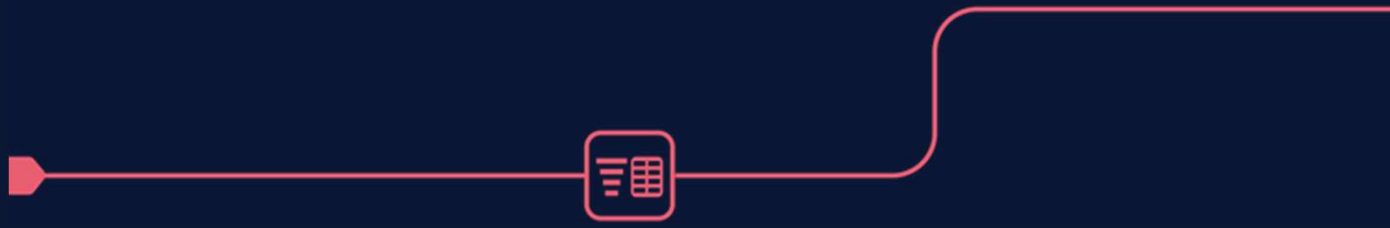

UNDERSTANDING OPIOID PRESCRIBING BEHAVIOR IN ENGLAND

Dan Putler PhD, Chief Data Scientist, Alteryx

BBSW/BARUG Meetup, February 20, 2020

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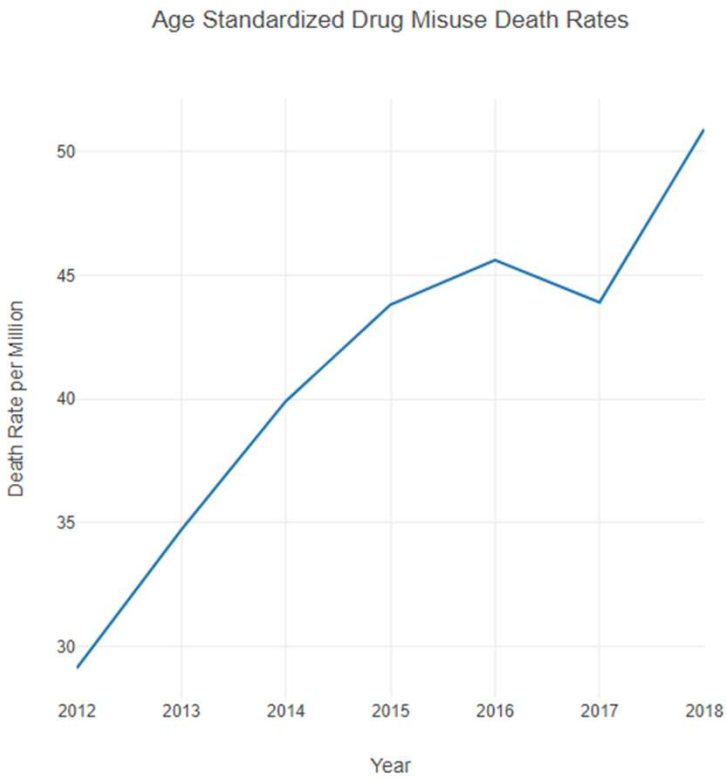
- Trends in drug misuse death rates in England
- The relationship between prescription opioids and drug related deaths
- Patterns and trends in opioid prescribing behavior
- Modeling the drivers of opioid using a spatial panel approach in R
- Policy implications of the model

RISING DRUG MISUSE DEATH RATES

- Annual drug misuse death rates have increased by nearly 75% between 2012 and 2018
- Over half of all drug misuse deaths are associated with opiates



