Value of Information In Supply Chain

MGT 239 Simulation For Business Group Project

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Story Line

- Our project incorporates information flow between a supplier and a retailer and evaluates the value of information.
- We consider two situations: (1) a traditional model (model 0) where there is no information for the supplier to set different inventory levels prior to a demand to him except for past data; (2) the supplier knows the (s, S) policy used by the retailer as well as the end-item demand distribution, so he can set different inventory levels in each period (model 1).

- We proved….
  - Information is Cost-saving thus Valuable in supply chains
- Through…comparing the COST of
  - Model 0 (without information-sharing)
  - Model 1 (with information-sharing)
  - We found….
  - Cost of Model 1 is dominantly LESS than Cost of Model 0
  - Or saying… INFORMATION saves COST

Assumptions

- The sequence of events in every period is as follows.
  - First, the supplier decides on his production quantity for the period.
  - Next, the retailer realizes her demand for the period.

Assumptions

- Retailer follows a (s, S) Inventory Policy
- Also known as Safety Stock Model
- How does it work?

  When the retailer's inventory level is below s after satisfying the demand of customer, she places an order with the supplier to bring her inventory level to S; Otherwise, no order!

Assumptions

- The supplier incurs linear holding and penalty costs at unit rates h and b respectively. (We assume h=5 and b=14.)
- h occurs when the suppliers hold more inventory than ordered
- b occurs when the suppliers hold more inventory than ordered
- h<b, this makes sense!

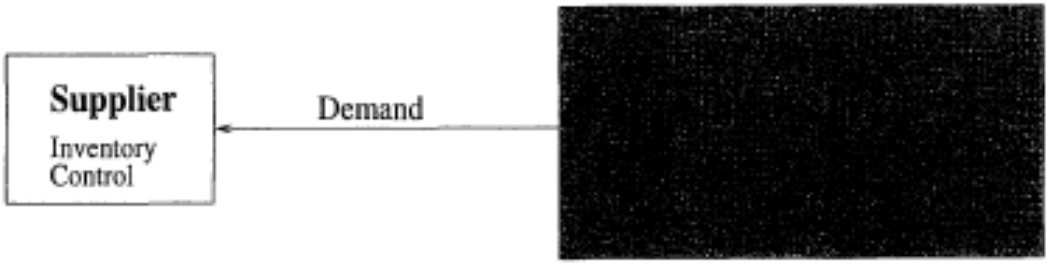
Parameters

- delta= S- s =50;
- Manufactory capacity: unlimited (it doesn't really matter)
- Customer Demand has a mean of 20, follows…
  - Exponential (20)
  - Norm(20,10)
  - Norm(20,20)
  - Uniform (15,25)
  - Uniform (5,35)
  - Sample Runs: 1,000
  - Periods: 50

The Models

- Model 0

Figure 1 **Model 0—The Traditional Supply Chain**

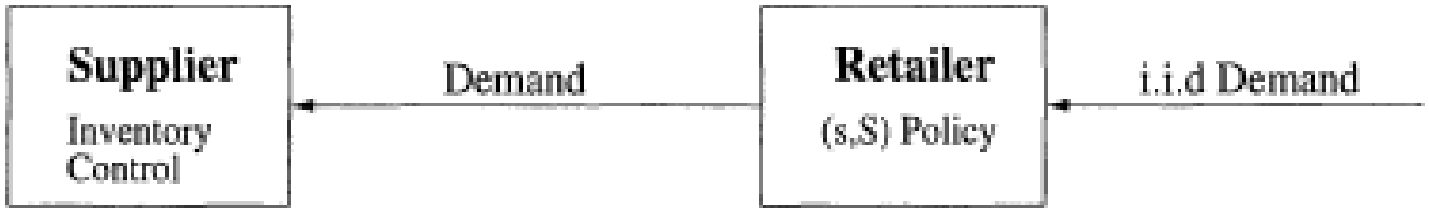


- Supplier knows nothing about Customer Demand
- Supplier only observes historical Order information from Retailer

