# Árbol de decisiones sobre lesiones por fuegos artificiales

## Introducción y visión general del problema

En Colombia, el problema de las lesiones relacionadas con los fuegos artificiales, especialmente durante las fiestas, sigue siendo un importante problema de salud pública. Los fuegos artificiales, aunque están culturalmente arraigados y son una fuente de celebración, plantean riesgos sustanciales, especialmente para los niños. Esto ha llevado a los responsables políticos a considerar diversas estrategias para mitigar estos riesgos y mejorar la seguridad pública.

El problema de decisión que vamos a considerar gira en torno al análisis de enfoques para reducir las lesiones y muertes causadas por los fuegos artificiales. Las dos estrategias principales que se barajan son **(1) la prohibición total de los fuegos artificiales** y **(2) una reglamentación estricta**, como la restricción de las licencias de venta y una aplicación rigurosa de la ley.

La prohibición total pretende eliminar la causa principal de las lesiones prohibiendo la venta, el almacenamiento y el uso de fuegos artificiales. Este enfoque pretende proteger directamente la salud pública, pero puede encontrar resistencia debido a su impacto en las tradiciones culturales y los medios de subsistencia de los vendedores.

Por otro lado, la regulación estricta implica la aplicación de controles estrictos sobre la venta y el uso de fuegos artificiales. Esta estrategia incluye medidas como la expedición de licencias de venta sólo a vendedores autorizados, la imposición de restricciones de edad y la realización de campañas de educación pública sobre los peligros de los fuegos artificiales. Este enfoque pretende reducir las lesiones al tiempo que permite un uso controlado y seguro de los fuegos artificiales.

Nuestros estudios de casos explorarán estas estrategias a través de dos enfoques de modelización de decisiones. Este estudio de caso utilizará un modelo de árbol de decisión para evaluar los resultados inmediatos y los costes asociados a cada estrategia.

Posteriormente, emplearemos un modelo de cohortes de Markov para examinar las repercusiones sanitarias y económicas a largo plazo, teniendo en cuenta factores como las tasas de lesiones, los costes sanitarios y los niveles de cumplimiento.

Mediante el análisis de estos modelos, pretendemos ofrecer una evaluación exhaustiva del planteamiento más rentable y sostenible para reducir las lesiones relacionadas con la pólvora en Columbia en la actualidad. # Model Inputs and Parameters

### Injury Rates

Your colleagues have compiled the following data on gunpowder injuries by year in Columbia. We will construct a decision tree model based on injuries in the most recent year reported (2022).

| 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 |

### Injury Types and Consequences

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

- **Minor Or Moderate Injury**: First-degree burns, which may cause pain, redness, and minor swelling. This category also includes 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.
- **Fatal Injury**

> **!** There are very likely many minor and moderate injuries that go unreported in official statistics. For this case study, we will assume that severe injuries are 30% of reported injuries.

| Description | Base Case Value | Parameter Name |
|---|---|---|
| Probability of Injury | 0.0000292 | p_injury |
| Probability Injury is Severe | 0.30 | p_severe |
| Probability Injury is Fatal | 0.0046 | p_fatality |

We will also assume that a small percentage (15%) of individuals with mild/moderate injuries experience long-term consequences (i.e., 85% recover), while the majority (60%) of those with severe injuries do not fully recover and experience long-term complications.

| Description | Base Case Value | Parameter Name |
|---|---|---|
| Probability of Recovery: Mild/Moderate Injury | 0.85 | p_recover_mildmod |
| Probability of Recovery: Major Injury | 0.6 | p_recover_severe |

### Strategies and Impact

When the mayor of Bogota banned the sale of fireworks in 1995, fireworks-related burns fell by 62%, from 204 in the 1994-1995 Christmas season to 77 during the 1995-1996 season.[1] We will assume a similar 60% relative risk reduction under the "Ban" scenario.

By comparison, we will assume that stricter regulation will reduce firework injuries by just 20%. We will examine the sensitivity of our findings to these assumpions later in the case study.

## Exercises

### 1.1. Build a "Do Nothing" Strategy

*Construct a decision tree in Amua for a "Do Nothing" strategy. Your tree should work through the following chance nodes*:

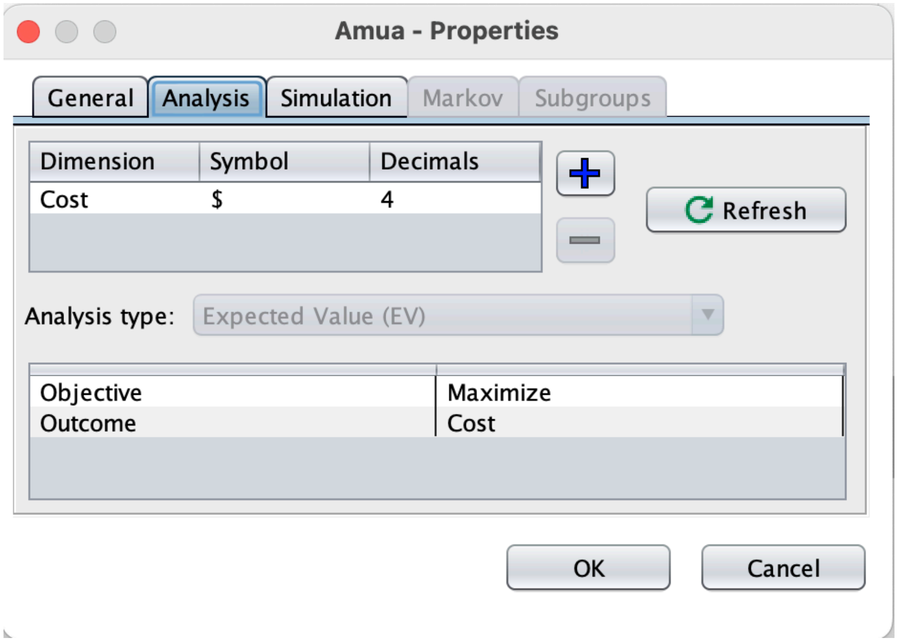
1. Injury vs. No Injury
2. Fatal injury vs. non-fatal injury
3. Mild/Moderate vs. Severe injury
4. Full recovery vs. Recovery with injury sequelea

