※ 考生請注意：本試題不可使用計算機

***Numerical Problem and Analysis* [50%]**

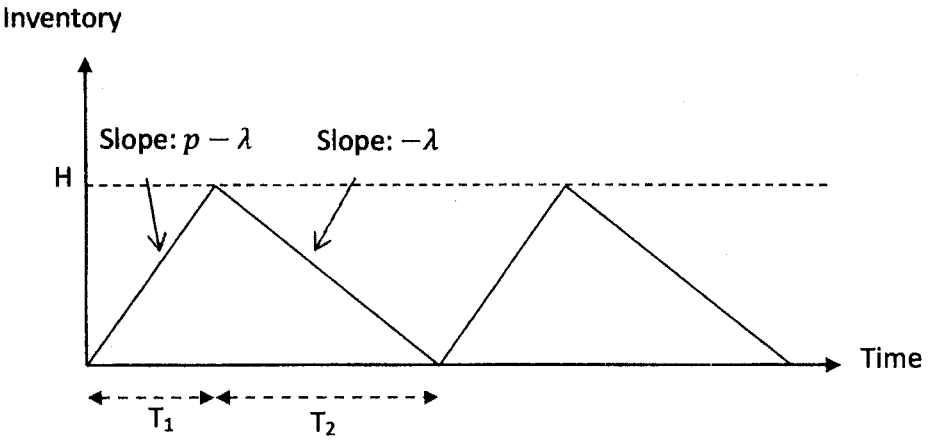
6. **[10%]** Variant of Economic Order Quantity (EOQ) Model- "Finite Production Rate"

Parameters:

Production rate: p (units/year)
Demand rate: λ (unit/year), where $p > \lambda$
Cycle time: $T = T_1 + T_2$ (years)
Maximal inventory on hand: H (units), where $H < Q$
Holding cost: h ($/unit/unit time)
Setup cost: K ($/order)
Cost per unit ordered: c ($/unit)

Decision Variable:

Order quantity: Q (units)



Derive the equation of optimal order quantity Q^* to minimize total cost (including setup, purchasing, and holding cost)?

7. **[12%]** Job Assignment Problem

In an airline company, n pilots should be assigned to n flight routes. Let $i = \{1,2,\ldots,n\}$ represent an index of pilot and $j = \{1,2,\ldots,n\}$ be an index of flight route. C_{ij} is the cost of assigning pilot i to flight route j. Let x_{ij} be the "binary" decision variable, where $x_{ij} = 1$ if pilot i is assigned to flight route j; otherwise $x_{ij} = 0$.

(a) **[5%]** Give a linear programming formulation for assignment problem.

(b) **[2%]** What is Hungarian method? Why does it contribute to the optimization procedure?

(c) **[5%]** Given the cost matrix ($n = 4$) as follows, find the optimal solution of assignment problem by Hungarian method.

		Flight Route			
		1	2	3	4
Pilot	1	$2	$3	$4	$6
	2	$8	$7	$8	$5
	3	$7	$5	$11	$4
	4	$10	$9	$9	$7

系所組別：製造資訊與系統研究所乙組

考試科目：生產管理

考試日期：0223，節次：3

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***Questions* [*50%*]**

Please answer the following questions and justify your answer. Show all your work in detail.

1. **[*10%*]** Bottle and Little's law: (a) What's bottleneck? (b) how to define or identify bottleneck workstation? (c) What's Little's law? and is Little's law always true? If no, why? (d) What's the relationship between bottleneck and Little's law? (e) Do you have any idea to release bottleneck and improve the throughput?

2. **[*10%*]** Inventory analysis: (a) Why do you want to hold inventory? Please give a simple reason or example to justify your answer. (b) Do you have any idea to reduce inventory? (c) What's perpetual review system? (d) What's periodic review system? (e) What's the pros and cons of these two systems?

3. **[*10%*]** Factory variability: (a) What's the factor or source of variability in factory? (b) Do you have any idea to eliminate the variability or reduce the negative impact of variability caused by the factor you propose? (c) What's mean time between failure (MTBF) and mean time to repair (MTTR)? (d) Given two machines A and B, machine A has long repair time, but infrequent outages. Machine B has short repair time, but more frequent outages. From the perspective of variability effects, which machine has better performance (machine A or B)? and why?

4. **[*10%*]** Capacity planning: two scenarios may occur in capacity planning due to demand fluctuation: capacity surplus vs. capacity shortage. (a) What's the factor causing demand fluctuation? (b)What's capacity surplus? (c) What's capacity shortage? (d) What's the negative impact of each scenario? (e) Do you have any idea or suggestion to adjust your capacity level (i.e., capacity flexibility) for demand fulfillment?

5. **[*10%*]** Lean Production/ Toyota Production System (TPS): (a) What's lean philosophy? (b) What's lean manufacturing? (c) What's the pull production system and how does it operate? (d) What's line balancing? (e) Why does TPS promote small-batch-size production even though the loss of frequent setup and changeover?

(背面仍有題目，請繼續作答)

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8. **[13%]** Forecast Problem

NCKU's plant estimates weekly demand for its many materials held in inventory. One such part, the P2, is being studied. The most recent 6 weeks of demand for the P2 are:

Week	Demand (units)	Week	Demand (units)
1	21	4	34
2	24	5	30
3	22	6	38

(a) **[5%]** Use linear regression method to find the fitted line by ordinary least squares (OLS)

(b) **[5%]** What's the underlying assumption applied to linear regression model?

(c) **[3%]** Does high correlation imply cause-effect relation? If no, why? what's other necessary condition of cause-effect relation?

9. **[15%]** Operations Scheduling Problem

Four shipping boats, 1,2,3, and 4, are waiting on a loading/unloading harbor at NCKU Boat Transport Company that has only a single service bay. That is, the harbor can only contain one boat at a time. The boats are labeled in the order that they arrived at the harbor. Assume the current time is 0. The process times required to unload each boat and the due that the boat should leave the harbor are given in the following table.

Boat (in coming order)	Unloading process time (time unit)	Due (time unit)
1	20	25
2	14	45
3	35	50
4	10	30

Determine the schedules that result for each of the following rules. In each case compute the mean flow time, average tardiness, and number of tardy jobs.

(a) **[5%]** First-come-first-served (FCFS)

(b) **[5%]** Shortest-process-time (SPT)

(c) **[5%]** Early-due-date (EDD)