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100
1918 - 2018

RESEP
Research on Socio-Economic Policy

NOT JUST ABOVE EXPECTATION: IDENTIFYING SCHOOLS WITH POTENTIAL IN MATHEMATICS

(ADAPTED FROM REPORT TO TSHIKULULU ON IDENTIFYING PROMISING SCHOOLS FOR THE 'MATHS CHALLENGE' OF THE
EPOCH AND OPTIMA TRUSTS)

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**RESEP QER CONFERENCE
STIAS, 13 SEPTEMBER 2019**

FINDINGS ON MATH PERFORMANCE IN SA

- 1. General gains** in Mathematics performance observed since the early 2000s
 - Number of black African learners attaining a Maths mark that would allow entry into e.g. engineering at university rose by 65% between 2002 and 2016.
 - Q1 schools saw 160% increase in the number of high-level Maths achievers between 2009 and 2016 (Q2 and Q3 around 90% increase).
- 2. Equity gains** in Mathematics performance by race and school quintile
 - Over two-thirds of high-level Maths achievers in 2016 NSC were BCI.
 - 41% of Q1 schools produced high-level Mathematics passes in 2016.
- 3. Gender equity still lagging**
 - Female Gr12 student only two-thirds as likely of being a high-level Mathematics performer than a male student (has not changed over time).
- 4. Gains in Mathematics performance take SA from a 'very poor' to 'poor' performing national system**
 - 61% of Gr5 learners perform below TIMSS low international benchmark.
 - 65% of SA Gr9 learners perform below TIMSS low international benchmark.

DATA USED IN THIS REPORT

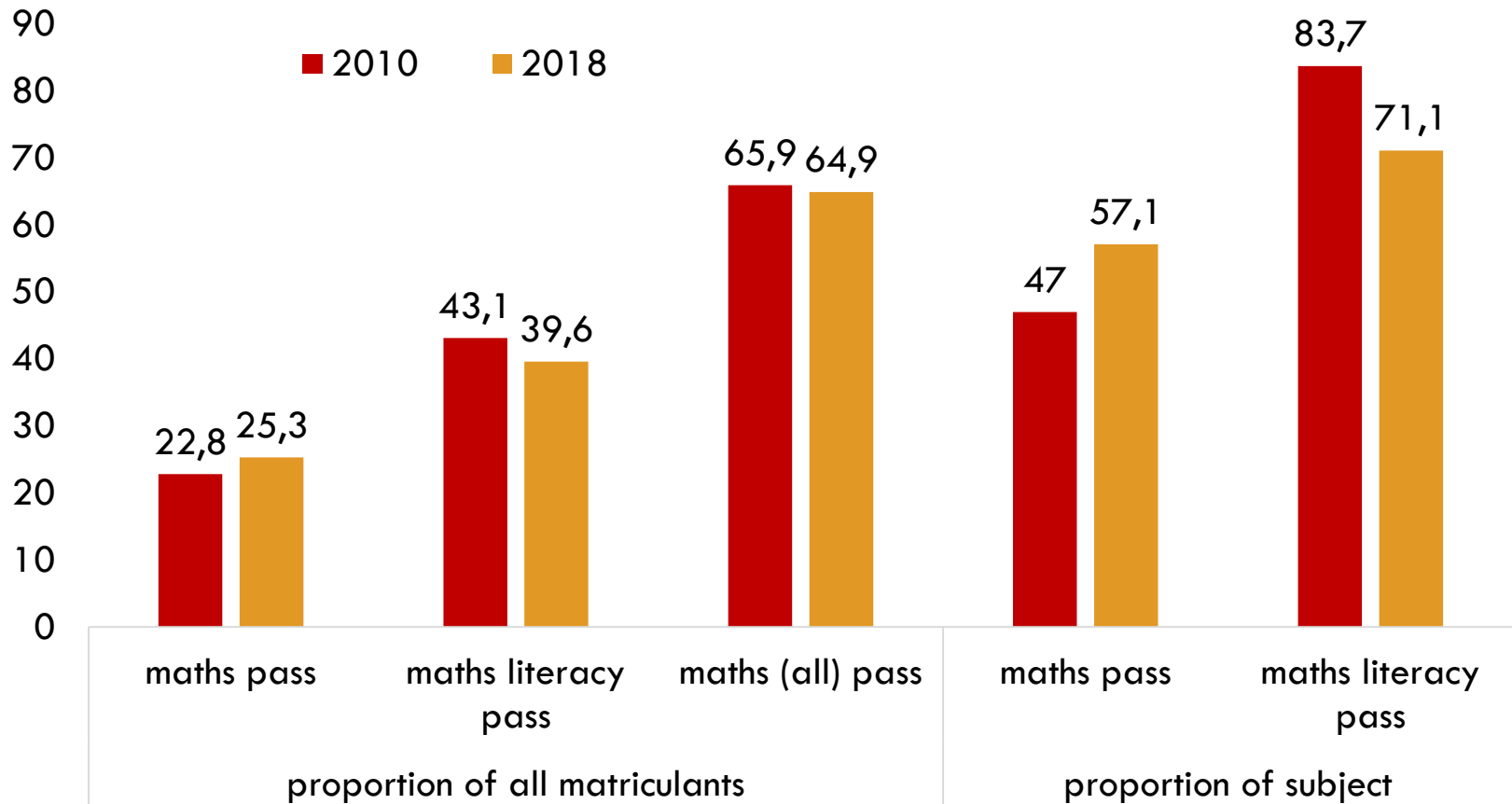


Administrative data

Matric examination data sets for 2010 to 2018

MATHEMATICS PERFORMANCE

Figure 1: Gr12 enrolment in Mathematics by school quintile, 2010 & 2018



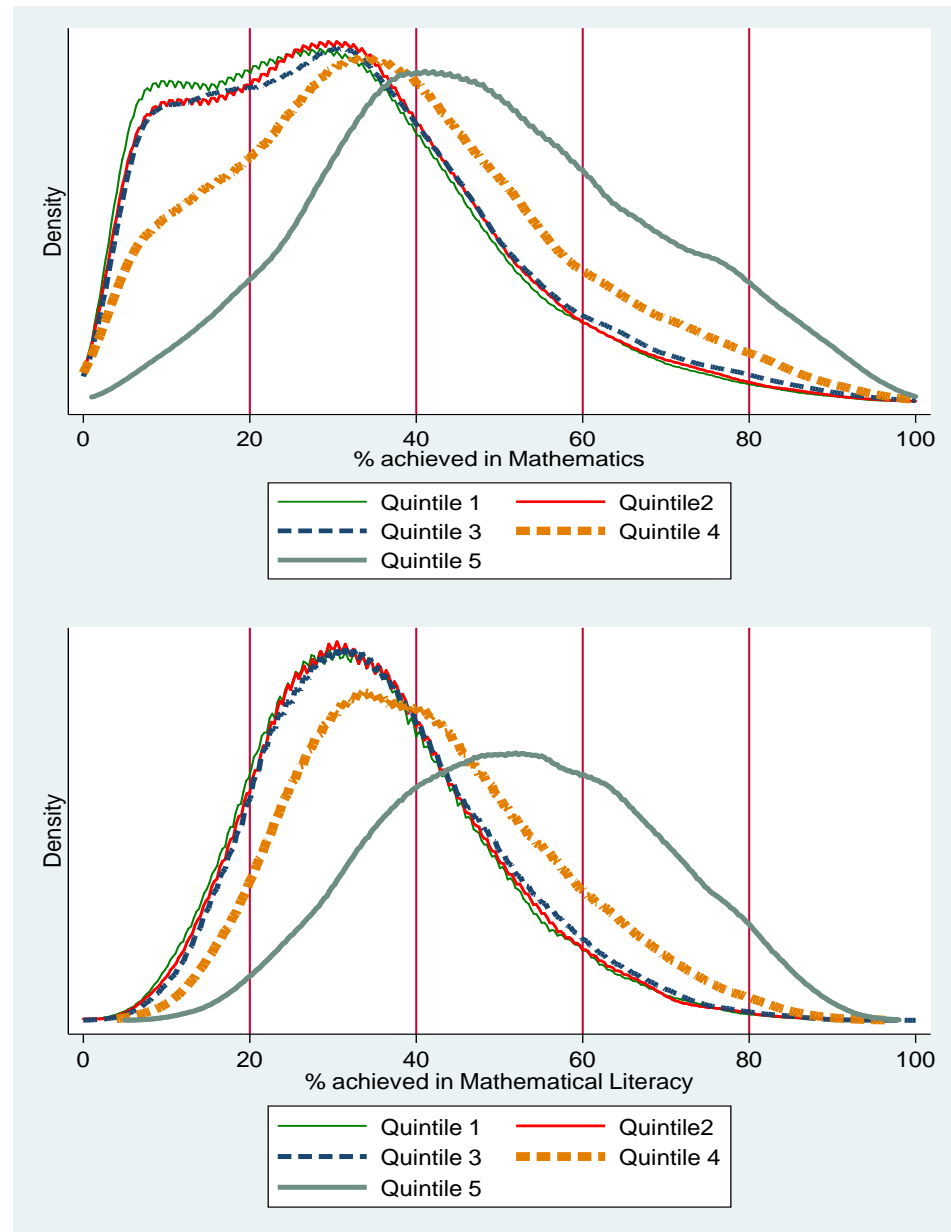
MATH PERFORMANCE

Distribution of Gr12 maths performance in Q1-Q3 schools indistinguishable.

Higher density of poor performance (<30%) in Maths than MathsLit across all quintiles.



