Observatory for Mathematical Education

Cohort study school sampling technical report 2025/02

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Record of changes

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1.0	25/04/2025	Report published
1.1	01/05/2025	Abstract added and pagination adjusted

Abstract

A key component of the Observatory for Mathematical Education's work is the cohort studies of primary and secondary school children in England; following cohorts of pupils through these phases of education and using surveys of pupils, teachers and parents as well as administrative data to chart their experiences of, attitudes towards and attainment in mathematics. An essential component of these studies is the recruitment of partner schools, through which the pupils are recruited to the studies and many of the surveys are administered. In this report we first outline (i) the refinement of the scope of these studies from "state schools in England" to particular sampling frames of primary and secondary schools, and (ii) the process of sampling schools from these frames for invitation and recruitment to the cohort studies. Then, for each cohort we analyse over a dozen variables which characterise different aspects of schools' administration and pupils and their characteristics, showing that the recruited partner schools are representative of their respective sampling frames.

1 Introduction

A central strand of the Observatory for Mathematical Education's work is the primary and secondary cohort studies, following tens of thousands of learners through their seven years of primary/secondary state education. Annual surveys of pupils collect data on their experiences and attitudes towards mathematics and surveys of teachers give information on the learning environment, pedagogy and workforce. The study also uses publicly available data about schools and the National Pupil Database to give more information about the individuals participating in the study. This document outlines how the Observatory sampled the partner schools that are participating in the cohort studies and demonstrates that these schools give a sample which is representative of schools in the frame of reference.

The main unit of interest in the cohort studies is the learner - their experiences, achievements, attitudes, etc. but for practical purposes the unit of sampling needs to be the school, through which significant numbers of children can be reliably reached throughout the 7-year duration of the cohort studies. A small minority of children will inevitably move schools and this will muddle the data somewhat; but by focusing on schools there is also the opportunity to explore in detail the staffing structure and policies of different schools and the attitudes and approaches of the staff who teach mathematics at classroom level.

Partner schools for the primary and secondary cohort studies were recruited in 2024. The intention was to mirror the numbers of schools in international comparative studies, e.g. there were 165 English secondary schools in PISA (Programme for International Student Assessment) 2022[1], and 139 primary and 136 secondary schools in TIMSS (Trends in International Mathematics and Science Study) 2019[2] (results relating to TIMSS 2023 were not available at the time of planning and recruitment). In contrast to those studies, which sample pupils within schools, the Observatory cohort studies include all pupils in the relevant cohorts so the sample size in terms of learners will be considerably higher (PISA 2019 had 4,763 pupils and TIMSS 2019 had 3,396 primary and 3,365 secondary pupils; in the cohort studies approximately 7,000 primary and 29,000 secondary pupils will be studied). Furthermore, the cohort studies will have information about which classes pupils are grouped into each year as they move through their primary and secondary education. In this sense, the cohort study data will be much richer and will permit a much wider range of comparisons and analysis than the comparative studies mentioned above.

Initial analysis involved sourcing publicly available data on schools to examine the nationwide education landscape in terms of various high-level properties of the schools

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[1] Ingram, J., Stiff, J., Cadwallader, S., Lee, G. & Kayton, H. (2023). PISA 2022: National Report for England. Department for Education. Accessed 13/Mar/2025 at https://assets.publishing.service.gov.uk/media/656dc3321104cf0013fa742f/PISA_2022_England_National_Report.pdf.

[2] Richardson, M., Isaacs, T., Barnes, I., Swensson, C., Wilkinson, D. & Golding, J. (2020). Trends in International Mathematics and Science Study (TIMSS) 2019: National report for England (Research Report RR1086). Department for Education. Accessed 17/Mar/2025 at https://assets.publishing.service.gov.uk/media/5fca467ad3bf7f5d09db26ae/TIMSS_2019_National_Report.pdf.

and the pupils that attend them. This data was used to (i) refine the "sampling frames" of primary and secondary schools considered in the study, (ii) inform the procedure used to sample and recruit schools from the sampling frames to the study and (iii) monitor the recruited schools to ensure, as far as possible, that they were representative of schools in the sampling frames.

2 Defining the sampling frames

2.1 Data sources

The data used to manage and monitor partner school recruitment were the following publicly available datasets, sourced from the UK Government website gov.uk.

- Main source of administrative data about schools: Get information about schools (GIAS) data https://get-information-schools.service.gov.uk.
- More detailed data about pupil numbers and their characteristics: Schools, pupils and their characteristics (SPC) data https://explore-education-statistics.service.gov.uk/find-statistics/school-pupils-and-their-characteristics.
- School attainment and progress data: Compare school and college performance in England (CSCPE) data https://www.compare-school-performance.service.gov.uk/download-data.
- Data related to SEN and EHCP prevalence in schools: Special educational needs in England (SENE) data https://explore-education-statistics.service.gov.uk/find-statistics/special-educational-needs-in-england.
- A level entry data: A level and other 16 to 18 results (16-18 results) data https://explore-education-statistics.service.gov.uk/find-statistics/a-level-and-other-16-to-18-results.

Since the planning and recruitment took place in Spring and Summer 2024, the data was up to date at the end of the 2022/23 school year. From the hundreds of variables giving information about each school across the data sets, those listed in Table 1 were chosen to be used and/or analysed on the basis that they capture what are likely to be the most important characteristics of schools, their administrative environments and their pupils.

Variable(s)	Source	Comments
Establishment type	GIAS	A categorisation that gives information about the structures through which schools are funded and administered. 7 such classifications are relevant for us: Academy converter, Academy sponsor led, Community school, Foundation school, Free school, Voluntary aided school, Voluntary controlled school. (There are other classifications too, but these are excluded from the study for reasons explained in following sections.)
Trust size	GIAS	Number of schools of the same type (primary/secondary) in the same academy trust as the school in question. Calculated from the recorded name of trust for each school.
Statutory ages	GIAS	The age range of children the school provides for. Calculated from recorded lower and upper statutory ages covering, for example, lower, primary, infants, junior, middle, secondary, upper and all-through schools; with and without nursery and/or sixth form provision.
Gender	GIAS	Gender of admitted pupils; either mixed, girls or boys.
Admissions policy	GIAS	Whether or not the school is academically selective.
Closure status	GIAS	Details of if/when/why the school is scheduled to open/close.

Variable(s)	Source	Comments
Religious character	GIAS	The official religious character (if any) of the school. Simplified from a detailed classification with dozens of categories to a four-category classification (None, Church of England, Catholic, Other).
Numbers of pupils	GIAS/ SPC	Data is available on schools' capacity, total enrolment and enrolment by age and school year group. We used the number of pupils enrolled in Reception and Year 7, the initial years for each cohort study.
A-level maths entries	16-18 results	(Secondary only) The number of entries recorded in A Level Mathematics.
Region	GIAS	Which of the nine Government Office Regions the school is located in.
Urban/Rural classification	GIAS	A classification of the character of the area the school is located in. Simplified from a detailed 10-category classification into a simpler 3-category classification (Conurbation, City/town, Rural).
%FSM	GIAS/ SPC	The percentage of enrolled students recorded as eligible for Free School Meals.
%WB	SPC	The percentage of enrolled students recorded as being of White British ethnicity.
%EAL	SPC	The percentage of enrolled students with English as an additional language. (Calculated from the percentage recorded as having English as a first language.)
%SEN	SENE	The percentage of enrolled students recorded as having Special Educational Needs.
%EHCP	SENE	The percentage of enrolled students recorded as having an Education, Health and Care Plan.
Ofsted rating	GIAS	The school's latest Ofsted rating.
Attainment	CSCPE	Officially-reported Attainment 8 (secondary schools) or average KS2 mathematics SAT score (primary schools) - a measure of average academic attainment at the school.
Progress	CSCPE	Officially-reported Progress 8 (secondary schools) or KS2 mathematics progress (primary schools) progress measure - a measure of the average academic progress made by pupils at the school.

Table 1 List of variables analysed during the recruitment of research partner schools.

The government data, like all data, is imperfect and requires some cleaning before it can be usefully analysed. Missing data generally seems not to be a significant problem: all variables with more than 2% missingness are so for good reason. There is zero or essentially-zero missingness for most administrative and geographical type data (Establishment type, Trust size, Statutory ages, Religious character, Region, Urban/rural classification) and just under 2% for the demographic type variables (%FSM, %WB, %EAL, %SEN, %EHCP).

For the attainment and progress variables, missingness is just over 4% among secondary schools and 3.5% among primary schools with year 6 pupils (it is over 13% among all primaries, but this includes infant schools who do not teach Key Stage 2); this is expected as most schools with this data missing have recently opened and thus have

not had cohorts of students progress through the relevant stages for these measures to be calculated.

The exception to the general statement of low missingness for administrative type variables was the admissions policy variable. For secondary schools it takes the value "Selective" or "Non-selective" for most schools, but it is recorded as "Not applicable" for 1.5% and is blank for around 7% of secondary schools in the dataset. See Section 3.1 for further discussion of cleaning of data for this variable, which is important for the stratification that we used. Among primary schools, around 5% have blank or "Not applicable" admissions policies; but with none having selective policies reported we assumed that all are non-selective.

Missingness for the Ofsted rating variable (recording the overall rating from the latest Ofsted inspection) is just over 10% in both sampling frames. Nearly all of this missingness is related to schools converting to academy status: academisation technically involves the closing of one school and the opening of another (albeit with essentially the same estate and people), so the new (i.e. recently-academised) school will not have had an inspection. Most of the schools with missing Ofsted ratings have converted during the 2-3 years before the data were collected, which coincided with the Covid-19 pandemic and much-reduced rates of Ofsted inspections. Outside this group of recently-academised schools, most with a missing Ofsted rating are schools which converted to academy status longer ago but whose predecessor school had an Outstanding rating; between 2012 and 2020 such schools were exempt from routine inspections. Of course, some are genuinely new schools which have not yet been inspected, but these are a very small minority.

Lastly, there are around 15% of 11-18 schools in the secondary sampling frame with no recorded A level maths entries (for Summer 2023). The nature of the data source is such that very few of these schools will genuinely have no entries. Most of the missingness in this variable can be attributed to either recent academisation or students being entered for exams in collaboration with another partner school or college.

