

Intern Roster v9.1

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1 Intern Roster version 9.1

1.1 Tuples and Decision Variables

range Week = [1,54]

range Intern = [1,11]

range Rotation = [1,17]

Boolean Decision Variable: $x_{j,k}^i$

Boolean Decision Variable: D_k

Boolean Decision Variable: $y1_k^i$

Boolean Decision Variable: $y2_k^i$

Boolean Decision Variable: $y3_k^i$

Boolean Decision Variable: $y4_k^i$

Boolean Decision Variable: $y5_k^i$

Boolean Decision Variable: $y6_k^i$

Boolean Decision Variable: $y7_k^i$

Boolean Decision Variable: $y8_k^i$

Boolean Decision Variable: $y9_k^i$

Boolean Decision Variable: $y11_k^i$

Boolean Decision Variable: $y12_k^i$

Boolean Decision Variable: $L2_k$

Boolean Decision Variable: $L3_k$

Boolean Decision Variable: s^i

Integer: $M = 1000$

1.2 Objective Function

minimise $\sum_{i=1}^{11} \sum_{j=1}^{17} \sum_{k=1}^{54} x_{j,k}^i$

1.3 Constraints

1.3.1 Staggered start/ staggered finish

$$\sum_{k=51}^{54} x_{17,k}^i = 4 \quad \forall_{i=1}^6$$

$$\sum_{k=1}^4 x_{17,k}^i = 4 \quad \forall_{i=7}^{11}$$

$$\sum_{k=1}^{50} x_{17,k}^i = 0 \quad \forall_{i=1}^6$$

$$\sum_{k=5}^{54} x_{17,k}^i = 0 \quad \forall_{i=7}^{11}$$

1.3.2 Orientation Constraints

$$\begin{aligned}
\sum_{k=1}^4 x_{5,k}^i &= 1 \quad \forall_{i=1}^6 \\
\sum_{k=5}^8 x_{5,k}^i &= 1 \quad \forall_{i=7}^{11} \\
\sum_{k=1}^4 x_{9,k}^i &= 1 \quad \forall_{i=1}^6 \\
\sum_{k=5}^8 x_{9,k}^i &= 1 \quad \forall_{i=7}^{11} \\
\sum_{k=1}^4 x_{10,k}^i &= 2 \quad \forall_{i=1}^6 \\
\sum_{k=5}^8 x_{10,k}^i &= 2 \quad \forall_{i=7}^{11}
\end{aligned}$$

1.3.3 Physical Constraint

$$\sum_{j=1}^{17} x_{j,k}^i \leq 1 \quad \forall_{i=1}^{11} \quad \forall_{k=1}^{54}$$

1.3.4 Rotation Completion Constraint

$$\begin{aligned}
\sum_{k=1}^{54} x_{1,k}^i &= 8 \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{54} x_{2,k}^i &= 3 \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{49} x_{3,k}^i &= 4 \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{49} x_{4,k}^i &= 4 \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{30} x_{5,k}^i &= 3 \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{54} x_{6,k}^i &= 3 \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{54} x_{7,k}^i &= 3 \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{54} x_{8,k}^i &= 3 \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{43} x_{9,k}^i &= 5 \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{54} x_{10,k}^i &= 5 \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{54} x_{11,k}^i &= 4 \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{30} x_{12,k}^i &= 2 \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{30} x_{13,k}^i &= 1 \quad \forall_{i=1}^{11}
\end{aligned}$$

1.3.5 Clinical Competency

$$\sum_{k=1}^{27} \sum_{j=1}^2 x_{j,k}^i + \sum_{k=1}^{27} \sum_{j=6}^8 x_{j,k}^i + \sum_{k=1}^{27} x_{11,k}^i \geq 3 \quad \forall_{i=1}^{11}$$

1.3.6 CPD-G ($j = 1$) Rotation Pairing

$$\begin{aligned}
2 - \left(\sum_{i=1}^{10} x_{1,k}^i \right) &\leq M \cdot D_k \quad \forall_{k=1}^{54} \\
x_{1,k}^i &\leq M \cdot (1 - D_k) \quad \forall_{i=1}^{10} \quad \forall_{k=1}^{54}
\end{aligned}$$

