

Composing schedules in multi-skill contact centers

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Scope of this presentation

How to schedule agents 2-4 weeks in advance?

- One-day period
- Multi-skill call center



Characteristics

- Workload is hard to predict
- Productivity of an agent fluctuates
 - Breaks, meetings, personal activities
 - Service times are stochastic
 - Experience of the agent
 - Agents switching between call types

Presence of agents is subject to change by illness



Characteristics (continued)

- Reconnections to back-offices, outbound calls
- Redials
- Service level measurement
- Complex information flows \Rightarrow correlations
- Agents stand-by



Model

- Multiple job types
- Agents with one or several skills
- Agent groups
- Overflow routing policies
 - Call-to-agent
 - Agent-to-call
- Shifts and schedules



Model (continued)

- Poisson and time-varying arrival rates
- Service rates are exponential and job-type and agent-group dependent
- Service-level measure
- Costs of agents
- Inbound



Forecasting

How much work will appear 30 days in future?

- Difficult problem but very important,
 - low service levels or
 - low productivity
- Many factors involved: long-term trend, day-of-week distribution, seasonal pattern, weather



Forecasting model

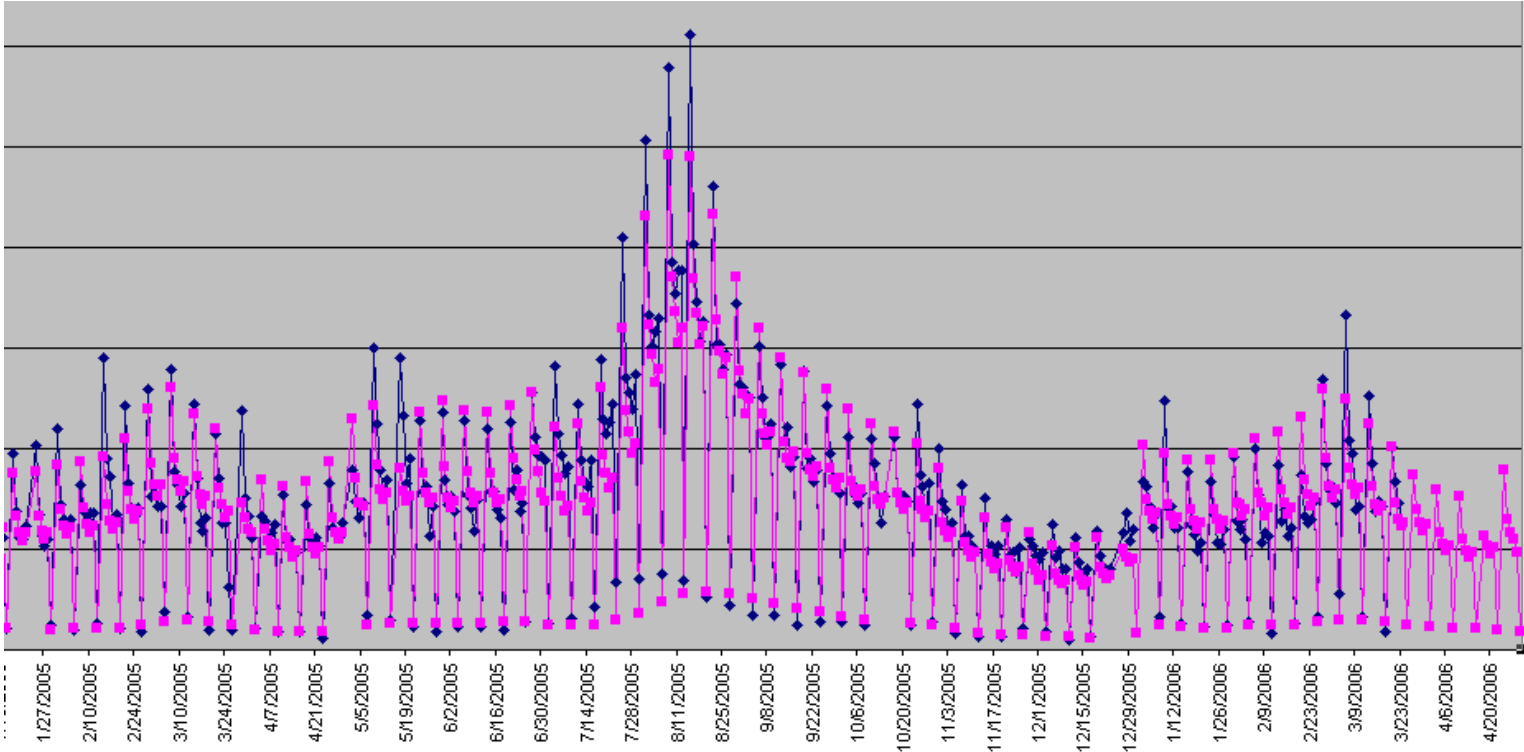
An approach is to fit a model on the historical data, and extrapolation into future

$$y_{t+30} = s(t + 30)d(t + 30)(a + b(t + 30)) + f(s, d, a, b, t, y_t, y_{t-1}, y_{t-2}, \dots, y_{t-n})$$

