MINI ARTICLE

Distribution of daily patrols in Catalonia per police region

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Abstract
Catalonia is divided in different police regions, RPs, in which daily patrols watch the streets in order to prevent conflicts and solve them. In this article, the distribution of daily patrols per RP is studied. In addition, it is searched the reason why they are distributed this way considering the number of inhabitants per RP and the area of them. This analysis is focused on the years 2020 and 2021.

Keywords: daily patrols, police region, area, inhabitants

1. Background

Analysis

A different amount of patrols look the streets every day in Catalonia depending on the police region. In this study, first we find the distribution of daily patrols per RP in Catalonia. Secondly, we search the explanation behind this distribution. In order to do this, we make an hypothesis: *The distribution of daily patrols is done according to the population or the area of each RP*. All the study is focused in the years 2020 and 2021.

Data set

Different sources of data are used in this study:
Number of daily patrols per RP are extract from *Portal de dades obertes Catalunya* [5]. It consist of five columns: number of month, name of the month, year, supply origin service and average of daily patrols. There are three types of territorial limitations in the supply of origin service: Serveis Centrals, Serveis Regionals and ABP.
The source of the vectorized map used to represent the results, is *Institut Cartogràfic i*

Geològic de Catalunya [3]. It contains the limits of the "municipis", "comarques", "vagueries", "províncies", "Catalunya" and "caps de municipi, comarca" and "província". The source of the inhabitants per RP is *Departament de l'Interior* and *Nació Digital* [2]. This data contains thirteen columns: region, ratio of penalties per 1000 inhabitants, total of penalties, the article violated and its state (columns 4 to 12) and the population. The area of the different RPs was extract from *idescat* [4] and it consist of seven columns: "comarca", different altitude zones (columns 2 to 6) and the area expressed in km^2. Another file is necessary to obtain the total area of RPs due to the fact that Barcelonès has its "municipis" divided in different police regions. These data can be obtained from *AMB* [1]. It consists in thirty six boxes of each "municipi" of "Àrea Metropolitana Barcelona" and it includes the area and the population of it.

2.   Methods

The transformation of the data set into the results can be divided in different sections: daily patrols data curation, bar plot, map making, RP area data curation, RP inhabitants data curation and map plots. The code is done with Python and the necessary libraries are Pandas, Sodapy, Matplotlip.pyplot, Numpy and Geopandas. The code can be found in GitHub: https://github.com/martinamorenofina/learn-git-a-bit.

Daily patrols data curation

In order for data to be useful, it has to be cured. Firstly, the data of daily patrols, is imported by Socrata using API and then converted to DataFrame:

```
#Import of data regarding daily patrols
client = Socrata("analisi.transparenciacatalunya.cat", None)
# First 10000 results, returned as JSON from API, converted to Python
#list of dictionaries by sodapy.
results = client.get("vvp8-t2ai", limit=10000)
# Convert to pandas DataFrame
results_df = pd.DataFrame.from_records(results)
```

We only keep the data of 2020 and 2021 and transform all data to capital letters in order to be able to treat it in a general way. In addition, it is necessary to correct one typo that appears in the data: "SERVEIS EGIONALS - RPCT". Moreover, all names of RPs have to be in the same format, since some appear like "SERVEIS REGIONALS - RP CENTRAL" and some like "SERVEIS REGIONALS - RPC". This process has to be made for each RP. Finally, we only keep only the data that is related with RPs.

Bar plot

In order to do the bar plot, we have to put the data of daily patrols in a list and average it along along the years. In addition, we obtain and plot the total mean in order to make a clear comparison. Finally, we create a data frame with the averaged information per RP obtained.

Map making

Since there is not a map generated that is limited by RPs, it is necessary to create one

through a map divided in "comarques". First of all, we create a dictionary with all RPs and its "comarques". Also, we create a new inverted dictionary, which has all the RPs for each "comarca" since it will be useful in the next steps. Due to the fact that the "comarca" Barcelonès has different "municipis" that correspond to different police regions, it is necessary to add them to the dictionary created. Then, we create a new map delimited by the RPs through joining all the areas of the "comarques" of the same RP. The result is a DataFrame that has one column for RPs and one for the geometry, which consists on the features of the multipolygons and polygons. Finally, we add to this DataFrame the number of daily patrols as a new column.

