ENHANCING EMERGENCY RESPONSE EFFICIENCY IN SAN FRANCISCO

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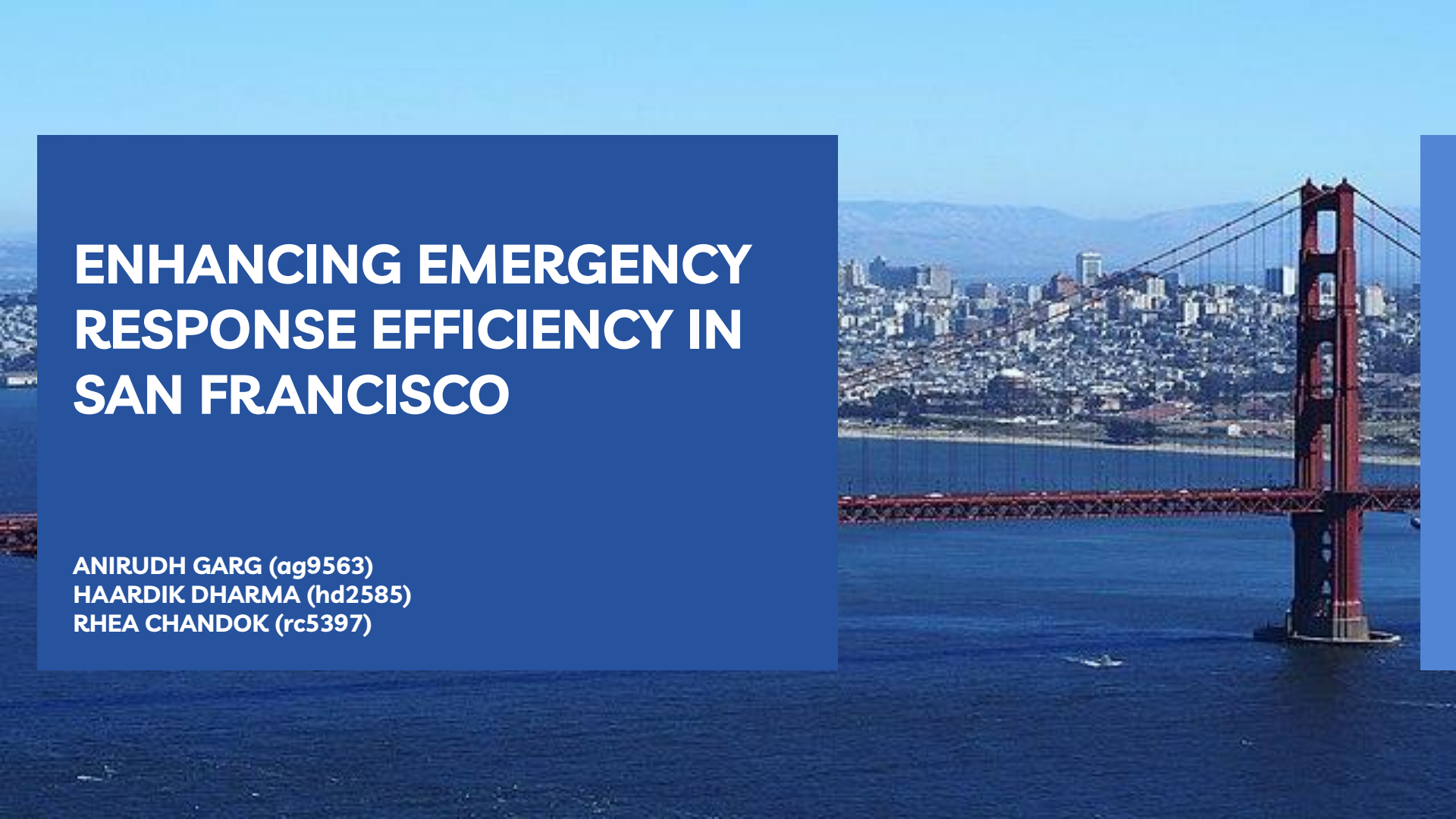


ABSTRACT

This project aims to analyze and provide actionable insights into emergency response times and incident patterns for fire and EMS services in San Francisco. Using publicly available datasets, we investigate response efficiency, identify frequent call types, and uncover temporal patterns. Insights generated from this study can assist policymakers and public safety departments in improving preparedness, resource allocation, and operational workflows.

PLATFORMS USED

1. Hadoop MapReduce - for Data Cleaning
2. Hive - To create tables from data sources
3. Trino - for running queries and analysing data
4. Tableau - for visualizing results of analysis

WHO ARE THE USERS OF THIS ANALYSIS?

EMERGENCY RESPONSE MANAGERS

These individuals oversee operations and coordinate teams during emergencies. They will use the insights to allocate resources effectively, prioritize high-urgency cases, and address systemic inefficiencies.

EXISTING RESIDENTS / POTENTIAL MIGRANTS

The analysis will help current residents of SF by identifying areas with high incident rates and considering moving to safer areas and also new migrants looking to move into the city.

CITY POLICY MAKERS

Policymakers can leverage the data to guide long-term strategies for urban planning and resource investments, ensuring that public safety infrastructure meets the growing demands of the city.

WHO WILL BENEFIT FROM THIS ANALYTICS?

SAN FRANCISCO RESIDENTS

Faster response times during emergencies

FIRST RESPONDERS

Streamlined workflows and improved resource readiness.

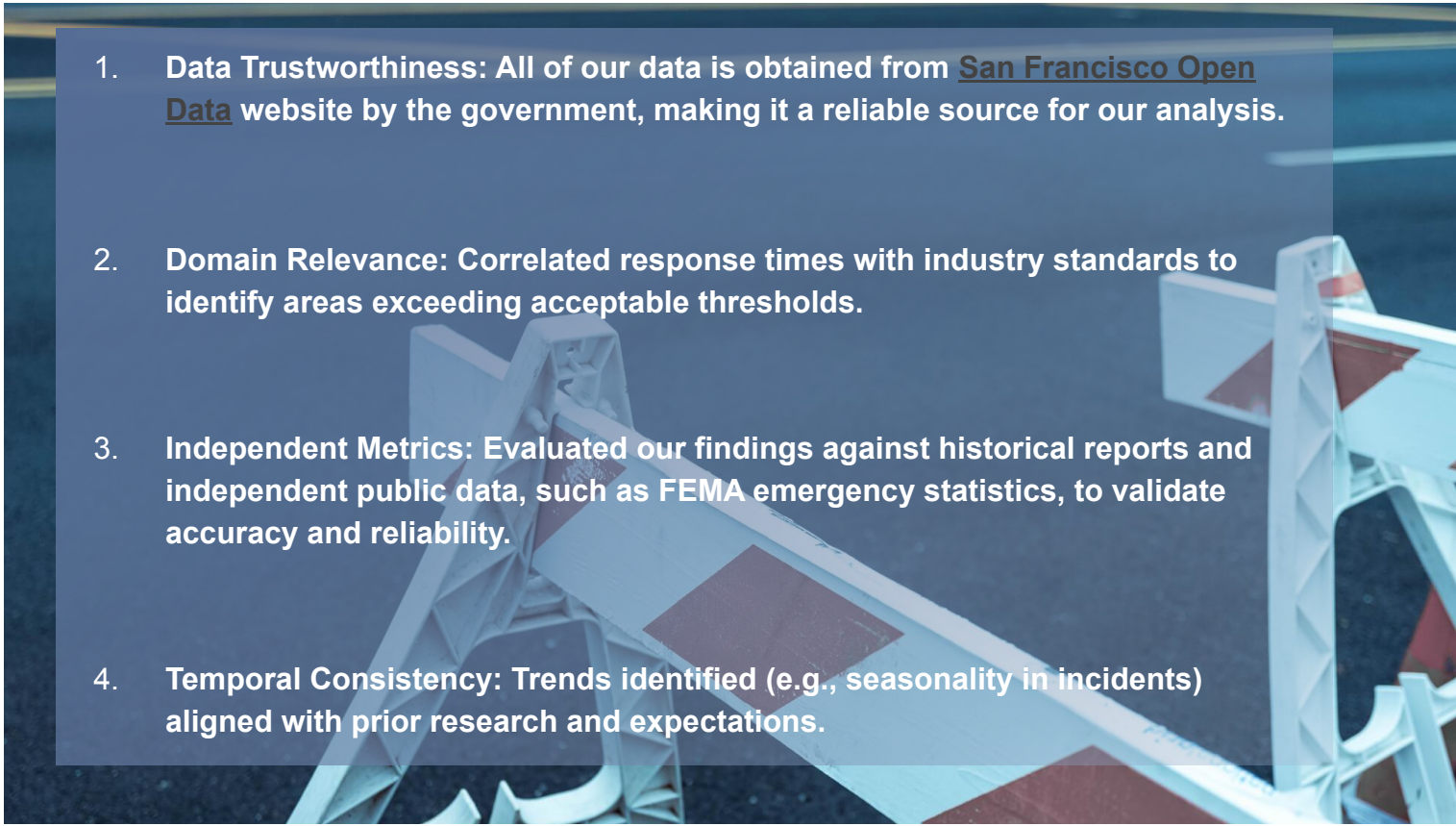
URBAN PLANNERS

Insights for infrastructure improvements in high-incident areas.

