

Temporal Variations on the Allocation of Time

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ABSTRACT

This study investigates the allocation of time and trip-making across time-of-day, day-of-week, and month-of-year, as well as over the past forty years. Some interesting findings result. People are working much more, shopping somewhat more on weekends, and stay at home less today than forty years ago. Time spent in travel on each weekend day (Saturday or Sunday) exceeds that on any weekday, as it did forty years ago. Time spent shopping on a typical day in the busiest month (December) is more than double that in the least busy month (September). Monthly variations in daily time in travel exceed 10 percent. The time of day patterns of shop and other trips for workers and nonworkers are both rational: nonworkers peak in mid-day away from rush hour while workers peak just after work, indicating trip chaining.

INTRODUCTION

Growing congestion and changing travel patterns in urban areas have forced transportation researchers to venture beyond the confines of the daily work trip. Although work trips have been the traditional focus in transportation planning and policy formulation, recent studies have shown that nonwork trips are a dominant component of daily trip-making and are growing faster than work trips (1,2). The historic emphasis on work trips was justified by the fact that the temporal clustering of work trips resulted in peak hour congestion, dictating most investment decisions. However, as the role of transportation planners moves from investment to management, we believe it worthwhile to reexamine this issue in the broader perspective of activity patterns. One purpose of this paper is to look at both work and nonwork activity patterns, across all seven days of the week.

Nonwork trips are tied to some very basic and necessary human activities such as shopping, performing errands, and socializing. Previous studies have related trip-making and activity patterns to demographics and socio-economic conditions (3), and trip generation to variations in land use patterns and metropolitan size (4). However, these activity patterns vary even more significantly across some fundamental criteria: natural and cultural cycles reflected in the calendar and the clock.

The study of human activity patterns has engaged the attention of researchers across disciplines. Recent developments by transportation engineers and modelers include attempts to introduce the concepts of trip chaining, activity sequencing, and combined time-of-day and route choice into demand forecasting procedures (5-7). While these models have focused on methods for simulation of activity patterns, less empirical work has analyzed their long term stability and their placement in a broader economic context. Pioneering work quantifying the use of time has been conducted by Szalai comparing these results internationally and Robinson who conducted and reported on the American portion of that study (8,9). Meanwhile, sociologists have examined the impact of increasing female labor force participation on quality of life and changing roles of time at

work and leisure (10-12); planners have studied the allocation of time by activity and location for demographic and socio-economic classes (13-16); and economists have developed a theory of the allocation of time wherein individuals or households combine time and market goods to produce “commodities” (17).

This study, part of a larger investigation into activity patterns, evaluates empirically the influence of temporal variations on the allocation of time. Much attention has been paid to trends in activity patterns, that is the aspects of behavior which increase or decrease as a linear function of time. Less has been placed on the cyclical aspects of time, recurring patterns over the course of days, weeks, and years. While most previous studies of travel behavior and time usage are atemporal, assuming an average day, this study, using the 1990 Nationwide Personal Transportation Survey, investigates variations in activity patterns by day of week and month of year, as well as the more traditional time of day. Information on weekend travel is sparse, and this analysis partially fills that gap. Answers to a number of questions are sought: What is the difference in activity patterns on Saturday vs. Sunday? How different are the weekend activity patterns from an average weekday? Is there an average weekday? Does weekend travel exhibit the same diurnal relationship as weekday travel? How different are shop trip from other nonwork trips?

Next in this paper is a discussion of the database used in the analysis. This is followed by a review of long term trends in the use of time, comparing studies performed in 1954 and 1966 and the 1990 NPTS used here. Cyclical patterns are reviewed, and several hypotheses are tested in a comparison of month of year and day of week variations, respectively. Last is a discussion of time-of-day variations across the weekdays, Saturdays, and Sundays. The paper concludes with a discussion of the relevance of considering nonwork as well as work travel, and considering the temporal variations in human activity patterns.

DATA

The original database used in this analysis comes from the 1990/91 Nationwide Personal Transportation Survey (NPTS). The NPTS was conducted as a telephone interview survey by the Research Triangle Institute, sponsored by the United States Department of Transportation (18). The survey collected data on household demographics, income, vehicle availability, all trips made on the survey day, long trips made over a two week period, and traffic accidents within the past five years. Characteristics of trips include departure time, distance and duration of the trip, trip purpose and mode, day of week, and month of year. The survey was conducted between March 1990 and March 1991 and consisted of 21,817 household interviews and 47,499 persons making almost 150,000 trips. Because each interview consists of a single day, it is important to remember that the comparisons in this study across day of week and month of year do not come from the same individual. Conclusions must therefore be treated with caution. Further research with panel data will be able to compare the same individual across these time slices, offering another perspective on this issue.

First, it may be useful to define travel, activities, and their inter-relationship. Activities are of two classes: location-specific activities and travel. Location-specific activities are defined based on the reported destination activity (purpose) from the travel survey. Travel is the activity which links other spatially separated location-specific activities. The core of this study comes from the 1990 NPTS, which like most travel surveys, provided respondents with a choice of answering where they went next (trip purpose), how they got there (mode), and how long it took (trip duration). These location-specific activities are consolidated into the categories: Home, Work, Shop, and Other. The time spent traveling is accumulated into the Travel activity category.

Only two pieces of time information were provided: the time of departure for a trip, and the travel time for that trip. To create activity data, this study takes the NPTS "Travel Day" database, and by looking ahead to the departure time of the next trip, determines the duration of the stop at the destination. A number of individuals did not report the time of arrival or departure for one trip during the day. These individuals were excluded as their daily time did not add to 1440 minutes.

Only individuals who ended the day at home were considered in this study, and time at home was computed based on final arrival time at home and initial departure at the beginning of the day. This is added to any stops at home in the middle of the day. For the graphs and tables presented in this paper, only adults aged 18 to 65 were considered. The elderly and children clearly have different diurnal, weekly, and seasonal time allocation patterns, and these may be evaluated in further research.

ANALYSIS OF LONG TERM TRENDS

Table 1 summarizes some long term trends in activity patterns in the United States. These data are illustrative, but cannot be compared in rigorous detail due to different methodologies used in the studies as well as limitations on the reported data. The 1954 results are reported by de Grazia (11) from an unpublished study "A Nationwide Study of Living Habits" conducted for the Mutual Broadcasting System by J.A. Ward. The J.A. Ward study used quarter hour diaries during March and April 1954. The 1954 sample was quite large, 7,000 households and 20,000 individuals. The diaries were collected from 6 a.m. to 11 p.m., we have assumed the remaining time to be spent at home.

The 1966 results are drawn from tables reported by Robinson and Szalai in the monumental 1966 international use of time study (8,9). The sample was much smaller, over 2000 adults, primarily as a day after diary. The data from this study were cross-classified in numerous ways and tables. Some of the tables, such as for travel, shop, and work were directly comparable with the other two studies. However, the results for home and other had to be inferred from several tables and adjusted by us to get a best estimate. This is because a number of activities which could occur at either location (home, other) were reported by type of activity (for instance television watching or socializing with friends) rather than location.

Despite the differences in methods, some clear trends emerge. In 1990, adult Americans are working more on weekdays, and less on Saturday than in 1954. The weekday rise is principally due to the larger number of women working outside the home. Although Schor has argued that time at work has risen for men as well, this may not show up in a travel or activity

survey, but rather in wage data (12). The Saturday drop reflects the widespread adoption of the five-day work week since 1954. The amount of time spent shopping has held remarkably steady, although even small time differences in this category represent larger percentage differences. Americans would appear to be shopping more on weekends now than before. This in part is due to Sunday shopping, which was rare in 1954 due to Blue Laws, but this also seems to be true on Saturdays.

The amount of time in travel is almost identical between 1954 and 1990, though the 1966 study shows 10%-30% higher weekend and 40% higher weekday travel time. To what extent this is real and to what extent it is a result of survey methods is unclear. However another study by the authors (3) shows that time in travel in metropolitan Washington has increased between 1968 to 1988 (from 1.3 to 1.7 hours for men on weekdays and from 1.2 to 1.5 hours for women) due to the rise in nonwork trips and the increase in workers. This increased time is not, as has often been supposed, due to a longer duration of work trips. The most important information for transportation analysis, the amount of time spent traveling, is ironically the least clear.

The two most curious categories are home and other. Given the increase in female labor force participation, time spent at home from 1954 to 1990 should be expected to decrease on weekdays. This is supported by the data. However several interacting factors make the issue more complicated. Saturday work has decreased, which makes more time available on Saturdays (for home and shop), while the opening of stores (and other activity locations) on Sunday enables people to get out on Sunday.

ANALYSIS OF CYCLICAL PATTERNS

The analysis of cyclical variations on the allocation of time in 1990 America takes several forms: time of day, day of week, and month of year. Five activity patterns are identified in this paper: home, work, shop, other, and travel. "Other" activities here are defined to include trips for the following: family or personal business, school or church, doctor/dentist, visiting friends or relatives, social/ recreational, and any otherwise non-specified activity (not home, work, shop, or vacation). The "other" trips were grouped to maintain sample size significance and simplify the

analysis. Time spent at each of the activities, diurnal variations, average frequency, activity durations are computed for the different time slices: month of the year, day of the week, and time of day. These are addressed in turn below.

The information is presented in graphs which show the mean daily duration of each activity. Behind each graph lies a table, not presented for space reasons and available from the authors on request, which contain matrices of the t-statistic resulting from a difference of means tests for month vs. month and for day vs. day. In this way, the statistical significance of differences of points on the graph could be ascertained. Monday can be compared with Tuesday, and March with April, and comparisons between any given day and the average are also made possible. The statistical significance of the difference of means which are reported were developed from those tables, a report of significance indicates that the difference is significant at the 90% confidence level or better on a two-tailed t-test.

Hypotheses

The NPTS database offers innumerable possibilities for analysis. Keeping our focus on temporal variations, several hypotheses are explicitly evaluated in this study. First, it is hypothesized that there is a tie between human activity patterns and seasonal cycles, which will be indicated by differences in average activity durations in winter and summer, spring and fall. These differences are expected to occur in each of the activities, with different activity-specific patterns across the months of the year.

