

Night Time Light & Population

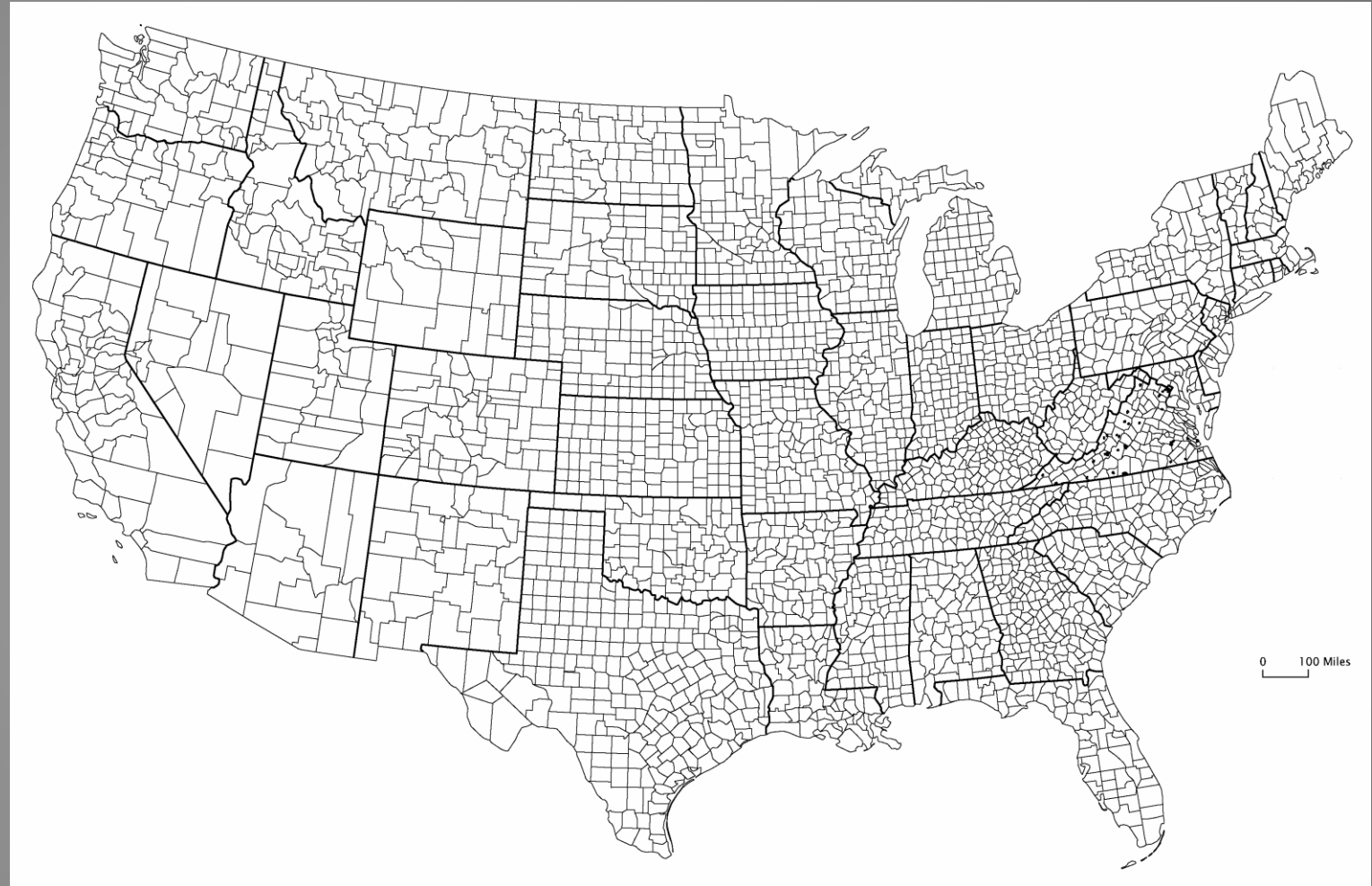


[1]

