911 Call Data Analysis – Montgomery County, PA

Course: BUAN 6320 – Database Foundations for Business Analytics

Team: Group 11

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Dataset Link: Emergency 911 Calls – Montgomery County, PA

INTRODUCTION

Project Overview: This project analyzes over 663,000 emergency 911 calls from Montgomery County, Pennsylvania (December 2015 to July 2020). Each record includes the call time, emergency type, location details, and coordinates. For analysis, we derived additional fields such as the emergency category (EMS, Traffic, Fire), specific call reason, and time-based attributes like year, hour of day, and weekday vs. weekend. Using SQL, we explored these features to uncover meaningful patterns in emergency demand.

Scope: The analysis focuses on questions that help emergency services understand how demand changes over time and location. We examined call volumes throughout the day, compared weekdays and weekends, and reviewed year-to-year trends. We also looked at how many incidents fall into EMS, Traffic, or Fire categories and identified the most frequent reasons within each category. To understand geographic needs, we highlighted townships and intersections with the highest number of calls. These findings show how SQL exploration of historical 911 data can uncover important insights for planning.

Relevance: Understanding when and where emergencies happen helps agencies allocate people and resources more effectively. The insights from this project can guide staffing during busy hours, support training and equipment decisions for EMS teams, and inform safety improvements in high-call areas. Using real data instead of assumptions, emergency service managers, dispatch supervisors, and local officials can make decisions that improve response times and strengthen public safety.

Problem Statement

Emergency services in Montgomery County deal with changing demand across different times, locations, and incident types while working with limited staff, vehicles, and budgets. Planning often relies on assumptions instead of data, which can lead to slower response times and inefficient use of resources.

Key Challenges

- **Time-based changes:** Call volume rises and falls throughout the day, week, and year, with predictable spikes such as afternoon accidents or busy holiday periods.
- **Different emergency types:** EMS, Traffic, and Fire calls follow different patterns, so using the same staffing approach for all types is not effective.
- **Geographic hotspots:** Some townships and intersections consistently produce high call volumes, creating uneven demand across the county.
- **Lack of data-driven planning:** Without insight from historical data, staffing and resource allocation may not match real needs.

Business Objectives

The goal of this project is to use historical 911 call data to understand emergency demand and support smarter planning.

Objectives

- **Measure overall demand:** Calculate total call volume, time span, and average calls per day to understand the workload on the 911 system.
- **Identify peak periods:** Analyze calls by hour, day, weekday vs weekend, and year to determine the busiest and quietest times.
- **Understand incident types:** Break down calls into EMS, Traffic, and Fire categories and identify the most common reasons within each group.
- **Locate high-demand areas:** Find the townships and intersections with the highest call activity to understand where resources are needed most.
- **Create practical recommendations:** Use the insights to inform staffing, training, prevention programs, and safety improvements.

Target Audience

This analysis is designed for people involved in emergency services and public safety who rely on accurate information to make decisions.

Stakeholders

- **Emergency service managers and dispatch supervisors:** They can adjust staffing and deployment based on peak times and high-demand locations.
- **Police, fire, and EMS leadership:** They can use incident patterns to guide training, equipment needs, and department planning.
- **City planners and local government officials:** They can use geographic insights to improve roads, signage, and community safety infrastructure.
- **Policy makers and public safety analysts:** They can design better policies, safety programs, and community outreach based on the trends in the data.

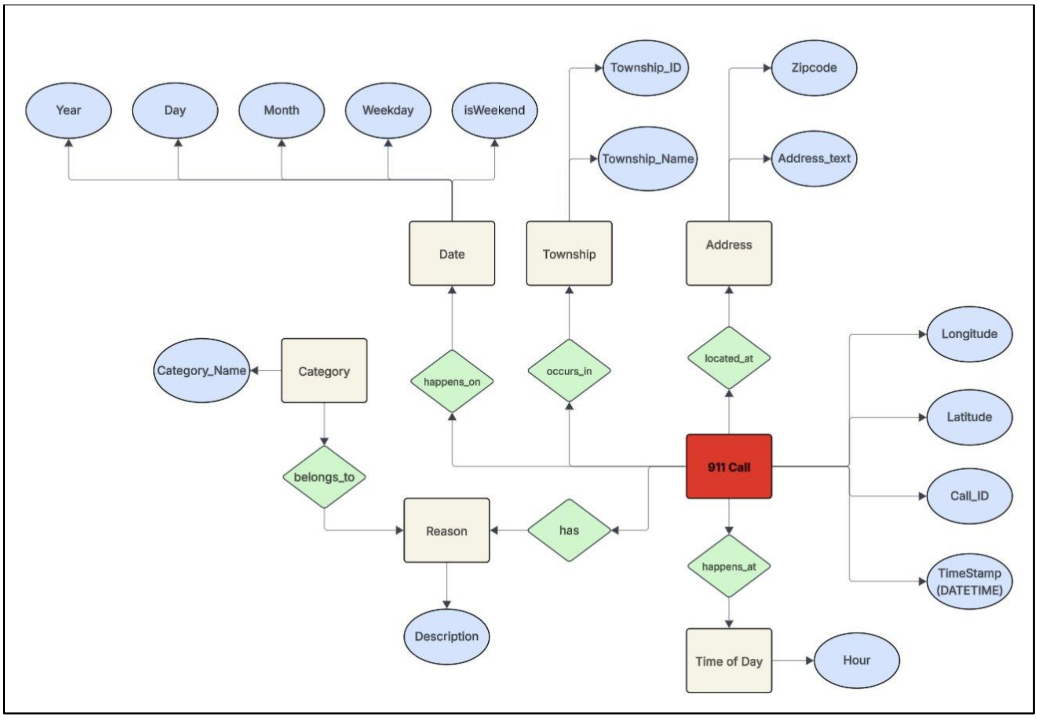
The findings are presented in a simple and clear way so that both technical and non-technical audiences can understand the insights and apply them to real decisions.

