12 mathematics results:
Did the 2006 provincial boundary changes have an impact?

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October 2012

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Introduction

- Poor mathematics outcomes in schools continues to be a problem, whether one looks at national assessment systems (such as the Grade 12 examinations), SACMEQ 2007 (assesses Grade 6) or listens to complaints from universities and employers.
- TIMSS 2011 results will undoubtedly put school mathematics in the spotlight again when results are released early in 2013.
- There have been some positive trends, e.g. % of accountants entering the profession who are African increased from 13% to 23% in period 2002 to 2007. (Yet overall % of chartered accountants who are African was still only 3.5% in 2007.)

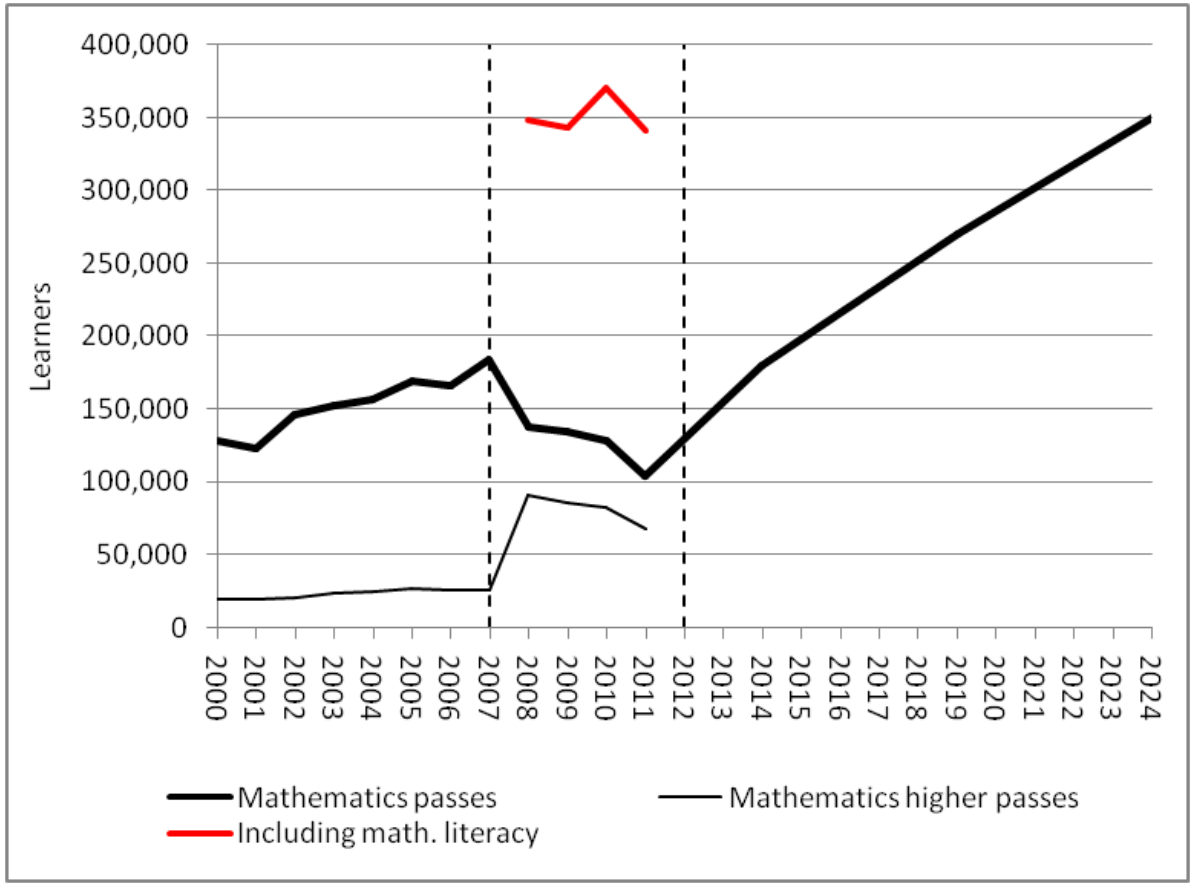
- The provincial boundary changes that occurred between 2005 and 2006 create a natural experiment situation that appears not to have been used yet by researchers. In total 710 schools changed provinces, 160 being public ordinary schools offering Grade 12.

The recent trend in Grade 12 mathematics performance

Mathematics passes since 2000

The longer-term trend looks a bit better. Between 1995 and 2007, the total number of mathematics passes doubled.

The post-2007 movements up and down are clearly mostly a function of adjustments to a new system, and not qualitative declines. E.g. 'mathematics higher' is officially 40 out of 100, though Simkins (2010) has found it to be 54.



