NAAN MUDHALVAN

PUBLIC TRANSPORTATION EFFICIENCY

IN

DATA ANALYTICS

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TEAM NUMBER :

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1.ABSTRACT:

Project Overview: This project aims to enhance public transportation systems in urban areas to promote sustainable and efficient mobility. The modern world is witnessing unprecedented urbanization, leading to increased congestion, pollution, and reduced quality of life. The need for robust and eco-friendly public transportation systems has never been greater. This project sets out to address these challenges by improving public transportation infrastructure, optimizing services, and incorporating innovative technologies to make urban mobility more accessible, efficient, and environmentally friendly.

Key Objectives:

Infrastructure Enhancement: This project will focus on upgrading existing public transportation infrastructure, including the expansion of bus rapid transit (BRT) networks, construction of dedicated bus lanes, and the introduction of modernized bus stops.

Service Optimization: The project will streamline public transportation services by introducing efficient route planning, real-time tracking systems, and fare integration to reduce waiting times and increase convenience for commuters.

Integration of Sustainable Technologies: Embracing environmentally friendly technologies is a core element of this project. We plan to introduce electric and hybrid buses, implement solar-powered charging stations, and promote the use of alternative fuels to reduce the carbon footprint of public transportation.

Accessibility and Inclusivity: We will work on making public transportation accessible to all members of the community, including the elderly and people with disabilities. This will involve installing ramps, ensuring clear signage, and providing low-floor buses.

Public Awareness and Education: We will develop public awareness campaigns to educate citizens about the benefits of using public transportation and encourage the adoption of sustainable travel habits.

Data-Driven Decision-Making: Data analysis and predictive modeling will play a vital role in optimizing routes, schedules, and maintenance, leading to better service delivery and resource allocation.

Financial Viability: To ensure the long-term success of the project, we will explore innovative funding mechanisms and partnerships with private enterprises to manage costs and increase the financial sustainability of public transportation systems.

Safety and Security: The safety and security of passengers and public transportation personnel are paramount. We will introduce surveillance systems, emergency response protocols, and safety awareness initiatives.

Expected Outcomes: The successful implementation of this project will result in a more efficient, sustainable, and reliable public transportation system. This will lead to a reduction in traffic congestion, lower greenhouse gas emissions, improved air quality, and enhanced urban livability. Additionally, the project aims to boost the economy by creating jobs in the transportation and renewable energy sectors.

In conclusion, this project seeks to transform public transportation systems into the backbone of sustainable urban mobility. By focusing on infrastructure, services, technology, and accessibility, we aim to build a brighter and more sustainable future for our cities and their residents.

The abstract outlines the primary goals of public transportation, including providing convenient, affordable, and sustainable mobility options to a diverse population. It explores various strategies for optimizing public transportation, such as route planning, real-time monitoring, and sustainable practices, which collectively contribute to increased efficiency and ridership.

Additionally, the abstract discusses the challenges that public transportation systems face, including funding constraints, infrastructure maintenance, and ensuring accessibility for all residents, including those with disabilities. The paper underscores the importance of data analytics and technology in addressing these challenges and improving system performance.

The abstract concludes by emphasizing the need for collaboration between government authorities, transportation agencies, and the public to create public transportation systems that are efficient, reliable, and accessible to all, promoting the development of sustainable and inclusive cities.

Public transportation systems play a pivotal role in addressing the challenges of urbanization, traffic congestion, and environmental sustainability in modern cities. This abstract provides an overview of the key components and strategies

for improving public transportation systems, emphasizing the significance of efficiency and accessibility. Efficient public transportation systems are essential to fostering economic development, reducing individual vehicle use, and enhancing the overall quality of life for urban residents

The abstract concludes by emphasizing the need for collaboration between government authorities, transportation agencies, and the public to create public transportation systems that are efficient, reliable, and accessible to all, promoting the development of sustainable and inclusive cities.

2. INTRODUCTION:

Public transportation systems serve as the lifeblood of urban environments worldwide. In our rapidly urbanizing world, these systems are indispensable for addressing the growing challenges of traffic congestion, environmental sustainability, and equitable access to mobility services. Public transportation is not merely about moving people from one point to another; it is about creating dynamic, interconnected communities and improving the quality of life in cities. This introduction provides a comprehensive overview of the critical role public transportation systems play in shaping urban mobility and influencing the way we live, work, and thrive in our cities.