Methodology

Our approach combines data modeling techniques with SQL analysis to transform raw 911 call data into meaningful information. We followed a structured methodology: Conceptual, Logical, and Physical Data Models

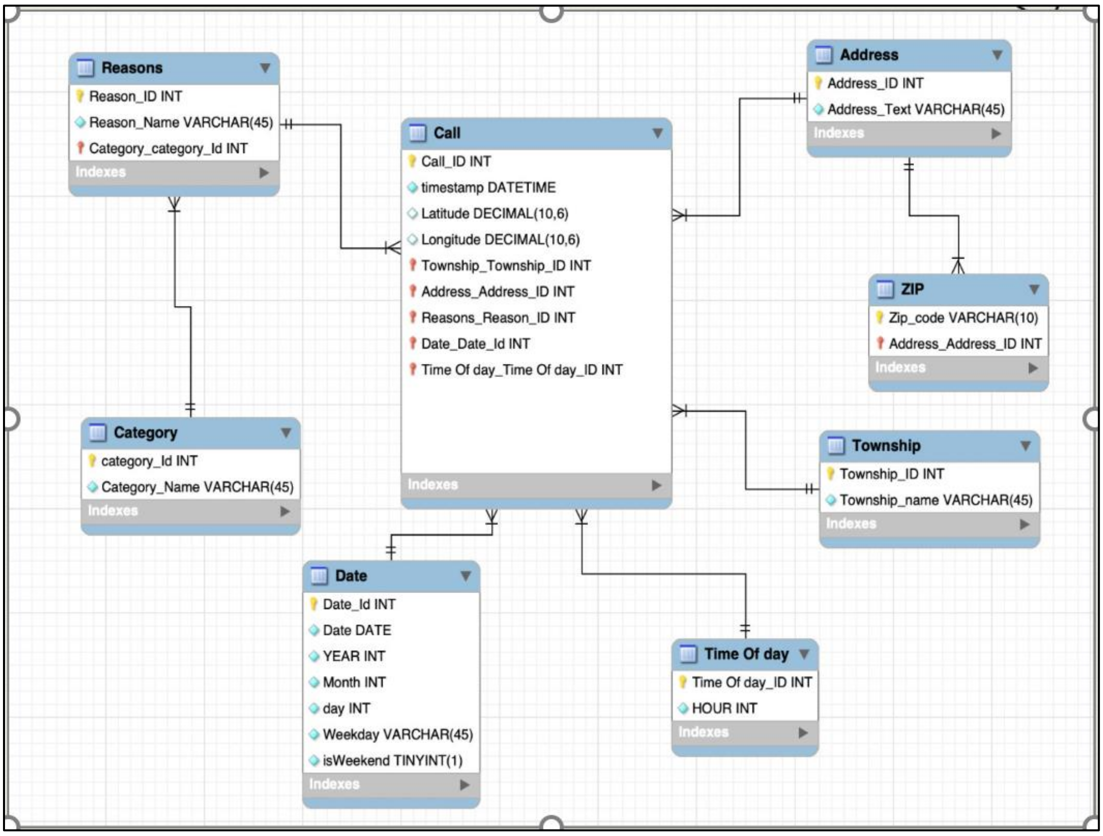
Conceptual Model

The conceptual model provides a high-level overview of the 911 call system, identifying the main entities such as Call, Category, Reason, Date, Time of Day, Township, Address, and ZIP. It shows how these entities relate to each other without focusing on technical details. The goal is to represent the overall business structure and data requirements.



Logical Model

The logical model translates the conceptual design into a more structured format by defining attributes, primary keys, and foreign key relationships for each entity. It focuses on organizing the data logically while remaining independent of any specific database system. This ensures clarity, normalization, and accurate representation of data flow.



Physical Model (Forward Engineering): -

DROP SCHEMA IF EXISTS mydb;
CREATE SCHEMA IF NOT EXISTS mydb DEFAULT CHARACTER SET utf8mb4;
USE mydb;

SET FOREIGN_KEY_CHECKS = 0;

Table: Category

CREATE TABLE Category (
  category_ID INT NOT NULL AUTO_INCREMENT,
  Category_Name VARCHAR(45) NOT NULL,
  PRIMARY KEY (category_ID)

```
) ENGINE=InnoDB;
```

Table: Reasons

```
CREATE TABLE Reasons (
  Reason_ID INT NOT NULL AUTO_INCREMENT,
  Reason_Name VARCHAR(45) NOT NULL,
  Category_category_ID INT NOT NULL,
  PRIMARY KEY (Reason_ID),
  INDEX fk_Reasons_Category_idx (Category_category_ID ASC),
  CONSTRAINT fk_Reasons_Category
    FOREIGN KEY (Category_category_ID)
    REFERENCES Category (category_ID)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION
) ENGINE=InnoDB;
```

Table: Township

```
CREATE TABLE Township (
  Township_ID INT NOT NULL AUTO_INCREMENT,
  Township_name VARCHAR(45) NOT NULL,
  PRIMARY KEY (Township_ID)
) ENGINE=InnoDB;
```

Table: ZIP

```
CREATE TABLE ZIP (
  Zip_code VARCHAR(10) NOT NULL,
  PRIMARY KEY (Zip_code)
) ENGINE=InnoDB;
```

Table: Address

```
CREATE TABLE Address (
  Address_ID INT NOT NULL AUTO_INCREMENT,
  Address_Text VARCHAR(45) NULL,
  Zip_code VARCHAR(10) NULL,
  PRIMARY KEY (Address_ID),
  INDEX fk_Address_ZIP_idx (Zip_code ASC),
  CONSTRAINT fk_Address_ZIP
    FOREIGN KEY (Zip_code)
```

```
    REFERENCES ZIP (Zip_code)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION
) ENGINE=InnoDB;
```

Table: Date

```
CREATE TABLE Date (
  Date_ID INT NOT NULL AUTO_INCREMENT,
  Date DATE NOT NULL,
  YEAR INT NOT NULL,
  Month INT NOT NULL,
  Day INT NOT NULL,
  Weekday VARCHAR(45) NULL,
  isWeekend TINYINT(1) NULL,
  PRIMARY KEY (Date_ID)
) ENGINE=InnoDB;
```

Table: Time_Of_day

```
CREATE TABLE Time_Of_day (
  Time_Of_day_ID INT NOT NULL AUTO_INCREMENT,
  HOUR INT NOT NULL,
  PRIMARY KEY (Time_Of_day_ID)
) ENGINE=InnoDB;
```

