

CBRE Datathon – E.S.G.

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Background:

It is natural to be concerned that flooding will be inundating our cities as global sea levels continue to rise as the Arctic and Antarctic regions continue to melt. As cities take on water there are going to be people with the means to move themselves out of harm's way but there are going to be others who lack the means to get out of harm's way and may require the coordination of Local, State and Federal officials, developers and landlords (stakeholders) to help rehome displaced people. There are excellent resources available for data that might allow you to advise the stakeholders and steer policy to help those that most need it.

Source 1: Census data: the US census (census.gov) has a ton of variables at the census tract and block group level that can be used to identify areas where the income level is low or high.

Income:

Column Name	Label
GEO_ID	geography
NAME	geographic_area_name
S1903_C01_015E	families_number
S1903_C01_015M	families_number_moe
S1903_C02_015E	families_percent_distribution
S1903_C02_015M	families_percent_distribution_moe
S1903_C03_015E	families_median_income
S1903_C03_015M	families_median_income_moe

Housing:

Column Name	Label
GEO_ID	geography
NAME	geographic_area_name
DP04_0001E	total_housing_units
DP04_0001M	total_housing_units_moe
DP04_0002E	occupied_housing_units
DP04_0002M	occupied_housing_units_moe
DP04_0003E	vacant_housing_units
DP04_0003M	vacant_housing_units_moe
DP04_0004E	homeowner_vacancy_rate
DP04_0004M	homeowner_vacancy_rate_moe
DP04_0005E	rental_vacancy_rate

DP04_0005M	rental_vacancy_rate_moe
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Financial:

Column Name	Label
GEO_ID	geography
NAME	geographic_area_name
S2503_C01_001E	occupied_housing_units
S2503_C01_001M	occupied_housing_units_moe
S2503_C01_024E	median_monthly_costs_occupied_units
S2503_C01_024M	median_monthly_costs_occupied_units_moe
S2503_C02_001E	occupied_units_percentage
S2503_C02_001M	occupied_units_percentage_moe
S2503_C03_001E	owner_occupied_units
S2503_C03_001M	owner_occupied_units_moe
S2503_C03_024E	median_monthly_costs_owner_occupied
S2503_C03_024M	median_monthly_costs_owner_occupied_moe
S2503_C04_001E	owner_occupied_units_percentage
S2503_C04_001M	owner_occupied_units_percentage_moe
S2503_C04_024E	median_monthly_costs_owner_percentage
S2503_C04_024M	median_monthly_costs_owner_percentage_moe
S2503_C05_001E	renter_occupied_units
S2503_C05_001M	renter_occupied_units_moe
S2503_C05_023E	no_cash_rent_renter_units
S2503_C05_023M	no_cash_rent_renter_units_moe
S2503_C05_024E	median_monthly_costs_renter_units
S2503_C05_024M	median_monthly_costs_renter_units_moe
S2503_C06_001E	renter_occupied_units_percentage
S2503_C06_001M	renter_occupied_units_percentage_moe
S2503_C06_024E	median_monthly_costs_renter_percentage
S2503_C06_024M	median_monthly_costs_renter_percentage_moe

Poverty:

Column Name	Label
GEO_ID	geography
NAME	geographic_area_name
S1702_C01_001E	all_families
S1702_C01_001M	all_families_moe
S1702_C01_017E	householder_65_and_over
S1702_C01_017M	householder_65_and_over_moe
S1702_C01_018E	families_received_ssi_or_public_assistance
S1702_C01_018M	families_received_ssi_or_public_assistance_moe
S1702_C01_019E	families_received_social_security
S1702_C01_019M	families_received_social_security_moe
S1702_C01_032E	family_2_people
S1702_C01_032M	family_2_people_moe
S1702_C01_033E	family_3_or_4_people
S1702_C01_033M	family_3_or_4_people_moe
S1702_C01_034E	family_5_or_6_people
S1702_C01_034M	family_5_or_6_people_moe
S1702_C01_035E	family_7_or_more_people
S1702_C01_035M	family_7_or_more_people_moe
S1702_C01_041E	owner_occupied
S1702_C01_041M	owner_occupied_moe
S1702_C01_042E	renter_occupied
S1702_C01_042M	renter_occupied_moe
S1702_C02_001E	percent_below_poverty_level
S1702_C02_001M	percent_below_poverty_level_moe
S1702_C02_041E	percent_below_poverty_level_owner_occupied
S1702_C02_041M	percent_below_poverty_level_owner_occupied_moe
S1702_C02_042E	percent_below_poverty_level_renter_occupied
S1702_C02_042M	percent_below_poverty_level_renter_occupied_moe