WHY IS THIS ANALYSIS IMPORTANT?

Emergency response efficiency directly impacts survival rates in critical situations and reduces the extent of damage during disasters. This analytic provides data-backed insights to address inefficiencies, enabling proactive and reactive solutions. For example, high response times in specific neighborhoods can guide new resource deployments, while seasonal trends can prompt preemptive resource planning.

GOODNESS



1. **Data Trustworthiness: All of our data is obtained from San Francisco Open Data website by the government, making it a reliable source for our analysis.**

2. **Domain Relevance: Correlated response times with industry standards to identify areas exceeding acceptable thresholds.**

3. **Independent Metrics: Evaluated our findings against historical reports and independent public data, such as FEMA emergency statistics, to validate accuracy and reliability.**

4. **Temporal Consistency: Trends identified (e.g., seasonality in incidents) aligned with prior research and expectations.**

DATA SOURCES

FIRE DEPARTMENT AND EMS DISPATCHED CALLS FOR SERVICE	A detailed record of calls made to emergency services, including timestamps, incident types, and response locations.	2.6 GB
FIRE INCIDENTS	Logs of fire incidents, including causes, outcomes, and resource utilization.	285 MB
EMSA EMERGENCY MEDICAL SERVICES RESPONSE TIME	Response time data with priority classifications and timestamps.	482 MB

DATA SOURCE 1: Fire Department and EMS Dispatched Calls for Service

Call Number	Incident Number	Call Type	Call Date	Received DtTm	Response DtTm	On Scene DtTm	Transport DtTm	Hospital DtTm	Call Final Disposition	Address	City
221840342	22084610	Medical Incident	20220703	07/03/2022 04:21:35 AM	07/03/2022 04:23:02 AM	07/03/2022 04:31:00 AM	07/03/2022 04:46:12 AM	07/03/2022 04:51:41 AM	Code 2 Transport	08TH ST/GROVE ST/HYDE ST/MARKET ST	San Francisco
221800915	22083005	Medical Incident	20220629	06/29/2022 10:08:29 AM	06/29/2022 10:12:06 AM	06/29/2022 10:23:36 AM			Code 2 Transport	CALL BOX: ACADEMY OF SCIENCES	San Francisco
221802682	22083229	Medical Incident	20220629	06/29/2022 08:05:59 PM	06/29/2022 08:07:48 PM	06/29/2022 08:09:15 PM			Patient Declined Transport	REVERE AVE/JENNINGS ST	San Francisco
221822278	22084015	Medical Incident	20220701	07/01/2022 05:42:54 PM	07/01/2022 05:44:01 PM	07/01/2022 05:52:54 PM	07/01/2022 06:15:38 PM	07/01/2022 06:26:52 PM	Code 3 Transport	THE EMBARCADERO/KING ST/TOWNSEND ST	San Francisco
221802166	22083151	Medical Incident	20220629	06/29/2022 04:56:01 PM	06/29/2022 05:02:17 PM	06/29/2022 05:20:28 PM	06/29/2022 05:41:38 PM	06/29/2022 05:57:30 PM	Code 2 Transport	ARBOR ST/HILIRITAS AVE	San Francisco
221852209	22085286	Medical Incident	20220704	07/04/2022 05:33:25 PM	07/04/2022 05:34:55 PM	07/04/2022 05:41:47 PM	07/04/2022 06:06:18 PM	07/04/2022 06:12:15 PM	Code 2 Transport	ARGUELLO BLVD/CALIFORNIA ST	San Francisco
221831314	22084355	Medical Incident	20220702	07/02/2022 01:15:00 PM	07/02/2022 01:15:43 PM	07/02/2022 01:18:07 PM			Patient Declined Transport	03RD ST/NEWHALL ST	San Francisco
221772108	22081813	Traffic Collision	20220626	06/26/2022 04:46:27 PM	06/26/2022 04:48:58 PM	06/26/2022 04:51:16 PM			Code 2 Transport	JULIAN AVE/16TH ST	San Francisco
221840134	22084573	Medical Incident	20220703	07/03/2022 01:25:33 AM	07/03/2022 01:26:59 AM				Cancelled	PACIFIC AVE/POWELL ST	San Francisco
221801108	22083030	Medical Incident	20220629	06/29/2022 11:15:33 AM	06/29/2022 11:19:33 AM				Code 2 Transport	ESSEX ST/FOLSOM ST	San Francisco
221801439	22083067	Other	20220629	06/29/2022 01:04:45 PM					SFPD	23RD AVE/CRESTLAKE DR/SLOAT BLVD	San Francisco
221802307	22083166	Medical Incident	20220629	06/29/2022 05:34:22 PM	06/29/2022 05:41:53 PM	06/29/2022 05:47:39 PM			Code 2 Transport	POLK ST/PINE ST	San Francisco
221771500	22081733	Medical Incident	20220626	06/26/2022 01:47:27 PM	06/26/2022 01:54:50 PM				No Merit	STEVENSON ST/07TH ST/ODD FELLOWS WAY	San Francisco
221821966	22083977	Medical Incident	20220701	07/01/2022 03:59:08 PM	07/01/2022 04:03:28 PM	07/01/2022 04:07:18 PM			Patient Declined Transport	EDDY ST/LEAVENWORTH ST	San Francisco
221852463	22085322	Smoke Investigation (Outside)	20220704	07/04/2022 06:49:07 PM	07/04/2022 06:50:58 PM				Fire	CALL BOX: GILMAN AV/EARL ST	San Francisco
221842309	22084876	Other	20220703	07/03/2022 07:42:21 PM	07/03/2022 07:42:21 PM	07/03/2022 07:42:21 PM			Fire	02ND AVE/IRVING ST	San Francisco
221810406	22083369	Medical Incident	20220630	06/30/2022 07:07:42 AM	06/30/2022 07:15:09 AM				Code 2 Transport	POST ST/HYDE ST	San Francisco
221781801	22082237	Medical Incident	20220627	06/27/2022 02:22:59 PM	06/27/2022 02:26:28 PM	06/27/2022 02:31:01 PM			No Merit	02ND ST/STEVENSON ST	San Francisco
221782945	22082399	Structure Fire / Smoke in Building	20220627	06/27/2022 09:15:39 PM	06/27/2022 09:19:37 PM	06/27/2022 09:24:54 PM			Fire	ONONDAGA AVE/OCEAN AVE	San Francisco
221840374	22084614	Medical Incident	20220703	07/03/2022 04:51:15 AM	07/03/2022 04:55:36 AM	07/03/2022 04:58:03 AM			Code 3 Transport	MARY ST/MISSION ST	San Francisco
221783002	22082405	Medical Incident	20220627	06/27/2022 09:33:08 PM	06/27/2022 09:34:11 PM	06/27/2022 09:36:59 PM			Code 2 Transport	ELLIS ST/LARKIN ST	San Francisco
221841670	22084784	Medical Incident	20220703	07/03/2022 03:29:09 PM	07/03/2022 03:31:19 PM	07/03/2022 03:34:42 PM	07/03/2022 04:06:03 PM	07/03/2022 04:23:35 PM	Code 2 Transport	VALLEJO ST/POWELL ST	San Francisco
221850530	22085035	Medical Incident	20220704	07/04/2022 06:35:16 AM	07/04/2022 06:39:43 AM	07/04/2022 06:53:17 AM	07/04/2022 07:08:52 AM	07/04/2022 07:21:23 AM	Code 2 Transport	POLK ST/AUSTIN ST/FRANK NORRIS ST	San Francisco
221822277	22084014	Other	20220701	07/01/2022 05:40:51 PM	07/01/2022 05:45:27 PM	07/01/2022 05:48:53 PM			Fire	VISTA LN/BURNETT AVE	San Francisco

