Integration of the supplier capacity for choosing the less risky schedule within an uncertain environment

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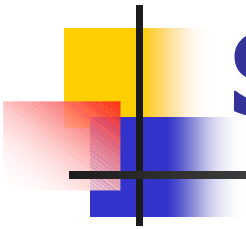
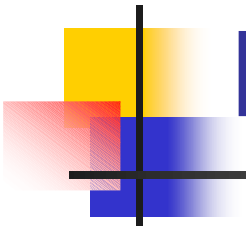


Summary

- Context
- Model of gross requirements
- Computation of feasibility level
- Choice of the manufacturing sequence
- Conclusion and perspectives



Environment

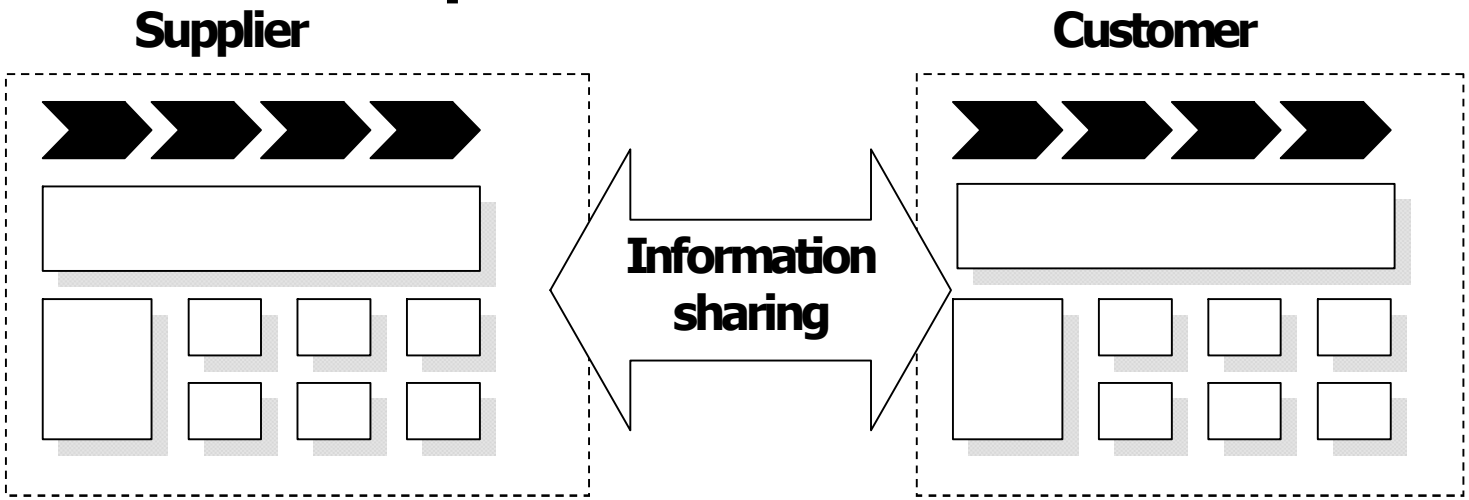
- Uncertainty on the supply chain demand
  - Shortening of the product life cycle
  - Customer versatility
- Risk for the supply chain
  - Backordering
  - Obsolete inventory

Risk mitigation

- Collaboration
  - Vertical: centralized decision making which synchronizes the supply chain
  - Horizontal: referring to the collaborative planning (supply chain of independent entities)

Collaborative supply chain

- Point-to-point (customer / supplier) relationships with partial information sharing
  - Inventory levels
  - Allocated capacity levels
  - Procurement plans



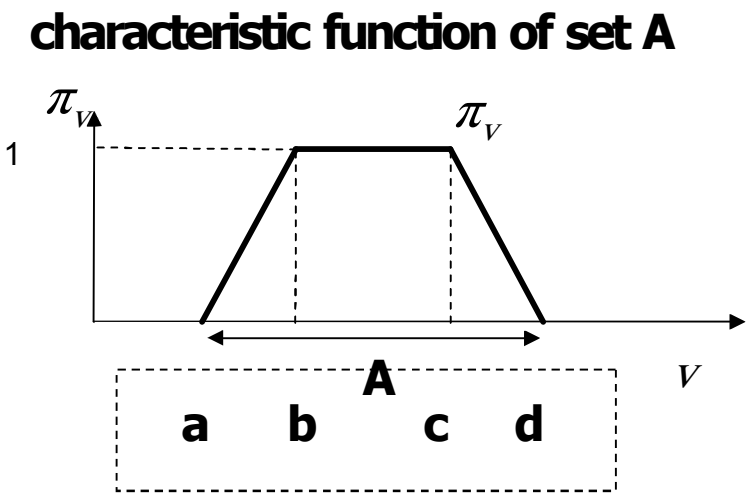
Uncertain environment

- Integration of the uncertainty in the decision process
- Two different types of models can be used for representing the uncertainty
  - Stochastic models
  - Possibilistic models

Without observation allowing to build a stochastic model => possibilistic model.

