Beyond the Classroom

Environmental Determinants of Student Achievement in North Carolina

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Contents

Abstract

Background

Environmental conditions play a crucial yet understudied role in shaping education outcomes. This study investigates the influence of environmental factors on student achievement across North Carolina using an extensive, multisource data set and advanced statistical modeling.

Methods

We merged student- and school-level academic data from the North Carolina Department of Education with 229 environmental variables derived from 10 sources, including the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), the U.S. Census Bureau, and PurpleAir. Student achievement outcomes include standardized test scores, graduation indicators, and other performance metrics. We then applied a Bayesian spatiotemporal linear model to account for school characteristics as well as spatial and temporal dependencies. We also used a secondary assessment and variable selection procedure to identify environmental predictors.

Results

Environmental factors such as food access, area deprivation, and sociodemographic indicators were significantly associated with student achievement outcomes. These variables explained additional spatial variation beyond what was captured by baseline models. In most models, the inclusion of environmental variables reduced spatial heterogeneity, as evidenced by declines in Moran's I and spatial random effect variance.

Conclusion

Environmental exposures are important determinants of student achievement. Interventions aimed at improving education outcomes should consider environmental inequities, particularly those related to food access and socioeconomic deprivation. These findings support the integration of place-based strategies into education and public health policy to promote academic equity.

Acknowledgements

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Introduction

The relationship between environmental factors and student achievement has been a topic of increasing interest in education research. Understanding how various environmental exposures impact student achievement outcomes is crucial for developing effective education policies and interventions (Koçak et al., 2020; Li & Li, 2022; Omolo et al., 2020). This study explores the influence of environmental factors on student achievement in North Carolina, utilizing a comprehensive data set from the North Carolina Department of Education.

The data set includes detailed information on student achievement, such as end-of-grade test scores for 3rd- and 8th-grade reading and math as well as algebra 1 and English 2. Additionally, it encompasses various student-level characteristics (e.g., sex, ethnicity, economically disadvantaged status) and school-level characteristics (e.g., race/ethnicity distribution, locale).

To assess the environmental impact, we incorporated 229 variables from 10 different data sources, including air quality data from the Environmental Protection Agency (EPA) and PurpleAir, community resilience estimates from the U.S. Census Bureau, and vegetation indices from the National Aeronautics and Space Administration (NASA). These diverse data sources provided a robust framework for analyzing the multifaceted environmental influences on student achievement.

Our methodological approach involved applying a Bayesian spatiotemporal linear model that adjusted for student- and school-level characteristics while incorporating random effects at the school, county, and temporal levels. This model allowed us to account for the complex hierarchical structure of the data and the spatial and temporal dependencies inherent in the environmental variables.

By integrating these comprehensive data sources and employing advanced statistical modeling techniques, we developed a nuanced understanding of how environmental factors contribute to student achievement outcomes. The findings from this study will offer valuable insights for educators, policy makers, and researchers aiming to enhance student achievement through targeted environmental and educational interventions.

Materials and Methods

Data Sources

North Carolina Department of Education Data

For this analysis, we used a North Carolina Department of Education data set that contained student achievement data as well as student- and school-level characteristics. We aggregated this student-level data set to the school level, largely for improved model and computational performance, but also to explore the relationship between school level student achievement and environmental exposures.

The school-level student achievement data served as the outcome variables for these analyses. We considered school means of end-of-grade test scores for 3rd- and 8th-grade reading and math as well as Algebra 1 and English 2. Other school-level measures of student achievement included the mean of earned quality points per student,[1] the rate of students' who intended to attend college, rate of students who ever received an out-of-school suspension, rate of students who were ever retained in a grade level, rate of students' AP course enrollment, mean number of AP courses taken per student, and mean rate of days absent per student.

The aggregated student-level characteristics included sex, race/ethnicity, economically disadvantaged status, language services status, disability status, and academically gifted status; the school-level characteristics included race/ethnicity distribution, locale (i.e., large, midsize, and small cities; large, midsize, and small suburban areas; fringe, distant, and remote towns; and rural, distant, and remote rural areas), minority distribution, and type (i.e., K–12, elementary, middle, junior high, and high school, other, and unknown).

Environmental Data Sources

In our analyses, we considered 229 environmental variables (see **Table A.1**) from 10 data sources (see **Table 1**) and merged these variables with the North Carolina data set at the school level. To be selected, the data sources had to meet three criteria: (1) be publicly available; (2) contain environmental variables related to health; and (3) provide data at detailed geographic levels (e.g., census tract, ZIP code, latitude and longitude). The only data source that does not meet the publicly available criterion is PurpleAir. However, we obtained the necessary data using tokens provided upon creating an account.

[1] Quality points are a numerical representation of a student's academic performance in a course, based on both the grade earned and the credit value of the course. They are used to calculate GPA, but they are not the GPA itself.

Table 1. Data Sources and Summarized Variable Descriptions

Source	Description
EPA Air Quality System Data	$PM_{2.5}$[2] measures interpolated to gain estimates at school locations
PurpleAir	$PM_{2.5}$ measures interpolated to gain estimates at school locations
Center for Health Disparities Research, University of Wisconsin School of Medicine and Public Health	A composite measure at the census tract level representing income, education, employment, and housing quality
U.S. Census Bureau Community Resilience Estimates	Measures of community resilience to heat and natural disasters
U.S. Department of Agriculture Food access Research Atlas	Food access indicators based on measures of supermarket accessibility
Environmental Protection Agency Superfund Data Reports	Distance in km from schools to sites contaminated by potential smelting-related operations and other contaminants of concern
Warner College of Natural Resources, Colorado State University	Ambient noise measured in decibels (dB)
U.S. Geological Survey	Vegetation monitoring – EROS Visible Infrared Imaging Radiometer Suite (eVIIRS)
National Land Cover Database	Average tree canopy coverage within 250m buffer for each school
The Payne Institute for Public Policy at Colorado School of Mines Light at Night	Annual average of light at night at 1 km resolution in radiance (nW/cm2/sr)

Methods

Student Achievement Models

We applied a Bayesian spatiotemporal linear model that adjusted for the available student and school level characteristics and incorporated school, county, and temporal random (latent) effects. For school i in county j and year k, this model was defined as

$$Y_{ijk} = X_{ijk}\beta + \varsigma_i + \upsilon_j + \phi_k$$

where Y_{ijk} denoted the student level outcome (e.g., 3rd-grade math scores); $X_{ijk}\beta$ denoted the linear predictor associated with the school-level set of predictors (e.g., percent of students with

[2] Particulate matter that is 2.5 micrometers or smaller in diameter.

a disability status); ς_i denoted the school level random effect; v_j denoted the spatial (county) level random effect; and ϕ_k denoted the temporal (year) random effect (Besag & Green, 1993). An initial fit of this model produced a baseline for the estimates. Variable(s) selected in the variable selection procedure were included in X_{ijk} in subsequent model fits. The spatial random effect was defined as $\upsilon_j = u_j + v_j$ such that u_j was the uncorrelated spatial parameter with prior distribution $\mathrm{u_j} \sim \mathrm{N}(0, \tau_\mathrm{j}^{-1})$; precision τ_j. v_j was the correlated spatial parameter with prior distribution $v_j \sim N((1/h_j)\sum_{l=1}^{h_j} v_l, 1/(h_j\tau_v))$; and precision τ_v. for v_j, h_j was the number of first-degree neighbors for area j. Thus, area j was only directly related to its nearest h_j neighbors. This correlated parameter followed an intrinsic conditional autoregressive model (1-3). The temporal random effect was defined using a random walk prior distribution such that $\phi_k|\phi_{k-1} \sim N(\phi_{k-1}, \tau_\phi^{-1})$ with $\phi_1 = 0$. Other prior distributions we utilized are as follows: $\tau_\cdot^{-1/2} \sim Unif(0,10)$ and $\beta \sim N(0,0.001)$. For computation, we used the integrated nested Laplace approximation method of Bayesian estimation via the R package INLA (Blangiardo et al., 2013; Carroll et al., 2015; Martins et al., 2013; Rue et al., 2009; Schrödle & Held, 2010; Sørbye, 2013).

Secondary Assessment

To reduce the set of environmental variables for the variable selection procedure, we also introduced a secondary assessment. The model for the secondary assessment was defined as

$$x_i = q_i B + z_i$$

where x_i was the environmental variable under examination and z_i was an uncorrelated school-level random effect (as in ς_i above) and q_i was a categorical representation of the estimated school-level random effect from the initial student achievement model (ς_i) (Carroll & Zhao, 2018). Specifically, this categorical variable represented if a school was contained in the first ($q_i = 0$), second ($q_i = 1$), third ($q_i = 2$), or fourth ($q_i = 3$) quartile of the spatial random effect (the first quartile was the reference level). Finally, B represented the coefficient estimates associated with q_i. These were the estimates that we examined to determine if there was a relationship between q_i and x_i, specifically the estimate that represented a comparison of the first and fourth quartiles. For computation, we performed the secondary assessment using the assessmap function from the fillmap package (Carroll, 2016).

Variable Selection Procedure

For each iteration, we used a forward selection procedure to select the variable that improved the model fit the most—until no variables offered an improvement. We compared the models in terms of model fit using the widely acceptable information criteria (WAIC) values (Gelman, Hwang, & Vehtari, 2014). For these values, lower indicated a better model fit, and we

considered a difference of 5 points as significantly different and a difference of 3 points as marginally different (Gelman, Hwang, & Vehtari, 2014).

Results

In total, we examined 229 variables across 14 outcomes. This section describes our overall results across the full set of outcomes and highlights findings from the 3rd-grade math score outcome, which serves as a representative example of how the modeling and variable selection procedures operate. Full results for all outcomes are available in the files linked under each table throughout this section and are graphically represented in the appendixes.

Table 2 presents estimates for the 3rd-grade math baseline models. These estimates show expected relationships between the outcome and student- and school-level covariates. For example, schools with higher percentages of academically or intellectually gifted students have higher test scores, and schools with more economically disadvantaged students have lower rates of college intent.

Table 2. Parameter Estimates for 3rd-Grade Math Baseline Models

Covariate	Mean	95% credible interval
School locale		
City – large (ref)	0.000	†
City – midsize	0.013	(-0.111,0.139)
City – small	0.035	(-0.375,0.446)
Suburban – large	0.260	(-0.016,0.536)
Suburban – midsize	-0.084	(-0.239,0.072)
Suburban – small	0.160	(-0.638,0.958)
Town – fringe	-0.050	(-0.27,0.17)
Town – distant	0.121	(-0.109,0.35)
Rural – fringe	-0.072	(-0.175,0.031)
Rural – distant	-0.084	(-0.194,0.026)
Rural – remote	-0.107	(-0.699,0.485)
Unknown	-0.035	(-0.159,0.089)
% Black race	-0.033	(-0.071,0.004)
% Hispanic ethnicity	-0.033	(-0.059,-0.006)*

Covariate	Mean	95% credible interval
% minority	-0.029	(-0.073,0.015)
School type		
Elementary school	0.000	†
Middle school	—	†
Junior high school	—	†
K–12 school	-0.201	(-0.562,0.16)
High school	—	†
Other	-0.051	(-0.199,0.097)
Unknown	-0.036	(-0.142,0.07)
% male	-0.075	(-0.167,0.017)
% economic disadvantaged	-0.640	(-0.724,-0.557)*
% English language service	-0.535	(-0.659,-0.412)*
% disability	-0.491	(-0.609,-0.374)*
% academic gifted	1.145	(0.972,1.318)*

— Not available.

† Not applicable.

* Well-estimated.

Note. Results from the full set of outcomes are available in **Table 2 Supplement**.

After the secondary assessment, we considered 129 of the total 229 variables as candidates for variable selection (there were a minimum of 6, maximum of 61, and median of 41.5 variables per outcome). The most common candidate variables were measures of food access, area deprivation, sociodemographic composition, and community resilience. These variables were selected using the forward selection procedure described previously. **Table 3** displays the selected 3rd-grade math baseline model spatial random effect secondary assessment results.

Table 3. Selected 3rd-Grade Math Baseline Model Spatial Random Effect Secondary Assessment Results

Variable	Mean	95% credible interval
MedianFamilyIncome	0.606	(0.37,0.841)
lawhitehalf	0.362	(0.165,0.559)
lawhitehalfshare	0.424	(0.22,0.629)
lablackhalfshare	-0.487	(-0.685,-0.288)
lahunvhalf	-0.362	(-0.591,-0.133)

Variable	Mean	95% credible interval
lasnaphalf	-0.490	(-0.727,-0.254)
lawhite1share	0.228	(0.013,0.444)
lablack1share	-0.348	(-0.55,-0.147)
lahunv1share	-0.270	(-0.469,-0.07)
TractLOWI	-0.258	(-0.396,-0.12)
TractAsian	0.375	(0.095,0.656)
TractSNAP	-0.529	(-0.737,-0.322)
ADI_NATRANK	-0.546	(-0.765,-0.328)
ADI_STATERNK	-0.514	(-0.726,-0.302)
PRED3_PE_heat19	-0.359	(-0.573,-0.146)
PRED0_PE_nat19	0.452	(0.232,0.672)

Note. This table shows parameter estimates associated with comparisons of the first and fourth quartiles. Results from the full set of outcomes are available in **Table 3 Supplement**.

We ultimately selected a total of 35 variables, with a few commonalities across the outcomes (e.g., share of tract population that is Black or African American and lives more than a ½ mile from supermarket; area deprivation index). **Table 4** displays estimates associated with the final models for 3rd-grade math, including those associated with the selected variables. The estimates for the school-level variables were similar to the baseline models, suggesting that the environmental variables explain variation beyond what these variables account for. The estimates associated with the environmental variables were also generally as expected. For example, as the share of the population that is Black or African American and lives more than a ½ mile from a supermarket increases and as the number of housing units receiving SNAP benefits increases, schools have lower 3rd-grade math scores on average. Alternatively, as the share of the population that is White and lives more than a ½ mile from a supermarket increases, schools have higher 3rd-grade math scores on average.

Table 4. Parameter Estimates for 3rd-Grade Math Final Models

Predictor	Mean	95% credible interval
School locale		
City – large (ref)	0.000	†
City – midsize	-0.030	(-0.155,0.095)
City – small	0.012	(-0.415,0.44)
Suburban – large	0.028	(-0.25,0.307)

Predictor	Mean	95% credible interval
Suburban – midsize	0.017	(-0.138,0.173)
Suburban – small	0.296	(-0.525,1.117)
Town – fringe	0.022	(-0.2,0.245)
Town – distant	-0.026	(-0.261,0.209)
Rural – fringe	-0.074	(-0.177,0.03)
Rural – distant	-0.053	(-0.162,0.057)
Rural – remote	-0.380	(-0.985,0.225)
Unknown	0.015	(-0.11,0.14)
% Black race	-0.055	(-0.094,-0.016)*
% Hispanic ethnicity	-0.048	(-0.075,-0.021)*
% minority	0.008	(-0.038,0.053)
School type		
Elementary school	0.000	†
Middle school	—	†
Junior high school	—	†
K–12 school	-0.163	(-0.541,0.214)
High school	—	†
Other	-0.088	(-0.24,0.064)
Unknown	-0.088	(-0.197,0.02)
% Male	0.159	(0.064,0.253)*
% Economic disadvantaged	-0.571	(-0.658,-0.484)*
% English language service	-0.370	(-0.5,-0.24)*
% Disability	-0.557	(-0.68,-0.434)*
% Academic gifted	1.100	(0.916,1.284)*
Share of tract population that are White beyond 1/2 mile from supermarket	0.061	(0.024,0.098)*
Share of tract population that are Black or African American beyond 1/2 mile from supermarket	-0.048	(-0.086,-0.01)*
Total count of housing units receiving SNAP benefits in tract	-0.055	(-0.087,-0.022)*

— Not available.

† Not applicable.

* Well-estimated.

Note. Results from the full set of outcomes are available in **Table 4 Supplement**.

Plots of the spatial (county) random effects for both the baseline and final models by outcome are available in **Appendix B**. These plots suggest strong spatial autocorrelation and variation across all outcomes. They also largely indicate less autocorrelation and variation in the final models, suggesting that the environmental variables help explain some of this residual in the baseline models. This decrease in heterogeneity and variation is confirmed by the statistics (Moran's I and estimated variance of the spatial random effect hyperparameter) and presented in **Table 5**.

Table 5. Comparisons of the Spatial Components Between the Baseline and Final Models for 3rd-Grade Math

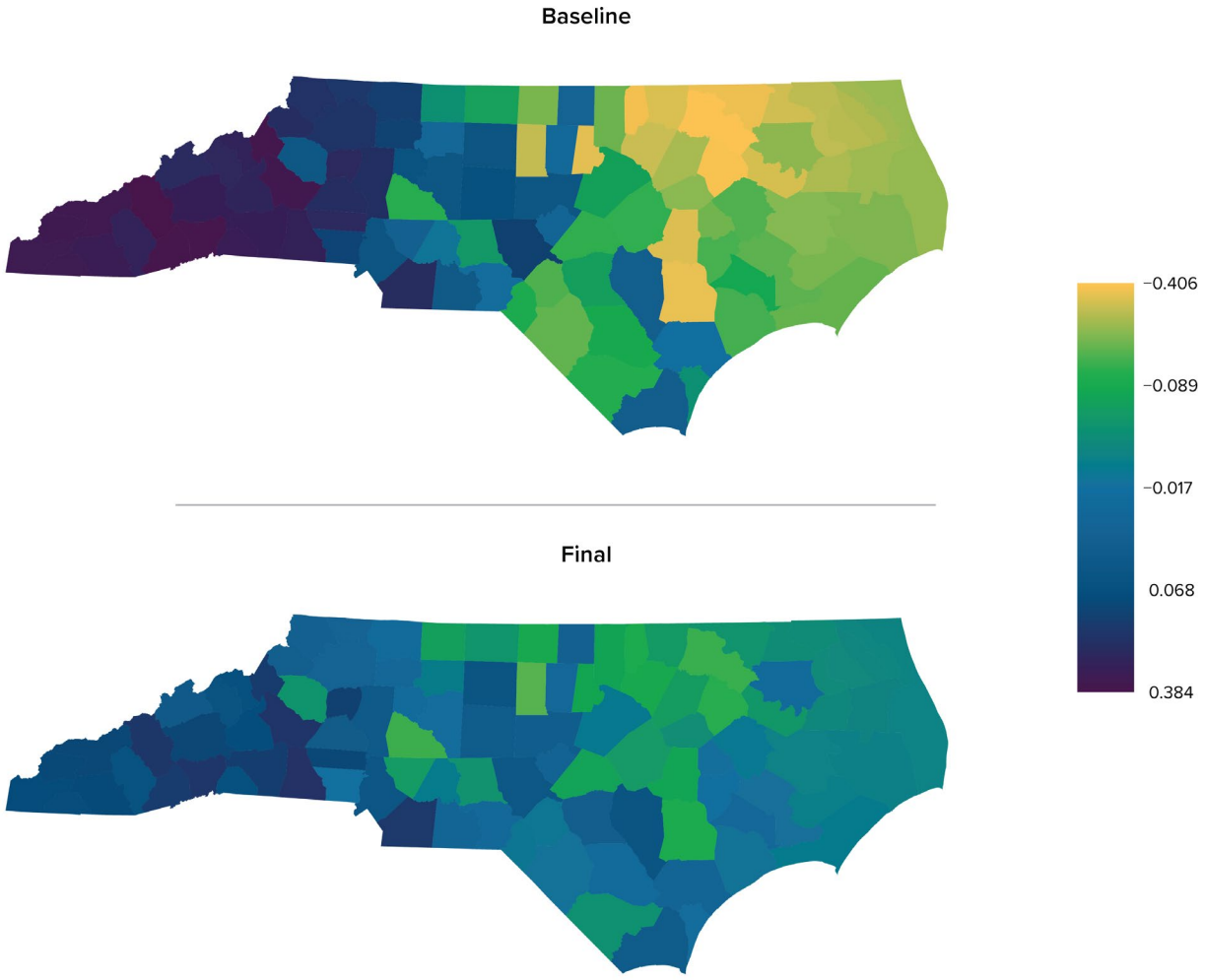
Measure	Value
Moran's I	
Baseline model	
Statistic	14.052
P value	3.72232687378117e-45
Final model	
Statistic	9.206
P value	1.69321404658923e-20
Difference in statistics	4.846
Spatial random effect hyperparameter	
Baseline model	0.00398
Final model	0.00026
Percent explained	1416.050

Note. Results from the full set of outcomes are available in **Table 5 Supplement**.

