Using Satellite Data to Guide Urban Poverty Reduction

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Summary

- Motivation:
  - Lack of data on within-city distribution of poverty in Mozambique
- Method:
  - Apply Convolutional Neural Networks (CNN) on high-resolution satellite images and combines their outputs with household level geo-referenced survey data
  - Interesting application of remote sensing image recognition for urban poverty reduction
- Central Question:
  - Is this method a viable alternative to data collection by surveys?
    - Accuracy of predicting poverty
    - Cost Efficiency
    - Time Efficiency
    - Capability

Method

- A **Convolutional Neural Network (CNN)** is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other.
- CNN is able to successfully capture the Spatial and Temporal dependencies in an image through the application of relevant filters.
- The architecture performs a better fitting to the image dataset due to the reduction in the number of parameters involved and reusability of weights.
- In other words, the network can be trained to understand the sophistication of the image better.

- Reference: A Comprehensive Guide to Convolutional Neural Networks — the ELI5 way (2018)

Comments on Application

- Households are eligible to join a social safety net program based on a number of observable characteristics that result in a poverty score.
- Households with a poverty score below a certain threshold are eligible to participate in the program.

- What are the observable characteristics used to calculate the poverty score?
- How many of these characteristics observed/deduced by using CNN to satellite imagery?
- What about poverty which is not based on observable characteristics?

Comments on Application

- Poverty score predictions based on geospatial data (method 2) are notably more accurate than those based on image recognition only (out-of-sample r square of 0.58 compared to 0.38).
- Important variables for predictions:
  - city variable for Maputo
  - distance to city center
  - share of high-quality roofs
- Less important variables
  - road data is less prominent
- Why are these variables important? What is their relation to poverty scores? What variables are not included?

Comments on Method

- What is the extent of measurement error?
- Any kind of confidence intervals around poverty scores?
- What about privacy concerns with high-efficiency imaging?
  - "*An image of the location for each household was downloaded using Google Maps API in November, 2018. Images for training and predictions are from Google Maps and were accessed for free for non-commercial use, according to Google's "Fair use" agreement*."
- How does this method compare with night lights imaging?
- Any thoughts on replacing satellite images by images from drones?