- Function f corrects if the trend is not linear
- n is for example 500
- Job types are considered separately



Forecasting example



Staffing

How to determine staffing levels

- Costs are group dependent
- Specialists have lower costs (work faster)
- Generalists and X-trained agents are flexible
- Performance measurement



Staffing formulation

Objective

$$\begin{aligned} \min_s & f(s) \\ \text{s.t.} & \\ & Q(s) \geq \alpha \end{aligned}$$

For each interval of the day

- Minimize costs
- Satisfy service-level conditions



Staffing solution

- Lagrange relaxation
- Decomposition such that:
 - an efficient search method can be applied
 - the number of simulations is moderate

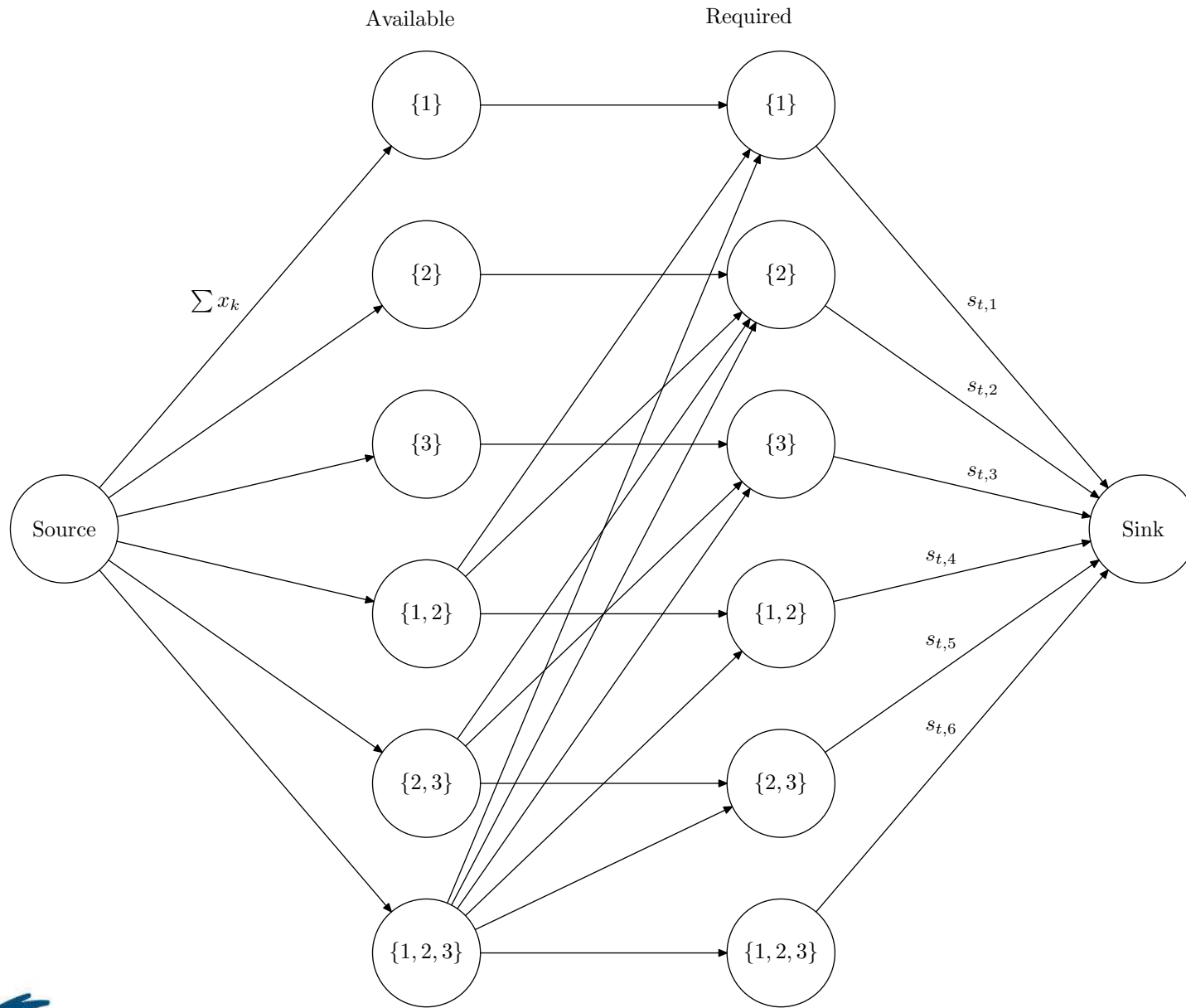


Shift scheduling

Composing a set of shifts

- Minimizing costs
- Fulfill staffing requirements
- Optimizing the skills of agents
- Assigning an agent to different groups during one shift
- Fast: solution needs reoptimization when parameters change, e.g., forecasts and sickness of employees

