캡스톤 디자인 프로젝트

Analyzing 911 Emergency Calls from Montgomery County

2021012800 베네딕터스 에스라 헤루노오
데이터사이언스학과

데이터사이언스학과

캡스톤디자인 결과보고서

번호	*학과에서 배정 후 공지*			
분야	데이터 과학 및 기급 서비스 분석석			
프로젝트 명	(국문) 몽고메리 카운티의 911 긴급 전화 분석			
	(영문) Analyzing 911 Emergency Calls from Montgomery County			
팀 명	KHB			
책임자	학 과	데이터사이언스		
	성 명	베네딕터스 에스라 헤르노오	학 번	2021012800
	휴대폰	010-8213-3520	E-mail	zealots404@gmail.com

참여자 세부정보	번 호	세부역할	성 명	전 공	학 번
	1				
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수행기간	2024년 03월 28일 ~ 2024년 06월 13일 (3개월)
지도교수	박상성성 교수님

2024년도 캡스톤디자인을 성실히 수행한 결과를 보고합니다.

2024년 06월 13일

캡스톤디자인 책임자 베네딕터스 에스라 헤르노오 서명

데이터사이언스학과 학과장 귀하

캡스톤디자인 요약서

팀 명	KHB
프로젝트 명	Analysing 911 Emergency Calls from Montgomery County, PA
참여자	베네딕터스 에스라 헤르노오

1. 캡스톤디자인 목표

The primary goal of this Capstone Design project is to analyse the 911 call data from Montgomery County, PA, to identify patterns and trends in emergency services. By examining the correlation between the time of day and the type of emergency calls, we aim to understand which types of emergencies are most common at different times. Additionally, we will investigate the frequency of 911 calls across different days of the week and months to identify peak periods and trends. Analysing hourly patterns in emergency calls by department (EMS, Fire, Traffic) will help determine when each type of service is most in demand. Based on the analysis, we will recommend optimal staffing and resource allocation strategies for emergency services. Furthermore, we will develop targeted public awareness and prevention programs to help reduce the occurrence of emergencies. Through these efforts, the project aims to enhance the efficiency and effectiveness of emergency response services in Montgomery County, PA.

2. 캡스톤디자인 수행 결과

The Capstone Design project successfully analysed the 911 call data from Montgomery County, PA, revealing significant patterns and trends in emergency services. The analysis identified that EMS calls peak between 10 AM and 1 PM, while Fire and Traffic calls peak around 5 PM. It was also found that Fridays and the month of March have the highest volume of 911 calls. These findings suggest the need for increased staffing and resource allocation during these peak times and days.

Additionally, the project produced detailed heatmaps illustrating the distribution of 911 calls by day of the week and hour, as well as by day of the week and month. These visualizations provided clear insights into the temporal patterns of emergency calls. The analysis of hourly patterns by department showed that EMS calls are more frequent in the late morning, whereas Fire and Traffic calls tend to increase in the late afternoon, particularly around 5 PM.

These results highlight the importance of data-driven decision-making in optimizing emergency response strategies. The project's findings support recommendations for adjusting staffing schedules, enhancing preparedness for peak periods, and implementing targeted public awareness campaigns. By leveraging these insights, emergency services in Montgomery County can improve their efficiency and effectiveness, ultimately leading to better outcomes for the community.

3. 캡스톤디자인 개발에 따른 기대효과 및 활용방안

Expected Effects:

The Capstone Design project is anticipated to significantly enhance the operational efficiency of emergency services in Montgomery County, PA. By providing data-driven insights into the patterns and trends of 911 calls, emergency response teams can optimize their resource allocation and staffing schedules. The ability to predict peak times for different types of emergencies will lead to faster response times and better management of resources, ultimately improving service delivery and potentially saving lives. Additionally, the identification of high-risk periods, such as specific days and times with increased call volumes, will enable targeted preventive measures and public awareness campaigns, reducing the overall incidence of emergencies.

