



# Option Valuation for National Retailer

Business Strategy for Transportation Fleet

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## Presentation Outline

- Introduction
- System Description
- Decision Analysis
- Lattice Analysis
- Conclusions

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## Introduction

- *System under consideration*: national retailer's transportation policy in a distribution network.
- Data based on history of transactions, but also uses approximations for some costs.
- *Motivation*: minimize transportation costs.
- *Solution*: Decide the allocation of trucks in distribution network.

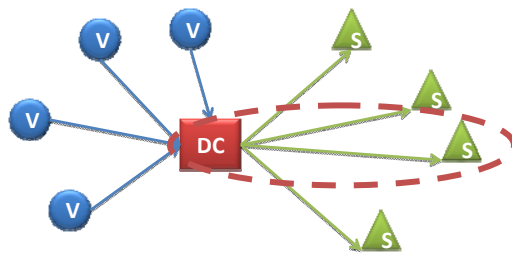
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## System Description

- Distribution Network:  $V - DC - S$



- Key System Uncertainty: Demand for full Tls in the lane (= {DC;S} pairing).

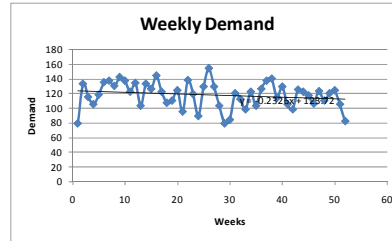
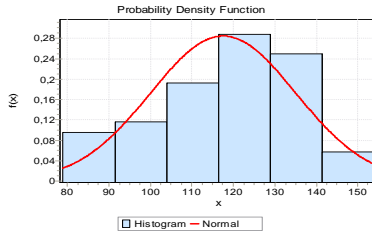
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## Uncertainty and Design Levers

- For a week, assume  $D \sim N(118; 17)$ . Project duration: 1 year, divided in 12 periods.
- Slightly decreasing trend



- Design levers: number of private fleet trucks and number of for-hire carrier trucks assigned.

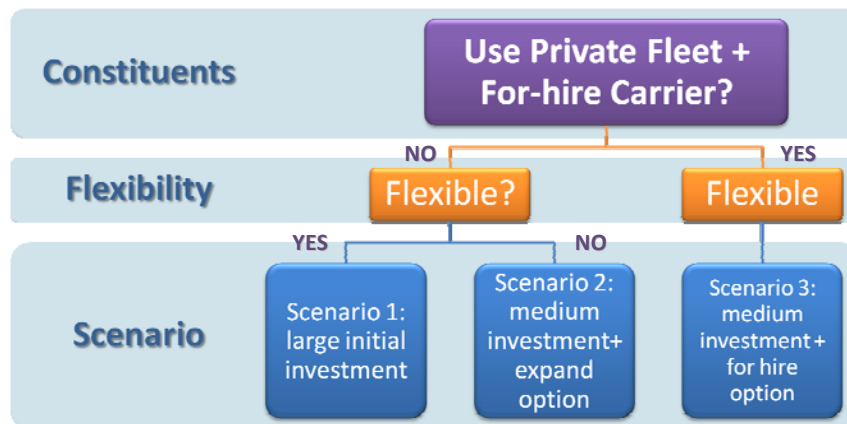
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## Available Scenarios

- 3 Scenarios:



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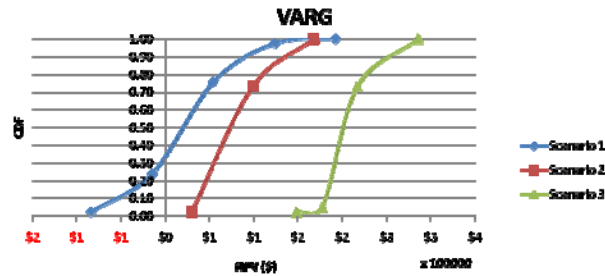
## 2-Stage Decision Analysis Assumptions

Probabilities		Demand	Costs
High	0.16	Mean 118	Benefit (/transaction) \$1,600
Average	0.68	StDev 17	Private Fleet Rate (/mi) \$1.95
Low	0.16	1 Period (wks)= 4	FH Rate (/mi) \$2.50
		Hi 135	Distance (mi) 300
		Av 118	Investment (/truck) \$6,300
		Lo 101	Maintenance (/month) \$200

**High:  $x > \mu + \sigma$  for 4 consecutive weeks,**  
**Low:  $x < \mu - \sigma$  “ “ “ “**  
**Medium:  $\mu - \sigma < x < \mu + \sigma$  “ “ “ “**