Distribution of possibility

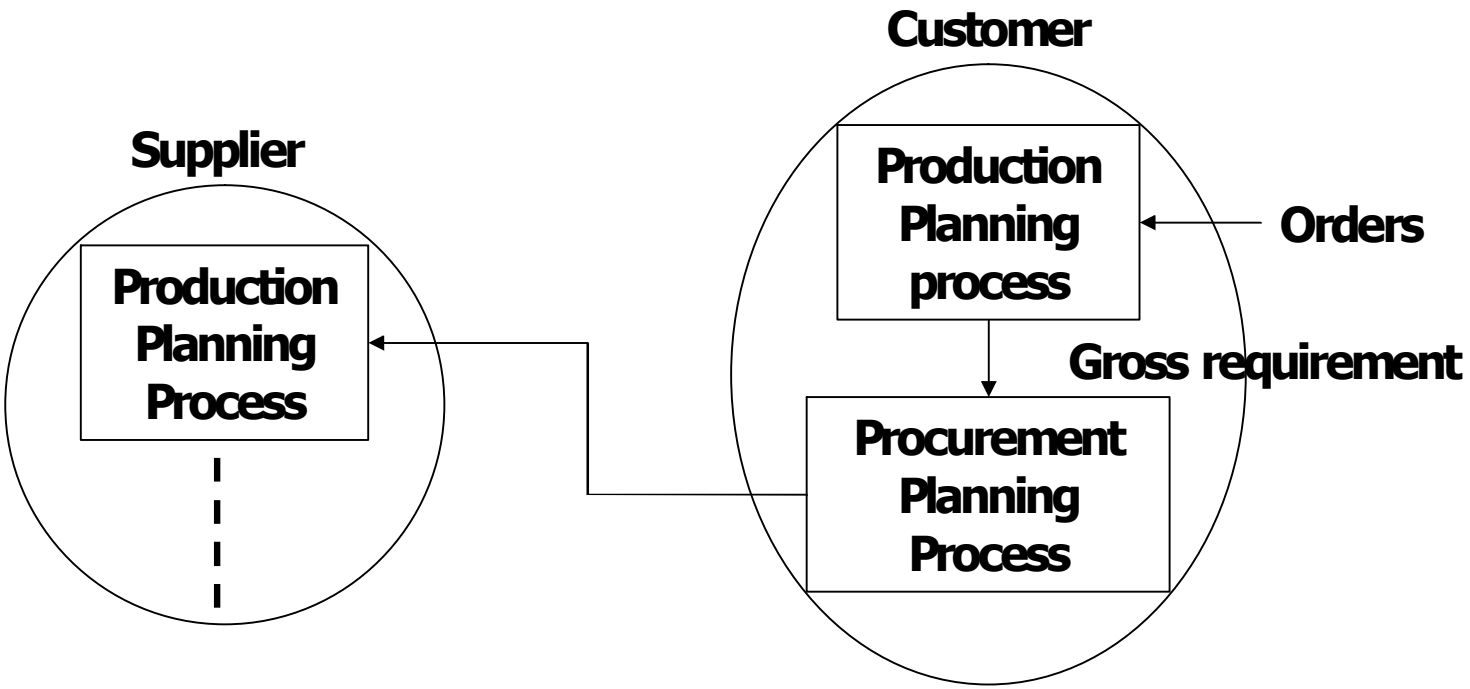
- **Imprecision on quantities**



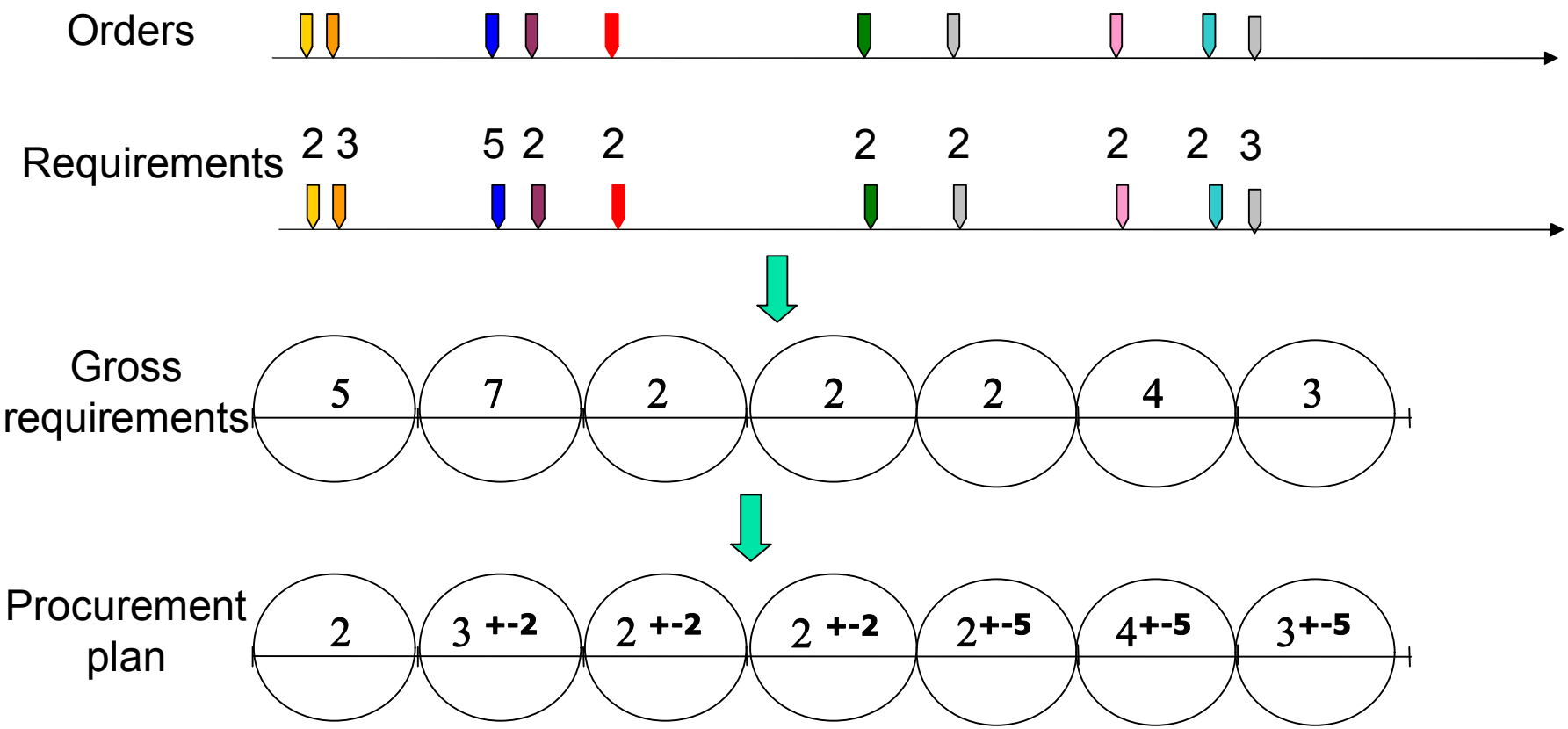
fuzzy numbers are used to model the possibility distributions: represented by 4 values (a; b; c; d)