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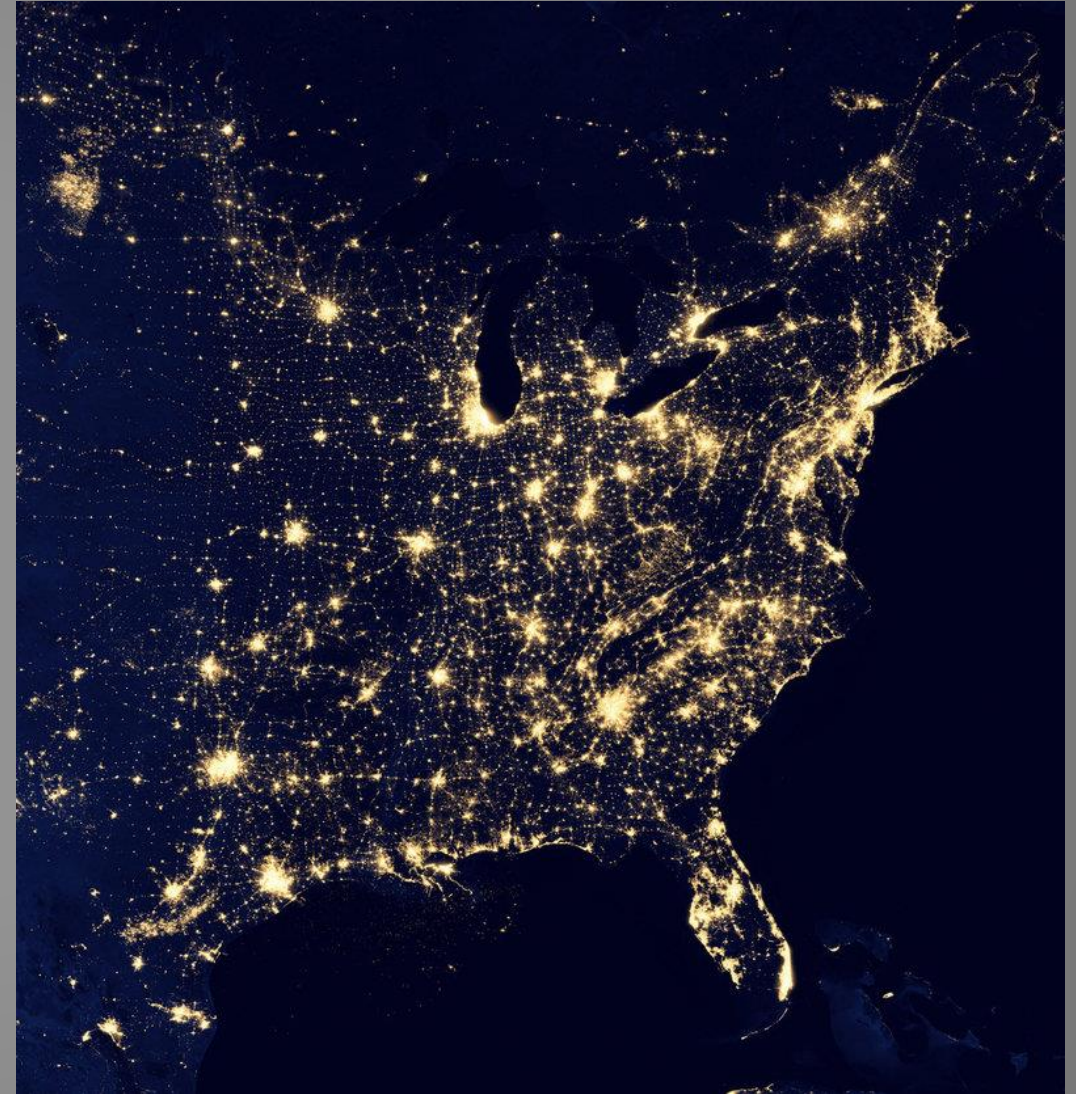


Project intent

The intent of this project is to measure how accurately night time light (NTL) can be used to assess population across a large scale.