2.2 Scope of studies

The scope of the Observatory cohort studies is the mainstream state education system in England. With education being a devolved matter for the UK government, restricting the study to England means all participating schools are operating as part of the same education system and enables the linking of student responses to the Department for Education's National Pupil Database which only covers students in England. The scope was limited to 'mainstream' state schools which serve the great majority of children in state education. This amounts to excluding more specialist school settings such as alternative provision providers, secure units, pupil referral units, special schools and offshore and online schools. These schools were excluded on the basis that they are highly diverse and distinctive in the provision that they offer and the characteristics of the students they serve, and they are generally very different from mainstream schools. University Technical Colleges and Studio schools were also excluded on the basis that their provision is often quite distinctive. We take the view that research into the provision of specialist settings is best done through targeted research that focuses on the specific challenges and opportunities they have.

This scope excludes around 4.9% of age-5 and 9.7% of age-12 school pupils in England; in both cases roughly three quarters of these excluded pupils attend independent schools and one quarter attend non-mainstream state schools (see Table 2 and Table 3 below). Note these are proportions of pupils in terms of age groups rather than school years. This is because, although the SPC data breaks down student enrolment numbers by age group and by school year, the latter is missing for all independent and some non-mainstream schools.

2.3 Refining the sampling frames

Due to the long-term nature of the Observatory cohort studies, the sampling process paid particular attention to scheduled closures and openings of schools. Many of the scheduled school closures in the data were due to academisation (where technically one school closes and a new one opens, but for most practical purposes the school continues operating with the same staff and pupils). Schools were only included in the sampling frames if they were currently open and either not scheduled to close or scheduled to close because of academisation. That is, schools were excluded if scheduled to close for reasons other than academisation (i.e. genuine closures, mergers, academisation through the Fresh Start scheme; 3 primary and 4 secondary schools in the sampling frames were scheduled to close for one of these reasons) or if scheduled to open in the future.

Additionally, schools were excluded from the sampling frame if they did not educate pupils through the entirety of the standard primary school years (Reception to Year 6) or secondary school years (Year 7 to Year 11). This excluded schools in parts of England with a three-tier education system (though these are increasingly rare nowadays, there are some areas of England where the three-tier system of lower, middle and upper schools is prevalent, mainly within the traditional counties of Bedfordshire, Dorset, Northumberland, Somerset, Staffordshire and Worcestershire). It also excludes areas with separate infant (Reception to Year 2) and junior schools (Year 3 to Year 6), though again these are increasingly uncommon, and University Technical Colleges and Studio schools which typically serve only older secondary students (Year 9 or 10 through to Year 13). These drawbacks are offset by the operational benefits of having cohorts of students remain in the same school throughout the studies: each school commits to administering surveys to pupils every year and it avoids situations where pupils might leave or join partner schools at, for example, the transition from infant to junior schools. Therefore, there is confidence that the large majority of pupils will be in the study throughout.

Note that the criteria described above mean that all-though schools are included in both the primary and secondary sampling frames and therefore could have been invited to participate in either cohort study (or indeed both, though this is extremely unlikely).

Primary schools with 12 or fewer Reception year pupils (in 2022/23, the most recent cohort for which data was available at the time of planning) were also excluded. This was to minimise the amount of disruption that participation would likely cause in smaller schools with mixed-year classes and fewer staff, and a desire to ensure a reasonable sample size at the school/class level. The intention of excluding schools with 12 or fewer Reception year pupils was to include schools that recruit a half-form of 15 pupils, including some allowance for year-to-year fluctuation of pupil numbers.

For secondary schools, the intention is to follow pupils not just from year 7 to year 11, but also through whatever they progress to in the following two years. However, around one third of schools in the secondary sampling frame have provision only to age 16. Students at these schools who wish to continue their school education typically progress to a sixth form college. Considering the large proportion of Year 7 pupils who attend 11-16 schools, it is not feasible to exclude them from the study, so some pupils will only be tracked to age 16 in the cohort study schools.

2.4 Summary of the sampling frames

Thus we arrive at the two "sampling frames" of schools. For the primary cohort:

- mainstream provider (i.e. not in any of the special categories mentioned in Section 2.2),
- either currently open or scheduled to close due to converting to an academy,
- lower statutory age 5 or less,
- upper statutory age 11 or more,
- at least 13 pupils in the 2022/23 Reception cohort.

And for the secondary cohort:

- mainstream provider (i.e. not in any of the special categories mentioned in Section 2.2),
- either currently open or scheduled to close due to converting to an academy,
- lower statutory age 11 or less,
- upper statutory age 16 or more.

Table 2 and Table 3 provide a summary of the proportion of pupils of ages 5 and 12 who attended schools falling into various categories defined by these exclusions as of January 2024 (i.e. using the SPC data from 2023/24). Note that (i) the scope of the data here is all schools in England; so that, for example, children who are home-schooled are not accounted for, and (ii) for reasons explained at the end of Section 2.2 data is shown for specific age groups rather than year groups.

Category of school	Number	Percentage
Independent	24,688	3.8
State, non-mainstream	6,990	1.1
State, mainstream age-excluded	80,525	12.5
State, mainstream size-excluded	17,523	2.7
State, mainstream age-and-size-excluded	1,115	0.2
Sampling frame	516,333	79.7

Table 2 Numbers of age-5 pupils attending various categorisations of schools in England which are included in the Primary sampling frame or excluded for various reasons.

Category of school	Number	Percentage
Independent	50,601	7.1
State, non-mainstream	18,323	1.6
State, mainstream excluded	11,486	2.6
Sampling frame	632,889	88.7

Table 3 Numbers of age-12 pupils attending various categorisations of schools in England which are included in the Secondary sampling frame or excluded for various reasons.

Table 2 and Table 3 show that the proportions of pupils at independent schools and non-mainstream state schools is small but increasing with age. The key difference between the primary and secondary cohort is the exclusions from the mainstream state schools: in the secondary cohort this is made up of pupils in areas with a 3-tier education system; but in the primary cohort there are additionally pupils in areas served by separate infant and junior schools. The effect of excluding primary schools with small cohort sizes is also observed: although these account for around 10% of schools with age-5 children, only 2.7% of age-5 children attend such schools.

3 Sampling and recruitment procedure

3.1 School sampling

There are many possible approaches to sampling schools, ranging from simple (uniform) random sampling to highly stratified or clustered sampling based on the many properties of schools and their pupils already outlined. The Observatory's philosophy when planning the sampling was to try to keep it as simple as possible, avoiding stratification or any other structuring or weighting in the sampling procedure unless there was a compelling reason to do so. This simplifies the process somewhat from an operational point of view but, crucially for a large observational study with many different research questions, there are few grounds for structuring the sampling when the results are potentially unexpected and diverse in nature. This contrasts with an experimental setup where close control of confounding variables is both more important and more realistic.

That said, a decision was made to stratify the sampling of secondary schools according to their selectivity and gender and then implement quota sampling within each stratum of secondary schools. In short, this will enable exploration of issues in the context of selective vs non-selective schools and also mixed-gender vs girls-only vs boys-only schools. Such stratification is complicated somewhat by the fact that selective schools are far more likely than non-selective schools to be single-gender (overall around 5% of schools are single-gender, but among selective schools this figure is around 70%) and that there may be interactions between selectivity and gender in terms of their effect on other variables of interest. With simple random sampling of 150 secondary schools from the sampling frame, over 130 of them would be expected to be non-selective & mixed-gender, which would mean that each of the 5 combinations of single-gender and/or selective categories would be represented by very few schools. To ensure representation of each of these 5 groups of schools, the sampling frame was stratified with the intention of recruiting 7 schools in each of the 5 smaller strata (i.e. non-selective boys/girls and selective boys/girls/mixed) and 115 in the "main" non-selective & mixed stratum. The target numbers of schools in each stratum were a compromise between (i) having enough schools in each of the smaller strata to yield data which captures school-to-school variation within those strata, and (ii) the desire not to over-represent these small-strata schools to the extent that the main stratum of non-selective & mixed-gender schools was unduly reduced in size.

The method of recruitment was to invite schools to participate by sampling them uniformly at random (within each stratum for secondaries and within the sampling frame for primaries).

Further data cleaning was required once the decision was made to stratify on the basis of gender and admissions policy, in order that every school could be placed in the right stratum. Within the sample frame there were missing/uninformative entries for admissions policy for 7.5% of schools and one school was missing a gender classification. The latter could be easily resolved by examining the school website. We investigated the 10 single-gender schools with missing admissions policy in the same way and found that they were all non-selective. We therefore decided to assume, for the purposes of stratification, that the 253 mixed-gender schools with missing admissions policy were also non-selective (this was corroborated by examining their websites for a

randomly chosen sample of 10 of these schools). Given the size of the strata we concluded that misclassifying a mixed selective school as non-selective would have much less impact on our recruitment than misclassifying a mixed non-selective school as selective. We later confirmed the admissions policy of any of these schools that we recruited.

3.2 Recruitment and monitoring

Since the response rate from schools was unknown in advance, schools were invited in several waves between April and June 2024 (with follow-up continuing through to October). Invitations were sent by email and post to sampled schools, who were invited to fill in an online form to indicate interest and/or ask questions about the studies. Schools that agreed to take part signed a Memorandum of Agreement (MOA). The group of "partner schools" reported here comprises all schools with MOAs in place and who participated in the first phases of the study in winter 2024/25.

Inviting schools to participate in several waves gave the opportunity to continuously monitor the schools that signed MOAs in terms of the variables examined earlier in the planning process. This monitoring allowed the adjustment of sampling of later waves in such a way that the characteristics of participating partner schools (not invited/sampled schools) would be as close as possible to being representative of the whole sampling frame. For example, should schools with lower Ofsted ratings turn out to be less likely to sign up than those with higher ratings, a disproportionately large number of schools with lower ratings could be invited in subsequent waves.

This monitoring of responses to early waves showed that positive responses were received close to uniformly across all invited schools, with the following exceptions.

1. The response rate was much lower among invited non-selective boys secondary schools than for other strata. As recruitment progressed, the main (non-selective, mixed-gender) stratum was prioritised in order to achieve the overall target of 150 secondary schools, so there are fewer non-selective boys secondary schools than initially intended. Given that concerns about participation and achievement in maths relate largely to females, not males, the study will still generate interesting findings regarding gender gaps.

2. Among invited secondary schools, those with higher reported levels of pupils who qualify for free school meals (FSM) were initially less likely to agree to participate in the study. Later waves of schools to invite were chosen in a way that made schools with higher levels of FSM more likely to be invited. The result was that the partner schools include slightly more high-FSM schools than would be the case if they were truly randomly sampled. As a consequence of this (i.e. because having English as an Additional Language and being White British are associated with FSM eligibility), the sample of partner schools also includes slightly more schools with above-average proportions of students with English as an Additional Language and below-average proportions of students who are White British than would be the case if they were truly randomly sampled.

