Improving the quality of life by reducing city noise levels

Challenge Provider: City hall of Torino

Turin (45°04′45″N 07°40′34″E, 847,033 inhabitants) is a city and an important business and cultural centre in northern Italy.

Throughout its history, Torino has never stepped away from a challenge nor from the need to change direction and rethink its future. The city has found its inner strength to react and has used its vast resources to reinvent itself, often acting as a **laboratory** for the future of the entire countrywide system. Italian cinema, television, fashion and automobile were originally based in Torino where they found a breeding ground to grow.

Beyond its quality manufacturing vocation, in the darkest years of the crisis, Torino has been able to change skin and to show its **new vocations** to the world. With its vast artistic and cultural heritage Torino is *a hybrid between Paris and New York*" according to the Financial Times and has been described as "*Unique and different from the rest of Italy*" by the Wall Street Journal.

Today Torino is an important centre of research and high education with its excellent Polytechnic and University to drive the city towards new technological and relational skills: from an innovative PhD program on soft skills and new technologies for business employees to the creation of a competence centre where companies are guided toward the "4.0 Industry". All this confirms Torino as the Italian capital of "**Open Innovation**", enabling it to become the second most innovative city in Europe under the prestigious "**iCapital**" award in 2016.

Since 2009 the city underwent a process to become a "**Smart City**", signing in 2017 – first in Italy – a Memorandum of Understanding with the Innovation Team of the Italian Government for the creation of large infrastructure of **Big / Open Data** for the development of the city and of the country. After a century as an automotive capital, Torino has diversified its ambitions and focused on industries with high-knowledge content, giving great importance to **research** and **innovation**, in particular in the strategic areas promoted also at the regional level such as automotive, ICT, aerospace, biomedical and high-quality food.

In the last two decades changes in individuals' behaviors, modifications of cities rhythms and investments to revitalize the historical city centre led to increasing **open-air nightlife**, to so-called "Movida", with the need for both citizens and the public administration to face **leisure noise**, mostly due to people with their behaviors in an urban open space, as the most evident negative social and environmental externality.

Context

According to the European Environment Agency (EEA) report on environmental noise in Europe, health risks are posed when the population is exposed to an increased amount of noise. Some vulnerable groups have been particularly identified, for example:

- In children, exposure to aircraft noise can affect cognition skills in school;
- The elderly are more vulnerable to sleep disturbances, and noise during the night can affect their rest and have a negative impact on cardiovascular diseases;

- Pregnant women are also more vulnerable to sleep disturbance, and environmental noise may also increase the risk for pre-term and low weight birth;
- Socio-economically disadvantaged people might also be at higher exposure to noise levels due to poor housing conditions, pre-existing health conditions or fewer opportunities to cope with noise.

However, it's not only humans affected by noise, but the report also shows that biodiversity can be negatively affected on terrestrial and aquatic species.

This shows that there are several benefits to reducing noise pollution in cities. One source of noise pollution is the recreational nightlife noise, which comes from loud conversations during nighttime on the streets.

The city of Torino has been studying the noise levels of recreational nightlife noise in the San Salvario area, which is home to many bars and clubs. They have installed several IoT sensors in order to measure the noise levels with records since 2016, developed in San Salvario the H2020 "MONICA" project as a large-scale demonstration of new and existing IoT applications for a smarter living, and approved in 2021 the first Action Plan in Italy focused on leisure noise.

Background Information

Here are some documents (but not limited to) that might be interesting to take into account:

- How to average noise levels
- Report: EEA report on environmental noise in Europe
- Paper: "*Analysis of leisure noise levels and assessment of policies impact in San Salvario district, Torino (Italy), by low-cost IoT noise monitoring network*"
- Paper: "*Long term monitoring of noise pollution in social gatherings places: time analysis and acoustic capacity as support of management strategies*"
- COVID restrictions regarding nightlife (pubs/restaurants):
    - Until March 11th: always open
    - March 12th - June 14th: always closed
    - June 15th - October 13rd: always open
    - October 14th - October 25th : dance club closed, café and restaurants closed after 0 A.M., outdoor consumption prohibited after 9 PM
    - October 26th - November 5th: café and restaurants open 5 A.M.- 6 P.M.; consumption indoor and oudoor prohibited after 6 P.M.; curfew 11 P.M. - 5 A.M.
    - November 6th until April 25th always closed;
    - April 26th - May 17th: only terraces open, curfew 10 P.M. - 5 A.M.;
    - May 18th - June 6th: curfew 11 P.M. - 5 A.M.;
    - June 7th - June 13th: curfew 0 A.M. - 5 A.M.;
    - June 14th - June 20th: indoor and terraces open, curfew 0 A.M. - 5 A.M.,
    - June 21st: no curfew, alcohol cannot be served after 3 AM (National Security Act).