The Models

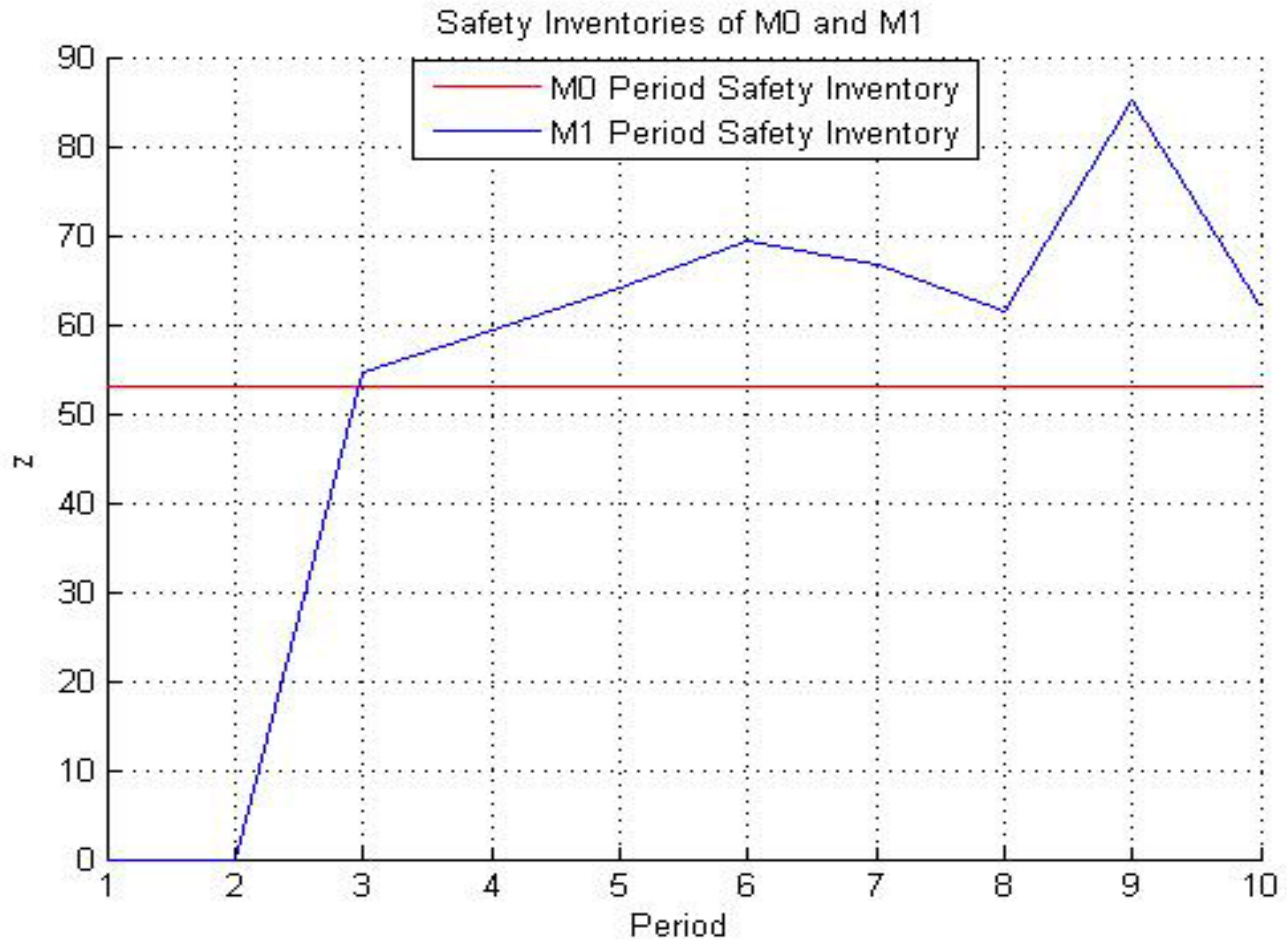
- Model 1

Figure 2 **Model 1—Supply Chain with Some Information Flow**



- Supplier knows information about Customer Demand
- Supplier optimizes an safety Inventory Level set basing on historical demand data