Utilization:

1. Emergency Service Optimization: Adjust staffing schedules and resource distribution to match the identified peak times for different types of emergencies. Develop and implement training programs that prepare personnel for the most common emergencies during peak periods.
2. Public Awareness and Prevention: Launch targeted public awareness campaigns focusing on safety during high-risk periods, such as Friday evenings and the month of March. Work with local communities to educate them about common emergency scenarios and preventive measures.
3. Policy and Decision-Making: Utilize the insights from the analysis to inform policy decisions regarding emergency preparedness and resource management. Implement systems for continuous monitoring and analysis of 911 call data to adapt strategies dynamically based on emerging trends.
4. Emergency Preparedness: Conduct regular drills and simulations based on the identified patterns to ensure readiness for actual emergencies. Foster better coordination among EMS, Fire, and Police departments by sharing insights and aligning response strategies.

데이터사이언스학과

캡스톤디자인 결과보고서

캡스톤디자인 명 : 고메리 카운티의 911 긴급 전화 분석

캡스톤디자인 참여자 : 데이터사이언스학과 / 베네딕터스 에스라 헤르노오

1. 캡스톤디자인 목표

1. 캡스톤디자인 목표

The goal of this Capstone Design project is to enhance the operational effectiveness and efficiency of emergency response services in Montgomery County, PA, through a comprehensive data analysis of 911 calls. By identifying patterns and trends in emergency call data, we aim to provide actionable insights that can be used to optimize resource allocation, reduce response times, and improve overall emergency preparedness and public safety. This project seeks to support emergency services in making data-driven decisions, thereby ensuring that they are better equipped to handle emergencies promptly and effectively, ultimately leading to improved outcomes for the community.

2. 캡스톤디자인 제안 배경

1. Background and Motivation

a) Topic Setting Background: The 911 call data from Montgomery County, PA, provides crucial information that can improve the efficiency and effectiveness of emergency services. By analyzing this data, the project aims to better understand and develop response strategies for emergency situations.

b) Problem Causes: Emergency services face challenges in optimizing resource allocation and response times, primarily due to the lack of systematic analysis of 911 call data. There is insufficient understanding of the types of emergencies that occur at different times of the day, week, and month.

c) Problem Analysis: Analyzing the patterns and trends in 911 call data can help identify the frequency and timing of emergency situations. This understanding allows emergency services to allocate resources more efficiently, reduce response times, and enhance overall service quality.

2. Expected Effects and Utilization

a) Optimization of Resource Allocation: Use the analysis results to optimize resource allocation, thereby reducing response times and increasing efficiency of emergency services.

b) Raising Public Awareness: Increase public awareness about specific times and days to prevent the occurrence of emergency situations.

c) Supporting Policy Decisions: Provide data-driven insights to policymakers to help them formulate better policies for emergency preparedness and response.

