Roads and Water Quality in Vermont: A Statistical Analysis

Maya Thomas
University of Vermont ‘11
Developing The Research Question

- Previous research: rural, forested roads and sedimentation in streams
- Vermont context
- More water quality variables, like *E. Coli* and phosphorus
- How to quantify roads?
The Plan

- **Road metrics (independent variable)**
  - Road length
  - Gravel road length
  - Crossings between roads and streams

- **Water quality (dependent variable)**
  - Total phosphorus
  - Total suspended solids (TSS)
  - *E. Coli*
Generating Road Metrics

Elmore Branch
Generating Road Metrics (cont.)

- Road/Gravel road length
  - Spatial join
- Road/stream crossings
  - Intersect
The Analysis
Preliminary Findings

- All three road metrics were positively correlated
- TSS and total phosphorus were correlated
- Gravel roads were negatively correlated with water quality

<table>
<thead>
<tr>
<th></th>
<th>Road Length</th>
<th>Gravel Road Length</th>
<th>Road/Stream Crossings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Length</td>
<td>1</td>
<td>0.54</td>
<td>0.906</td>
</tr>
<tr>
<td>Gravel Road Length</td>
<td>1</td>
<td>1</td>
<td>0.68</td>
</tr>
<tr>
<td>Road/Stream Crossings</td>
<td>1</td>
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<td>1</td>
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</table>
Principle Component Analysis

- Removes the correlation between the different road metrics
- Replaces the original road metrics values with independent values
- Log transformation
Phosphorus

Multiple $R^2 = 0.237$

<table>
<thead>
<tr>
<th>Component 1</th>
</tr>
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<tbody>
<tr>
<td>Road Length</td>
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<td>Gravel Road Length</td>
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<tr>
<td>Road/Stream Crossings</td>
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</tbody>
</table>

Phosphorus (μg/L) vs. PC 1

Graph showing the relationship between Phosphorus (μg/L) and PC 1.
### Component 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Log (E. Coli) (MPN)</th>
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<tbody>
<tr>
<td>Road Length</td>
<td>0.779</td>
</tr>
<tr>
<td>Gravel Road Length</td>
<td>-0.374</td>
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<tr>
<td>Road/Stream Crossings</td>
<td>0.504</td>
</tr>
</tbody>
</table>

**Graph**

- **PC 2**
- **Multiple R² = 0.243**
Conclusions

• Phosphorus is negatively correlated with gravel road length
• Log $E. \text{Coli}$ is positively correlated with road length
• These findings seem to be indicative of human development
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- Evelyn Boardman

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Thank You

Questions?