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A comparative analysis

Rita Marques Costa

Dissertation presented as a partial requirement for obtaining the Master's degree in Statistics and Information Management

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SCHOOL RETENTION RATES IN PORTUGUESE MUNICIPALITIES:

A COMPARATIVE ANALYSIS

by

Rita Marques Costa

Dissertation presented as a partial requirement for obtaining the Master's degree in Information Management, with a specialization in Information Analysis and Management

Advisor: Professor Paulo Pinho Gomes

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ABSTRACT

One of the measures used to evaluate the success of an education system is the retention rate. In Portugal, in spite of the progress achieved in the past decades, students' retention is still a problem. The phenomenon of school failure has been extensively studied throughout the world. Nevertheless, the way it is distributed across the country and the potential reasons that contribute to it being more intense in some areas than in others have not. The idea behind this project is to analyze the retention rates in middle school and in high school in the Portuguese public system, since the beginning of the decade and understand how they are distributed across the territory. The methods used were Principal Components Analysis and cluster analysis.

The data related to potentially explanatory indicators of student failure – such as the average number of students per class, percentage of students in families who benefit from social support and the percentage of teachers with a permanent contract – were analyzed.

The differences between the north and the south of the country are remarkable. Generally, the retention rates are much higher in the south than in the north. We also conclude that municipalities that are closer to each other have similar behaviors regarding their students' success or unsuccess in terms of retention rates. Nevertheless, there are exceptions to the rule. For example, in Algarve, São Brás de Alportel stands out as a municipality that does particularly well in a context where retention rates are relatively high.

Lastly, in this dissertation, we zoomed in the conurbations of Lisboa and Porto, where almost one in four children was enrolled in 2015/2016. The conclusions are striking: there are schools with some of the lowest retention rates while others, sometimes right across the street, can double the percentage of retained students.

KEYWORDS

PCA; cluster analysis; school failure; municipalities; geographic distribution

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LIST OF ABBREVIATIONS AND ACRONYMS

DGE	Direção-Geral da Educação
EB	Escola Básica (middle school)
ES	Escola Secundária (high school)
EBS	Escola Básica e Secundária (middle and high school)
INE	National Statistics Institute
NUT	Nomenclature of Territorial Units for Statistics
PCA	Principal Components Analysis
PC	Principal Component
TEIP	Territórios Escolares de Intervenção Prioritária (translates to school territories of priority intervention)

1. INTRODUCTION

To retain a student is to make him or she repeat the school level that was finished in a given year instead of allowing them to move forward. This practice is usually justified as a way to reduce any shortcomings in students' academic progress (Jimerson, 1997 in Ferreira et al., 2015)

Several authors have argued though that this type of practice has significant impacts on the students that are subjected to it. And it is very rare for authors to cite positive consequences for the retained children or adolescents (Ferreira et al., 2015). On the contrary, lower self-esteem, early school leaving, poorer financial and creative capabilities during adulthood and a significant toll in the school and state's budget are some of the most common impacts enumerated by Ferreira et al. (2015).

In general, Portugal shows clear improvements in the effort to reduce the school retention rate. Particularly since the beginning of the century. But it is still one of the European countries where this statistic is higher. For Pereira & Reis (2014) the country is actually an example of a place where making a student repeat one year "is common practice" and it is embedded in the school culture (Sousa, 2017).

In spite of that, grade repetition is not homogeneous throughout the Portuguese territory. There are places where the ratio of retained students is higher than in others. That has to do with students' socioeconomic conditions and with the specificities of the territories themselves as Justino et al. (2014) and Pereira & Reis (2014) put it. Recognizing that this characteristics can (and have) impact on the schools results, the Portuguese Ministry of Education implemented a program called TEIP – which is an acronym for educative territories of priority intervention – that is aimed at schools located in "economically and socially disadvantaged areas, marked by poverty and social exclusion, where violence, indiscipline, abandonment, and school failure are most evident" (DGE, 2016).

Taking all this into consideration, the goal of this project is to understand how the school retention rates are distributed in the country by analyzing data for each municipality since 2010 for six different school levels – 7th, 8th, 9th, 10th, 11th, and 12th. The Portuguese school system (which is of mandatory enrolment until the age of 18 since 2009) is divided into three main groups: primary school, middle school (split into the second and third cycle) and high school. The grades under analysis correspond to what is called in Portugal the third cycle of middle school and high school.

By using the different grades and multiple school years the aim is to capture the diversity in the growth trends of the indicator, such as Justino & Santos (2017) did when analyzing other measures of unsuccess. Also, these are the school levels where retention is higher. In the years chosen, the Portuguese population has also gone through severe challenges because of the financial, economic and social crisis so it will be interesting to understand if these reflect on the retention rates.

Do neighbor territories have similar retention rates? Is the phenomenon bigger in the countryside or in coastline areas? In the places where school retention strongly differs from the average do the indicators regarding social support, the average number of students per class or the ratio of professors with a permanent contract also stand out? These are some of the questions that we intend to answer.

Regarding data analysis, the first step was to run a PCA of the school retention rates in each municipality and then cluster the individuals based on those results. After that, the territories that stand out were analyzed further in order to understand what makes them have a particularly bad (or good) performance in this indicator. An analysis focused solely on retention rate in the conurbations of Lisboa and Porto was also applied.

This type of analysis focused solely on school retention rate in public schools of each municipality was never done. One thing that is clear is that not every data related to school failure is in the hands of the local governments. Nevertheless, at a time when the decentralization of education is being discussed, and there will be more local power to manage this field it is relevant for policymakers to have this specific information.

2. LITERATURE REVIEW

2.1. THE CONCEPT

The school retention rate measures the proportion of students in a given year who do not advance to the next one. It is a concept that corresponds to the situation of a student staying at the same level of education for an additional year instead of advancing to the above level at the same time as his or her peers (Brophy, 2006) as quoted in (Ferreira, Félix, & Perdigão, 2015). The goal is to reduce any shortcomings in students' academic progress (Jimerson, 1997) in (Ferreira et al., 2015), but some authors also state that it is a "measure that sanctions and which, to a greater or lesser extent and depending on the school level and the age at which the students meet, can diminish their self-esteem, revolt them, disinterested them in the school and demote them from commitment to learning" (Rebelo, 1992; 1999) in (Ferreira et al., 2015).

INE (2018) calculates this indicator based on the number of students in one school level who stay in that same level because they are unsuccessful or because they are voluntarily trying to get better grades, divided by the total number of the students in that school level.

2.2. NATIONAL AND INTERNATIONAL DATA

In Portugal, the retention rate has been decreasing. At the beginning of the 2000s, 18.2% of public and private school students in Portugal had been retained. In 2016 this figure fell to 10% (Direcção-Geral de Estatísticas da Educação e da Ciência, 2018). In primary education, in 2001, 12.7% of students were retained. In 2017 they were 5.5%. In high school, the reduction was even greater, from a rate of 39.4% at the beginning of the millennium to 15.1% in 2017. (DGEEC, 2018)

The decrease was even higher in the rate of early school leaving than in the retention rate. "There is a greater emphasis on promoting learning success, which leads to a higher retention rate and a lower number of early school leavers" (Sousa, 2017).