Research Questions

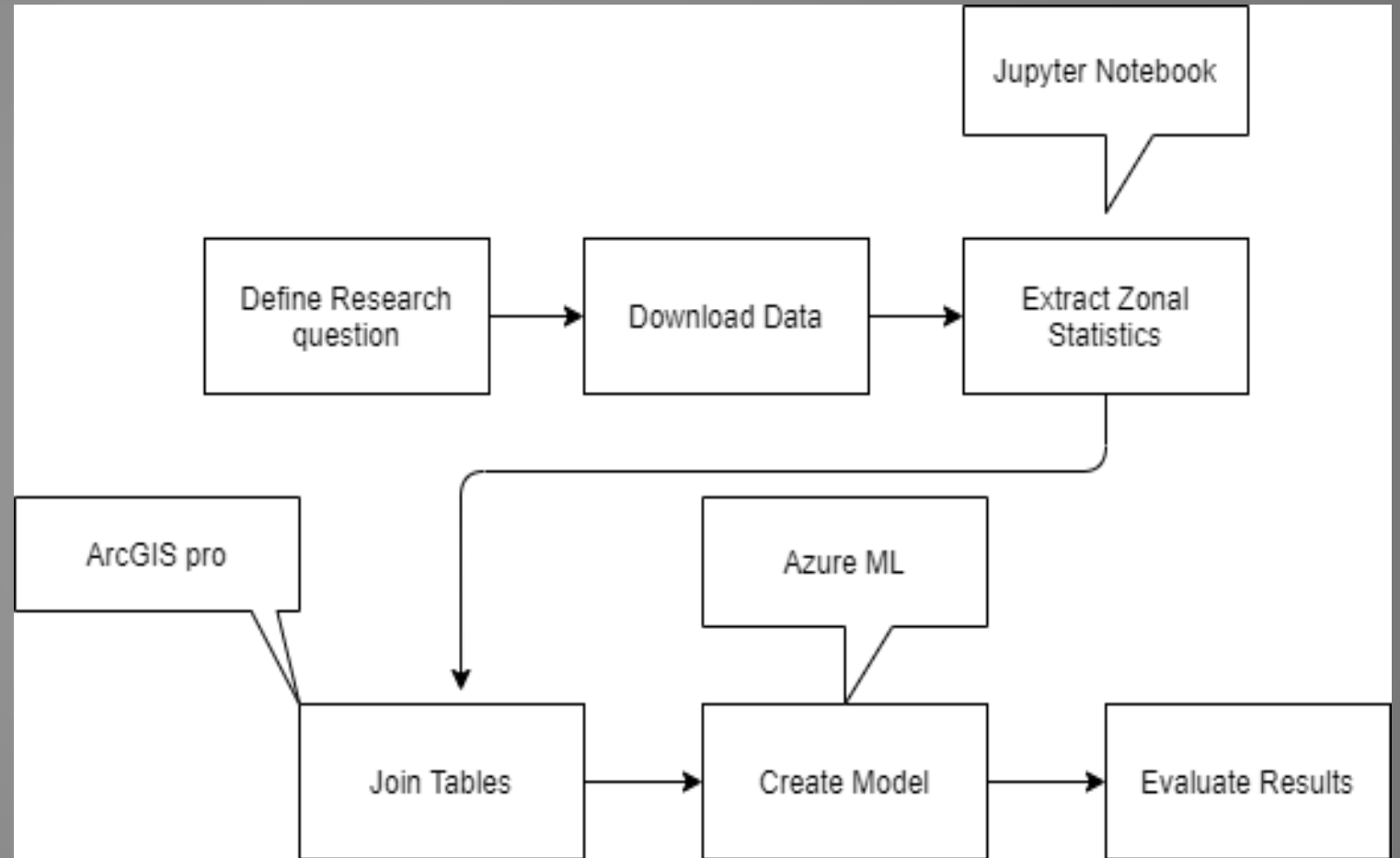
- Can night time light data be used to predict population at the county level?
- Does the linear regression method produce more accurate results than the Decision Forest method when assessing population using night time light data?



Work flow start to finish

Three programs are used to produce the results needed to answer the question.

