Measurement of outbound tourism using mobile phone positioning

Technical Project

Sub-Directorate General of Tourism and Science and Technology Statistics

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Index

INE. National Statistics Institute

Measurement of outbound tourism using mobile phone positioning

1 Introduction

The National Statistics Institute (INE) is the statistical body responsible for the Resident Tourism Survey (ETR/FAMILITUR, hereinafter RTS[1]). The objectives of this survey are:

– To estimate the total number of tourist trips made by residents in Spain, within the national territory and abroad, broken down by the main characteristics of said trips and by the main sociodemographic characteristics of the travelers. It also estimates the number of overnight stays and the tourist expenditure associated with the trips.

– Know the number of excursions made by residents aged 15 or over, as well as the associated expense.

The ETR is published quarterly, although results are offered for the months that make up the quarter.

The data collection for the survey is carried out through a personal interview, with an effective monthly sample of around 8,200 households (one informant per household), providing information on the trips and excursions made by the respondent. The cost of the collection is high and the results obtained do not provide good geographical granularity (autonomous community), because it lacks the necessary sample support.

Technological advances and the presence in daily life of a wide variety of eletronic devices, applications and tools that leave a digital footprint, combined with the widespread use of these devices and the continuous growth of the capacity to process and analyse immense volumes of data (commonly known as Big Data), provide new sources of information that must be incorporated into official statistical systems.

The INE - through the Sub-directorate General of Tourism and Science and Technology Statistics, and together with the three major mobile phone operators in Spain - has developed a project to exploit aggregate mobile phone data. This will allow the movements of resident and foreign tourists and day visitors to be followed, and the information is disaggregated by the AC, provinces and municipalities through which tourists and day visitors moved. It also provides imformation on the countries to which tourists residing in Spain travel when they go abroad.

Due to the wide coverage of this project - which includes domestic, inbound and outbound tourism - it has been divided into three independent publications, with this methodology being focused on outbound tourism: that is, on the trips of resident tourists to foreign countries.

In summary, this study uses mobile phone signals, via active and passive events captured by telephone antennas, to determine the following:

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[1] All the information on RTS can be consulted on the INE website

1. The origin and destination countries visited by resident tourists on their trips abroad.

2. The patterns of tourist behavior (movements) associated with each country of destination.

Due to the complexity of the positioning data captured by a mobile phone antenna, the transformation to adapt data to the definitions of the field of tourism and the processing necessary to obtain a set of aggregated data that allows for statistical processes to be applied, it has been necessary to develop of a series of of algorithms. These algorithms have been prepared by each of the mobile phone operators participating in this project, with on-going support and interaction from the INE. Since this project's start at the end of 2020, work has been carried out jointly between the INE and each operator: analysing the results, detecting systematic differences and drawing conclusions. A set of algorithms was then built to convert positioning data into variables that conform with international definitions for the measurement of tourist flows.

1.1 MOBILE NETWORK INFORMATION

All the data used in this project is generated by the mobile networks of the mobile phone operators. These networks are basically made up of mobile devices with a SIM card and the antennas with which they communicate.

The location of mobile phones is estimated from the mobile phone antennas. This implies that phone location cannot not established with total precision. The rate of error depends on the concentration of mobile antennas (the higher the concentration of antennas, the greater the precision).

The information on the location of the telephones is anonymized and processed by each company, with the INE receiving only aggregated and tabulated data. At no time does it have access to individual records of any element of the mobile network.

The basis of this project is the network events taking place in the communication between mobile devices and antennas:

– Mobile devices (turned on and in range) communicate continuously with the antennas to which they are connected.

– Each antenna is assigned a theoretical geographic coverage area or cell. All mobile devices physically located in a cell connect to that antenna. The coverage area of a cell is very varied (from a hundred meters to several kilometers), depending on the density of the network in an area. Density is thus higher in urban areas than in rural or sparsely populated areas.

Network events are classified into the following two types:

– Active events: when a call is made or received, a text message, an email, an app is used or updated, web pages are navigated, or the device is turned on or off. In addition, when the device is active and moves, it generates records in the antennas to which it is connected, leaving a record of its new location.

– Passive Events: These are generated when the device is powered on and in motion, but no action is taking place.

