Deliverable 1-a: Modelling and Deterministic Optimization

- **Sets**
  Warehouse: $w \in W = \{1, 2, 3\}$
  Neighboring warehouse: $q \in W = \{1, 2, 3\}$
  Stage $t \in T = \{1, 2, \ldots\}$
- **Variables**
  $x_{w,t}$: *At stage t, warehouse w can order an amount* $x_{w,t} \geq 0$ *of coffee from external suppliers*
  $z_{w,t}$: *storage level of w at t*
  $m_{w,t}$: *the missing amount*
  $y^{send}_{w,q,t}$: *At stage t, the amount of coffee is sent from warehouse w to the neighboring warehouse q*
  $y^{receive}_{w,q,t}$: *At stage t, the amount of coffee is received by the neighboring warehouse q*
- **Parameters**
  p: *the price of ordering coffee*
  $b_{w,t} \cdot m_{w,t}$: *the cost of failing to miss the demand*
  $e_{w,q}$: *the per-unit transportation cost*
  $C^{storgae}_{w}$: *each warehouse can store coffee up to a capacity limit*
  C^{transp}_{w}: *daily transportation limit*
  $D_{w,t}$: *demand*
  $z_{w,0} = 2$
- **Objective model**
  Min cost $= \sum_{w,t} \left(x_{w,t} \cdot p + \sum_q e_{w,q} \cdot y^{send}_{w,q,t} + b_{w,t} \cdot m_{w,t} \right)$
- **Constraints**
  1. Storage capacity: $z_{w,t} \leq C^{storgae}_{w}$,∀w,t
  2. Transportation capacity: $y^{send}_{w,q,t} \leq C^{transp}_{w,q}$,∀w,t,q
  3. Inventory balance:

     $$D_{w,t} = z_{w,t-1} - z_{w,t} + x_{w,t} + \sum_{w,q,t} y^{receive}_{w,q,t} - \sum_{w,q,t} y^{send}_{w,q,t} + m_{w,t} \quad ,\forall w,t,q$$

     $$D_{w,1} = z_{w,0} - z_{w,1} + + \sum_{w,q,1} y^{receive}_{w,q,1} - \sum_{w,q,1} y^{send}_{w,q,1} + m_{w,t} \quad ,\forall\ t=1,w\ ,q$$

  4. $y^{send}_{w,q,t} \leq z_{w,t-1}$, ∀w,t,q
  5. $y^{send}_{w,q,t} = 0$, when w=q
  6. $y^{send}_{w,q,1} \leq 2$
  7. $x_{w,t}, z_{w,t}, m_{w,t}, y^{send}_{w,q,t}, y^{receive}_{w,q,t} \geq 0$,∀w,t,q

Deliverable 1-b: The Expected-Value Benchmark

- **Sets**
  Warehouse: $w \in W = \{1, 2, 3\}$
  Neighboring warehouse: $q \in W = \{1, 2, 3\}$
  Stage $t \in T = \{1, 2, \ldots\}$