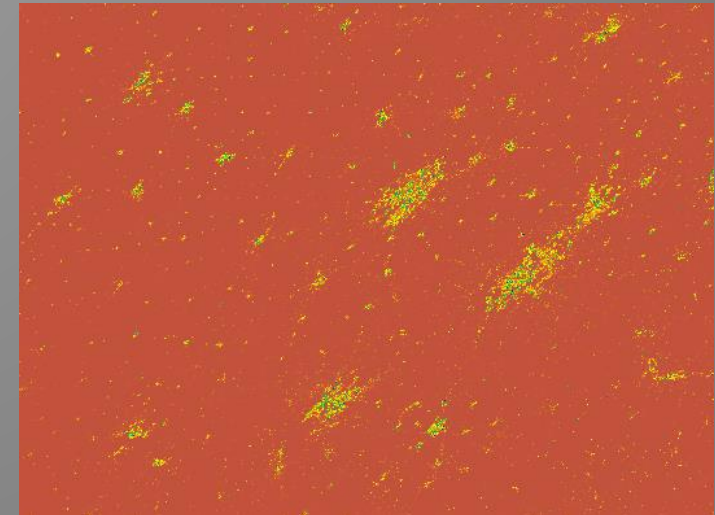
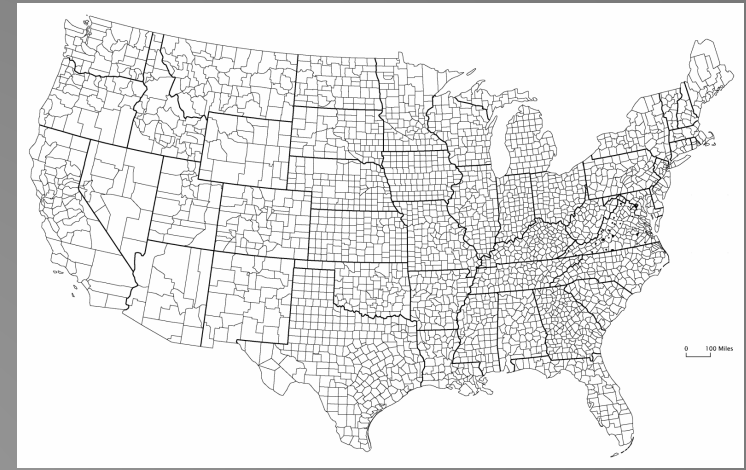
- Jupyter Notebook
- ArcGIS pro
- Azure ML



Data Acquisition

Three Datasets were utilized

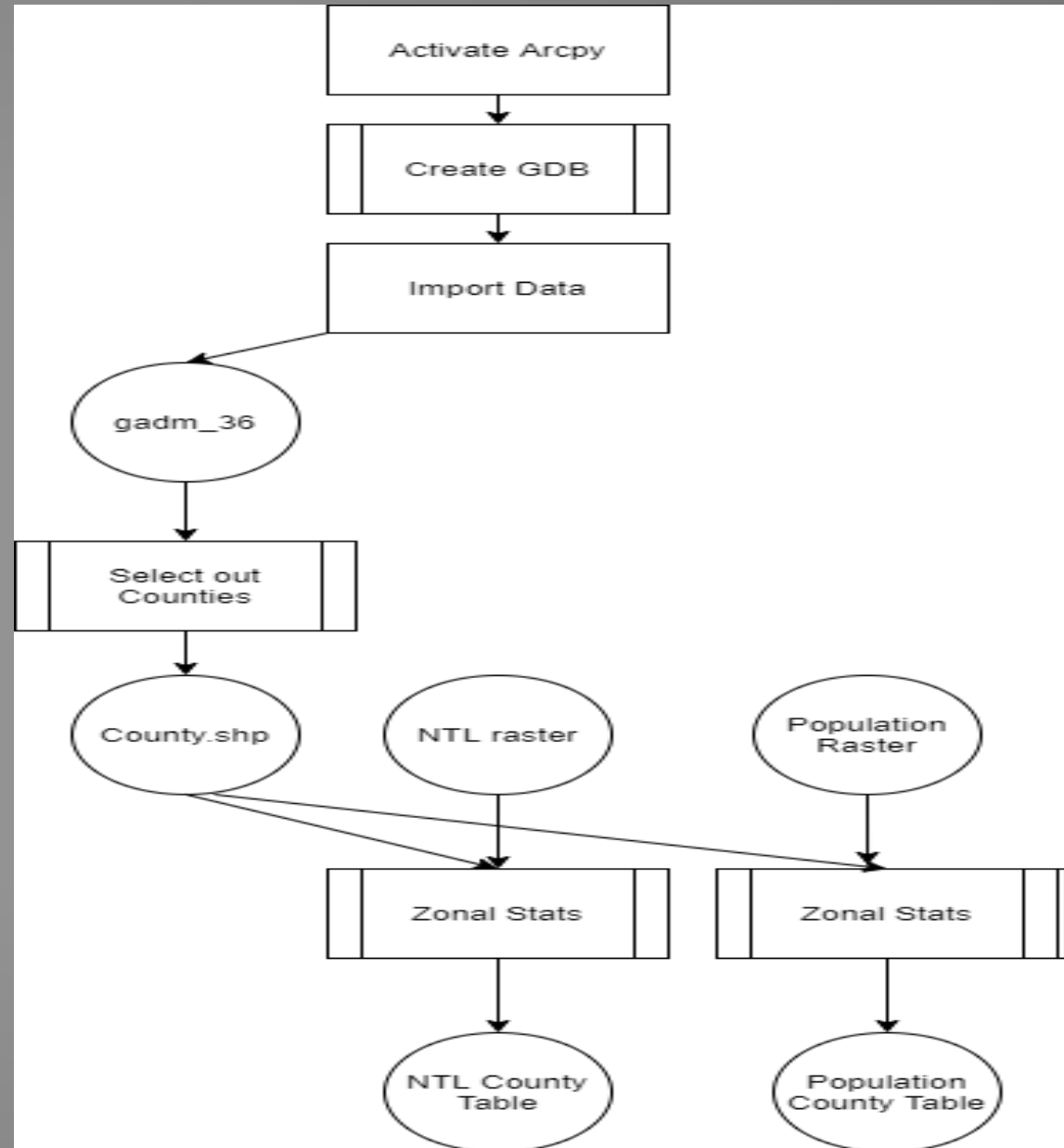
- Boundaries data
 - University of California Davis
 - Contained global boundary data at different scales
 - County level for the USA was used
- Night time light data
 - NOAA
 - Contained raster data with global coverage
 - Used to Calculate NTL Zonal Stats with boundaries.
- Population data
 - Global Human Settlement Layer
 - Contained Raster data with global coverage
 - Used to calculate Population Zonal Stats using boundaries.



