Finding Poverty in Satellite Images

Motivation

- Lack of reliable poverty data in developing countries poses a major challenge for making informed policy decisions
- Comprehensive surveys are often prohibitively expensive – a cheap, scalable method of producing detailed poverty maps would greatly facilitate economic progress [1]

High-Level Overview

- **Goal:** Accurately predict poverty levels through consumption-based wealth measures and asset-based wealth measures using satellite images

Daytime Satellite Imagery

![Daytime Satellite Imagery](image)

Convolutional Neural Network

Low-dimensional Feature Representation

Continuous Wealth Measures

![Figure 1](image)

Predicting Consumption

- The Living Standards Measurement Study collects consumption expenditure data at the household level
- Consumption is often a better indicator of well-being among the poor than income [2]

![Cross-Border Model Generalization](image)

<table>
<thead>
<tr>
<th>Features</th>
<th>Survey</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training $r^2$</td>
<td>0.407</td>
<td>1.000</td>
</tr>
<tr>
<td>Test $r^2$</td>
<td>0.327</td>
<td>-1.007</td>
</tr>
</tbody>
</table>

Table 1. Linear regression models predicting consumption expenditures in Tanzania

Predicting Assets

- The Demographic and Health Surveys (DHS) record asset-based wealth measures in developing countries

![Predicting Asset-Based Wealth](image)

<table>
<thead>
<tr>
<th>OLS</th>
<th>Lasso (L1)</th>
<th>Ridge (L2)</th>
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</thead>
<tbody>
<tr>
<td>Training $r^2$</td>
<td>0.978</td>
<td>0.676</td>
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<tr>
<td>Test $r^2$</td>
<td>0.653</td>
<td>0.634</td>
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</tbody>
</table>

Table 3. Combined vs. separate urban and rural regression models

**Conclusion**

- Our predictions for consumption expenditures approach survey accuracy; our predictions for asset-based wealth measures improved upon recent state-of-the-art results
- Poverty estimation techniques based on remote sensing and machine learning can be applied on a global scale at a fraction of the cost of traditional survey-based methods

References


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