# Gunpowder Injury Decision Tree

## Introduction

In Columbia, the issue of gunpowder-related injuries, particularly during festive seasons, remains a significant public health concern. Fireworks, while culturally ingrained and a source of celebration, pose substantial risks, especially to children. This has led policymakers to consider various strategies to mitigate these risks and enhance public safety.

The decision problem we will consider revolves around identifying the most effective approach to reducing injuries and fatalities caused by fireworks. Two primary strategies under consideration are **(1) a complete ban on fireworks** and **(2) heavy regulation**, such as restricted sales licenses and stringent enforcement.

A complete ban aims to eliminate the root cause of injuries by prohibiting the sale, storage, and use of fireworks. This approach seeks to protect public health directly but may face resistance due to its impact on cultural traditions and the livelihoods of vendors.

On the other hand, heavy regulation involves implementing strict controls over the sale and use of fireworks. This strategy includes measures such as issuing sales licenses only to authorized vendors, enforcing age restrictions, and conducting public education campaigns about the dangers of fireworks. This approach aims to reduce injuries while allowing for controlled, safe use of fireworks.

Our case studies will explore these strategies through two decision modeling approaches. This case study will utilize a decision tree model to evaluate the immediate outcomes and costs associated with each strategy.

Later, we will employ a Markov cohort model to examine the long-term health and economic impacts, considering factors such as injury rates, healthcare costs, and compliance levels.

By analyzing these models, we aim to provide a comprehensive assessment of the most cost-effective and sustainable approach to reducing gunpowder-related injuries in Bogotá today.

## Model Inputs and Parameters

We will assume that reported injuries fall into three major categories:

- **Minor Injury**: first-degree burns, which may cause pain, redness, and minor swelling
- **Moderate Injury**: second-degree burns that cover a more significant portion of the body and involve blisters, pain, and potential infection risk
- **Major Injury**: third-degree burns or severe trauma that affects deeper tissues and can lead to significant complications.

There are very likely many minor or even moderate injuries that go unreported. For this reason, we will assume that minor injuries are a low percentage of **reported** injuries, but remain the most common type of injury overall.

| Description | Base Case Value | Parameter Name |
|---|---|---|
| Probability of Injury | 0.00292 | pInjury |
| Probability Injury is Mild | 0.15 | pMinor |
| Probability Injury is Moderate | 0.3 | pModerate |
| Probability Injury is Major | 0.5 | pMajor |
| Probability Injury is Fatal | 0.05 | pFatal |

We will also assume that nearly all individuals who experience minor injuries recover fully in the year they are injured, while moderate and major injuries have some probability of long-term sequalae with some annual probability of recurrence.

| Description | Base Case Value | Parameter Name |
|---|---|---|
| Probability of Recovery: Minor Injury | 0.99 | pFullRecoveryMinor |
| Probability of Recovery: Moderate Injury | 0.50 | pFullRecoveryModerate |
| Probability of Recovery: Major Injury | 0.20 | pFullRecoveryMajor |

```
library(flextable)

# Create a data frame with the data
firework_data <- data.frame(
  Year = as.character(c(2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 20
  Cases = c(275, 754, 812, 1061, 1096, 1351, 1407, 848, 2012, 1469, 1778, 1477, 1378, 1504, 
  Population = c(42658630, 43134017, 43608630, 44086292, 44553416, 45001731, 45434492, 46301
  `Rate per 100,000` = c(0.64, 1.75, 1.86, 2.41, 2.46, 3.00, 3.10, 1.83, 4.31, 3.17, 3.75, 3
)
```

```r
# Create the flextable
ft <- flextable(tail(firework_data ))

# Print the flextable
ft
```

| Year | Cases | Population | Rate.per.100.000 |
|---|---|---|---|
| 2017 | 1,778 | 47,419,000 | 3.75 |
| 2018 | 1,477 | 48,259,442 | 3.06 |
| 2019 | 1,378 | 49,269,676 | 2.80 |
| 2020 | 1,504 | 50,407,437 | 2.98 |
| 2021 | 1,694 | 51,177,378 | 3.31 |
| 2022 | 1,510 | 51,826,932 | 2.92 |

Table 3: Decision Tree Parameters

| Description | Base Case Value | Parameter Name |
|---|---|---|
| Firework Ban: Relative Risk of Minor Injury | 0.5 | rrMinorBan |
| Firework Ban: Relative Risk of Moderate Injury | 0.2 | rrModerateBan |
| Firework Ban: Relative Risk of Major Injury | 0.9 | rrMajorBan |
| Firework Ban: Relative Risk of Fatal Injury | 0.95 | rrFatalBan |
| Firework Regulation: Relative Risk of Minor Injury | 0.7 | rrMinorBan |
| Firework Regulation: Relative Risk of Moderate Injury | 0.5 | rrModerateBan |
| Firework Regulation: Relative Risk of Major Injury | 0.95 | rrMajorBan |

| Description | Base Case Value | Parameter Name |
|---|---|---|
| Firework Regulation: Relative Risk of Fatal Injury | 0.98 | rrFatalBan |

**Minor Injuries**

- Up-front: $100 (simple first aid) to $500 (doctor visits and medications)
- Annual: $0

**Moderate Injuries**

- Up-front: $1,000 (outpatient treatment) to $5,000 (minor surgery, stitches)
- Annual: $0

**Major Injuries**

- Up-front: $10,000 (initial hospitalization) to $50,000+ (multiple surgeries, ICU)
- Annual: $1,000 - $10,000 for rehabilitation, follow-up surgeries, and long-term care

## Scratch

In Amua, on the menu at the top, go to **Model** -> **New** -> **Decision Tree**. This will create a new model with a single decision node on the left side of the screen.

- Decision Node
- Plus
- Align right
- Run Model
- Check Model
- Clear
- Change