Data pre processing

Data Processing Steps

- Create GDB
- Select county
- Calculate zonal statistics
 - NTL & county
 - Population & county
- Join Tables (performed in ArcGIS pro)



Machine Learning analysis

Key Step inputs

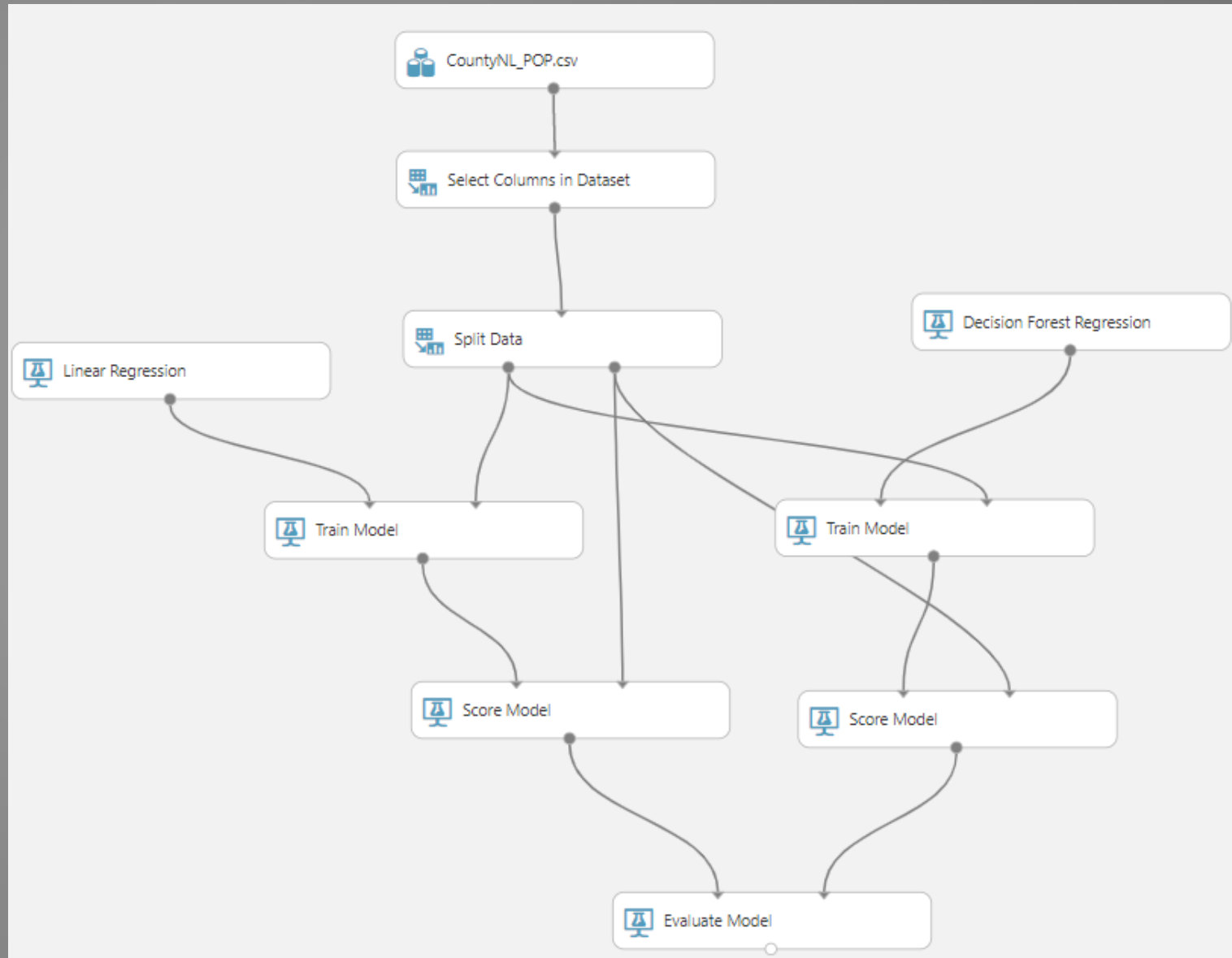
Columns selection:
AreaNL, MeanNL,
SumNL, SumPop