In spite of the positive progress, the latest data from the International Program for Student Assessment (PISA, 2015), indicates that Portugal is the third country in the OECD where more 15-year-olds report having been retained at least once. Ahead of Portugal, there is only Belgium and Spain. According to PISA (2015) data, "in general, in OECD countries, students with socioeconomic, immigrant and youth deficiencies are more likely to have repeated one year".

In Portugal, the law makes school mandatory until children are 18 years old since 2009 (Law 85/2009). The students enrolling in 7th grade and levels below in 2009 were the ones that started to be covered by the new rules. So, the first ones only reached 12th grade in 2014/2015. That resulted in an increase in the number of students enrolled in high school (Viana, 2017). Judging by the global drop in retention rates previously presented, this modification did not have a negative impact on school unsuccess.

2.3. THE IMPACTS

The impacts of the retention phenomenon in children and adolescents occur at various levels (Ferreira et al., 2015) and ultimately costs money. Researchers at the Portuguese research project called Aqeduto adapted estimates from the Education Endowment Foundation to conclude that

retaining a student costs 6000 euros per year (Aqeduto, n.d.). Among the measures used to fight school unsuccess, researchers concluded that this is the most expensive and also the most inefficient approach – the student finishes the repeated level with less knowledge than when started.

The table below adapted from Ferreira et al. (2015) shows some of these effects.

Impacts	**Description**
Self-esteem	• Retaining students do not contribute to better learning or to achieving pedagogical goals in subsequent years but increases the probability of dropout and decreases self-esteem (Jimerson, 2001) apud (Ferreira et al., 2015). • Retention leads to decreased self-esteem, impairs the socialization process and contributes to the alienation of the school according to Brophy (2006) and Xia Kirby (2009) apud (Ferreira et al., 2015). • "It is worth mentioning that early school retention may lead to a decrease in the student's self-esteem and lead either to the weakening of school ties or to a tendency to interact with deviant peers." (Simões et al., 2008: 148) apud (Ferreira et al., 2015).
Early school leaving	• Retention is a significant predictor of school dropout by students in the secondary level of education according to EACEA/Eurydice (2014) apud (Ferreira et al., 2015). • Increases the probability of eventual abandonment according to Brophy (2006) and Xia Kirby (2009) apud (Ferreira et al., 2015).
Financial capacity and creativity	• "These students have much lower expectations of training than students who never repeat, this is a cost that will be perpetuated for entire lives, both financially, as well as the creative and productive capacity of these young people, and consequent contribution in human and financial capital to the whole system. "(Flores et al., 2013) apud (Ferreira et al., 2015).
School and state budget and finances	• Brophy (2006) and Xia Kirby (2009) apud (Ferreira et al., 2015) point out that it creates budgetary and patrimonial problems for schools and educational systems. • The retention costs for Education budgets are substantial. In short, retention is inefficient, costly, having implications for efficiency and equity, say Field et al. (2007); OECD (2012); OECD (2013) apud (Ferreira et al., 2015).
Adjust students' capacities	• "The stated goal of repeating the failed grade level is to remediate academic failure or social immaturity. Many educators who support the practice of retention believe that it is an effective solution to school failure or maladjustment" (Goodlad & Anderson, 1963) apud (Jimmerson, 1997) apud (Ferreira et al., 2015). • Nevertheless, Shepard and Smith (1990) concluded that "although grade retention is widely practiced, it does not help children to 'catch up.' Retained children may appear to do better in the short term, but they are at much

	greater risk for future failure than their equally achieving, nonretained peers" (Jimmerson, 2001) apud (Ferreira et al., 2015).

Table 1 – Impacts of retention on students

2.4. GEOGRAPHICAL DISTRIBUTION

The distribution of this phenomenon is not the same for each level of education, school or municipality. As Brophy (2006) explains: "The poor performance patterns of those repeating the year tend to be associated with indicators of poverty both at school and in the family. Schools in poor areas (especially remote rural areas) often have limitations: short school years, frequent teacher absenteeism, limited supplies, low-skilled teachers, large classes, multi-age classes, or double-shift classes. Within any school, students from poorer families are at greater risk of repetition because their origins leave them less prepared to succeed and are likely to miss more school days. "

According to Justino et al. (2014) "the contrast between urban and rural areas, the north and south of the country, the interior at risk of desertification and the coastline that concentrates a high proportion of the population, is so striking that it is difficult to speak of territorial cohesion". The problem is also more evident in more isolated schools and in classes with many students (Wong, 2018).

In a 2016 study, DGEEC (2016a) also assesses the impact of the socioeconomic context of school retention. It concludes that children of lower socioeconomic levels may suffer more from retention, but other factors must be taken into account. "The influence of local factors such as the dynamism of schools and their teachers, the degree of importance placed in teaching children and school work in the region's culture, may perhaps overlap locally with the effect of socioeconomic status, so that pupils from regions with low socioeconomic levels may nevertheless have school performance levels in the second cycle, which are clearly higher than the national average. For the third cycle, the conclusions are similar. (DGEEC, 2016b)

In studies that focus on the role of education in specific municipal strategies, the local authorities are already looking at how their municipality is positioned in relation to the neighbors of the same region.

For example, in Lousã, "in the school year 2012/2013, the value of 11.3% [retention] was well above the average of the region, with only the innermost and mountainous municipalities having higher retention. The completion/transition rate in secondary education, with 76.7%, is well below the average for the region and the continent" (Cordeiro & Manuel, 2017).

On the other hand, in Alvito, Alentejo, "in terms of retention and dropout rates in primary and secondary education, the trend registered is decreasing, being close to those registered in the Lower Alentejo "(Saúde, Lopes, & Machado, 2018).

In a study at the municipal level focused on gathering the factors – social and organizational – that explain success or unsuccess, Justino & Santos (2017) found out that, the percentage of mothers with a university degree is the "strongest predictor of results". Aspects such as the country of origin of the students (because of language barriers) and the socioeconomic deficiencies also contribute to explain the phenomenon.

Understanding how these inequalities are distributed can be useful, especially at a time when decentralization of education is being debated. In this field, there are several views on whether education should be the responsibility of municipalities. There are teachers who "do not agree with the transfer of competences to municipalities because they fear that the management of teaching staff will pass to the chambers, causing the loss of autonomy of the school and that the national dimension of teaching, can generate conflicts between school and local authority, which adds to the risk of politicization of educational action "(Carvalho, 2012). However, the councils defend the idea that the transfer of this power to the municipal level can bring benefits and bring education management closer to local politics (Carvalho, 2012).

In the academic year 2019/2020, the management of 43.626 employees and 996 schools will become the responsibility of local authorities. This decentralization will cost 797 million euros (Francisco, 2018).

