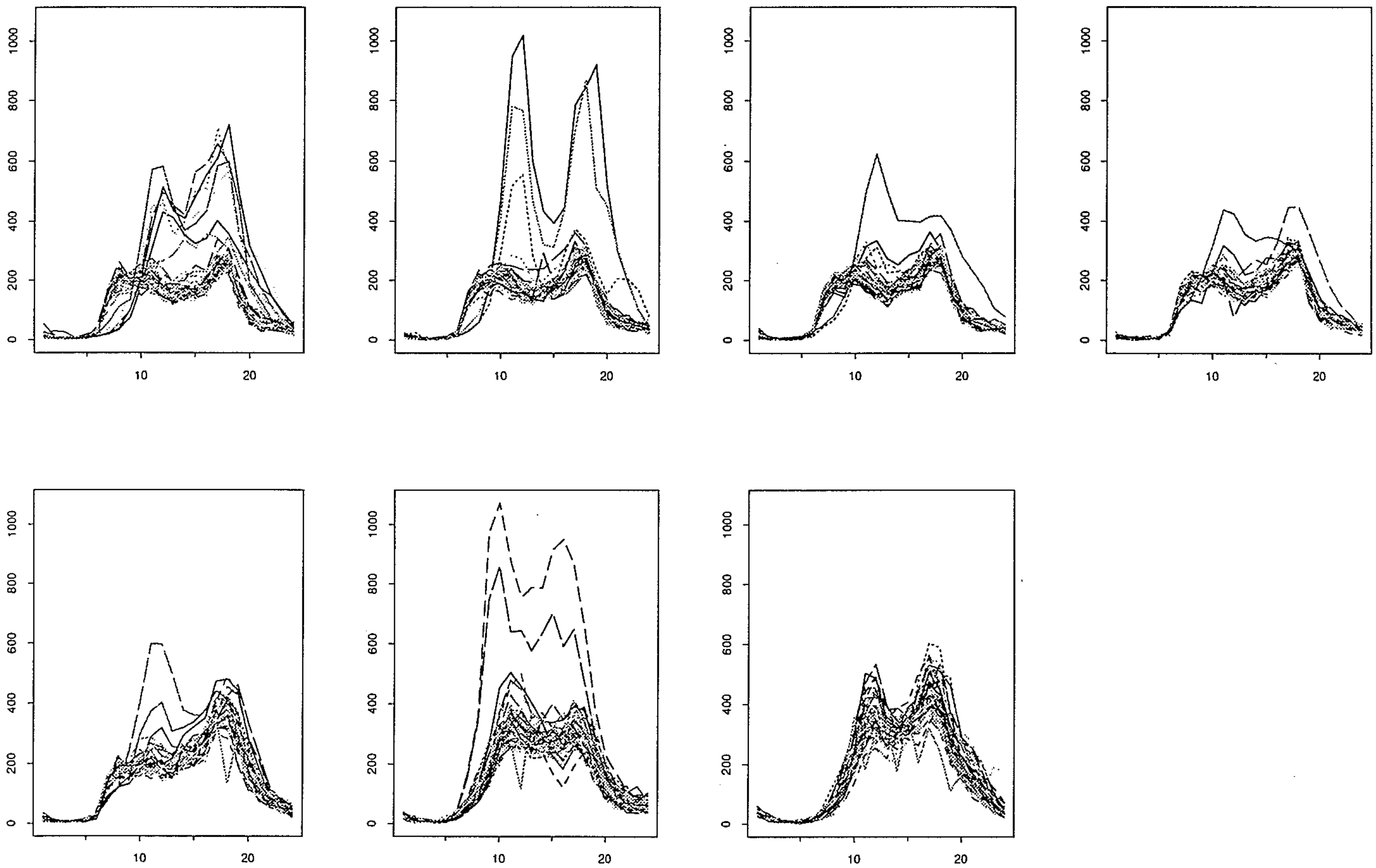
Sample Pages from Each Appendix

Appendix 1

Daily Usage Patterns

Transpac Roads

tp9001t.out



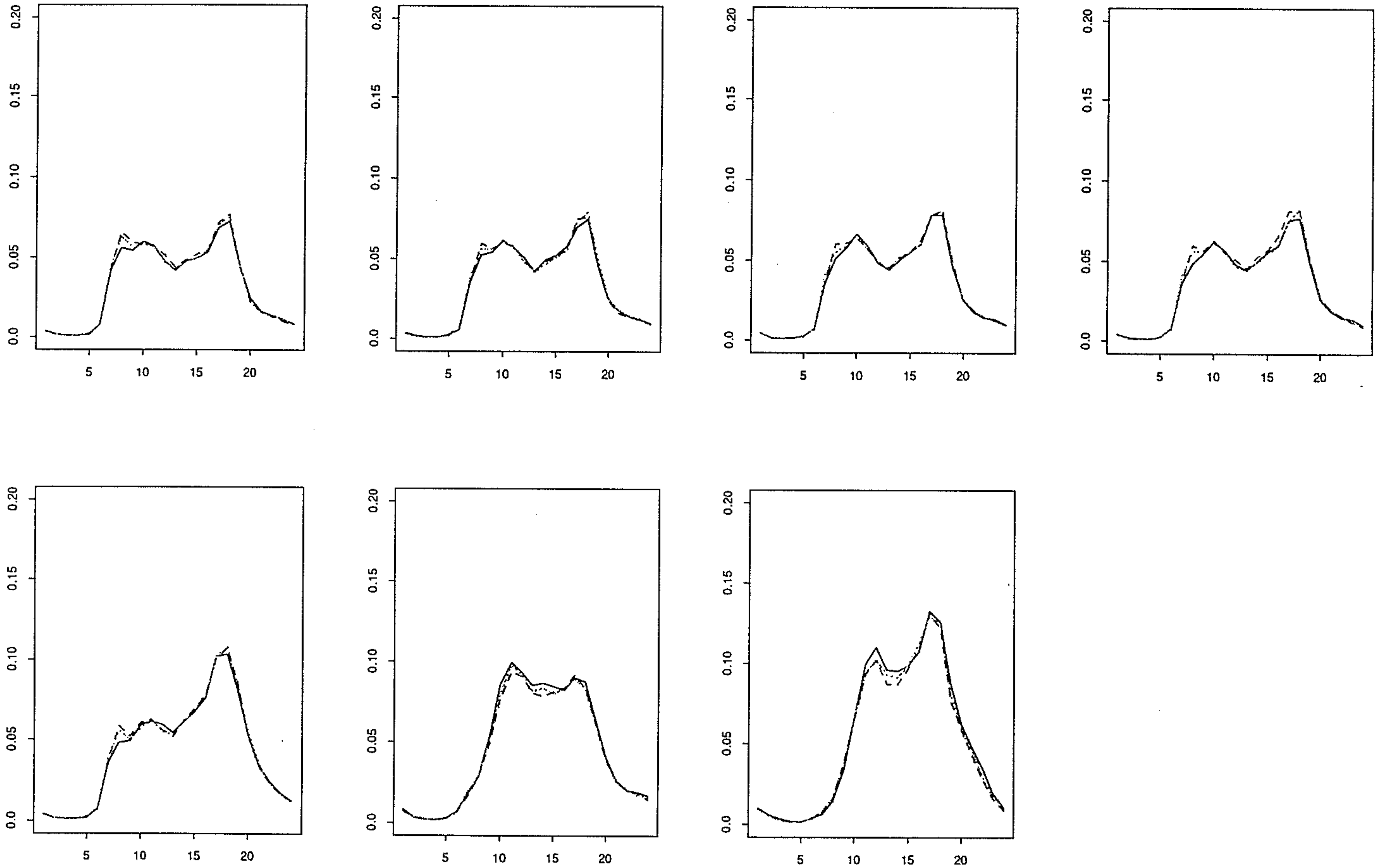
Appendix 2

Median Daily Usage Patterns

1989, 1990, 1991

Transpac Roads

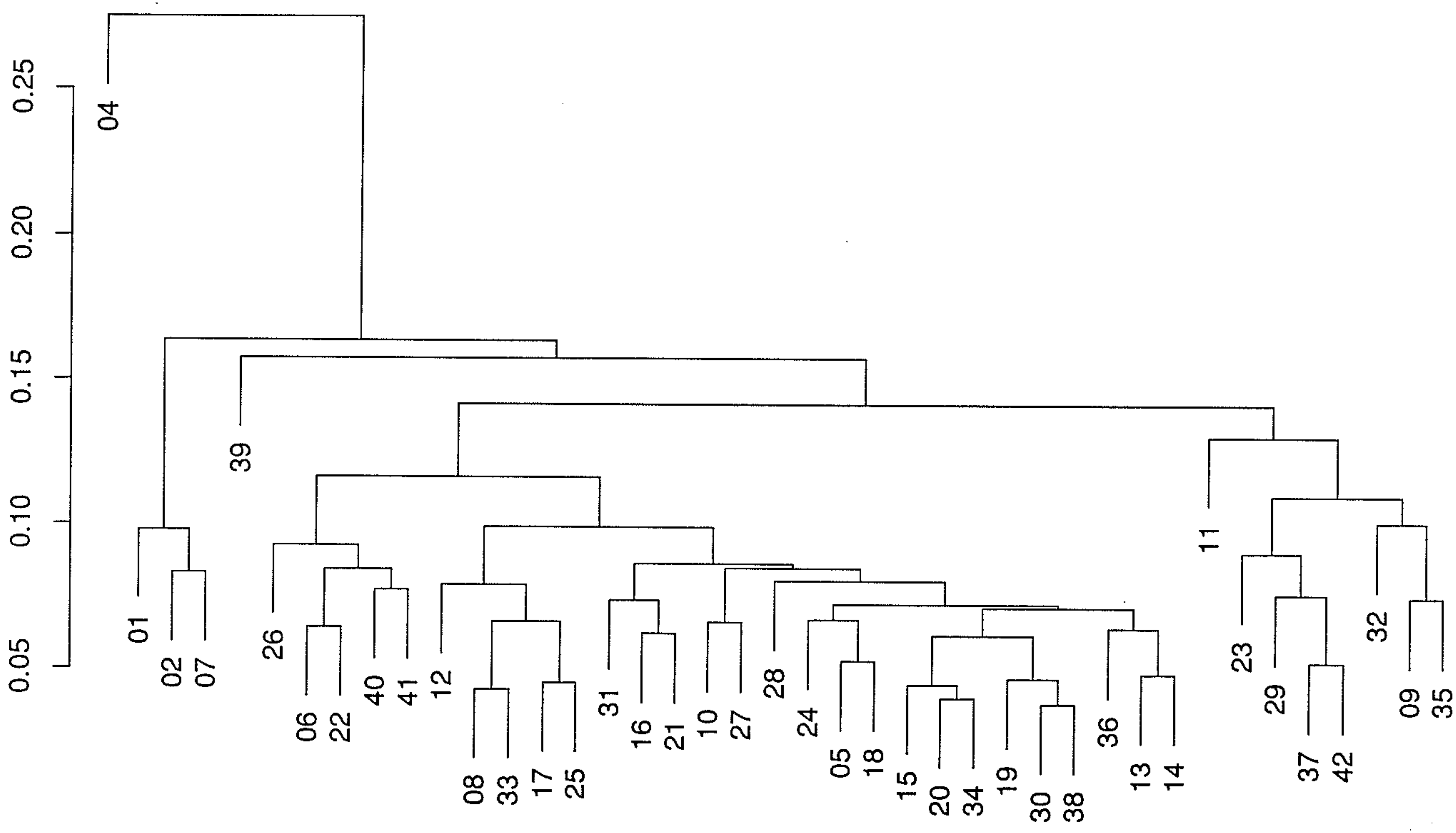
tp01t



Appendix 3

Dendogram for Transpac Roads 1-42

Hierachical Clustering based on daily patterns
Transpac data 1990

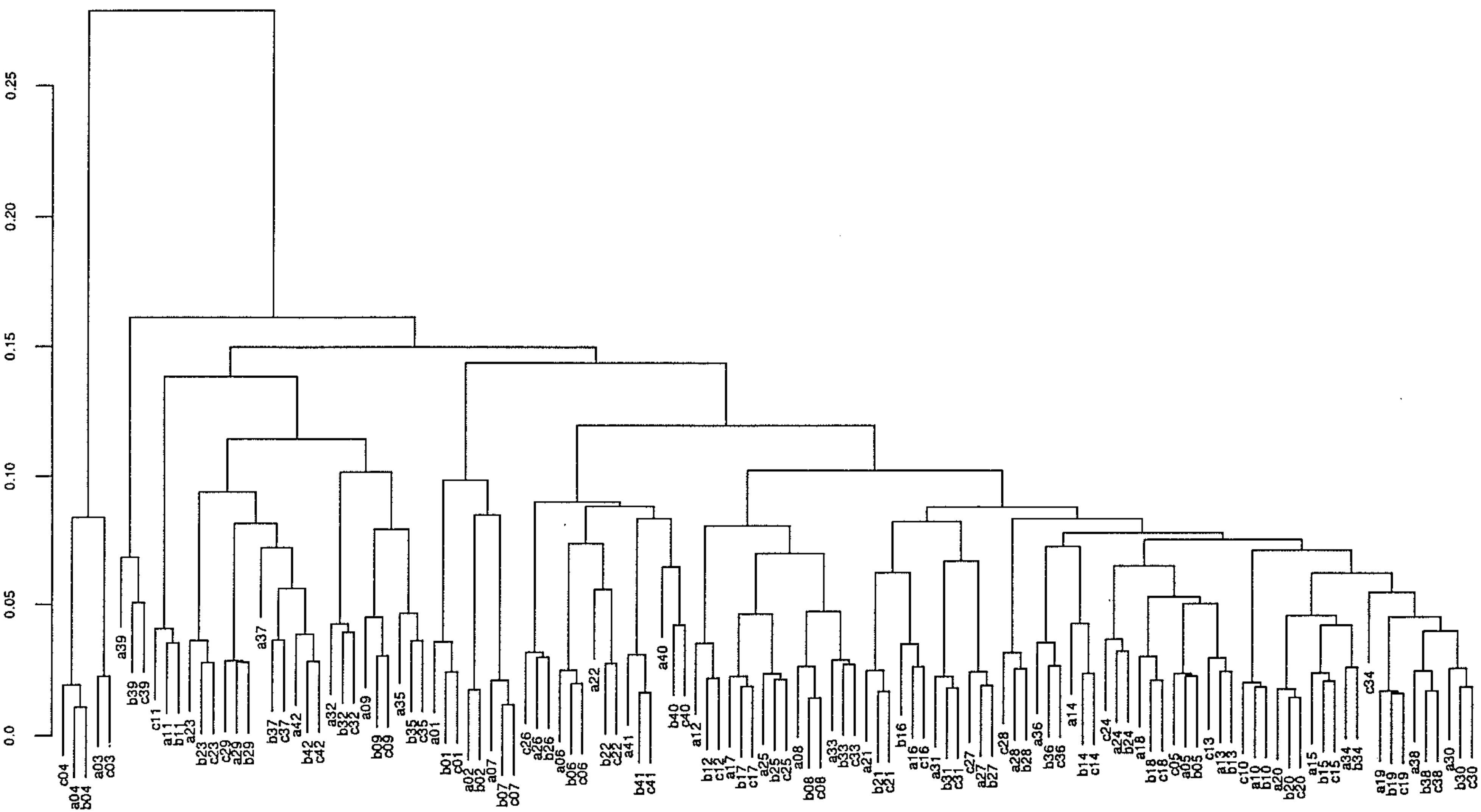


Appendix 4

Dendogram for Transpac Roads

Code: 1989 - a ; 1990 - b ; 1991 - c.