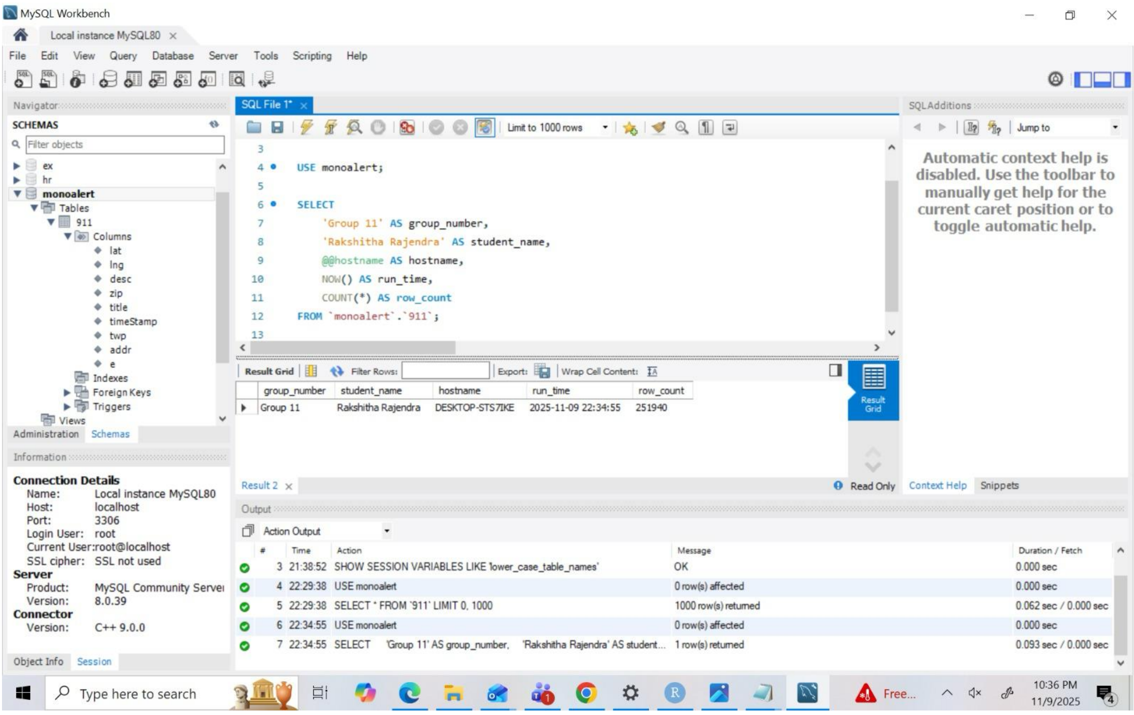
Table: Call

```
CREATE TABLE Call (
  Call_ID INT NOT NULL AUTO_INCREMENT,
  timestamp DATETIME NOT NULL,
  Latitude DECIMAL(10,6) NULL,
  Longitude DECIMAL(10,6) NULL,

  Township_Township_ID INT NOT NULL,
  Address_Address_ID INT NOT NULL,
  Reasons_Reason_ID INT NOT NULL,
  Date_Date_ID INT NOT NULL,
  Time_Of_day_Time_Of_day_ID INT NOT NULL,

  PRIMARY KEY (Call_ID),
  INDEX fk_Call_Township_idx (Township_Township_ID ASC),
```

```
  INDEX fk_Call_Address_idx  (Address_Address_ID  ASC),
  INDEX fk_Call_Reasons_idx  (Reasons_Reason_ID  ASC),
  INDEX fk_Call_Date_idx  (Date_Date_ID  ASC),
  INDEX fk_Call_TimeOfDay_idx  (Time_Of_day_Time_Of_day_ID  ASC),

  CONSTRAINT  fk_Call_Township
    FOREIGN KEY (Township_Township_ID)
    REFERENCES  Township  (Township_ID)
    ON DELETE  NO ACTION  ON UPDATE  NO ACTION,

  CONSTRAINT  fk_Call_Address
    FOREIGN KEY (Address_Address_ID)
    REFERENCES  Address  (Address_ID)
    ON DELETE  NO ACTION  ON UPDATE  NO ACTION,

  CONSTRAINT  fk_Call_Reasons
    FOREIGN KEY (Reasons_Reason_ID)
    REFERENCES  Reasons  (Reason_ID)
    ON DELETE  NO ACTION  ON UPDATE  NO ACTION,

  CONSTRAINT  fk_Call_Date
    FOREIGN KEY (Date_Date_ID)
    REFERENCES  Date  (Date_ID)
    ON DELETE  NO ACTION  ON UPDATE  NO ACTION,

  CONSTRAINT  fk_Call_TimeOfDay
    FOREIGN KEY (Time_Of_day_Time_Of_day_ID)
    REFERENCES  Time_Of_day  (Time_Of_day_ID)
    ON DELETE  NO ACTION  ON UPDATE  NO ACTION
) ENGINE=InnoDB;

SET FOREIGN_KEY_CHECKS  = 1;
```

Data Loading Concepts Used: -

We used ETL-based data loading, where the raw 911 dataset was extracted, cleaned, and transformed to match the structure of our database model. Key steps included splitting the title into Category and Reason, deriving date and time attributes, and standardizing location fields. Finally, the transformed data was loaded into the respective tables following referential integrity.



SQL Analysis and Key Insights

Below we present the core findings of our analysis, structured by specific questions and insights. Each subsection addresses a particular question relevant to emergency services planning. For each, we state the business question, summarize the SQL approach used, then detail the key findings (with relevant statistics), followed by a brief interpretation or recommendation that explains the significance of the result in a business context.

Insight 1: Overall Call Volume and Average per Day

Business Question: How many 911 calls are recorded in our dataset, over what period, and what is the average number of calls per day?

```sql
-- INSIGHT 1: Total 911 Calls, Time Span, and Average Calls Per Day
SELECT
    COUNT(*) AS total_calls,
    MIN(DATE(timeStamp)) AS first_date,
    MAX(DATE(timeStamp)) AS last_date,
    DATEDIFF(MAX(DATE(timeStamp)), MIN(DATE(timeStamp))) + 1 AS num_days,
    ROUND(COUNT(*) / (DATEDIFF(MAX(DATE(timeStamp)), MIN(DATE(timeStamp))) + 1), 2) AS avg_calls_per_day
FROM `911`;
```

Result Grid | Filter Rows: Search | Export:

total_calls	first_date	last_date	num_days	avg_calls_per_day
663522	2015-12-10	2020-07-29	1694	391.69

Key Findings:

- Total 911 calls recorded: 663,522
- Time period covered: December 2015 to July 2020 (1,694 days)
- Average daily call volume: approximately 392 calls per day

Final recommendations: The dataset spans more than four and a half years and includes over 663,000 emergency calls, averaging about 392 calls per day. This consistently high volume shows that Montgomery County's emergency services experience steady daily demand with very little downtime.

Because of this, the county should maintain reliable baseline staffing levels every day, supported by flexible scheduling to handle routine fluctuations. Planning resources around this predictable daily load, rather than assuming large swings in activity that can help ensure that teams are prepared; response times stay stable, and coverage remains consistent throughout the year.

