PREDICTING NATIONAL STANDARDS

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Predicting students National Standards achievement in mathematics using JAM assessment results.

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Springboard Foundations of Data Science Capstone Project

National Standards Explained

- In New Zealand, National Standards are a national benchmark for student progress throughout the primary school years.
- The standards set clear expectations that students need to meet in reading, writing, and mathematics in the first eight years at school.
- At the end of each year of schooling teachers use a range of student achievement evidence to judge whether a student is ‘At’, ‘Below’, or ‘Above’ the expected National Standard.

National Standards Achievement

According to Ministry of Education data from 2015 (Ministry of Education) :

- 84.5% of students after one year at school are achieving ‘At’ or ‘Above’ the National Standard in Mathematics
- 74.2% of students at the end of Year 3

Is it possible that some of the students who are judged as being ‘Below’ the expected National Standard after 3 years could have been ‘At’ if they had been identified after 1 year and had some intervention put in place to support or accelerate their progress?

The Aim of the Project

The purpose of this analysis is to identify key early warning signs for students at risk of not achieving the National Standard at the end of Year 3, and therefore taking action to support their progress and learning so that they may have the best chance of achieving ‘At’ the National Standard.

The Data Set

Data in this project will come from one school with a roll size of 485 students.

Complete data for 147 students includes:

- JAM (Junior Assessment in Mathematics) assessment tool results (after 1 year at school)
- National Standards Mathematics OTJ (after 3 years)
- Other data included are student gender and ethnicity.

The Data Set

We are using 7 domains from the JAM Assessment:

- Additive Strategies
- Numeral Identification
- Forward Number Sequence
- Backwards Number Sequence
- Fraction Knowledge
- Place Value Knowledge
- Basic Facts Recall

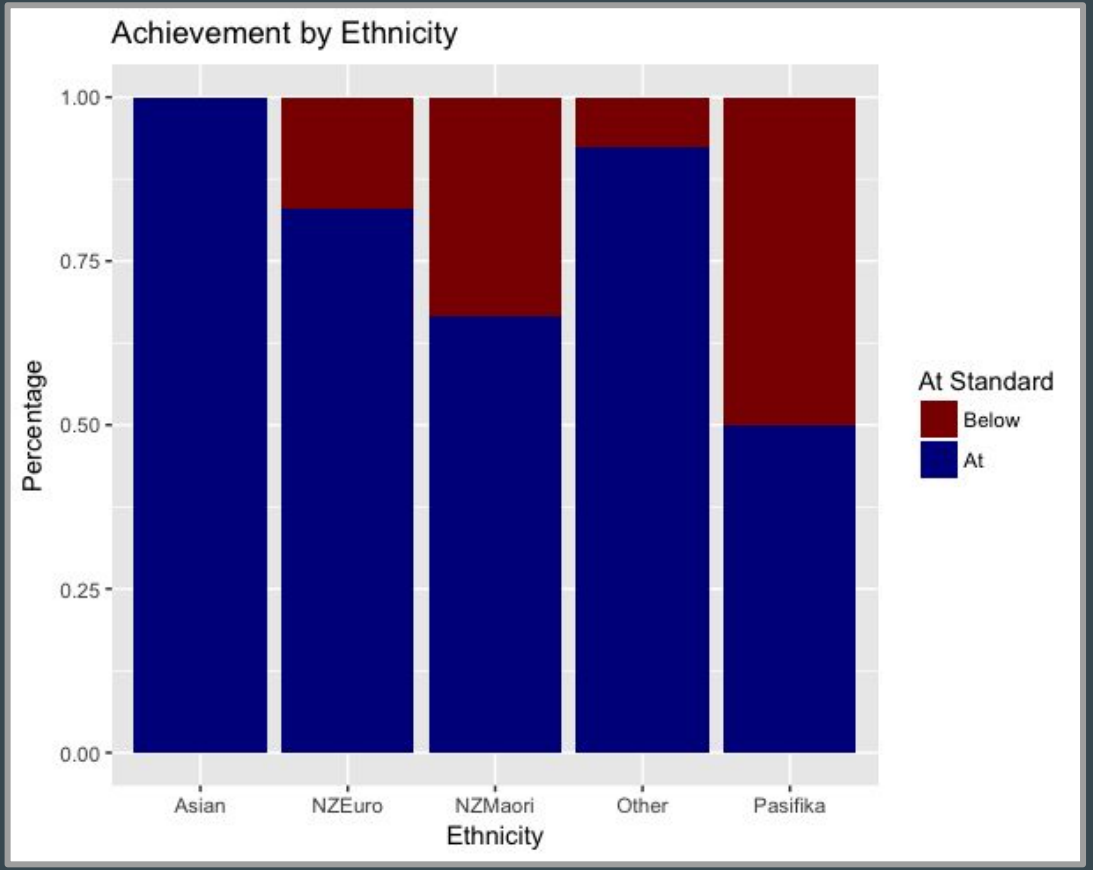
Exploratory Analysis - How many students are achieving ‘At’?