Source 2: FEMA – Federal Emergency Management Agency – produces maps that track a handful of natural disasters including coastal and fluvial (river) flooding. These data include fields that score the susceptibility to natural disaster as well as a value for each census tract.

Field Name	Field Alias	Relevant Layer	Metric Type
OBJECTID	OBJECTID	n/a	n/a
Shape	Shape	n/a	n/a
Shape_Length	Shape_Length	n/a	n/a
Shape_Area	Shape_Area	n/a	n/a
STATE	State Name	All	n/a
STATEABBRV	State Name Abbreviation	All	n/a
STATEFIPS	State FIPS Code	All	n/a
COUNTY	County Name	All	n/a
COUNTYTYPE	County Type	All	n/a
COUNTYFIPS	County FIPS Code	All	n/a
STCOFIPS	State-County FIPS Code	All	n/a
TRACT	Census Tract	All	n/a
TRACTFIPS	Census Tract FIPS Code	All	n/a
NRI_ID	National Risk Index ID	All	n/a
POPULATION	Population (2020)	All	n/a
BUILDVALUE	Building Value (\$)	All	n/a
AGRIVALUE	Agriculture Value (\$)	All	n/a
AREA	Area (sq mi)	All	n/a
RISK_VALUE	National Risk Index - Value - Composite	National Risk Index	Value

RISK_SCORE	National Risk Index - Score - Composite	National Risk Index	Score
RISK_RATNG	National Risk Index - Rating - Composite	National Risk Index	Rating
RISK_SPCTL	National Risk Index - State Percentile - Composite	National Risk Index	State Percentile
EAL_SCORE	Expected Annual Loss - Score - Composite	Expected Annual Loss	Score
EAL_RATNG	Expected Annual Loss - Rating - Composite	Expected Annual Loss	Rating
EAL_SPCTL	Expected Annual Loss - State Percentile - Composite	Expected Annual Loss	State Percentile
EAL_VALT	Expected Annual Loss - Total - Composite	Expected Annual Loss	Value
EAL_VALB	Expected Annual Loss - Building Value - Composite	Expected Annual Loss	Value
EAL_VALP	Expected Annual Loss - Population - Composite	Expected Annual Loss	Value
EAL_VALPE	Expected Annual Loss - Population Equivalence - Composite	Expected Annual Loss	Value
EAL_VALA	Expected Annual Loss - Agriculture Value - Composite	Expected Annual Loss	Value
ALR_VALB	Expected Annual Loss Rate - Building - Composite	Expected Annual Loss Rate	Value
ALR_VALP	Expected Annual Loss Rate - Population - Composite	Expected Annual Loss Rate	Value
ALR_VALA	Expected Annual Loss Rate - Agriculture - Composite	Expected Annual Loss Rate	Value
ALR_NPCTL	Expected Annual Loss Rate - National Percentile - Composite	Expected Annual Loss Rate	National Percentile
ALR_VRA_NPCTL	Social Vulnerability and Community Resilience Adjusted Expected Annual Loss Rate - National Percentile - Composite	Social Vulnerability and Community Resilience Adjusted Expected Annual Loss Rate	National Percentile
SOVI_SCORE	Social Vulnerability - Score	Social Vulnerability	Score
SOVI_RATNG	Social Vulnerability - Rating	Social Vulnerability	Rating

