Simulation Group Project

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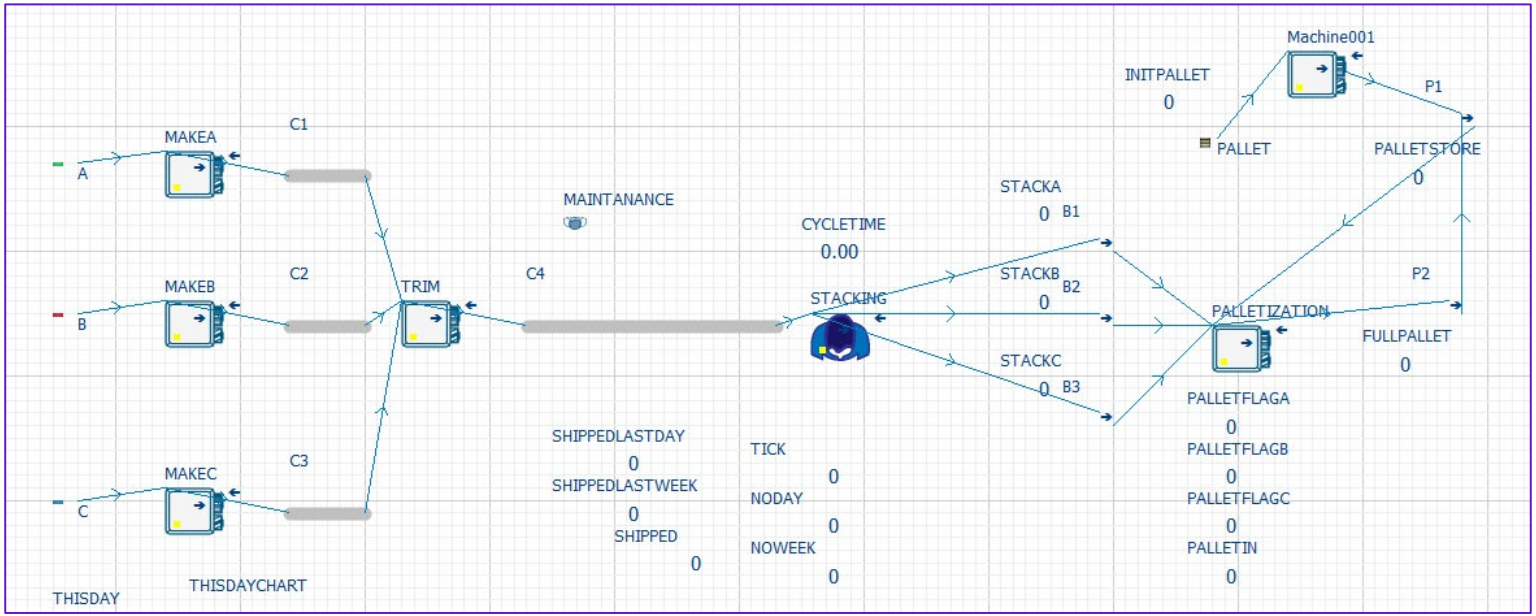
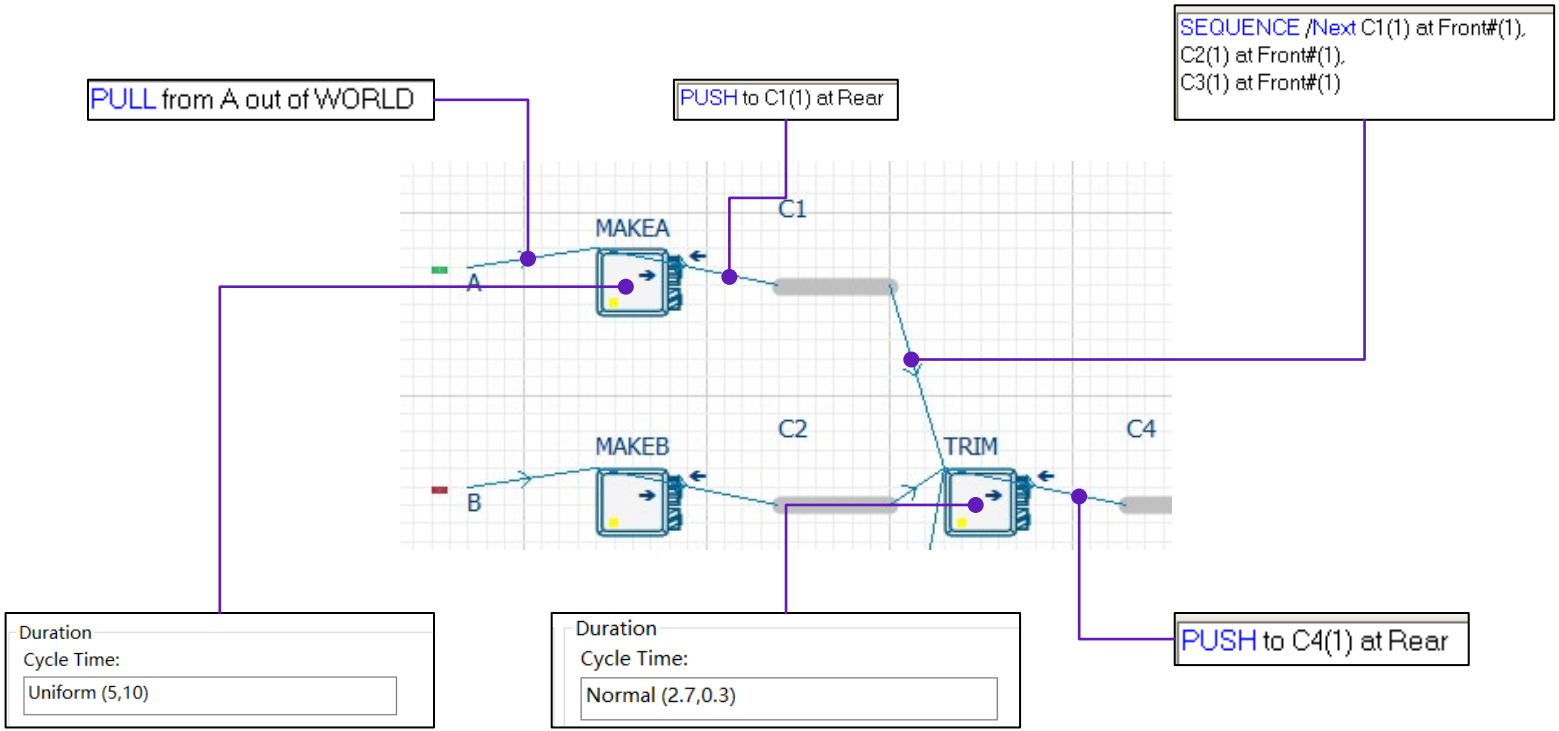
IE 6823 Factory Simulation