Data Split: 70:30

Training Model

Selection: SumPop

- Linear Regression
- Decision Forest Regression
8 trees



Results

- Yes, we are able to use Night time light data to predict Population over an area.
- The Coefficient of determination was higher with the Decision Forest Regression method over the Linear regression method which suggest the decision forest is a better method to utilize when modeling Night time light to predict Population.

rows	columns
2	6
	<div>Negative Log Likelihood</div> <div>Mean Absolute Error</div> <div>Root Mean Squared Error</div> <div>Relative Absolute Error</div> <div>Relative Squared Error</div> <div>Coefficient of Determination</div>
view as	
<div><div></div><div></div></div>	<div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div>
	<div>Infinity</div> <div>7824.833009</div> <div>113737.053973</div> <div>77070.315364</div> <div>248978.919629</div> <div>224417.512971</div> <div>0.559856</div> <div>0.379369</div> <div>0.361166</div> <div>0.293424</div> <div>0.638834</div> <div>0.706576</div>

Discussion: Issues during analysis & refinement

Issues Faced

- Exporting table to CSV from Jupyter using python.
 - Solution: Utilized Arc Pro to join and Export data as CSV.
 - Result: data was formatted for Azure
-
- Azure modeling, first run had Multicollinearity with input variables.
 - Solution: reduce the number of variables so variables are not too closely related.
 - Result: model becomes more reliable by increasing precision but sacrifices accuracy.

Refining the Project

Predicting population with Night time light data is logical, very rarely is infrastructure built in an area without habitation.

If I were to reproduce this project I would incorporate economic productivity into the analysis to better understand the relationship between NTL and Economic activity.

Is night time lighting useful for predicting economic productivity for an area?

GitHub Link

https://github.com/CarK3/NTL_K.Car/blob/master/Azurelink

Presentation Image Source:

- [1] <https://www.newscientist.com/gallery/mg20327215-nighttime-photos/>
- [2] <https://external-preview.redd.it/q0nNoWgi-WrSUvKGuaFAbt9IGoFbThlVUYhyioQtrgs.png?auto=webp&s=7b6a8f9f0e7271748ebda5303780cc18a3114b7c>
- [3] <https://www.npr.org/sections/krulwich/2013/01/16/169511949/a-mysterious-patch-of-light-shows-up-in-the-north-dakota-dark>