Optimization Model for SCRUM-based Software Development

Sets and Indices

- T: Teams, indexed by t
- E: Employees, indexed by e
- S: Sprints, indexed by s
- U: User Stories / Tasks, indexed by u
- F: Features, indexed by f
- B: Blockers, indexed by b

Decision Variables

$$x_{e,s,u} \in \{0,1\} \quad \text{Employee } e \text{ assigned to task } u \text{ in sprint } s$$

$$v_s \geq 0 \quad \text{Velocity (story points completed) in sprint } s$$

$$b_u \geq 0 \quad \text{Number of blockers on task } u$$

$$a_e \in [0,100] \quad \text{Availability of employee } e \text{ (percentage)}$$

$$w_e \geq 0 \quad \text{Workload (effort points) assigned to employee } e$$

Parameters

- Effort_u: Estimated effort for task u
- $\text{SkillMatch}_{e,u} \in \{0,1\}$: 1 if employee e has skills for task u, else 0
- $\text{Status}_u \in \{\text{Ready}, \text{InProgress}, \ldots\}$: Current status of task u
- $\text{MaxWorkload} = 40$: Max effort points per employee per sprint
- $\text{TeamSizeMin} = 3, \quad \text{TeamSizeMax} = 9$
- $\text{SprintDurationMin} = 7, \quad \text{SprintDurationMax} = 28$ (days)
- $\text{MaxBlockersPerTask} = 10$

Objective Functions

$$\max \quad \sum_{s \in S} v_s \quad \text{(maximize total sprint velocity)}$$

Additional goals can be added as weighted sums or constraints.

Constraints

$$\text{TeamSizeMin} \leq |E_t| \leq \text{TeamSizeMax} \quad \forall t \in T$$

where $E_t = \{e \in E \mid \text{employee } e \text{ belongs to team } t\}$.

$$\sum_{s \in S} \sum_{u \in U} \text{Effort}_u \cdot x_{e,s,u} \leq a_e \cdot \text{SprintDurationMax} \quad \forall e \in E$$

$$x_{e,s,u} \leq \text{SkillMatch}_{e,u} \quad \forall e \in E, s \in S, u \in U$$

$$x_{e,s,u} = 0 \quad \text{if Status}_u \notin \{\text{Ready}, \text{InProgress}\}$$

$$w_e = \sum_{s \in S} \sum_{u \in U} \text{Effort}_u \cdot x_{e,s,u} \leq \text{MaxWorkload} \quad \forall e \in E$$

$$b_u \leq \text{MaxBlockersPerTask} \quad \forall u \in U$$

$$v_s = \sum_{u \in U} \text{StoryPoints}_u \cdot \left(\max_{e \in E} x_{e,s,u} \right) \quad \forall s \in S$$

$$\text{SprintDurationMin} \leq \text{Duration}_s \leq \text{SprintDurationMax} \quad \forall s \in S$$

Notes

This model can be extended by including more variables and constraints related to features, user stories, backlog management, and other SCRUM events.