The second hypothesis is that Saturday and Sunday behavior are expected to differ from each other and from weekdays, but weekdays are expected to be similar to each other. The difference in activity patterns between Saturday and Sunday results from a variety of obvious religious and cultural reasons. This is tested across activities.

A third hypothesis concerns the temporal distribution of regional and neighborhood shopping: longer shopping trips to farther away stores will occur on weekends. A similar pattern is also expected to emerge for other trips, which should be longer on the less constrained weekends.

The last set of hypotheses concern time of day. They are that on weekdays, workers will tend to perform shop and other activities on the way home from work, while nonworkers, will tend to perform shop and other trips outside of the peak commuting hours. This results from a desire to avoid congestion during peak periods on the part of nonworkers and to minimize travel time on the part of workers by combining nonwork trips with the work trip. In short, individuals are assumed to make boundedly rational decisions on the allocation of time which produces this scheduling behavior (3).

Activity Duration By Month of Year

Figures 1 and 2 display average daily time distribution by month and activity. These graphs show seasonal variations in the time spent at various activities. It is hypothesized that there is a link between human activity patterns and natural (and cultural) cycles which will be reflected by differences in activity durations. Future research may compare activity patterns and geography to get an indication the relative importance of climate as opposed to other seasonal/ cultural patterns.

Several statistically significant results are found. Time at home peaks around the December holidays (1015 minutes) and reaches a nadir in April (960 minutes). Many of the differences between months are significant, and while some pairwise comparisons of months don't appear significant, the trends seem to be. For instance, for time at home, January does not significantly differ from February, and February does not significantly differ from March. But January differs more from March for time spent at home (than February), and is significantly different from April, all suggesting a real trend.

Time at work (per person, not per worker) is the opposite from time at home, peaking in April (275 minutes) and with a low in December (220 minutes). Moreover, time at work has a secondary valley during July due to summer vacation (250 minutes). The differences here are not as significant, only December is significantly different from the average month.

Time spent shopping per day peaks in December (34 minutes), from a September low (15 minutes). December, January, May and September are significantly different from the average

month, and the months with a great deal of shopping are different from those with below average shopping.

Time at other is flat, ranging from 100 minutes in Winter to 120 minutes in Spring and Summer. May and October are significantly different from the average months, and again, a number of pairwise comparisons are also significantly different.

Travel consumes 62 minutes per day in most months, but in summer consumes 70 minutes. May, July, and August differ from the average month, and the winter months are different from the summer months.

Activity Duration by Day of Week

Figures 3 and 4 display time spent at each of the five activities (home, work, shop, other, and travel), by day of week. For each day, the total time of the five activities adds to 1440 minutes. The hypothesis is that weekday activity patterns are very similar to each other, but differ from weekends, and that Saturday differs from Sunday.

As expected, time spent at each of the activities tends to be somewhat the same across the work-week while it differs over the weekend. However, even during the work-week, some variations can be observed:

Time at home on Mondays is greater than the other four weekdays, perhaps due to recovery from the weekend or the “three day weekend” (due to official holidays and personal vacation), while time at work is slightly less on Monday. This difference is statistically significant. However, the time at home on the other weekdays is not statistically different. Time at home is greatest on Sundays (1125 minutes) followed by Saturday (1080 minutes). The weekends are statistically different from the weekdays and from each other, validating the hypothesis.

Also, time at work on Mondays is significantly different from other weekdays, and as expected the weekends do differ from the weekdays and each other. However, Tuesday through Friday are similar.

Time spent shopping rises from Monday to Friday, with a small peak on Thursday (19 minutes). Shopping peaks on Saturday (45 minutes), followed by Sunday (25 minutes). While

adjacent weekdays are not different from each other, (the difference between Monday and Tuesday or between Tuesday and Wednesday is not significant), the difference between non-adjacent weekdays does tend to be significant, again suggesting a trend over the week. The weekend days are significantly different from each other and weekdays.

Time at other activities is fairly flat over the weekdays, with a dip on Thursday (90 minutes). Time at other activities peaks on Sunday (165 minutes) followed by Saturday (135 minutes). The weekdays are not significantly different from each other, though the weekend days are different from each other and weekdays.

Time in travel rises slightly from Monday to Wednesday, but more sharply from Wednesday to Friday. Time in travel on the weekends is greater than on weekdays, Saturday is highest at 68 minutes. However, weekdays are not significantly different from each other, and Saturday is not significantly different from Sunday, but the weekends are significantly higher than weekdays.

Trip-Making by Day of Week

Figures 5,6, and 7 show trip frequency, duration, and distance by day of week. These figures are classified by worker and nonworker and come out as might be expected from the earlier discussion.

Figure 5 shows trip frequency. Work trips for workers are basically flat across weekdays, as are trips for shopping. Work trips are more frequent on weekdays than weekends, and higher on Saturdays than Sundays. Other trips are fairly consistent across weekdays until Friday, when there is a rise for both workers and nonworkers. Weekends have more nonwork trips than weekdays. However, a higher share of other and shop trips for workers occurs on weekends than weekdays compared with nonworkers, indicating a displacement. Again, nonworkers can make these trips on weekdays in mid-day, which is relatively uncongested, while workers must perform these activities on weekends.

Trip duration and distance by day of week, shown in Figures 6 and 7, come out as might be expected, in part because work trips are longest. Weekend work trips are shorter than weekday,

likely due to different types of job (weekend employment is more often part-time, retail jobs). Somewhat surprisingly, the work trip duration variances within the week show statistical significance. Among those who work, Thursday and Friday trips take longer than Monday or Wednesday. The Monday vs. Friday difference may be explainable by congestion (there are fewer trips on Monday than other days, many three-day weekends begin during Friday evening rush-hour). Alternatively, some of the difference may be due to trip chaining, which might add to reported times, but for some activities (getting gas, stopping at a convenience retail) may not be reported 100% of the time.

Interestingly, social/recreational trips are longer than personal business, which are longer than shop, indicating that not all nonwork trips share the same characteristics. Other trips on weekends are longer than weekdays, but this is hardly true for shop trips. Personal business is significantly longer on Friday, Saturday, and Sunday than the rest of the week, social recreational trips are longest on the weekend, and shortest on Monday.

It was anticipated that regional shopping (mall-going, shopping for durable goods, etc.) would necessitate longer trips than neighborhood shopping (groceries), they are somewhat longer in distance (6.5 vs. 5.5 miles) and somewhat less longer in duration (Friday and Saturday have durations of 13 minutes, while other days average 12 minutes), indicating higher speeds, due both to less congestion on weekends and the use of different, higher speed roads for regional shopping as opposed to local shopping. The differences between Friday and Saturday and the rest of the week are statistically significant.

Another noteworthy point is that though the trip frequency for other trips exceeds that of the non-other categories, even for workers, the average other trip (either personal business or social recreational) is shorter than the average work trip. So their impact on total travel (e.g. VMT) are similar. Fortunately, they do have different peaking patterns, as shown in the next section, and use different roadways.

Time of Day Distribution

This section analyzes the time of day distribution of trips, for workers and nonworkers, for the

average weekday, Saturday, and Sunday, classified for shop and other trip purposes. The time of day distribution for work trips on weekdays is well documented and has remained largely stable over the past few decades, with some peak spreading (3). Figures 8 and 9 show the time of day distributions for shop and other trips, respectively.

Given the obligatory and regular nature of work trips, it is expected that workers and nonworkers will have somewhat different behavior. The hypothesis is that on weekdays, workers will tend to perform shop and other activities after work, often on the way home, to minimize travel through trip chaining; nonworkers, also to achieve travel economies, will tend to perform weekday shop and other trips outside of the peak commuting hours. In addition, for a variety of religious and cultural reasons, Saturday and Sunday behavior are expected to differ from each other and from weekdays. Probably due to the need to rise early for work on Monday, as well the closing of shops, Sunday “ends” for most people earlier than Saturday.

Several results are found from inspection of the graphs. On weekdays, for workers, shopping trips peak after the close of work, while other trips have two peaks: at lunch and after the close of work. On weekdays, for nonworkers, shopping trips peak before mid-day and decline thereafter, and other trips peak after mid-day (3:00). Saturday shopping patterns are similar to nonworkers’ weekday patterns, while Saturday, like a typical workday, has two peaks for other activities, at noon and 6:00 p.m. People shop earlier on Saturday than Sunday, probably due to Sunday church-going, as evidenced by other activities (which includes school/church) being conducted earlier on Sunday than Saturday.

CONCLUSIONS

The prime mover in the rise in both work and nonwork trip-making over the past few decades has been the growth in female labor force participation. This rise has directly increased the number of workers and thus work trips. It also resulted in the increase of per capita (if not household) incomes while reducing available time, and thereby permitted the substitution of household commodities from outside the home, (day care for at-home child rearing, eating out for home-cooked meals), which leads to more nonwork trips per person.

This analysis brings out some interesting results. People are working much more, shopping somewhat more on weekends, and stay at home less today than forty years ago. Time spent in travel on each weekend day (Saturday or Sunday) exceeds that on any weekday, as it did forty years ago. This finding underscores the need to focus greater attention on weekend travel. Time spent shopping on a typical day in the busiest month (December) is more than double that in the least busy month (September). Monthly variations in daily time in travel exceed 10 percent. The time of day patterns of shop and other trips for workers and nonworkers are both a result of rational decision making processes: nonworkers peak in mid-day away from rush hour while workers peak just after work, indicating trip chaining.

Several factors suggest that, in the future, nonwork activities will become relatively more important. First, advances in telecommunication should enable more work-at-home, and thus free some time formerly spent commuting for nonwork trips. Second, the large increase in the number of workers in the labor market caused by females joining the workforce is ending. The share of the labor force held by men and women is equalizing. One factor which is certainly related to travel demand is income, but over the past two decades income growth has slowed (3). If this is in part due to the rapid rise in female labor force participation (and a relatively higher labor supply), this trend of sluggish income growth may end as labor becomes scarcer and costlier. These higher incomes may result in nonwork travel and changes in activity patterns.