Goal

The goal of this challenge is to help cities predict future noise levels and, if possible, explain complaint trends that can be attributed to leisure noise levels, starting from the San Salvario District and extending to different parts of the City.
This enables the creation of expert systems to support better policies to prevent and decrease noise levels and complaints related to noise.
It is encouraged to look at other data sources besides those provided here, such as events (e.g. football games), school and university calendar, weather, etc.…

Outcome

The outcome of this challenge is three-fold:

1. Build a model that can predict noise in recreational nightlife, especially peaks of noise outside what is considered normal (outliers);
2. Study the feasibility of predicting the complaints related to noise levels;
3. Suggesting a framework of how these models can be integrated into the city's decision making process and allocation of resources.

Available Resources

All the data resources can be found here: https://bit.ly/wdl-data

As a reminder, you can also use any data that is open, free and legally available.

Torino has a very big open data portal with many interesting datasets: https://www.torinocitylab.it/en/asset-to/open-data.

If you want to explore social media, some interesting hashtags might be #sansa, #sansalvario, #movida, #movidatorino, #torino.

The following list of resources is available for you to use.

Population, by census micro-areas
GIS files with the data related to the census data.

Pub, restaurants, other business activities
The dataset includes the WKT coordinates of businesses in the San Salvario area.

Noise level measurements
Noise levels measured at several locations in San Salvario. Due to technical issues, some data might be missing on the time series.
Data provided by ARPA Piemonte

There are also two other noise sensors in the following locations, outside of San Salvario, with an increasing busy nightlife:

- TTO-001: via Matteo Pescatore 17; LAT LONG: 45.06499, 7.69756

- TTO-002: via Reggio 3; LAT LONG: 45.07452, 7.69446

Data provided by NOISEMOTE

Noise zoning

The city of Torino is divided into different noise level zones, which can be found here: http://geoportale.comune.torino.it/geocatalogocoto/index.jsp. Typically at night time 10:00 P.M - 06:00 A.M. the noise limit is 50dBa in zone III and 55dBa in zone IV.

Municipal police complaints

All complaints to the police, including the ones related to noise and leisure noise. You will need to use a translation software to aid you.

Number of people in locations - SIM cards

There are 4 + 12 weeks of available data obtained from SIM cards in the area. The data is aggregated by several demographic variables and is representative of all TELCO operators.

Data for 2020 and 2021:

- F1: Age < 18 years old
- F2: Age 18-30 years
- F2: Age 31-40 years
- F3: Age 41-50 years
- F4: Age 51-60 years
- F5: Age > 60 years
- GF: Woman
- GM: Man
- NS: Foreigner
- NI: Italian
- P: Presence
- PH: Human Presence
- TB: Business
- TC: Consumer
- VE: Extraregional visitor
- VI: Intraregrional visitor
- VP: Commuters
- VR: Residents
- VS: Foreigner visitor

The data follows the following rules:

- P = PH
- PH = NI + NS
- NI = TB + TC
- TC = GM + GF
- TC = Sum (Fx)
- PH = VE + VI + VP + VR + VS
- VS = NS

Data for the previous years: the clusters follow the same pattern.

Data gently provided by Olivetti - https://www.olivetti.com (holding Gruppo TIM)

Number of people in locations - WiFi
Data sample collected from connections to the public WiFi in the hot spot of San Salvario.
Data provided by H2020 Rock Project

Georeferenced Data
Other georeferenced data can be found here: http://geoportale.comune.torino.it/geocatalogocoto/?sezione=catalogo, search for 'WFS' (vector) of 'WMS' (raster/images)

Tips

- There is already interesting work done in correlating crowd size and the noise level - it can be a good starting point;
- Don't forget to start with a basic approach and develop it further later on;
- Do not forget the business and product evaluation criteria;
- Do not forget that your model should be explainable.

Submissions

Deadline: 05 - 07 - 2021 @ 01h00 GMT + 1

Don't forget that you will need to submit the solution using the notebook template provided (see below) and a **3-minute** video summary.

Submission template: http://bit.ly/wdl-template