Hierachical Clustering based on daily patterns
Transpac data 1989,1990,1991

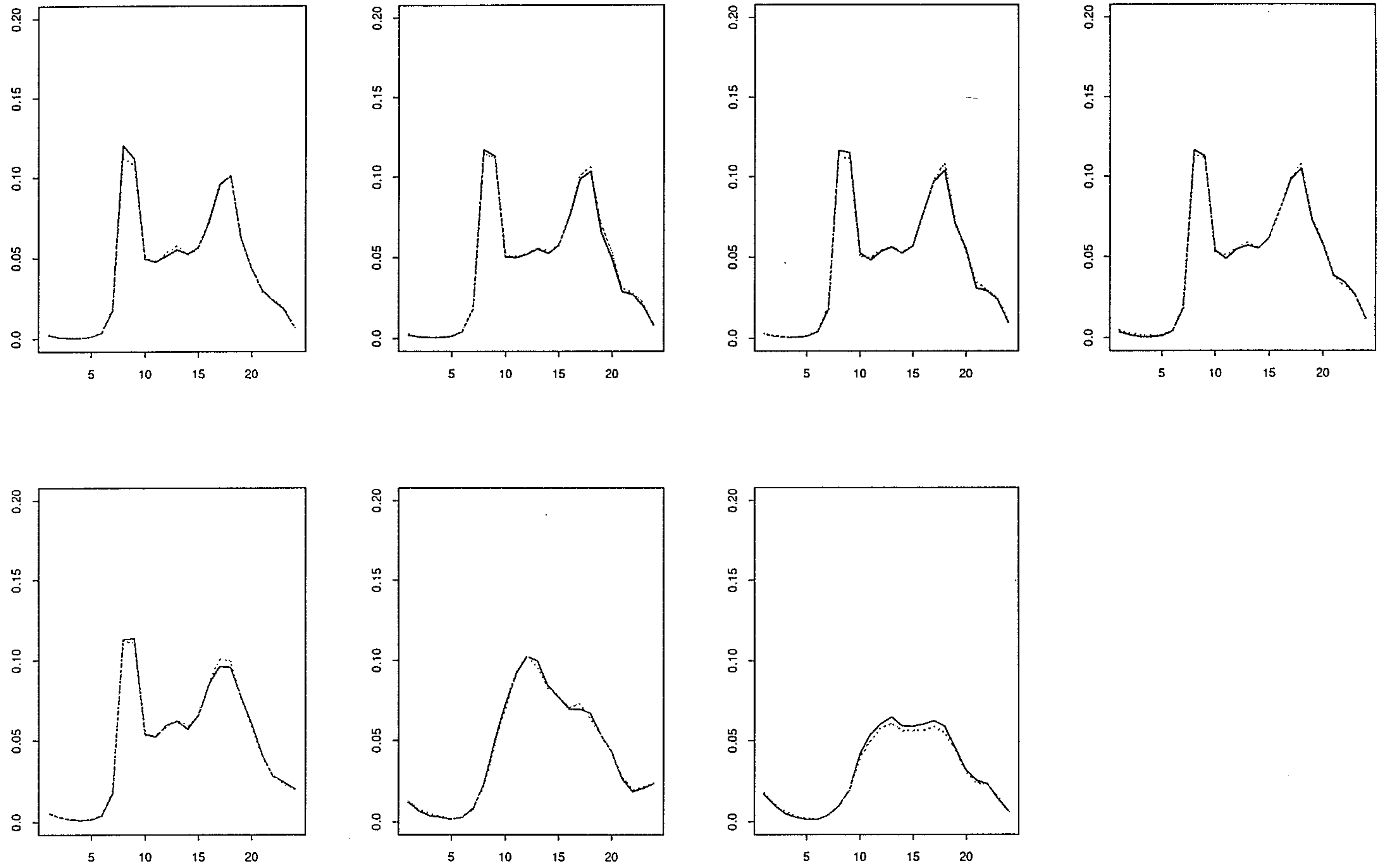


Appendix 5

Daily Usage Patterns

Local Authority Roads

n61t

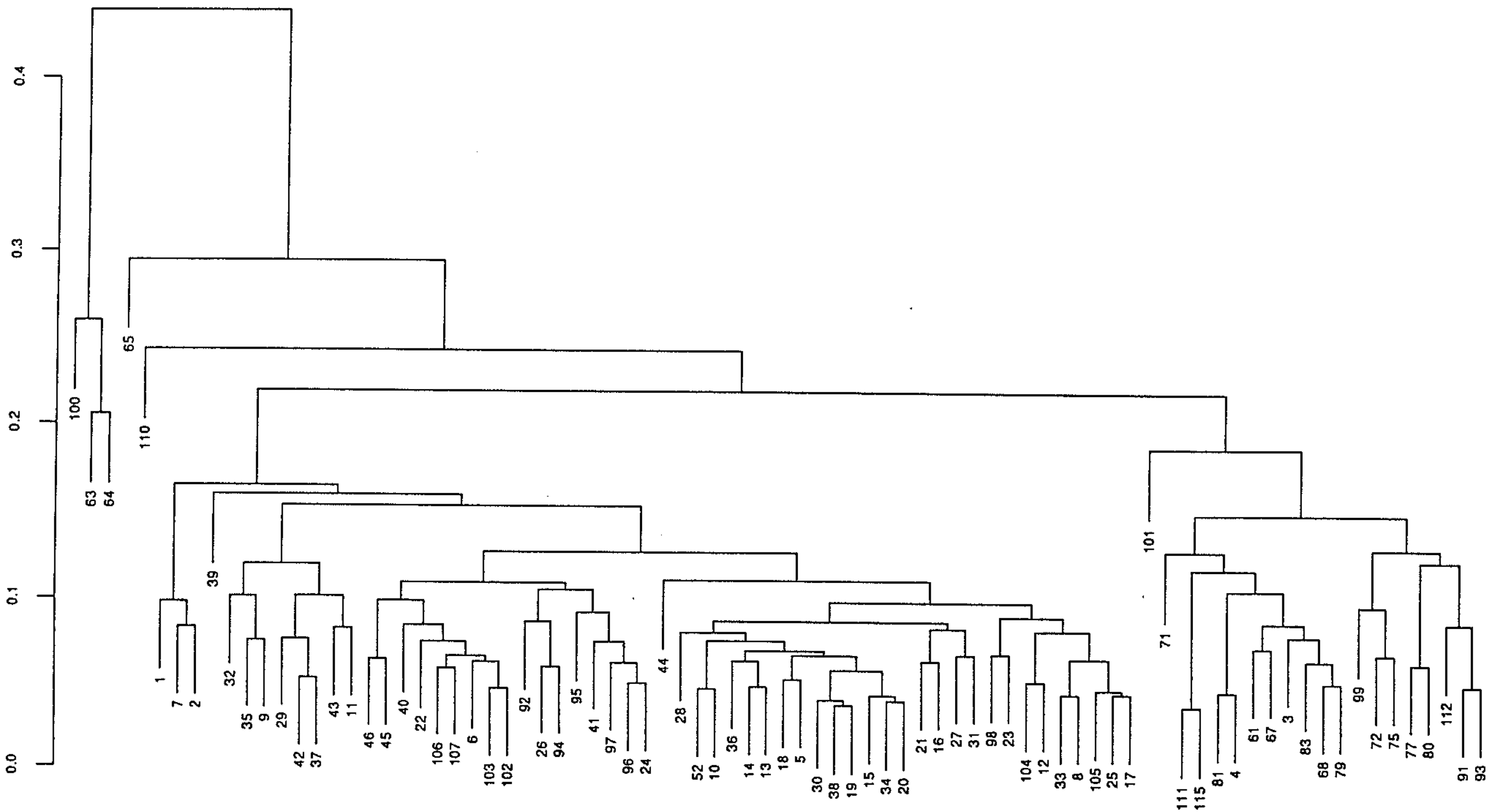


Appendix 6

Dendogram Based on Analysis

UsingAll Roads

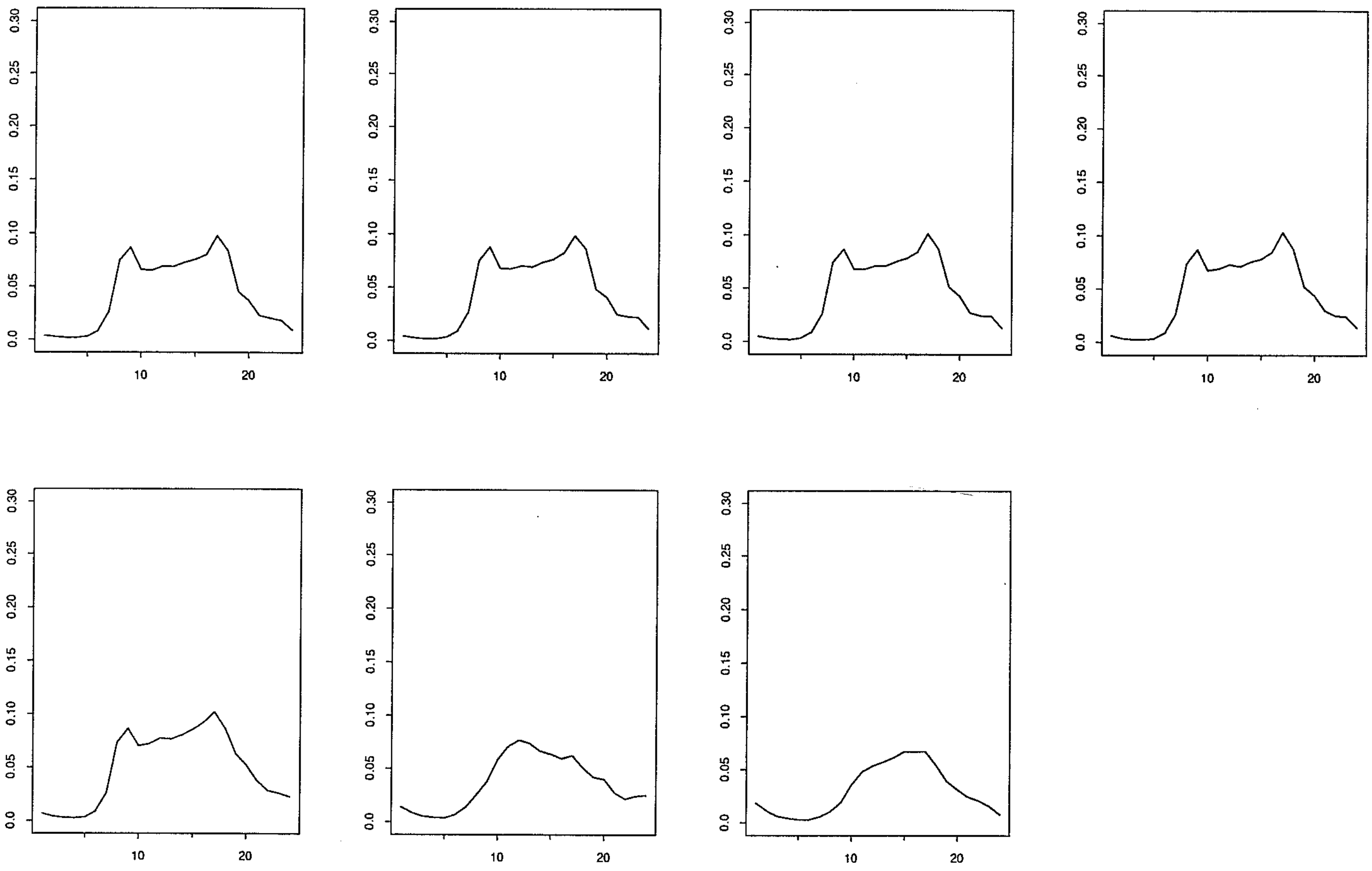
Hierarchical Cluster Dendogram Based on Daily Patterns



Appendix 7

Group Averages of Daily Patterns

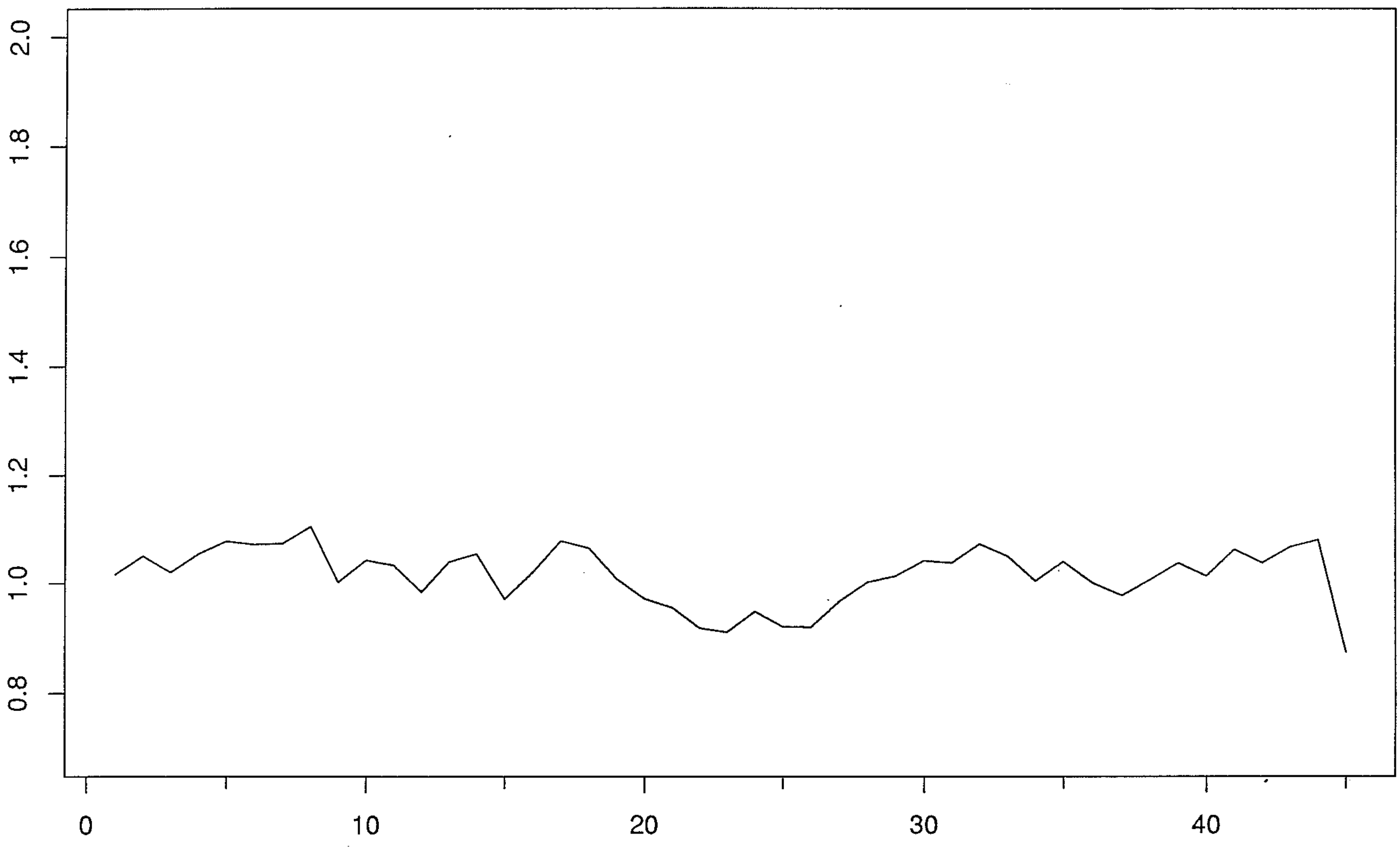
Group 1



Appendix 8

Group Average Annual Patterns

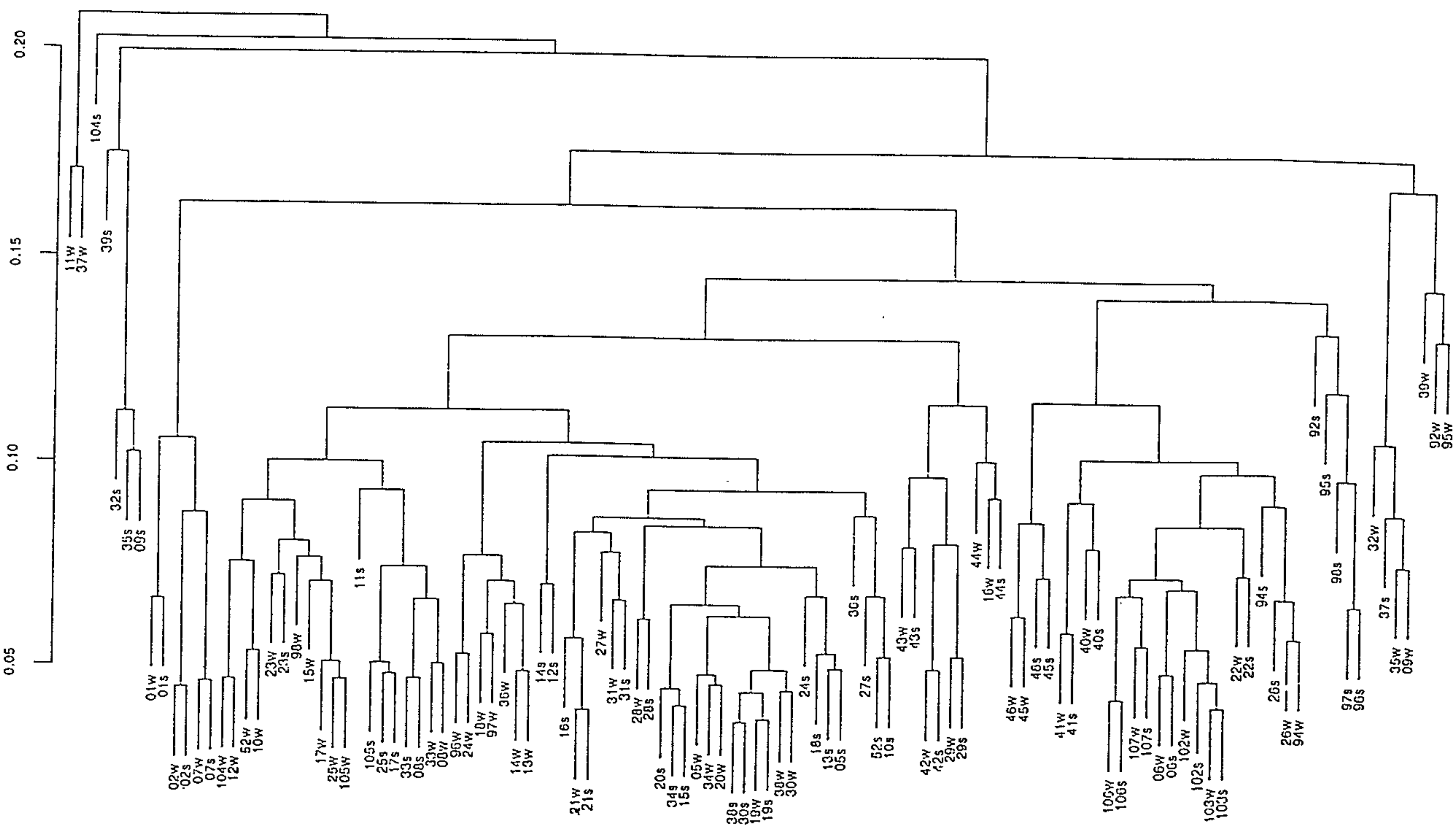
Weekly Totals : Group 1 : Median Method



Appendix 9

Dendograms Resulting From Using Seasonal Information

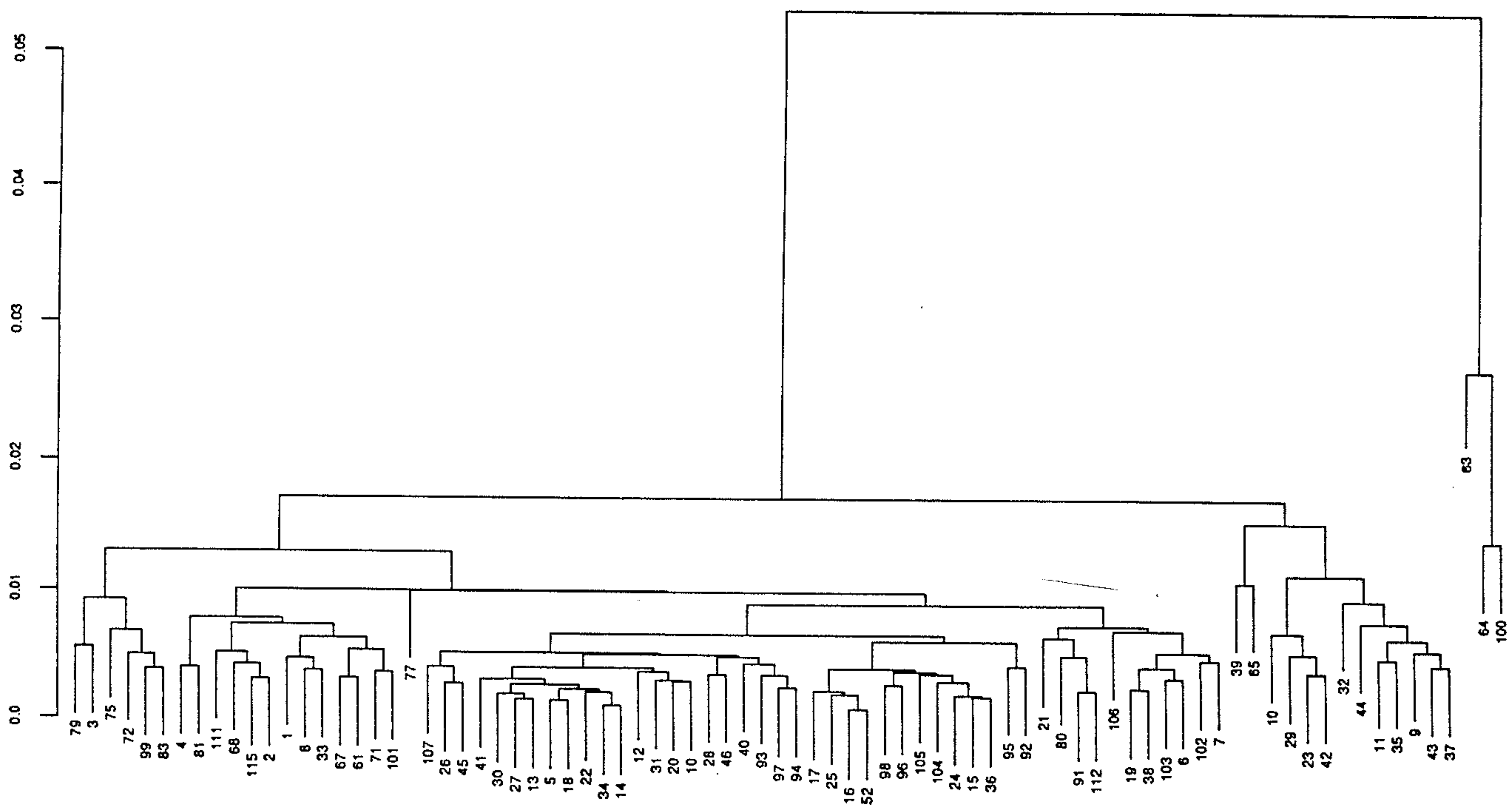
Hierachical cluster using summer/winter daily patterns



Appendix 10

Dendogram Resulting From Analysis of Top 10% Hourly Flows

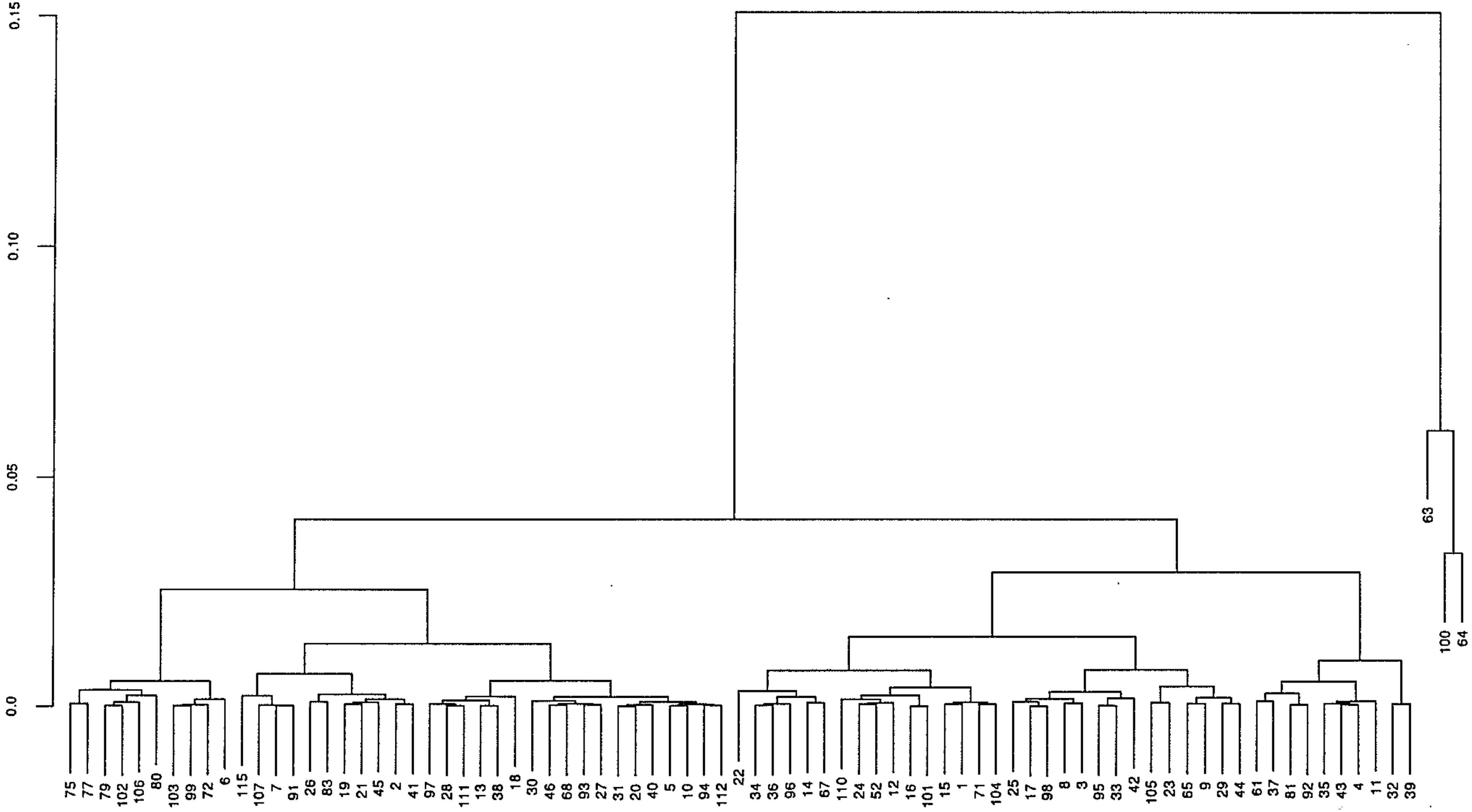
Hierarchical Cluster From Ranked Top 10% Hourly Flows