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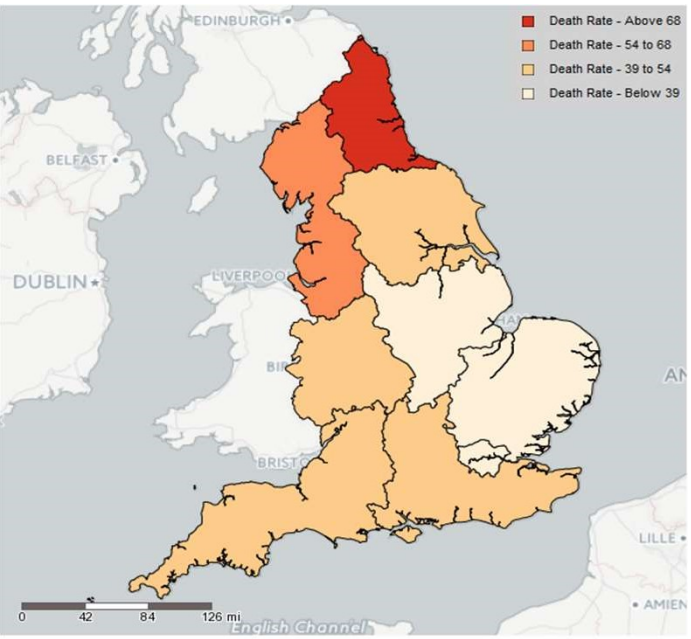
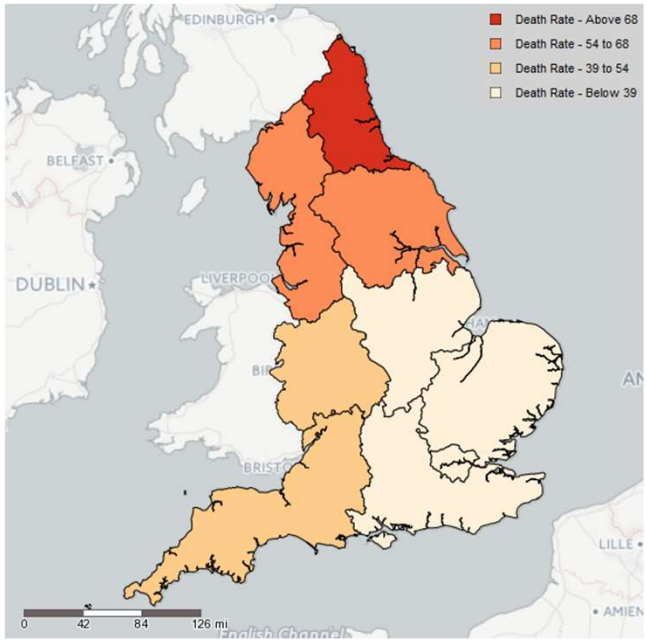
DRUG MISUSE DEATH RATES BY REGION

