Dylan Gordon

Dominick Kubica

Tabitha Tomori

Matthew Yee

Tesla Optimization Report

This report, through optimization models, focuses on the decisions Alex should make to fulfill staffing requirements given the circumstances.

a) How many full-time English-speaking agents, full-time Spanish-speaking agents, and part-time agents should Alex hire for each 2-hour shift to minimize operating costs while attending to all calls? (Please round each number to the nearest integer.)

After running the posted R model, we received the following optimized numbers. The number of full-time English-speaking agents Alex should hire for each 2-hour shift to minimize operating costs are 5 agents for 7am-9am, 12 agents for 9am-11am, 6 agents for 11am-1pm, 1 agent for 1pm-3pm, and 1 agent for 3pm-5pm. This gives us a total number of 25 English speaking full time agents.

The amount of English part-time agents are 4 agents for 3pm-5pm and 0 for 5pm-7pm. The amount of full-time Spanish-speaking agents are 1 agent for 7am-9am, 3 agents for 9am-11am, 2 agents for 11am-1pm, 1 agent for 1pm-3pm, and 0 agents for 3pm-5pm. This gives us a total number of 7 full time Spanish.

English:

```
> answer$value
[1] 3620.102
> round(answer$par)
[1]  5 12  6  1  1  4  0
```

English Full-time Start times (Assuming 2 hours on, 2 hour break, 2 hours on):
7-9: 5
9-11: 12
11-1: 6
1-3: 1
3-5: 1

Total Needed: 25 English Speaking Full Time Employees

English Part time Start Times (4 hours straight)

3-5: 4

5-7: 0

Total Needed: 4 English Speaking Part times

Spanish:

```
> answer$value
[1] 1005.002
> round(answer$par)
[1] 1 3 2 1 0
```

Spanish Full Time Employee Start Times:

7-9: 1

9-1 : 3

11-1: 2

1-3: 1

3-5: 0

Total Needed: 7 Spanish Speaking full Time Employees

b) What is the minimum cost for the optimization model to assist Alex's decision in hiring all agents that she needs? (Please round to two decimal places, e.g., 123.45.)

Based on the optimization models for English (full time and part time) and Spanish agents, we get an optimized cost for English workers of $3620.10 and $1005.00 for Spanish workers. Combined, the minimum cost for the optimization model that will assist Alex in hiring all of the agents she needs is $4625.10.

Total for English: $3620.10

Total for Spanish: $1005.00

Total for Both: $4625.10

Due to a preference among full-time agents to avoid late evening shifts, Alex can find only one qualified English-speaking agent willing to start work at 1 P.M. and 3 P.M. Given this new constraint:

c) How many full-time English-speaking agents, full-time Spanish-speaking agents, and part-time agents should Alex hire for each 2-hour shift to minimize operating costs while attending to all calls? (Please round each number to the nearest integer.)

Taking into account the new constraint of 1 English-speaking agent starting at 1pm and 3pm, we formatted our R code to have x[4] and x[5] to be <= 1. The function normally takes the equality as >=, so we flipped it by making the variable negative, which is shown below. Running this new R code gives us the same values as we received in question (a).

This question was interesting because our first output of the English Speaking Group already only had 1 person working from 1-3, and 3-5. This meant that we didn't need to make any adjustments to the code to fit this parameter. BUT, if our original answer was not already a solution we could've added the parameters below for H[15] and H[16].

These add another constraint that makes sure that the x4 and x5 variables are one or less. This means that the number of people starting work at either 1 and 3 would be less than or equal to 1. One key part to the constraint is the negative sign put in front of the variable x4 and the addition of 1 to the equation. These changes effectively flip the inequality from being a greater than or equals to, to a less than or equals to.

```
h[8] = x[1]  # Ensures x[1] >= 0
h[9] = x[2]
h[10] = x[3]
h[11] = x[4]
h[12] = x[5]
h[13] = x[6]
h[14] = x[7]
h[15] = 1 - x[4]  # New constraint: x[4] <= 1
h[16] = 1 - x[5]  # New constraint: x[5] <= 1
```

English:

```
> answer$value
[1] 3620.102
> round(answer$par)
[1]  5 12  6  1  1  4  0
```

English Full-time Start times (Assuming 2 hours on, 2 hour break, 2 hours on):

7-9: 5

9-11: 12

11-1: 6

1-3: 1

3-5: 1

Total Needed: 25 English Speaking Full Time Employees

English Part time Start Times (4 hours straight)

3-5: 4
5-7: 0
Total Needed: 4 English Speaking Part times

Spanish:

```
> answer$value
[1] 1005.002
> round(answer$par)
[1] 1 3 2 1 0
```

Spanish Full Time Employee Start Times:
7-9: 1
9-1 : 3
11-1: 2
1-3: 1
3-5: 0
Total Needed: 7 Spanish Speaking full Time Employees

d) What is the minimum cost for the optimization model to assist Alex's decision in hiring all agents that she needs? (Please round to two decimal places.)

Similar to answer (c), our answers were the same as part (a) and (b).

Total for English: $3620.10

Total for Spanish: $1005.00

Total for Both: $4625.10

Alex is now exploring the possibility of hiring bilingual agents instead of monolingual agents. If all agents are bilingual:

e) How many full-time and part-time agents should Alex hire for each 2-hour shift to minimize operating costs while attending to all calls? (Please round each number to the nearest integer.)

```
> answer$value
[1] 4525.032
> round(answer$par)
[1]  7 14  7  2  2  4  0
```

Full Time Agents: 7 , 14 , 7 , 2 , 2
7-9: 7

9-1: 14
11-1: 7
1-3: 2
3-5: 2
Part Time Agents: 4 , 0
3-5: 4
5-7: 0
Total = 36

f) What is the minimum cost for the optimization model to assist Alex's decision in hiring all agents that she needs? (Please round to two decimal places.)

Minimum Cost: $4525.03

g) What is the maximum percentage increase in the hourly wage rate that Alex can offer to bilingual agents over monolingual agents without increasing the total operating costs? (Please round to one decimal place, e.g., 8.7%.)

We struggled to create a clean equation to show a percentage change to just the hourly pay and overtime pay. However we had a sufficient workaround. We did a guess and check method to come up with an initial percentage and then back checked it by multiplying this percentage by the hourly rate and added it up, to make sure it came up to the higher original total of the non-bilingual policy. This shows that the percentage modifier sufficiently accounts for the spending cuts created by the bilingual policy.

Maximum Percentage Increase: 1.4% (after rounding)

```
#Difference out between Normal and Billingual -> 4625.10 - 4525.03 = 100.07 extra spending

Guessandcheck = (1.0142763*(( 7*120) + (14*120) + (7*120)+(2*150)+(6*150)))
#Guess and check Method got us a rate of 1.427% Increase to the normal rate to get $4625.10

#NormalRate*1.01427 = 30.429
#OvertimeRate*1.01427 = 45.643

#4hoursofNormalRate = 121.716

#2HoursofNormalRate+2HoursofOT = (91.286 + 60.858 = 152.144)

Confirmation = (( 7*121.716) + (14*121.716) + (7*121.716)+(2*152.144)+(6*152.144))
#Confirmation shows that this percentage increase changes hourly pay by flat rate
#and not just flat percentage on take home
```