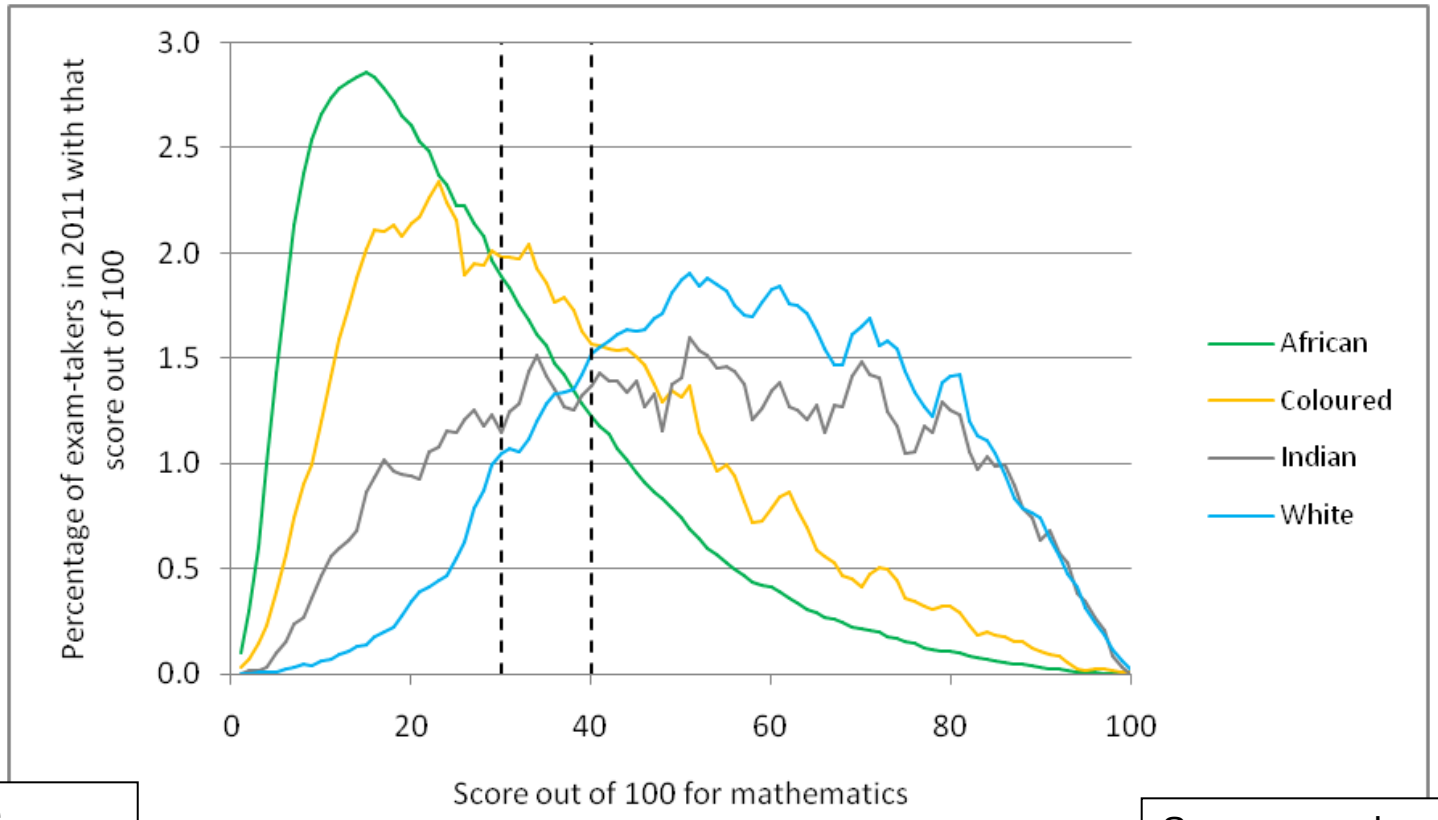
Simkins (2010) has also quantified the inevitable increase in the pool of mathematics skills amongst youths resulting from the fact that some form of mathematics is now compulsory.

Demographic factors indicate that outputs should decrease by about 13% in 2008 to 2011, but this can only explain a part of the declines we see.

Our full analysis points to the importance of considering the effects of supplementary examinations, part-time candidates and examination repeaters.

Concentrations of better African learner performance and the Limpopo puzzle

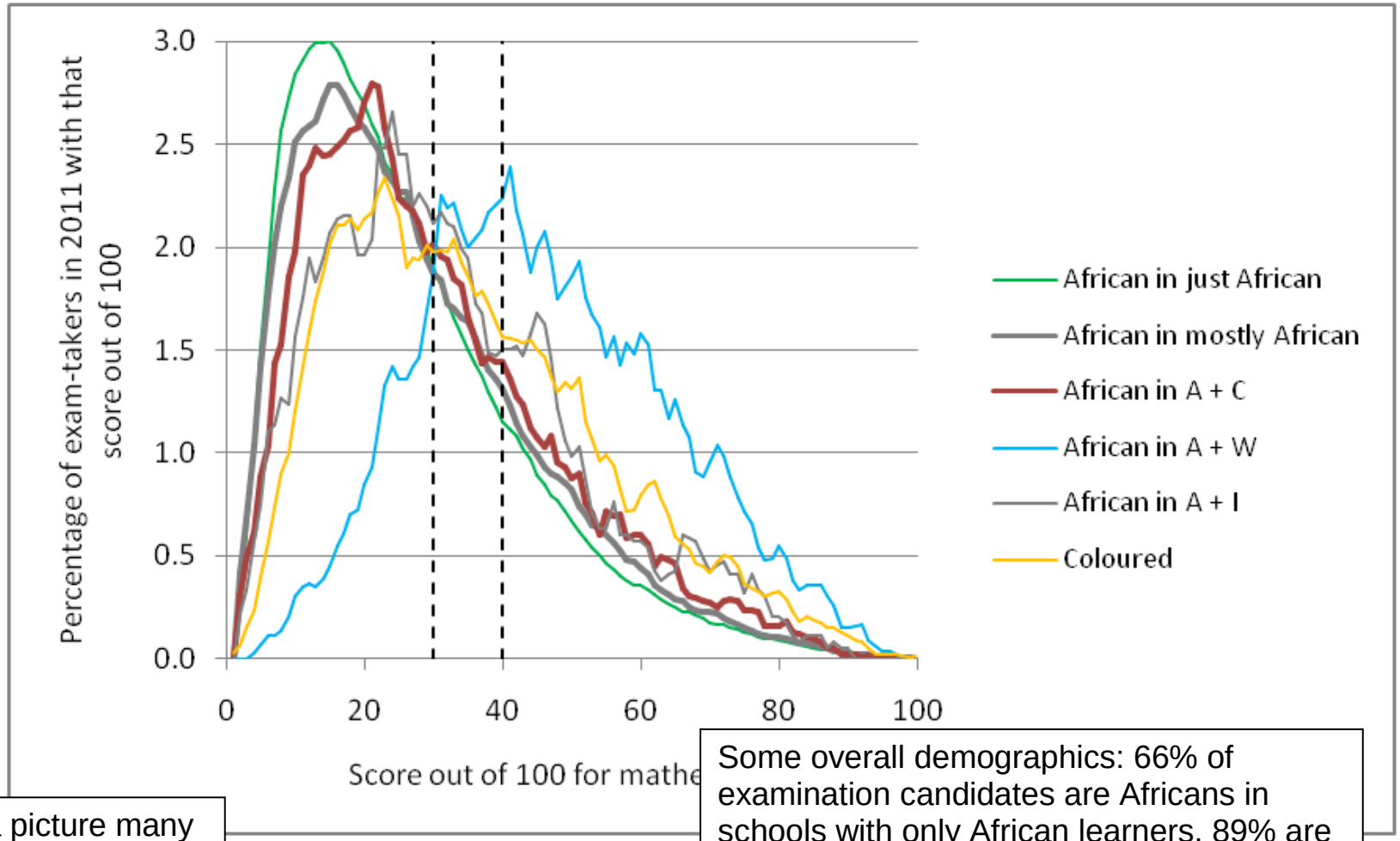
Distribution of 2011 mathematics marks by race