Appendix 11

Dendogram Resulting From Hourly Counts Exceeding 10% AADT

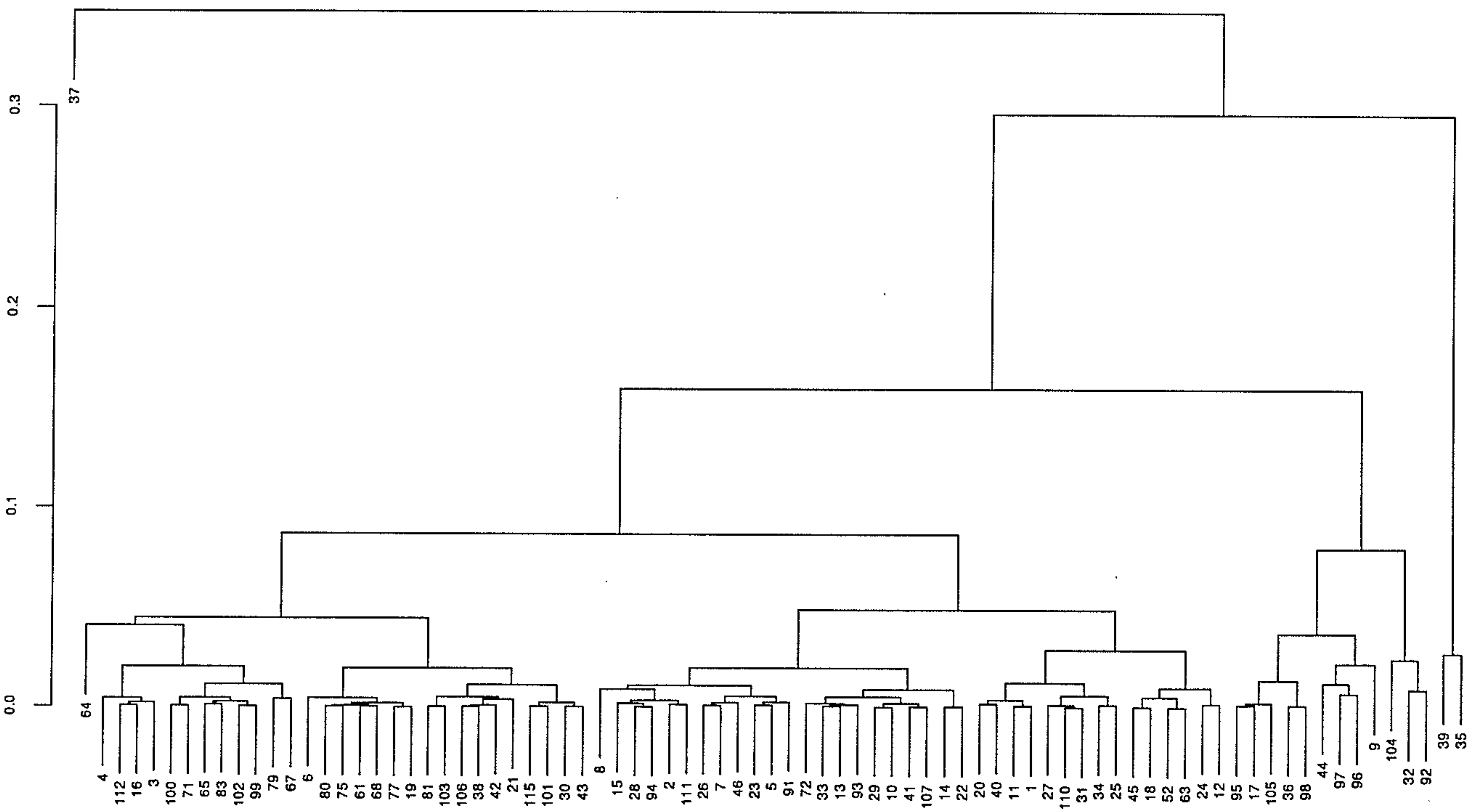
Clustering based on number of hours
with hourly count above 10% aadt



Appendix 12

Dendogram Resulting From Summer/Winter Ratio

Clustering based on
median summer hourly count / median winter hourly count



Appendix B1

List of Sites Used in Study

Road Site Code	Name	Years

Transpac (TNZ Telemetry)

Road Site Code	Name	Years
1	Rimutaka	1989,1990,1991
2	Paekakariki	1989,1990
3	Ngauranga S/B	1989,1990,1991
4	Ngauranga N/B	1989,1990,1991
5	Waitotara	1989,1990,1991
6	Tariki	1989,1990,1991
7	Drury	1989,1990,1991
8	Pokeno	1989,1990,1991
9	Kaikoura	1989,1990,1991
10	Rakaia	1989,1990,1991
11	Springfield	1989,1990,1991
12	Kaimai	1989,1990,1991
13	Ohinepanea	1989,1990,1991
14	Paengaroa	1989,1990,1991
15	Tarukenga	1989,1990,1991
16	Te Kuiti	1989,1990,1991
17	Wellsford	1989,1990,1991
18	Kawakawa	1989,1990,1991
19	Taupiri	1989,1990,1991
20	Karapiro	1989,1990,1991
21	Lichfield	1989,1990,1991
22	Lake Rotoma	1989,1990,1991
23	Te Pohue	1989,1990,1991
24	Tangoio	1989,1990,1991
25	Norsewood	1989,1990,1991
26	Ormond	1989,1990,1991
27	Milton	1989,1990,1991
28	Upokongaro	1989,1990,1991
29	Hihitahi	1989,1990,1991
30	Manawatu Gorge	1989,1990,1991
31	St Andrews	1989,1990,1991
32	Lewis Pass	1989,1990,1991
33	Kaihere	1989,1990,1991
34	Waihi	1989,1990,1991
35	Murchison	1989,1990,1991
36	Hira	1989,1990,1991
37	Horopito	1989,1990,1991
38	Sanson	1989,1990,1991
39	Punakaiki	1989,1990,1991
40	Ahaura	1989,1990,1991
41	Waipa	1989,1990,1991
42	Halletts Bay	1989,1990,1991
43	West Lake Taupo	1990,1991

44	Alexandra South	1990,1991
45	Gore South	1990,1991
46	Winton South	1990,1991
47	Pukerua Bay	1991
52	Waipara	1990,1991

Local Authority/Other State Highway

Manakau City

61	Gossamer Dr.	1987
63	Kerwyn	1987
64	Birmingham Cr.	1987
65	Leyton Way	1987,1988
67	Beaumaris	1987,1988
68	Pakuranga Dr.	1988

Auckland City

71	Alford St.	1987,1988,1989
72	Orakei Rd.	1986,1987,1988,1989
75	Remuera Rd.	1986,1987,1988,1989
77	Khyber Pass	1986,1987,1988,1989
79	Blockhouse Bay Rd.	1986,1987,1988,1989
80	College Hill	1987,1988,1989
81	Fanshawe St.	1987,1988,1989
83	Great North Rd.	1988,1989

Napier

91	N50S78	1983,1984,1986,1987
92	N35S64	1985,1986,1987
93	N2S30	1982 - 1987
94	NP2S11	1983 - 1987
95	NP2S17	1985,1986,1987
96	NP2S24	1985,1986,1987
97	NP2S33	1985,1986,1987
98	NP2S39	1985,1986
110	NP2S47	1985,1986,1987

Lower Hutt

99	High Street	1986,1987

Invercargill

100	Benmore	1986,1987

101	Heywood	1986,1987

Hamilton

102	HM1NS4	1985,1986,1987
103	HM1NS5	1986,1987
104	HM29S5	1987
105	HM2S1A	1982,1984,1986
106	HM2S5	1987
107	HM2S7	1987

Christchurch

108	CHNMN	1986,1987
109	CHNMS	1986,1987
111	CHNMT(Totals)	
112	CHR999	1991
115	CHR998	1991

Additional Sites Incorporated into Task 2:

All Transpac sites 1-52 for 1992 (excepting site 2) and the following new sites:

55	Auckland Harbour Bridge	1992
56	Ohau Overbridge	1992
57	SH 56 Palmerston North	1992
58	SH 50 Napier South	1992
59	SH 1S Christchurch City North	1992
60	SH6 Nelson South	1992
61*	SH30A Rotorua City	1992
64*	SH30 Rotorua East	1992
65*	SH2 Te Puna West	1992

NB* Relabelled as 51,54,53 for analysis purposes.

Appendix B2

Weekly Median Patterns for New Sites

55	Auckland Harbour Bridge	1992
56	Ohau Overbridge	1992
57	SH 56 Palmerston North	1992
58	SH 50 Napier South	1992
59	SH 1S Christchurch City North	1992
60	SH6 Nelson South	1992
61*	SH30A Rotorua City	1992
64*	SH30 Rotorua East	1992
65*	SH2 Te Puna West	1992

NB* Relabelled as 51,54,53 for analysis purposes.

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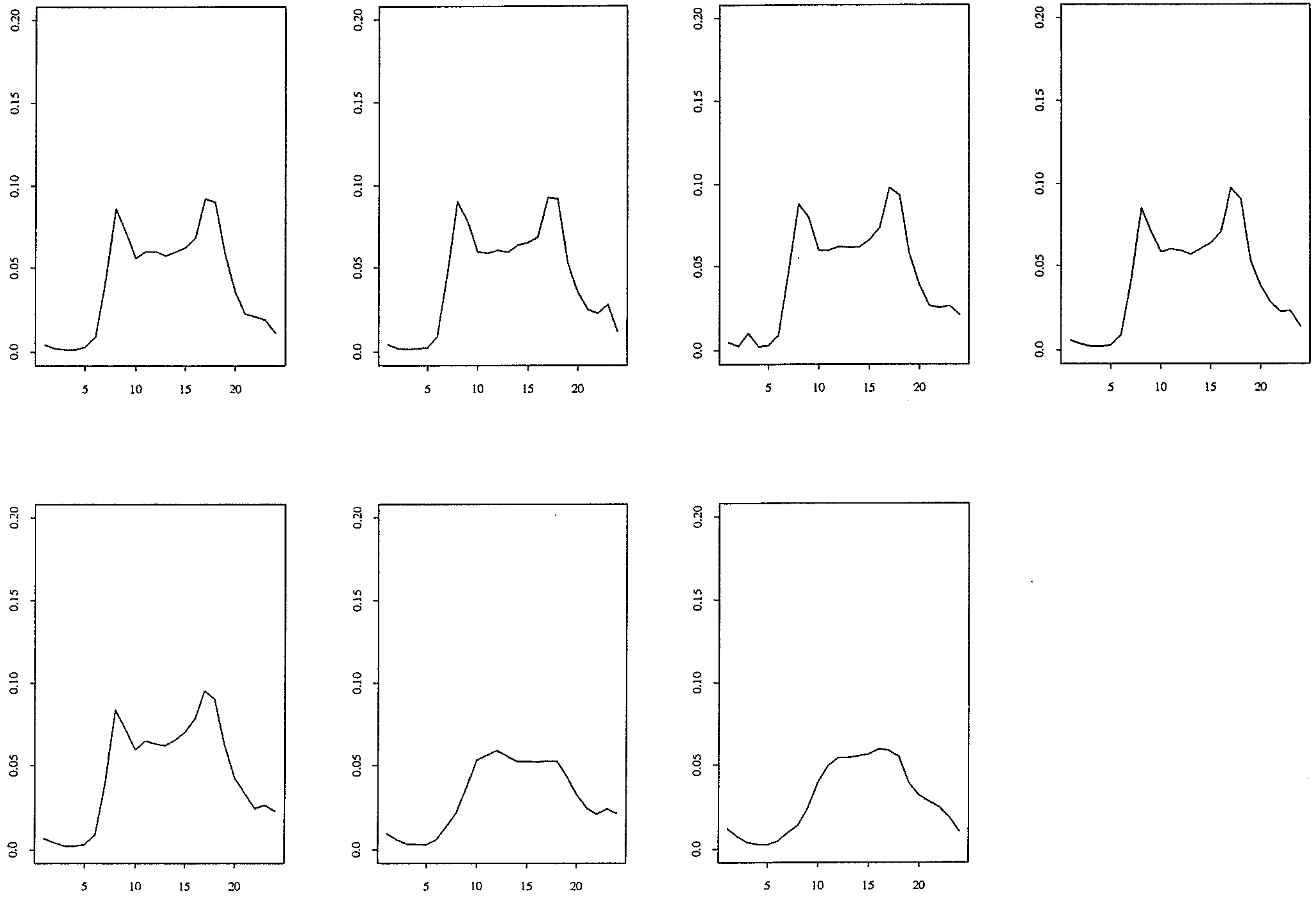


Appendix B3.1

Weekly Multipliers and Summaries

All Groups

URBAN ARTERIAL : MAJOR

WEEK	AVERAGE	LOW	LOWER QUARTILE	MEDIAN	UPPER QUARTILE	HIGH	STANDARD DEVIATION	95% INTERVAL LOW	95% INTERVAL HIGH	NUMBER OF SITES
2	1.2311	0.9531	1.1578	1.2414	1.3060	1.4378	0.1123	0.9988	1.4634	24
3	1.1050	0.9254	1.0576	1.0902	1.1415	1.3804	0.0917	0.9148	1.2952	23
4	1.0691	0.9154	1.0305	1.0564	1.0710	1.3828	0.0915	0.8798	1.2584	24
5	1.0358	0.9762	0.9982	1.0222	1.0443	1.1816	0.0565	0.9186	1.1530	23
6	1.0536	0.9911	1.0303	1.0476	1.0577	1.1874	0.0439	0.9626	1.1446	23
7	0.9871	0.9008	0.9520	0.9755	1.0079	1.1203	0.0542	0.8737	1.1005	20
8	0.9748	0.9221	0.9442	0.9679	0.9840	1.1088	0.0494	0.8714	1.0782	20
9	1.0008	0.9268	0.9500	0.9650	1.0157	1.2844	0.0859	0.8221	1.1795	22
10	0.9495	0.6970	0.9410	0.9547	0.9675	1.0524	0.0631	0.8189	1.0801	24
11	0.9658	0.3587	0.9537	0.9864	1.0152	1.1357	0.1444	0.6670	1.2646	24
12	1.0193	0.9098	0.9588	1.0279	1.0621	1.1427	0.0632	0.8889	1.1497	25
13	1.0012	0.9081	0.9540	0.9779	1.0377	1.2090	0.0715	0.8539	1.1485	26
14	0.9912	0.8942	0.9657	0.9726	1.0355	1.0642	0.0464	0.8950	1.0874	23
15	0.9946	0.9070	0.9624	0.9922	1.0289	1.0917	0.0492	0.8934	1.0958	27
16	0.9946	0.9162	0.9571	0.9785	1.0400	1.1425	0.0553	0.8807	1.1085	26
17	1.0104	0.9336	0.9667	1.0048	1.0508	1.1032	0.0485	0.9103	1.1105	25
18	0.9927	0.9438	0.9733	0.9883	1.0032	1.1016	0.0354	0.9196	1.0658	25
19	0.9669	0.9290	0.9441	0.9503	0.9809	1.0637	0.0352	0.8944	1.0394	26
20	0.9848	0.9375	0.9518	0.9755	1.0021	1.0588	0.0396	0.9031	1.0665	25
21	1.0031	0.9456	0.9813	0.9997	1.0122	1.1165	0.0375	0.9258	1.0804	26
22	0.9944	0.9456	0.9601	0.9892	1.0058	1.1731	0.0485	0.8945	1.0943	26
23	1.0671	0.9780	1.0040	1.0527	1.0917	1.2458	0.0736	0.9158	1.2184	27
24	1.0228	0.9534	1.0021	1.0197	1.0471	1.0863	0.0327	0.9556	1.0900	27
25	1.0133	0.9123	0.9895	1.0034	1.0225	1.1493	0.0513	0.9072	1.1194	24
26	0.9956	0.9524	0.9785	0.9926	1.0043	1.1129	0.0305	0.9330	1.0582	28
27	0.9899	0.9387	0.9743	0.9896	0.9964	1.0497	0.0248	0.9390	1.0408	28
28	0.9943	0.9017	0.9864	0.9990	1.0135	1.0254	0.0282	0.9362	1.0524	26
29	1.0221	0.9241	0.9850	0.9963	1.0088	1.4871	0.1108	0.7947	1.2495	28
30	0.9779	0.6655	0.9805	0.9909	1.0087	1.0423	0.0772	0.8195	1.1363	28
31	0.9847	0.8122	0.9737	0.9895	1.0026	1.0488	0.0409	0.9009	1.0685	29
32	0.9803	0.8023	0.9710	0.9788	1.0045	1.0323	0.0444	0.8887	1.0719	25
33	0.9821	0.7877	0.9698	0.9878	1.0105	1.0342	0.0484	0.8822	1.0820	25
34	0.9945	0.7861	0.9835	0.9902	1.0062	1.1156	0.0584	0.8740	1.1150	25
35	0.9895	0.7943	0.9832	0.9958	1.0083	1.0459	0.0491	0.8882	1.0908	25

URBAN ARTERIAL : MAJOR

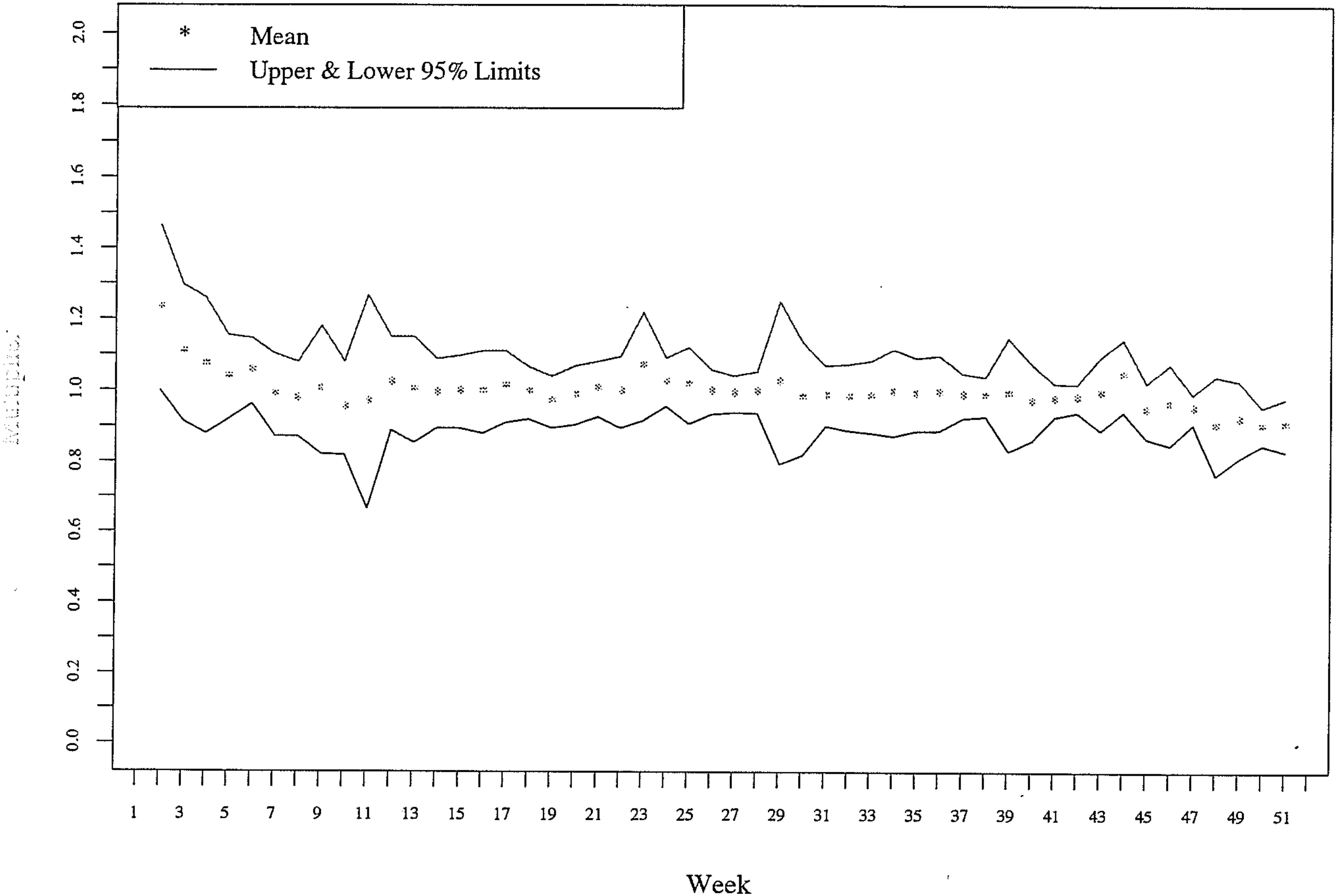
WEEK	AVERAGE	LOW	LOWER QUARTILE	MEDIAN	UPPER QUARTILE	HIGH	STANDARD DEVIATION	% INTERVAL LOW	HIGH	NUMBER OF SITES
36	0.9931	0.8780	0.9701	0.9916	1.0056	1.1578	0.0506	0.8884	1.0978	24
37	0.9856	0.9283	0.9694	0.9793	0.9978	1.0628	0.0299	0.9239	1.0473	25
38	0.9836	0.9294	0.9643	0.9835	1.0011	1.0410	0.0264	0.9291	1.0381	25
39	0.9896	0.9334	0.9635	0.9757	0.9835	1.3175	0.0761	0.8321	1.1471	24
40	0.9685	0.7748	0.9594	0.9722	0.9885	1.0569	0.0515	0.8619	1.0751	24
41	0.9741	0.9375	0.9599	0.9714	0.9807	1.0391	0.0226	0.9273	1.0209	24
42	0.9787	0.9392	0.9641	0.9784	0.9897	1.0131	0.0190	0.9392	1.0182	22
43	0.9924	0.9305	0.9642	0.9810	1.0190	1.1385	0.0489	0.8907	1.0941	22
44	1.0417	0.9326	1.0108	1.0469	1.0675	1.1270	0.0486	0.9411	1.1423	24
45	0.9449	0.8731	0.9286	0.9397	0.9582	1.0579	0.0366	0.8683	1.0215	20
46	0.9606	0.8830	0.9308	0.9511	0.9883	1.0708	0.0533	0.8490	1.0722	20
47	0.9490	0.9252	0.9352	0.9446	0.9586	1.0014	0.0196	0.9076	0.9904	18
48	0.9018	0.8533	0.8791	0.8864	0.8925	1.1104	0.0641	0.7652	1.0384	16
49	0.9201	0.7764	0.9051	0.9211	0.9278	1.0434	0.0508	0.8134	1.0268	19
50	0.9019	0.8549	0.8845	0.9053	0.9199	0.9412	0.0244	0.8504	0.9534	18
51	0.9048	0.8451	0.8834	0.9072	0.9248	0.9659	0.0341	0.8321	0.9775	16