Figure 1 demonstrates this with a comparison of the baseline and final model spatial random effect estimates for 3rd-grade math scores. Specifically, 10 of the 13 final models indicate a reduction in Moran's I, suggesting less spatial heterogeneity in the final models; 10 of the 13 final models suggest that a percentage of variance estimated in the baseline model was explained in the final model; and 6 of the 13 final models are common among these two sets of 10.

Plots of the associated temporal random effect estimates are available in **Appendix C**. These plots suggest that the estimated temporal residual is largely the same in the baseline and final models, as expected.

Figure 1. Baseline and Final Model Spatial Random Effect Estimates for 3rd-Grade Math Scores



Note. Estimates for county retention rates are available in a tabular format in **Figure 1 Supplement**.

Discussion

This study provides a comprehensive analysis of the relationship between environmental factors and student achievement across North Carolina, employing a Bayesian spatiotemporal modeling approach to account for the complex structure of the data. By integrating 229 environmental variables from diverse sources—including air quality, food access, and community resilience data—into detailed education records, we were able to assess how environmental conditions shape academic outcomes at the school level.

The results indicate that environmental factors contribute meaningfully to variation in student achievement outcomes, beyond what can be explained by school-level characteristics. Variables

like food access, area deprivation, and sociodemographic composition (e.g., racial/ethnic population shares, economic indicators) emerged as recurrent predictors across outcomes. These findings reinforce existing literature suggesting that place-based disadvantage—especially related to nutrition and economic opportunity—can hinder academic performance.

The secondary assessment and variable selection procedures were instrumental in distilling a large set of potential predictors to a focused subset that contributed significantly to model performance. This methodological rigor helped isolate meaningful signals from noise and improved model interpretability. Moreover, the reductions in spatial heterogeneity (as evidenced by decreases in Moran's I and spatial random effect variance) suggest that environmental variables explain a portion of the residual spatial variation in student achievement outcomes. This provides strong evidence that geographically linked environmental factors play a substantive role in education equity.

Conclusion

This study demonstrates that environmental context is a crucial yet often overlooked dimension in understanding academic achievement. Through rigorous statistical modeling and the integration of rich multisource environmental data, we show that environmental disadvantage—particularly related to food access, economic deprivation, and community resilience—is associated with lower achievement outcomes among North Carolina students.

These findings have important implications for education policy and public health. Interventions aimed at improving academic achievement should consider incorporating place-based strategies, such as improving food environments near schools, investing in deprived communities, and addressing racial/economic segregation. Moreover, the methods employed here offer a scalable and replicable framework for future research in other regions or states, potentially enabling broader policy relevance.

Future research should continue to explore dynamic environmental exposures (e.g., real-time air quality, climate events) and assess causal mechanisms through longitudinal or quasi-experimental designs. Additionally, more granular data at the household or neighborhood level may enhance understanding of how environmental risks are experienced differently across student populations. Expanding the analytical scope to include teacher- or curriculum-related variables could also deepen our understanding of how environmental and educational inputs interact to shape academic outcomes.

In summary, this study underscores the importance of an interdisciplinary, data-driven approach to education equity—one that recognizes the classroom does not exist in a vacuum but rather within a broader environmental context that must be understood and addressed.

Appendix A: Definitions of Environmental Variables

Table A.1. Environmental Variables

Label	Name	Description
X	Latitude	School latitude
Y	Longitude	School longitude
sound	Ambient noise	Ambient noise
ndvi	NDVI	Normalized Difference Vegetation Index
dist_superfund2	Distance to Superfund Site	Distance in m to nearest superfund site
lan	light at night	Estimated light at night
lan3	light at night masked	Masked estimate of light at night
Urban	Urban tract	Flag for urban tract
Pop2010	Population, tract total	Population count from 2010 census
OHU2010	Housing units, total	Occupied housing unit count from 2010 census
GroupQuartersFlag	Group quarters, tract with high share	Flag for tract where >=67%
NUMGQTRS	Group quarters, tract population residing in, number	Count of tract population residing in group quarters
PCTGQTRS	Group quarters, tract population residing in, share	Percent of tract population residing in group quarters
LILATracts_1And10	Low income and low access tract measured at 1 mile for urban areas and 10 miles for rural areas	Flag for low-income and low access when considering low accessibility at 1 and 10 miles
LILATracts_halfAnd10	Low income and low access tract measured at 1/2 mile for urban areas and 10 miles for rural areas	Flag for low-income and low access when considering low accessibility at 1/2 and 10 miles
LILATracts_1And20	Low income and low access tract measured at 1 mile for urban areas and 20 miles for rural areas	Flag for low-income and low access when considering low accessibility at 1 and 20 miles
LILATracts_Vehicle	Low income and low access tract using vehicle access or low income and low access tract measured at 20 miles	Flag for low-income and low access when considering vehicle access or at 20 miles
HUNVFlag	Vehicle access, tract with low vehicle access	Flag for tract where >= 100 of households do not have a vehicle, and beyond 1/2 mile from supermarket
LowIncomeTracts	Low income tract	Flag for low income tract
PovertyRate	Tract poverty rate	Share of the tract population living with income at or below the Federal poverty thresholds for family size
MedianFamilyIncome	Tract median family income	Tract median family income

Label	Name	Description
LA1and10	Low access tract at 1 mile for urban areas and 10 miles for rural areas	Flag for low access tract at 1 mile for urban areas or 10 miles for rural areas
LAhalfand10	Low access tract at 1/2 mile for urban areas and 10 miles for rural areas	Flag for low access tract at 1/2 mile for urban areas or 10 miles for rural areas
LA1and20	Low access tract at 1 mile for urban areas and 20 miles for rural areas	Flag for low access tract at 1 mile for urban areas or 20 miles for rural areas
LATracts_half	Low access tract at 1/2 mile	Flag for low access tract when considering 1/2 mile distance
LATracts1	Low access tract at 1 mile	Flag for low access tract when considering 1 mile distance
LATracts10	Low access tract at 10 miles	Flag for low access tract when considering 10 mile distance
LATracts20	Low access tract at 20 miles	Flag for low access tract when considering 20 mile distance
LATractsVehicle_20	Low access tract using vehicle access and at 20 miles in rural areas	Flag for tract where >= 100 of households do not have a vehicle, and beyond 1/2 mile from supermarket; or >= 500 individuals are beyond 20 miles from supermarket; or >= 33% of individuals are beyond 20 miles from supermarket
LAPOP1_10	Low access, population at 1 mile for urban areas and 10 miles for rural areas, number	Population count beyond 1 mile for urban areas or 10 miles for rural areas from supermarket
LAPOP05_10	Low access, population at 1/2 mile for urban areas and 10 miles for rural areas, number	Population count beyond 1/2 mile for urban areas or 10 miles for rural areas from supermarket
LAPOP1_20	Low access, population at 1 mile for urban areas and 20 miles for rural areas, number	Population count beyond 1 mile for urban areas or 20 miles for rural areas from supermarket
LALOWI1_10	Low access, low-income population at 1 mile for urban areas and 10 miles for rural areas, number	Low income population count beyond 1 mile for urban areas or 10 miles for rural areas from supermarket
LALOWI05_10	Low access, low-income population at 1/2 mile for urban areas and 10 miles for rural areas, number	Low income population count beyond 1/2 mile for urban areas or 10 miles for rural areas from supermarket
LALOWI1_20	Low access, low-income population at 1 mile for urban areas and 20 miles for rural areas, number	Low income population count beyond 1 mile for urban areas or 20 miles for rural areas from supermarket
lapophalf	Low access, population at 1/2 mile, number	Population count beyond 1/2 mile from supermarket
lapophalfshare	Low access, population at 1/2 mile, share	Share of tract population that are beyond 1/2 mile from supermarket
lalowihalf	Low access, low-income population at 1/2 mile, number	Low income population count beyond 1/2 mile from supermarket
lalowihalfshare	Low access, low-income population at 1/2 mile, share	Share of tract population that are low income individuals beyond 1/2 mile from supermarket
lakidshalf	Low access, children age 0-17 at 1/2 mile, number	Kids population count beyond 1/2 mile from supermarket
lakidshalfshare	Low access, children age 0-17 at 1/2 mile, share	Share of tract population that are kids beyond 1/2 mile from supermarket
laseniorshalf	Low access, seniors age 65+ at 1/2 mile, number	Seniors population count beyond 1/2 mile from supermarket
laseniorshalfshare	Low access, seniors age 65+ at 1/2 mile, share	Share of tract population that are seniors beyond 1/2 mile from supermarket
lawhitehalf	Low access, White population at 1/2 mile, number	White population count beyond 1/2 mile from supermarket
lawhitehalfshare	Low access, White population at 1/2 mile, share	Share of tract population that are white beyond 1/2 mile from supermarket
lablackhalf	Low access, Black or African American population at 1/2 mile, number	Black or African American population count beyond 1/2 mile from supermarket

Label	Name	Description
lablackhalfshare	Low access, Black or African American population at 1/2 mile, share	Share of tract population that are Black or African American beyond 1/2 mile from supermarket
laasianhalf	Low access, Asian population at 1/2 mile, number	Asian population count beyond 1/2 mile from supermarket
laasianhalfshare	Low access, Asian population at 1/2 mile, share	Share of tract population that are Asian beyond 1/2 mile from supermarket
lanhopihalf	Low access, Native Hawaiian or Other Pacific Islander population at 1/2 mile, number	Native Hawaiian or Other Pacific Islander population count beyond 1/2 mile from supermarket
lanhopihalfshare	Low access, Native Hawaiian or Other Pacific Islander population at 1/2 mile, share	Share of tract population that are Native Hawaiian or Other Pacific Islander beyond 1/2 mile from supermarket
laaianhalf	Low access, American Indian or Alaska Native population at 1/2 mile, number	American Indian or Alaska Native population count beyond 1/2 mile from supermarket
laaianhalfshare	Low access, American Indian or Alaska Native population at 1/2 mile, share	Share of tract population that are American Indian or Alaska Native beyond 1/2 mile from supermarket
laomultirhalf	Low access, Other/Multiple race population at 1/2 mile, number	Other/Multiple race population count beyond 1/2 mile from supermarket
laomultirhalfshare	Low access, Other/Multiple race population at 1/2 mile, share	Share of tract population that are Other/Multiple race beyond 1/2 mile from supermarket
lahisphalf	Low access, Hispanic or Latino population at 1/2 mile, number	Hispanic or Latino ethnicity population count beyond 1/2 mile from supermarket
lahisphalfshare	Low access, Hispanic or Latino population at 1/2 mile, share	Share of tract population that are of Hispanic or Latino ethnicity beyond 1/2 mile from supermarket
lahunvhalf	Vehicle access, housing units without and low access at 1/2 mile, number	Housing units without vehicle count beyond 1/2 mile from supermarket
lahunvhalfshare	Vehicle access, housing units without and low access at 1/2 mile, share	Share of tract housing units that are without vehicle and beyond 1/2 mile from supermarket
lasnaphalf	Low access, housing units receiving SNAP benefits at 1/2 mile, number	Housing units receiving SNAP benefits count beyond 1/2 mile from supermarket
lasnaphalfshare	Low access, housing units receiving SNAP benefits at 1/2 mile, share	Share of tract housing units receiving SNAP benefits count beyond 1/2 mile from supermarket
lapop1	Low access, population at 1 mile, number	Population count beyond 1 mile from supermarket
lapop1share	Low access, population at 1 mile, share	Share of tract population that are beyond 1 mile from supermarket
lalowi1	Low access, low-income population at 1 mile, number	Low income population count beyond 1 mile from supermarket
lalowi1share	Low access, low-income population at 1 mile, share	Share of tract population that are low income individuals beyond 1 mile from supermarket
lakids1	Low access, children age 0-17 at 1 mile, number	Kids population count beyond 1 mile from supermarket
lakids1share	Low access, children age 0-17 at 1 mile, share	Share of tract population that are kids beyond 1 mile from supermarket
laseniors1	Low access, seniors age 65+ at 1 mile, number	Seniors population count beyond 1 mile from supermarket
laseniors1share	Low access, seniors age 65+ at 1 mile, share	Share of tract population that are seniors beyond 1 mile from supermarket
lawhite1	Low access, White population at 1 mile, number	White population count beyond 1 mile from supermarket

Label	Name	Description
lawhite1share	Low access, White population at 1 mile, share	Share of tract population that are white beyond 1 mile from supermarket
lablack1	Low access, Black or African American population at 1 mile, number	Black or African American population count beyond 1 mile from supermarket
lablack1share	Low access, Black or African American population at 1 mile, share	Share of tract population that are Black or African American beyond 1 mile from supermarket
laasian1	Low access, Asian population at 1 mile, number	Asian population count beyond 1 mile from supermarket
laasian1share	Low access, Asian population at 1 mile, share	Share of tract population that are Asian beyond 1 mile from supermarket
lanhopi1	Low access, Native Hawaiian and Other Pacific Islander population at 1 mile, number	Native Hawaiian or Other Pacific Islander population count beyond 1 mile from supermarket
lanhopi1share	Low access, Native Hawaiian and Other Pacific Islander population at 1 mile, share	Share of tract population that are Native Hawaiian or Other Pacific Islander beyond 1 mile from supermarket
laaian1	Low access, American Indian and Alaska Native population at 1 mile, number	American Indian or Alaska Native population count beyond 1 mile from supermarket
laaian1share	Low access, American Indian and Alaska Native population at 1 mile, share	Share of tract population that are American Indian or Alaska Native beyond 1 mile from supermarket
laomultir1	Low access, Other/Multiple race population at 1 mile, number	Other/Multiple race population count beyond 1 mile from supermarket
laomultir1share	Low access, Other/Multiple race population at 1 mile, share	Share of tract population that are Other/Multiple race beyond 1 mile from supermarket
lahisp1	Low access, Hispanic or Latino population at 1 mile, number	Hispanic or Latino ethnicity population count beyond 1 mile from supermarket
lahisp1share	Low access, Hispanic or Latino population at 1 mile, share	Share of tract population that are of Hispanic or Latino ethnicity beyond 1 mile from supermarket
lahunv1	Vehicle access, housing units without and low access at 1 mile, number	Housing units without vehicle count beyond 1 mile from supermarket
lahunv1share	Vehicle access, housing units without and low access at 1 mile, share	Share of tract housing units that are without vehicle and beyond 1 mile from supermarket
lasnap1	Low access, housing units receiving SNAP benefits at 1 mile, number	Housing units receiving SNAP benefits count beyond 1 mile from supermarket
lasnap1share	Low access, housing units receiving SNAP benefits at 1 mile, share	Share of tract housing units receiving SNAP benefits count beyond 1 mile from supermarket
lapop10	Low access, population at 10 miles, number	Population count beyond 10 miles from supermarket
lapop10share	Low access, population at 10 miles, share	Share of tract population that are beyond 10 miles from supermarket
lalowi10	Low access, low-income population at 10 miles, number	Low income population count beyond 10 miles from supermarket
lalowi10share	Low access, low-income population at 10 miles, share	Share of tract population that are low income individuals beyond 10 miles from supermarket
lakids10	Low access, children age 0-17 at 10 miles, number	Kids population count beyond 10 miles from supermarket
lakids10share	Low access, children age 0-17 at 10 miles, share	Share of tract population that are kids beyond 10 miles from supermarket
laseniors10	Low access, seniors age 65+ at 10 miles, number	Seniors population count beyond 10 miles from supermarket
laseniors10share	Low access, seniors age 65+ at 10 miles, share	Share of tract population that are seniors beyond 10 miles from supermarket