This is a picture education analysts are familiar with.

Scores are always whole numbers.

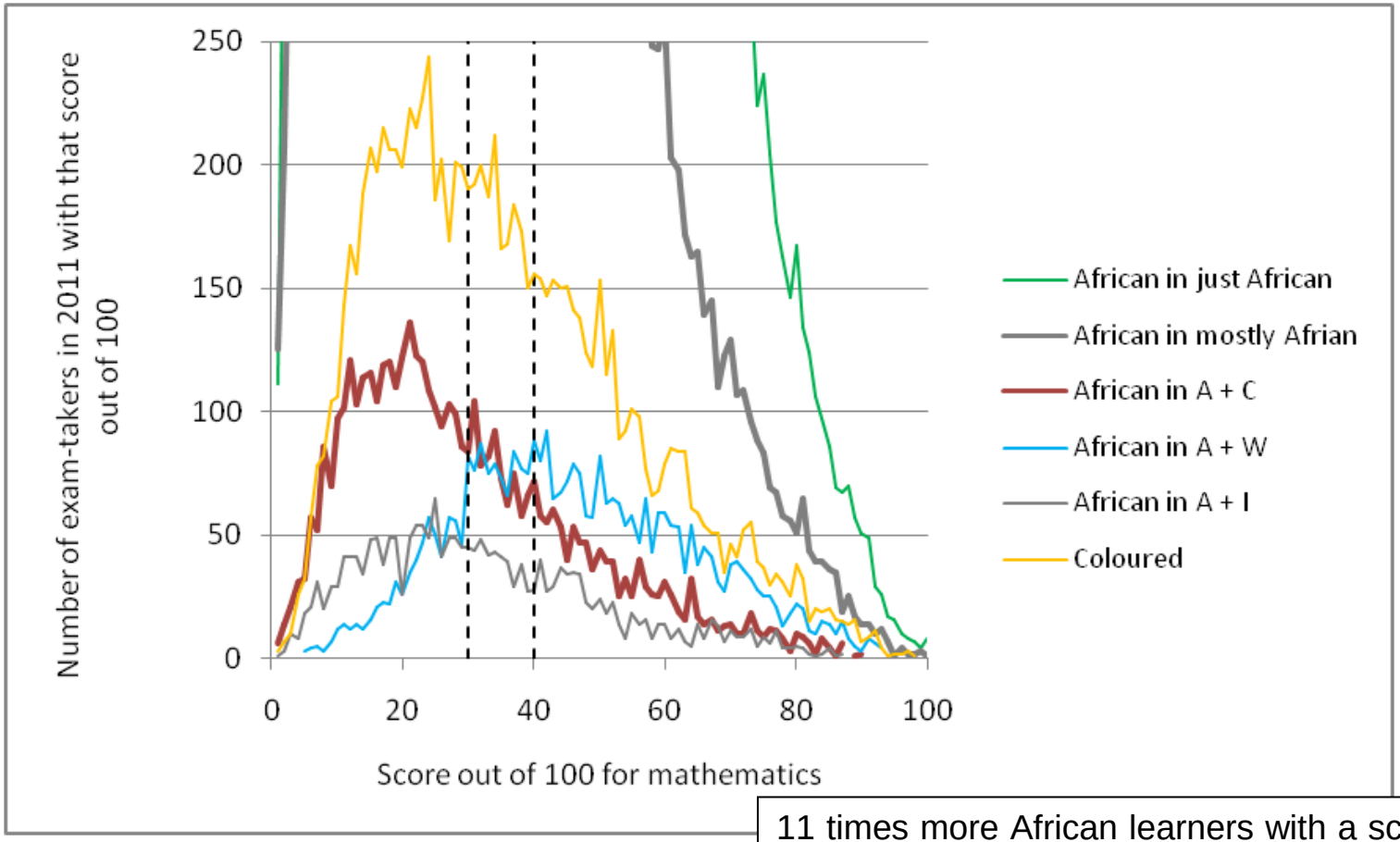
Distribution of 2011 African mathematics marks by school type



Again, a picture many are familiar with.