Appendix B3.2

Graphs of Mean Multipliers and 95% Interval Estimates

All Groups

Weekly Multipliers : Urban Arterial Major

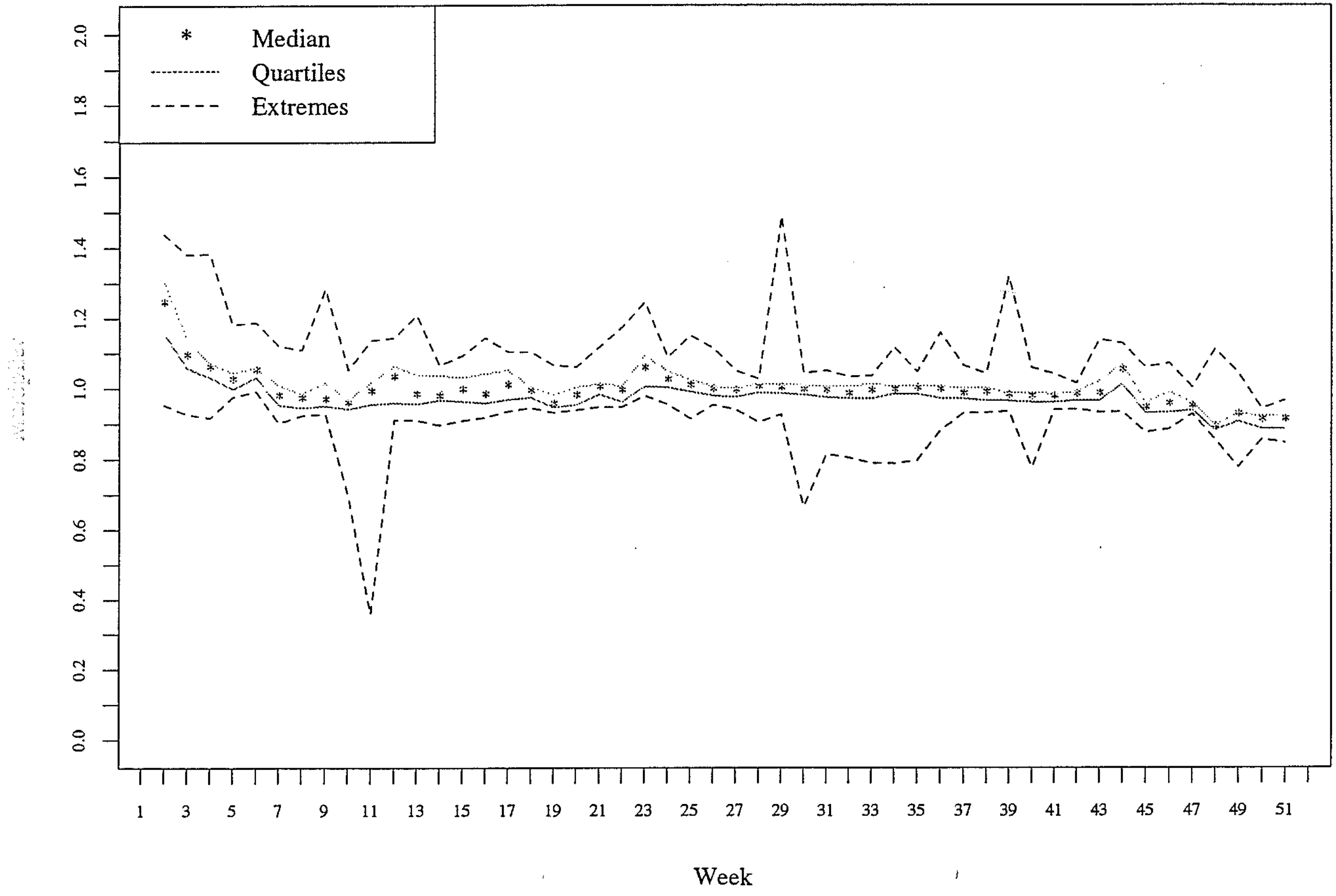


Appendix B3.3

Graphs of Five Number Summaries of Weekly Multipliers

All Groups

Weekly Multipliers : Urban Arterial Major

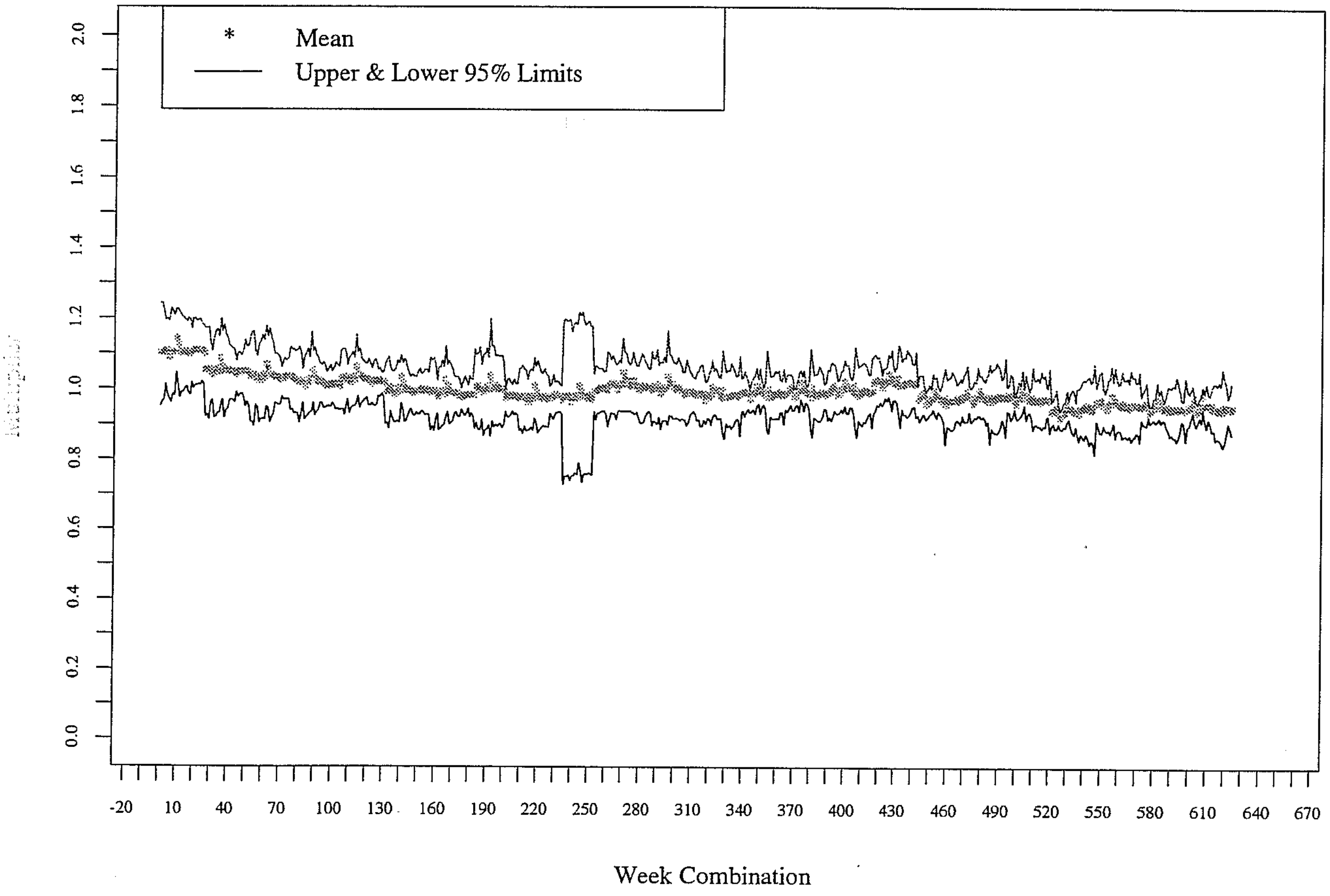


Appendix B4.1

Graphs of Mean Bi-Weekly (Seasonal) Multipliers and 95% Interval Estimates

All Groups

Bi-Weekly Multipliers : Urban Arterial Major

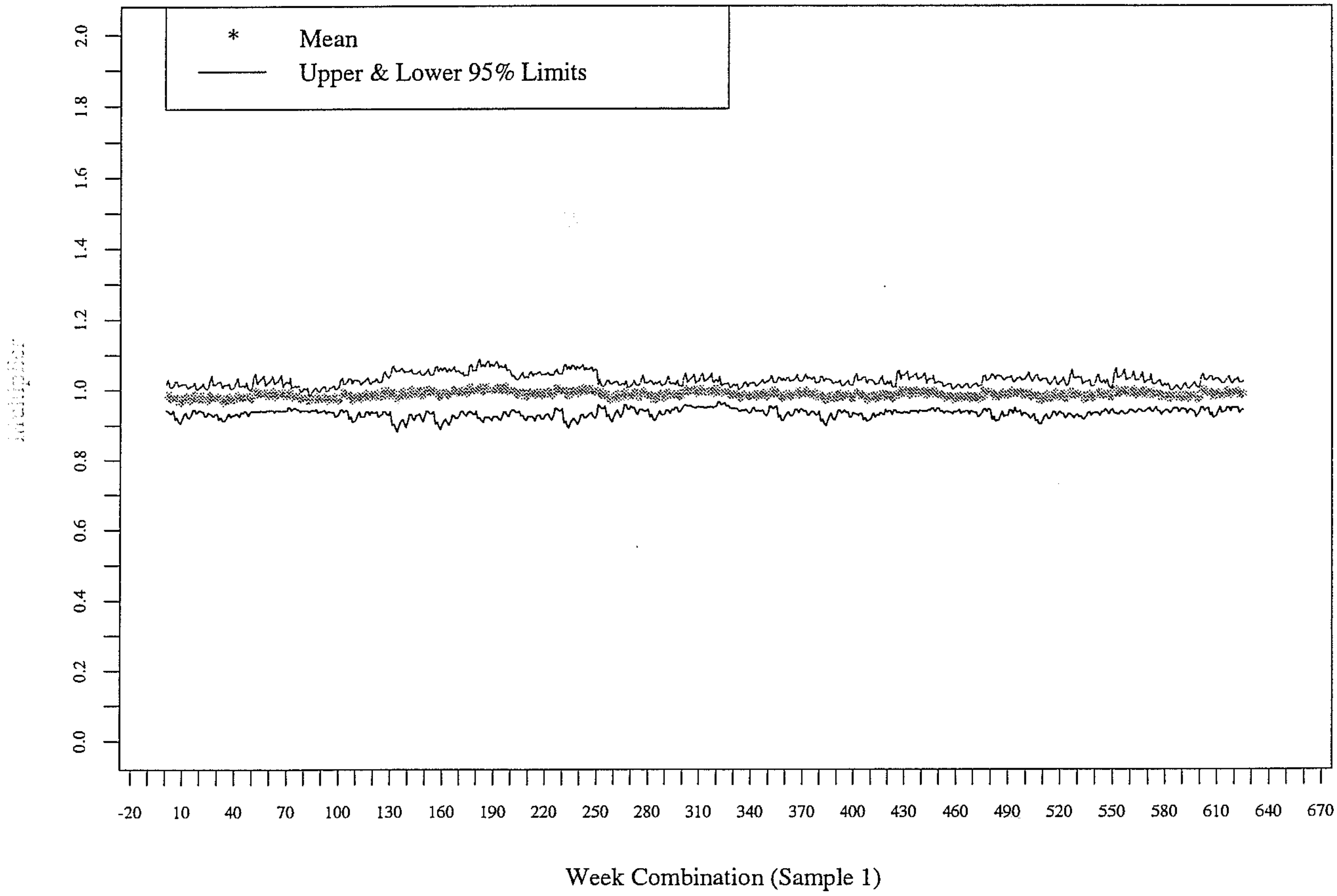


Appendix B5.1

Graphs of Mean Four Weekly (Quarterly) Multipliers and 95% Interval Estimates

All Groups

Quarterly Multipliers : Urban Arterial Minor

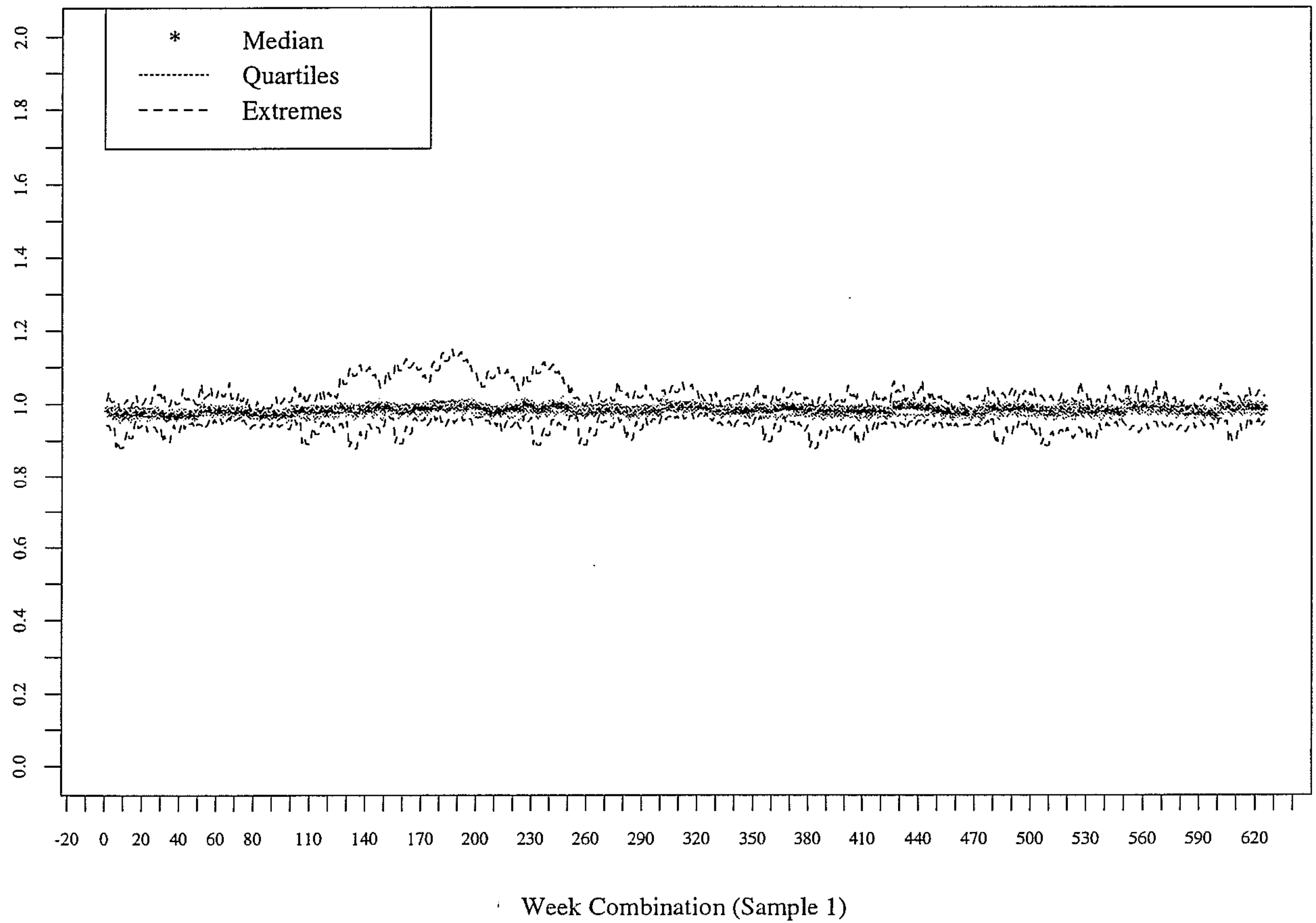


Appendix B5.2

Graphs of Five Number Summaries of Four Week (Quarterly) Multipliers

All Groups

Quarterly Multipliers : Urban Arterial Minor

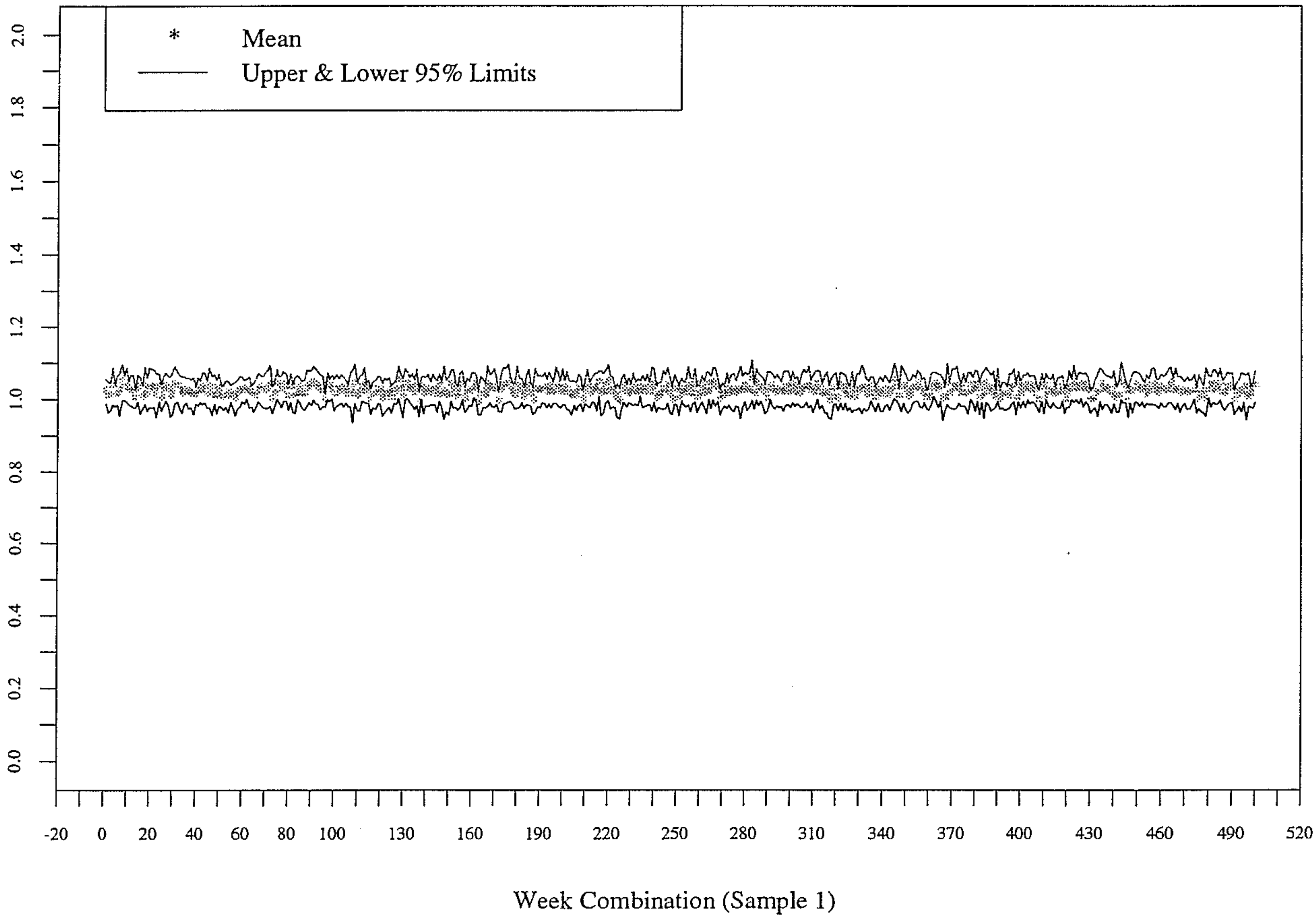


Appendix B6.1

Graphs of Mean Monthly Multipliers and 95% Interval Estimates

All Groups

Monthly Multipliers : Rural Strategic (b)

