Sets

$M \triangleq$ machines
$O \triangleq$ orders
$H \triangleq$ colours

Indices

$m \in M$
$o, o_1, o_2 \in O$
$h, h_1, h_2 \in H$

Parameters (FOLLOW FROM EXCEL INPUT)

$s_o \triangleq$ surface for order $o \in O$
$colour_o \triangleq$ colour for order $o \in O$, $colour_o \in O$
$d_o \triangleq$ deadline for order $o \in O$
$c_o \triangleq$ penalty cost for order $o \in O$
$v_m \triangleq$ speed of machine m
$t^{colour}_{h_1,h_2} \triangleq$ set-up time from colour $h_1 \in H$ to $h_2 \in H$

Derived input

$t^{order}_{o_1,o_2} \triangleq$ set-up time $o_1 \to o_2$; $= t^{colour}_{colour_{o_1}, colour_{o_2}}$

$p_{o,m} \triangleq$ processing time o on m
$= s_o / v_m$

Small instance

$H = \{green, yellow, blue\}$

o	s_o	$colour_o$	d_o	c_o
O1	150	green	18	10
O2	200	yellow	28	12
O3	180	blue	12	8

m	v_m
M1	20
M2	25

M

O

h_1 \ h_2	green	yellow	blue
green	0	5	3
yellow	2	0	11
blue	4	10	0

$= t^{colour}_{h_1,h_2}$

H

o_1	o_2	$t^{order}_{o_1,o_2}$
O1	O2	5
O1	O3	3
O2	O1	2
O2	O3	11
O3	O1	4
O3	O2	10

green → yellow
green → blue
yellow → green
yellow → blue
blue → green
blue → yellow

o	m	$p_{o,m}$
O1	M1	7.5
O1	M2	6
O2	M1	10
O2	M2	8
O3	M1	9
O3	M2	7.2

150/20
150/25
200/20
200/25
180/20
180/25

$O_m \triangleq$ orders assigne to m
$n_m \triangleq$ number orders executed on $m = |O_m|$

Decision variables

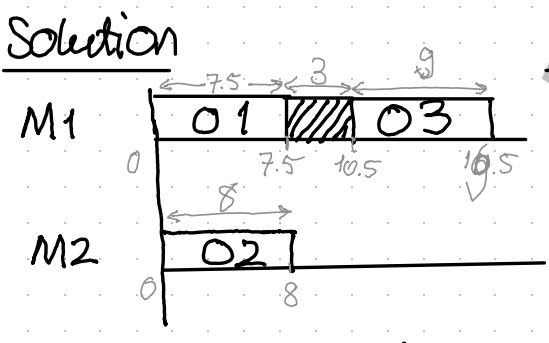
$machine_o \triangleq$ machine on which o is executed
$machine_o \in M$.

$seqno_o \triangleq$ sequence number of $o \in O$ on $machine_o$

$sequence_m \triangleq$ order in which orders assigned to m are executed

↝ – "no two orders o_1, o_2 assigned to the same machine m have same seqno"
– "all seqno for orders assigned to the same machine have seqno $1, 2, \dots, n_m$, where n_m is number orders assigned to machine m."

Solution



o	$machine_o$	$seqno_o$
o_1	M1	1
o_2	M2	1
O3	M1	2

m	$sequence_m$: 1	2
m_1	O1	O3
m_2	O2	

→ derived variables:

$pred_o \triangleq$ predecessor of o on $machine_o$; $pred_o \in O$

$$= \begin{cases} - & \text{if } seqno_o = 1 \\ sequence(machine_o, seqno_o - 1) & \text{if } seqno_o > 1 \end{cases}$$

o	$pred_o$
O1	–
O2	–
O3	O1

$b_o \triangleq$ start time order $o \in O$
$e_o \triangleq$ end time order $o \in O$

$$b_o = \begin{cases} 0 & \text{if } seqno_o = 1 \\ e_{pred_o} + t^{order}_{pred_o, o} & \text{if } seqno_o > 1 \end{cases}$$

$$e_o = b_o + p_{o, machine_o}$$

o	b_o	e_o
O1	0	7.5
O2	0	8
O3	10.5	19.5

7.5 + 3

$l_o \triangleq$ lateness order $o \in O$
$l_o = \max\{0, e_o - d_o\}$ max{0, 18 − 7.5}

o	l_o
O1	0
O2	0
O3	7.5

16.5 − 12

schedule cost:
$\sum_{o \in O} c_o \cdot l_o = 10 \cdot 0 + 12 \cdot 0 + 8 \cdot 7.5 = 60$

import input data from excel
define sets O, M
set parameters based on input data $s_o, d_o \dots$
calculate derived parameters $t^{order}_{o_1,o_2}$, $p_{o,m}$
... manually set solution ...
calculate derived variables $b_o, e_o, \dots$
calculate costs
output schedule