3. Among invited secondary schools, those that belong to large MATs were initially less likely to agree to participate. In later waves, CEOs of some of these MATs were directly contacted to outline the study and ask them to encourage their schools who had been invited to participate to do so. The result was that the

sample of partner schools had notably more schools from large MATs than would be the case if partner schools were truly random. Moreover, these schools in large MATs are clumped into few MATs to a much greater degree than if partner schools were randomly sampled. Although unintentional, this sampling enables future research into both within-MAT and between-MAT variability.

4. Among invited primary schools, those with larger cohort sizes were less likely to agree to participate. In later waves of recruitment, such large schools were more likely to be chosen to be invited. The resulting sample of partner schools closely reflects the sampling frame from which it was taken, suggesting that the correction was successful.

4 Properties of partner schools

Overall, the samples of primary and secondary partner schools are broadly representative of their respective sampling frames. There are some small differences between the overall numbers recruited in each stratum and the original targets due to operational reasons (e.g. time lags between invitations being sent and accepted), as described in the previous section. Within each stratum schools were sampled randomly - with adjustments as described in the previous section - and as a result the distributions of properties of the sampling frames and corresponding samples of partner schools are very similar, even if not exactly the same. The exceptions are those described at the end of the previous section: in the primary cohort there were none but, in the secondary cohort, schools in large MATs and schools with high proportions of FSM-eligible pupils are somewhat over-represented in the partner schools.

The remainder of this section presents visualisations and simple statistics comparing the properties of the partner schools with all schools in the sampling frame. These comparisons are in terms of the variables listed in Section 2.1 which were explored and monitored before and during recruitment. (Note that the stacked bar charts include percentages in each area, but these are excluded for areas which make up less than 2.5% of the total.) A table of medians (excluding any missing values) of the numerical variables (those visualised with density plots, plus the underlying numerical values for the cohort size variable) within the sampling frame and within the sample of partner schools is presented at the end of each subsection (Table 4 and Table 6).

4.1 Primary schools

Overall, 174 primary schools were recruited to the primary cohort study, corresponding to around 6800 pupils in Reception year in 2022/23. (Based on birth data for England and Wales[3], we anticipate that the number of Reception pupils during data collection in 2024/25 will be around 6% lower than this.)

Figures 1-12 and Table 4 show that the sample of partner schools is representative of the sampling frame. A few observations from these figures are noteworthy:

- Only a very small proportion (1.2%) of schools in the sampling frame are all-though, so it is quite reasonable that the sample of partner schools does not include any all-through schools.
- There is some over-recruitment of schools in the East Midlands; this may be down to natural variation in the sampling process but equally could be due to schools in the East Midlands having prior awareness of, or stronger existing links, with the University of Nottingham and thus being more likely to participate in the study. There is also some under-representation of the London region, but with 11 schools there is still sufficient sample size in all regions to make reasonable comparisons between them.

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[3] Office for National Statistics, Births in England and Wales dataset. Accessed 31/Mar/2025 at https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/livebirths/datasets/birthsummarytables.
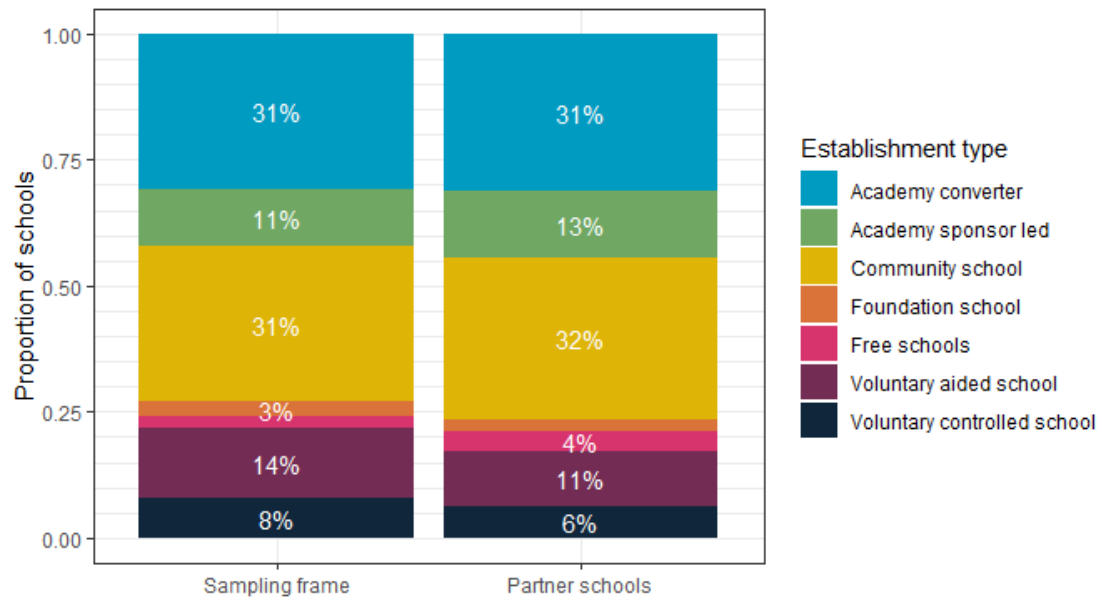
Figure 1 Comparison of the distribution of establishment type among schools in the sampling frame and partner schools.
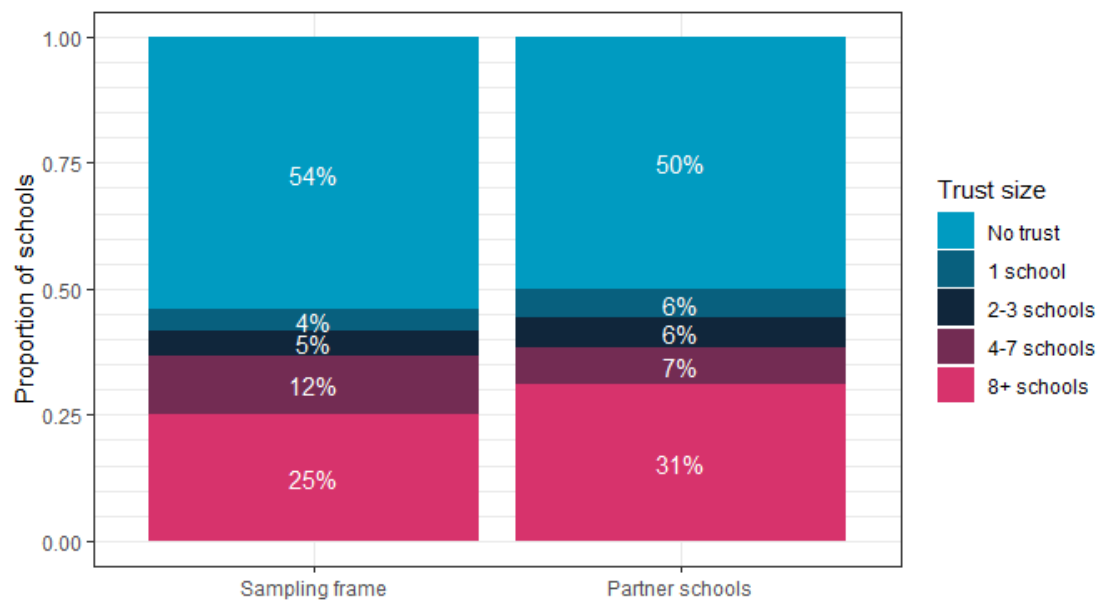