Figure 2: Distribution of marks by school quintile, 2018



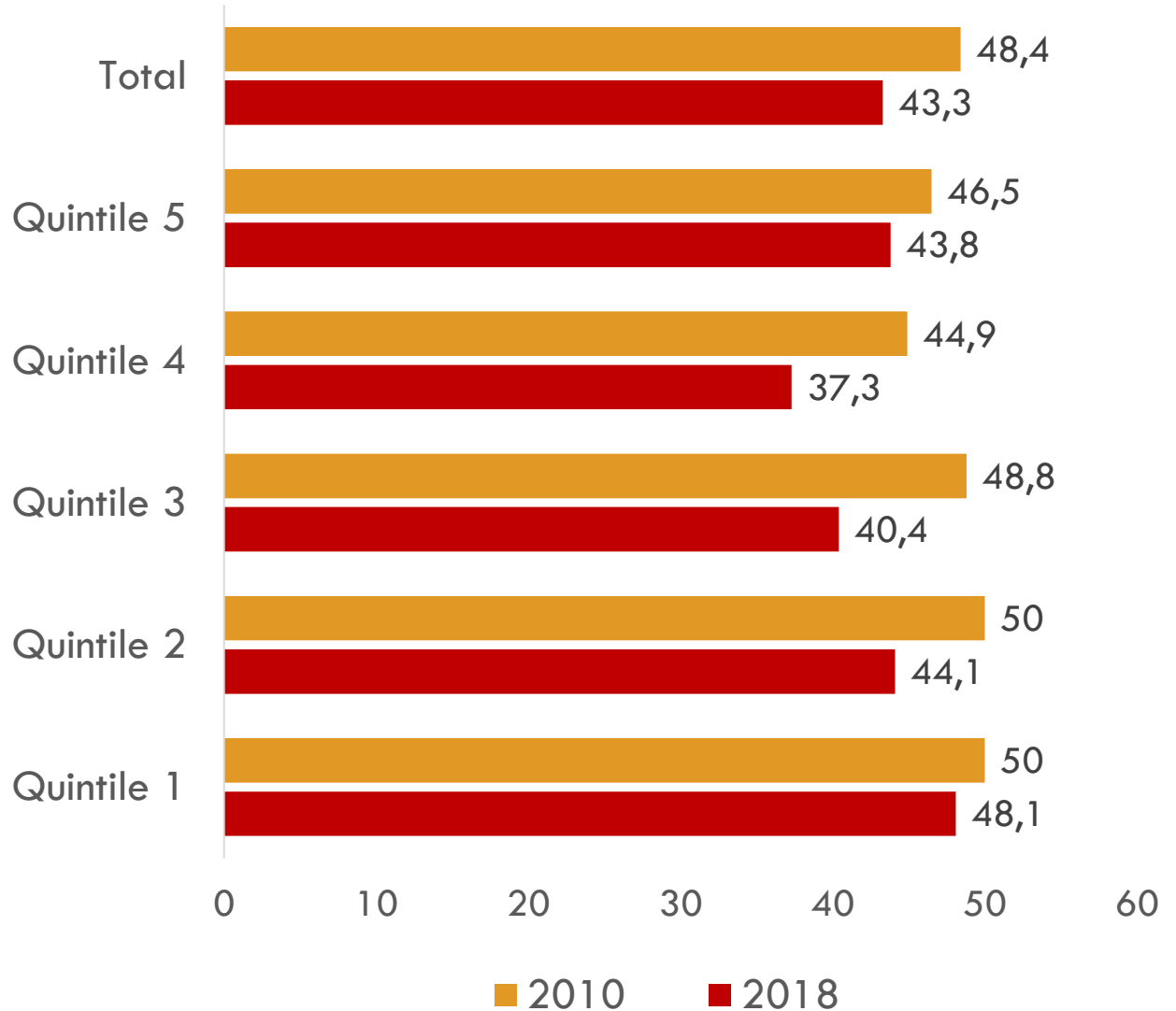
MATH ENROLMENT

Enrolment in
Math is highest
amongst Q1
Gr12 learners

Enrolment in
Math
decreased
between 2010
and 2018



Figure 3: Gr12 enrolment in Mathematics by school quintile,
2010 & 2018



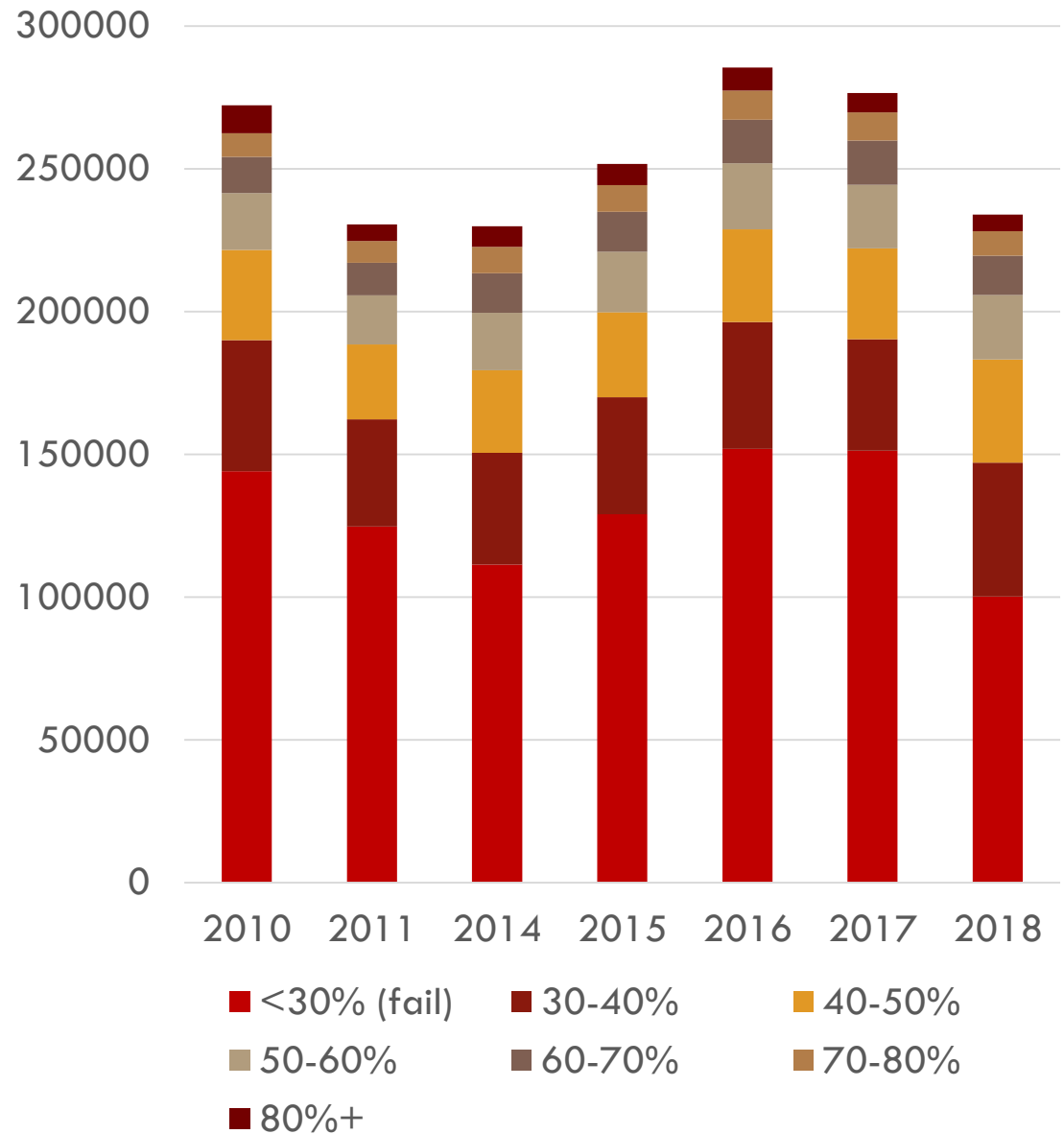
MATH PERFORMANCE

Just over 100 000 Gr12s failed Mathematics in 2018.

Number of Gr12s achieving 80%+ has fallen to about 4 000.

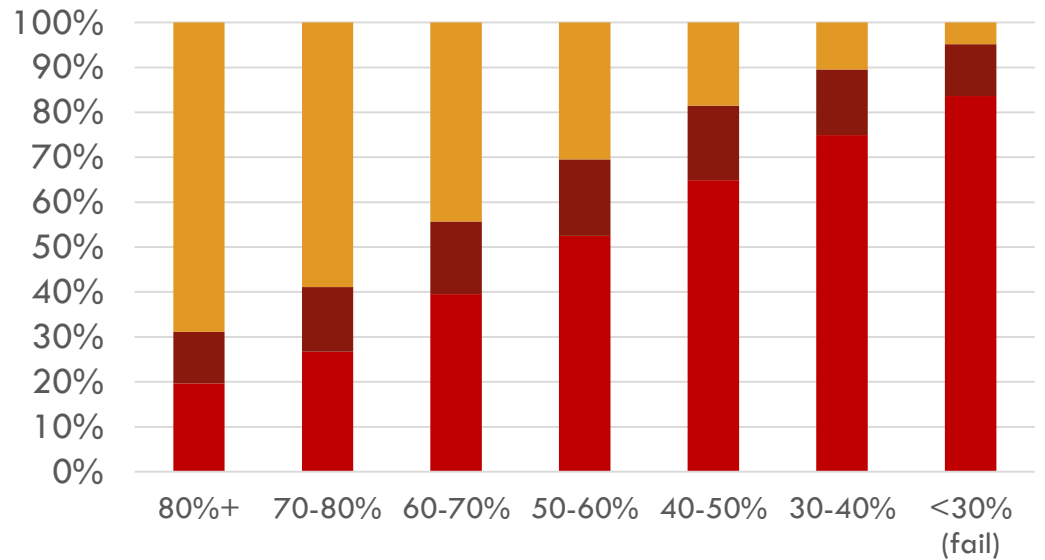
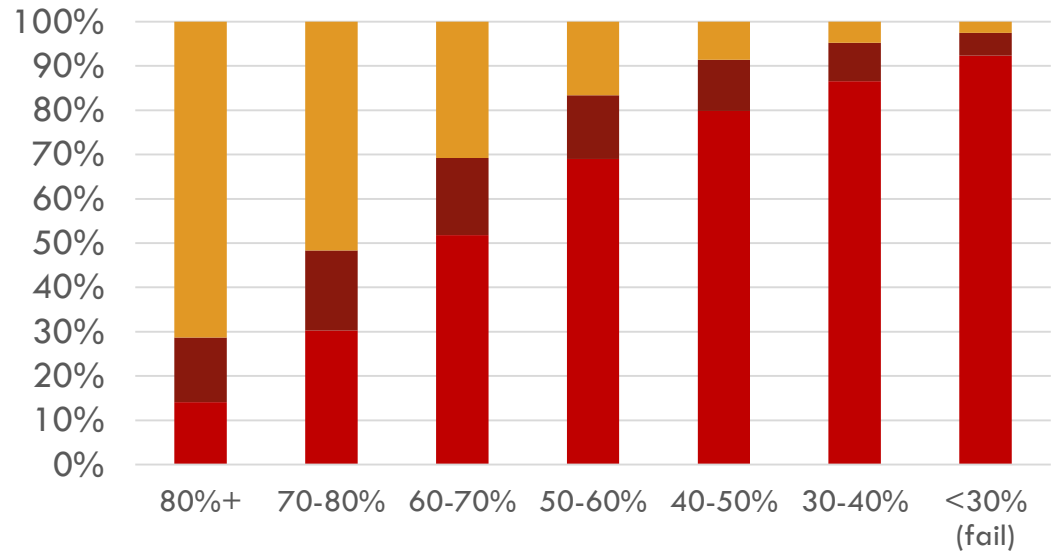