Thus an understanding in the patterns of nonwork activity should become even more important in coming years. This is pertinent with the growing concern about developing strategies for traffic mitigation and environmental control, which are currently focused almost entirely on work trips. Some of the findings of this study may be particularly relevant for effective travel demand management programs as well as monitoring environmental consequences. Most air pollution emissions analyses derived from traffic forecasting models assume the "average" day. But as can be seen from these figures, not all weekdays are created equal, weekdays differ from weekends, and travel patterns vary seasonally. As weather patterns also vary seasonally, climate-specific, as well as congestion-inspired, demand programs may be targeted to account for these

variations. In addition, dynamic travel simulation models which estimate changes over time, should incorporate variations due to these cycles.

In brief, this study shows empirical relationships between activity patterns and trip-making and natural and cultural cycles (time of day, day of week, and month of year). While now many causes can only be speculated, the results are predictable. Further analysis is required to tie down the causes of many of these variations, and determine how the same factors influence different individuals. This research should focus on the interaction of temporal, spatial, socio-economic, and demographic characteristics of individuals in consuming various amounts of activities.

AUTHORS' NOTE

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REFERENCES

1. Gordon, P., A. Kumar, and H. Richardson (1988) *Beyond the Journey to Work* Transportation Research A, Vol. 22A No 6, pp. 419-426
2. Pisarski A. (1992) *New Perspectives in Commuting* United States Department of Transportation
3. Levinson, D. and A. Kumar (1995) *Activity, Travel, and the Allocation of Time* Journal of the American Planning Association forthcoming
4. Levinson D. and A. Kumar (1993) *Is Residential Density a Transportation Issue ?* working paper, Montgomery County Planning Dept., Silver Spring MD
5. Clarke, M.I., Dix, M.C, Jones, P.M. and Heggie, I.G. (1981) *Some Recent Developments in Activity Travel Analysis and Modeling* Transportation Research Record 794 pp. 1-8
6. Recker W.W., McNally M.G. and Root G.S. (1986) *A Model of Complex Travel Behavior: Part I--Theoretical Development, and Part II--An Operational Model.* Transportation Research 20A, 307-318 and 319-330.
7. Kitamura R. (1988) *Formulation of Trip Generation Models Using Panel Data.* Transportation Research Record 1203, 60-68.
8. Szalai, Alexander (1972) The Use of Time: Daily Activities of Urban and Suburban Populations in Twelve Countries. Mouton Publishers, The Hague

9. Robinson, John P. (1977) How Americans Use Time: A Social-Psychological Analysis of Everyday Behavior, Praeger Publishers, New York
10. Cross, Gary (1993) Time and Money: The Making of Consumer Culture, Routledge Books, New York
11. de Grazia, Sebastian (1962) Of Time, Work, and Leisure Vintage Books, New York (1990 ed.)
12. Schor, J.B. (1991) The Overworked American: the Unexpected Decline of Leisure BasicBooks, New York
13. Chapin, F.S. and Hightower, H. (1965) *Household Activity Patterns and Land Use* AIP Journal, 31:3 August 1965
14. Chapin, F.S. (1968) *Activity Systems and Urban Structure: A Working Schema* AIP Journal 34:1 January, 1968
15. Chapin, F.S. (1971) *Free Time Activities and Quality of Urban Life* AIP Journal 37:6 November, 1971
16. Chapin, F.S. (1974) Human Activity Patterns in the City: Things People Do In Time and in Space John Wiley & Sons, New York
17. Becker, G. (1965) *A Theory of the Allocation of Time* Economic Journal 75 no 299 (Sept.. 1965) pp. 493-517
18. USDOT (1991) The 1990/91 Nationwide Personal Transportation Survey: User's Guide for the Public Use Tapes Dec. 1991, USDOT/FHWA

FIGURE 1

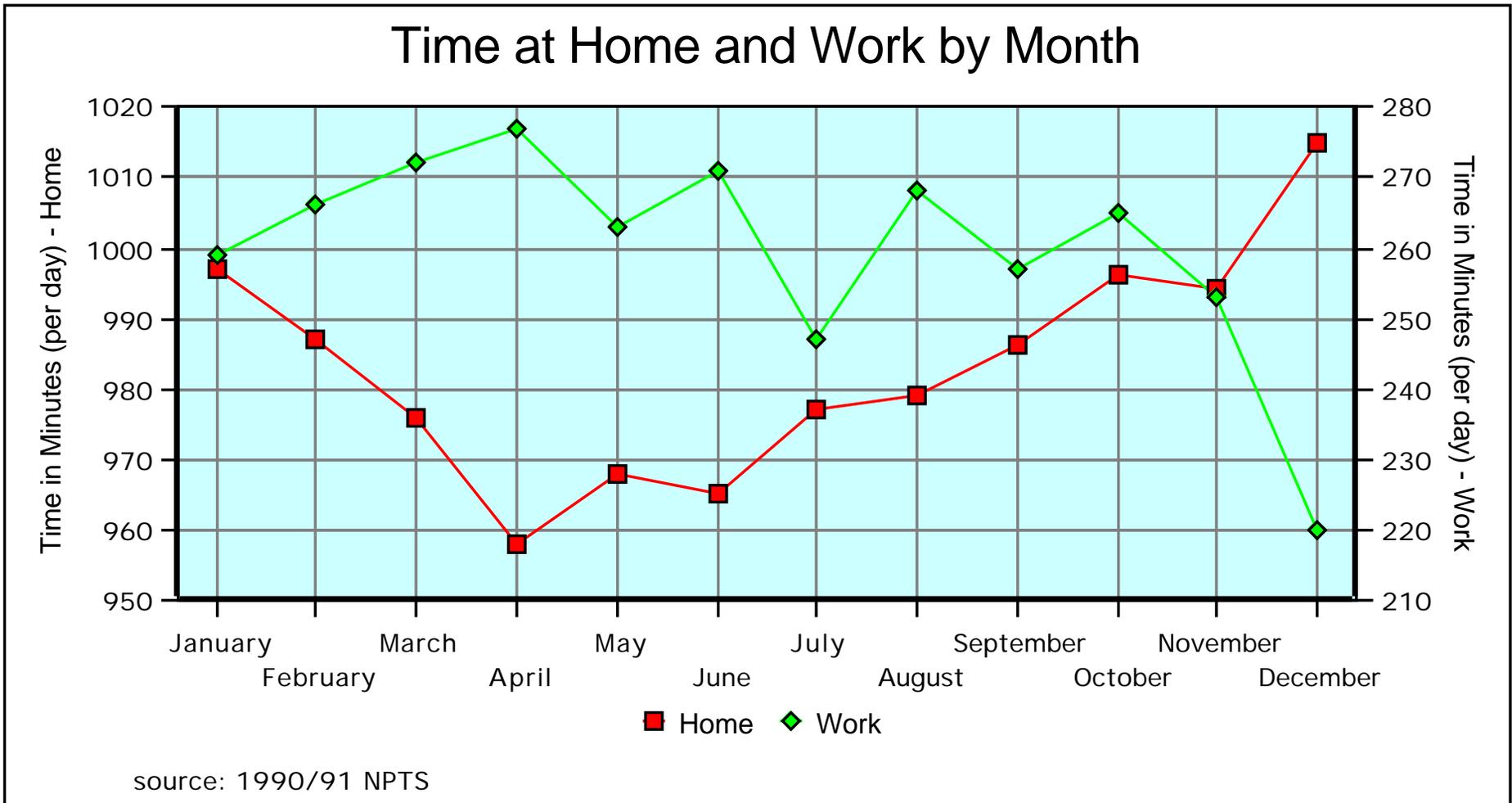


FIGURE 2:

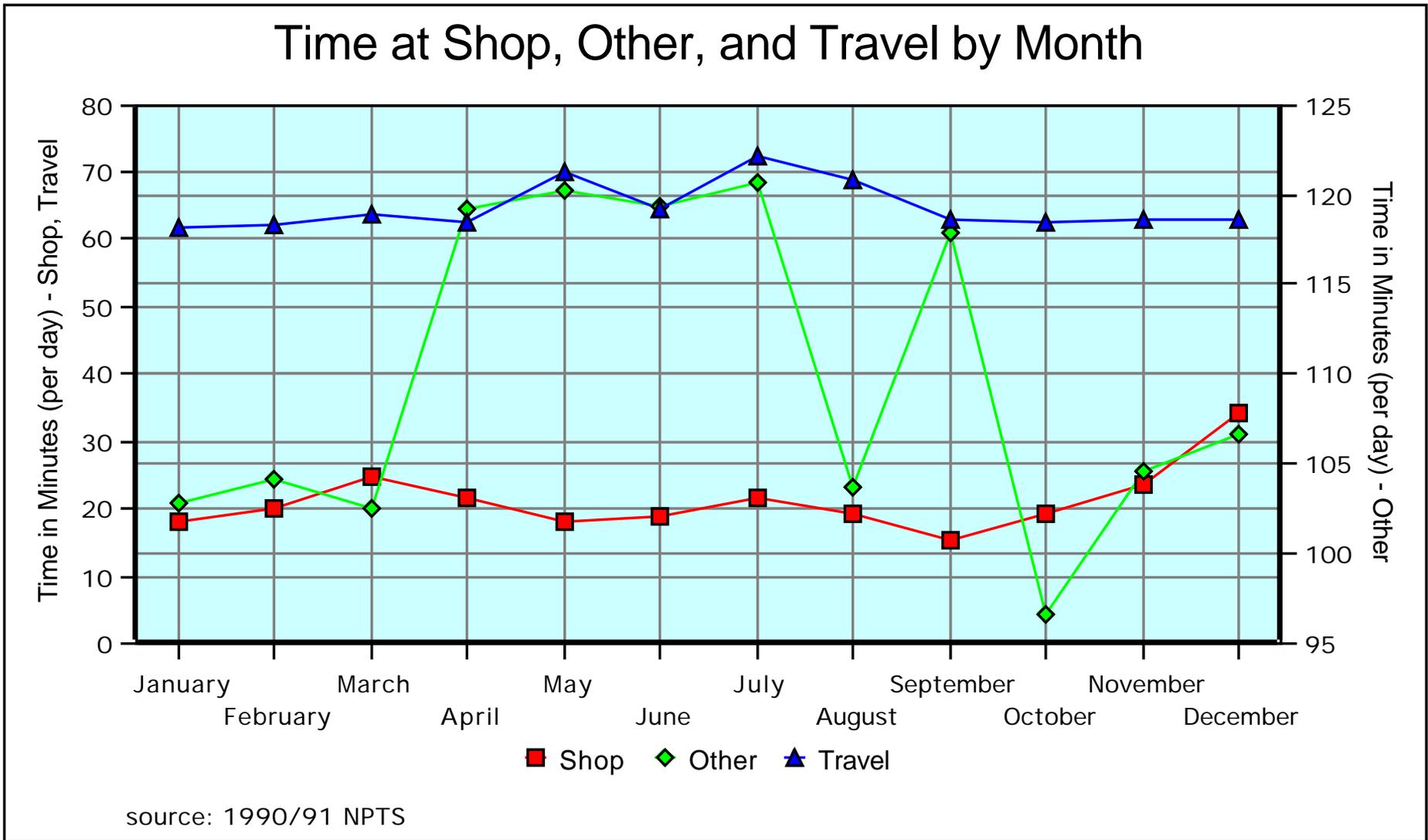


FIGURE 3:

