



0 • Exam Map

COURSE DATA · CANVAS

Final exam 35%

Computer exam 35%

Group report 30%

ASSESSMENT	FORMAT / TIMING	WEIGHT
Final Exam essay and model-based questions	Written · 2 h · formal exam period	35%
Computer exam – inventory control	Practical · 2 h · Week 08	35%
Group assignment Report	Written group work · 8 pages max	30%

“You can bring a double-sided A4 sheet of paper full of whatever notes you want into the exam.” (ITLS6002 Canvas final exam information, Semester 2 2026)

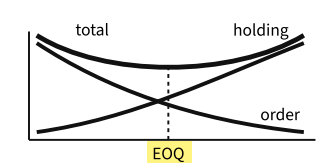
★ All material is assessable; the guide identifies particular emphasis on **aggregate planning** and the **first network-design block**. Excel is required. For every model: define the decision, keep units/time bases visible, make constraints auditable, interpret the operating consequence, then state what change would reverse the choice.

1 • Method Router

TOPIC MAPS · FAQ

CASE SIGNAL	USE	OUTPUT
Steady repeated demand; fixed order + holding cost	EOQ	Order size Q*
Certain lead time/demand	ROP	Trigger, not lot size
Uncertain demand; monitored continuously	(Q,R)	Q* + ROP
Review every R periods	Order-up-to	Target S; order S-IP
One selling chance	Newsvendor	Demand percentile
Demand varies by period	Lot-sizing / MIP	Q _t , I _t , setup
Open sites + allocate flow	Fixed-charge MIP	Y _i , x _{ij}

EXAM Method marks begin with the policy question: **how much, when, where, or through which channel?** Name it before calculating.



EOQ trade-off: the minimum occurs where annual ordering and cycle-stock holding costs balance.

TRAP → FIX With constant price, purchase cost cannot change EOQ; when price varies, restore it and test bracket breakpoints. Apply ROP to inventory position—not shelf stock—to avoid duplicating an order in transit.



Apply the trigger to inventory position; receipt occurs after the lead-time interval.

2 • EOQ + Reorder Trigger

CH 1 • FINAL MODEL

SYMBOLS AND CALCULATION

D	annual demand, units/year	S	fixed cost/order
C	unit value	I	annual carrying rate
H	IC, \$/unit-year	D,L	demand/time; lead time

LOT SIZE
 $Q^* = \sqrt{(2DS/H)}$
orders/year = D/Q · average cycle stock = $Q/2$
 $TRC(Q) = DS/Q + HQ/2$

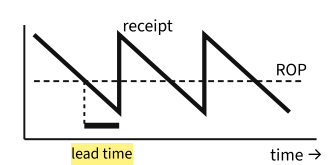
TIMING
Inventory position IP = on-hand + scheduled receipts - backorders
certain-demand ROP = dL
with uncertainty: ROP = mean lead-time demand + safety stock

Assumptions: constant demand; instantaneous replenishment; no stockouts; constant order and holding costs. Constant purchase cost drops from the basic objective because it cannot change Q*. It returns for quantity discounts. **Lead time changes ROP, not basic EOQ.**

CHECK	WHAT FAILURE MEANS
At unconstrained Q*: $DS/Q \approx HQ/2$	Time basis, H conversion or brackets wrong
Q has units; ROP has position units	Lot size and trigger were mixed
Candidate is feasible	Test neighbouring cartons/breakpoints
All candidates use same annual basis	Comparison is invalid

INPUT CHANGE	POLICY EFFECT
S rises	Q* rises through the square root; trigger unchanged if d and L do not move.
H rises	Q* falls; more frequent, smaller orders.
D rises	Q* rises and lead-time demand rises when d rises.
L rises, certain	ROP rises; basic Q* does not.

EXAM Report the mathematical Q*, then compare neighbouring feasible multiples. Equality of order and holding cost need not survive a carton, capacity or discount constraint.



Apply the trigger to inventory position; receipt occurs after the lead-time interval.

3 • Safety Stock + Review

CH 2 • POLICY COMPARISON

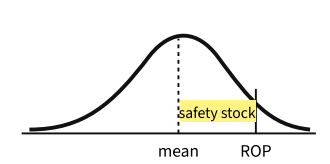
Protection interval is the exposure the policy must cover. Continuous review can react immediately and protects L. Periodic review waits until the next review and protects R+L. Draw the interval before choosing mean and deviation.