RP area data curation

The next step is to do a process of data curation of the areas in order to take into account the number of daily patrols per area. Again, we only have the information of the surfaces per "comarca" and not per RP. In addition, the data includes the area of Catalonia and the one of the four "províncies", so we have to drop them. Since we will use the dictionary that we have created for the map, we must have the same names for all the "comarques". It is important to notice that this is not the case for Val d'Aran, so we have to rename it. In addition, we have to take into account that, as before, "municipis" of Barcelonès correspond to different RPs. Because of this, the data regarding the area of these "municipis" is needed. Since the data used can not be downloaded, it is necessary to added as the following:

```
areas_RP_df.loc['Barcelona']=[100.3]
areas_RP_df.loc['Sant Adria del Besos']=[3.8]
areas_RP_df.loc['Hospitalet de Llobregat']=[12.4]
areas_RP_df.loc['Badalona']=[21.2]
areas_RP_df.loc['Santa Coloma de Gramanet']=[7]
```

Moreover, we add these "municipis" with their surfaces in the inverted dictionary. This way, it is possible to join all the areas that correspond to the same RP easily using the function *groupby* of Pandas. Then, we have to sum all the subgroups. Finally, we add the logarithm of daily patrols for each RP divided by its areas as a new column in the DataFrame obtaining a column for the RPs, geometry, daily patrols and logarithm of daily patrols divided by area. The logarithm is necessary to make clearer the results.

RP inhabitants data curation

Now, we have to do a process of data curation of the inhabitants in order to consider the number of daily patrols per inhabitants. First of all, we have to take from data only the population regarding the RPs. Then, we add the daily patrols divided by the inhabitants of each RP and multiply it by 100.000 in order to have a obtain a great number and be able to understand better the results.

Map plots

Finally, we plot three maps: Daily patrols per RP, logarithm of daily patrols per area and daily patrols per 100.000 inhabitants. In addition, each map has the name of the police regions annotated.
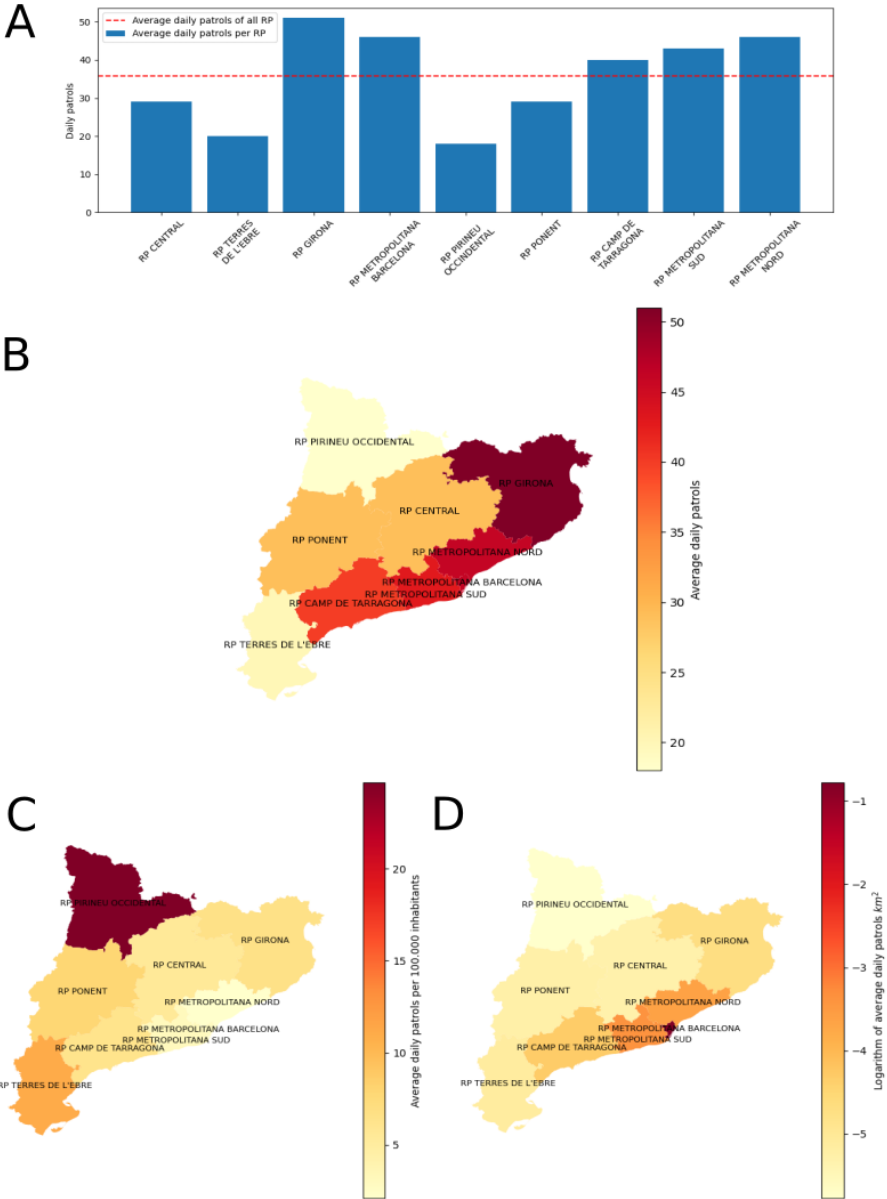
3.   Results