Zipcode of Incident	Battalion	Station Area	Box	Final Priority	ALS Unit	Call Type Group	Number of Alarms	Unit Type	Neighborhooods - Analysis Boundaries
94103.0	B02	36.0	2317.0	3	TRUE	Potentially Life-Threatening	1	MEDIC	Tenderloin
94118.0	B07	22.0	7744.0	3	TRUE	Potentially Life-Threatening	1	ENGINE	Golden Gate Park
94124.0	B10	17.0	6571.0	3	TRUE	Potentially Life-Threatening	1	ENGINE	Bayview Hunters Point
94107.0	B03	8.0	2154.0	3	TRUE	Potentially Life-Threatening	1	MEDIC	Financial District/South Beach
94131.0	B06	26.0	8173.0	2	TRUE	Non Life-threatening	1	MEDIC	Glen Park
94118.0	B07	10.0	7114.0	3	TRUE	Potentially Life-Threatening	1	MEDIC	Presidio Heights
94124.0	B10	25.0	6467.0	3	TRUE	Potentially Life-Threatening	1	MEDIC	Bayview Hunters Point
94103.0	B02	7.0	5236.0	3	TRUE	Potentially Life-Threatening	1	ENGINE	Mission
94133.0	B01	2.0	1416.0	2	FALSE	Non Life-threatening	1	PRIVATE	Chinatown
94105.0	B03	35.0	2136.0	3	TRUE	Potentially Life-Threatening	1	ENGINE	Financial District/South Beach
94132.0	B08	19.0	7463.0	3	TRUE	Alarm	1	ENGINE	Sunset/Parkside
94109.0	B04	3.0	3121.0	2	TRUE	Non Life-threatening	1	ENGINE	Nob Hill
94103.0	B02	1.0	2248.0	3	FALSE	Potentially Life-Threatening	1	SUPPORT	South of Market
94102.0	B02	3.0	1545.0	3	FALSE	Potentially Life-Threatening	1	TRUCK	Tenderloin
94124.0	B10	17.0	6616.0	3	TRUE	Alarm	1	ENGINE	Bayview Hunters Point
94122.0	B05	12.0	7323.0	3	TRUE	Non Life-threatening	1	MEDIC	Inner Sunset
94109.0	B04	3.0	1543.0	3	FALSE	Potentially Life-Threatening	1	TRUCK	Nob Hill
94105.0	B03	1.0	2144.0	3	TRUE	Potentially Life-Threatening	1	ENGINE	Financial District/South Beach
94112.0	B09	15.0	8277.0	3	TRUE	Fire	1	RESCUE CAPTAIN	Outer Mission
94103.0	B03	1.0	2246.0	3	TRUE	Potentially Life-Threatening	1	ENGINE	South of Market
94109.0	B02	3.0	3115.0	3	TRUE	Potentially Life-Threatening	1	SUPPORT	Tenderloin
94133.0	B01	2.0	1353.0	3	TRUE	Potentially Life-Threatening	1	MEDIC	Chinatown
94109.0	B04	41.0	3122.0	2	TRUE	Non Life-threatening	1	MEDIC	Nob Hill
94131.0	B06	24.0	5281.0	3	FALSE	Alarm	1	ENGINE	Twin Peaks

DATA SOURCE 2: Fire Incidents

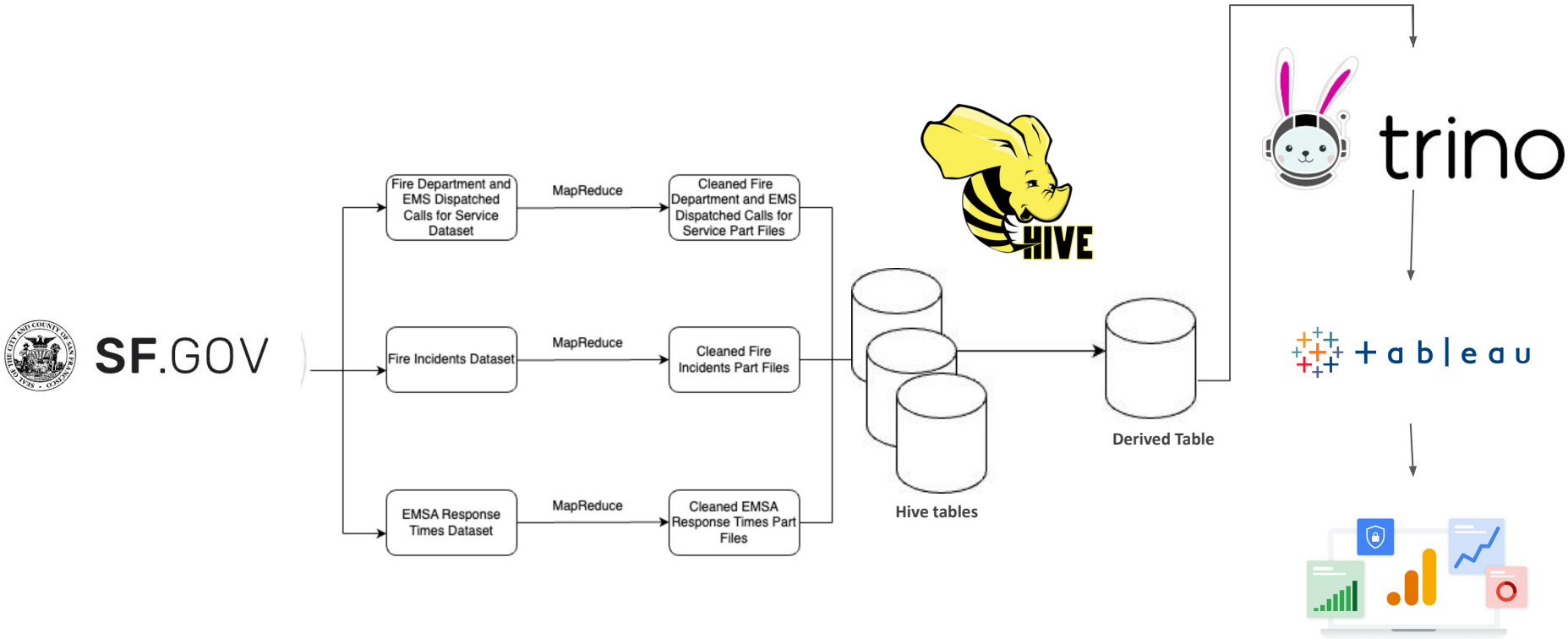
Incident Number	Exposure Number	ID	Address	Incident Date	Call Number	Alarm DtTm	Arrival DtTm	Close DtTm	City	zipcode	Battalion
22077209	0	220772090	DODGE STREET	2022/06/17	221680293	2022/06/17 02:59:32 AM	2022/06/17 03:05:19 AM	2022/06/17 03:05:56 AM	San Francisco	94102	B02
22077219	0	220772190	8TH STREET	2022/06/17	221680374	2022/06/17 04:24:58 AM	2022/06/17 04:30:53 AM	2022/06/17 04:34:48 AM	San Francisco	94103	B03
22077224	0	220772240	THE EMBARCADERO SOU	2022/06/17	221680396	2022/06/17 04:52:37 AM	2022/06/17 04:58:39 AM	2022/06/17 05:01:41 AM	San Francisco	94105	B03
22077228	0	220772280	121 7TH STREET	2022/06/17	221680413	2022/06/17 05:14:59 AM	2022/06/17 05:22:38 AM	2022/06/17 05:22:42 AM	San Francisco	94103	B02
15030507	0	150305070	WEBSTER ST/LOMBARD STREET	2015/03/21	150800248	2015/03/21 01:34:30 AM	2015/03/21 01:38:11 AM	2015/03/21 01:38:55 AM	San Francisco	94123	B04
22077234	0	220772340	54 MCALLISTER STREET	2022/06/17	221680442	2022/06/17 05:42:02 AM	2022/06/17 05:43:30 AM	2022/06/17 06:01:20 AM	San Francisco	94102	B03
22077236	0	220772360	180 12TH STREET	2022/06/17	221680454	2022/06/17 05:54:11 AM	2022/06/17 05:58:59 AM	2022/06/17 06:02:47 AM	San Francisco	94103	B02
22077237	0	220772370	DELANCEY STREET	2022/06/17	221680456	2022/06/17 05:55:36 AM	2022/06/17 06:05:36 AM	2022/06/17 06:05:41 AM	San Francisco	94107	B03
22077238	0	220772380	833 BRYANT STREET	2022/06/17	221680471	2022/06/17 06:08:09 AM	2022/06/17 06:13:42 AM	2022/06/17 06:26:49 AM	San Francisco	94103	B03
22077241	0	220772410	DELANCEY STREET	2022/06/17	221680495	2022/06/17 06:25:59 AM	2022/06/17 06:29:43 AM	2022/06/17 07:28:03 AM	San Francisco	94107	B03
22077242	0	220772420	888 OFARRELL STREET	2022/06/17	221680503	2022/06/17 06:32:15 AM	2022/06/17 06:35:51 AM	2022/06/17 06:47:11 AM	San Francisco	94109	B04
22077244	0	220772440	101 TOWNSEND STREET	2022/06/17	221680509	2022/06/17 06:38:09 AM	2022/06/17 06:42:27 AM	2022/06/17 06:49:52 AM	San Francisco	94107	B03
22077245	0	220772450	303 2ND STREET	2022/06/17	221680510	2022/06/17 06:38:31 AM	2022/06/17 06:43:57 AM	2022/06/17 06:47:27 AM	San Francisco	94107	B03
22077249	0	220772490	MISSION STREET	2022/06/17	221680544	2022/06/17 07:05:31 AM	2022/06/17 07:13:24 AM	2022/06/17 07:14:18 AM	San Francisco	94103	B02
22077251	0	220772510	519 ELLIS STREET	2022/06/17	221680561	2022/06/17 07:14:52 AM	2022/06/17 07:18:44 AM	2022/06/17 07:27:54 AM	San Francisco	94109	B02
15030508	0	150305080	1415 GUERRERO STREET	2015/03/21	150800250	2015/03/21 01:35:15 AM	2015/03/21 01:39:56 AM	2015/03/21 01:51:44 AM	San Francisco	94110	B06
22077253	0	220772530	800 INDIANA STREET	2022/06/17	221680569	2022/06/17 07:19:37 AM	2022/06/17 07:24:44 AM	2022/06/17 07:35:19 AM	San Francisco	94107	B10
22077261	0	220772610	1188 MISSION STREET	2022/06/17	221680601	2022/06/17 07:37:26 AM	2022/06/17 07:42:32 AM	2022/06/17 07:52:51 AM	San Francisco	94103	B02
22077265	0	220772650	3421 VICENTE STREET	2022/06/17	221680632	2022/06/17 07:54:16 AM	2022/06/17 08:02:52 AM	2022/06/17 09:24:45 AM	San Francisco	94116	B08
22077268	0	220772680	GUERRERO STREET	2022/06/17	221680658	2022/06/17 08:07:32 AM	2022/06/17 08:11:48 AM	2022/06/17 09:23:39 AM	San Francisco	94103	B02