INDEPENDENT PERIOD DEMAND
Exposure T: mean = μT · deviation = $\sigma\sqrt{T}$
 $SS = z\sigma\sqrt{T}$
CONTINUOUS REVIEW
 $T=L$ · $ROP = \mu L + z\sigma\sqrt{L}$
PERIODIC REVIEW
 $T=R+L$ · order-up-to to S = $\mu(R+L) + z\sigma\sqrt{R+L}$
order now = S - current inventory position

QUESTION	CORRECT RESPONSE
What varies?	Demand, lead time, or both; use compatible time bases.
May σ scale by $\sqrt{T}$?	Only for independent, identically distributed period demands.
Cycle service or fill rate?	Cycle service = no stockout probability. Fill rate = demand supplied immediately.
Use z directly for fill rate?	No: use the expected-shortage relation.
Both demand and lead time uncertain?	Use the course compound variance; do not add raw SDs.

Raising the target raises z and safety stock. Price the consequence as incremental stock × annual holding cost. A service recommendation names the metric, protection, added carrying cost and assumption about demand dependence.

Policy sentence: “Review continuously and release Q when IP reaches R,” or “At each review order S-IP.” Add the units and the service metric. This prevents a correct target from becoming the wrong operational action.



Mean protected demand sets the centre; z × exposure deviation moves the trigger into the tail.

EXAM The periodic target is not the order quantity. The action is **S-IP at review**, then apply rounding or capacity.

4 • Advanced Inventory

CH 3 • CHOOSE STRUCTURE

ALL-UNITS QUANTITY DISCOUNTS

1. For each price bracket compute $H=IC$ and its EOQ.
2. Retain a feasible EOQ; otherwise retain the bracket’s lowest qualifying quantity.
3. Compare **full annual cost** for every feasible candidate.
 $TAC(Q) = DC + DS/Q + icQ/2$
Reject a Q that does not qualify for its assumed price. Purchase cost and price-based holding cost both change across brackets.

SINGLE-PERIOD NEWSVENDOR

Use only for one selling opportunity with defined underage/overage consequences—not normal carry-over or routine backorders.

C_u = selling price - salvage cost
 C_o = purchase cost - purchase value
critical fractile = $C_u/(C_u+C_o)$
choose first demand Q with $F(Q) \geq$ fractile

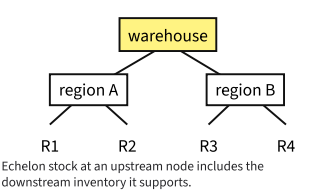
TIME-VARYING LOT SIZING

$I_t = I_{t-1} + Q_t - D_t$
 $Q_t \leq$ capacity, $x \ y_t$; $y_t \in \{0,1\}$

The balance preserves flow. Binary y_t activates the fixed setup cost and blocks positive quantity when no setup is released. Audit every period, non-negativity and the final position.

Installation stock is one location’s own inventory. Echelon stock includes that location and the downstream inventory it supports. Circle what each control point counts before assigning demand and lead-time exposure; otherwise the same protection can be treated as unrelated buffers.

SIGNAL	BOUNDARY CHECK
Price break	Bracket feasibility + all cost components
Short-life item	Cu/Co defined from the case
Seasonal demand	Period balance; do not force EOQ
Several stages	Installation vs echelon stock



Echelon stock at an upstream node includes the downstream inventory it supports.

5 • Aggregate Planning + S&OP

CH 4 • FINAL EMPHASIS

Translate medium-term demand into production, workforce, overtime, subcontracting, inventory and backlog decisions. The model supplies trade-offs; S&OP reconciles demand, operations and finance and approves one feasible plan.

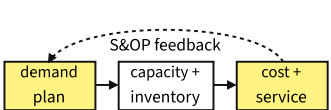
NO-BACKLOG MATERIAL BALANCE
ending inventory_t = beginning inventory_t + regular_t + overtime_t + subcontract_t - demand_t
beginning inventory_{t+1} = ending inventory_t

POLICY	ADJUSTMENT	WHAT TO EXPOSE
Level	Stable capacity/workforce; inventory or backlog absorbs variation	Holding, backlog, service and final stock
Chase	Capacity/workforce tracks demand	Hiring, firing, disruption and capacity
Hybrid	Spreads response across levers	Every limit and category cost

BUILD → AUDIT → RECOMMEND

- Separate forecast, capacities, costs and opening conditions from decisions.
- Reconcile each period before calculating cost. Keep one sign convention for inventory/backlog.
- Check regular/overtime/subcontract limits, non-negativity and final-balance requirement.
- Recompute every cost category from displayed quantities; compare plans on the same horizon, opening position, service rules and cost basis.
- Explain the operating pattern; test demand, capacity or cost sensitivity; state a reversal condition.