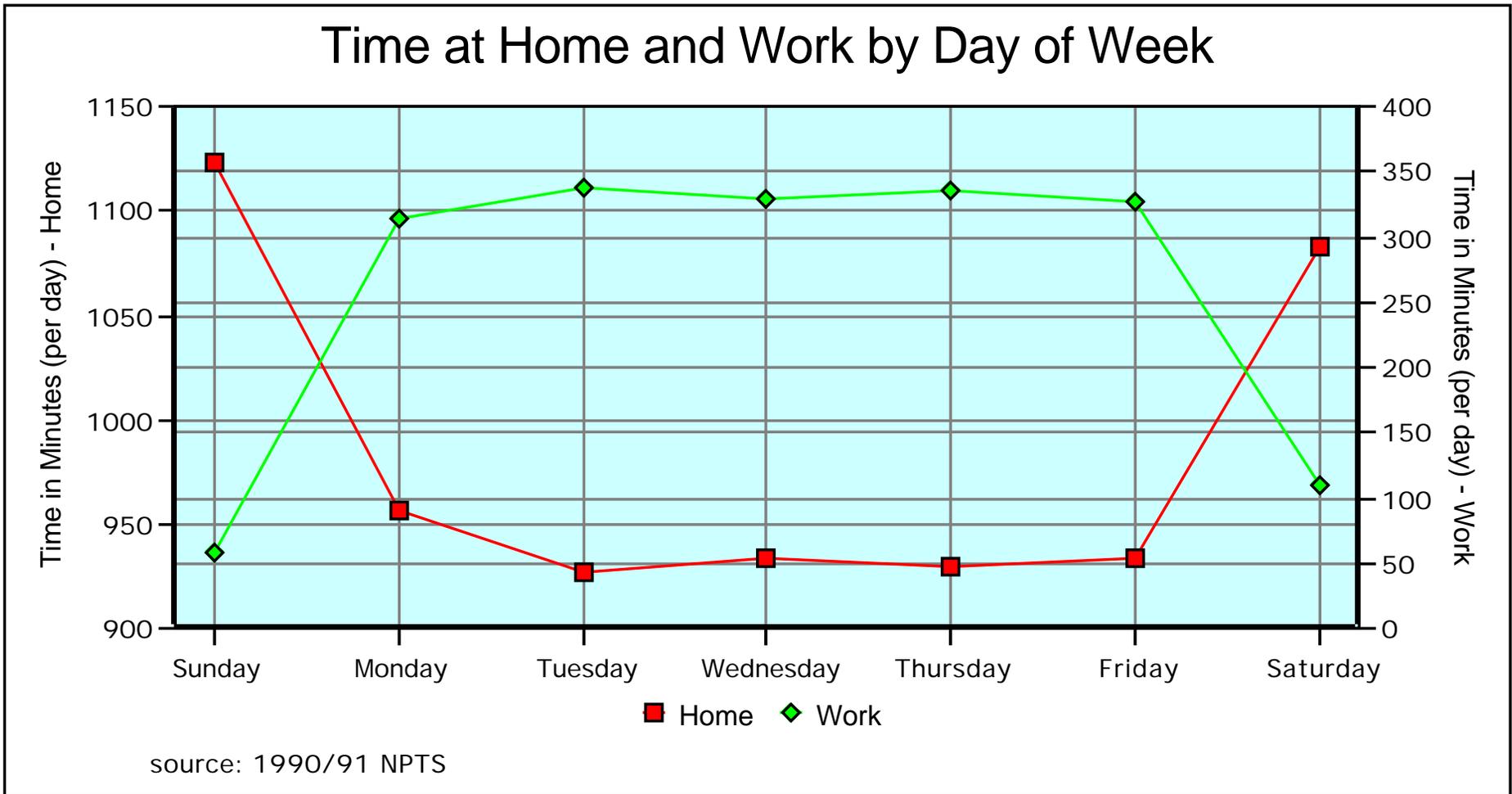


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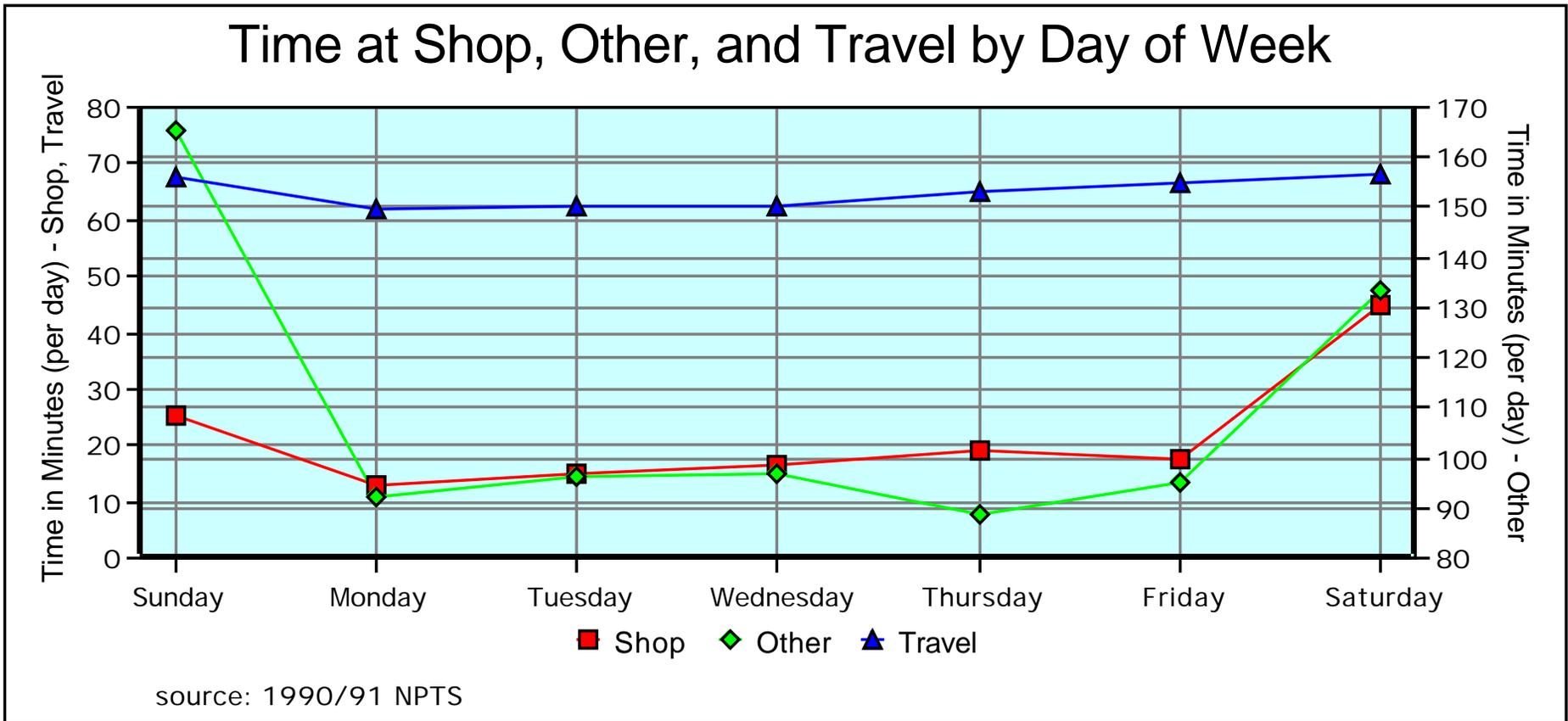


FIGURE 5:

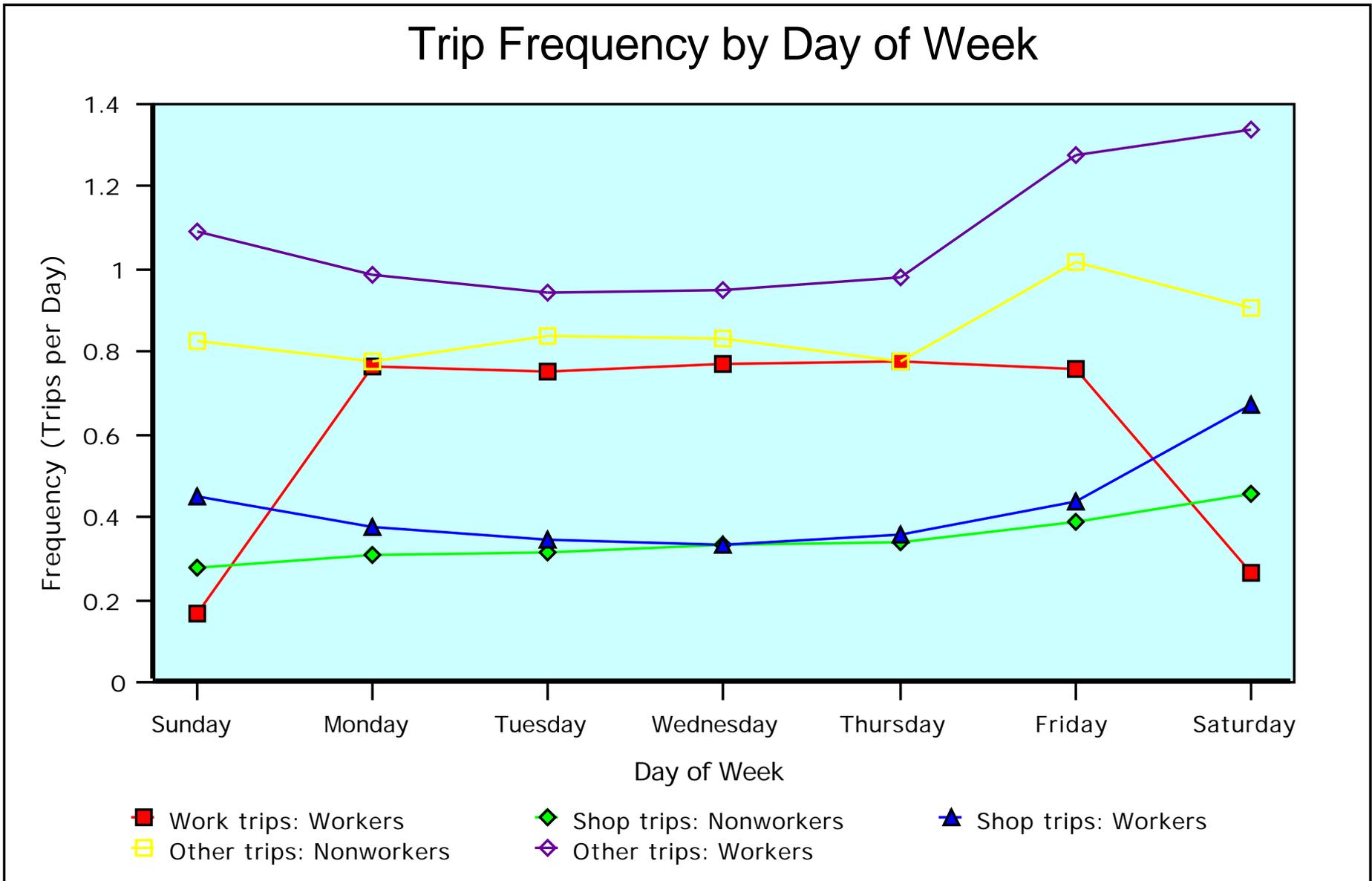


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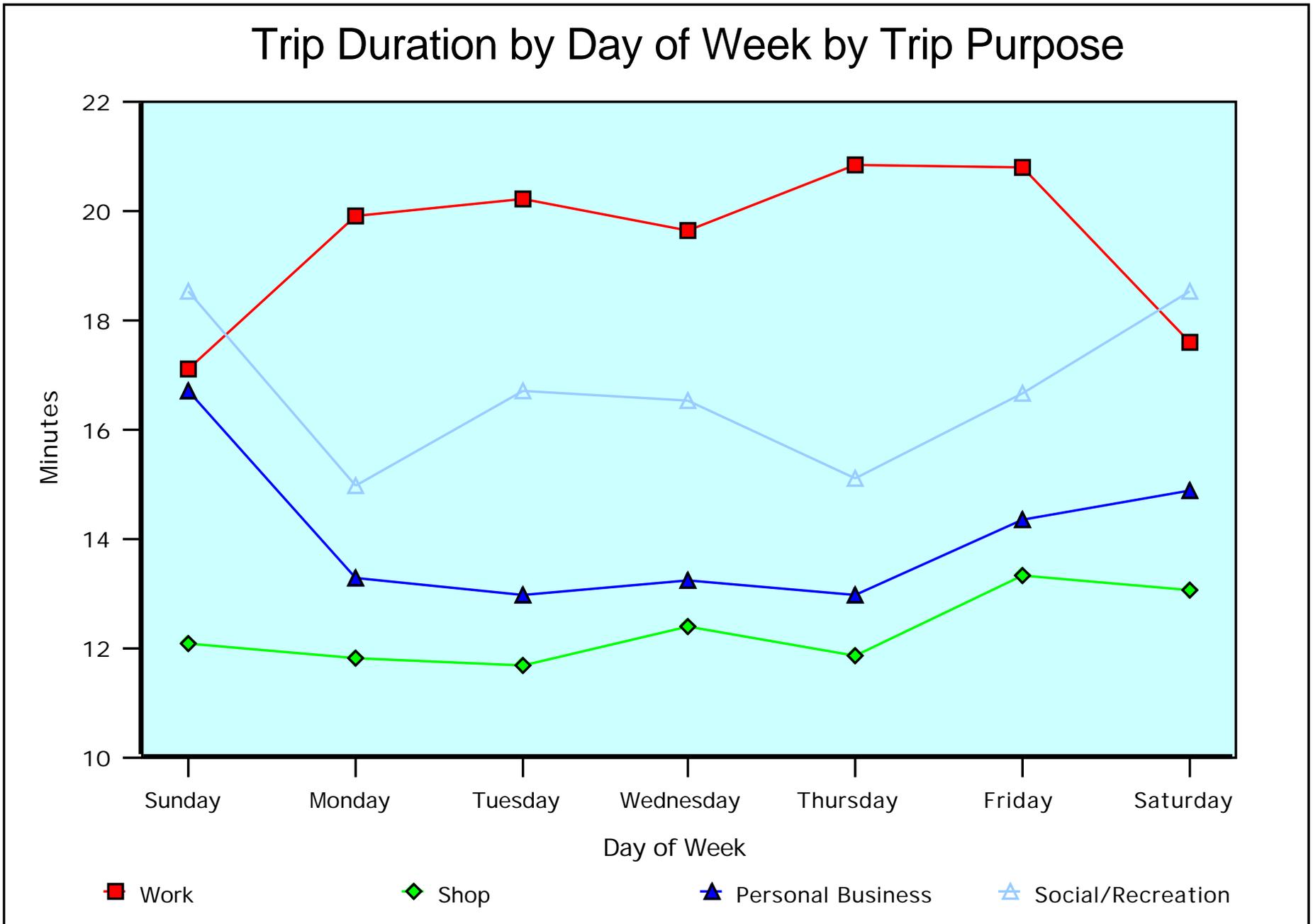


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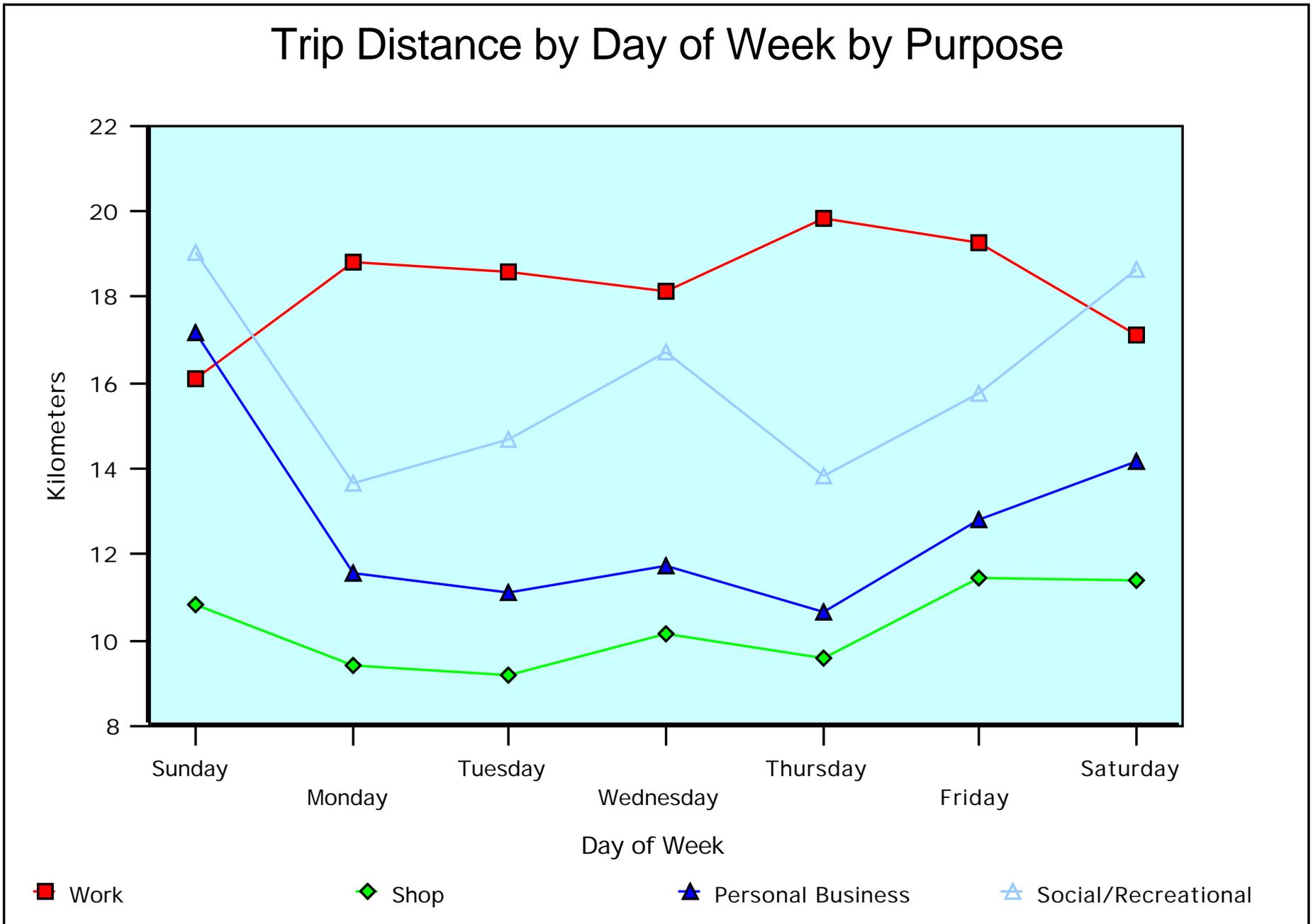