Computation of the procurement plan

- Customer « Make-to-Order »
- Supplier « Make-to-Stock »

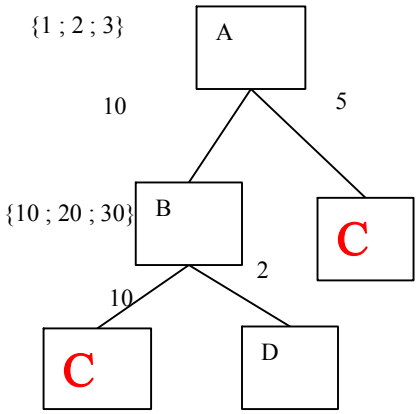


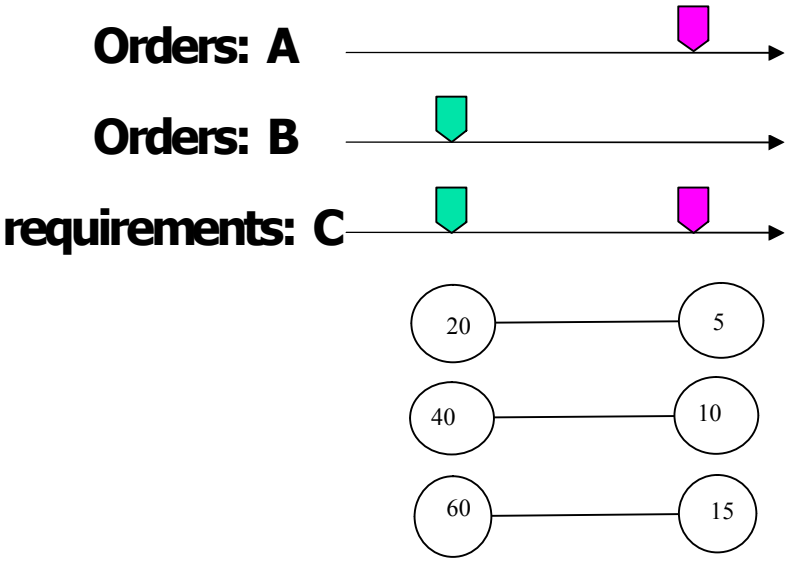
Procurement planning process



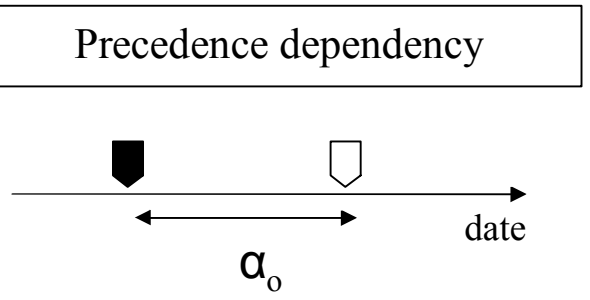
Dependencies

- **Quantities Dependencies**
  - The required component appears at different levels of the bill of material of the same final product



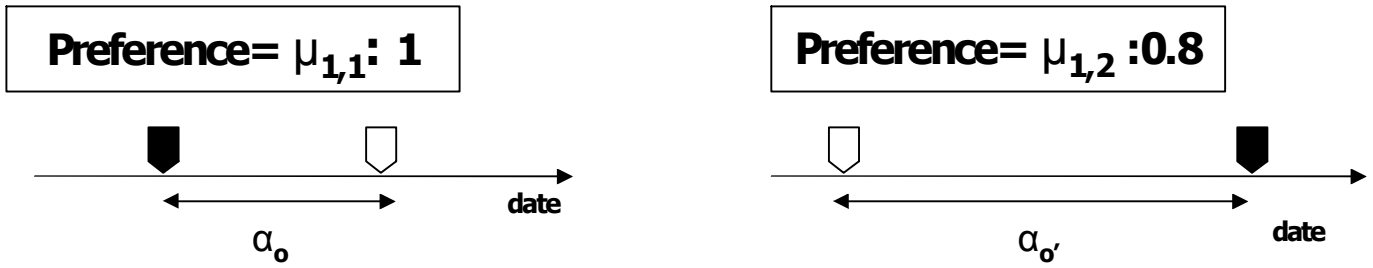


- **Precedence Dependencies**
  - requirements processed on a given assembly line