Insight 2: Call Distribution by Category (EMS, Traffic, Fire)

Business Question: What share of 911 calls are related to medical emergencies (EMS), traffic incidents, and fire incidents? Which category dominates the overall demand?

```sql
-- INSIGHT 2: Distribution of Calls by Category (EMS, Traffic, Fire)
SELECT
    SUBSTRING_INDEX(title, ':', 1) AS category,
    COUNT(*) AS num_calls,
    ROUND(100 * COUNT(*) / (SELECT COUNT(*) FROM `911`), 2) AS pct_of_total
FROM `911`
GROUP BY category
ORDER BY num_calls DESC;
```

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Result Grid Filter Rows: Search Export:

category	num_calls	pct_of_total
EMS	332692	50.14
Traffic	230208	34.69
Fire	100622	15.16

Key Findings:

- EMS calls: 332,692, representing about 50.1% of all 911 calls
- Traffic-related calls: 230,208, representing around 34.7%
- Fire-related calls: 100,622, representing about 15.2%
- Together, these three categories cover all calls, with EMS alone making up roughly half of all incidents, more than both traffic and fire combined

Final Recommendations: EMS accounts for the largest share of 911 calls at just over half of all emergencies, followed by traffic-related incidents and then fire calls. Since medical emergencies make up the majority of the workload, the county should prioritize EMS staffing, training, and equipment. Traffic and fire units remain important, but EMS needs the strongest support because it handles the highest and most consistent demand. Strengthening EMS capacity will have the greatest impact on overall response readiness and community safety.

Insight 3: Yearly Trend in Call Volume

Business Question: Is the 911 call volume increasing, decreasing, or relatively stable year over year?

```sql
-- INSIGHT 3: Call Volume Trend by Year
SELECT
    YEAR(timeStamp) AS year,
    COUNT(*) AS num_calls
FROM `911`
GROUP BY YEAR(timeStamp)
ORDER BY year;
```

year	num_calls
2015	7916
2016	142360
2017	140343
2018	151527
2019	149118
2020	72258

Key Findings: Call volumes were consistently high from 2016 to 2019, ranging between 140,000 and 152,000 calls per year.

- 2015 and 2020 show lower totals because both years contain partial data in the dataset.
- Overall, the multi-year trend shows a steady and sustained demand for emergency services across the county

Final Recommendations: The year-over-year analysis shows that 911 call volume stays consistently high, with the largest counts occurring between 2016 and 2019. Even though 2020 appears lower, it is only a partial year in the dataset. This steady demand means emergency services should plan a consistently heavy workload each year instead of expecting large drops or spikes. Long-term staffing levels, training programs, and resource budgets should reflect the fact that call volume remains strong and does not decrease over time. Building plans around this stable trend will help maintain reliable response performance across the county.

Insight 4: Busiest and Quietest Hours of the Day

Business Question: At what time of day do 911 calls spike, and during which hours are call volume relatively low (quietest)?

```sql
-- INSIGHT 4: Calls Grouped by Hour of Day (Peak Hours)
SELECT
    HOUR(timeStamp) AS hour_of_day,
    COUNT(*) AS num_calls
FROM `911`
GROUP BY hour_of_day
ORDER BY num_calls DESC;
```

Result Grid

hour_of_day	num_calls
17	44119
16	42797
15	42263

Key Findings: The busiest hour of the day is 5–6 PM, with 44,119 calls, the highest of any hour.

- The quietest hour is 4–5 AM, with about 9,265 calls, marking the lowest daily activity.
- Overall, emergencies are the lowest in the early morning, rise steadily through the day, and peak in the late afternoon before declining at night.

Final Recommendations: Since calls peak around 5 PM and drop sharply in the early morning, emergency services should align staffing with these predictable daily patterns. Increasing the number of available units in the late afternoon can help manage the surge in demand, while reducing staffing during quieter early morning hours can improve efficiency without impacting response times.

Insight 5: Weekday vs Weekend Patterns

Business Question: Do weekdays and weekends show different patterns in terms of the types of 911 calls (EMS, Traffic, Fire)?

```sql
-- INSIGHT 5: Weekday vs Weekend Call Patterns by Category
SELECT
    CASE WHEN DAYOFWEEK(timeStamp) IN (1,7) THEN 'Weekend' ELSE 'Weekday' END AS day_type,
    SUBSTRING_INDEX(title, ':', 1) AS category,
    COUNT(*) AS num_calls
FROM `911`
GROUP BY day_type, category
ORDER BY day_type, num_calls DESC;
```

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Result Grid Filter Rows: Search Export:

day_type	category	num_calls
Weekday	EMS	242148
Weekday	Traffic	179289
Weekday	Fire	73774
Weekend	EMS	90544
Weekend	Traffic	50919
Weekend	Fire	26848

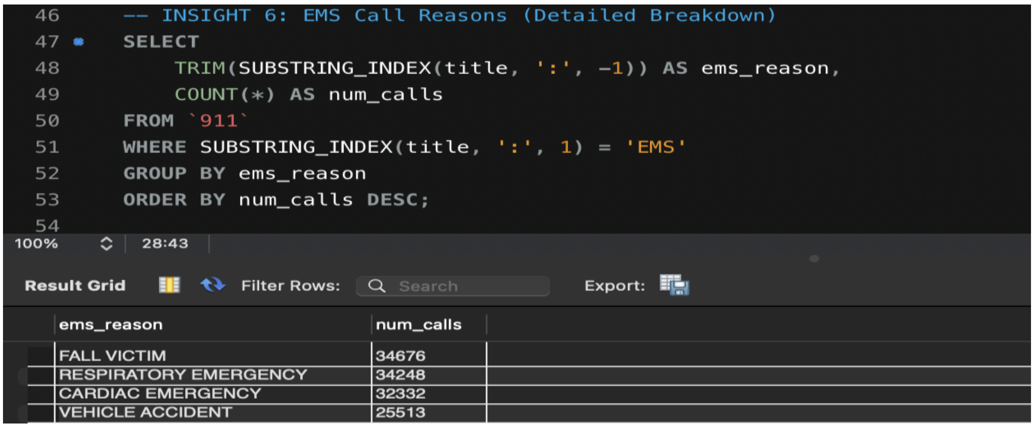
Key Findings:

- On weekdays, EMS accounts for nearly half of all calls, while traffic incidents make up just over one-third.
- Fire-related calls remain in the smallest category on weekdays at about 15 percent.
- On weekends, EMS makes a slightly larger share of all calls, rising to about 54 percent.
- Traffic calls drop on weekends, while fire calls increase slightly in proportion compared to weekdays.