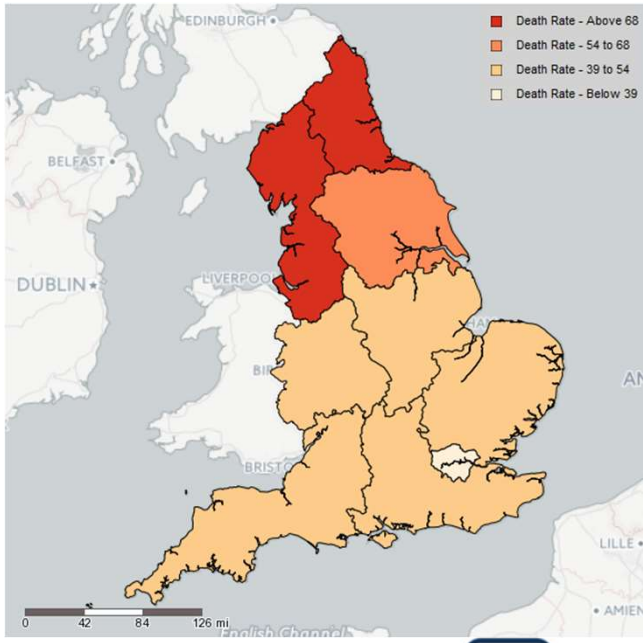
2016



2017



2018



Source: Office of National Statistics

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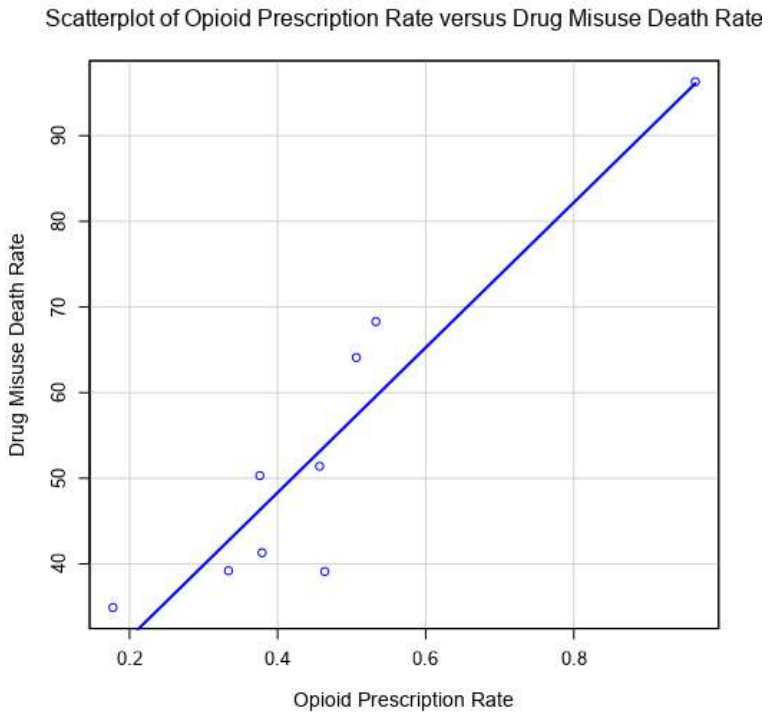
OPIOID PRESCRIPTION RATES AND DRUG DEATHS

- US Research has shown that prescription opioids act as a gateway to illegal drug use
- Consistent with this, the correlation between opioid prescription rates and drug misuse death rates is over 0.9 across England's nine regions



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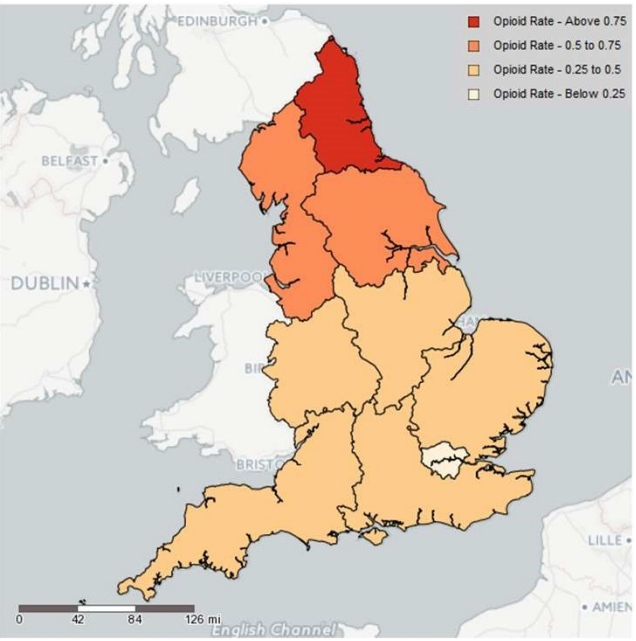
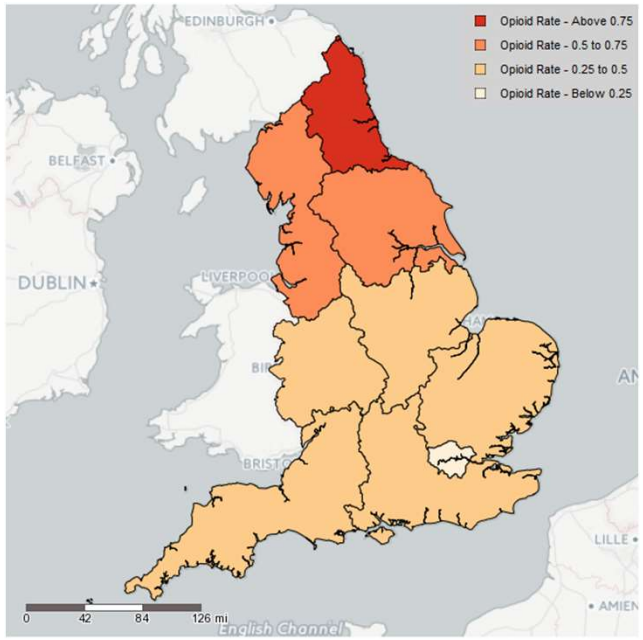
THE STABILITY OF OPIOID PRESCRIPTION RATES