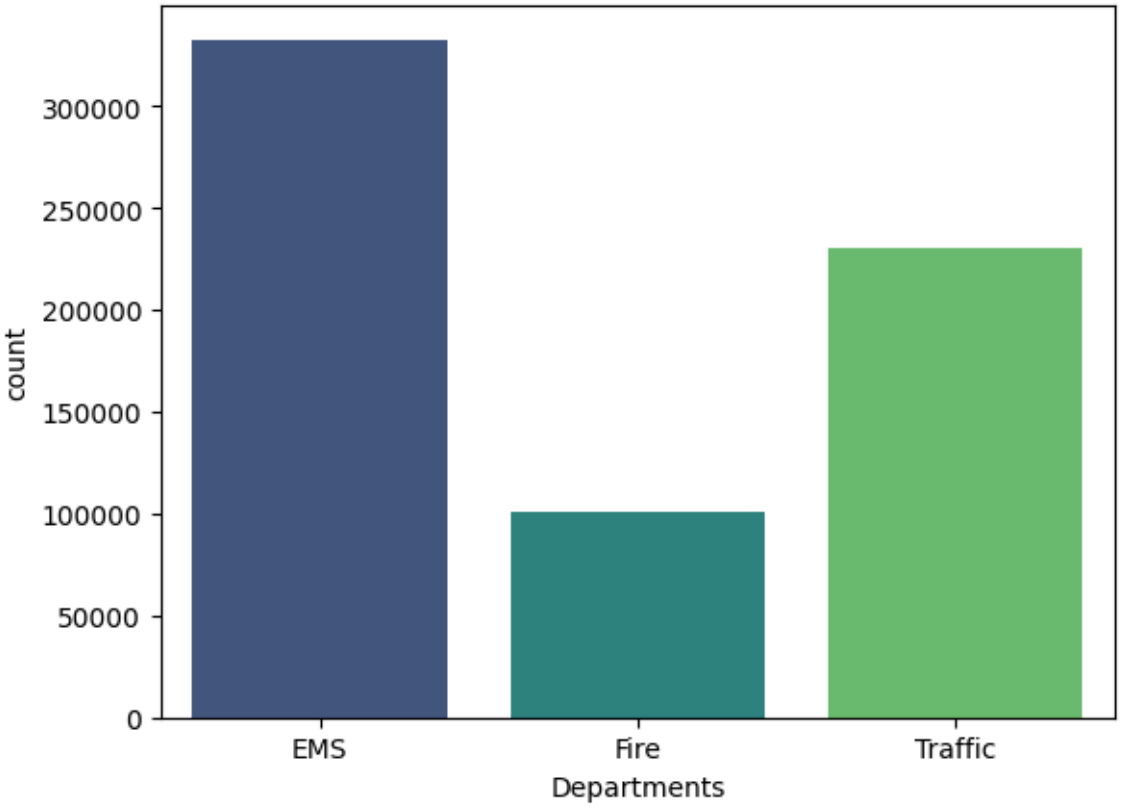
2. 캡스톤디자인 내용

Zip Codes	Counts
19401	45606
19464	43910
19403	34888
19446	32270
19406	22464

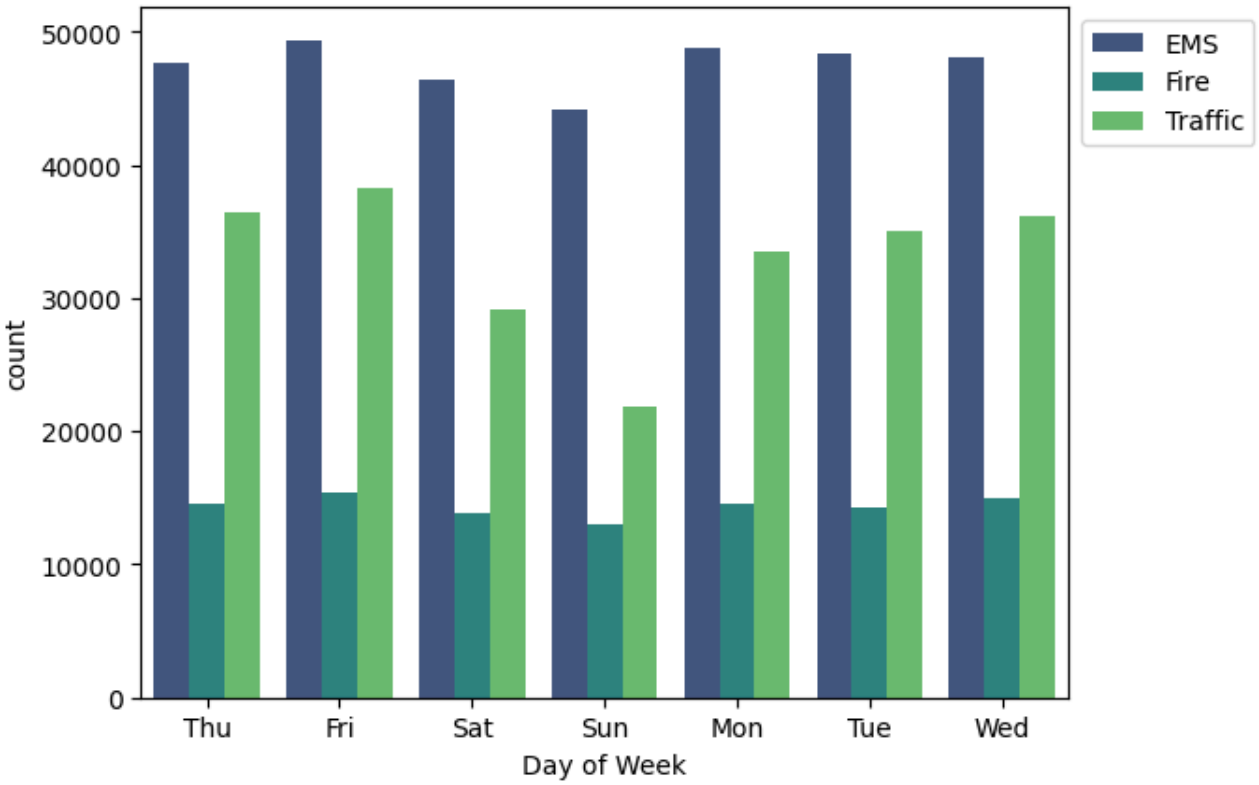
The analysis of the 911 call data from Montgomery County, PA, revealed several key insights. Firstly, the top five zip codes with the highest number of 911 calls were identified as follows: 19401 with 45,606 calls, 19464 with 43,910 calls, 19403 with 34,888 calls, 19446 with 32,270 calls, and 19406 with 22,464 calls. This indicates that these areas have the highest demand for emergency services.

