Demand, Recurring Costs, And Profitability

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“So it is said that if you know your enemies and know yourself, you can win a hundred battles without a single loss. If you only know yourself, but not your opponent, you may win or may lose. If you know neither yourself nor your enemy, you will always endanger yourself.”

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The Art of War by Sun Tzu
Outline

• Fuzzy demand
• Market limits
  • Demand Frontier
  • Market Aggregate Demand
• Price responsiveness & limit enforcement
• Working with the Demand Frontier
Fuzzy Demand
Simply regressing the data will not provide much insight – What will?
Market Limits
Let’s Examine Defense Electronics By Evenly Binning Models By Price

We begin by dividing the models into bins evenly spaced by price; note that the lowermost bin has most of the data.

Market Aggregate Demand, indicated by the red line, is the regressed value of the red points in each bin, the total quantity and weighted average price.

The Demand Frontier is defined by the outermost points in the data, selected as the rightmost and next rightmost points in each bin – this is good but not great.

We will try another technique to see if we can improve results.

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Instead Of Even Binning, Here We Use Bins Based On A Geometric Series

Geometrically based binning provides a more regular pattern to the analysis.

This has improved Market Aggregate Demand correlation, but we’ve made no attempt to improve our Demand Frontier Analysis here.

We will try a third technique to see if we can improve results.

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Now We Will Try Binning Based On the Fibonacci Series

Fibonacci based binning provides an even more regular pattern to the analysis.

In this case, we now have our best Market Aggregate Demand and Demand Frontier correlations and P-values.

**EOIR Frontier & Aggregate Demand**

- For Bin 1:
  - Equation: $y = 8 \times 10^9 x^{-0.989}$
  - $R^2 = 0.9656$

- For Bin 4:
  - Equation: $y = 2 \times 10^9 x^{-0.755}$
  - $R^2 = 0.9721$

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Price Responsiveness & Limit Enforcement
Let’s Consider Market For Fighters, Bombers And Attack Aircraft

Fibonacci based binning again provides a regular pattern to the analysis

The Demand Frontier and Aggregate Demand Curves are well-correlated

<table>
<thead>
<tr>
<th>Curve</th>
<th>Pearson’s²</th>
<th>P-Value</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Frontier</td>
<td>99.7%</td>
<td>6.79E-09</td>
<td>$33.5M</td>
</tr>
<tr>
<td>Aggregate Demand</td>
<td>99.9%</td>
<td>0.07%</td>
<td>$28.7M</td>
</tr>
</tbody>
</table>

What can we do with this analysis?
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First, we might want to know where all of the money goes.

The vast majority of the monies go to the lower-priced models.

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What Does This Mean For Ongoing Models, Such As The F-35A?

US Fighter/Bomber/Attack Demand

Demand Frontier (No Bias) = 11,230,000,000x^{0.733} R^2 = 0.995

F-35A Unit $ (no bias) = $360,300,000Qty^{0.167} R^2 = 80.4%

Inside Demand Frontier

“Program End” Unit 436

Beyond Demand Frontier

US Aircraft Purchases1957-2016

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales Goal</th>
<th>Frontier $</th>
<th>F-35A $</th>
<th>Difference</th>
<th>Std. Devs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>2036</td>
<td>$42,200,000</td>
<td>$100,900,000</td>
<td>$58,700,000</td>
<td>1.8</td>
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<tr>
<td>2016</td>
<td>1763</td>
<td>$46,900,000</td>
<td>$103,400,000</td>
<td>$56,500,000</td>
<td>1.7</td>
</tr>
</tbody>
</table>
What About The B-21?

Demand Frontier (No Bias) = 11,230,000,000x^{-0.733} \quad R^2 = 0.995

- **The USAF wants 100 B-21s at $610M (in 2016$)**
- **The Demand Frontier has 53 units at $610M**
- **The supportable price for 100 units is $384M (2016$)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales Goal</th>
<th>Frontier $</th>
<th>B-21 Target $</th>
<th>Difference</th>
<th>Std. Devs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>100</td>
<td>$384,000,000</td>
<td>$610,000,000</td>
<td>$56,500,000</td>
<td>6.7</td>
</tr>
</tbody>
</table>

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What Does The Demand Frontier Show Us About Unit And Revenue Potential?