SOVI_SPCTL	Social Vulnerability - State Percentile	Social Vulnerability	State Percentile
RESL_SCORE	Community Resilience - Score	Community Resilience	Score
RESL_RATNG	Community Resilience - Rating	Community Resilience	Rating
RESL_SPCTL	Community Resilience - State Percentile	Community Resilience	State Percentile
RESL_VALUE	Community Resilience - Value	Community Resilience	Value
CRF_VALUE	Community Risk Factor - Value	Community Risk Factor	Value
CFLD_EVNTS	Coastal Flooding - Number of Events	Coastal Flooding	Number of Events
CFLD_AFREQ	Coastal Flooding - Annualized Frequency	Coastal Flooding	Annualized Frequency
CFLD_EXPB	Coastal Flooding - Exposure - Building Value	Coastal Flooding	Exposure - Building Value
CFLD_EXPP	Coastal Flooding - Exposure - Population	Coastal Flooding	Exposure - Population
CFLD_EXPPE	Coastal Flooding - Exposure - Population Equivalence	Coastal Flooding	Exposure - Population Equivalence
CFLD_EXPT	Coastal Flooding - Exposure - Total	Coastal Flooding	Exposure - Total
CFLD_EXP_AREA	Coastal Flooding - Exposure - Impacted Area (sq mi)	Coastal Flooding	Exposure - Area
CFLD_HLRB	Coastal Flooding - Historic Loss Ratio - Buildings	Coastal Flooding	Historic Loss Ratio - Buildings
CFLD_HLRP	Coastal Flooding - Historic Loss Ratio - Population	Coastal Flooding	Historic Loss Ratio - Population
CFLD_HLRR	Coastal Flooding - Historic Loss Ratio - Total Rating	Coastal Flooding	Historic Loss Ratio - Total Rating
CFLD_EALB	Coastal Flooding - Expected Annual Loss - Building Value	Coastal Flooding	Expected Annual Loss - Building Value
CFLD_EALP	Coastal Flooding - Expected Annual Loss - Population	Coastal Flooding	Expected Annual Loss - Population
CFLD_EALPE	Coastal Flooding - Expected Annual Loss - Population Equivalence	Coastal Flooding	Expected Annual Loss - Population Equivalence

CFLD_EALT	Coastal Flooding - Expected Annual Loss - Total	Coastal Flooding	Expected Annual Loss - Total
CFLD_EALS	Coastal Flooding - Expected Annual Loss Score	Coastal Flooding	Expected Annual Loss Score
CFLD_EALR	Coastal Flooding - Expected Annual Loss Rating	Coastal Flooding	Expected Annual Loss Rating
CFLD_ALRB	Coastal Flooding - Expected Annual Loss Rate - Building	Coastal Flooding	Expected Annual Loss Rate - Building
CFLD_ALRP	Coastal Flooding - Expected Annual Loss Rate - Population	Coastal Flooding	Expected Annual Loss Rate - Population
CFLD_ALR_NPCTL	Coastal Flooding - Expected Annual Loss Rate - National Percentile	Coastal Flooding	National Percentile
CFLD_RISKV	Coastal Flooding - Hazard Type Risk Index Value	Coastal Flooding	Hazard Type Risk Index Value
CFLD_RISKS	Coastal Flooding - Hazard Type Risk Index Score	Coastal Flooding	Hazard Type Risk Index Score
CFLD_RISKR	Coastal Flooding - Hazard Type Risk Index Rating	Coastal Flooding	Hazard Type Risk Index Rating
HRCN_EVNTS	Hurricane - Number of Events	Hurricane	Number of Events
HRCN_AFREQ	Hurricane - Annualized Frequency	Hurricane	Annualized Frequency
HRCN_EXPB	Hurricane - Exposure - Building Value	Hurricane	Exposure - Building Value
HRCN_EXPP	Hurricane - Exposure - Population	Hurricane	Exposure - Population
HRCN_EXPPE	Hurricane - Exposure - Population Equivalence	Hurricane	Exposure - Population Equivalence
HRCN_EXPA	Hurricane - Exposure - Agriculture Value	Hurricane	Exposure - Agriculture Value
HRCN_EXPT	Hurricane - Exposure - Total	Hurricane	Exposure - Total
HRCN_EXP_AREA	Hurricane - Exposure - Impacted Area (sq mi)	Hurricane	Exposure - Area
HRCN_HLRB	Hurricane - Historic Loss Ratio - Buildings	Hurricane	Historic Loss Ratio - Buildings
HRCN_HLRP	Hurricane - Historic Loss Ratio - Population	Hurricane	Historic Loss Ratio - Population