1.3.7 Rotation Capacity

$$\begin{aligned}
\sum_{i=1}^{11} x_{1,k}^i &\leq 2 \quad \forall_{k=1}^{54} \\
\sum_{i=1}^{11} x_{2,k}^i &\leq 1 \quad \forall_{k=1}^{54} \\
\sum_{i=1}^{11} x_{3,k}^i &\leq 1 \quad \forall_{k=1}^{54} \\
\sum_{i=1}^{11} x_{4,k}^i &\leq 1 \quad \forall_{k=1}^{54}
\end{aligned}$$

$$\begin{aligned}
\sum_{i=1}^{11} x_{5,k}^i &\leq 2 \quad \forall_{k=1}^8 \\
\sum_{i=1}^{11} x_{5,k}^i &\leq 1 \quad \forall_{k=9}^{30} \\
\sum_{i=1}^{11} x_{6,k}^i &\leq 1 \quad \forall_{k=1}^{54} \\
\sum_{i=1}^{11} x_{7,k}^i &\leq 1 \quad \forall_{k=1}^{54} \\
\sum_{i=1}^{11} x_{8,k}^i &\leq 1 \quad \forall_{k=1}^{54} \\
\sum_{i=1}^{11} x_{9,k}^i &\leq 2 \quad \forall_{k=1}^{54} \\
\sum_{i=1}^{11} x_{10,k}^i &\leq 3 \quad \forall_{k=1}^{54} \\
\sum_{i=1}^{11} x_{11,k}^i &\leq 5 \quad \forall_{k=1}^{54} \\
\sum_{i=1}^{11} x_{12,k}^i &\leq 1 \quad \forall_{k=1}^{54} \\
\sum_{i=1}^{11} x_{13,k}^i &\leq 1 \quad \forall_{k=1}^{54}
\end{aligned}$$

1.3.8 Duration Constraints

$$\begin{aligned}
\sum_{k=1}^{47} y1_k^i &= 1 \quad \forall_{i=1}^{11} \\
8 - \left(\sum_{\alpha=0}^7 x_{1,k+\alpha}^i \right) &\leq M \cdot (1 - y1_k^i) \quad \forall_{i=1}^{11} \quad \forall_{k=1}^{47} \\
\sum_{k=1}^{52} y2_k^i &= 1 \quad \forall_{i=1}^{11} \\
3 - \left(\sum_{\alpha=0}^2 x_{2,k+\alpha}^i \right) &\leq M \cdot (1 - y2_k^i) \quad \forall_{i=1}^{11} \quad \forall_{k=1}^{52} \\
\sum_{k=1}^{51} y3_k^i &= 1 \quad \forall_{i=1}^{11} \\
4 - \left(\sum_{\alpha=0}^3 x_{3,k+\alpha}^i \right) &\leq M \cdot (1 - y3_k^i) \quad \forall_{i=1}^{11} \quad \forall_{k=1}^{51} \\
\sum_{k=1}^{26} y4_k^i &= 1 \quad \forall_{i=1}^{11} \\
2 - \left(\sum_{\alpha=0}^1 x_{4,k+\alpha}^i \right) &\leq M \cdot (1 - y4_k^i) \quad \forall_{i=1}^{11} \quad \forall_{k=1}^{26} \\
\sum_{k=28}^{48} y4_k^i &= 1 \quad \forall_{i=1}^{11} \\
2 - \left(\sum_{\alpha=0}^1 x_{4,k+\alpha}^i \right) &\leq M \cdot (1 - y4_k^i) \quad \forall_{i=1}^{11} \quad \forall_{k=28}^{48} \\
x_{4,28}^i &\leq M \cdot s^i \quad \forall_{i=1}^{11} \\
x_{4,27}^i &\leq M \cdot (1 - s^i) \quad \forall_{i=1}^{11} \\
\sum_{k=1}^{53} y5_k^i &= 1 \quad \forall_{i=1}^{11} \\
2 - \left(\sum_{\alpha=0}^1 x_{5,k+\alpha}^i \right) &\leq M \cdot (1 - y5_k^i) \quad \forall_{i=1}^{11} \quad \forall_{k=1}^{53} \\
\sum_{k=1}^{52} y6_k^i &= 1 \quad \forall_{i=1}^{11} \\
3 - \left(\sum_{\alpha=0}^2 x_{6,k+\alpha}^i \right) &\leq M \cdot (1 - y6_k^i) \quad \forall_{i=1}^{11} \quad \forall_{k=1}^{52} \\
\sum_{k=1}^{52} y7_k^i &= 1 \quad \forall_{i=1}^{11} \\
3 - \left(\sum_{\alpha=0}^2 x_{7,k+\alpha}^i \right) &\leq M \cdot (1 - y7_k^i) \quad \forall_{i=1}^{11} \quad \forall_{k=1}^{52} \\
\sum_{k=1}^{52} y8_k^i &= 1 \quad \forall_{i=1}^{11} \\
3 - \left(\sum_{\alpha=0}^2 x_{8,k+\alpha}^i \right) &\leq M \cdot (1 - y8_k^i) \quad \forall_{i=1}^{11} \quad \forall_{k=1}^{52} \\
\sum_{k=1}^{51} y9_k^i &= 1 \quad \forall_{i=1}^{11}
\end{aligned}$$