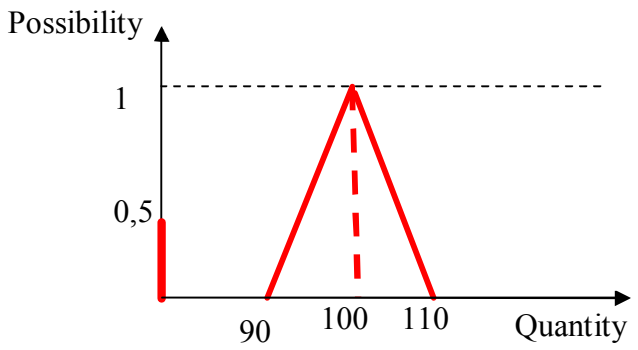
Feasible Sequence

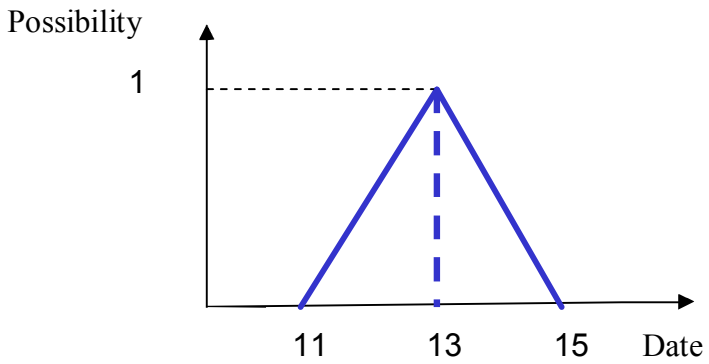
- The planner makes a decision on the production planning given a set of possible sequences evaluated by preference level



Requirement representation

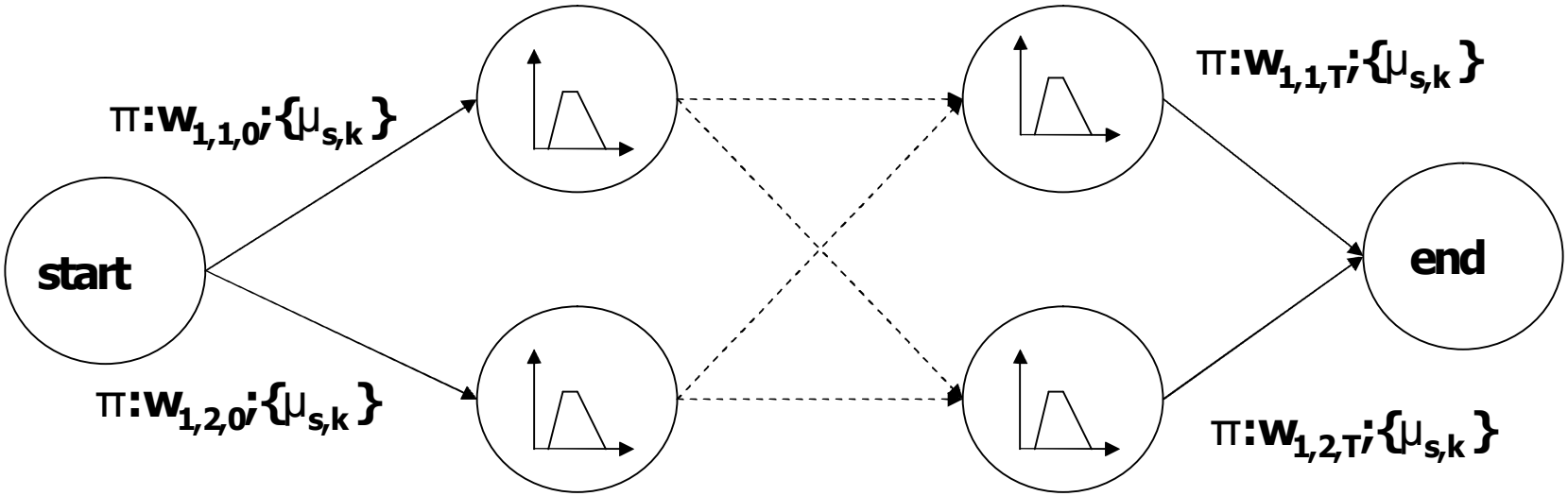
- Model composed by two sub-models
  - Quantity model
    - possible quantities
    - uncertainty of the requirement
  - Date model