Please use the parameter names and values supplied above in the construction of your tree.

[1] Source: "Antanas Mockus: The Prohibition of Fireworks in Bogotá Sequel," *Harvard Kennedy School Case Study*. Available fromhttps://case.hks.harvard.edu/antanas-mockus-the-prohibition-of-fireworks-in-bogota-sequel/

## 1.2. Add Outcomes

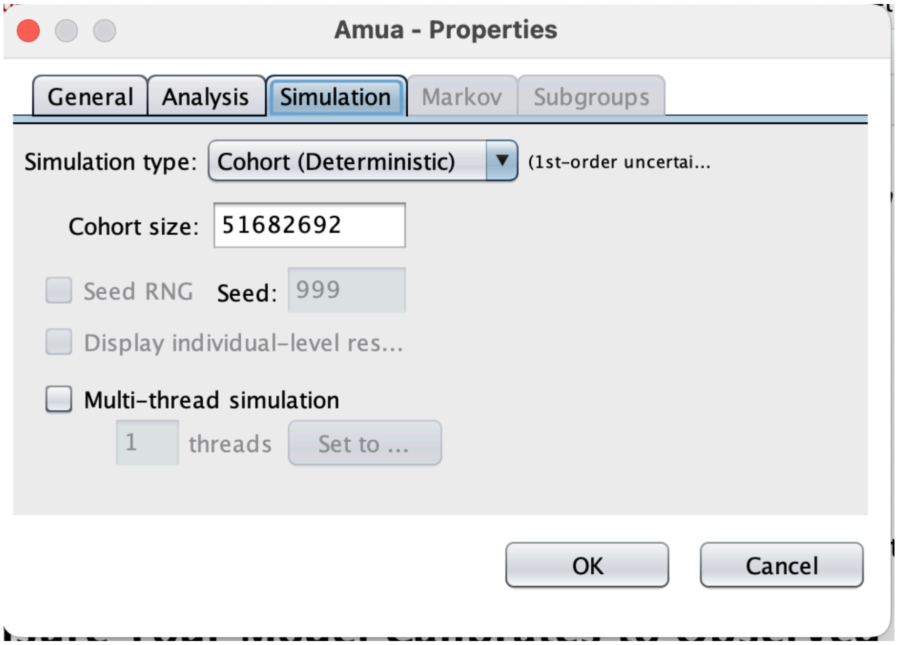
Amua defaults to cost outcomes. Please remove the cost outcome and define a new primary outcome based on injury. In other words, the outcome "payoff" should be 1.0 if an injury occurs, and 0 otherwise.

> Tip
>
> You can edit the outcomes by clicking Model → Properties → Analysis:
>
> 
> 

## 1.3. Ensure Your Model Calibrates to Observed Injury Totals

*Run your initial decision tree using a cohort size of 51,682,692 (2022 population of Columbia). Verify that the total number of firework injuries closely matches the reported total of 1,510.*

> Tip
>
> You can enter the cohort size by clicking Model → Properties → Simulation:




## 2.1. Include Additional Policy Scenarios

*Create a duplicate version of your "Do Nothing" tree to construct separate branches for the "Ban" and "Regulate" scenarios. Under each, the probability of injury should be modified by a relative risk reduction parameter with values set based on the text above and the table below.*

| Description | Base Case Value | Parameter Name |
|---|---|---|
| Relative risk reduction: probability of injury under "Ban" policy scenario | 0.40 | rr_ban |
| Relative risk reduction: probability of injury under "Regulate" policy scenario | 0.80 | rr_regulate |

Tip

You can copy and paste the "Do Nothing" branch by right-clicking on the first chance node and selecting "Copy." You can then paste a copy of the entire tree structure on the red decision node .

### 2.2. Add Additional Outcomes

Add additional outcomes based on each injury type (mild/moderate, severe, fatal). Use your decision tree to project injuries overall and by type under each strategy. Use your results to fill out the table below. Each cell should have calculated counts of the number of each type of injury under each strategy.

| Strategy | Any Injury | Mild/Moderate | Severe | Fatal |
|---|---|---|---|---|
| Do Nothing | | | | |
| Ban Fireworks | | | | |
| Regulate Fireworks | | | | |