$$\begin{aligned}
4 - \left(\sum_{\alpha=0}^3 x_{9,k+\alpha}^i \right) &\leq M \cdot (1 - y_{9,k}^i) \quad \forall_{i=1}^{11} \quad \forall_{k=1}^{51} \\
\sum_{k=1}^{51} y_{11,k}^i &= 1 \quad \forall_{i=1}^{11} \\
4 - \left(\sum_{\alpha=0}^3 x_{11,k+\alpha}^i \right) &\leq M \cdot (1 - y_{11,k}^i) \quad \forall_{i=1}^{11} \quad \forall_{k=1}^{51} \\
\sum_{k=1}^{29} y_{12,k}^i &= 1 \quad \forall_{i=1}^{11} \\
2 - \left(\sum_{\alpha=0}^1 x_{12,k+\alpha}^i \right) &\leq M \cdot (1 - y_{12,k}^i) \quad \forall_{i=1}^{11} \quad \forall_{k=1}^{29}
\end{aligned}$$

1.3.9 Annual Leave

$$\begin{aligned}
\sum_{i=1}^{11} x_{14,21}^i &= 11 \\
\sum_{k=37}^{38} L2_k &= 1 \\
\sum_{i=1}^{11} x_{15,k}^i &= 6 \cdot L2_k \quad \forall_{k=37}^{38} \\
\sum_{k=37}^{38} L3_k &= 1 \\
\sum_{i=1}^{11} x_{16,k}^i &= 5 \cdot L3_k \quad \forall_{k=37}^{38}
\end{aligned}$$

1.3.10 Avoidance for H ($j = 13$)

$$\begin{aligned}
x_{13,4}^i &= 0 \quad \forall_{i=1}^{11} \\
x_{13,5}^i &= 0 \quad \forall_{i=1}^{11} \\
x_{13,9}^i &= 0 \quad \forall_{i=1}^{11} \\
x_{13,11}^i &= 0 \quad \forall_{i=1}^{11} \\
x_{13,15}^i &= 0 \quad \forall_{i=1}^{11} \\
x_{13,19}^i &= 0 \quad \forall_{i=1}^{11} \\
x_{13,20}^i &= 0 \quad \forall_{i=1}^{11} \\
x_{13,26}^i &= 0 \quad \forall_{i=1}^{11} \\
x_{13,28}^i &= 0 \quad \forall_{i=1}^{11} \\
x_{13,33}^i &= 0 \quad \forall_{i=1}^{11} \\
x_{13,43}^i &= 0 \quad \forall_{i=1}^{11} \\
x_{13,44}^i &= 0 \quad \forall_{i=1}^{11} \\
x_{13,49}^i &= 0 \quad \forall_{i=1}^{11}
\end{aligned}$$