Zip Codes	Counts
Lower Merion	55490
Abington	39947
Norristown	37633
Upper Merion	36010
Cheltenham	30574

In terms of townships, Lower Merion had the highest number of calls at 55,490, followed by Abington with 39,947 calls, Norristown with 37,633 calls, Upper Merion with 36,010 calls, and Cheltenham with 30,574 calls. These townships represent the areas where emergency services are most frequently required.

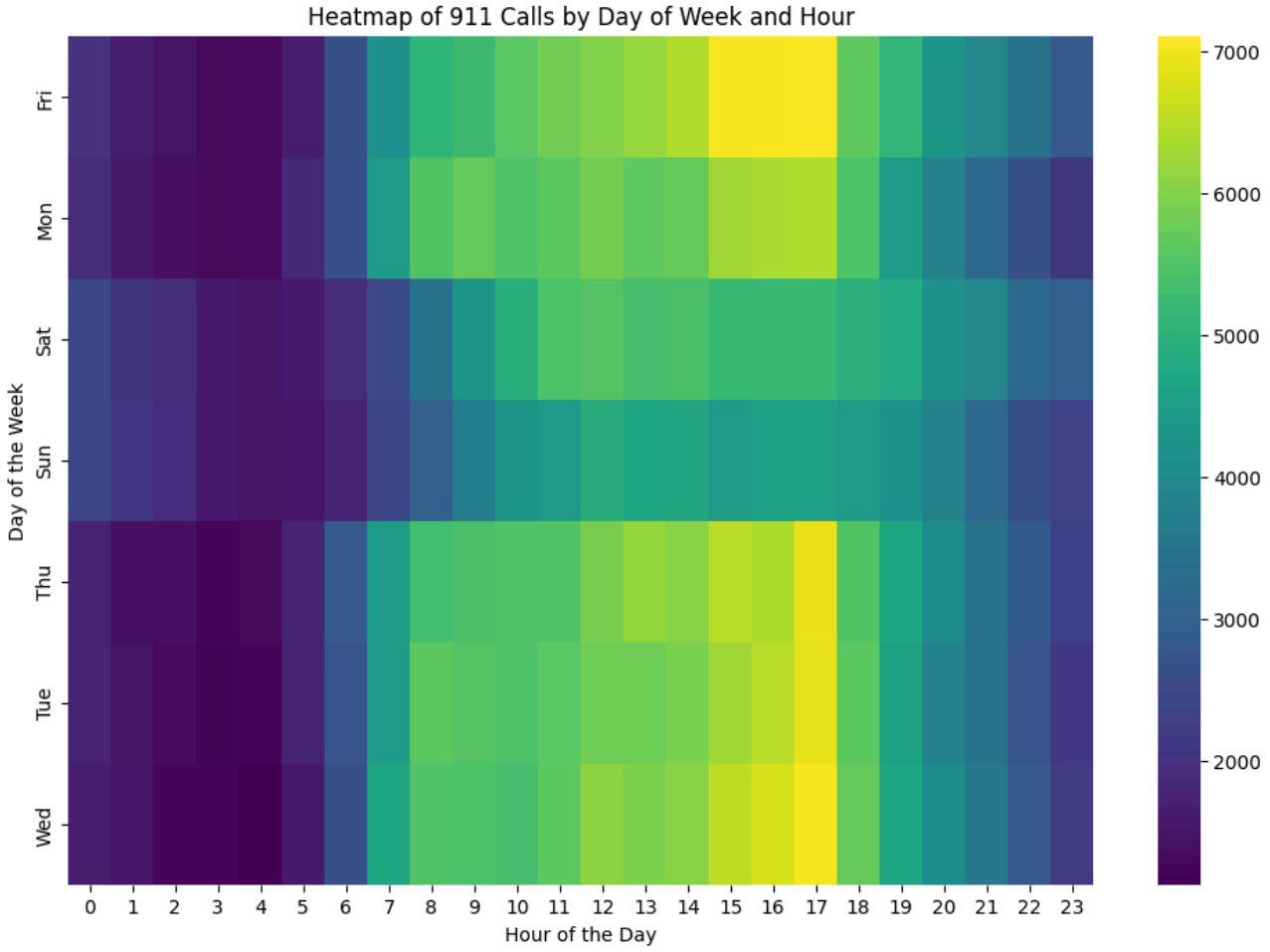


Department-wise, the analysis showed that EMS had the highest number of calls at 332,692, followed by Traffic with 230,208 calls, and Fire with 100,622 calls. This distribution highlights that medical emergencies are the most common reason for 911 calls in the county.