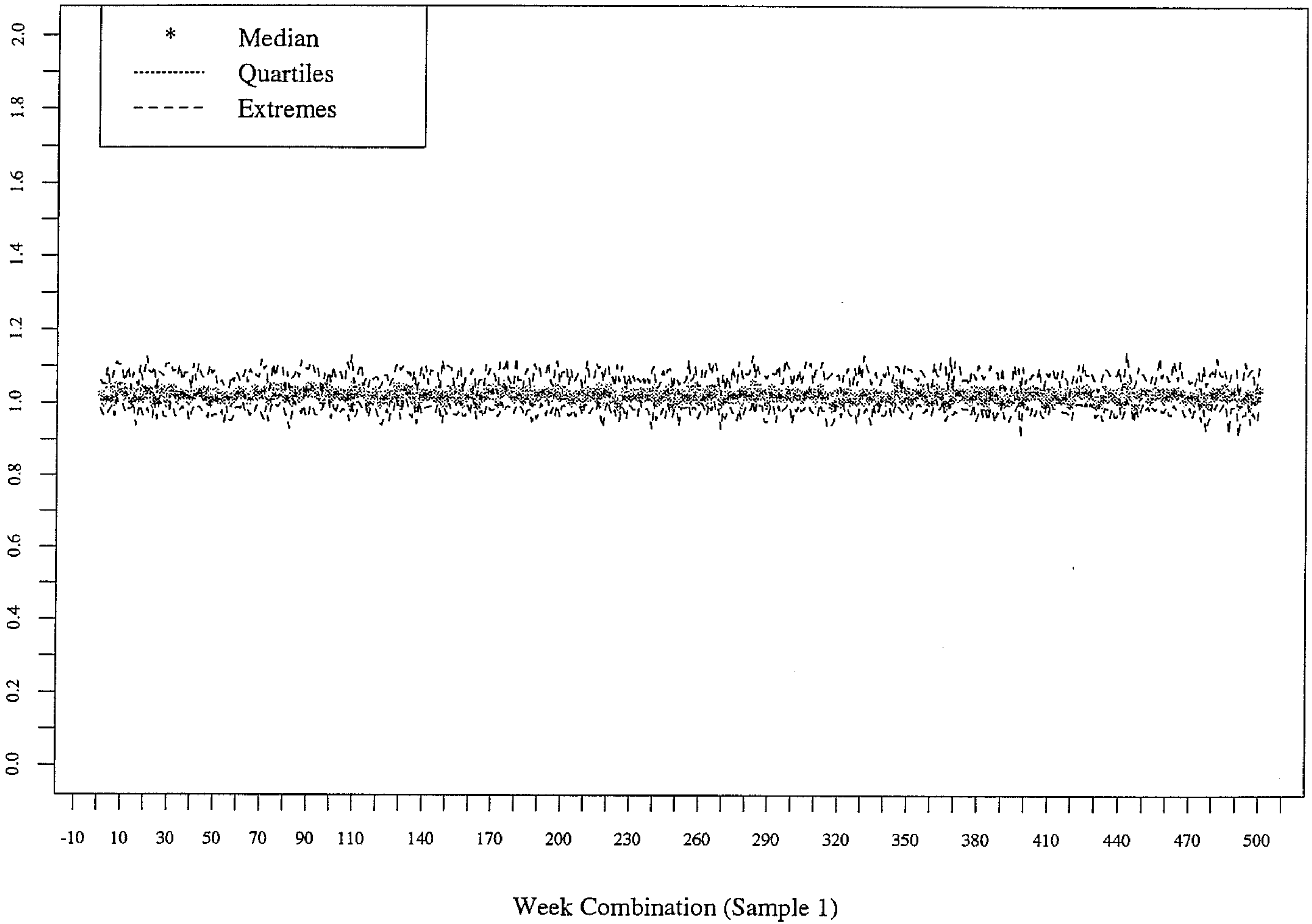


Appendix B6.2

Graphs of Five Number Summaries of Monthly Multipliers

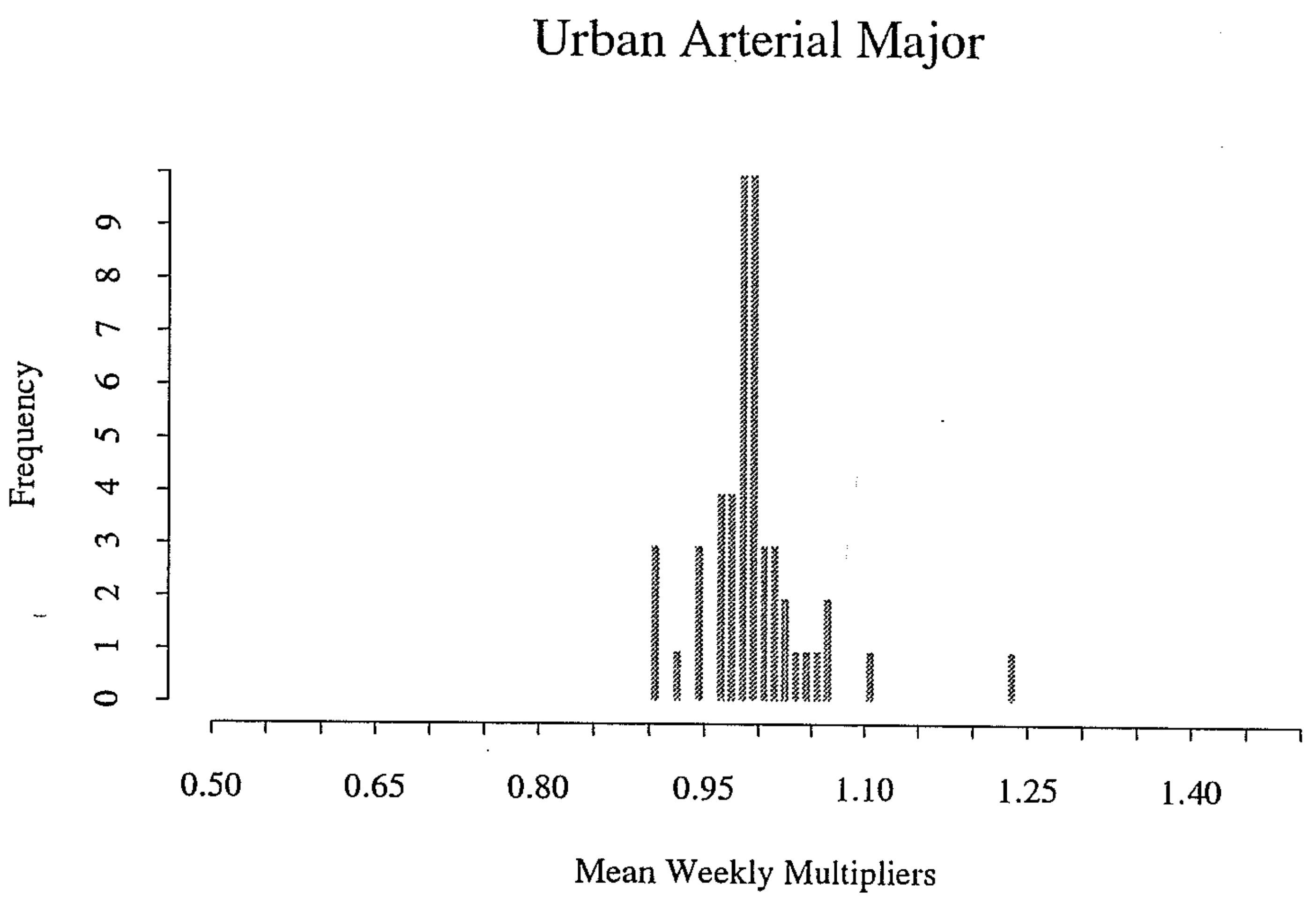
All Groups

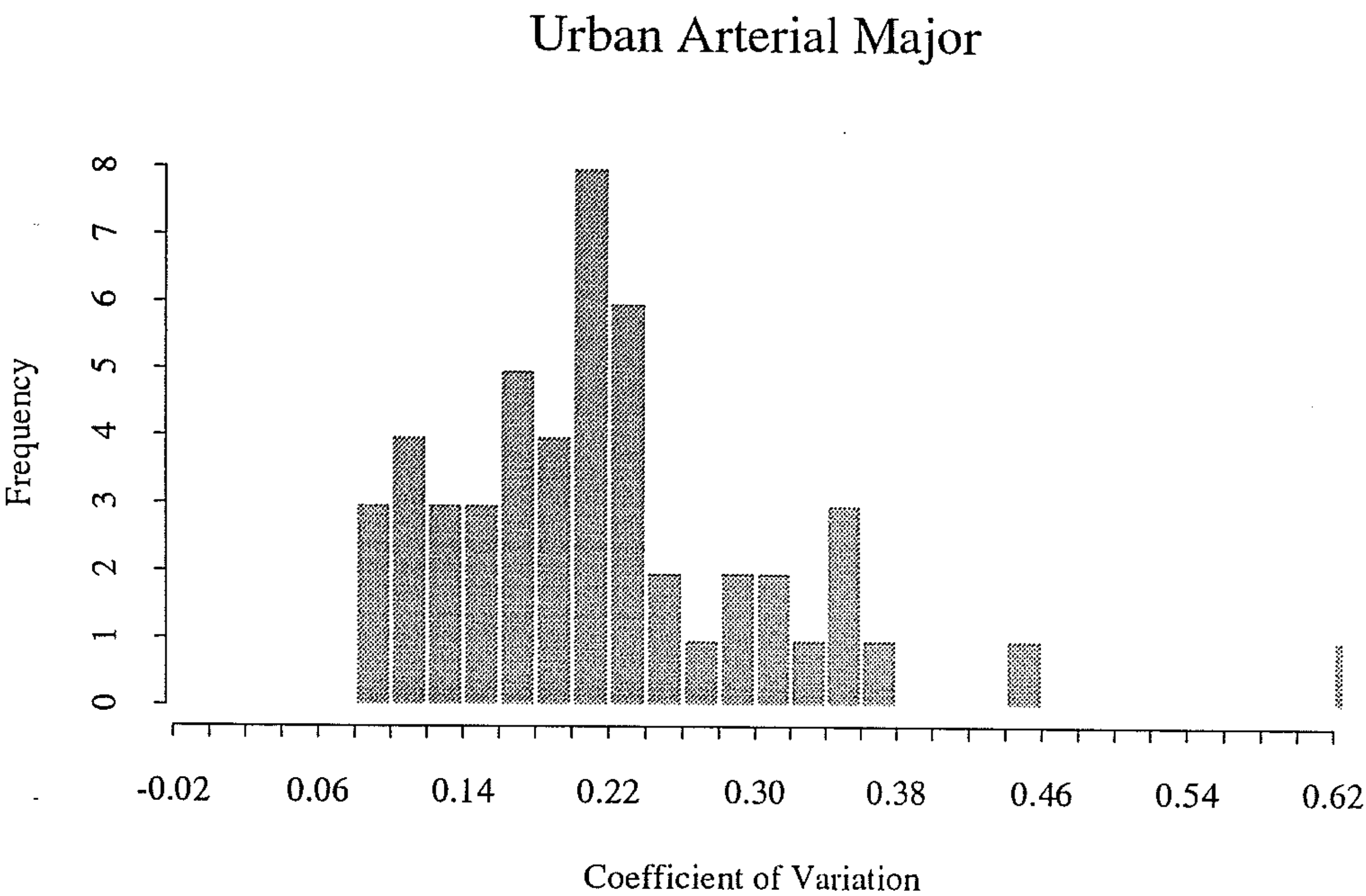
Monthly Multipliers : Rural Strategic (b)



Appendix B7.1

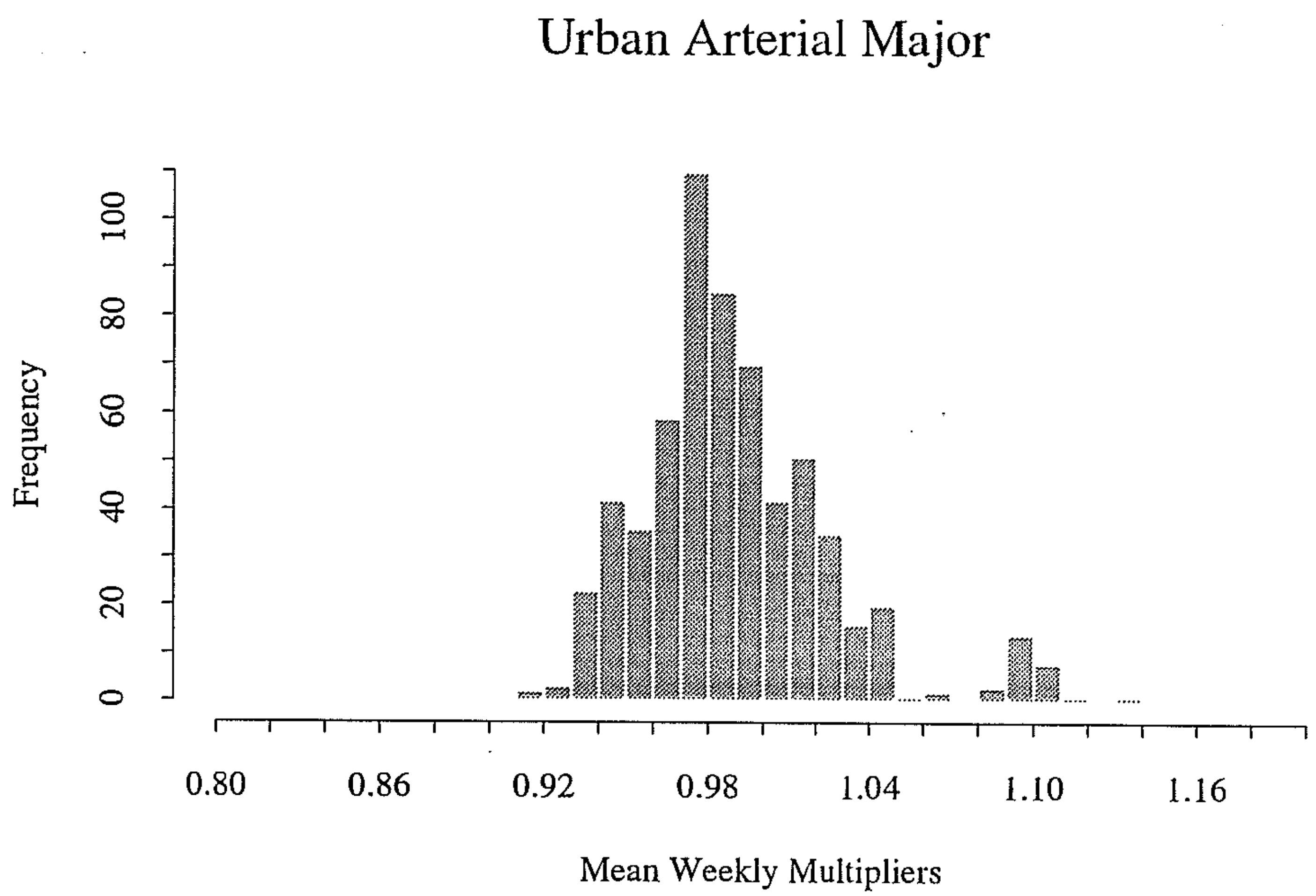
Histograms of Distributions of Mean Weekly Multipliers and 95% Ranges of Relative Variation

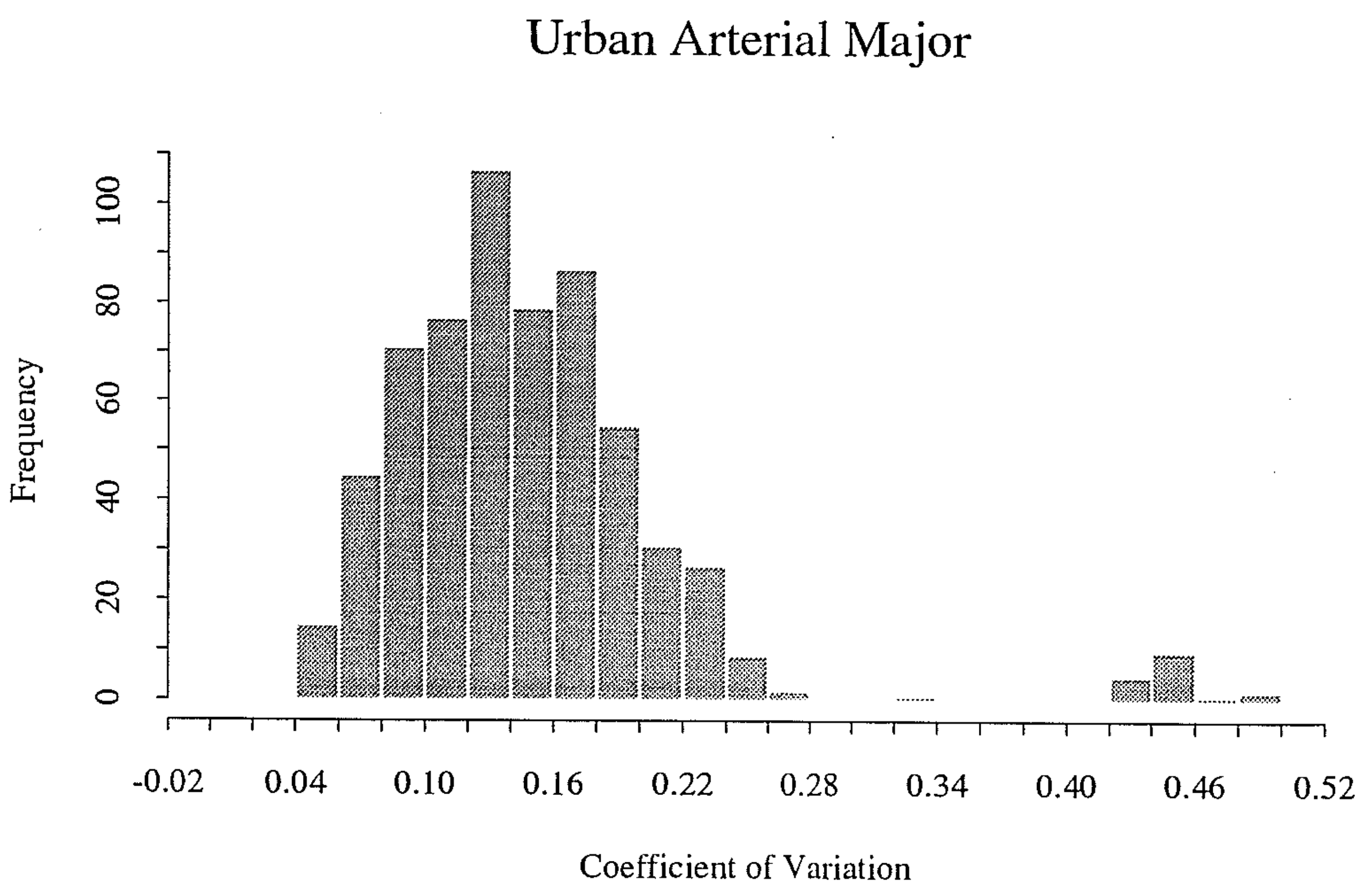

Urban Arterial Major
Frequency
0
1
2
3
4
5
6
7
8
9
0.50
0.65
0.80
0.95
1.10
1.25
1.40
Mean Weekly Multipliers


Urban Arterial Major
Frequency
0
1
2
3
4
5
6
7
8
-0.02
0.06
0.14
0.22
0.30
0.38
0.46
0.54
0.62
Coefficient of Variation

Appendix B7.2

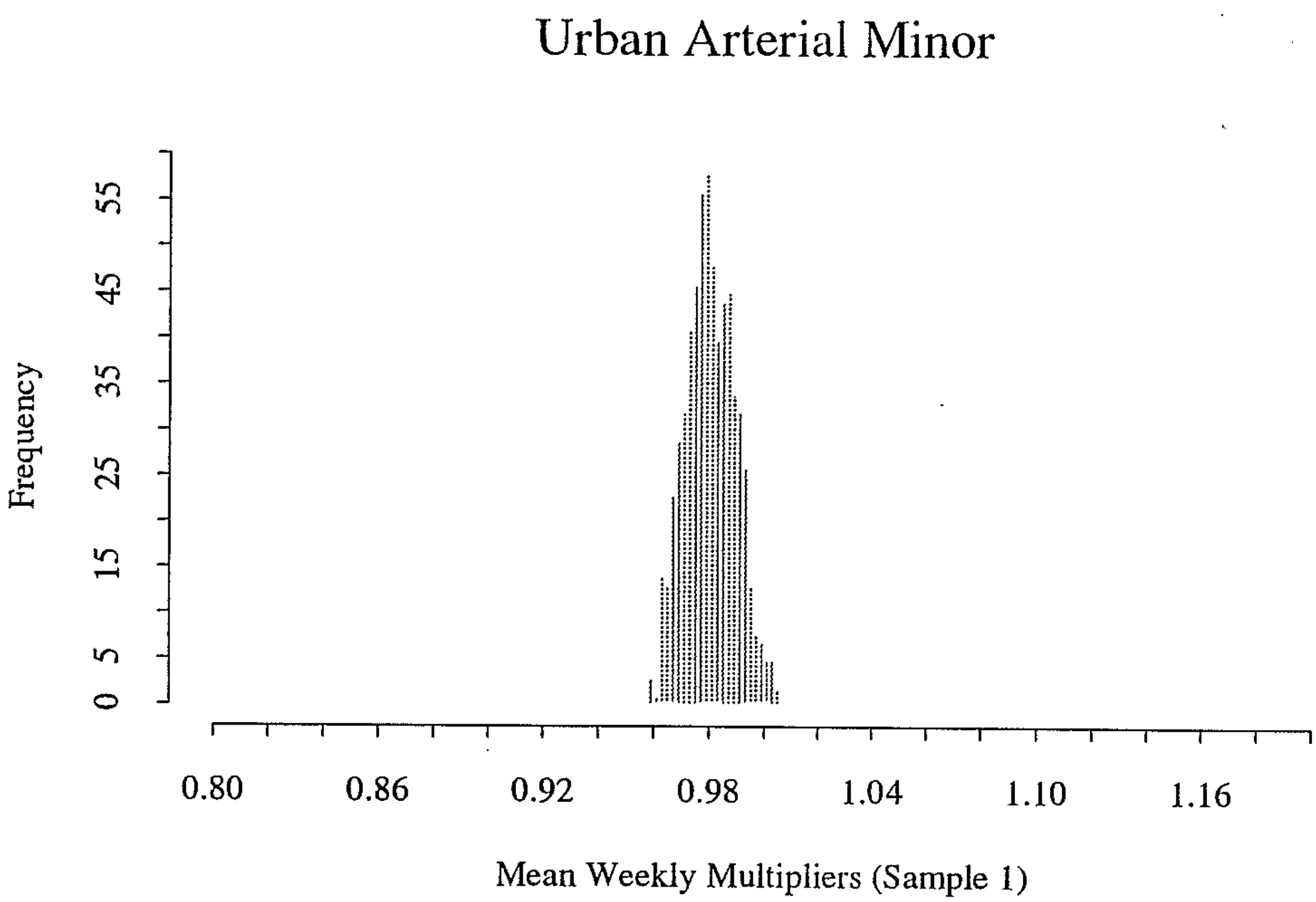
Histograms of Distributions of Mean Bi-Weekly Multipliers and 95% Ranges of Relative Variation