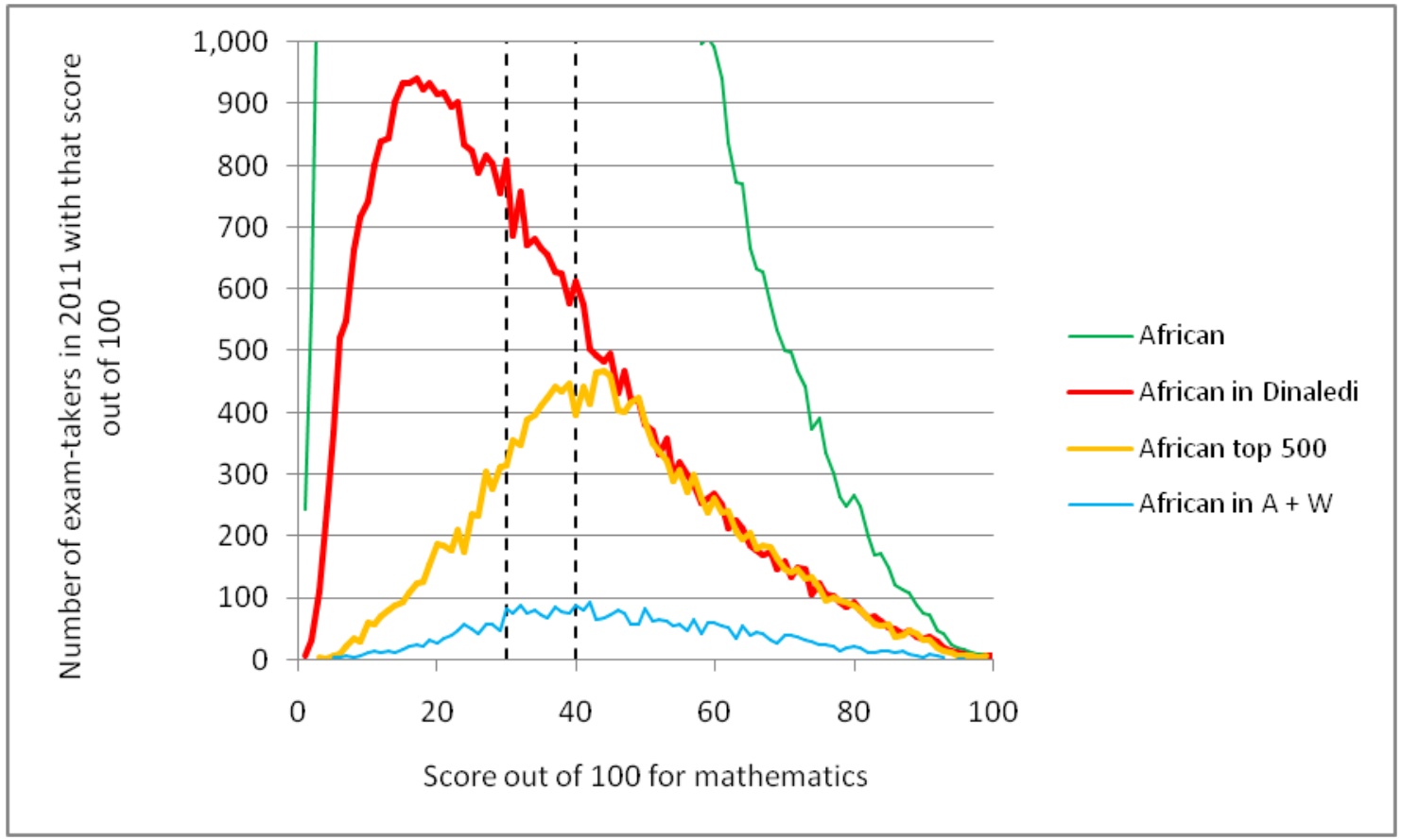
Some overall demographics: 66% of examination candidates are Africans in schools with only African learners. 89% are African in schools which are either only African or at least 90% African.

