Using Stata for Educational Accountability & Compliance Reporting

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   - Old System
2. The Challenge
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   - MegaReporting = LaTeX2ε + Bash
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  - When 65% of schools/districts are rated as a "B" or higher **OR** 75% of students are proficient or above on student assessments new thresholds for performance labels will be set
- The State Board of Education (SBE) convened a task force to define the components of the accountability system model, weighting of the components, how student growth would be determined, and to set thresholds for performance labels

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  - A scale for schools/districts with a secondary/high school graduating class
- And started a process of programming a new system from the ground up as well as reverse engineering parts of the legacy code base
- In order to provide information to the public, a "prototype" had to be developed in a period of roughly 30 days

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- In 2013 there were no staff available/able to run the myriad SAS scripts and manage the numerous output files; the original designer was contracted to run the former system

In the beginning...
(continued)

Area	# Scripts	# Data Files
Growth	32	80
Graduation Rates	23	75
AYP†	81	119
ESEA (Federal Law)	16	22

† Various aggregated proportions of achievement levels/participation rates on standardized tests

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- Data acquisition involved processing raw assessment files from test vendors, running a variety of stored procedures/function calls on a large Oracle database, and retaining/using archived SAS datasets

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- So the workload was split: information systems staff would assemble the data needed into a flat file and I would have responsibility for the implementation of the "business rules" and computations
- Given the set of rules/operational definitions, it seemed like it would be fairly feasible; then we started working with the data and getting reminders about existing SBE and federal policies that also needed to be incorporated into the design

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- Additional challenges regarding the handling of special cases of student scores would have reduced sample sizes to the point where any estimates would have been highly unstable

MECE (continued)

example

Student ID	District ID	School ID	Date	Code
000123456	0001	020	09aug2013	E1
000123456	0001	024	19aug2013	E1
000123456	0001	020	10sep2013	T2
000123456	0002	016	20oct2013	E4
000123456	0001	024	20oct2013	T3
000123456	0002	016	13apr2014	T8

- Codes beginning with an E represent different classifications of enrollments
- Codes beginning with a T represent different classifications of transfers
- For the original prototype, these data were originally stored in a wide format in the same flat file/table as the assessment data
- In cases like the first three observations, there was no way to determine when to close the enrollment window without making assumptions about which data were "true" and/or "correct" and which were not
- Since the first file submission from districts covers August and September, there isn't a good/clean way of reconciling the records when they enter the data system without substantial time/effort that would have a negative effect on system performance

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- Some data elements (e.g., enrollment/transfer records, monthly enrollment histories, etc. . .) were best suited for a "long" file format, while the assessment data were easier to store in a "wide" format

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- Full Academic Year data was originally stored in wide format as part of the dataset that contained student assessment data; now this part of the process can be implemented independently of the other data
- Graduation rate computations were included; this includes managing the 150+ files distributed to each of the school districts to validate and verify the data and make any appeals/submit documentation to update records (made easier by the UCLA Stats Consulting Group's FAQ pages)

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  - Currently, the IT staff are setting up a Solaris workspace and the data will be pulled directly from the source data system (Oracle 11g soon Oracle 12c)
  - Since the information systems office began sharing their code, I've been able to modify the SQL queries to implement the naming conventions and type casting on the back-end; unfortunately date and datetime fields imported from `odbc load` still need a little clean up

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  - One program used to take the results set and build "reports" for schools/districts as well as options to add graphs to the file

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- More importantly, however, is that this program labels all of the variables, adds value labels where appropriate/necessary, and creates a checksum that can be used to ensure the estimates can be replicated and validated independently

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- `mde_fay, tsd(01sep2013) ted(28apr2014) fbed(01dec2013) sbsd(01feb2014)` and 2 minutes later and full academic year (FAY) determinations were made for 500,000 + students at the state, district, and school levels for full year, fall semester, and spring semester