Safety Inventories Comparison



(Parameters: exp(20), h=5, b=14)

Simulation Brief

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1. Generate demand;
2. Find the order period of each sample; cumsum(d,2)>=delta(50);
3. Calculate the cost and find the optimal z to achieve the minimum cost
4. Calculate total Costo

Simulation Brief

- M1

1. Use the same customer demand as M0
2. Calculate the cost1 formula
   $f(x)= a*z1+b*z2+c*z3... \alpha *z49$ (non-linear)
3. Use fmincon() function to find a minimum of a constrained nonlinear multivariable function (Infitesimal Perturbation Analysis);
4. Get an optimal z set to achieve the minimum cost and calculate the total cost1

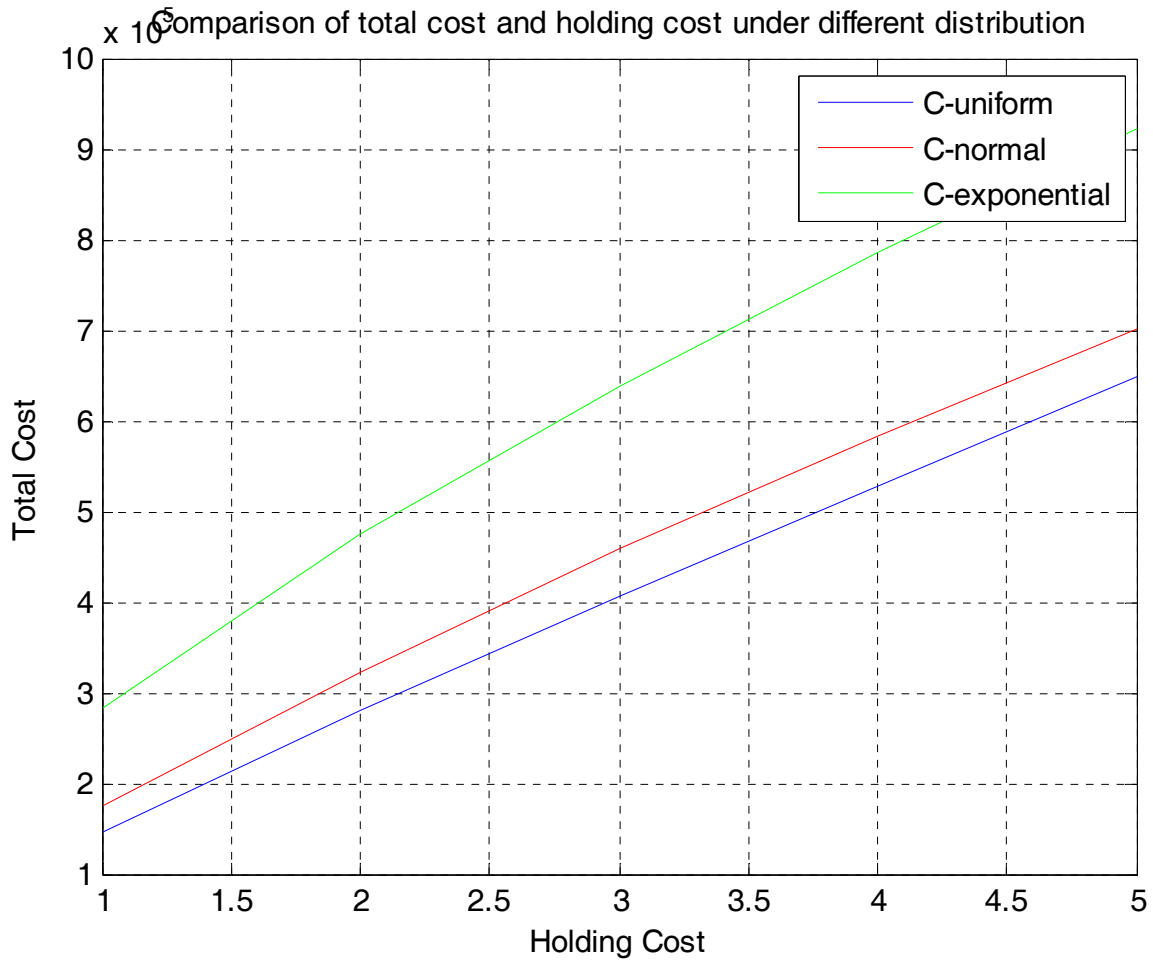
Computational Results

- Observe 4 parameters: Holding Cost (1:5), Demand Variance, Saving Ratio and Total Cost;

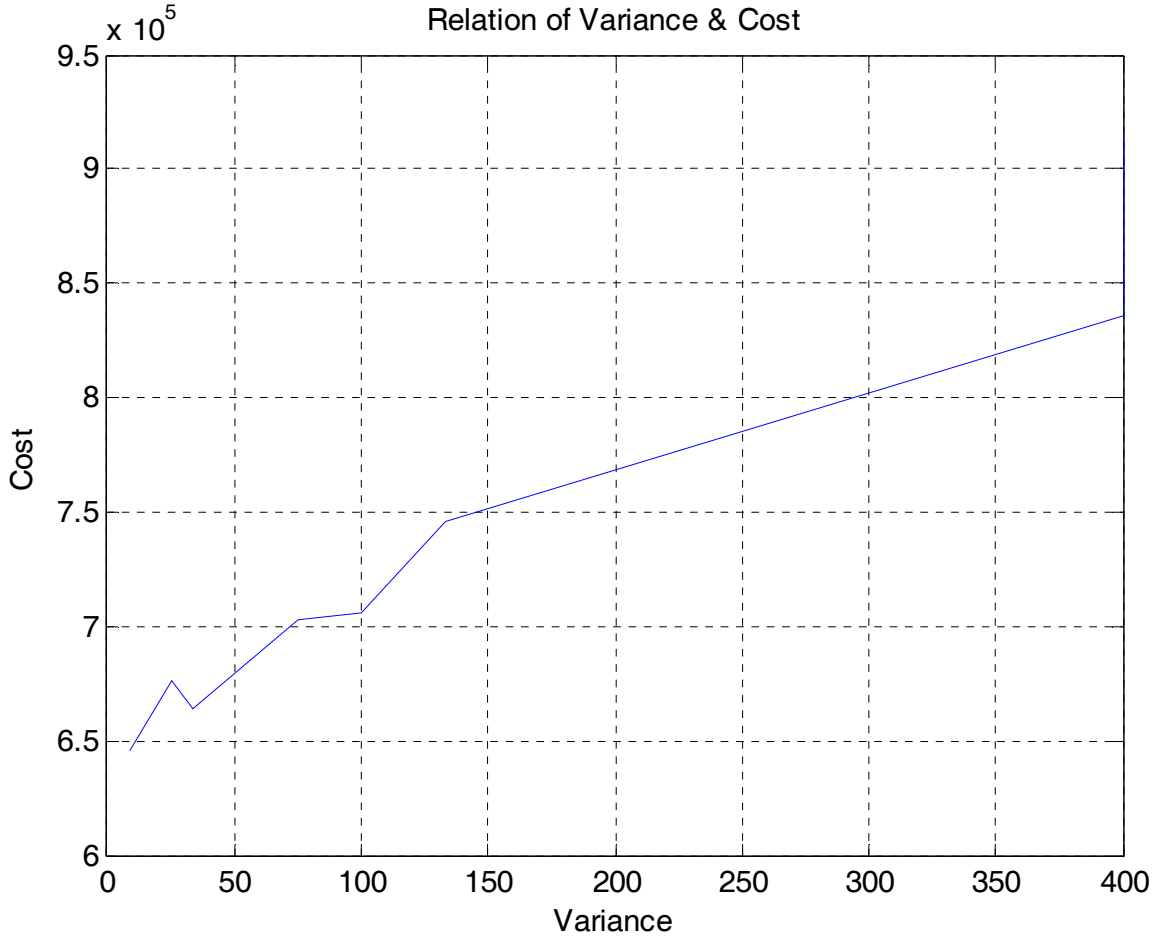
Comparison:

- Holding Cost vs. Total Cost
- Total Cost-Demand Variance

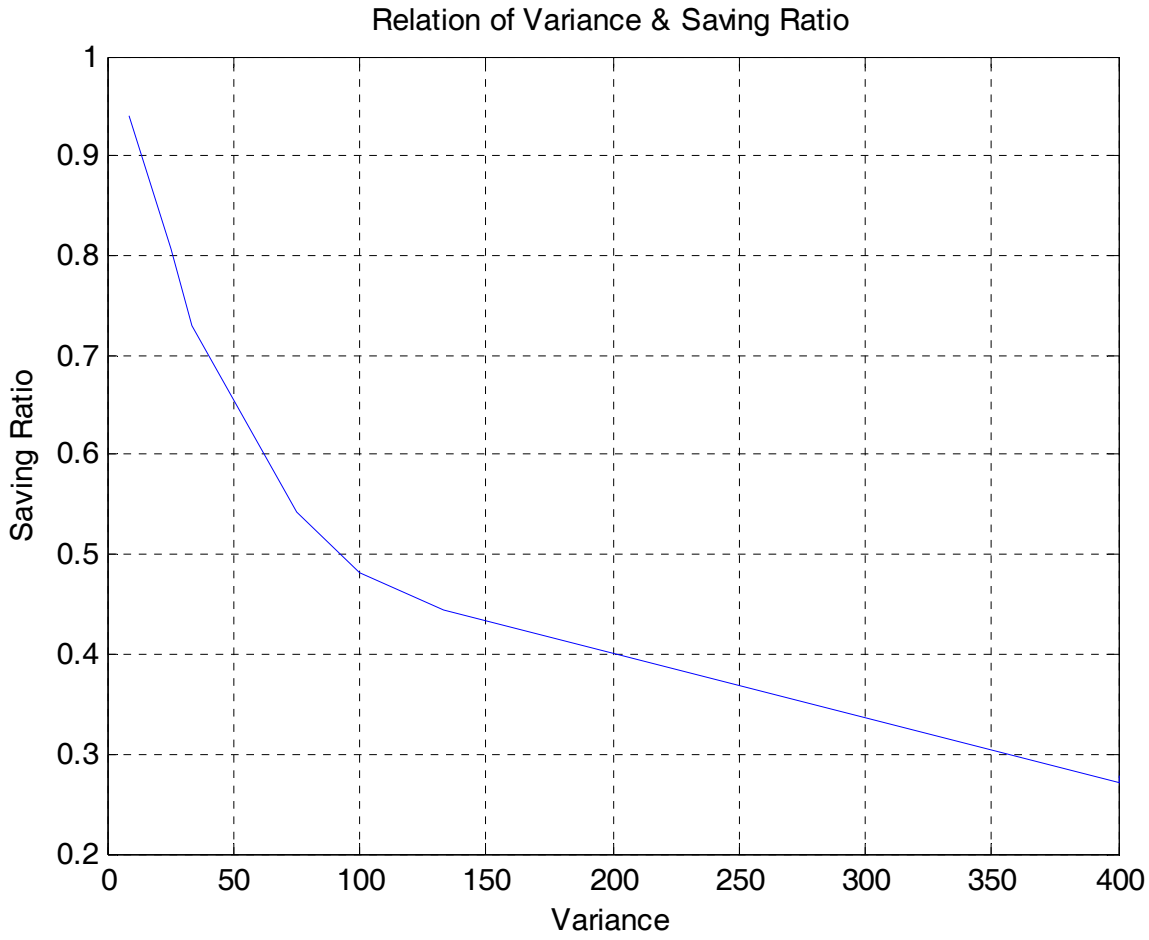
Holding Cost - Total Cost



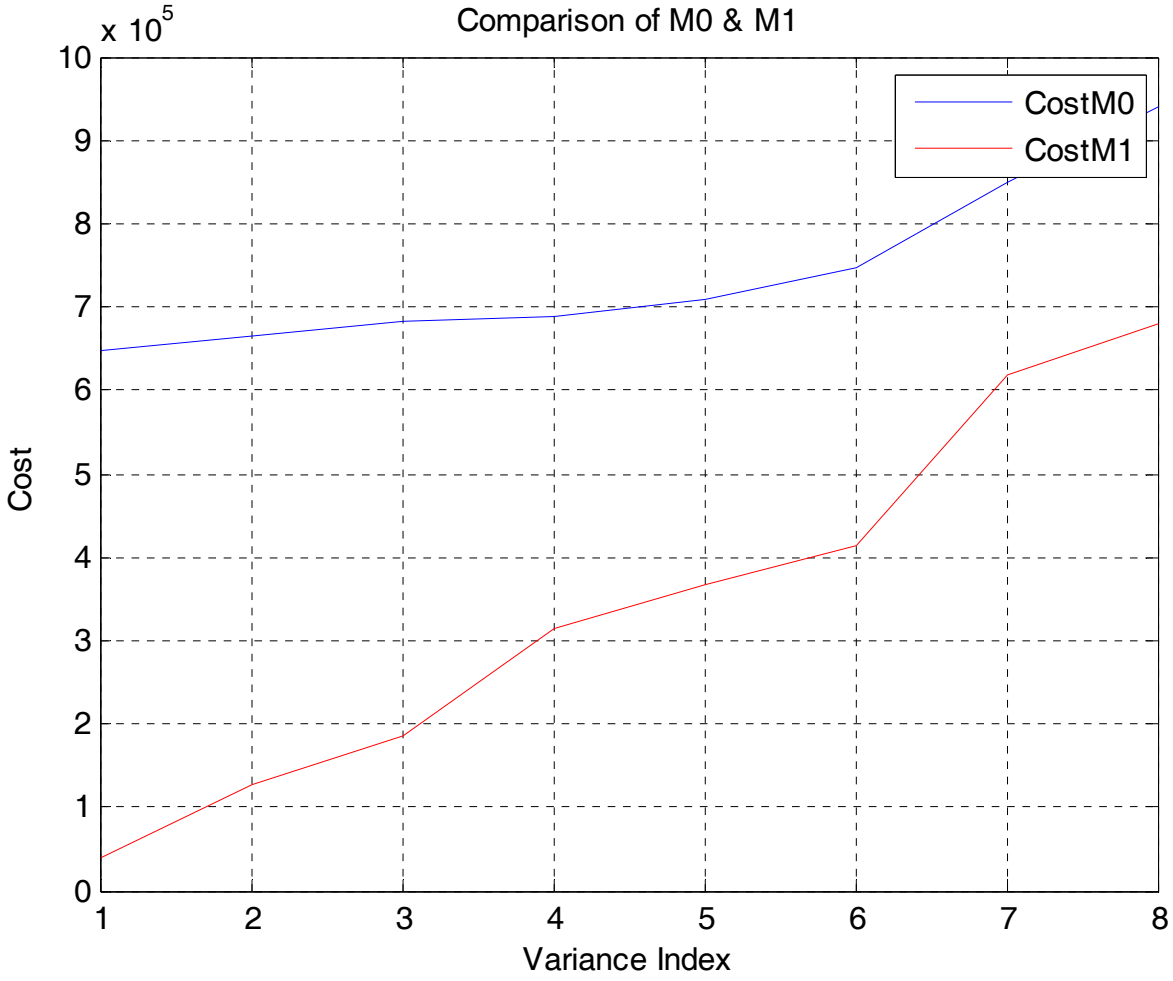
Demand Variance-Total Cost