2.1 DATASET DESCRIPTION:

Let's begin with a comprehensive overview of the dataset. The table below provides a summary of the key attributes that constitute our dataset. Each attribute is a piece of the puzzle, offering a unique perspective on seismic events

2.2 SIGNIFICANCE OF DATASET:

The dataset on public transportation systems is of significant importance as it provides valuable insights and metrics for optimizing urban mobility, reducing environmental impact, and enhancing the overall quality of life in cities.

2.3 INSIGHTS INTO TEMPORAL PATTERNS:

Analyzing temporal patterns within the public transportation system dataset can offer valuable insights into passenger behavior, allowing for more efficient scheduling and resource allocation, ultimately improving the system's overall performance and user experience.

2.4 GEOGRAPHICAL CLUES:

Geographical clues within the dataset of a public transportation system provide essential information about service coverage, route planning, and accessibility, aiding in the development of more inclusive and effective urban transit networks.

2.5 UNDERSTANDING EVENT TYPES:

Understanding event types within the public transportation system dataset is crucial for assessing and responding to disruptions, such as accidents, special events, or maintenance activities, to ensure the system's reliability and passenger satisfaction.

2.6 DEPTH AND MAGNITUDE RELATIONSHIP:

Exploring the depth and magnitude relationship within the public transportation system data can reveal the intricacies of network performance, helping to identify areas where system improvements are most needed for enhanced efficiency and user experience.

2.7 SIESMIC MONITORING INSIGHTS:

Seismic monitoring insights integrated with the public transportation system data provide valuable information for assessing earthquake-related risks and vulnerabilities, contributing to the development of robust safety protocols and infrastructure resilience.

2.8 DATA QUALITY ASSURANCE:

Data quality assurance for the public transportation system is essential to ensure accurate, reliable, and consistent data, which, in turn, enables effective decision-making, planning, and the delivery of high-quality services to passengers.

2.9 CATEGORICAL ATTRIBUTES:

Categorical attributes within the public transportation system dataset encompass information such as service types, vehicle classes, and stop categories, allowing for the classification and organization of data to better understand and manage the system's diverse components and operations.

2.10 EVENT STATUS:

Event status within the context of a public transportation system refers to the real-time condition or situation affecting the network's operations. These events can encompass a wide range of occurrences, such as delays, accidents, maintenance activities, or special events that might disrupt the regular schedule or service quality. Monitoring and reporting event status is crucial for transportation authorities and passengers alike.

Transportation rely on event status information to assess the impact of events on service delivery, allocate resources efficiently, and implement timely interventions to minimize disruptions. For passengers, event status data is valuable as it enables them to make informed travel decisions, such as choosing alternative routes or modes of transportation to avoid delays or other inconveniences. By providing real-time updates and clear communication about event status, public transportation systems can enhance their reliability, customer satisfaction, and overall resilience in the face of unexpected disruptions.

"Event status" in the context of a public transportation system typically refers to the real-time operational condition of the system, particularly when unexpected incidents or disruptions occur. When an event status is reported, it provides essential information to passengers, transportation authorities, and service operators about any disruptions or delays. This status can range from normal operations (no disruptions) to various event statuses, such as "delayed," "canceled," "diverted," or "suspended." By promptly and accurately communicating event statuses, transportation systems aim to minimize inconvenience to passengers and efficiently manage resources to resolve issues, ensuring the continued reliability of services. Effective communication during such events is crucial to maintaining passenger trust and overall system resilience.

Event status for the public transportation system is currently 'normal,' indicating that all services are running as scheduled without disruptions or delays."

2.11 CONCLUSION

In conclusion, data analytics plays a crucial role in improving public transportation efficiency. By harnessing the power of data, transportation authorities and stakeholders can make informed decisions, optimize routes, and enhance the overall experience for commuters.

3. LOADING THE DATASET

Loading a dataset for your data analytics project depends on the specific dataset you have and the tools or programming languages you're using. Here, I'll provide a general outline of how to load a dataset using Python, a popular language for data analytics, along with the Pandas library.