Figure 4: Gr12 Maths performance 2010-2018



MATH PERFORMANCE

Figure 5: Gr12 Math performance 2010 & 2018

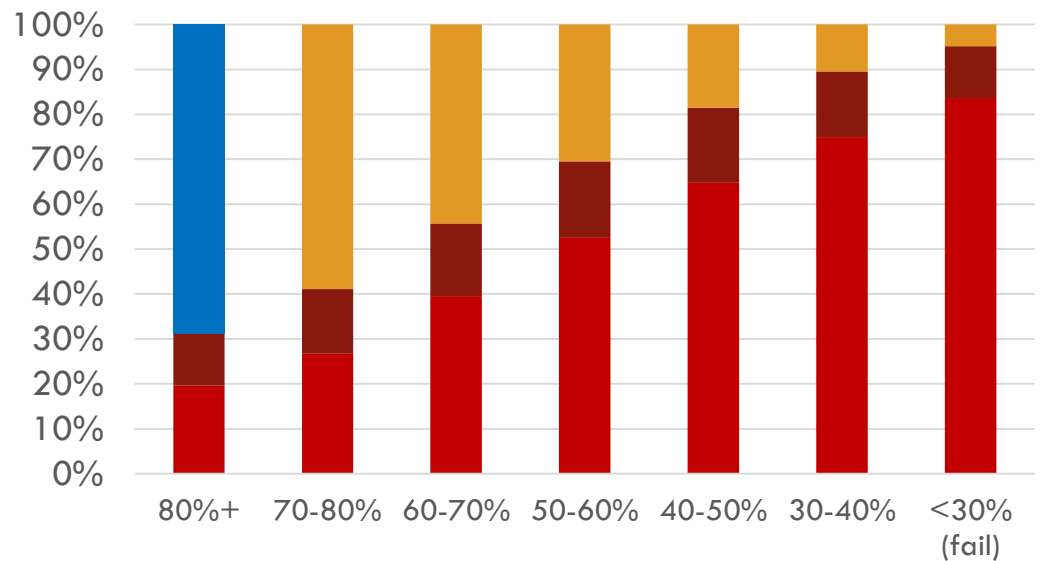
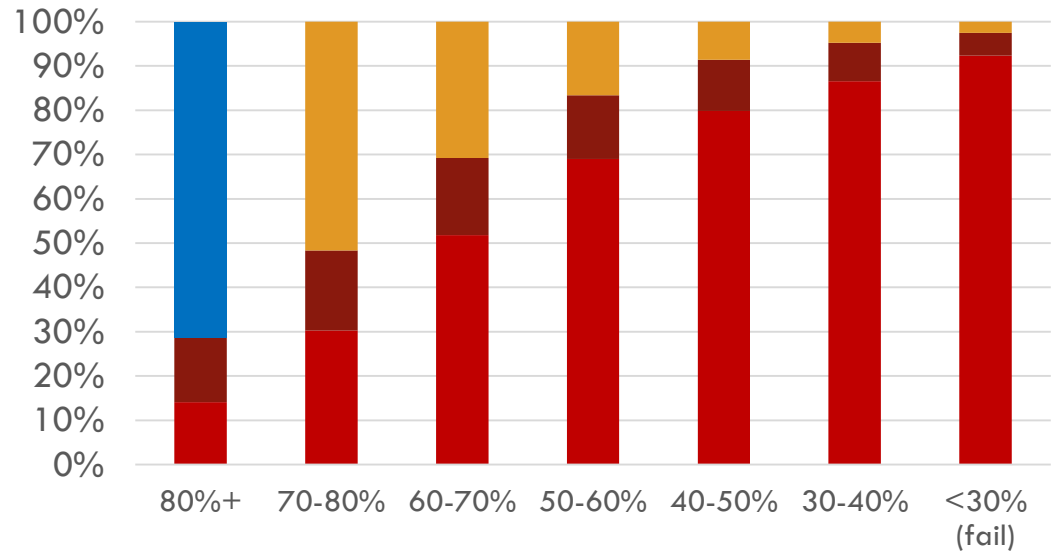


■ Q1-Q3 ■ Q4 ■ Q5

MATH PERFORMANCE

Q5 Gr12 learners account for 70% of all 80%+ achievements.

Figure 5: Gr12 Math performance 2010 & 2018



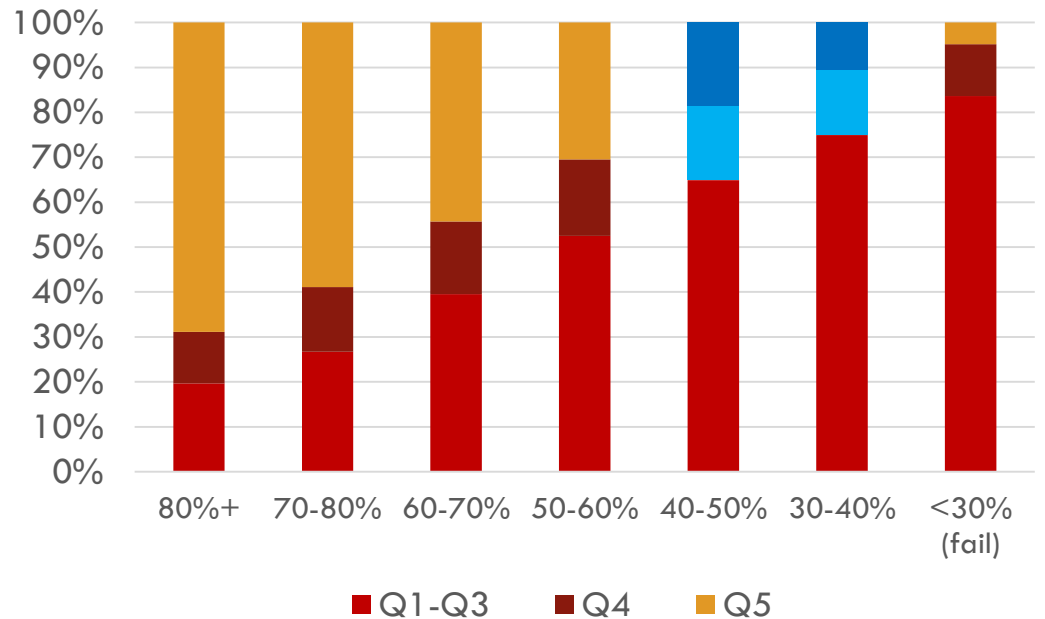
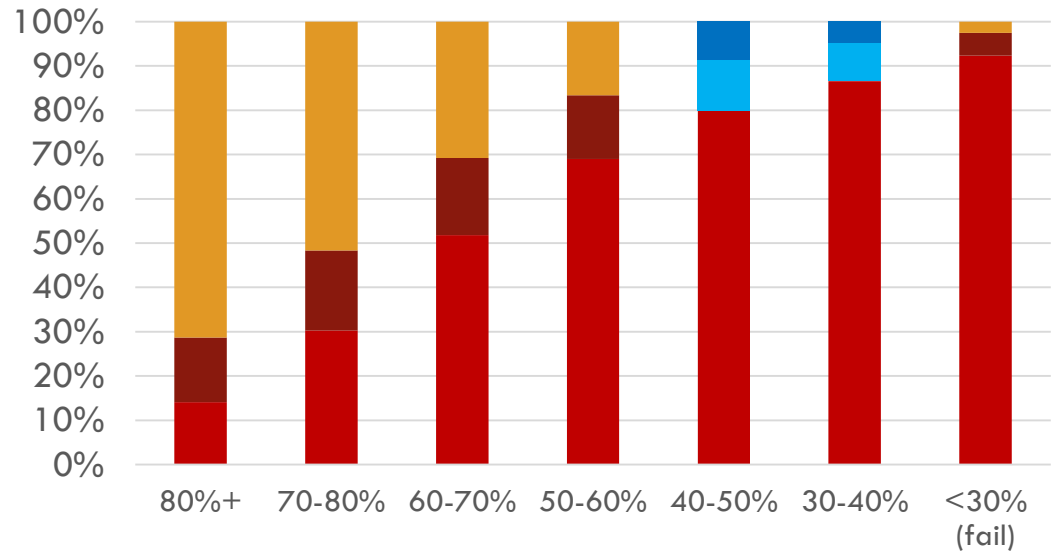
■ Q1-Q3 ■ Q4 ■ Q5

MATH PERFORMANCE

Q5 Gr12 learners account for 70% of all 80%+ achievements.

Q1-Q3 Gr12 learner share of performance below 50% decreasing over time.

Figure 5: Gr12 Math performance 2010 & 2018



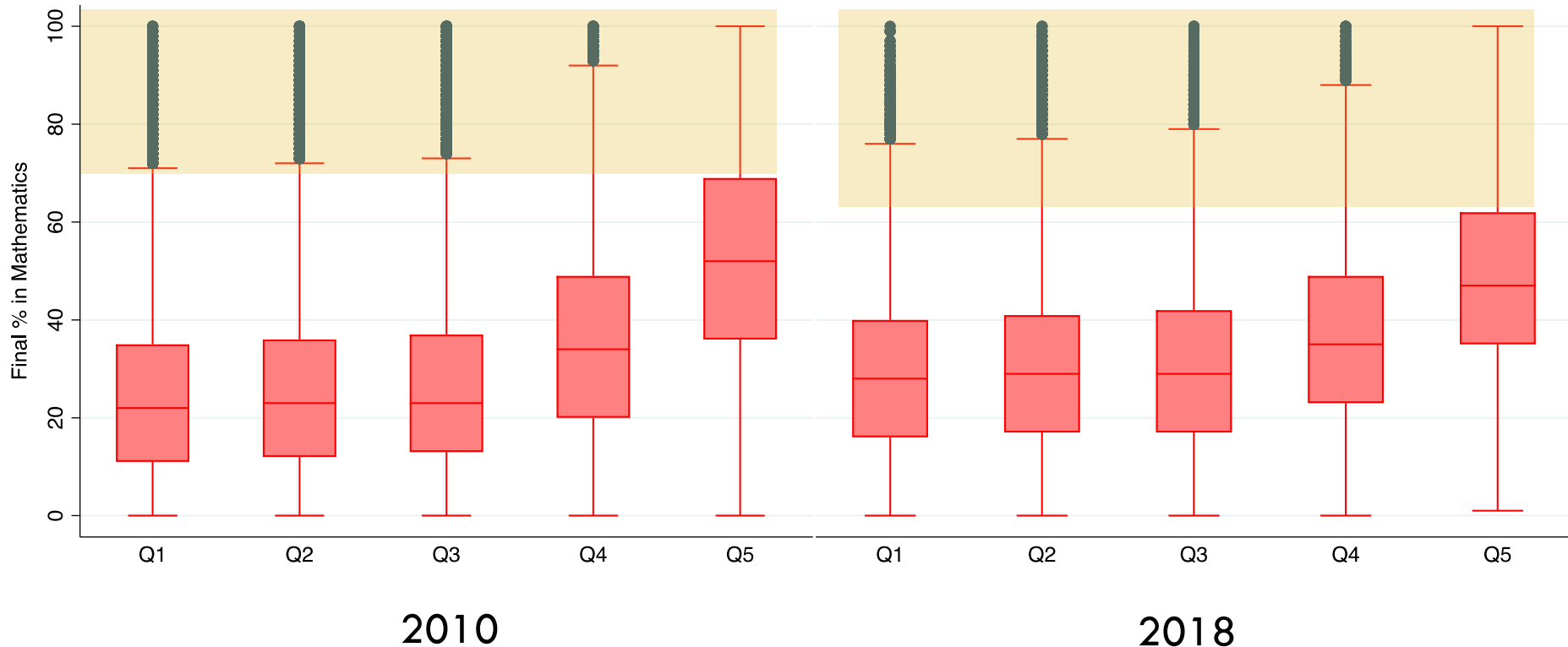
Can use the top performing students within Q5 schools as a benchmark.

