

# My title\*

My subtitle if needed

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First sentence. Second sentence. Third sentence. Fourth sentence.

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## 1 Introduction

The urban fire hazard is one of the most pressing issues in this context, especially in Canada where cities are dealing with such issues like climate, facilities or population density. As of July 1 2023, the population in urban area in Canada reached 33,812,133 (Statistics Canada 2024). Not only do fires in highly populated regions result in heavy losses in terms of property, but also, in the contest of people and the environment, the consequences are enormous. Also, urban fires are resources-dependent and require attention from city services and emergency services, thus indicating the need for prevention, action and planning based on risk assessment. With

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\*Code and data are available at: <https://github.com/yulexun/toronto-fire>.

such issues in mind, the knowledge of urban fire hazards in Canadian cities is needed for creating policies that address public safety and increase urban resilience.

In Canada, articles about fire incidents has a focus on wildfire. For instance, Goemans and Ballamingie (2012) discuss the fire mitigation plan during the 2003 wildfire at Kelowna, British Columbia, while Mamuji and Rozdilsky (2018) talk about the evacuation during the Fort McMurray wildfire in Alberta. The researches conducted about urban fire incidents are done in other parts of the world such as East Asia. Masood Rafi, Wasiuddin, and Hameed Siddiqui (2012) research the nature and level of this threat. They conclude that the lack of training in fire department, shortage of facilities and infrastructure the major issues in Pakistan. The research by Hari Murti et al. (2023) in Semarang City also emphasize the importance of community understanding and the installation of fire protection facilities. This article uses the data provided by opendatatoronto library (Gelfand 2022) in order to analyze fire occurrences in the city of Toronto, which is an important research gap in the study of fire incidents in America. This study seeks to provide a deeper understanding of fire patterns to improve fire prevention and emergency response strategies.

In this paper we visualize Toronto’s Fire Incidents’ data.

## 2 Data

### 2.1 Raw Data

This project uses R Core Team (2024), Gelfand (2022), Xie (2014), Wickham et al. (2019), Wickham (2016), Wickham et al. (2023)

### 2.2 Cleaned Data

Table 1: Top rows of cleaned Toronto Fire Service response time and loss data

Alarm Time	TFS Arrival Time	TFS Response Time	Civilian Casualties	Estimated Loss in Dollar
2018-02-25 15:48:34	2018-02-25 15:52:04	3.500000	0	5000
2018-02-26 18:11:59	2018-02-26 18:15:50	3.850000	0	500
2018-03-03 09:49:14	2018-03-03 09:53:09	3.916667	0	0
2018-03-03 17:54:38	2018-03-03 17:59:42	5.066667	0	15000

Alarm Time	TFS Arrival Time	TFS Response Time	Civilian Casualties	Estimated Loss in Dollar
2018-03-03 18:34:35	2018-03-03 18:40:47	6.200000	0	0

Table 2: Top rows of cleaned data showing Area of Origin, Ignition source and Fire, Smoke, Sprinkler System Presence.

Area of Origin	Ignition Source	Fire Alarm Status	Smoke Alarm Status	Sprinkler System Status
28	41	P	PO	P
24	11	P	PO	N
24	11	N	PO	P
25	24	N	N	N
24	11	P	PO	P

Note: 'PO' = System present,  
 'N' = System not present,  
 'P' = System present but not operated

## A Appendix

### A.1 Graph of areas of origin of fire incidents by number of occurrences

Index of 'Area of Origin':

- 11 - Lobby, Entranceway
- 12 - Hallway, Corridor
- 13 - Stairway, Escalator
- 18 - Covered Court, Atrium, mall concourse
- 19 - Other Means of Egress
- 21 - Living Area (e.g. living, TV, recreation, etc)
- 22 - Sleeping Area or Bedroom (inc. patients room, dormitory, etc)
- 23 - Dining or Beverage Area (inc mess, canteen, lunchroom, cafeteria
- 24 - Cooking Area or Kitchen
- 25 - Washroom or Bathroom (toilet, restroom/locker room)
- 26 - Sauna
- 27 - Laundry Area
- 28 - Office
- 29 - Electronic Equipment
- 30 - Sales, Showroom Area
- 31 - Process Manufacturing (inc manf, prod assembly, repair)
- 32 - Assembly Area (inc school room, spectator area, church, etc)
- 33 - Laboratory
- 34 - Operating Room, Treatment or Examination Area
- 35 - Performance Area (inc stage, rink, boxing ring, gym floor, altar
- 36 - Backstage, dressing room
- 39 - Other Functional Area
- 41 - Closet (eg. clothes, broom, linen closet, etc.)
- 42 - Garage
- 43 - Locker (apartment storage)
- 44 - Trash, Rubbish Storage (inc garbage chute room, garbage/industri
- 45 - Supply Storage Room (inc maintenance/office/document storage, et
- 46 - Product Storage (inc products or materials awaiting manuf, assembly)
- 47 - Shipping/Receiving/Loading Platform
- 48 - Records storage area (inc vaults)
- 49 - Other Storage Area
- 50 - Basement/cellar (not partitioned)
- 51 - Elevator (includes shaft)
- 52 - HVAC Equipment Room (furnace room, water heater closet, boiler)
- 53 - Chimney/Flue Pipe
- 54 - Incinerator Room