Creating Rule-Based Composite Variables

mde_page, mde_fayvars, & mde_growvars

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- `mde_fayvars` checks student course schedule types and builds new variables that select the appropriate FAY district and school ID values for each subject area

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- `mde_onepercent rla mth sci, district(dist)` estimates the proportion of these students scoring proficient or above and defines a weight $\frac{1}{\%Proficient/Above} \times 0.01$ to impose a ceiling of 1%

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- `mde_growvars` builds a dataset containing scaled score cut points and uses a combination of `merge m:1` and the `cond()` function to recode proficiency levels from 4 to 6 values

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- `ceil(N * .25)` is used to identify the position of the student within a subject, grade, and school/district whose score is used for the membership threshold
- `mde_low25 rla mth, district(dist) school(sch)` implements these rules and creates indicator variables for the students

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- `mde_proficiency rla mth sci his, district(dist) school(sch) disfile(district_proficiency) schfile(school_proficiency)` would generate all of the proficiency values for each of the four subject areas at the state, district, and school levels
- Although not included in the original design/build, the current version of the program includes an option `amovars` that is used to create all of the result sets require for federal reporting of Annual Measurable Objectives

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- Because the lowest 25% membership is only used in growth calculations, this program includes options to specify each of the group identifiers for their respective subject areas, as well as state, district, and school identifiers to aggregate the data properly

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- `mde_grads` can call `mde_gradfiles` to build the file above; import, clean, and merge the two other distinct data sources; compute the rates; and accept a do file as an argument to implement changes from the appeals process as well as adding characteristics into the dataset to document the change to each variable for each appeal and add a label identifying the school the filed the appeal

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mde_grades

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- A recent addition to this program — at the request of a district superintendent — is adding percentile rankings for each component score to the output file; the results are also classified into quintiles which are used to define fill colors for cells in the reports

Visualizing Comparisons for Schools, LEAs, & the Public

mde_graphs

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- However, some folks weren't immediately comfortable with scatter plots, so I also created a short animated graph using Stata and `ffmpeg` (thanks to the tutorial developed by R. Grant) that provides an over simplified way of reading scatter plots

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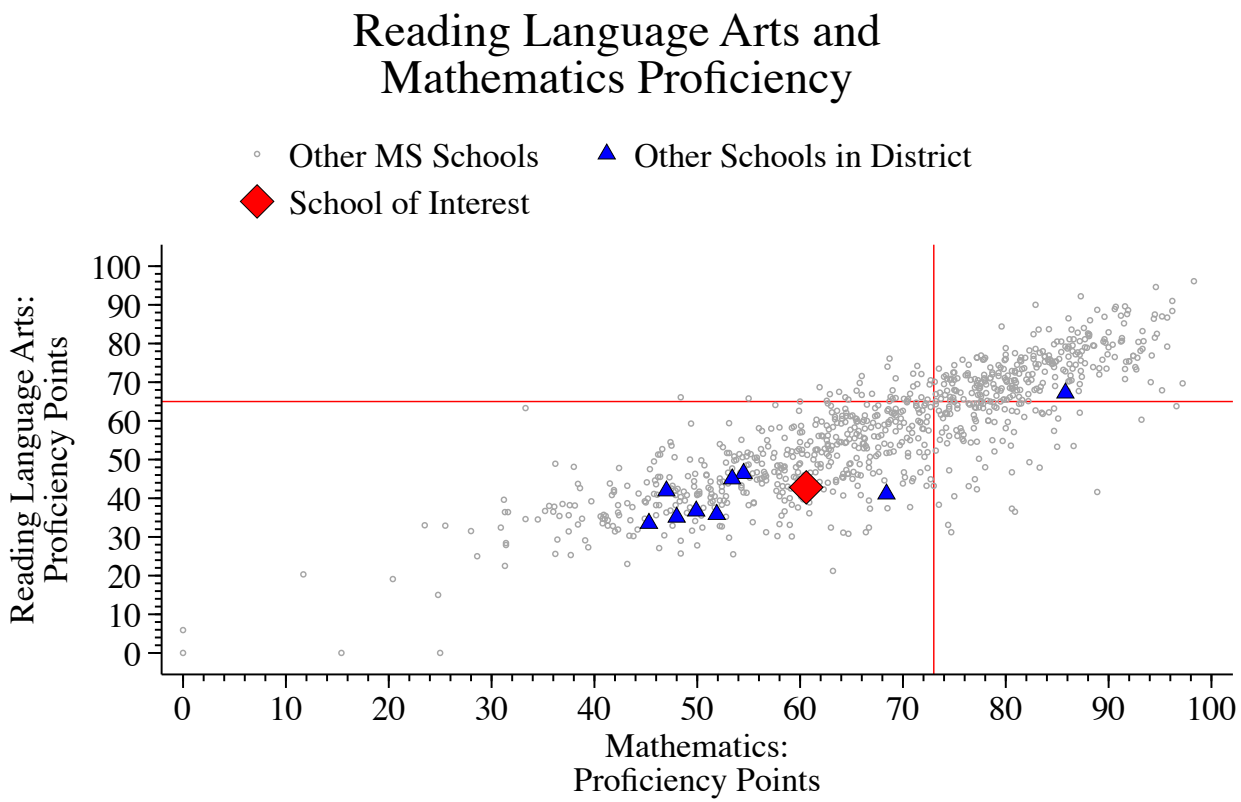
Visualizing Comparisons for Schools, LEAs, & the Public

