

# Optimization Model for Scrum-Based Software Development

## Sets

$P$  = Projects  
 $T$  = Teams  
 $E$  = Employees  
 $S$  = Sprints  
 $F$  = Features  
 $U$  = User Stories  
 $K$  = Skills  
 $R$  = Roles  
 $B$  = Blockers

## Parameters

$\text{effort}_j$  = estimated effort for task  $j$   
 $\text{skillLevel}_{e,k}$  = skill level of employee  $e$  in skill  $k$   
 $\text{certified}_{e,k} \in \{0, 1\}$  = certification status  
 $\text{availability}_e \in \{0, 1\}$  = availability of employee  $e$   
 $\text{priority}_f$  = priority of feature  $f$   
 $\text{severity}_b$  = severity of blocker  $b$   
 $\text{budget}_p$  = budget for project  $p$   
 $\text{capacity}_t$  = max team size of team  $t$

## Decision Variables

$x_{j,e} \in \{0, 1\}$	Task assignment: task $j$ to employee $e$
$y_s \in \mathbb{Z}^+$	Sprint duration in days
$w_e \geq 0$	Workload (hours) of employee $e$
$z_f \in \{0, 1\}$	Feature completion status
$r_b \geq 0$	Blocker resolution time (hours)
$u_t \in \mathbb{Z}^+$	Team size
$c_p \geq 0$	Budget used for project $p$

## Objectives

$\max \sum_{s \in S} \text{velocity}_s$	(Maximize team velocity)
$\min \sum_{b \in B} r_b$	(Minimize blocker resolution time)
$\max \sum_{f \in F} z_f$	(Maximize feature completion)
$\min \sum_{s \in S} \max(0, y_s - y_s^{\text{planned}})$	(Minimize sprint overruns)
$\max \sum_{e \in E} w_e$	(Maximize employee utilization)

## Constraints

$$u_t = \sum_{e \in E} \text{belongs\_to\_team}(e, t), \quad u_t \leq \text{capacity}_t \quad \forall t \in T$$

$$x_{j,e} \leq \text{certified}_{e,k} \quad \forall j, k, e \text{ (skill requirement)}$$

$$\sum_j x_{j,e} \cdot \text{effort}_j \leq w_e \leq \text{availability}_e \times \text{maxHours} \quad \forall e \in E$$

$$\sum_j \text{effort}_j \cdot x_{j,e} \leq y_s \times \text{workHoursPerDay} \quad \forall s \in S, e \in E$$

$$\text{startDate}_s \geq \text{plannedStartDate}_s, \quad \text{endDate}_s \leq \text{plannedEndDate}_s \quad \forall s \in S$$

$$\sum_{e \in E} \text{takes\_on\_role}(e, \text{ScrumMaster}) \cdot \text{belongs\_to\_team}(e, t) = 1 \quad \forall t \in T$$

$$\text{status}_{\text{productBacklog}} = \text{Active}$$

$$r_b \leq \text{maxAllowedTime} \quad \forall b \in B : \text{severity}_b \geq \text{threshold}$$

$$z_f = 1 \quad \forall f \in F : \text{priority}_f \geq \text{highPriorityThreshold}$$

$$\text{locationDifference}(e_1, e_2) \leq \text{maxAllowedDifference} \quad \forall e_1, e_2 \in E \text{ on team } t$$