- The first step was to identify the percentage of students in the data set who were achieving ‘At’ or ‘Above’ the standard.

- 28 students (19%) were achieving ‘Below’ or ‘Well Below’, 119 students (81%) were achieving ‘At’ the standard.

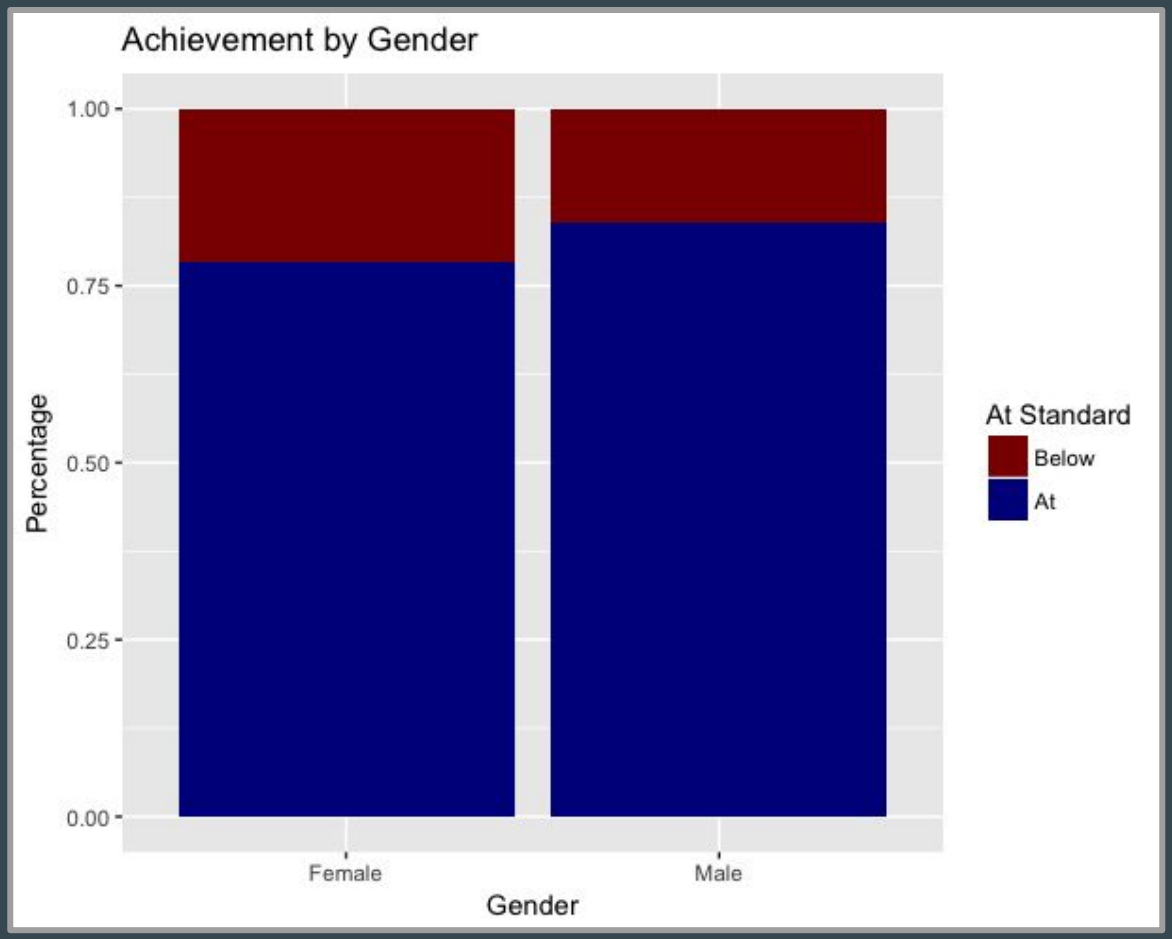
Exploratory Analysis - Achievement in Ethnic Groups