4. PREPROCESSING THE DATASET

4.1 OVERVIEW

An overview of public transportation efficiency provides insight into the importance, challenges, and strategies involved in optimizing public transportation systems:

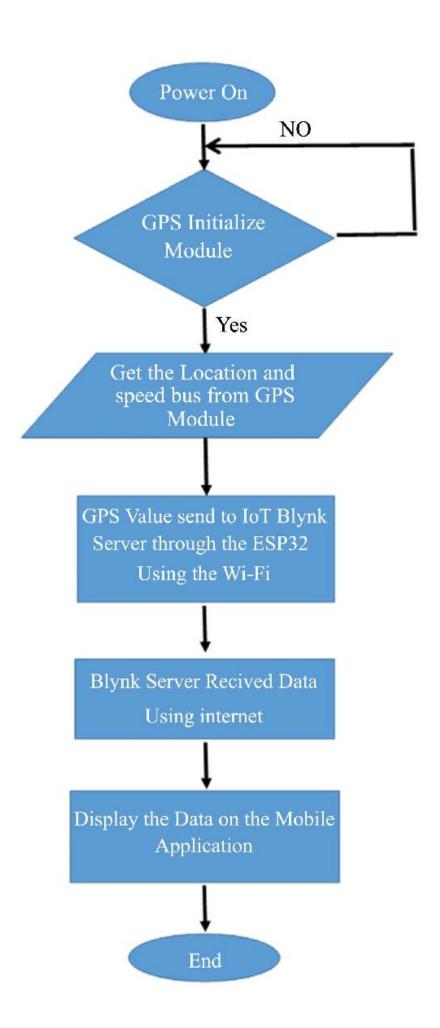Importance of Public Transportation Efficiency:

Urban Mobility: Public transportation is a fundamental component of urban mobility, reducing traffic congestion, pollution, and energy consumption in cities.

Accessibility: Efficient public transportation enhances accessibility, making it easier for people to reach jobs, education, healthcare, and other essential services.

Environmental Sustainability: Reducing the number of individual vehicles on the road lowers greenhouse gas emissions and supports environmental sustainability.

Economic Benefits: Efficient public transportation can reduce transportation costs for individuals and governments, thus contributing to economic well-being.

Social Equity: It promotes social equity by providing affordable and accessible transportation options for a wide range of socio-economic groups.

```
                    ┌──────────────┐
                    │   Power On   │
                    └──────┬───────┘
                           │            NO
                           │◄───────────────────┐
                           ▼                     │
                   ╱───────────────╲             │
                  ╱  GPS Initialize  ╲───────────┘
                  ╲     Module       ╱
                   ╲───────┬────────╱
                           │ Yes
                           ▼
                  ╱─────────────────────╱
                 ╱  Get the Location and ╱
                ╱   speed bus from GPS  ╱
               ╱        Module        ╱
              ╱─────────┬────────────╱
                        ▼
            ┌────────────────────────┐
            │ GPS Value send to IoT  │
            │ Blynk Server through   │
            │ the ESP32 Using the    │
            │        Wi-Fi           │
            └───────────┬────────────┘
                        ▼
            ┌────────────────────────┐
            │ Blynk Server Recived   │
            │ Data Using internet    │
            └───────────┬────────────┘
                        ▼
            ┌────────────────────────┐
            │ Display the Data on the│
            │  Mobile Application    │
            └───────────┬────────────┘
                        ▼
                 ┌──────────────┐
                 │     End      │
                 └──────────────┘
```

4.2 THINGS DONE IN DATA PRE-PROCESSING

Combine data from multiple sources into a single dataset, resolving any discrepancies in data formats and values.

Data Data preprocessing is a critical step in data analysis and machine learning. It involves cleaning and transforming raw data into a format that's suitable for analysis. Here are some common tasks done in data preprocessing:

Data Cleaning:

Handling missing values: Decide whether to remove rows with missing data, impute missing values, or use other methods.

Removing duplicates: Identify and remove duplicate records from the dataset.

Handling outliers: Detect and manage data points that significantly deviate from the norm.

Data Transformation:

Encoding categorical data: Convert categorical variables into numerical representations, such as one-hot encoding or label encoding.

Scaling features: Normalize or standardize numerical features to ensure that they have similar scales.

Log transformations: Apply logarithmic transformations to data to handle skewed distributions.

Feature Selection:

Identify and select the most relevant features for analysis to reduce dimensionality and improve model performance.

