VISTA Activities 2012-16

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1 About

1.1 Document

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This document describes the process for calculating the spread of activities of Melbournians by time of day. The Victorian Integrated Survey of Travel & Activity (VISTA) 2012-16 data is used for this purpose.

2 Data | Victorian Integrated Survey of Travel & Activity

2.1 Sourcing VISTA 2012-16 Data

The Victorian Integrated Survey of Travel & Activity (VISTA) 2012-16 data was downloaded from the following URL on 10th May 2019:

`https://transport.vic.gov.au/-/media/tfv-documents/vista/vista_2012_16_v1_sa1_csv.zip`

The Zip archive was uncompressed, and the contained CSV files recompressed using GZip giving:

```
./VISTA_2012_16_v1_SA1_CSV/JTW_VISTA12_16_SA1_V1.csv.gz
./VISTA_2012_16_v1_SA1_CSV/S_VISTA12_16_SA1_V1.csv.gz
./VISTA_2012_16_v1_SA1_CSV/H_VISTA12_16_SA1_V1.csv.gz
./VISTA_2012_16_v1_SA1_CSV/P_VISTA12_16_SA1_V1.csv.gz
./VISTA_2012_16_v1_SA1_CSV/JTE_VISTA12_16_sa1_V1.csv.gz
./VISTA_2012_16_v1_SA1_CSV/T_VISTA12_16_SA1_V1.csv.gz
```

2.2 Understanding Trip Data

We use Trip Table (`T_VISTA12_16_SA1_V1.csv`) with these select columns:

Column	Description
PERSID	Person ID number
TRAVDOW	Travel day day-of-week
ORIGPURP1	Origin Purpose (Summary)
DESTPURP1	Destination Purpose (Summary)
STARTIME	Time of Starting Trip Stage (in minutes, from midnight)
ARRTIME	Time of Ending Trip Stage (in minutes, from midnight)
CW_WDTRIPWGT_LGA	Trip weight for an 'Average weekday' of the combined 2012-14 and 2014-16 ReportingPeriods, using the ASGC.
CW_WETRIPWGT_LGA	Trip weight for an 'Average weekend day' of the combined 2012-14 and 2014-16 ReportingPeriods, using the ASGC.

2.3 Example Trip Record for a Person

PERSID	TRAVDOW	ORIGPURP1	DESTPURP1	STARTIME	ARRTIME	CW_WDTRIPWGT_LGA
Y12H0000126P01	Friday	At or Go Home	Work Related	475	535	139.78
Y12H0000126P01	Friday	Work Related	Personal Business	580	590	139.78
Y12H0000126P01	Friday	Personal Business	Work Related	600	610	139.78
Y12H0000126P01	Friday	Work Related	At or Go Home	1050	1125	139.78

3 Activities by Time of Day

3.1 Extracting Activities from Trip Records

We convert every person's trip record:

PERSID	TRAVDOW	ORIGPURP1	DESTPURP1	STARTIME	ARRTIME	CW_WDTRIPWGT_LGA
Y12H0000126P01	Friday	At or Go Home	Work Related	475	535	139.78
Y12H0000126P01	Friday	Work Related	Personal Business	580	590	139.78
Y12H0000126P01	Friday	Personal Business	Work Related	600	610	139.78
Y12H0000126P01	Friday	Work Related	At or Go Home	1050	1125	139.78

To that person's activity record like this:

PERSID	TRAVDOW	ACTIVITY	ACT.START.TIME	ACT.END.TIME	CW_WDTRIPWGT_LGA
Y12H0000126P01	Friday	At or Go Home	0	475	139.78
Y12H0000126P01	Friday	Work Related	535	580	139.78
Y12H0000126P01	Friday	Personal Business	590	600	139.78
Y12H0000126P01	Friday	Work Related	610	1050	139.78
Y12H0000126P01	Friday	At or Go Home	1125	1439	139.78

3.2 Simplifying Activity Labels

Group activities into activity groups as follows:

Activities	Activity Group
At or Go Home	Home
Accompany Someone	With Someone
Change Mode	Mode Change
Unknown purpose (at start of day), Other Purpose, Not Stated	Other
Personal Business	Personal
Work Related	Work
Education	Study
Buy Something	Shop