Exercise 1

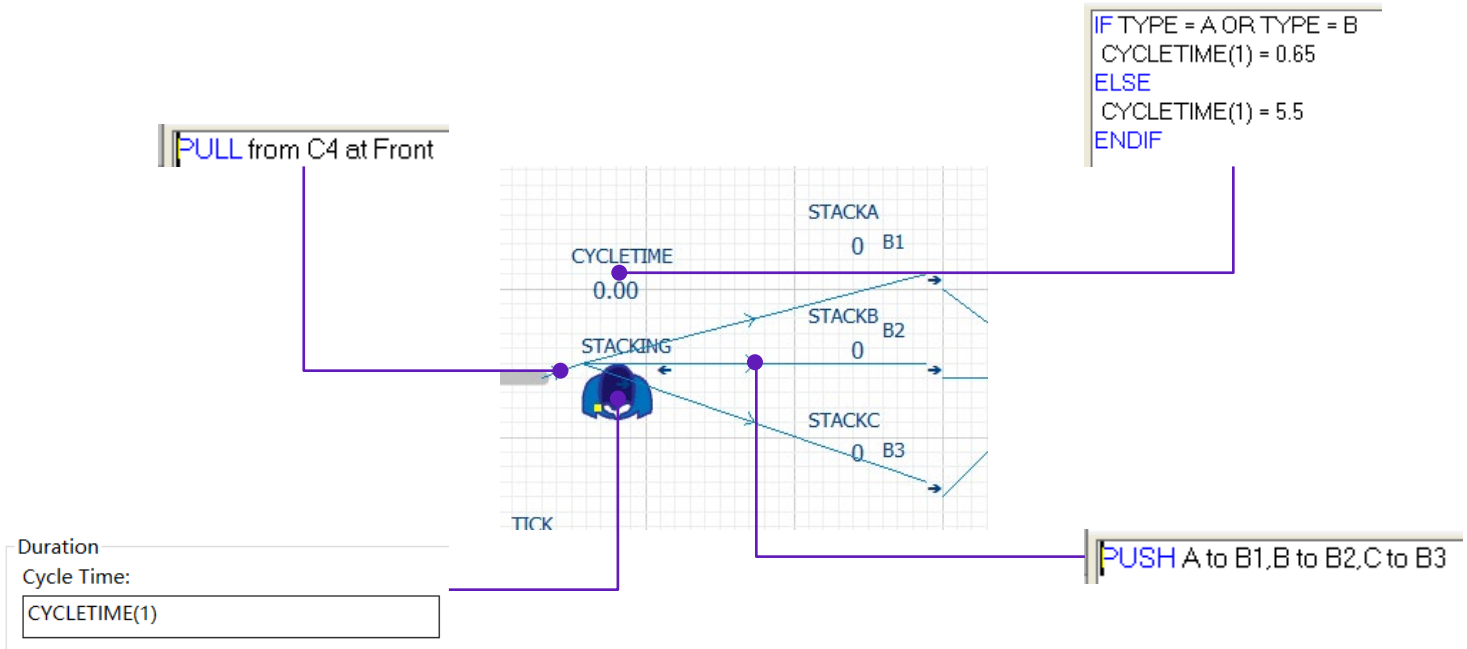


Model layout

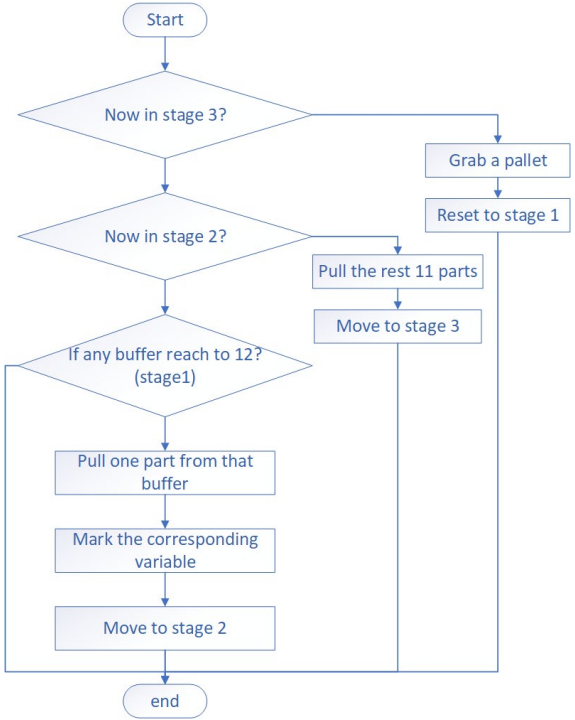
EX1 - Trimming

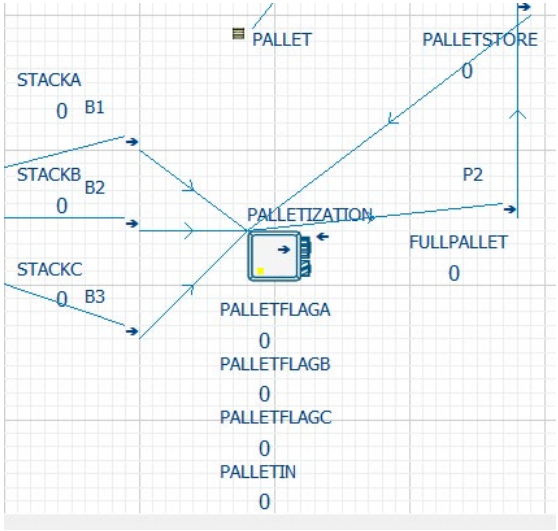


EX1 - Stacking



EX1 - Palletizing





Pick one part from a full buffer

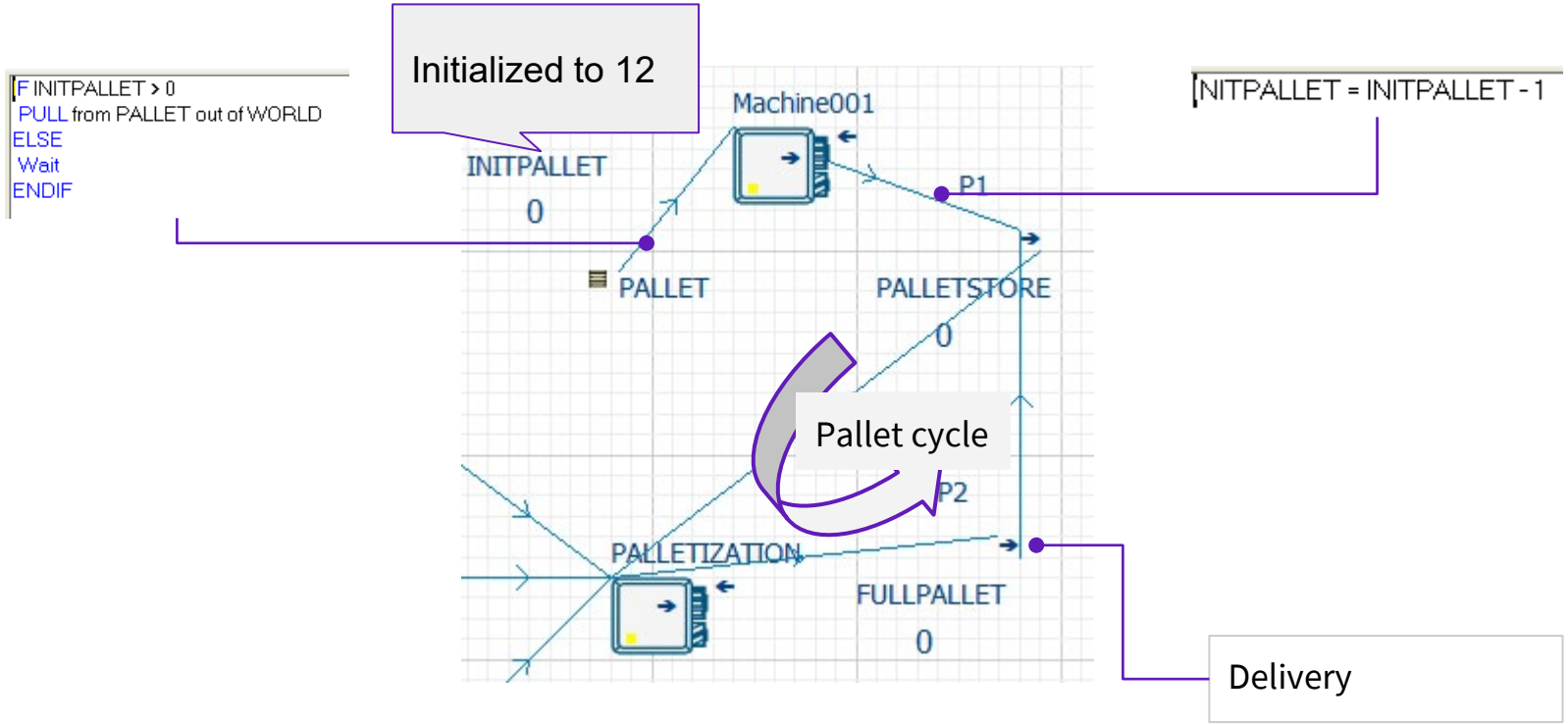
Record the type

Pick 11 parts from that type

Pick a pallet

Process

EX1 - Cycle of pallet



Model validation

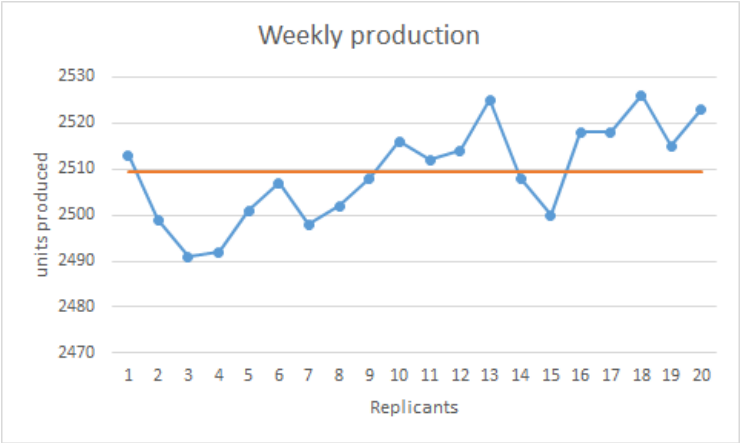
Mean	Std. Dev
2509.3	10.438