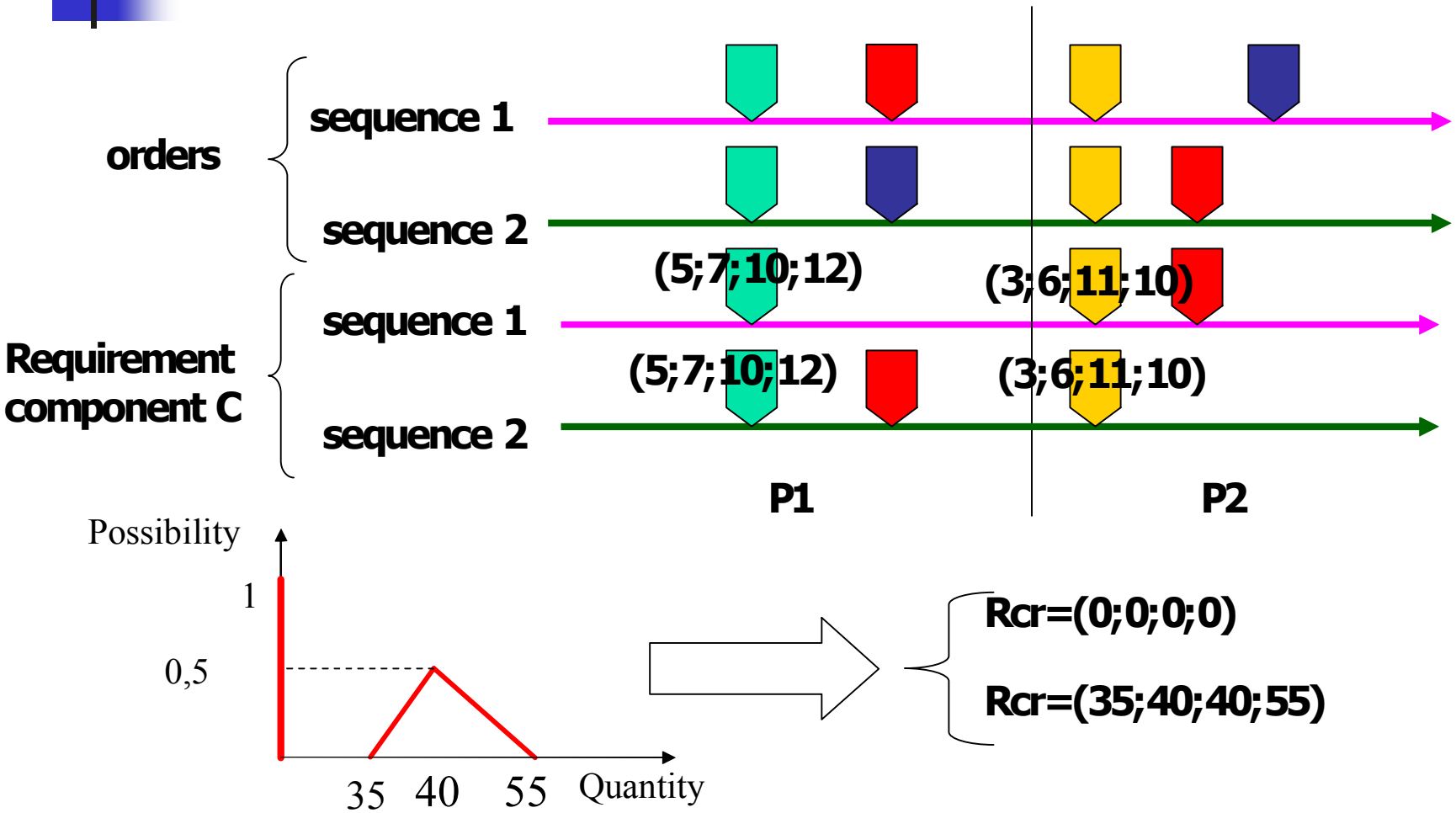


Gross requirement

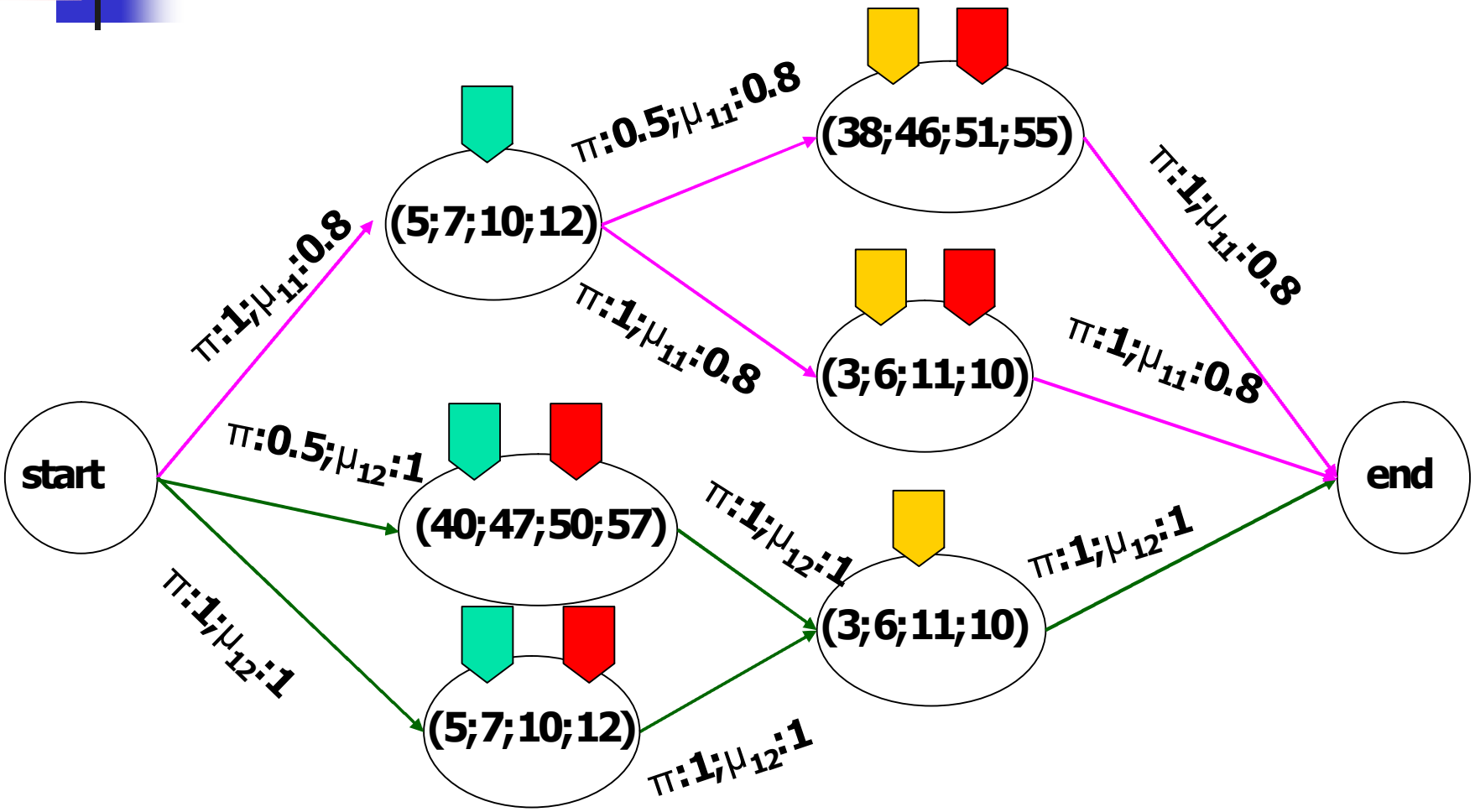
- Graph representation
  - Nodes are fuzzy gross required quantities
  - Arcs are valued by set of characteristics
    - Possibility level
    - Preferences of sequence