Final Recommendations: Weekdays show higher call activity, especially for traffic and fire incidents, while EMS demand remains consistently high every day. To respond effectively, weekday staffing should emphasize traffic and fire support, while EMS teams should stay well-covered throughout the entire week. This balanced approach helps maintain steady response quality across all categories.

Insight 6: Top 10 EMS Incident Reasons

Business Question: What are the most common specific reasons for EMS (medical) calls?



```sql
-- INSIGHT 6: EMS Call Reasons (Detailed Breakdown)
SELECT
    TRIM(SUBSTRING_INDEX(title, ':', -1)) AS ems_reason,
    COUNT(*) AS num_calls
FROM `911`
WHERE SUBSTRING_INDEX(title, ':', 1) = 'EMS'
GROUP BY ems_reason
ORDER BY num_calls DESC;
```

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Result Grid Filter Rows: Search Export:

ems_reason	num_calls
FALL VICTIM	34676
RESPIRATORY EMERGENCY	34248
CARDIAC EMERGENCY	32332
VEHICLE ACCIDENT	25513

Key Findings: The top 10 EMS call reasons (with their total call counts over the dataset) are as follows:

- FALL VICTIM – 34,676 calls
- RESPIRATORY EMERGENCY – 34,248 calls
- CARDIAC EMERGENCY – 32,332 calls
- VEHICLE ACCIDENT – 25,513 calls *(note: these are medical calls related to vehicle accidents, likely when injuries are reported)*
- SUBJECT IN PAIN – 19,646 calls
- HEAD INJURY – 18,301 calls
- GENERAL WEAKNESS – 11,867 calls
- SEIZURES – 10,823 calls
- SYNCOPAL EPISODE (fainting) – 10,806 calls
- UNKNOWN MEDICAL EMERGENCY – 10,698 calls

Final Recommendations: The most frequent EMS calls relate to falls, respiratory problems, and cardiac emergencies. Because these issues drive much of the medical workload, the county should focus on training EMS teams for these conditions, ensuring the availability of the right equipment, and encouraging community programs aimed at fall prevention and respiratory health.

Insight 7: Top Traffic Incident Reasons

Business Question: Within traffic-related 911 calls, what are the most frequent specific incident types? How significant are vehicle accidents compared to other traffic incidents?

```sql
-- INSIGHT 7: Traffic Incident Reasons (Detailed Breakdown)
SELECT
    TRIM(SUBSTRING_INDEX(title, ':', -1)) AS traffic_reason,
    COUNT(*) AS num_calls
FROM `911`
WHERE SUBSTRING_INDEX(title, ':', 1) = 'Traffic'
GROUP BY traffic_reason
ORDER BY num_calls DESC;
```

traffic_reason	num_calls
VEHICLE ACCIDENT -	148372
DISABLED VEHICLE -	47909
ROAD OBSTRUCTION -	23235
HAZARDOUS ROAD CONDITIONS -	6833
VEHICLE FIRE -	3366
VEHICLE LEAKING FUEL -	292
DEBRIS/FLUIDS ON HIGHWAY -	201

Key Findings: Vehicle accidents make up 148,372 calls, about 64% of all traffic-related 911 incidents.

- This is the most common traffic issue by a wide margin.
- Disabled vehicles and road obstructions are the next most frequent but far lower in volume.
- Smaller categories like hazardous conditions, vehicle fires, and fuel leaks appear but make up only a small share of traffic calls.

Final Recommendations: In this, vehicle accidents dominate traffic-related emergencies, far exceeding other incident types. This highlights the need for targeted road safety improvements in high-accident areas, along with stronger enforcement and awareness efforts. Placing units closer to these locations can also help improve response times and reduce the strain on emergency services.

Insight 8: Top Fire Incident Reasons

Business Question: What types of fire-related incidents are most common in the 911 calls? Are most fire calls for actual fires, or for other situations like alarms and investigations?

```sql
-- INSIGHT 8: Fire Related Call Reasons
SELECT
    TRIM(SUBSTRING_INDEX(title, ':', -1)) AS fire_reason,
    COUNT(*) AS num_calls
FROM `911`
WHERE SUBSTRING_INDEX(title, ':', 1) = 'Fire'
GROUP BY fire_reason
ORDER BY num_calls DESC;
```

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Result Grid Filter Rows: Search Export:

fire_reason	num_calls
FIRE ALARM	38336
VEHICLE ACCIDENT	10864
FIRE INVESTIGATION	9444
GAS-ODOR/LEAK	6740
ELECTRICAL FIRE OUTSIDE	5111
BUILDING FIRE	4754

Key Findings:

- Fire alarms are the most common fire-related call, with over 38,000 incidents, far higher than any other fire category.
- Actual fires such as building fires, electrical fires, and vehicle fires occur much less often and appear lower on the list.
- Vehicle accidents rank second, showing that fire services are frequently called to assist at crash scenes.
- Other fire-related calls include gas leaks, fire investigations, carbon monoxide alarms, and outdoor brush fires, but these occur at smaller volumes.

Final Recommendations: Fire alarms and investigations make up most fire-related calls, rather than large structural fires. This suggests that outreach, maintenance checks, and safety education could reduce unnecessary alarms and help residents address small issues before they escalate. Better alarm system upkeep may also prevent false or avoidable callouts.

Insight 9: Top Townships by Call Volume

Business Question: Which townships in Montgomery County generate the highest number of 911 calls, and what portion of the total calls do these top townships represent?

```sql
-- INSIGHT 9: Top Townships by Call Volume
SELECT
    twp AS township,
    COUNT(*) AS num_calls,
    ROUND(100 * COUNT(*) / (SELECT COUNT(*) FROM `911`), 2) AS pct_of_total
FROM `911`
GROUP BY township
ORDER BY num_calls DESC;
```

township	num_calls	pct_of_total
LOWER MERION	55490	8.36
ABINGTON	39947	6.02
NORRISTOWN	37633	5.67
UPPER MERION	36010	5.43

Key Findings:

- Lower Merion has the highest 911 call volume with 55,490 calls, making it the top-demand township in the county.
- Abington, Norristown, and Upper Merion follow closely, each with call totals in the high 30,000 range.
- Cheltenham also contributes to a significant number of calls at over 30,000.
- Together, these five townships account for roughly 30 percent of all 911 calls, showing that emergency demand is concentrated in a small set of areas.