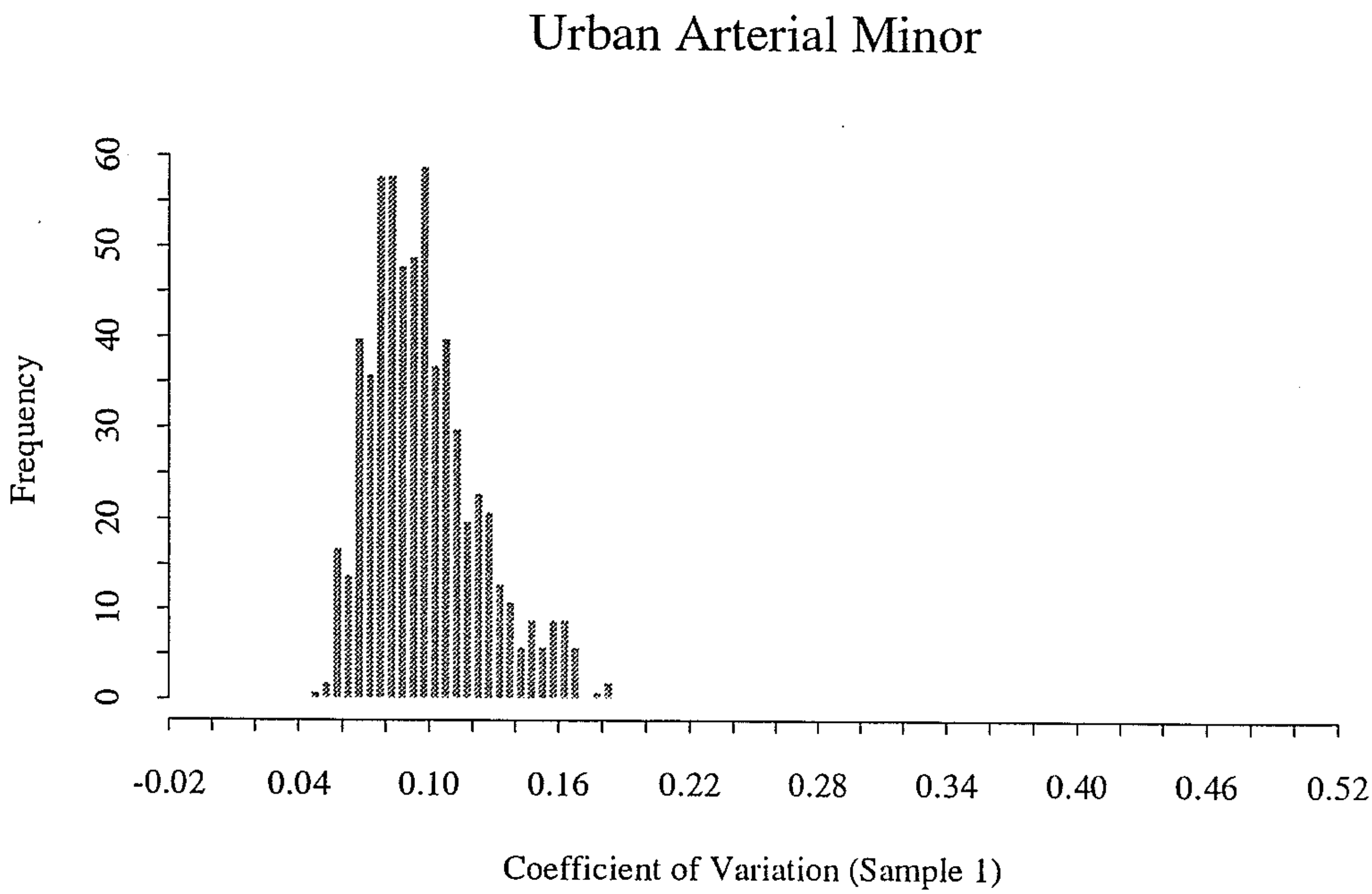

Urban Arterial Major
Frequency
0
20
40
60
80
100
0.80
0.86
0.92
0.98
1.04
1.10
1.16
Mean Weekly Multipliers


Urban Arterial Major
Frequency
0
20
40
60
80
100
-0.02
0.04
0.10
0.16
0.22
0.28
0.34
0.40
0.46
0.52
Coefficient of Variation

Appendix B7.3

Histograms of Distributions of Mean Quarterly Multipliers and 95% Ranges of Relative Variation

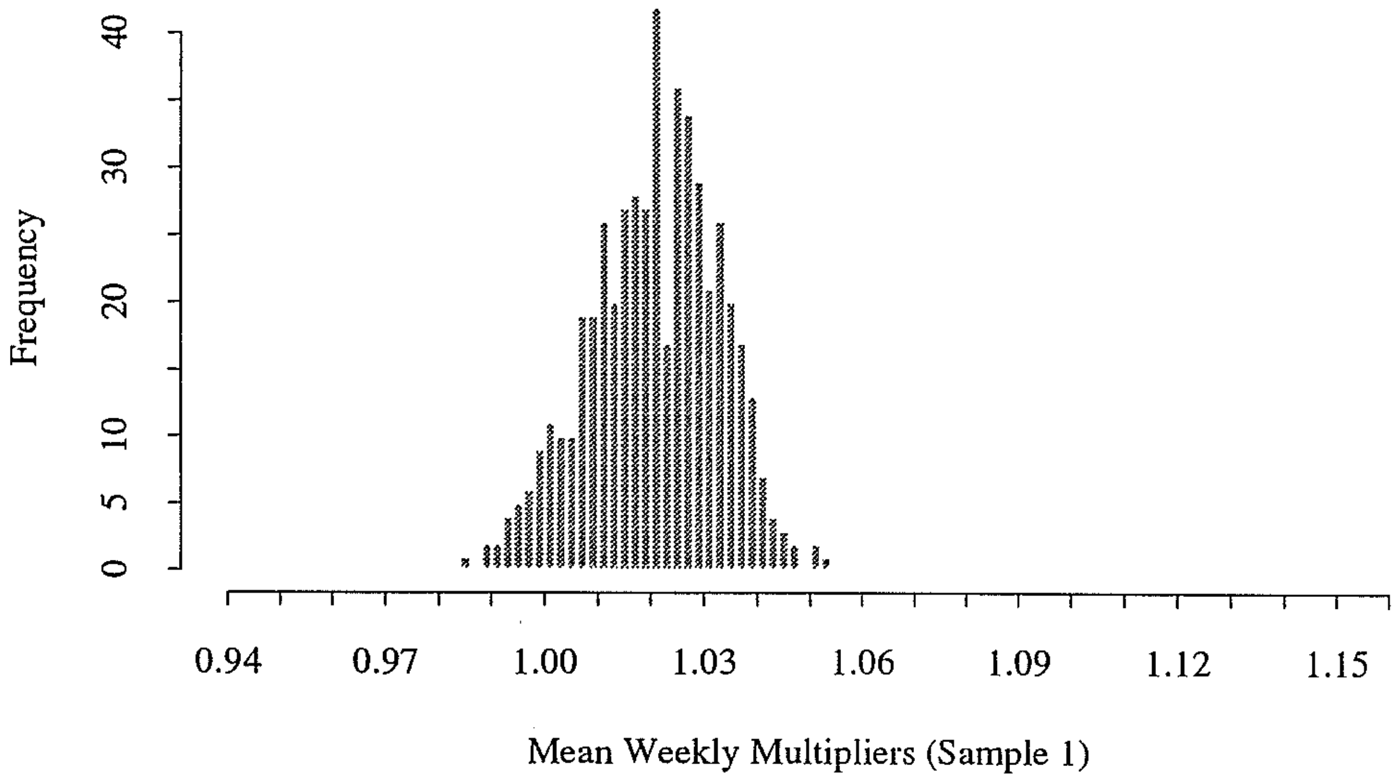

Urban Arterial Minor
Frequency
0
5
15
25
35
45
55
0.80
0.86
0.92
0.98
1.04
1.10
1.16
Mean Weekly Multipliers (Sample 1)


Urban Arterial Minor
Frequency
0
10
20
30
40
50
60
-0.02
0.04
0.10
0.16
0.22
0.28
0.34
0.40
0.46
0.52
Coefficient of Variation (Sample 1)

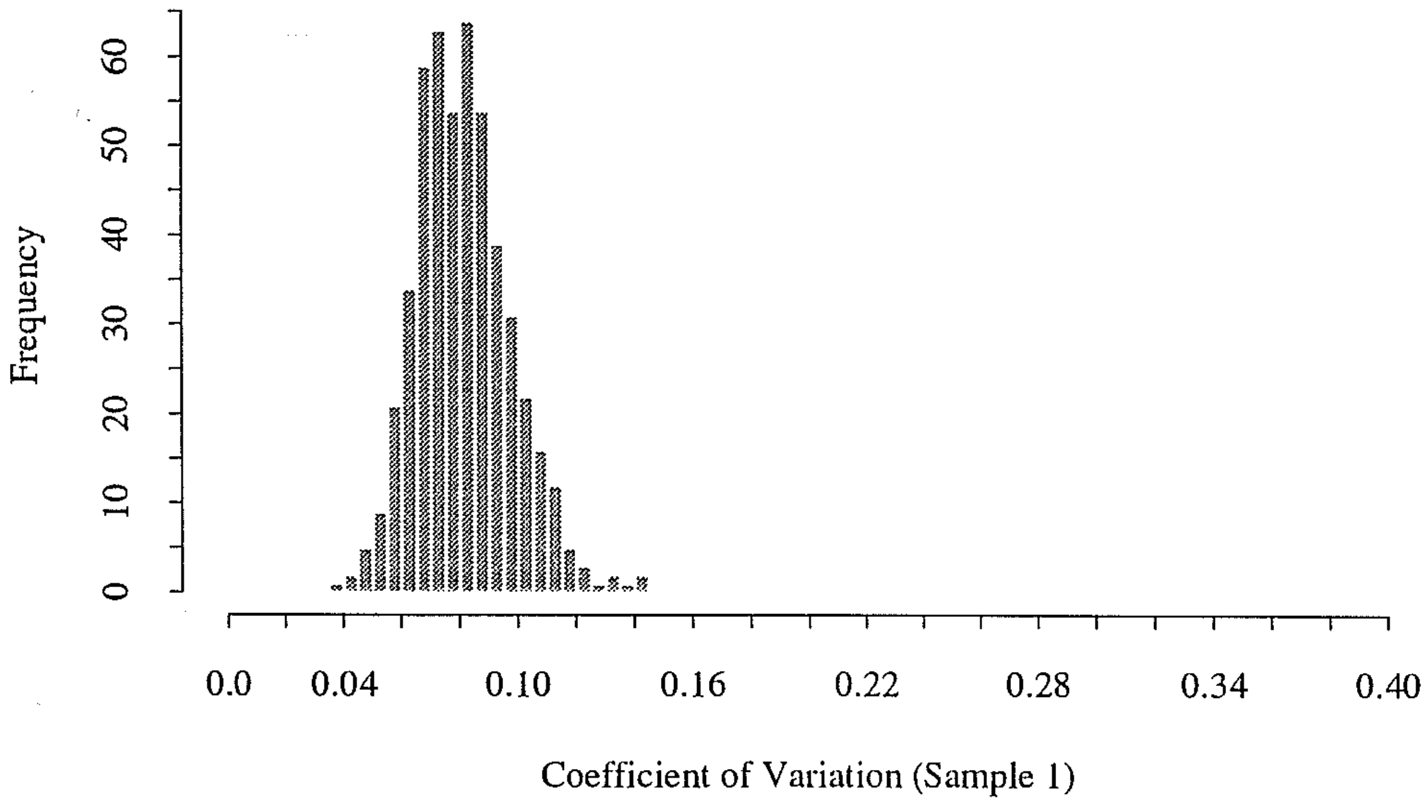
Appendix B7.4

Histograms of Distributions of Mean Monthly Multipliers and 95% Ranges of Relative Variation

Rural Strategic (b)



Rural Strategic (b)



Appendix B8

Factor Averages and 95% Relative Error Ranges

Weekly Averages and Overall Summaries(Strategy 1)

Seasonal Summaries (Strategy 2)

Quarterly Summaries (Strategy 3)

Monthly Summaries (Strategy 4)

Weekly Factors All Groups

	URBAN ARTERIAL MAJOR		URBAN ARTERIAL MINOR		URBAN COMMERCIAL		URBAN INDUSTRIAL		URBAN OTHER	
WEEK	Average Factors	95% Ranges	Average Factors	95% Ranges	Average Factors	95% Ranges	Average Factors	95% Ranges	Average Factors	95% Ranges
2	1.2311	0.3774	1.0879	0.6256	1.0763	NA	2.1248	1.2566	1.1704	NA
3	1.1050	0.3443	1.0173	0.3574	1.0755	NA	1.2212	0.3238	1.0822	NA
4	1.0691	0.3541	0.9953	0.4421	0.9860	NA	1.2479	0.8164	1.0101	NA
5	1.0358	0.2263	0.9894	0.3481	1.0330	NA	1.0621	0.5854	0.9665	NA
6	1.0536	0.1727	0.9938	0.2425	1.1760	NA	1.0571	0.6684	0.9502	NA
7	0.9871	0.2298	0.9752	0.3255	0.8916	NA	0.8956	0.3609	0.8990	NA
8	0.9748	0.2121	0.9643	0.2553	1.0583	NA	1.0530	0.6165	0.9190	NA
9	1.0008	0.3571	0.9724	0.2986	1.0323	NA	1.0004	0.7459	0.9586	NA
10	0.9495	0.2751	0.9603	0.1806	1.0055	NA	0.9995	0.5151	0.9074	NA
11	0.9658	0.6188	0.9683	0.2119	1.0452	NA	1.0374	0.4351	0.9479	NA
12	1.0193	0.2559	0.9799	0.2039	0.9993	NA	0.9807	0.3581	0.9556	NA
13	1.0012	0.2942	0.9772	0.1719	1.0011	NA	0.9876	0.4316	0.9599	NA
14	0.9912	0.1941	0.9658	0.2290	1.0229	NA	1.0925	0.8152	0.9892	0.2697
15	0.9946	0.2035	0.9764	0.1778	1.0655	NA	1.0276	0.8377	1.0154	0.7552
16	0.9946	0.2290	0.9910	0.2733	0.9824	NA	1.1382	0.9378	0.9733	NA
17	1.0104	0.1981	1.0006	0.1949	0.9808	NA	1.1098	0.9519	1.0445	NA
18	0.9927	0.1473	1.0033	0.1643	1.0527	NA	1.1248	0.5749	0.9746	NA
19	0.9669	0.1500	0.9740	0.0996	0.9586	NA	0.9690	0.5226	0.9582	0.2649
20	0.9848	0.1659	0.9728	0.1875	0.9458	NA	1.0419	1.0320	1.0501	0.1484
21	1.0031	0.1541	0.9979	0.1858	0.9470	NA	1.0287	0.8757	1.0820	0.2028
22	0.9944	0.2009	0.9983	0.1985	0.9766	NA	1.0523	0.8003	1.0310	0.2270
23	1.0671	0.2836	1.0510	0.2392	1.0697	NA	1.1388	0.6019	1.0343	0.4393
24	1.0228	0.1314	1.0356	0.1365	1.0228	NA	1.1162	1.3116	1.0231	0.3356
25	1.0133	0.2094	1.0315	0.1633	1.0063	NA	0.9893	0.4864	1.0314	0.1970
26	0.9956	0.1258	1.0156	0.2265	0.9615	NA	1.0066	0.7856	1.0345	0.0682
27	0.9899	0.1028	1.0312	0.2669	1.0219	NA	0.9364	0.4223	1.0406	0.2018
28	0.9943	0.1169	1.0447	0.3442	0.9346	NA	0.9076	0.5738	1.1054	0.5021
29	1.0221	0.4450	1.0262	0.2463	1.1695	NA	0.9673	0.8457	1.0608	0.2328
30	0.9779	0.3240	1.0311	0.2010	0.9506	NA	0.9858	0.6206	1.0547	NA
31	0.9847	0.1702	1.0339	0.3064	1.0183	NA	0.9343	0.4915	1.0637	NA
32	0.9803	0.1869	1.0656	0.5171	0.9953	NA	0.9209	0.4339	1.0567	NA

WEEK	URBAN ARTERIAL MAJOR Average Factors	URBAN ARTERIAL MAJOR 95% Ranges	URBAN ARTERIAL MINOR Average Factors	URBAN ARTERIAL MINOR 95% Ranges	URBAN COMMERCIAL Average Factors	URBAN COMMERCIAL 95% Ranges	URBAN INDUSTRIAL Average Factors	URBAN INDUSTRIAL 95% Ranges	URBAN OTHER Average Factors	URBAN OTHER 95% Ranges
33	0.9821	0.2034	1.0763	0.5116	1.0004	NA	0.9135	0.4020	1.0154	NA
34	0.9945	0.2423	1.0270	0.2680	0.9688	NA	0.8896	0.3260	0.9791	NA
35	0.9895	0.2047	1.0147	0.2038	0.9373	NA	0.8913	0.3507	1.0437	NA
36	0.9931	0.2109	1.0134	0.1476	0.9114	NA	0.8920	0.5408	1.0640	NA
37	0.9856	0.1252	1.0024	0.2366	0.9067	NA	0.9579	0.4224	1.0495	NA
38	0.9836	0.1108	1.0121	0.2425	1.0017	NA	0.9210	0.4499	0.9870	NA
39	0.9896	0.3183	1.0033	0.2867	1.0598	NA	0.8982	0.3796	0.9645	NA
40	0.9685	0.2201	0.9971	0.2505	0.9720	NA	0.8551	0.6554	0.9549	NA
41	0.9741	0.0961	1.0003	0.2289	0.9822	NA	0.9703	0.8241	0.9839	NA
42	0.9787	0.0807	0.9974	0.2005	0.9169	NA	0.9787	0.5105	0.9444	NA
43	0.9924	0.2050	0.9753	0.2147	0.9761	NA	0.9182	0.1684	0.9493	NA
44	1.0417	0.1931	1.0473	0.2305	1.0678	NA	1.1934	0.8311	1.0184	NA
45	0.9449	0.1621	0.9630	0.2399	0.9549	NA	0.9165	0.2950	0.9584	NA
46	0.9606	0.2324	0.9740	0.2259	0.8563	NA	0.8489	0.5669	0.9518	NA
47	0.9490	0.0872	0.9564	0.1729	1.0159	NA	1.0099	0.7890	0.9339	NA
48	0.9018	0.3029	0.9170	0.1771	NA	NA	0.7923	NA	0.9017	NA
49	0.9201	0.2319	0.9420	0.2021	0.8878	NA	0.9976	0.6718	0.9283	NA
50	0.9019	0.1142	0.9232	0.2173	0.8833	NA	0.8766	0.3493	0.9122	NA
51	0.9048	0.1607	0.9174	0.2492	0.8350	NA	0.8590	0.3800	0.8714	NA
SUMMARY										
Low	0.9018	0.0807	0.9170	0.0996	0.8350	NA	0.7923	0.1684	0.8714	0.0682
Low Quartile	0.9756	0.1558	0.9740	0.1958	0.9506	NA	0.9169	0.4224	0.9526	0.2018
Median	0.9906	0.2041	0.9976	0.2290	0.9953	NA	0.9867	0.5738	0.9854	0.2328
High Quartile	1.0026	0.2525	1.0240	0.2677	1.0323	NA	1.0528	0.8003	1.0429	0.3356
High	1.2311	0.6188	1.0879	0.6256	1.1760	NA	2.1248	1.3116	1.1704	0.7552
Range	0.3293	0.5381	0.1709	0.5260	0.3410	NA	1.3325	1.1432	0.2990	0.6870
Mid 80% Rang	0.0943	0.2314	0.0850	0.1779	0.1645	NA	0.2500	0.5377	0.1454	0.3314
80th Percentile		0.2857		0.2891		NA		0.8195		0.3978

