Optimization Model for Scrum-based Software Development

Sets and Indices

- P: Set of projects
- T: Set of teams
- E: Set of employees
- F: Set of features
- S: Set of sprints
- U: Set of user stories
- K: Set of tasks
- B: Set of blockers
- R: Set of roles
- L: Set of skills

Parameters

budget_p	Budget for project $p \in P$
effort_k	Estimated effort for task $k \in K$
storyPoints_u	Story points for user story $u \in U$
availability_e	Availability percentage of employee $e \in E$
priority_f	Priority of feature $f \in F$
velocity_t	Average velocity of team $t \in T$
severity_b	Severity of blocker $b \in B$
$\text{skillLevel}_{e,l}$	Skill level of employee e in skill l
$\text{role}_{e,r}$	1 if employee e has role r, else 0

Decision Variables

$x_{e,k} \in \{0,1\}$	Employee e assigned to task k
$y_{f,s} \in \{0,1\}$	Feature f assigned to sprint s
$z_{k,s} \in \{0,1\}$	Task k assigned to sprint s
$v_t \geq 0$	Velocity of team t
$u_b \geq 0$	Resolution time for blocker b

Objective Function

$$\max Z = w_1 \sum_{p \in P} \text{DeliveredOnTime}_p - w_2 \sum_{b \in B} u_b + w_3 \sum_{t \in T} v_t + w_4 \sum_{f \in F, s \in S} y_{f,s} - w_5 \sum_{s \in S} \max(0, \text{actualDuration}_s -$$

where w_i are weights representing importance of each goal.

Constraints

Team size limits:

$$\underline{\text{teamSize}} \leq \sum_{e \in E} \text{belongsToTeam}(e, t) \leq \overline{\text{teamSize}}, \quad \forall t \in T \tag{1}$$

Skill match for tasks:

$$x_{e,k} \leq \text{skillMatch}(e, k), \quad \forall e \in E, k \in K \tag{2}$$

Effort vs. availability:

$$\sum_{k \in K} \text{effort}_k \cdot x_{e,k} \leq \text{availability}_e \times \text{maxHours}, \quad \forall e \in E \tag{3}$$

Task assigned to exactly one sprint:

$$\sum_{s \in S} z_{k,s} = 1, \quad \forall k \in K \tag{4}$$

Feature priority order:

$$\text{if priority}_{f_1} > \text{priority}_{f_2} \Rightarrow \sum_s s \cdot y_{f_1,s} \leq \sum_s s \cdot y_{f_2,s} \tag{5}$$

Budget constraint:

$$\sum_{k \in K_p} \text{cost}_k \leq \text{budget}_p, \quad \forall p \in P \tag{6}$$

Blocker resolution time limits:

$$u_b \leq \text{maxResolutionTime}_b, \quad \forall b \in B \tag{7}$$

Roles assigned to team:

$$\exists e \in E : \text{role}_{e,\text{Product Owner}} = 1 \wedge \text{belongsToTeam}(e, t), \quad \forall t \in T \tag{8}$$

$$\exists e \in E : \text{role}_{e,\text{Scrum Master}} = 1 \wedge \text{belongsToTeam}(e, t), \quad \forall t \in T \tag{9}$$