## Problem Description:

Santa allowed each of the 5,000 families who would attend the workshop to choose a list of dates they would like to attend the workshop. It was impossible for everyone to get their best picks, so Santa decided to give extra perks to the families who did not get their preferences (i.e., their desired date)

1. The total number of people attending the workshop each day must be between 125 – 300
2. Santa provides consolation gifts (of varying value) to families according to their preferences on the day assigned to him. These are added together per household, and the total is the preference: value
    - choice_0: no consolation gifts
    - choice_1: one $50 gift card to Santa's Gift Shop
    - choice_2: one $50 gift card and 25% off Santa's Buffet ($9 value) for each family member
    - choice_3: one $100 gift card and 25% off Santa's Buffet ($9 value) for each family member
    - choice_4: one $200 gift card and 25% off Santa's Buffet ($9 value) for each family member
    - choice_5: one $200 gift card and 50% off Santa's Buffet ($18 value) for each family member
    - choice_6: one $300 gift card and 50% off Santa's Buffet ($18 value) for each family member
    - choice_7: one $300 gift card and a free Santa Buffet ($36 value) for each family member
    - choice_8: one $400 gift card and a free Santa Buffet ($36 value) for each family member
    - choice_9: one $500 gift card and a free Santa Buffet ($36 value) for each family member and 50% off North Pole Helicopter Ride ($199 value) for each family member
    - otherwise: one $500 gift card and a free Santa Buffet ($36 value) for each family member and free North Pole Helicopter Ride ($398 value) for each family member

3. Santa's accountants also developed a rule of thumb equation for the cost to Santa, which comes from a variety of different effects, such as reduced shopping at the gift shop when it gets too crowded, extra cleanup costs, the North Pole's very complicated tax code, etc.:

$$\text{penalty} = \sum_{d=100}^{1} \frac{(\text{N}_\text{d} - 125)}{400} N_d^{\left(\frac{1}{2}+\frac{|N_d - N_{d+1}|}{50}\right)}$$

where Nd is the current day's occupancy, and Nd+1 is the previous day's occupancy (since we're counting back from Christmas!). For the initial condition d=100, N101=N100 – 100 days before the Christmas

Santa needs help to optimize the day each family should visit the workshop to minimize any extra costs.

## Data description:

1. Number of families (number of raws in dataset): 5000
2. Number of days: 100
3. Number of people per day: 125 – 300
4. Consolation gifts:
    0. 0
    1. 50
    2. 50 + 9 N
    3. 100 + 9 N
    4. 200 + 9 N
    5. 200 + 18 N
    6. 300 + 18 N
    7. 300 + 36 N
    8. 400 + 36 N
    9. 500 + 36 N + 199 N = 500 + 235 N
    10. 500 + 36 N + 398 N = 500 + 434 N
5. Penalty:

$$\mathrm{P} = \sum_{d=100}^{1} \frac{(\mathrm{Nd} - 125)}{400} N_d^{\left(\frac{1}{2} + \frac{|N_d - N_{d+1}|}{50}\right)}$$

Where: $N_d$ – occupancy of the current day

$N_{d+1}$ – occupancy of the previous day

($\mathrm{N}_1$ – Christmas Eve, $\mathrm{N}_{100}$ – 100 days before)