Proficiency Example

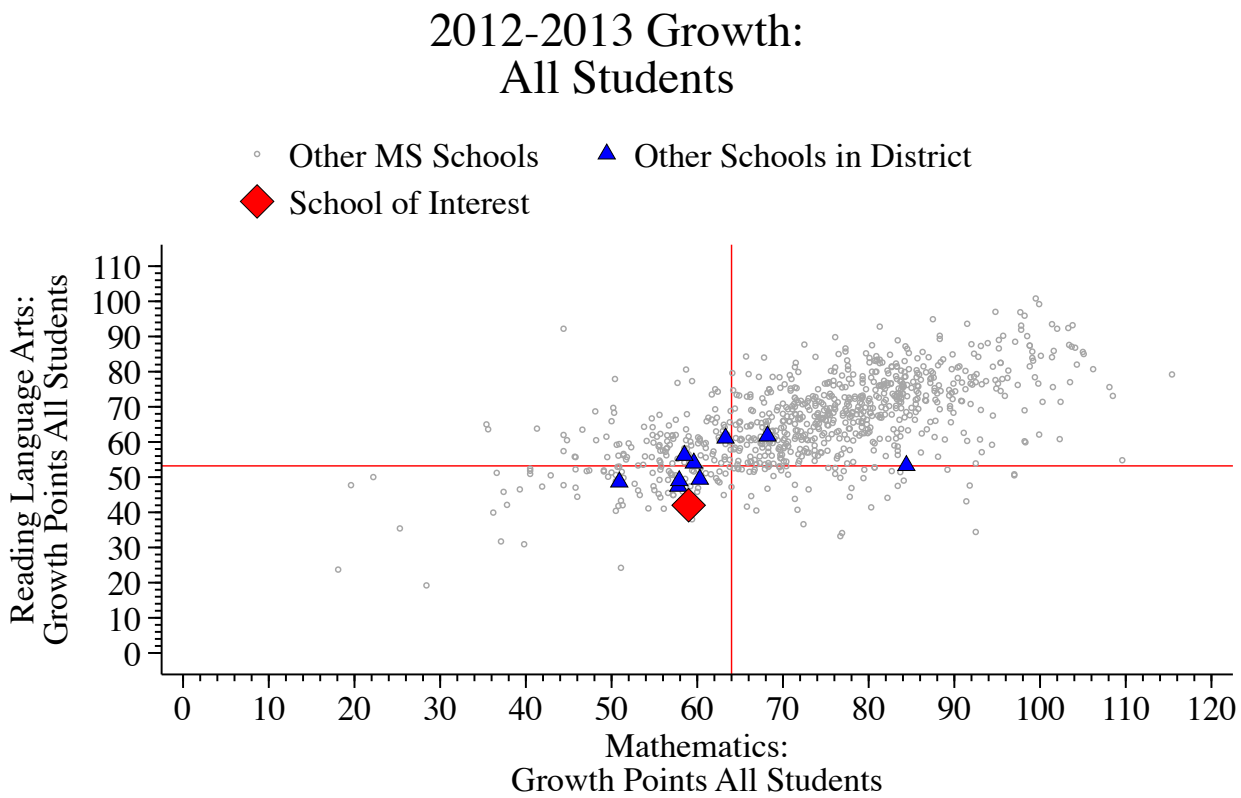


Red Lines Indicate the State's Performance.
For Example Purposes Only

All Data Are Simulated for Illustration Only