- This showed that NZ Maori and Pasifika students were more likely to achieve below the standard.
- 33% of NZ Maori students were below the standard, as were 50% of Pasifika students.



Exploratory Analysis - Achievement in Gender Groups

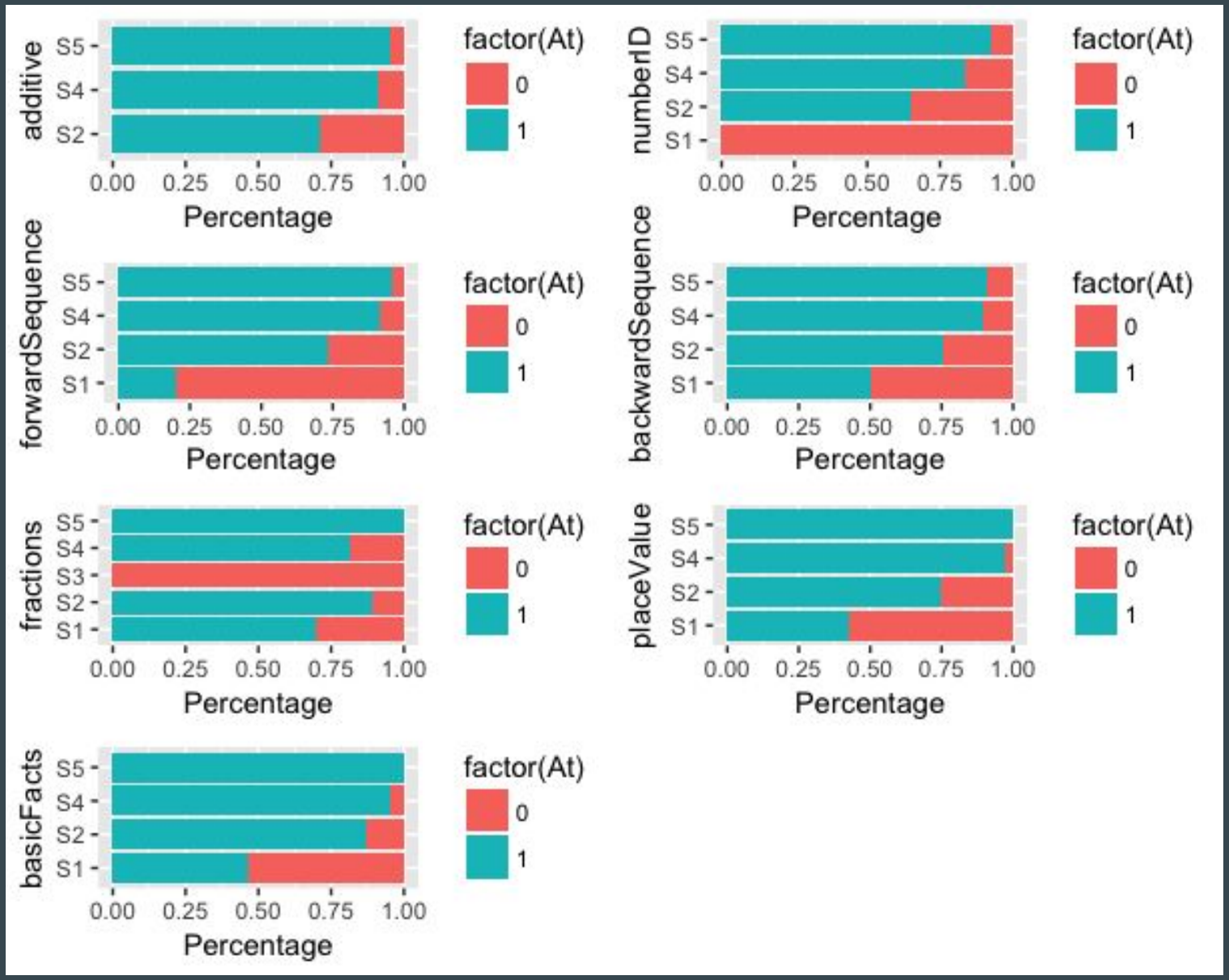
- This showed that 21% of female students and 16% of male students were achieving below the standard.



