Combining Satellite Imagery and Machine Learning to Predict Poverty

Neal Jean, Michael Xie, Stefano Ermon
{nealjean, xie, ermon}@stanford.edu

Motivation
- Global poverty line: $1.90/person/day
- Almost 1 billion people live in abject poverty
- Lack of reliable data in developing countries poses a major challenge for making informed policy decisions

Goal
- Accurately and scalably predict poverty and wealth measures from daytime satellite images, using only publicly available data

Inputs: Daytime satellite imagery

Transfer learning approach
- Standard supervised learning won’t work—there isn’t enough ground truth poverty data
- **Key idea**: Use nighttime light intensity as a proxy for economic development

High-level overview
- **Goal**: Train a convolutional neural network (CNN) to extract image features relevant to nighttime lights
- A subset of these features are also useful for predicting economic well-being

Results
- **Task**: Predict consumption expenditures and asset wealth in 5 African countries

- Asset-based wealth predictions for (a) Nigeria and (b) Tanzania
- Cross-border generalization for (a) expenditure and (b) asset models

- Accuracy compares favorably with recent study in *Science* that uses mobile phone data to predict poverty
- Models generalize well across borders, suggesting that satellite imagery reveals shared features of poverty

References