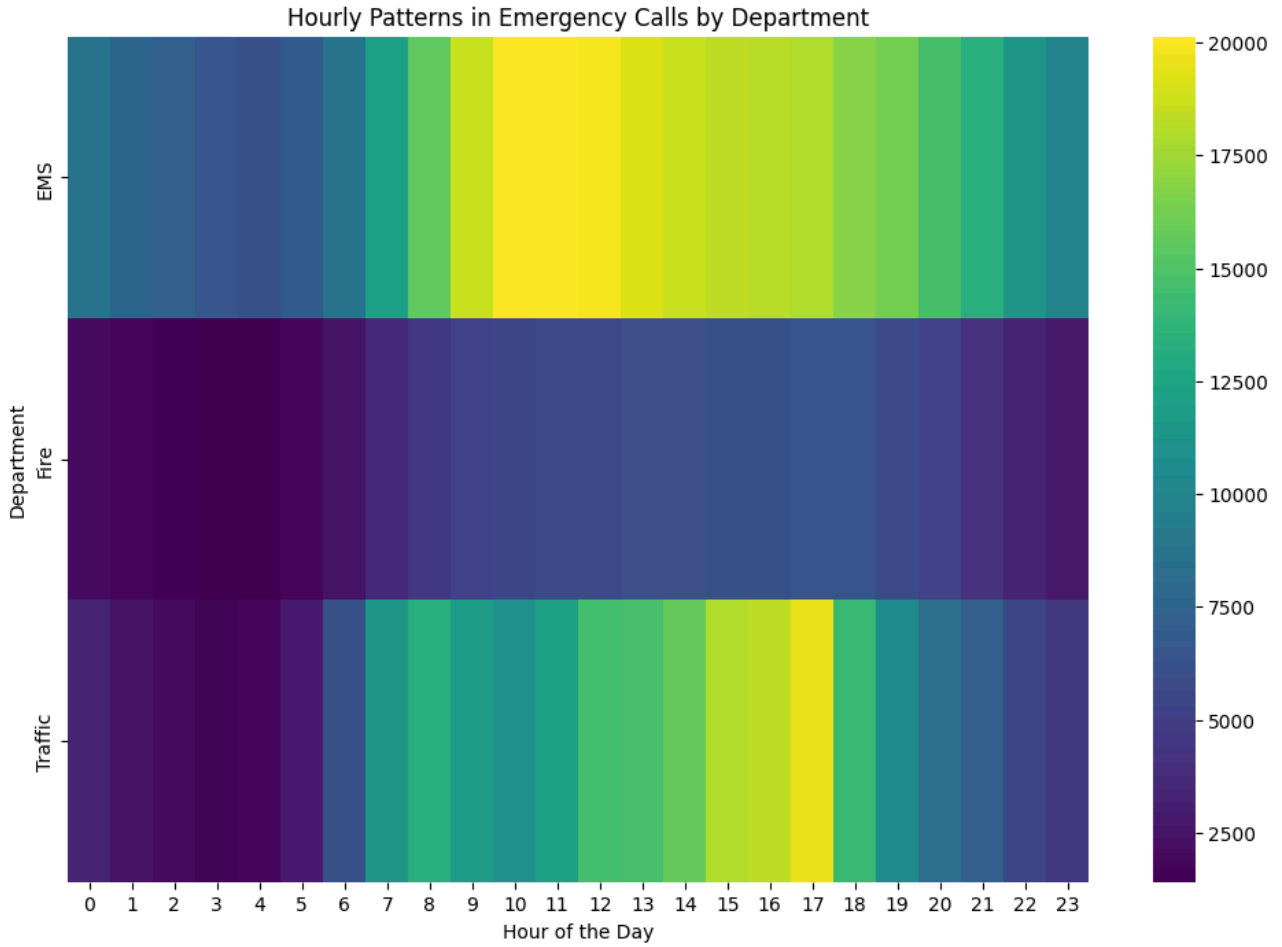


The daily call pattern analysis revealed that Fridays have the highest number of 911 calls, with more

than 100,000 calls, while Monday to Thursday remain stable at around 90,000 calls. The weekends, however, show a lower call volume, with calls dropping below 90,000.



Temporal analysis indicated that 911 call volumes are stable from Monday to Thursday, peak on Friday, and drop during the weekends. A detailed hourly analysis showed that the highest number of calls on weekdays occurs between 15:00 and 17:00, which is likely due to people returning home from work. Fridays have the highest hourly call volumes, while weekends remain stable throughout the day.



By departmental patterns, EMS calls peak between 10:00 and 13:00, while calls for police and fire services peak at around 17:00. This suggests that medical emergencies are more frequent in the late morning to early afternoon, whereas traffic-related incidents and fires are more common in the late afternoon.

3. 캡스톤디자인의 필요성 및 독창성

1. Necessity of Capstone Design

The capstone design project is essential for several reasons. Firstly, it addresses the increasing need for efficient emergency response services in Montgomery County, PA. With a growing population and the consequent rise in emergency incidents, analyzing 911 call data can provide valuable insights into patterns and trends. This data-driven approach enables the optimization of resource allocation and improves response times, ultimately enhancing public safety.

Additionally, this project fulfills an educational necessity by providing students with practical, real-world experience in data science. It bridges the gap between theoretical knowledge and practical application, preparing students for future careers in data analysis, machine learning, and emergency management. The project also emphasizes interdisciplinary collaboration, combining data science with public