## 2-Stage Decision Analysis Results

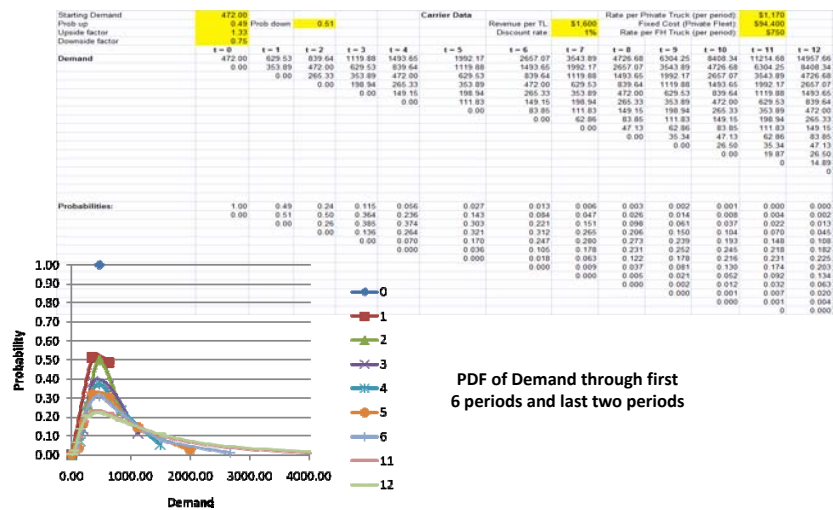
Metric	Large Private fleet now	Flexible Private Fleet	Small Private Fleet and For-hire	Best
E(NPV)	\$53,660	\$145,659	\$144,658	Scenarios 2
Max Profit	\$191,700	\$167,560	\$225,360	Scenario 3
Min Profit	(\$84,380)	(\$80,980)	(\$61,260)	Scenarios 3
Initial Investment	\$856,800	\$743,400	\$743,400	Scenarios 2,3



# Lattice Analysis Assumptions

Variable	Value	Explanation
Initial Demand	472	The average demand for one week (118) multiplied by the number of weeks in a period (4)
Starting probability	1	Assumption that the initial demand value of 354 is accurate
Discount rate	1%	A discount rate of 12% / year is chosen (reasonable value for this kind of projects) and it is then scaled to a month
Rate per Private Truck (per period)	\$1,170.00	The rate is \$1.95/mile and since private fleet trucks have to come back to their origin Distribution Center, the distance is $2 * 300 = 600$ mi
Fixed Cost (Private Fleet Maintenance)	\$94,400	The estimated maintenance cost (\$200/truck/period) multiplied by the number of Private Fleet Trucks (fixed and equal to 472)
Rate per FH Truck (per period):	\$750.00	The rate is \$2.50/mile but for-hire trucks don't have to come back to their origin Distribution Center; the distance is 300 mi
Revenue per TL	\$1,600.00	Assumed Revenue per Transaction (one Truckload)
Standard Deviation	28.80%	The standard deviation for one week is 17 so the relative Standard deviation for one month weeks is $\text{SQRT}(4) * (17/118)$
Growth Mode Base Case v	-0.80%	The growth mode base case for one week is -0.2% (exponential trend line in weekly demand plot) so for four weeks it is $(1 - 0.002)^4 - 1$

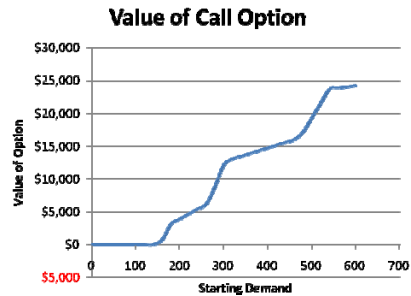
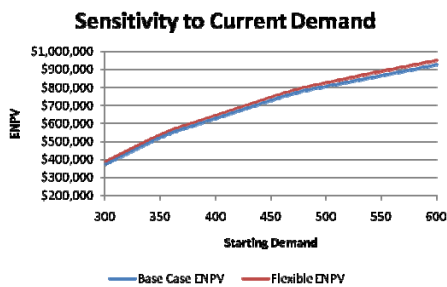
# Lattice Analysis Results



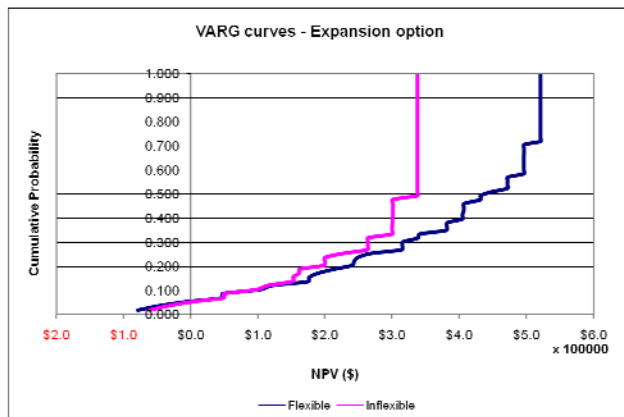


# Call Option Valuation (2)

<b>ENPV (flexible)</b>	789,062
<b>ENPV (inflexible)</b>	772,785
<b>Value of (call) option to expand</b>	<b>16,277</b>



# Call Option Valuation (3)



# Scenario 3 Put Option

- **Scenario 3 and Put Option: Flexible for-hire carrier scenario.** the company initially has a private fleet. Depending on demand variation, it can decide to: increase the number of contracts it has with for-hire contracts, to decrease it, or simply to cancel all for-hire contracts.
- If demand is lower than the private fleet capacity, the company can lease out its own unused private fleet trucks at the for-hire carrier rate.
- Once the company decides to abandon for-hire contracts, it cannot undo its decision.