HRCN_HLRA	Hurricane - Historic Loss Ratio - Agriculture	Hurricane	Historic Loss Ratio - Agriculture
HRCN_HLRR	Hurricane - Historic Loss Ratio - Total Rating	Hurricane	Historic Loss Ratio - Total Rating
HRCN_EALB	Hurricane - Expected Annual Loss - Building Value	Hurricane	Expected Annual Loss - Building Value
HRCN_EALP	Hurricane - Expected Annual Loss - Population	Hurricane	Expected Annual Loss - Population
HRCN_EALPE	Hurricane - Expected Annual Loss - Population Equivalence	Hurricane	Expected Annual Loss - Population Equivalence
HRCN_EALA	Hurricane - Expected Annual Loss - Agriculture Value	Hurricane	Expected Annual Loss - Agriculture Value
HRCN_EALT	Hurricane - Expected Annual Loss - Total	Hurricane	Expected Annual Loss - Total
HRCN_EALS	Hurricane - Expected Annual Loss Score	Hurricane	Expected Annual Loss Score
HRCN_EALR	Hurricane - Expected Annual Loss Rating	Hurricane	Expected Annual Loss Rating
HRCN_ALRB	Hurricane - Expected Annual Loss Rate - Building	Hurricane	Expected Annual Loss Rate - Building
HRCN_ALRP	Hurricane - Expected Annual Loss Rate - Population	Hurricane	Expected Annual Loss Rate - Population
HRCN_ALRA	Hurricane - Expected Annual Loss Rate - Agriculture	Hurricane	Expected Annual Loss Rate - Agriculture
HRCN_ALR_NPCTL	Hurricane - Expected Annual Loss Rate - National Percentile	Hurricane	National Percentile
HRCN_RISKV	Hurricane - Hazard Type Risk Index Value	Hurricane	Hazard Type Risk Index Value
HRCN_RISKS	Hurricane - Hazard Type Risk Index Score	Hurricane	Hazard Type Risk Index Score
HRCN_RISKR	Hurricane - Hazard Type Risk Index Rating	Hurricane	Hazard Type Risk Index Rating
NRI_VER	National Risk Index Version	All	n/a

Source 3: Data for Good: <https://dataforgood.facebook.com/dfg/tools> be creative with population density data, predicted electrical grids and other sets that could make your analysis interesting.

Source 4: NASA: <https://www.earthdata.nasa.gov/topics/human-dimensions/population>. Global population data, lots of options.