In 2010:

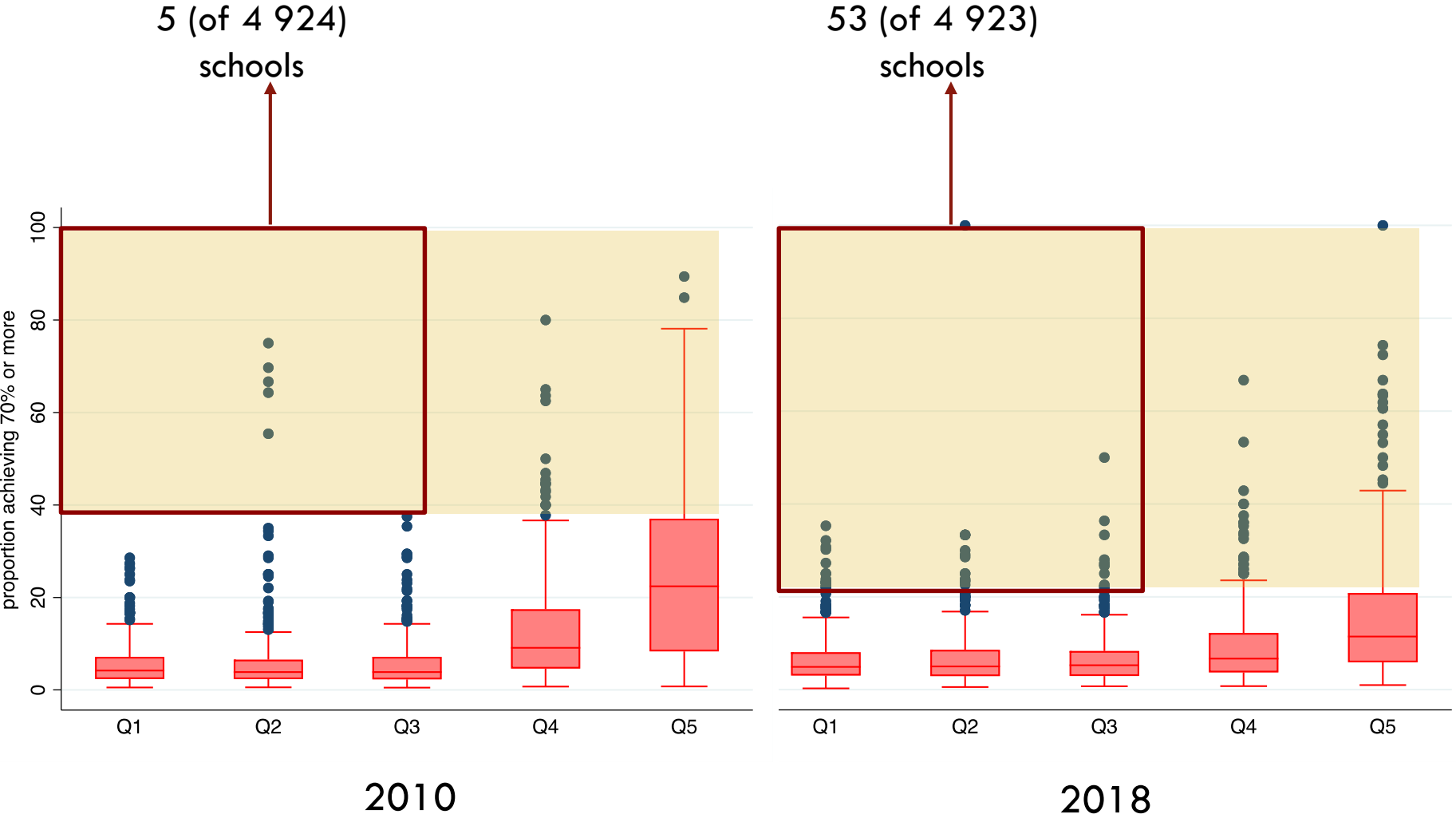
- 3 488 learners in Q1-Q3 schools (2% of all Q1-Q3 learners doing Maths) achieved at the level of the top 25% of Q5 learners
- Found in 27% of Q1-Q3 schools

In 2018

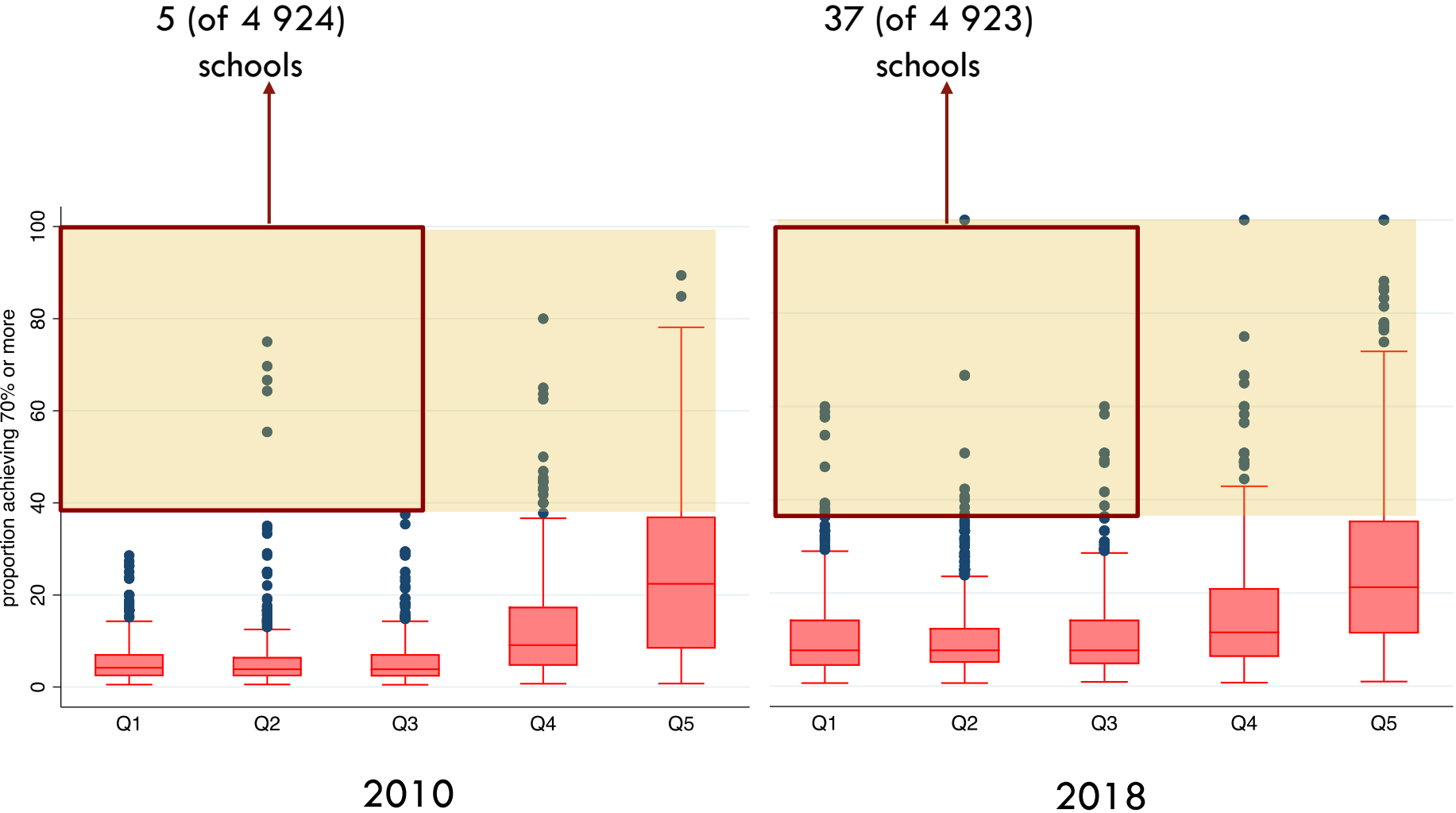
- 9 213 learners in Q1-Q3 schools (5.9% of all Q1-Q3 learners doing Maths) achieved at the level of the top 25% of Q5 learners
- Found in 50% of Q1-Q3 schools



Can use the top performing Q5 schools as a benchmark.