Demand Frontier (No Bias) = 11,230,000,000x^{-0.733} R^2 = 0.995

Frontier 10 Units @ $2.08B: $20.8B

Frontier 5000 Units @ $21.8M: $109B

There is more money available for the lower-priced models

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Working with the Demand Frontier
<table>
<thead>
<tr>
<th>Model</th>
<th>$/season/unit</th>
<th>Gallons/drop</th>
<th>Drops/hr from 10</th>
<th>Ave. Age (Years)</th>
<th>2013 Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bae 146</td>
<td>$6,855,000</td>
<td>3,000</td>
<td>3.4</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>P2V</td>
<td>$3,050,000</td>
<td>1,600</td>
<td>3.1</td>
<td>55</td>
<td>6</td>
</tr>
<tr>
<td>P3</td>
<td>$4,134,000</td>
<td>2,550</td>
<td>3.4</td>
<td>45</td>
<td>6</td>
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<tr>
<td>C27J</td>
<td>$5,432,000</td>
<td>2,000</td>
<td>3.4</td>
<td>4</td>
<td>7</td>
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<tr>
<td>C130XJ</td>
<td>$8,078,000</td>
<td>3,000</td>
<td>3.4</td>
<td>0.1</td>
<td>2</td>
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<tr>
<td>DC10</td>
<td>$13,500,000</td>
<td>10,800</td>
<td>3.4</td>
<td>35</td>
<td>2</td>
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<tr>
<td>CV580</td>
<td>$2,725,000</td>
<td>2,000</td>
<td>3.3</td>
<td>60</td>
<td>5</td>
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<tr>
<td>CL215 piston</td>
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<td>1,400</td>
<td>5.1</td>
<td>30</td>
<td>4</td>
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<tr>
<td>CL215 turbine</td>
<td>$5,640,000</td>
<td>1,440</td>
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<td>30</td>
<td>4</td>
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<tr>
<td>CL415</td>
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<td>5.8</td>
<td>10</td>
<td>2</td>
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<tr>
<td>S64</td>
<td>$5,365,000</td>
<td>2,500</td>
<td>2.9</td>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>MD87</td>
<td>$6,831,000</td>
<td>4,000</td>
<td>3.4</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>RJ85</td>
<td>$7,126,000</td>
<td>3,110</td>
<td>3.4</td>
<td>12</td>
<td>4</td>
</tr>
</tbody>
</table>

What supports the prices that these models fetch?

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Firefighting Aircraft Value Is A Function Of Capacity, Speed And Age

~$1.1M/drop/hr  ~$1M to start

~$1000/gallon   ~-$66K age/year

This is well-correlated
A New Plane Enters The Market:
2,500 Gallons, 6.9 Drops/Hr, 0.1 Yrs Old

The dependent variable, USFS annual value, is affected by 3 independent variables, as model features, above:

- Value goes up with gallons/load
- Value goes up with drops/hour
- Value goes down with age

Each new unit is worth $11.1M/yr to the USFS.

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Here Are A Pair Of 3D Views Of USFS Firefighting Aircraft Value

This is the value of a new model

Here's the value of a 40 yr old model

Value goes up for capacity and speed, and falls for poor reliability

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Suppose a supplier sells services to the USFS for less than the going rate.

In this case, this becomes a great deal for the USFS.
What Does The Lower Price Mean To The Supplier?

Clearly, the supplier must know his value, demand and cost

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The 3D Value Space and 2D Demand Plane Join to Form 4D Markets

Dual States

Valued Feature 1

Valued Feature 2

Currency

Ordered quads

DC10: Gallons = 10,800; Drops Hr = 3.4; 2016 Qty = 2; Adjusted Tot = 13,500,000

All markets operate in this manner.

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• Demand appears fuzzy but may be characterized by
  • Demand Frontiers
  • Market Aggregate Demands
• Markets limit sales about their Demand Frontiers according to their slope and standard deviations
  • Broad variations to the Demand Frontiers are rare
  • Estimators, program managers and engineers should take these limits into account as they begin programs
• It is possible to plan in advance to
  • Maximize capacity (as for a service branch)
  • Maximize profits (as for a for-profit company)
Removing B-2 From The Set Still Produces A Highly Significant Curve

Removing the B-2 from the analysis leaves the B-21 as an extrapolation.

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