2.5. PRIORITY INTERVENTION

The Ministry of Education recognizes that there are differences between territories and that there are schools in “economically and socially disadvantaged areas, marked by poverty and social exclusion, where violence, indiscipline, abandonment, and school failure are most evident” (DGE, 2016). Some of those schools are part of a program called TEIP – which is an acronym for educative territories of priority intervention – and receive financial support to enhance their organizational practices and also their teaching and learning techniques. In 2016 there were 137 schools (or school groups) in this network. The program exists since 2007.

In an evaluation of the first years of the program, the Ministry of Education mentions that between 2007 and 2010, the TEIP schools managed to reduce early school leaving and school absence.

Regarding the violence index at school, “generally, between 2006/2007 and 2009/2010 there was an increase in the number of indiscipline cases registered and a reduction in the gravity level of those cases” (ME, 2010). But this “should not be associated with a deterioration of the school climate, as it reflects an improvement in the capacity to register and respond to these situations” (ME, 2010). There is no reference to retention in this report.

In 2011, though, a group of researchers (Abrantes, Mauritti, & Roldão, 2011) set to evaluate the school and social impacts in seven TEIP schools. On it, one of the school directors notes that “the students' retention rate has improved, but that can only be partially attributed to the fact that it is a TEIP, something relatively new at the time”.

In a later stage of the analysis, we will be looking specifically into this schools performance regarding retention rates. Namely, the ones located in Lisboa and Porto and its bordering municipalities. For that reason, it is important to bear in mind that there are eight TEIP schools in Amadora, 14 in Lisboa, four in Loures and two in Oeiras – for Lisboa – and four in Gondomar, one in Maia, three in Matosinhos, three in Vila Nova de Gaia and eight in Porto.

2.6. INTERNATIONAL EXAMPLES

In the USA, Warren (2005) analyzed the high-school completion rates at the state level (though this is not the same as retention, it can be seen as an opposing measure). What the author concluded was

that “since the mid-1970s the national rate at which incoming 9th graders have completed high school has fallen slowly but steadily; this is also true in 41 states. In 2002, about three in every four students who might have completed high school actually did so; in some states, this figure is substantially lower”.

In New Zealand, Pool et al. (2005) went through the differences in school retention in several regions of New Zealand between 1986 and 2001. Only to conclude that they exist. Mainly because of the pre-existing differences between regions and how they historically favor education, and also because of the level of regional development.

3. METHODOLOGY

3.1. DATA DESCRIPTION

The data analyzed refers to the retention rates from 2010/2011 to 2015/2016 for the 3rd cycle of "Ensino básico" or middle school - children from 12 to 14 years old - and "Ensino secundário" or high school - 15 to 18 years old - in public schools in mainland Portugal. In total, 231 municipalities are considered - there are cases where there are no secondary schools and, therefore, the municipality in question is eliminated from the analysis - and 36 variables (the school levels in each year).

Since the existing data for retention in each municipality does not disaggregate this rate for public and private schools, it was calculated based on the retention rate in each public school averaged by the weight given by the number of students in each school year under analysis, that is, 7th, 8th, 9th, 10th, 11th and 12th grade. When calculating all the descriptive statistics and PCA, the data regarding each municipality was weighted by the number of students enrolled in each municipality in 2015/2016.

The boxplots show there are outliers in every variable. Both for middle school and high school levels. Some of the biggest variations happen in 7th and 9th grade, for middle school, and 12th grade, for high school (figure 1).

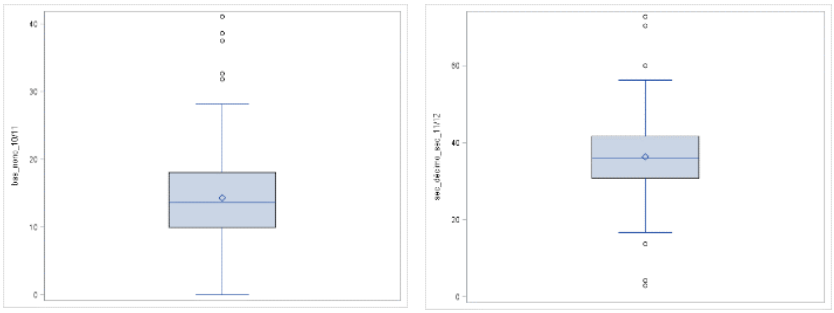


Figure 1 – Example boxplots for 9th grade 2010/2011 (left) and for 12th grade 2011/2012 (right)

The preliminary analysis of the data allowed to conclude that there are 19 severe outliers, that is the values that are three times above (the third quartile) or below (the first quartile) the interquartile range.

The data used shows significant differences among municipalities. For example, Amadora has, on average, the biggest retention rate (26.9%). It is followed by Sines, Loures, Odivelas, and Mogadouro. On the other end of the scale, there is Mortágua, Caminha, Sever do Vouga and Monção, all below 10%.

There are also differences in the grades and years analyzed. The highest retention rates happen consecutively in 12th grade. The worst value registered is from 2010/2011 and regards Almodôvar's retention rate for the 12th grade: 71%. The standard deviation is also slightly wider in 12th grade (as shown in table 2). In high school, the lowest retention values are registered in the 11th grade, which is an intermediate level.

Regarding the third cycle, the highest retention happens, on average, on 7th grade. And the lowest values happen in 8th grade. This phenomenon where the intermediate levels have a lower rate of unsuccess than the end of the cycle is not unknown. Conselho Nacional de Educação (2018) released a report where they point out "a significant increase [in the retention rate] in the first year of each study cycle, compared to the last year of schooling in the previous cycle".

	Min	Max	Mean	Median	Standard deviation	Variance
7th grade (2010/2011)	0.0	40.9	15.6	15.2	5.2	26.9
7th grade (2011/2012)	0.0	33.6	17.5	17.2	5.6	30.9
7th grade (2012/2013)	0.0	36.8	16.9	17.0	5.3	28.0
7th grade (2013/2014)	0.0	42.3	17.6	17.8	5.7	32.7
7th grade (2014/2015)	1.4	34.8	16.0	16.1	5.3	27.7
7th grade (2015/2016)	0.0	30.7	13.3	13.3	4.9	24.2
8th grade (2010/2011)	0.0	28.0	10.5	10.3	4.0	15.8
8th grade (2011/2012)	0.0	29.5	12.9	12.4	4.4	19.5
8th grade (2012/2013)	0.0	30.1	14.4	13.9	4.4	19.1
8th grade (2013/2014)	0.0	33.3	13.8	14.1	4.3	18.8
8th grade (2014/2015)	0.0	32.5	10.6	10.2	4.0	16.4
8th grade (2015/2016)	0.0	25.0	8.4	8.6	3.4	11.8
9th grade (2010/2011)	0.0	37.5	14.3	14.2	4.5	20.3
9th grade (2011/2012)	1.4	40.0	17.6	17.1	5.2	26.6
9th grade (2012/2013)	2.0	41.0	18.6	19.5	4.9	23.5
9th grade (2013/2014)	2.2	34.4	16.1	16.8	4.4	19.1
9th grade (2014/2015)	0.0	25.5	11.3	11.0	3.8	14.4
9th grade (2015/2016)	0.0	23.7	9.5	9.8	3.5	12.3
10th grade (2010/2011)	2.0	43.1	18.5	18.3	5.7	32.2
10th grade (2011/2012)	1.4	42.4	18.0	18.2	6.0	36.6
10th grade (2012/2013)	0.0	47.8	17.4	18.7	5.7	32.4