Figure 2 Comparison of the distribution of trust size among schools in the sampling frame and partner schools.
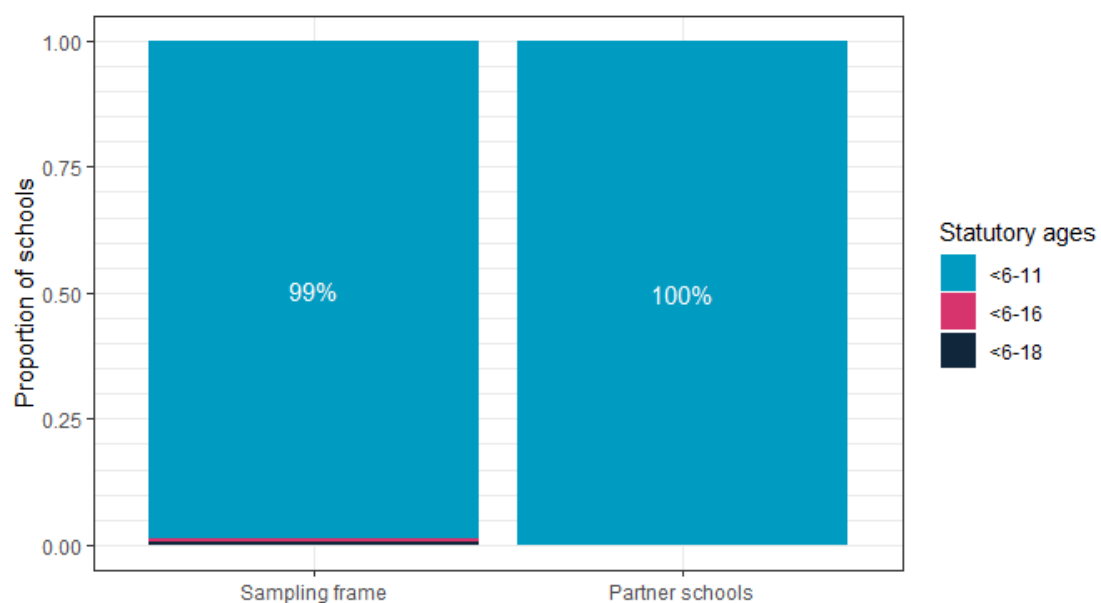
Figure 3 Comparison of the distribution of statutory ages among schools in the sampling frame and partner schools.
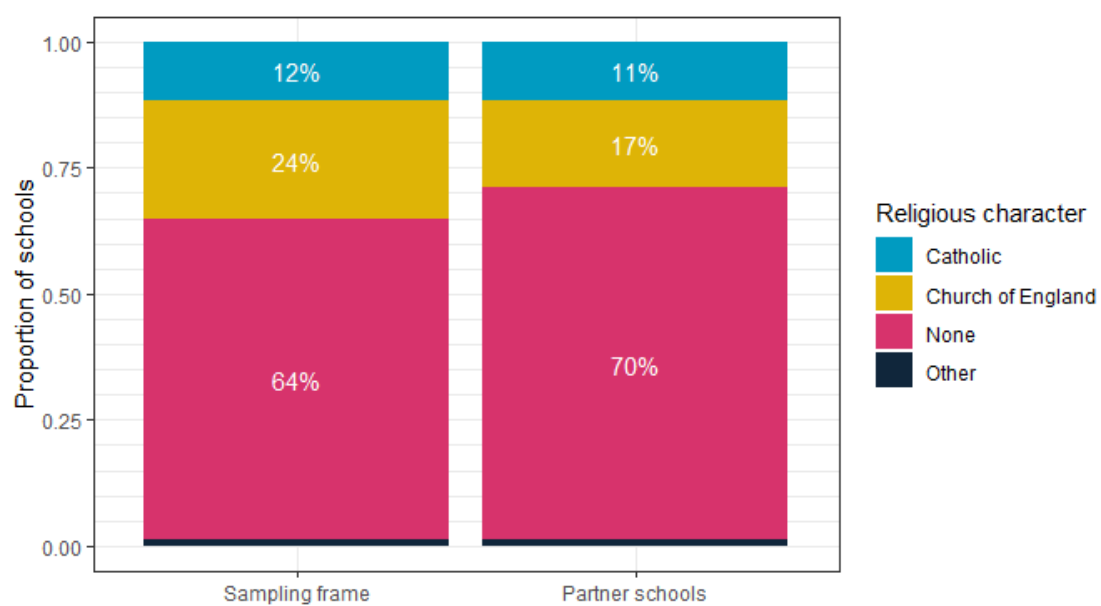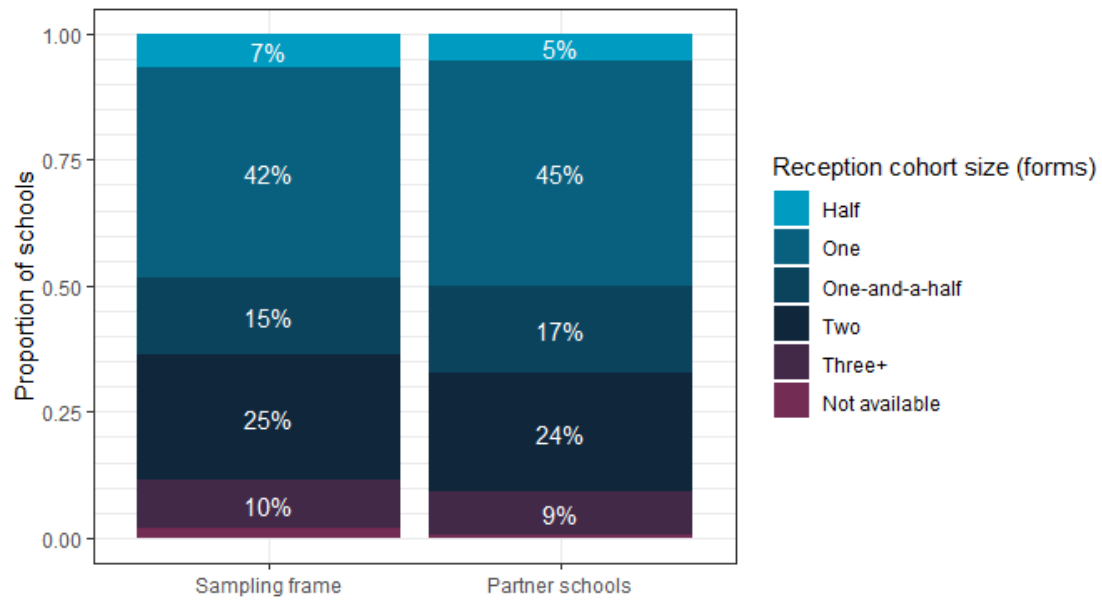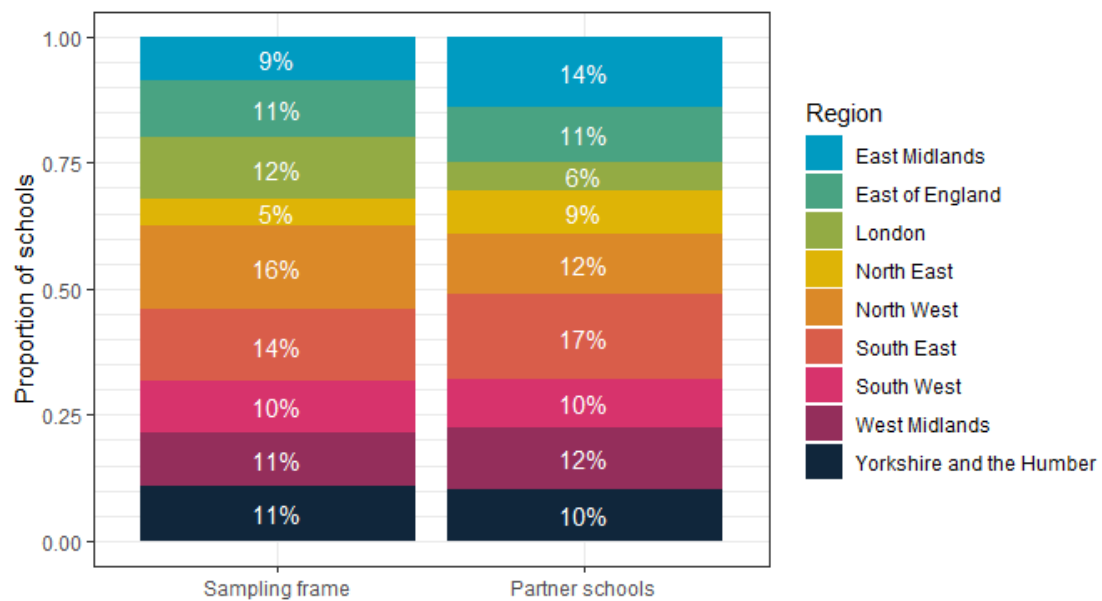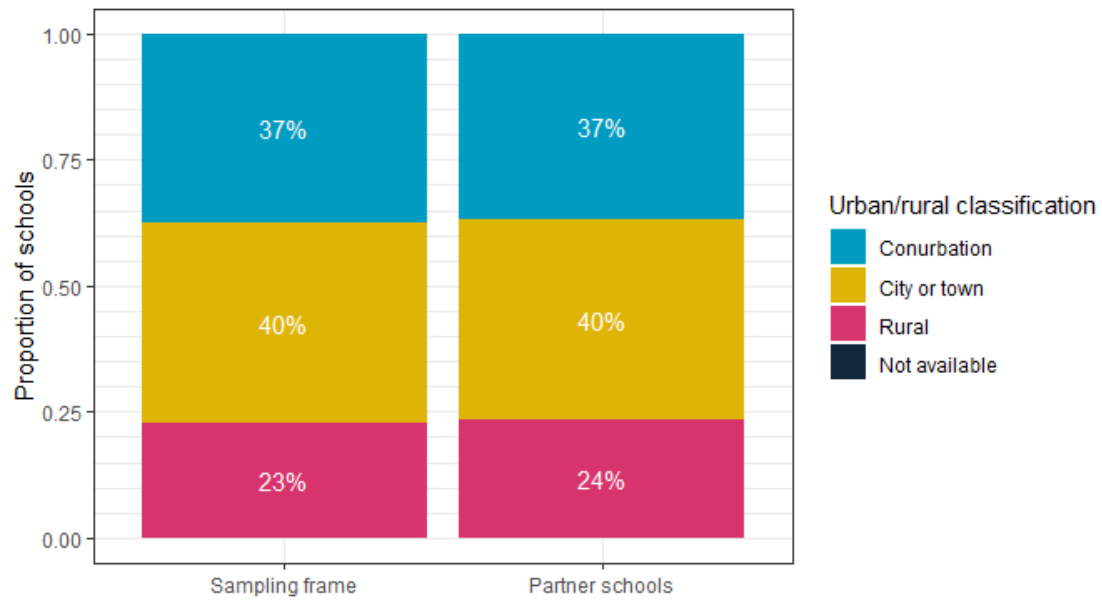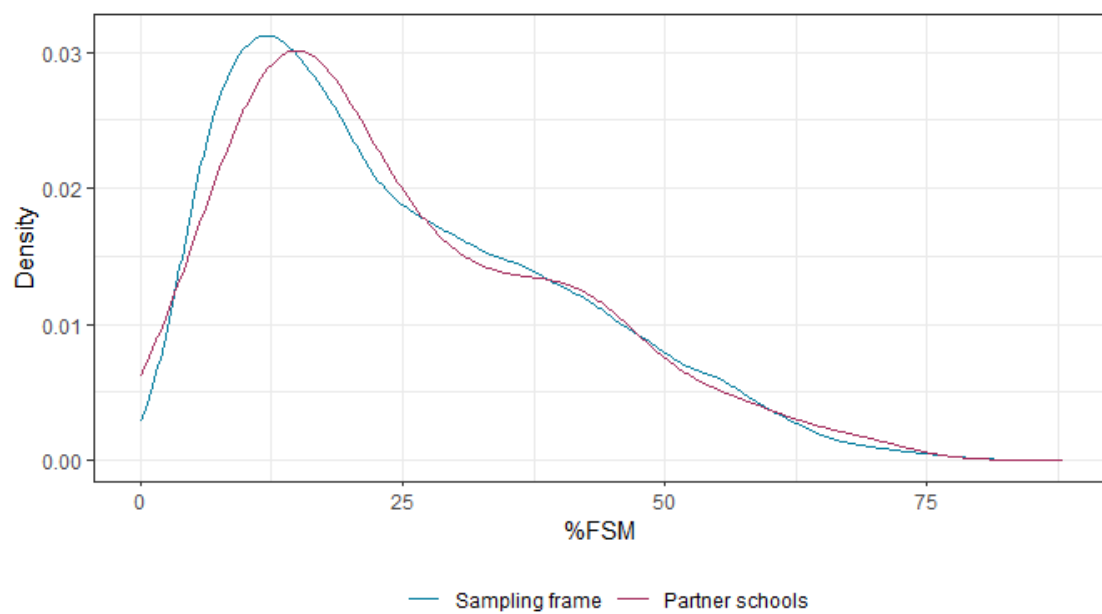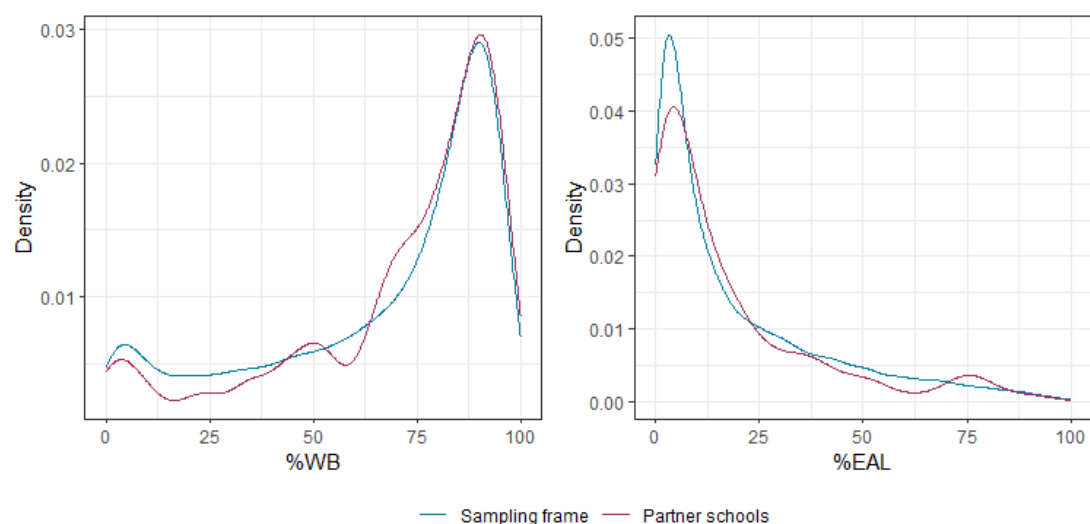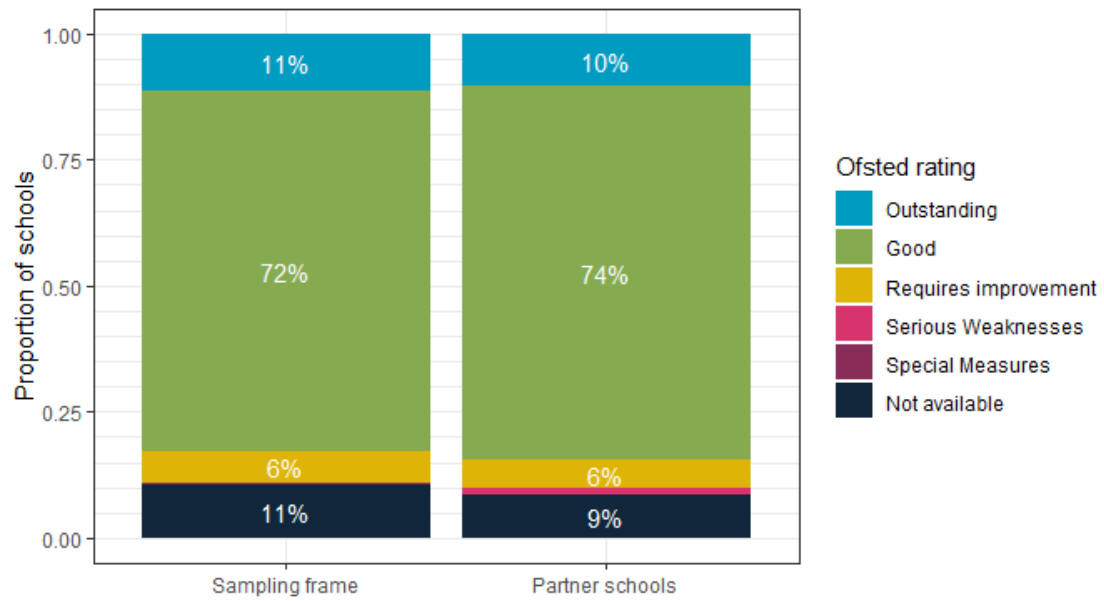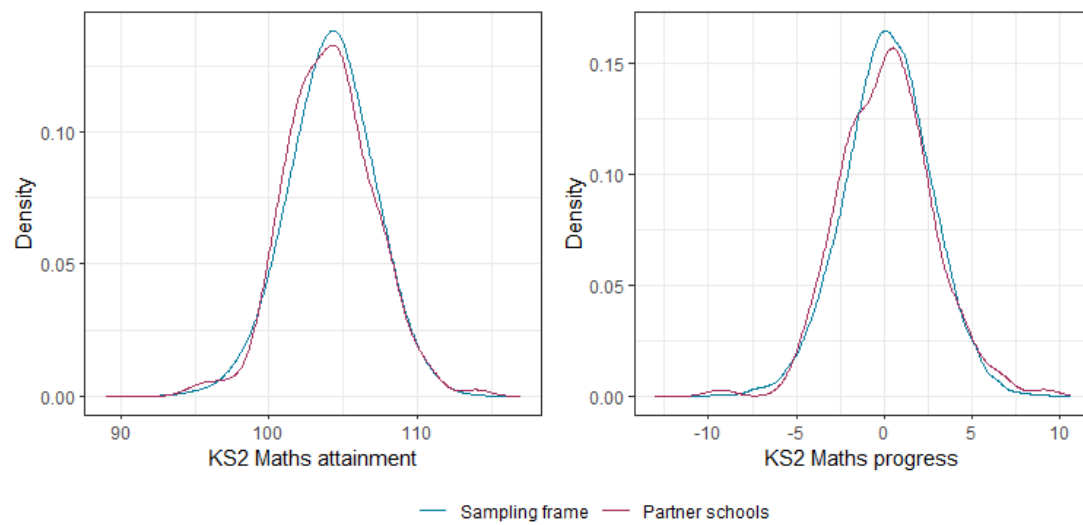