Data Imputation:

Fill in missing values using methods like mean, median, mode, or more advanced techniques like regression or k-nearest neighbors.

Data Reduction:

Reduce data dimensionality using techniques like Principal Component Analysis (PCA) or t-distributed Stochastic Neighbor Embedding (t-SNE).

Handling Imbalanced Data:

Address class imbalance in classification tasks by oversampling minority classes, undersampling majority classes, or using techniques like SMOTE (Synthetic Minority Over-sampling Technique).

Date and Time Features:

Extract relevant information from date and time columns, such as day of the week, month, or year.

Text Data Processing:

Tokenization: Split text into individual words or phrases.

Text cleaning: Remove special characters, punctuation, and stop words.

Text vectorization: Convert text data into numerical representations using techniques like TF-IDF or word embeddings.

Handling Skewed Data:

Apply transformations like the Box-Cox or Yeo-Johnson transformation to make data more normally distributed.

Feature Engineering:

Create new features that may be more informative for analysis or modeling.

Data Normalization and Standardization:

Scale numerical features to a common range (e.g., 0 to 1) or standardize them (mean = 0, standard deviation = 1).

Dealing with Data Inconsistencies:

Identify and address inconsistencies in data formatting or units.

Data Binning and Bucketing:

Group data into bins or categories to simplify analysis or to handle continuous data.

Handling Noisy Data:

Identify and remove or smooth noisy data points that may distort analysis or modeling results.

Data Integration:

Sampling:

In cases of large datasets, you might use techniques like random sampling to work with manageable subsets for analysis.

Data preprocessing is a crucial step in ensuring the quality and reliability of your data before analysis or modeling. The specific preprocessing steps you need to perform depend on the nature of your data, the goals of your analysis, and the requirements of your chosen machine learning or data analysis techniques.

4.3 DATA EXPORT

Data export involves saving or transferring data from one system, application, or format to another. This process is crucial for sharing, backing up, archiving, or migrating data. The specific method for data export depends on the source data and the destination. Here are common data export methods and considerations:

Exporting from Databases:

SQL databases: Use SQL queries or database tools to extract data in formats like CSV, Excel, or JSON.

NoSQL databases: Export data in a format suitable for your NoSQL database (e.g., JSON, BSON, or XML).

Exporting from Spreadsheets:

Spreadsheet software (e.g., Microsoft Excel or Google Sheets): Save data in various formats like CSV, Excel, or PDF.

Exporting from Cloud Services:

Cloud storage platforms (e.g., Amazon S3, Google Cloud Storage): Use the platform's tools or APIs to export data, often in various formats.

Cloud-based applications (e.g., Salesforce, Google Analytics): Export data through built-in export features or APIs.

Exporting from Web Applications:

Web scraping: Use web scraping tools, libraries, or code to extract data from websites.

Export functionality: Many web applications provide options to export data in formats like CSV, JSON, or XML.

Exporting from IoT Devices:

IoT devices and sensors: Collect data and transmit it to a server or storage location for export and analysis.

Exporting from ETL (Extract, Transform, Load) Tools:

ETL tools like Apache Nifi, Talend, or Informatica: Set up data pipelines to extract, transform, and load data into the desired destination.

Exporting from Data Warehouses:

Data warehouses (e.g., Snowflake, Amazon Redshift): Use SQL queries or data extraction tools to export data to various formats.

APIs (Application Programming Interfaces):

Some applications and platforms offer APIs that allow you to programmatically access and export data.

Considerations for Data Export:

Data Format: Choose the appropriate format for export, such as CSV, JSON, XML, Excel, or a database format.

Data Quality: Ensure that the data to be exported is accurate and clean, as exporting errors or issues can propagate to downstream systems.

Data Security: Protect sensitive or confidential data during the export process by using encryption and access controls.

Data Volume: Be mindful of the data volume being exported, as large datasets may require optimized export methods.

Destination: Determine where the data will be exported, whether it's another system, storage location, or application.

Data Frequency: Consider whether data export is a one-time task or part of a regular, scheduled process.

Data Mapping and Transformation: If the data format at the source and destination differs, you may need to map and transform the data during export.

Data Compliance: Ensure that your data export process complies with relevant data privacy and legal regulations, such as GDPR or HIPAA.

Data Backup: Data export can serve as a backup or archival process, ensuring that data is safe and can be restored in case of loss or corruption.

