Mobility Database of the Metropolitan Region of Belo Horizonte, Brazil

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Abstract. This paper describes the mobility database of the metropolitan region of Belo Horizonte, Brazil. It comprises the official data from the origin and destination survey carried out in 2012, 2019 and 2021 and it is available on GitHub online repository. It contains vector files (shapefiles) and alphanumeric files (.txt and .xlsx). Shapefiles refers to: municipalities, macro mobility unit, homogeneous areas, traffic zones and census sectors’ boundaries and the road system. The geography coordinate system is EPSG 4326 – SIRGAS2000.

Metropolitan Region of Belo Horizonte (MRBH)


According to data from the 2010 Census, the MRBH has almost five million inhabitants, of which 98% are urban. The population density is around 500 inhab./Km². With a GDP of BRL 120,833,976 and a GDP per capita of BRL 828,821.73, the RMBH is the third largest metropolitan region in Brazil, in economic and population terms (MRBH Agency, 2012).
Origin and Destination Survey

The Origin and Destination (OD) Survey is the main data source for knowing the dynamics of people's movements in the researched area, associating the characteristics of the trips with socioeconomic variables.

In 2012, the Belo Horizonte Metropolitan Region Development Agency carried out a household OD Survey in all 34 municipalities in the MRBH to identify the trips patterns of its inhabitants. The official data of this OD Survey can be found at RMBH Agency site (RMBH Agency, 2022).

The spatial unit adopted for carrying out the research was the homogeneous area, defined as a set of aggregated census sectors, according to socioeconomic and occupation criteria. A total of 1,289 Homogeneous Areas (HA) were defined, 554 of which in the municipality of Belo Horizonte and 735 distributed in the other municipalities of the MRBH. Each HA aggregates, on average, three census sectors. This unit is geared towards addressing urban issues.

A spatial unit called Macro Mobility Unit - MMU was also created to analyze specific characteristics of urban mobility. 67 MMUs were defined, resulting from the aggregation of HAs. Figure 2 shows their boundaries.

In 2019/2021, they collected information from the mobile phone network to develop an updated OD matrix for the MRBH (RMBH Agency, 2022). This matrix expresses the daily number of trips among all OD pairs, classifying them as to their reason, period of travel, and travelers’ sociodemographic profile.
Two periods of 20 days were considered for the analysis of trips, obtaining the average volume of trips per business day and holidays. The first period was from November 01 to 20, 2019. The second period was from May 01 to 20, 2021.

The Traffic Zone (TZ) was the spatial unit used to report the results of the OD matrix. It is defined as a set of aggregated HAs whose land use and sociodemographic profile are similar, resulting in 393 polygons. There is a relational table between TZ and HA. Figure 3 shows the TZs boundaries.

Database

This database (DB) is available on GitHub online repository (Tomás, 2022). It contains vector files (shapefiles) and text files (.txt). Shapefiles refers to: municipalities, MMUs (2012), HAs (2012), TZs (2019/2021) and census sectors’ boundaries (2010) and the road system. The geography coordinate system is EPSG 4326 – SIRGAS2000.

Text files consider the number of trips between OD pairs. Being ‘trip’ the movement of one person, for any specific reason, with the use of one or more means of transport, and may be composed of one or more transfers. Therefore, each trip has an origin, a destination, a reason and a mode of transport. In this DB, the origin and destination are one of the MMUs or HAs (for 2012) and TZs for 2019/2021. The 2019 and 2021 matrices consider trips carried out on business days for comparison with the OD 2012.

Matrices consider metropolitan trips, that is, trips starting and ending in the MRBH, which in turn are divided into internal trips (intrazone trip), trips for which origin and destination are both located in the same zone; and external trips (interzone trip), which are trips between different zones. The DB also presents the produced trips, that is, the trips that originated in the same zone with different destinations; attracted trips, that is, trips with different origins and destinations in the same zone; as well as total trips.

Considering the total trips in 2012, Figure 2A shows a choropleth map by MMU. It is possible to visualize the relationship of territorial proximity of the MMU with the highest volume of trips, Center-South, with the others. In order to compare the pattern of trips between the 2012 and 2019/2021 surveys, the number of trips, originally aggregated by HA, was also aggregated by TZ, as Figure 2B shows. Figure 3 shows the total trips by TZ in (a) 2019 and (b) 2021. The class ranges are the same for both years; however, the features values of each year were used at the extremes (minimum and maximum values).
In 2012 there were a total of 23,137,457 trips in MRBH, and TZs with the highest number of trips were, respectively, 126, 69, 233, 11, and 109. In 2019 there were a total of 162,869,637 trips, and TZs with the highest number of trips were 109, 126, 69, 35, and 236, respectively. In 2021 there were a total of 122,424,794 trips and
TZs with highest number of trips were 233, 109, 126, 29, and 238, respectively. These TZs belong to Belo Horizonte and Contagem municipalities.

Final remarks

Although it is older, the 2012 OD research is home-based and it has a greater number of variables. The 2019/2021 surveys use mobile phone networks, which makes the research faster and cheaper, but it has fewer variables and some of them are estimated. The combined use of these two types of research allows us to understand changes in the pattern of trips over time. Observing the total trips in MRBH by year, it is possible to note that there was almost a 604% growth between 2012 and 2019; and there was almost a 25% decrease from 2019 to 2021. When we look at the highest number of trips by TZ per year (i.e. in 2012 the number of trips for TZ 126; in 2019, the number of trips for TZ 109; and in 2021 the number of trips for TZ 233), that there was a 15% growth in the number of trips between the years 2012 and 2019; and a 41% decrease from 2019 to 2021. This decrease is explained by the change in the pattern of travel caused by the SARS-CoV-1 pandemic, in which many people started working from home.

References


Tomás, L. R. (2022) “Mobility database of Metropolitan Region of Belo Horizonte, Brazil”, https://github.com/liviatomas/RMBH.