# Optimization Model for SCRUM-based Software Development

Generated by ChatGPT

## 1. Sets and Entities

- $P$ – Set of Projects
- $T$ – Set of Teams
- $E$ – Set of Employees
- $F$ – Set of Features
- $S$ – Set of Skills
- $R$ – Set of Roles
- $PO$ – Set of Product Owners
- $SM$ – Set of Scrum Masters
- $PB$ – Set of Product Backlogs
- $SP$ – Set of Sprints
- $SB$ – Set of Sprint Backlogs
- $U$ – Set of User Stories
- $TSK$ – Set of Tasks
- $BLK$ – Set of Blockers
- $SH$ – Set of Stakeholders

## 2. Decision Variables

$$x_{e,t} = \begin{cases} 1 & \text{if employee } e \in E \text{ is assigned to team } t \in T \\ 0 & \text{otherwise} \end{cases}$$

$$y_{t,p} = \begin{cases} 1 & \text{if team } t \in T \text{ is assigned to project } p \in P \\ 0 & \text{otherwise} \end{cases}$$

$$z_{e,tsk} = \begin{cases} 1 & \text{if employee } e \in E \text{ is assigned to task } tsk \in TSK \\ 0 & \text{otherwise} \end{cases}$$

$$l_{s,e} = \begin{cases} 1 & \text{if skill } s \in S \text{ is possessed by employee } e \in E \\ 0 & \text{otherwise} \end{cases}$$

Other variables:

- $d_s$ – Duration of sprint $s \in SP$

- $effort_{tsk}$ – Estimated effort for task $tsk \in TSK$
- $priority_f$ – Priority value of feature $f \in F$
- $budget_p$ – Budget available for project $p \in P$
- $velocity_t$ – Expected story points per sprint for team $t \in T$

# 3. Objective Functions

**Minimize Project Duration:**

$$\min \sum_{p \in P} (\text{End}_p - \text{Start}_p)$$

**Maximize Team Utilization:**

$$\max \sum_{e \in E} \sum_{tsk \in TSK} z_{e,tsk}$$

**Minimize Employee Idle Time:**

$$\min \sum_{e \in E} \left( \text{Available}_e - \sum_{tsk \in TSK} z_{e,tsk} \cdot effort_{tsk} \right)$$

**Maximize Skill Utilization:**

$$\max \sum_{e \in E} \sum_{s \in S} \sum_{tsk \in TSK} l_{s,e} \cdot z_{e,tsk}$$

**Minimize Blockers:**

$$\min \sum_{b \in BLK} 1$$

# 4. Constraints

| | |
|---|---|
| $\sum_{t \in T} x_{e,t} \leq 1$ | $\forall e \in E$ (One team per employee) |
| $\sum_{e \in E} x_{e,t} \leq \text{MaxTeamSize}$ | $\forall t \in T$ |
| $z_{e,tsk} \leq \sum_{t \in T} x_{e,t}$ | $\forall e \in E, \forall tsk \in TSK$ |
| $\sum_{e \in E} z_{e,tsk} = 1$ | $\forall tsk \in TSK$ (Task must be assigned) |
| $l_{s,e} \geq \text{SkillThreshold} \Rightarrow z_{e,tsk} = 1$ | if task $tsk$ requires skill $s$ |
| $\sum_{tsk \in TSK} z_{e,tsk} \cdot effort_{tsk} \leq \text{Available}_e$ | $\forall e \in E$ |
| $\sum_{f \in F} cost_f \leq budget_p$ | $\forall p \in P$ (Budget constraint) |
| $d_s \in [7, 30]$ | $\forall s \in SP$ (Sprint duration bounds) |

# 5. Notes

The model can be extended to include stakeholder feedback, task dependencies, and sprint review satisfaction. Each goal and condition can be included as soft or hard constraints using the CriteriaType logic levels.