Beating the odds in Mississippi: Identifying schools exceeding achievement expectations

What's Happening

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Identifying schools that are beating the odds—schools that are performing better than expected given their demographic and socioeconomic characteristics—can lead to promising practices that other schools serving similar populations can implement. This study used test data for the 2013/14 school year and latent profile analysis to identify Mississippi public schools serving grades 3–8 that were beating the odds in English language arts and math.

Why this study?

Mississippi passed the Literacy-Based Promotion Act (SB 2347) in 2013 to improve early literacy so that every student completing grade 3 would be able to read at or above grade level. Identifying schools that are performing better than expected can provide an initial indication of the efficacy of the legislation and can be an important step toward examining these schools for promising practices. To achieve the early literacy goal, it may be useful to adapt practices from schools that are beating the odds—that is, performing better than expected given their demographic and socioeconomic characteristics—for use in schools that are not performing as well (see box 1 for definitions of key terms). While this study's primary focus is literacy, math performance was also analyzed to see whether schools that beat the odds in reading also beat the odds in math, the other main focus of assessment in Mississippi during the study period.

Through the Improving Schools in Mississippi Research Alliance,[1] the Mississippi Department of Education worked in partnership with Regional Educational Laboratory (REL) Southeast to identify schools that were beating the odds. The Mississippi Department of Education was also interested in whether any of the state's 7 School Improvement Grant or 40 priority schools, which were among the state's lowest

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Box 1. Key terms

Beating-the-odds school. A school identified through statistical techniques as performing better than expected —that is, with student achievement that is statistically higher than expected (at $p < .05$) given school demographic and socioeconomic characteristics.

Common Core of Data. A national database maintained by the U.S. Department of Education that annually collects data related to all public schools, public school districts, and state education agencies in the United States.

Latent profile analysis. A statistical method for finding subtypes or groupings of related cases (in this case schools) from demographic and socioeconomic variables. Demographically and socioeconomically similar schools are grouped within profiles, which is useful for comparing education outcomes.

Priority school. A school belonging to the lowest 5 percent of Title I schools in the state based on both achievement and lack of progress of all students, a Title I–participating or Title I–eligible high school with a graduation rate of less than 60 percent over several years, or a currently served Tier I or Tier II School Improvement Grant school.

School Improvement Grant. A grant awarded by the U.S. Department of Education to state education agencies under Section 1003(g) of the Elementary and Secondary Education Act of 1965. State education agencies in turn award these funds to local education agencies to facilitate school improvement.

performing schools, performed better than expected. These schools received intense, onsite technical assistance and continuous monitoring, made possible through federal and state resources. Some of the schools achieved enough academic growth to exit the low-performing designation.

This study also includes a latent profile analysis, which identifies schools with similar socioeconomic and demographic characteristics. These groupings of schools can be useful when combined with the beating-the-odds analysis because some schools in the same groups may be identified in the beating-the-odds analysis as performing better than others. Schools identified as beating the odds may be engaging in promising practices whose adoption could benefit similar schools.

What the study examined

Two research questions guided the study:

- Which schools were beating the odds in English language arts and math on the Mississippi Curriculum Test, Second Edition, in the 2013/14 school year?
- What are the demographic profiles of all traditional schools in Mississippi, and which profiles included schools that were beating the odds?

The beating-the-odds analysis compared the actual and expected performance of 639 schools serving students in grades 3–8 on the basis of demographic and socioeconomic characteristics (percentage of students who are Black, percentage of students who are White, percentage of students who are other races/ethnicities, urbanicity, number of students tested, and percentage of students eligible for the federal school lunch program) and a latent profile analysis, which clusters similar schools on the basis of the same demographic and socioeconomic characteristics. See box 2 for a description of the study data and appendix A for technical details of the analyses.

Box 2. Study data

Data for this study were obtained from the Mississippi Department of Education's website and the Common Core of Data (see table; U.S. Department of Education, 2014). Much of the Mississippi Department of Education demographic data were missing or masked, so these data were supplemented by demographic data from the Common Core of Data.

Statewide school summary statistics, grades 3–8

Variable	Mean
Data from the Mississippi Department of Education	
Percentage of students scoring proficient in English language arts	54
Percentage of students scoring proficient in math	61
Number of students tested in English language arts	326
Number of students tested in math	326
Percentage of students who are eligible for the federal school lunch program	79
Data from the Common Core of Data	
Percentage of students who are Black[a]	55
Percentage of students who are White[a]	41
Percentage of students who are other races/ethnicities[a]	4
Percentage of schools that are in rural areas	54

a. Calculated by the study team on the basis of numbers for each race/ethnicity and total student enrollment.