Use t-test for validation

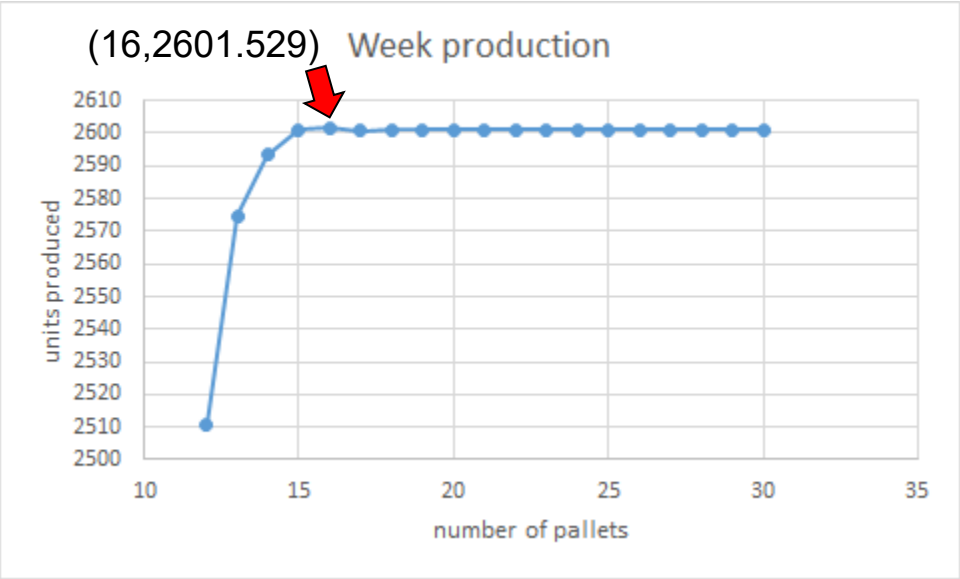
$$|t_0| = |\frac{\bar{y} - \mu}{\sqrt{\frac{S^2}{n}}}| = |\frac{2509.3 - 2546}{\sqrt{\frac{108.95}{20}}}| = 15.72$$

$$t_{0.05,20} = 2.09$$

15.72>2.09, the model is not accepted

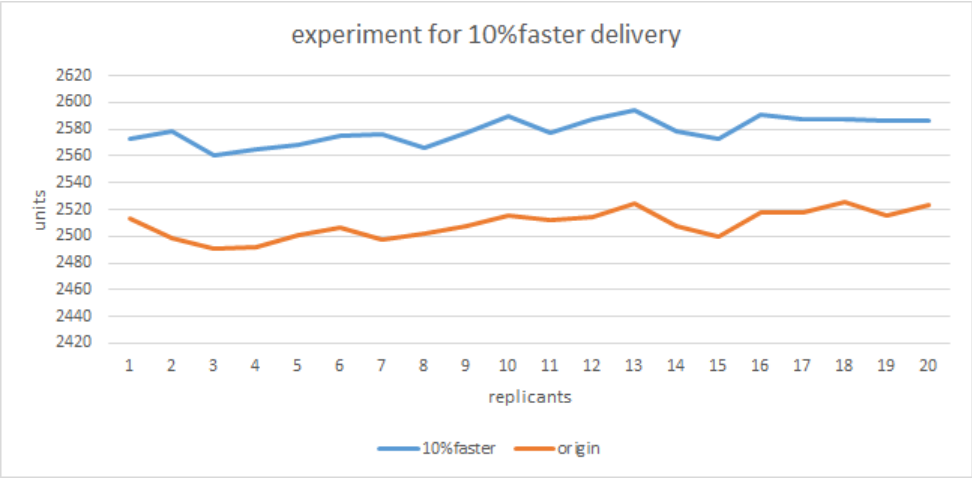


Exercise 2 - pallet



Adding pallet is useful to improve production. The best amount of pallet is 16. In this case, the average production number is 2601.5

Exercise 2 - 10% faster delivery



Origin average production:2509
New average production:2579

(2579-2509)/2509 = 2.77% improvement

Exercise 3

Assumptions:

1. Assume that each optimization equipment listed in the handbook can be used within one whole year without repairing or substitutions.
2. The yields are calculated by stable data from each replication. We use the increased income each week to estimated the year increased revenue and assume that there are 52 weeks a year.

