SINGAPORE POLICY JOURNAL
AT THE HARVARD KENNEDY SCHOOL

2015-00-02
JULY 5 2015

PU LIANG,
CARNEGIE MELLON UNIVERSITY

DEEPAK WARRIER
NEW YORK UNIVERSITY

EVERY SCHOOL AN ACCESSIBLE SCHOOL? PROPERTY PRICES AND PRIORITY ADMISSION TO SINGAPORE'S PRIMARY SCHOOLS

Abstract

This paper investigates the extent to which the use of home-school distance as a criteria for primary school admission allows inequalities of wealth and income to be transmitted across generations in Singapore. It applies cluster analysis to a dataset that maps the relative ranking of each school to the prices of property in a one-kilometer radius around it. It then finds that the best-ranked and most-popular schools are concentrated in the most expensive neighborhoods. At these schools, a significant number of places are already taken up by applicants with connections to the school; competition for the remaining places is intense and home-school distance is critical to stand good chances of admission. Thus, the location of elite schools in expensive neighborhoods tends to favor applicants with wealthy or well-connected parents. It then considers the implications of these findings for meritocracy in Singapore, and discusses policy options to mitigate the transmission of inequalities across generations in this manner.

1 Introduction

"'At the primary stage, the choice is not made in a uniform way. You have a brother there or sister there, your father or mother is an alumnus, and so on… So ***it's not meritocratic; it's based on the social class of your parents****, whether they went into better schools.*
…
The important thing is that at Primary 6, there should be a sorting out. And those who missed going to the good (primary) schools should get into better secondary schools. … That's what we're aiming to do: Regardless of who your father or mother was or is, we go by your performance"
- Lee Kuan Yew, 2010 (Emphasis added)[1]

This paper stems from two anecdotal observations. Firstly, Singapore's best primary schools tend to be located in expensive neighborhoods. Secondly, the prime, downtown locations of these neighborhoods probably means that they would still be expensive even if the primary schools were relocated elsewhere; in other words, proximity to good schools does not significantly increase property prices. For instance, the upscale Bukit Timah neighborhood, located within minutes from the Central Business District and home to the trendy Holland Village area, is also home to six nominally 'elite' schools: Nanyang Primary, Henry Park Primary, Anglo-Chinese School (Primary), Methodist Girls' School (Primary), Singapore Chinese Girls' School (Primary) and Raffles Girls' Primary School.

Singapore's Ministry of Education (MOE) mandates that all primary schools give priority to applicants who reside within one kilometer of the school she applies to. This paper finds that these two anecdotal observations are empirically and demonstrably true. It argues that, since that is the case, the combination of the home-school distance rule and the high property prices near the best primary schools erects a barrier to entry to such schools for children born to poorer families. Conversely, children born to wealthier families are more likely to successfully gain admission to the best schools.

The presence of such a barrier to entry should be of concern to policymakers because it is fundamentally unmeritocratic. This is problematic for three reasons. Firstly, Singapore's policymakers have enshrined meritocracy as a core tenet of governance, not just because it is fair but also leads to the most efficient allocation of talent: "The meritocracy principle – that we try to equalize opportunities not outcomes, and that we allocate rewards on the basis of an individual's merit or his abilities and achievements – is as close as anything gets to being a national ideology" (Low, 2013). However, the status quo is likely to produce outcomes that are not only unfair but also inefficient: talented individuals born in underprivileged circumstances may not get the opportunity to fulfil their potential, a lost opportunity not just for economic productivity but also for these individuals. Singapore's scarcity of natural resources, often cited as a justification for meritocracy (Low, 2013), amplifies the significance of this wastage.

Secondly, the status quo insidiously transmits inequalities of income and wealth across generations. If wealthy students have a better chance of attending a good primary school, then they are also more likely to do better in school and eventually earn higher wages[2]. In this manner, the status quo erects an obstacle to equality of opportunity and social mobility (Tan K. P., 2008). In a country where

[1] (Straits Times, 2010)
[2] The extent to which this is actually the case is discussed in section 1.2.

income inequality is relatively high and has been rising (Bhaskaran, Ho, Low, Tan, Vadaketh, & Yeoh, 2012), preventing the transmission of these equalities across generations is a significant long-term policy imperative (Straits Times, 2014).

Third, the high-stakes nature of Singapore's education system is likely to magnify this unequal distribution of opportunity. The intensive degree of tracking (otherwise known as streaming) by ability levels throughout school is likely to fix the direction (success or failure) and amplify the magnitude of a given student's performance over time (Rosenbaum, 1976); early success in primary school is likely to disproportionately improve later educational outcomes. Because primary schools vary in their ability to prepare students for examinations[3] that sort students by ability level to enable such tracking, students who are admitted to higher-quality primary schools are likely to have an amplified chance of performing well at these examinations, and in turn an amplified chance of access to the best secondary schools, tertiary institutions and employment opportunities (Altonji & Dunn, 1996).

This paper tests the hypothesis that the combination of the home-school distance rule and the geographical distribution of good primary schools across Singapore creates a barrier to entry for children born to poorer families. It finds that this barrier to entry exists: better schools tend to be concentrated in more expensive neighborhoods. Essentially, parents of prospective applicants at elite schools need to own property that is significantly more expensive than average in order to stand a good chance of admission – this represents an indirect cost of admission that constitutes the barrier to social mobility. Essentially, using home-school distance as a criteria for admission renders the education system's outcomes less than equitable, while ostensibly attempting to optimize for other ends such as parental interests and convenience.

1.1 Background to the status quo

Before this paper delves into its methodology and findings, it explains here for the non-Singaporean reader some of the terminology and policy contexts specific to Singapore. It briefly describes three aspects of the status quo: the education system in general, the standardized system of allocating places at primary schools, and the housing landscape.

1.1.1 Background to Singapore's education system[4]

Singaporean students go through six compulsory years of primary school, four or five years of secondary school, and then move on to several possible educational endpoints: vocational institutes, diploma-awarding polytechnics, pre-university 'junior colleges' and/or universities. The education system, as noted in section 1.0, extensively uses tracking (more commonly known in Singapore as streaming) in order to optimize teaching resources and curricula to student abilities, and to sort students by ability among these endpoints. At the ends of primary and secondary schools, students sit for standardized examinations whose results are used to carry out this sorting and allocation.

[3] See section 1.1.11 for an explanation of Singapore's education system and a discussion of why primary schools are likely to vary in quality.
[4] For official explanations from the MOE, see http://www.moe.gov.sg/education/landscape/ and http://www.moe.gov.sg/education/admissions/.

This system is fairly standardized across schools, especially at the primary school level: all schools follow a standardized curriculum fixed by the MOE, all teachers are centrally trained and employed by the MOE, schools fees are standardized[5], and the curriculum is designed to prepare students for the standardized Primary School Leaving Examination (PSLE) at the end of the six years of primary schooling. The results of the PSLE are then used for a centralized allocation of students to secondary schools: students with the best PSLE scores get into the most sought-after secondary schools. The best performers at the end of secondary school are admitted to the most sought-after junior colleges, and so on to the most competitive courses in the best universities.

Admittedly, the high level of standardization, centralization, and control by the MOE renders the system markedly more egalitarian than the education systems of many other countries. To a large extent, the centralized nature of the curricula and examinations ease social mobility. Notably, there are no private schools[6] that *directly* allow wealthy parents to purchase high-quality educations for their children. This paper argues that the location of the best schools in expensive neighborhoods *indirectly* allows wealthy parents to do so.

1.1.2 Background to the Primary One Registration Exercise[7]

In the status quo, Singapore's Ministry of Education (MOE) allocates places at primary schools following rules consistently applied across all schools, during its annual Primary One Registration Exercise. Parents of six-year-old children submit an application to one desired primary school. If the number of applications to any school exceeds the available number of places there, the school is mandated by the MOE to follow a standardized multi-phase admissions process, which gives priority to certain interest groups, then to Singapore citizens over foreigners, and finally to applicants residing closest to the school campus.

In what is known as Phase 1, applicants with siblings who are studying in the desired primary school at the point of application are automatically admitted. The remaining seats are transferred to Phase 2A1, in which *children of alumni* and of management are admitted. The seats remaining after Phase 2A1 are transferred to Phase 2A2, in which children of staff members and *siblings of alumni* are admitted. A minimum of twenty places, in addition to half of the places remaining after Phase 2A2, are allocated to Phase 2B, in which admission is given to children of school volunteers, 'active community leaders', and members of churches and Chinese clans affiliated to the school. The same number of places is allocated to Phase 2C, in which applicants who do not fall into any of the priority groups are admitted. Phase 2C Supplementary and Phase 3 are essentially repeats of Phase 2C.

Within each of these phases, if the number of applicants exceeds the available number of places, all Singapore Citizens (SCs) who reside within 1 kilometer of the school are admitted, after which all SCs who reside between 1 and 2 kilometers of the school are admitted, and finally all Singaporeans who reside more than 2 kilometers away from the school are admitted. After all Singaporeans have been admitted, Permanent Residents and then foreigners are given admission, with priority given to home-school distance in the same manner and order.

---

[5] Primary schools are free for Singaporean citizens, and nominal for others.

[6] There is a small number of international schools which are privately run, are not subject to the MOE's standardized rules, and charge relatively high fees, but Singaporeans are generally not allowed to attend them in lieu of compulsory primary education. Homeschooling is also only rarely allowed.

[7] For an official explanation, see http://www.moe.gov.sg/education/admissions/primary-one-registration/phases/ and http://www.moe.gov.sg/education/admissions/primary-one-registration/allocation/.

If, at any point in this process, applicants still outnumber remaining places after discrimination by citizenship status *and* home-school distance, then places are allocated randomly through balloting. For instance, assume 30 places are left for Phase 2C at a certain school, and 10 of them are taken up by SCs who reside within one kilometer of the school. If there are 50 SC applicants who reside between 1 and 2 kilometers of the school, then the 20 remaining places at the school will be filled by 20 of these 50 SCs randomly chosen through balloting.

As such, home-school distance *appears* to have only tertiary significance as a factor in gaining admission to a given primary school, as it is considered only after membership in priority groups and citizenship: this issue is discussed in section 6.55.

1.1.3 Background to Singapore's Housing Policy

As of 2014, 82% of Singaporeans live in apartments developed by the Housing Development Board (HDB), a government agency that develops affordable, subsidized property. 12% of Singaporeans can afford to live in condominium apartments which offer amenities that HDB apartments lack, such as security, swimming pools and gyms. Finally, the wealthiest 6% of Singaporeans can afford to live in 'landed' or 'private' property: low-rise, free-standing, single-family or semi-detached houses that are especially expensive in land-scarce Singapore. (Singapore Department of Statistics, 2014)

1.2 How much does your primary school really matter?

Central to the arguments in this paper is the premise that primary school choice has some appreciable impact on eventual outcomes – that a Singaporean's academic performance, employability, wages, and other life outcomes are influenced by the primary school he went to. Here, the extent to which this might be the case is discussed.

It is, of course, difficult to determine how far this is true. In public perception, that primary school choice affects educational outcomes is arguably something of a truism. The website kiasuparents.com, a portal and forum for 'kiasu'[8] parents of young children to discuss their concerns about their children's education, devotes substantial space to analyzing the annual outcomes of the Primary One Registration Exercise. Purchasing property near prestigious schools and volunteering in such schools (to qualify for admission in Phase 2B), often years before a child is old enough for primary school, is an anecdotally widespread practice (Davie, 2014). Separately, in 2013, there was a case of a parent who "lied about where he lived to get his daughter enrolled in a prestigious primary school" (Straits Times, 2015) and was subsequently sentenced to two weeks' jail. These trends reveal a "survival of the fittest" mentality (Khong, 2004) among parents when it comes to primary school admissions: if they are spending substantial amounts of money, time, and effort (and even incurring legal liability) to secure places at the best primary schools, then, in their perceptions, places at the best primary schools must be highly valuable, scarce, and contested resources.

By virtue of the strength of these perceptions alone, students at non-elite schools may plausibly be less motivated and meet with poorer academic academic outcomes: student performance is particularly susceptible to the labels attached to students, a relationship Rosenthal & Jacobson (1968) termed the Pygmalion effect. Thus, the 'elite' and 'neighborhood' dichotomy may be self-fulfilling, to a small extent. Nevertheless, the anecdotal evidence does not reveal how true these perceptions are, and what proportion of parents actually hold such perceptions. Ideally, we would collect longitudinal data on PSLE scores, 'O'-level results, tertiary graduation rates, and income of a sample of individuals, and test whether the primary school that they attended had any statistical impact on these outcomes. Though this claim has not yet been empirically tested in the absence of publicly-available data for Singapore, there is a theoretical framework for arguing that primary school choice in Singapore is *likely* to influence these outcomes. Altonji & Dunn (1996) draw from a large longitudinal dataset to compare the wages of adult siblings who attended different schools, thereby "estimating the effects of school inputs on wages". In this manner, they control for the possibility that wages may be influenced by family factors rather than school quality. They find that school quality, teacher salary, and expenditure-per-student have "a substantial positive relationship" with wages.

To be sure, Singapore's existing education system is structured in a largely egalitarian manner: in line with the PAP government's meritocratic tenets, resources are distributed somewhat equally, much unlike the schools in Altonji & Dunn's dataset. Central control by the MOE means that primary schools are largely standardized in terms of curricula, teachers' quality and training, teachers' salaries, and facilities. Nevertheless, there are three considerable leakages to the ostensibly egalitarian, meritocratic system.

[8] 'Kiasu' is a colloquial Hokkien term that means 'afraid of losing'.

Firstly, some systemic leakages on the periphery of the meritocratic structure allow additional resources to accumulate to elite schools. Expenditure per student may be higher at elite schools: schools on the Special Assistance Plan (SAP) are given additional resources (Gopinathan, 2013), as are schools running the Gifted Education Programme (see section 6.2). Crucially, schools with strong alumni and community relationships benefit immensely from donations (Mortimore, et al., 2000).

As such, historically well-established, elite schools are likely to be predisposed to accumulating pedagogic capital (Selvaraj, 2011), in terms of better management, organizational practices, facilities, extracurricular enrichment opportunities, teaching, and alumni/community support, as compared to 'neighborhood' schools. By MOE's own admission, "for schools to thrive, key stakeholders such as former students, members of the school advisory committees and parent volunteers, are critical as they help build up and strengthen the school's tradition and ethos, and support its students" (Lim, 2009) – conversely, 'neighbourhood' schools without the brand-names, school spirit, and alumni base to attract such stakeholder support may not be able to thrive.

Secondly, problems in the implementation of the meritocratic design lead to leakages. Technically, there are Learning Support Programmes at all schools to assist students without preschool educations (Fu, 2009) and Student Care Centres at "several" schools "to cater to pupils who have no adult supervision at home" (Khong, 2004). In reality, however, if some schools get a disproportionate share of students from underprivileged backgrounds, then resources for these programmes are likely to be stretched. This may especially be the case for unpopular schools (see section 6.6) with low Phase 1/2A Take-Up Rates (see section 6.4), whose students may be self-selecting for having parents with lesser investment in their education.

Finally, huge inequalities of opportunity originate from disparities in parental wealth and support. In the pithy words of educator and academic Jason Tan, "instead of having a meritocracy, increasingly what we have in Singapore is a parentocracy" (Ong, 2014). Parents' education levels, wealth, and investment in child-rearing are sources of inequity that the system does not attempt to level (Khong, 2004). This is egregiously manifested in the SGD 1.1 billion value of the shadow-education that provides private 'tuition' classes for paying students, allowing parents to purchase an academic advantage for their children. Kang (2011) writes that "in Singapore … how much education parents have matters for how their children are educated … As more generations of Singaporeans succeed and benefit from the educational system, those who succeed will be better positioned to navigate the system to ensure success for their children. And accumulation of small advantages along the way can lead to big advantages down the road." Whether the education system should level these inherited inequalities is a normative judgement – perhaps even one characteristic of the political left. Nevertheless, it arguably should not be *magnifying* them through the Primary One Registration Exercise.

Principally because of the existence of this 'parentocracy', and secondarily because of systemic leakages in the meritocratic design of the education system, the PSLE is not the meritocratic "sorting out" of students by ability, "regardless of who your mother or father … is", that Lee Kuan Yew made it out to be (Straits Times, 2010). Only 20% of students coming from the poorest 15% of families scored in the top third at the 2010 PSLE, and "half of the students who come from the lower one-third percentile of households in Singapore would likely be channelled to the bottom of the Normal stream by virtue of their PSLE performance" (Kang, 2011). The disproportionately poor performance of underprivileged students at the PSLE mirror the socio-economic composition

of students at elite secondary schools, which students can enter if they do exceptionally well at the PSLE. In Raffles Girls' School (Secondary), 72.3% of students are children of at least one university graduate. "The figures for other top schools like Hwa Chong Institution and Anglo-Chinese School (Independent) are similar – all above 50 per cent. In contrast, in neighbourhood schools like Jurong West Secondary and Bukit Merah Secondary, the share of students with graduate parents hovers at around 10 per cent" (Chang, 2011). Although these figures do not account for the possibility that intelligent parents may produce intelligent kids, these disparities appear large enough to remain significant even after doing so.

The MOE's "Every School A Good School" policy direction[9], announced in 2013 and intentioned as an attempt to level the quality of schools, arguably amounts to an admission that these disparities are significant. Although Every School A Good School was never explicitly framed as being redistributive in intent, its essentially redistributive nature is evident not just in its name but also in the specific policies it has led to. For instance, in October 2013, MOE the former minister for education, Heng Swee Keat, announced that his ministry would be "sending some of our most experienced and well regarded principals to head schools in our heartland[10]." (Heng, 2013) The word 'heartland' refers to the suburban HDB towns of Singapore, but has connotations of the familiar, the ordinary, and the commonplace. Inadvertently or otherwise, Heng associates average, middle-class neighborhoods with unexceptional, nondescript schools that need exceptional principals to improve. This then amounts to two more remarkable, implicit concessions from the MOE: first, that the best schools indeed are, as this paper argues, concentrated in expensive neighborhoods; and second, that the disparities between the best schools and the rest are significant enough to merit policy action.

[9] For an official explanation, see http://www.moe.gov.sg/initiatives/every-school-good-school/.
[10] The 'heartland' is a term commonly used in Singapore, especially in government communications, to describe the suburban HDB towns. Even in the popular psyche, it conveys "a sense of the local and of national authenticity" (Poon, 2013). It was popularized in former Prime Minister Goh Chok Tong's 1999 National Day Rally speech.

2 Relevant Literature

A body of existing literature exists that explores the impact of school quality *on* housing prices (Hernandez-Murillo, Chiodo, & Owyang, 2010; Franklin & Waddell, 2002; Black, 1999) using hedonic pricing models, finding that school quality does have a significant on the prices of nearby property.

However, the literature tends to focus on cases in the United States, where access to the best public schools tends to be contingent on living in a good school district. Funding for public schools tends to come from property taxes collected within school districts – thus, school quality directly correlates to neighborhood wealth, perpetuating inequality with little redistribution (Chetty & Friedman, 2011; Reynolds, 2004).

Singapore's context differs; as explained in section 1.1.1, school quality is standardized nation-wide. Moreover, living outside a one- or two-kilometer radius of a given school merely *diminishes* admission chances, while living outside an American school district typically renders it *impossible* to enter schools within that district.

For these reasons, Wong (2011) uses a hedonic pricing model to find that the proximity of a popular, high-quality school to a given property has a far smaller effect on that property's price. After controlling for other factors that influence property prices, Wong finds that property within 1km of a popular school is only 1.8% more expensive than similar property not within a kilometer of a popular school. Essentially, elite schools do not significantly drive up the prices of nearby properties.

Thus, Wong's finding suggests that, if elite schools are located in expensive neighborhoods (as this paper goes on to demonstrate), then those neighborhoods are *that* expensive not because proximity to elite schools endogenously drives up demand, but because exogenous factors (typically proximity to downtown Singapore) already render it expensive. This then lends credence to the second anecdotal observation noted in section 1, that neighborhoods with elite schools will still be expensive even if these elite schools were relocated elsewhere. In short, it is the location of schools in *already expensive locales* that represents an indirect socioeconomic barrier to admission.

3 Data and Sample

To test this paper's hypothesis, at least two values needed to be obtained for each school: a value quantifying the educational quality of the school relative to other schools, and another value quantifying the property prices a parent would need to incur in order to utilize the home-school distance criteria as an admission strategy.

3.1 Schools

The MOE does not officially release data on the performance of primary schools. Arguably, the best substitute was to utilize data on MOE-conferred awards under its Masterplan of Awards that recognize excellence and best practices at schools.[11] A publicly-accessible ranking of schools by the number of such awards received from 2009 to 2014 was obtained from SGTeach, an online social-network community of educators and parents,[12] based on data compiled from MOE press releases over that period of time announcing the presentation of these awards. The greater the number of awards a given school has received between 2009 and 2013, the higher that school is ranked. All primary schools in Singapore were given a ranking for each year.[13]

Schools receive one or more of these seven awards if they fulfil benchmarks, fixed by the MOE, that measure the performance of each school in both academic and extra-curricular domains. It then follows that the greater number of awards at a given school, the better the education a student who attends that school is likely to get.

MOE's standardized, criteria-referenced approach to conferring these awards make them a reliable means of comparing educational quality between schools. A particular strength of the data lies in the fact that it captures the performance of a school at delivering excellence even beyond the curriculum in non-academic domains. This is likely to be a significant factor in influencing student outcomes given that students talented in non-academic domains can apply for preferential admission[14] to top secondary and post-secondary institutions, and also given that soft skills are increasingly essential for success in post-secondary institutions and the workplace (Heckman & Kautz, 2012).

Moreover, using data based on MOE awards largely controls for the possibility that the children of the wealthy tend to do better in school regardless of how good a school they attend, due to both inherited and environmental factors. Ranking schools by the performance of their students at standardized tests, for instance, would fail to control for this possibility. In short, the data measure the quality of schools' educational *processes*, independent of the *outcomes* they deliver.

---

[11] For official explanations of the Masterplan of Awards, see http://www.moe.gov.sg/media/press/2004/pr20040317a/AnnexB.pdf and http://www.moe.gov.sg/media/press/files/2008/09/moe-masterplan-of-awards-for-schools.pdf.

[12] The data were accessed at https://www.facebook.com/media/set/?set=a.613996402040132.1073741833.278605648912544.

[13] The full rankings are available in the Appendix, section 9.1.

[14] Direct School Admission is an MOE scheme that allows students to be admitted to secondary schools and junior colleges of choice based on talent and achievement in extra-curricular fields, such as sports and the arts. See http://www.moe.gov.sg/education/admissions/dsa-sec/ and http://www.moe.gov.sg/education/admissions/dsa-jc/.

That said, the distribution of awards among schools differed slightly over the years, appearing to be contingent on changes to MOE policy in evaluating schools for the awards. In 2009, there were a total of 29 distinct ranks for 172 primary schools. In 2012, there were a total of 36 distinct ranks for 180 primary schools. By 2014, although the number of schools increased to 190, the number of distinct ranks fell to 27. To circumvent this problem, a program was designed to be able to take in any desired year from 2009 to 2014 as input for school rankings, as well as to aggregate the rankings for all six years to produce a final ranking linearly weighted towards more recent, up-to-date rankings (see section 4).

3.2 Housing Prices

Housing price data for was obtained from publicly-available information on the website of the Singapore Real Estate Exchange, a comprehensive "information exchange formed by the leading real estate agencies in Singapore", for real estate transactions dated between 16 April 2015 and 15 July 2015.[15] The median per-square-feet (PSF) resale and rental prices were listed for HDB apartments, condominium apartments, and landed property within one kilometer of each school,[16] providing six data-points for each school.

The strength of the data, besides its exhaustiveness, lies in the fact that it captures the cost parents would have to incur in order to qualify for the highest-priority, one-kilometer home-school distance category: this is the relevant cost to young parents attempting to purchase or rent. While it does not include housing price data for the 1-2km home-school distance category, it gives a fair representation of the most recent transactions for the highest priority, within-one-kilometer category.[17]

[15] The data were compiled by and is copyright of Streetsine Pte Ltd, and were accessed at http://www.srx.com.sg/property-prices-near-primary-schools.

[16] See section 1.1.3 for an explanation of these housing categories.

[17] Certain fields are blank because properties of that type did not undergo transactions during the 3-month time period relevant to the data. Generally, this indicates that there are negligibly few properties of that type within a one-kilometer radius of a school, or none at all.