Example: Requirements

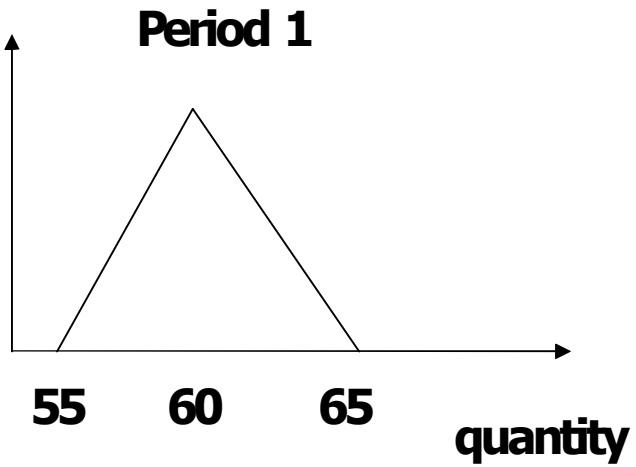


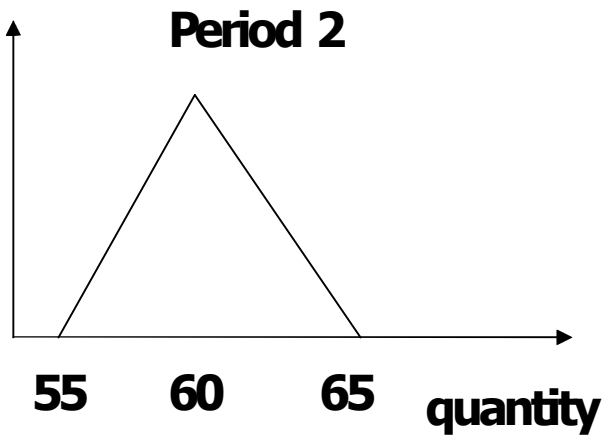
Example: gross requirement



Feasibility level

- Data
  - Gross requirement (graph)
  - Constraints set by the uncertain capacity of the supplier (possibility distribution)

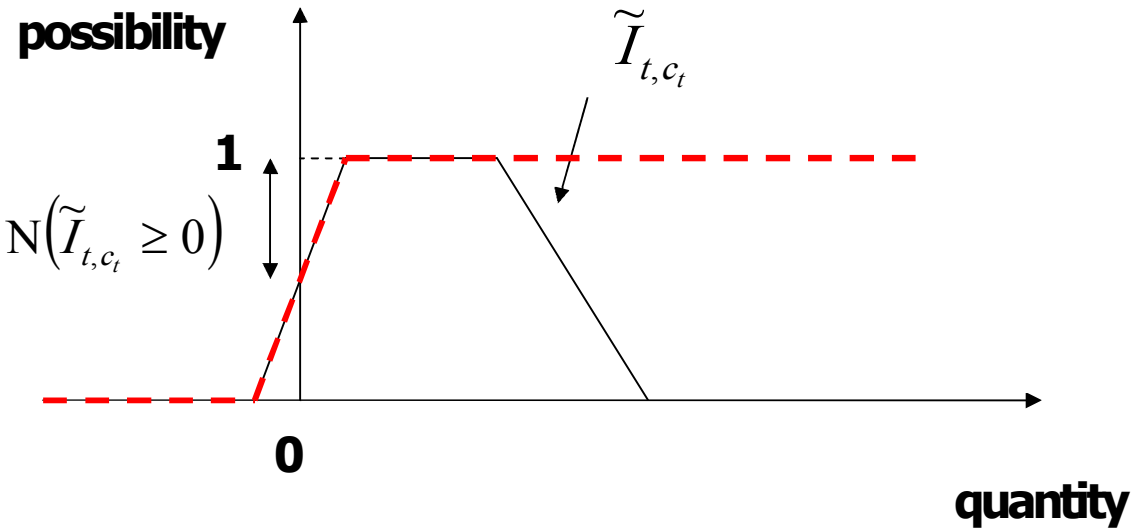




Feasibility level

- **Necessity that the gross requirement is satisfied whatever the supplier capacity is**

$$\Phi_{t,c_t} = 1 - \left(1 - \mathrm{N}\left(\widetilde{I}_{t,c_t} \geq 0\right)\right) * w_{c_{t-1},c_t,t}$$



