Scheduling for Multi-Skill Call Center

German Gutierrez

June 16, 2009

This example is adapted (almost verbatim) from the article Athanassios N. Avramidis, et al., (2009) Optimizing daily agent scheduling in a multiskill call center. European Journal of Operational Research, In Press.

Consider a scheduling problem for a Call center that operates from 8 am to 5 pm; the working day is divided into 36, 15-minute periods and 74 shifts that range from 7:30 to 9 hours are considered (detailed in Table 1). Each shift has a 30 minute "lunch break" and two 15-minute "coffee breaks".

Table 1: Shifts considered

Length	**Start**	**First Break**	**Second Break**	**Third Break**
7:30	8:00, 9:00	10:00, 10:15	12:00, 13:00	14:15,14:30
8:00	8:00,8:30,9:00	10:30,11:00	12:30,13:00	14:30,15:00
8:30	8:00,8:30	10:15,10:45	12:00, 13:00	14:30, 14:45
9:00	8:00	10:30, 11:00	12:30, 13:00, 13:30	15:00, 15:15, 15:30

K types of calls are received, which arrive according to a stationary Poisson process with rate λ_{jk} during period j; call arrivals are independent across periods and types of calls. Agents, which are divided into I groups, have different skills and preference for different types of calls. Routing is done according to a rank matrix R, which assigns a priority R_{ik} for calls of type k to be answered by agents of group i; the lower the value of R_{ik} the higher the preference for group i to take calls of type k. When there is a tie, the agent group with the smaller number (i) takes the call. $R_{ik} = \infty$ whenever group i cannot serve calls of type k. Service and patience times are exponentially distributed with means $\mu = 8$ and $\rho = 10$, respectively.

Agents are paid according to

$$c_{iq} = (1 + (\eta_i - 1)\,\varsigma)\,\frac{l_q}{30}$$

where η_i is the cardinality of S_i, i.e. the number of call types that agents of group i are able to take; ς is the cost per agent's skill and l_q is length of shift q. In order to ensure good service, it is required that at least 80% of calls per period and call type are answered in less than 20 seconds.

With this in mind, our goal is to find $x = \{x_{11}, \ldots, x_{iq}, \ldots, x_{I74}\}$, i.e. the number of agents of each group and shift that should be hired in order to minimize the expected total cost while satisfying the service level constraints.

Recommended parameter settings: The following two problems are proposed:

- A small problem: take $K = 2$, $\varsigma = 0.2$, $S_1 = \{1\}$ and $S_2 = \{1, 2\}$. Agents in set 2 prefer calls of type 2. Service and patience times as discussed above ($\mu = 8$ and $\rho = 10$) and call arrival rates, shown in Figure 1, as detailed in "ArrivalRatesSmall.csv".

- A larger problem: take $K = 20$, $I = 35$, $\varsigma = 0.1, \mu = 8$ and $\rho = 10$. The routing policy and agent groups as detailed in "routing.csv". The call arrival rates, shown in Figure 2, are detailed in "ArrivalRatesLarge.csv".

Starting Solutions:

- For the small problem, take $x_{1,57} = x_{1,68} = 20$ and $x_{2,57} = x_{2,68} = 10$. If multiple solutions are needed, distribute 40 agents of type 1 and 20 agents of type 2 uniformly across all 9-hour shifts (57 - 74), i.e. each agent has a 1/18 chance of being assigned to each 9-hour shift, independently of all other agents.

- For the large problem, take $x_{i,57} = x_{i,68} = 3$, $\forall\, i$. To generate multiple starting solutions, distribute 6 agents of each type uniformly across all 9-hour shifts (57-74).

Measurement of Time: Number of days simulated.

Optimal Solution: Unknown

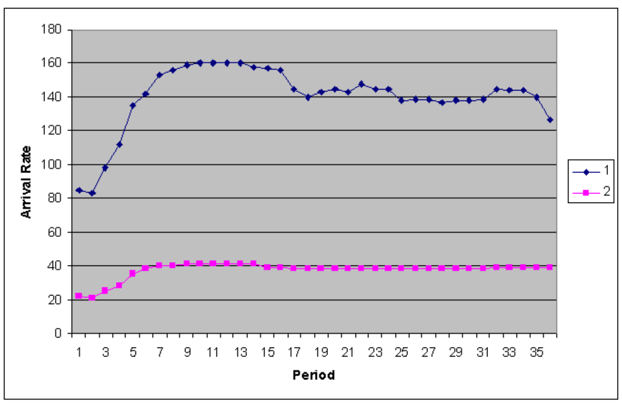

Figure 1: Arrival rates per hour of small call center

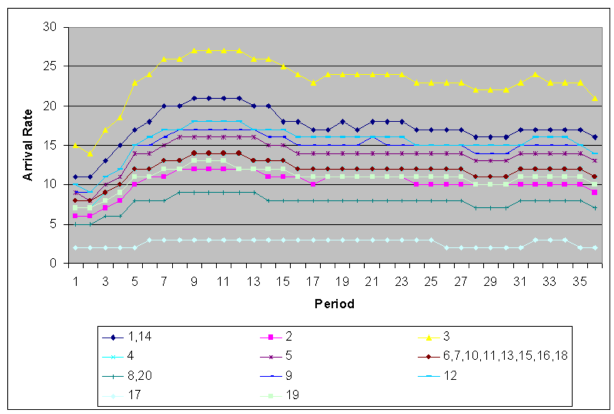

Figure 2: Arrival rates per hour of large call center