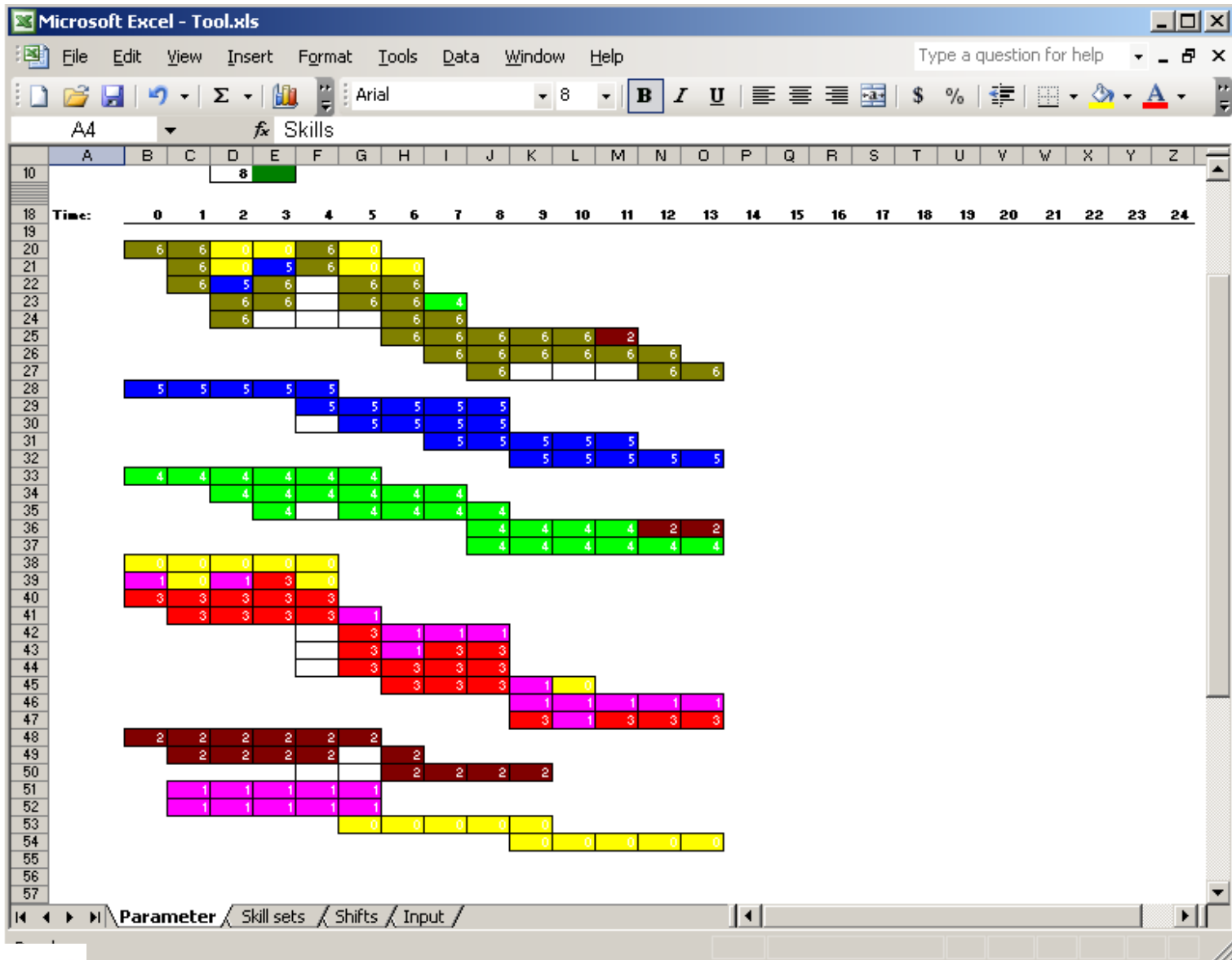




Shift scheduling solution

- formulated as a (linear) integer programming problem
- solved within a fraction of a second





Shift scheduling extensions

Possible extensions:

- including breaks
- pairing shifts into rosters
- assignment of rosters to employees



Subjects to discuss..

How to:

- Forecast workload
 - What other methods can be useful?
 - Should a forecast be represented by a single number?
 - How to use forecast for the calculation of staffing levels?
- Determine staffing levels
 - Job routing
 - Performance estimations



Subjects to discuss..

How to:

- Compose shifts and roster agents, e.g., include breaks?
- What are the desired requirements for a tool?
- What are the advantages and disadvantages of this method compared to cutting planes and simulation
- Is accuracy important with a planning horizon of 2-4 weeks?
- Is the model realistic enough?



Final notes

- Thesis on skill-based routing published soon
- Home page: www.math.vu.nl/~sapot
- Company with G. Koole: www.ccmath.com