For the overall project to measure both tourist flows both domestic and abroad, outbound and inbound, the following will be taken into account:

– Domestic tourism: events generated by mobile devices that belong to a certain operator and their connections to said operator's network.

– Outbound tourism: mobile devices that belong to a certain operator that connect to mobile networks outside the country.

– Inbound tourism: mobile devices from international operators that connect to the network of Spanish companies.

2   Purpose of this statistic and improvements over traditional sources

The objective of this project is to carry out and publish experimental statistics on the movements of resident tourists using a more detailed level of geographic granularity than in RTE, along with improving opportunity.

The improvements achieved using this information source in outbound tourism are:

– The set of individuals about which the operators have information is much larger than the RTE sample. Considering that a large percentage of the population has a mobile phone and that the main operators each have around a 25% market share, the coverage of each far exceeds the sample size of ETR. This means that the trip estimation obtained through its algorithms is much more accurate.

– By obtaining information on the movements of a much larger number of individuals, disaggregation at a geographical level is much broader. Currently, the information provided in RTE is for the national total. With this project, it will be extended to the level of the autonomous communities, provinces and municipalities.

– The results of the RTE are published quarterly by the INE, three months after the end of the reference quarter, which significantly reduces its opportunity. The new experimental survey will offer monthly results around one month after the end of the reference month.

– On the other hand, RTE provides monthly information for a reduced list of countries of origin and groupings. With this experimental statistic, monthly information can be provided for the complete list of countries (as long as information on a minimum number of trips is available).

– Using mobile telephone information,when geographically disaggregated both in the destination of the trip or in the origin, more accurate and robust variation rates are obtained than in RTE.

The short-term objective of this operation is to provide a rapid and highly detailed estimate of the number of residents who travel abroad –based on innovative sources and processes– that can serve as a complement to the estimates provided by the RTS. In the medium term, the goal will be to integrate the two operations, thus combining the speed and granularity of the first with the details of tourist's trips (reason for the trip, type of accommodation,...) provided by the second.

3 Research areas

3.1 POPULATION SCOPE

The population under observation is made up of Spanish mobile phone users who make use the networks of the operators participating in this project; while the population under analysis includes resident tourists traveling abroad.

3.2 SCOPE OF STUDY

The scope of study is resident tourists who travel abroad and their trips.

Trips are considered to be trips to a foreign country that involve at least one overnight stay.

3.3 GEOGRAPHICAL SCOPE

Trips abroad made by tourists residing in Spain are analysed.

3.4 TIME SCOPE

The study period for which results will be obtained is the month.

Information is available from July 2019 onwards.

3.5 STUDY AND CLASSIFICATION VARIABLES

The study variables are the number of tourists, overnight stays and the average trip duration.

The classification variables are: country or continent for trip destination, and autonomous community, province and municipality for origin.

4 Basic concepts

To carry out this project, the definitions and concepts of the RTE, which follows international methodologies and standards, have been adjusted and adapted to the information available to mobile phone operators.

The definitions of the most relevant concepts within the field of statistics and mobile telephony are included below.

4.1 TOURIST TRIPS AND TOURISTS

Definition in the field of tourism statistics

Tourist trips are considered to be all trips to a main destination outside the person's regular place of residence, which involve at least one overnight stay elsewhere and have a duration of less than one year, provided that the main reason for the trip - including business, leisure or other personal reasons - is not for a job in a company established in the place visited. In the case of outbound tourism, individuals reside in Spain and the destination of their trip is abroad.

They are round trips and end when the person returns to their usual place of residence.

A tourist is any person who makes a trip. In these statistics, a person who travels abroad several times in the same month will be counted as many times as trips are made. In other words, if a resident of Spain travels to France three times in the month of April, they will count as three tourists.

Definition adapted to mobile phone operators

A mobile resident in Spain is considered to have crossed the border into a foreign country, when the mobile has been detected in that country for the majority of the time between 10:00 p.m. and 06:00 a.m., and when it has also been detected the following day (from 06:00 a.m.) in that country.

The trip will end when the mobile phone is once more detected in the municipality of residence for the majority of the time between 22:00 and 06:00.