4 Correlation

The collected data were aggregated such that only two values were assigned to each school: one capturing school quality, and the other, property prices. The distribution of these two values were then correlated with each other, revealing a result consistent with the hypothesis that the best schools are concentrated in expensive neighborhoods.

4.1 General correlation

First, the six data points capturing property prices in a one-kilometer vicinity of each school were aggregated into a single weighted price. Given that the percentage of Singaporeans living in HDB apartments, condominiums and private property is 82%, 12% and 6% respectively[18], this weighted price was calculated for each school as follows, based on the national distribution of property types:

Weighted price of property within 1km of each school =
0.82 * Median Price of HDB flats within 1km
+ 0.12 * Median Price of Condominium flats within 1km
+ 0.06 * Median Price of Private property within 1km

This method of aggregation also managed, to a large extent, to capture local distributions of property types wherever they differ significantly from the national distribution. In the vicinity of some schools, properties of one or more types did not undergo any transactions during the 3-month time period relevant to the data. This indicates that there are negligibly few properties of that type within a one-kilometer radius of a school, or none at all. To reflect this, the weighted price calculated for these schools consisted only of the remaining values, with the weights adjusted to reflect the local distribution.

Secondly, the six data points capturing the relative rank of each school – from annual rankings over six years from 2009 to 2014 – were weighted linearly as follows, with more recent rankings given greater weights:

Weighted ranking of each school =
6/21 * 2014 ranking + 5/21 * 2013 ranking + 4/21 * 2012 ranking
+ 3/21 * 2011 ranking + 2/21 * 2010 ranking + 1/21 * 2009 ranking

This gives precedence to the latest, most up-to-date school rankings.
Using Pylab as a graphing tool, weighted house prices were plotted against weighted school rankings in Figure 4.1, with each point representing a primary school.

[18] See section 1.1.3.

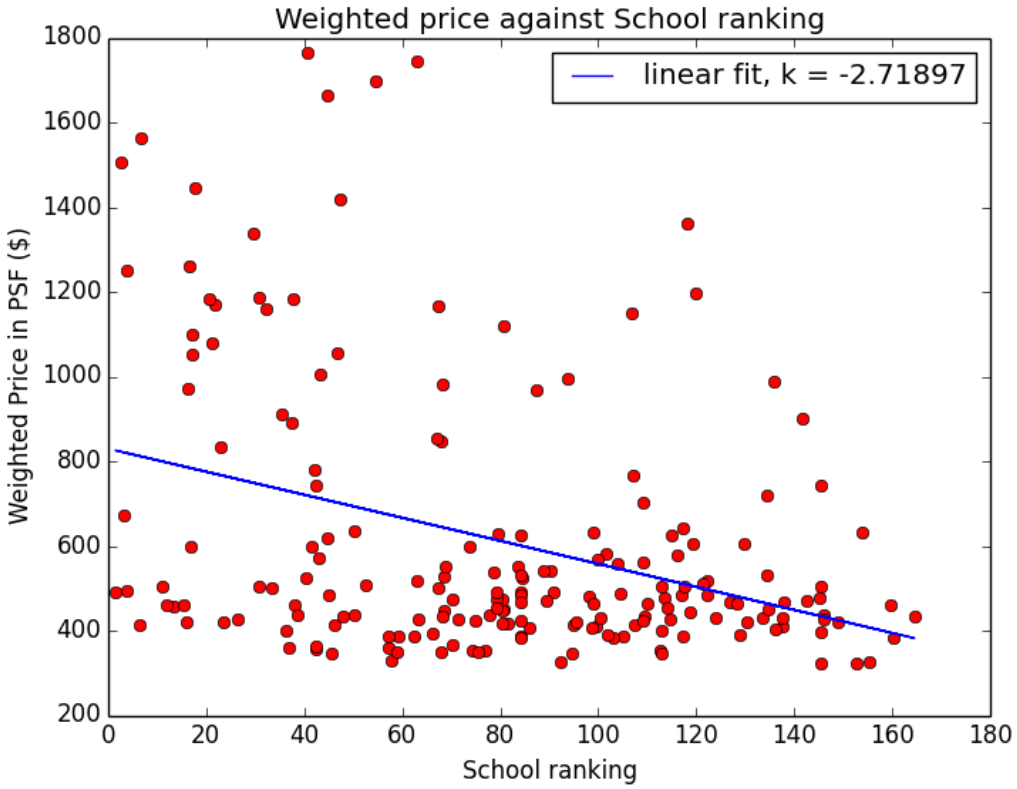


Figure 4.1 Graph of weighted property prices plotted against weighted school rankings without applying the statistical control, with line of best fit (k = -2.72).

The gradient of the best-fit line for the data was negative and had a value of 2.71897. This implies that, on average, an increase in property prices of 135.95 Singapore Dollars per square foot will produce a corresponding increase in school ranking of 50 places.

By this measure, the average parent, who may be living within one kilometer of a typical school,[19] will have to pay a premium of 131,000 Singapore Dollars to move to a new house located within one kilometer of a school in the top quartile. It is a significant sum, about 30% more than the average annual household income,[20] that represents a clear barrier to entry to elite schools for children from less wealthy households.

That said, the data had a correlation coefficient of r = -0.353635492786. Although it was negative as expected, its value was not large enough to demonstrate a clear correlation, with prominent outliers visible in the top-left quadrant of the scatter plot.

[19] The average Singaporean household in 2014 resided in a 4-room HDB flat (Singapore Department of Statistics, 2014), which have an average size of 90 square meters or 968.75 square feet (from http://www.hdb.gov.sg/fi10/fi10321p.nsf/w/BuyingNewFlat4room).
[20] Singapore's median annual household income in 2014 was 99,480 Singapore Dollars (Singapore Department of Statistics, 2014).

4.2 Statistical Control

Proximity to a school is likely to induce an endogenous effect on property prices. Thus, it is a variable that needs to be controlled for in order to prevent omitted variable bias. Wong (2009) quantifies this effect: all else held equal, "a school with good performance raises the resale price of flats within 1km by 1.8%". This is a premium that properties within one kilometer of "schools with good performance" are likely to command, regardless of the neighborhood or district on which the school is located. Other schools did not have statistically significant effects on property prices within one kilometer.

Therefore, statistical control was applied to the data by discounting the 1.8% premium for property near elite schools. Wong only considered schools in a handful of Singapore's districts, "schools with good performance"; these were approximated to be the top twenty schools in this paper's weighted ranking. The new set of data is plotted in Figure 4.2.

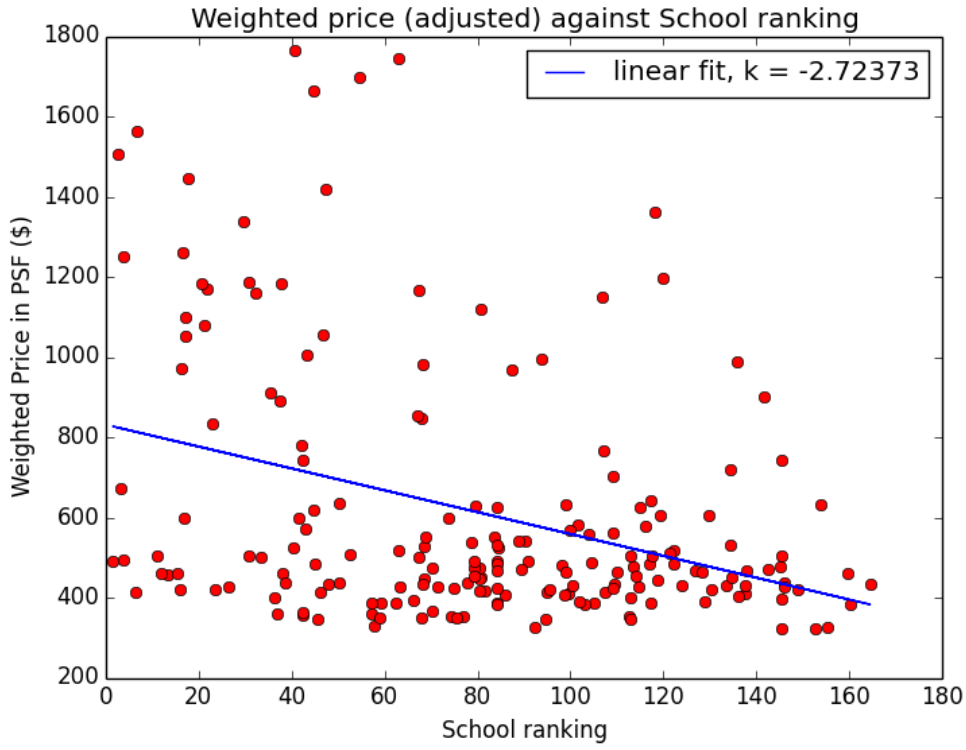


Figure 4.2 Graph of weighted property prices plotted against weighted school rankings after applying the statistical control, with line of best fit (k = -2.72).

Commensurate with the small magnitude of the proximity-premium Wong identifies, after applying the statistical control, the gradient of the best-fit line differs from the initial one only at the second decimal place. Similarly, the correlation coefficient (r = -0.352693380677) remains almost constant. Therefore, applying the statistical control has little effect on the data, and the correlation established in section 4.1 arguably still stands.

4.3 Conclusion

The simple correlation of two aggregated variables produced results consistent with the hypothesis that the best schools are concentrated in expensive neighborhoods. Nevertheless, the relatively low value of the correlation coefficient, the large number of outliers in the top-left quadrant of the scatter plot, and the concentration of data points in the bottom-right quadrant suggested that a simple linear-fit model was insufficient to analyze the correlation.

5 Clustering Methodology

To fully exploit the nuances of the rich dataset, and for it to yield richer insights, it was deemed necessary to capture all six data point for each of the two variables, rather than simply aggregating them into single weighted averages. To this end, cluster analysis, a Machine Learning algorithm, was applied to the data.

5.1 Data Analysis

A Python program was designed to perform four functions:

1. Parse a text file containing school names, rankings and housing price data.
2. Create relevant data sets of school names, rankings and pricing data that are easily accessible.
3. Implement k-means clustering of schools based on housing price data.
4. With schools now clustered based on housing prices, a thorough analysis of schools across clusters can be performed.

Python was chosen as the language of choice due to its portability and user-friendliness: it is one of the few high-level languages that is accessible to beginner programmers, with its syntax similar to that of English. In addition, Pylab as a graphing tool is easily accessible as a Python library. Moreover, Python files are easily convertible to Matlab files, and Pylab's graphing functions are similar in usage to those of Matlab.

As such, schools were grouped into three clusters: one cluster contained those located within one kilometer of the most expensive housing; another cluster contained those located within the cheapest housing; and the final cluster contained the intermediate schools.

5.2 Cluster Analysis

Cluster analysis is a Machine Learning algorithm that is designed to group data sets by similarities in their attributes. Schools with similar property prices were clustered together (instead of schools with similar rankings) because many types of data were available to capture different aspects of school quality: apart from the rankings, school performance over time, the popularity of schools, and the relevance of home-school distance to securing admission could be compared across clusters.

In order to prepare data for clustering, three values needed to be assigned to each school: a lower-bound price, an upper-bound price, and the weighted-average price generated in section 4. The lowest median-PSF price, between the three available price points (for HDB, condominium, and private property), was used as the lower-bound price. The highest-PSF price between the same three price points was used as the upper-bound price.

A particular strength of this methodology was that it captured the availability of different housing types and the different prices relevant to each of them. Considering these three values means that the data analysis captures the significant variance in house prices between HDB apartments, condominiums and private property, and the resulting range of housing options available to families. This allowed for a more accurate analysis of the data than if a single aggregated value had been used for each school.

K-means clustering was the specific clustering algorithm that was utilized. In the field of machine learning, k-means clustering is one of the simplest algorithms for unsupervised learning.[21] The value of 'k' was fixed at 3 clusters to enable us to identify high-end, low-end and intermediate house prices, effectively allowing comparison between clusters. With 3 clusters, the clustered schools can be clearly identified as those in expensive neighborhoods, typical neighborhoods and inexpensive neighborhoods.

The following steps describe the k-means clustering algorithm:

1. Three initial centers, one for each cluster, are randomly chosen.
2. Each of the points is assigned to one cluster by computing the center that the point is closest to.
3. Each cluster is updated with the new points and the centroid is also updated.
4. The algorithm converges when the centroids no longer change.

As such, schools were clustered based on similarities across all three values. This meant that, for instance, schools within one kilometer of generally expensive private housing were grouped into the same cluster; schools with nearby properties in similar price ranges were grouped into the same cluster. Crucially, schools with little or no HDB apartments within one kilometer were grouped into

[21] Unsupervised learning is a branch of machine learning that investigates pattern-finding within unlabeled data, i.e. data with no specified inputs and outputs. Its applications include density estimation, clustering and pattern recognition. In contrast, supervised leaning investigates pattern-finding within sets of labelled data i.e. data with clear inputs and outputs. Its applications include classification and regression with large datasets. (Bishop, 2006) 'Large dataset' is a commonly used term in Big Data analysis. For our purposes, the dataset is the matrix of 190 schools with various indicators such as min, max, weighted, housing prices, yearly ranks etc.

the same cluster; this meant that local distributions of the three property types were accounted for even when they differed from the national distributions (described in section 1.1.3).
Figures 5.1 to 5.3 show the results of clustering, with data points belonging to the same cluster sharing a common color. From the outset, the cluster analysis reveals trends consistent with this paper's hypothesis. Schools in Cluster 1 (red color), located in the most expensive neighborhoods, are represented by points generally concentrated in the top-left quadrant of highly-ranked schools. Meanwhile, points in Clusters 2 and 3, in blue and green respectively, are more horizontally distributed across the scatter plots. A complete list specifying which schools were assigned to each cluster is included in the Appendix, section 10.4.

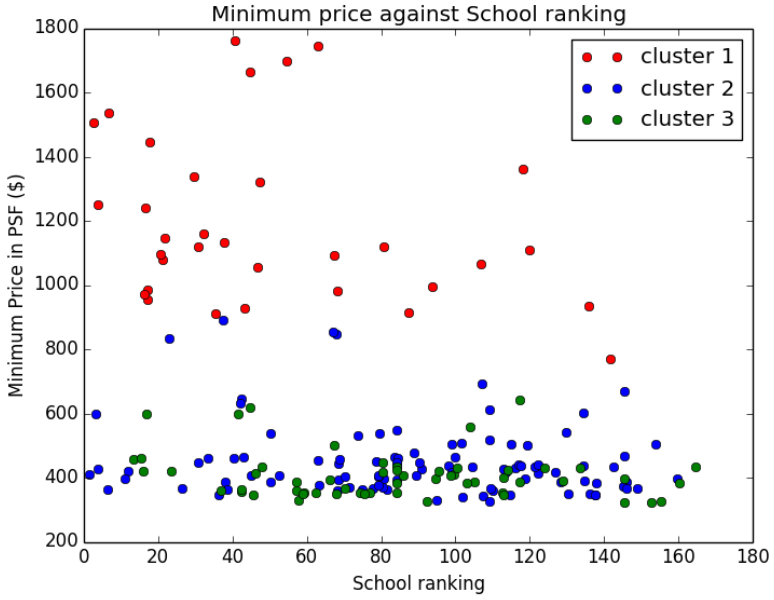


Figure 5.25.1 Graph of lower-bound price points plotted against weighted school rankings, colored by cluster.

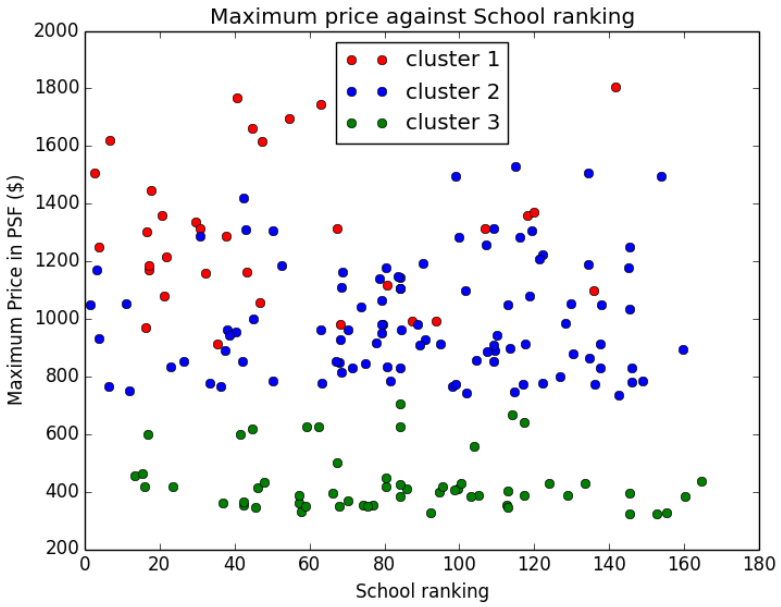


Figure 5.25.2 Graph of upper-bound price points plotted against weighted school rankings, colored by cluster.

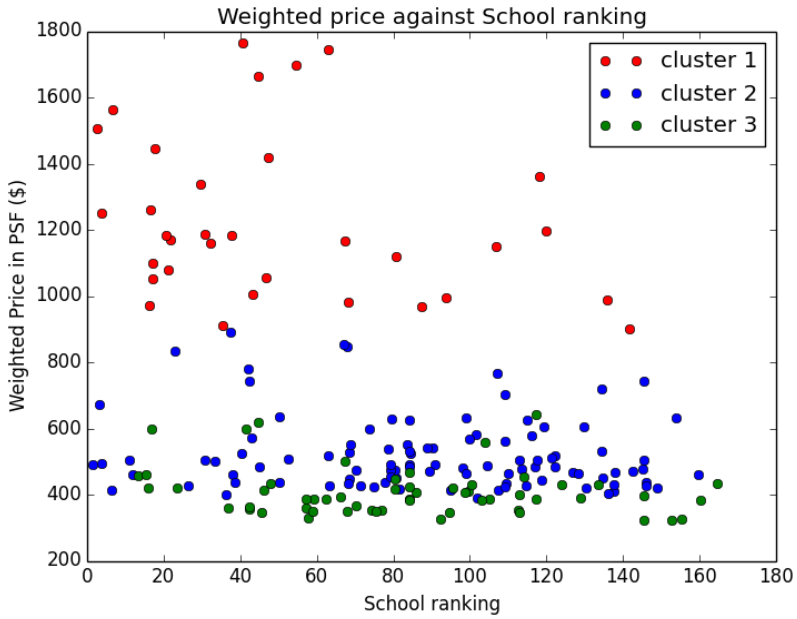


Figure 5.25.3 Graph of weighted-average price points plotted against weighted school rankings, colored by cluster.

5.3 Price differences across clusters

Cluster 1 consists of schools in relatively expensive neighborhoods. From Table 5.4, the lower- and upper-bound prices are consistently much higher than average. Furthermore, from Figure 5.5, the difference between the lower- and upper-bound values for Cluster 1 is barely a third of same

difference for the whole dataset: the lower-bound value is heavily skewed upward by the relative dearth of cheap HDB apartments in these neighborhoods. This means that most of the properties in these regions tend to be condominiums and private property, with fewer affordable HDB apartments. From Figure 5.6, even the few HDB flats on sale in Cluster 1 neighborhoods were significantly more expensive than other HDB flats.

Cluster 2 comprises schools in neighborhoods with intermediate property prices. The lower-bound cost of purchasing a house is at an affordable 450.32 Singapore Dollars per square feet, and the upper-bound is 997.09 Singapore Dollars. From Table 5.4, both of these figures are very close to the overall average lower and upper bounds of property prices in Singapore. As such, properties near schools in Cluster 2 are typical of Singapore property in general.

Cluster 3 represents schools situated in relatively inexpensive neighborhoods. The price values for Cluster 3 are the inverse of those for Cluster 1: the relative abundance of affordable HDB apartments in Cluster 3 neighborhoods skews the upper-bound value downward, leading to the deviation between the upper- and lower-bound prices being close to zero. Indeed, a sample of the raw PSF data from these areas show that the mean condominium resale is an exceptionally low 703 Singapore Dollars per square foot, while no recent transactions of private property have been made.

Table 5.4 Values for lower-bound, upper-bound, and weighted-average prices of property in each cluster.

	Lower-bound Price			Weighted-average Price			Upper-bound Price		
	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Cluster 1	770.0	1193.4	1760.0	902.4	1228.2	1765.3	912.0	1308.1	1807.0
Cluster 2	327.0	450.3	891.0	389.8	521.9	891.0	736.0	997.1	1531.0
Cluster 3	322.0	407.2	642.0	322.0	409.3	642.0	322.0	430.6	705.0
Mean	322.0	566.4	1760.0	322.0	610.8	1765.3	322.0	881.16	1807.0

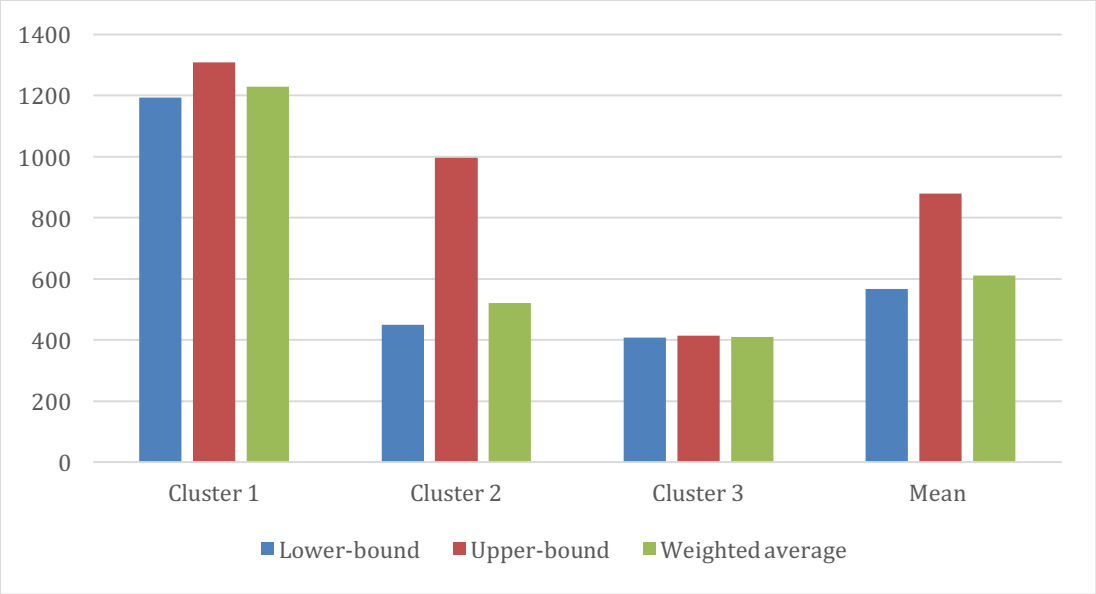
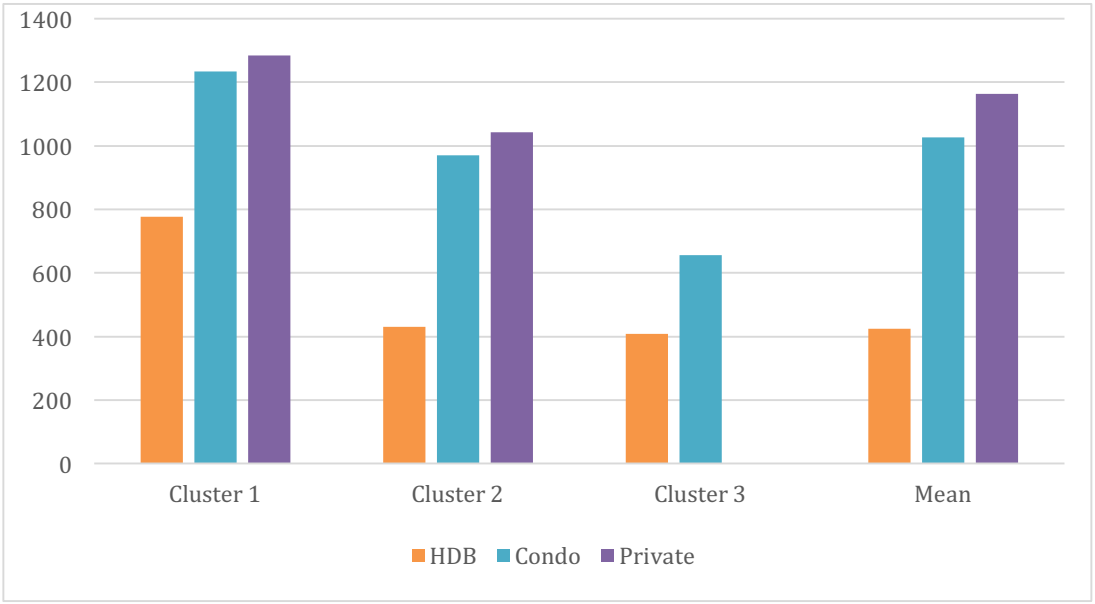


Figure 5.35 Minimum, average, and maximum price points in each cluster.

