Line Assignment and CO Optimization

Set:

$P: Set\ of\ products, p \in P$

$L: Set\ of\ lines, l \in L$

Parameters:

$COT_{pq}: Changeover\ time\ between\ product\ p\ and\ q\ where\ p, q \in P$

$PT_{pl}: Production\ Time\ for\ product\ p\ in\ line\ l\ \forall p \in P\ and\ l \in L$

$LC_l: Capacity\ of\ line\ l\ \forall l \in L$

Decision Variables:

$x_{pt} = 1\ if\ product\ p\ is\ produced\ in\ line\ l, else\ 0$

$y_{pql} = 1\ if\ product\ q\ to\ be\ produced\ after\ product\ p\ \ in\ line\ l, else\ 0$

Objective Function (Minimize Total Cost):

$$\sum_p \sum_q \sum_l CO_{pq} * y_{pql} + \sum_p \sum_l PT_{pl} * x_{pl}$$

Constraints:

Logical relationship among decision variables

$$y_{pql} \leq x_{pl}\ \forall\ p, q\ \in P\ and\ l \in L \quad ---------- (1)$$

$$y_{pql} \leq x_{ql}\ \forall\ p, q\ \in P\ and\ l \in L \quad ---------- (2)$$

Changeover from a product to a product constraint:

$$\sum_q \sum_l y_{pql} = 1\ \forall\ p \in P \quad ---------- (3)$$

$$\sum_q \sum_l y_{pql} = 1\ \forall\ q \in P \quad ---------- (4)$$

A product can't be produced in multiple lines:

$$\sum_L x_{pl} = 1\ \forall p \in P \quad ---------- (5)$$

Line Capacity balance constraint:

$$\sum_p TC_{pl} * x_{pl} \geq 0.15 * LC_l\ \forall l \in L \quad ---------- (6)$$

$$\sum_p TC_{pl} * x_{pl} \leq 0.85 * LC_l\ \forall l \in L \quad ---------- (7)$$

Appendix (Ignore this part)

$$z_l = \sum_p x_{pl} \; \forall p \in P \; ---------- (5.a)$$

$$w_{pql} \leq M * y_{pql} \; \forall p, q \in P \; and \; l \in L \; ---------- (5.b)$$

$$w_{pql} \geq z_l - \left(1 - y_{pql}\right) * M \; \forall p, q \in P \; and \; l \in L \; ---------- (5.c)$$

$$w_{pql} \leq z_l \; \forall lp, q \in P \; and \; l \in L \; ---------- (5.d)$$

$$u_{pl} - u_{ql} + w_{pql} \leq z_l - 1 \; \forall p, q \in P \; and \; l \in L \; ---------- (5.e)$$