If a mobile cannot be detected for a period of time during a trip, the following procedure will be followed:

– If, when it is detected again, the mobile is in the municipality of residence, the trip comes to an end the day it is once more detected in that municipality.

– If the mobile is no longer detected for a certain period of time of less than seven days:

  • If the mobile is in the last country in which it was detected, the trip continues and all intermediate overnight stays will be assigned to that country.

  • If the mobile phone is in another country that is neither the last one in which it was detected nor the municipality of residence, the trip continues and all intermediate overnight stays will be assigned to the last country in which it was detected.

– If the mobile is no longer detected for a certain period of time greater than seven days:

  • If the mobile is in the last country in which it was detected, a new trip will be assigned whose first stage is that country; the previous trip would have ended the last time the mobile was detected.

  • If the mobile is in another country that is neither the last one in which it was detected, nor the municipality of residence, a new trip will be assigned whose first stage is that country; the previous trip would have ended the last time the mobile was detected.

4.2 OVERNIGHT STAYS

Definition in the field of tourism statistics

Number of consecutive nights that a person spends the night in a country other than the country of residence as part of a trip.

Definition adapted to mobile phone operators

Number of consecutive nights in which a mobile phone has been detected for a the majority of the time between 10:00 p.m. and 06:00 a.m. in a country other than the country of residence and has also been detected the following day (after 06:00 a.m.) in that country.

4.3 MAIN TRAVEL DESTINATION

Definition in the field of tourism statistics

The country in which the informant has spent the greatest number of nights.

Definition adapted to mobile phone operators

The country in which a mobile phone has been for the most overnight stays as part of a trip (according to the definition).

4.4 STOPOVER

Definition in the field of tourism statistics

A stopover refers to each overnight stay made during the trip. In other words, a trip has as many stopovers as countries where you have stayed overnight.

Definition adapted to mobile phone operators:

Each of the countries in which a mobile phone has been detected for the majority of the time between 10:00 p.m. and 6:00 a.m. and has also been detected the following day (after 6:00 a.m.) as part of a trip .

4.5 DAY TRIP[1]

Definition in the field of tourism statistics

Day trips are visits to a foreign country that do not include an overnight stay; that is, they begin and end on the same day. In other words, a day trip is considered any visit to a foreign country without an overnight stay that has as its starting point

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[1] The definitions of stopover and day trip are included, although the information regarding these two variables has not yet been exploited and is not included in the initial publication of this experimental statistic. However, work is underway to expand its scope of study to include results of the number for the number of stopovers and day trips.

the usual surroundings of the traveller; this being the geographical area (not necessarily contiguous) in which a person carries out their usual daily activities. In this way, visits that are part of a trip will thus not be considered day trips.

To qualify a visit as a day trip, the following criteria must be considered:

– Objective of the visit: it is considered a day trip when it is not part of the daily routine and there is a singular motivation for going.

– Administrative borders: in a foreign country.

– Duration of the visit: at least three hours at the destination, and must not include overnight stays.

– Frequency of the visit: the frequency must be less than once a week.

Definition adapted to mobile phone operators

When these conditions are met at the same time, it will be considered a day trip:

– A mobile phone has been detected in a country other than the country of residence.

– The mobile phone has "stayed overnight" (has been detected for a longer period of time between 22:00 and 06:00) the night before and the night after in the municipality of residence.

– The mobile phone has been detected in the destination country for at least three hours.

– The mobile phone has not been detected in the destination country more than eight times in the last eight weeks, fulfilling the above conditions.

5   Data collection

The INE receives the tabulated and aggregated data prepared by each operator. It is important to emphasize the fact that the INE does not have individual information on a device at any time. They receive only the aggregated information provided by mobile phone operators.

We always work on the premise that the data for the disaggregations requested are provided for with a sufficient number of associated observations. Otherwise, they are aggregated into 'remainder' categories.

6   Information processing Indicators

6.1   PROCESSING OF OPERATOR FILES

The files sent to the INE on a monthly basis by mobile phone operators contain information on trips and overnight stays abroad, by Autonomous Community, province and municipality of origin, made by resident tourists. The INE carries out

a preliminary purification, in order to adequately adapt their format before processing the information contained.