Station Area	Box	Suppression Units	Suppression Personnel	Fire Fatalities	Fire Injuries	Civilian Fatalities	Civilian Injuries	Number of Alarms	Primary Situation	Mutual Aid	Action Taken Primary	Action Taken Secondary	Action Taken Other	Supervisor District	neighborhood_district
3	1554	1	4	0	0	0	0	1	151 Outside rubbish, trash or waste fire	N None	87 Investigate fire out on arrival			5	Tenderloin
29	2324	1	4	0	0	0	0	1	324 Motor vehicle accident with no injuries.	N None	31 Provide first aid & check for injuries			6	South of Market
35	2131	1	4	0	0	0	0	1	531 Smoke or odor removal	N None	86 Investigate			6	Financial District/South Beach
1	2315	1	5	0	0	0	0	1	600 Good intent call, other	N None	00 Action taken, other			6	South of Market
16	3461	2	9	0	0	0	0	1	700 False alarm or false call, other	N None	86 Investigate			2	Marina
36	1455	8	29	0	0	0	0	1	150 Outside rubbish fire, other	N None	86 Investigate	45 Remove hazard		5	Tenderloin
36	5116	3	10	0	0	0	0	1	735 Alarm system sounded due to malfunction	N None	86 Investigate			6	Mission
35	2134	1	4	0	0	0	0	1	500 Service Call, other	N None	86 Investigate			6	Financial District/South Beach
8	2255	3	10	0	0	0	0	1	745 Alarm system activation, no fire - unintentional	N None	86 Investigate			6	South of Market
35	2134	4	14	0	0	0	0	1	151 Outside rubbish, trash or waste fire	N None	11 Extinguishment by fire service personnel			6	Financial District/South Beach
3	1642	3	10	0	0	0	0	1	735 Alarm system sounded due to malfunction	N None	86 Investigate			5	Tenderloin
8	2154	3	11	0	0	0	0	1	745 Alarm system activation, no fire - unintentional	N None	86 Investigate			6	Mission Bay
35	2147	3	11	0	0	0	0	1	745 Alarm system activation, no fire - unintentional	N None	86 Investigate			6	Financial District/South Beach
1	2318	1	4	0	0	0	0	1	151 Outside rubbish, trash or waste fire	N None	11 Extinguishment by fire service personnel			6	South of Market
3	1555	3	11	0	0	0	0	1	730 System malfunction, other	N None	86 Investigate	63 Restore fire alarm system		5	Tenderloin
11	5612	3	10	0	0	0	0	1	733 Smoke detector activation due to malfunction	N None	86 Investigate			8	Mission
25	2535	3	10	0	0	0	0	1	735 Alarm system sounded due to malfunction	N None	60 Systems and services, other			10	Potrero Hill
1	2318	3	11	0	0	0	0	1	743 Smoke detector activation, no fire - unintentional	N None	86 Investigate			6	South of Market
23	7711	1	4	0	0	0	0	1	320 Emergency medical service incident, other	N None	33 Provide advanced life support (ALS)			4	Sunset/Parkside
6	5126	1	4	0	0	0	0	1	320 Emergency medical service incident, other	N None	32 Provide basic life support (BLS)			8	Mission
12	4544	3	10	0	0	0	0	1	735 Alarm system sounded due to malfunction	N None	86 Investigate			5	Haight Ashbury
12	7323	3	10	0	0	0	0	1	744 Detector activation, no fire - unintentional	N None	86 Investigate			7	Inner Sunset
51	4612	3	10	0	0	0	0	1	500 Service Call, other	N None	80 Information, investigation & enforcement, other			2	Presidio
33	8462	3	11	0	0	0	0	1	746 Carbon monoxide detector activation, no CO	N None	86 Investigate			11	Oceanview/Merced/Ingleside
35	938	7	27	0	0	0	0	1	364 Surf rescue	N None	30 Emergency medical services, other			6	Mission Bay
16	3444	3	10	0	0	0	0	1	733 Smoke detector activation due to malfunction	N None	86 Investigate			2	Marina
13	1233	3	11	0	0	0	0	1	700 False alarm or false call, other	N None	86 Investigate			3	Chinatown
16	4111	1	5	0	0	0	0	1	522 Water or steam leak	N None	80 Information, investigation & enforcement, other			2	Marina
7	5245	3	12	0	0	0	0	1	324 Motor vehicle accident with no injuries.	N None	86 Investigate			9	Mission
29	2413	1	4	0	0	0	0	1	324 Motor vehicle accident with no injuries.	N None	31 Provide first aid & check for injuries			6	Mission Bay