10th grade (2013/2014)	0.0	35.5	17.5	18.0	5.4	29.0
10th grade (2014/2015)	0.0	35.7	15.9	15.7	5.0	25.5
10th grade (2015/2016)	0.0	33.0	17.7	18.2	5.6	31.4
11th grade (2010/2011)	0.0	38.1	14.0	13.7	4.8	22.7
11th grade (2011/2012)	2.3	33.3	15.3	15.2	4.9	23.8
11th grade (2012/2013)	0.0	29.2	15.4	15.7	4.8	23.3
11th grade (2013/2014)	0.0	32.0	13.6	13.4	4.6	20.9
11th grade (2014/2015)	0.0	26.7	11.5	11.1	4.2	17.7
11th grade (2015/2016)	0.0	23.8	9.0	8.9	3.7	13.5
12th grade (2010/2011)	6.7	71.4	38.9	38.6	6.8	46.4
12th grade (2011/2012)	2.8	60.0	37.2	37.1	6.4	40.4
12th grade (2012/2013)	15.0	67.4	38.1	38.5	7.1	51.1
12th grade (2013/2014)	8.3	65.4	37.4	38.4	7.4	54.2
12th grade (2014/2015)	0.0	62.2	32.3	33.8	7.1	50.7
12th grade (2015/2016)	4.9	54.1	32.3	31.6	7.1	50.2

Table 2 – Data description

The graphs in figure 2 show an interesting phenomenon, particularly in middle school. The retention rates reach a peak between 2012/2013 and 2013/2014 and tend to decrease, reaching lower values than at the beginning of the decade. In high school that is more obvious in 11th and 12th grade. In 10th grade, though that does happen. The percentage of retained students at that level is more or less stable throughout the years.

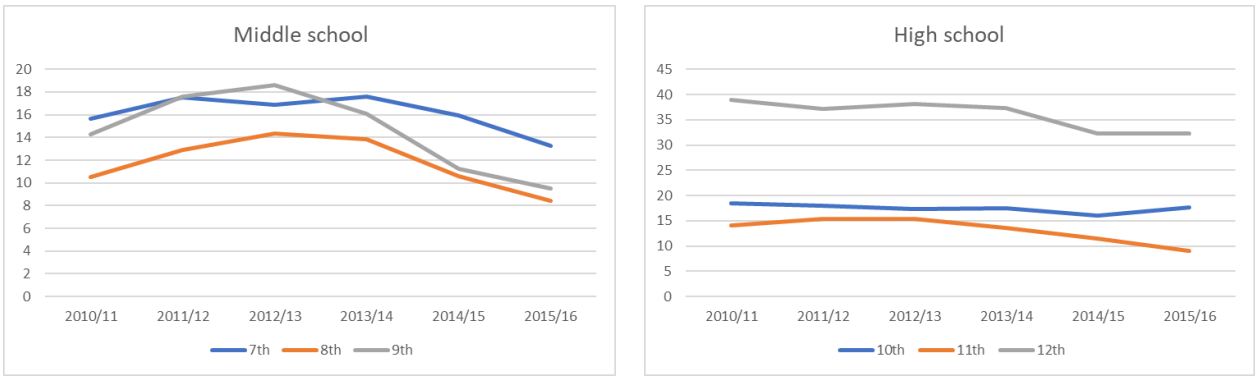


Figure 2 – Evolution of median retention rates in each school level along the years under study

3.2. PRINCIPAL COMPONENTS ANALYSIS

For the analysis of retention data, a PCA methodology was used. According to Jolliffe (2002) "the central idea of principal components analysis is to reduce the dimensionality of a data set consisting of a large number of interrelated variables while retaining as much as possible of the variation present in the data set. This is achieved by transforming to a new set of variables, the principal components (PCs), which are uncorrelated, and which are ordered so that the first few retain most of the variation present in all the original variables". This means that the dimensionality of the retention rates for every grade in each school year will be reduced. Producing a much smaller number of variables.

The variables analyzed are all on the same scale so the covariances matrix was chosen over the correlation matrix to perform the PCA. Also, by keeping the covariance matrix we preserve the differences in variance in the different school years and levels. The covariance matrix shows that the school levels from the same cycle – that is 7th, 8th, 9th, and 10th, 11th 12th – are closer to each other and have bigger covariance when between groups. Even though the matrix of covariances was the one used, we also looked at the correlations. The highest values, around 0.75, happen between the retention rates on 7th grade in several school years. And it is bigger if they are closer in time to each other. This is a sign of the evolution in the indicator, that has reached a peak somewhere between 2012 and 2014 and has been decreasing since then.

As said before, the variables used were weighted by the total number of enrolled students in 2015/2016. The software used to perform the PCA was R. In some instances, SAS Enterprise Guide and Excel were also used. The full results can be seen in the annexed tables.

3.3. CLUSTER ANALYSIS

The PCA output was then used in the cluster analysis, a method that groups data objects based on the data that describes these objects and their relationships (Tan et al., 2018). With a goal in mind: that the objects within the group are similar to one another and different from the objects in other groups. The greater the similarity (or homogeneity) within a group and the greater the difference between groups, the better or more distinct the clustering, add Tan et al. (2018).

Also, according to Jollife (2002), "there are two main ways in which PCs are employed within cluster analysis: to construct distance measures or to provide a graphical representation of the data; the latter is often called ordination or scaling and is useful in detecting or verifying a cluster structure".

First of all, three different methods of hierarchical clustering were applied in order to evaluate the number of clusters to use in the non-hierarchical k-means. In this stage, the individuals that were considered as severe outliers (and were not included in the PCA) were added to the clustering procedure as supplementary individuals.

The Average method is described as a process that uses the average distance from members of one cluster to members of another cluster as the measure of inter-group distance (Everitt & Skrondal, 2010). In the Single linkage method, the distance between two clusters is defined as the least distance between a pair of individuals, one member of the pair being in each group (Everitt & Skrondal, 2010). The Ward's method is an agglomerative hierarchical clustering method in which a

sum-of-squares criterion is used to decide on which individuals or which clusters should be fused at each stage in the procedure (Everitt & Skrondal, 2010).

Afterward, the data was clustered with a k-means method. This is a non-hierarchical approach to clustering. Some of the authors behind its introduction were Macqueen (1967) and Diday (1973). Macqueen described it as a process "of partitioning an N-dimensional population into k sets on the basis of a sample". As for Diday he named the process "dynamic clusters method" (DCM) and explained that "the DCM can be classified among those clustering procedures that have been called 'iterative relocation procedures' by some authors and 'K-means' and 'cluster centers' by others. These various methods start from K points that are drawn either at random or among the population. These K points are chosen as initial centers; all the points are then allocated to the nearest centers".