Notes:

1. The reason that average production is not a integer is that we run the models for many times and get the data by average.
2. When calculating the increased revenue per week, we use the maximum integer that does not exceed average production. Meanwhile, the increased revenue is determined by the different between the original settings and the improved settings.
3. Income Cost Ratio is the measure of the costs of running a company in relation to its operating income. Apparently, the ratio should be as small as possible when evaluating whether the investment is effective. If the value shows less than 1, the outcome will yield profits and the optimization can be considered.

Exercise 3

CASE 1: Adding new pallet:

Pallet number	Average production per week	Cost	Increased Revenue per week	Estimated revenue per year	Income Cost Ratio	profit
12	2509.3	/	/	/	/	/
13	2574.05	2000	324	16848	0.12	14848
14	2593	4000	418	21736	0.18	17736
15	2600.15	6000	454	23608	0.25	17608
16	2600.9	8000	453	23556	0.34	15556
17	2599.85	10000	448	23296	0.43	13296
18	2600.35	12000	453	23556	0.51	11556

Adding new pallet number improves the average production by almost 70 parts in the first week and the increase becomes slow afterwards; the income cost ratio is very small at first and then increases with the accumulation of new pallet. Thus, certain investments in new pallet can be highly recommended.

Exercise 3

CASE 2: Faster delivery service:

Scenario	Average production	Cost	Increased Revenue	estimated revenue per year	Income Cost Ratio	profit
origin set	2509.3	/	/	/	/	/
10% faster delivery	2579	6500	350	18200	0.36	11700

The table presents that the change in delivery service improve the average production by 70 each week and income cost ratio is relatively low. Thus, we can take the investment in delivery service into consideration.

Exercise 3

CASE 3: Adding capacity to each conveyors:

Conveyor	Adding Capacity	Average Production	Cost	Increased Revenue	estimated revenue per year	Income Cost Ratio	profit
NONE	0	2509.3	/	/	/	/	/
C1	1	2510.85	3000	5	260	11.54	<0
C2	1	2510.5	3000	5	260	11.54	<0
C3	1	2508.75	3000	0	0	-	<0
C4	1	2516.35	3000	35	1820	1.65	<0

Obviously, the change in the capacity in each conveyors does not affect the overall production and income cost ratio is relatively high. Thus, the investment in conveyors is not accepted.

Exercise 3

CASE 4: Additional labor

Scenario	Average production	Cost	Increased Revenue	estimated revenue per year	Income Cost Ratio	profit
original set	2509.3	/	/	/	/	/
additional labor	2504.4	30000	0	0	-	<0

As is shown in table, since both the increased revenue and income cost ratio are below zero, the optimization by adding additional labor leads to deficit. Thus, this approach is not accepted.

Exercise 3

CASE 5: Improving the reliability of the trim machine:

Scenario	Average production	Cost	Increased Revenue	estimated revenue per year	Income Cost Ratio	profit
original set	2509.3	/	/	/	/	/
improvement in reliabilty	2531.95	2500	110	5720	0.44	3220

Obviously, improvements on trim machine's reliability contribute to the increase of average production on around 30 parts per week and the income cost ratio is less than 1. Thus, improving the reliability of the trim machine can be considered later.

Exercise 3

CASE 6: Improving the repair time of the palletizer machine:

Scenario	Average production	Cost	Increased Revenue	estimated revenue per year	Income Cost Ratio	profit
original set	2509.3	/	/	/	/	/
Improving repairing time	2623.4	3500	570	29640	0.12	26140

Apparently, Improving the repair time of the palletizer machine yields 100 parts more than the original settings each week and the income cost ratio is small, indicating that this approach should highly considered in later combination.

Exercise 3

Solutions:

-Combination#1: Maximum profit

Optimization	Adding 2 more new pallets	Faster delivery service	Improving the reliability of the trim machine	Improving the repair time of the palletizer machine	Sum up
profit	17736	11700	3220	26140	58796

If it is a start-up company, we would recommend this combination as their priority to earn as much profit as they can to ensure a stable operation later on.

-Combination#2: Most effective investment

Optimization	Adding 1 more new pallets	Improving the repair time of the palletizer machine	Sum up
cost	2000	3500	5500
revenue	16848	29640	46488
Income cost ratio	0.12	0.12	0.12

If it is a mature company already with good financial backgrounds, we would recommend combination 2 whose investments are all used effectively and the rest investment can be used to seek for better solutions.