Label	Name	Description
lawhite10	Low access, White population at 10 miles, number	White population count beyond 10 miles from supermarket
lawhite10share	Low access, White population at 10 miles, share	Share of tract population that are white beyond 10 miles from supermarket
lablack10	Low access, Black or African American population at 10 miles, number	Black or African American population count beyond 10 miles from supermarket
lablack10share	Low access, Black or African American population at 10 miles, share	Share of tract population that are Black or African American beyond 10 miles from supermarket
laasian10	Low access, Asian population at 10 miles, number	Asian population count beyond 10 miles from supermarket
laasian10share	Low access, Asian population at 10 miles, share	Share of tract population that are Asian beyond 10 miles from supermarket
lanhopi10	Low access, Native Hawaiian and Other Pacific Islander population at 10 miles, number	Native Hawaiian or Other Pacific Islander population count beyond 10 miles from supermarket
lanhopi10share	Low access, Native Hawaiian and Other Pacific Islander population at 10 miles, share	Share of tract population that are Native Hawaiian or Other Pacific Islander beyond 10 miles from supermarket
laaian10	Low access, American Indian and Alaska Native population at 10 miles, number	American Indian or Alaska Native population count beyond 10 miles from supermarket
laaian10share	Low access, American Indian and Alaska Native population at 10 miles, share	Share of tract population that are American Indian or Alaska Native beyond 10 miles from supermarket
laomultir10	Low access, Other/Multiple race population at 10 miles, number	Other/Multiple race population count beyond 10 miles from supermarket
laomultir10share	Low access, Other/Multiple race population at 10 miles, share	Share of tract population that are Other/Multiple race beyond 10 miles from supermarket
lahisp10	Low access, Hispanic or Latino population at 10 miles, number	Hispanic or Latino ethnicity population count beyond 10 miles from supermarket
lahisp10share	Low access, Hispanic or Latino population at 10 miles, share	Share of tract population that are of Hispanic or Latino ethnicity beyond 10 miles from supermarket
lahunv10	Vehicle access, housing units without and low access at 10 miles, number	Housing units without vehicle count beyond 10 miles from supermarket
lahunv10share	Vehicle access, housing units without and low access at 10 miles, share	Share of tract housing units that are without vehicle and beyond 10 miles from supermarket
lasnap10	Low access, housing units receiving SNAP benefits at 10 miles, number	Housing units receiving SNAP benefits count beyond 10 miles from supermarket
lasnap10share	Low access, housing units receiving SNAP benefits at 10 miles, share	Share of tract housing units receiving SNAP benefits count beyond 10 miles from supermarket
lapop20	Low access, population at 20 miles, number	Population count beyond 20 miles from supermarket
lapop20share	Low access, population at 20 miles, share	Share of tract population that are beyond 20 miles from supermarket
lalowi20	Low access, low-income population at 20 miles, number	Low income population count beyond 20 miles from supermarket
lalowi20share	Low access, low-income population at 20 miles, share	Share of tract population that are low income individuals beyond 20 miles from supermarket
lakids20	Low access, children age 0-17 at 20 miles, number	Kids population count beyond 20 miles from supermarket
lakids20share	Low access, children age 0-17 at 20 miles, share	Share of tract population that are kids beyond 20 miles from supermarket

Label	Name	Description
laseniors20	Low access, seniors age 65+ at 20 miles, number	Seniors population count beyond 20 miles from supermarket
laseniors20share	Low access, seniors age 65+ at 20 miles, share	Share of tract population that are seniors beyond 20 miles from supermarket
lawhite20	Low access, White population at 20 miles, number	White population count beyond 20 miles from supermarket
lawhite20share	Low access, White population at 20 miles, share	Share of tract population that are white beyond 20 miles from supermarket
lablack20	Low access, Black or African American population at 20 miles, number	Black or African American population count beyond 20 miles from supermarket
lablack20share	Low access, Black or African American population at 20 miles, share	Share of tract population that are Black or African American beyond 20 miles from supermarket
laasian20	Low access, Asian population at 20 miles, number	Asian population count beyond 20 miles from supermarket
laasian20share	Low access, Asian population at 20 miles, share	Share of tract population that are Asian beyond 20 miles from supermarket
lanhopi20	Low access, Native Hawaiian and Other Pacific Islander population at 20 miles, number	Native Hawaiian or Other Pacific Islander population count beyond 20 miles from supermarket
lanhopi20share	Low access, Native Hawaiian and Other Pacific Islander population at 20 miles, share	Share of tract population that are Native Hawaiian or Other Pacific Islander beyond 20 miles from supermarket
laaian20	Low access, American Indian and Alaska Native population at 20 miles, number	American Indian or Alaska Native population count beyond 20 miles from supermarket
laaian20share	Low access, American Indian and Alaska Native population at 20 miles, share	Share of tract population that are American Indian or Alaska Native beyond 20 miles from supermarket
laomultir20	Low access, Other/Multiple race population at 20 miles, number	Other/Multiple race population count beyond 20 miles from supermarket
laomultir20share	Low access, Other/Multiple race population at 20 miles, share	Share of tract population that are Other/Multiple race beyond 20 miles from supermarket
lahisp20	Low access, Hispanic or Latino population at 20 miles, number	Hispanic or Latino ethnicity population count beyond 20 miles from supermarket
lahisp20share	Low access, Hispanic or Latino population at 20 miles, share	Share of tract population that are of Hispanic or Latino ethnicity beyond 20 miles from supermarket
lahunv20	Vehicle access, housing units without and low access at 20 miles, number	Housing units without vehicle count beyond 20 miles from supermarket
lahunv20share	Vehicle access, housing units without and low access at 20 miles, share	Share of tract housing units that are without vehicle and beyond 20 miles from supermarket
lasnap20	Low access, housing units receiving SNAP benefits at 20 miles, number	Housing units receiving SNAP benefits count beyond 20 miles from supermarket
lasnap20share	Low access, housing units receiving SNAP benefits at 20 miles, share	Share of tract housing units receiving SNAP benefits count beyond 20 miles from supermarket
TractLOWI	Tract low-income population, number	Total count of low-income population in tract
TractKids	Tract children age 0-17, number	Total count of children age 0-17 in tract
TractSeniors	Tract seniors age 65+, number	Total count of seniors age 65+ in tract
TractWhite	Tract White population, number	Total count of White population in tract
TractBlack	Tract Black or African American population, number	Total count of Black or African American population in tract

Label	Name	Description
TractAsian	Tract Asian population, number	Total count of Asian population in tract
TractNHOPI	Tract Native Hawaiian and Other Pacific Islander population, number	Total count of Native Hawaiian and Other Pacific Islander population in tract
TractAIAN	Tract American Indian and Alaska Native population, number	Total count of American Indian and Alaska Native population in tract
TractOMultir	Tract Other/Multiple race population, number	Total count of Other/Multiple race population in tract
TractHispanic	Tract Hispanic or Latino population, number	Total count of Hispanic or Latino population in tract
TractHUNV	Tract housing units without a vehicle, number	Total count of housing units without a vehicle in tract
TractSNAP	Tract housing units receiving SNAP benefits, number	Total count of housing units receiving SNAP benefits in tract
ADI_NATRANK	ADI national rank	ADI national rank
ADI_STATERNK	ADI state rank	ADI state rank
POPUNI_heat19	Community resilience - Heat - 2019 - Total population	Community resilience - Heat - 2019 - Total population
PRED0_E_heat19	Community resilience - Heat - 2019 - Estimated number of individuals with zero risk factors	Community resilience - Heat - 2019 - Estimated number of individuals with zero risk factors
PRED0_M_heat19	Community resilience - Heat - 2019 - Estimated margin of error for individuals with zero risk factors	Community resilience - Heat - 2019 - Estimated margin of error for individuals with zero risk factors
PRED0_PE_heat19	Community resilience - Heat - 2019 - Rate of individuals with zero risk factors	Community resilience - Heat - 2019 - Rate of individuals with zero risk factors
PRED0_PM_heat19	Community resilience - Heat - 2019 - Rate margin of error for individuals with zero risk factors	Community resilience - Heat - 2019 - Rate margin of error for individuals with zero risk factors
PRED12_E_heat19	Community resilience - Heat - 2019 - Estimated number of individuals with one-two risk factors	Community resilience - Heat - 2019 - Estimated number of individuals with one-two risk factors
PRED12_M_heat19	Community resilience - Heat - 2019 - Estimated margin of error for individuals with one-two risk factors	Community resilience - Heat - 2019 - Estimated margin of error for individuals with one-two risk factors
PRED12_PE_heat19	Community resilience - Heat - 2019 - Rate of individuals with one-two risk factors	Community resilience - Heat - 2019 - Rate of individuals with one-two risk factors
PRED12_PM_heat19	Community resilience - Heat - 2019 - Rate margin of error for individuals with one-two risk factors	Community resilience - Heat - 2019 - Rate margin of error for individuals with one-two risk factors
PRED3_E_heat19	Community resilience - Heat - 2019 - Estimated number of individuals with three plus risk factors	Community resilience - Heat - 2019 - Estimated number of individuals with three plus risk factors
PRED3_M_heat19	Community resilience - Heat - 2019 - Estimated margin of error for individuals with three plus risk factors	Community resilience - Heat - 2019 - Estimated margin of error for individuals with three plus risk factors
PRED3_PE_heat19	Community resilience - Heat - 2019 - Rate of individuals with three plus risk factors	Community resilience - Heat - 2019 - Rate of individuals with three plus risk factors
PRED3_PM_heat19	Community resilience - Heat - 2019 - Rate margin of error for individuals with three plus risk factors	Community resilience - Heat - 2019 - Rate margin of error for individuals with three plus risk factors
POPUNI_heat22	Community resilience - Heat - 2022 - Total population	Community resilience - Heat - 2022 - Total population

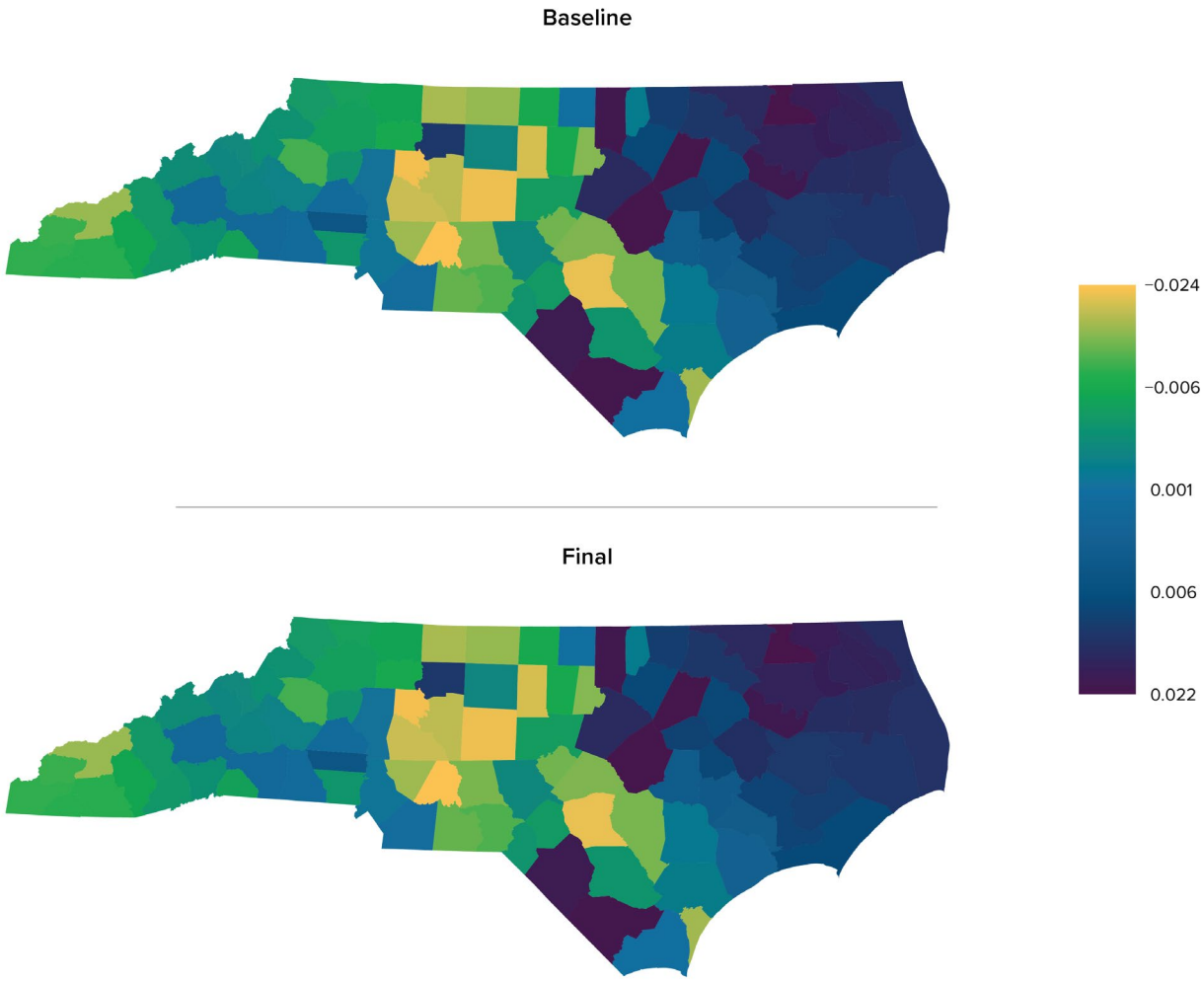
Label	Name	Description
PRED0_E_heat22	Community resilience - Heat - 2022 - Estimated number of individuals with zero risk factors	Community resilience - Heat - 2022 - Estimated number of individuals with zero risk factors
PRED0_M_heat22	Community resilience - Heat - 2022 - Estimated margin of error for individuals with zero risk factors	Community resilience - Heat - 2022 - Estimated margin of error for individuals with zero risk factors
PRED0_PE_heat22	Community resilience - Heat - 2022 - Rate of individuals with zero risk factors	Community resilience - Heat - 2022 - Rate of individuals with zero risk factors
PRED0_PM_heat22	Community resilience - Heat - 2022 - Rate margin of error for individuals with zero risk factors	Community resilience - Heat - 2022 - Rate margin of error for individuals with zero risk factors
PRED12_E_heat22	Community resilience - Heat - 2022 - Estimated number of individuals with one-two risk factors	Community resilience - Heat - 2022 - Estimated number of individuals with one-two risk factors
PRED12_M_heat22	Community resilience - Heat - 2022 - Estimated margin of error for individuals with one-two risk factors	Community resilience - Heat - 2022 - Estimated margin of error for individuals with one-two risk factors
PRED12_PE_heat22	Community resilience - Heat - 2022 - Rate of individuals with one-two risk factors	Community resilience - Heat - 2022 - Rate of individuals with one-two risk factors
PRED12_PM_heat22	Community resilience - Heat - 2022 - Rate margin of error for individuals with one-two risk factors	Community resilience - Heat - 2022 - Rate margin of error for individuals with one-two risk factors
PRED3_E_heat22	Community resilience - Heat - 2022 - Estimated number of individuals with three plus risk factors	Community resilience - Heat - 2022 - Estimated number of individuals with three plus risk factors
PRED3_M_heat22	Community resilience - Heat - 2022 - Estimated margin of error for individuals with three plus risk factors	Community resilience - Heat - 2022 - Estimated margin of error for individuals with three plus risk factors
PRED3_PE_heat22	Community resilience - Heat - 2022 - Rate of individuals with three plus risk factors	Community resilience - Heat - 2022 - Rate of individuals with three plus risk factors
PRED3_PM_heat22	Community resilience - Heat - 2022 - Rate margin of error for individuals with three plus risk factors	Community resilience - Heat - 2022 - Rate margin of error for individuals with three plus risk factors
LONG_90_DAY	Longest consecutive number of days where the temperature was at or above 90 degrees F in 2022	Longest consecutive number of days where the temperature was at or above 90 degrees F in 2022
MAX_WBT	Maximum recorded wet bulb temperature in 2022	Maximum recorded wet bulb temperature in 2022
EXPOSED	Meets the definition of having a heat event for the CRE for Heat.	Meets the definition of having a heat event for the CRE for Heat.
POPUNI_nat19	Community resilience - Natural disaster - 2019 - Total population	Community resilience - Natural disaster - 2019 - Total population
PRED0_E_nat19	Community resilience - Natural disaster - 2019 - Estimated number of individuals with zero risk factors	Community resilience - Natural disaster - 2019 - Estimated number of individuals with zero risk factors
PRED0_M_nat19	Community resilience - Natural disaster - 2019 - Estimated margin of error for individuals with zero risk factors	Community resilience - Natural disaster - 2019 - Estimated margin of error for individuals with zero risk factors
PRED0_PE_nat19	Community resilience - Natural disaster - 2019 - Rate of individuals with zero risk factors	Community resilience - Natural disaster - 2019 - Rate of individuals with zero risk factors
PRED0_PM_nat19	Community resilience - Natural disaster - 2019 - Rate margin of error for individuals with zero risk factors	Community resilience - Natural disaster - 2019 - Rate margin of error for individuals with zero risk factors

Label	Name	Description
PRED12_E_nat19	Community resilience - Natural disaster - 2019 - Estimated number of individuals with one-two risk factors	Community resilience - Natural disaster - 2019 - Estimated number of individuals with one-two risk factors
PRED12_M_nat19	Community resilience - Natural disaster - 2019 - Estimated margin of error for individuals with one-two risk factors	Community resilience - Natural disaster - 2019 - Estimated margin of error for individuals with one-two risk factors
PRED12_PE_nat19	Community resilience - Natural disaster - 2019 - Rate of individuals with one-two risk factors	Community resilience - Natural disaster - 2019 - Rate of individuals with one-two risk factors
PRED12_PM_nat19	Community resilience - Natural disaster - 2019 - Rate margin of error for individuals with one-two risk factors	Community resilience - Natural disaster - 2019 - Rate margin of error for individuals with one-two risk factors
PRED3_E_nat19	Community resilience - Natural disaster - 2019 - Estimated number of individuals with three plus risk factors	Community resilience - Natural disaster - 2019 - Estimated number of individuals with three plus risk factors
PRED3_M_nat19	Community resilience - Natural disaster - 2019 - Estimated margin of error for individuals with three plus risk factors	Community resilience - Natural disaster - 2019 - Estimated margin of error for individuals with three plus risk factors
PRED3_PE_nat19	Community resilience - Natural disaster - 2019 - Rate of individuals with three plus risk factors	Community resilience - Natural disaster - 2019 - Rate of individuals with three plus risk factors
PRED3_PM_nat19	Community resilience - Natural disaster - 2019 - Rate margin of error for individuals with three plus risk factors	Community resilience - Natural disaster - 2019 - Rate margin of error for individuals with three plus risk factors
WATER_TRACT	Flag that denotes tracts composed completely of water, where no populations reside*	Flag that denotes tracts composed completely of water, where no populations reside*
POPUNI_nat22	Community resilience - Natural disaster - 2022 - Total population	Community resilience - Natural disaster - 2022 - Total population
PRED0_E_nat22	Community resilience - Natural disaster - 2022 - Estimated number of individuals with zero risk factors	Community resilience - Natural disaster - 2022 - Estimated number of individuals with zero risk factors
PRED0_M_nat22	Community resilience - Natural disaster - 2022 - Estimated margin of error for individuals with zero risk factors	Community resilience - Natural disaster - 2022 - Estimated margin of error for individuals with zero risk factors
PRED0_PE_nat22	Community resilience - Natural disaster - 2022 - Rate of individuals with zero risk factors	Community resilience - Natural disaster - 2022 - Rate of individuals with zero risk factors
PRED0_PM_nat22	Community resilience - Natural disaster - 2022 - Rate margin of error for individuals with zero risk factors	Community resilience - Natural disaster - 2022 - Rate margin of error for individuals with zero risk factors
PRED12_E_nat22	Community resilience - Natural disaster - 2022 - Estimated number of individuals with one-two risk factors	Community resilience - Natural disaster - 2022 - Estimated number of individuals with one-two risk factors
PRED12_M_nat22	Community resilience - Natural disaster - 2022 - Estimated margin of error for individuals with one-two risk factors	Community resilience - Natural disaster - 2022 - Estimated margin of error for individuals with one-two risk factors
PRED12_PE_nat22	Community resilience - Natural disaster - 2022 - Rate of individuals with one-two risk factors	Community resilience - Natural disaster - 2022 - Rate of individuals with one-two risk factors
PRED12_PM_nat22	Community resilience - Natural disaster - 2022 - Rate margin of error for individuals with one-two risk factors	Community resilience - Natural disaster - 2022 - Rate margin of error for individuals with one-two risk factors
PRED3_E_nat22	Community resilience - Natural disaster - 2022 - Estimated number of individuals with three plus risk factors	Community resilience - Natural disaster - 2022 - Estimated number of individuals with three plus risk factors