Figure 4 Comparison of the distribution of religious character among schools in the sampling frame and partner schools.

Figure 5 Comparison of the distribution of Reception cohort size among schools in the sampling frame and partner schools.

Figure 6 Comparison of the distribution across regions of schools in the sampling frame and partner schools.

Figure 7 Comparison of the distribution of urban/rural classification among schools in the sampling frame and partner schools.

Figure 8 Comparison of the distribution of the percentage of FSM-eligible pupils among schools in the sampling frame and partner schools.

Figure 9 Comparison of the distribution of the percentages of pupils recorded as White British and having English as an Additional Language among schools in the sampling frame and partner schools.
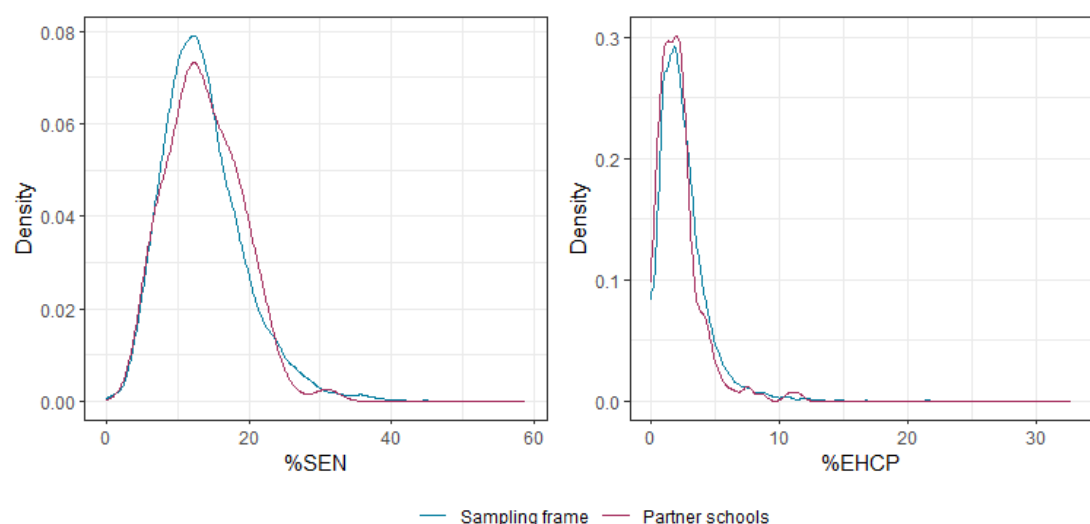
Figure 10 Comparison of the distribution of the percentages of pupils recorded as having SEN and an EHCP among schools in the sampling frame and partner schools.

Figure 11 Comparison of the distribution of Ofsted ratings among schools in the sampling frame and partner schools.

Figure 12 Comparison of the distribution of the average KS2 maths attainment and KS2 maths progress scores among schools in the sampling frame and partner schools.

Variable	Median within sampling frame	Median within partner schools
Cohort size	31.0	30.0
%FSM	21.0	20.8
%WB	77.9	79.2
%EAL	10.6	9.40
%SEN	12.9	13.3
%EHCP	2.14	1.94
KS2 maths attainment	104	104
KS2 maths progress	0.20	0.20

Table 4 Medians of the numerical variables presented above as density plots, plus cohort size.

4.2 Secondary schools

In total, 150 secondary schools were recruited to the study, which based on the data should correspond to around 29000 pupils in Year 7 in 2022/23. Of these, 122 schools and around 24000 pupils are in the main (non-selective, mixed-gender) stratum. (Based on birth data for England and Wales[4], we anticipate that the number of Year 7 pupils during data collection in the 2024/25 cohort will be around 2% lower than this.)

Table 5 shows the numbers of secondary schools recruited in the six strata that combine the selective/non-selective and boys/girls/mixed classifications.

	Boys	Girls	Mixed
Selective	6 (7)	6 (7)	7 (7)
Non-selective	3 (7)	6 (7)	122 (115)

Table 5 Numbers of partner secondary schools in the 6 different strata. Table entries are in the format "achieved (target)".

Overall, 150 partner secondary schools were recruited, which matched the target of 150; but recruitment was uneven across the strata. Despite several waves of invitations to recruit non-selective boys schools, time limitations meant more resource became focused on recruiting to the "main" (mixed & non-selective) stratum and non-selective boys schools are under-represented. However, the study will still be able to compare selective and non-selective outcomes, and single-sex versus mixed settings for girls, which is important given there are concerns regarding attainment and participation of female students in post-16 mathematics.

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[4] Office for National Statistics, Births in England and Wales dataset. Accessed 31/Mar/2025 at https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/livebirths/datasets/birthsummarytables.

The remainder of this analysis focuses on the main stratum of non-selective, mixed-gender secondary schools. (With relatively small numbers in the other strata, any visualisations will not be very informative.)