Exploratory Analysis - Achievement in each JAM domain

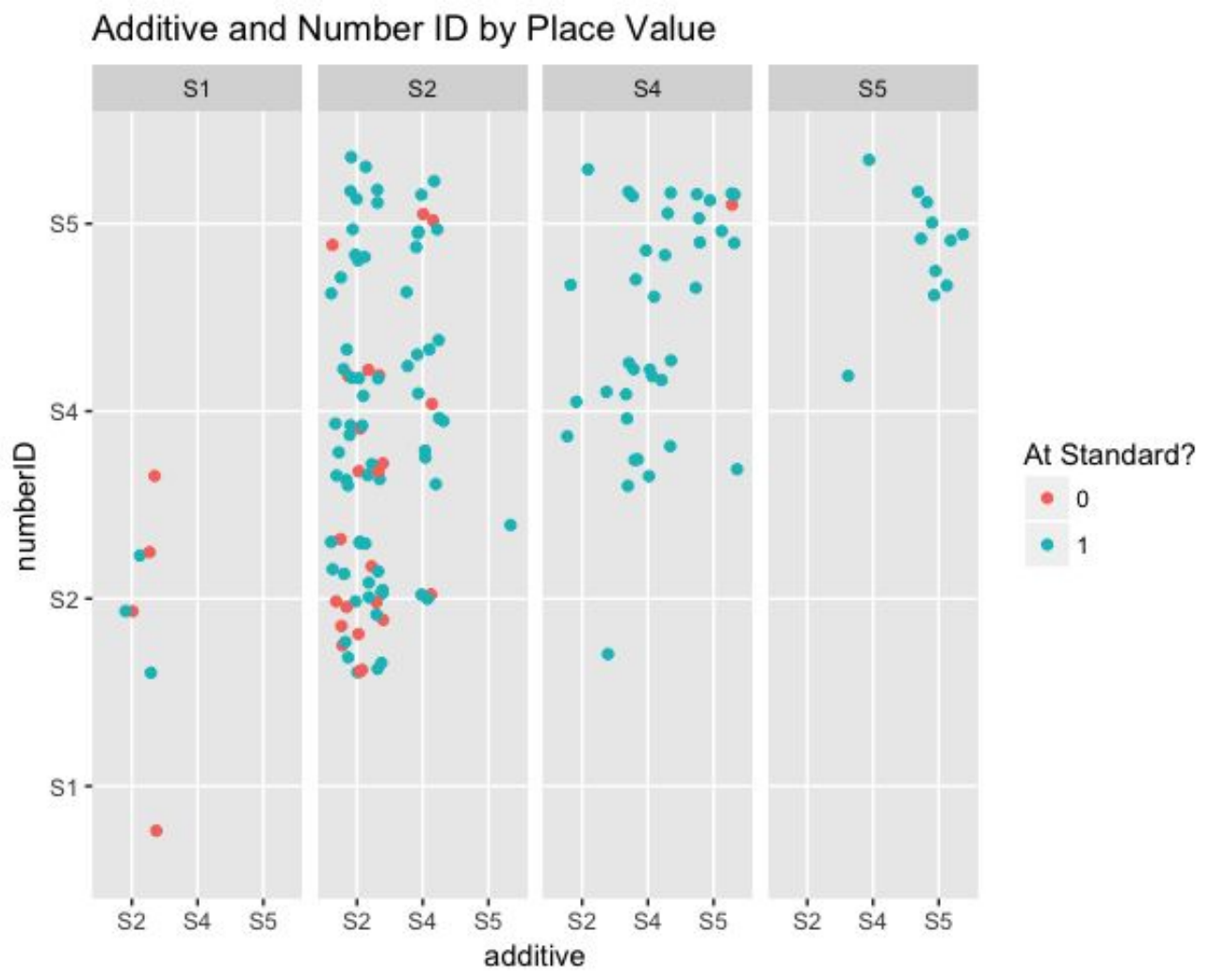
- With nearly every domain, the higher stage that a student is assessed as being at, the more likely it is that they will be achieving ‘At’ the standard.
- The one exception is the ‘fractions’ domain
- To visualize this I plotted each domain in a combined plot.
- Each individual bar plot showing the percentage of students at each stage of that domain who are judged ‘At’ or ‘Below’ the standard.
- The ‘numberID’, ‘placeValue’, ‘forwardSequence’, and ‘basicFacts’ domains have the largest proportion of students who were at stage 1 (S1) and then judged as ‘Below’ the standard.
- Over half of the students who were Stage 1 in these domains did not reach the standard.