Visualizing Comparisons for Schools, LEAs, & the Public

Growth Example



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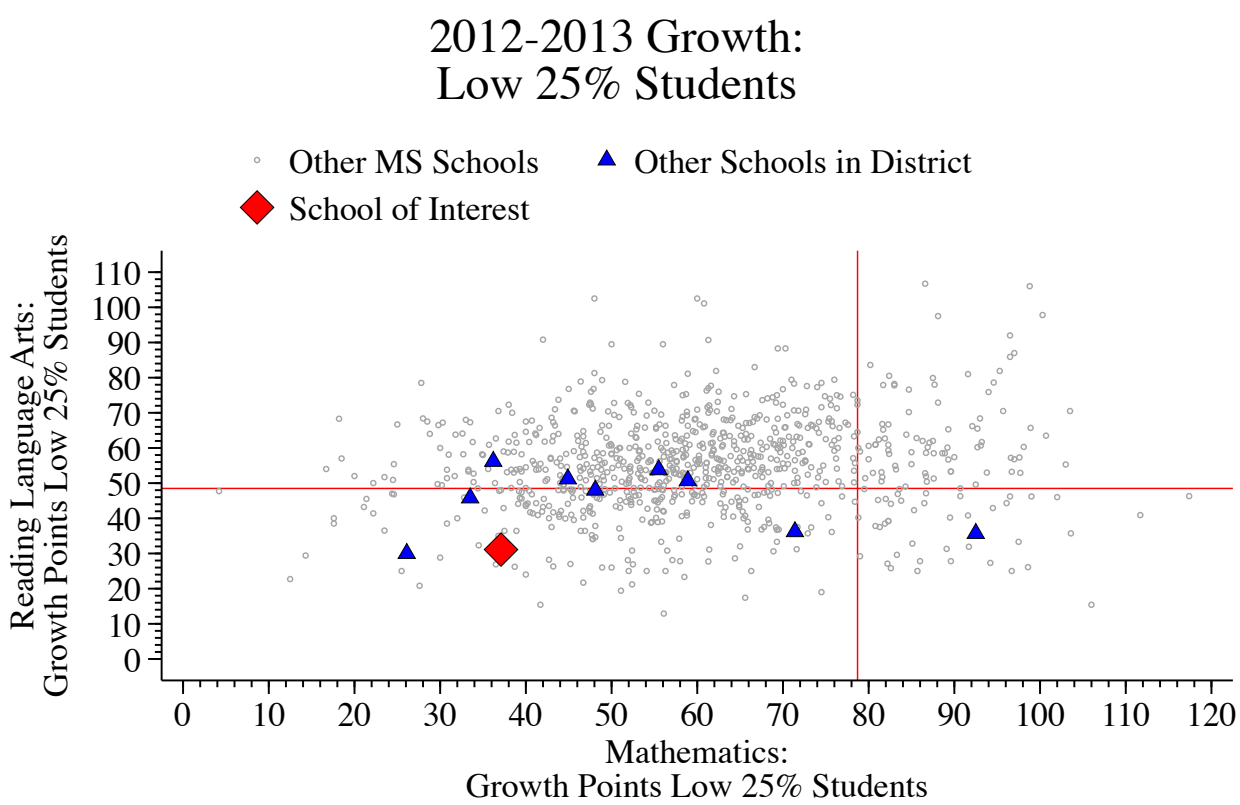
Low 25% Student Growth Example