Label	Name	Description
PRED3_M_nat22	Community resilience - Natural disaster - 2022 - Estimated margin of error for individuals with three plus risk factors	Community resilience - Natural disaster - 2022 - Estimated margin of error for individuals with three plus risk factors
PRED3_PE_nat22	Community resilience - Natural disaster - 2022 - Rate of individuals with three plus risk factors	Community resilience - Natural disaster - 2022 - Rate of individuals with three plus risk factors
PRED3_PM_nat22	Community resilience - Natural disaster - 2022 - Rate margin of error for individuals with three plus risk factors	Community resilience - Natural disaster - 2022 - Rate margin of error for individuals with three plus risk factors
dist_superfund2_within5k	Indicator of if at least one listed superfund site is within 5 kilometers	Indicator of if at least one listed superfund site is within 5 kilometers
dist_superfund2_within10k	Indicator of if at least one listed superfund site is within 10 kilometers	Indicator of if at least one listed superfund site is within 10 kilometers
treecanopy_250m	250m Tree Canopy	Average NLCD 2021 tree canopy for 250m buffer around the school
avg_relative_humidity	Average relative humidity	average relative humidity from the NASA Power Project
avg_solar_radiation	Average solar radiation	average solar radiation from the NASA Power Project
avg_wind_speed	Average wind speed	average wind speed from the NASA Power Project
avg_precipitation	Average precipitation	average precipitation from the NASA Power Project
avg_temperature	Average temperature	average temperature from the NASA Power Project
road_dist	Road distance	road distance in meters
pm25_kg_annavg	PM2.5 Kriging Annual Average	2023 PM2.5 projected daily via kriging and averaged across all available days
pm25est_kg_annavgwknd	PM2.5 Kriging Weekend Average	2023 PM2.5 projected daily via kriging and averaged across weekend days
pm25est_kg_annavgwkdy	PM2.5 Kriging Weekday Average	2023 PM2.5 projected daily via kriging and averaged across week days
pm25est_kg_annavgsmmr	PM2.5 Kriging Summer Average	2023 PM2.5 projected daily via kriging and averaged across summer days
pm25est_kg_annavgschd	PM2.5 Kriging School Average	2023 PM2.5 projected daily via kriging and averaged across school days
pm25_idw_10_annavg	PM2.5 IDW Annual Average	2023 PM2.5 projected daily via inverse distance weighting and averaged across all available days
pm25est_idw_10_annavgwknd	PM2.5 IDW Weekend Average	2023 PM2.5 projected daily via inverse distance weighting and averaged across weekend days
pm25est_idw_10_annavgwkdy	PM2.5 IDW Weekday Average	2023 PM2.5 projected daily via inverse distance weighting and averaged across week days
pm25est_idw_10_annavgsmmr	PM2.5 IDW Summer Average	2023 PM2.5 projected daily via inverse distance weighting and averaged across summer days
pm25est_idw_10_annavgschd	PM2.5 IDW School day Average	2023 PM2.5 projected daily via inverse distance weighting and averaged across school days
pm25est_kg_annavgmay	PM2.5 Kriging May Average	2023 PM2.5 projected daily via kriging and averaged across days in the month of May

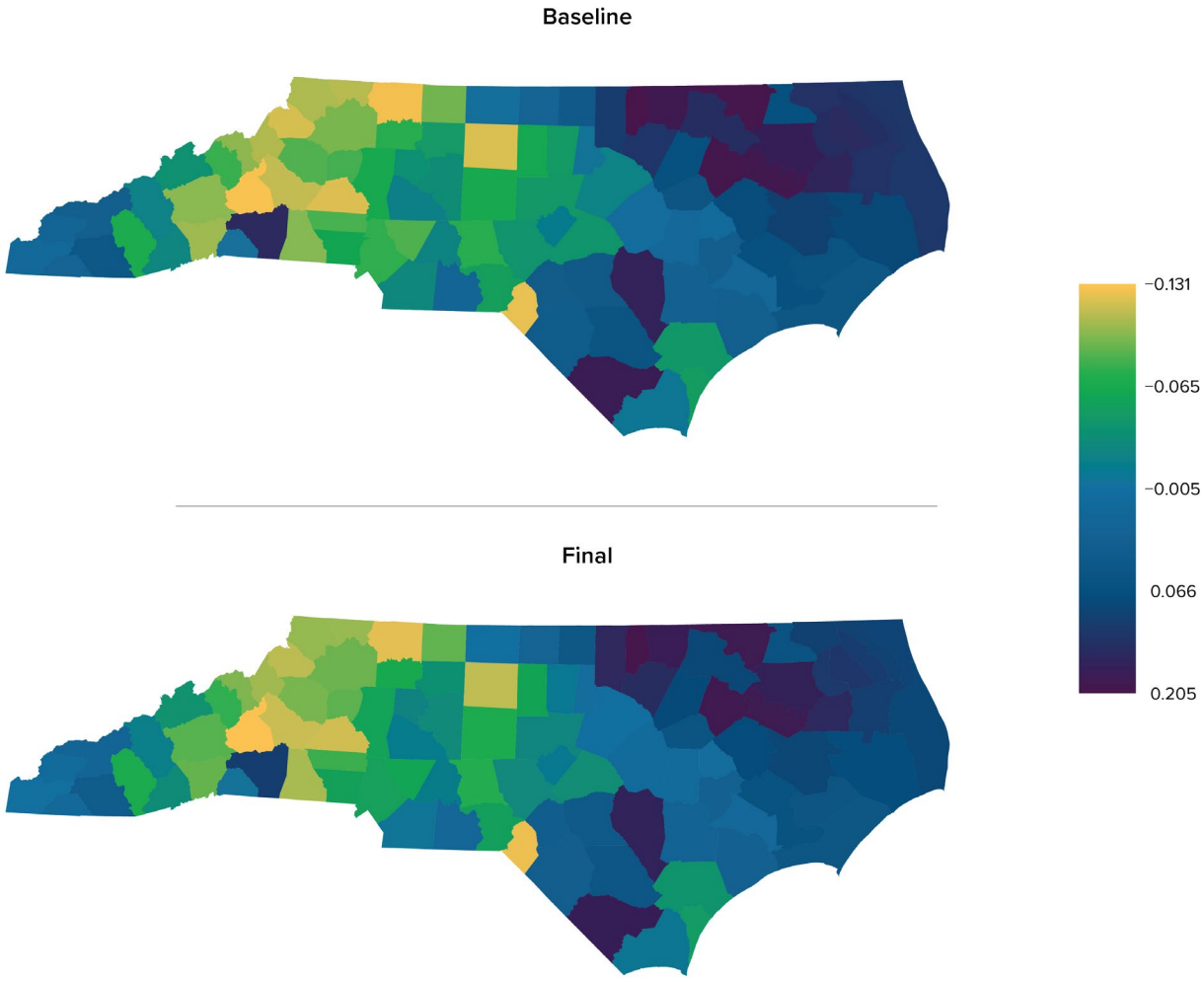
Appendix B: Spatial Random Effect Estimates

Figure B.1. Baseline and Final Model Spatial Random Effect Estimates for College Intent Rate



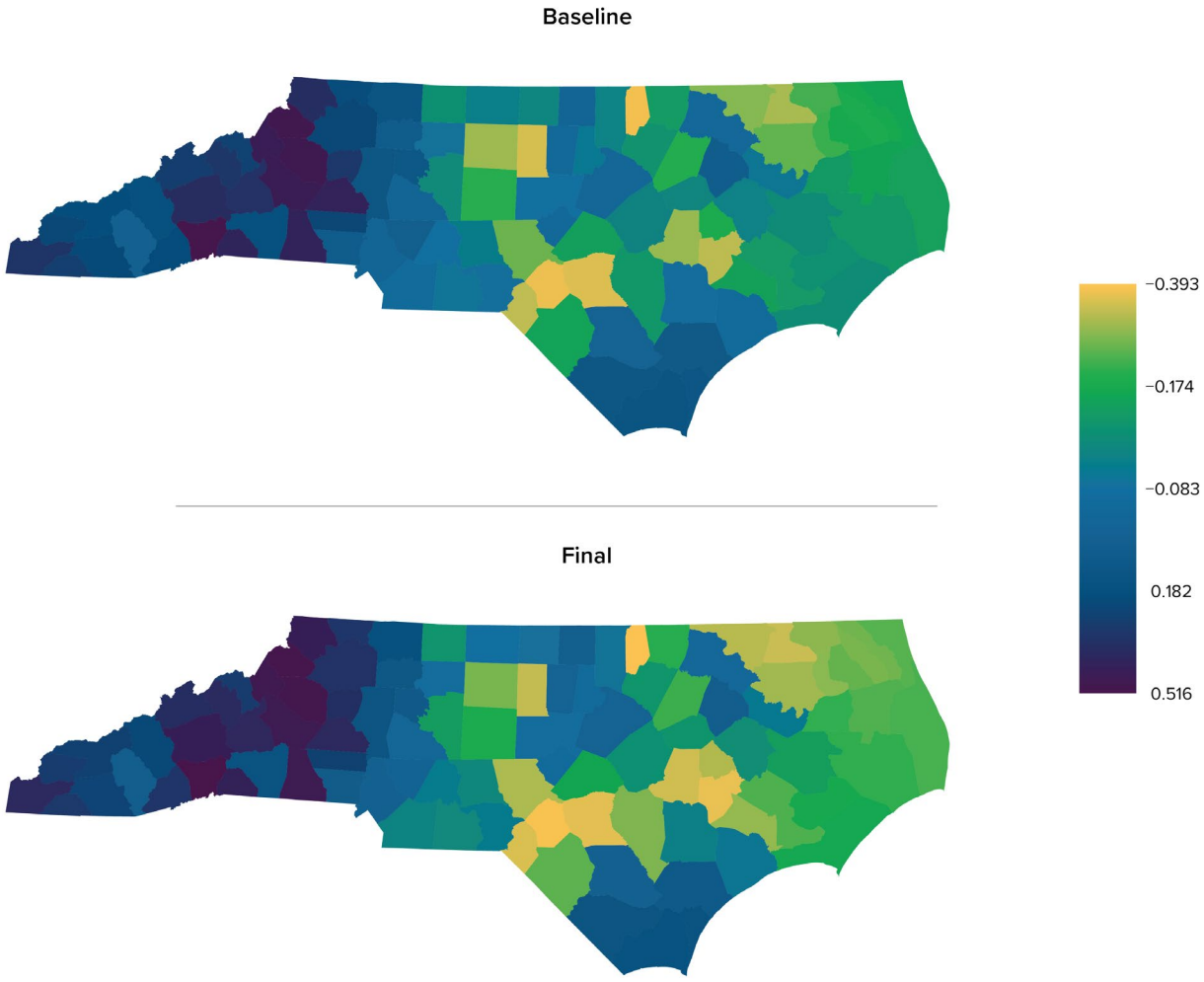
Note. Estimates for county retention rates are available in a tabular format in **Figure B.1 Supplement**.

Figure B.2. Baseline and Final Model Spatial Random Effect Estimates for Ever Retention Rate



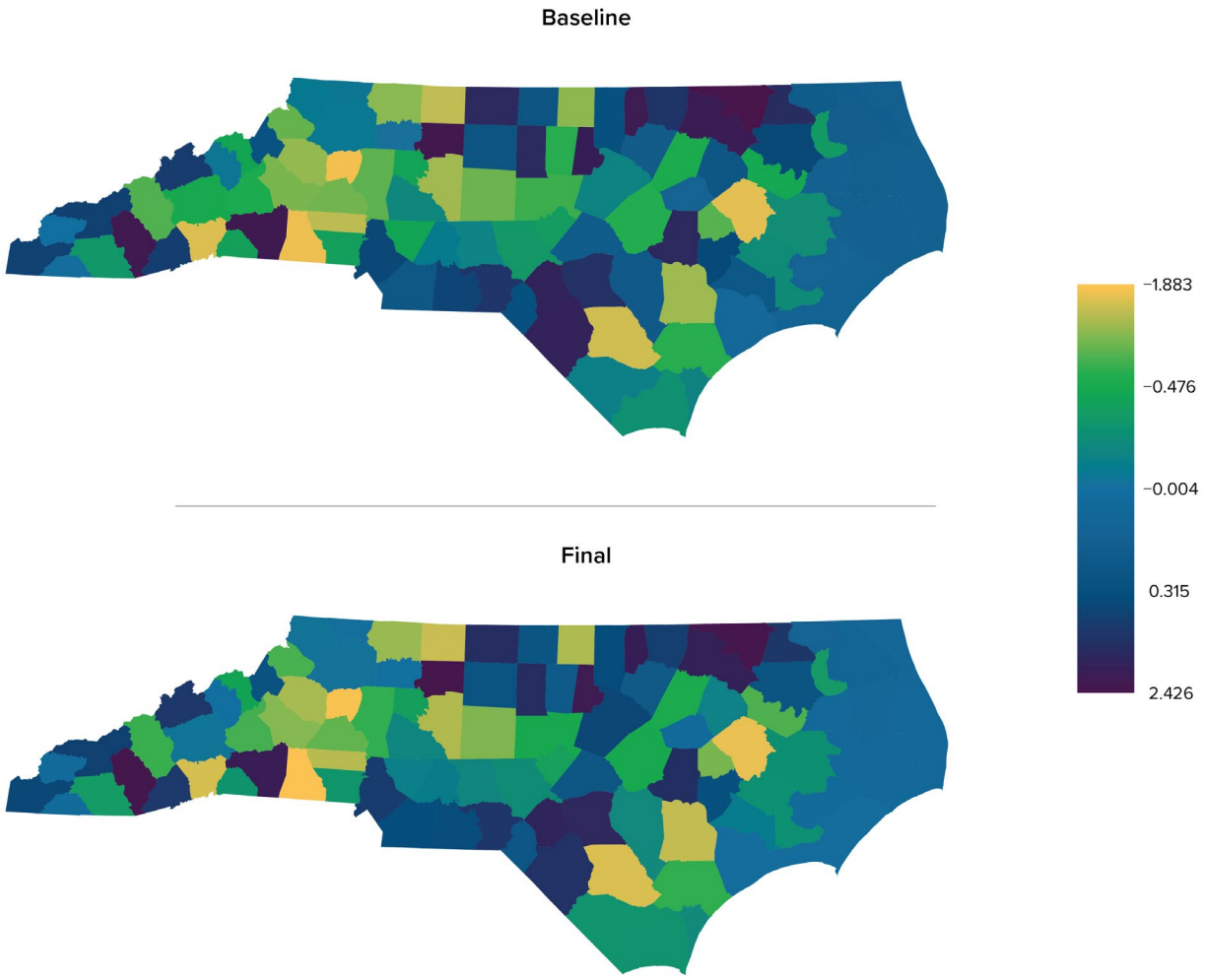
Note. Estimates for county retention rates are available in a tabular format in **Figure B.2 Supplement**.

Figure B.3. Baseline and Final Model Spatial Random Effect Estimates for Mean Quality Points



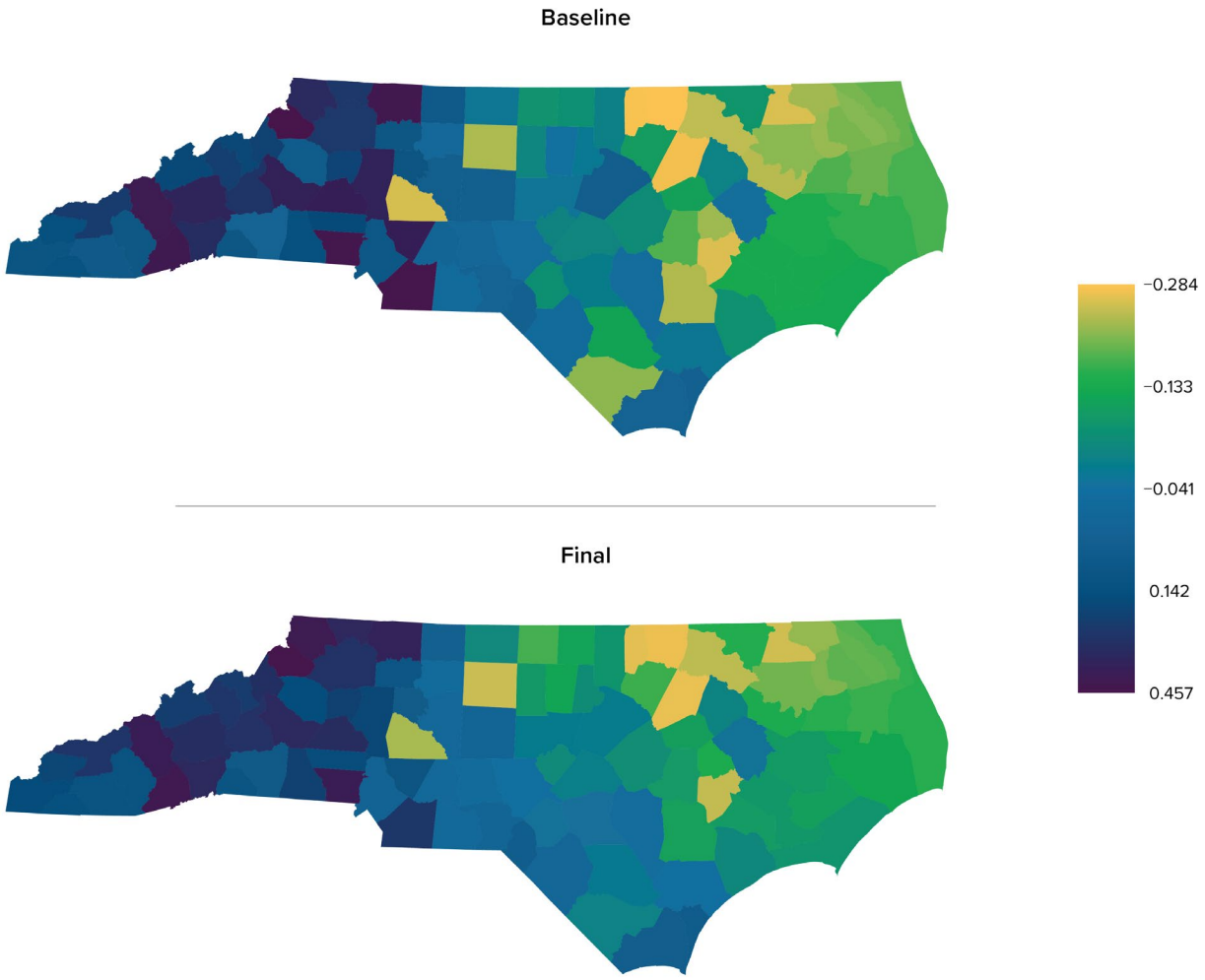
Note. Estimates for county retention rates are available in a tabular format in **Figure B.3 Supplement**.