DATA SOURCE 3: EMSA Emergency Medical Services Response Time

rowid	response_type	incident_number	call_date	final_priority	month_name	month_no	response_time_min	data_as_of	data_loaded_at
5699373574936218805	BLS	19078955	2019-07-04	3	Jul	7	1.733333	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-4817722923399318001	BLS	19079602	2019-07-05	3	Jul	7	3.516667	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-8006228636267180647	BLS	19078858	2019-07-04	3	Jul	7	3.916667	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-1609864475943773635	BLS	19080529	2019-07-08	3	Jul	7	3.15	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-8101582846987144501	BLS	10067250	2010-08-01	3	Aug	8	2.05	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
6910895476729004508	BLS	10067534	2010-08-02	3	Aug	8	1.033333	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-2407938200679982125	BLS	10068356	2010-08-05	3	Aug	8	3.366667	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
1600089472899853076	BLS	19005149	2019-01-12	3	Jan	1	4.4	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
8852301842815362010	BLS	19006374	2019-01-16	3	Jan	1	4.633333	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
3379911484554788744	BLS	19007492	2019-01-18	3	Jan	1	4.666667	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-3342905748076593977	BLS	10067581	2010-08-02	3	Aug	8	3.133333	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-198416464718374291	BLS	19006213	2019-01-15	3	Jan	1	2.9	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
8615084355900929939	BLS	19006727	2019-01-16	3	Jan	1	3	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-3659412390443698931	BLS	19008469	2019-01-20	3	Jan	1	2.166667	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
2103277144190636100	BLS	19009093	2019-01-22	3	Jan	1	3.75	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-97228868725526834	BLS	23035980	2023-03-15	3	Mar	3	3.666667	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-6282736837130140111	BLS	23036246	2023-03-15	3	Mar	3	1.616667	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-1204622472667913916	BLS	23036385	2023-03-16	3	Mar	3	6.4	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
3899269936510890316	BLS	23035796	2023-03-14	3	Mar	3	4.05	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-7613540884387732618	BLS	7014641	2007-02-19	3	Feb	2	4.95	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM
-1277337936450507911	BLS	7015417	2007-02-21	3	Feb	2	2.633333	2024/06/03 03:29:28 AM	2024/06/03 01:02:30 PM

DESIGN DIAGRAM



CODE CHALLENGE

- Preserving the header row while cleaning the dataset using MapReduce.
- The header row cannot be processed as a key-value pair.
- It's not guaranteed to appear first in the output when processed normally.

Solution:

- Implemented a static boolean variable in the reducer function.
- The boolean variable ensured that the header row was added to the output first.
- After adding the header, the reducer emitted the remaining key-value pairs.

```
private boolean isHeaderWritten = false;

@Override
public void reduce(Text key, Iterable<Text> values, Context context) throws IOException, InterruptedException {
    // Write the header only once
    if (!isHeaderWritten) {
        String header = "Call Number,Incident Number,Call Type,Call Date,Received DtTm,Response DtTm,
            On Scene DtTm,Transport DtTm,Hospital DtTm,Call Final Disposition,Address,City,
            Zipcode of Incident,Battalion,Station Area,Box,Final Priority,ALS Unit,Call Type Group,
            Number of Alarms,Unit Type,Neighborhooods - Analysis Boundaries";
        context.write(null, new Text(header));
        isHeaderWritten = true;
    }
```

CODE CHALLENGE

- Managing the many-to-many relationship between zip codes and neighborhoods.
- Multiple variations of a single zip code (example: **94111** and **94111-0000**).

Solution:

- Changing query from:
  - **SELECT zipcode, COUNT(*) AS incident_count**

    TO

  - **SELECT SUBSTR(zipcode, 1, 5) AS zipcode, COUNT(*) AS incident_count**
- This query extracted the first five characters of the zipcode, effectively standardizing all zipcodes to their five-digit format and grouped the results by this five-digit zipcode.

CODE CHALLENGE

The query involved joining large datasets **(Fire Department and EMS Dispatched Calls for Service**) with smaller datasets (**Fire Incidents/Medical Services Response Time**) while ensuring minimal data shuffling to improve performance.

Solution: Implemented a Broadcast Join, which replicates the smaller table (response_data) across all nodes, reducing data movement and enabling faster joins

Without broadcast

```
Query 20241212_060132_00125_fv4rc, FINISHED, 2 nodes
Splits: 108 total, 108 done (100.00%)
7.60 [5.66M rows, 874MB] [745K rows/s, 115MB/s]
```

With broadcast

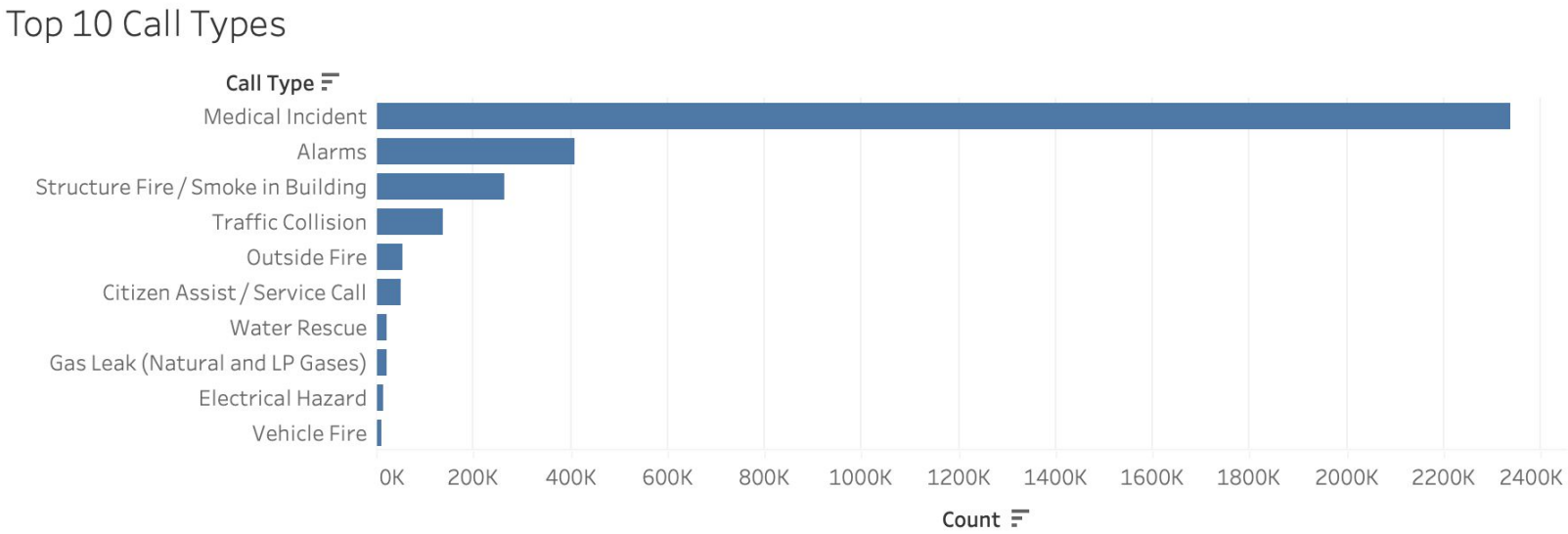
```
Query 20241212_062351_00193_fv4rc, FINISHED, 2 nodes
Splits: 108 total, 108 done (100.00%)
2.27 [5.66M rows, 874MB] [2.49M rows/s, 385MB/s]
```

Impact: The query execution time was reduced significantly by avoiding data shuffling, demonstrating the effectiveness of broadcast joins for queries involving small lookup tables.