EXAM A smaller total is not enough if one plan quietly permits backlog, omits a cost, or violates service/labour/supplier limits.



Demand commitments loop back when capacity, inventory, cost or service evidence is infeasible.

TRAP → FIX A Solver screenshot alone proves neither feasibility nor recommendation. Separate inputs and opening conditions from decisions; show each period balance and capacity rule; trace every objective term to displayed quantities; add scenario logic and state the operating consequence.

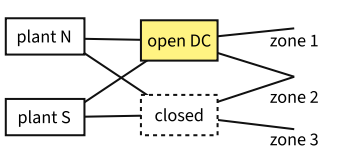
6 • Facility + Distribution Design

CH 5-6 • FINAL EMPHASIS

FIXED-CHARGE FACILITY MODEL

minimise $\sum_i F_i y_i + \sum_{ij} \sum_{kl} c_{ijkl} x_{ij}$
serve each zone: $\sum_{ij} x_{ij} = d_j$
open/capacity link: $\sum_{ij} x_{ij} \leq Cap_{ij} y_i$
 $x_{ij} \geq 0$; $y_i \in \{0,1\}$

Fixed cost rewards consolidation; transport, handling and service may reward proximity. Verify each destination separately—a correct network total can hide one short zone and one oversupplied zone. Report opened sites, flows, utilisation and cost; test demand growth, cost change, capacity loss and service constraints.



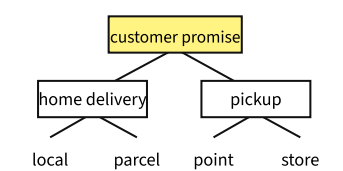
Binary links must make positive flow through a closed site impossible.

LOCATION ESTIMATE + CHANNEL CHOICE

centre of gravity: $x^* = \sum x_j w_j / \sum w_j$ · $\bar{y} = \sum y_j w_j / \sum w_j$

This generates a candidate, not a decision: test discrete sites, road access, capacity, fixed cost, risk and response requirements. For distribution, compare inventory aggregation, facility expense, transport, response time, assortment, customer effort, returns and scalability.

STRUCTURE	TRADE-OFF
Direct / central parcel	Pooling and less duplication; longer individual transport
Local storage/delivery	Fast response; fragmented stock and route economics
Pickup / stores	Consolidated last mile; customer effort/local presence
Hybrid	Valid only with explicit product/customer routing rules



Start with the customer promise, then choose the operating structure and test its reversal condition.

TRAP → FIX Do not stop at base-case cost. Pilot first; update route density, participation, failure rates and customer-response assumptions. State which product/customer segment uses each hybrid channel and why.



Full guide · ask Sia
about ITLS6002

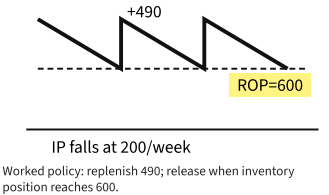
7 · Drill 1 – EOQ + CH 1 WORKED · 8 MARKS

Given: D=9,600 units/year; S=\$75/order; H=\$6/unit-year; L=3 weeks; 48 operating weeks/year.

STEP	WORKING	RESULT
1 · lot size	$\sqrt{2 \times 9,600 \times 75 / 6}$	489.90 units
2 · feasible	round to a workable quantity	490 units
3 · demand basis	9,600/48	200 units/week
4 · trigger	200×3	600 units

Decision: order about **490 units** whenever inventory position reaches **600 units**. The first number is how much; the second is when. At unconstrained EOQ, annual ordering and holding costs should be approximately balanced.

TRAP Do not use 600 as the replenishment quantity or 490 as the trigger. A longer certain *L* moves the trigger but not basic EOQ.



7b · Feasible-Quantity Check CH 1 DECISION CHECK

For D=9,600, S=\$150, C=\$40 and i=25%: H=\$10 and unconstrained EOQ=536.66. With cartons of 60, compare 480, 540 and 600 on annual ordering + holding cost. **540 has the smallest displayed relevant total**; keep ROP as a separate timing decision.

CANDIDATE RULE	KEEP?
Neighbouring feasible multiples	Yes—same annual basis
Mechanically rounded integer	No if cartons constrain
Purchase cost	Only if price varies

7c · EOQ Answer Audit CH 1 FAQ

LINE TO SHOW	ERROR PREVENTED
H=iC in \$/unit-year	Unconverted carrying rate
D and H annual	Weeks-versus-years error
IP beside ROP	Duplicate order in transit

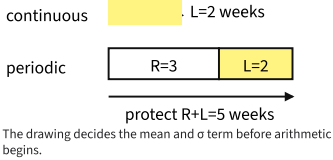
If price varies, restore purchase cost. Name any broken basic-model assumption.