Figure B.4. Baseline and Final Model Spatial Random Effect Estimates for Mean Percent Days Absent



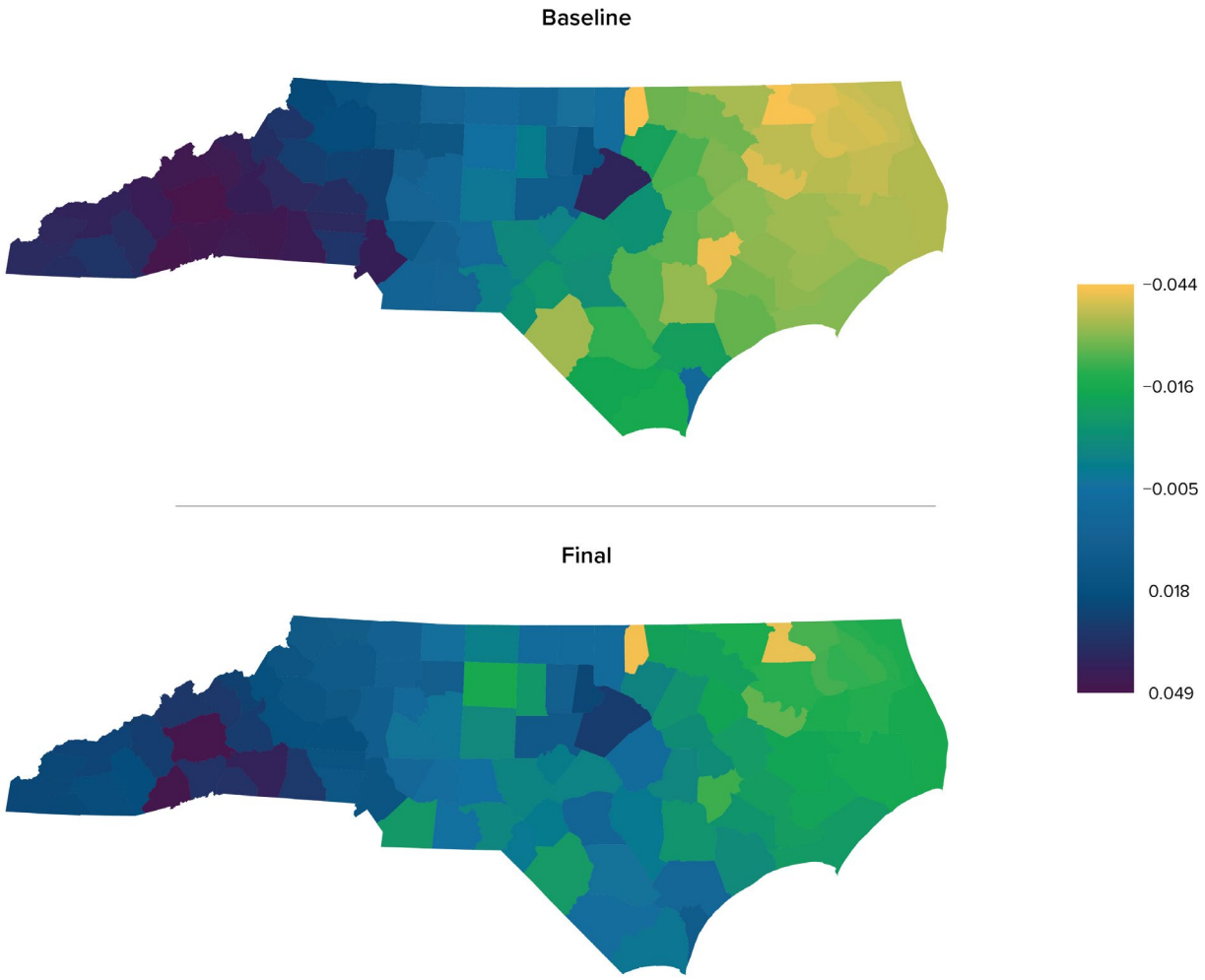
Note. Estimates for county retention rates are available in a tabular format in **Figure B.4 Supplement**.

Figure B.5. Baseline and Final Model Spatial Random Effect Estimates for Mean Algebra 1 Score



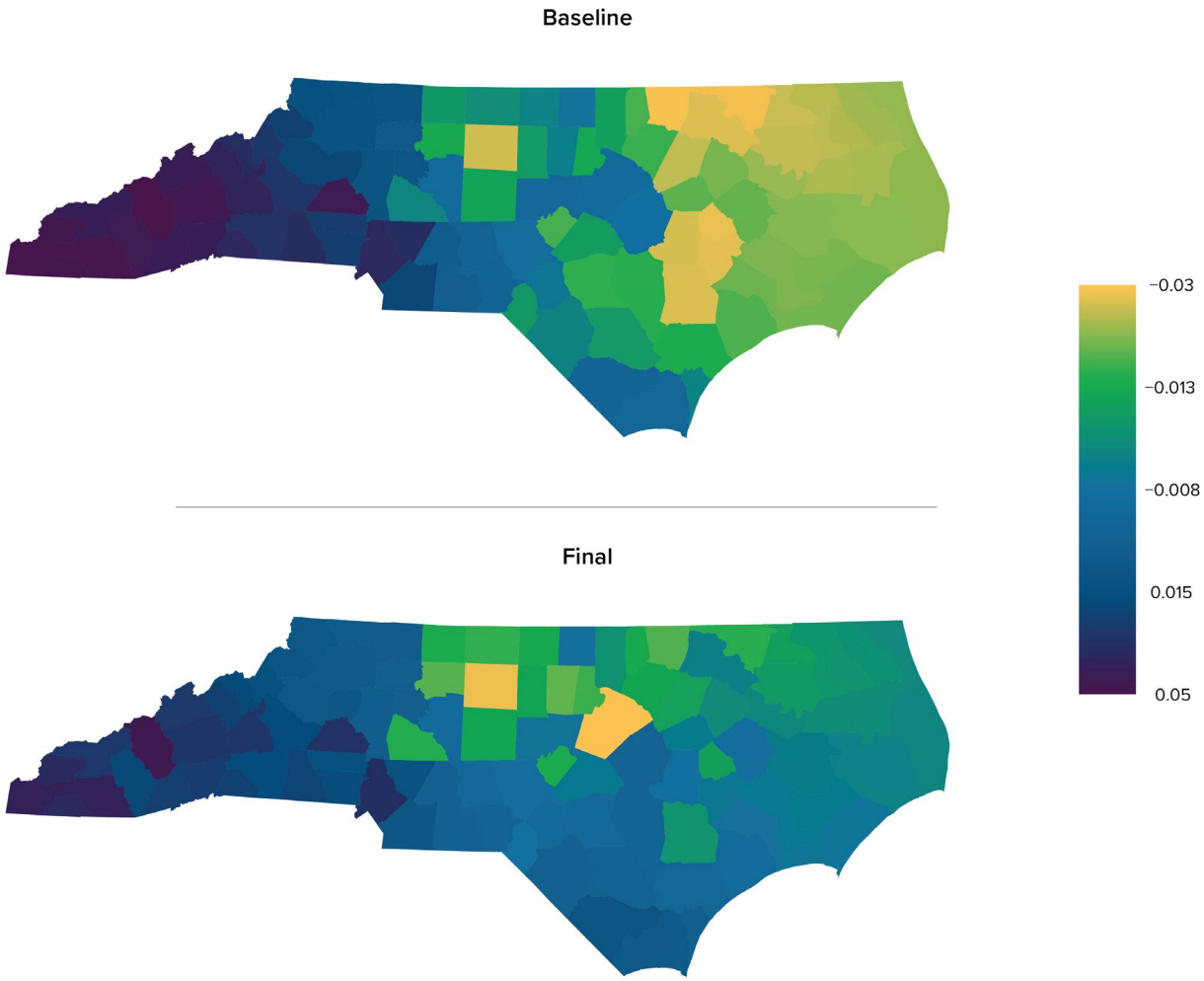
Note. Estimates for county retention rates are available in a tabular format in **Figure B.5 Supplement**.

Figure B.6. Baseline and Final Model Spatial Random Effect Estimates for Mean English 2 Score



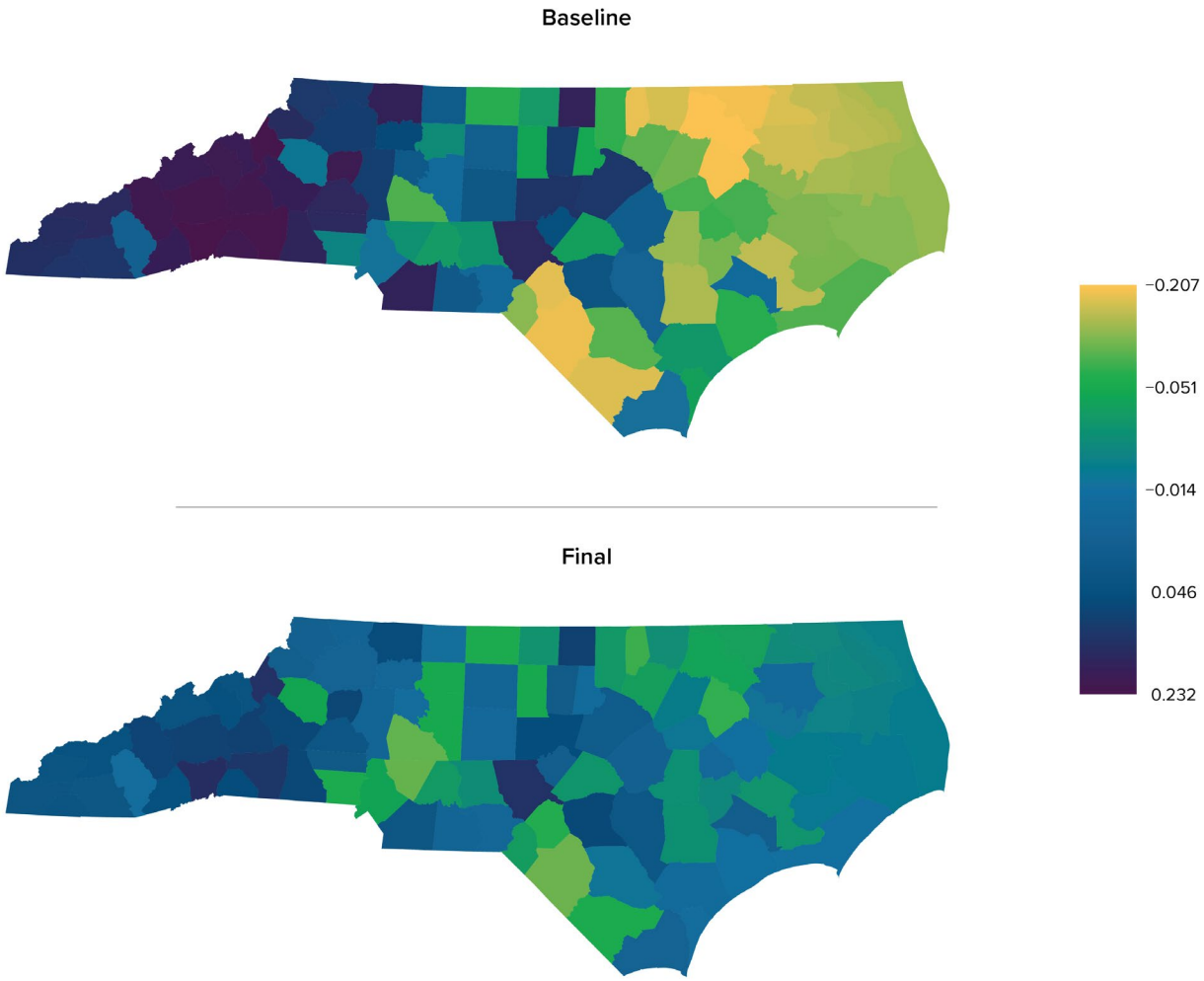
Note. Estimates for county retention rates are available in a tabular format in **Figure B.6 Supplement**.

Figure B.7. Baseline and Final Model Spatial Random Effect Estimates for Mean 8th-grade Math Score



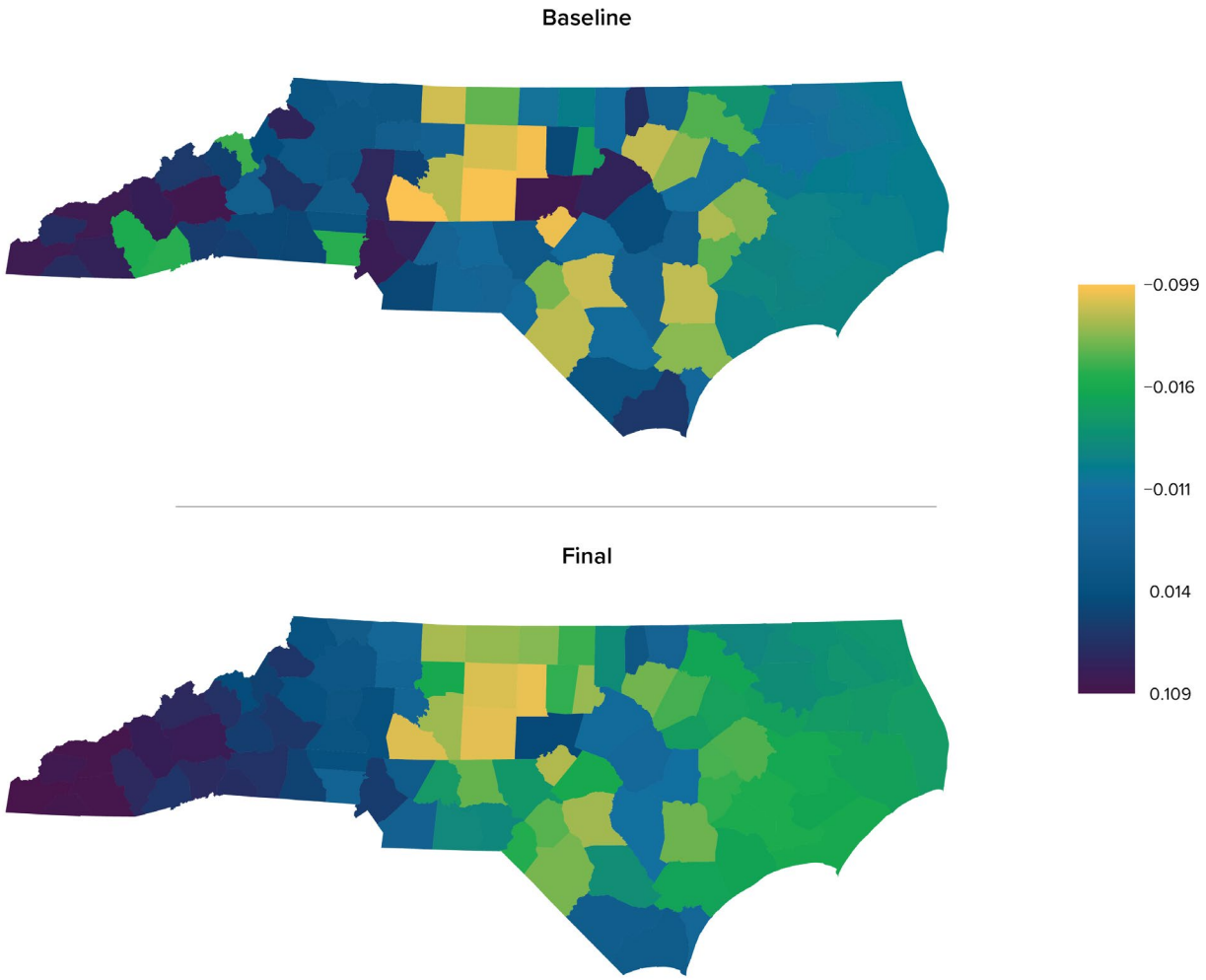
Note. Estimates for county retention rates are available in a tabular format in **Figure B.7 Supplement**.