Source: Authors' analysis of publicly available data from the Mississippi Department of Education for 2013/14 and the Common Core of Data (U.S. Department of Education, 2014) for 2012/13.

Data from the Mississippi Department of Education were for the 2013/14 school year, and data from the Common Core of Data were for the 2012/13 school year. Data from the Common Core of Data were correlated nearly perfectly with the data from the Mississippi Department of Education, meaning that demographic characteristics remained stable from 2012/13 to 2013/14. While the analyses used data for the 2013/14 school year, student achievement data for 2012/13 were also examined, and the results were stable across years.

What the study found

This section details the study findings.

Schools that were performing better than expected and beating the odds

Of the 639 schools examined, 7 (about 1.1 percent) were beating the odds in both English language arts and math, as demonstrated by a statistically significant positive difference between actual and expected performance. Similar numbers were considered to be beating the odds in English language arts (18) and in math (19). One school that was beating the odds in math was both a School Improvement Grant school and a priority school. (See table B1 in appendix B for detailed information on the schools that were beating the odds in English language arts and math, including the difference between actual and expected student achievement, urbanicity, School Improvement Grant status, and priority school status.)

Demographic profiles of all schools

The latent profile analysis yielded four distinct school profiles. For interpretation purposes, the four profiles were named on the basis of their highest concentration of a specific demographic characteristic. The

term "high" was used to describe schools where the percentage of students in a given category exceeded 70 percent, and the term "low" was used to describe schools where the percentage of students in a given category was less than 40 percent. The four profiles are:

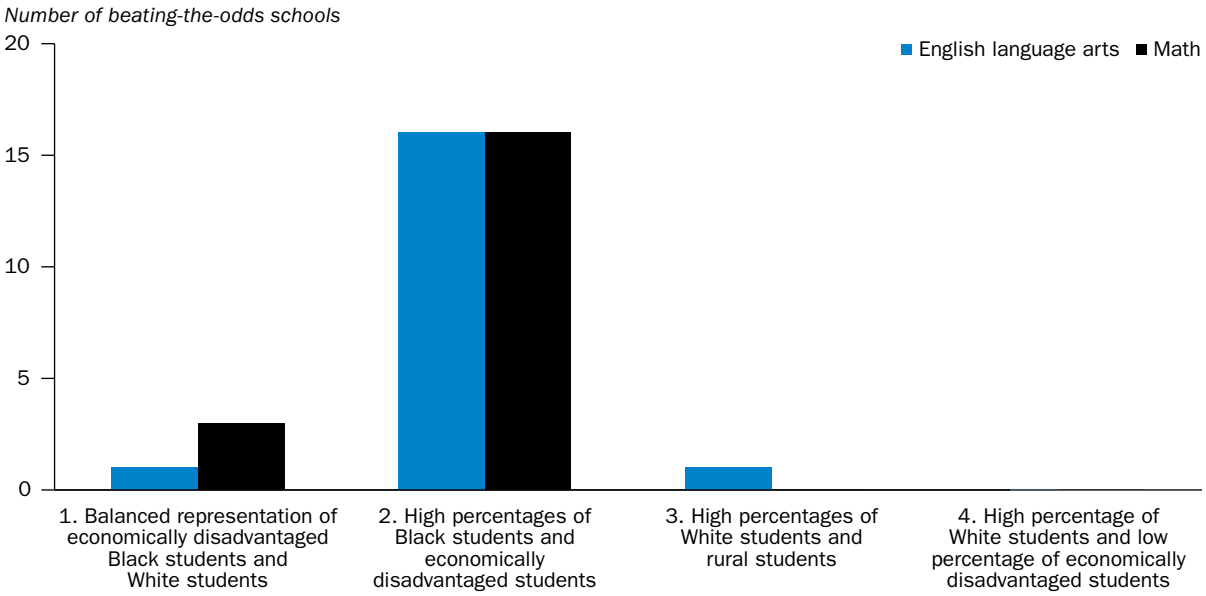
- *Profile 1. Balanced representation of economically disadvantaged Black students and White students* (25 percent of schools). Schools in this category had mostly economically disadvantaged students, with a fairly even split between Black students and White students.
- *Profile 2. High percentages of Black students and economically disadvantaged students* (41 percent of schools). Schools in this category had mostly Black students and economically disadvantaged students.
- *Profile 3. High percentages of White students and rural students* (28 percent of schools). Schools in this category had mostly White students in rural schools.
- *Profile 4. High percentage of White students and low percentage of economically disadvantaged students* (6 percent of schools). Schools in this category had mostly White students who were not economically disadvantaged.