3.4. WORKFLOW

The workflow diagram can be seen below. The analysis begins with the raw data on retention rates, on which a Principal Components Analysis is performed. Afterward, the data is clustered using both hierarchical and non-hierarchical methods.

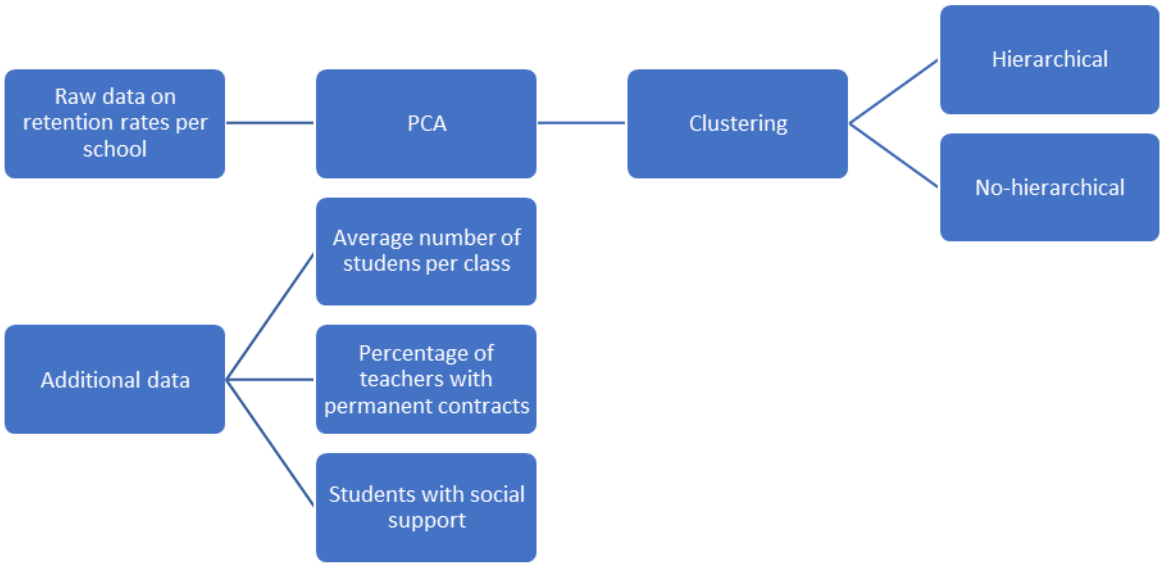


Figure 3 – Workflow

4. RESULTS AND DISCUSSION

Given that the idea with PCA was to reduce dimensionality to have a clearer picture of how the retention rates evolved, the number of principal components that were taken further into the analysis had to be selected. There is no hard rule on how to make this decision. And there was some iteration throughout the development of this dissertation.

After taking into consideration the scree plot of the eigenvalues and by analyzing the variance retained by each of them, the first decision was to keep the first six principal components. This decision was supported by analyzing the mean of the eigenvalues – 27.5 – which shows that all but the sixth eigenvalue are above that threshold. Together they represent 73% of the inertia associated with the data.

But by going further in the analysis and interpretation of the PCA outputs, it became evident that there were a reasonable number of individuals (93 had a CTR sum in the six dimensions below 50%) that were not well explained by this first six dimensions.

The decision was to go back, and retain the first 10 dimensions of the PCA that together explain 81% of the inertia. In this new scenario, only 36 municipalities are not explained well enough (the inertia of these 36 municipalities is less than 50%).

	Eigenvalue	**Variance (%)**	**Cumulative variance (%)**
λ.1	503.64	50.88	50.87
λ.2	76.95	7.77	58.65
λ.3	48.61	4.91	63.56
λ.4	35.99	3.64	67.19
λ.5	29.74	3.00	70.19
λ.6	24.95	2.52	72.72
λ.7	21.22	2.14	74.86
λ.8	20.16	2.04	76.89
λ.9	19.04	1.92	78.82
λ.10	16.89	1.71	80.53
λ.11	15.14	1.53	82.06
λ.12	13.89	1.40	83.46
⋮	⋮	⋮	⋮

Table 3 – Eigenvalues obtained from PCA

The decision on which components to retain was also taken by looking at the scree plot below.

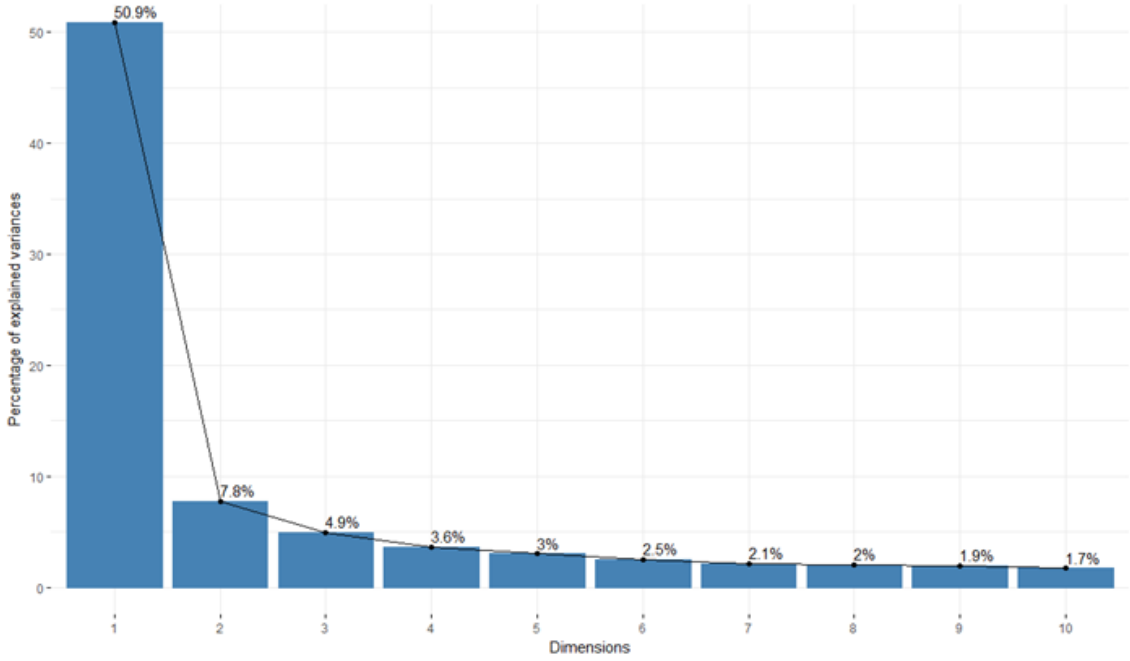


Figure 4 – Screeplot

The full PCA results can be seen in tables 2 and 3 (annex). The variables with a CTA bigger than 1/36 were taken into consideration for the analysis. As for the individuals, as previously said, there are 36 whose CTR sum in axis 1 to 10 is lower than 50%. Regarding all others: 83 have a CTR sum between 50% and 70%; for 67 the sum is between 70% and 90%; and 26 have a CTR sum along axis 1 to 10 that is greater than 90%.