$$NPV = \sum_{t=0}^T \frac{CF_t}{(1+r)^t} - \sum_{t=0}^T \frac{C_t}{(1+r)^t} - \frac{K}{(1+r)^0} + \sum_{t=1}^T \frac{L_t}{(1+r)^t}$$

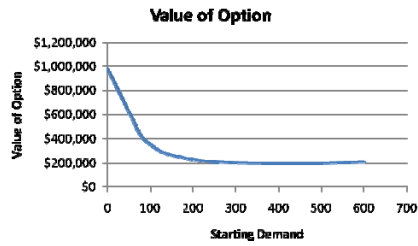
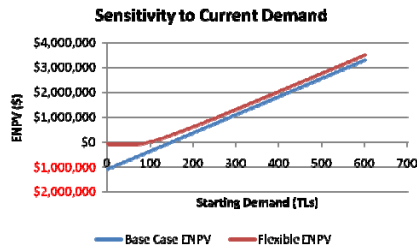
# Put Option Valuation

<b>Cash Flow</b>	242,463	421,058	659,260	976,964	1,400,703	1,965,869	2,719,663	3,725,041	5,065,971	6,854,446	9,239,839	12,421,373
	8,164	108,560	242,463	421,058	659,260	976,964	1,400,703	1,965,869	2,719,663	3,725,041	5,065,971	6,854,446
		67,108	8,164	108,560	242,463	421,058	659,260	976,964	1,400,703	1,965,869	2,719,663	3,725,041
			123,545	67,108	8,164	108,560	242,463	421,058	659,260	976,964	1,400,703	1,965,869
				165,859	123,545	67,108	8,164	108,560	242,463	421,058	659,260	976,964
					197,585	165,859	123,545	67,108	8,164	108,560	242,463	421,058
						221,371	197,585	165,859	123,545	67,108	8,164	108,560
							239,205	221,371	197,585	165,859	123,545	67,108
								252,577	239,205	221,371	197,585	165,859
									262,602	252,577	239,205	221,371
										270,119	262,602	252,577
											275,754	270,119
												279,980
<b>ENPV(Cash Flow)</b>	<b>2,559,223</b>	4,133,300	5,877,216	7,886,008	10,130,980	12,562,274	15,091,868	17,564,418	19,716,981	21,125,877	21,131,154	18,729,259
<b>WITH SHUTDOWN OPTION</b>		1,107,582	2,068,614	3,237,282	4,584,973	6,063,587	7,606,621	9,119,064	10,452,546	11,368,909	11,497,169	10,273,196
Dynamic programming approach		198,656	780,472	1,534,325	2,427,699	3,399,849	4,371,571	5,244,615	5,884,102	6,081,497	5,519,684	3,725,041
(check next year)			217,242	62,751	496,799	1,068,075	1,704,966	2,317,015	2,800,860	3,037,118	2,847,533	1,965,869
				293,556	217,242	48,433	288,363	675,525	1,007,638	1,325,744	1,345,404	976,964
					291,282	259,556	217,242	128,880	101,629	101,629	363,707	500,993
						315,068	291,282	259,556	217,242	160,806	26,314	108,560
							332,903	315,068	291,282	259,556	217,242	67,108
								346,274	332,903	315,068	291,282	165,859
									356,299	346,274	332,903	221,371
										363,616	356,299	252,577
											369,452	270,119
												279,980
<b>Shut Down?</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
<b>WITH SHUTDOWN OPTION</b>		<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
Dynamic programming approach		<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
(check next year)			<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
				<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
					<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>NO</b>
						<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>
							<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>
								<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>
									<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>

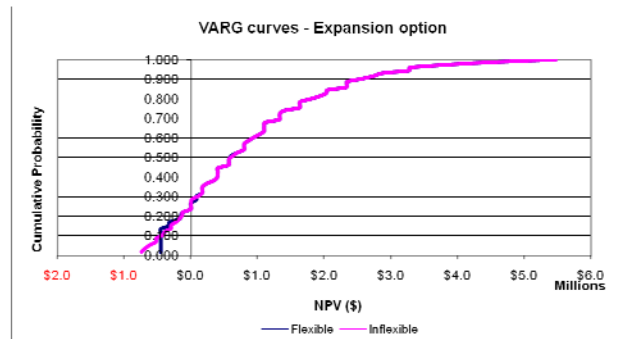


# Put Option Valuation (2)

ENPV (flexible)	2,559,223
ENPV (inflexible)	2,362,821
<b>Value of (put) option to abandon FH contracts</b>	<b>196,401</b>



# Put Option Valuation (3)



## Conclusions

- Same result as decision analysis: choose one of the two flexible scenarios. But which one?
- FH Carriers because: higher ENPV, higher value of put option (purely financial considerations), better service level (crucial consideration in practice)
- The reason for the advantage of the flexible design due to the possibility to save expansion costs until these are really needed (if demand is really consistently higher than its expected value at the start of the project).

## Questions??