- 55 - Mechanical/Electrical Services Room
- 56 - Conveyor Shaft or Chute (inc dumbwaiter, laundry chute, garbage
- 57 - Ducting - Heating, Air Conditioning
- 58 - Ducting - Exhaust (inc cooking, fumes, etc.)
- 59 - Utility Shaft (eg. electrical wiring/phone, etc.)
- 60 - Other Building Services/Support Facilities
- 61 - Exterior Wall
- 62 - Roof
- 63 - Awning or Canopy
- 64 - Porch or Balcony
- 65 - Crawl Space (includes sub-structure)
- 66 - Concealed Ceiling Area
- 67 - Concealed Floor Area
- 68 - Concealed Wall Area
- 69 - Attic Area
- 70 - Other Structural Area
- 71 - Open Area (inc lawn, field, farmyard, park, playing field, pier,
- 72 - Court, Patio, Terrace
- 73 - Parking Area, Parking Lot
- 74 - Storage Area (outside)
- 75 - Trash, rubbish area (outside)
- 78 - Attached Deck
- 79 - Other Outside Area
- 81 - Engine Area
- 82 - Running Gear (inc wheels and braking systems, transmission syste
- 83 - Electrical Systems
- 84 - Fuel Systems (eg. fuel tank, etc.)
- 85 - Operator/Control Area
- 86 - Passenger Area
- 87 - Trunk/Cargo Area
- 89 - Other Vehicle Area
- 91 - Multiple Areas of Origin
- 92 - Residential/Business: Restaurant area
- 93 - Residential/Business: Other busines area

## **B Attribution Statement**

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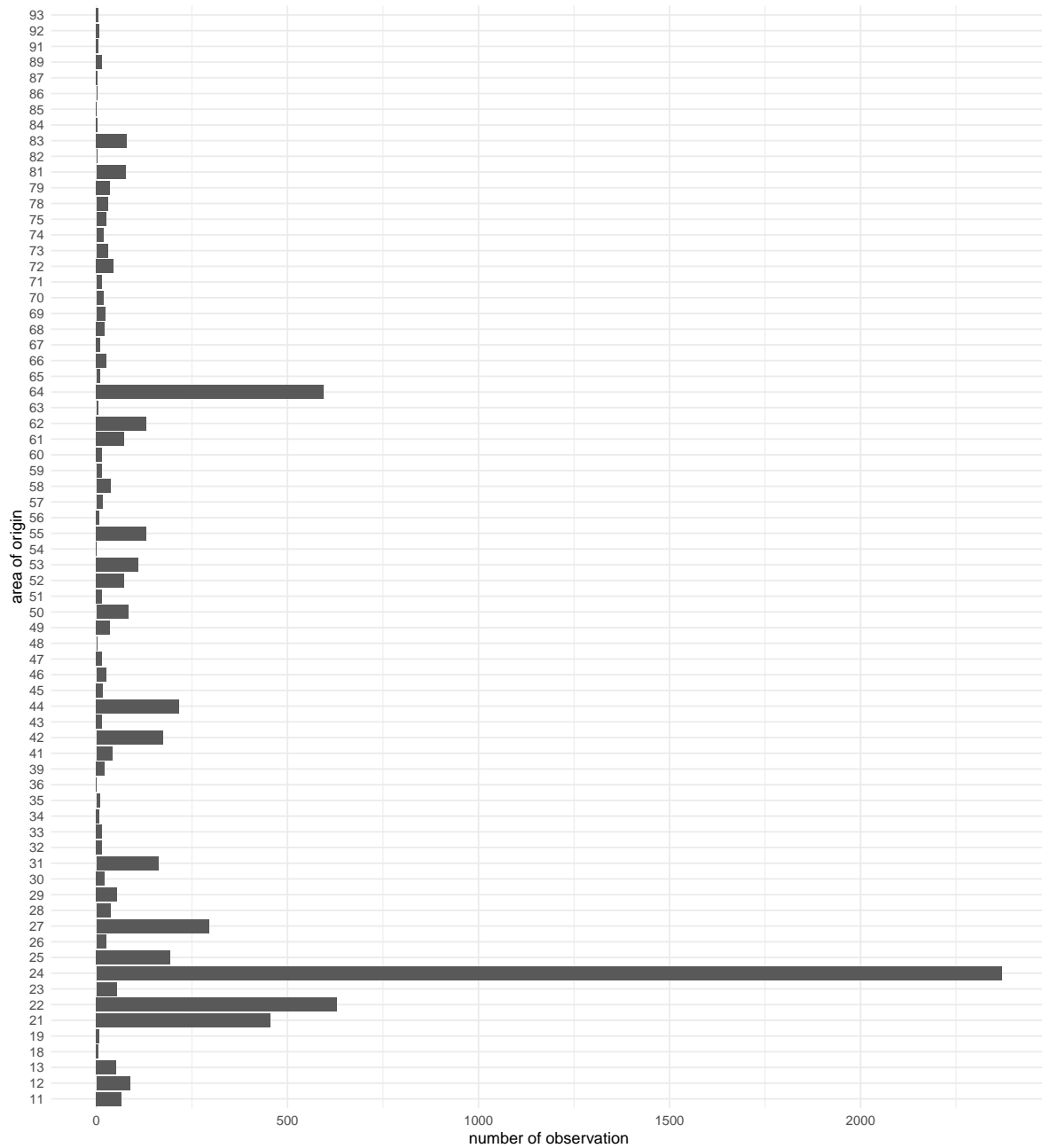


Figure 1: Areas of origin of fire incidents by number of occurrences

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