safety, health services, and urban planning.

2. Originality of Capstone Design

The originality of this capstone design project lies in its innovative use of data analytics to improve emergency response systems. While traditional emergency management relies heavily on historical data and manual analysis, this project leverages advanced data science techniques, including heatmaps and predictive modeling, to uncover hidden patterns and predict future trends.

Furthermore, the project integrates multiple dimensions of data, such as geographical information, temporal patterns, and departmental analysis, to provide a comprehensive understanding of emergency call dynamics. This holistic approach is unique and offers a more nuanced perspective than existing studies that often focus on a single aspect of emergency calls.

By employing cutting-edge data visualization tools and machine learning algorithms, the project not only enhances the efficiency of emergency services but also contributes to the academic field of data science. The findings from this project can serve as a model for other regions and inspire further research in the intersection of data science and public safety.

4. 캡스톤디자인 수행 결과

1. 최종 결과물

The final deliverables of the capstone design project include a comprehensive analysis of 911 call data from Montgomery County, PA. Key results are presented through visualizations such as heatmaps and bar charts, providing insights into emergency call patterns and trends. The strengths of the project lie in its detailed data analysis, clear visual representations, and actionable insights for emergency service optimization. However, some limitations include the reliance on a single data source and potential data quality issues. Overall, the project meets the initial plan's objectives, providing valuable findings and recommendations.