4.1. PRINCIPAL COMPONENTS

4.1.1. First principal component (PC1)

The first principal axis explains the relative dimension of retention rates in the universe of public schools in the Portuguese mainland in the school levels targeted in this study and along six years (2010 to 2016). Concretely, the first axis opposes 95 municipalities where the retention rates were clearly lower or much lower than the mean global value of school retention rate to other 49 municipalities where that rate was higher or much higher.

The linear coefficient of correlation between the variables under study and the first principal component is always positive (size effect) and varies between 0.646 and 0.811.

The municipalities that are positioned in the positive side of the first axis are those who present a retention rate that is higher than the mean global value for the years under analysis. The ones on the negative side are those with the values that are lower than the global mean.

The first principal component represents 50.9% of the inertia associated with the data and explains at least 40% of the variance of all the variables under study. The 144 municipalities explain 98% of the inertia associated with the first axis.

All the school years in the 12th grade, 10th grade in 2011/2012 and 7th grade in 2011/2012 are the ones that contribute the most to explain the variance associated with the first axis (this is also

confirmed by the correlation matrix between variables and principal components). As previously seen, these are the variables that have a higher variance and a higher mean.

The individuals that are better represented in PC1 are Amadora, Loures, Odivelas, and Lisboa (all in the Lisboa district), to name a few. They all have high retention rates in the school levels that are best represented in this axis. On the other hand, municipalities such as Sever do Vouga, Ponte de Lima, São João da Madeira or Viana do Castelo have lower retention rates in those school years. This first dimension is very important in picturing the biggest and broadest differences between municipalities.

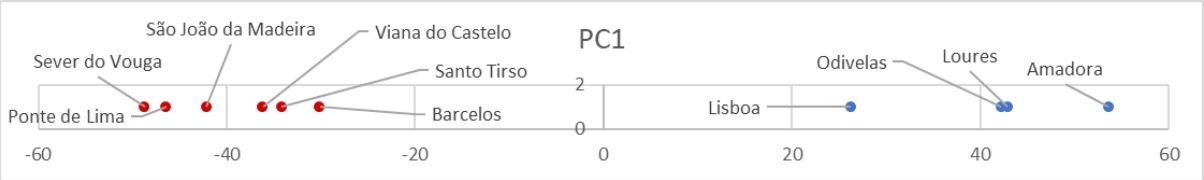


Figure 5 – Principal Component 1

Other municipalities with a relatively low retention rate

Norte: Vila Nova de Famalicão; Oliveira de Azeméis; Vila Real; Esposende; Amarante; Marco de Canaveses; Guimarães; Caminha; Paredes de Coura; Monção; Espinho; Chaves; Moimenta da Beira; Póvoa de Varzim; Arcos de Valdevez; Santa Maria da Feira; Arouca; Vale de Cambra; Fafe; Penafiel; Vila Nova de Cerveira; Murça; Braga; Carrazeda de Ansiães; Lamego; Vizela; Mesão Frio; Bragança; Cinfães; Melgaço; Amares; Celorico de Basto; Valença; Vila do Conde; Maia; Vila Pouca de Aguiar; Ribeira de Pena.

Centro: Figueira da Foz; Covilhã; Coimbra; Viseu; Mortágua; Fundão; Leiria; Marinha Grande; Aveiro; Porto de Mós; Guarda; Entroncamento; Soure; Ovar; Ansião; Cantanhede; Nelas; Castro Daire; Condeixa-a-Nova; Tomar; São Pedro do Sul; Mira; Ourém; Proença-a-Nova; Batalha; Pombal; Oliveira de Frades; Santa Comba Dão; Sobral de Monte Agraço; Oleiros; Trancoso; Torres Vedras; Sátão; Alcanena; Estarreja; Águeda; Vagos; Penacova; Castelo Branco; Penalva do Castelo; Tondela; Mealhada; Sabugal.

Área Metropolitana de Lisboa: Oeiras.

Alentejo: Évora; Santarém; Estremoz; Ponte de Sor; Viana do Alentejo; Coruche; Moura.

Algarve: São Brás de Alportel.

Other municipalities with a relatively high retention rate

Norte: Mogadouro; Porto; Matosinhos; Miranda do Douro; Montalegre; Valpaços; Paredes; Torre de Moncorvo; Macedo de Cavaleiros; Alfândega da Fé; Castelo de Paiva; Resende.

Centro: Cadaval; Tábua; Óbidos; Lousã; Anadia; Figueira de Castelo Rodrigo.

Área Metropolitana de Lisboa: Amadora; Odivelas; Loures; Lisboa; Almada; Sintra; Seixal; Moita; Barreiro; Setúbal; Vila Franca de Xira; Sesimbra; Cascais; Alcochete.

Alentejo: Sines; Reguengos de Monsaraz; Benavente; Cartaxo; Odemira; Serpa; Grândola; Vila Viçosa; Beja.

Algarve: Loulé; Albufeira; Vila Real de Santo António; Lagos; Olhão; Portimão; Lagoa; Silves.

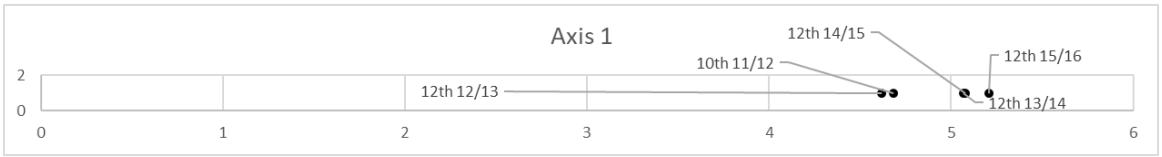
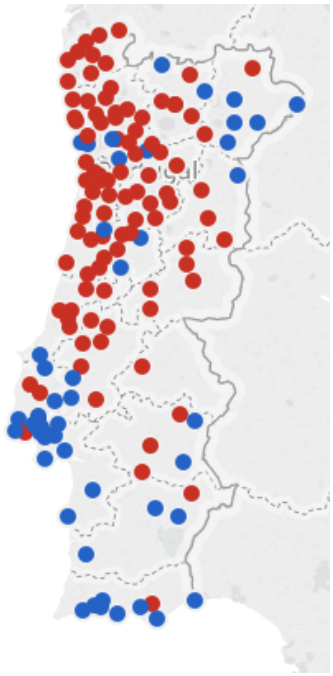


Figure 6 – Axis 1



It should be kept in mind that there is already a geographical pattern coming up in the distribution of municipalities in this dimension.

The ones colored in blue in figure 7 are those on the positive half of the axis (and also, globally, the worst performing ones) are mostly in the south of Portugal.