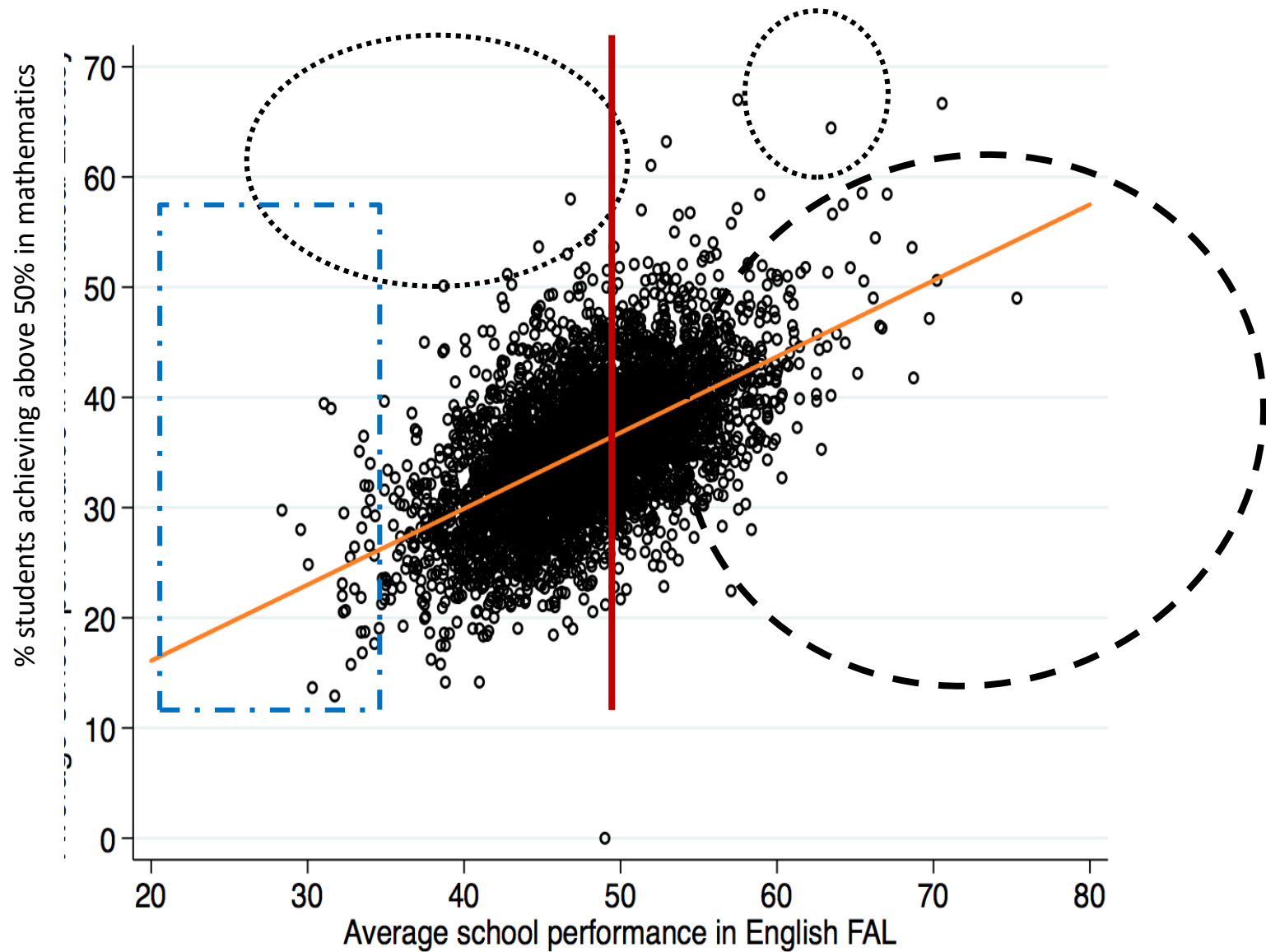


Can use the top performing Q5 schools as a benchmark.



PERFORMANCE AND ENROLMENT

Figure 6: Relationship between Maths passes above 50% and Maths enrolment in Q1 schools



INDICATORS OF INTEREST

Comparison of performance in Maths and Maths Literacy to English FAL and/or school SES

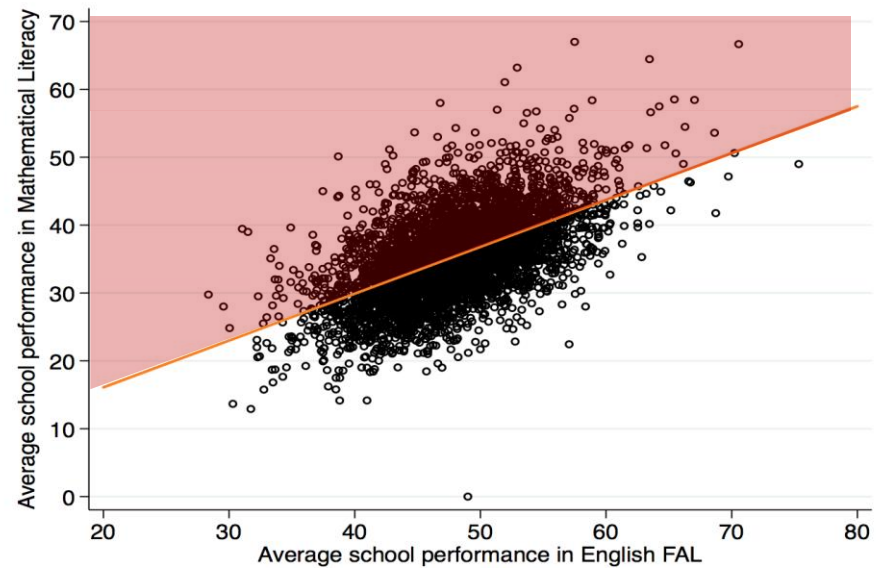
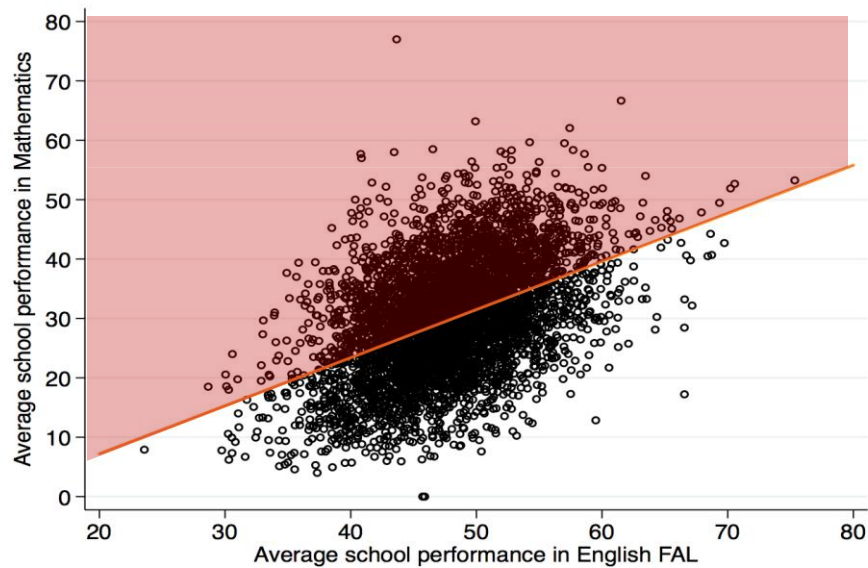
- Identify those schools performing above expectation

Consistency in performance over time

Distribution of matric candidates between Maths and Maths Literacy, and conversions

- schools “wasting” Math potential (using conversion scales of performance)

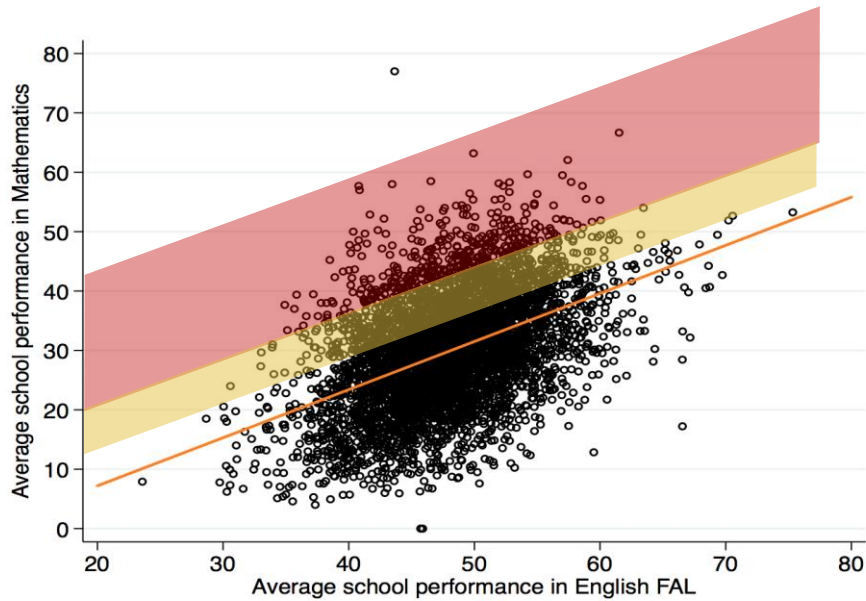
PERFORMANCE “ABOVE EXPECTATIONS”



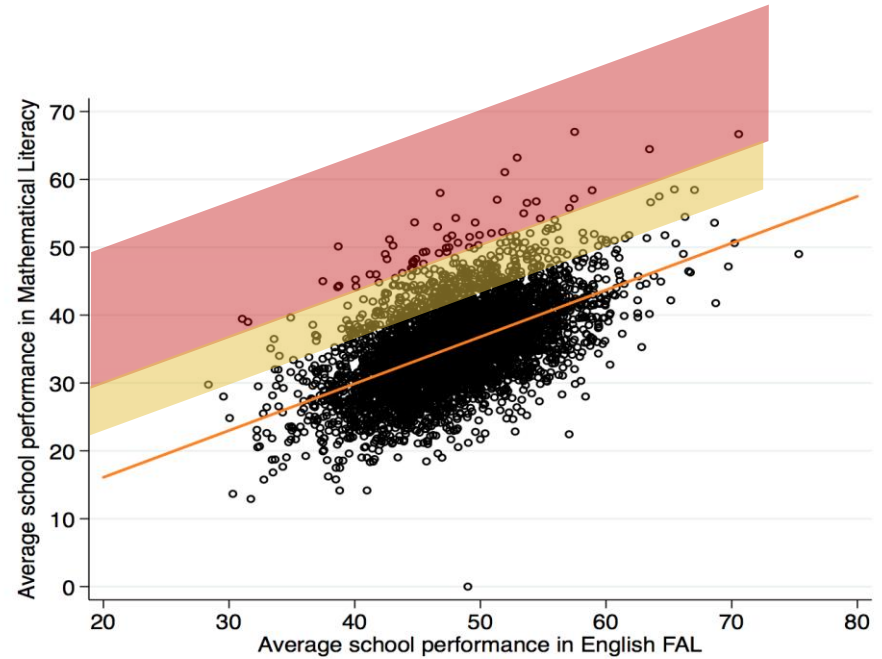
Is the observed performance of the school greater than “expected” performance considering factors related to better performance (e.g. socioeconomic conditions of the school, performance in other NSC examinations, learner demographics)?

(observed performance $>$ that predicted by multivariate regression)

PERFORMANCE “ABOVE EXPECTATIONS”



105 schools 1 s.d. above expected



428 schools 1/2 s.d. above expected

Is the observed performance of the school greater than “expected” performance considering factors related to better performance (e.g. socioeconomic conditions of the school, performance in other NSC examinations, learner demographics)?