RESULTS

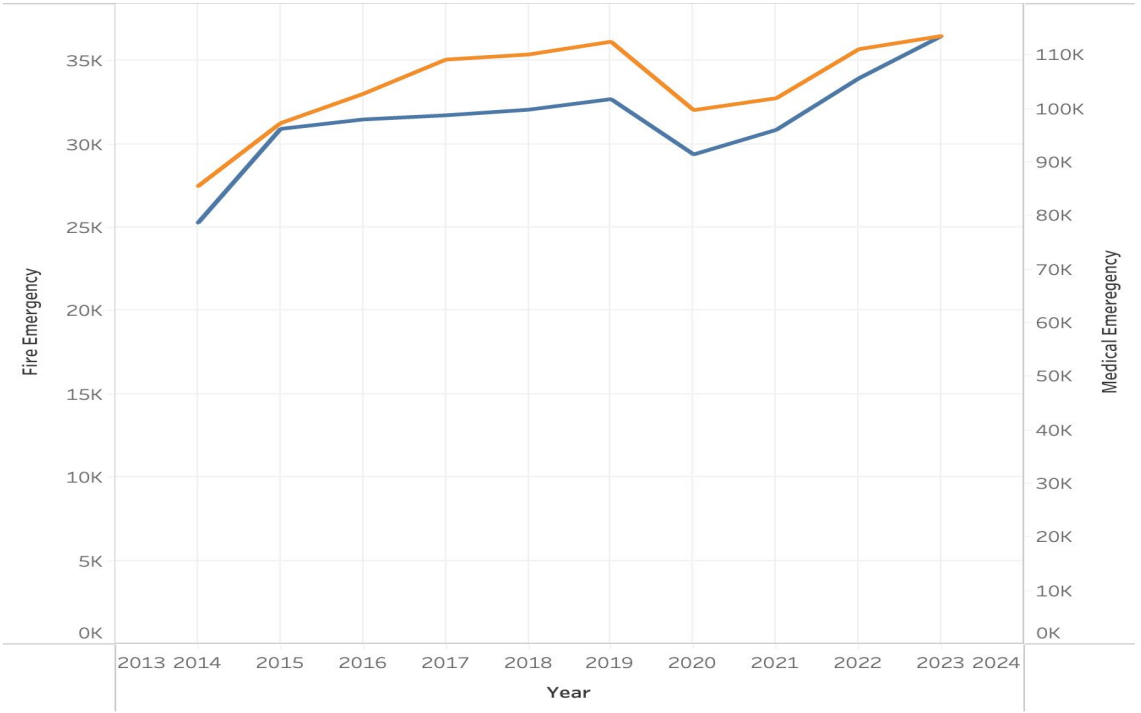
CALL TYPES

First, we looked at what are the top 10 emergency call types



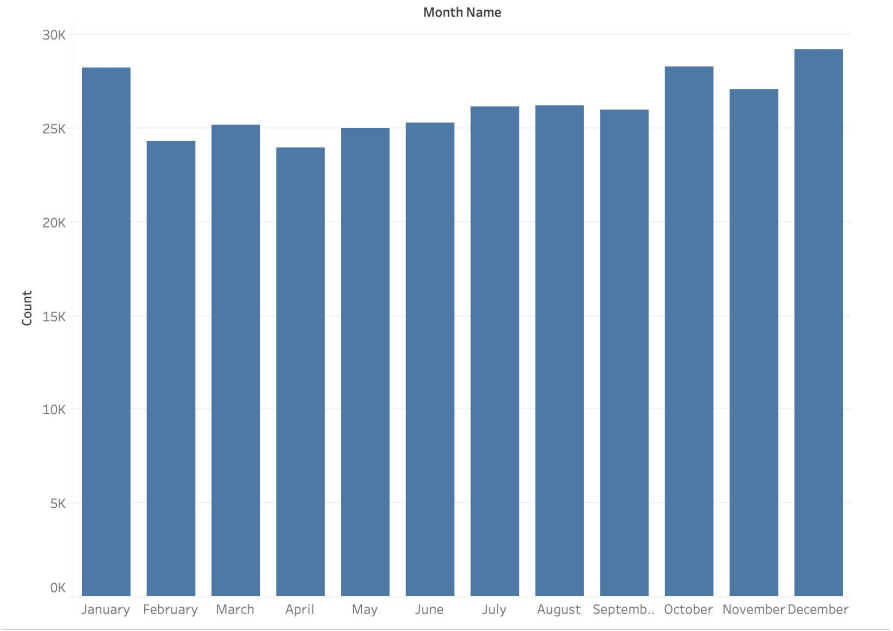
Medical and Fire Emergencies are the top 2 categories

UNDERSTANDING TEMPORAL TRENDS

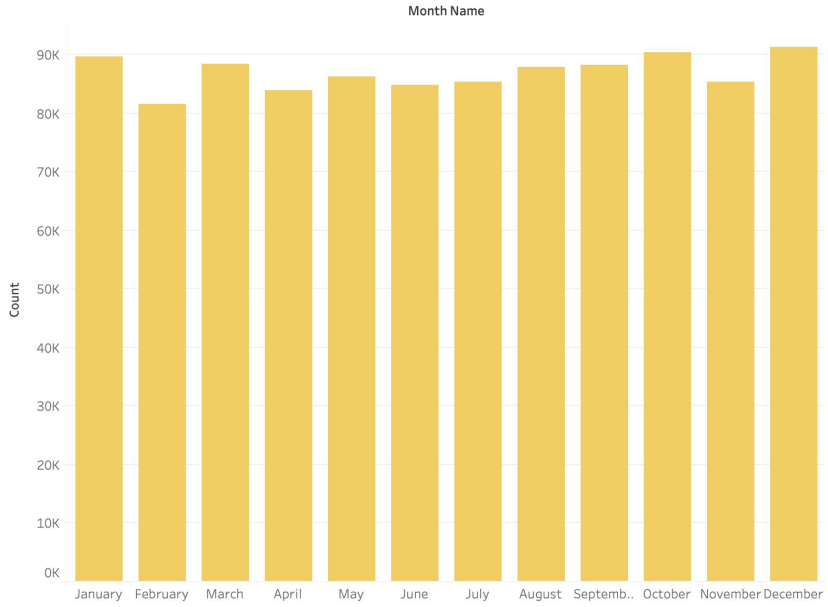


There is a dip in 2019-2021 because most of the emergencies during this time were due to the Covid-19 pandemic, and that data is not included in these datasets.

Fire Emergency Monthly Trend



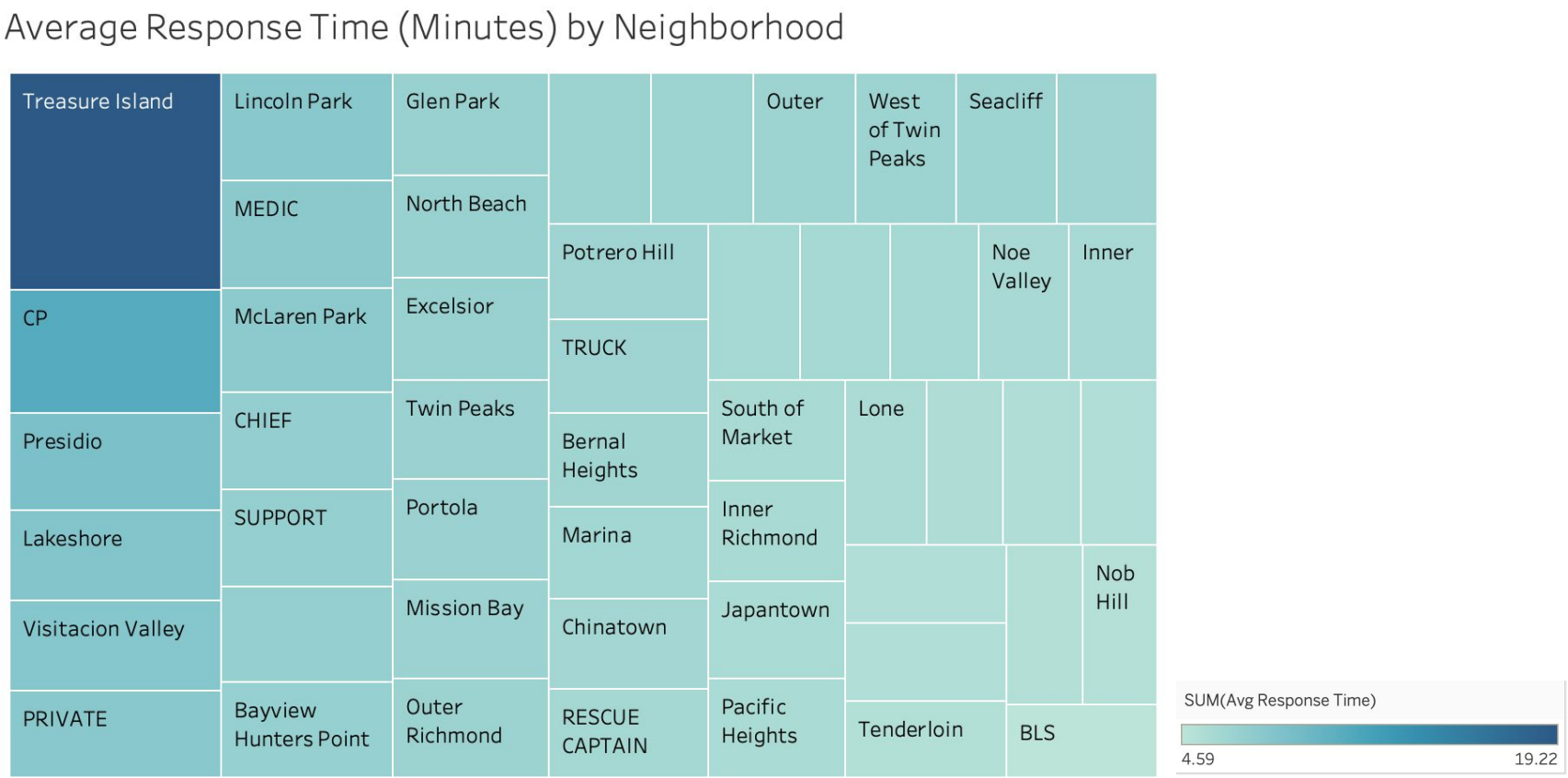
Medical Emergency Monthly Trend



There are more fire emergencies in winter months vs summer months

Heating, holiday decorations, winter storms and candles all contribute to an increased risk of fire during the winter months.