The ones colored in red are the ones that do better. Those are spread in the North, mostly in the municipalities in the coastline.

Figure 7 – Geographic distribution of the municipalities in PC1

4.1.2. Second principal component (PC2)

PC2 represents 7.8% of the inertia associated with the data. In PC2 there is an opposition between the variables related to 7th and 12th grade. It is reasonable, then, to assume that this dimension represents the contrast of retention rates in the extreme school levels. From the first grade under analysis to the last one.

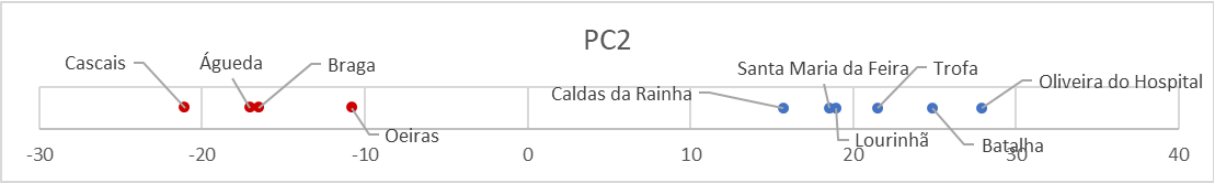


Figure 8 – Principal Component 2

Other relevant individuals to interpret this axis
Norte: Resende; Bragança; Lamego; Vila Verde; Tarouca; Mogadouro; Terras de Bouro; Melgaço; Maia; Gondomar; Murça; Alfândega da Fé; Valença; Cinfães; Ribeira de Pena.
Centro: Sátão; Sabugal; Trancoso; Mortágua; Almeida; Gouveia.
Área Metropolitana de Lisboa: Sesimbra; Palmela; Alcochete.
Alentejo: Vila Viçosa; Odemira; Almeirim; Cartaxo.
Algarve: Lagoa.

Other relevant individuals to interpret this axis
Norte: Paredes; Vila Nova de Gaia; Vale de Cambra; Felgueiras; Macedo de Cavaleiros; Vizela; Valpaços.
Centro: Sobral de Monte Agraço; Tondela; Oliveira de Frades; Figueira de Castelo Rodrigo; Peniche; Alcanena; Penacova; Castelo Branco; Mira; Entroncamento.
Área Metropolitana de Lisboa: Vila Franca de Xira.
Alentejo: Serpa; Moura; Grândola; Benavente; Montemor-o-Novo; Beja.
Algarve: São Brás de Alportel; Vila Real de Santo António; Silves.

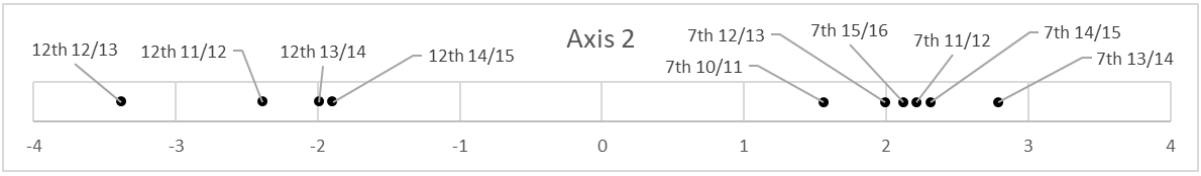


Figure 9 – Axis 2

those in 7th grade and other 35 where the retention rates for 7th grade is greater than in 12th grade or, in certain cases, both values are very close to each other. These municipalities explain 68.9% of the inertia associated with this axis.

Regarding the municipalities that are better explained by this axis, we confirm (much like in the first dimension) one of the assumptions made in the beginning: there is, in fact, a similar behavior between municipalities that are geographically closer to each other. That is the case, for example, with Cascais and Oeiras, both in the Lisboa district. These municipalities (Águeda, Braga and some others as well) are the ones that perform relatively well in 7th grade, but the retention rate tends to get worse in 12th grade.

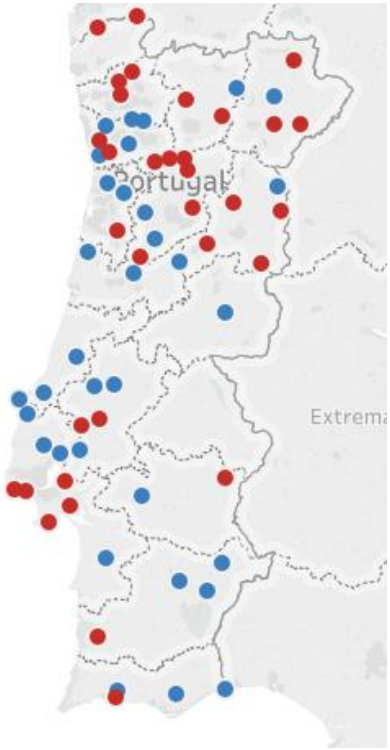


Figure 10 – Geographic distribution of the municipalities in PC2

Batalha and Caldas da Rainha, both in Leiria, and Lourinhã, located in Lisboa (although these three municipalities are not all part of the same district they are geographically close to each other) show some similarities that are the opposite of the ones previously described. They have, in certain school years, higher retention rates in 7th grade and lower in 12th. Although it must be noted that it is not common that retention rates in 7th grade are higher than those in 12th. In the municipalities that are positioned in the positive side (blue) of this axis, the retention rates in 7th grade tend to be much closer to those obtained in 12th grade than in the municipalities on the other half.

In spite of the proximity between the municipalities that stand out in this dimension, there is no clear geographic pattern associated with the distribution of these schools. But is a higher concentration of municipalities in red (negative side of the axis) in the interior north and Lisboa.

What we observe in this axis, though, is a pattern that needs to be understood. Why do schools have the worst retention rates in 7th grade and get better in 12th? Are the students that retain the most led to pursue professional courses? Because if that is what happens they “disappear” from these statistics (in high school, we are only looking onto the standard choice courses, called “cursos científico-humanísticos” in Portugal).

4.1.3. Third principal component (PC3)

In PC3, the percentage of inertia explained is 4.9%. Much less than the other two dimensions. In this case, there is a zoom in the high school years with all the three highest school levels represented.

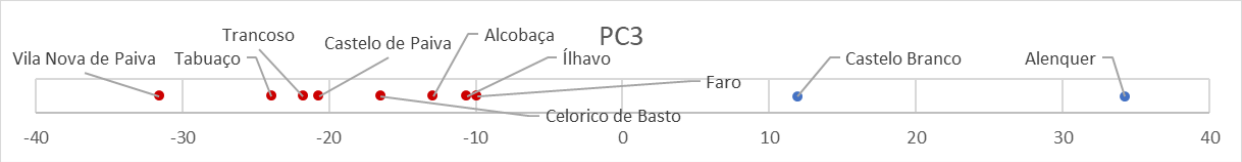


Figure 11 – Principal Component 3

Other relevant individuals to interpret this axis:
Norte: Vieira do Minho; Mesão Frio; Fafe; Felgueiras; Cinfães; Amarante; Arcos de Valdevez; Gondomar; Valpaços; Tarouca; Valongo; Paredes; Carrazeda de Ansiães; Marco de Canaveses; Resende.
Centro: Penalva do Castelo; Gouveia; Almeida; Marinha Grande; Castro Daire; Lourinhã; Santa Comba Dão.
Área Metropolitana de Lisboa: Setúbal; Barreiro; Palmela.
Alentejo: Vila Viçosa; Almodôvar; Estremoz; Santarém.
Algarve: Faro.