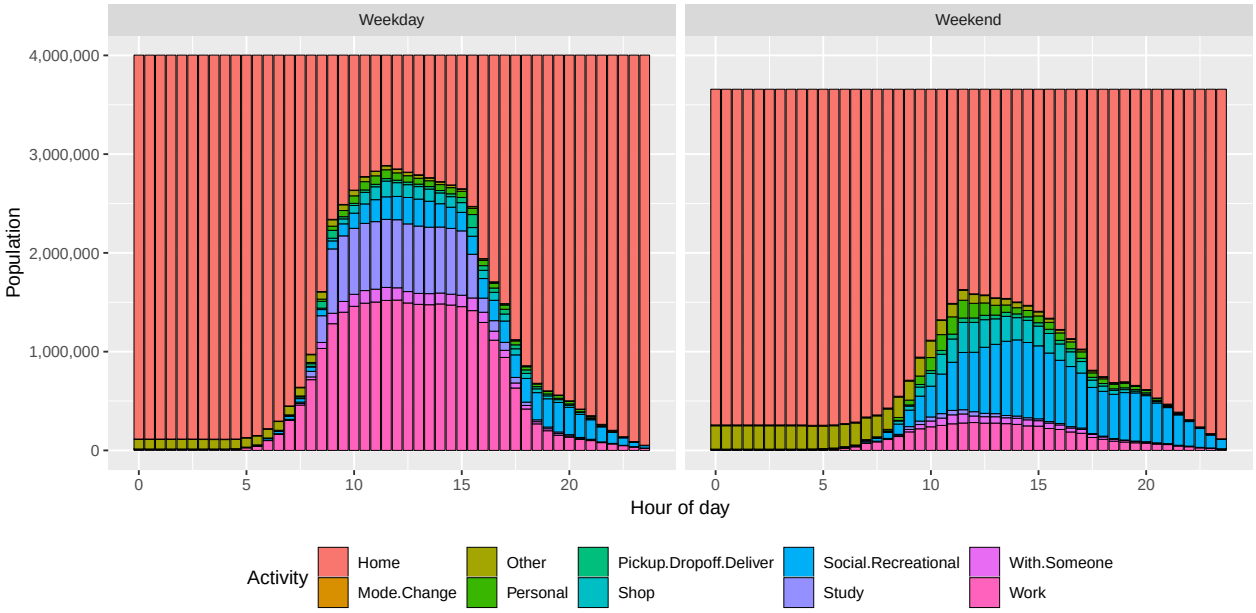
```
Social Recreational                                                    Social/Recreational
Pick-up or Drop-off Someone, Pick-up or Deliver Something              Pickup/Dropoff/Deliver
-------------------------------------------------------------------------------------------
```

3.3 Creating Activity Bins by Time of Day

1. Cut the day into fixed time bins of configurable size (30/60/120 mins)
2. For every activity record, count `CW_WDTRIPWGT_LGA` persons in every time bin that overlaps with the activity time
3. For any time bins that do not add up to the expected population (sum of `CW_WDTRIPWGT_LGA` per unique person), scale up the time bin vector of activities to the expected population size, proportionally.

```
dd<-aggregate(activities,by=list(activities$Person),FUN=head,n=1)
popnsize<-sum(dd$Count)
actCounts<-t(apply(actCounts,1, function(x, mx) {(x/sum(x))*mx}, mx=popnsize))
```