Figure 1. A: Bar plot of average daily patrols per RP. It includes the average of daily patrols for all police regions in a red line. B: Map of Catalonia divided in police regions in which is represented the average daily patrols. C: Map of Catalonia divided in police regions in which is represented the average daily patrols per 100.000 inhabitants. D: Map of Catalonia divided in police regions in which is represented the logarithm of the average daily patrols per area, in km^2.

Looking at *Figure 1* we can see the results of this study. In **A** we can clearly see that daily patrols are not homogeneous distributed: four RPs are below the mean and five of them over it. It is important to notice that there is a big difference between the amount of daily patrols in different police regions. For instance, there are less than twenty daily patrols in average in RP Pirineu Occidental and, contrary, more than fifty in RP Girona. In *B* we can see the same results, but plotted in a map of Catalonia divided by RPs. Here, we can easily notice that, except for RP Ponent and RP Central, the other police regions have very different colours, which means very different number of daily patrols.

In figures **C** and **D**, we try to obtain similar colours between RPs in the map considering the area of the RPs and its inhabitants. We have to keep in mind that if we achieve a more homogeneous map, we will be able to say that the distribution of daily patrols could be done taking into account the areas or the inhabitants. In **C** we can see that except for RP Terres de l'Ebre and RP Pirineu Occidental, all the maps appear in similar colours. On the other hand, in **D**, RPs look very similar except for the "Àrees Metropolitanes" and especially Barcelona.

Moreover, we can see that for most of the RPs, these last two maps compensate each other. For instance, it is clear that in RP Metropolitana Barcelona, there are a lot of daily patrols per area because it is super crowded. If we look at the map regarding the inhabitants for this RP, we can check that there are not a lot of daily patrols per 100.000 inhabitants and, in fact, it is one of the RPs with less daily patrols per inhabitants.

4.   Conclusions / Discussion

In this study, we have processed data from public research and thanks to it we have been able to obtain some useful and informative results. It is important to notice that without these data, it would have been not possible to do this article. Here we can see a clear example of the importance of keeping data open for others to create new content. Because of this, this study has also all the results and data public unhindered.

The results clearly indicate that daily patrols are not distributed homogeneously along Catalonia since there is a big difference between the number of daily patrols in the police regions. This study contemplates the possibility of the patrols being distributed taking into account the area of the RPs or the population in them. Thanks to the results, we can say that neither the area nor the population are the single reason of the distribution of daily patrols. However, the maps that consider these two features, appear in more similar colours than the one that only consider the daily patrols. Because of this, it is possible that daily patrols are distributed taking into account different factors and two of them are the area and population of RPs.

A future research would be necessary in order to examine other features, such as disappearances, crimes, accidents, etc. It will also be interesting to mix sets of different factors and see when the map appears entirely with similar colours. One further research can be found at: https://github.com/robedamo/data_analysis_project. In this study, it has been taken into account: missing people reports per RP, waiting time

between entering in a police office to file a complaint and being attended per RP and number of hate crimes per RP.

In conclusion, in this study we have obtained some interesting results thanks to data from public research. It is clear that daily patrols are distributed more homogeneously along Catalonia taking into account the area of the police regions or its inhabitants, however, not completely. A future research would be necessary to consider more features in order to obtain exactly the reason of daily patrols distribution.

References

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