Figure 5.6 further illustrates the difference in housing prices across clusters. Of note is the absence of a value for private property in Cluster 3; *none* of the schools in Cluster 3 have private property within one kilometer.

Figure 5.36 Average property prices in each cluster, by property type.



6 Findings

Having grouped all the primary schools in Singapore into 3 clusters of neighborhood property prices, data on school performance was introduced, and analyzed sequentially in five ways:

1. School ranking data were compared across clusters.
2. A subjective sample of fifteen elite schools was located among the clusters.
3. School performance between 2009 and 2014 was compared across clusters.
4. The percentage of available places at each schools taken up by priority groups during Phase 2A was compared between schools.
5. The relevance of home-school distance as a factor in admissions was compared across clusters.
6. The popularity of schools was compared across clusters.

6.1 Analysis of school rankings across clusters

From Table 6.1, the average school in Cluster 1 is ranked markedly higher than average schools in the other clusters. Schools in Cluster 1, the most cluster with the most expensive homes in a 1-km radius, have a mean rank of 51; the mean ranks of schools in Clusters 2 and 3 are 92 and 94 respectively.

Table 6.1 The ranks of the best, average, and worst schools in each cluster.

	Weighted rankings from 2009-2014			
	Best ranking	**Avg ranking**	**Worst ranking**	**SD**
Cluster 1	2.57 (Singapore Chinese Girls' Primary)	51.8	163.8	40.4
Cluster 2	1.48 (Rulang Primary)	91.8	159.6	41.3
Cluster 3	13.38 (Ai Tong School)	94.1	164.5	45.2

A Kruskal-Wallis test[22] was conducted to determine the extent to which the differences between the mean ranks between clusters are statistically significant, with the null hypothesis that the three means are the same. The results of that analysis, $\chi^2(2) = 21.6$, $p < .001$, indicated that these difference are sufficiently significant at both the 5% and 1% levels for the null hypothesis to be rejected. Post-hoc Mann-Whitney tests indicated significant differences between the means of Clusters 1 and 2 ($p <$

[22] The Kruskal-Wallis test was selected here and in sections 6.4 to 6.6 because three sets of data needed to be compared without making any assumptions about their normality.

.001, r = 0.44) and between the means of Clusters 1 and 3 ($p < .001$, r = 0.44). However, the mean ranks of Cluster 2 and 3 did not differ significantly, p = 0.42, r = 0.03.

The box plot[23] in Figure 6.2 illustrates similar results. Not only is the median school in Cluster 1 ranked 56 and 54 places higher than the median schools in Cluster 2 and 3 respectively; the interquartile range of Cluster 1 hardly overlaps with those of the other two clusters. The long upper whisker of the Cluster 1 box-plot suggests also that the distribution of Cluster 1 schools (in red) is skewed heavily towards the lower (better) ranks. At the same time, schools in Clusters 2 and 3 do not differ significantly in their quality despite the significant difference in their house prices: the median ranks of schools in these clusters differ only by two rank points.

In section 4.1, based on the line of best fit for the aggregated data, it was found that a parent could effectively buy 50-rank increase in school quality for $131,000; here, the cluster analysis reveals that for a 40-rank difference between the average schools in Clusters 1 and 2 costs more than five times that amount. This suggests that property prices increase *exponentially* as school quality increases, not just. Crucially, the average school in Cluster 1 is ranked 40 places higher than the average school in Cluster 2. The average parent in a Cluster 2 neighborhood lives in a house worth $505,590; to purchase a house in the average Cluster 1 neighborhood, she would have to pay $1,189,818, more than twice the value of her current house. The increase of $684,228 is a colossal sum, nearly seven times the annual household income, in exchange for a school ranked 40 places better.

[23] The box plots in this paper were generated using a web application created by the Tyers and Rappsilber labs and accessed at http://boxplot.tyerslab.com. Whiskers and outliers are defined using the Tukey method.

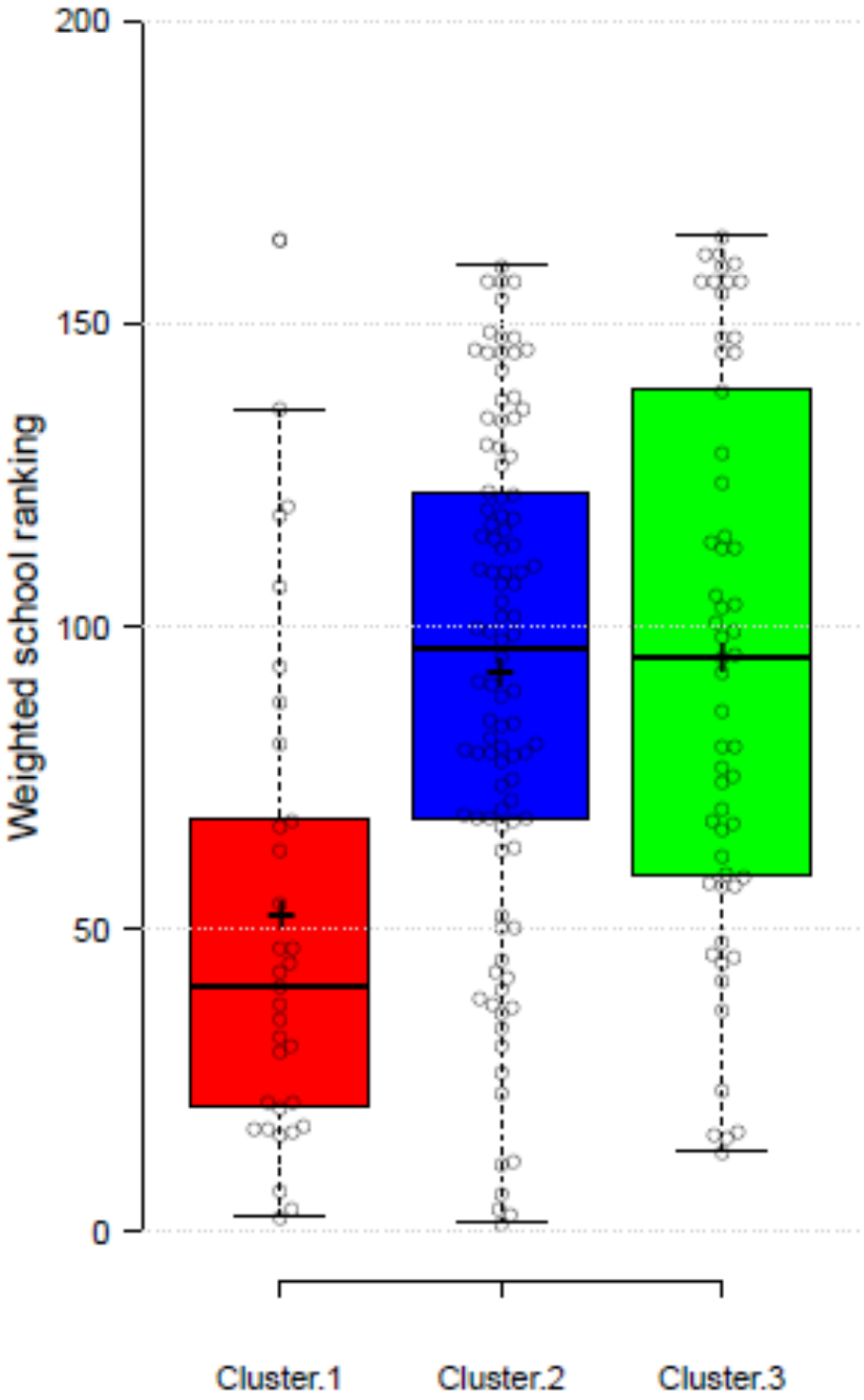


Figure 6.2 Box-plot illustrating the distribution of weighted school rankings within clusters, where a lower rank denot better quality. The plus-sign (+) marks the value of the mean for each cluster.

As such, the data are consistent with the hypothesis that Cluster 1 neighborhoods are home to significantly better schools than cheaper locales, though they also reveal no significant differences between the quality of Cluster 2 and 3 schools. In particular, four different types of schools emerge:

1. elite and expensive; a small group of schools fall well into this category.
2. elite but accessible; schools of this type are a minority among accessible schools in general, though notable ones exist.
3. mediocre and accessible; there is a large base of such schools.
4. mediocre but expensive; a small number of such schools exists too, as indicated by the long upper-whisker for Cluster 1 in Figure 6.2.

The stark difference between the results here and those in section 4 suggest that elite schools are *concentrated* in expensive neighborhoods, though poor schools are not concentrated in cheap neighborhoods: there is only a weak correlation (low r-value) between all school rankings and weighted property prices, but a very significant difference (low p-value) between the rankings of the 33 Cluster 1 schools and the rankings of the other 157 schools. The lack of any significant difference in school quality between Clusters 2 and 3 is consistent with this pattern.

6.2 Subjective sample of elite schools

As the data hinted at a concentration of elite schools in Cluster 1, a list of fifteen schools subjectively judged to be elite were then examined and located among the clusters, as shown in Table 6.3.

9 of the 15 schools in the sample of elite schools were selected because they offer the Gifted Education Program (GEP). Although only 40 to 60 students are enrolled in the GEP per cohort in each of the 9 schools, and although admissions to the GEP are wholly independent of the Primary One Registration Exercise, the fact that a school runs the GEP is an indicator of high quality even for the majority of its students not enrolled in the GEP. Firstly, schools are selected to run the GEP by the MOE on the basis of sustained organizational commitment to delivering excellent educational outcomes. Secondly, non-GEP students in GEP schools tend to benefit from overflowing funding and resources allocated to the GEP: for instance, enrichment programs run for GEP students tend to be open to selected non-GEP students as well.[24]

The other 6 schools were selected for their prominent 'brand names', these brands being an arguably indisputable indicator of quality. All of them have a tradition of excellence: they were all set up in the 19th century or early 20th century by Christian missionaries or Chinese philanthropists,[25] rendering them the schools of choice for the elite of colonial Singapore. These histories enables them to attract private donations from alumni, affiliated churches and affiliated Chinese clans, supplementing government funding – this amplifies the increase in educational quality arising from their brand names. Moreover, all of them except Ai Tong School are affiliated to secondary schools of good quality – MOE policy gives students of these schools an advantage in admission to their respective affiliated secondary schools, thereby giving their students a higher chance of succeeding in the tracking-intensive PSLE system (Wijeysingha, 1989).[26] Ultimately, these factors give these schools significant pedagogic capital (Selvaraj, 2011); their elite status, and in particular their historical traditions, directly lead to better educations provided at these schools.

A complete list of these fifteen elite schools, and their corresponding cluster numbers, is given in Table 6.3. Clearly, most of the best schools are located in cluster 1.

Table 6.23 List of subjectively elite schools and their corresponding cluster numbers.

School type	School name	Cluster
GEP Schools	Nanyang Primary School	1
	Rosyth School	2
	Tao Nan School	1
	St Hilda's Primary School	2
	Raffles Girls' Primary School	1
	Nan Hua Primary School	1
	Anglo Chinese School (Primary)	1

[24] See http://www.moe.gov.sg/education/programmes/gifted-education-programme/gep-schools/.
[25] For instance, ACS and MGS are part of a family of schools started in Singapore and Indonesia by missionaries of the Methodist Church, SJI was established by the De La Salle Brothers, and Ai Tong was started by the Singapore Hokkien Huay Kuan clan association.
[26] See http://www.moe.gov.sg/education/admissions/secondary-one-posting/option-exercise/considerations/.

	Catholic High School	2
	Henry Park Primary School	1
Branded Schools	Anglo Chinese School (Junior)	1
	Singapore Chinese Girls' Primary School	1
	Methodist Girls' (Primary)	1
	CHIJ St Nicholas Girls' School	1
	Ai Tong School	3
	St Joseph's Institution Junior	3

Cluster 1 is overrepresented in this list of elite primary schools: 10 schools are in Cluster 1, while only 3 are in Cluster 2 and 2 are in Cluster 3. From Table 6.4, the 10 schools in Cluster 1 represent almost a third of all schools in the Cluster, while the 3 schools in Cluster 2 and 2 schools in Cluster 3 represent only 3% of both clusters combined. Thus, elite schools constitute a substantial portion of schools within one kilometer of expensive properties, while they constitute a very small minority of schools within a kilometer of affordable properties.

Table 6.24 Distribution of subjectively elite schools across clusters.

	% GEP schools	**% Branded schools**	**% All elite schools**
Cluster 1	18.18	12.12	30.30
Cluster 2	3.33	0.00	3.33
Cluster 3	0.00	3.51	3.51

6.3 School performance over time

Figure 6.5 shows the mean rank of schools in each Cluster for each year between 2009 and 2014, where a lower rank denotes a relatively better school. Consistent with the hypothesis, Cluster 1 schools performed significantly better than schools in Cluster 2 and 3, although schools in the latter two Clusters performed similarly. Once again, this points towards a concentration of elite schools within the small Cluster 1 (only 33 out of 190 schools), and a correspondingly diffuse distribution across the other two clusters.

Figure 6.5 also adds a temporal dimension to the findings in sections 6.1 and 6.2. Over the 5-year period, the performance of Cluster 1 and 2 schools have improved slightly. In contrast, while the performance of Cluster 3 schools have worsened, albeit slightly with fluctuations. In particular, the constantly improving schools further point to the existence of elite schools within this cluster; the disparity between elite and non-elite schools is not only enduring, but also increasing. That said, as comparing rankings between years may not be reliable, the differences over time may not be significant.

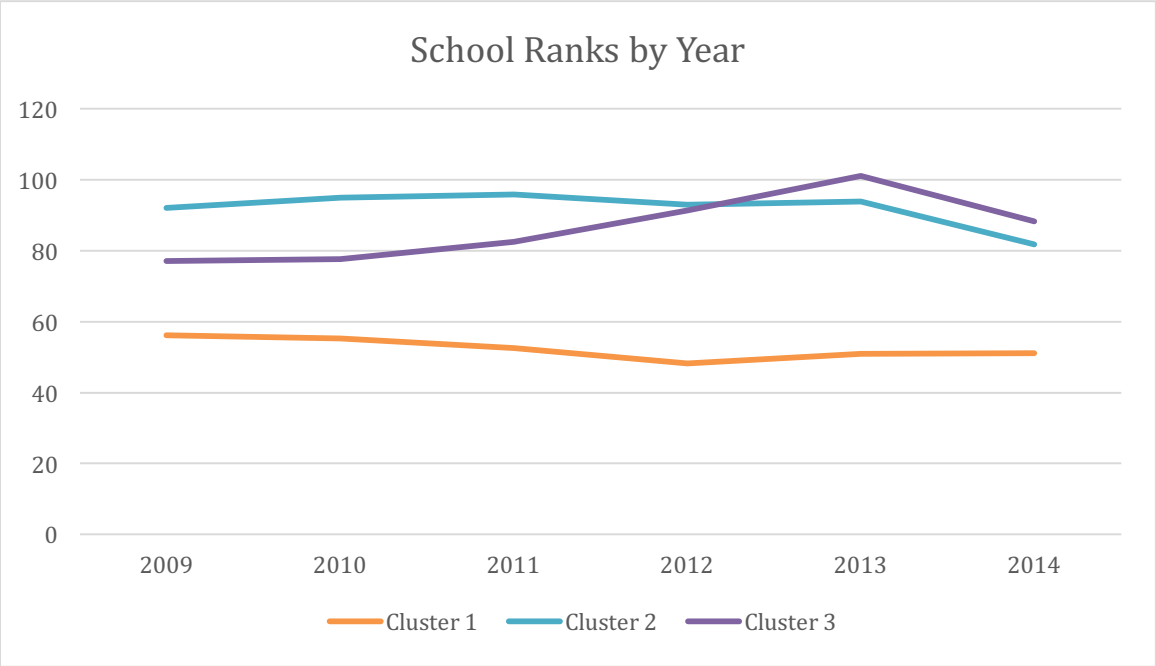


Figure 6.35 The average annual ranks of schools in each cluster between 2009 and 2014, inclusive.

6.4 Phase 2A Take up Rate

Sections 6.1 to 6.3 have demonstrated the manifest concentration of elite schools in expensive neighborhoods. Sections 6.4 to 6.6 will go on to illustrate the impact this has on the broader process of primary school admissions.

First, this paper finds that the schools where most available places are filled up by applicants who belong to priority groups are concentrated in expensive neighborhoods. School-specific data for 2015 collected from MOE press releases[27] was compared with the clustering results, demonstrating that elite schools were not only in the most expensive neighborhoods, but also the least accessible to applicants outside priority groups.

As explained in section 1.1.2, applicants whose siblings are current students, or whose parents are alumni or school management, are given priority admission in Phases 1 and 2A. The take-up-rate (TUR) at the end of phase 2A at a given school is then a percentage of the total available at the school, as follows:

$$\textbf{TUR} = \frac{\textit{Vacancies taken up at phases 1 and 2A}}{\textit{Total vacancies}} \times 100\%$$

Thus, the higher the TUR for given school, the more difficult it is to get in without prior family connections to the school. From Table 6.6, the TUR at the average Cluster 1 school is 58.9%, while the TUR is much lower at 41.2% and 42.1% for clusters 2 and 3 respectively.

A Kruskal-Wallis test was conducted to determine the extent to which the differences between the mean TURs between clusters are statistically significant, with the null hypothesis that the three means are the same. The results of that analysis, $\chi^2(2) = 19.6$, $p < .001$, indicated that these difference are sufficiently significant at both the 5% and 1% levels for the null hypothesis to be rejected. Post-hoc Mann-Whitney tests indicated significant differences between the means of Clusters 1 and 2 ($p < .001$, $r = 0.44$) and between the means of Clusters 1 and 3 ($p < .001$, $r = 0.42$). However, the mean ranks of Cluster 2 and 3 did not differ significantly, $p = 0.21$, $r = 0.03$.

Likewise, the box plot in Figure 6.7 also reveals no substantial differences between the median TURs between clusters, though the upper-quartile TUR for Cluster 1 is appreciably higher than those of Clusters 2 and 3 (by 20 and 17 percentage points respectively). Still, the upper whiskers for Clusters 2 (25 p.p.) and 3 (22 p.p.) are considerably higher than that of Cluster 1 (16 p.p.), and Clusters 2 and 3 have several prominent outliers

Table 6.6 Lowest, highest, and average Take-Up Rate at the end of Phase 2A of schools in each cluster.

	Lowest TUR (%)	Average TUR (%)	Highest TUR (%)	SD
Cluster 1	21.0 (Angsana Primary)	58.9	90.0 (Nanyang Primary)	18.0
Cluster 2	0.0 (several)	41.2	84.0 (Rulang Primary)	16.0

[27] The data were compiled and is copyright of iInspire Pte Ltd, and were accessed at by kiasuparents.com, and accessed at http://www.kiasuparents.com/kiasu/event/2015-p1-registration-phase-2a2.

Cluster 3	0.0 (Hong Kah Primary)	42.1	88.0 (Ai Tong)	15.9

Figure 6.7 displays consistency with the trend for Cluster 1 schools to stand out markedly from schools in the other two clusters, while schools in Cluster 2 and 3 have similar profiles, both in terms of school quality *and* Phase 2A TUR. There are substantial differences (of 15 to 16 percentage points) between the median TURs of Cluster 1 as compared to the other clusters. The medians of Clusters 2 and 3 are almost equal to the lower quartile of Cluster 1, and the upper quartile of Cluster 1 exceeds those of the other two clusters by 23 to 25 p.p.

This implies that elite schools are not just concentrated in expensive neighborhoods, but *also* difficult to get into without family connections to the school; to get in, an applicant's parents must either be wealthy, well-connected, or both. The *combination* of the home-school distance with the preference given to priority groups creates a double-layer socio-economic barrier to entry to elite schools.

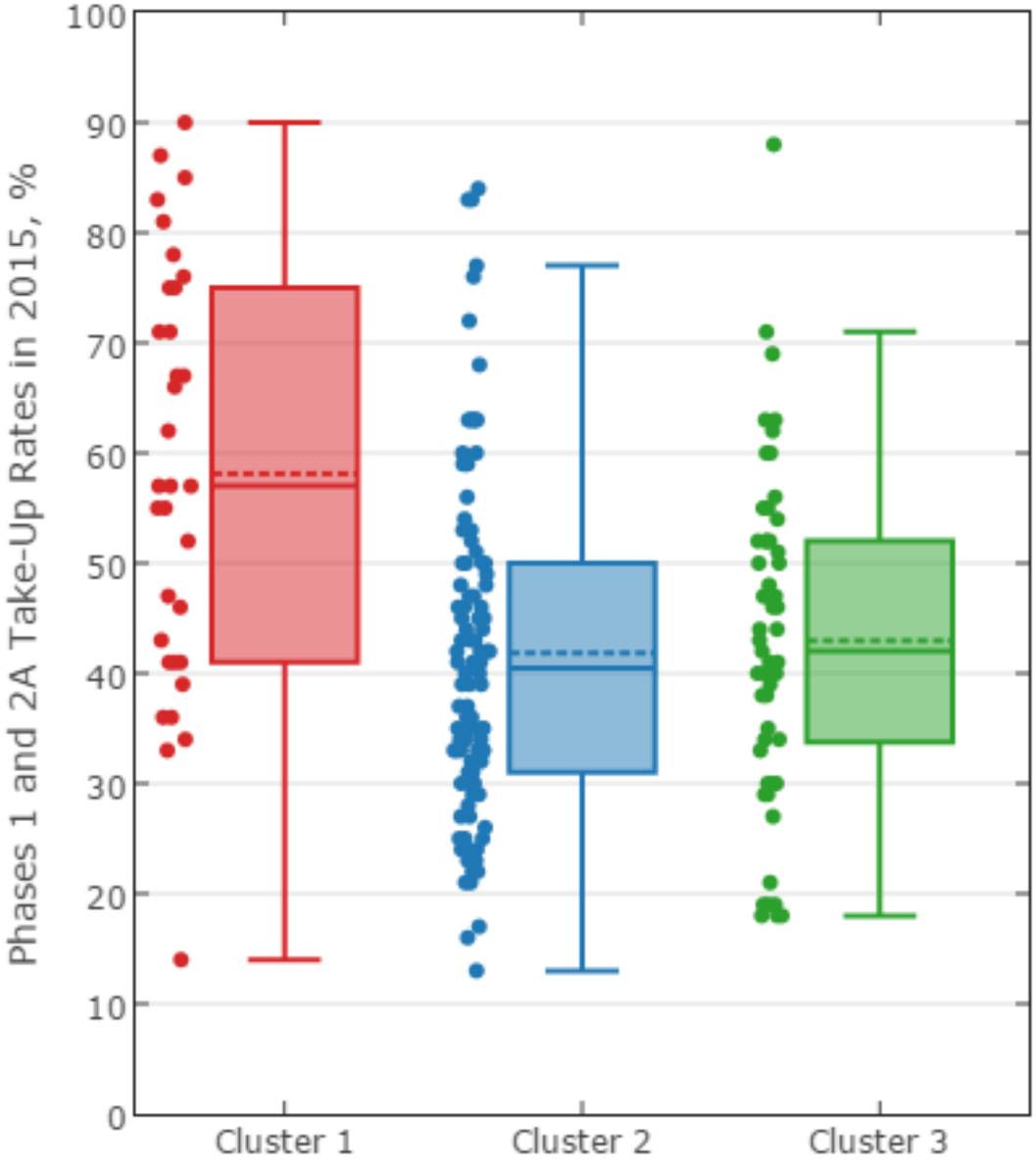


Figure 6.7 Box-plot illustrating the distribution of Take-Up Rates at the end of Phase 2A within clusters. The plus-sign value of the mean value for each cluster.

6.5 Relevance of home-school distance to application process

Next, this paper finds that the schools at which home-school distance matters the most in gaining admission are concentrated in expensive neighborhoods. In MOE's allocation system (described in section 1.1.2), home-school distance *appears* to have only tertiary significance as a factor in gaining admission to a given primary school, as it is considered only after membership in priority groups and citizenship. Thus, home-school distance is likely to matter to different extents in securing admission at different schools, depending on the magnitude and composition of demand for a given school.