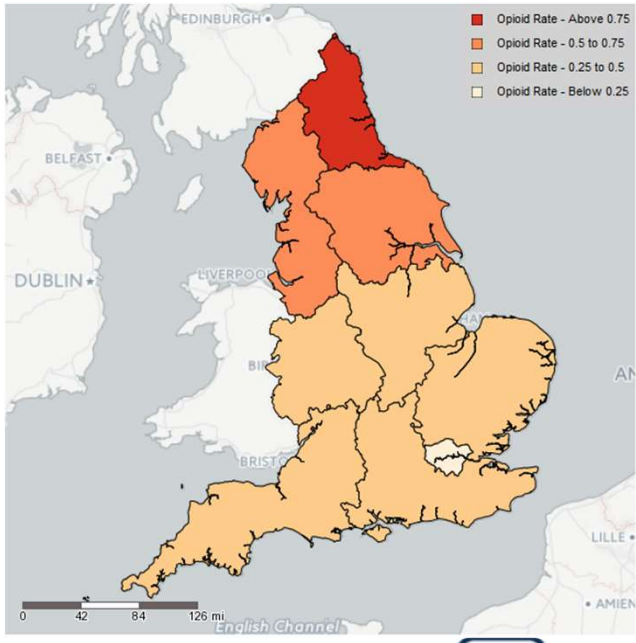
2016



2017



2018



Source: National Health Service

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ISSUES FACING PUBLIC HEATH AGENCIES

- Can public health programs be developed to lower opioid prescription rates?
  - What should be the nature of any programs developed?
- What are the drivers of opioid prescription rates across England?
  - Do some of the drivers lend themselves to public health intervention efforts?

POSSIBLE DRIVERS OF PRESCRIPTION RATES

- Economic opportunity
  - Household income levels (-)
  - Working age unemployment (+)
- Household structure and composition
  - The percentage of households with children present (-)
  - The percentage of households headed by married couples (-)
- The age of the population
  - Measured as the average age of the population 18 years and older (+)
- Local area “standard of care” (+/-)

ADDRESSING LATENT FEATURES IN DATA SCIENCE

- Meaningful predictors are often not directly observable
- Related observable features are used to infer the unobservable
- Two basic approaches exist to do this
  - Separate from model training (e.g., factor analysis, word embeddings)
  - As part of model training itself
- When done in model training, additional structure needs to be imposed
  - Adding the needed structure relies on the use of parametric statistical models
- In this use case a spatial "lag" model is needed

OTHER DATA AND MODELING ISSUES

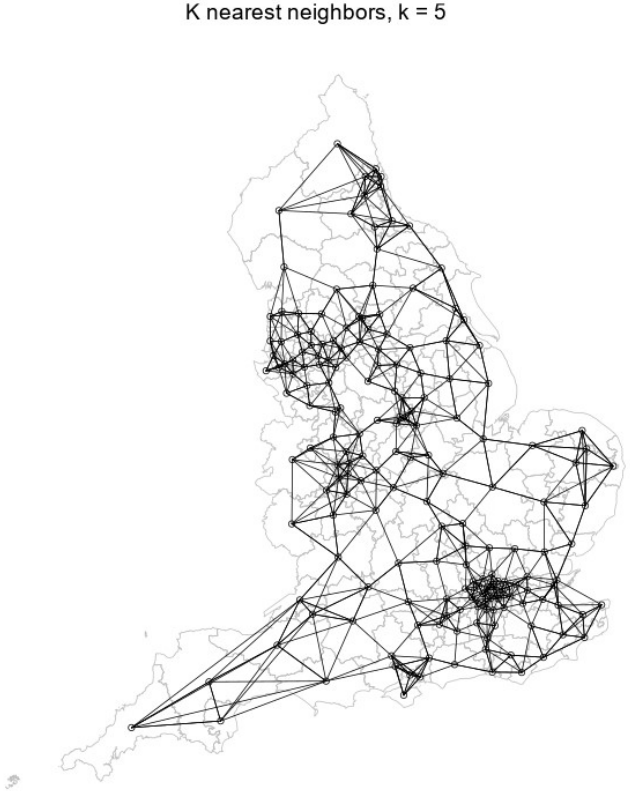
- Much of the available data is on an area level
  - There are only nine regions in England
  - It is not possible to map practices to low level geographies
  - Using the 195 Clinical Commissioning Group areas (circa 2018) works
- Socioeconomic and demographic factors are often highly correlated with one another across areas
  - Increasing the number of observations partially alleviates the multicollinearity problems
  - Three years of data can be used to triple the number of observations
  - Doing this results in a “panel data” situation that needs to be addressed using a “random effects” approach