Example: Computation of the feasibility level

Gross requirements

1 → (5;7;10;12)

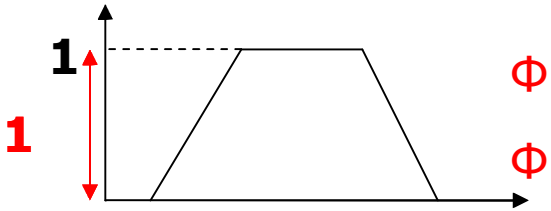
0.5 → (40;47;50;57)

1 → (5;7;10;12)

Capacity of supplier:

(55;60;60;65)

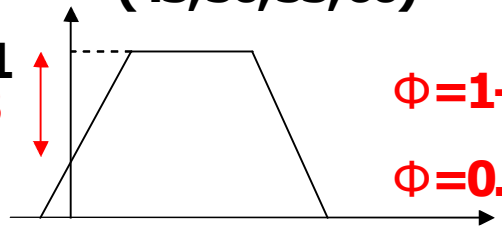
Inventory at the end of the period:



Φ=1-((1-1)*1)

Φ=1

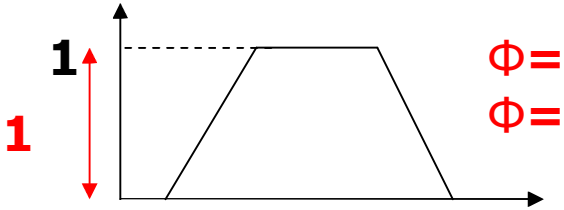
(43;50;53;60)



Φ=1-((1-0.833)*0.5)

Φ=0.916

(-2;10;13;25)

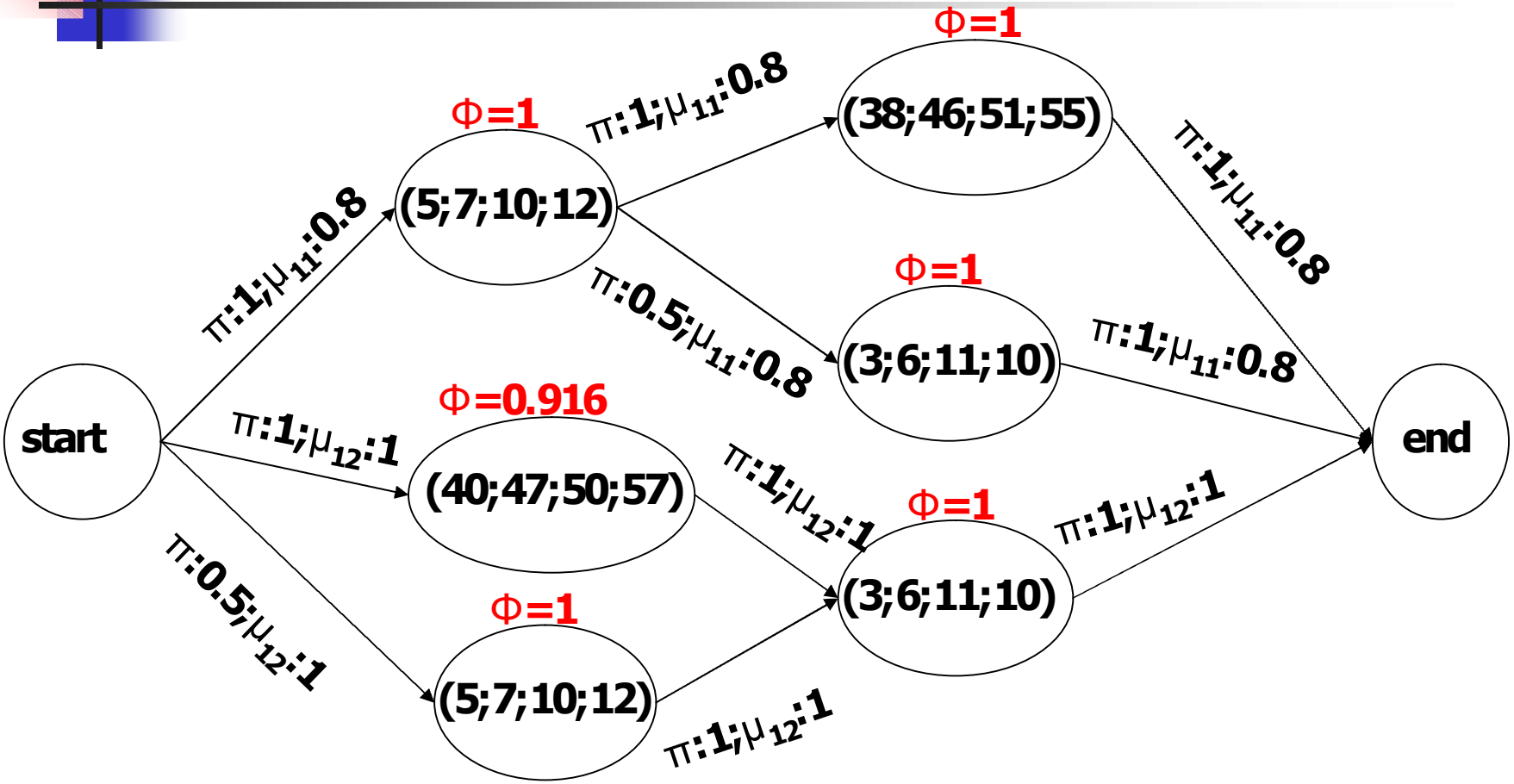


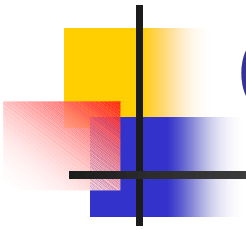
Φ=1-((1-1)*1)