Exercise 4 -Zero Spend Options

Possible options for this model:

1. **Priority of maintenance**
2. **Priority of selection of Machine Trim**
3. **Only producing part A, B**

Exercise 4 -Zero Spend Options

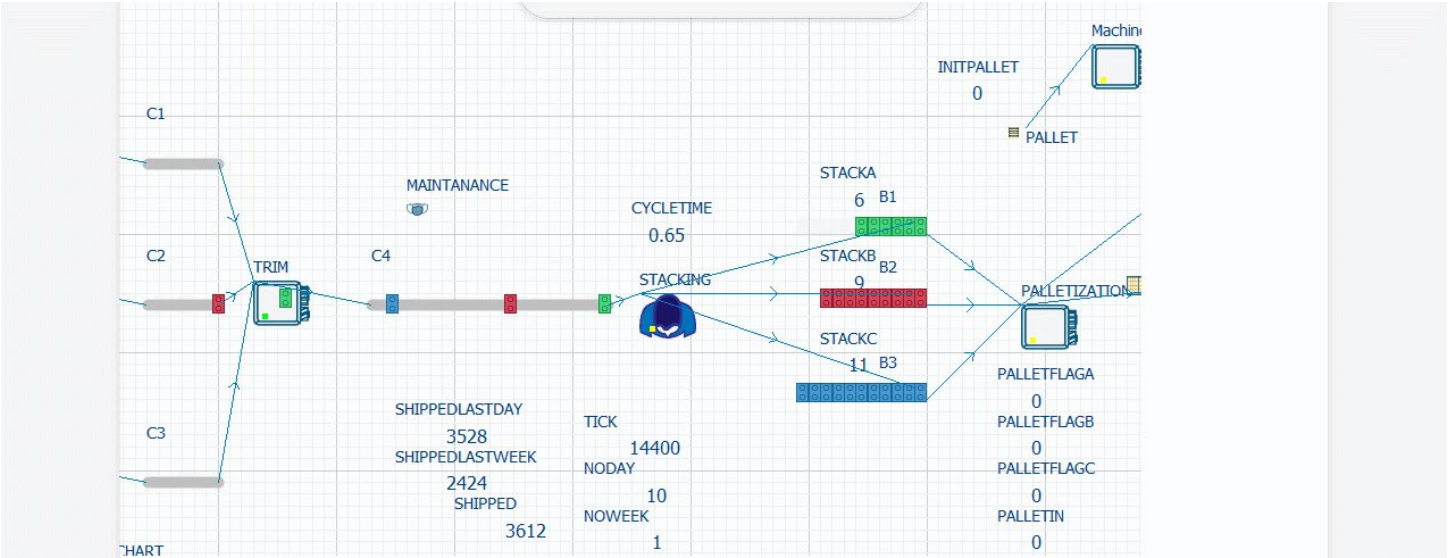
1.Priority of Maintenance

Reason 1	Reason 2
Only 1 maintenance man	Time to Repair Trim: 20-25 mins Palletizer: 60 - 240 mins