THE MODEL TAKEN TO THE DATA

$$y = \lambda(I_T \otimes W_N)y + X\beta + u$$

- W_N is a spatial weight matrix
  - A value of 0.2 is given in the matrix is an area is one of the five closest to an area, and is zero otherwise
- This is a very specialized model type
  - The R spdep package is used to construct the spatial weight matrix
  - The R splm package is used to estimate the model

THE SPATIAL WEIGHT MATRIX



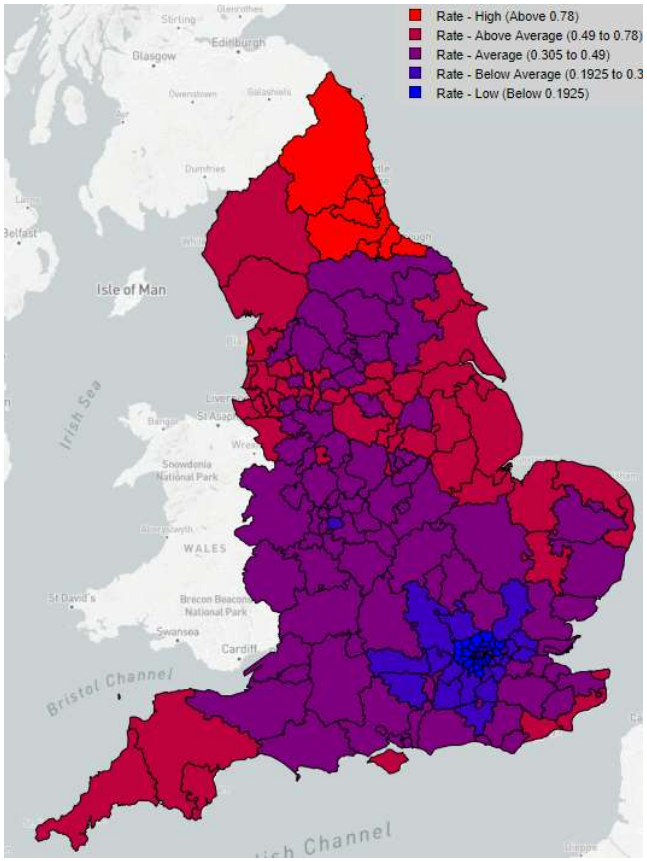
DATA SOURCES

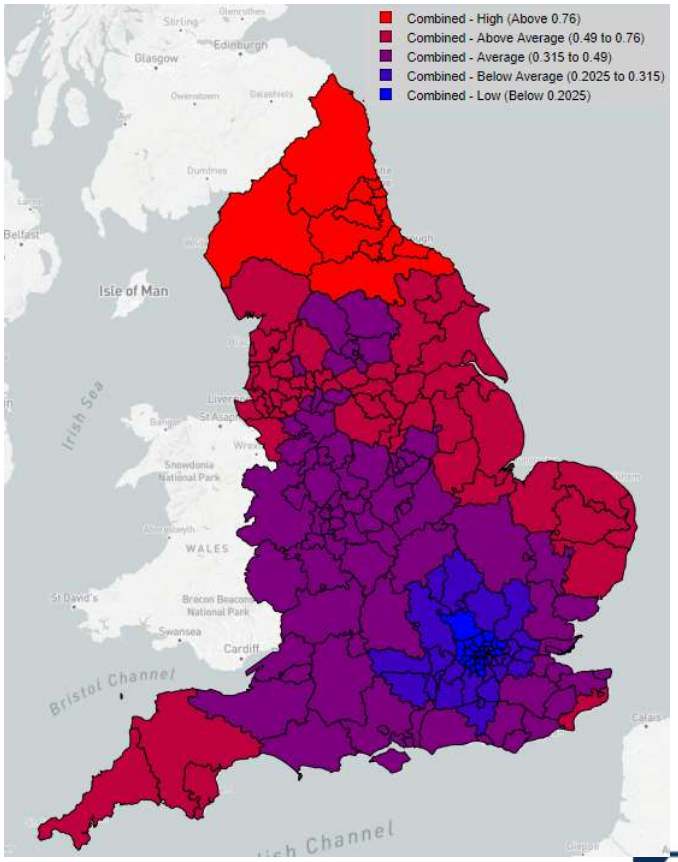
- MB-Research
  - Area level disposable income
  - Number of individuals unemployed
  - Households with children present