(observed performance > that predicted by multivariate regression)

PERFORMANCE “ABOVE EXPECTATIONS”

	Q1	Q2	Q3	Q4	Q5	All
Schools performing above expectations in Mathematics						
School Math % > expected (without English FAL)	924	870	712	317	391	3 524
School Math % > expected (with OR without English FAL)	1 009	945	772	379	469	3 920
School Math % > ½ s.d. above expected (with OR without English FAL)	621	548	479	256	277	2 439
School Math % > 1 s.d. above expected (with OR without English FAL)	332	283	239	148	136	1 318
Schools performing above expectations in Mathematical Literacy						
School Math Literacy % > expected (without English FAL)	1 012	934	766	303	379	3 683
School Math Literacy % > expected (with OR without English FAL)	1 099	1 005	841	347	438	4 057
School Math Literacy % > ½ s.d. above expected (with OR without English FAL)	526	445	333	188	251	1 959
School Math Literacy % > 1 s.d. above expected (with OR without English FAL)	344	240	167	105	105	528
Schools performing above expectations in Mathematics AND Mathematical Literacy						
Math Literacy and Math % > expected (with OR without English FAL)	669	651	577	278	374	2 803
Math Literacy and Math % > ½ s.d. above expected (with OR without English FAL)	190	182	156	83	105	528
Math Literacy and Math % > 1 s.d. above expected (with OR without English FAL)	37	35	33	58	55	302

528 (11%) schools

105 (2%) schools

CONSISTENCY IN MATHEMATICS PERFORMANCE

Decile rank 2011

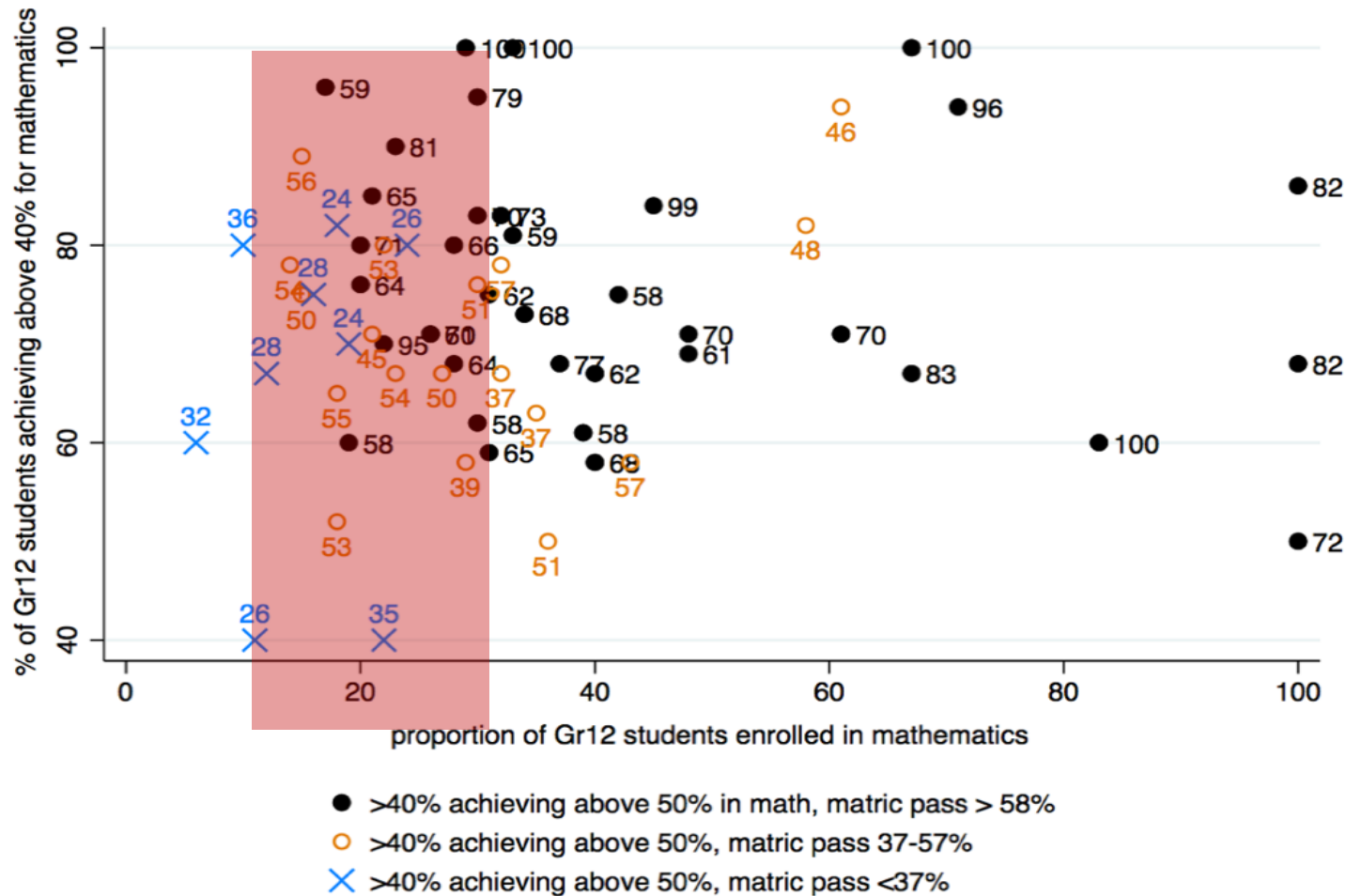
		1	2	3	4	5	6	7	8	9	10
Decile rank 2010	1	51.5	17.1	10.8	7.3	6.3	1.5	2.1	1.7	1.3	0.6
	2	21.4	25.5	19.3	12.4	7.0	7.8	2.9	2.1	1.2	0.4
	3	9.0	20.4	19.0	17.4	12.2	7.4	5.6	4.4	4.0	0.8
	4	6.8	13.4	18.8	13.5	14.9	13.5	7.5	7.2	3.3	1.2
	5	2.5	10.7	13.5	18.9	16.4	13.5	12.4	6.7	3.2	2.3
	6	1.2	4.5	8.9	12.2	17.3	17.5	15.9	14.4	7.0	1.2
	7	0.6	2.9	5.2	10.4	12.9	17.9	21.9	13.7	11.0	3.7
	8	1.0	2.3	4.1	5.2	9.9	13.7	16.2	25.9	14.7	7.1
	9	1.6	0.6	2.2	3.5	3.7	7.1	12.4	20.6	31.4	17.1
	10	0.4	0.7	0.7	0.4	1.3	2.6	3.5	6.1	22.6	61.8

Decile rank 2018

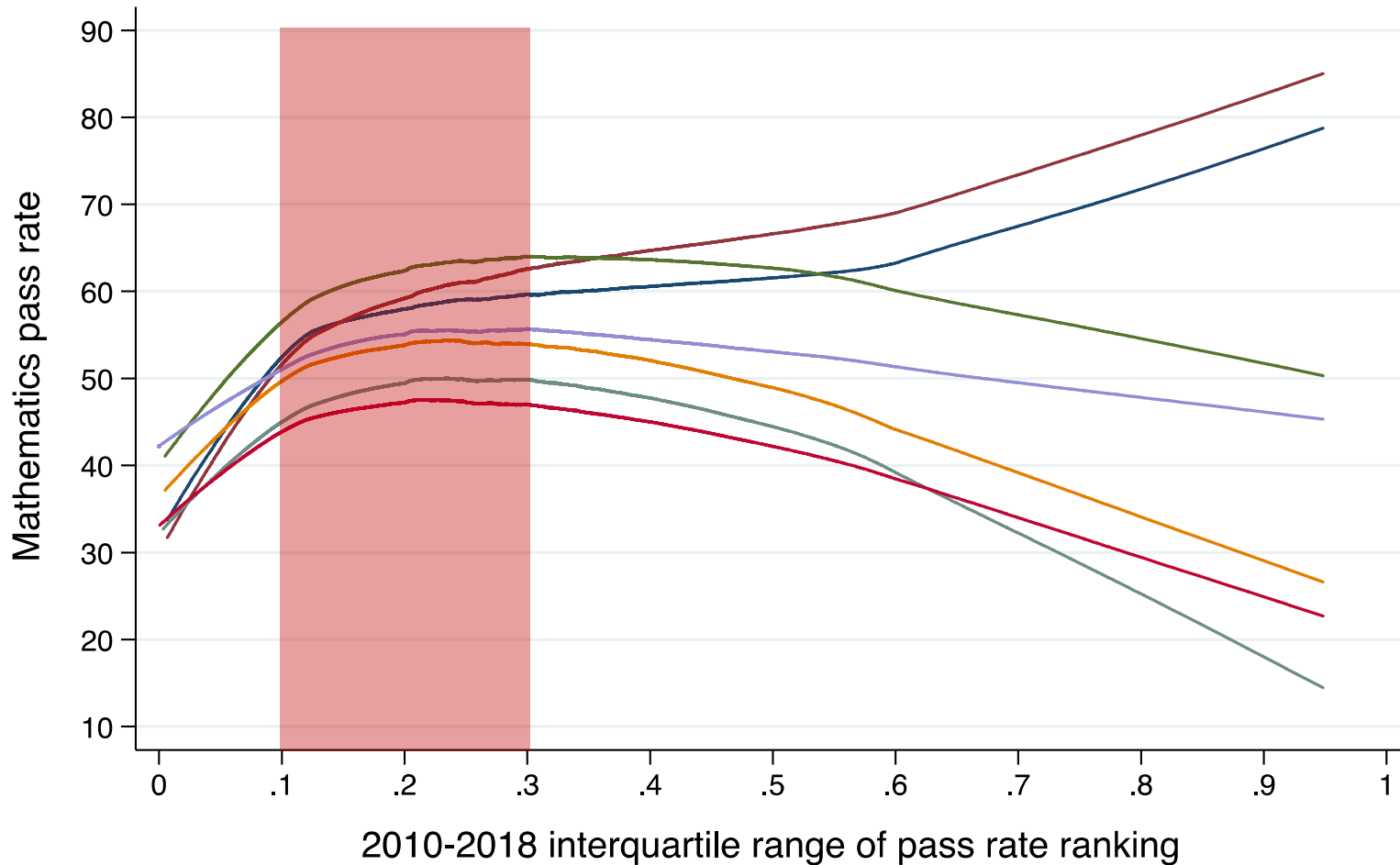
		1	2	3	4	5	6	7	8	9	10
Decile rank 2017	1	54.1	18.7	10.4	7.3	3.7	2.2	1.0	1.0	0.8	0.8
	2	23.1	25.3	19.1	12.1	7.9	6.1	2.6	2.9	0.7	0.2
	3	7.9	24.7	21.2	12.2	14.3	7.9	7.0	3.3	1.6	0.0
	4	4.8	17.9	17.7	17.7	15.0	12.7	6.8	4.3	1.6	1.4
	5	3.8	8.1	14.0	17.2	15.4	15.2	13.1	7.1	5.2	0.9
	6	1.1	6.3	9.9	15.4	17.7	16.9	14.3	10.4	5.4	2.6
	7	1.4	2.4	7.2	11.1	16.9	17.5	13.7	19.5	8.6	1.8
	8	0.6	0.8	1.8	7.8	8.2	16.6	22.4	20.6	18.6	2.8
	9	0.5	0.5	1.2	1.9	4.8	6.2	12.4	27.0	30.8	14.8
	10	0.0	0.0	0.3	0.5	0.8	0.0	2.4	5.4	19.7	70.8

CONSISTENCY IN MATHEMATICS PERFORMANCE

Figure 7: Relationship between school ranking interquartile range and Maths pass rate



CONSISTENCY IN MATHEMATICS PERFORMANCE



— 2010 — 2011 — 2014 — 2015
— 2016 — 2017 — 2018

PERFORMANCE “ABOVE EXPECTATIONS” AND CONSISTENCY IN PERFORMANCE (2014-2018)

	Q1	Q2	Q3	Q4	Q5	All
Schools that never performed above expectations	219	209	209	57	132	931


Number of schools performing above expectations...