Exercise 4 -Zero Spend Options

1.Priority of Maintenance

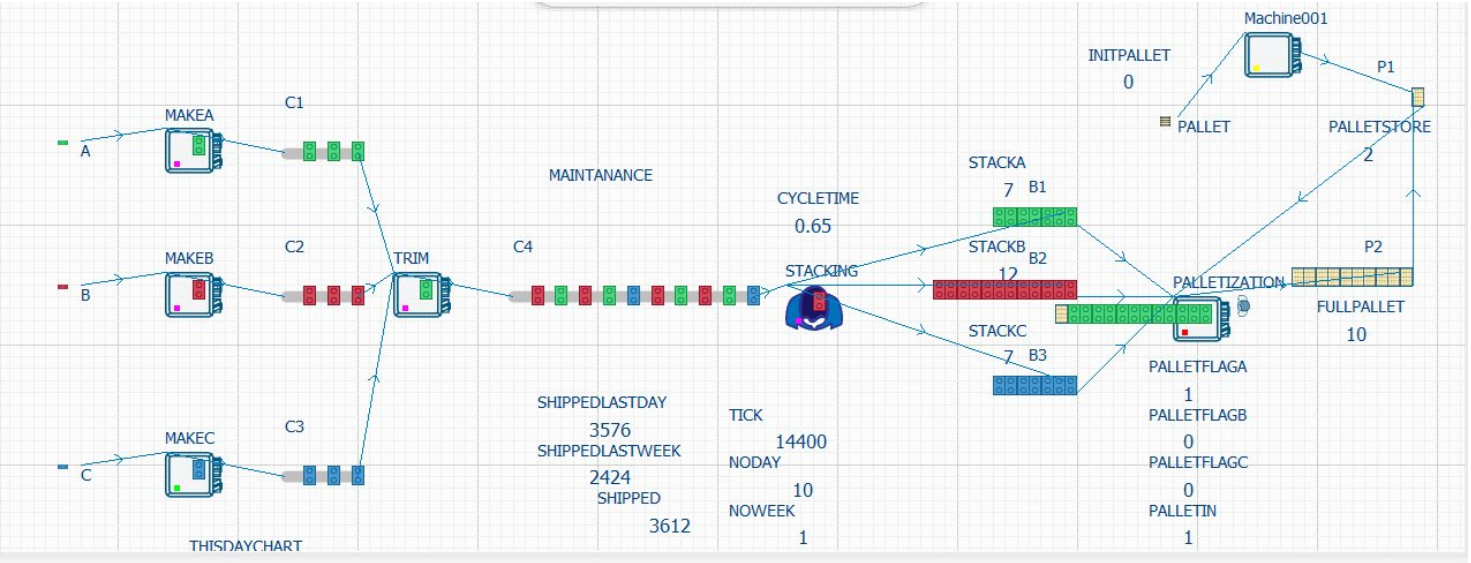
Current: First Come First Served



Exercise 4 -Zero Spend Options

1.Priority of Maintenance

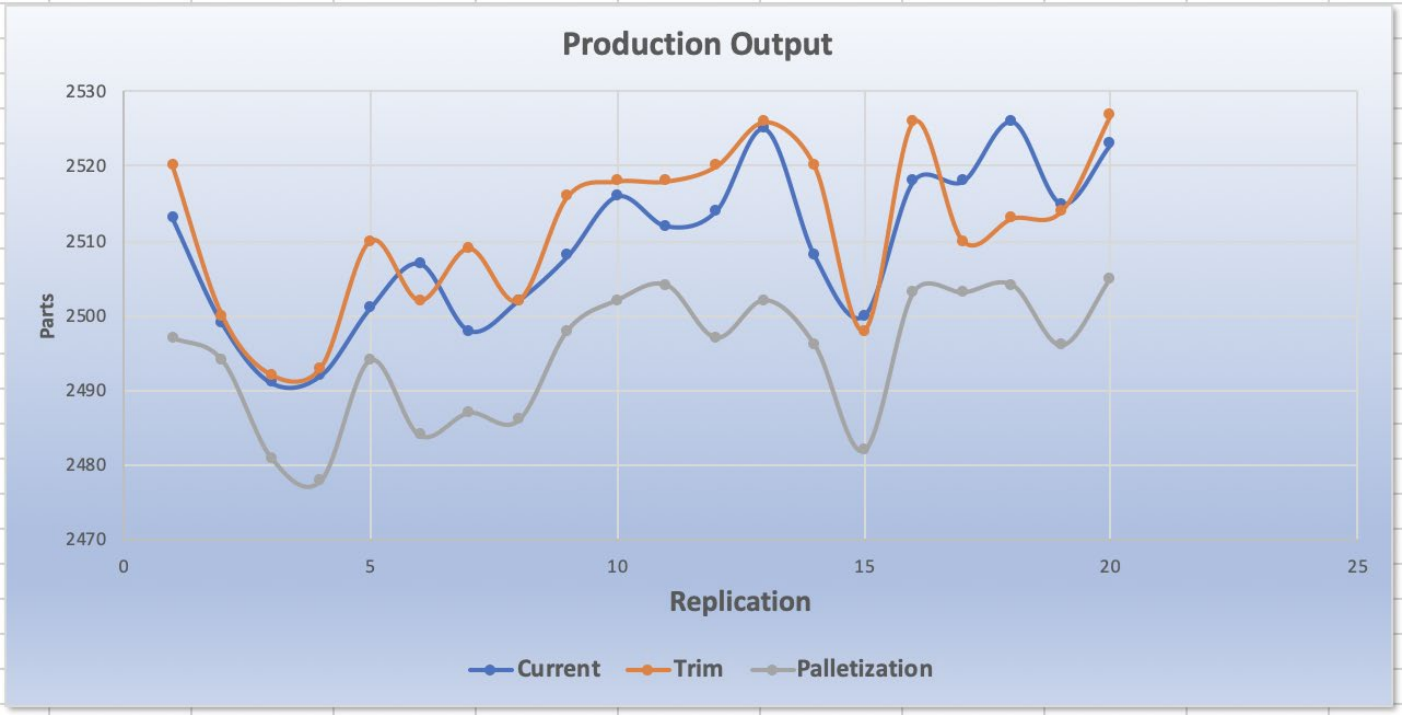
Case1 : Trim has higher maintenance priority.



Case2: Palletization has higher maintenance priority.

Exercise 4 -Zero Spend Options

1.Priority of Maintenance



Exercise 4 -Zero Spend Options

2. Priority of selection of Machine Trim

Reason

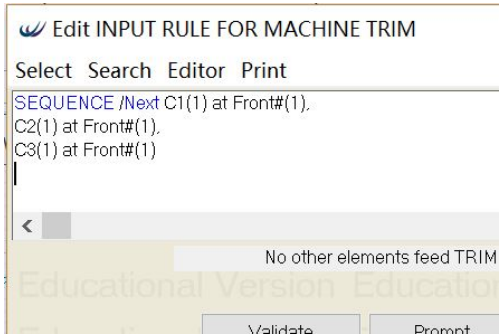
Cycle time

MakeA - UNIFORM(5,10)

MakeB - UNIFORM(5,10)

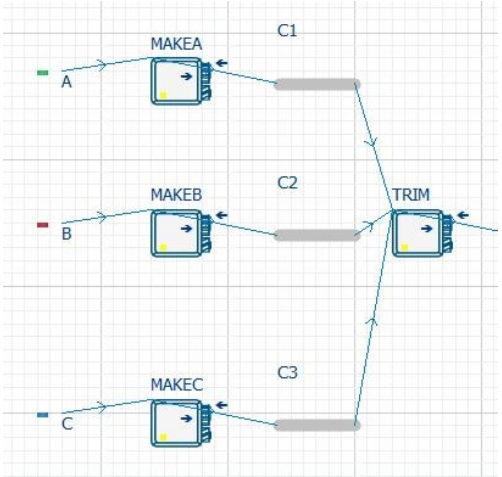
MakeC - UNIFORM(10,20)