  - Households headed by a married couple
- Office of National Statistics
  - Total population
  - Average age of the population for those 18 years or older
- National Health Service
  - Opioid prescriptions

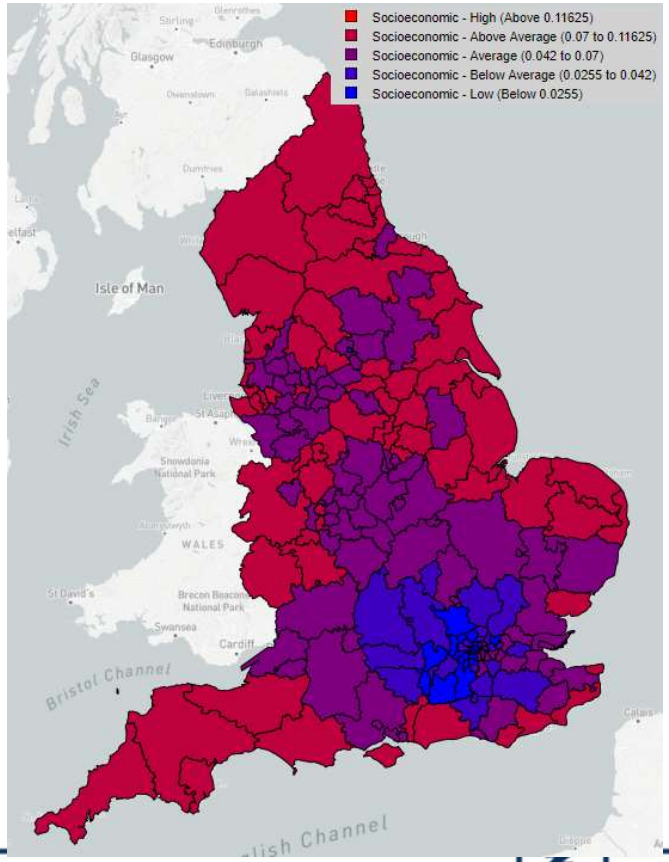
THE ACTUAL DRIVERS OF PRESCRIPTION RATES

- Economic opportunity
  - Household income levels (-)
  - Working age unemployment (+)
- Household structure and composition
  - The percentage of households with children present (-)
- The age of the population
  - Measured as the average age of the population 18 years and older (+)
- Local area “standard of care” (+/-)

