ENGSCI 355 Project 1

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1 Formulation

1.a Parameters

$$S = \{\text{A, P, N, Z, X, O}\}; \quad \text{Set of shift types}$$
$$W = \{1,2,3,4,5,6\}; \quad \text{Set of weeks in the roster cycle}$$
$$D = \{\text{Mon}, \ldots, \text{Sun}\}; \quad \text{Set of days in a week}$$

Note that for continuity, a dummy week 0 and dummy day $\text{Sun}_{\text{dummy}}$ also exist but are not part of the sets W and D.

1.b Decision Variables

X is the array of binary variables determining if a type of shift belongs to a given week and day in the roster:

$$x_{s,w,d} \in \{0,1\} \quad \forall s \in S,\ w \in W \cup \{0\},\ d \in D \cup \{\text{Sun}_{\text{dummy}}\}$$

Y determines if a given week in the roster is the night shift week. Note the night shift also includes the final three days of the preceding week:

$$y_w \in \{0,1\} \quad \forall w \in W \cup \{\text{Sun}_{\text{dummy}}\}$$

V denotes whether registrars are forced to take a weekend off:

$$v_w \in \{0,1\} \quad \forall w \in W \cup \{\text{Sun}_{\text{dummy}}\}$$

1.c Constraints

Create a dummy week 0 that is equal to week 6.

$$x_{s,0,d} = x_{s,|W|,d} \quad \forall s \in S,\ d \in D \tag{1}$$

Create a dummy day 0 that is equal to Sunday of the previous week, allowing wrap-around from Sunday to Monday.

$$x_{s,w-1,|D|} = x_{s,w,0} \quad \forall s \in S, w \in W \tag{2}$$

Ensure every slot has a shift assigned, except for the night-shift week which must have two.

$$\sum_{s \in S} x_{s,w,d} - y_w = 1 \quad \forall w \in W, d \in D \tag{3}$$