Final Recommendations: A small group of townships consistently account for a large share of the county's emergencies. These areas should receive focused support, including more staffed units, improved infrastructure, and community safety programs. Allocating resources according to these patterns helps ensure faster responses where demand is highest.

Insight 10: High-Call Locations and Intersections

Business Question: Which specific addresses or intersections appear most often in 911 calls, indicating local hotspots for emergencies?

```sql
-- INSIGHT 10: Call Volume by Address / Intersection
SELECT
    addr AS address,
    COUNT(*) AS num_calls,
    ROUND(100 * COUNT(*) / (SELECT COUNT(*) FROM `911`), 2) AS pct_of_total
FROM `911`
GROUP BY address
ORDER BY num_calls DESC;
```

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Result Grid | Filter Rows: Search | Export: | Fetch rows:

address	num_calls	pct_of_total
SHANNONDELL DR & SHANNONDELL BLVD	7285	1.10
MAIN ST & OLD SUMNEYTOWN PIKE	2576	0.39
THE FAIRWAY & RYDAL RD	1986	0.30
EAGLEVILLE RD & SUNDERLAND DR	1618	0.24
EVERGREEN RD & W LIGHTCAP RD	1591	0.24

Key Findings:

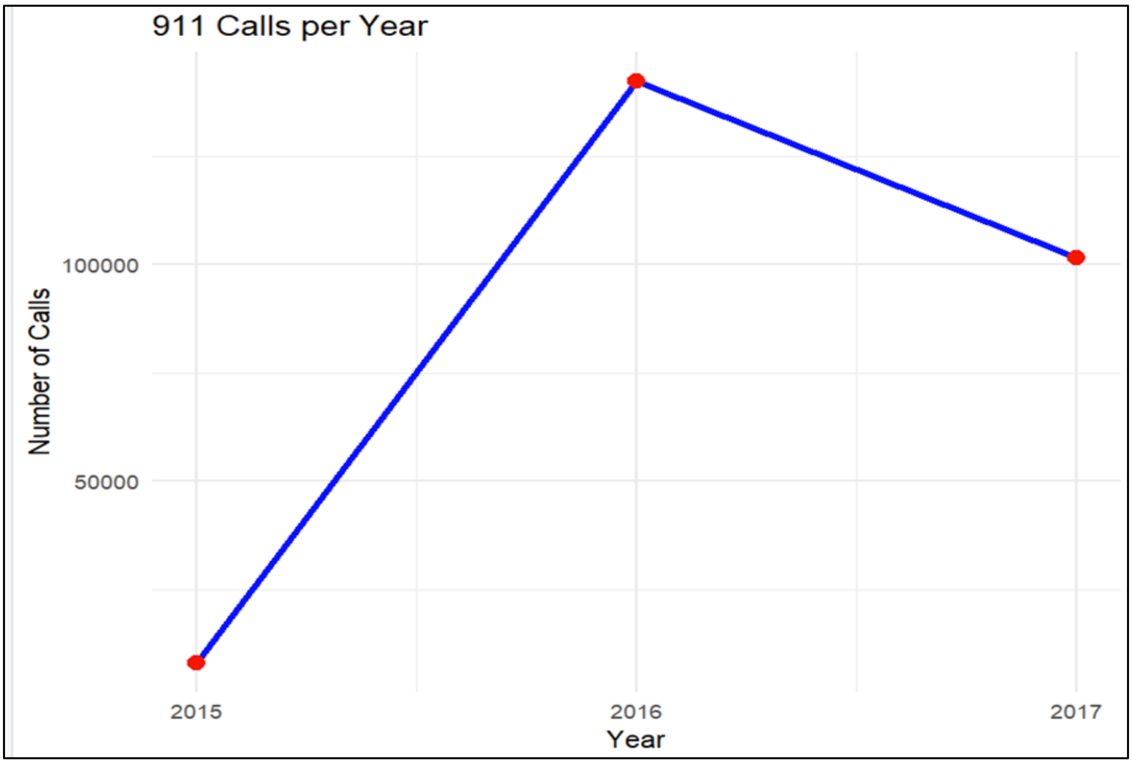
- Shannondell Dr and Shannondell Blvd is the highest-call location with 7,285 calls, accounting for more than 1 percent of all 911 calls in the dataset.
- The next highest intersections, such as Main St and Old Sumneytown Pike and The Fairway and Rydal Rd, each have between 1,500 and 2,500 calls.
- These intersections likely serve large residential communities, medical facilities, or busy traffic areas, which naturally increase call volume.
- Identifying these high-call locations helps emergency services position units more effectively and focus on safety efforts where they are needed most.

Interpretation: Certain intersections repeatedly show high call activity, indicating local problem spots. Simple improvements like better lighting, signage, or road layout changes could significantly reduce incidents in these areas. Keeping emergency units closer to these hotspots can also cut down response times and improve overall safety.

Visualization Charts

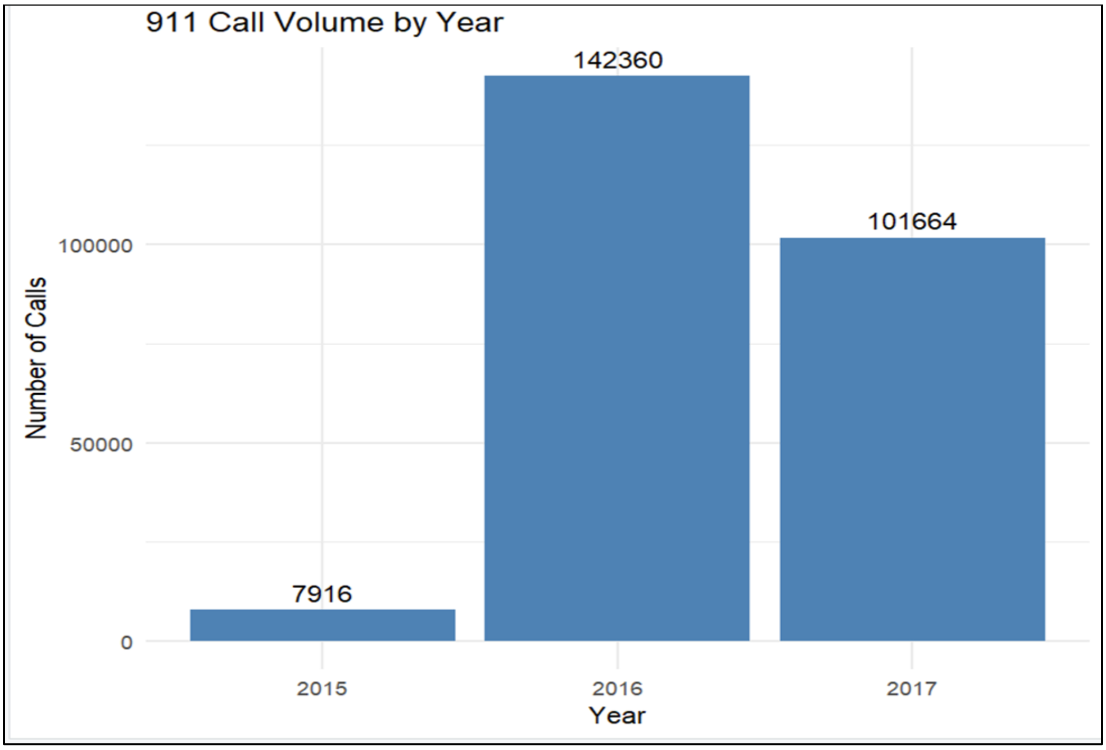
For our visualization charts, we decided to use R to create a few charts.