8 · Drill 2 – Protection CH 2 WORKED · 8 MARKS

Given: weekly μ =120, σ =24 units; L=2 weeks; review R=3 weeks; z=1.645.

POLICY	EXPOSURE + DEVIATION	PROTECTION RESULT
Continuous	T=2; $24/\sqrt{2}$ =33.94	SS=1.645×33.94=55.83
Continuous ROP	120×2+55.83	295.83 ≈ 296
Periodic	T=3+2=5; $24/\sqrt{5}$ =53.67	larger exposure
Order-up-to	120×5+1.645×53.67	688.28 ≈ 688

Decision: use ROP>296 under continuous review, or target S≈688 at the three-week review. Periodic order quantity is **688-IP**, not 688 automatically.



CHECKS Units → exposure → mean → deviation → z → SS → trigger/target → carrying cost. If demand is seasonal or correlated, do not scale one-period σ automatically.

8b · Service-Language Trap CH 2 CLINIC

PHRASE	MODEL MEANING
Finish cycle without stockout	Cycle service probability; z quantile
Demand supplied immediately	Fill rate; expected shortage
“Better service”	Undefined until metric is named

Report both the service gain and annual carrying-cost consequence. More protection is not free.

8c · Sensitivity Narrative CH 2 FAQ

R↑ raises periodic mean and variability exposure; z↑ raises only protection; σ ↑ raises safety stock; μ ↑ raises expected exposure. Continuous ROP is unchanged by R.

BEFORE $\sqrt{T}$	CONFIRM
Pattern	Independent, identically distributed period demand
Units	μ , σ , R and L use one time basis

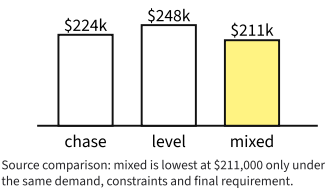
9 · Drill 3 – Aggregate Plan CH 4 WORKED · 8 MARKS

Given: demand=900, 1,100, 1,300; beginning inventory=200; regular production=1,050 each period; ending inventory cost=\$4/unit-period.

PERIOD	BALANCE	ENDING I	COST
1	200+1,050–900	350	\$1,400
2	350+1,050–1,100	300	\$1,200
3	300+1,050–1,300	50	\$200
TOTAL ENDING-INVENTORY COST	700 UNIT-PERIODS		\$2,800

Decision: the level plan is flow-feasible, finishes with 50 units and incurs \$2,800 stated inventory cost before production/workforce costs. Each ending balance becomes the next opening balance.

EXAM Numerical feasibility comes before the managerial recommendation. Confirm final position and capacity; then compare relevant categories on the same assumptions.



9b · Plan-Audit Grid CH 4 FAQ

AUDIT	QUESTION TO ANSWER
Row balance	Does opening + every supply source = demand reconcile?
Capacity	Are regular, overtime and subcontract limits obeyed?
Sign	Are inventory and backlog conventions consistent?
Horizon	Does opening supply reconcile to demand + closing position?
Objective	Can each cost component be recomputed independently?
Recommendation	Which operational risk can justify a higher-cost hybrid?

9c · Compare Like with Like CH 4 EVIDENCE

Chase=\$224,000, level=\$248,000 and mixed=\$211,000 only under the same demand, limits and final-stock rule. Mixed wins this case, not every case.

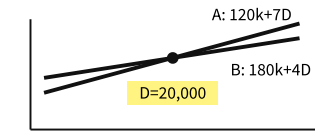
REPORT BESIDE TOTAL	MEANING
Inventory/backlog + capacity profile	Where service and disruption sit
Changed-case result	Whether the choice survives

10 · Drill 4 – Facility Choice CH 5 WORKED · 8 MARKS

Given: Site A fixed=\$120,000, variable=\$7/unit; Site B fixed=\$180,000, variable=\$4/unit; D=25,000 units. Both have sufficient capacity.

STEP	WORKING	ANSWER
A cost	120,000+7×25,000	\$295,000
B cost	180,000+4×25,000	\$280,000
Break-even	120,000+7D = 180,000+4D	D=20,000
Saving at forecast	295,000–280,000	\$15,000

Decision: choose B at 25,000; A is cheaper below 20,000 under the stated assumptions. State the volume range because the recommendation changes at the threshold. Recheck capacity and service.