6.2 ESTIMATION OF TOTALS BY COUNTRY

To estimate the total number of trips to each country, the trips to the corresponding country provided by the three operators in the AC files are added.

Since the three operators do not cover 100% of mobile phone users in Spain, some correction factors have been estimated that raise this sum to the total population. These factors vary depending on the number of operators that provide data for each country, and have been estimated quarterly based on CMNC market share data.

Similarly, total overnight stays in each country are estimated. Average durations are calculated as the quotient of the trips and the overnight stays of each country estimated independently.

6.3 DISTRIBUTION BY AC, PROVINCE AND MUNICIPALITY

Once we have the estimates of total trips and overnight stays for each country of destination, we proceed to distribute these totals by AC of origin as follows:

1. For each country, the percentage of trips (and overnight stays) from each autonomous community for each of the operators is determined.

2. For each AC-country crossover, the average of the three percentages obtained in the previous point is calculated.

3. Finally, the calculated averages are adjusted so that their total sum per country is 100%.

4. These percentages are applied to the estimation of trips (and overnight stays) for each country, thus distributing them by AC.

The distribution of totals by province and municipality is carried out in a similar way.

7 Dissemination of information

7.1 PUBLISHED VARIABLES

The variables to be published are:

– Number of tourists.

– Number of overnight stays.

– Average duration.

7.2 VARIABLES TO DISAGGREGATE

The variables to be used for breakdowns are:

– Geographical - Travel destination: continents, countries.

– Geographical - Origin of the trip: national, AC, provinces and municipalities.

– Temporary – monthly.

7.3 MONTHLY TABLES

– Number of tourists, overnight stays and average monthly duration by continent and country of destination[1].

– Number of tourists, overnight stays and average monthly duration by continent and country of destination, broken down by autonomous community of origin.

– Number of tourists, overnight stays and average monthly duration by continent and country of destination, broken down by province of origin.

– Monthly Excel file with tourist data by country of destination broken down by municipality of origin.

7.4 INFOGRAPHICS

The publication is accompanied by the following infographics:

– World map: marked by colors according to value ranges and the number of tourists by destination countries.

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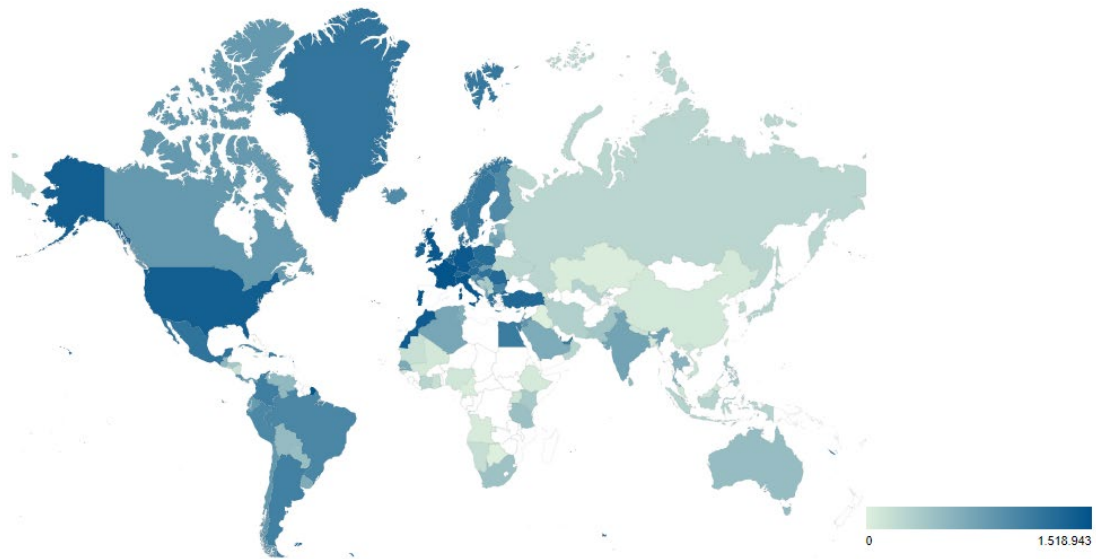
[1] In the complete list of destination countries, Spain is excluded and Gibraltar is included. Data from the five continents are provided: Europe-without Spain, Africa, America (distinguishing North America, Central America and the Caribbean, and South America), Asia and Oceania. In addition, the aggregate EU-27 without Spain is provided.

