

Case 1: Scheduling Employees at Big Town Fire (Updated 5/29/21 - updates in BOLD)

This case focuses on developing a deeper understanding of the personnel scheduling problem.

Big Town Fire Department would like to schedule their human resource requirements in fire and safety operations, **aka, firefighters**. The town runs two schedules per day, 12 hours each. Firefighters are compensated hourly at \$30 per hour plus 33% for benefits. Firefighters who work the night shift received \$5 more per hour and have a commensurate increase in benefits.

The weekly firefighter personnel requirements are:

| | Mon | Tues | Weds | Thurs | Fri | Sat | Sun |
|-------|-----|------|------|-------|-----|-----|-----|
| 5a-5p | 11 | 13 | 15 | 19 | 15 | 13 | 9 |
| 5p-5a | 17 | 13 | 15 | 17 | 19 | 21 | 14 |

The normal shift for a firefighter is 4 days 12 hours a day followed by 3 consecutive days off, working on either the day or the night shift (not both). Big Town managers would like to schedule the firefighters in the least cost way, but must make sure the requirements are met?

Questions to Address

- What is the fundamental challenge that Big Town faces in this setting? What assumptions are made when building a model to schedule the fire fighters or in any similar personnel scheduling problem?
- Given the above information what is the optimal schedule **for firefighters** and the associated cost **that meets (or exceeds) the personnel needs for Big Town Fire**? Call this solution and the associated total cost the “benchmark solution”.
- How does the benchmark solution change with increases in the needed number of firefighters on the weekend night shifts (Friday, Saturday, and Sunday) of 5%, 10%, and 20%? **Note: Assume that increases mean that the number of firefighters needed at the specified times go up by 5% or more, 10% or more, etc.**
- How does the benchmark optimal solution change if there are part-time employees who work two consecutive days with 5 days off either day or night **but not both day and night**?
- Provide a table with different solutions for **upper limits of 0%, 20%, 40%, etc., of part time firefighters as defined in part d (not part c). For example, assume that at most the total number of firefighters who are part time is 20% of the total number and so on.**

- f. What if the total number of firefighters are limited due to turnover or other challenges in hiring? Starting from the benchmark solution, limit the total number of firefighters by 1, 2, 3, ..., 10. To enable finding an answer, allow the firefighters to work “double” shifts (day and night), but double cost the Big Town “time and a half” for all hours over 48 hours per week. Report the implications in terms of cost. **Note 1: If the benchmark solution had 22 firefighters in total (not the actual answer), then, the goal here would be to find the best schedule with 21 firefighters, with some overtime involved. Then repeat for 20, 19, etc. Note 2: To include shifts that allow for overtime, you may need to make some assumptions about how much overtime is permitted for a firefighter per week. How safe is it if firefighters are working too much?**
- g. Summarize and generalize the findings in this case.