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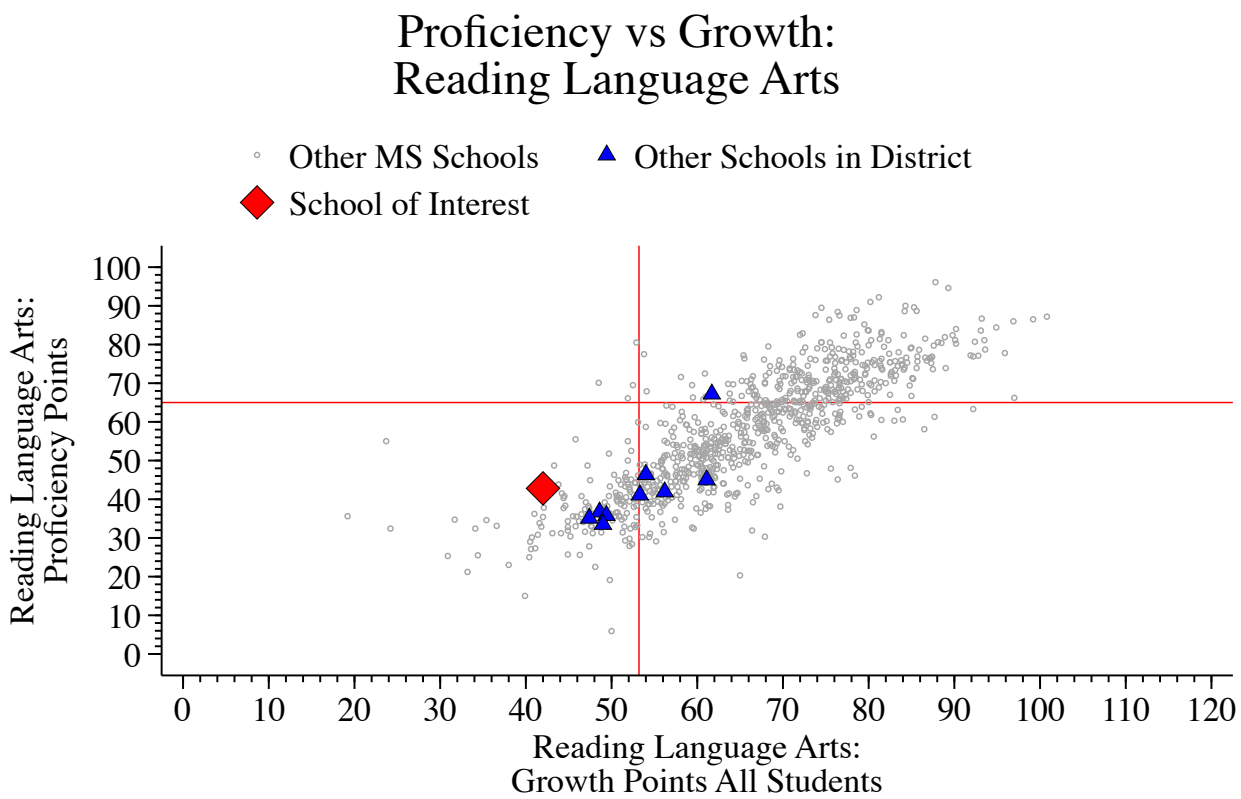
Proficiency v Growth Example