Figures 13-25 and Table 6 show that the sample of partner schools is representative of the sampling frame. A few observations from these figures are noteworthy:

- There is over-representation of sponsor-led academy schools and schools in large MATs; and under-representation of community and voluntary aided and controlled schools and schools not in a trust. The former has arisen, at least in part, due to targeted invitations to large MATs (several of which include large numbers of sponsor-led academy schools) following an initial distinct lack of these schools joining the study in the recruitment process. The latter are also closely related to each other but the reason for their under-representation is less clear. Despite this sampling variation, the partner schools nonetheless provide a reasonable representation of the sampling frame.

- There is some under-representation of schools in towns and smaller cities (i.e. non-conurbations) and corresponding over-representation of the other two classifications of urban/rural status; but this is one of very few variables where an unexplained discrepancy arises and is unlikely to impact the validity of the study findings.

- As noted previously, the sample of recruited partner schools is somewhat over-representative of high-FSM schools and under-representative of mid-range-FSM schools, but this slight bias will enable the study to further investigate the impact of economic disadvantage. The association of FSM status with ethnicity and having English as an additional language means that the sample of partner schools is slightly over-representative in terms of schools with few White British pupils and under-representative of schools with lower EAL levels. However, the table of medians (Table 6) shows that the differences between the sampling frame and the sample of partner schools are much smaller than might be initially suggested by the density plots in Figure 21 and Figure 22.
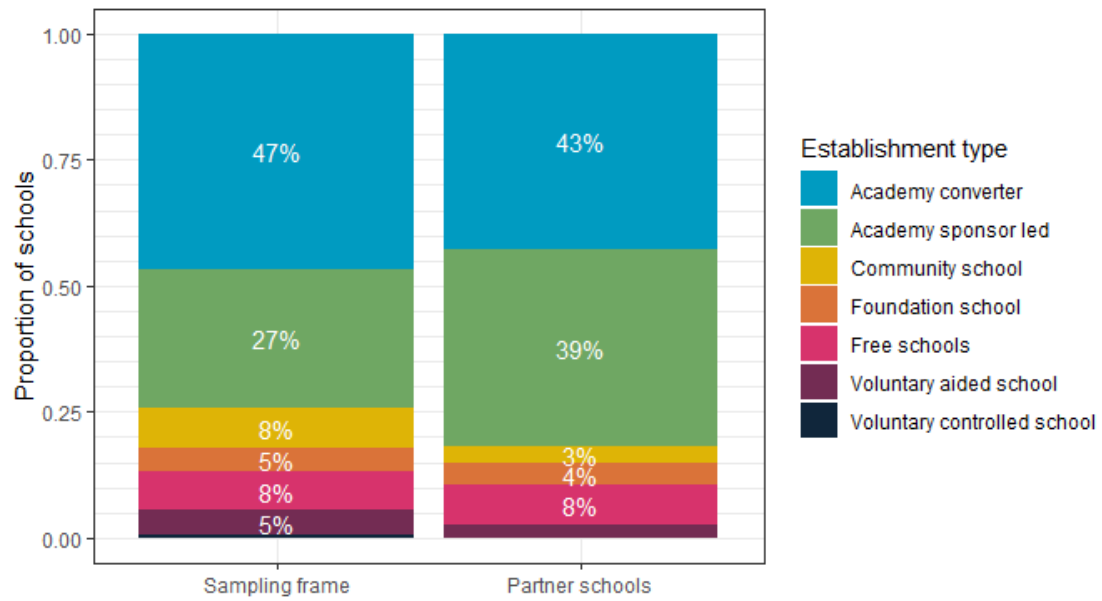
Figure 13 Comparison of the distribution of establishment type among schools in the sampling frame and partner schools.
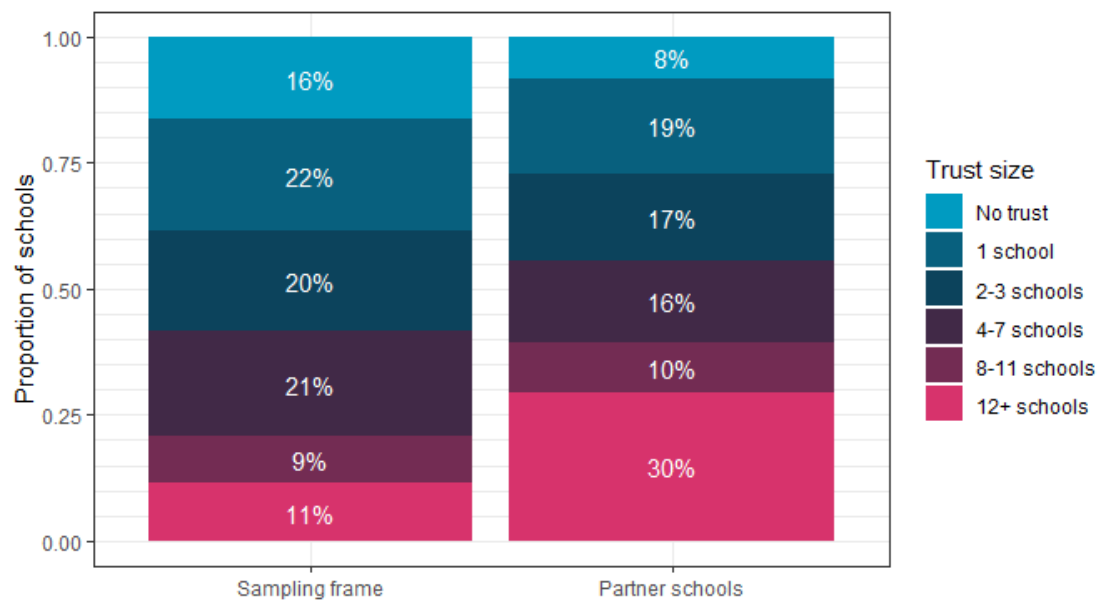