Φ=1

(43;50;53;60)

Result


start
Φ=1
(5;7;10;12)
Φ=0.916
(40;47;50;57)
Φ=1
(5;7;10;12)
Φ=1
(38;46;51;55)
Φ=1
(3;6;11;10)
Φ=1
(3;6;11;10)
end
π:1;μ11:0.8
π:1;μ12:1
π:0.5;μ12:1
π:1;μ11:0.8
π:0.5;μ11:0.8
π:1;μ11:0.8
π:1;μ12:1
π:1;μ12:1
π:1;μ12:1

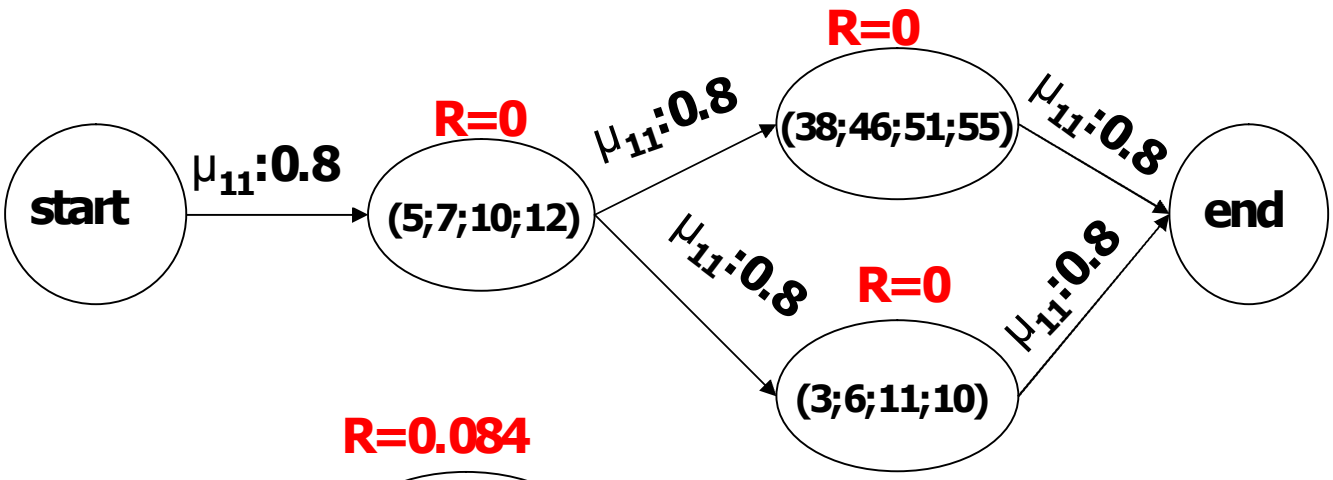


Choice a sequence

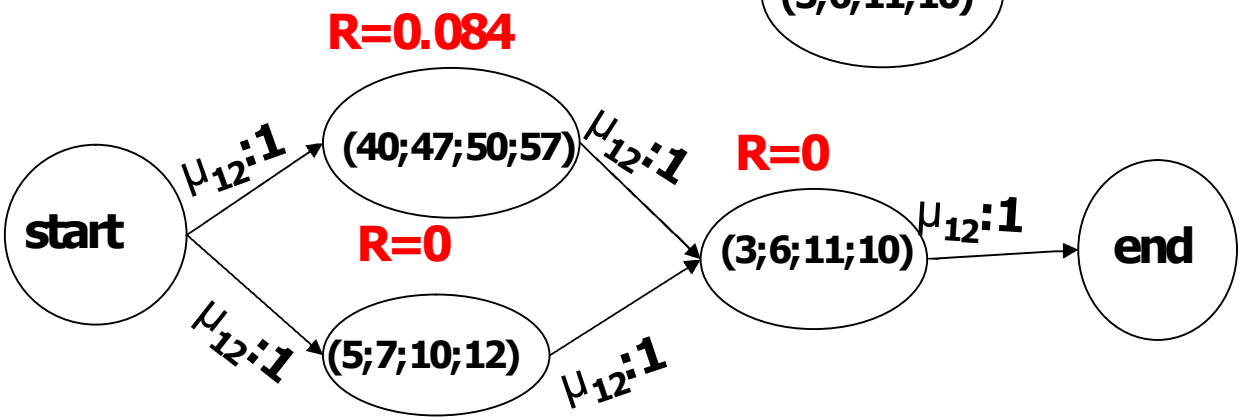
- Computation of the risk of each possible sequence
- Choice the less risky sequences
- Within the less risky sequences, choice of the preferred one

Exemple

- Two possible sequences

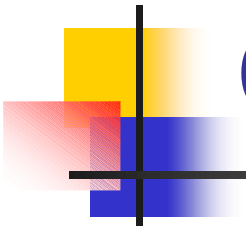


μ_{11}:0.8
R_{11}=0



μ_{12}:1
R_{12}=0.167

Update of Gross requirement



Conclusion

- The method allows the customer to choose the less risky sequence in terms of backorder.
- Within a collaborative process, the customer and the supplier can negotiate:
  - delivering capacity
  - risk level
  - price

Questions ?