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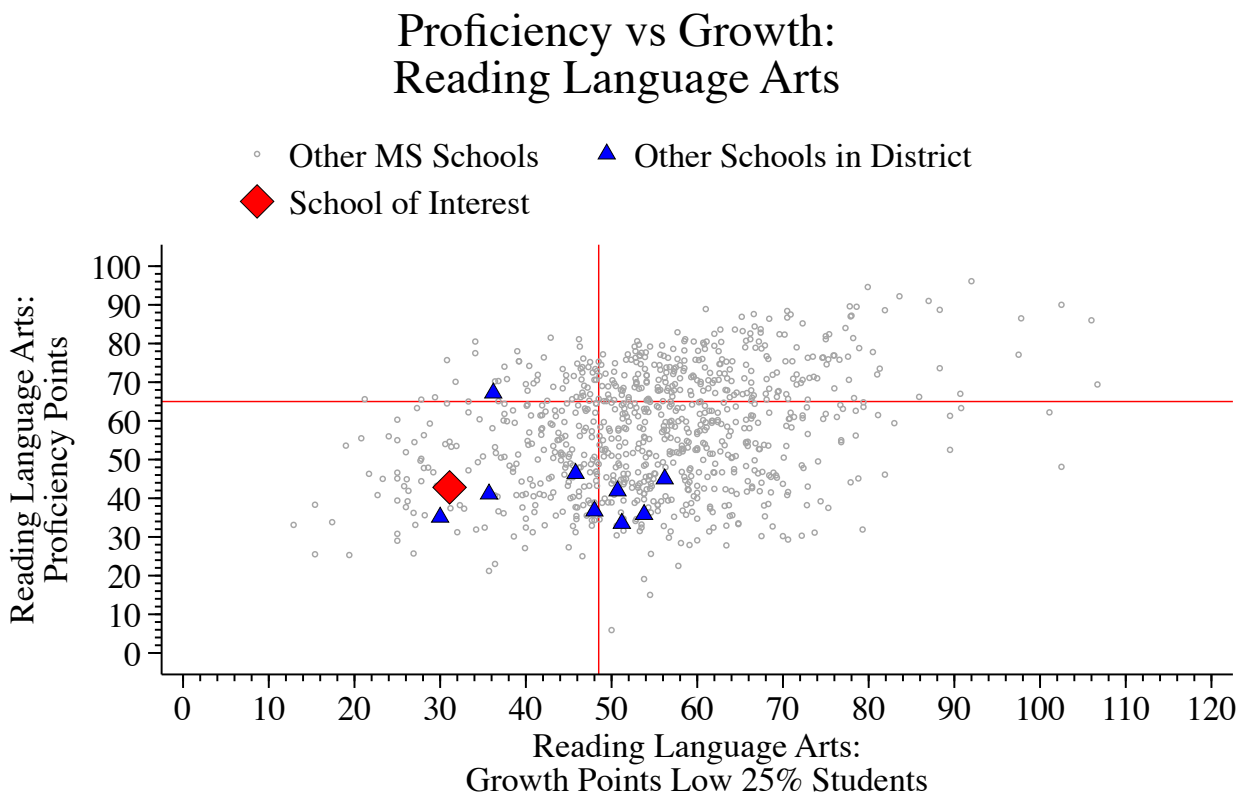
Proficiency v Low 25% Student Growth Example



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Homemade LaTeXMail Merge

mde_reports

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- To make the values of the component scores more informative, we created quintiles for each component score and used the quintiles to define the fill colors for the cells
- `mde_reports` reads the result set data file and uses `file` to write the LaTeXand write a Bash script that is optionalled called by `shell` to compile the .tex files and remove all of the ancillary files after compilation

Homemade LaTeXMail Merge

Schools/Districts with a 12th Grade Example

SCHOOL NAME HERE
DISTRICT NAME HERE

Grade: **C** Total Points: **586**	READING	MATHEMATICS	SCIENCE	US HISTORY	ACCELERATION ⇓
PROFICIENCY	**60.5**	**71.6**	**60.8**	**68.3**	N/A
GROWTH ALL STUDENTS	**66.9**	**70.7**	GRADUATION RATE ⇓	PARTICIPATION RATE ⇓	COLLEGE & CAREER READINESS ⇓
GROWTH LOW 25%	**52.0**	**50.6**	**85.9**	**99.6**	N/A

0–20%ile | **21–40%ile** | **41–60%ile** | **61–80%ile** | **81–100%ile**

The colors above indicate in which quintile the individual component is in compared to other schools in the MS Statewide Accountability System.