Exploratory Analysis - Achievement in each JAM domain



Exploratory Analysis - Achievement in JAM domains

Visualising achievement in 3 JAM Domains with National Standards



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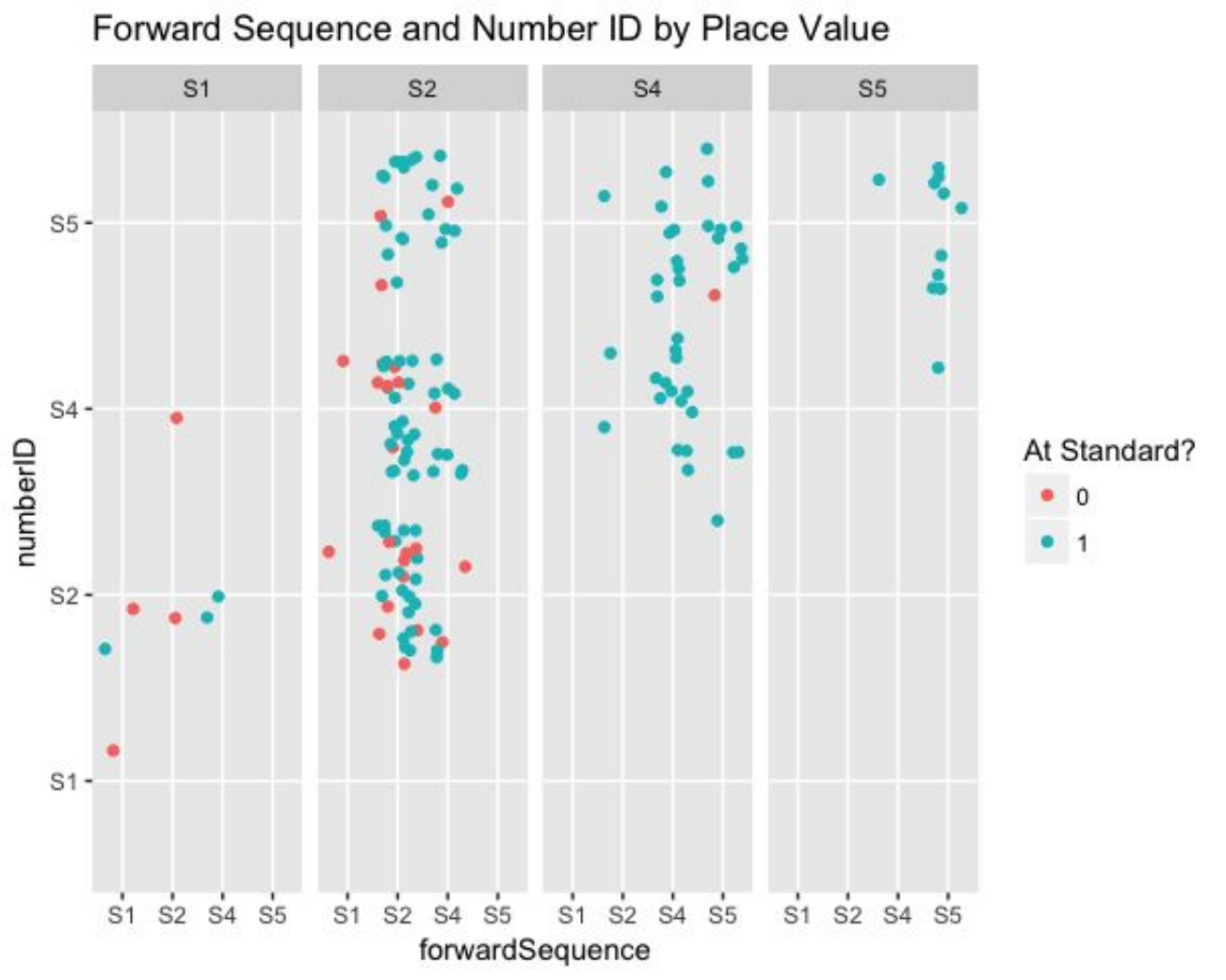