Figure B.8. Baseline and Final Model Spatial Random Effect Estimates for Mean 3rd-Grade Reading Score



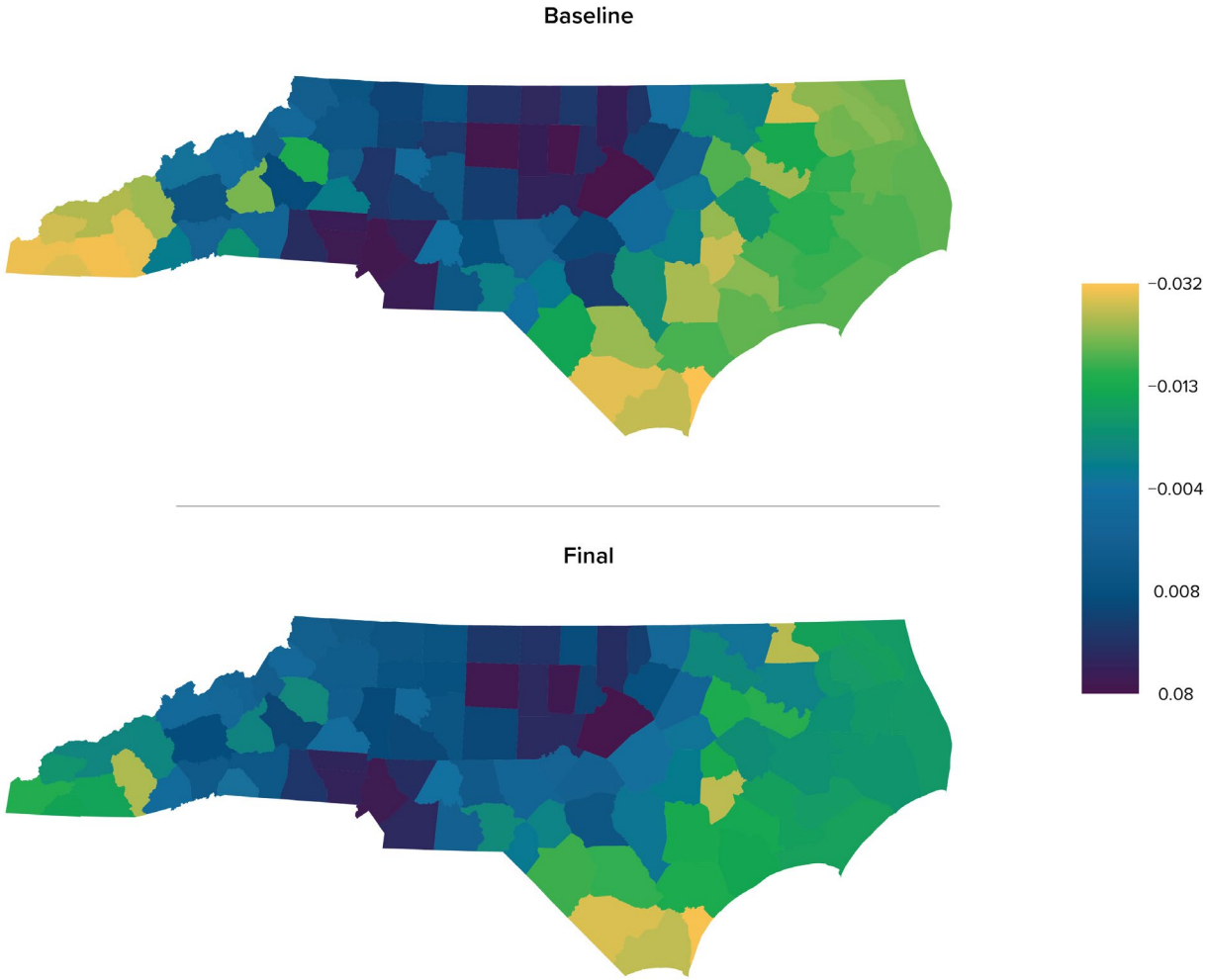
Note. Estimates for county retention rates are available in a tabular format in **Figure B.8 Supplement**.

Figure B.9. Baseline and Final Model Spatial Random Effect Estimates for Mean 8th-Grade Reading Score



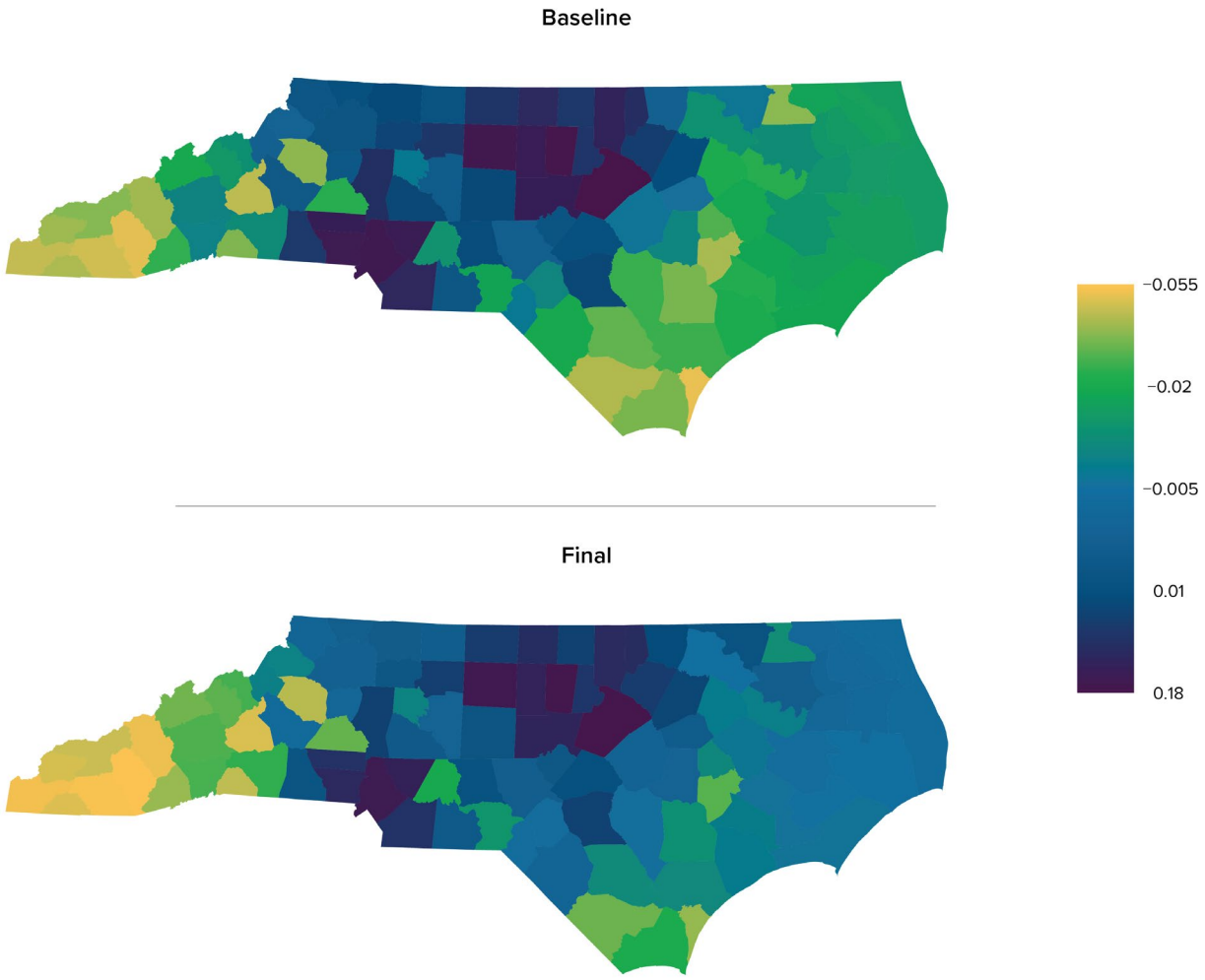
Note. Estimates for county retention rates are available in a tabular format in **Figure B.9 Supplement**.

Figure B.10. Baseline and Final Model Spatial Random Effect Estimates for the Rate of Taking AP Courses



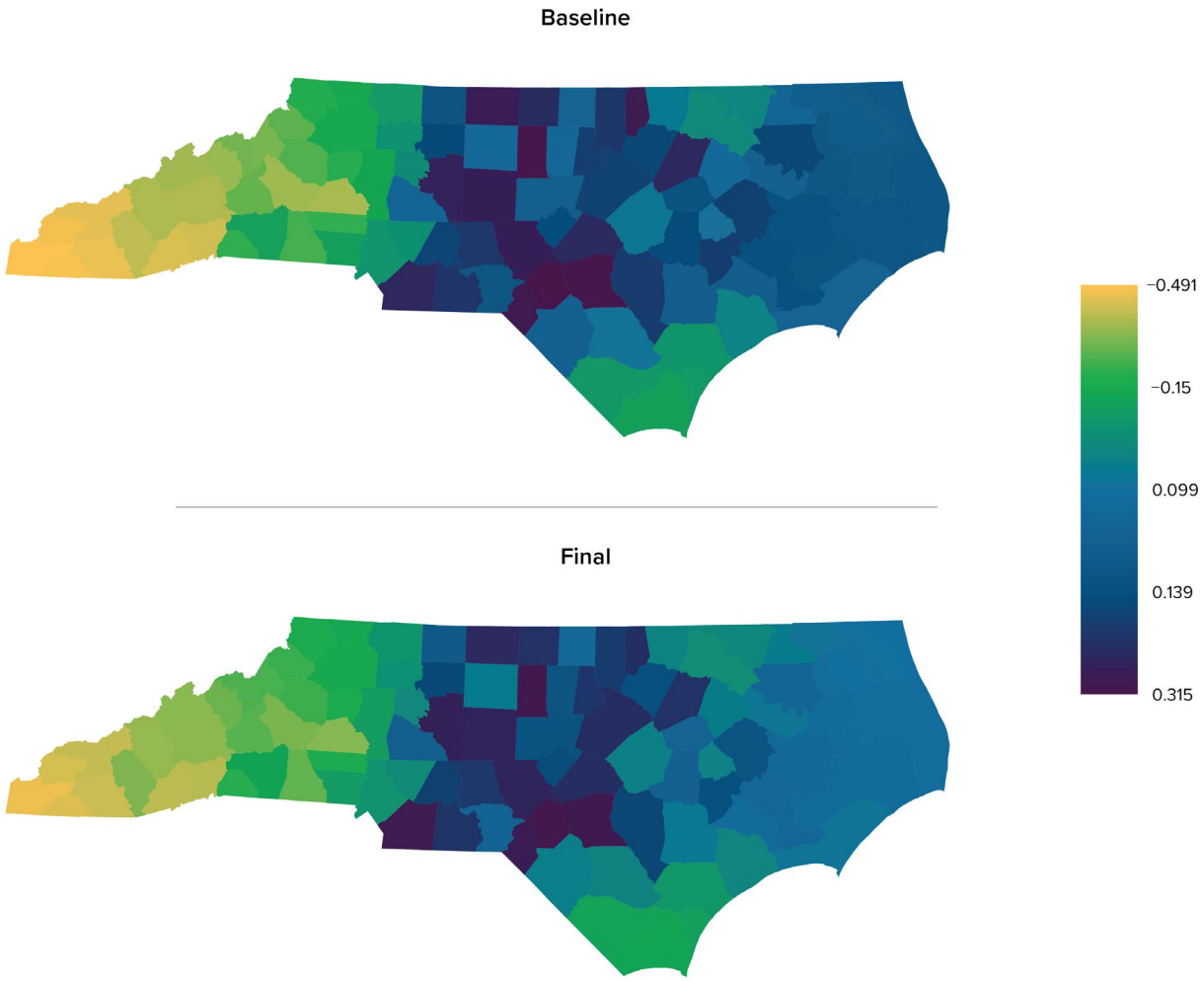
Note. Estimates for county retention rates are available in a tabular format in **Figure B.10 Supplement**.

Figure B.11. Baseline and Final Model Spatial Random Effect Estimates for Mean Number of AP Courses Taken



Note. Estimates for county retention rates are available in a tabular format in **Figure B.11 Supplement**.

Figure B.12. Baseline and Final Model Spatial Random Effect Estimates for Mean Number of Courses Failed



Note. Estimates for county retention rates are available in a tabular format in **Figure B.12 Supplement**.

