3

We denote the $f(x,k)$ as the profit of selecting kth schedule, $f(x)$ as the profit for all schedules. This has been fomulated in problem (1). Then the model as maximum value of risk is

$$\begin{aligned} \max_x \quad & t \\ s.t. \quad & f(x,k) \geq t \text{ for some } k \\ & P(f(x) \leq t) \leq 1-\alpha \end{aligned}$$

Now the problem is how to formulate $P(f(x) < t) \leq 1-\alpha$. We suppose each schedule has equal contribution. Thus we can sort $f(x)$. The condition is equivalent to there are at least $K(1-\alpha)$ schedules whose $f(x) \geq t$. Denote $\epsilon_i = 1$ if $f(x,i) \geq t$ otherwise $\epsilon_i = 0$. Then the model becomes:

$$\begin{aligned} \max_x \quad & t \\ s.t. \quad & f(x,k) \geq t \text{ for some } k \\ & \sum_{i=1}^{K} \epsilon_i \geq K(1-\alpha) \end{aligned}$$

5

The variables that we ant to optimize are x_1, x_2, x_3, x_4 and y_1, y_2, y_3. y is the indicator for schedule selection. If we choose ith schedule, we set $y_i = 1$, otherwise we set $y_i = 0$. The profit of first four periods is

$$\sum_{k=1}^{3} \sum_{i=1}^{4} \frac{1}{2} x_i (p_{k,i} - 90)$$

Because we don't know the prices of reset periods, we use $\frac{1}{2}x(0-90)$ to estimate the profit. Then the model for x is

$$\begin{aligned} \max_x \sum_{k=1}^{3} \frac{1}{3} & \sum_{i=1}^{4} \frac{1}{2} x_i (p_{k,i} - 90) - \sum_{j=1}^{3} 50 C_{j,j+1} \\ s.t. \quad & x_1 \leq 50 \\ & 25 \leq x_i \leq 180 \text{ if } x_i > 0 \\ & -80 \leq x_{i+1} - x_i \leq 50 \end{aligned}$$

The model for y is

$$\begin{aligned} \max_y \sum_{k=1}^{3} & y_k \sum_{i=5}^{18} \frac{1}{2} x_{k,i} (0-90) \\ s.t. \quad & y_i \in \{0,1\} \\ & y_1 + y_2 + y_3 = 1 \end{aligned}$$

6

We develop the rule using training data. Given p_1, p_2, p_3, p_4, we want to predict p_i for $i > 4$. This is difficult. Instead, we predict the mean and standard deviation of the rest prices.

$$\mu_i, \sigma_i = f(p_1, p_2, p_3, p_4), \quad 5 \leq i \leq 18$$

We use deep learning or linear regression to do this. Based on mean and standard deviation, we can sample T instances of prices $p_{t,i} = \mu_i + \sigma_i \mathcal{N}(0, 1)$. Then the cost for kth schedule is

$$Cost(k) = \frac{1}{T} \sum_{t=1}^{T} \sum_{i=5}^{18} \frac{1}{2} x_{k,i}(p_{t,i} - 90)$$

Then we select the schedule which minimize this cost.