Homemade LaTeXMail Merge

Schools/Districts without a 12th Grade Example

SCHOOL NAME HERE
DISTRICT NAME HERE

Grade: **C** Total Points: **418**	READING	MATHEMATICS	SCIENCE
PROFICIENCY	49.5	45.8	54.8
GROWTH ALL STUDENTS	65.9	61.1	PARTICIPATION RATE ⇓
GROWTH LOW 25%	74.1	68.2	**99.6**

0–20%ile **21–40%ile** **41–60%ile** **61–80%ile** **81–100%ile**

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Efficiency Gains from Stata

Comparing the code bases

Area	# Scripts	# Data Files
Growth	32	80
Graduation Rates	23	75
AYP†	81	119
ESEA (Federal Law)	16	22

† Various aggregated proportions of achievement levels/participation rates on standardized tests

- The process of estimating growth previously required the use of 32 static SAS Scripts; Now . . . it is completed with 1 .ADO file.
- Graduation Rates previously used 23 static SAS Scripts; Now . . . it can be completed with 2 .ADO files.
- Proficiency/Participation Rate Measures used $>$ 50 Scripts previously. Now . . . it is completed with 2 .ADO files.

Efficiency Gains from Stata
(continued)

- In addition to reducing the code base, the use of ADO files should also reduce long term maintenance (so long as the rules don't change)
- The migration also gives the agency the flexibility to deploy open sourced toolkits developed by the Strategic Data Project http://www.gse.harvard.edu/sdp/resources/toolkit.php for measuring and leveraging existing data to drive human capital policies/practices as well as inform policies, practices, and program development to support college and career readiness goals

Ease of use for additional end-users

Menu/Dialog Driven Interface

- Although Stata may be user friendly to folks accustomed to working in the Stata environment, scripting languages can often be intimidating for many folks in the education sector whose only experience with analytic software is Some Program for Some Statistics and/or spreadsheet-based programs
- While dialog programming in Stata may not be the easiest, creating menu driven systems can make the interface more welcoming to novice users
- Stata is also still fairly new to the education sector in general and many graduate training programs in education tend to favor Some Program for Some Statistics even though it is a less robust platform for analysis and development

Optimizing the code base
computations/data management

- Since a few of the operations take several minutes to run, it would be great to push some of the computations into Mata
- Currently working on refining the SQL codebase to force queries to return SIF values for date fields (e.g., TO_NUMBER(TO_DATE('09012014', 'MMDDYYYY') - TO_DATE('01jan1960', 'DDmmmYYYY')) = 19967) to reduce cleaning/formatting operations on the Stata side of things
- Because of the tight development timeline, the majority of the code took the "brute force" approach so there are likely to be numerous opportunities for code optimization

Adding more robust support for data visualization

interactive visualizations and code efficiency

- One of the biggest runtime efficiency challenges is in graph creation
- Currently all of the graphs are static, but I'm hoping that I'll learn enough about `stata2d3` during the conference to change that a bit more
- I also hope to better integrate tools like QGIS and/or `spmap (Available from SSC)` to develop data products for public consumption

Training additional end-users

- Used some of the existing examples of building .smcl-based presentations as a starting point
- Replaced nearly all code with hypertext to reduce end-users' anxiety of script-based software and allow them to get an idea of what the software is capable of without having to learn to code first
- After some initial participant feedback, added two sub-routines that would allow users to fetch data sets created with `aisa (Written by S Kolenikov)` and a routine that would launch video tutorials in Stata