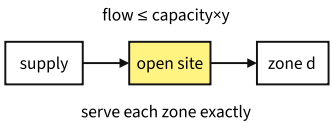


Break-even is the recommendation boundary; above 20,000 the lower variable-cost site wins.

10b · Fixed-Charge Audit CH 5 MODEL

TEST	EVIDENCE TO SHOW
Demand	One conservation rule per zone
Open link	y=0 forces all linked x=0
Capacity	assigned flow ≤ available capacity
Fixed cost	charged once per selected site
Utilisation	flow/capacity and spare capacity
Stress test	demand growth, capacity loss, costs, service

Two close-cost networks can differ sharply in resilience. A base-case optimum is not automatically implementable.



10c · Recommendation Stress Test CH 5 FAQ

Change demand, cost, capacity loss or service; then compare sites, flows, utilisation and cost. A small base saving may conceal disruption exposure.

OUTCOME	INTERPRETATION
Flow shifts; sites stay	Allocation/capacity is the margin
Site set changes	Name the reversal threshold

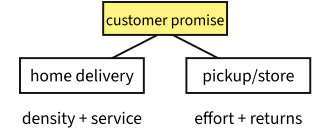
11 · Drill 5 – Last Mile CH 6 WORKED · 8 MARKS

Given: local delivery route=\$360/day+\$3/stop; parcel carrier=\$15/order; one order per stop; sufficient route capacity.

STEP	WORKING
Local cost	360+3N
Parcel cost	15N
Equalise	360+3N=15N → 12N=360
Threshold	N=30 orders/day

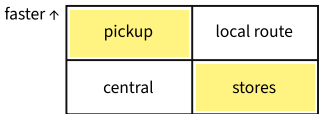
Decision: above 30 daily orders the local route has lower stated cost; below 30 the parcel carrier does.

Add capacity, geography and service-quality checks.



Channel selection begins with the customer promise, then tests cost, density, service and reverse flow.

CRITERION	CENTRAL/DIRECT	LOCAL/STORE
Inventory	aggregation; less duplication	fragmented; faster availability
Transport	individual longer parcels	route density matters
Response	generally slower	faster if stocked
Returns	collection/inspection flow	local consolidation possible



facility cost → No network wins every dimension: response, facilities, inventory and transport move together.

TRAP A hybrid is defensible only when the routing rule by product/customer is explicit and the information system can support it.

11b · Segment the Channel CH 6 APPLICATION

SIGNAL	DESIGN PRESSURE
Slow mover / varied range	Centralise for pooling
Urgent / high volume	Position nearer demand
High stop density	Local route gains
High returns	Design reverse flow too

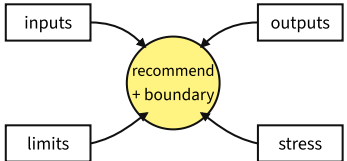
Monitor density, participation, failure, response and return cost; name the switch value.

12 · Model Chooser + Traps ALL CHAPTERS · FINAL RECALL

IF THE CASE CHANGES...	FIRST PLACE AFFECTED	EXPECTED DIRECTION/CHECK
Ordering cost S ↑	EOQ	Q* rises; ROP unchanged if d,L unchanged
Certain lead time L ↑	ROP	Trigger rises; EOQ unchanged
Review interval R ↑	Periodic S	Mean and variability exposure rise
Salvage value ↑	Co	Co falls; fractile and percentile rise
Facility fixed cost ↑	site choice	Consolidation pressure rises
Demand/capacity shock	balances + links	Re-solve; inspect utilisation

HIGH-FREQUENCY FAILURE MODES

- Using on-hand stock rather than inventory position for ROP.
- Combining raw deviations or mixing weeks with years.
- Calling cycle service and fill rate the same measure.
- Accepting an EOQ outside its price bracket or omitting discount purchase cost.
- Allowing flow when its setup/opening binary is zero.
- Ranking plans with different backlog, horizon or final rules.
- Giving a network winner without a reversal condition.



Every final answer closes the loop: verified inputs and constraints → outputs → sensitivity → conditional recommendation.

13 · Two-Sentence Finish REPORTING RULE

Sentence 1: choose the option, give its quantities/flows/cost and comparator. **Sentence 2:** state the operating reason and reversal condition.

BEFORE SUBMITTING	TICK
Units/time basis shown	☐
Balances/constraints reconciled	☐
Feasible candidate selected	☐
Service/resilience interpreted	☐
Reversal condition stated	☐

EXAM Model → check → interpret → recommend.