1. Distribution of Calls by Category (EMS, Traffic, Fire)



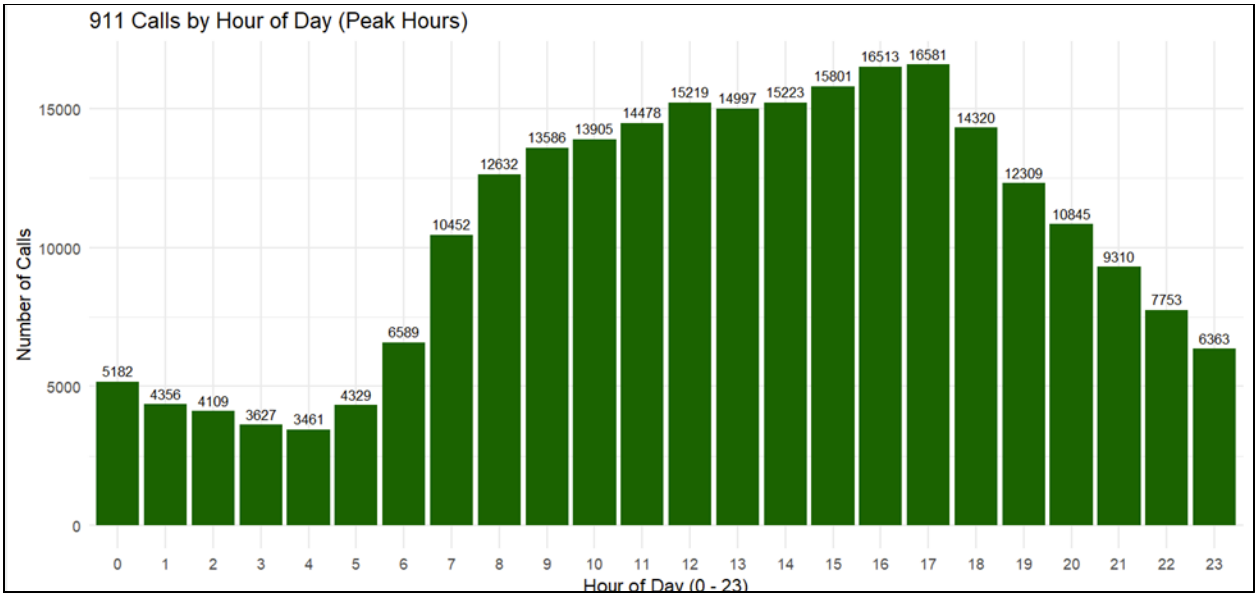
This chart shows how 911 calls are distributed across the three major emergency categories: EMS, Traffic, and Fire. EMS-related calls dominate the dataset, making up the largest share of emergencies reported. Traffic incidents form the second largest category, reflecting frequent roadway emergencies in the region. Fire-related calls represent the smallest portion, indicating that fire emergencies occur far less often compared to medical and traffic incidents.

2. Call Volume Trend by Year



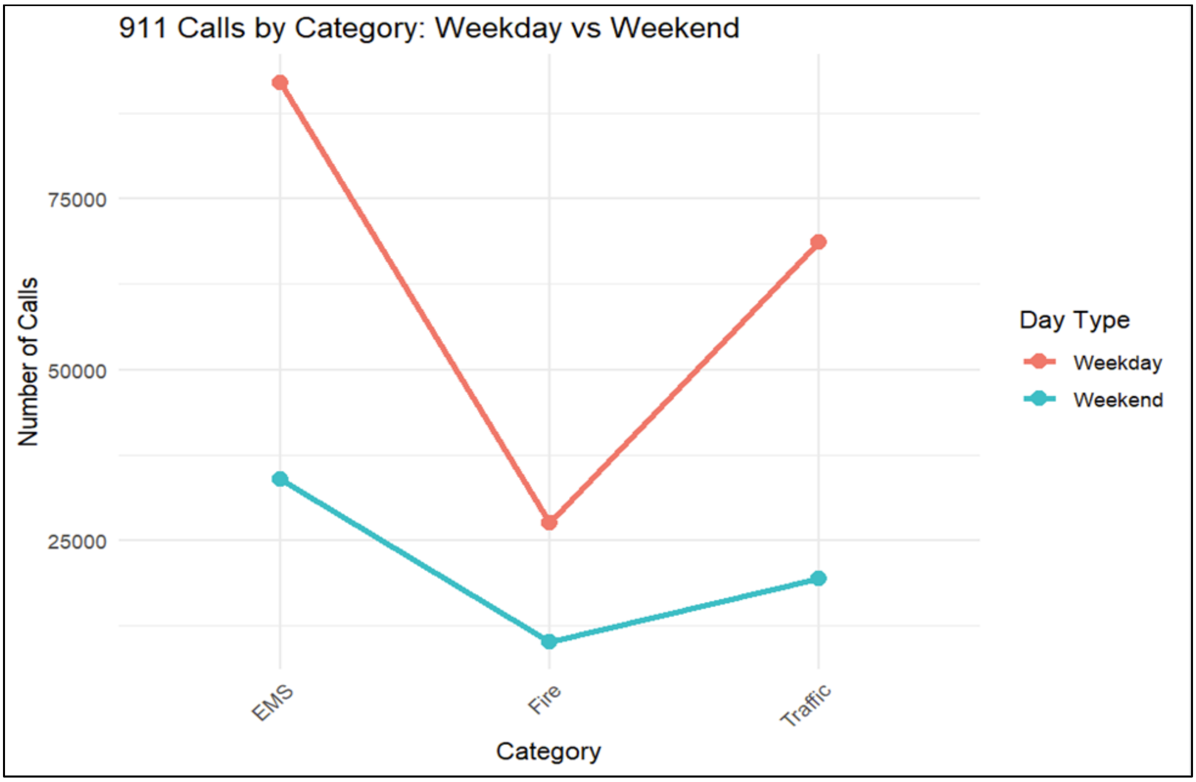
This chart shows the total number of 911 calls recorded each year from 2015 to 2017. Call volume rises sharply between 2015 and 2016, indicating a major surge in emergency activity during that period. In 2017, call volume decreased from the 2016 peak but remains significantly higher than 2015 levels. The overall trend suggests increasing demand for emergency services, with 2016 representing the busiest year in the dataset. This pattern may reflect population growth, improved reporting, or increased public reliance on emergency services.