Schools were ranked by the relevance of home-school distance in securing admission, by identifying which phase[28] balloting was required at.[29] A score of 1 to 15 was assigned to each school,[30] based on the following logic:

1. The earlier the phase where balloting is required, the more competitive the school is.
2. The smaller the distance that balloting is required for, the more competitive the school is. This is due to the fact that applicants within 1 km are given priority so the presence of balloting within 1 km indicated large significant application.
3. The presence of balloting for citizens implies that a school is more competitive since citizens are already given priority over PRs.

Every marginal point represents a discontinuous change in the relevance of home-school distance as a factor in gaining admission into that school: the higher the number of points assigned to a given school, the greater the number people who were discriminated against on the basis of home-school distance, and the greater the discontinuity in admission probability between the distance categories (<1km, 1-2km, and >2km). Table 6.8 details the method with which scores were assigned to schools.

Table 6.8 *Methodology for assigning scores from 0 to 15 to schools based on the extent to which home-school distance is relevant as a factor in gaining successful admission; a higher score denotes greater relevance.*

Category			**Corresponding score**
Phase	**Competitiveness**		
2A	Balloting for	SC >2km	15
2B	Balloting for	SC <1km	14
	Balloting for	SC 1-2km	13
	Balloting for	SC >2km	12
	Balloting for	PR <1km	11
2C	Balloting for	SC <1km	10

[28] The data were compiled by and is copyright of iInspire Pte Ltd, and were accessed at http://www.kiasuparents.com/kiasu/event/2014-p1-registration-phase-2c.
[29] Balloting, as explained in section 1.1.1, takes places when, after discrimination by membership in priority groups, citizenship, and home-school distance, applicants still outnumber remaining available places.
[30] The list of schools with their associated rankings from 0-15 is included in the appendix, section 10.3.

	Cut-off for	SC <1km	9
	Balloting for	SC 1-2km	8
	Balloting for	SC >2km	7
	Cut-off for	all SCs	6
	Balloting for	PR <1km	5
	Balloting for	PR 1-2km	4
	Balloting for	PR >2km	3
	Cut-off for	All SCs & PRs	2
2C Supplementary	Excess demand		1
3	Excess demand		0

Table 6.9 *Lowest, highest and average scores for the relevance of home-school distance to admission for schools in each cluster.*

	Least important	**Average importance**	**Most important**	**SD**
Cluster 1	0	7.58	15.00	5.43
Cluster 2	0	3.65	14.00	4.55
Cluster 3	0	4.07	15.00	4.79

Table 6.9 shows that, despite the low priority apparently given to home-school distance in MOE's allocation system, the reality is that it is crucial for admission at Cluster 1 schools. A Kruskal-Wallis test was conducted to determine the extent to which the differences between the mean relevance scores between clusters are statistically significant, with the null hypothesis that the three means are the same. The results of that analysis, $\chi^2(2) = 14.6$, $p = .0004$, indicated that these difference are sufficiently significant at both the 5% and 1% levels for the null hypothesis to be rejected. Post-hoc Mann-Whitney tests indicated significant differences between the means of Clusters 1 and 2 ($p < .001$, $r = 0.38$) and between the means of Clusters 1 and 3 ($p = .002$, $r = 0.33$). However, the mean ranks of Cluster 2 and 3 did not differ significantly, $p = 0.19$, $r = 0.05$.

At the average school in Cluster 1, the mean value of 7.58 implies that residing within 1km of the school guaranteed admission, but residing between 1km and 2km did not – applicants in these distance categories were subject to selection by balloting. At the 26 schools with 11 points or more, *both* membership in priority groups *and* residence within 2km of these schools did not guarantee admission for everyone. An intense level of competition for admission to these schools is produced by the disproportionate advantage generated by living within 1km of the school. This renders plausible the anecdotally well-known trend of well-heeled young couples purchasing and moving into property within 1km elite schools as an admission strategy.

Thus, if home-school distance does not have a significant influence on likelihood of admission at a given school, then that school is likely to be a lower-ranked, less-popular, mediocre school. At such schools, either supply of places outstrips demand, or demand only outstrips supply to the extent that discrimination of applicants only needs to take place on the basis of citizenship.

6.6 Popularity of school

Finally, this paper finds that most popular schools are concentrated in expensive neighborhoods. To analyze how popular a school is, MOE data[31] about the spots reserved and the number of applications for phase 2 was matched to the results of the cluster analysis.[32]

At each phase, the following formula calculates the deficit in spots for that particular phase.

Deficit = Number of vacancies – Number of applicants

Thus, the overall difference between number of applicants and number of available places could be deduced for each school. In Table 6.10, large negative number denotes a heavily oversubscribed school, while a large positive number denotes a heavily undersubscribed school was heavily undersubscribed.

Table 6.10 Largest deficit, largest surplus, and average deficit/surplus in each cluster; a school in deficit is oversubscribed and thus popular, while a school in surplus is undersubscribed.

	Largest deficit	Average deficit/surplus	Largest surplus	SD
Cluster 1	-55 (Fairfield Methodist)	-12.0	96 (Angsana)	31.1
Cluster 2	-83 (Rosyth)	29.5	123 (Coral)	46.7
Cluster 3	-131 (Nan Chiau)	18.7	151 (Juying)	52.6

Table 6.10 shows that the average Cluster 1 school is oversubscribed by 12 places, while the average Cluster 2 and 3 school is undersubscribed by between 19 and 30 places, out of between 270 and 300 places available at most schools. A Kruskal-Wallis test was conducted to determine the extent to which the differences between the mean deficits/surpluses between clusters are statistically significant, with the null hypothesis that the three means are the same. The results of that analysis, $\chi^2(2) = 25.2$, $p < .001$, indicated that these difference are sufficiently significant at both the 5% and 1% levels for the null hypothesis to be rejected. Post-hoc Mann-Whitney tests indicated significant differences between the means of Clusters 1 and 2 ($p < .001$, $r = 0.43$) and between the means of Clusters 1 and 3 ($p = .0003$, $r = 0.32$). However, the mean ranks of Cluster 2 and 3 did not differ significantly, $p = 0.055$, $r = 0.11$.

Having already established that elite schools are concentrated in Cluster 1, it can then be deduced that elite schools tend to be markedly more competitive to get into than mediocre schools. Once again, the inequity of the system is apparent: a parent living in a Cluster 1 home may successfully enroll his child in a worse school because they are undersubscribed, but the inverse cannot take

[31] The data were compiled by and is copyright of Emant Pte Ltd, and were accessed at http://www.elite.com.sg/phase2C-supp-vacancy-2009.page.

[32] A complete breakdown of the number school places and applications by phases is included in the appendix, section 9.3.

place because a parent living in a Cluster 3 property is unlikely to stand a chance at an oversubscribed Cluster 1 elite school.

That said, this analysis also reveals outliers: the school with the largest deficit, Nan Chiau Primary, lies in Cluster 3. Nevertheless, Nan Chiau's large deficit may also hint at a dearth of alternative elite schools in its area, which is consistent with the non-reciprocal inequity described previously. In fact, Nan Chiau is ranked relatively highly at 47.90, which is much higher than the average school rank in Cluster 3, 94.1. Moreover, Figure 6.11 reveals that nearly *all* schools in Cluster 1 were oversubscribed, compared with fairly wide distributions of over- and under-subscribed schools across Clusters 2 and 3.

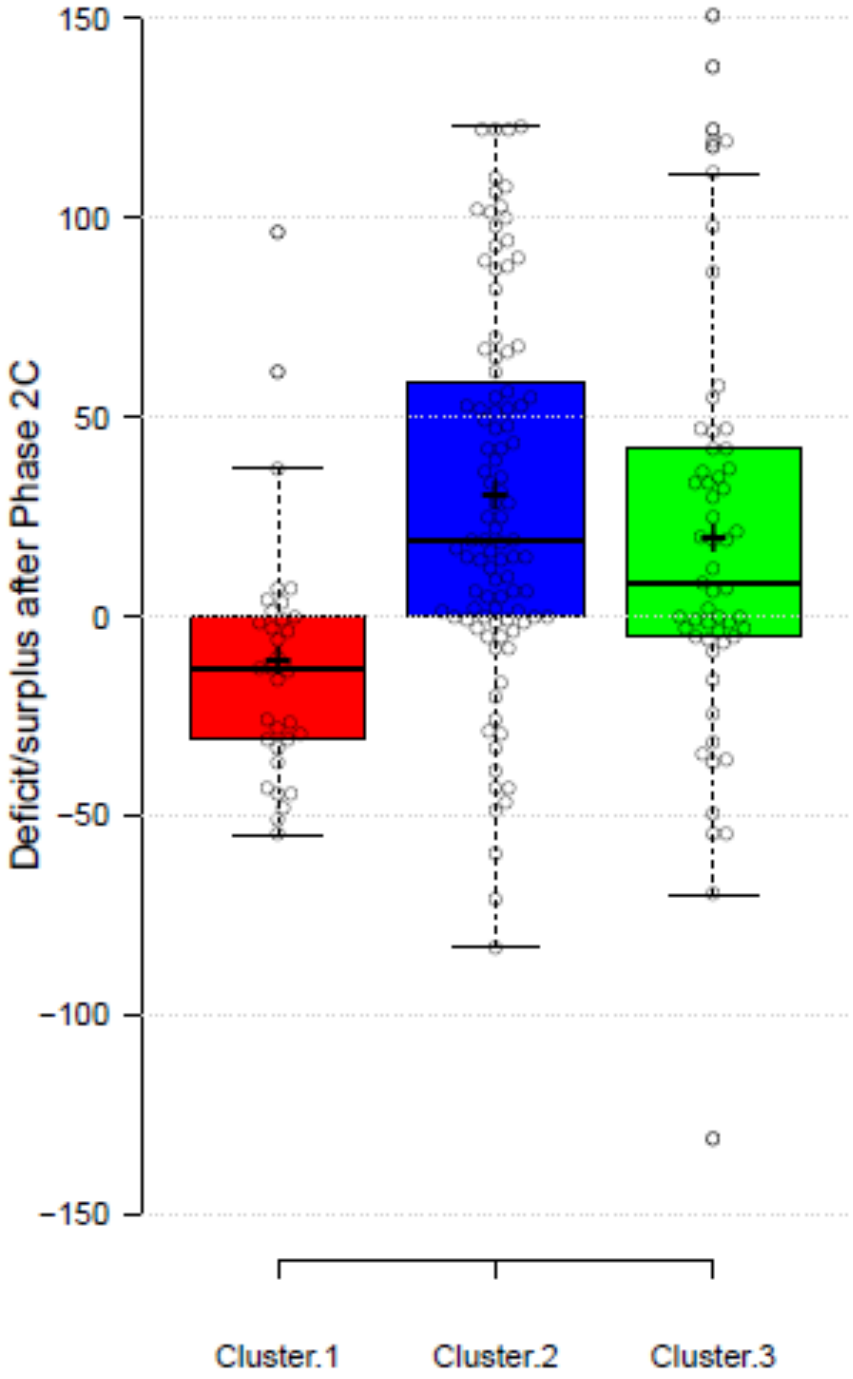


Figure 6.11 Distribution of popularity within clusters; oversubscribed, popular schools are represented by data points below the horizontal line.

7 Conclusion

Overall, the data consistently point towards a concentration of the best-performing primary schools in Cluster 1. Cluster 1 consistently and significantly stands out from Clusters 2 and 3, even at the 1% level of significance, on four measures:

1. school ranking;
2. Phase 2A Take-Up Rate;
3. relevance of home-school distance to admission; and
4. school popularity.

In addition, a subjective sample of schools of outstanding quality is also found to originate largely from Cluster 1. Meanwhile, there are no significant differences between these latter two clusters on any of these measures.

The overall picture that emerges is one in which the 33 Cluster 1 school differ markedly from the remaining 157 schools in three ways: they are elite, expensive, and inaccessible.

Cluster 1 schools are not only better schools *per se*, but also vastly more difficult to get into for students whose parents lack either wealth, connections, or both. Admissions at these schools is significantly more competitive: home-school distance becomes most crucial to maximizing chances of admission, as priority groups take up most of the available places. This is consistent with the hypothesis that the locations of these schools in expensive neighborhoods, *combined* with the priority given to home-school distance in admissions, represents a socio economic barrier that hinders underprivileged children from succeeding in the education system.

As such, the data testify to the significance of the gap – between a minority of expensive, 'elite' schools and a majority of accessible but unexceptional 'neighborhood' schools – that is entrenched in public perception and was hinted at by the former education minister's 'heartland' remark (see section 1.2). This gap exists despite the standardization of school fees across schools, effectively acting as an invisible, financial barrier to entry to 'elite' schools for students from even average households.

To be sure, schools in Clusters 2 and 3 are largely similar to each other in terms of both school quality and admissions competitiveness. However, this means that the benefits of the inequality-generating system that is the Primary One Registration Exercise accrue disproportionately to a small, privileged minority. The elite character of the Cluster 1 schools points towards a stratification in primary schools that mirrors as well as feeds into the stratification of wealth and opportunity across the rest of society.

8 Discussion

Here, we consider the implications of our findings, while recognizing limitations to their accuracy, reliability and relevance.

8.1 Limitations

First, we consider limitations to the data used in this paper. While its use of MOE awards to indicate school quality controls for a possible correlation, *ceteris paribus*, between family wealth and school performance, the school ranking data may be improved by capturing two more variables: aggregate PSLE scores of students, students' chances of entry into top secondary schools, and even future employment rates, tertiary education graduation rates, and future earnings. This can allow the measurement of schools by their success at preparing their students for the tracking system in the short run and employment prospects in the long run.

The other main data used captured property prices; with six data points for each school, the comprehensiveness of the data arguably assured a large degree of accuracy. That said, the calculation of a weighted-average property value for each school *out* of the six data points, weighted according to the national distribution of property types, may not have reflected local distributions in some exceptional cases. Although the data captured the lack of certain property types near some schools could capture local distributions in a relatively blunt manner, a systematic survey of property near each school should be done for a perfect dataset.

The second layer of limitations arose in the analysis of the data. Omitted variable bias was largely avoided due to properties unique to the data (see section 3.1). However, assigning lower and upper bounds for each school's house prices (as explained in section 5.2) possibly rendered the cluster analysis sensitive to outliers. For instance, when schools had only one type of housing (out of three) within a one-kilometer radius, the lower-bound, upper-bound and weighted prices were all skewed towards the single value present in the data. Nevertheless, clustering was largely able to smoothen out the anomalies. While there were outliers, these were mainly the few schools that are poorly ranked but located in exceptionally expensive neighborhoods, such as the centrally-located Cantonment Primary School.

The choice of k-means clustering (because of its efficiency and ubiquity – see section 5.2) over other clustering methods arguably influenced the magnitude but not the direction of this paper's findings. Agglomerative hierarchical clustering,[33] for instance, is an alternative algorithm that can be used to verify the clustering done using k means algorithm. Running the hierarchical clustering algorithm on the dataset produced results consistent with those rising from k-means clustering, but showing an exaggerated concentration of good schools in expensive neighborhoods. This suggests that the magnitudes of the findings in this paper were, to a small extent, a function of decisions taken on how to analyze the data, although the direction implied by these findings is likely to be consistent and independent of the analysis methodology. Sections 9.5 and 9.6 in the appendix give a closer

[33] Agglomerative clustering refers to starting from singleton clusters and merging them until the desired number of clusters are reached, in contrast to divisive clustering, where it begins with one cluster and splits occur till the desired number of clusters are reached. Thus, in agglomerative hierarchical clustering, each point is first assigned its own singleton cluster. The distances between centroids of different clusters are compared, and clusters close to each other are merged, repeatedly until a desired number of clusters is arrived at.

analysis of the results of hierarchical clustering including the associated cluster analysis results, tables and conclusions.

Finally, two assumptions made in this paper must be considered. This paper finds principally that Cluster 1 schools are ranked significantly better than other schools. The first assumption underlying this observation is that property prices are independent of school quality. The plausibility of this assumption was established in section 2: Wong (2011) convincingly demonstrates that elite schools only drive up the prices of properties within one kilometer by 1.8%. This is a margin too small to explain the much larger differences in property prices between schools: in section 4.2, the property prices for elite schools were adjusted down by this margin with no significant impact on the direction or even the magnitude of the results. Rather, exogenous factors (typically proximity to downtown Singapore) plausibly explain this difference.

The second assumption is the reverse, that a school's quality is independent of the socio-economic profile of its students. In other words, this paper's findings are irrelevant if a wealthy student body enables a school to deliver a higher-quality education: in that case, school quality would largely be a function of nearby property prices. However, as discussed in section 3.1, the nature of our dataset largely controls for this possibility. The MOE awards do not measure student performance directly, because such measurements would be distorted by the possibility that the children of the wealthy tend to do better in school regardless of how good a school they attend. This is in fact highly likely: given the dominance of the 'parentocracy' (see section 1.2), rich Singaporean children are likely to be good students. Instead, they measure the quality of schools' *processes* independent of the *outcomes* they deliver.

Nevertheless, it is possible that the support of wealthy parents does improve a school's *processes* and not just its outcomes. But if that is the case, this paper's findings are only all the more important: children of wealthy parents should be distributed across schools in the interests of equity, rather than concentrated in a few schools along with other, similar children.

8.2 Further research

Firstly, further research can test the *accuracy* of the findings – and in particular, the magnitude of certainty of these findings – by using different datasets and methods of data analysis. In particular, students' PSLE scores and statistics on admission to secondary schools can be included as metrics of primary school quality, and locally accurate house-price data that capture property prices at the 1-2km distance category for each school can be included. Cluster analysis methods other than k-means clustering, and the many data analysis methods other than cluster analysis, can be employed.

Secondly, further research go on to examine the fundamental assumptions of this paper, especially the two named in section 8.1. The first of these assumptions is drawn from Wong's (2009) finding that the proximity of an elite school to a property does not *significantly* increase its price. As Wong's dataset is restricted to HDB flats in five of Singapore's neighborhoods, the extent to which his findings can be generalized across Singapore can be studied.

Separately, further research can also attempt to quantify the extent to which Singapore's primary schools differ in the quality of education they provide, and in the quality of PSLE-preparation they provide, as discussed in section 1.2. In particular, a longitudinal study drawing from Altonji & Dunn

(1996) and tracking a variety of students through Singapore's educational system may reveal subtle and qualitative insights into the way inequity and other related problems manifest themselves. It may be exceptionally useful in revealing insights about Singapore's primary schools in particular and its education system in general.

It should be noted that that the MOE may possibly have carried out such studies confidentially, and probably also possesses data on the socio-economic profile of students within each school – if this is the case, publicly releasing these insights and information will significantly inform the policy debates concerning Singapore's education system.

8.3 Policy Options

As it stands, four specific aspects of the status quo generate the inequity issue that this paper identifies: the uneven quality of primary schools; the location of schools in expensive neighborhoods; the priority given to home-school distance in Phases 2B and 2C; and the priority given to special groups in Phases 1 and 2A. Here, policy options in these four areas are considered individually. Another two policy options in the broader context of education in Singapore are also considered: restraining the 'parentocracy'; and restructuring employment practices.

8.3.1 Levelling the quality of primary schools

Levelling the quality of primary schools by equalizing resources is an obvious and effective solution to the problem. The "Every School a Good School" policy direction (discussed in section 1.2) attempts to do this, and this paper affirms its importance and urgency. Although the system had always keep schools largely equal, inequity is allowed to seep in when schools are allowed to solicit and accept donations from alumni and community partners; regulating the ways in which schools can do so will help. A necessary angle to this would be to signal to the public that schools are indeed of level quality, since the notion that primary schools differ significantly seems to be a well-entrenched and harmful public perception (as discussed in section 1.2). That said, levelling the actual and perceived quality of primary schools is likely to require systemic, time-consuming change – this is then an option for the long run.

8.3.2 Relocating Cluster 1 schools

Of course, elite schools will continue to exist at least nominally even if school quality is levelled. Given that the crux of the problem here is the location of elite schools in expensive neighborhoods, relocating Cluster 1 schools to less affluent neighborhoods may further mitigate the problem of accessibility to elite schools: some students from underprivileged families may be able to gain successful admission on the basis of home-school distance. However, relocation is a possibly disruptive process for existing staff and students at these schools, and an appreciable number of the 33 Cluster 1 schools need to be relocated for this option to have a significant impact – this, too, is an option for the long run.

8.3.3 Relooking the priority given to home-school distance

Diminishing the relevance of home-school distance to the Primary One Registration Exercise is a policy option that is arguably far easier to implement, perhaps even immediately. However, as demonstrated in section 6.5, home-school distance is a lot more relevant to admission at Cluster 1 schools than at other schools; this implies that diminishing the relevance of home-school distance across all schools is an inappropriately blunt option. In any case, "proximity is an important consideration for parents" (Lim, 2009) so home-school distance should still be considered in allocating Primary One places. The MOE can nevertheless consider the possible impacts of shifting the size of the distance-boundaries (currently one and two kilometers) on accessibility of elite schools to underprivileged children.

8.3.4 Relooking Phases 2A and 2B

Diminishing the priority given to special groups in Phase 2A (children of alumni, management, and staff, and siblings of alumni) and 2B (children of school volunteers, 'active community leaders', and members of affiliated churches and Chinese clans) is also a useful policy option. Giving priority to these groups is arguably unfair, unmeritocratic, and anachronistic, because it directly allows parents

to transfer privilege and opportunity to their children; it is effectively an open sanction of social immobility. MOE's decision in 2014 to reserve 40 places for phases 2B and 2C combined is a step in the direction of equitability.[34] Yet, as explained in section 6.4, *even after* this decision was made, elite schools in expensive neighborhoods had a vast majority of places taken up by the end of Phase 2A in 2015, which implies that the magnitude of this change may be insufficient to achieve a desired level of equity.

The home-school distance criteria and Phase 1 (in which priority is given to applicants whose siblings are current students of the school) both serve the pragmatic interest of convenience. Unlike them, the priority given to special groups in Phase 2A have little clear justification. The MOE argues that alumni and community "help build up and strengthen the school's tradition and ethos, and support its students" (Lim, 2009). Firstly, even if that is the case, it is not clear why the benefits from alumni and community support justify the inequity of raising barriers to entry for applicants without connections. Secondly, the MOE's argument implies that alumni and community support is contingent on being granted Phase 2A/2B priority. If this is the case, the relationships between schools and alumni/community are merely transactional rather than founded upon any deeper sense of attachment or school spirit. This then casts doubt on the claim that these relationships "strengthen the school's tradition and ethos". Third, as discussed in section 1.2, even if stakeholder relationships genuinely benefit the school, they are likely to further perpetuate inequality between schools: the minority of elite, brand-name institutions can benefit from these stakeholders in ways large majority of new, nondescript, 'neighborhood' primary schools that lack any alumni base, school spirit, or demand for places cannot. Finally, the relative lack of standardization and transparency in who is selected as a volunteer or 'active community leader', and in who qualifies as a member of affiliated clans and churches, is a potential entry-point for corruption in the system.

Nevertheless, recognizing the possible benefits of stakeholder relationships, this paper recommends striking a better balance between priority admissions for stakeholders and keeping school accessible to applicants without connections. It supports a recommendation made by the Straits Times journalist Sandra Davie: "the current rule should be inverted: Only 40 places should be set aside for those with alumni connections to the school. The rest should be left open" to applicants without connections (Davie, 2014). It does so with the added caveat that, to keep these stakeholders engaged and to prevent their alienation, this inversion takes places incrementally and gradually over several years.

8.3.5 Restraining the 'parentocracy'

As discussed in section 1.2, the 'parentocracy', a termed coined by the educator and academic Jason Tan (Ong, 2014), refers to the reality that the education system has allowed parental wealth and support to considerably influence student performance. Wealthy parents can, for instance, pay for private tuition or enrichment classes. This distorts the meritocratic principle, and, through competitive, zero-sum examinations, disadvantages underprivileged students. To be sure, the 'parentocracy' operates on a much larger scale than at the Primary One Registration Exercise alone, and it merits being restrained by the MOE across the entire education system. Nevertheless, the MOE must recognize that making the allocation of primary school places egalitarian is a feasible first step to re-establishing meritocracy in the education system.

[34] For an official explanation, see http://www.moe.gov.sg/media/press/Annex-B-2014-P1-Registration.pdf.

8.3.6 Restructuring employment practices

Since an election in 2011 in which it was returned to power but with a historically low victory margin, the PAP government's rhetoric on meritocracy has evolved palpably. It began to aspire towards building a "compassionate meritocracy" to "ensure that our brand of meritocracy remains … fair and inclusive for all – not just those who are lucky in their backgrounds or genetic endowments" (Goh, 2013). In 2014, it announced an initiative it called SkillsFuture[35], which seeks to radically alter employment and promotion practices in the workplace, moving away from paper qualifications and towards specific skillsets.