... once	298	289	209	91	84	1 112
... twice	275	304	265	122	86	1 077
... 3 times	288	285	219	102	95	1 051
... 4 times	341	266	214	107	110	1 159
... 5 times	388	353	240	133	207	1 470

Number of schools performing ½ s.d. above expectations...

... once	403	392	300	129	130	1 464
... twice	293	293	245	119	79	1 004
... 3 times	246	226	188	119	79	1 004
... 4 times	252	194	137	119	79	1 004
... 5 times	81	62	49	41	111	408

192 (4%)
schools

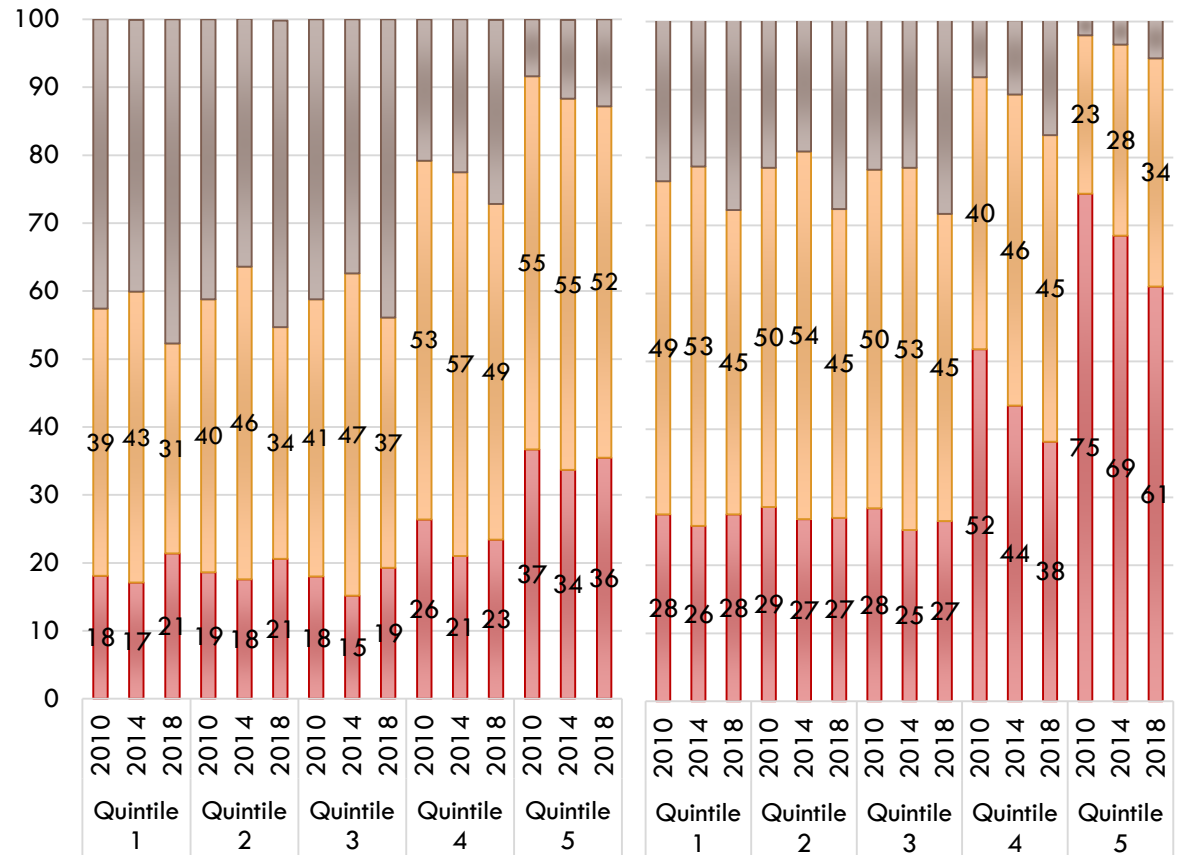


POTENTIAL PERFORMANCE IN MATHEMATICS

Table 2: Correspondences between Mathematics and Mathematical Literacy marks, 2008

Mathematics	Mathematical Literacy
13	30
19	40
26	50
30	54
36	60
40	64
47	70
50	72
54	75
60	78
62	80
66	82
70	84
80	86

Source: (Simkins, 2010)



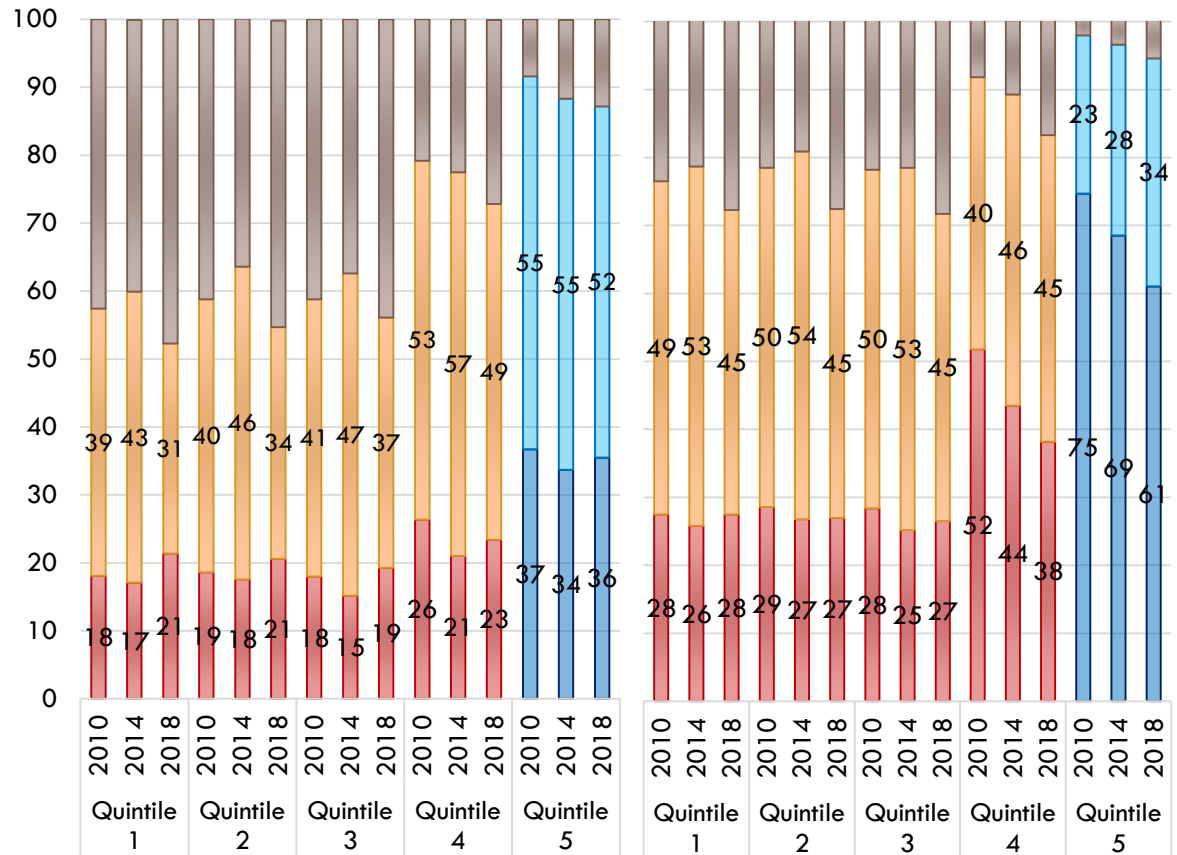
- math pass
- math literacy pass
- math fail
- potential math fail
- potential math literacy pass
- potential math pass

POTENTIAL PERFORMANCE IN MATHEMATICS

Table 2: Correspondences between Mathematics and Mathematical Literacy marks, 2008

Mathematics	Mathematical Literacy
13	30
19	40
26	50
30	54
36	60
40	64
47	70
50	72
54	75
60	78
62	80
66	82
70	84
80	86

Source: (Simkins, 2010)



- math pass
- math literacy pass
- math fail
- potential math literacy pass
- potential math pass

POTENTIAL PERFORMANCE IN MATHEMATICS

Table 3: Number of schools meeting criteria and showing potential in maths pass rates in 2018

	Q1	Q2	Q3	Q4	Q5	All
Meet potential						
Maths pass rate \geq group's average potential pass rate	501 (27.7%)	457 (26.8%)	349 (24.8%)	138 (17.1%)	138 (12.0%)	138 (4.8%)
Maths pass rate \geq overall average potential pass rate (33.9%)	310 (17.1%)	256 (15.0%)	207 (14.7%)	138 (22.2%)	138 (12.0%)	138 (4.8%)
Maths pass rate \geq Q5 average potential pass rate (61%)	57 (3.2%)	49 (2.9%)	32 (2.3%)	3 (4.9%)	12 (12.0%)	3 (4.8%)
Maths fail rate $<$ group's average potential fail rate	425 (23.5%)	426 (25.0%)	393 (27.9%)	196 (32.2%)	308 (27.7%)	2119 (70.2%)
Maths fail rate $<$ overall average potential fail rate (24.2%)	307 (17.0%)	325 (19.1%)	260 (18.5%)	113 (18.5%)	113 (10.2%)	113 (3.7%)
Maths fail rate $<$ Q5 average potential fail rate (5.9%)	50 (2.8%)	38 (2.2%)	25 (1.8%)	8 (14.5%)	31 (43.1%)	6 (9.9%)
Maths pass rate \geq group's average potential pass rate AND Maths fail rate $<$ group's average potential fail rate	198 (10.9%)	195 (11.4%)	176 (12.5%)	59 (9.6%)	62 (8.7%)	883 (13.0%)
Maths pass rate \geq overall average potential pass rate AND Maths fail rate $<$ overall average potential fail rate	106 (5.9%)	99 (5.8%)	78 (5.5%)	21 (3.4%)	21 (1.9%)	21 (0.7%)
Maths pass rate \geq Q5 average potential pass rate AND Maths fail rate $<$ Q5 average potential fail rate	12 (0.7%)	6 (0.4%)	3 (0.2%)	3 (0.8%)	6 (8.7%)	3 (2.0%)