Absolute numbers of African and coloured Grade 12 learners

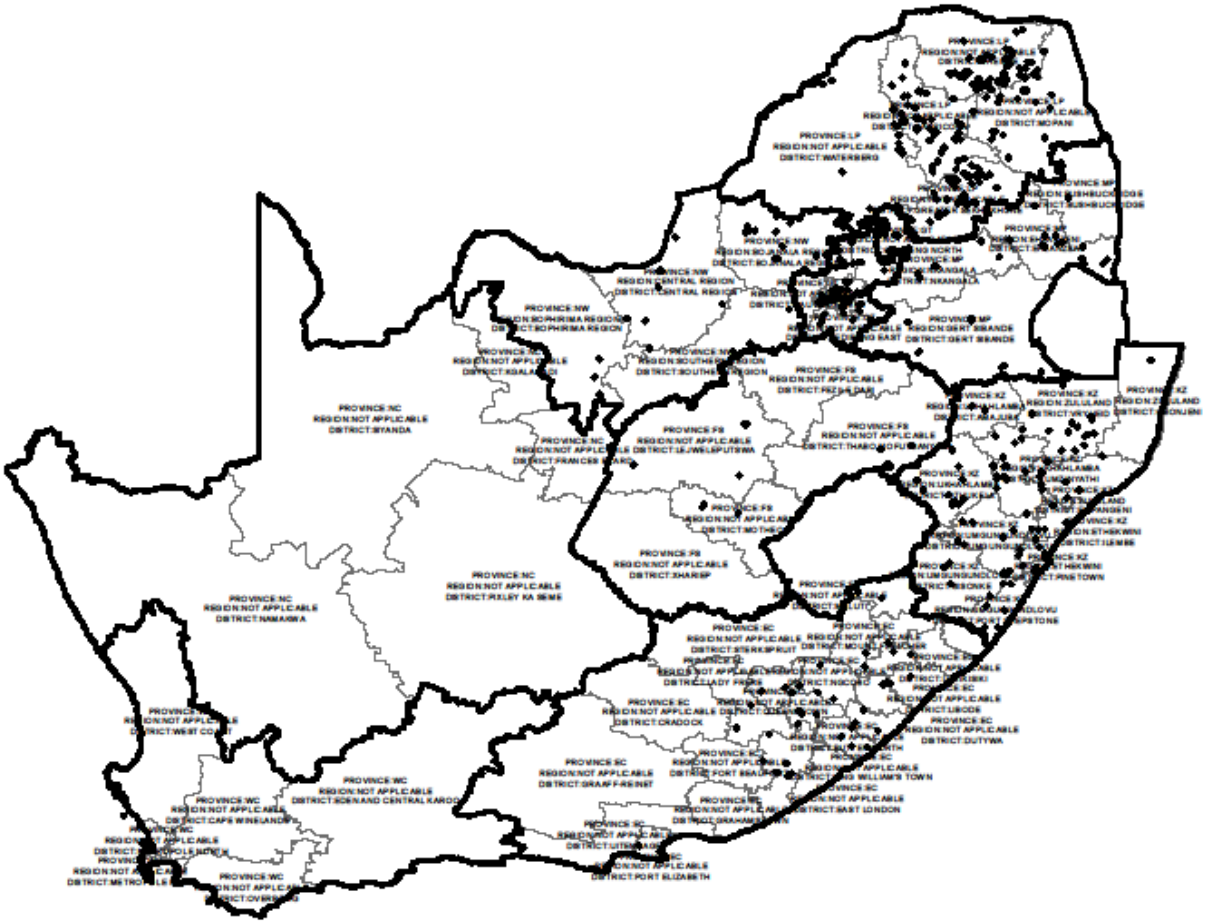


11 times more African learners with a score of 70 or above are from African schools ('just' or 'mostly') than from African plus white schools.

Absolute numbers of African learners by school type



Location of the top 500 African schools

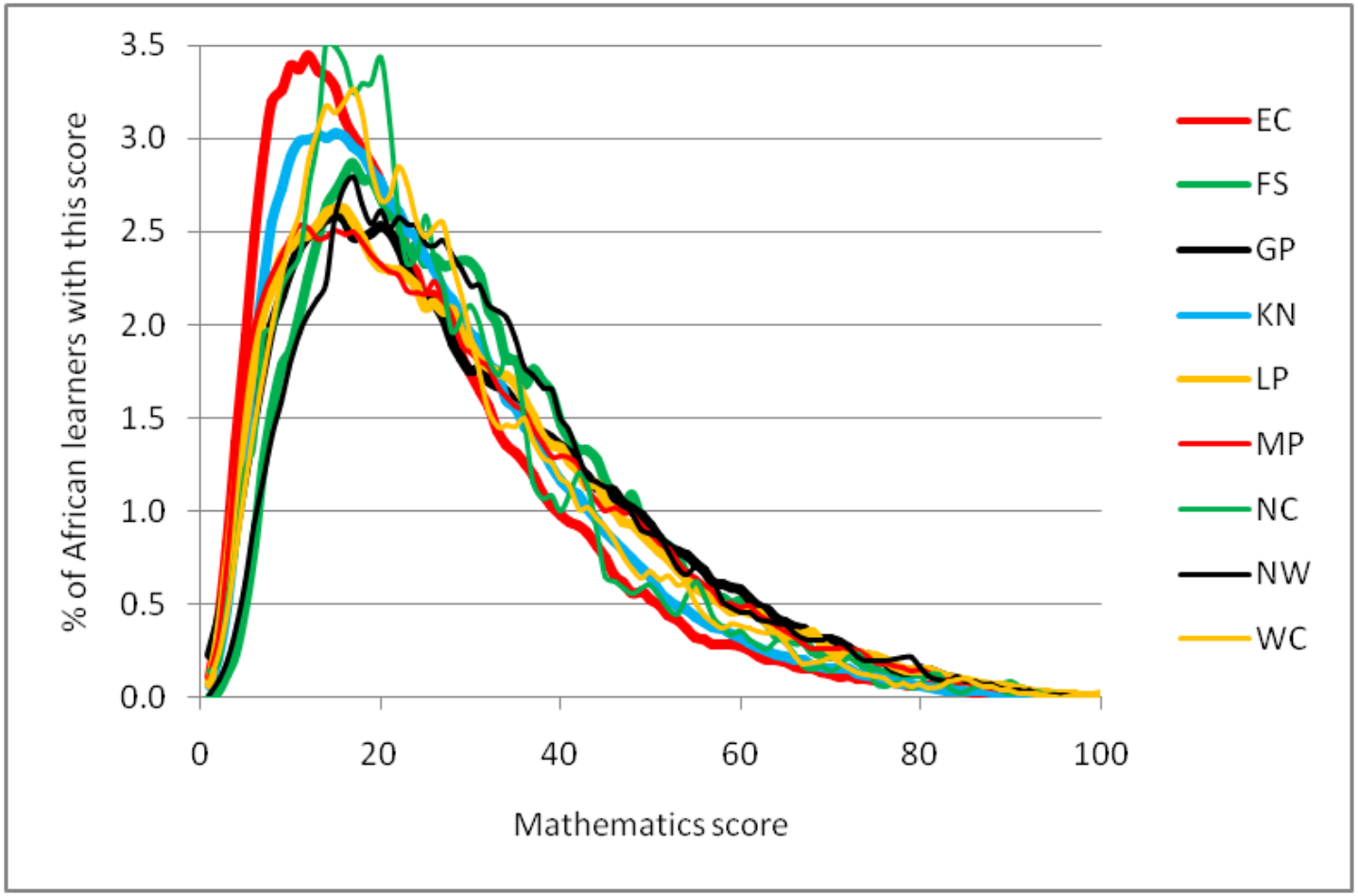


- The Limpopo surprise.