DECOMPOSING THE EFFECTS







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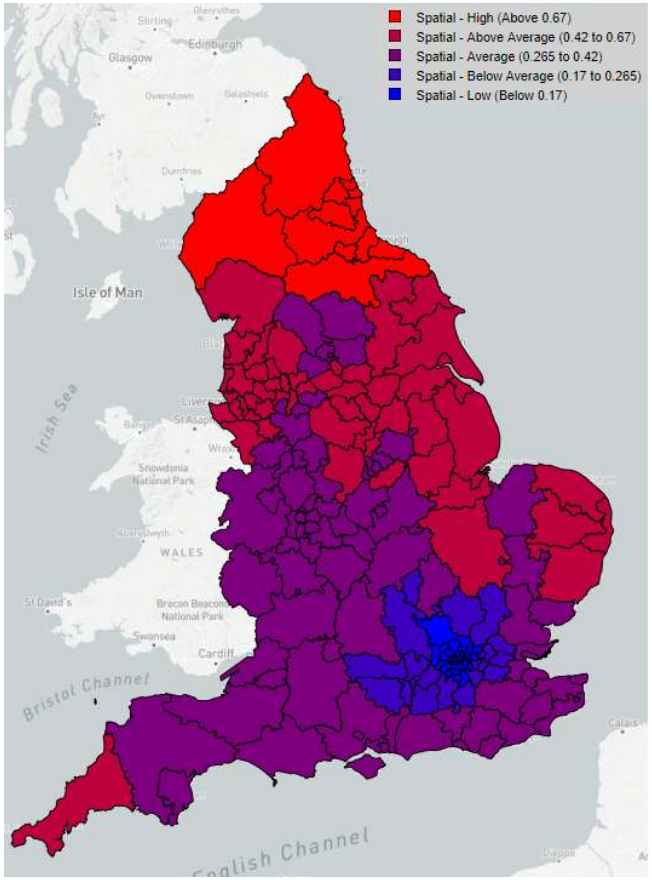
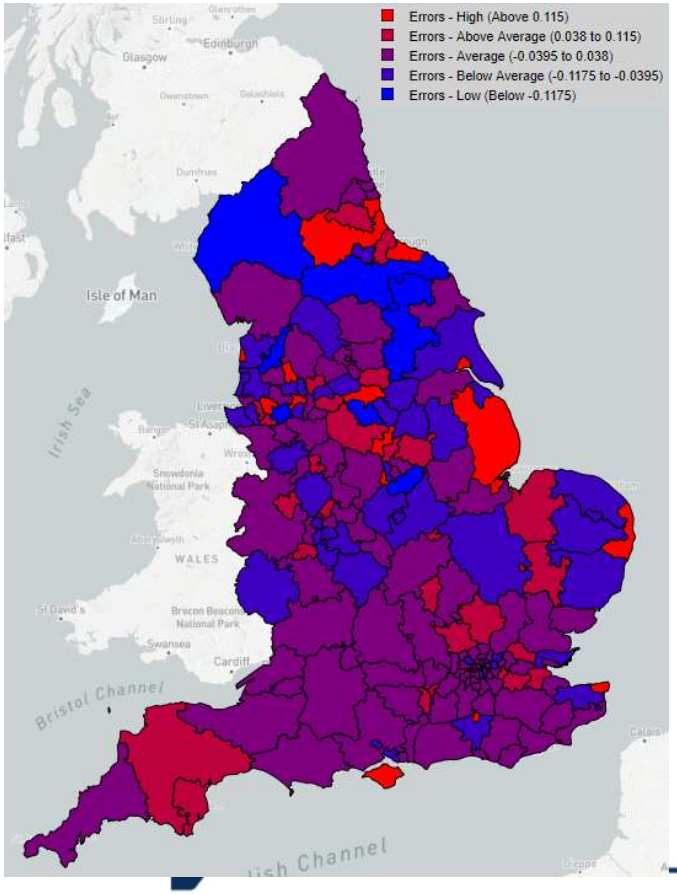
DECOMPOSING THE EFFECTS





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RESULT SUMMARY AND IMPLICATIONS

- Result summary
  - There are extremely strong local effects, consistent with local “standards of care”
  - Opioid prescription rates increase with work-age population unemployment and the average age of the population 18 years and over in an area
  - Opioid prescription rates decrease with average disposable income and the percentage of households with children in an area
- Implications
  - Programs that attempt to improve the local “standard of care” with respect to physician opioid prescription behavior in some areas in the country are warranted
  - Developing individual level opioid abuse risk scoring based on economic, household structure, and other factors may well be worthwhile

THANK YOU

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