Of the 18 schools that were beating the odds in English language arts, 1 (5.5 percent) belonged to profile 1, 16 (89 percent) belonged to profile 2, and 1 (5.5 percent) belonged to profile 3 (figure 1; see also table B1 in appendix B). Of the 19 schools that were beating the odds in math, 3 (16 percent) belonged to profile 1 and 16 (84 percent) belonged to profile 2. Table 1 describes the characteristics of each demographic profile as well as the characteristics of the general population of students in the state.

Implications and use of the study findings

This study identified 18 schools that were beating the odds in English language arts, 19 schools that were beating the odds in math, and 7 schools that were beating the odds in both subjects. Most schools that were beating the odds belonged to the demographic profile of schools with high percentages of Black students and economically disadvantaged students. The Mississippi Department of Education, in partnership

Figure 1. Most schools that were beating the odds belonged to demographic profile 2, the largest demographic profile



Source: Authors' analysis of publicly available data from the Mississippi Department of Education for 2013/14 and the Common Core of Data (U.S. Department of Education, 2014) for 2012/13.

Table 1. Characteristics of the four demographic profiles of Mississippi public schools and state averages, 2013/14

Characteristic	1. Balanced representation of economically disadvantaged Black students and White students (*n* = 159; 24.9 percent)	2. High percentages of Black students and economically disadvantaged students (*n* = 265; 41.5 percent)	3. High percentages of White students and rural students (*n* = 178; 27.9 percent)	4. High percentage of White students and low percentage of economically disadvantaged students (*n* = 37; 5.8 percent)	State average (*n* = 639)
Percentage of students scoring proficient in English language arts	56.3	45.3	60.8	71.2	53.8
Percentage of students scoring proficient in math	63.0	52.5	68.9	78.0	61.2
Number of students tested	398	241	322	646	326
Percentage of students who are eligible for the federal school lunch program	75.6	95.2	67.3	34.3	79.0
Percentage of students who are Black[a]	46.0	90.5	15.8	20.5	54.6
Percentage of students who are White	47.0	6.6	80.0	74.3	41.0
Percentage of schools that are in rural areas	40.0	43.0	82.4	56.3	53.8

a. Not used in the regression analysis or latent profile analysis because it was found to be collinear with the percentage of students who are White. Data appear in the table only to provide further information about class membership.

Note: Percentages of schools in each demographic profile do not sum to 100 because of rounding.

Source: Authors' analysis of publicly available data from the Mississippi Department of Education for 2013/14 and the Common Core of Data (U.S. Department of Education, 2014) for 2012/13.

with REL Southeast, plans to follow up with these schools to conduct technical support activities to identify practices that may help other schools perform better than expected.

The study's analyses can be replicated and used to study schools in different contexts. For example, further inspection of schools that are beating the odds can occur for other school characteristics, leadership characteristics, or other student information. The Mississippi Department of Education is particularly interested in the leadership practices at schools that are beating the odds, since similar schools (schools within the same demographic profile) that did not beat the odds may benefit from these practices. For example, leadership practices such as professional development, time management, and other activities in a school identified as beating the odds in math could be examined to see whether any of the leadership practices targeted math performance. Promising practices could be shared with similar schools that are not beating the odds.

Limitations of the study

This study has three main limitations.

First, confidentiality requirements precluded the Mississippi Department of Education from providing much of the demographic data needed for the analyses. Instead, the study team used data from prior years from the Common Core of Data (U.S. Department of Education, 2014). While the data from the Common Core of Data correlate nearly perfectly with the Mississippi Department of Education data, the results should be interpreted with caution.

Second, the analyses use aggregated school-level data. Student-level data could yield more precise estimates of achievement because the aggregated school-level data that were provided included redacted information and because calculated variances and standard deviations were not available. Also, the analyses were conducted using a small number of variables. Schools may look similar in race/ethnicity and socioeconomic status but could differ in other ways that were not captured in the analyses. It is well documented that different specifications of the statistical model for estimating which schools are beating the odds can yield different results (Abe et al., 2015).