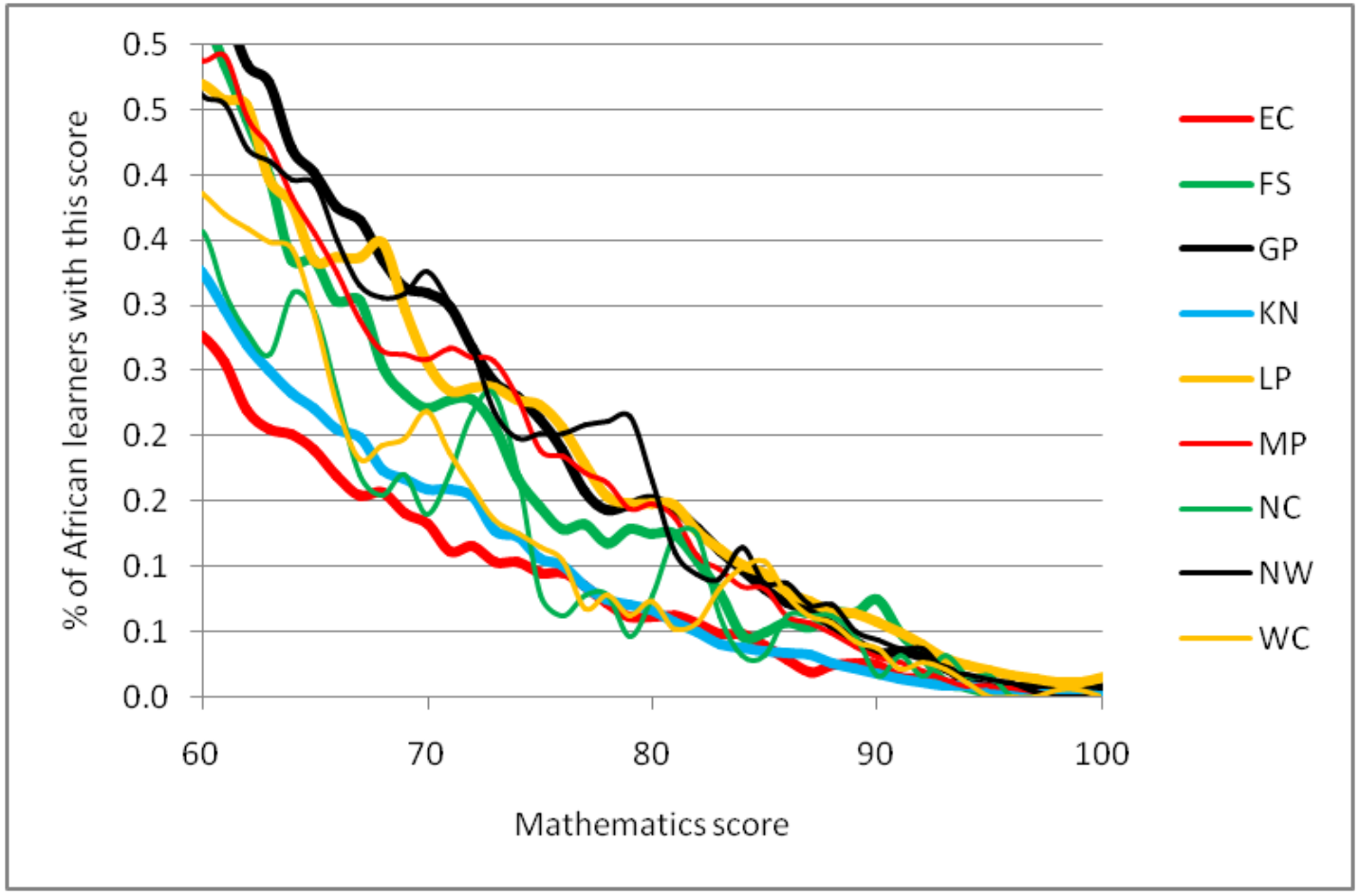
	Top 500 schools	Identified schools which are also independent schools	Total NSC exam-takers in identified schools	Average exam-takers per school	% of all African NSC exam-takers in the province in these schools
EC	48	4	3,492	73	4
FS	18	3	1,888	105	7
GP	83	77	7,922	95	8
KN	96	11	6,776	71	5
LP	184	18	9,682	53	11
MP	37	5	3,575	97	7
NW	31	2	2,089	67	8
WC	3	2	204	68	1
SA	500	122	35,628	71	7

- A more straightforward look:

Distribution of African mathematics scores by province



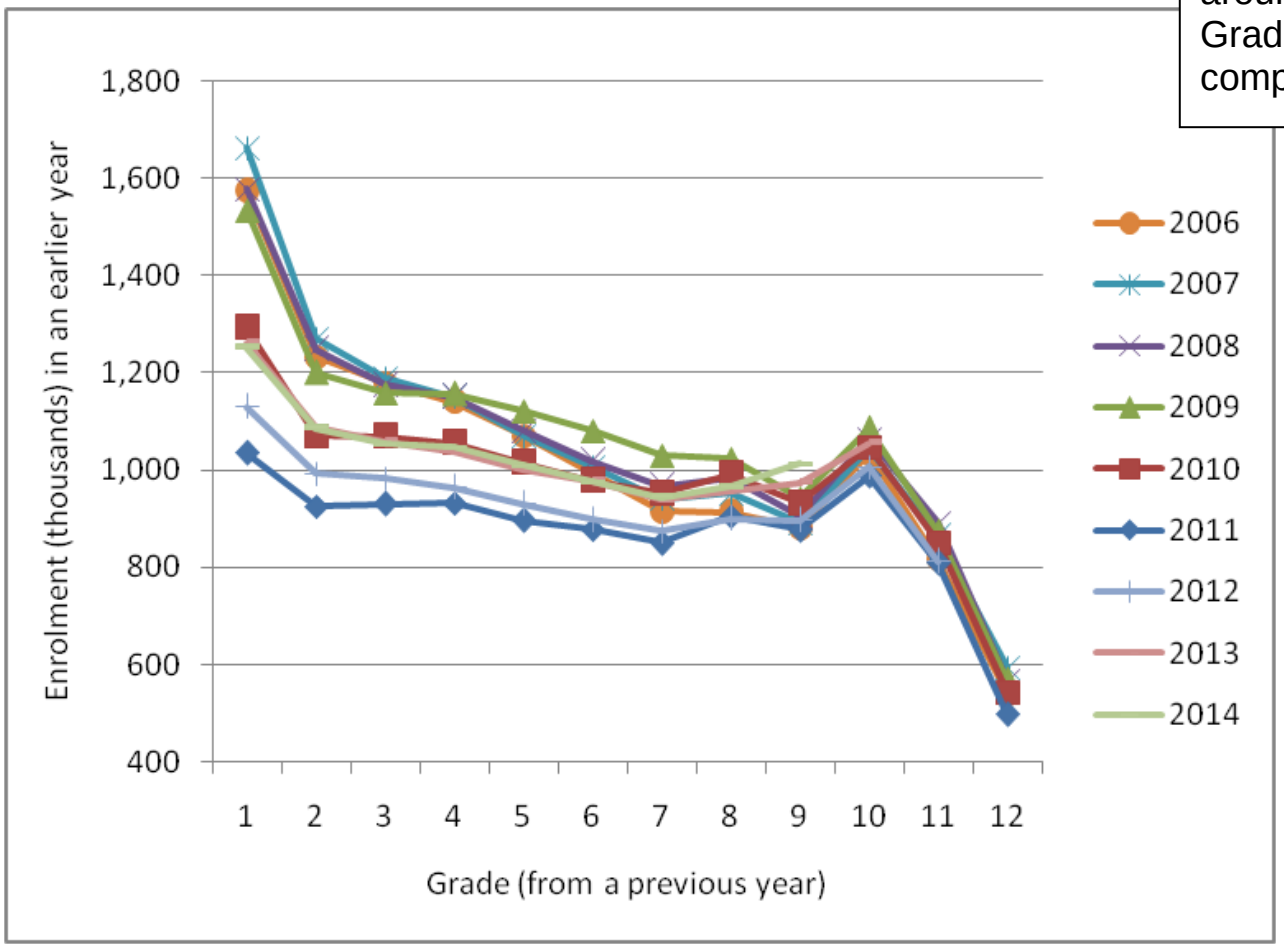
Magnification of previous



	% of African NSC exam-takers achieving 70 or above in mathematics	% of African mathematics exam-takers achieving 70 or above	NSC exam-writers in 2011 as a % of the average population cohort size ages 15 to 19
EC	0.8	1.5	41
FS	1.0	2.7	47
GP	1.4	3.3	61
KN	0.8	1.6	62
LP	1.5	3.4	61
MP	1.2	3.1	67
NC	0.7	2.1	51
NW	1.3	3.5	44
WC	0.7	2.1	55
SA	1.1	2.4	56

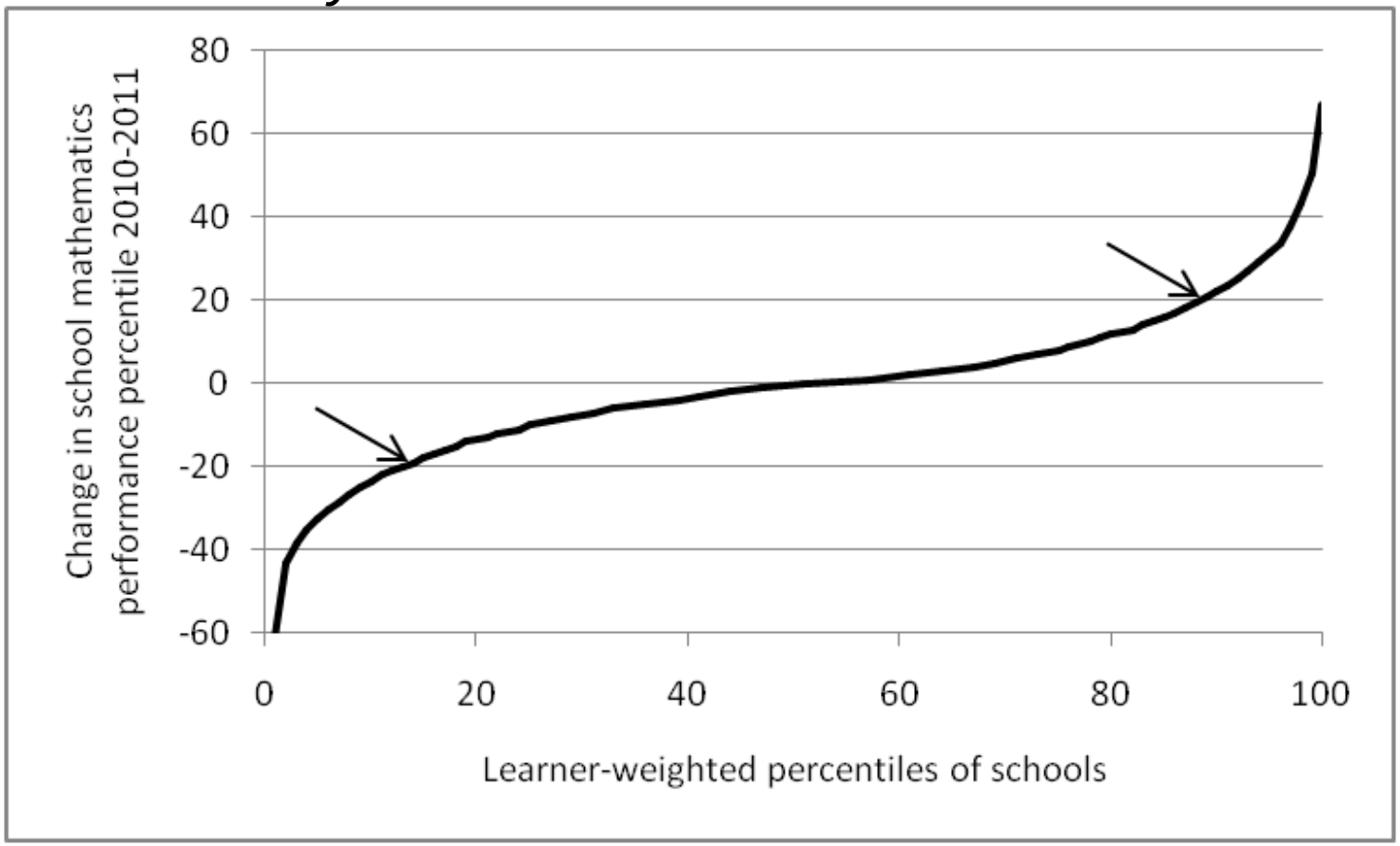
Issues to consider when gauging Grade 12 progress over time

