Assignment 1: *Game Theory Concepts (Week 1)*

Due Date: Monday, July 7th, 2025.

The paper "Emergency department visits respond nonlinearly to wildfire smoke" (PNAS, 2023) examines how extreme air pollution events affect emergency department (ED) visits in California between 2006 and 2017. Key findings include:

- Moderate smoke exposure (PM 5–15 μg/m³): ED visits increase by an average of 0.9 additional daily visits per 100,000 people (95% CI: 0.6–1.2), representing a 1.1% increase over the baseline rate of 75.3 visits per 100,000.
- Figure 1 shows that All-cause ED visits increase with additional exposure to moderate levels of smoke pollution but decline dramatically on the most extreme days.
- Peak response occurs at 10 μg/m³ of smoke PM (88th percentile).
- Heavy smoke exposure (PM ≥ 20 μg/m³): ED visits decline, becoming 7.3 visits lower per 100,000 at 50 μg/m³ (99th percentile), a 9.8% decrease.

These results suggest that individuals adjust their behavior in response to air quality, particularly during extreme pollution events.

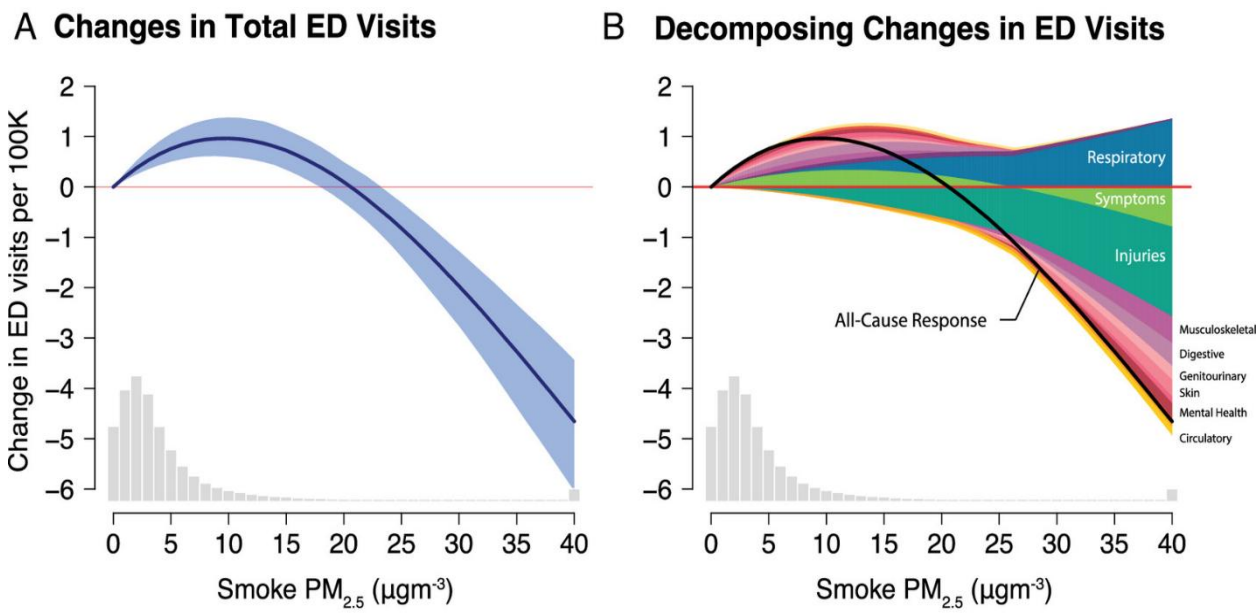

Figure 1

Instructions: Using the concepts discussed in Week 1, answer the following questions.

1. **Simultaneous and sequential games.** Emma and Oscar are deciding whether to engage in outdoor activities. Assume that both players value being together, but Oscar values it more than Emma.
    a. Model this situation as a simultaneous-move game.
    b. Then, model it as a sequential-move game, where Emma moves first.
    c. Clearly state your **assumptions about payoffs** (you may use general parameters like *a* or *b*).
    d. Discuss the equilibrium results in each time structure and compare your results.

2. **Introducing uncertainty.** Now assume that p represents the probability that wildfire smoke is in the 5-15 μg/m³ range and $(1-p)$ is the probability that the wildfire smoke reaches 50 μg/m³, where $p \in [0,1]$. Consider that players' payoffs are lower when the wildfire smoke reaches 50 μg/m³ than smoke is in the 5-15 μg/m³ range.
    a. Discuss how this uncertainty affects the outcomes from Question 1.
    b. Determine the threshold value of p that would lead both Emma and Oscar to stay home.
    c. Interpret the strategic implications of this result.

3. **Connection to research.** Consider again the paper "Emergency department visits respond nonlinearly to wildfire smoke" (PNAS, 2023).
    a. What strategic incentives might explain the nonlinear pattern in ED visits?
    b. Why might ED visits decrease when smoke PM reaches 50 μg/m³, despite the health risks?