Estimating Owning & Operating Costs
Estimating Equipment Costs

1. Equipment Costs
2. Annual Cost Model
3. Cumulative Cost Model
4. NCDOT Models

The take home…
1. Equipment Costs
1. Equipment Costs

Operating Costs

- Rate ($/hr) increases with age due to increasing frequency & magnitude of repairs.
- Also a “fixed” rate component for fuel, PMs, and wear parts.
- Timing and size of repairs are the real unknowns.
2. Annual Cost Model

Owning Costs

- Sum of Years Digits to estimate machine value
- Depreciation term and ultimate value from:
  - Current NCDOT depreciation schedule
  - Construction Equipment Ownership and Operating Expense Schedule by US Corps of Engineers

Class 0201 – Truck, Pickup 5000 GVW

  Term: 5 years
  Salvage Value: 20% of purchase price
2. Annual Cost Model

Operating Costs

• Estimated cost and use in each year of life
• Snapshot of the fleet in a year (2011)

\[ y = 0.2462e^{0.0373x} \]
\[ R^2 = 0.1228 \]

\[ y = -697.07x + 17653 \]
\[ R^2 = 0.064 \]
2. Annual Cost Model

Observations

1. Operating cost ($/mi) highly variable
   - Snapshot of a trend longer than 1 year
   - Investment periods – high cost and low use
   - Honeymoon periods – reaping benefits of previous investments

2. Data included all possible variations
   - All makes/models, applications, and operator skills
   - Some older machines no longer produced/purchased
   - May not accurately reflect expected future
3. Cumulative Cost Model

- Track machine age in miles or hours, rather than years
- Tangent point defines economic life (lowest rate)
- Cost growth largely comes from increasing operating costs
3. Cumulative Cost Model

**Mitchell Curve**

*LTD Repair Cost = A*Age² + B*Age*

- For similar machines – type, size, and application
- Must have LTD cost and use (age) data
- Best to have:
  - Machines of varying ages
  - Some machines at or beyond economic life

\[ y = 0.0011x^2 + 0.9613x \]

\[ R^2 = 0.9382 \]
4. NCDOT Models

Equipment classes, model years 2003-08:

- 0201 Pickup trucks
- 0205 Dump trucks, 35k GVW
- 0314 Backhoes
- 0900 Motor graders

Cumulative Cost Index – Operating cost as a percentage of purchase price

\[ CCI = \frac{\text{LTD Oper Cost [2012$]}}{\text{Purchase Price [2012$]}} \]
4. NCDOT Models

9,200 data points for 1,300 pickups (class 0201)

\[ y = -9.61 \times 10^{-12} x^2 + 1.18 \times 10^{-5} x \]

\[ R^2 = 0.875 \]
4. NCDOT Models

2003 Model Pickups

Low miles → High A values

Machine Age (mi) vs. Cumulative Cost Index
4. NCDOT Models

Average A value of top quartile machines by age
4. NCDOT Models

\[ y = 2.03 \times 10^{-11} x^2 + 8.34 \times 10^{-6} x \]
## 4. NCDOT Models

### Class 0201 Pickup Trucks

Note: Based on 8,600 miles per year; $23,000 purchase price; and 80 percent depreciation over 5 years

<table>
<thead>
<tr>
<th>Year</th>
<th>Age (mi)</th>
<th>Annual Depreciation Charge</th>
<th>End of Year Machine Value</th>
<th>Life to Date Owning Rate ($/mi)</th>
<th>Annual Operating Cost</th>
<th>Life to Date Operating Cost</th>
<th>Life to Date Operating Rate ($/mi)</th>
<th>Life to Date Total Rate ($/mi)</th>
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</table>
4. NCDOT Models

[Graph showing the relationship between average LTD Total Rate ($/mile) and Machine Age (miles).]
4. NCDOT Models

## Comparison of Results

<table>
<thead>
<tr>
<th>Equipment Class</th>
<th>Annual Cost Models</th>
<th>Cumulative Cost Models</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Econ. Life</td>
<td>Total Rate</td>
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<tr>
<td>0201 Pickups</td>
<td>186,379 mi</td>
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<td>0205 35k GVW Dumps</td>
<td>113,525 mi</td>
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<td>0314 Backhoes</td>
<td>5,197 hrs</td>
<td>$34.33</td>
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<tr>
<td>0900 Motor graders</td>
<td>6,568 hrs</td>
<td>$52.20</td>
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</tbody>
</table>
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The take home…
1. Equipment Costs

**Owning Costs**
Rate ($/hr) decreases with age as hours are accumulated over which to spread the loss in value

**Operating Costs**
Rate ($/hr) increases with age due to increasing frequency & magnitude of repairs
2. Annual Cost Model

- Estimated cost and use in each year of life
- Snapshot of the fleet in a year (2011)
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2003 Model Pickups

![Graph showing Cumulative Cost Index vs Machine Age (mi)]

- Low miles ➔ High A values
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Average A value of top quartile machines by age
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