Figure 14 Comparison of the distribution of trust size among schools in the sampling frame and partner schools.
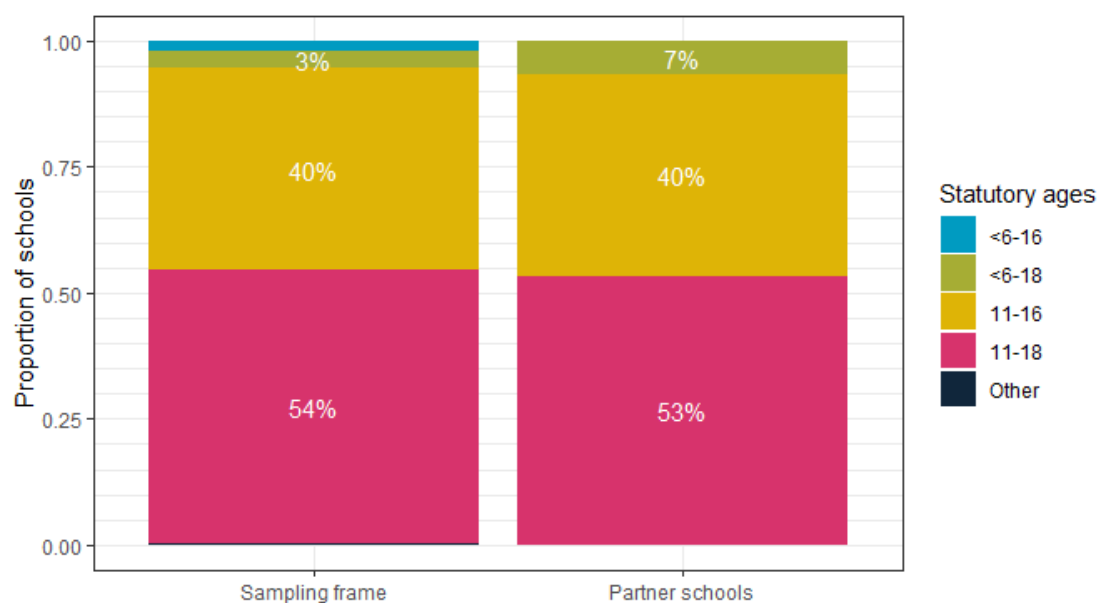
Figure 15 Comparison of the distribution of statutory ages among schools in the sampling frame and partner schools.
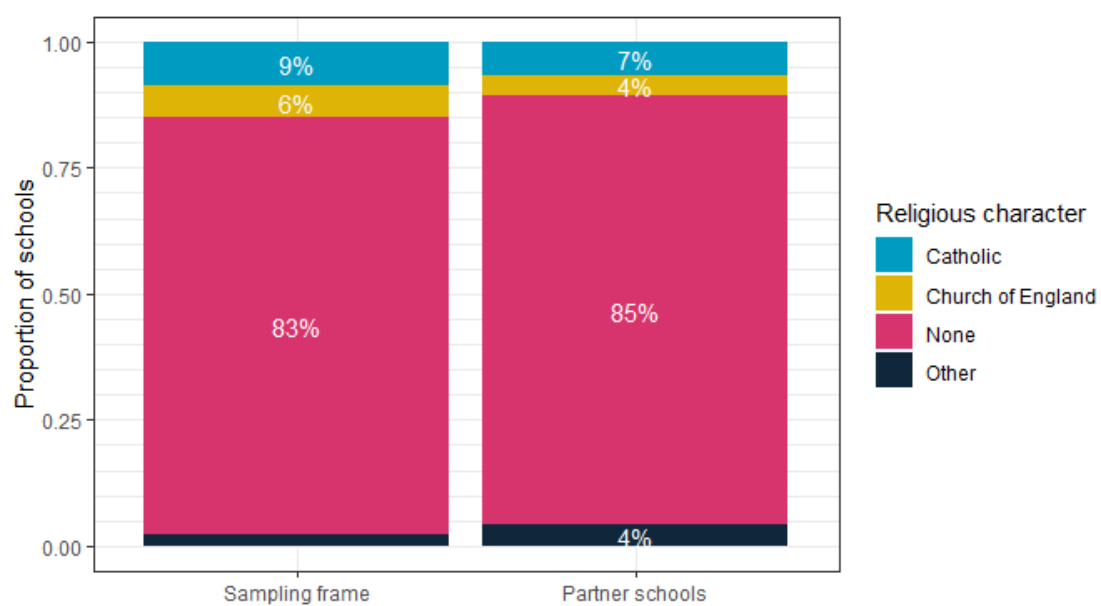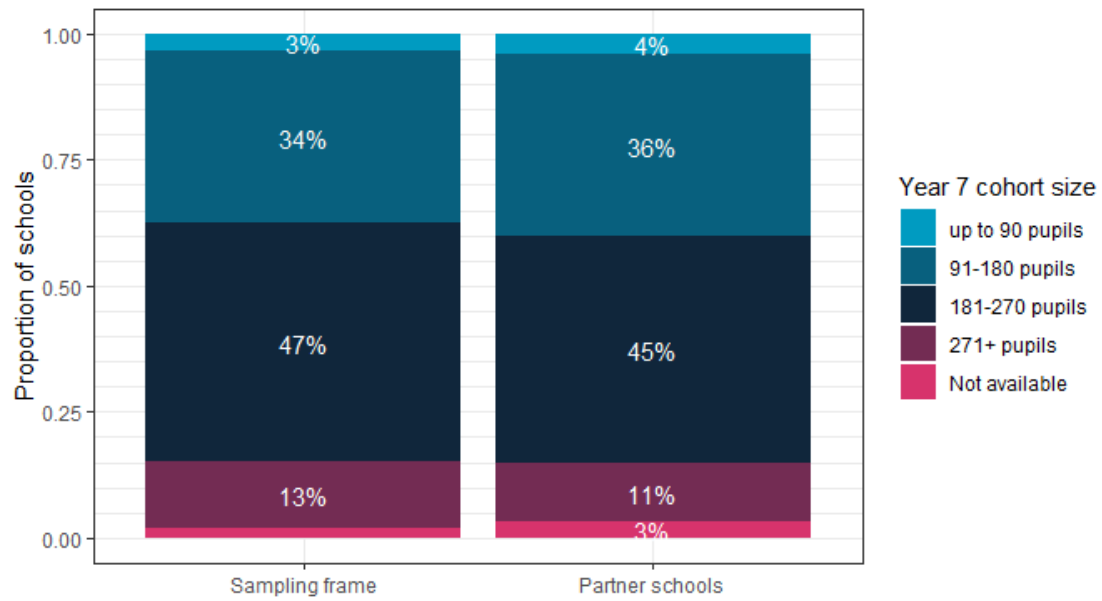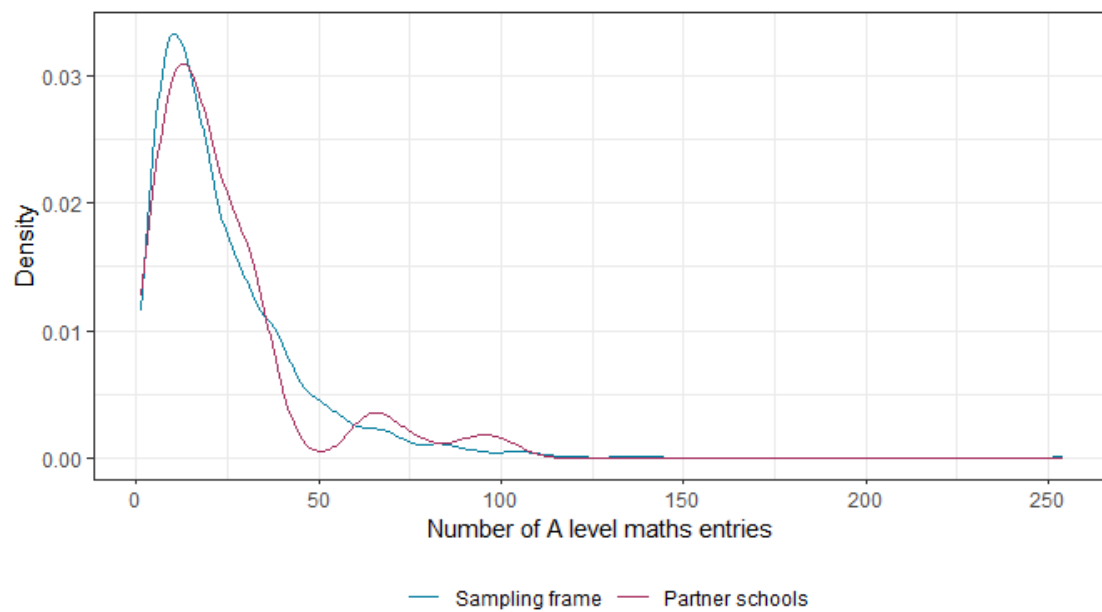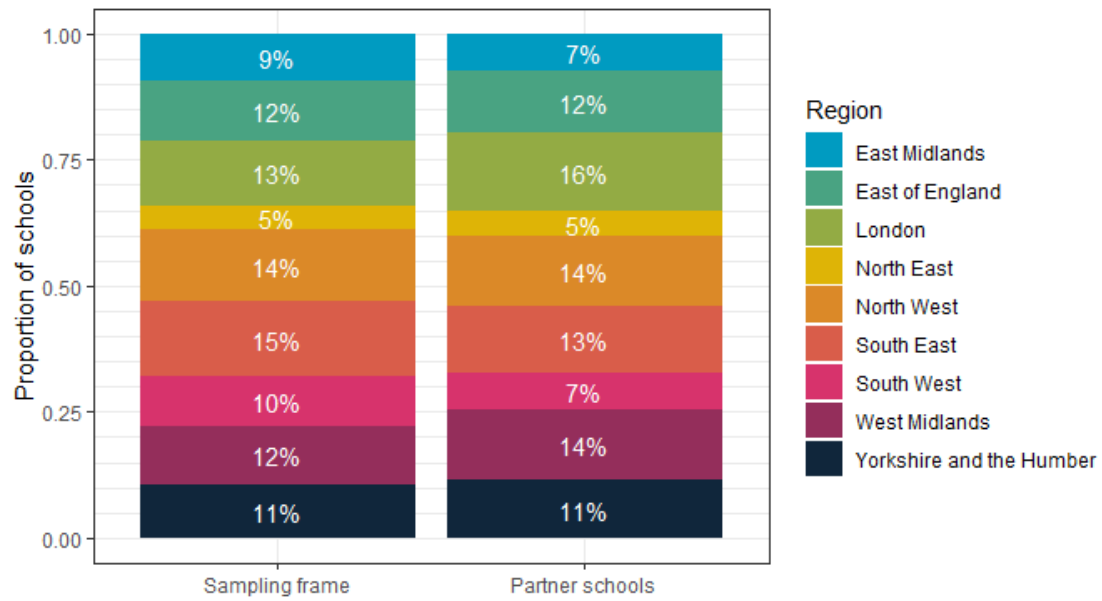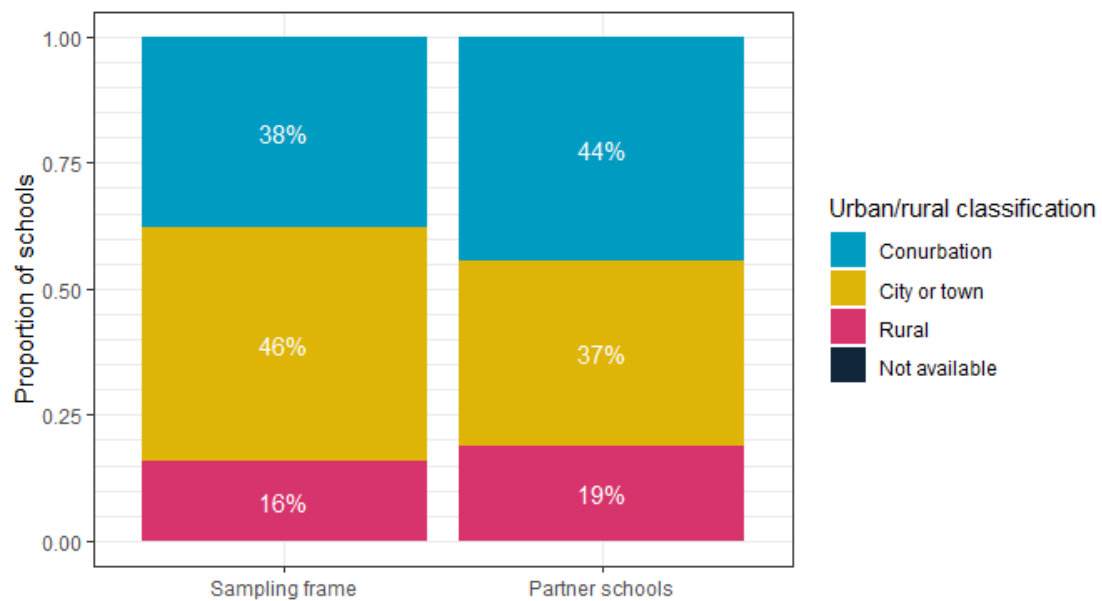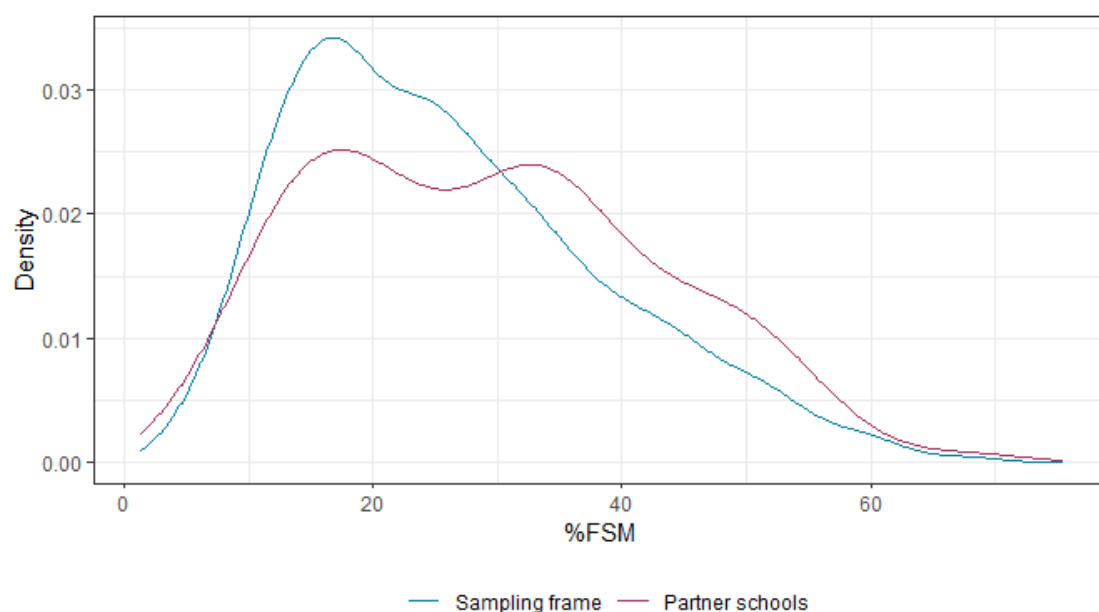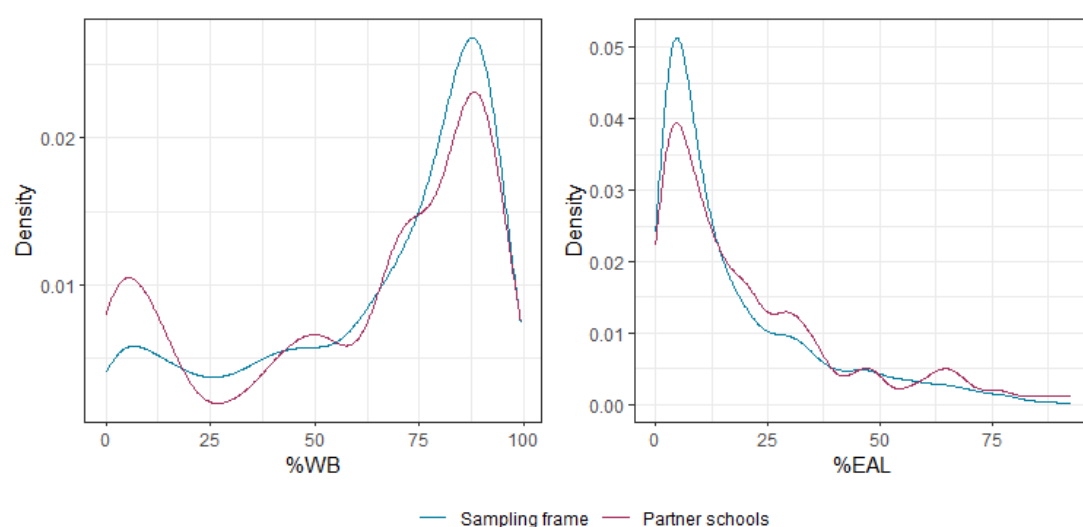

