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Decision-Making for Public Policy

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## Final Project Modeling Overview

### *Introduction*

The purpose of the model was to estimate the total cost of the 2022 Fourth of July celebration events in Washington, DC. The modeling centered on Monte Carlo simulation. In addition, a sensitivity analysis was performed to capture how the changes in input would affect the output. The model did not yield satisfactory results due to imbalanced and limited data. However, its framework, along with the sensitivity analysis, revealed how the COVID-19 situation could distort policy planning.

### *Background*

From 2016 to 2019, the Fourth of July Celebration events held in the National Mall included the National Independence Day Parade; A Capitol Fourth Concert; Independence Day Fireworks Display; and in 2019 and 2020, A Salute to America.<sup>1</sup> In 2020, the Fourth of July events were modified due to the COVID-19 pandemic, the National Independence Day Parade was canceled, and the Capitol Fourth Concert was prerecorded.<sup>2</sup> Moreover, during the 2020 events, a fireworks display was held in Mount Rushmore, South Dakota.

Except for the Independence Day parades, which were funded by non-federal sponsors, producing and executing the Fourth of July events in Washington, DC requires government funding, command, control, and coordination between several federal agencies and state and local jurisdictions. Federal agencies and state and local jurisdictions were also responsible for

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<sup>1</sup> Office, U. S. G. A. (n.d.). *Independence Day celebrations: Estimated costs and covid-19 protective measures for 2020 Fourth of July events*. Independence Day Celebrations: Estimated Costs and COVID-19 Protective Measures for 2020 Fourth of July Events | U.S. GAO. Retrieved December 9, 2021, from <https://www.gao.gov/products/gao-21-458>.

<sup>2</sup> Ibid.

ensuring the safety and health of the public attending the events, considering the large crowds, high temperatures in July in Washington, D.C., and especially the COVID-19 situation in 2020.

### *Theoretical Approach and Data*

To estimate total cost, a microeconomic model was adopted. The micro-economic model of total cost defines the total cost as the sum of fixed and variable costs. Realizing that the uncertainties posed by the pandemic would likely alter the execution of the 2022 Fourth of July events in Washington, DC, the model identified the fixed costs as the costs that would occur regardless of the possible modifications to the execution of the 2022 Fourth of July events. Variable costs, naturally, were identified as the costs that would fluctuate with the possible modifications to the execution of the 2022 Fourth of July events.

The data were collected from the performance auditing reports generated by the Government Accountability Office (GAO), which estimated the annual cost of the Fourth of July celebration events in Washington, DC, from 2016 to 2020. The estimates produced by GAO were based on the data provided by the federal agencies and state and local jurisdictions that sponsored and produced the events.

### *Modeling Approach*

The following total cost model was developed:

$$\text{Total Cost} = \text{Fixed Cost} + \text{Variable Cost Variable} * \text{Cost Per Variable Cost Variable}$$

A Monte Carlo simulation was performed 10,000 iterations using the Variable Cost Variable. Each iteration represented an estimated scenario of the 2022 Fourth of July events in Washington, DC, as well as the total cost of the events, by varying the Variable Cost Variable. The Monte Carlo simulation showed where the projection fell in relation to 10,000 other simulations.

### *Variables and Variable Formulation*

Fixed Cost Variable:

#### **Fixed General Organization Cost:**

Fixed General Organization Cost was defined as the overall cost of producing and executing the Capitol Fourth Concert and fireworks display during the Fourth of July events in Washington, DC. Note that the Capitol Fourth Concert and fireworks display occurred annually during the Fourth of July events in Washington, DC, from 2016 to 2020. Although the Independence Day Parade was held annually as well, it does not require federal funding and therefore was excluded from the analysis. The Fixed General Organization Cost was estimated by:

1. Calculating the annual general organization cost
2. Calculating the mean and standard deviation
3. Generating a random number based on the mean, standard deviation, and the nature of the costs being normally distributed

Variable Cost Variable:

#### **Number of People:**

Number of People was defined as the number of attendees at the Fourth of July events in Washington, DC, and was considered as normally distributed. It was estimated by:

1. Estimating the number of attendees at the Fourth of July events each year. Note that the 2016-2019 estimates (i.e., 700,000 people each year) were based on the data from *The District*, a well-known Washington, DC tourism website, which stated that about 700,000 people came to the

National Mall for the events each year.<sup>3</sup> The 2020 estimates (i.e., 300,000) were based on a news article, which stated that over 300,000 face coverings were distributed during the 2020 Fourth of July celebration on the National Mall.<sup>4</sup>

2. Calculating the mean and standard deviation

3. Generating a random number based on the mean, standard deviation, and the nature of the number of attendees being normally distributed

Cost Per Variable Cost Variable:

### **Cost of Security and Health Ensuring Measures Per Person (CHEMPP):**

CHEMPP was defined as the cost of ensuring health and safety of the attendees at the Fourth of July events in Washington, DC. It was considered as normally distributed and was estimated by:

1. Using the cost of security and health ensuring measures each year to calculate the mean and standard deviation

2. Generating a random number based on the mean, standard deviation, and the nature of the costs being normally distributed

3. Using the generated random number divided by a randomly generated Number of People

### *Results and Sensitivity Analysis*

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<sup>3</sup> says, E. (n.d.). *DC discounts*. Visit Washington DC. Retrieved December 9, 2021, from <https://www.thedistrict.com/sightseeing/events/a-capitol-fourth-4th-of-july/>.

<sup>4</sup> Cox, J. W. (2021, July 4). *On July 4th, thousands gather in D.C. to celebrate a nearly normal Independence Day*. Stars and Stripes. Retrieved December 9, 2021, from <https://www.stripes.com/theaters/us/2021-07-04/july-4-dc-2050059.html>.

The model projecting the total cost of the 2022 Fourth of July events in Washington, DC did not yield satisfactory results. Considering that the inputs relied heavily on estimates, this result was not surprising. It is important to note that the COVID-19 situations in 2020 had a minimal impact on the cost of safety and health ensuring measures. Federal agencies and state and local jurisdictions did not incur COVID-19 mitigation costs for the events because personal protective equipment (PPE) and other related supplies used were from existing stockpiles.<sup>5</sup> Therefore, the sole factor that affected the model the most would be the number of people. Note that due to the COVID-19 pandemic, there were far fewer people attending the events in 2020, distorting the mean and standard deviation of Number of People, and accordingly, Cost of Security and Health Ensuring Measures Per Person (CSHEMPP).

The sensitivity analysis was then performed to capture how the changes in the number of people would affect the total cost. According to the sensitivity analysis, in order to achieve the goal of having the total cost of the 2022 Fourth of July events in Washington, DC incurred at \$700,0000, which is approximately the mean projected by the Monte Carlo simulation, the number of attendees should be 114346, implying a highly unlikely case.

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<sup>5</sup> Office, U. S. G. A. (n.d.). *Independence Day celebrations: Estimated costs and covid-19 protective measures for 2020 Fourth of July events*.

## References

- Cox, J. W. (2021, July 4). *On July 4th, thousands gather in D.C. to celebrate a nearly normal Independence Day*. Stars and Stripes. Retrieved December 9, 2021, from <https://www.stripes.com/theaters/us/2021-07-04/july-4-dc-2050059.html>.
- Office, U. S. G. A. (n.d.). *Independence Day celebrations: Estimated costs and covid-19 protective measures for 2020 Fourth of July events*. Independence Day Celebrations: Estimated Costs and COVID-19 Protective Measures for 2020 Fourth of July Events | U.S. GAO. Retrieved December 9, 2021, from <https://www.gao.gov/products/gao-21-458>.
- says, E. (n.d.). *DC discounts*. Visit Washington DC. Retrieved December 9, 2021, from <https://www.thedistrict.com/sightseeing/events/a-capitol-fourth-4th-of-july/>.

## Data Source

- Office, U. S. G. A. (n.d.). *Independence Day celebrations: Estimated costs and covid-19 protective measures for 2020 Fourth of July events*. Independence Day Celebrations: Estimated Costs and COVID-19 Protective Measures for 2020 Fourth of July Events | U.S. GAO. Retrieved December 9, 2021, from <https://www.gao.gov/products/gao-21-458>.