This paradigm shift in the government's approach to meritocracy will undoubtedly lead to a softening the cut-throat, tracking-intensive nature of the education system. Performance at early examinations will become less critical to a student's eventual employability and wages; there is room to rectify inequities in school quality 'down the line'. This may counter inequities in the allocation of primary one places, though only to a limited extent: employment practices cannot feasibly be decoupled from educational performance, especially when education is an indispensable and universal screening mechanism for employers. In any case, it is difficult to see why the distortions introduced by the location of schools in expensive neighborhoods and the Phase 2A/2B special priority scheme must trickle downstream of the education system, when they can be corrected with feasible and immediately-effective solutions as discussed above.

At their crux, these recommendations are possible solutions to the problem of how and to whom to allocate scarce resources in the education system. Positive discrimination, or even egalitarianism, when carrying out such allocations may not always be realistic or desirable: they may not be perfectly realistic because leaks can persist, and they may not be politically desirable in every context.

However, this paper demonstrates that the best primary schools places are allocated disproportionately to the wealthy and well-connected, which is a clearly untenable status quo. Even in politically conservative Singapore, this is inconsistent with broader principles of governance: in the opinion of senior civil servant Eddie Teo, "we should level the playing field for our students to have equal chances of winning scholarships, but the way to ensure this is to help the less advantaged throughout their school lives, starting from pre-school" (Teo, 2013).

As such, in the short run, this paper recommends radically altering Phases 2A/2B and modifying the way home-school distance is given priority. Cluster 1 schools can be relocated to less-affluent neighborhoods in the long term. At the same time, deliberately restraining the 'parentocracy', levelling the quality of schools, and building a 'compassionate meritocracy' will serve the broader interest of equity.

To the MOE's credit, the education system is fundamentally meritocratic with little room for its corruption. Against such a backdrop, it is puzzling why, in the specific case of the Primary One Registration Exercise, unfair, unmeritocratic disparities are allowed to seep into the education system at an early, formative stage of a child's educational career. It is a major problem, but one with small-scale, feasible, and effective solutions.

[35] For an official explanation, see http://www.moe.gov.sg/media/press/2014/11/skillsfuture-council-begins-work.php and http://www.skillsfuture.sg/what-is-skillsfuture.html.

"Ironically, the original social leveler and purest form of Singaporean meritocracy – our educational system – may perpetuate inter-generational stratification rather than level the playing field….

Giving admissions priority on the basis of distance of homes has to also be relooked, because the most prestigious and elite schools are also located in the most wealthy parts of the island. *… We must not forget that when the PAP came to power it took the then radical step of essentially nationalizing the entire educational system, in order to achieve its then socialist goals. Similarly radically steps need to be at least discussed, if not immediately adopted."*

- Ho Kwon Ping, Singaporean businessman, speaking in 2015 in a lecture series titled *Singapore: The Next Fifty Years* (Emphasis added)

9 Bibliography

Altonji, J., & Dunn, T. (1996). Using Siblings to Estimate the Effect of School Quality on Wages. *The Review of Economics and Statistics* , 665-671.

Bhaskaran, M., Ho, S., Low, D., Tan, K., Vadaketh, S., & Yeoh, K. (2012). *Inequality and the Need for a New Social Compact.* Singapore: Institute of Policy Studies.

Bishop, C. (2006). *Pattern recognition and machine learning.* New York: Springer.

Black, S. E. (1999). Do Better Schools Matter? Parental Valuation of Elementary Education. *The Quarterly Journal of Economics* , 577-599.

Chambers, J. M., Cleveland, W., Kleiner, B., & Tukey, P. A. (1983). *Graphical Methods for Data Analysis.* Wadsworth.

Chetty, R., & Friedman, J. (2011). Does Local Tax Financing of Public Schools Perpetuate Inequality?

Davie, S. (2014, August 7). *Move top schools out of Bukit Timah.* Retrieved from The Straits Times: http://www.straitstimes.com/opinion/move-top-schools-out-of-bukit-timah

Franklin, J. P., & Waddell, P. (2002). *A Hedonic Regression of Home Prices in King County, Washington, using Activity-Specific Accessibility Measures* . Retrieved from http://nexus.umn.edu/courses/pa8202/waddell%20-%20hedonic.pdf

Fu, G. (2009). *Report of the primary education review and implementation committee.* Singapore: Ministry of Education.

Goh, C. T. (2013, July 27). Speech by ESM Goh at Raffles Homecoming 2013 Gryphon Award Dinner. Singapore.

Heckman, J. J., & Kautz, T. (2012). Hard evidence on soft skills. *Labour Economics* , 451-464.

Heng, S. K. (2013, October 13). Retrieved from https://www.facebook.com/hengsweekeat/posts/605760666129129

Hernandez-Murillo, R., Chiodo, A. J., & Owyang, M. T. (2010). Nonlinear Effects of School Quality on House Prices. *Federal Reserve Bank of St. Louis Review* , 185-204.

Ho, K. P. (2015). *Singapore: The Next Fifty Years - Lecture V: Society and Identity.* Singapore: IPS-Nathan Lectures.

Kang, T. (2011). Providing for needy students: policies and initiatives. In W. Choy, & C. Tan, *Education Reform in Singapore.* Singapore: Pearson.
Khong, L. Y. (2004). *Family matters: the role of parents in Singapore education.* Singapore: Marshall Cavendish International.

Lim, H. C. (2009, June 3). P1 places not for sale. *The Straits Times* .

Low, D. (2013, February 1). *Good Meritocracy, Bad Meritocracy*. Retrieved from Institute of Policy Studies Commons: http://www.ipscommons.sg/good-meritocracy-bad-meritocracy/

Ong, A. (2014, March 30). Beware growing 'parentocracy': NIE don. *The Straits Times* .

Poon, A. (2013). Common Ground, Multiple Claims: Representing and Constructing Singapore's "Heartland". *Asian Studies Review* .

Reynolds, L. (2004). Skybox Schools: Public Education As Private Luxury. *Washington University Law Review* .

Rosenbaum, J. E. (1976). *Making Inequality; the Hidden Curriculum of High School Tracking*. New York: John Wiley & Sons.

Rosenthal, R., & Jacobson, L. (1968). *Pygmalion in the Classroom*. New York: Holt, Rinehart & Winston.

Selvaraj, C. N. (2011). *The Making of Elite Schools in Singapore, 1940s-1980s*. Singapore: National University of Singapore .

Singapore Department of Statistics. (2014). *Key Household Income Trends, 2014*. Singapore: Ministry of Trade and Industry.

Singapore Department of Statistics. (2014). *Population Trends 2014*. Singapore: Ministry of Trade & Industry.

Straits Times. (2015, March 3). Man gets two weeks' jail for lying about address for daughter's Primary 1 registration. *Straits Times* .

Straits Times. (2010, November 14). MM Lee acknowledges admission to primary school is unfair. *Straits Times* .

Straits Times. (2014, September 20). Real solutions needed to deal with income inequality, says PM Lee at Singapore Summit. *Straits Times* .

Straughan, P. T. (2012). *Delayed marriage and ultra-low fertility in Singapore: the confounding challenges to social stability*. Singapore: Institute of Policy Studies.

Tan, J. (2002). Education in the Early 21st Century: Challenges and Dilemmas. In D. Da Cunha, *Singapore in the New Millennium: Challenges Facing the City-state* (pp. 177-178). Singapore: Institute of Southeast Asian Studies.

Tan, K. P. (2008). Meritocracy and Elitism in a Global City: Ideological Shifts in Singapore. *International Political Science Review* , 7-27.

Teo, E. (2013, September 17). *Chairman's Open Letter*. Retrieved from Public Service Commission Scholarships: http://www.pscscholarships.gov.sg/about-the-psc/chairmans-open-letter

Wijeysingha, E. (1989). *The eagle breeds a gryphon*. Singapore: Pioneer Book Centre.

Wong, W.-K. (2011). *Parental Valuation of Priority Admission to Primary Schools: The Effects of Academic Reputation and Choices*. Retrieved from https://courses.nus.edu.sg/course/ecswong/workingpapers/wkwong87.pdf

10 Appendix

10.1 Complete list of schools with latest HDB, Condo and Private housing prices

School Name				MedianResale PSF ($)within 1km			Housing prices		
	% hdb	% condo	% landed	HDB	Condo	Landed	min	max	ave
ADMIRALTY PRIMARY SCHOOL	0.87	0.13	0.00	352.00	626.00	0.00	352.00	626.00	386.98
AHMAD IBRAHIM PRIMARY SCHOOL	0.87	0.13	0.00	387.00	963.00	0.00	387.00	963.00	460.53
AI TONG SCHOOL	1.00	0.00	0.00	457.00	0.00	0.00	457.00	457.00	457.00
ALEXANDRA PRIMARY SCHOOL	0.87	0.13	0.00	645.00	1420.00	0.00	645.00	1420.00	743.94
ANCHOR GREEN PRIMARY SCHOOL	0.87	0.13	0.00	432.00	736.00	0.00	432.00	736.00	470.81
ANDERSON PRIMARY SCHOOL	0.00	0.67	0.33	0.00	1057.00	1057.00	1057.00	1057.00	1057.00
ANG MO KIO PRIMARY SCHOOL	1.00	0.00	0.00	559.00	0.00	0.00	559.00	559.00	559.00
ANGLO CHINESE SCHOOL (JUNIOR)	0.00	1.00	0.00	0.00	1696.00	0.00	1696.00	1696.00	1696.00
ANGLO CHINESE SCHOOL (PRIMARY)	0.00	1.00	0.00	0.00	1663.00	0.00	1663.00	1663.00	1663.00
BALESTIER HILL PRIMARY SCHOOL	0.00	1.00	0.00	0.00	1360.00	0.00	1360.00	1360.00	1360.00
BEACON PRIMARY SCHOOL	1.00	0.00	0.00	322.00	0.00	0.00	322.00	322.00	322.00
BEDOK GREEN PRIMARY SCHOOL	0.87	0.13	0.00	428.00	928.00	0.00	428.00	928.00	491.83
BEDOK WEST PRIMARY SCHOOL	1.00	0.00	0.00	389.00	0.00	0.00	389.00	389.00	389.00
BENDEMEER PRIMARY SCHOOL	0.87	0.13	0.00	532.00	1041.00	0.00	532.00	1041.00	596.98
BLANGAH RISE PRIMARY SCHOOL	0.87	0.13	0.00	549.00	1145.00	0.00	549.00	1145.00	625.09
BOON LAY GARDEN PRIMARY SCHOOL	0.87	0.13	0.00	396.00	895.00	0.00	396.00	895.00	459.70
BUKIT PANJANG PRIMARY SCHOOL	0.82	0.12	0.06	359.00	942.00	915.00	359.00	942.00	462.32
BUKIT TIMAH PRIMARY SCHOOL	0.00	0.67	0.33	0.00	935.00	1097.00	935.00	1097.00	989.00
BUKIT VIEW PRIMARY SCHOOL	0.87	0.13	0.00	396.00	834.00	0.00	396.00	834.00	451.91
CANBERRA PRIMARY SCHOOL	1.00	0.00	0.00	347.00	0.00	0.00	347.00	347.00	347.00
CANOSSA CONVENT PRIMARY SCHOOL	1.00	0.00	0.00	409.00	0.00	0.00	409.00	409.00	409.00
CANTONMENT PRIMARY SCHOOL	0.87	0.13	0.00	770.00	1807.00	0.00	770.00	1807.00	902.38
CASUARINA PRIMARY SCHOOL	0.87	0.13	0.00	362.00	784.00	0.00	362.00	784.00	415.87
CATHOLIC HIGH SCHOOL	0.87	0.13	0.00	598.00	1169.00	0.00	598.00	1169.00	670.89
CEDAR PRIMARY SCHOOL	0.82	0.12	0.06	430.00	1243.00	1284.00	430.00	1284.00	578.80
CHANGKAT PRIMARY SCHOOL	0.00	0.67	0.33	0.00	852.00	632.00	632.00	852.00	778.67
CHIJ (KATONG) PRIMARY	0.00	0.67	0.33	0.00	1094.00	1314.00	1094.00	1314.00	1167.33
CHIJ (KELLOCK)	1.00	0.00	0.00	598.00	0.00	0.00	598.00	598.00	598.00
CHIJ (OUR LADY OF GOOD COUNSEL)	0.00	0.67	0.33	0.00	929.00	1162.00	929.00	1162.00	1006.67
CHIJ (OUR LADY OF THE NATIVITY)	0.87	0.13	0.00	437.00	767.00	0.00	437.00	767.00	479.13
CHIJ (OUR LADY QUEEN OF PEACE)	0.00	0.67	0.33	0.00	994.00	915.00	915.00	994.00	967.67
CHIJ PRIMARY (TOA PAYOH)	0.00	1.00	0.00	0.00	1338.00	0.00	1338.00	1338.00	1338.00
CHIJ ST NICHOLAS GIRLS' SCHOOL	0.00	0.67	0.33	0.00	1171.00	956.00	956.00	1171.00	1099.33
CHOA CHU KANG PRIMARY SCHOOL	0.00	1.00	0.00	0.00	980.00	0.00	980.00	980.00	980.00
CHONGFU PRIMARY SCHOOL	0.87	0.13	0.00	419.00	752.00	0.00	419.00	752.00	461.51
CHONGZHENG PRIMARY SCHOOL	0.00	1.00	0.00	0.00	848.00	0.00	848.00	848.00	848.00
CLEMENTI PRIMARY SCHOOL	0.87	0.13	0.00	447.00	1193.00	0.00	447.00	1193.00	542.23
COMPASSVALE PRIMARY SCHOOL	1.00	0.00	0.00	367.00	0.00	0.00	367.00	367.00	367.00
CONCORD PRIMARY SCHOOL	1.00	0.00	0.00	330.00	0.00	0.00	330.00	330.00	330.00
CORAL PRIMARY SCHOOL	0.87	0.13	0.00	369.00	829.00	0.00	369.00	829.00	427.72
CORPORATION PRIMARY SCHOOL	1.00	0.00	0.00	383.00	0.00	0.00	383.00	383.00	383.00

DA QIAO PRIMARY SCHOOL	0.93	0.00	0.07	466.00	0.00	1035.00	466.00	1035.00	504.80
DAMAI PRIMARY SCHOOL	0.87	0.13	0.00	413.00	1224.00	0.00	413.00	1224.00	516.53
DAZHONG PRIMARY SCHOOL	1.00	0.00	0.00	401.00	0.00	0.00	401.00	401.00	401.00
DE LA SALLE	0.82	0.12	0.06	330.00	744.00	914.00	330.00	914.00	414.72
EAST COAST PRIMARY SCHOOL	0.93	0.00	0.07	396.00	0.00	1080.00	396.00	1080.00	442.64
EAST SPRING PRIMARY SCHOOL	0.87	0.13	0.00	368.00	785.00	0.00	368.00	785.00	421.23
EAST VIEW PRIMARY SCHOOL	1.00	0.00	0.00	416.00	0.00	0.00	416.00	416.00	416.00
EDGEFIELD PRIMARY SCHOOL	1.00	0.00	0.00	430.00	0.00	0.00	430.00	430.00	430.00
ELIAS PARK PRIMARY SCHOOL	0.00	1.00	0.00	0.00	891.00	0.00	891.00	891.00	891.00
ENDEAVOUR PRIMARY SCHOOL	1.00	0.00	0.00	353.00	0.00	0.00	353.00	353.00	353.00
EUNOS PRIMARY SCHOOL	0.82	0.12	0.06	449.00	856.00	1140.00	449.00	1140.00	539.30
EVERGREEN PRIMARY SCHOOL	1.00	0.00	0.00	352.00	0.00	0.00	352.00	352.00	352.00
FAIRFIELD METHODIST SCHOOL (PRIMARY)	0.00	1.00	0.00	0.00	1158.00	0.00	1158.00	1158.00	1158.00
FARRER PARK PRIMARY SCHOOL	0.87	0.13	0.00	504.00	1495.00	0.00	504.00	1495.00	630.51
FENGSHAN PRIMARY SCHOOL	0.87	0.13	0.00	407.00	1185.00	0.00	407.00	1185.00	506.32
FERNVALE PRIMARY SCHOOL	0.82	0.12	0.06	432.00	705.00	1208.00	432.00	1208.00	511.32
FIRST TOA PAYOH PRIMARY SCHOOL	1.00	0.00	0.00	500.00	0.00	0.00	500.00	500.00	500.00
FRONTIER PRIMARY SCHOOL	1.00	0.00	0.00	388.00	0.00	0.00	388.00	388.00	388.00
FUCHUN PRIMARY SCHOOL	0.87	0.13	0.00	369.00	1178.00	0.00	369.00	1178.00	472.28
FUHUA PRIMARY SCHOOL	0.87	0.13	0.00	435.00	855.00	0.00	435.00	855.00	488.62
GAN ENG SENG PRIMARY SCHOOL	0.87	0.13	0.00	613.00	1314.00	0.00	613.00	1314.00	702.49
GEYLANG METHODIST SCHOOL (PRIMARY)	0.87	0.13	0.00	477.00	982.00	0.00	477.00	982.00	541.47
GONGSHANG PRIMARY SCHOOL	1.00	0.00	0.00	419.00	0.00	0.00	419.00	419.00	419.00
GREENDALE PRIMARY SCHOOL	1.00	0.00	0.00	430.00	0.00	0.00	430.00	430.00	430.00
GREENRIDGE PRIMARY SCHOOL	1.00	0.00	0.00	360.00	0.00	0.00	360.00	360.00	360.00
GREENWOOD PRIMARY SCHOOL	0.87	0.13	0.00	352.00	626.00	0.00	352.00	626.00	386.98
GRIFFTHS PRIMARY SCHOOL	0.87	0.13	0.00	417.00	798.00	0.00	417.00	798.00	465.64
GUANGYANG PRIMARY SCHOOL	0.87	0.13	0.00	507.00	1100.00	0.00	507.00	1100.00	582.70
HAIG GIRLS' SCHOOL	0.00	0.67	0.33	0.00	1132.00	1287.00	1132.00	1287.00	1183.67
HENRY PARK PRIMARY SCHOOL	0.00	0.67	0.33	0.00	1241.00	1301.00	1241.00	1301.00	1261.00
HOLY INNOCENTS' PRIMARY SCHOOL	0.87	0.13	0.00	405.00	950.00	0.00	405.00	950.00	474.57
HONG KAH PRIMARY SCHOOL	1.00	0.00	0.00	388.00	0.00	0.00	388.00	388.00	388.00
HONG WEN SCHOOL	0.87	0.13	0.00	463.00	1146.00	0.00	463.00	1146.00	550.19
HORIZON PRIMARY SCHOOL	1.00	0.00	0.00	435.00	0.00	0.00	435.00	435.00	435.00
HOUGANG PRIMARY SCHOOL	0.87	0.13	0.00	393.00	813.00	0.00	393.00	813.00	446.62
HUAMIN PRIMARY SCHOOL	1.00	0.00	0.00	353.00	0.00	0.00	353.00	353.00	353.00
INNOVA PRIMARY SCHOOL	0.87	0.13	0.00	347.00	830.00	0.00	347.00	830.00	408.66
JIEMIN PRIMARY SCHOOL	1.00	0.00	0.00	382.00	0.00	0.00	382.00	382.00	382.00
JING SHAN PRIMARY SCHOOL	0.87	0.13	0.00	460.00	962.00	0.00	460.00	962.00	524.09
JUNYUAN PRIMARY SCHOOL	1.00	0.00	0.00	415.00	0.00	0.00	415.00	415.00	415.00
JURONG PRIMARY SCHOOL	0.00	1.00	0.00	0.00	854.00	0.00	854.00	854.00	854.00
JURONG WEST PRIMARY SCHOOL	0.87	0.13	0.00	397.00	0.00	0.00	397.00	397.00	346.32
JUYING PRIMARY SCHOOL	1.00	0.00	0.00	326.00	0.00	0.00	326.00	326.00	326.00
KEMING PRIMARY SCHOOL	0.00	1.00	0.00	0.00	834.00	0.00	834.00	834.00	834.00
KHENG CHENG SCHOOL	0.87	0.13	0.00	464.00	1310.00	0.00	464.00	1310.00	572.00
KONG HWA SCHOOL	0.00	1.00	0.00	0.00	1078.00	0.00	1078.00	1078.00	1078.00
KRANJI PRIMARY SCHOOL	0.82	0.12	0.06	345.00	748.00	914.00	345.00	748.00	427.50
KUO CHUAN PRIESBYTERIAN PRIMARY SCHOOL	1.00	0.00	0.00	618.00	0.00	0.00	618.00	618.00	618.00
LAKESIDE PRIMARY SCHOOL	0.87	0.13	0.00	461.00	954.00	0.00	461.00	954.00	523.94
LIANHUA PRIMARY SCHOOL	0.87	0.13	0.00	391.00	863.00	0.00	391.00	863.00	451.26
LOYANG PRIMARY SCHOOL	0.87	0.13	0.00	388.00	784.00	0.00	388.00	784.00	438.55
MACPHERSON PRIMARY SCHOOL	0.93	0.00	0.07	446.00	0.00	1286.00	446.00	1286.00	503.27
MAHA BODHI SCHOOL	1.00	0.00	0.00	448.00	0.00	0.00	448.00	448.00	448.00
MARIS STELLA HIGH SCHOOL	0.00	0.67	0.33	0.00	985.00	1184.00	985.00	1184.00	1051.33
MARSILING PRIMARY SCHOOL	1.00	0.00	0.00	345.00	0.00	0.00	345.00	345.00	345.00
MARYMOUNT COVENENT SCHOOL	0.87	0.13	0.00	501.00	1307.00	0.00	501.00	1307.00	603.89
MAYFLOWER PRIMARY SCHOOL	0.87	0.13	0.00	454.00	961.00	0.00	454.00	961.00	518.72
MEE TOH SCHOOL	1.00	0.00	0.00	430.00	0.00	0.00	430.00	430.00	430.00
MERIDIAN PRIMARY SCHOOL	0.87	0.13	0.00	367.00	891.00	0.00	367.00	891.00	433.89
METHODIST GIRLS' (PRIMARY)	0.00	1.00	0.00	0.00	1447.00	0.00	1447.00	1447.00	1447.00
MONTFORT JUNIOR SCHOOL	1.00	0.00	0.00	406.00	0.00	0.00	406.00	406.00	406.00
NAN CHIAU PRIMARY SCHOOL	1.00	0.00	0.00	433.00	0.00	0.00	433.00	433.00	433.00