RESPONSE TIME ANALYSIS

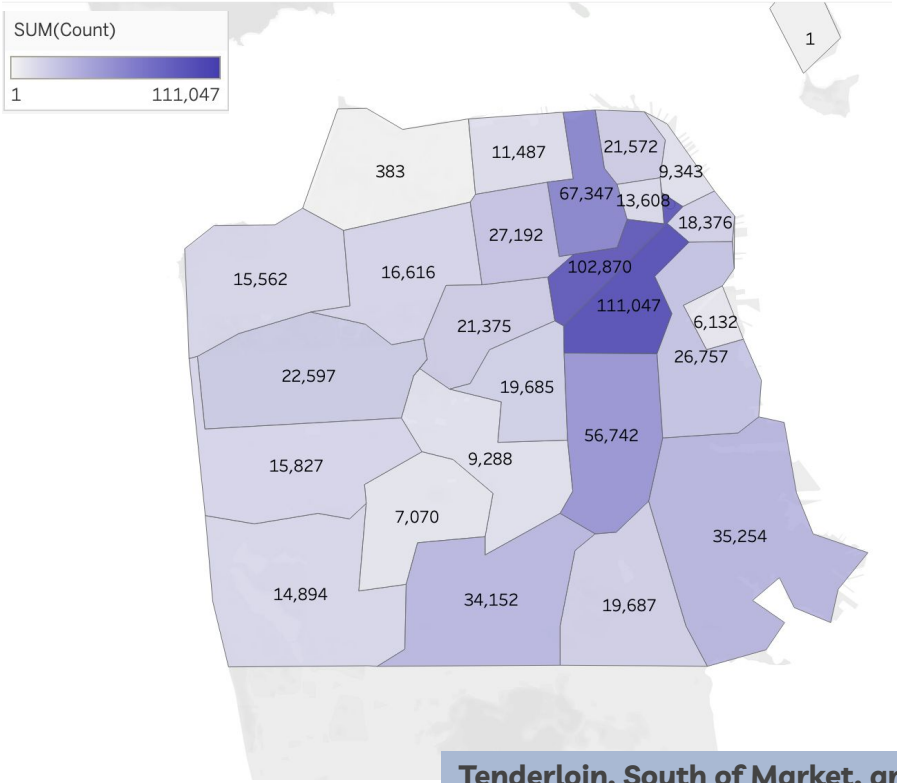


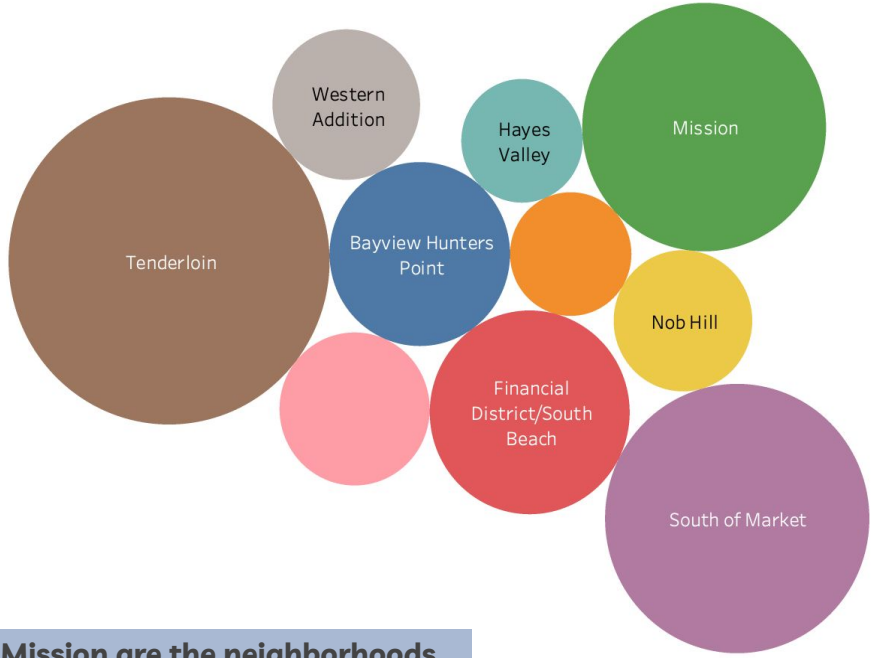
REGION WISE ANALYSIS

These areas are characterized by a combination of:

- **High population density, transient populations, and socio-economic challenges.**
- **Limited accessibility for emergency response vehicles in densely packed urban environments.**

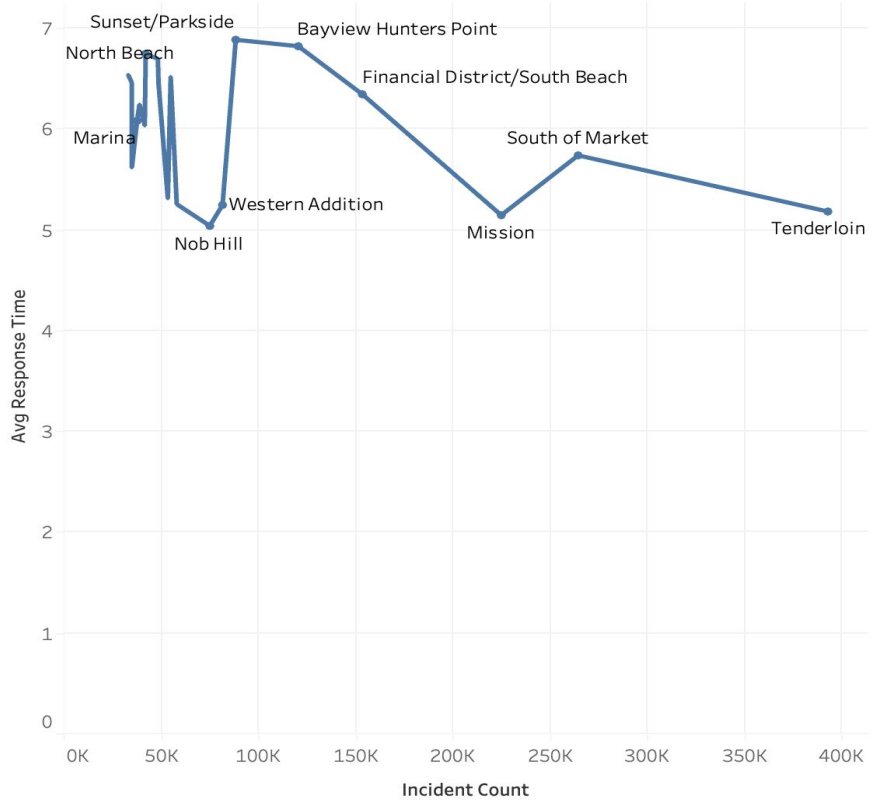
Potentially Life Threatening Incidents by Area





Tenderloin, South of Market, and Mission are the neighborhoods with highest number of life threatening incidents