Exploratory Analysis - Achievement in JAM domains

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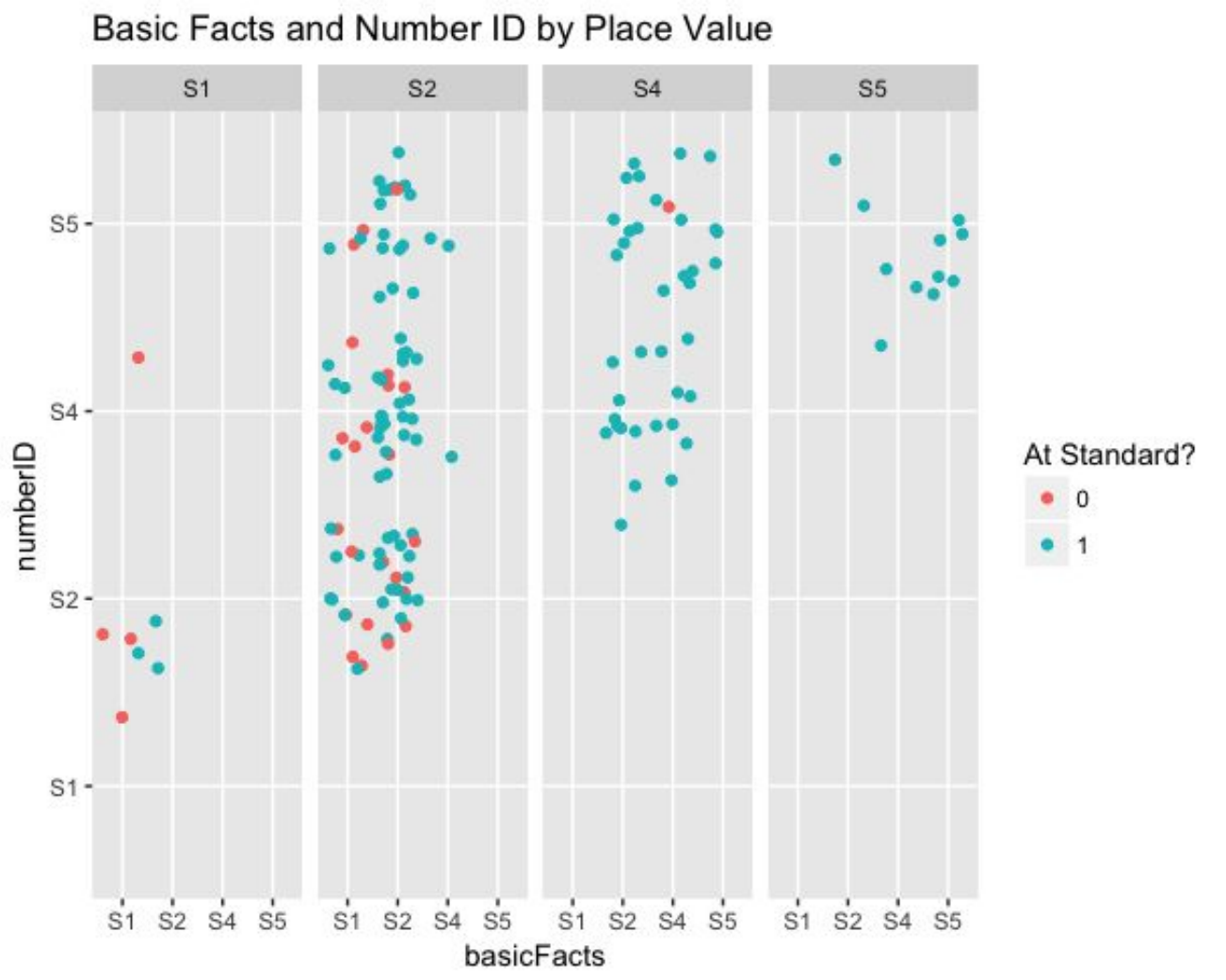
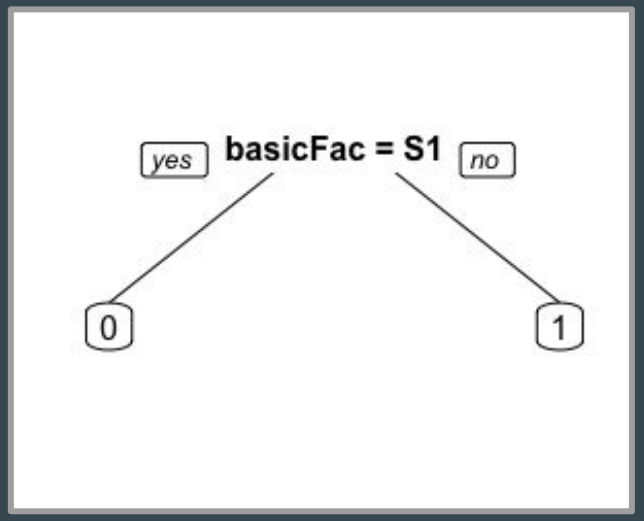