– Map by continents: marked by colors according to value ranges and number of tourists by destination countries. By hovering the cursor over a country, you can see data for the last month is displayed and on one side is a graph with the available monthly series.
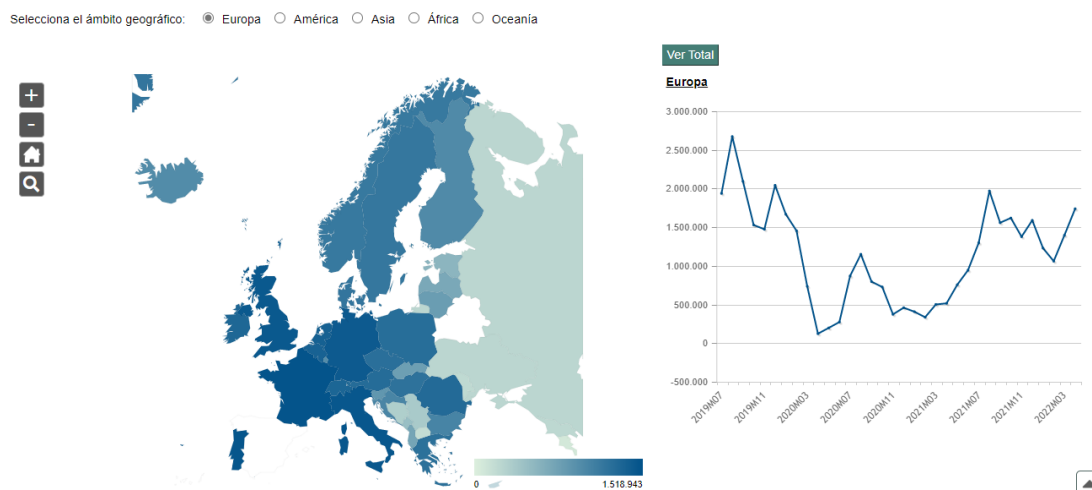
– Maps by AC: marked by colors according to the range of values and the number of tourists whose origin was in each autonomous community. By selecting a specific community, a graph is displayed with the number of tourists broken down by country of destination in the selected community.
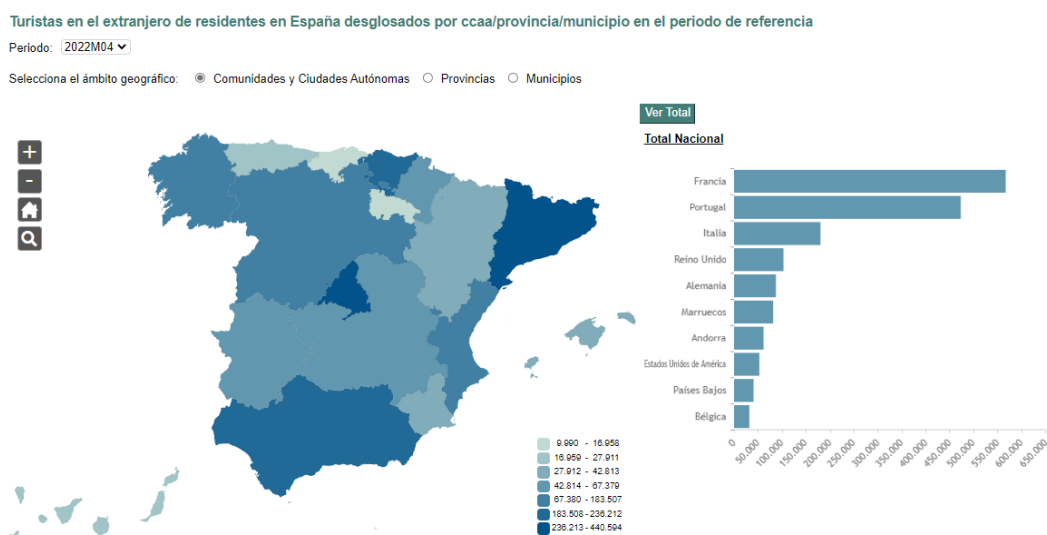

– Provincial maps: marked by colors according to the range of values and the number of tourists whose origin was each province. By selecting a specific province, a graph is displayed with the number of tourists broken down by country of destination in the selected province.