NAN HUA PRIMARY SCHOOL	0.00	0.67	0.33	0.00	1120.00	1315.00	1120.00	1315.00	1185.00
NANYANG PRIMARY SCHOOL	0.00	0.67	0.33	0.00	1536.00	1619.00	1536.00	1619.00	1563.67
NAVAL BASE PRIMARY SCHOOL	0.87	0.13	0.00	387.00	780.00	0.00	387.00	780.00	437.17
NEW TOWN PRIMARY SCHOOL	1.00	0.00	0.00	642.00	0.00	0.00	642.00	642.00	642.00
NGEE ANN PRIMARY SCHOOL	0.00	1.00	0.00	0.00	994.00	0.00	994.00	994.00	994.00
NORTH SPRING PRIMARY SCHOOL	0.87	0.13	0.00	418.00	773.00	0.00	418.00	773.00	463.32
NORTH VIEW PRIMARY SCHOOL	1.00	0.00	0.00	351.00	0.00	0.00	351.00	351.00	351.00
NORTH VISTA PRIMARY SCHOOL	0.87	0.13	0.00	440.00	775.00	0.00	440.00	775.00	482.77
NORTHLAND PRIMARY SCHOOL	1.00	0.00	0.06	360.00	0.00	0.00	360.00	360.00	360.00
NORTHOAKS PRIMARY SCHOOL	1.00	0.00	0.00	355.00	0.00	0.00	355.00	355.00	355.00
OPERA ESTATE PRIMARY SCHOOL	0.00	0.67	0.33	0.00	1110.00	1370.00	1110.00	1370.00	1196.67
PALM VIEW PRIMARY SCHOOL	0.87	0.13	0.00	442.00	831.00	0.00	442.00	831.00	491.66
PARK VIEW PRIMARY SCHOOL	0.87	0.13	0.00	365.00	917.00	0.00	365.00	917.00	435.47
PASIR RIS PRIMARY SCHOOL	0.87	0.13	0.00	362.00	764.00	0.00	362.00	764.00	413.32
PAYA LEBAR METHODIST GIRLS SCHOOL (PRIMARY)	0.00	0.67	0.33	0.00	1146.00	1217.00	1146.00	1217.00	1169.67
PEI CHUN PRIMARY SCHOOL	1.00	0.00	0.00	462.00	0.00	0.00	462.00	462.00	462.00
PEI HWA PRESBYTERIAN PRIMARY SCHOOL	0.00	1.00	0.00	0.00	1118.00	0.00	1118.00	1118.00	1118.00
PEI TONG PRIMARY SCHOOL	0.87	0.13	0.00	540.00	1053.00	0.00	540.00	1053.00	605.49
PEIYING PRIMARY SCHOOL	0.87	0.13	0.00	362.00	843.00	0.00	362.00	843.00	423.40
PIONEER PRIMARY SCHOOL	1.00	0.00	0.00	324.00	0.00	0.00	324.00	324.00	324.00
POI CHING SCHOOL	1.00	0.00	0.00	408.00	0.00	0.00	408.00	408.00	408.00
PRINCESS ELIZABETH PRIMARY SCHOOL	0.87	0.13	0.00	366.00	854.00	0.00	366.00	854.00	428.30
PUNGGOL GREEN PRIMARY SCHOOL	0.87	0.13	0.00	392.00	1106.00	0.00	392.00	1106.00	483.15
PUNGGOL PRIMARY SCHOOL	0.87	0.13	0.00	461.00	775.00	0.00	461.00	775.00	501.09
PUNGGOL VIEW PRIMARY SCHOOL	0.87	0.13	0.00	448.00	1106.00	0.00	448.00	1106.00	532.00
QIAONAN PRIMARY SCHOOL	0.87	0.13	0.00	417.00	899.00	0.00	417.00	899.00	478.53
QIFA PRIMARY SCHOOL	0.87	0.13	0.00	436.00	1190.00	0.00	436.00	1190.00	532.26
QIHUA PRIMARY SCHOOL	1.00	0.00	0.00	348.00	0.00	0.00	348.00	348.00	348.00
QUEENSTOWN PRIMARY SCHOOL	0.87	0.13	0.00	694.00	1256.00	0.00	694.00	1256.00	765.74
RADIN MAS PRIMARY SCHOOL	1.00	0.00	0.00	598.00	0.00	0.00	598.00	598.00	598.00
RAFFLES GIRLS' PRIMARY SCHOOL	0.00	1.00	0.00	0.00	1250.00	0.00	1250.00	1250.00	1250.00
RED SWASTIKA SCHOOL	0.87	0.13	0.00	407.00	909.00	0.00	407.00	909.00	471.09
RIVER VALLEY PRIMARY SCHOOL	0.00	0.67	0.33	0.00	1768.00	1760.00	1760.00	1768.00	1765.33
RIVERSIDE PRIMARY SCHOOL	0.87	0.13	0.00	353.00	626.00	0.00	353.00	626.00	387.85
RIVERVALE PRIMARY SCHOOL	1.00	0.00	0.00	393.00	0.00	0.00	393.00	393.00	393.00
ROSYTH SCHOOL	0.82	0.12	0.06	396.00	963.00	1053.00	396.00	1053.00	503.46
RULANG PRIMARY SCHOOL	0.87	0.13	0.00	409.00	1050.00	0.00	409.00	1050.00	490.83
SEMBAWANG PRIMARY SCHOOL	0.87	0.13	0.00	344.00	885.00	0.00	344.00	885.00	413.06
SENG KANG PRIMARY SCHOOL	0.87	0.13	0.00	440.00	773.00	0.00	440.00	773.00	482.51
SENGKANG GREEN PRIMARY SCHOOL	0.87	0.13	0.00	432.00	705.00	0.00	432.00	705.00	466.85
SHUQUN PRIMARY SCHOOL	0.87	0.13	0.00	426.00	1050.00	0.00	426.00	1050.00	505.66
SI LING PRIMARY SCHOOL	0.87	0.13	0.00	374.00	1178.00	0.00	374.00	1178.00	476.64
SINGAPORE CHINESE GIRLS' PRIMARY SCHOOL	0.00	1.00	0.00	0.00	1506.00	0.00	1506.00	1506.00	1506.00
SOUTH VIEW PRIMARY SCHOOL	0.00	1.00	0.00	0.00	912.00	0.00	912.00	912.00	912.00
SPRINGDALE PRIMARY SCHOOL	1.00	0.00	0.00	424.00	0.00	0.00	424.00	424.00	424.00
ST ANDREW'S JUNIOR SCHOOL	0.87	0.13	0.00	443.00	1111.00	0.00	443.00	1111.00	528.28
ST ANTHONY'S CANOSSIAN PRIMARY SCHOOL	0.82	0.12	0.06	436.00	914.00	590.00	436.00	914.00	502.60
ST ANTHONY'S PRIMARY SCHOOL	1.00	0.00	0.00	396.00	0.00	0.00	396.00	396.00	396.00
ST GABRIELS'S PRIMARY SCHOOL	0.82	0.12	0.06	505.00	984.00	1531.00	505.00	1531.00	624.04
ST HILDA'S PRIMARY SCHOOL	0.87	0.13	0.00	428.00	933.00	0.00	428.00	933.00	492.47
ST JOSEPH'S INSTITUTION JUNIOR	0.87	0.13	0.00	504.00	1496.00	0.00	504.00	1496.00	630.64
ST MARGARET'S PRIMARY SCHOOL	0.00	1.00	0.00	0.00	1744.00	0.00	1744.00	1744.00	1744.00
ST STEPHEN'S SCHOOL	0.00	0.67	0.33	0.00	1066.00	1315.00	1066.00	1315.00	1149.00
STAMFORD PRIMARY SCHOOL	0.87	0.13	0.00	603.00	1506.00	0.00	603.00	1506.00	718.28
TAMPINES NORTH PRIMARY SCHOOL	1.00	0.00	0.00	419.00	0.00	0.00	419.00	419.00	419.00
TAMPINES PRIMARY SCHOOL	1.00	0.00	0.00	419.00	0.00	0.00	419.00	419.00	419.00
TANJONG KATONG PRIMARY SCHOOL	0.00	0.67	0.33	0.00	1321.00	1615.00	1321.00	1615.00	1419.00
TAO NAN SCHOOL	0.00	0.67	0.33	0.00	1095.00	1360.00	1095.00	1360.00	1183.33
TECK GHEE PRIMARY SCHOOL	0.87	0.13	0.00	539.00	1305.00	0.00	539.00	1305.00	636.79
TECK WHYE PRIMARY SCHOOL	0.82	0.12	0.06	327.00	848.00	908.00	327.00	908.00	424.38

TELOK KURAU PRIMARY SCHOOL	0.87	0.13	0.00	364.00	943.00	0.00	364.00	943.00	437.91
TEMASEK PRIMARY SCHOOL	0.00	1.00	0.00	0.00	971.00	0.00	971.00	971.00	971.00
TOWNSVILLE PRIMARY SCHOOL	0.87	0.13	0.00	464.00	1284.00	0.00	464.00	1284.00	568.68
UNITY PRIMARY SCHOOL	0.87	0.13	0.00	338.00	744.00	0.00	338.00	744.00	389.83
WELLINGTON PRIMARY SCHOOL	1.00	0.00	0.00	350.00	0.00	0.00	350.00	350.00	350.00
WEST GROVE PRIMARY SCHOOL	0.87	0.13	0.00	383.00	1048.00	0.00	383.00	1048.00	467.89
WEST SPRING PRIMARY	1.00	0.00	0.00	363.00	0.00	0.00	363.00	363.00	363.00
WEST VIEW PRIMARY SCHOOL	0.87	0.13	0.00	351.00	880.00	0.00	351.00	880.00	418.53
WESTWOOD PRIMARY SCHOOL	1.00	0.00	0.00	383.00	0.00	0.00	383.00	383.00	383.00
WHITE SANDS PRIMARY SCHOOL	0.87	0.13	0.00	376.00	778.00	0.00	376.00	778.00	427.32
WOODGROVE PRIMARY SCHOOL	0.87	0.13	0.00	368.00	830.00	0.00	368.00	830.00	426.98
WOODLANDS PRIMARY SCHOOL	0.87	0.13	0.00	347.00	766.00	0.00	347.00	766.00	400.49
WOODLANDS RING PRIMARY SCHOOL	0.87	0.13	0.00	349.00	774.00	0.00	349.00	774.00	403.26
XINGHUA PRIMARY SCHOOL	0.87	0.13	0.00	407.00	1063.00	0.00	407.00	1063.00	490.74
XINGNAN PRIMARY SCHOOL	1.00	0.00	0.00	326.00	0.00	0.00	326.00	326.00	326.00
XINMIN SCHOOL	0.87	0.13	0.00	403.00	963.00	0.00	403.00	963.00	474.49
XISHAN PRIMARY SCHOOL	0.87	0.13	0.00	387.00	986.00	0.00	387.00	986.00	463.47
YANGZHENG PRIMARY SCHOOL	0.82	0.12	0.06	537.00	980.00	1155.00	537.00	980.00	627.24
YEW TEE PRIMARY SCHOOL	0.82	0.12	0.06	347.00	746.00	914.00	347.00	914.00	428.90
YIO CHU KANG SCHOOL	1.00	0.00	0.00	388.00	0.00	0.00	388.00	388.00	388.00
YISHUN PRIMARY SCHOOL	0.87	0.13	0.00	376.00	982.00	0.00	376.00	982.00	453.36
YU NENG PRIMARY SCHOOL	0.87	0.13	0.00	407.00	998.00	0.00	407.00	998.00	482.45
YUHUA PRIMARY SCHOOL	0.87	0.13	0.00	518.00	854.00	0.00	518.00	854.00	560.89
YUMIN PRIMARY SCHOOL	0.87	0.13	0.00	424.00	666.00	0.00	424.00	666.00	454.89
ZHANGDE PRIMARY SCHOOL	0.87	0.13	0.00	668.00	1250.00	0.00	668.00	1250.00	742.30
ZHENGHUA PRIMARY SCHOOL	0.87	0.13	0.00	361.00	927.00	0.00	361.00	927.00	433.26
ZHONGHUA PRIMARY SCHOOL	0.82	0.12	0.06	457.00	883.00	1162.00	457.00	1162.00	550.42

10.2Complete list of schools with rankings from 2009-2014

School Name	School Rankings						
	2014	2013	2012	2011	2010	2009	weighted
ADMIRALTY PRIMARY SCHOOL	30	50	101	93	75	45	62.29
AHMAD IBRAHIM PRIMARY SCHOOL	33	30	45	38	36	82	37.90
AI TONG SCHOOL	22	10	11	11	8	6	13.38
ALEXANDRA PRIMARY SCHOOL	148	0	0	0	0	0	148.00
ANCHOR GREEN PRIMARY SCHOOL	113	165	162	170	167	0	147.87
ANDERSON PRIMARY SCHOOL	55	50	45	38	36	37	46.81
ANG MO KIO PRIMARY SCHOOL	148	137	72	53	49	62	103.81
ANGLO CHINESE SCHOOL (JUNIOR)	42	30	45	93	91	102	54.52
ANGLO CHINESE SCHOOL (PRIMARY)	42	50	45	38	49	45	44.71
BALESTIER HILL PRIMARY SCHOOL	55	144	140	154	146	118	118.19
BEACON PRIMARY SCHOOL	148	165	162	170	167	0	159.53
BEDOK GREEN PRIMARY SCHOOL	55	98	101	93	132	140	90.81
BEDOK WEST PRIMARY SCHOOL	55	154	150	170	167	160	128.76
BENDEMEER PRIMARY SCHOOL	55	50	45	112	146	160	73.71
BLANGAH RISE PRIMARY SCHOOL	55	98	101	93	75	118	84.33
BOON LAY GARDEN PRIMARY SCHOOL	148	165	162	170	167	147	159.62
BUKIT PANJANG PRIMARY SCHOOL	113	98	101	129	116	118	109.95
BUKIT TIMAH PRIMARY SCHOOL	148	137	136	129	116	118	135.90
BUKIT VIEW PRIMARY SCHOOL	55	98	101	93	75	40	80.62
CANBERRA PRIMARY SCHOOL	37	50	45	38	75	40	45.52
CANOSSA CONVENT PRIMARY SCHOOL	113	98	101	93	75	89	99.52
CANTONMENT PRIMARY SCHOOL	148	176	174	170	0	0	163.80
CASUARINA PRIMARY SCHOOL	55	77	80	75	146	160	81.52
CATHOLIC HIGH SCHOOL	4	1	1	6	5	3	3.05
CEDAR PRIMARY SCHOOL	55	144	140	142	132	140	116.19
CHANGKAT PRIMARY SCHOOL	55	38	35	33	32	62	42.14
CHIJ (KATONG) PRIMARY	113	50	45	53	58	29	67.24
CHIJ (KELLOCK)	55	38	35	38	36	25	41.48
CHIJ (OUR LADY OF GOOD COUNSEL)	55	38	35	38	36	62	43.24
CHIJ (OUR LADY OF THE NATIVITY)	113	98	101	53	91	147	98.10
CHIJ (OUR LADY QUEEN OF PEACE)	113	50	45	112	146	102	87.52
CHIJ PRIMARY (TOA PAYOH)	33	30	28	24	31	29	29.67
CHIJ ST NICHOLAS GIRLS' SCHOOL	26	16	13	12	11	11	17.00
CHOA CHU KANG PRIMARY SCHOOL	55	77	80	93	36	45	68.14
CHONGFU PRIMARY SCHOOL	14	10	11	9	17	11	11.90
CHONGZHENG PRIMARY SCHOOL	55	77	80	75	62	40	67.81
CLEMENTI PRIMARY SCHOOL	113	98	45	93	91	89	90.38
COMPASSVALE PRIMARY SCHOOL	55	77	80	75	62	89	70.14
CONCORD PRIMARY SCHOOL	55	98	45	38	36	29	57.86
CORAL PRIMARY SCHOOL	55	77	80	75	62	118	71.52
CORPORATION PRIMARY SCHOOL	148	165	162	170	167	160	160.24

DA QIAO PRIMARY SCHOOL	148	154	150	136	126	137	145.48
DAMAI PRIMARY SCHOOL	55	154	150	142	146	147	122.14
DAZHONG PRIMARY SCHOOL	113	154	101	93	75	89	112.86
DE LA SALLE	113	123	65	53	91	102	95.05
EAST COAST PRIMARY SCHOOL	113	123	124	93	132	160	118.67
EAST SPRING PRIMARY SCHOOL	148	137	174	170	116	118	149.00
EAST VIEW PRIMARY SCHOOL	48	143	76	70	62	45	80.29
EDGEFIELD PRIMARY SCHOOL	55	77	140	142	132	147	100.57
ELIAS PARK PRIMARY SCHOOL	37	30	45	33	36	62	37.38
ENDEAVOUR PRIMARY SCHOOL	55	144	140	154	146	0	115.00
EUNOS PRIMARY SCHOOL	55	77	80	75	126	140	78.67
EVERGREEN PRIMARY SCHOOL	148	50	45	38	49	29	74.24
FAIRFIELD METHODIST SCHOOL (PRIMARY)	14	14	9	53	91	147	32.29
FARRER PARK PRIMARY SCHOOL	148	165	162	154	146	118	153.95
FENGSHAN PRIMARY SCHOOL	55	38	35	53	91	102	52.52
FERNVALE PRIMARY SCHOOL	113	154	50	154	146	147	121.38
FIRST TOA PAYOH PRIMARY SCHOOL	113	50	45	38	75	45	67.48
FRONTIER PRIMARY SCHOOL	148	176	174	0	0	0	161.67
FUCHUN PRIMARY SCHOOL	55	98	101	75	75	89	80.38
FUHUA PRIMARY SCHOOL	55	98	124	142	146	160	104.48
GAN ENG SENG PRIMARY SCHOOL	113	123	124	93	75	76	109.24
GEYLANG METHODIST SCHOOL (PRIMARY)	55	77	80	142	132	140	88.81
GONGSHANG PRIMARY SCHOOL	33	27	26	9	8	16	23.62
GREENDALE PRIMARY SCHOOL	113	154	150	154	146	0	139.00
GREENRIDGE PRIMARY SCHOOL	46	35	32	27	26	62	36.86
GREENWOOD PRIMARY SCHOOL	55	50	45	75	91	76	59.19
GRIFFTHS PRIMARY SCHOOL	148	77	140	142	132	140	126.81
GUANGYANG PRIMARY SCHOOL	113	98	101	112	91	45	101.67
HAIG GIRLS' SCHOOL	10	50	45	53	49	45	37.71
HENRY PARK PRIMARY SCHOOL	10	24	22	15	11	11	16.48
HOLY INNOCENTS' PRIMARY SCHOOL	55	98	101	75	62	89	79.14
HONG KAH PRIMARY SCHOOL	113	98	101	112	91	118	105.14
HONG WEN SCHOOL	113	65	65	53	116	102	83.62
HORIZON PRIMARY SCHOOL	148	176	174	170	167	147	164.52
HOUGANG PRIMARY SCHOOL	55	77	80	75	75	29	68.52
HUAMIN PRIMARY SCHOOL	55	98	101	75	62	45	77.05
INNOVA PRIMARY SCHOOL	113	154	150	170	167	0	142.53
JIEMIN PRIMARY SCHOOL	113	98	101	112	91	76	103.14
JING SHAN PRIMARY SCHOOL	55	77	80	136	126	82	84.62
JUNYUAN PRIMARY SCHOOL	55	50	45	33	32	45	46.10
JURONG PRIMARY SCHOOL	48	77	80	70	62	82	67.10
JURONG WEST PRIMARY SCHOOL	55	144	80	112	91	102	94.76
JUYING PRIMARY SCHOOL	148	165	162	154	146	147	155.33
KEMING PRIMARY SCHOOL	26	16	13	30	30	45	23.00
KHENG CHENG SCHOOL	37	38	35	38	75	89	43.10
KONG HWA SCHOOL	29	20	19	15	17	19	21.33
KRANJI PRIMARY SCHOOL	148	137	72	66	116	118	114.71
KUO CHUAN PRIESBYTERIAN PRIMARY SCHOOL	37	98	24	22	21	21	44.62
LAKESIDE PRIMARY SCHOOL	55	38	35	33	32	22	40.24
LIANHUA PRIMARY SCHOOL	148	165	124	112	91	102	134.71
LOYANG PRIMARY SCHOOL	55	77	29	25	24	102	50.29
MACPHERSON PRIMARY SCHOOL	37	28	31	27	26	25	30.67
MAHA BODHI SCHOOL	55	98	101	75	75	89	80.38
MARIS STELLA HIGH SCHOOL	10	20	19	20	21	19	17.00
MARSILING PRIMARY SCHOOL	55	154	150	93	146	102	113.00
MARYMOUNT COVENENT SCHOOL	148	70	136	129	116	102	119.19
MAYFLOWER PRIMARY SCHOOL	22	20	101	112	116	118	62.95
MEE TOH SCHOOL	113	98	150	142	132	147	124.05
MERIDIAN PRIMARY SCHOOL	55	144	140	154	91	45	109.48
METHODIST GIRLS' (PRIMARY)	22	14	22	15	11	16	17.76
MONTFORT JUNIOR SCHOOL	148	77	80	75	75	102	98.57
NAN CHIAU PRIMARY SCHOOL	48	77	35	33	36	22	47.90

NAN HUA PRIMARY SCHOOL	26	18	15	66	58	29	30.90
NANYANG PRIMARY SCHOOL	6	6	7	7	8	8	6.62
NAVAL BASE PRIMARY SCHOOL	113	165	162	154	146	160	145.95
NEW TOWN PRIMARY SCHOOL	148	176	174	0	0	0	161.67
NGEE ANN PRIMARY SCHOOL	113	123	65	38	91	118	93.67
NORTH SPRING PRIMARY SCHOOL	148	123	65	53	49	62	99.14
NORTH VIEW PRIMARY SCHOOL	55	77	80	75	62	40	67.81
NORTH VISTA PRIMARY SCHOOL	55	144	150	154	146	160	122.10
NORTHLAND PRIMARY SCHOOL	48	73	76	32	32	82	57.10
NORTHOAKS PRIMARY SCHOOL	148	0	0	0	0	0	148.00
OPERA ESTATE PRIMARY SCHOOL	55	154	150	142	146	102	120.00
PALM VIEW PRIMARY SCHOOL	148	176	0	0	0	0	157.33
PARK VIEW PRIMARY SCHOOL	55	38	80	142	132	102	77.71
PASIR RIS PRIMARY SCHOOL	7	7	6	5	4	8	6.29
PAYA LEBAR METHODIST GIRLS SCHOOL (PRIMARY)	9	28	29	25	24	22	21.67
PEI CHUN PRIMARY SCHOOL	18	10	19	15	17	11	15.43
PEI HWA PRESBYTERIAN PRIMARY SCHOOL	113	65	65	53	91	89	80.62
PEI TONG PRIMARY SCHOOL	113	98	150	154	167	160	129.71
PEIYING PRIMARY SCHOOL	55	38	80	93	167	118	74.81
PIONEER PRIMARY SCHOOL	148	123	162	154	146	147	145.33
POI CHING SCHOOL	148	65	65	53	49	76	86.00
PRINCESS ELIZABETH PRIMARY SCHOOL	30	26	25	23	26	25	26.48
PUNGGOL GREEN PRIMARY SCHOOL	148	176	0	0	0	0	157.33
PUNGGOL PRIMARY SCHOOL	17	36	33	30	49	102	33.52
PUNGGOL VIEW PRIMARY SCHOOL	148	176	0	0	0	0	157.33
QIAONAN PRIMARY SCHOOL	55	144	140	142	132	82	113.43
QIFA PRIMARY SCHOOL	148	123	124	129	167	102	134.38
QIHUA PRIMARY SCHOOL	55	98	101	75	36	62	75.38
QUEENSTOWN PRIMARY SCHOOL	55	144	140	142	75	62	107.05
RADIN MAS PRIMARY SCHOOL	18	18	15	12	20	18	16.76
RAFFLES GIRLS' PRIMARY SCHOOL	2	5	5	4	3	2	3.67
RED SWASTIKA SCHOOL	148	70	72	66	58	37	89.38
RIVER VALLEY PRIMARY SCHOOL	18	8	26	70	126	137	40.52
RIVERSIDE PRIMARY SCHOOL	148	176	0	0	0	0	157.33
RIVERVALE PRIMARY SCHOOL	48	73	80	75	75	45	66.33
ROSYTH SCHOOL	18	8	10	8	7	6	11.05
RULANG PRIMARY SCHOOL	1	1	3	1	2	1	1.48
SEMBAWANG PRIMARY SCHOOL	113	98	101	93	132	140	107.38
SENG KANG PRIMARY SCHOOL	55	144	140	136	146	147	117.00
SENGKANG GREEN PRIMARY SCHOOL	148	176	0	0	0	0	157.33
SHUQUN PRIMARY SCHOOL	113	123	124	112	91	62	112.81
SI LING PRIMARY SCHOOL	148	137	174	142	132	89	145.14
SINGAPORE CHINESE GIRLS' PRIMARY SCHOOL	2	3	2	1	6	4	2.57
SOUTH VIEW PRIMARY SCHOOL	22	10	45	38	75	118	35.43
SPRINGDALE PRIMARY SCHOOL	148	176	0	0	0	0	157.33
ST ANDREW'S JUNIOR SCHOOL	48	70	72	112	49	76	68.38
ST ANTHONY'S CANOSSIAN PRIMARY SCHOOL	113	123	124	93	132	140	117.71
ST ANTHONY'S PRIMARY SCHOOL	148	123	162	154	146	147	145.33
ST GABRIELS'S PRIMARY SCHOOL	55	144	140	136	126	147	115.10
ST HILDA'S PRIMARY SCHOOL	5	4	4	3	1	5	3.90
ST JOSEPH'S INSTITUTION JUNIOR	113	65	124	112	91	62	99.00
ST MARGARET'S PRIMARY SCHOOL	113	50	45	38	36	29	63.00
ST STEPHEN'S SCHOOL	148	98	101	53	91	118	106.71
STAMFORD PRIMARY SCHOOL	55	176	174	154	146	160	134.29
TAMPINES NORTH PRIMARY SCHOOL	113	98	101	75	62	82	95.38
TAMPINES PRIMARY SCHOOL	8	25	15	12	11	45	16.00
TANJONG KATONG PRIMARY SCHOOL	55	50	45	38	36	45	47.19
TAO NAN SCHOOL	13	50	7	15	11	10	20.62
TECK GHEE PRIMARY SCHOOL	55	38	35	75	62	45	50.18
TECK WHYE PRIMARY SCHOOL	148	38	124	112	146	89	109.10