3. Calls Grouped by Hour of Day (Peak Hours)



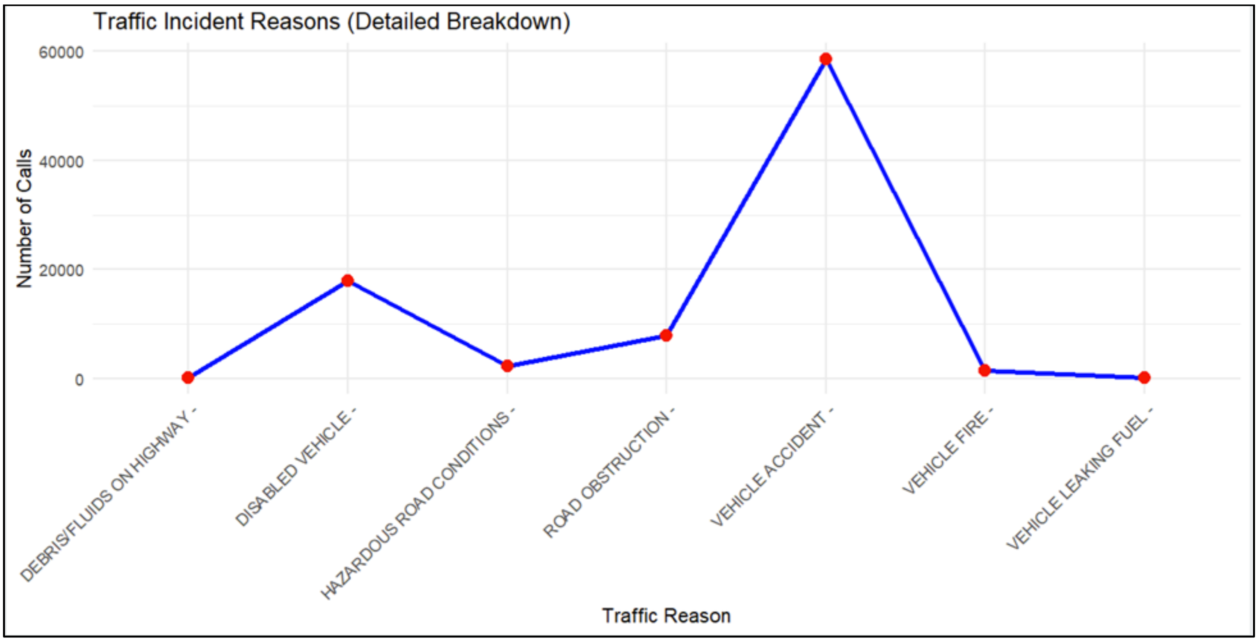
This chart shows how 911 call volume varies across the 24-hour day. Call activity is lowest between midnight and 6 AM, reflecting typical overnight quiet periods. A sharp increase begins around 7 AM, with call volume continuing to rise throughout the morning hours. The busiest period occurs between 2 PM and 5 PM, which represents the peak window for emergencies. After 6 PM, call volume gradually declines into the late evening hours, showing a consistent daily pattern of activity.

4. Weekday vs Weekend Call Patterns by Category



The graph compares 911 call volumes for EMS, Fire, and Traffic incidents between weekdays and weekends. Weekdays consistently show a higher number of calls across all three categories, especially EMS and Traffic. Fire-related calls are the lowest for both weekdays and weekends, forming the dip in the middle of both lines. The upward trend from Fire to Traffic indicates that Traffic incidents increase again, particularly on weekdays, reflecting higher weekday mobility and congestion. Overall, the graph highlights that emergency demand is significantly higher during weekdays, with clear variation across incident categories.

5. Traffic Incident Reasons (Detailed Breakdown)



The chart shows the distribution of traffic-related 911 calls broken down by specific incident reasons. Vehicle accidents account for the largest share of traffic calls, with a sharp peak compared to other categories, indicating they are the most frequent traffic emergency. Disabled vehicles and road obstructions also contribute a noticeable number of calls, though far fewer than accidents. Categories such as hazardous road conditions, vehicle fire, and vehicle leaking fuel appear at the lower end, showing these incidents occur less frequently. Overall, the graph highlights that most traffic emergencies involve vehicle accidents, while other traffic-related situations occur far less often.

Conclusion & Recommendations

Our analysis of more than 663,000 emergency 911 calls shows clear patterns when and where emergencies occur in Montgomery County. EMS calls make up the largest share; call volume peaks in the late afternoon and on weekdays, and a small group of townships and intersections generate a significant portion of all emergencies. These patterns are consistent and predictable, which means they can be used to guide better planning.

Based on these insights, the recommendations below can help emergency services and local decision-makers improve efficiency and response readiness:

Adjust staffing to match demand: Increase available units during late-afternoon peak hours and busy weekdays, and scale down slightly during quieter early mornings.

- **Prioritize EMS capacity**: Since medical emergencies are most common, focus on training, equipment, and staffing where EMS teams need it most.
- **Improve safety in high-incident areas:** Use the identified townships and intersections to guide road-safety efforts, infrastructure upgrades, and strategic unit placement.
- **Strengthen prevention programs:** Reduce avoidable calls by improving fire-alarm maintenance, promoting health and safety education, and addressing common causes of EMS and traffic incidents.
- **Continue monitoring the data:** Regular analysis helps detect new trends and supports ongoing improvements in planning and resource allocation.

In summary, letting data guide decisions can help Montgomery County respond more effectively, allocate resources more strategically, and ultimately support a safer community.