Logic



"NEXT": moving on to the next choice

"RESET": starting the sequence again



	Next	Reset
Mean	2509.3	2505.5
Std.Dev	10.438	8.829

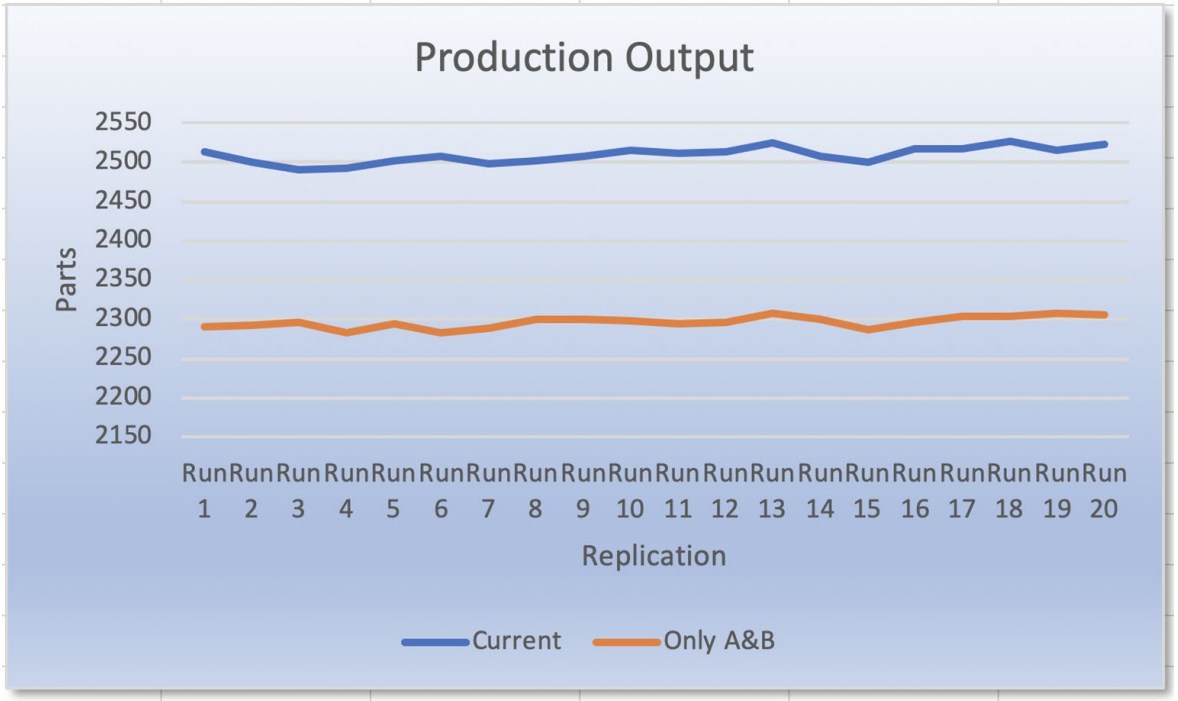
Exercise 4 -Zero Spend Options

3.Only Producing Part A, B

Reason 1	Reason 2
Cycle time MakeA - UNIFORM(5,10) MakeB - UNIFORM(5,10) MakeC - UNIFORM(10,20)	**Stack time** A: 0.65 mins B: 0.65 mins C: 5.5 mins

Exercise 4 -Zero Spend Options

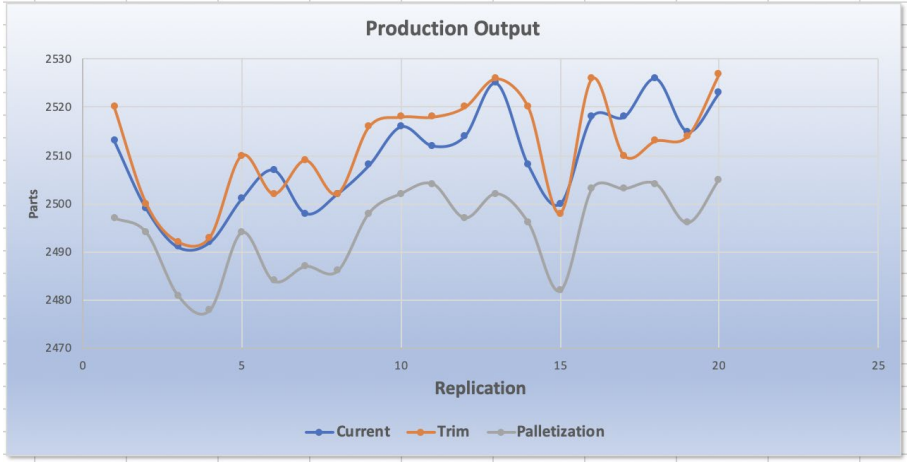
3.Only Producing Part A, B



Exercise 4 -Zero Spend Options

Possible options for this model:

1. **Priority of maintenance** √
2. **Priority of selection of Machine Trim**
3. **Only producing part A, B**



Thank You !

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