TELOK KURAU PRIMARY SCHOOL	36	36	33	66	23	37	38.52
TEMASEK PRIMARY SCHOOL	14	20	15	21	11	11	16.19
TOWNSVILLE PRIMARY SCHOOL	113	98	101	93	91	62	99.76
UNITY PRIMARY SCHOOL	55	154	101	112	91	118	101.90
WELLINGTON PRIMARY SCHOOL	55	38	80	93	36	45	58.86
WEST GROVE PRIMARY SCHOOL	113	123	162	154	167	160	137.95
WEST SPRING PRIMARY	148	0	0	0	0	0	148.00
WEST VIEW PRIMARY SCHOOL	148	123	124	129	116	118	130.29
WESTWOOD PRIMARY SCHOOL	148	176	0	0	0	0	157.33
WHITE SANDS PRIMARY SCHOOL	48	73	76	70	62	40	63.38
WOODGROVE PRIMARY SCHOOL	113	165	162	154	146	160	145.95
WOODLANDS PRIMARY SCHOOL	42	30	45	27	26	45	36.19
WOODLANDS RING PRIMARY SCHOOL	113	165	162	154	91	62	136.05
XINGHUA PRIMARY SCHOOL	55	77	80	93	116	118	79.24
XINGNAN PRIMARY SCHOOL	32	123	124	112	91	118	92.33
XINMIN SCHOOL	42	65	65	112	91	118	70.14
XISHAN PRIMARY SCHOOL	148	137	136	129	58	76	128.38
YANGZHENG PRIMARY SCHOOL	48	73	80	136	132	25	79.52
YEW TEE PRIMARY SCHOOL	148	176	136	112	91	62	137.71
YIO CHU KANG SCHOOL	55	77	35	38	36	160	57.19
YISHUN PRIMARY SCHOOL	55	77	80	93	132	89	79.38
YU NENG PRIMARY SCHOOL	55	38	35	53	49	29	45.05
YUHUA PRIMARY SCHOOL	113	98	101	129	116	102	109.19
YUMIN PRIMARY SCHOOL	113	123	124	112	91	89	114.10
ZHANGDE PRIMARY SCHOOL	148	154	150	136	126	137	145.48
ZHENGHUA PRIMARY SCHOOL	55	77	76	70	62	82	68.33
ZHONGHUA PRIMARY SCHOOL	55	77	80	75	62	62	68.86

10.3 Complete list of schools with other detailed data

School Name			2C spaces	2C applying	2C net	2B spaces	2B applying	2B net
	deficit	popularity						
ADMIRALTY PRIMARY SCHOOL	7	6	75	85	-10	58	41	17
AHMAD IBRAHIM PRIMARY SCHOOL	39	0	59	20	39			
AI TONG SCHOOL	-25	12	30	49	-19	31	37	-6
ALEXANDRA PRIMARY SCHOOL	25	8	187	254	-67	96	4	92
ANCHOR GREEN PRIMARY SCHOOL	53	0	118	121	-3	61	5	56
ANDERSON PRIMARY SCHOOL	-4	9	42	56	-14	30	20	10
ANG MO KIO PRIMARY SCHOOL	47	0	58	11	47			
ANGLO CHINESE SCHOOL (JUNIOR)	-30	7	73	101	-28	73	75	-2
ANGLO CHINESE SCHOOL (PRIMARY)	-27	7	30	54	-24	32	35	-3
BALESTIER HILL PRIMARY SCHOOL	96	0	103	7	96			
BEACON PRIMARY SCHOOL	118	0	129	11	118			
BEDOK GREEN PRIMARY SCHOOL	25	0	35	10	25			
BEDOK WEST PRIMARY SCHOOL	-6	1	58	64	-6			
BENDEMEER PRIMARY SCHOOL	28	0	45	17	28			
BLANGAH RISE PRIMARY SCHOOL	122	0	129	7	122			
BOON LAY GARDEN PRIMARY SCHOOL	36	0	83	47	36			
BUKIT PANJANG PRIMARY SCHOOL	16	10	68	83	-15	38	7	31
BUKIT TIMAH PRIMARY SCHOOL	4	0	55	51	4			
BUKIT VIEW PRIMARY SCHOOL	68	0	87	19	68			
CANBERRA PRIMARY SCHOOL	-50	11	42	78	-36	43	57	-14
CANOSSA CONVENT PRIMARY SCHOOL	42	0	52	10	42			
CANTONMENT PRIMARY SCHOOL	37	0	80	43	37			
CASUARINA PRIMARY SCHOOL	1	0	37	36	1			
CATHOLIC HIGH SCHOOL	-26	14	23	42	-19	22	29	-7
CEDAR PRIMARY SCHOOL	5	0	18	13	5			
CHANGKAT PRIMARY SCHOOL	0	1	1	1	0			
CHIJ (KATONG) PRIMARY	1	0	35	34	1			
CHIJ (KELLOCK)	19	3	90	98	-8	64	37	27
CHIJ (OUR LADY OF GOOD COUNSEL)	-3	1	9	12	-3			
CHIJ (OUR LADY OF THE NATIVITY)	12	7	101	116	-15	74	47	27
CHIJ (OUR LADY QUEEN OF PEACE)	-1	1	13	14	-1			
CHIJ PRIMARY (TOA PAYOH)	-37	13	51	74	-23	50	64	-14
CHIJ ST NICHOLAS GIRLS' SCHOOL	-26	15	20	32	-12	20	34	-14
CHOA CHU KANG PRIMARY SCHOOL	-45	12	56	93	-37	55	63	-8
CHONGFU PRIMARY SCHOOL	14	10	58	66	-8	36	14	22
CHONGZHENG PRIMARY SCHOOL	31	5	113	135	-22	60	7	53
CLEMENTI PRIMARY SCHOOL	61	3	130	133	-3	66	2	64
COMPASSVALE PRIMARY SCHOOL	-9	8	97	137	-40	67	36	31
CONCORD PRIMARY SCHOOL	-3	1	7	10	-3			
CORAL PRIMARY SCHOOL	123	0	125	2	123			
CORPORATION PRIMARY SCHOOL	-16	1	45	61	-16			

DA QIAO PRIMARY SCHOOL	110	0	117	7	110			
DAMAI PRIMARY SCHOOL	102	0	114	12	102			
DAZHONG PRIMARY SCHOOL	46	0	63	17	46			
DE LA SALLE	-5	8	80	97	-17	68	56	12
EAST COAST PRIMARY SCHOOL	122	0	139	17	122			
EAST SPRING PRIMARY SCHOOL	6	0	12	6	6			
EAST VIEW PRIMARY SCHOOL	111	0	117	6	111			
EDGEFIELD PRIMARY SCHOOL	33	5	124	152	-28	63	2	61
ELIAS PARK PRIMARY SCHOOL	52	4	110	113	-3	56	1	55
ENDEAVOUR PRIMARY SCHOOL	25	5	89	93	-4	61	32	29
EUNOS PRIMARY SCHOOL	66	0	86	20	66			
EVERGREEN PRIMARY SCHOOL	33	5	112	129	-17	62	12	50
FAIRFIELD METHODIST SCHOOL (PRIMARY)	-55	13	28	58	-30	26	51	-25
FARRER PARK PRIMARY SCHOOL	122	0	129	7	122			
FENGSHAN PRIMARY SCHOOL	17	8	88	115	-27	45	1	44
FERNVALE PRIMARY SCHOOL	48	0	95	47	48			
FIRST TOA PAYOH PRIMARY SCHOOL	138	0	161	23	138			
FRONTIER PRIMARY SCHOOL	-5	10	124	175	-51	78	32	46
FUCHUN PRIMARY SCHOOL	19	0	29	10	19			
FUHUA PRIMARY SCHOOL	-8	1	30	38	-8			
GAN ENG SENG PRIMARY SCHOOL	9	0	77	68	9			
GEYLANG METHODIST SCHOOL (PRIMARY)	55	5	149	163	-14	80	11	69
GONGSHANG PRIMARY SCHOOL	6	10	69	84	-15	49	28	21
GREENDALE PRIMARY SCHOOL	-5	1	86	91	-5			
GREENRIDGE PRIMARY SCHOOL	37	5	104	115	-11	56	8	48
GREENWOOD PRIMARY SCHOOL	0	1	15	15	0			
GRIFFTHS PRIMARY SCHOOL	0	0			0			
GUANGYANG PRIMARY SCHOOL	87	0	118	31	87			
HAIG GIRLS' SCHOOL	-2	1	14	16	-2			
HENRY PARK PRIMARY SCHOOL	-31	15	21	50	-29	20	22	-2
HOLY INNOCENTS' PRIMARY SCHOOL	-29	12	41	62	-21	40	48	-8
HONG KAH PRIMARY SCHOOL	0	0			0			
HONG WEN SCHOOL	-39	14	46	68	-22	46	63	-17
HORIZON PRIMARY SCHOOL	-55	10	94	177	-83	66	38	28
HOUGANG PRIMARY SCHOOL	-8	10	90	120	-30	69	47	22
HUAMIN PRIMARY SCHOOL	-1	1	25	26	-1			
INNOVA PRIMARY SCHOOL	-47	10	68	137	-69	47	25	22
JIEMIN PRIMARY SCHOOL	20	5	71	82	-11	40	9	31
JING SHAN PRIMARY SCHOOL	18	0	31	13	18			
JUNYUAN PRIMARY SCHOOL	12	0	73	61	12			
JURONG PRIMARY SCHOOL	14	8	73	86	-13	47	20	27
JURONG WEST PRIMARY SCHOOL	-4	5	99	146	-47	56	13	43
JUYING PRIMARY SCHOOL	151	0	184	33	151			
KEMING PRIMARY SCHOOL	1	9	63	82	-19	44	24	20
KHENG CHENG SCHOOL	56	5	137	150	-13	69	0	69
KONG HWA SCHOOL	-48	14	33	67	-34	33	47	-14
KRANJI PRIMARY SCHOOL	108	0	127	19	108			
KUO CHUAN PRIESBYTERIAN PRIMARY SCHOOL	-2	9	63	68	-5	60	57	3
LAKESIDE PRIMARY SCHOOL	55	5	123	130	-7	62	0	62
LIANHUA PRIMARY SCHOOL	101	0	105	4	101			
LOYANG PRIMARY SCHOOL	88	0	101	13	88			
MACPHERSON PRIMARY SCHOOL	90	0	106	16	90			
MAHA BODHI SCHOOL	-32	12	48	70	-22	48	58	-10
MARIS STELLA HIGH SCHOOL	-31	8	54	65	-11	53	73	-20
MARSILING PRIMARY SCHOOL	98	0	105	7	98			
MARYMOUNT COVENENT SCHOOL	-17	1	42	59	-17			
MAYFLOWER PRIMARY SCHOOL	67	0	93	26	67			
MEE TOH SCHOOL	-70	12	56	123	-67	58	61	-3
MERIDIAN PRIMARY SCHOOL	98	0	102	4	98			
METHODIST GIRLS' (PRIMARY)	-28	14	28	40	-12	28	44	-16
MONTFORT JUNIOR SCHOOL	122	0	135	13	122			
NAN CHIAU PRIMARY SCHOOL	-131	14	64	163	-99	64	96	-32

NAN HUA PRIMARY SCHOOL	-51	15	21	64	-43	20	28	-8
NANYANG PRIMARY SCHOOL	-16	14	23	30	-7	23	32	-9
NAVAL BASE PRIMARY SCHOOL	103	0	121	18	103			
NEW TOWN PRIMARY SCHOOL	21	0	62	41	21			
NGEE ANN PRIMARY SCHOOL	-13	7	62	88	-26	48	35	13
NORTH SPRING PRIMARY SCHOOL	65	0	107	42	65			
NORTH VIEW PRIMARY SCHOOL	-2	0	13	15	-2			
NORTH VISTA PRIMARY SCHOOL	5	10	20	15	5			
NORTHLAND PRIMARY SCHOOL	-55	0	76	156	-80	52	27	25
NORTHOAKS PRIMARY SCHOOL	119	1	136	17	119			
OPERA ESTATE PRIMARY SCHOOL	-6	1	10	16	-6			
PALM VIEW PRIMARY SCHOOL	6	0	41	35	6			
PARK VIEW PRIMARY SCHOOL	42	0	46	4	42			
PASIR RIS PRIMARY SCHOOL	-49	13	31	70	-39	31	41	-10
PAYA LEBAR METHODIST GIRLS SCHOOL (PRIMARY)	-10	8	77	97	-20	67	57	10
PEI CHUN PRIMARY SCHOOL	-37	13	34	65	-31	34	40	-6
PEI HWA PRESBYTERIAN PRIMARY SCHOOL	-13	10	40	52	-12	40	41	-1
PEI TONG PRIMARY SCHOOL	-5	1	51	56	-5			
PEIYING PRIMARY SCHOOL	6	0	39	33	6			
PIONEER PRIMARY SCHOOL	0	1	60	60	0			
POI CHING SCHOOL	-7	10	75	104	-29	53	31	22
PRINCESS ELIZABETH PRIMARY SCHOOL	22	8	92	116	-24	46	0	46
PUNGGOL GREEN PRIMARY SCHOOL	0	1	86	86	0			
PUNGGOL PRIMARY SCHOOL	-1	1	27	28	-1			
PUNGGOL VIEW PRIMARY SCHOOL	89	10	198	207	-9	101	3	98
QIAONAN PRIMARY SCHOOL	0	0			0			
QIFA PRIMARY SCHOOL	49	3	117	122	-5	62	8	54
QIHUA PRIMARY SCHOOL	36	0	61	25	36			
QUEENSTOWN PRIMARY SCHOOL	35	0	74	39	35			
RADIN MAS PRIMARY SCHOOL	-35	15	20	53	-33	20	22	-2
RAFFLES GIRLS' PRIMARY SCHOOL	0	7	102	143	-41	62	21	41
RED SWASTIKA SCHOOL	-33	10	36	79	-43	26	16	10
RIVER VALLEY PRIMARY SCHOOL	7	8	64	78	-14	43	22	21
RIVERSIDE PRIMARY SCHOOL	86	2	188	194	-6	96	4	92
RIVERVALE PRIMARY SCHOOL	-36	10	83	144	-61	59	34	25
ROSYTH SCHOOL	-83	14	28	95	-67	28	44	-16
RULANG PRIMARY SCHOOL	-71	12	28	98	-70	29	30	-1
SEMBAWANG PRIMARY SCHOOL	19	0	40	21	19			
SENG KANG PRIMARY SCHOOL	-4	10	40	44	-4			
SENGKANG GREEN PRIMARY SCHOOL	30	1	193	256	-63	100	7	93
SHUQUN PRIMARY SCHOOL	-20	10	53	87	-34	40	26	14
SI LING PRIMARY SCHOOL	93	0	123	30	93			
SINGAPORE CHINESE GIRLS' PRIMARY SCHOOL	-14	12	28	39	-11	28	31	-3
SOUTH VIEW PRIMARY SCHOOL	-33	10	46	88	-42	36	27	9
SPRINGDALE PRIMARY SCHOOL	19	0	135	116	19			
ST ANDREW'S JUNIOR SCHOOL	-43	8	55	76	-21	54	76	-22
ST ANTHONY'S CANOSSIAN PRIMARY SCHOOL	2	10	28	26	2			
ST ANTHONY'S PRIMARY SCHOOL	2	12	82	96	-14	65	49	16
ST GABRIELS'S PRIMARY SCHOOL	10	0	61	61	0	50	40	10
ST HILDA'S PRIMARY SCHOOL	-60	7	54	106	-52	54	62	-8
ST JOSEPH'S INSTITUTION JUNIOR	-43	4	57	79	-22	58	79	-21
ST MARGARET'S PRIMARY SCHOOL	3	3	82	95	-13	67	51	16
ST STEPHEN'S SCHOOL	7	0	74	80	-6	60	47	13
STAMFORD PRIMARY SCHOOL	100	0	112	12	100			
TAMPINES NORTH PRIMARY SCHOOL	42	0	63	21	42			
TAMPINES PRIMARY SCHOOL	47	4	110	116	-6	58	5	53
TANJONG KATONG PRIMARY SCHOOL	61	1	123	124	-1	62	0	62
TAO NAN SCHOOL	-45	14	42	65	-23	42	64	-22
TECK GHEE PRIMARY SCHOOL	51	5	123	131	-8	65	6	59
TECK WHYE PRIMARY SCHOOL	106	0	130	24	106			

TELOK KURAU PRIMARY SCHOOL	15	0	30	15	15			
TEMASEK PRIMARY SCHOOL	-43	10	25	66	-41	25	27	-2
TOWNSVILLE PRIMARY SCHOOL	43	0	75	32	43			
UNITY PRIMARY SCHOOL	52	5	120	125	-5	64	7	57
WELLINGTON PRIMARY SCHOOL	35	0	47	12	35			
WEST GROVE PRIMARY SCHOOL	33	10	111	128	-17	62	12	50
WEST SPRING PRIMARY	8	0	31	23	8			
WEST VIEW PRIMARY SCHOOL	82	0	87	5	82			
WESTWOOD PRIMARY SCHOOL	55	10	180	211	-31	94	8	86
WHITE SANDS PRIMARY SCHOOL	15	10	71	83	-12	44	17	27
WOODGROVE PRIMARY SCHOOL	28	5	91	96	-5	59	26	33
WOODLANDS PRIMARY SCHOOL	-2	1	24	26	-2			
WOODLANDS RING PRIMARY SCHOOL	-3	1	8	11	-3			
XINGHUA PRIMARY SCHOOL	53	0	74	21	53			
XINGNAN PRIMARY SCHOOL	-3	0	20	23	-3			
XINMIN SCHOOL	19	10	64	71	-7	38	12	26
XISHAN PRIMARY SCHOOL	70	0	83	13	70			
YANGZHENG PRIMARY SCHOOL	2	8	57	73	-16	40	22	18
YEW TEE PRIMARY SCHOOL	-2	1	9	11	-2			
YIO CHU KANG SCHOOL	32	0	67	35	32			
YISHUN PRIMARY SCHOOL	-1	1	8	9	-1			
YU NENG PRIMARY SCHOOL	-30	13	20	45	-25	20	25	-5
YUHUA PRIMARY SCHOOL	94	0	122	28	94			
YUMIN PRIMARY SCHOOL	58	0	76	18	58			
ZHANGDE PRIMARY SCHOOL	47	5	123	132	-9	68	12	56
ZHENGHUA PRIMARY SCHOOL	15	0	24	9	15			
ZHONGHUA PRIMARY SCHOOL	42	0	83	41	42			

10.4Results of k-means clustering:

10.4.1 Cluster 1: 33 schools

['ANDERSON PRIMARY SCHOOL', 'ANGLO CHINESE SCHOOL (JUNIOR)', 'ANGLO CHINESE SCHOOL (PRIMARY)', 'BALESTIER HILL PRIMARY SCHOOL', 'BUKIT TIMAH PRIMARY SCHOOL', 'CANTONMENT PRIMARY SCHOOL', 'CHIJ (KATONG) PRIMARY', 'CHIJ (OUR LADY OF GOOD COUNSEL)', 'CHIJ (OUR LADY QUEEN OF PEACE)', 'CHIJ PRIMARY (TOA PAYOH)', "CHIJ ST NICHOLAS GIRLS' SCHOOL", 'CHOA CHU KANG PRIMARY SCHOOL', 'FAIRFIELD METHODIST SCHOOL (PRIMARY)', "HAIG GIRLS' SCHOOL", 'HENRY PARK PRIMARY SCHOOL', 'KONG HWA SCHOOL', 'MARIS STELLA HIGH SCHOOL', "METHODIST GIRLS' (PRIMARY)", 'NAN HUA PRIMARY SCHOOL', 'NANYANG PRIMARY SCHOOL', 'NGEE ANN PRIMARY SCHOOL', 'OPERA ESTATE PRIMARY SCHOOL', 'PAYA LEBAR METHODIST GIRLS SCHOOL (PRIMARY)', 'PEI HWA PRESBYTERIAN PRIMARY SCHOOL', "RAFFLES GIRLS' PRIMARY SCHOOL", 'RIVER VALLEY PRIMARY SCHOOL', "SINGAPORE CHINESE GIRLS' PRIMARY SCHOOL", 'SOUTH VIEW PRIMARY SCHOOL', "ST MARGARET'S PRIMARY SCHOOL", "ST STEPHEN'S SCHOOL", 'TANJONG KATONG PRIMARY SCHOOL', 'TAO NAN SCHOOL', 'TEMASEK PRIMARY SCHOOL']

10.4.2 Cluster 2: 100 schools

['AHMAD IBRAHIM PRIMARY SCHOOL', 'ALEXANDRA PRIMARY SCHOOL', 'ANCHOR GREEN PRIMARY SCHOOL', 'BEDOK GREEN PRIMARY SCHOOL', 'BENDEMEER PRIMARY SCHOOL', 'BLANGAH RISE PRIMARY SCHOOL', 'BOON LAY GARDEN PRIMARY SCHOOL', 'BUKIT PANJANG PRIMARY SCHOOL', 'BUKIT VIEW PRIMARY SCHOOL', 'CASUARINA PRIMARY SCHOOL', 'CATHOLIC HIGH SCHOOL', 'CEDAR PRIMARY SCHOOL', 'CHANGKAT PRIMARY SCHOOL', 'CHIJ (OUR LADY OF THE NATIVITY)', 'CHONGFU PRIMARY SCHOOL', 'CHONGZHENG PRIMARY SCHOOL', 'CLEMENTI PRIMARY SCHOOL', 'CORAL PRIMARY SCHOOL', 'DA QIAO PRIMARY SCHOOL', 'DAMAI PRIMARY SCHOOL', 'DE LA SALLE', 'EAST COAST PRIMARY SCHOOL', 'EAST SPRING PRIMARY SCHOOL', 'ELIAS PARK PRIMARY SCHOOL', 'EUNOS PRIMARY SCHOOL', 'FARRER PARK PRIMARY SCHOOL', 'FENGSHAN PRIMARY SCHOOL', 'FERNVALE PRIMARY SCHOOL', 'FUCHUN PRIMARY SCHOOL', 'FUHUA PRIMARY SCHOOL', 'GAN ENG SENG PRIMARY SCHOOL', 'GEYLANG METHODIST SCHOOL (PRIMARY)', 'GRIFFTHS PRIMARY SCHOOL', 'GUANGYANG PRIMARY SCHOOL', "HOLY INNOCENTS' PRIMARY SCHOOL", 'HONG WEN SCHOOL', 'HOUGANG PRIMARY SCHOOL', 'INNOVA PRIMARY SCHOOL', 'JING SHAN PRIMARY SCHOOL', 'JURONG PRIMARY SCHOOL', 'KEMING PRIMARY SCHOOL', 'KHENG CHENG SCHOOL', 'KRANJI PRIMARY SCHOOL', 'LAKESIDE PRIMARY SCHOOL', 'LIANHUA PRIMARY SCHOOL', 'LOYANG PRIMARY SCHOOL', 'MACPHERSON PRIMARY SCHOOL', 'MARYMOUNT COVENENT SCHOOL', 'MAYFLOWER PRIMARY SCHOOL', 'MERIDIAN PRIMARY SCHOOL', 'NAVAL BASE PRIMARY SCHOOL', 'NORTH SPRING PRIMARY SCHOOL', 'NORTH VISTA PRIMARY SCHOOL', 'PALM VIEW PRIMARY SCHOOL', 'PARK VIEW PRIMARY SCHOOL', 'PASIR RIS PRIMARY SCHOOL', 'PEI TONG PRIMARY SCHOOL', 'PEIYING PRIMARY SCHOOL', 'PRINCESS ELIZABETH PRIMARY SCHOOL', 'PUNGGOL GREEN PRIMARY SCHOOL', 'PUNGGOL PRIMARY