Appendix C1

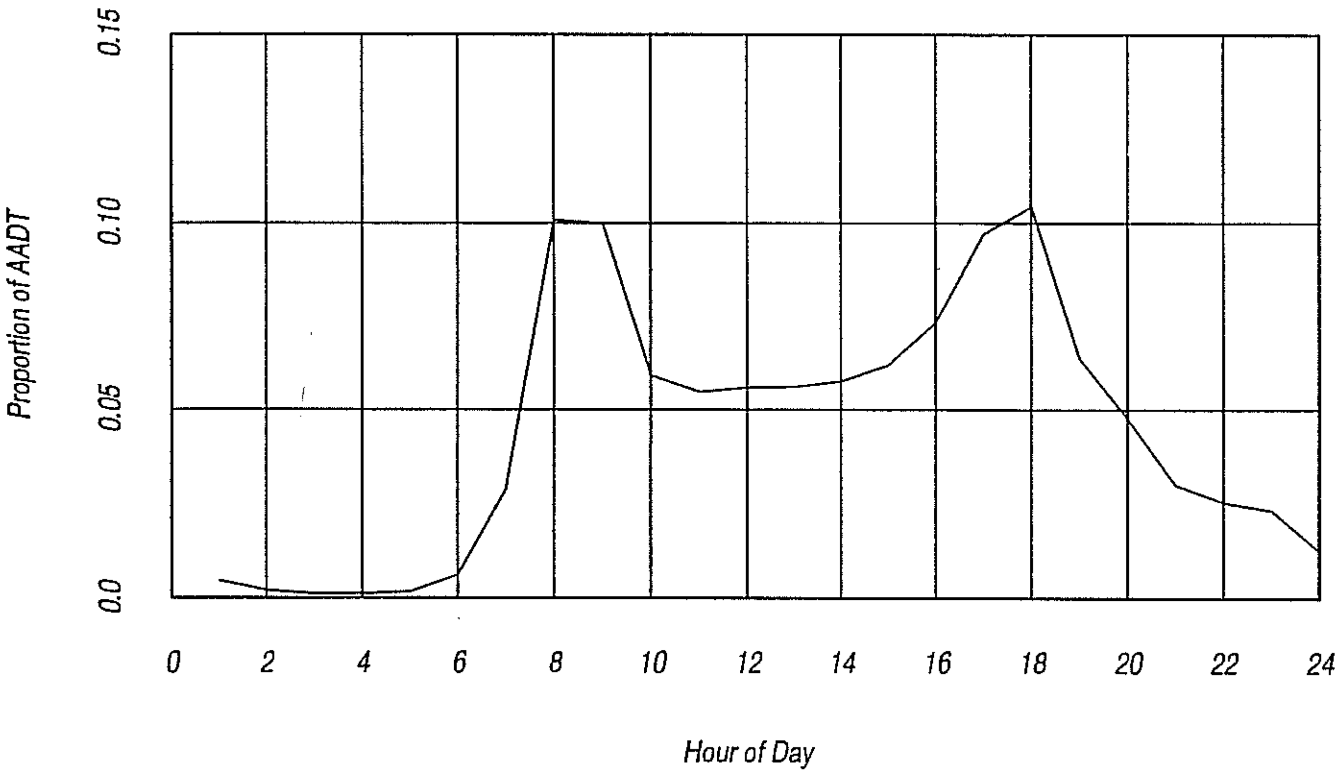
Group Median Daily Usage Patterns

Vertical Scale : 0.5cm = 1% AADT

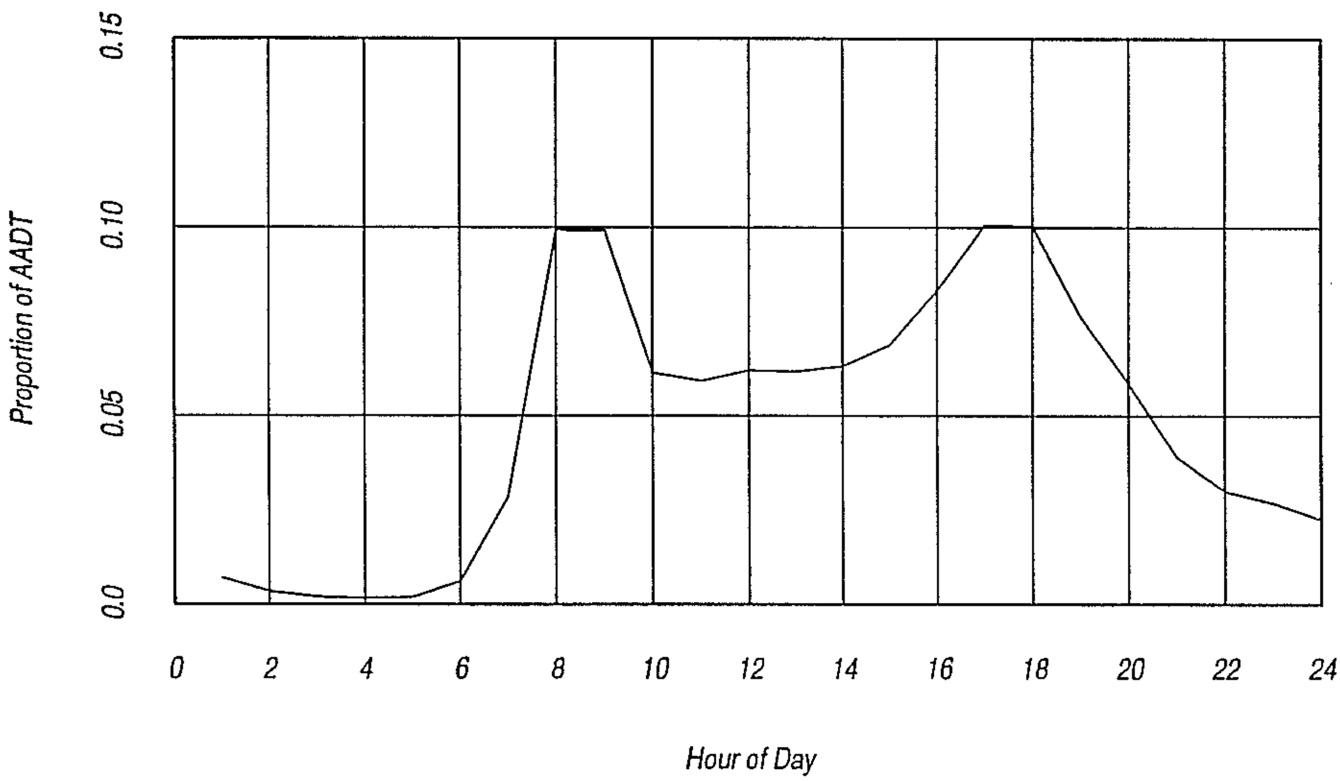
Monday to Thursday Patterns Combined

Group 1a (Medians)

Monday-Thursday



Friday



Appendix C2

Directional Patterns

Groups 1a, 1b, 5, 6a, 6b, 7a, 7b.

Seasonal Pattern Graphs for 7a & 7b

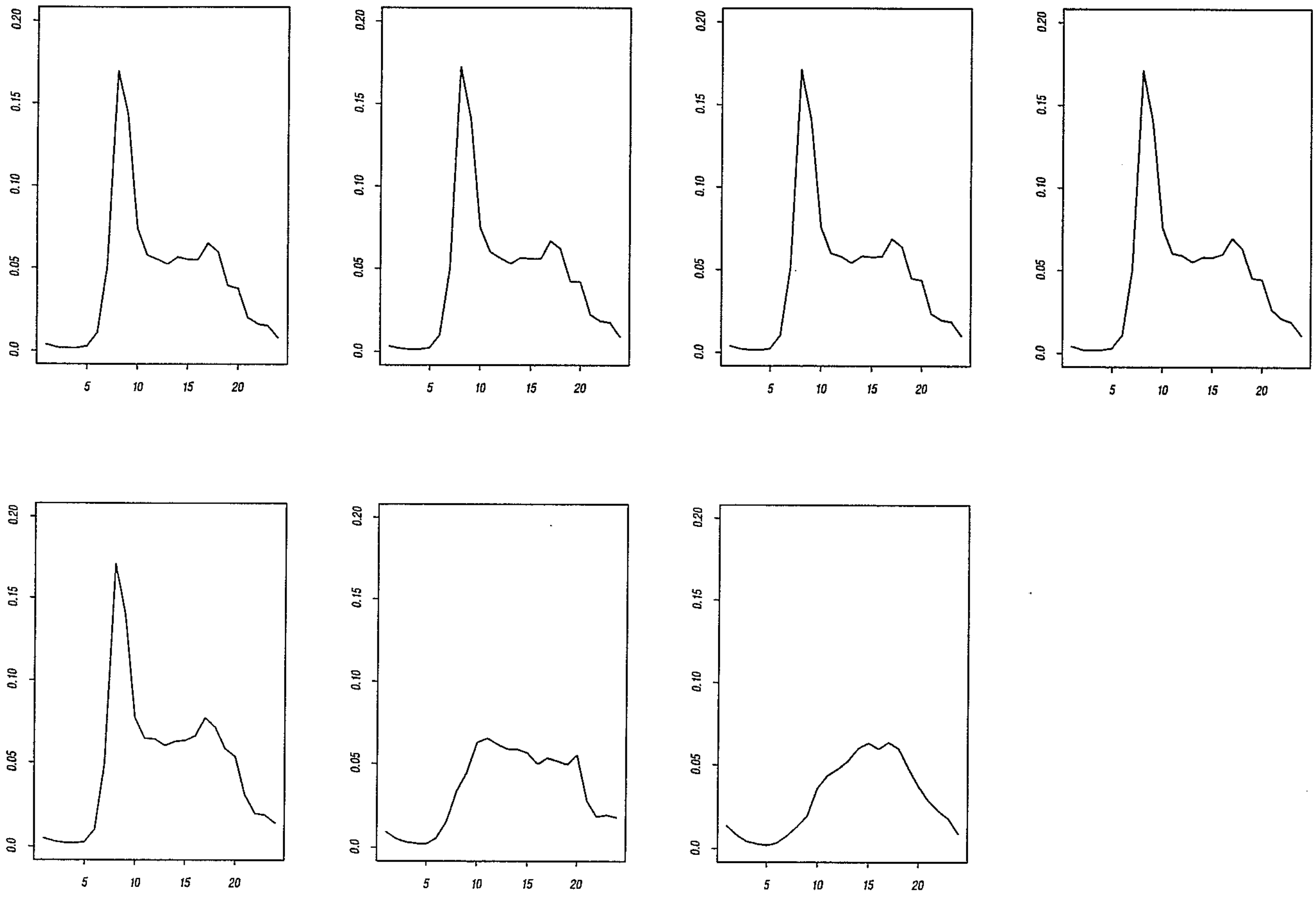
Seven Day Graphs

Scaled Graphs : Monday to Thursday Combined

Vertical Scale : 0.5cm = 1% AADT

Separate Graph for Curletts Rd Site

Group 1a (A Direction)



Appendix C3

Weekly Multipliers and Summaries

Excluding Easter Week Counts

All Groups

URBAN ARTERIAL : Group 1a

WEEK	AVERAGE	LOW	LOWER QUARTILE	MEDIAN	UPPER QUARTILE	HIGH	STANDARD DEVIATION	95% INTERVAL LOW	95% INTERVAL HIGH	NUMBER OF SITES
2	1.2410	0.9581	1.1523	1.2597	1.3134	1.4419	0.1146	1.0058	1.4762	28
3	1.0828	0.9303	1.0497	1.0815	1.1254	1.2383	0.0689	0.9403	1.2254	24
4	1.0627	0.9202	1.0285	1.0542	1.0725	1.3889	0.0891	0.8791	1.2463	26
5	1.0260	0.9338	0.9872	1.0214	1.0297	1.1868	0.0608	0.9004	1.1515	25
6	1.0513	0.9957	1.0319	1.0501	1.0555	1.1941	0.0438	0.9609	1.1417	25
7	0.9830	0.9059	0.9548	0.9778	1.0053	1.1253	0.0499	0.8798	1.0862	24
8	0.9728	0.9034	0.9456	0.9688	0.9892	1.1137	0.0492	0.8709	1.0747	24
9	0.9841	0.9291	0.9507	0.9651	0.9958	1.1060	0.0521	0.8760	1.0922	23
10	0.9501	0.7010	0.9418	0.9534	0.9682	1.0571	0.0582	0.8303	1.0699	26
11	0.9936	0.9264	0.9565	0.9942	1.0151	1.1368	0.0481	0.8944	1.0928	25
12	0.9988	0.9090	0.9558	0.9690	1.0471	1.1459	0.0635	0.8682	1.1294	27
13	0.9618	0.9036	0.9453	0.9563	0.9684	1.0538	0.0381	0.8830	1.0406	24
14	0.9706	0.8935	0.9490	0.9720	0.9860	1.0702	0.0367	0.8953	1.0459	28
15	0.9678	0.9076	0.9433	0.9679	0.9796	1.0708	0.0420	0.8805	1.0552	22
16	0.9655	0.9195	0.9535	0.9665	0.9770	1.0510	0.0277	0.9085	1.0225	27
17	0.9997	0.9363	0.9624	0.9949	1.0373	1.1095	0.0467	0.9019	1.0976	20
18	0.9900	0.9134	0.9719	0.9896	1.0061	1.1007	0.0383	0.9116	1.0685	29
19	0.9680	0.9322	0.9473	0.9523	0.9838	1.0697	0.0330	0.9006	1.0355	30
20	0.9796	0.8677	0.9542	0.9759	0.9959	1.0635	0.0413	0.8970	1.0622	31
21	0.9979	0.9342	0.9752	0.9918	1.0116	1.1214	0.0416	0.9147	1.0812	32
22	0.9924	0.9399	0.9626	0.9840	1.0077	1.1722	0.0456	0.9011	1.0837	32
23	1.0440	0.9789	0.9972	1.0491	1.0676	1.1671	0.0526	0.9363	1.1517	29
24	1.0218	0.9579	0.9961	1.0167	1.0536	1.0881	0.0366	0.9487	1.0949	31
25	1.0118	0.9141	0.9899	1.0058	1.0270	1.1544	0.0475	0.9146	1.1090	30
26	0.9946	0.9499	0.9784	0.9950	1.0084	1.1178	0.0312	0.9323	1.0569	34
27	0.9922	0.9387	0.9760	0.9927	1.0039	1.0543	0.0245	0.9431	1.0413	34
28	0.9936	0.9057	0.9847	0.9912	1.0128	1.0285	0.0254	0.9428	1.0445	32
29	0.9940	0.9282	0.9805	0.9930	1.0065	1.0392	0.0224	0.9492	1.0389	32
30	0.9825	0.6655	0.9803	0.9951	1.0136	1.0482	0.0714	0.8397	1.1252	32
31	0.9841	0.8158	0.9683	0.9893	1.0020	1.0480	0.0387	0.9067	1.0614	35
32	0.9822	0.8058	0.9728	0.9814	1.0049	1.0323	0.0412	0.8978	1.0666	29
33	0.9812	0.7912	0.9717	0.9817	1.0072	1.0353	0.0449	0.8889	1.0735	27
34	0.9891	0.7896	0.9726	0.9892	1.0022	1.1195	0.0523	0.8845	1.0938	31
35	1.0059	0.7978	0.9833	0.9985	1.0190	1.1783	0.0654	0.8720	1.1399	29

URBAN ARTERIAL : Group 1a

WEEK	AVERAGE	LOW	LOWER QUARTILE	MEDIAN	UPPER QUARTILE	HIGH	STANDARD DEVIATION	95% INTERVAL LOW	95% INTERVAL HIGH	NUMBER OF SITES
36	1.0119	0.8819	0.9840	1.0012	1.0119	1.2052	0.0709	0.8666	1.1573	28
37	0.9865	0.9276	0.9693	0.9816	0.9973	1.0678	0.0288	0.9274	1.0457	27
38	0.9865	0.9294	0.9706	0.9864	1.0033	1.0410	0.0251	0.9349	1.0382	27
39	0.9779	0.9360	0.9663	0.9795	0.9853	1.0292	0.0200	0.9367	1.0192	25
40	0.9745	0.7766	0.9642	0.9773	0.9919	1.0569	0.0487	0.8743	1.0747	26
41	0.9712	0.8963	0.9616	0.9739	0.9826	1.0440	0.0284	0.9132	1.0292	30
42	0.9765	0.8865	0.9680	0.9815	0.9913	1.0219	0.0315	0.9119	1.0411	28
43	0.9839	0.9149	0.9614	0.9739	1.0076	1.1413	0.0464	0.8887	1.0792	28
44	1.0405	0.9344	1.0107	1.0488	1.0620	1.1298	0.0451	0.9484	1.1327	30
45	0.9462	0.8731	0.9297	0.9427	0.9638	1.0605	0.0404	0.8629	1.0295	26
46	0.9581	0.8862	0.9320	0.9578	0.9750	1.0708	0.0487	0.8578	1.0584	26
47	0.9377	0.8539	0.9317	0.9464	0.9525	1.0062	0.0344	0.8661	1.0092	22
48	0.9156	0.8547	0.8813	0.8932	0.9383	1.1104	0.0608	0.7892	1.0421	22
49	0.9170	0.7769	0.9043	0.9202	0.9304	1.0471	0.0508	0.8121	1.0219	25
50	0.9095	0.8549	0.8853	0.9163	0.9275	0.9644	0.0322	0.8428	0.9762	24
51	0.9040	0.8489	0.8803	0.9095	0.9228	0.9685	0.0316	0.8378	0.9702	20
ADJUSTMENT FACTORS	-0.0023	-0.0056	-0.0030	-0.0024	-0.0010	0.0008	0.0015	-0.0054	0.0008	35

Appendix C4

Group Summaries of Within Group

and Between Group Variation

All Groups

Group 1a (Urban Arterial)

WEEK	Average Factor	Between Sites SD	Between Degrees of Freedom	Within Sites SD	Within Degrees of Freedom	Overall Ungrouped SD	Lower 95% Limit (Based on Within Group SD)	Upper 95% Limit
2	1.2424	0.1272	10	0.1045	16	0.1138	1.0208	1.4641
3	1.0964	0.1134	10	0.0655	13	0.0895	0.9550	1.2378
4	1.0638	0.0856	10	0.0900	14	0.0882	0.8708	1.2568
5	1.0271	0.0794	9	0.0390	14	0.0583	0.9433	1.1109
6	1.0508	0.0502	9	0.0370	14	0.0427	0.9715	1.1302
7	0.9829	0.0597	7	0.0440	15	0.0496	0.8891	1.0767
8	0.9732	0.0693	7	0.0325	15	0.0474	0.9041	1.0424
9	0.9941	0.0821	8	0.0783	15	0.0796	0.8273	1.1609
10	0.9474	0.0471	8	0.0629	17	0.0583	0.8147	1.0801
11	0.9666	0.1135	8	0.1410	17	0.1328	0.6692	1.2640
12	1.0127	0.0518	9	0.0645	17	0.0604	0.8767	1.1487
13	0.9911	0.0582	10	0.0746	18	0.0692	0.8343	1.1478
14	0.9941	0.0519	11	0.0442	14	0.0477	0.8992	1.0890
15	0.9946	0.0461	11	0.0548	18	0.0517	0.8795	1.1098
16	0.9958	0.0481	10	0.0551	18	0.0527	0.8800	1.1115
17	1.0087	0.0507	11	0.0445	16	0.0471	0.9144	1.1031
18	0.9903	0.0402	11	0.0338	16	0.0366	0.9185	1.0621
19	0.9664	0.0424	11	0.0249	17	0.0329	0.9139	1.0190
20	0.9779	0.0594	10	0.0267	19	0.0410	0.9220	1.0338
21	0.9975	0.0474	11	0.0353	19	0.0402	0.9236	1.0714
22	0.9916	0.0614	11	0.0333	19	0.0457	0.9220	1.0613
23	1.0565	0.0454	11	0.0837	18	0.0716	0.8807	1.2323
24	1.0210	0.0363	11	0.0344	18	0.0352	0.9487	1.0933
25	1.0109	0.0606	10	0.0378	18	0.0473	0.9314	1.0905
26	0.9936	0.0342	11	0.0278	21	0.0302	0.9357	1.0515
27	0.9909	0.0218	11	0.0247	21	0.0238	0.9394	1.0423
28	0.9917	0.0256	11	0.0255	19	0.0255	0.9383	1.0451
29	1.0157	0.1549	11	0.0490	21	0.0991	0.9138	1.1176
30	0.9813	0.0518	10	0.0800	20	0.0719	0.8144	1.1483
31	0.9834	0.0452	11	0.0343	22	0.0383	0.9123	1.0545
32	0.9816	0.0465	11	0.0378	16	0.0415	0.9015	1.0616
33	0.9804	0.0422	11	0.0485	14	0.0458	0.8763	1.0845
34	0.9882	0.0566	11	0.0504	18	0.0529	0.8822	1.0941
35	0.9976	0.0626	11	0.0540	16	0.0577	0.8831	1.1122
36	1.0025	0.0691	11	0.0541	15	0.0609	0.8872	1.1179
37	1.0182	0.1934	11	0.1723	16	0.1812	0.6528	1.3836
38	1.0160	0.1872	11	0.1562	16	0.1695	0.6849	1.3472
39	1.0206	0.1804	11	0.1769	15	0.1784	0.6437	1.3975
40	1.0046	0.1943	10	0.1606	16	0.1743	0.6642	1.3451
41	0.9718	0.0241	11	0.0252	17	0.0248	0.9187	1.0250
42	0.9779	0.0353	10	0.0191	16	0.0265	0.9375	1.0184
43	0.9846	0.0392	10	0.0487	16	0.0453	0.8813	1.0878
44	1.0404	0.0456	11	0.0435	17	0.0443	0.9485	1.1323
45	0.9471	0.0371	9	0.0392	15	0.0384	0.8635	1.0306
46	0.9591	0.0580	9	0.0401	15	0.0476	0.8736	1.0446
47	0.9380	0.0315	9	0.0333	11	0.0325	0.8648	1.0113
48	0.9161	0.0803	7	0.0487	13	0.0616	0.8110	1.0213
49	0.9181	0.0591	9	0.0411	14	0.0490	0.8299	1.0062
50	0.9100	0.0403	9	0.0221	13	0.0308	0.8623	0.9576
51	0.9040	0.0362	8	0.0262	10	0.0310	0.8458	0.9623

AVERAGE REDUCTION 0.8573
(WITHIN/TOTAL VARIANCE RATIO)