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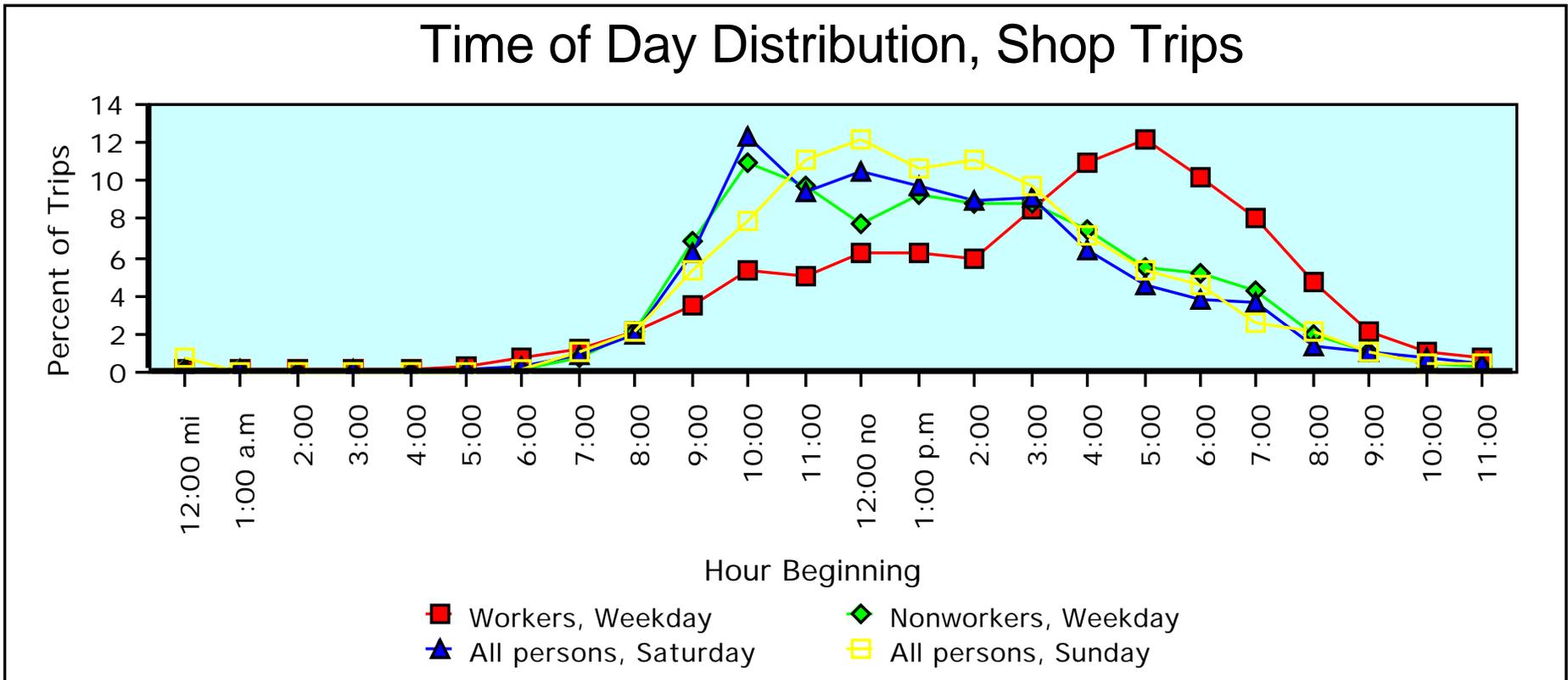
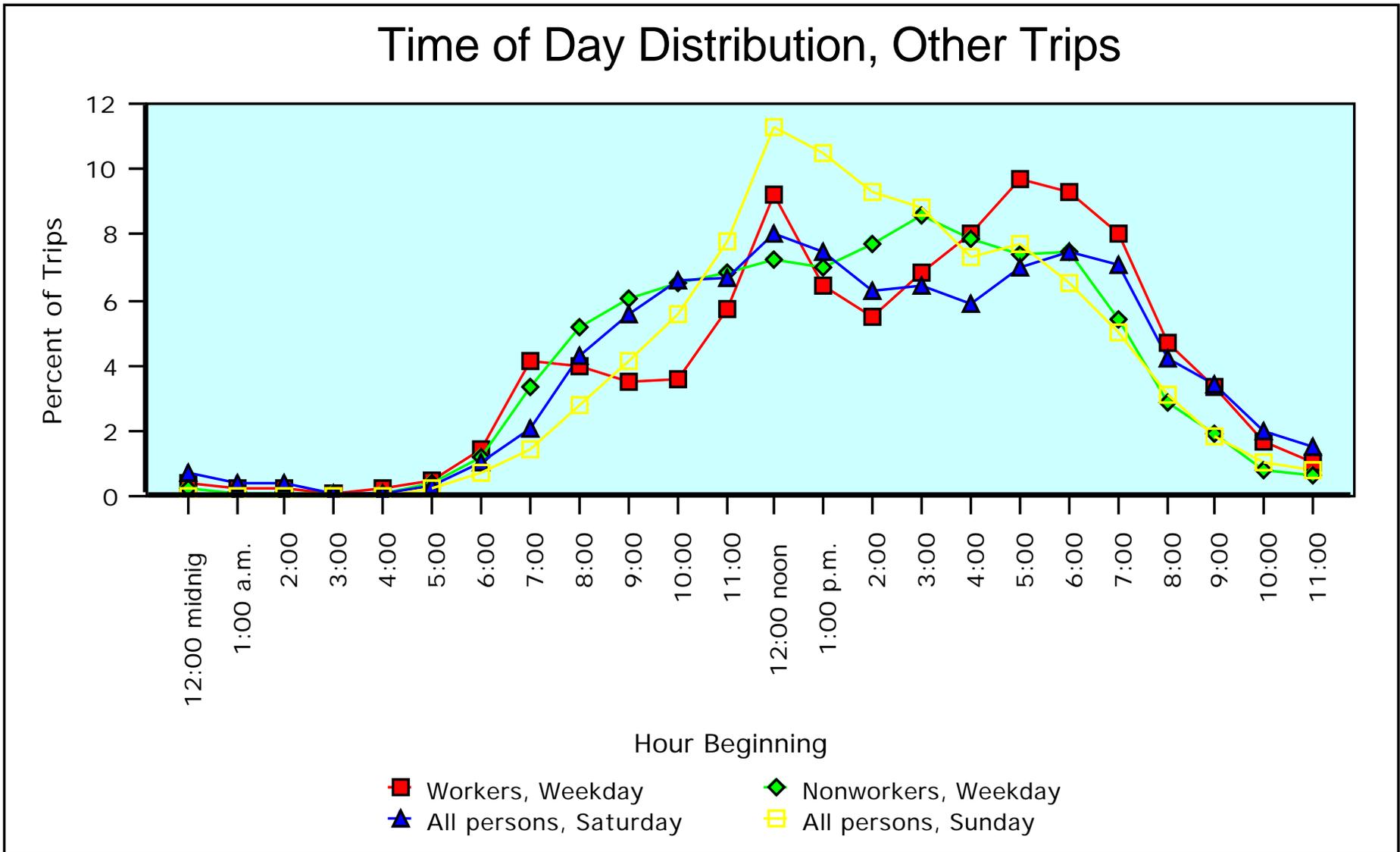


FIGURE 9:



Temporal Variations on the Allocation of Time

Table 1: Long Term Trends in Use of Time

Time Spent in Primary Activities by Day of Week (in hours)				
Activity	Year	Average		
		Weekday	Saturday	Sunday
Home	1954	17.0	17.8	19.2
	1965/66	15.8	18.0	19.1
	1990/91	15.7	18.1	18.7
Work	1954	4.6	2.6	0.8
	1965/66	5.0	1.8	0.8
	1990/91	5.4	1.8	1.0
Shop	1954	0.3	0.6	0.1
	1965/66	0.3	0.7	0.3
	1990/91	0.3	0.8	0.4
Other	1954	1.2	2.0	2.7
	1965/66	1.5	2.1	2.7
	1990/91	1.5	2.2	2.8
Travel	1954	1.0	1.1	1.2
	1965/66	1.4	1.4	1.1
	1990/91	1.0	1.1	1.1
Total	1954	24.0	24.0	24.0
	1965/66	24.0	24.0	24.0
	1990/91	24.0	24.0	24.0

Note: sources 1954 data - Sebastian de Grazia, J.A. Ward
 1966 data - Robinson, Szalai
 1990 data - Kumar and Levinson, 1990 NPTS
 see text for discussion

Temporal Variations on the Allocation of Time

Table 2: Time at Home (per day, in minutes) by Month: Mean, Standard Deviation, and Comparison of Difference of Means

Month	January	February	March	April	May	June	July	August	September	October	November	December	Average Month
Mean	997	987	976	958	968	965	977	979	986	996	994	1015	984
Std. Dev	258	263	260	257	253	247	259	251	255	261	257	258	257
n	676	660	646	592	788	601	600	666	807	659	715	749	8159
Month													
January	0.00	0.70	1.47	2.69 ***	2.16 **	2.26 **	1.38	1.30	0.82	0.07	0.22	-1.32	1.26
February	-0.70	0.00	0.76	1.97 **	1.39	1.53	0.68	0.57	0.07	-0.62	-0.50	-2.01 **	0.28
March	-1.47	-0.76	0.00	1.22	0.59	0.77	-0.07	-0.21	-0.73	-1.39	-1.28	-2.80 ***	-0.75
April	-2.69 ***	-1.97 **	-1.22	0.00	-0.72	-0.48	-1.27	-1.46	-2.02 **	-2.59 **	-2.52 ***	-4.03 ***	-2.38
May	-2.16 **	-1.39	-0.59	0.72	0.00	0.22	-0.65	-0.83	-1.42	-2.06 **	-1.97 **	-3.60 ***	-1.69 *
June	-2.26 **	-1.53	-0.77	0.48	-0.22	0.00	-0.82	-1.00	-1.56	-2.17 **	-2.08 **	-3.62 ***	-1.81 *
July	-1.38	-0.68	0.07	1.27	0.65	0.82	0.00	-0.14	-0.65	-1.30	-1.19	-2.68 ***	-0.64
August	-1.30	-0.57	0.21	1.46	0.83	1.00	0.14	0.00	-0.53	-1.21	-1.10	-2.66 ***	-0.49
September	-0.82	-0.07	0.73	2.02 **	1.42	1.56	0.65	0.53	0.00	-0.74	-0.61	-2.23 **	0.21
October	-0.07	0.62	1.39	2.59 ***	2.06 **	2.17 **	1.30	1.21	0.74	0.00	0.14	-1.37	1.14
November	-0.22	0.50	1.28	2.52 **	1.97 **	2.08 **	1.19	1.10	0.61	-0.14	0.00	-1.56	1.00
December	1.32	2.01 **	2.80 ***	4.03 ***	3.60 ***	3.62 ***	2.68 ***	2.66	2.23 **	1.37	1.56	0.00	3.15 ***
Average Month	-1.26	-0.28	0.75	2.38 ***	1.69 *	1.81 *	0.64	0.49	-0.21	-1.14	-1.00	-3.15 ***	0.00

note: * Significant at the 10 per cent level, two tailed test
 ** Significant at the 5 per cent level, two tailed test