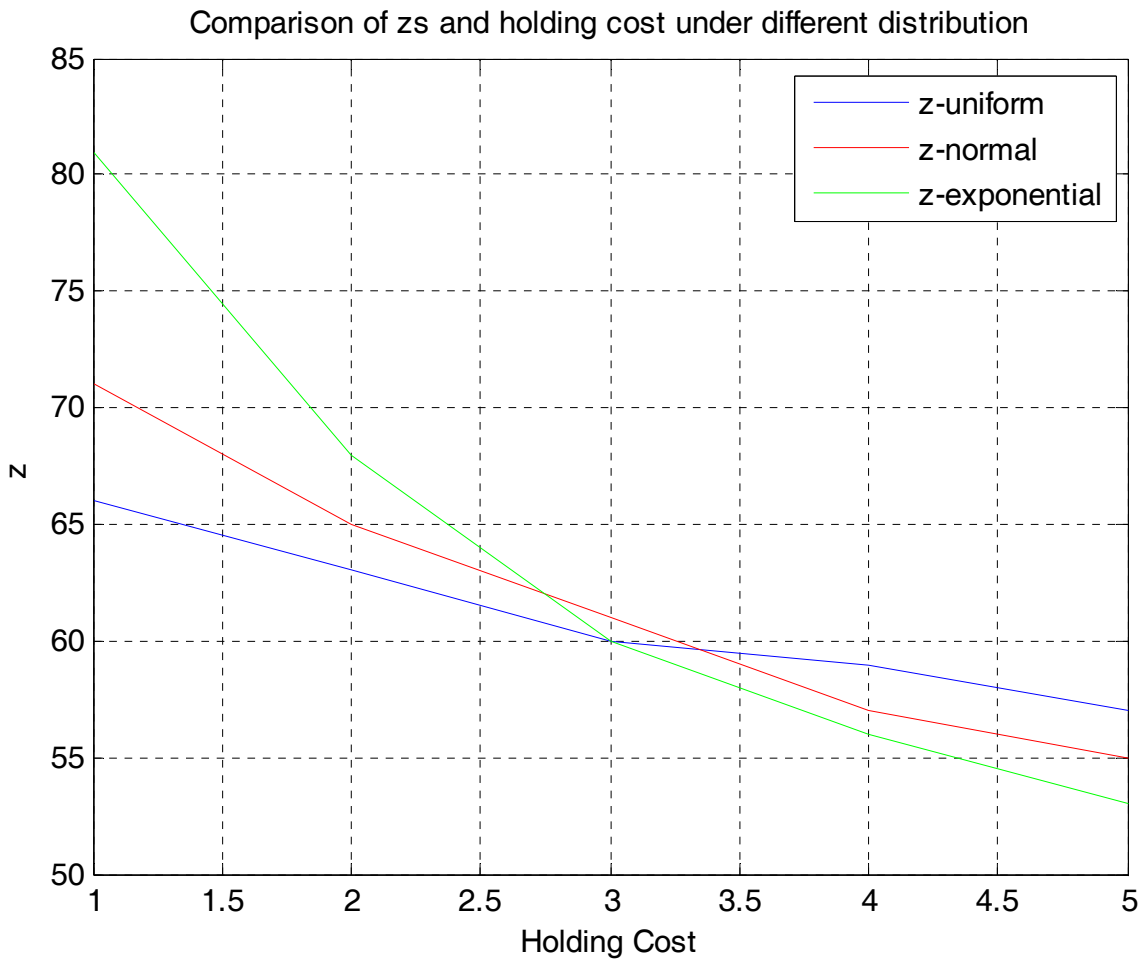
Demand Variance-Saving ratio



M0-M1 Cost Comparison



M1 Holding Cost-Optimal z set



Conclusion

- We have incorporated information flow into inventory control model (M1).
- The computational study provides us with insights on the savings and relative benefits due to information flow.

Future Work

- Considering the production capacity of supplier;
- Extending this analysis to multiple retailers;

Thank you!