138 (2.8%) schools

113 (2.3%) schools

21 (0.4%) schools

POTENTIAL PERFORMANCE IN MATHEMATICS

Table 3: Number of schools meeting criteria and showing potential in maths pass rates in 2018

	Q1	Q2	Q3	Q4	Q5	All
Meet potential						
Maths pass rate \geq group's average potential pass rate	501 (27.7%)	457 (26.8%)	349 (24.8%)	173 (17.1%)	138 (12.0%)	150 (13.0%)
Maths pass rate \geq overall average potential pass rate (33.9%)	310 (17.1%)	256 (15.0%)	207 (14.7%)	113 (11.0%)	59 (5.1%)	950 (82.0%)
Maths pass rate \geq Q5 average potential pass rate (61%)	57 (3.2%)	49 (2.9%)	32 (2.3%)	3 (0.3%)	3 (0.3%)	9 (0.8%)
Maths fail rate $<$ group's average potential fail rate	425 (23.5%)	426 (25.0%)	393 (27.9%)	196 (19.1%)	308 (26.3%)	2 119 (18.0%)
Maths fail rate $<$ overall average potential fail rate (24.2%)	307 (17.0%)	325 (19.1%)	260 (18.5%)	113 (11.0%)	19 (1.7%)	1 919 (16.5%)
Maths fail rate $<$ Q5 average potential fail rate (5.9%)	50 (2.8%)	38 (2.2%)	25 (1.8%)	8 (0.8%)	8 (0.7%)	6 (0.5%)
Maths pass rate \geq group's average potential pass rate AND Maths fail rate $<$ group's average potential fail rate	198 (10.9%)	195 (11.4%)	176 (12.5%)	59 (5.8%)	62 (5.3%)	883 (7.5%)
Maths pass rate \geq overall average potential pass rate AND Maths fail rate $<$ overall average potential fail rate	106 (5.9%)	99 (5.8%)	78 (5.5%)	21 (2.1%)	3 (0.3%)	3 (0.3%)
Maths pass rate \geq Q5 average potential pass rate AND Maths fail rate $<$ Q5 average potential fail rate	12 (0.7%)	6 (0.4%)	3 (0.2%)	0 (0.0%)	0 (0.0%)	3 (0.3%)
Show potential						
Maths potential pass rate is at least 1.5 times actual pass rate	482 (26.6%)	500 (29.3%)	529 (37.5%)	356 (34.6%)	505 (43.3%)	2 708 (23.0%)
Maths potential fail rate is at least 0.5 times actual fail rate	583 (32.2%)	498 (29.2%)	345 (24.5%)	240 (23.5%)	540 (46.3%)	2 577 (22.0%)

1 38 (2.8%) schools

1 13 (2.3%) schools

21 (0.4%) schools

TOWARDS A TOOL FOR SELECTING SCHOOLS THAT SHOW PROMISE FOR THE 'MATHS CHALLENGE'

INDICATOR 1: Above-expected performance

- combined Mathematics score is at least $\frac{1}{2}$ a standard deviation (7 percentage points) above the predicted performance of the school given (a) their socioeconomic circumstances and/or (b) their performance in English FAL.

1 673 Q1-Q3 schools in 2018 schools

INDICATOR 2: Stability in above-expected performance over time

- schools should have performed at least $\frac{1}{2}$ a standard deviation above expectations for 2018, and also at least twice in the previous four years.

Number reduced to **1 265** schools

TOWARDS A TOOL FOR SELECTING SCHOOLS THAT SHOW PROMISE FOR THE 'MATHS CHALLENGE'

INDICATOR 3: Combined Mathematics and Mathematical Literacy pass rate of at least 40%

- Q1-Q3 schools that achieve at least a 40% pass rate in mathematics are significantly more likely to outrank the lowest three deciles of school performance, *as well as* show relative consistency in their performance ranking over time.

Number reduced to **1 120** schools

TOWARDS A TOOL FOR SELECTING SCHOOLS THAT SHOW PROMISE FOR THE 'MATHS CHALLENGE'

INDICATOR 4: Shows the potential for lower failure and higher pass rates in mathematics

- A potential fail rate in Mathematics that is half their current fail rate in Mathematics

Number reduced to **361** schools

- A potential pass rate in Mathematics that is 1.5 times higher than their current pass rate in Mathematics

Number reduced to **275** schools

Meeting both criteria above

Number reduced to **50** schools

	Indicator 4.1	Indicator 4.2	Indicator 4.3	Indicator 4.4		
				Fail rate	Pass rate	Both
Total number: SA	1 680					
Eastern Cape	202					
Free State	98					
Gauteng	198					
KwaZulu Natal	389					
Limpopo	400					
Mpumalanga	255					
North-West	71					
Northern Cape	13					
Western Cape	47					
Quintile 1	614					
Quintile 2	566					
Quintile 3	493					
Average # of Gr12s	128					
Average mark in...						
... Mathematics	35.7%					
... Maths Lit	37.1%					
... English FAL	49.3%					
... Physical Sciences	42.5%					
NSC pass rate	65.1%					
Bachelor pass rate	26.2%					

	Indicator 4.1	Indicator 4.2	Indicator 4.3	Indicator 4.4		
				Fail rate	Pass rate	Both
Total number: SA	1 680	1 265				
Eastern Cape	202	128				
Free State	98	82				
Gauteng	198	177				
KwaZulu Natal	389	263				
Limpopo	400	300				
Mpumalanga	255	226				
North-West	71	43				
Northern Cape	13	9				
Western Cape	47	37				
Quintile 1	614	466				
Quintile 2	566	425				
Quintile 3	493	374				
Average # of Gr12s	128	141				
Average mark in...						
... Mathematics	35.7%	36.2%↑				
... Maths Lit	37.1%	37.5%↑				
... English FAL	49.3%	49.9%↑				
... Physical Sciences	42.5%	42.9%↑				
NSC pass rate	65.1%	67.3%↑				
Bachelor pass rate	26.2%	27.8%↑				

	Indicator 4.1	Indicator 4.2	Indicator 4.3	Indicator 4.4		
				Fail rate	Pass rate	Both
Total number: SA	1 680	1 265	1 120			
Eastern Cape	202	128	101			
Free State	98	82	81			
Gauteng	198	177	176			
KwaZulu Natal	389	263	226			
Limpopo	400	300	263			
Mpumalanga	255	226	187			
North-West	71	43	42			
Northern Cape	13	9	9			
Western Cape	47	37	35			
Quintile 1	614	466	394			
Quintile 2	566	425	385			
Quintile 3	493	374	341			
Average # of Gr12s	128	141	140			
Average mark in...						
... Mathematics	35.7%	36.2%	37.8%↑			
... Maths Lit	37.1%	37.5%	38.4%↑			
... English FAL	49.3%	49.9%	50.4%↑			
... Physical Sciences	42.5%	42.9%	43.8%↑			
NSC pass rate	65.1%	67.3%	69.2%↑			
Bachelor pass rate	26.2%	27.8%	29.3%↑			

	Indicator 4.1	Indicator 4.2	Indicator 4.3	Indicator 4.4		
				Fail rate	Pass rate	Both
Total number: SA	1 680	1 265	1 120	361	275	
Eastern Cape	202	128	101	44	14	
Free State	98	82	81	32	36	
Gauteng	198	177	176	32	93	
KwaZulu Natal	389	263	226	60	22	
Limpopo	400	300	263	105	35	
Mpumalanga	255	226	187	76	30	
North-West	71	43	42	8	20	
Northern Cape	13	9	9	0	3	
Western Cape	47	37	35	4	22	
Quintile 1	614	466	394	134	82	
Quintile 2	566	425	385	124	88	
Quintile 3	493	374	341	103	105	
Average # of Gr12s	128	141	140	127	142	
Average mark in...						
... Mathematics	35.7%	36.2%	37.8%	36.7%↓	40.2%↑	
... Maths Lit	37.1%	37.5%	38.4%	41.7%↑	42.3%↑	
... English FAL	49.3%	49.9%	50.4%	52.6%↑	50.5%↑	
... Physical Sciences	42.5%	42.9%	43.8%	43.1%↓	45.4%↑	
NSC pass rate	65.1%	67.3%	69.2%	72.2%↑	73.8%↑	
Bachelor pass rate	26.2%	27.8%	29.3%	32.6%↑	32.2%↑	

	Indicator 4.1	Indicator 4.2	Indicator 4.3	Indicator 4.4		
				Fail rate	Pass rate	Both
Total number: SA	1 680	1 265	1 120	361	275	50
Eastern Cape	202	128	101	44	14	3
Free State	98	82	81	32	36	11
Gauteng	198	177	176	32	93	13
KwaZulu Natal	389	263	226	60	22	6
Limpopo	400	300	263	105	35	9
Mpumalanga	255	226	187	76	30	6
North-West	71	43	42	8	20	3
Northern Cape	13	9	9	0	3	0
Western Cape	47	37	35	4	22	0
Quintile 1	614	466	394	134	82	13
Quintile 2	566	425	385	124	88	18
Quintile 3	493	374	341	103	105	19
Average # of Gr12s	128	141	140	127	142	110
Average mark in...						
... Mathematics	35.7%	36.2%	37.8%	36.7%	40.2%	37.7%
... Maths Lit	37.1%	37.5%	38.4%	41.7%	42.3%	47.3%↑
... English FAL	49.3%	49.9%	50.4%	52.6%	50.5%	53.4%↑
... Physical Sciences	42.5%	42.9%	43.8%	43.1%	45.4%	45.4%↑
NSC pass rate	65.1%	67.3%	69.2%	72.2%	73.8%	79.5%↑
Bachelor pass rate	26.2%	27.8%	29.3%	32.6%	32.2%	38.0%↑

	Maths average	MathLit average	Prop enrolled in Math	Prop enrolled in Math Lit	# 60%+ in Maths or 72%+ in MathLit	NSC pass (%)	Bach pass (%)	Pass rank in 2018	Math mark rank 2018
Consistently top performing Q1-Q3 schools	51	57	33	67	16 (19%)	94	55	10	10
All Q1-Q3 schools	30	35	46	62	6 (7%)	56	20	4.6	4.8
Promising Q1-Q3 schools	38	47	39	60	9 (8%)	80	38	8	6.8
Q4 schools	37	43	37	66	13 (10%)	72	33	6.9	6.6
Q5 schools	45	53	42	57	29 (21%)	87	53	8.7	8.2
Top performing Q5 schools	58	64	50	50	61 (39%)	98	81	10	10