Third, the beating-the-odds estimates and ranking of schools depend on which schools were included in the analyses. Some schools may serve a specialized student population based on specific enrollment criteria (for example, high-performing students or students with disabilities). Such schools have historically demonstrated higher or lower performance on statewide assessments than traditional schools have. As a result, including those schools might have affected which schools were identified as beating the odds. Future work could include sensitivity analyses[2] with variables that are currently unavailable in order to evaluate how the beating-the-odds estimates change as particular schools are excluded and to determine what enables certain schools to beat the odds.

Appendix A. Study methods

This appendix explains the methods used to conduct the beating-the-odds analysis and the latent profile analysis.

Beating-the-odds analysis

The beating-the-odds analysis entailed a two-stage process. In the first stage, expected school performance was calculated using a statistical model that accounted for school demographic and socioeconomic characteristics. This was done by estimating school-level percentages of grade 3–8 students proficient in English language arts and in math as measured on the Mississippi Curriculum Test, Second Edition (MCT2) using a multiple linear regression prediction model with school demographic characteristics as predictors:

$$Y_j = \beta_0 + \beta_1 ED_j + \beta_2 White_j + \beta_3 School\ Size_j + \beta_4 Rural_j + e_j$$

where each observation consists of a weighted average (by grade) of students who scored proficient at each school. Y_j is the percentage of students proficient at school j, controlling for *ED*, which is the percentage of students who are classified as economically disadvantaged; *White*, which is the percentage of students who are White (where all other races serve as the reference group); *School Size*, which is the number of students tested in each school; *Rural*, which is a dummy variable indicating the urbanicity of the school as rural or nonrural; and e_j, which is the school-level residual. Tests for linearity, reliability, and homoscedasticity were conducted, and model fit was examined using the R^2 statistic.

The analysis was conducted independently using 2012/13 and 2013/14 data to capture the respective residuals[3] for each year. Residuals were necessary to determine which schools were identified as beating the odds. Only the 2013/14 results are reported because they were similar to the 2012/13 results. Once the residuals were recovered from each model, the study team evaluated which schools' observed estimates were less than expected (that is, which schools performed worse than expected by having a lower than expected normed score on the MCT2), which schools' observed estimates were greater than expected, which schools performed close to their expected score (within 0.5 standard deviation), and which schools performed significantly better than expected (at $p < .05$).

To determine which schools performed significantly better than expected, a 95 percent confidence interval was constructed around the school-level residuals, and schools whose confidence interval did not include zero were identified as beating the odds; schools whose confidence interval included zero had no statistical difference between observed and expected performance. The confidence interval was constructed as follows:

95 percent confidence interval = School residual ± (1.96 * School residual standard error)

For the English language arts model (table A1), R^2 (the percentage of variation in the outcome that is explained by the model) was .47, and the coefficient on eligibility for the federal school lunch program was a statistically significant predictor of the outcome (expected school performance) at the .001 level. For the math model (table A1), R^2 was .43, and all coefficients were significant predictors of the outcome at the .001 level, except for urbanicity (where nonrural was the comparison group). These two specifications yielded average residuals that were not statistically different from zero. It is important to note that other specifications of the model that include additional demographic variables might provide different results. While the models in this analysis accounted for less than 50 percent of the variation in the dependent variable, the

Table A1. Model estimates for English language arts and math

Variable	English language arts		Math	
	Standardized effect estimate	Standard error	Standardized effect estimate	Standard error
Percentage of students who are White	1.214	0.686	2.114***	0.721
Percentage of students who are eligible for the federal school lunch program	–9.496***	0.769	–9.480	0.766
Whether a school is rural	–0.245	0.821	–1.322***	0.934
Number of students tested	–0.796	0.424	–2.215***	0.451
Intercept	54.498***	0.620	62.395***	0.657

*** Significant at the .001 level.

Note: Results represent the change in the percentage of students who are proficient in each subject expected with a one standard deviation change in the reported variables.

Source: Authors' analysis of publicly available data obtained from the Mississippi Department of Education for 2013/14 and the Common Core of Data (U.S. Department of Education, 2014) for 2012/13.

primary focus of this analysis is to compare demographically similar schools, not to account for variation in student outcomes. All available variables were used in this analysis.

Latent profile analysis

Latent profile analysis is typically used to classify individuals into groups on the basis of, for instance, their performance on a single exam or on their scores on multiple exams. Though it has been used predominantly for diagnostic purposes in psychology and marketing, it is an emerging descriptive classification technique in education (Logan & Petscher, 2010). In this case, the demographic profiles of schools were used to group demographically and socioeconomically similar schools.