Data export is a fundamental part of data management and plays a key role in data analysis, reporting, and sharing information across different systems and platforms. The choice of export method and format should align with your specific use case and data requirements.

5.CONCLUSION

In conclusion, data analytics plays a crucial role in improving public transportation efficiency. By harnessing the power of data, transportation authorities and stakeholders can make informed decisions, optimize routes, and enhance the overall experience for commuters.

6.REFERENCES

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7.APPENDIX: SOURCE CODE

```python
from mpl_toolkits.mplot3d import Axes3D
from sklearn.preprocessing import StandardScaler
import matplotlib.pyplot as plt # plotting
import numpy as np # linear algebra
import os # accessing directory structure
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
```
There are 2 csv files in the current version of the dataset:

```python
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```
```
/kaggle/input/Station_shapefiles.shx
/kaggle/input/Station_shapefiles.dbf
/kaggle/input/Regularities_by_liaisons_Trains_France.csv
/kaggle/input/Travel_titles_validations_in_Paris_and_suburbs.csv
/kaggle/input/Station_shapefiles.prj
/kaggle/input/Station_shapefiles.shp
/kaggle/input/Station_shapefiles.cpg
```
Let's check 1st file: /kaggle/input/Regularities_by_liaisons_Trains_France.csv

```python
nRowsRead = 1000 # specify 'None' if want to read whole file
# Regularities_by_liaisons_Trains_France.csv may have more rows in reality,
but we are only loading/previewing the first 1000 rows
df1 =
pd.read_csv('/kaggle/input/Regularities_by_liaisons_Trains_France.csv',
delimiter=',', nrows = nRowsRead)
df1.dataframeName = 'Regularities_by_liaisons_Trains_France.csv'
nRow, nCol = df1.shape
print(f'There are {nRow} rows and {nCol} columns')
```
```
There are 1000 rows and 32 columns
```
Let's take a quick look at what the data looks like:

```python
df1.head(5)
```

	Year	Month	Departure station	Arrival station	Average travel time (min)	Number of expected circulations	Number of cancelled trains	Number of late trains at departure	Average delay of late departing trains (min)	Average delay of all departing trains (min)	...	Average train delay > 15 min	Number of late trains > 30 min	Number of late trains > 60 min	Period	Delay due to external causes	Delay due to railway infrastructure	Delay due to traffic management	Delay due to rolling stock	Delay due to station management and reuse of material	Delay due to travellers taken into account
0	2019	7.0	ANGOULEME	PARIS MONTPARNASSE	131.914980	247.0	0.0	191.0	3.576353	2.678273	...	32.965873	7.0	2.0	2019-07	25.000000	15.000000	27.500000	12.500000	2.500000	17.500000
1	2019	7.0	PARIS MONTPARNASSE	LA ROCHELLE VILLE	175.611570	242.0	0.0	178.0	9.780805	7.033609	...	32.057143	14.0	2.0	2019-07	20.000000	24.444444	26.666667	24.444444	0.000000	4.444444
2	20	7.0	LE MANS	PARIS MONT	62.395	435.0	5.0	39	3.896	3.529	...	42.367	13.0	4.0	2019	16.176	32.35	26.47	14.705	2.941	7.35

	Year	Month	Departure station	Arrival station	Average travel time (min)	Number of expected circulations	Number of cancelled trains	Number of late trains at departure	Average delay of late departing trains (min)	Average delay of all departing trains (min)	...	Average train delay > 15 min	Number of late trains > 30 min	Number of late trains > 60 min	Period	Delay due to external causes	Delay due to railway infrastructure	Delay due to traffic management	Delay due to rolling stock	Delay due to station management and reuse of material	Delay due to travellers taken into account
19				PARNASSE	349			1.0	974	341		241			-07	471	2941	0588	882	176	2941
3	2019	7.0	ST MALO	PARIS MONTPARNASSE	172.421053	114.0	0.0	101.0	1.9509990	1.6856673	. . .	27.62083	2.0	0.0	2019-07	15.384615	15.384615	23.076923	38.461538	0.000000	7.692308
4	2019	7.0	PARIS MONTPARNASSE	ST PIERRE DES CORPS	67.310000	404.0	4.0	284.0	8.379108	5.803125	. . .	37.658333	12.0	3.0	2019-07	18.461538	12.307692	40.000000	16.923077	7.692308	4.615385

5 rows × 32 columns

Let's check 2nd file:
/kaggle/input/Travel_titles_validations_in_Paris_and_suburbs.csv