3.4 Activities by Time of Day for Greater Melbourne



4 Activity Chains | or what follows what

4.1 Markov Chain Model

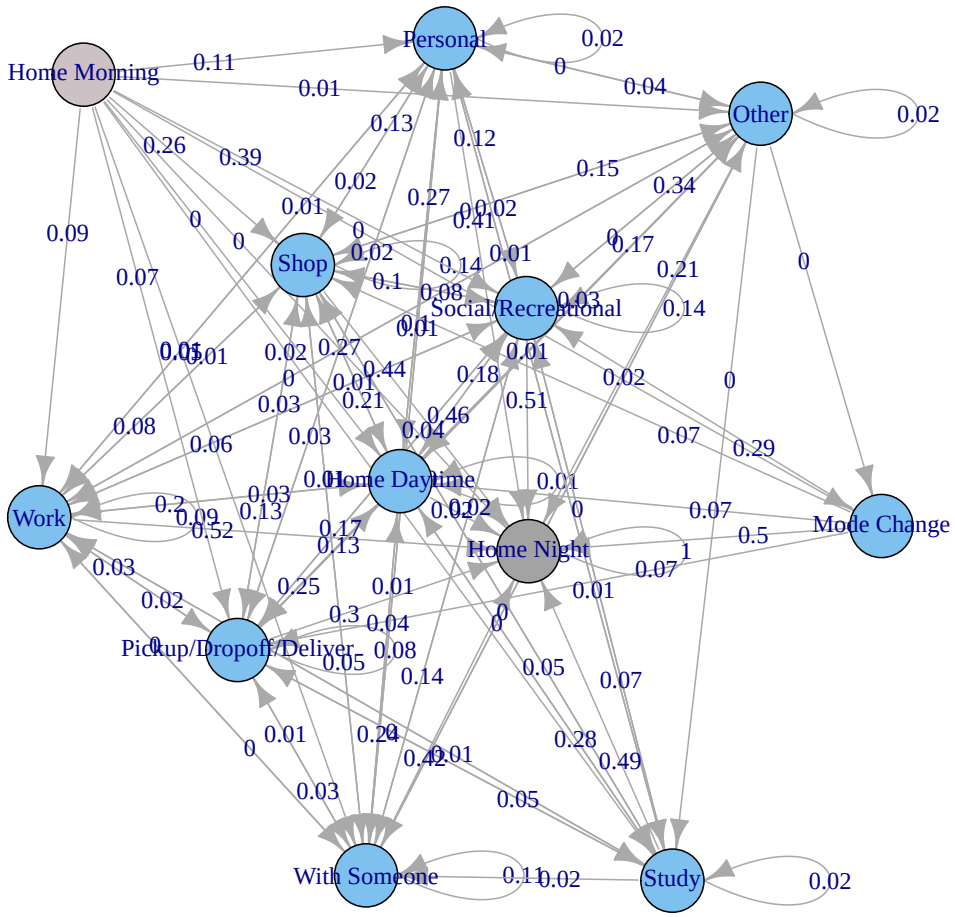
- Start with our activity groups, but with the Home group refined as follows:

```
-------------------------------------------------------------------------------------------
Activity Type       Mapping to VISTA Activity
------------------- -----------------------------------------------------------------------
Home Morning           At or Go Home, when first activity of the day
Home Night             At or Go Home, when last activity of the day
Home Daytime           At or Go Home, when not the first or last activity of the day
Mode Change            Change Mode
```

```
Other                   Unknown purpose (at start of day), Other Purpose, Not Stated
Personal                Personal Business
Pickup/Dropoff/Deliver Pick-up or Drop-off Someone, Pick-up or Deliver Something
Shop                    Buy Something
Social/Recreational     Social, Recreational
Study                   Education
With Someone            Accompany Someone
Work                    Work Related
--------------------------------------------------------------------------------
```

- Use VISTA data to create a matrix giving transition probabilities between each activity
- `Home Night` is the *absorbing state* as there are zero transitions out from it.
- Use the transition matrix to create a *Markov Chain* model (using R package `markovchain`)

4.2 Weekend Activities - Markov Chain Model



4.3 Weekend Activities - Generating New Chains

- Markov Chain model can be used to generate any number of sequences of activities, for example:

```
> c("Home Morning",rmarkovchain(n=9,mc,t0="Home Morning")) # chain of size 10
[1] "Home Morning"        "Shop"           "Home Daytime"        "Social/Recreational"
[5] "Social/Recreational" "Home Daytime"   "Social/Recreational" "Home Night"
[9] "Home Night"          "Home Night"
```

∴ Home -> Shop -> Home -> Social/Rec -> Social/Rec -> Home -> Social/Rec -> Home.

4.4 Generating Weekend Activities for 15,000 Persons

```
popnsz<-15000; chainlen<-50; startAct<-"Home Morning"; endAct<-"Home Night"
df<-data.frame(row.names = seq(1:chainlen))
for (i in seq(1:popnsz)) {
  v<-c(startAct,rmarkovchain(n=chainlen-1,mc,t0=startAct)) # chain of requested length
  idx<-match(endAct, v); v[seq(idx+1,length(v))]<-'' # remove repeating endActs
  df[,i]<-v # assign to new column
}
acts<-as.data.frame(table(t(df))) # return the transposed matrix and summarise
acts<-acts[2:nrow(acts),] # remove first row of total counts
acts$Percentage<-round(100*(acts$Freq/sum(acts$Freq)),digits = 1) # get percentage split
print(acts[order(acts$Percentage, decreasing = TRUE),]) # report
```

```
##                      Var1  Freq Percentage
## 3            Home Morning 15000       21.4
## 4              Home Night 15000       21.4
## 10    Social/Recreational 13291       18.9
## 9                    Shop  9038       12.9
## 2            Home Daytime  7445       10.6
## 8  Pickup/Dropoff/Deliver  3264        4.7
## 7                Personal  3016        4.3
## 13                   Work  2006        2.9
## 12           With Someone  1485        2.1
## 11                  Study   318        0.5
## 6                   Other   296        0.4
## 5             Mode Change     1        0.0
```