Appendix C: Temporal Random Effect Estimates

Figure C.1. Associated Temporal Random Effect Estimates for College Intent Rate

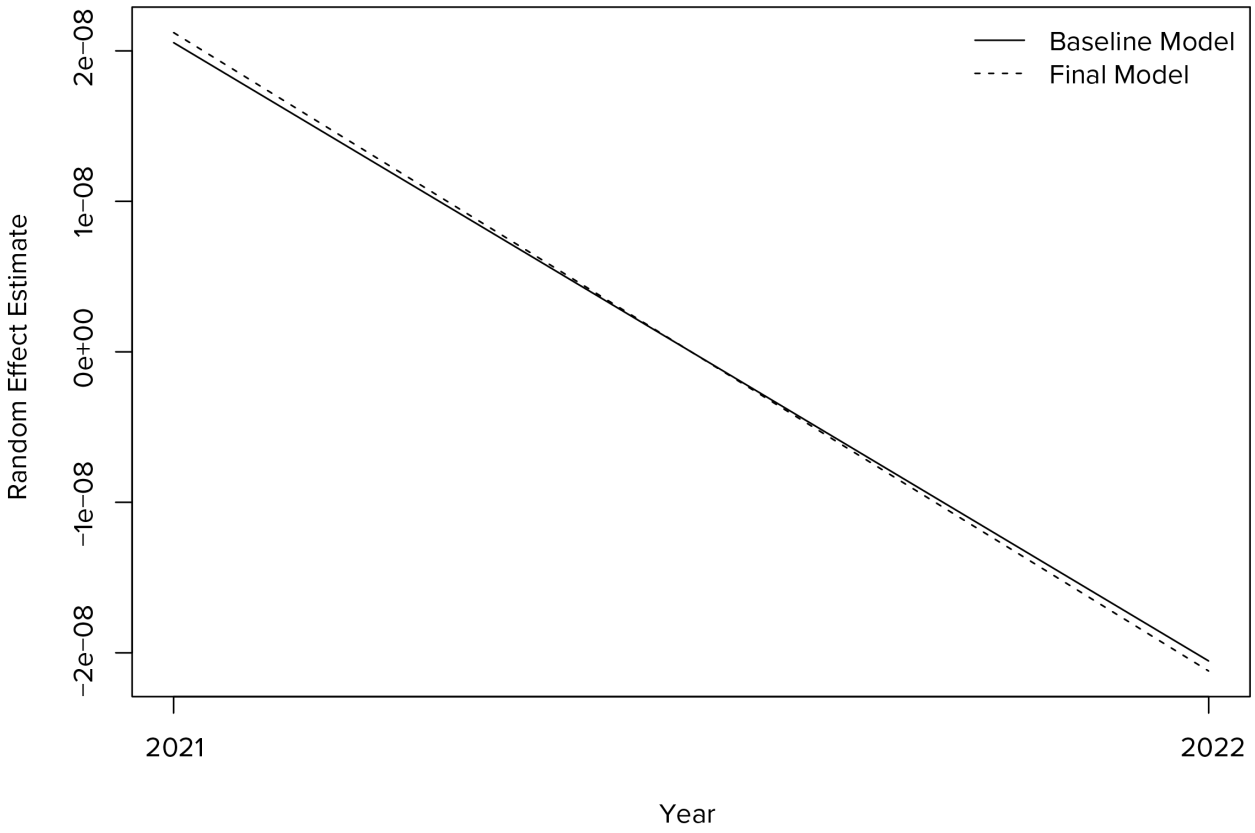


Figure C.2. Associated Temporal Random Effect Estimates for Ever Retention Rate

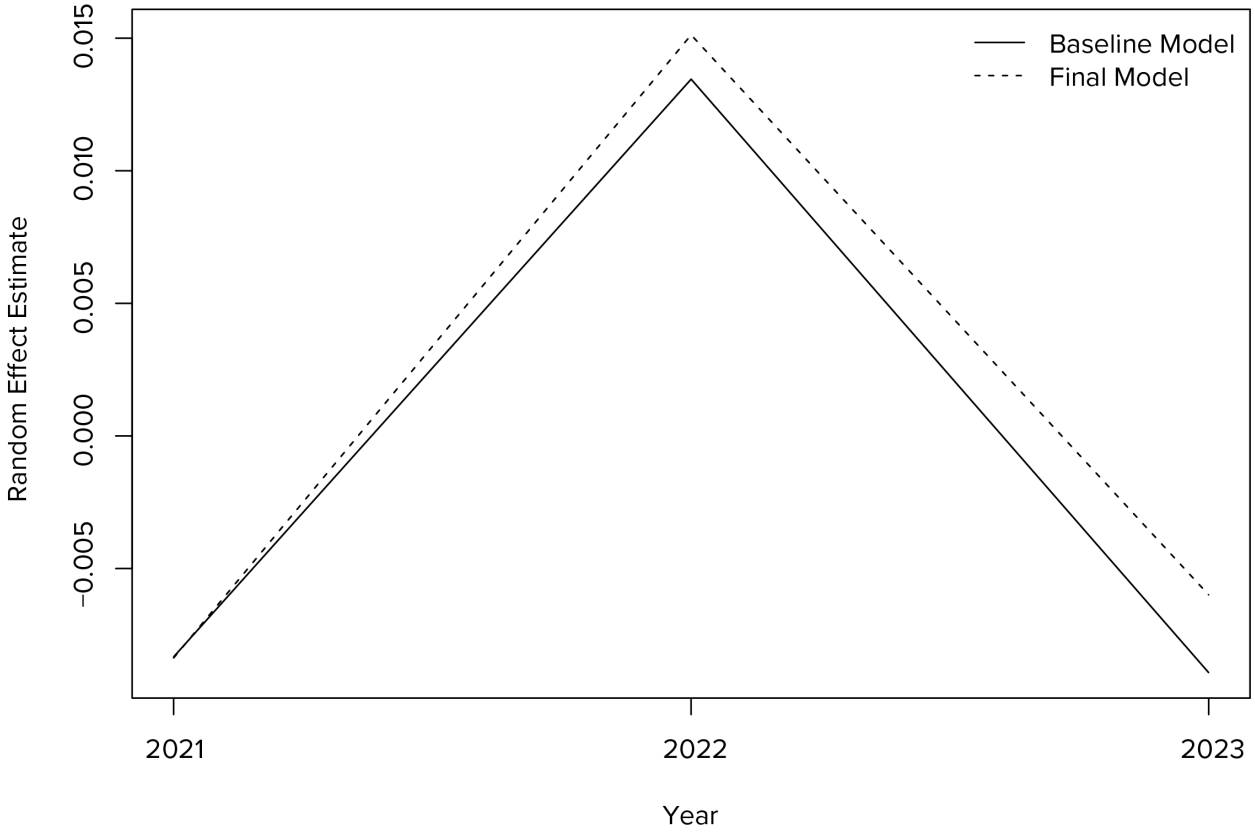


Figure C.3. Associated Temporal Random Effect Estimates for Mean Quality Points

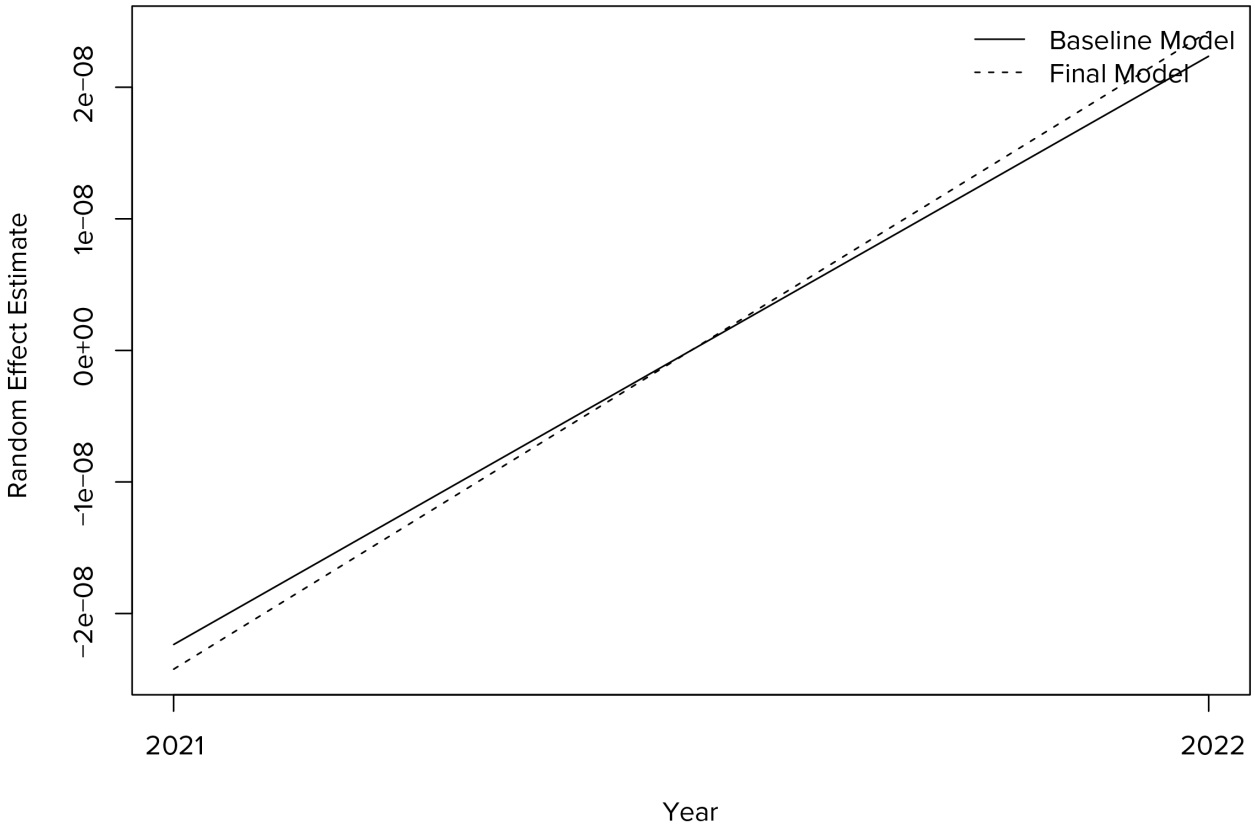


Figure C.4. Associated Temporal Random Effect Estimates for Percent Days Absent

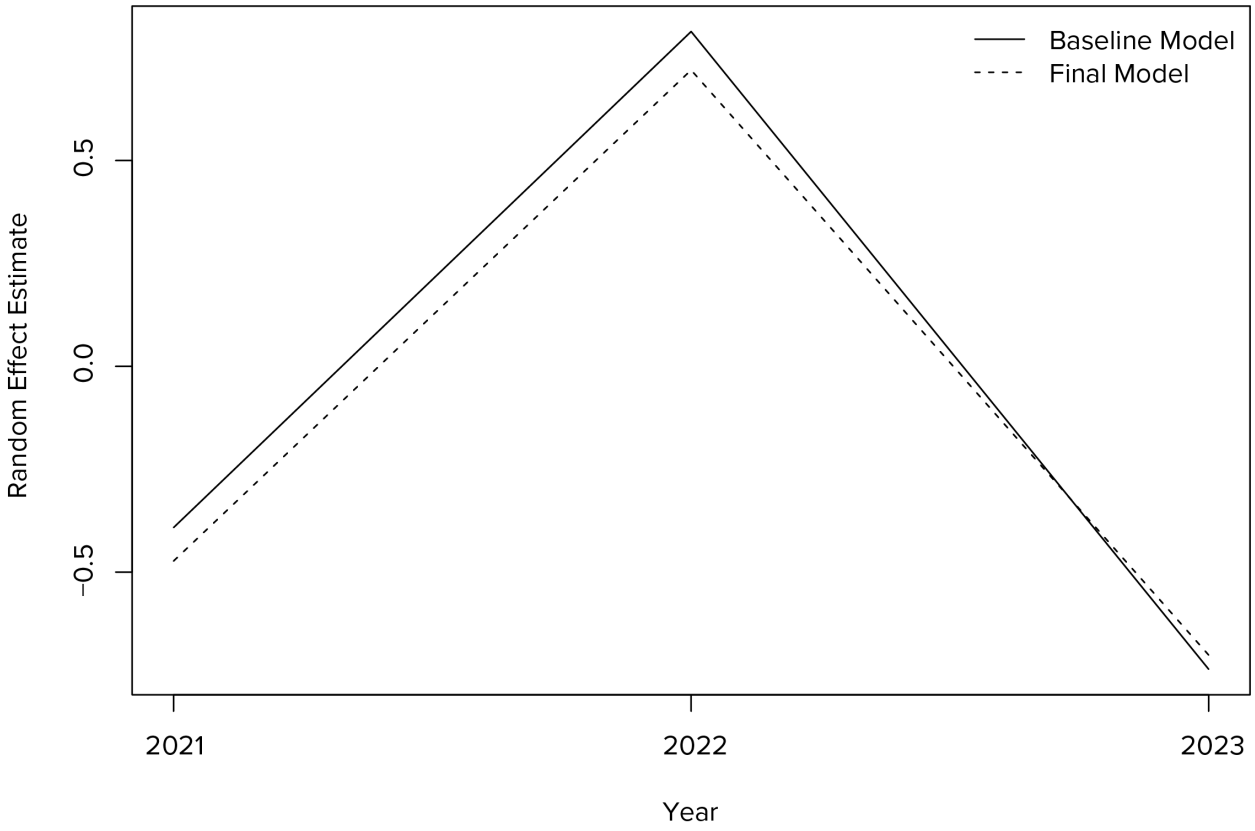


Figure C.5. Associated Temporal Random Effect Estimates for Mean Algebra 1 Score

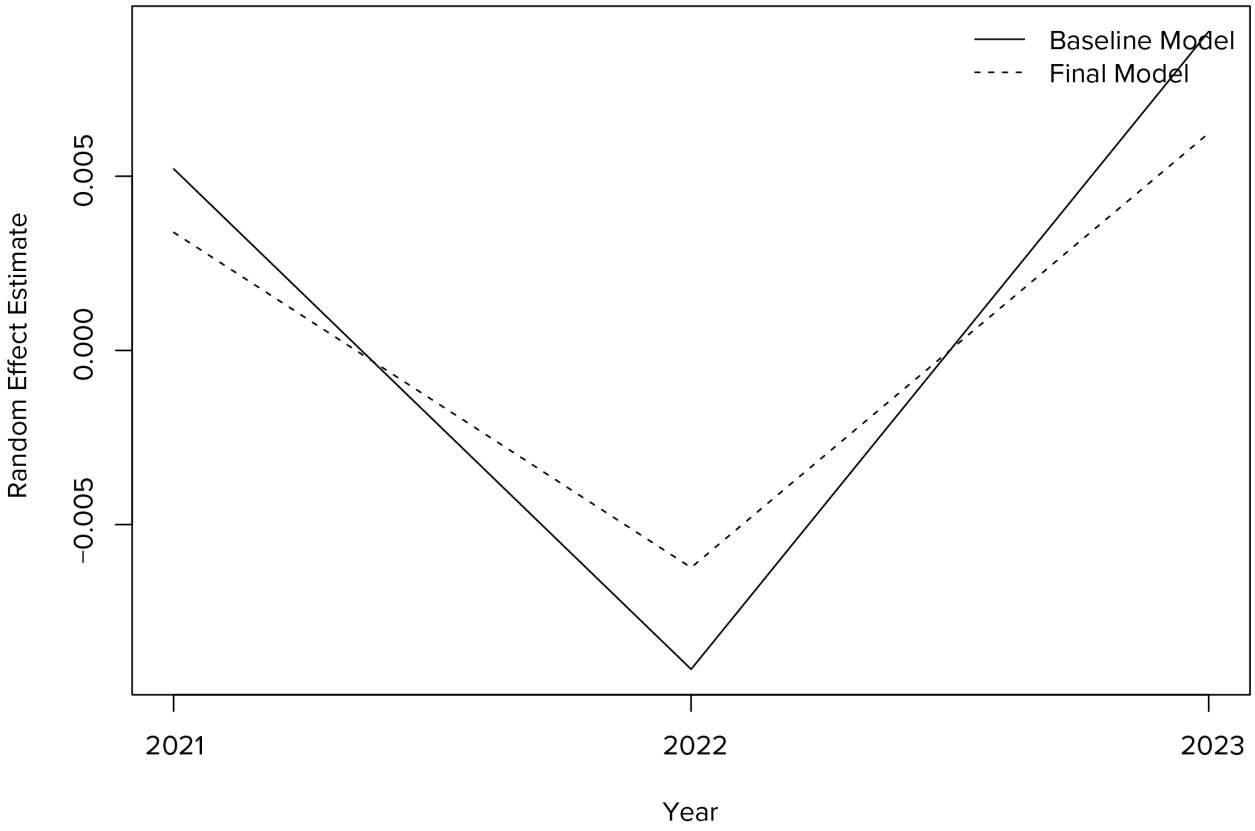


Figure C.6. Associated Temporal Random Effect Estimates for Mean English 2 Score

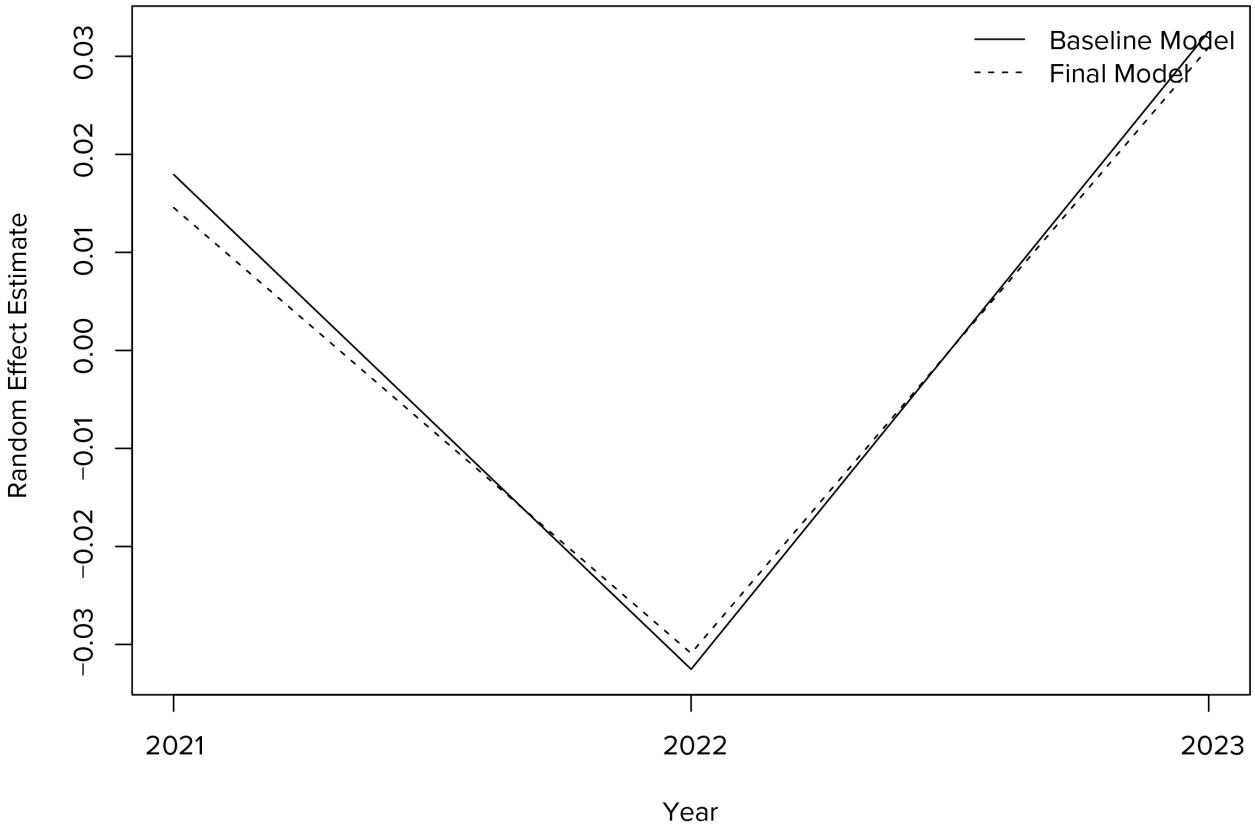


Figure C.6. Associated Temporal Random Effect Estimates for Mean 3rd Grade Math Score

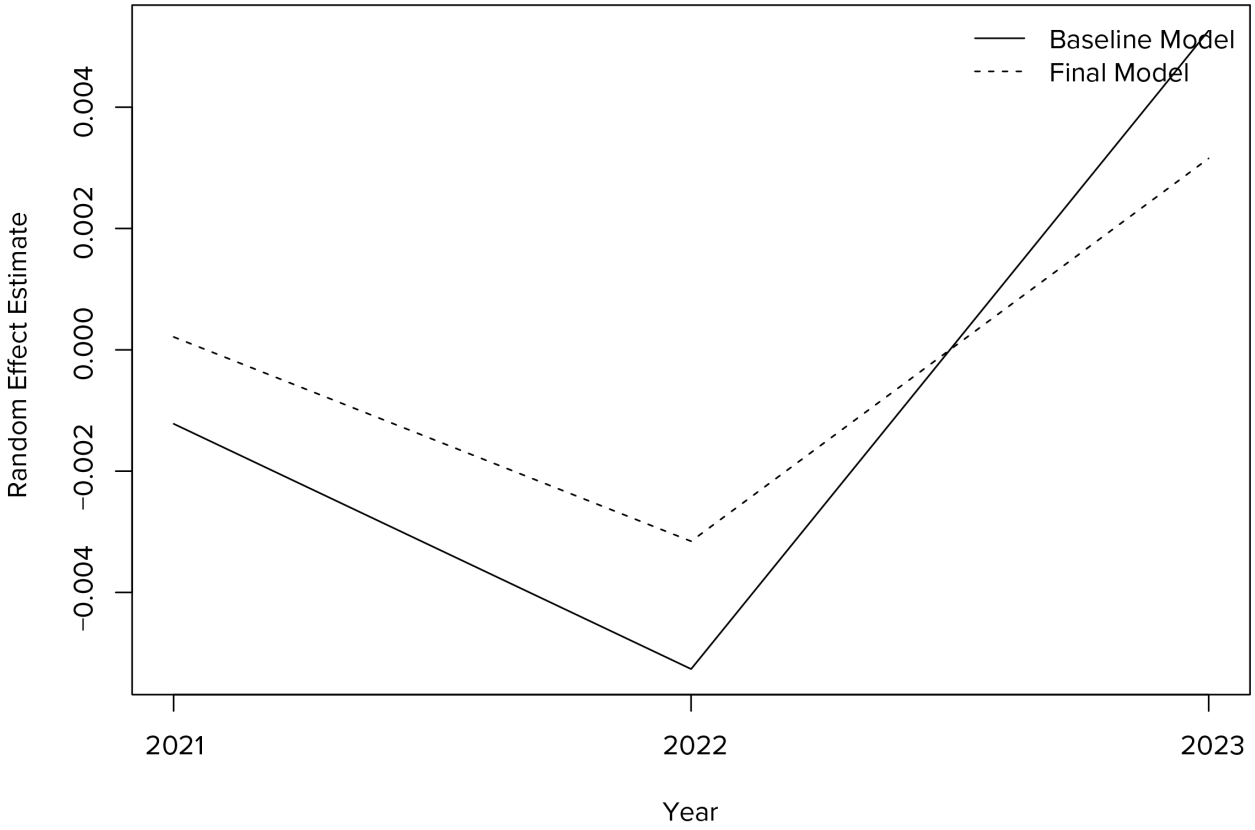


Figure C.8. Associated Temporal Random Effect Estimates for Mean 8th Grade Math Score

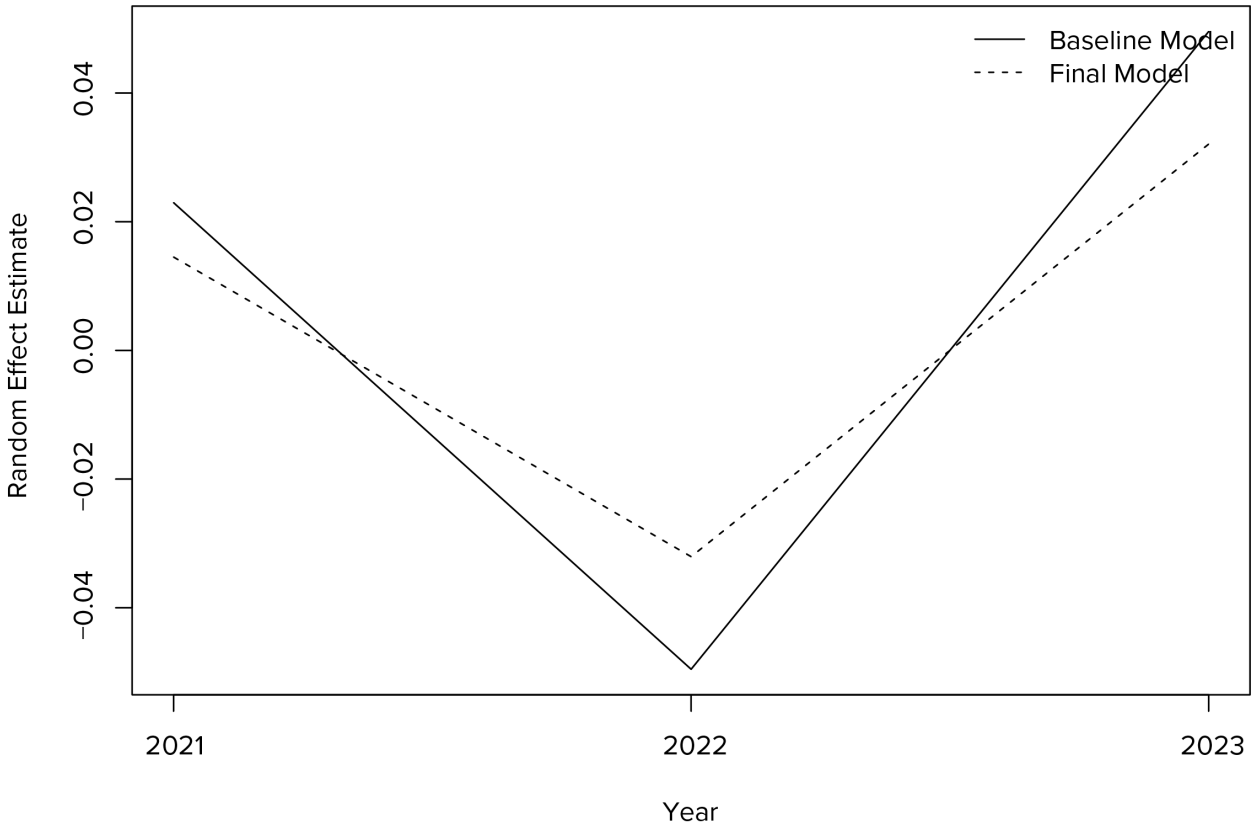


Figure C.9. Associated Temporal Random Effect Estimates for Mean 3rd Grade Reading Score