The utility of a latent profile analysis lies in its ability to empirically categorize schools into similar groups on the basis of variables of interest. For example, using latent profile analysis to identify two profiles (or groups) of schools on the basis of available demographic and socioeconomic data would most likely lead to one group of schools with a high percentage of students at high risk of difficulty in math and one group of schools with a low percentage of students at high risk of difficulty in math. The variation in individual school outcomes within a profile can also be described (for example, using school residual scores).

The basic representation of a multivariate latent profile analysis model is:

$$f(y_i|\theta) = \sum_{k=1}^{K} \pi_k f_k(y_i|u_k\Sigma_k)$$

where y_i represents the multivariate distribution of cluster indicators (school demographics) for school i (with the number of clusters represented by k), θ represents the unique set of model parameters to be estimated within each cluster, and π_k is the weight given to each cluster (Pastor, Barron, Miller, & Davis, 2007). The weights are constrained to be non-negative and must sum to 1. Each cluster distribution is defined by u_k (the mean vector) and Σ_k (the covariance matrix).

Multiple indices reported by the Mplus program (Muthén & Muthén, 1998) were used to determine the most appropriate number of profiles for the data (table A2). The indices include Akaike information criteria and Bayesian information criteria (Kaplan, 2000), with smaller values being preferred. Also, entropy was used on a scale of 0 to 1, with higher values being preferred (Ramaswamy, DeSarbo, Reibstein, & Robinson, 1993). Finally, the Lo–Mendell–Rubin likelihood ratio test (Lo, Mendell, & Rubin, 2001) and a

parametric bootstrapped likelihood ratio test (McLachlan & Peel, 2000) were used, with a significant value indicating more classes should be added because these models compare the model with *K* classes to the model with *K*–1 classes.

Statistical tests indicated that four classes (groups of schools) described the data better than the models with fewer or more classes, given the included characteristics (see table A2).

The probability of each school's class membership can be averaged by class to further evaluate the model results. The average latent class probabilities for most likely latent class membership range from .921 to .930, suggesting good model fit (table A3).

Table A2. Summary of latent profile analysis model fit indices

Number of classes	Akaike information criteria	Bayesian information criteria	Adjusted Bayesian information criteria	Entropy	Lo–Mendell–Rubin likelihood ratio test (*p*-value)	Bootstrapped likelihood ratio test (*p*-value)
1	6,183	6,214	6,192	na	na	na
2	5,383	5,436	5,398	.90	.00	.00
3	5,136	5,212	5,158	.92	.03	.00
4	4,928	5,026	4,956	.91	.00	.00
5	4,817	4,937	4,851	.90	.43	.00

na is not applicable.

Source: Authors' analysis of publicly available data obtained from the Mississippi Department of Education for 2013/14 and the Common Core of Data (U.S. Department of Education, 2014) for 2012/13.

Table A3. Average latent class probabilities for most likely latent class membership (row) by latent class (column)

Class	1	2	3	4
1	.921	.022	.051	.005
2	.010	.990	.000	.000
3	.059	.000	.923	.018
4	.010	.000	.060	.930

Source: Authors' analysis of publicly available data obtained from the Mississippi Department of Education for 2013/14 and the Common Core of Data (U.S. Department of Education, 2014) for 2012/13.

Model results for the four-class model are provided in table A4.

Table A4. Latent class model estimates for the four-class model, by latent class

Class characteristics	Estimate[a]	Standard error	Estimate/ standard error	*p*-value
Latent class 1				
Percentage of students who are White	0.20	0.06	3.54	.00
Percentage of students who are eligible for the federal school lunch program	–0.11	0.07	–1.66	.10
Percentage of students who are proficient in English language arts	0.31	0.11	2.91	.00
Whether a school is rural	0.40	0.05	8.68	.00
Latent class 2				
Percentage of students who are White	–1.04	0.02	–50.98	.00
Percentage of students who are eligible for the federal school lunch program	0.84	0.02	54.30	.00
Percentage of students who are proficient in English language arts	–0.38	0.04	–9.13	.00
Whether a school is rural	0.43	0.03	13.82	.00
Latent class 3				
Percentage of students who are White	1.19	0.04	28.30	.00
Percentage of students who are eligible for the federal school lunch program	–0.51	0.06	–8.48	.00
Percentage of students who are proficient in English language arts	–0.01	0.08	–0.18	.86
Whether a school is rural	0.82	0.05	18.21	.00
Latent class 4				
Percentage of students who are White	1.00	0.07	14.44	.00
Percentage of students who are eligible for the federal school lunch program	–2.05	0.19	–10.91	.00
Percentage of students who are proficient in English language arts	1.34	0.32	4.22	.00
Whether a school is rural	0.56	0.10	5.85	.00

a. Normed means for continuous variables (*z*-scores) and probabilities for the binary variable rural.

