

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 sequelae 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, 2018, 2019, 2020)),
  Cases = c(275, 754, 812, 1061, 1096, 1351, 1407, 848, 2012, 1469, 1778, 1477, 1378, 1504, 1600),
  Population = c(42658630, 43134017, 43608630, 44086292, 44553416, 45001731, 45434492, 46301000, 47180000, 48060000, 48940000, 49820000, 50700000, 51580000, 52460000),
  `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, 3.00, 3.00, 3.00, 3.00)
)
```

```
# 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