SCHOOL', 'PUNGGOL VIEW PRIMARY SCHOOL', 'QIAONAN PRIMARY SCHOOL', 'QIFA PRIMARY SCHOOL', 'QUEENSTOWN PRIMARY SCHOOL', 'RED SWASTIKA SCHOOL', 'ROSYTH SCHOOL', 'RULANG PRIMARY SCHOOL', 'SEMBAWANG PRIMARY SCHOOL', 'SENG KANG PRIMARY SCHOOL', 'SHUQUN PRIMARY SCHOOL', 'SI LING PRIMARY SCHOOL', "ST ANDREW'S JUNIOR SCHOOL", "ST ANTHONY'S CANOSSIAN PRIMARY SCHOOL", "ST GABRIELS'S PRIMARY SCHOOL", "ST HILDA'S PRIMARY SCHOOL", "ST JOSEPH'S INSTITUTION JUNIOR", 'STAMFORD PRIMARY SCHOOL', 'TECK GHEE PRIMARY SCHOOL', 'TECK WHYE PRIMARY SCHOOL', 'TELOK KURAU PRIMARY SCHOOL', 'TOWNSVILLE PRIMARY SCHOOL', 'UNITY PRIMARY SCHOOL', 'WEST GROVE PRIMARY SCHOOL', 'WEST VIEW PRIMARY SCHOOL', 'WHITE SANDS PRIMARY SCHOOL', 'WOODGROVE PRIMARY SCHOOL', 'WOODLANDS PRIMARY SCHOOL', 'WOODLANDS RING PRIMARY SCHOOL', 'XINGHUA PRIMARY SCHOOL', 'XINMIN SCHOOL', 'XISHAN PRIMARY SCHOOL', 'YANGZHENG PRIMARY SCHOOL', 'YEW TEE PRIMARY SCHOOL', 'YISHUN PRIMARY SCHOOL', 'YU NENG PRIMARY SCHOOL', 'YUHUA PRIMARY SCHOOL', 'ZHANGDE PRIMARY SCHOOL', 'ZHENGHUA PRIMARY SCHOOL', 'ZHONGHUA PRIMARY SCHOOL']

10.4.3 Cluster 3: 57 schools

['ADMIRALTY PRIMARY SCHOOL', 'AI TONG SCHOOL', 'ANG MO KIO PRIMARY SCHOOL', 'BEACON PRIMARY SCHOOL', 'BEDOK WEST PRIMARY SCHOOL', 'CANBERRA PRIMARY SCHOOL', 'CANOSSA CONVENT PRIMARY SCHOOL', 'CHIJ (KELLOCK)', 'COMPASSVALE PRIMARY SCHOOL', 'CONCORD PRIMARY SCHOOL', 'CORPORATION PRIMARY SCHOOL', 'DAZHONG PRIMARY SCHOOL', 'EAST VIEW PRIMARY SCHOOL', 'EDGEFIELD PRIMARY SCHOOL', 'ENDEAVOUR PRIMARY SCHOOL', 'EVERGREEN PRIMARY SCHOOL', 'FIRST TOA PAYOH PRIMARY SCHOOL', 'FRONTIER PRIMARY SCHOOL', 'GONGSHANG PRIMARY SCHOOL', 'GREENDALE PRIMARY SCHOOL', 'GREENRIDGE PRIMARY SCHOOL', 'GREENWOOD PRIMARY SCHOOL', 'HONG KAH PRIMARY SCHOOL', 'HORIZON PRIMARY SCHOOL', 'HUAMIN PRIMARY SCHOOL', 'JIEMIN PRIMARY SCHOOL', 'JUNYUAN PRIMARY SCHOOL', 'JURONG WEST PRIMARY SCHOOL', 'JUYING PRIMARY SCHOOL', 'KUO CHUAN PRIESBYTERIAN PRIMARY SCHOOL', 'MAHA BODHI SCHOOL', 'MARSILING PRIMARY SCHOOL', 'MEE TOH SCHOOL', 'MONTFORT JUNIOR SCHOOL', 'NAN CHIAU PRIMARY SCHOOL', 'NEW TOWN PRIMARY SCHOOL', 'NORTH VIEW PRIMARY SCHOOL', 'NORTHLAND PRIMARY SCHOOL', 'NORTHOAKS PRIMARY SCHOOL', 'PEI CHUN PRIMARY SCHOOL', 'PIONEER PRIMARY SCHOOL', 'POI CHING SCHOOL', 'QIHUA PRIMARY SCHOOL', 'RADIN MAS PRIMARY SCHOOL', 'RIVERSIDE PRIMARY SCHOOL', 'RIVERVALE PRIMARY SCHOOL', 'SENGKANG GREEN PRIMARY SCHOOL', 'SPRINGDALE PRIMARY SCHOOL', "ST ANTHONY'S PRIMARY SCHOOL", 'TAMPINES NORTH PRIMARY SCHOOL', 'TAMPINES PRIMARY SCHOOL', 'WELLINGTON PRIMARY SCHOOL', 'WEST SPRING PRIMARY', 'WESTWOOD PRIMARY SCHOOL', 'XINGNAN PRIMARY SCHOOL', 'YIO CHU KANG SCHOOL', 'YUMIN PRIMARY SCHOOL']

10.5Results of hierarchical clustering:

10.5.1 Cluster 1: 16 schools

['RIVER VALLEY PRIMARY SCHOOL', "ST MARGARET'S PRIMARY SCHOOL", 'ANGLO CHINESE SCHOOL (JUNIOR)', 'ANGLO CHINESE SCHOOL (PRIMARY)', 'BALESTIER HILL PRIMARY SCHOOL', 'CHIJ PRIMARY (TOA PAYOH)', 'HENRY PARK PRIMARY SCHOOL', "RAFFLES GIRLS' PRIMARY SCHOOL", 'TANJONG KATONG PRIMARY SCHOOL', 'NANYANG PRIMARY SCHOOL', "METHODIST GIRLS' (PRIMARY)", "SINGAPORE CHINESE GIRLS' PRIMARY SCHOOL"]

10.5.2 Cluster 2: 66 schools

['CHANGKAT PRIMARY SCHOOL', 'KEMING PRIMARY SCHOOL', 'CHONGZHENG PRIMARY SCHOOL', 'JURONG PRIMARY SCHOOL', 'ELIAS PARK PRIMARY SCHOOL', 'SOUTH VIEW PRIMARY SCHOOL', 'MARYMOUNT COVENENT SCHOOL', 'TECK GHEE PRIMARY SCHOOL', 'MACPHERSON PRIMARY SCHOOL', 'CEDAR PRIMARY SCHOOL', 'KHENG CHENG SCHOOL', 'TOWNSVILLE PRIMARY SCHOOL', 'PUNGGOL GREEN PRIMARY SCHOOL', 'EAST COAST PRIMARY SCHOOL', 'WEST GROVE PRIMARY SCHOOL', 'DA QIAO PRIMARY SCHOOL', 'SHUQUN PRIMARY SCHOOL', 'ROSYTH SCHOOL', 'RULANG PRIMARY SCHOOL', 'XINGHUA PRIMARY SCHOOL', 'PUNGGOL VIEW PRIMARY SCHOOL', "ST ANDREW'S JUNIOR SCHOOL", 'EUNOS PRIMARY SCHOOL', 'HONG WEN SCHOOL', 'ZHONGHUA PRIMARY SCHOOL', 'FUCHUN PRIMARY SCHOOL', 'SI LING PRIMARY SCHOOL', 'CLEMENTI PRIMARY SCHOOL', 'QIFA PRIMARY SCHOOL', 'FENGSHAN PRIMARY SCHOOL', 'DAMAI PRIMARY SCHOOL', 'FERNVALE PRIMARY SCHOOL', 'BLANGAH RISE PRIMARY SCHOOL', 'CATHOLIC HIGH SCHOOL', 'YANGZHENG PRIMARY SCHOOL', 'GUANGYANG PRIMARY SCHOOL', 'BENDEMEER PRIMARY SCHOOL', 'PEI TONG PRIMARY SCHOOL', 'GAN ENG SENG PRIMARY SCHOOL', 'QUEENSTOWN PRIMARY SCHOOL', 'ZHANGDE PRIMARY SCHOOL', "ST GABRIELS'S PRIMARY SCHOOL", 'FARRER PARK PRIMARY SCHOOL', "ST JOSEPH'S INSTITUTION JUNIOR", 'ALEXANDRA PRIMARY SCHOOL', 'STAMFORD PRIMARY SCHOOL', 'CANTONMENT PRIMARY SCHOOL', 'CHIJ (OUR LADY QUEEN OF PEACE)', 'NGEE ANN PRIMARY SCHOOL', 'CHOA CHU KANG PRIMARY SCHOOL', 'TEMASEK PRIMARY SCHOOL', "CHIJ ST NICHOLAS GIRLS' SCHOOL", 'MARIS STELLA HIGH SCHOOL', 'BUKIT TIMAH PRIMARY SCHOOL', 'CHIJ (OUR LADY OF GOOD COUNSEL)', 'OPERA ESTATE PRIMARY SCHOOL', 'TAO NAN SCHOOL', "HAIG GIRLS' SCHOOL", 'NAN HUA PRIMARY SCHOOL', 'CHIJ (KATONG) PRIMARY', "ST STEPHEN'S SCHOOL", 'FAIRFIELD METHODIST SCHOOL (PRIMARY)', 'PAYA LEBAR METHODIST GIRLS SCHOOL (PRIMARY)', 'PEI HWA PRESBYTERIAN PRIMARY SCHOOL', 'ANDERSON PRIMARY SCHOOL', 'KONG HWA SCHOOL']

10.5.3 Cluster 3: 112 schools

['BEACON PRIMARY SCHOOL', 'PIONEER PRIMARY SCHOOL', 'CONCORD PRIMARY SCHOOL', 'JUYING PRIMARY SCHOOL', 'XINGNAN PRIMARY SCHOOL',

'COMPASSVALE PRIMARY SCHOOL', 'WEST SPRING PRIMARY', 'GREENRIDGE PRIMARY SCHOOL', 'NORTHLAND PRIMARY SCHOOL', 'MARSILING PRIMARY SCHOOL', 'CANBERRA PRIMARY SCHOOL', 'QIHUA PRIMARY SCHOOL', 'NORTHOAKS PRIMARY SCHOOL', 'ENDEAVOUR PRIMARY SCHOOL', 'HUAMIN PRIMARY SCHOOL', 'WELLINGTON PRIMARY SCHOOL', 'EVERGREEN PRIMARY SCHOOL', 'NORTH VIEW PRIMARY SCHOOL', 'JURONG WEST PRIMARY SCHOOL', 'DAZHONG PRIMARY SCHOOL', 'MONTFORT JUNIOR SCHOOL', 'CANOSSA CONVENT PRIMARY SCHOOL', 'POI CHING SCHOOL', 'RIVERVALE PRIMARY SCHOOL', "ST ANTHONY'S PRIMARY SCHOOL", 'BEDOK WEST PRIMARY SCHOOL', 'YIO CHU KANG SCHOOL', 'FRONTIER PRIMARY SCHOOL', 'HONG KAH PRIMARY SCHOOL', 'JIEMIN PRIMARY SCHOOL', 'CORPORATION PRIMARY SCHOOL', 'WESTWOOD PRIMARY SCHOOL', 'MAHA BODHI SCHOOL', 'AI TONG SCHOOL', 'PEI CHUN PRIMARY SCHOOL', 'MEE TOH SCHOOL', 'EDGEFIELD PRIMARY SCHOOL', 'GREENDALE PRIMARY SCHOOL', 'HORIZON PRIMARY SCHOOL', 'NAN CHIAU PRIMARY SCHOOL', 'SPRINGDALE PRIMARY SCHOOL', 'TAMPINES PRIMARY SCHOOL', 'GONGSHANG PRIMARY SCHOOL', 'TAMPINES NORTH PRIMARY SCHOOL', 'EAST VIEW PRIMARY SCHOOL', 'JUNYUAN PRIMARY SCHOOL', 'NEW TOWN PRIMARY SCHOOL', 'KUO CHUAN PRIESBYTERIAN PRIMARY SCHOOL', 'CHIJ (KELLOCK)', 'RADIN MAS PRIMARY SCHOOL', 'ANG MO KIO PRIMARY SCHOOL', 'FIRST TOA PAYOH PRIMARY SCHOOL', 'UNITY PRIMARY SCHOOL', 'KRANJI PRIMARY SCHOOL', 'PASIR RIS PRIMARY SCHOOL', 'WOODLANDS PRIMARY SCHOOL', 'WOODLANDS RING PRIMARY SCHOOL', 'CASUARINA PRIMARY SCHOOL', 'EAST SPRING PRIMARY SCHOOL', 'WHITE SANDS PRIMARY SCHOOL', 'LOYANG PRIMARY SCHOOL', 'NAVAL BASE PRIMARY SCHOOL', 'INNOVA PRIMARY SCHOOL', 'CORAL PRIMARY SCHOOL', 'WOODGROVE PRIMARY SCHOOL', 'PEIYING PRIMARY SCHOOL', 'PRINCESS ELIZABETH PRIMARY SCHOOL', 'RIVERSIDE PRIMARY SCHOOL', 'ADMIRALTY PRIMARY SCHOOL', 'GREENWOOD PRIMARY SCHOOL', 'YUMIN PRIMARY SCHOOL', 'ANCHOR GREEN PRIMARY SCHOOL', 'SENGKANG GREEN PRIMARY SCHOOL', 'YUHUA PRIMARY SCHOOL', 'CHONGFU PRIMARY SCHOOL', 'NORTH SPRING PRIMARY SCHOOL', 'PUNGGOL PRIMARY SCHOOL', 'CHIJ (OUR LADY OF THE NATIVITY)', 'NORTH VISTA PRIMARY SCHOOL', 'SENG KANG PRIMARY SCHOOL', 'FUHUA PRIMARY SCHOOL', 'PALM VIEW PRIMARY SCHOOL', 'GRIFFTHS PRIMARY SCHOOL', 'BUKIT VIEW PRIMARY SCHOOL', 'HOUGANG PRIMARY SCHOOL', 'LIANHUA PRIMARY SCHOOL', 'BOON LAY GARDEN PRIMARY SCHOOL', 'QIAONAN PRIMARY SCHOOL', 'RED SWASTIKA SCHOOL', 'BUKIT PANJANG PRIMARY SCHOOL', 'TELOK KURAU PRIMARY SCHOOL', 'MERIDIAN PRIMARY SCHOOL', 'SEMBAWANG PRIMARY SCHOOL', 'WEST VIEW PRIMARY SCHOOL', 'DE LA SALLE', 'TECK WHYE PRIMARY SCHOOL', 'YEW TEE PRIMARY SCHOOL', 'PARK VIEW PRIMARY SCHOOL', 'ZHENGHUA PRIMARY SCHOOL', "HOLY INNOCENTS' PRIMARY SCHOOL", 'XINMIN SCHOOL', 'YU NENG PRIMARY SCHOOL', 'AHMAD IBRAHIM PRIMARY SCHOOL', 'XISHAN PRIMARY SCHOOL', 'YISHUN PRIMARY SCHOOL', "ST ANTHONY'S CANOSSIAN PRIMARY SCHOOL", 'BEDOK GREEN PRIMARY SCHOOL', "ST HILDA'S PRIMARY SCHOOL", 'GEYLANG METHODIST SCHOOL (PRIMARY)', 'MAYFLOWER PRIMARY SCHOOL', 'JING SHAN PRIMARY SCHOOL', 'LAKESIDE PRIMARY SCHOOL']

10.6Analysis of hierarchical clustering results

Figure 10.1 plots weighted house prices against weighted school rankings, with data points clustered through agglomerative hierarchical clustering.
From this analysis, Cluster 1 consists of schools that are located in extremely expensive regions.

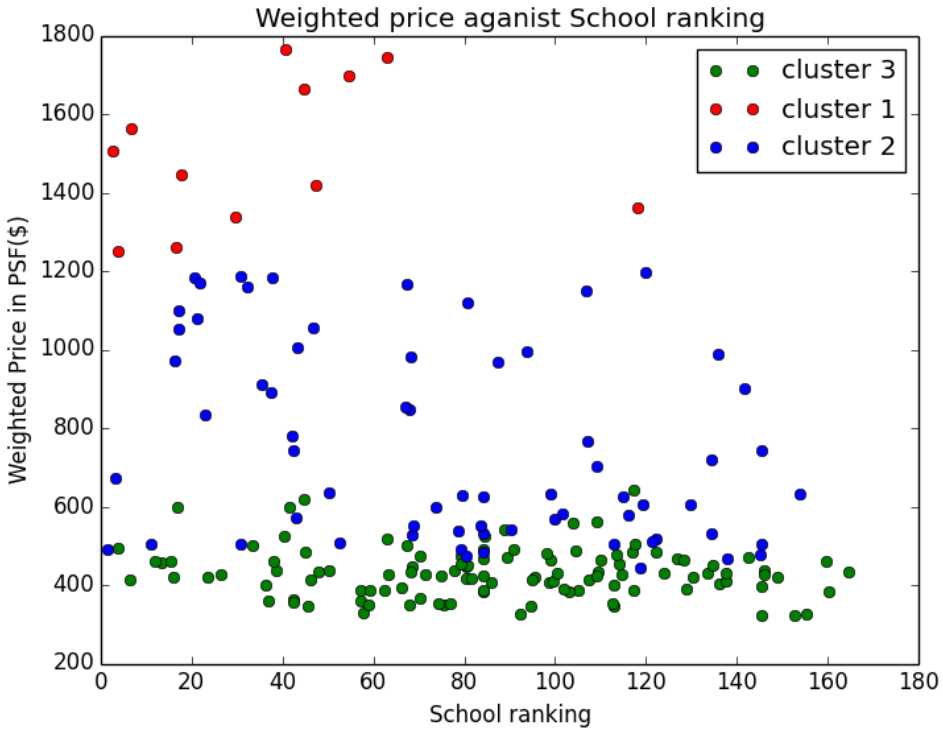


Figure 10.1 Graph of weighted-average price points plotted against weighted school rankings, colored b hierarchical clustering.

The price differences are much more exaggerated as compared to the analysis done using k-means clustering. These differences are summarized in Table 10.2.

Table 10.2 Minimum, maximum, and average price points in each cluster after hierarchical clustering.

	Lower-bound Price			Weighted Price			Upper-bound Price		
	Min	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**
Cluster 1	1241.0	1488.5	1760.0	1250.0	1501.1	1765.3	1250.0	1525.6	1768.0
Cluster 2	369.0	679.3	1158.0	442.6	751.6	1196.7	834.0	1169.4	1807.0
Cluster 3	322.0	401.1	642.0	322.0	432.0	642.0	322.0	624.3	998.0
Total	322.0	566.4	1760.0	322.0	610.8	1765.3	322.0	881.2	1807.0

An investigation of the weighted school rankings in Table 10.3 also notes the extreme disproportionate success of schools in cluster 1, with its average ranked school being a high 37.08 as compared to 81.99 and 92.83 for clusters 2 and 3 respectively.

Table 10.3 The ranks of the best, worst, and average schools in each cluster after hierarchical clustering.

	Weighted rankings from 2009-2014			
	Best ranking	**Avg ranking**	**Worst ranking**	**SD**
Cluster 1	2.57 (Singapore Chinese Girls' Primary)	37.08	118.19	31.38
Cluster 2	1.48 (Rulang Primary)	81.99	163.80	45.25
Cluster 3	3.90 (St Hilda's Primary School)	92.83	164.52	45.27

Further analysis of the criteria used in section 6 also demonstrate a similar point despite the differences in clustering algorithm: that selective, popular and good schools are commonly located in expensive districts that serves as an economic barrier to childhood success. Tables and Figure 10.4 through 10.9 provide a visual summary of our conclusions. These are largely similar to our findings using k-means clustering and elaborated in the body.

Note that the absolute number of GEP and branded schools in cluster 1 fell, as shown in table 10.4. However, this can be explained by the fact that cluster 1 decreased in size, from to 33 to 12. Analyzing the percentage of schools that belong to the GEP and branded category shows that cluster 1 was even more selective, as shown in table 10.6.5.

Table 10.4 List of subjectively elite schools and their corresponding cluster numbers after hierarchical clustering.

School type	School name	Cluster
GEP Schools	Nanyang Primary School	1
	Rosyth School	2
	Tao Nan School	2
	St Hilda's Primary School	3
	Raffles Girls' Primary School	1
	Nan Hua Primary School	2
	Anglo Chinese School (Primary)	1
	Catholic High School	2
	Henry Park Primary School	1
Branded Schools	Anglo Chinese School (Junior)	1
	Singapore Chinese Girls' Primary School	1
	Methodist Girls' (Primary)	1
	CHIJ St Nicholas Girls' School	2
	Ai Tong School	3
	St Joseph's Institution Junior	2

Table 10.5 Distribution of subjectively elite schools across clusters after hierarchical clustering.

	% GEP schools	% Branded schools	% All elite schools
Cluster 1	33.3	25.0	58.3
Cluster 2	6.06	3.03	9.09
Cluster 3	0.89	0.89	1.79

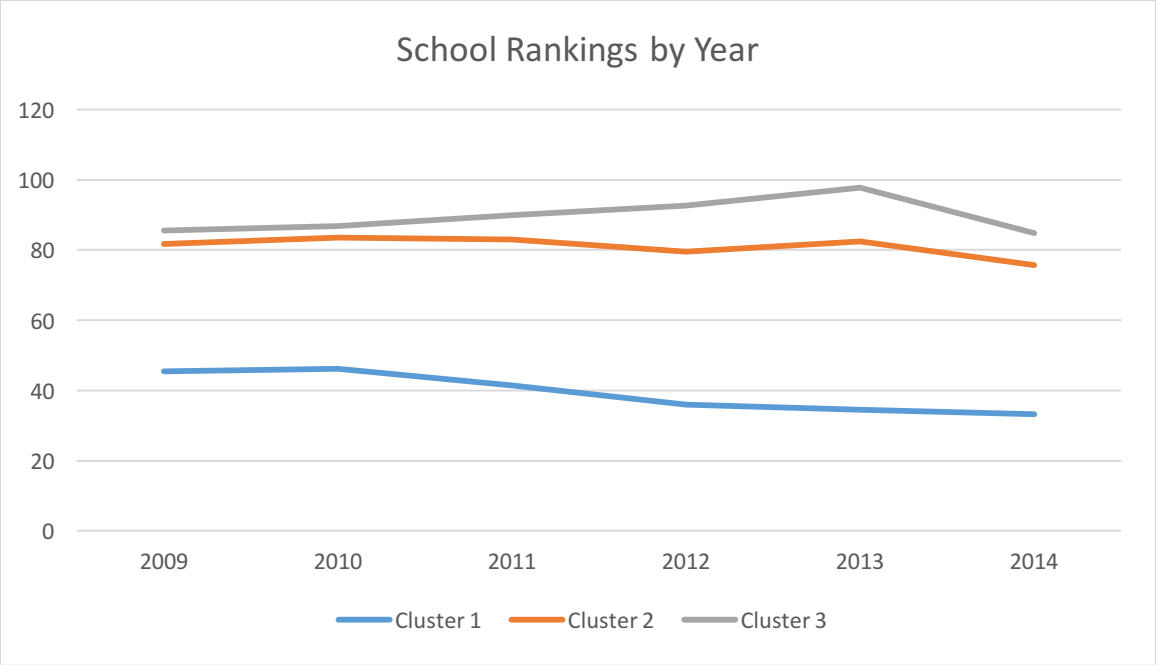


Figure 10.6 The average annual ranks of schools in each cluster between 2009 and 2014, inclusive, after hierarchical clustering.

Table 10.7 Largest deficit, largest surplus, and average deficit/surplus in each cluster after hierarchical clustering; a school in deficit is oversubscribed and thus popular, while a school in surplus is undersubscribed.

	Largest deficit	Average deficit/surplus	Largest surplus	SD
Cluster 1	-37 (CHIJ Primary (Toa Payoh))	-1.33	96 (Angsana)	38.91
Cluster 2	-83 (Rosyth)	16.77	122 (Blangah Rise)	49.77
Cluster 3	-131 (Nan Chiau)	22.62	151 (Juying)	48.37

Table 10.8 Lowest, highest and average scores for the relevance of home-school distance to admission for schools in each cluster after hierarchical clustering; a higher score denotes greater relevance at a given school.

	Least important	Average importance	Most important	SD
Cluster 1	0	8.42	15.0	5.01
Cluster 2	0	4.84	15.0	5.15
Cluster 3	0	3.80	15.0	4.68

Table 10.9 Lowest, highest, and average Take-Up Rate at the end of Phase 2A of schools in each cluster after hierarchical clustering.

	Lowest TUR	**Average TUR**	**Highest TUR**	**SD**
Cluster 1	21.0 (Angsana Primary)	61.1	90.0 (Nanyang Primary)	19.3
Cluster 2	0.0 (several)	45.9	85.0 (Tao Nan Primary)	19.2
Cluster 3	0.0 (Hong Kah Primary)	42.0	88.0 (Ai Tong)	15.3

To conclude, using hierarchical clustering further exemplifies the divergences in housing price and school quality across clusters.