2.22

The trick to approaching this problem is to realize that the workers modeled via inventory-type balance constraints. Note also that 3 sneakers can be made per hour.

**Input parameters.** Let

\[ T = \text{set of months} = \{1, 2, 3, 4, 5, 6\} \]
\[ I_0 = \text{initial inventory} = 1000 \]
\[ K_0 = \text{initial number of workers} = 15 \]
\[ d_i = \text{demand in period } i \quad \text{for } i \in T \]

**Decision variables.** Let

\[ S_i = \text{number of sneakers produced during month } i \quad \text{for } i \in T \]
\[ I_i = \text{number of sneakers stored at the end of month } i \quad \text{for } i \in T \]
\[ H_i = \text{number of workers hired in month } i \quad \text{for } i \in T \]
\[ F_i = \text{number of workers fired in month } i \quad \text{for } i \in T \]
\[ W_i = \text{number of workers working in month } i \quad \text{for } i \in T \]
\[ K_i = \text{number of workers kept at the end of month } i \quad \text{for } i \in T \]
\[ O_i = \text{number of overtime hours in month } i \quad \text{for } i \in T \]

**Objective function and constraints.**

\[
\begin{align*}
\min & \quad \sum_{i \in T} (5I_i + 3000W_i + 2000H_i + 3000F_i + 75O_i) \quad \text{(cost)} \\
\text{s.t.} & \quad 0 \leq S_i \leq 3 \cdot 200W_i + 3O_i \quad \text{for } i \in T \quad \text{(labor/overtime)} \\
& \quad 0 \leq O_i \leq 40W_i \quad \text{for } i \in T \quad \text{(overtime limit)} \\
& \quad W_i = K_{i-1} + H_i \quad \text{for } i \in T \quad \text{(workers available)} \\
& \quad K_{i-1} + H_i = K_i + F_i \quad \text{for } i \in T \quad \text{(workers hired/fired/kept balance)} \\
& \quad 0 \leq I_i \leq 3000 \quad \text{for } i \in T \quad \text{(inventory limit)} \\
& \quad I_{i-1} + S_i = I_i + d_i \quad \text{for } i \in T \quad \text{(inventory/demand balance)} \\
& \quad S_i, I_i, H_i, F_i, W_i, K_i, O_i \geq 0 \quad \text{for } i \in T
\end{align*}
\]