Real Options for Computer Wholesaler Distribution Center Expansion Strategy

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System Background

- Computer Wholesaler in Peru seeks to expand to interior Junin province since there is the potential for higher sales and a growing market
- Adding DC's in the region increases demand since removes risk of transportation from Lima for clients

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Sources of Uncertainty

- Transportation to interior susceptible to logistical disruptions due to weather and roads
- General political and economic issues
- How responsive clients will be to DC system that minimizes transportation risk

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Fixed versus Flexible Expansion

- **Fixed:** Establish 1 large DC which establishes customer base and confidence. Remain with only this DC over system 5 year life.
- **Flexible:** After year 1, have one time option to establish second, smaller DC in a sub region with growing potential to the end of increasing demand further.

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Cost Structure and Assumptions

- Only PC's considered as units sold
- Profit/unit = $51
- DC Locales are rented or leased
  - Leasing Cost/yr=$20,000 for large DC
    $5,000 for small DC
  - Operating Cost/yr= $80,000 for large DC
    $37,500 for small DC
- Discount Rate=12%

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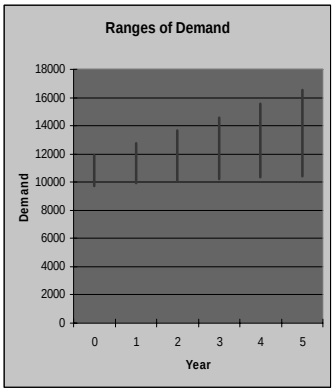
Two-Stage Decision Analysis: Demand Model

- Uniform distribution ranges assumed over system life

	Year					
	0	1	2	3	4	5
Demand	10800	11340	11880	12420	12960	13500
% Unc.	10.0%	12.5%	15.0%	17.5%	20.0%	22.5%
low end	9720	9922.5	10098	10246.5	10368	10462.5
high end	11880	12757.5	13662	14593.5	15552	16537.5



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Two-Stage Decision Analysis: Fixed vs. Flexible Strategies

- Two-Stage refers to years 1 and 2, since first DC is established year 1
- High, Medium, Low demands classified in 25:50:25 ratio over the uniform distributions each year
- 27 demand combinations to consider over 2 years: 9 Fixed, 18 Flexible since Flexible has option to expand in year 2
- Adding small DC increases demand by 7.5%

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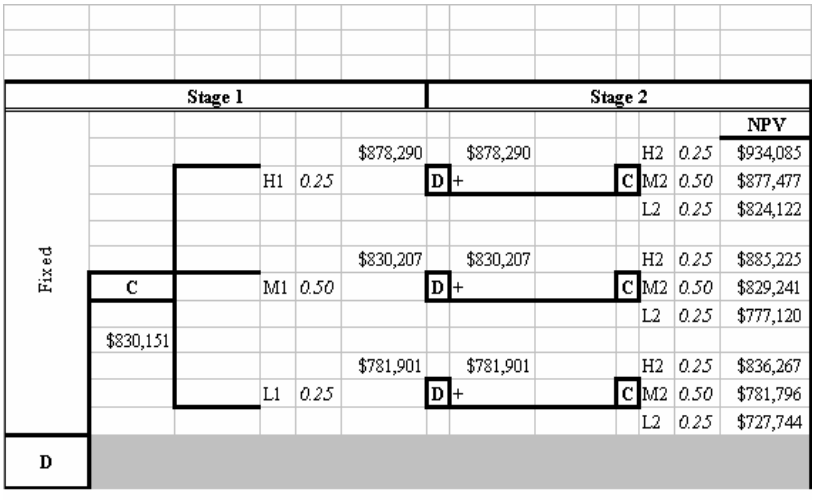
Two-Stage Decision Tree: Fixed Portion



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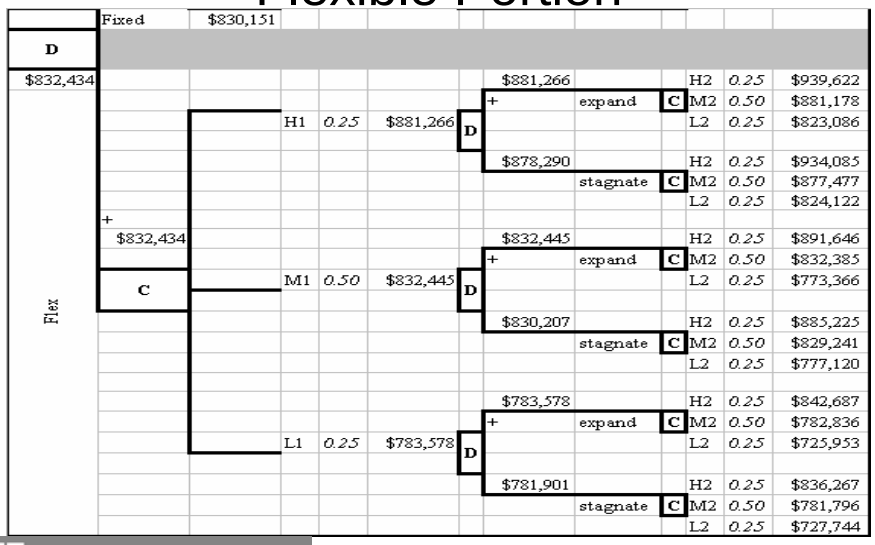
Two-Stage Decision Tree: Flexible Portion