Figure 16 Comparison of the distribution of religious character among schools in the sampling frame and partner schools.

Figure 17 Comparison of the distribution of Year 7 cohort size among schools in the sampling frame and partner schools.

Figure 18 Comparison of the distribution of the number of A Level maths entries in the sampling frame and partner schools.

Figure 19 Comparison of the distribution across regions of schools in the sampling frame and partner schools.

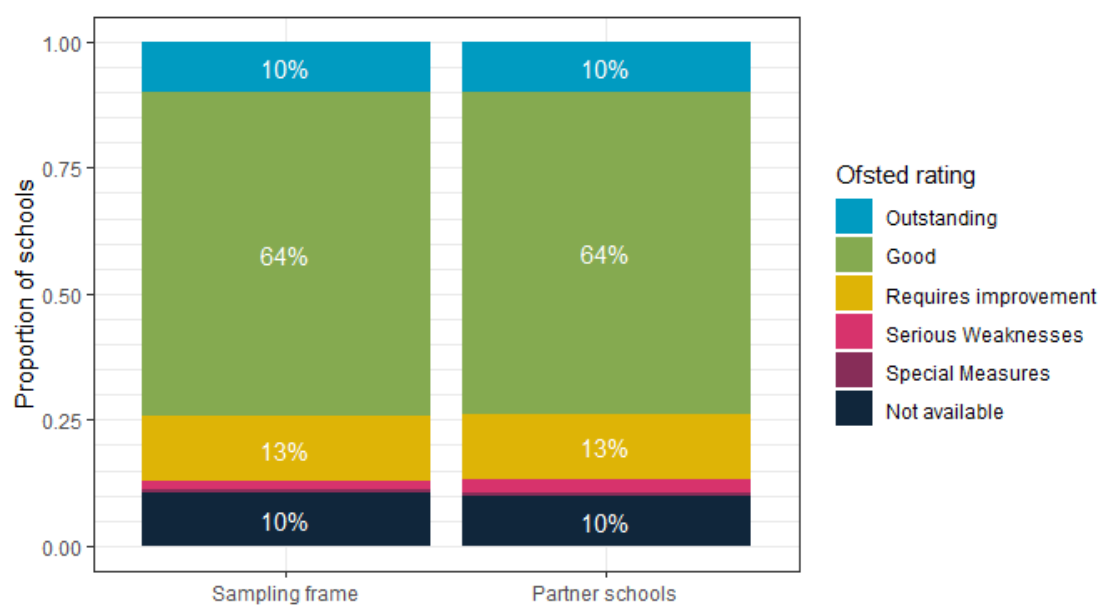Figure 20 Comparison of the distribution of urban/rural classification among schools in the sampling frame and partner schools.

Figure 21 Comparison of the distribution of the percentage of FSM-eligible pupils among schools in the sampling frame and partner schools.

Figure 22 Comparison of the distribution of the percentages of pupils recorded as White British and having English as an Additional Language among schools in the sampling frame and partner schools.
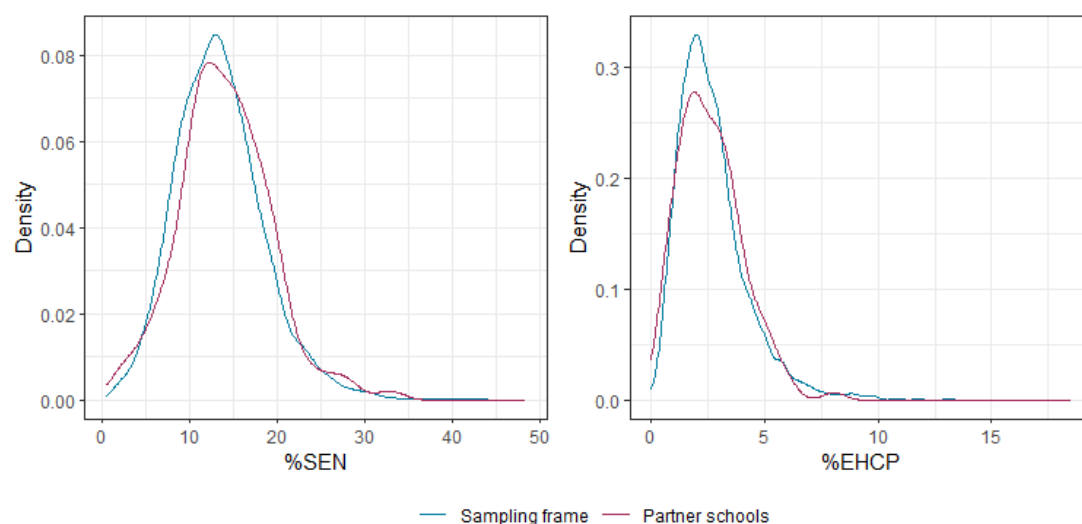
Figure 23 Comparison of the distribution of the percentages of pupils recorded as having SEN and an EHCP among schools in the sampling frame and partner schools.

Figure 24 Comparison of the distribution of Ofsted ratings among schools in the sampling frame and partner schools.
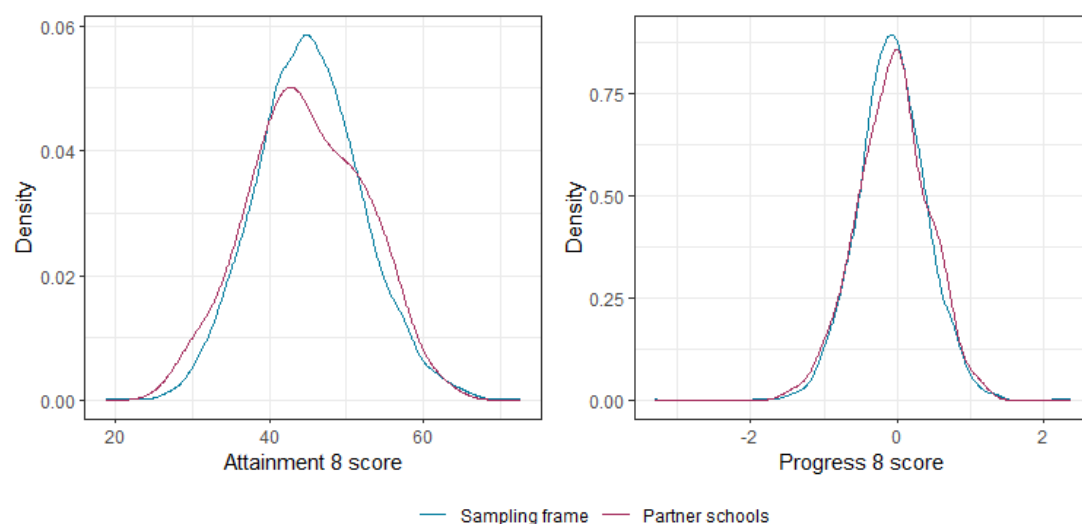
Figure 25 Comparison of the distribution of Attainment 8 and Progress 8 scores among schools in the sampling frame and partner schools.

Variable	Median within sampling frame	Median within partner schools
Cohort size	192	186
A Level entries	20.0	24.0
%FSM	23.0	23.6
%WB	74.2	69.1
%EAL	11.3	15.0
%SEN	12.7	12.8
%EHCP	2.25	2.02
Attainment 8 score	46.0	46.6
Progress 8 score	-0.010	0.045

Table 6 Medians of the numerical variables presented above as density plots, plus cohort size.

5 Conclusion

The Observatory for Mathematical Education is embarking on an ambitious 7-year programme to track thousands of learners through primary and secondary education. Each year pupils and teachers will be completing surveys to monitor, amongst other things, pupils' attitudes to learning mathematics, pedagogical techniques and an audit of who is teaching and learning mathematics. For these purposes, it is important that the partner schools are representative of schools nationally. The analysis presented above demonstrates that this is broadly true.

Of course, representativeness at school level does not guarantee representativeness at individual level. It is anticipated that some groups of pupils and teachers will be more likely to respond to future surveys than others. Therefore, some post-hoc correction using weighted responses may be necessary during the analysis of each instrument. However, the analysis presented above gives confidence that the raw sample will give a sufficiently good baseline from which minor adjustments to weightings can be made as necessary.

The above analysis also paints a picture of the sheer scale and variety within a single education system. Whether it is small primary schools in rural communities or large inner-city secondary schools; or MATs disseminating programmes of work across their network or an isolated teacher devising their own lesson plans, the Observatory's cohort studies will be able to measure the variability in pupil and teacher experiences and give insights at school, classroom and pupil level.

The Observatory for Mathematical Education

The Observatory for Mathematical Education is undertaking an unprecedented ten-year programme of longitudinal research from reception to postgraduate level. This holistic, multi-scale and mixed-method programme aims to better understand our national system of mathematical education and support those trying to improve it. Further details can be found in the Introductory Report on the website.

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