WORST NEIGHBORHOODS TO STAY IN



Neighborhoods with high incident count and high response time

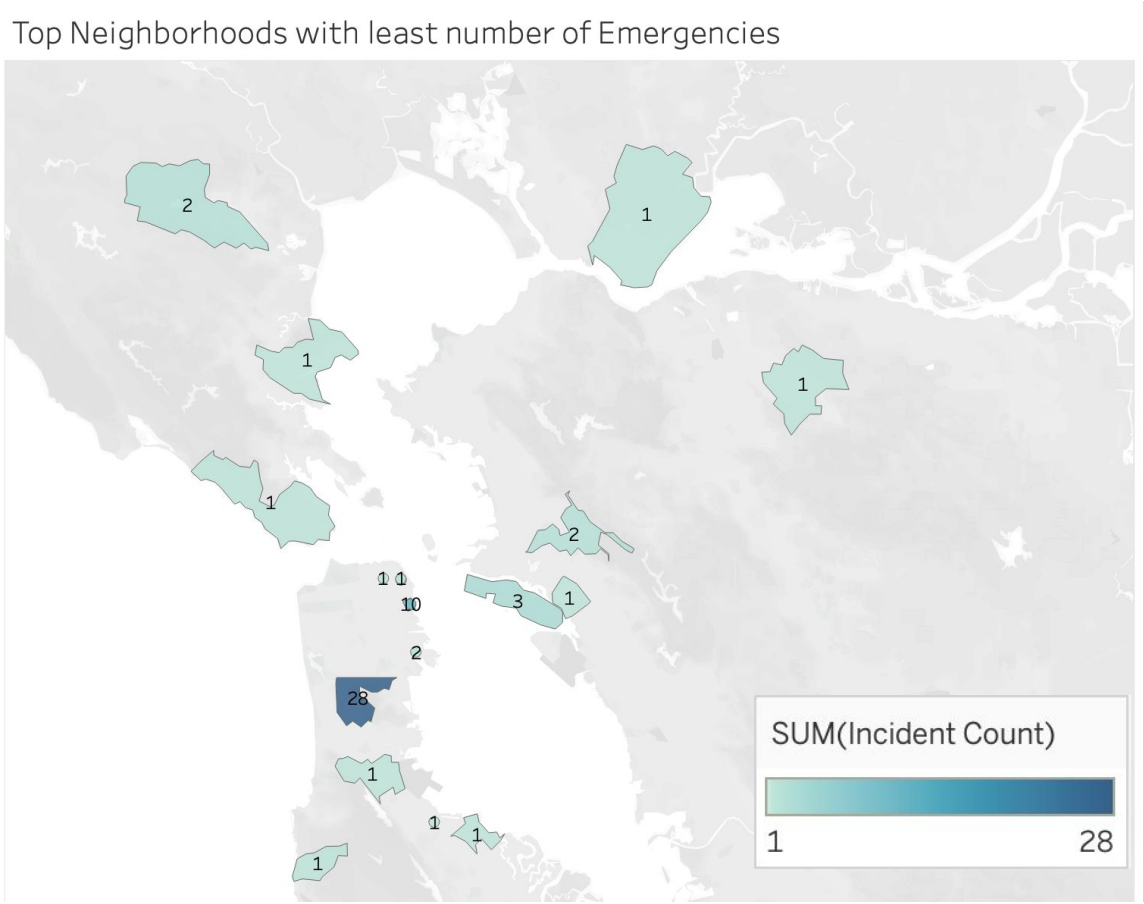
1. **Bayview Hunters Point**
2. **Financial District/South Beach**
3. **Sunset/Parkside**

Correlation Between Incident Volume and Response Delays

Neighborhoods with both high incident counts and elevated average response times include:

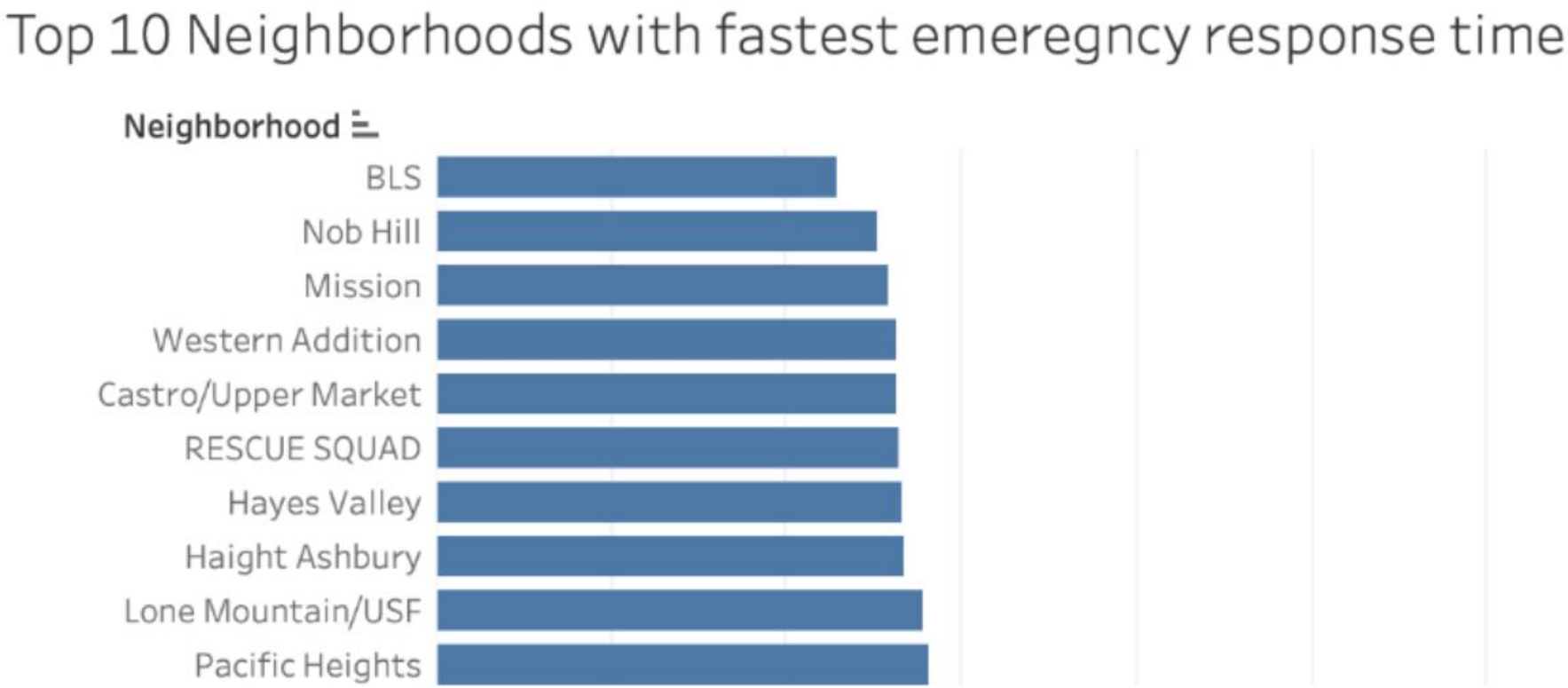
- **Bayview Hunters Point, Financial District/South Beach, and Sunset/Parkside: Urban zones with high traffic congestion and complex layouts.**
- **Suburban and Peripheral Areas:**
  - **Benicia, Muir Beach, Alameda, San Bruno, San Mateo: Limited proximity to emergency response hubs and extended travel times contribute to delays.**
- **These findings highlight the importance of strategic resource allocation and localized response units.**

BEST NEIGHBORHOODS TO STAY IN



1. Benicia
2. Muir Beach
3. Alameda
4. San Bruno
5. San Mateo

BEST NEIGHBORHOODS TO STAY IN



OBSTACLES

NEIGHBORHOOD TO ZIP CODE MAPPING

In some cases a particular neighborhood mapped to multiple zip codes and vice versa.

UNDERSTANDING DATA

The data had certain domain specific columns eg. Response Type (ALS/BLS), Unit Type (MEDIC/ENGINE/TRUCK) which required us to dig deeper and understand its context

SUMMARY

This project analyzed emergency response times and patterns in San Francisco, focusing on fire and EMS incidents. The goal was to identify trends and provide actionable insights for improving response efficiency. Key findings include:

- Top Incident Types: Medical and fire emergencies were the most frequent.
- Impact of the Pandemic: A noticeable dip in incidents during 2019-2021, as Covid-19-related data was excluded from the datasets.
- Seasonal Patterns: Fire emergencies were more frequent in winter months compared to summer.
- High-Risk Neighborhoods: Tenderloin, South of Market, and Mission had the highest number of life-threatening incidents.
- Response Time Insights: Several neighborhoods (e.g., Bayview Hunters Point, Financial District/South Beach) showed high incident counts and response times, indicating a need for better resource allocation.

ACKNOWLEDGEMENTS

- **Professor Yang Tang**: For his guidance and support throughout the Realtime and Big Data Analytics course, which provided invaluable insights and direction for this project.

- **NYU High-Performance Computing (HPC)**: For granting access to computational resources that facilitated efficient data processing and analysis.

- **Tableau**: For providing a free trial of their software, enabling advanced data visualization and analytics for this project.

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THANK YOU!