Historical enrolment trends



One should expect around 20% fewer Grade 12s in 2011 compared to 2007!

Volatility of school-level results 2010 to 2011



- 8 indicators of progress examined:
  1. % taking mathematics (SG included for 2005)
  2. Number of passes (SG excluded for 2005)
  3. Number of high-level passes**
  4. Number of passes (SG included for 2005)
  5. % of mathematics-takers passing mathematics
  6. Average mark (SG included for 2005)
  7. Average mark (SG excluded for 2005)
  8. Average mark spread across all candidates**

The impact of provincial border changes on mathematics results

Basic statistics on the categories of schools

	Total schools	... of which independent schools	... of which Dinaledi schools	... of which just or mostly African schools	Exam-takers 2005	Exam-takers 2011	Avg. school Gr 12 groups size 2005	Avg. school Gr 12 groups size 2011
EC	859	24	58	752	67,901	65,267	79	76
EC->KN	15	0	2	15	1,298	1,323	87	88
FS	303	9	36	235	25,882	25,853	85	85
GP	589	114	97	379	74,906	74,155	127	126
KN	1,488	35	86	1,300	118,791	117,735	80	79
LP	1,240	29	51	1,224	79,934	67,380	64	54
LP->MP	84	2	3	82	7,361	8,044	88	96
MP->LP	15	2	0	15	984	661	66	44
MP	367	14	41	320	35,231	35,347	96	96
NC	106	2	12	20	7,931	8,282	75	78
NW->GP	30	0	1	30	4,226	3,727	141	124
NW->NC	11	0	2	11	1,016	905	92	82
NW	341	11	51	293	30,694	24,241	90	71
WC	362	31	44	63	38,217	38,627	106	107
Total	5,810	273	484	4,739	494,372	471,547	85	81

Regression results

Dependent variable:	Number of high-level passes in 2011 (natural logarithm)			Average mark spread across all candidates in 2011 (untransformed values)		
	Coeff.		t-value	Coeff.		t-value
2005 value	0.32	***	20.09	0.2	***	59.49
2011 exam-takers (all subjects)	1.52	***	21.44	0.0		-1.52
Is EC->KN	0.07		0.07	0.2		0.12
Is FS	0.49	**	2.04	-2.3	***	-5.16
Is GP	1.15	***	5.67	-2.7	***	-7.26
Is KN	0.18		1.17	-0.4		-1.45
Is LP	1.37	***	8.44	2.0	***	6.92
Is LP->MP	0.23		0.57	1.2		1.62
Is MP->LP	1.61	*	1.74	0.0		-0.02
Is MP	1.75	***	7.87	1.3	***	3.26
Is NC	-0.33		-0.86	-2.8	***	-3.91
Is NW->GP	2.05	***	3.10	-1.2		-1.02
Is NW->NC	-2.16	**	-2.00	-2.3		-1.14
Is NW	0.47	**	2.04	-1.3	***	-3.05
Is WC	-0.68	***	-2.75	-2.4	***	-5.21
n	5810			5810		
R squared (adj.)	0.363			0.494		

Note: Independent variables not shown above: is Dinaledi, is just or mostly African, is independent, dummies for quintile. In the case of the first model the natural logarithm was used for this and the next variable.

Regression results (continued)

Is Dinaledi	1.81	***	9.94	3.3	***	9.72
Is African	-0.99	***	-5.43	0.4		1.31
Is independent	1.16	***	4.34	2.6	***	5.33
Is quintile 1	-1.65	***	-8.10	0.7	*	1.85
Is quintile 2	-1.75	***	-8.64	0.1		0.31
Is quintile 3	-1.07	***	-5.59	0.2		0.58
Is quintile 4	-1.04	***	-5.34	-0.8	**	-2.19
Constant	-7.69	***	-21.52	3.1	***	6.69

- To do:
  - Above all, get values for all the years 2005 to 2011 – NW to GP group is just 30 schools.
  - Perform statistical robustness checks.
  - Check whether there were noteworthy staffing changes in the 30 NW to GP schools.
  - Talk to a few people from the 30 schools.

Conclusion

- Recent trends in mathematics results need to be explained with care. You have to look below the surface.
- There seems to be an exciting research topic: How can Limpopo be bottom at the primary level yet amongst the top in Grade 12 (in terms of African learners)?
- One needs a variety of indicators when tracking Grade 12 progress over time.
- There seems to be empirical evidence for viewing certain provinces as better practice provinces when it comes to administering and supporting schools.