Advanced Data Analytics Portfolio Project Report

Project Title: 911 Calls Analysis Using Advanced Data Analytics
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Learning Track: Data Analysis and Visualisation

Project Overview

This project focuses on analysing 911 call data using big data technologies and visualisation tools as part of the Advanced Data Analytics training with **3MTT Nigeria.** The goal is to extract meaningful patterns from large datasets to aid emergency response optimisation and resource allocation.

Using Python and Power BI, I explored temporal and spatial patterns in emergency call data, focusing on call reasons, peak periods, and high-frequency locations. The project demonstrates the application of advanced data analytics in supporting decision-making within emergency services.

Research Questions
Based on the dataset provided, the following research questions guided the analysis:
1. What are the most common reasons for 911 calls?
2. What are the top zip codes and townships with the highest volume of 911 calls?
3. How do 911 call volumes vary across days of the week and hours of the day?
4. How do 911 call volumes vary across different months?
5. What patterns can be observed in the temporal distribution of 911 calls for each reason category (EMS, Fire, Traffic)?

Data Cleaning & Preparation
Using Python:
- Extracted Reason from the title column.
- Converted time Stamp to datetime format and extracted Hour, Month, DayOfWeek, and DayOfWeekName.
- Checked for missing values and duplicates, cleaning where necessary.
- Created a cleaned dataset for Power BI import.

Using Power BI:
- Imported the cleaned CSV dataset.
- Created calculated columns where necessary for time-based analysis.

Data Analysis & Visualizations

Visuals Created:
- Donut Chart: Distribution of 911 Calls by Reason (EMS, Fire, Traffic).
- Bar Charts: Top zip codes and top townships with the highest call volumes.
- Line Charts: Trends of call volumes over time and by Reason.
- Matrix Heatmap: (created using matrix visual plus conditional formatting) Hour of the day vs. Day of the week to identify peak call periods.
- Clustered Bar Charts: Calls by zip code and township, substituting map visuals for location-based analysis.

Insights:
- EMS calls constitute the majority of 911 calls, followed by Traffic and Fire.
- Specific zip codes and townships consistently report higher call volumes, indicating areas requiring more resources.
- Call volumes peak during daytime hours and mid-week, with reduced activity during late-night hours.
- Seasonal variations are evident, with certain months experiencing higher call volumes.
- Temporal patterns vary across Reason categories, providing insights for targeted emergency response planning.

Issues and Solutions in Big Data Analytics

Issues Identified:
- Difficulty handling date and time parsing and sorting issues due to circular dependencies in Power BI.
- Map visuals were disabled due to Power BI tenant security settings, requiring alternative approaches for spatial analysis.
- Managing large datasets for visualization without performance lag.

Solutions Applied:
- Used Python preprocessing to clean and transform data before visualization.
- Substituted map visuals with bar charts for location-based analysis while maintaining clarity.
- Applied best practices in Power BI (custom sort columns, clear filters, and consistent colour coding) to enhance usability and interpretation.

Conclusion

This project successfully demonstrates the application of advanced data analytics using Python and Power BI for real-world emergency call data. Key insights extracted from the dataset can support emergency services in effective decision-making, resource allocation, and pattern recognition.

The project has strengthened skills in:
- Handling large datasets efficiently.
- Extracting and analysing meaningful patterns using advanced tools.

- Presenting insights in a clear, interactive dashboard for stakeholders.

DASHBOARD RESULTS

Detailed Patterns & Hotspots
Hourly and Location-Based Analysis

Reason

Reason
- [ ] EMS
- [ ] Fire
- [ ] Traffic

Month

Month
- [ ] 1/1/1900
- [ ] 1/10/1900
- [ ] 1/11/1900
- [ ] 1/2/1900
- [ ] 1/3/1900
- [ ] 1/4/1900
- [ ] 1/5/1900

Day of Week

Days
- [ ] Fri
- [ ] Mon
- [ ] Sat
- [ ] Sun
- [ ] Thu
- [ ] Tue
- [ ] Wed

Calll Volume by Hour and Day of Week

DayOfWeekName	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Fri	1983	1635	1449	1296	1239	1639	2670	4143	5018	5288	5584	5843	5994	6181	6394	7040	7065	7113	5668	50
Mon	1898	1517				1944	2675	4430	5504	5724	5458	5632	5881	5664	5713	6289	6346	6408	5441	44
Sat	2447	2059	1883	1592	1631	1580	1880	2499	3457	4315	4944	5450	5555	5378	5421	5181	5211	5213	4980	47
Sun	2424	2135	1945	1616	1577	1506	2400	3001	3728	4262	4438	4882	4654	4744	4475	4560	4505	4402		41
Thu	1731	1408	1426	1238	1293	1775	2816	4432	5297	5412	5464	5492	5898	6173	6079	6493	6375	6935	5512	47
Tue	1720	1210				1797	2784	4425	5634	5566	5498	5582	5795	5794	5926	6252	6495	6883	5628	46
Wed	1660	1368				1609	2668	4644	5469	5444	5367	5639	6092	5953	6069	6533	6745	7062	5691	46
Total	**13863**	**11751**	**10653**	**9488**	**9265**	**11676**	**17219**	**26971**	**33380**	**35477**	**36577**	**38076**	**40097**	**39797**	**40346**	**42263**	**42797**	**44119**	**37322**	**324**

911 Calls by Zip Code

Reason ● EMS ● Fire ● Traffic

911 Calls by Township

Reason ● EMS ● Fire ● Traffic