Strengths:

- Detailed and insightful data analysis
- Clear and informative visualizations
- Actionable recommendations for emergency services

Weaknesses and Areas for Improvement:

- Dependence on a single data source
- Potential issues with data quality

2. 주차별 캡스톤디자인 수행 내용

주차	수행 내용	진척도(%)
2		
3		
4	Acquired 911 call data and performed initial data exploration.	10%
5	Cleaned data, handled missing values, and created new features (e.g., hour, day of the week).	20%
6	Conducted EDA to understand data structure and distributions.	30%
7	Analyzed patterns and trends in the data, focusing on top zip codes and townships.	40%
8	Analyzed call distribution across EMS, Fire, and Traffic departments.	50%
9	Analyzed daily and hourly call patterns, created heatmaps.	60%
10	Developed final visualizations, compiled findings,	70%
11	Created the results PPT	80%
12	Created the results PPT and project report	90%
13	Created the project report	100%

14		
15		

5. 기대효과 및 활용방안

Expected Effects

The capstone design project on analyzing 911 call data from Montgomery County, PA, is expected to produce several significant benefits. Firstly, it enhances the understanding of emergency call patterns, providing insights into when and where emergencies are most likely to occur. This can lead to improved resource allocation for emergency services, ensuring that personnel and equipment are optimally distributed to meet demand. By identifying peak times for different types of emergencies, the project helps in strategic planning and preparedness, potentially reducing response times and improving overall efficiency.

Moreover, the project contributes to public safety by highlighting critical areas and times that require heightened attention from emergency services. This can lead to targeted awareness campaigns, community engagement, and preventive measures tailored to specific high-risk periods and locations. The detailed analysis also aids policymakers and public safety officials in making data-driven decisions, fostering a proactive approach to emergency management.

Utilization Plan

a. Emergency Services Optimization:

   The findings from the project can be used by emergency services to optimize their operations. By understanding peak call times and high-demand areas, resources can be allocated more effectively, ensuring faster response times and better service coverage.

b. Policy and Planning:

   Policymakers can utilize the insights to develop more informed public safety strategies. The data can inform decisions on funding, resource distribution, and infrastructure improvements to support emergency services.

6. 소요장비 및 재료, 소프트웨어

장비 및 재료명	수량	용 도	비 고
개인 PC	1	프로젝트 개발 및 보고서, PPT 작성	
Google Colab	-	분석 및 시각화에 사용되는 코드 작성	
Kaggle		Data Collection	
Chrome	-	자료조사	
Microsoft Word	-	보고서 작성	
Microsoft PowerPoint	-	PPT 작성	

7. 구매품목

장비 및 재료명	수량	용 도	가 격	비 고

8. 참여인원 상세정보

#1					
1) 인적사항					
	성 명				
	학 번		생년월일		
	주 소				
	연 락 처	핸드폰		e-mail	
2) 학적 사항					

연도	학적변동 사항	비고

3) 현장실습, 인턴쉽, 어학연수, 교육연수 현황

연도	연수명	연수기관	비 고

4) 자격증 현황

자격증명	발행기관	취득연도	비고

#2

1) 인적사항

	성 명				
	학 번		생년월일		
	주 소				
	연 락 처	핸드폰		e-mail	

2) 학적 사항

연도	학적변동 사항	비고

3) 현장실습, 인턴쉽, 어학연수, 교육연수 현황

연도	연수명	연수기관	비 고

4) 자격증 현황

자격증명	발행기관	취득연도	비고

#3

1) 인적사항

	성 명				
	학 번		생년월일		
	주 소				
	연 락 처	핸드폰		e-mail	

2) 학적 사항

연도	학적변동 사항	비고

3) 현장실습, 인턴쉽, 어학연수, 교육연수 현황

연도	연수명	연수기관	비 고

4) 자격증 현황

자격증명	발행기관	취득연도	비고