```python
nRowsRead = 1000 # specify 'None' if want to read whole file
# Travel_titles_validations_in_Paris_and_suburbs.csv may have more rows in
reality, but we are only loading/previewing the first 1000 rows
df2 =
pd.read_csv('/kaggle/input/Travel_titles_validations_in_Paris_and_suburbs.c
sv', delimiter=',', nrows = nRowsRead)
df2.dataframeName = 'Travel_titles_validations_in_Paris_and_suburbs.csv'
nRow, nCol = df2.shape
print(f'There are {nRow} rows and {nCol} columns')
There are 1000 rows and 5 columns
```
Let's take a quick look at what the data looks like:

```python
df2.head(5)
```

	DATE	STATION_NAME	ID_REFA_LD A	TITLE_CATEGOR Y	NB_VALID
0	21/07/2019	LA TOUR MAUBOURG	71242	NAVIGO	1141
1	21/07/2019	PARMENTIER	71801	NOT DEFINED	Less than 5
2	21/07/2019	PARMENTIER	71801	TST	97
3	21/07/2019	PEREIRE-LEVALLOIS	71453	FGT	53
4	21/07/2019	PERNETY	412687	OTHER	36

Let's check the third file

```python
# Import

from geopandas.tools import geocode
```

```python
import pandas as pd
import geopandas as gpd
```

In [8]:

```python
poly = gpd.read_file('/kaggle/input/Station_shapefiles.shp',
SHAPE_RESTORE_SHX='YES')
```

In [9]:

```python
poly.head(5)
```

Out[9]:

	name	id_refa_ld	station_ty	geometry
0	Boulay	479932	Bus station	POLYGON ((649749.001 6866157.000, 649749.003 6...
1	Drancy Cottage / Pasteur	72669	Bus station	POLYGON ((659702.000 6870754.000, 659702.003 6...
2	Royal	65061	Bus station	POLYGON ((638102.000 6872346.000, 638102.002 6...
3	Fougères	479850	Bus station	POLYGON ((656667.000 6863849.000, 656667.002 6...
4	Charlotte Perriand	71215	Bus station	POLYGON ((650490.000 6861746.000, 650490.003 6...

In [10]:

```python
# Let's merge with df2

df2.merge(poly, how='left', right_on='id_refa_ld', left_on='ID_REFA_LDA')
```

Out[10]:

	DATE	STATION_NAME	ID_REFA_LDA	TITLE_CATEGORY	NB_VALID	name	id_refa_ld	station_ty	geometry
0	21/07/2019	LA TOUR MAUBOURG	71242	NAVIGO	1141	La Tour Maubourg	71242.0	Subway station	POLYGON ((649339.477 6862036.102, 649334.523 6...
1	21/07/2019	PARMENTIER	71801	NOT DEFINED	Less than 5	Parmentier	71801.0	Subway station	POLYGON ((653966.024 6863137.792, 653966.041 6...
2	21/07/2019	PARMENTIER	71801	TST	97	Parmentier	71801.0	Subway station	POLYGON ((653966.024 6863137.792, 653966.041 6...
3	21/07/2019	PEREIRE-LEVALLOIS	71453	FGT	53	Péreire	71453.0	Railway station	POLYGON ((648278.001 6865236.000, 648278.044 6...
4	21/07/2019	PERNETY	412687	OTHER	36	Pernety	412687.0	Subway station	POLYGON ((649882.000 6859520.000, 649882.011 6...

	DATE	STATION_NAME	ID_REFA_LDA	TITLE_CATEGORY	NB_VALID	name	id_refa_ld	station_ty	geometry
...	...	...	...	...	...	...	...	...	...
999	22/07/2019	BUZENVAL	71697	OTHER	30	Avron	71697.0	Subway station	POLYGON ((655779.097 6861454.481, 655779.099 6...
1000	19/08/2019	TRINITE-D'ESTIENNE D'ORVES	71355	OTHER	29	Trinité d'Estienne d'Orves	71355.0	Subway station	POLYGON ((650868.000 6864323.000, 650868.003 6...
1001									