Source: Authors' analysis of publicly available data from the Mississippi Department of Education for 2013/14 and the Common Core of Data (U.S. Department of Education, 2014) for 2012/13.

Appendix B. Statistics for beating-the-odds schools

Table B1 provides information on how many students were tested; schools' demographic and socioeconomic makeup; estimated residuals; indicators for beating-the-odds schools, schools receiving School Improvement Grants, priority schools, and rural schools; and the latent profile number for each school in the study. Schools are identified by number rather than by name to protect confidentiality.

Table B1. Characteristics of Mississippi public schools that were beating the odds in English language arts or math, 2013–14

School number	Number of students tested	Percentage of students who are Black	Percentage of students who are White	Percentage of students who are eligible for the federal school lunch program	English language arts residual	Beating the odds in English language arts?	Math residual	Beating the odds in math?	Received a school improvement grant?	Priority school?	Rural school?	Latent profile number
1	618	97	2	76	39.28	Yes	38.64	Yes	No	No	No	2
2	147	98	1	81	46.59	Yes	36.63	Yes	No	No	No	2
3	135	93	3	65	35.81	Yes	30.73	Yes	No	No	No	2
4	170	74	24	94	20.76	Yes	28.22	Yes	No	No	No	2
5	186	98	0	100	24.23	Yes	26.23	Yes	No	No	No	2
6	71	97	1	100	37.95	Yes	25.31	Yes	No	No	No	2
7	85	91	2	100	22.17	Yes	23.13	Yes	No	No	Yes	2
8	130	100	0	99	15.28	No	35.25	Yes	No	No	Yes	2
9	115	97	3	94	12.13	No	29.37	Yes	No	No	Yes	2
10	60	98	0	99	5.93	No	28.54	Yes	No	No	Yes	2
11	143	88	10	89	17.72	No	24.90	Yes	No	No	No	2
12	157	91	8	98	9.17	No	23.84	Yes	No	No	Yes	2
13	157	93	6	94	2.25	No	23.54	Yes	No	No	No	2
14	861	66	32	86	12.57	No	23.36	Yes	No	No	No	1
15	220	10	51	83	0.99	No	22.77	Yes	No	No	Yes	1
16	313	38	61	77	17.43	No	22.76	Yes	No	No	Yes	1
17	213	94	3	89	9.56	No	22.65	Yes	Yes	Yes	No	2
18	177	80	6	96	11.12	No	22.45	Yes	No	No	No	2
19	156	95	5	95	10.12	No	22.44	Yes	No	No	Yes	2
20	158	88	10	68	29.06	Yes	20.32	No	No	No	No	2
21	116	59	32	95	20.43	Yes	20.27	No	No	No	Yes	2
22	221	99	1	99	18.95	Yes	19.62	No	No	No	No	2
23	211	96	3	99	43.81	Yes	18.67	No	No	No	No	2
24	59	19	73	91	24.43	Yes	16.74	No	No	No	Yes	3
25	154	98	0	95	22.04	Yes	15.89	No	No	No	Yes	2
26	422	56	39	80	19.24	Yes	15.45	No	No	No	Yes	1
27	206	98	0	99	19.26	Yes	12.78	No	No	No	Yes	2
28	87	96	4	89	20.40	Yes	10.78	No	No	No	Yes	2
29	126	100	0	100	28.69	Yes	10.33	No	No	No	No	2
30	139	94	3	95	21.27	Yes	3.51	No	No	No	Yes	2

Source: Authors' analysis of publicly available data from the Mississippi Department of Education for 2013/14 and the Common Core of Data (U.S. Department of Education, 2014) for 2012/13.

Notes

1. The Improving Schools in Mississippi Research Alliance is a group of Mississippi educators, state and local education administrators, and REL Southeast researchers who work to identify promising practices and to disseminate research findings for Mississippi schools.
2. Sensitivity analyses were conducted by estimating the beating-the-odds models with and without predictor variables, including eligibility for the federal school lunch program, urbanicity, and the number of students in grades 3–5 and 6–8. As long as race/ethnicity was included in the estimated model, no meaningful differences were found in the estimates.
3. Residuals in this case represent the degree to which a school's observed performance differs from the performance estimated using a statistical model that accounts for school demographics and socioeconomics.

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