Appendix C5

Regression Summaries of Weekly Multipliers

Transpac Sites 01 to 42

Transpac Site 01

WEEK	Average Factor	Factor SD	Regression Intercept	Slope	P-value for Slope	Residual Standard Error
2	0.9679	0.0468	1.1013	-0.0296	0.1828	0.0330
3	0.9463	0.0209	0.9662	-0.0044	0.7267	0.0246
4	0.8651	0.0380	0.8640	0.0002	0.9916	0.0466
5	0.8155	0.0411	0.8700	-0.0121	0.6196	0.0465
6	0.8633	0.0125	0.8622	0.0003	0.9742	0.0153
7	1.0034	0.0136	1.0310	-0.0061	0.4174	0.0135
8	0.9802	0.0692	1.0597	-0.0209	0.3038	0.0650
9	0.8649	0.1460	0.9520	-0.0193	0.8291	0.1762
10	0.9932	0.1417	1.2372	-0.0642	0.0540	0.0801
11	0.9811	0.0917	0.8628	0.0311	0.2322	0.0802
12	1.0103	0.0680	0.9962	0.0037	0.8665	0.0781
13	0.9585	0.1240	1.0558	-0.0256	0.5081	0.1314
14	1.0016	0.1023	1.0319	-0.0080	0.8098	0.1168
15	1.0545	0.1237	0.8852	0.0376	0.6073	0.1394
16	0.9653	0.0973	0.9670	-0.0004	0.9889	0.1124
17	0.9335	0.1554	0.7834	0.0395	0.4030	0.1565
18	1.1166	0.0317	1.1622	-0.0120	0.1633	0.0251
19	1.0468	0.0656	1.0225	0.0064	0.7627	0.0745
20	0.9799	0.0424	0.9304	0.0130	0.2946	0.0395
21	1.0640	0.0913	1.1723	-0.0285	0.2846	0.0843
22	1.0614	0.0816	1.1192	-0.0152	0.5535	0.0880
23	1.0046	0.0444	0.9748	0.0078	0.5757	0.0482
24	1.1983	0.0423	1.1618	0.0096	0.4612	0.0439
25	1.1794	0.0531	1.2200	-0.0107	0.5198	0.0565
26	1.1662	0.0387	1.1904	-0.0064	0.6028	0.0424
27	1.0734	0.0501	1.0839	-0.0028	0.8653	0.0575
28	1.0793	0.0606	1.0650	0.0038	0.8480	0.0694
29	1.1144	0.0336	1.0998	0.0039	0.7211	0.0378
30	1.1452	0.0508	1.0768	0.0180	0.2052	0.0429
31	1.1196	0.0223	1.0814	0.0117	0.0995	0.0119
32	1.1778	0.0523	1.0905	0.0230	0.0717	0.0324
33	1.1329	0.0339	1.0753	0.0152	0.0612	0.0199
34	1.0965	0.0330	1.0539	0.0114	0.2348	0.0260
35	1.0363	0.0418	1.0327	0.0010	0.9439	0.0482
36	0.9727	0.0320	0.9096	0.0166	0.0001	0.0022
37	1.0303	0.0786	0.9859	0.0127	0.6638	0.0906
38	1.0693	0.0709	0.9961	0.0183	0.4424	0.0721
39	1.0618	0.0691	1.0032	0.0146	0.5419	0.0752
40	1.0928	0.0368	1.0277	0.0171	0.0399	0.0189
41	1.0624	0.0226	1.0248	0.0084	0.5228	0.0244
42	1.1031	0.1408	1.1995	-0.0253	0.5679	0.1525
43	0.9424	0.0634	0.8577	0.0223	0.2103	0.0540
44	0.9279	0.0967	0.8608	0.0168	0.6255	0.1098
45	1.0124	0.0317	0.9677	0.0118	0.1754	0.0256
46	1.0101	0.0358	0.9871	0.0061	0.5930	0.0391
47	0.9240	0.0769	0.9654	-0.0109	0.6575	0.0855
48	1.0267	0.0612	0.9198	0.0282	0.0459	0.0329
49	0.9810	0.0326	1.0171	-0.0095	0.3266	0.0312
50	1.0052	0.0175	1.0063	-0.0002	0.9816	0.0214
51	0.9538	0.0345	0.8983	0.0146	0.0932	0.0231

Appendix C6

Hourly Multipliers

Friday 8am - 9am

Friday 4pm - 5pm

Saturday 11am - 12pm

All Groups

GROUP 1a - URBAN ARTERIAL

WEEK	FRIDAY 8am - 9am AVERAGE MULTIPLIER	STANDARD DEVIATION	MULTIPLIER 95% LIMITS LOW	HIGH	NUMBER OF SITE-HOURS	**	FRIDAY 4pm - 5pm AVERAGE MULTIPLIER	STANDARD DEVIATION	MULTIPLIER 95% LIMITS LOW	HIGH	NUMBER OF SITE-HOURS
2	14.4301	4.1536	5.8902	22.9700	27	**	11.6593	2.4753	6.5701	16.7484	27
3	13.0977	3.2582	6.3012	19.8943	21	**	10.6046	1.5522	7.4009	13.8082	25
4	12.0705	2.3337	7.2538	16.8872	25	**	9.9923	1.6893	6.4685	13.5161	21
5	11.2939	2.4338	6.2705	16.3173	25	**	10.2141	1.6756	6.7557	13.6725	25
6	10.3786	2.2921	5.6362	15.1210	24	**	10.6292	2.2650	5.9632	15.2951	26
7	10.4770	2.2937	5.7060	15.2480	22	**	9.9111	1.3486	7.1059	12.7163	22
8	10.2340	2.1054	5.9053	14.5628	27	**	9.8139	1.2737	7.1953	12.4326	27
9	10.3770	2.5383	5.0212	15.7328	18	**	10.1921	1.5343	7.0008	13.3835	22
10	10.4375	2.5041	5.2564	15.6185	24	**	9.9933	1.1866	7.5383	12.4483	24
11	10.4585	2.1651	6.0071	14.9100	27	**	9.9165	1.2121	7.4244	12.4085	27
12	9.5301	1.0998	7.1710	11.8892	15	**	9.7447	1.1426	7.3533	12.1361	20
13	10.2837	2.3084	5.4961	15.0713	23	**	10.3959	2.3981	5.4342	15.3576	24
14	10.4631	2.5543	5.2013	15.7250	26	**	9.8550	1.1479	7.4904	12.2195	26
15	10.1010	1.7206	6.5634	13.6386	27	**	9.5626	0.9530	7.6033	11.5218	27
16	10.2646	2.4551	5.1262	15.4031	20	**	9.8668	1.3105	7.1240	12.6096	20
17	10.4997	2.1860	6.0228	14.9767	29	**	9.7277	1.2690	7.1287	12.3266	29
18	9.9853	2.1852	5.5165	14.4541	30	**	9.7673	1.1547	7.4060	12.1287	30
19	10.7501	2.4024	5.8300	15.6701	29	**	9.8303	1.1193	7.5379	12.1226	29
20	11.7357	2.2905	7.1547	16.3167	31	**	9.9607	1.1942	7.5724	12.3491	31
21	11.3187	2.0456	7.2276	15.4098	31	**	10.1980	1.2589	7.6803	12.7158	31
22	10.2846	2.3918	5.5010	15.0681	31	**	9.9756	1.1887	7.5983	12.3529	31
23	10.2125	2.3159	5.4511	14.9739	27	**	9.8632	1.1558	7.5515	12.1748	31
24	10.3469	2.2452	5.8564	14.8374	31	**	9.7702	1.1264	7.5174	12.0230	31
25	10.1874	2.2017	5.6850	14.6898	30	**	9.8227	1.1120	7.5987	12.0467	31
26	10.0373	2.0224	5.9926	14.0821	31	**	9.8405	1.1697	7.5011	12.1798	31
27	10.3152	2.4944	5.3264	15.3040	32	**	9.9266	1.1098	7.7071	12.1461	32
28	11.1744	1.9232	7.3281	15.0207	31	**	9.8296	0.9914	7.8467	11.8125	31
29	10.2460	2.1700	5.9060	14.5859	33	**	9.8767	1.2200	7.4367	12.3166	33
30	9.9713	2.0948	5.7818	14.1609	31	**	9.8714	1.1375	7.5965	12.1463	31
31	10.1282	1.9988	6.1306	14.1258	34	**	9.7931	1.1500	7.4932	12.0930	34
32	10.2033	2.3091	5.4559	14.9507	27	**	9.7113	1.2619	7.1168	12.3058	27

Appendix D1

Week by Day Multipliers

All Groups

	Mon	Tue	Wed	Thu	Fri	Sat	Sun/Hol
GROUP 1a	**Urban Arterial (a)**						
Mean	1.027	0.9516	0.9364	0.9223	0.8727	1.1078	1.2978
Std Dev	0.1269	0.0872	0.0836	0.0973	0.1184	0.0811	0.2050
Number	1233	1230	1248	1247	1230	1223	1284
GROUP 1b	**Urban Arterial (b)**						
Mean	1.111	0.985	0.9595	0.9399	0.8995	1.0051	1.2037
Std Dev	0.1166	0.0705	0.0575	0.0898	0.1063	0.0991	0.1932
Number	1597	1558	1588	1570	1566	1528	1623
GROUP 2	**Urban Commercial**						
Mean	1.2624	1.1038	1.0539	0.7365	0.8677	0.8065	1.7489
Std Dev	0.2803	0.0955	0.1034	0.0395	0.1604	0.1144	0.2792
Number	75	70	73	72	69	67	75
GROUP 3	**Urban Industrial**						
Mean	1.3179	0.8103	0.7877	0.7924	0.8529	2.1323	6.0426
Std Dev	0.5570	0.0898	0.0704	0.1489	0.4389	0.4475	0.7291
Number	246	236	241	241	231	224	247
GROUP 4	**Urban Other**						
Mean	1.0632	1.0317	1.0017	0.953	0.9032	0.8911	1.2538
Std Dev	0.0844	0.0510	0.0467	0.0564	0.0883	0.0725	0.1257
Number	111	111	110	109	108	108	111
GROUP 5	**Rural Urban Fringe**						
Mean	1.1047	1.1458	1.1124	1.087	0.9302	0.935	0.8018
Std Dev	0.0644	0.0789	0.0650	0.0724	0.0558	0.0882	0.1709
Number	651	676	683	681	669	680	706
GROUP 6a	**Rural Strategic (a)**						
Mean	1.0528	1.0195	1.0022	0.9856	0.8781	1.0764	1.0237
Std Dev	0.0859	0.0668	0.0671	0.0730	0.0958	0.1262	0.2067
Number	2436	2430	2469	2455	2448	2402	2541
Group 6b	**Rural Strategic (b)**						
Mean	1.0713	1.1327	1.1176	1.0652	0.8835	1.0068	0.865
Std Dev	0.0970	0.0991	0.0915	0.0882	0.0706	0.1130	0.1858
Number	5537	5696	5739	5795	5741	5819	5907
Group 7a	**Rural Recreational (Summer)**						
Mean	1.0372	1.139	1.1456	1.0702	0.8669	1.0712	0.8789
Std Dev	0.1206	0.1302	0.1416	0.1107	0.0988	0.1594	0.2076
Number	610	620	629	626	626	636	643
Group 7b	**Rural Recreational (Winter)**						
Mean	1.1173	1.2617	1.2532	1.1723	0.8836	0.9881	0.7728
Std Dev	0.1827	0.2221	0.1673	0.1719	0.1215	0.1720	0.1903
Number	1045	1074	1092	1096	1088	1109	1117

Appendix D2

Seasonal Week by Day Multipliers

All Groups

SUMMER DAY FACTORS

		Mon	Tue	Wed	Thu	Fri	Sat	Sun/Hol
GROUP 1a	Urban Arterial (a)	1.0376	0.9447	0.9356	0.9228	0.8658	1.1019	1.2627
GROUP 1b	Urban Arterial (b)	1.1175	0.9816	0.9586	0.9418	0.898	0.9939	1.1844
GROUP 2	Urban Commercial	1.2924	1.0806	1.0571	0.7382	0.8387	0.803	1.8231
GROUP 3	Urban Industrial	1.3145	0.7906	0.7871	0.8048	0.8101	1.9932	5.7628
GROUP 4	Urban Other	1.0701	1.0371	1.0109	0.9557	0.9037	0.8744	1.2197
GROUP 5	Rural Urban Fringe	1.111	1.1661	1.1311	1.1029	0.9388	0.9152	0.7857
GROUP 6a	Rural Strategic (a)	1.0486	1.0232	1.0095	0.9854	0.8784	1.0607	1.0062
Group 6b	Rural Strategic (b)	1.0674	1.1469	1.1285	1.0682	0.8872	0.9962	0.8563
Group 7a	Rural Recreational (Summer)	1.0253	1.1472	1.1454	1.0647	0.8705	1.0515	0.8751
Group 7b	Rural Recreational (Winter)	1.0808	1.2326	1.2377	1.1511	0.8694	0.9805	0.7874

WINTER DAY FACTORS

		Mon	Tue	Wed	Thu	Fri	Sat	Sun/Hol
GROUP 1a	Urban Arterial (a)	1.0193	0.9565	0.937	0.9219	0.8777	1.1122	1.3237
GROUP 1b	Urban Arterial (b)	1.1057	0.9876	0.9602	0.9384	0.9007	1.0139	1.2192
GROUP 2	Urban Commercial	1.2444	1.1152	1.0522	0.7354	0.8864	0.8087	1.7047
GROUP 3	Urban Industrial	1.3201	0.822	0.788	0.7838	0.8812	2.2223	6.2298
GROUP 4	Urban Other	1.0583	1.0279	0.995	0.9512	0.9028	0.9029	1.278
GROUP 5	Rural Urban Fringe	1.0997	1.1295	1.0973	1.0742	0.9231	0.9509	0.815
GROUP 6a	Rural Strategic (a)	1.0563	1.0165	0.9963	0.9858	0.8778	1.0892	1.0382
Group 6b	Rural Strategic (b)	1.0746	1.1208	1.1087	1.0627	0.8804	1.0156	0.8722
Group 7a	Rural Recreational (Summer)	1.0473	1.1321	1.1458	1.0749	0.8639	1.0878	0.882
Group 7b	Rural Recreational (Winter)	1.1516	1.2887	1.2679	1.1923	0.897	0.9953	0.759

Appendix D3

Allocation Tables

InterPeak Distance

Peak Values

InterPeak:Peak Ratio

GROUP ALLOCATION USING INTERPEAK DISTANCE

		ALLOCATED GROUP MON-THURS INTER-PEAK DISTANCE										% ACCURATE	
		1a	1b	2	3	4	5	6a	6b	7a	7b		
	1a	20	13	0	0	0	0	0	0	0	0	60.61%	
	1b	2	28	0	0	3	0	2	4	0	1	70.00%	
ACTUAL	2	0	0	0	0	0	0	0	0	2	0	0.00%	
	3	0	4	0	0	0	0	0	1	0	1	0.00%	
GROUP	4	0	2	0	0	0	0	0	1	0	0	0.00%	
	5	8	8	0	0	0	0	0	0	0	0	0.00%	
	6a	0	8	2	0	4	0	12	24	8	9	17.91%	
	6b	0	0	5	0	2	0	21	72	6	27	54.14%	
	7a	0	0	0	0	0	0	0	0	10	5	66.67%	
	7b	0	0	2	0	0	0	0	0	13	10	40.00%	**44.71%**

		ALLOCATED GROUP FRIDAY INTER-PEAK DISTANCE											
		1a	1b	2	3	4	5	6a	6b	7a	7b		
	1a	25	0	0	0	0	8	0	0	0	0	75.76%	
	1b	29	0	1	0	0	2	2	3	3	0	0.00%	
ACTUAL	2	0	0	2	0	0	0	0	0	0	0	100.00%	
	3	2	0	0	0	0	0	2	2	0	0	0.00%	
	4	2	0	0	0	0	0	1	0	0	0	0.00%	
GROUP	5	2	0	0	0	0	7	7	0	0	0	43.75%	
	6a	4	0	2	5	0	0	30	19	7	0	44.78%	
	6b	0	0	1	7	0	0	78	40	7	0	30.08%	
	7a	0	0	3	6	0	0	0	0	6	0	40.00%	
	7b	0	0	0	4	0	0	1	9	11	0	0.00%	**32.35%**

Appendix D4.1

Allocation Thresholds for Peak Volumes

MONDAY-THURSDAY		FRIDAY	
7b	0.071211755	**1b**	0.097691905
6b	0.07823908	**7b**	0.09921037
5	0.08208532	**2**	0.100549735
7a	0.08439441	**1a**	0.102110475
6a	0.089325765	**6b**	0.10324466
1b	0.094865725	**6a**	0.103684625
2	0.100554015	**7a**	0.104497815
4	0.10387248	**5**	0.110694015
1a	0.122727925	**4**	0.12286192
3	NA	**3**	NA

SATURDAY		SUNDAY	
3	0.072085105	**3**	0.042851735
6a	0.074713415	**1a**	0.06814326
1a	0.078739025	**4**	0.07063573
7b	0.08230244	**1b**	0.07353502
1b	0.082898475	**2**	0.0826268
7a	0.08314438	**6a**	0.10230602
6b	0.08505057	**6b**	0.115432865
5	0.09347456	**5**	0.120223125
4	0.121097755	**7a**	0.126144495
2	NA	**7b**	NA

Appendix D4.2

Allocation Thresholds for InterPeak to Peak Ratio

MONDAY-THURSDAY		FRIDAY	
1a	0.5605464	4	0.56039525
4	0.6059546	5	0.5935336
5	0.67918235	1a	0.67535285
1b	0.7570454	6a	0.74300985
3	0.7961635	6b	0.7527061
6a	0.8124869	1b	0.7933081
2	0.86260905	7b	0.86070065
6b	0.93434765	3	0.8920474
7b	0.9744092	2	0.9101845
7a		7a	

SATURDAY		SUNDAY	
2	0.95016625	7a	0.71801975
3	0.97441395	7b	0.7197816
6b	0.98424335	6b	0.733055
5	0.98668395	5	0.76806155
6a	0.99396815	6a	0.8133043
1a	1	1b	0.8365196
1b	1	1a	0.8864316
4	1	3	0.9681495
7a	1	2	1
7b		4	

Appendix D5

5.1 Group Summaries : Peak Values

5.2 Histograms of Peak Values
All Groups

PEAKS MON-THURS

	min	low quartile	median	mean	upper quartile	high	number	std dev.
1a	0.09113	0.1011	0.1111	0.1083	0.1138	0.1199	33	0.008181564
1b	0.08261	0.09241	0.09686	0.09644	0.09982	0.1147	40	0.006286157
2	0.0954	0.09648	0.09756	0.09756	0.09864	0.09972	2	0.00305456
3	0.1241	0.1299	0.1359	0.1445	0.1585	0.1772	6	0.021559802
4	0.1003	0.1018	0.1032	0.1036	0.1052	0.1071	3	0.003416397
5	0.07584	0.07801	0.07995	0.08231	0.09003	0.09088	16	0.005803337
6a	0.07429	0.08501	0.08865	0.08847	0.09303	0.1	67	0.006172755
6b	0.06424	0.07338	0.07625	0.07698	0.08006	0.09144	133	0.005436358
7a	0.08254	0.08468	0.08648	0.08654	0.08796	0.09106	15	0.002505021
7b	0.06463	0.06806	0.0689	0.06951	0.07135	0.07436	25	0.002309705

PEAKS FRIDAY

	min	low quartile	median	mean	upper quartile	high	number	std dev.
1a	0.08799	0.1008	0.1078	0.1063	0.1121	0.1161	33	0.007326449
1b	0.08622	0.09368	0.1002	0.0995	0.1039	0.115	40	0.006680342
2	0.09801	0.09904	0.1001	0.1001	0.1011	0.1022	2	0.002938905
3	0.1241	0.1338	0.1424	0.1435	0.1528	0.1652	6	0.015328673
4	0.1134	0.1155	0.1177	0.1165	0.118	0.1184	3	0.002675737
5	0.1029	0.1034	0.1043	0.1049	0.1057	0.1088	16	0.001873674
6a	0.08959	0.1001	0.104	0.1044	0.1087	0.1219	67	0.007114868
6b	0.09028	0.1021	0.1052	0.1053	0.1076	0.1225	133	0.006479707
7a	0.102	0.1049	0.1071	0.1078	0.1101	0.1154	15	0.00400374
7b	0.08798	0.09578	0.1004	0.1	0.1031	0.109	25	0.005362422

Appendix D6

6.1 Group Summaries : InterPeak:Peak Ratios

6.2 Histograms of InterPeak:Peak Ratios All Groups

INTERPEAK : PEAK RATIOS BY GROUP

INTER PEAK:PEAKS MON-THURS

	min	low quartile	median	mean	upper quartile	high	number	std dev.
1a	0.4221	0.4671	0.5259	0.5208	0.5654	0.6155	33	0.058377923
1b	0.5383	0.6491	0.6872	0.7007	0.7243	0.9634	40	0.100525752
2	0.8139	0.816	0.8181	0.8181	0.8202	0.8223	2	0.005953344
3	0.6299	0.7138	0.7606	0.7788	0.8542	0.9379	6	0.113814794
4	0.5552	0.5701	0.585	0.5832	0.5972	0.6095	3	0.027184277
5	0.5165	0.5496	0.6363	0.6305	0.6992	0.7397	16	0.080605091
6a	0.6622	0.7431	0.781	0.7929	0.8452	1	67	0.078080245
6b	0.7233	0.8315	0.881	0.8818	0.9265	1	133	0.062504043
7a	0.8745	0.9097	0.9219	0.94	1	1	15	0.047787445
7b	0.8731	0.9045	0.9488	0.9386	0.962	0.9839	25	0.032487588

INTER PEAK:PEAKS FRIDAY

	min	low quartile	median	mean	upper quartile	high	number	std dev.
1a	0.4801	0.535	0.5985	0.5874	0.6346	0.7045	33	0.0560884
1b	0.5807	0.6891	0.7173	0.738	0.748	0.9688	40	0.09159937
2	0.8951	0.8953	0.8955	0.8955	0.8957	0.8959	2	0.000574666
3	0.7132	0.7898	0.7953	0.803	0.8215	0.8959	6	0.05958597
4	0.5102	0.5334	0.5566	0.5501	0.5701	0.5836	3	0.03712594
5	0.5054	0.5292	0.5609	0.5712	0.6233	0.6462	16	0.0491073
6a	0.5681	0.6842	0.7246	0.7311	0.7692	0.9556	67	0.07836893
6b	0.6073	0.6966	0.7378	0.7384	0.7802	0.95	133	0.06044673
7a	0.8065	0.8661	0.8794	0.8926	0.9392	0.9641	15	0.04855925
7b	0.7282	0.8	0.8163	0.8191	0.8453	0.9275	25	0.0490833