Optimization Model for Scrum-based Software Development

Sets and Indices

$$P : \text{Set of projects}$$
$$T : \text{Set of teams}$$
$$S : \text{Set of sprints}$$
$$R : \text{Set of release plans}$$
$$E : \text{Set of employees}$$
$$F : \text{Set of features}$$
$$U : \text{Set of user stories}$$
$$B : \text{Set of blockers/bugs}$$

Parameters

$$Budget_p : \text{Budget for project } p$$
$$cap_t : \text{Capacity (story points) of team } t$$
$$avail_e : \text{Availability indicator for employee } e$$
$$priority_f : \text{Priority level of feature } f$$

Decision Variables

$$
\begin{aligned}
d_s &\in \mathbb{Z}, & 1 \leq d_s &\leq 4 & \forall s &\in S \\
ts_t &\in \mathbb{Z}, & 3 \leq ts_t &\leq 9 & \forall t &\in T \\
fr_r &\in \mathbb{Z}, & 1 \leq fr_r &\leq 20 & \forall r &\in R \\
l_{t,s} &\in \mathbb{Z}, & 0 \leq l_{t,s} &\leq 200 & \forall t &\in T, s \in S \\
b_s &\in \mathbb{R}, & 0 \leq b_s &\leq 100000 & \forall s &\in S \\
tp_s &\in \mathbb{Z}, & 0 \leq tp_s &\leq 100 & \forall s &\in S \\
sc_p &\in \mathbb{Z}, & 1 \leq sc_p &\leq 52 & \forall p &\in P \\
wh_e &\in \mathbb{R}, & 20 \leq wh_e &\leq 40 & \forall e &\in E \\
sp_u &\in \mathbb{Z}, & 1 \leq sp_u &\leq 13 & \forall u &\in U \\
es_e &\in \mathbb{Z}, & 1 \leq es_e &\leq 50 & \forall e &\in E
\end{aligned}
$$

Objective Functions

$$\min G_1 = \sum_{s \in S} d_s$$

$$\max G_2 = \sum_{r \in R} fr_r$$

$$\min G_3 = \sum_{p \in P} \left| Budget_p - \sum_{s \in S_p} b_s \right|$$

$$\max G_4 = \sum_{\text{reviews } rev} sat_{rev}$$

$$\max G_5 = \sum_{t \in T} \sum_{s \in S} \frac{l_{t,s}}{cap_t}$$

$$\min G_6 = \sum_{b \in B} is\_bug_b$$

$$\max G_7 = \text{trend}\Big(\big\{ \tfrac{1}{|S|} \sum_{s \in S} l_{t,s} \big\}_{t \in T} \Big)$$

$$\min G_8 = \sum_{s \in S} co_s$$

$$\max G_9 = \sum_{r \in R} ontime_r$$

$$\min G_{10} = \sum_{t \in T} \sum_{e \in E} over_{t,e}$$

Constraints

(C1) Budget: $\quad \displaystyle\sum_{s \in S_p} b_s \leq Budget_p \qquad\qquad\qquad\qquad \forall p \in P \quad (1)$

(C2) Duration: $\quad 1 \leq d_s \leq 4 \qquad\qquad\qquad\qquad\qquad \forall s \in S \quad (2)$

(C3) Capacity: $\quad l_{t,s} \leq cap_t \qquad\qquad\qquad\qquad\qquad \forall t, s \qquad (3)$

(C4) Priority: $\quad \displaystyle\sum_r y_{f,r} = 1 \qquad\qquad\qquad\qquad\quad \forall f \in F_{\text{high}}$

$$(4)$$

(C5) Availability: $\quad x_{e,t,s} \leq avail_e \qquad\qquad\qquad\qquad \forall e, t, s \quad (5)$

(C6) No Overlap: $\quad$ no two sprints s, s' for t overlap $\qquad\qquad (6)$

(C7) Dependencies: $\quad z_{u,s} \leq z_{v,s'} \qquad\qquad\qquad\qquad\quad \forall (v \rightarrow u)$

$$(7)$$

(C8) Blocker: $\quad ResTime_b \leq 2 \qquad\qquad\qquad\qquad \forall b \in B \quad (8)$

(C9) Grooming: $\quad$ update_freq($ProductBacklog$) ≥ 1 /week $\qquad (9)$

(C10) Release Date: $\quad rel\_date_r = planned\_date_r \qquad\qquad \forall r \in R \ (10)$

(C11) Engagement: $\quad \displaystyle\sum rev\_fb_{f,rev} \geq 1 \qquad\qquad\qquad \forall rev \qquad (11)$