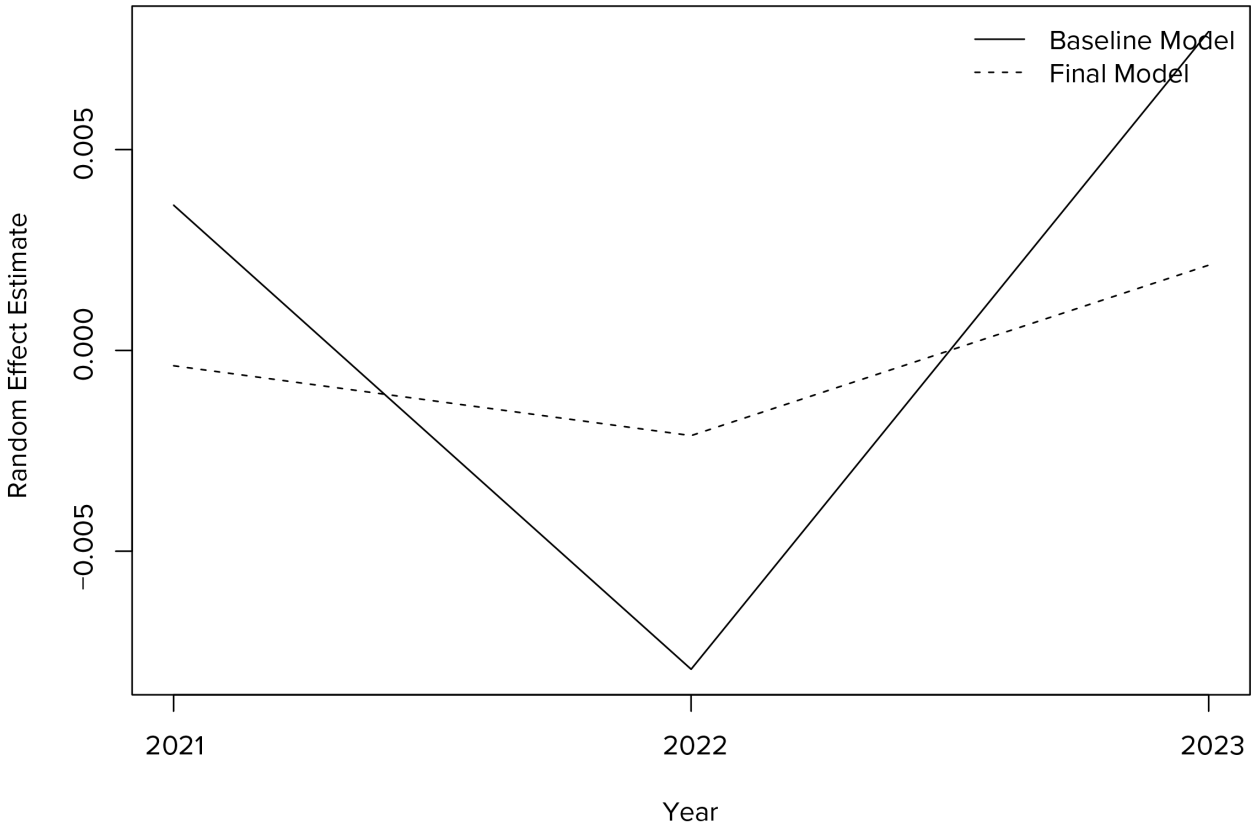


Figure C.10. Associated Temporal Random Effect Estimates for Mean 8th Grade Reading Score

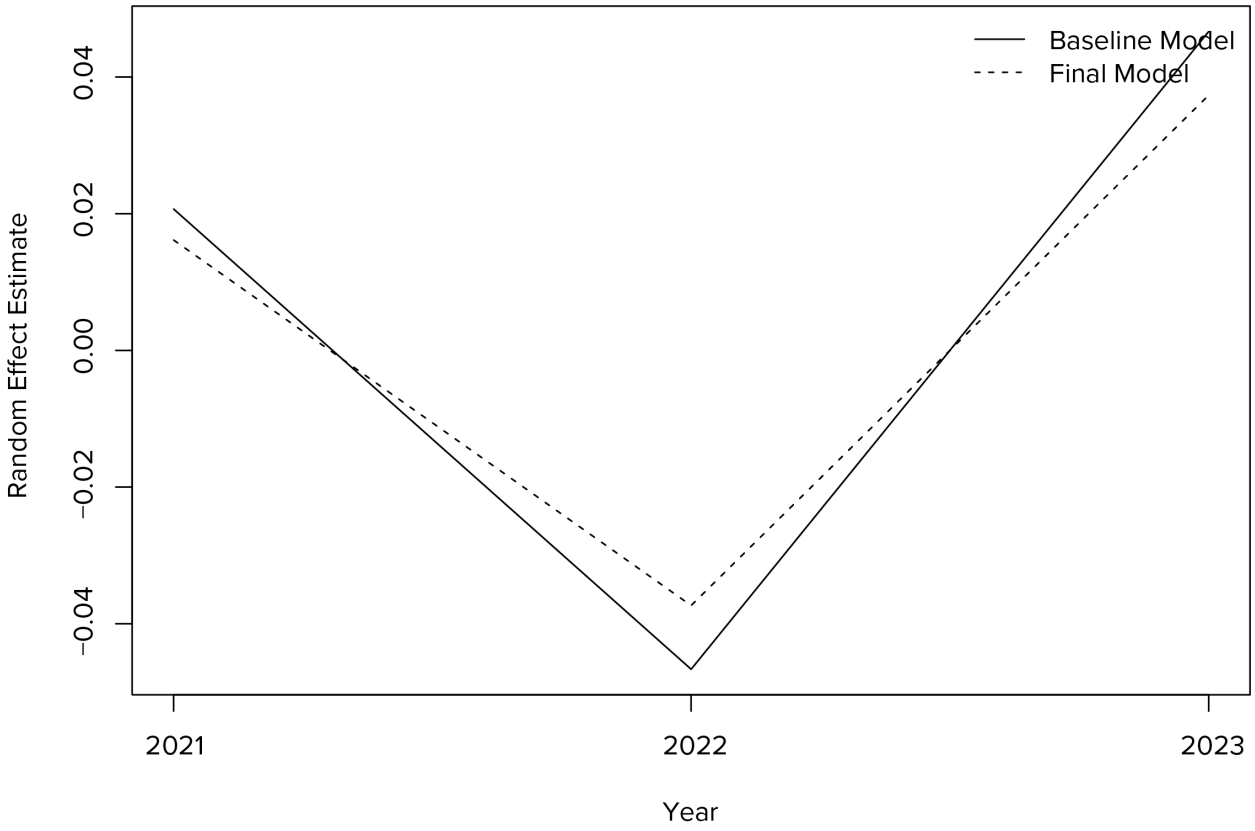


Figure C.11. Associated Temporal Random Effect Estimates for Rate of Taking AP Courses

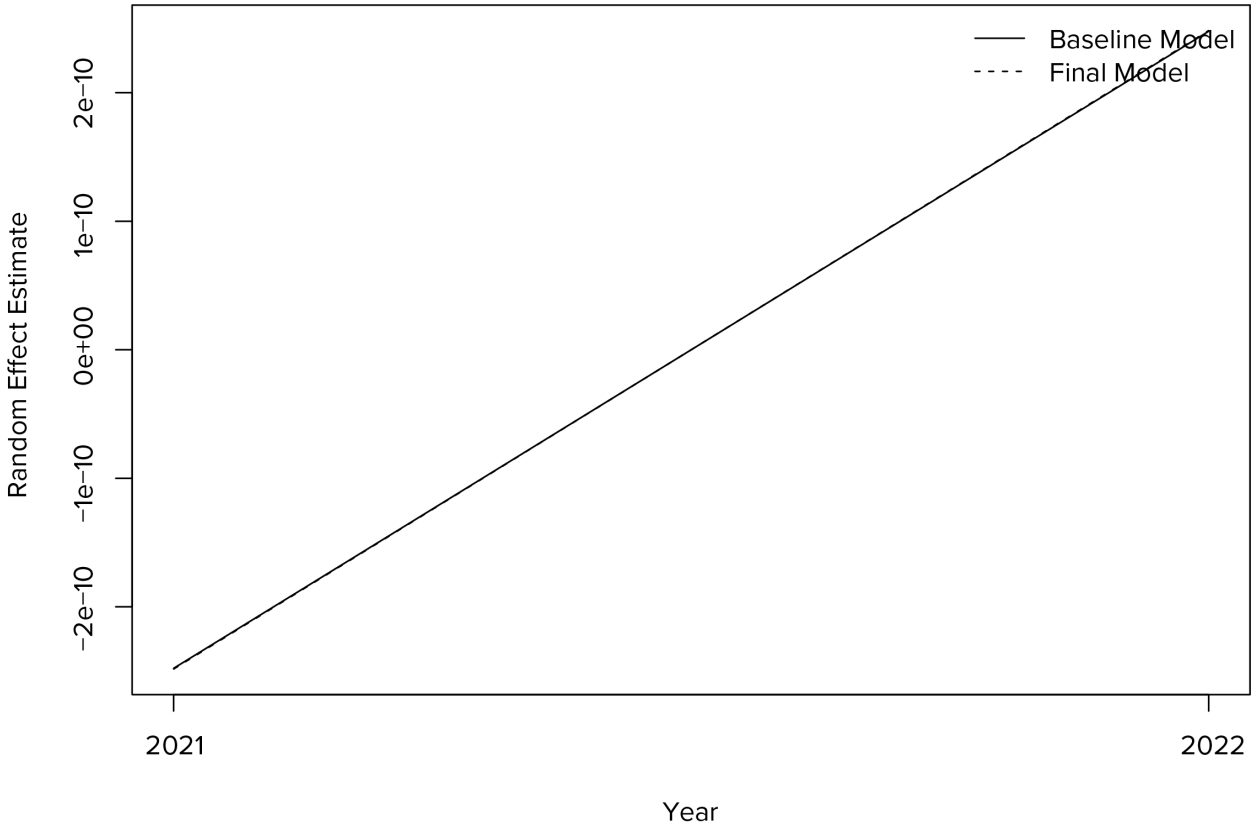


Figure C.12. Associated Temporal Random Effect Estimates for Mean Number of AP Courses Taken

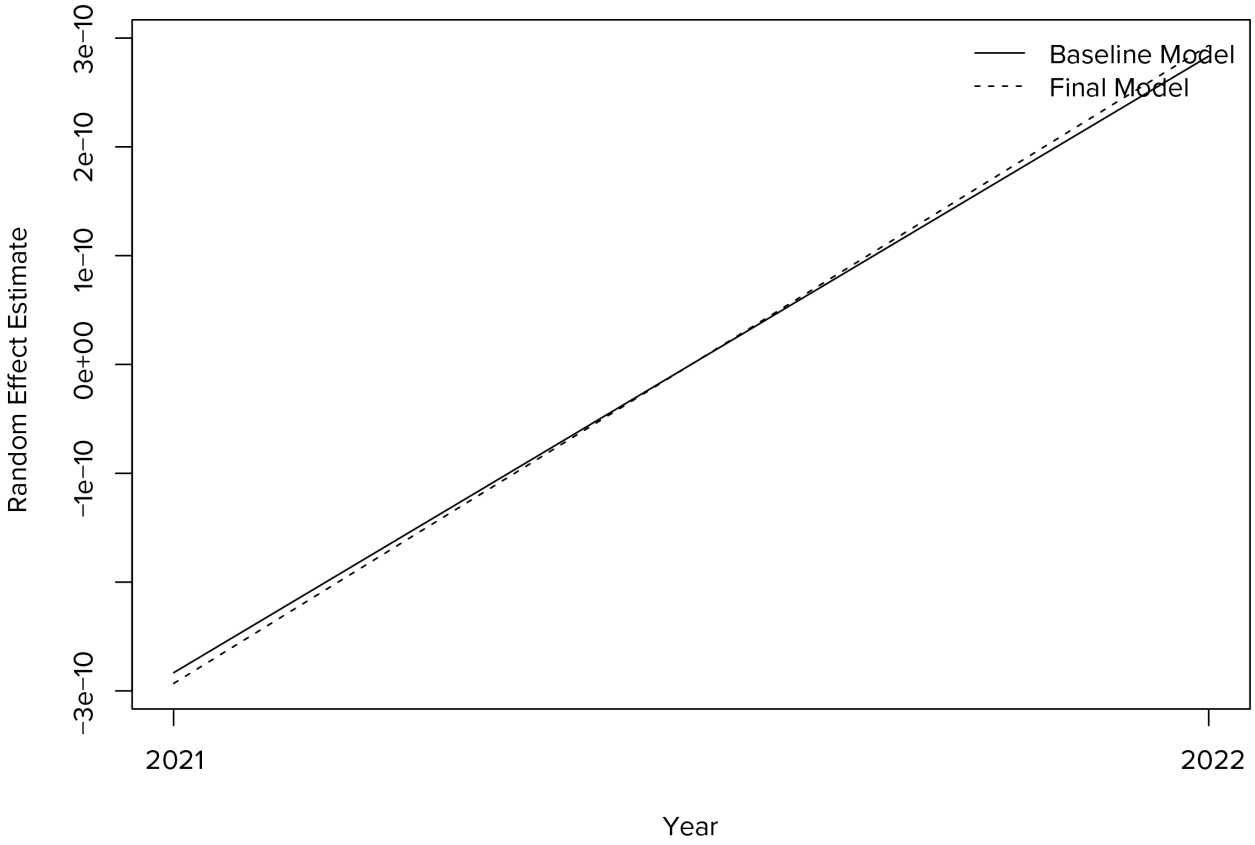
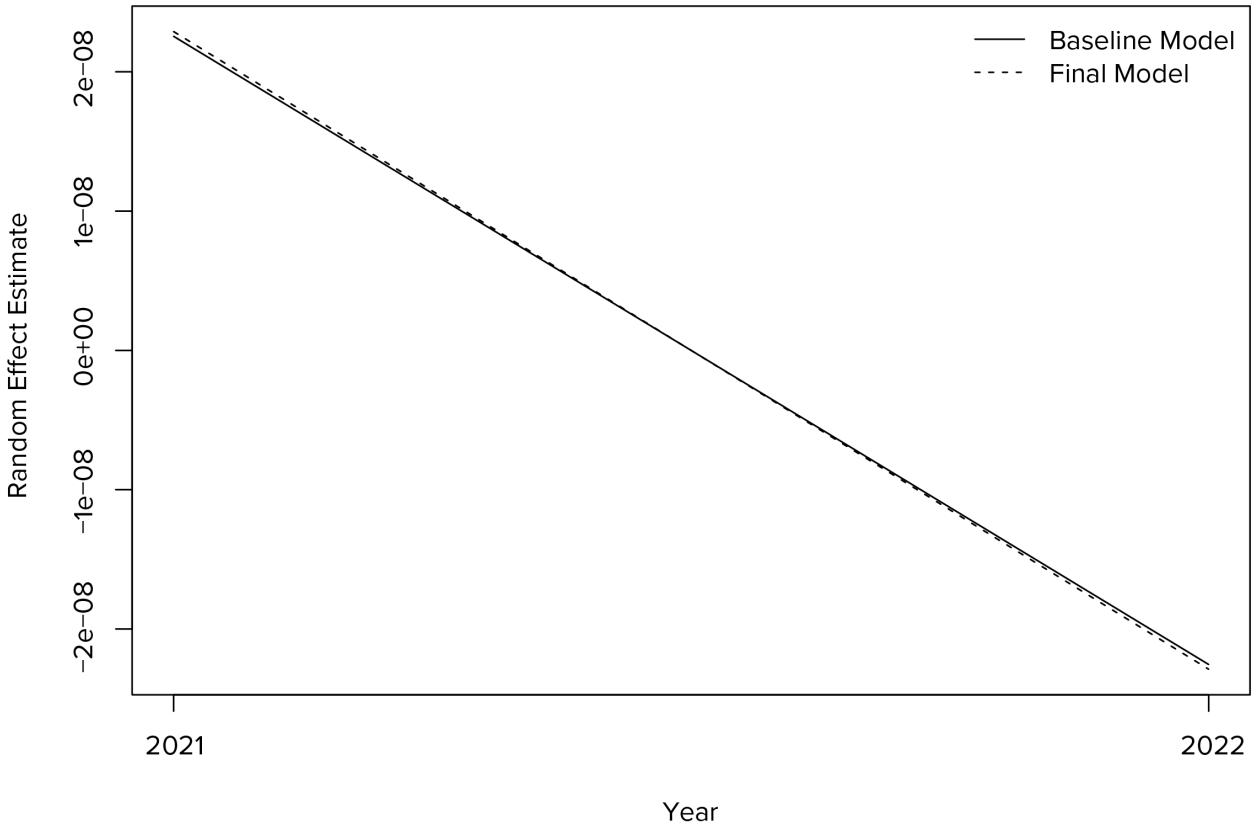


Figure C.13. Associated Temporal Random Effect Estimates for Mean Number of Courses Failed



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