Temporal Variations on the Allocation of Time

Table 3: Time at Work (per day, in minutes) by Month: Mean, Standard Deviation, and Comparison of Difference of Means

	January	February	March	April	May	June	July	August	September	October	November	December	Average Month
Mean	259	266	272	277	263	271	247	268	257	265	253	220	260
Std. Dev.	267	272	271	271	271	272	270	271	268	273	274	266	271
n	676	660	646	592	788	601	600	666	807	659	715	749	8159
Month													
January	0.00	-0.47	-0.88	-1.19	-0.28	-0.79	0.80	-0.61	0.14	-0.41	0.41	2.76 ***	-0.09
February	0.47	0.00	-0.40	-0.72	0.21	-0.33	1.24	-0.13	0.63	0.07	0.88	3.20 ***	0.55
March	0.88	0.40	0.00	-0.32	0.63	0.06	1.63	0.27	1.05	0.46	1.28	3.60 ***	1.08
April	1.19	0.72	0.32	0.00	0.95	0.38	1.91 *	0.59	1.37	0.78	1.59	3.86 ***	1.47
May	0.28	-0.21	-0.63	-0.95	0.00	-0.54	1.09	-0.35	0.44	-0.14	0.71	3.14 ***	0.30
June	0.79	0.33	-0.06	-0.38	0.54	0.00	1.53	0.20	0.96	0.39	1.19	3.46 ***	0.96
July	-0.80	-1.24	-1.63	-1.91 *	-1.09	-1.53	0.00	-1.38	-0.69	-1.18	-0.40	1.84 *	-1.14
August	0.61	0.13	-0.27	-0.59	0.35	-0.20	1.38	0.00	0.78	0.20	1.02	3.35 ***	0.73
September	-0.14	-0.63	-1.05	-1.37	-0.44	-0.96	0.69	-0.78	0.00	-0.56	0.29	2.73 ***	-0.30
October	0.41	-0.07	-0.46	-0.78	0.14	-0.39	1.18	-0.20	0.56	0.00	0.81	3.12 ***	0.45
November	-0.41	-0.88	-1.28	-1.59	-0.71	-1.19	0.40	-1.02	-0.29	-0.81	0.00	2.34 **	-0.66
December	-2.76 ***	-3.20 ***	-3.60 ***	-3.86 ***	-3.14 ***	-3.46 ***	-1.84 *	-3.35 ***	-2.73 ***	-3.12 ***	-2.34 **	0.00	-3.93 ***
Average Month	0.09	-0.55	-1.08	-1.47	-0.30	-0.96	1.14	-0.73	0.30	-0.45	0.66	3.93 ***	0.00

note: * Significant at the 10 per cent level, two tailed test
 ** Significant at the 5 per cent level, two tailed test
 *** Significant at the 1 per cent level, two tailed test

Temporal Variations on the Allocation of Time

Table 4: Time at Shop (per day, in minutes) by Month: Mean, Standard Deviation, and Comparison of Difference of Means

	January	February	March	April	May	June	July	August	September	October	November	December	Average Month
Mean	18.3	20.0	24.7	21.7	18.1	19.1	21.6	19.4	15.3	19.2	23.8	34.1	21.3
Std. Dev.	40.4	43.5	64.5	62.2	47.1	72.8	60.1	47.7	38.9	51.0	59.9	75.2	56.3
n	676	660	646	592	788	601	600	666	807	659	715	749	8159
Month													
January	0.00	-0.74	-2.15	-1.14	0.09	-0.24	-1.14	-0.46	1.45	-0.36	-2.02 **	-5.01 ***	-1.79 *
February	0.74	0.00	-1.54	-0.55	0.80	0.26	-0.54	0.24	2.16 **	0.31	-1.35	-4.37 ***	-0.72
March	2.15 **	1.54	0.00	0.83	2.17 **	1.43	0.88	1.69 *	3.26 ***	1.71 *	0.27	-2.51 **	1.30
April	1.14	0.55	-0.83	0.00	1.18	0.66	0.03	0.73	2.21 **	0.77	-0.62	-3.30 ***	0.15
May	-0.09	-0.80	-2.17 **	-1.18	0.00	-0.29	-1.18	-0.52	1.29	-0.42	-2.04 **	-4.97 ***	-1.79 *
June	0.24	-0.26	-1.43	-0.66	0.29	0.00	-0.65	-0.09	1.16	-0.03	-1.26	-3.71 ***	-0.73
July	1.14	0.54	-0.88	-0.03	1.18	0.65	0.00	0.72	2.24 **	0.76	-0.66	-3.39 ***	0.12
August	0.46	-0.24	-1.69 *	-0.73	0.52	0.09	-0.72	0.00	1.78 *	0.07	-1.52	-4.44 ***	-0.97
September	-1.45	-2.16 **	-3.26 ***	-2.21 **	-1.29	-1.16	-2.24 **	-1.78 *	0.00	-1.62	-3.24 ***	-6.12 ***	-3.99 ***
October	0.36	-0.31	-1.71	-0.77	0.42	0.03	-0.76	-0.07	1.62	0.00	-1.54	-4.39 ***	-1.01
November	2.02 **	1.35	-0.27	0.62	2.04 **	1.26	0.66	1.52	3.24 ***	1.54	0.00	-2.91 ***	1.08
December	5.01 ***	4.37 ***	2.51 **	3.30 ***	4.97 ***	3.71 ***	3.39 ***	4.44 ***	6.12 ***	4.39 ***	2.91 ***	0.00	4.54 ***
Average Month	1.79 *	0.72	-1.30	-0.15	1.79 *	0.73	-0.12	0.97	3.99 ***	1.01	-1.08	-4.54 ***	0.00

note: * Significant at the 10 per cent level, two tailed test
 ** Significant at the 5 per cent level, two tailed test
 *** Significant at the 1 per cent level, two tailed test

Temporal Variations on the Allocation of Time

Table 5: Time at Other (per day, in minutes) by Month: Mean, Standard Deviation, and Comparison of Difference of Means

	January	February	March	April	May	June	July	August	September	October	November	December	Average Month
Mean	102.9	104.1	102.5	119.2	120.3	119.4	120.7	103.7	117.9	96.6	104.6	106.7	109.9
Std. Dev.	151.2	158.4	157.3	174	162.4	162.2	170	147.7	165.2	145.2	152.2	153.8	158.4
n	676	660	646	592	788	601	600	666	807	659	715	749	8159
Month													
January	0.00	-0.14	0.05	-1.77 *	-2.12 **	-1.87 *	-1.97 **	-0.10	-1.82 *	0.78	-0.21	-0.47	-1.15
February	0.14	0.00	0.18	-1.60	-1.92 *	-1.69 *	-1.79 *	0.05	-1.63	0.90	-0.06	-0.31	-0.90
March	-0.05	-0.18	0.00	-1.77 *	-2.10 **	-1.87 *	-1.96 **	-0.14	-1.81 *	0.70	-0.25	-0.50	-1.15
April	1.77 *	1.60	1.77 *	0.00	-0.12	-0.02	-0.15	1.69 *	0.14	2.48 ***	1.60	1.37	1.26
May	2.12 **	1.92 *	2.10 **	0.12	0.00	0.10	-0.04	2.04 **	0.29	2.93 ***	1.93 *	1.69 *	1.72 *
June	1.87 *	1.69 *	1.87 *	0.02	-0.10	0.00	-0.14	1.79 *	0.17	2.62 ***	1.70 *	1.46	1.39
July	1.97 **	1.79 *	1.96 *	0.15	0.04	0.14	0.00	1.89 *	0.31	2.69 ***	1.79 *	1.57	1.51
August	0.10	-0.05	0.14	-1.69 *	-2.04 **	-1.79 *	-1.89 *	0.00	-1.74 *	0.88	-0.11	-0.37	-1.04
September	1.82 *	1.63	1.81 *	-0.14	-0.29	-0.17	-0.31	1.74 *	0.00	2.63 ***	1.63	1.38	1.32
October	-0.78	-0.90	-0.70	-2.48 **	-2.93 ***	-2.62 ***	-2.69 ***	-0.88	-2.63 ***	0.00	-1.00	-1.27	-2.25 **
November	0.21	0.06	0.25	-1.60	-1.93 *	-1.70 *	-1.79 *	0.11	-1.63	1.00	0.00	-0.26	-0.89
December	0.47	0.31	0.50	-1.37	-1.69 *	-1.46	-1.57	0.37	-1.38	1.27	0.26	0.00	-0.54
Average Month	1.15	0.90	1.15	-1.26	-1.72 *	-1.39	-1.51	1.04	-1.32	2.25 **	0.89	0.54	0.00

note: * Significant at the 10 per cent level, two tailed test
 ** Significant at the 5 per cent level, two tailed test
 *** Significant at the 1 per cent level, two tailed test

Temporal Variations on the Allocation of Time

Table 6: Time at Travel (per day, in minutes) by Month: Mean, Standard Deviation, and Comparison of Difference of Means