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Two-Stage Analysis Results

- Flexible plan is almost the same as Fixed. Only better by ~.4%
- It was assumed that adding small DC increased random demand by 7.5%
- Value of option very sensitive to this value in this model
- Analysis done over 3 years+ may show better long term effects of option

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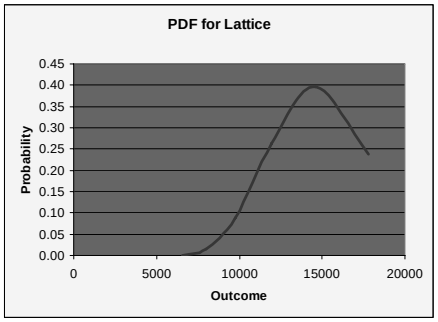
Lattice Model

- Assumes demand increases exponentially year to year
- Lognormal Binomial Distribution for demand over 5 years
- Parameters

  $\sigma = 10\%$

  $\nu = 5\%$

Demand Lattice					
Year 0	1	2	3	4	5
10800	11936	13191	14578	16112	17806
	9772	10800	11936	13191	14578
		8842	9772	10800	11936
			8001	8842	9772
				7239	8001
					6551



Lattice Analysis: Fixed Portion

	NET REVENUE Fixed No Option					
	Year 0	1	2	3	4	5
	$0	$508,728	$572,749	$643,502	$721,697	$808,116
		$398,384	$450,800	$508,728	$572,749	$643,502
			$350,957	$398,384	$450,800	$508,728
				$308,043	$350,957	$398,384
					$269,212	$308,043
						$234,077

	REVENUE Probability Contributions Fixed					
	Year 0	1	2	3	4	5
	$0	$381,546	$322,171	$271,478	$228,349	$191,770
		$99,596	$169,050	$214,620	$241,628	$254,510
			$21,935	$56,023	$95,091	$134,137
				$4,813	$16,451	$35,014
					$1,052	$4,512
						$229
UCF	$0	$481,142	$513,156	$546,933	$582,571	$620,172
Discounted	$0	$429,591	$409,085	$389,296	$370,234	$351,902
E[Rev]	$1,950,109					

Lattice Analysis: Flexible Portion

- Lattice for Flexible Strategy built by comparing at each node what is the best choice given Expected future values

PV Net Revenue: Flexible Strategy					
Year 0	1	2	3	4	5
$1,970,457	$2,335,524	$2,158,187	$1,864,914	$1,426,594	
	$1,821,074	$1,686,806	$1,465,080	$1,126,806	
		$1,313,232	$1,141,816	$881,361	
			$885,546	$686,492	
				$527,740	

Exercise Option? Exercise one time option when yellow					
Year 0	1	2	3	4	5
FALSE	TRUE	TRUE	TRUE	TRUE	
	FALSE	TRUE	TRUE	TRUE	
		FALSE	FALSE	TRUE	
			FALSE	FALSE	
				FALSE	

E[NPV] for Flexible Strate	$1,970,457
E[NPV] for Fixed Strategy	$1,950,109
Value of Option	$20,348

Results of Lattice Analysis

- Flexible strategy is only about 1% better than Fixed Strategy
- As in Two-Stage Analysis, value of option very sensitive to %Demand Increase parameter
- Value of Option increases for higher uncertainty scenarios

% Demand Increase Parameter	Value of Option
2.5%	$0
5.0%	$152
7.5%	$20,348
10.0%	$63,914
12.5%	$108,707
15.0%	$153,500

Option Value	v						
σ	0.0%	2.5%	5.0%	7.5%	10.0%	12.5%	15.0%
5.0%	$1,866	$7,939	$17,465				
10.0%	$5,537	$11,907	$20,348	$30,736	$42,469		
15.0%	$10,147	$16,835	$25,109	$35,030	$46,406	$59,009	$72,771
20.0%	$15,510	$22,646	$31,112	$40,941	$52,296	$64,855	$78,599
25.0%	$21,751	$29,427	$38,282	$48,345	$59,887	$72,658	$86,609
30.0%	$29,033	$37,314	$46,705	$57,244	$69,157	$82,360	$96,742
35.0%	$37,499	$46,481	$56,542	$67,722	$80,216	$94,052	$109,074
40.0%	$47,348	$57,142	$68,007	$79,987	$93,271	$107,929	$123,796
45.0%	$58,825	$69,554	$81,368	$94,315	$108,601	$124,279	$141,203
50.0%	$72,221	$84,031	$96,956	$111,050	$126,567	$143,477	$161,683

Conclusion

- Model assumptions matter
  - Lattice analysis implies significant assumptions, such as demand growing exponentially from year to year
  - Stage analysis is less restrictive since one can use whichever decision rules and distributions that apply specifically to the situation
- Value of Option depends on parameters used in this system
  - % Demand Increase parameter and Volatility change option value
- To extend this model to real life application, the true nature of demand in the Junin province must be ascertained.
- Despite the modeling and application challenges, there exists real possibility to incorporate very valuable options.

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