Turistas en el extranjero de residentes en España desglosados por ccaa/provincia/municipio en el periodo de referencia
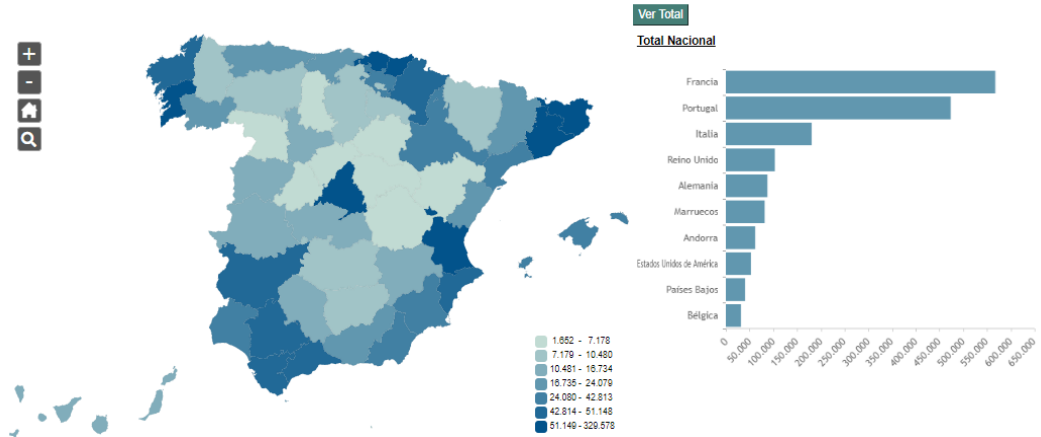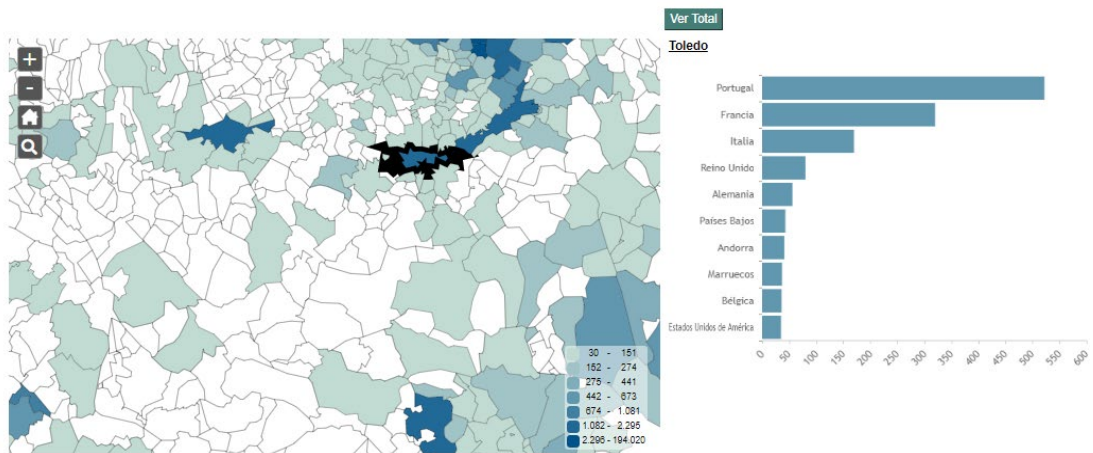
– Municipal maps: Similar to the provincial map, a municipal map is shown, also showing the breakdown by country of destination when selecting a specific municipality.

Turistas en el extranjero de residentes en España desglosados por ccaa/provincia/municipio en el periodo de referencia

7.5 STATISTICAL SECRET

Those a number of tourist crossing under 30 are hidden.

Likewise, to fully safeguard statistical secrecy, crossings where the number of tourists can be obtained by differences are hidden.

8 Implementation schedule

The information associated with this experimental statistic was made public in May 2022, providing monthly information for the July 2019 – April 2022 period.

Following that, results are published monthly.