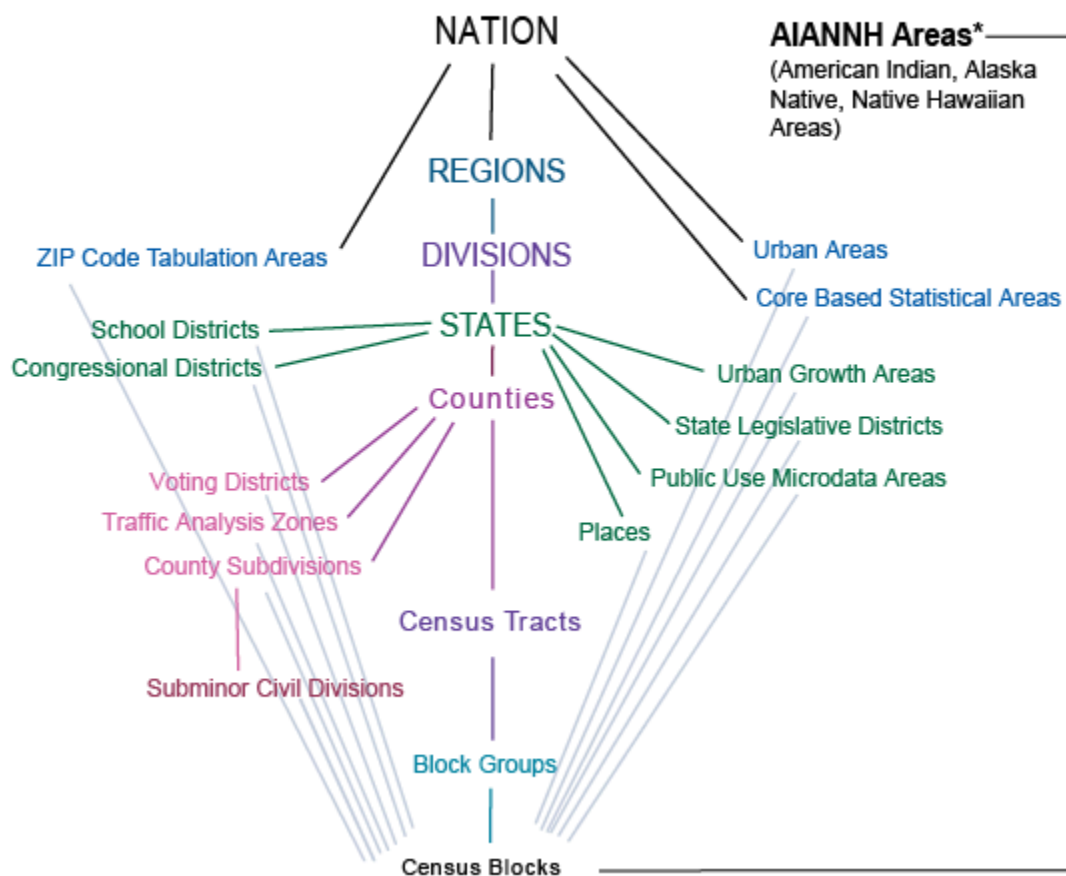
Source 5: Elevation data (option). Elevation data will determine the likelihood of flood prone areas within tracts or block groups.

Description:

Help shape policy for public and private policy and drive investment to lower risk areas. Requirements include:

1. Import data from sources and use Python, ARCGis or QGIS to do geospatial analysis.
2. Harmonize data to similar geographic regions. In this case it has been made easy because all provided data is aligned to the census tract. These units are geographical entities by which the US Census Bureau measures the population. The hierarchy they offer looks like this:

Standard Hierarchy of Census Geographic Entities



3. Combine Census and FEMA data in order to evaluate large populations of lower income families that live in zones that are at high risk of coastal flooding. The FEMA data offers a host of categories by which you can measure different types of natural disasters. We have pared the data down to a handful of categories but we have left a few extras in the event that you wish to create a model that accounts for other, prevalent risk factors like hurricanes. Feel free to experiment.
4. Once you identify potentially vulnerable populations, your next step is looking for areas of the city where stakeholders could rehouse the displaced families. These are areas where there are large tracts of land available for the construction of apartment buildings and retail.
 - a. It would be wise to consider the income level of the parts of the city and try to find close matches. You would likely want to avoid NIMBY issues (Not in My Back Yard) where residents are likely to put up a fight against large structures going in.
 - b. Look for median incomes of tracts, total populations and areas of low potential flood risk.
 - c. A good solution finds “move to” tracts that are similar to “move from” tracts but of much lower risk.

Judging Criteria:

Business Efficacy:

1. How will your solution help the stakeholders?
2. How much money would be saved by your solution than by building in neighboring block groups or tracts?
3. How effectively can it be used to model other cities?

Accuracy:

4. Difficulty of harmonizing geography.
5. Did you find the lower cost solution to the problem?
6. Thoughtfulness of solution. Are the at risk populations really helped by this solution? are they still in harm's way.

Scalability:

7. Can the model adapt to different heights of sea level rise?
8. Does the model work across multiple markets?
9. How well can you explain any disparities between the effectiveness of the model between markets?

Storytelling:

10. How well are you able to explain the effectiveness of your model?
11. Can you explain how your model works clearly and concisely?
12. In what ways do you believe your model is actionable?