PREDICTING - NATIONAL STANDARDS FROM JAM RESULTS

- Our machine learning created a decision tree predictive model that claimed that if a student was judged as being at Stage 1 in the Basic Facts domain of the JAM assessment they would be below the National Standard after 3 years at school.
- This model would be correct 82 % of the time, only marginally better than our baseline model of 81% assuming that all students would be at standard.



DISCUSSION

- This project did not have a large enough data set.
- Basic Facts domain was identified as key indicator.
- To put too much emphasis on just one aspect of the JAM assessment would be too simple a solution.
- Being able to recall an equation from memory does not demonstrate that one has deep conceptual understanding of numbers or what they represent.
- Students also need to have a good understanding of all of the other domains of mathematical knowledge that are assessed in the JAM assessment.
- We also know that for students to be successful learners in mathematics they need to be able to make connections between different concepts and explain, reason, and justify their mathematical thinking.

RECOMMENDATIONS

- According to our model the basic facts domain did appear to be the most significant indicator, therefore we recommend that teachers review how they are currently teaching basic facts knowledge and how they might change their classroom programme to support children to improve in this area.
- During the exploratory data analysis we identified that NZ Maori and Pasifika students are less likely to be ‘At’ the standard. We recommend that teachers reflect upon how they can develop their practice to ensure these students have the best possible opportunity to reach the standard.
- We also recommend that further work be done in this area. If a much larger data set was available with assessment and achievement data from students across multiple New Zealand schools there could more exploration and predictive modelling completed on a much larger scale.
- This could provide educators with valuable insights into which students are most at risk of not achieving the National Standard, and allow them to put in place earlier interventions to support their learning.