A mathematical approach for campus interview panel selection

Mangesh Gharote, Girish Palshikar and Sachin Lodha
mangesh.g@tcs.com, gk.palshikar@tcs.com, sachin.lodha@tcs.com
Tata Consultancy Services – Innovation Lab

Keywords: Assignment problem, Human resource planning, Service operations

Topic(s): Operations Planning, Scheduling and Control, Service Operations Management

Word count: 983

Purpose
In this paper we address the issue of interview panel selection for campus recruitment using network optimization. The problem is motivated by campus recruitment process of large IT service organizations.

As a part of campus recruitment drive, every year the IT service firms recruit fresh graduates from various educational institutes in large numbers. The recruitment team visits the campus for carrying out technical and management interviews. Each interviewer possesses varied skill set, differing in both campus and professional experience. The interested students enter their programming skill through the company’s web portal. The challenge is of selecting an effective pool of interviewers, forming panels and matching them with the students. Recruitment, being a regular exercise, automation of this process would save lot of time, planning efforts of the managers and recruit the right talent.

A similar flavor of this problem could be found in group-to-group reviewer assignment problem (Wang et al., 2013) where groups of reviewers are assigned to groups of articles, taking into account several constraints. In Human Resource Management journals, employment interview has been a popular research topic (Macan, 2009) addressing issues such as validity of interviewers judgment, impact of structured interviews, measuring applicants personality and so on. Apart from this linking, we could not find any article directly mapping to our problem.
Methodology
Consider a pool of interviewers with their basic details such as primary programming skill, previous campus interview experience and designation set of employees (interviewers). Assume for simplicity panel consisting of two members. Each student will be interviewed for his one primary skill by a panel. We cluster the students as per their skill. The number of students to be selected from each skill category and interview duration is uncertain. It has been observed that the ratio of the number of candidates selected to the candidates interviewed is 1:3.

We solve the problem in two stages. First we solve the problem of panel formation using weighted matching problem. In the second stage, we select few panels among the panels formed and allocate those selected panels to the students as per their skill. This problem is formulated as capacitated facility location problem. Both these problems are well studied in network optimization.

Panel Formation
We form two sets of interviewers, in one set we put interviewers with higher campus experience and in other we put interviewers with lower experience. We compute the utility value of assigning an interviewer from one set to the interviewer in another set. The utility value is computed on the following basis:
- A panel with members having different skill set preferred than same skill set, so that they can interview more number of candidates.
- A panel comprising senior and junior combination preferred than panel with same overall experience.
We solve the weighted bipartite matching problem using linear programming, where weights are captured through utility function. Output of this stage is panels formed with their utility values.

Panel Selection and Allocation
Notations
\( m \) Number of panels
\( k \) Students skill category

Decision Variables
\( X_{ij} \) Number of students of \( i^{th} \) skill category assigned to the \( j^{th} \) panel
\( Y_j \) =1, if panel \( j \) is selected for campus interview, otherwise 0.

Known Parameters
\( w_{ij} \) Matching value for assigning \( i^{th} \) student category to \( j^{th} \) panel in the range \([0 - 1]\)
\( U_j \) Utility value of panel \( j \) in the range \([0 -1]\)
\( \tilde{d}_i \) \hspace{1cm} Average number of students in \( i^{th} \) skill category

\( S_f \) \hspace{1cm} Scaling factor

The objective is to select the minimum number of panels such that the selected panels can interview maximum number of students. The goal is to select panel with maximum utility value (i.e. better panel composition) and having less skill set mismatch. We compute the matching value as per the panel and student skill fitment.

**Minimize**

\[
Z = \sum_{j} S_f \cdot (1 - U_j) \cdot Y_j + \sum_{i=1}^{k} \sum_{j=1}^{m} w_{ij} \cdot X_{ij}
\]  

(1)

**Subject to**

The constraint that the maximum number of interviews that can be taken by each panel cannot exceed a defined capacity (Cap) is satisfied with at least probability (\( \alpha_1 \in (0,1) \)). Capacity is calculated on the basis of working hours divided by average interview time per candidate.

\[
P \left\{ \sum_{i=1}^{k} X_{ij} \leq Y_j \cdot \frac{\text{Cap}}{} \right\} \geq \alpha_1 \hspace{1cm} \forall j = 1, \ldots, m
\]

(2)

The estimated number of interviews of each skill category must be conducted by the assigned panel. The constraint has to be satisfied by certain significance level (\( \alpha_2 \in (0,1) \)).

\[
P \left\{ \sum_{i=1}^{m} X_{ij} \geq \tilde{d}_i \right\} \leq (1 - \alpha_2) \hspace{1cm} \forall i = 1, \ldots, k
\]

(3)

\[
X_{ij} \geq 0, \forall i \text{ and } \forall j
\]

(4)

\[
Y_j = \{1, 0\}
\]

(5)

Due to equation (2 and 3) the problem becomes Mixed Integer Linear Programming (MILP) with non-linear constraint. Assuming normal distribution of the estimated number of students to be interviewed and interview time, we linearize the chance constraints. This MILP problem is solved using IBM ILOG CPLEX Optimization Studio with input output data files connection with MS Excel. Output of this module is panels selected and number of students allocated of different category.
Findings
Our solution methodology suggests a framework to find the minimum number of panels, with right composition, to conduct technical interviews of students. We compare the optimization solution against the naïve approach followed by managers. We compare the results on the three parameters, number of panel selected, utility value of the panels selected and panel to student’s skill matching index. Our experimentation results show that optimization is an efficient approach for interview panel selection.

Contributions
- Address a novel application using mathematical programming.
- Design a utility function to measure panel effectiveness and to compute matching index.
- Use network optimization with chance constraints to formulate the problem.
- Provide a framework for interview panel selection along with metrics for comparing solution with other approaches.

References