	January	February	March	April	May	June	July	August	September	October	November	December	Average Month
Mean	61.8	62.2	63.8	62.6	70.2	64.6	72.6	68.9	62.9	62.5	63.1	62.9	64.8
Std. Dev.	70.7	57.5	53.8	47.4	64	57.6	85	59.4	56.2	61.6	69.6	56.3	62.2
n	676	660	646	592	788	601	600	666	807	659	715	749	8159
Month													
January	0.00	-0.11	-0.58	-0.24	-2.37 **	-0.78	-2.45 **	-1.99 **	-0.33	-0.19	-0.35	-0.32	-1.07
February	0.11	0.00	-0.52	-0.13	-2.50 **	-0.74	-2.52 **	-2.09 **	-0.23	-0.09	-0.26	-0.23	-1.11
March	0.58	0.52	0.00	0.42	-2.06 **	-0.25	-2.16 **	-1.63	0.31	0.41	0.21	0.30	-0.45
April	0.24	0.13	-0.42	0.00	-2.53 **	-0.66	-2.51 **	-2.09 **	-0.11	0.03	-0.15	-0.11	-1.06
May	2.37 **	2.50 **	2.06 **	2.53 **	0.00	1.71 *	-0.58	0.40	2.42 **	2.33 **	2.05 **	2.38 **	2.27 **
June	0.78	0.74	0.25	0.66	-1.71	0.00	-1.91 *	-1.31	0.55	0.63	0.43	0.54	-0.08
July	2.45 **	2.52 **	2.16 **	2.51 **	0.58	1.91 *	0.00	0.89	2.43 **	2.39 **	2.19 **	2.40 **	2.20 **
August	1.99 **	2.09 **	1.63	2.09 **	-0.40	1.31	-0.89	0.00	1.98 **	1.92 **	1.67 *	1.94 *	1.71 *
September	0.33	0.23	-0.31	0.11	-2.42 **	-0.55	-2.43 **	-1.98 **	0.00	0.13	-0.06	0.00	-0.91
October	0.19	0.09	-0.41	-0.03	-2.33 **	-0.63	-2.39 **	-1.92 *	-0.13	0.00	-0.17	-0.13	-0.92
November	0.35	0.26	-0.21	0.15	-2.05 **	-0.43	-2.19 **	-1.67 *	0.06	0.17	0.00	0.06	-0.63
December	0.32	0.23	-0.30	0.11	-2.38 **	-0.54	-2.40 **	-1.94 *	0.00	0.13	-0.06	0.00	-0.88
Average Month	1.07	1.11	0.45	1.06	-2.27 **	0.08	-2.20 **	-1.71	0.91	0.92	0.63	0.88	0.00

note: * Significant at the 10 per cent level, two tailed test
 ** Significant at the 5 per cent level, two tailed test
 *** Significant at the 1 per cent level, two tailed test

Temporal Variations on the Allocation of Time

Table 7: Time at Home (per day, in minutes) by Day of Week: Mean, Standard Deviation, Sample Size, and Comparison of Difference of Means

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Average Day
Mean	1123	957	927	933	930	933	1083	984
Std.Dev.	223	251	250	248	247	258	242	257
n	1270	1256	1248	1228	1243	887	1027	8159
Day								
Sunday	0.00	17.56 ***	20.75 ***	20.11 ***	20.55 ***	17.78 ***	4.08 ***	20.22 ***
Monday	-17.56 ***	0.00	3.00 ***	2.40 **	2.71 ***	2.14 **	-12.17 ***	-3.54 ***
Tuesday	-20.75 ***	-3.00 ***	0.00	-0.60	-0.30	-0.54	-15.07 ***	-7.47 ***
Wednesday	-20.11 ***	-2.40 **	0.60	0.00	0.30	0.00	-14.49 ***	-6.69 ***
Thursday	-20.55 ***	-2.71 **	0.30	-0.30	0.00	-0.27	-14.85 ***	-7.14 ***
Friday	-17.78 ***	-2.14 **	0.54	0.00	0.27	0.00	-13.05 ***	-5.59 ***
Saturday	-4.08 ***	12.17 ***	15.07 ***	14.49 ***	14.85 ***	13.05 ***	0.00	12.27 ***
Average Day	-20.22 ***	3.54 ***	7.47 ***	6.69 ***	7.14 ***	5.59 ***	-12.27 ***	0.00

note: * Significant at the 10 per cent level, two tailed test
 ** Significant at the 5 per cent level, two tailed test
 *** Significant at the 1 per cent level, two tailed test

Temporal Variations on the Allocation of Time

Table 8: Time at Work (per day, in minutes) by Day of Week: Mean, Standard Deviation, Sample Size, and Comparison of Difference of Means

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Average Day
Mean	58	314	338	330	336	327	109	260
Std.Dev.	163	267	270	268	266	262	207	271
n	1270	1256	1248	1228	1243	887	1027	8159
Day								
Sunday	0.00	-29.05 ***	-31.44 ***	-30.52 ***	-31.51 ***	-27.13 ***	-6.44 ***	-36.93 ***
Monday	29.05 ***	0.00	-2.24 **	-1.49	-2.06 **	-1.12	20.66 ***	6.66 ***
Tuesday	31.44 ***	2.24 **	0.00	0.74	0.19	0.94	22.88 ***	9.50 ***
Wednesday	30.52 ***	1.49	-0.74	0.00	-0.56	0.26	22.08 ***	8.52 ***
Thursday	31.51 ***	2.06 **	-0.19	0.56	0.00	0.78	22.86 ***	9.36 ***
Friday	27.13 ***	1.12	-0.94	-0.26	-0.78	0.00	19.97 ***	7.21 ***
Saturday	6.44 ***	-20.66 ***	-22.88 ***	-22.08 ***	-22.86 ***	-19.97 ***	0.00	-21.20 ***
Average Day	36.93 ***	-6.66 ***	-9.50 ***	-8.52 ***	-9.36 ***	-7.21 ***	21.20 ***	0.00

note: * Significant at the 10 per cent level, two tailed test
 ** Significant at the 5 per cent level, two tailed test
 *** Significant at the 1 per cent level, two tailed test

Temporal Variations on the Allocation of Time

Table 9: Time at Shop (per day, in minutes) by Day of Week: Mean, Standard Deviation, Sample Size, and Comparison of Difference of Means

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Average Day
Mean	25.2	13.1	15.0	16.7	19.2	17.7	45.1	21.3
Std.Dev.	68.4	40.2	39.8	47.3	50.4	46.8	84.1	56.3
n	1270	1256	1248	1228	1243	887	1027	8159
Day								
Sunday	0.00	5.43 ***	4.58 ***	3.62 ***	2.51 **	3.02 ***	-6.12 ***	1.93 *
Monday	-5.43 ***	0.00	-1.19	-2.04 **	-3.34 ***	-2.37 **	-11.19 ***	-6.34 ***
Tuesday	-4.58 ***	1.19	0.00	-0.97	-2.31 **	-1.40	-10.54 ***	-4.89 ***
Wednesday	-3.62 ***	2.04 **	0.97	0.00	-1.27	-0.48	-9.62 ***	-3.09 ***
Thursday	-2.51 **	3.34 ***	2.31 **	1.27	0.00	0.71	-8.67 ***	-1.35
Friday	-3.02 ***	2.37 **	1.40	0.48	-0.71	0.00	-8.96 ***	-2.13 **
Saturday	6.12 ***	11.19 ***	10.54 ***	9.62 ***	8.67 ***	8.96 ***	0.00	8.82 ***
Average Day	-1.93 *	6.34 ***	4.89 ***	3.09 ***	1.35	2.13 **	-8.82 ***	0.00

note: * Significant at the 10 per cent level, two tailed test
 ** Significant at the 5 per cent level, two tailed test
 *** Significant at the 1 per cent level, two tailed test

Temporal Variations on the Allocation of Time

Table 10: Time at Other (per day, in minutes) by Day of Week: Mean, Standard Deviation, Sample Size, and Comparison of Difference of Mean

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Average Day
Mean	165.1	92.3	96.4	96.7	88.9	94.9	133.7	109.9
Std.Dev.	173.6	151.7	153.7	150.3	139.7	151.3	170.9	158.4
n	1270	1256	1248	1228	1243	887	1027	8159
Day								
Sunday	0.00	11.23 ***	10.52 ***	10.54 ***	12.13 ***	9.97 ***	4.35 ***	10.66 ***
Monday	-11.23 ***	0.00	-0.67	-0.73	0.58	-0.39	-6.05 ***	-3.80 ***
Tuesday	-10.52 ***	0.67	0.00	-0.05	1.27	0.22	-5.42 ***	-2.88 ***
Wednesday	-10.54 ***	0.73	0.05	0.00	1.34	0.27	-5.41 ***	-2.85 ***
Thursday	-12.13 ***	-0.58	-1.27	-1.34	0.00	-0.93	-6.74 ***	-4.85 ***
Friday	-9.97 ***	0.39	-0.22	-0.27	0.93	0.00	-5.27 ***	-2.79 ***
Saturday	-4.35 ***	6.05 ***	5.42 ***	5.41 ***	6.74 ***	5.27 ***	0.00	4.24 ***
Average Day	-10.66 ***	3.80 ***	2.88 ***	2.85 ***	4.85 ***	2.79 ***	-4.24 ***	0.00

note: * Significant at the 10 per cent level, two tailed test
 ** Significant at the 5 per cent level, two tailed test
 *** Significant at the 1 per cent level, two tailed test

Temporal Variations on the Allocation of Time

Table 11: Time at Travel (per day, in minutes) by Day of Week: Mean, Standard Deviation, Sample Size, and Comparison of Difference of Means

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Average Day
Mean	67.7	62.3	62.4	62.7	65.0	66.5	68.1	64.8
Std.Dev.	82.6	56.6	50.2	55.2	59.9	60.8	64.3	62.2
n	1270	1256	1248	1228	1243	887	1027	8159
Day								
Sunday	0.00	1.92 *	1.95 *	1.78 *	0.94	0.39	-0.13	1.20
Monday	-1.92 *	0.00	-0.05	-0.18	-1.16	-1.62	-2.26 **	-1.44
Tuesday	-1.95 *	0.05	0.00	-0.14	-1.17	-1.65	-2.32 **	-1.52
Wednesday	-1.78 *	0.18	0.14	0.00	-0.99	-1.47	-2.12 **	-1.22
Thursday	-0.94	1.16	1.17	0.99	0.00	-0.56	-1.18	0.11
Friday	-0.39	1.62	1.65	1.47	0.56	0.00	-0.56	0.79
Saturday	0.13	2.26 **	2.32 **	2.12 **	1.18	0.56	0.00	1.56
Average Day	-1.20	1.44	1.52	1.22	-0.11	-0.79	-1.56	0.00

note: * Significant at the 10 per cent level, two tailed test

** Significant at the 5 per cent level, two tailed test

*** Significant at the 1 per cent level, two tailed test