#2011089.

Homework 4.

Hungarian Method

Q.1.

Jobs \ Machine	A	B	C	D	E	
1	13	8	16	18	19	→ (-18)
2	9	15	24	9	12	→ (-9)
3	12	9	4	4	4	→ (-4)
4	6	12	10	8	13	→ (-6)
5	15	17	18	12	20	→ (-12)

Now deducting the lowest cost value from each row

	A	B	C	D	E
1	5	0	8	10	11
2	0	6	15	0	3
3	8	5	0	0	0
4	0	6	4	2	7
5	3	5	6	0	8
	(-0)	(-0)	(-0)	(-0)	(-0)

Now from each Column.

	A	B	C	D	E
1	5	[0]	8	10	11
2	0	6	15	0	3
3	8	5	[0]	0	0
4	[0]	6	4	2	7
5	3	5	6	[0]	8

Now assigning jobs to the machine having single 0 in a particular row.

Job 1 → Machine B
Job 4 → Machine A
Job 5 → machine D

(ii) If $Q = 100$ is assumed to be Q^*

then $Q^* = \sqrt{\frac{2AD}{h}}$

$100 = \sqrt{\frac{2 \times A \times 3100}{1}}$

$\boxed{A = 1.612}$

(iii) If $A = 10$, $D = 3100$, $h = 1$

$Q^* = \sqrt{\frac{2AD}{h}} = \sqrt{\frac{2 \times 10 \times 3100}{1}} \simeq 243$ Order quantity

(c) In the three cases, our reorder quantities were, 155, 100 and 249 respectively.

∴ No of orders per year 20, 31 and around 21, we see that for $A = 10\$$ and for $A = \$1.6$. we have Q changing from 100 to 249. which shows how much the value of A matter in case of reordering.

Q. 2.

(a) We know the formula for C by the cost function given as

$$Y(Q) = \frac{hQ}{2} + \frac{AD}{2} + CD$$

Now differentiating wrt Q and equte to 0 which gives us Q^* on double differentiation of $Y(Q)$

$$\frac{dY(Q)}{dQ^2} = 2\frac{AD}{Q^2}$$

The above quantity is always +ve
∴ It will always be minimum.

(b) Total dolls per year (D) = 310 × 10
= 3100 Units/year

Wholesale cost (C) = $5

$$h = iC = 0.2 \times 5 = \$1$$

Where i is the annual interest

$$i = 20\% = 0.2 \text{ (given)}$$

$$C = \$5$$

To get it done in 20 orders

we need $Q = \frac{3100}{20} = 155$ Units/order

Now assigning the left out jobs to the machine having single 0 in a particular column.

Job 3 → Machine C

Now since we are having only 4 assignments and there are 5 rows.

we will make lines to join Os with minimum no. of lines.

	A	B	C	D	E
1	5	0	8	10	11
2	0	(6)	(5)	0	(3)
3	8	5	0	0	0
4	0	(6)	(4)	2	(7)
5	3	(5)	(6)	0	(8)

Now from the no. in the dotted circle we take the lowest value and sub store it from the numbers in the dotted circle and add it to the junction of the lines intersecting each other

	A	B	C	D	E
1	8	[0]	8	13	11
2	0	3	12	0	[0]
3	11	5	[0]	3	0
4	[0]	3	1	2	4
5	3	2	3	[0]	5

Job	Machine
1 →	B
2 →	E
3 →	C
4 →	A
5 →	D

Q.3:

(a).

(1) Ford achieved a breakthrough in the early days of its existence by introducing the assembly line, which revolutionized the automobile industry by streamlining production and standardizing parts. By applying industrial engineering techniques, Ford enhanced its manufacturing process and decreased costs, resulting in more affordable cars for the masses.

(2). Toyota's accomplishments stemmed from core principles, specifically the Toyota Production System (TPS) and the philosophy of continuous improvement. The TPS centered on eradicating waste and generating customer value, while Kaizen stimulated a culture of perpetual refinement. By assimilating these principles, Toyota optimized processes, reduced inventory, and heightened quality, enhancing efficacy and profitability.

(B).

(1). During the Covid epoch, Ford and Toyota displayed their agility in responding to evolving market dynamics by pivoting their attention towards more lucrative vehicle categories, such as trucks and SUVs.

(2). During this period, a notable divergence between the two companies was observed in their respective production strategies. Ford encountered supply chain disruptions, whereas Toyota's lean production and just-in-time inventory management enabled prompt adjustments of production levels in response to demand fluctuations. Industrial engineering and operations research played a pivotal role in facilitating the swift recovery of both companies. Advanced techniques like simulation and optimization were deployed to model and analyze complex systems, enabling the identification of optimal solutions.

To summarize, the application of industrial engineering and operations research has been indispensable to the triumph of both Ford and Toyota. Starting from the inception of the assembly line to the establishment of the Toyota Production System and their swift recuperation during the Covid era, these companies leveraged these techniques to streamline their manufacturing procedures, lower expenses, and boost efficiency. This, in turn, has enabled them to retain their competitiveness and profitability in the market.