Other relevant individuals to interpret this axis:
Norte: Matosinhos; Terras de Bouro; Macedo de Cavaleiros; Montalegre; Braga; Porto; Amares.
Centro: Alenquer; Castelo Branco; Arganil; Oleiros; Estarreja; Águeda; Oliveira do Hospital; Nelas; Sobral de Monte Agraço; Seia.
Área Metropolitana de Lisboa: Vila Franca de Xira.
Alentejo: Beja; Odemira.
Algarve: Portimão; Silves.

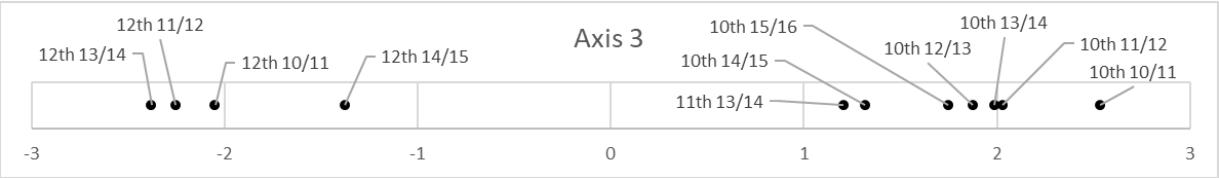


Figure 12 – Axis 3

The municipalities considered to be relatively well explained by this axis contributed to explain 66.9% of the inertia associated with this axis.

On the negative half of this dimension, there are four school years from 12th grade. And on the positive side, there is 11th and 10th grade. It represents the evolution in the retention in these years. This opposition is not surprising as we have already seen that the highest retention rates happen precisely in 12th grade. On one side, the municipalities where the percentage of retained students is lower or similar in the first year of high school compared with the last one. And on the other side, the ones that have started well but in the last year have much higher rates.

The most curious cases in this dimension are the ones from Alenquer and Castelo Branco. In both cases, there have been years when the retention rates in 10th grade were higher than the ones on 12th grade. That is very unusual. So, it might be interesting to see what happens to these students. Do unsuccessful students leave school when they reach 18 (which is the age of mandatory schooling in Portugal)? Do they choose another type of courses that are more hands-on (such as professional courses) and so disappear from these statistics? There will not be time to do this kind of evaluation for the purpose of this dissertation but it might be relevant to understand in the future.

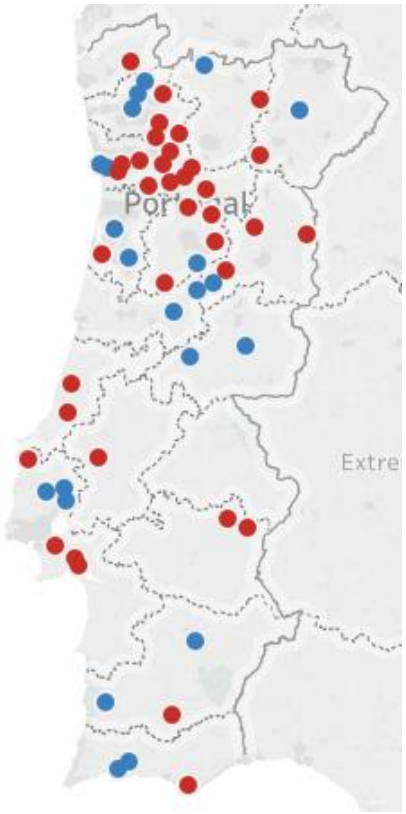


Figure 13 – Geographic distribution of the municipalities in PC3

Regarding the geographic distribution of the municipalities that are better explained in this axis, there is no clear opposition between north and south or rural and urban areas.

There is, though, an interesting spreading of the ones that fall on the negative side of the axis (represented in red). That is those municipalities that have a much lower retention rate in 10th and 11th grades than in 12th. They are mainly located in the regions of Tâmega e Sousa, Viseu, and Beiras. These regions are deeply industrialized and were in times associated with very high rates of early school leaving. The factories in the region rely on intensive labor. The aggravation of the retention rates in 12th grade might still be a symptom of those difficulties.

4.1.4. Fourth principal component (PC4)

In this case, where only 3.6% of the variability is explained, the zoom in high school is even greater.

Only four variables have a CTA that goes above 1/36, the value considered to be the minimum relevant contribution of the variables to each axis. Those are 12th grade retention rates in 2015/2016 and 2014/2015 on one side and the same grade on 2011/2012 and 2010/2011 on the other side. In spite of that, a closer look into the variables CTR shows that the retention rate on 12th grade 2011/2012 is not particularly well explained by this axis so it will not be considered.

The fourth principal component opposes the municipalities that, on one hand, have had big retention rates in the early years under analysis and then improved and, on the other hand, the ones that have had fairly good retention in the beginning and got worse. In total, these municipalities explain 64.3% of the inertia associated with this axis.

Alfândega da Fé and Seia are two examples of municipalities where the retention rates on 12th grade got worse since the beginning of the decade. Although these two places are 150 kilometers apart, they are both in the interior of the country, where the population is older and where there are fewer

people living. One of the struggles in these territories is to attract people, namely professors, so this might be an issue. On the other hand, Chamusca, Ferreira do Zêzere, Arganil and Viana do Alentejo, for example, improved.

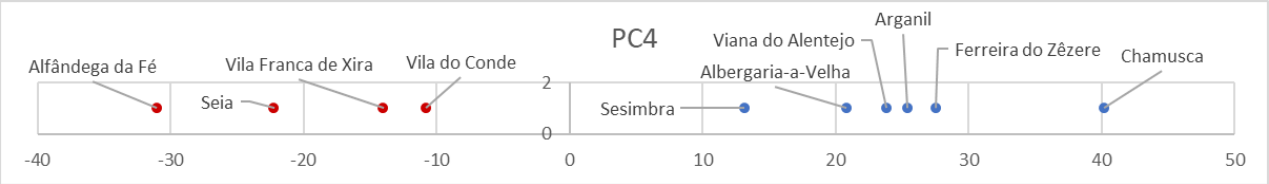


Figure 14 – Principal Component 4

Other relevant individuals to interpret this axis:
Norte: Arouca; Monção; Terras de Bouro; Amares; Resende.
Centro: Oliveira do Hospital; Óbidos; Almeida; Oliveira de Frades.
Área Metropolitana de Lisboa: Setúbal; Alcochete.
Alentejo: Beja; Santiago do Cacém; Reguengos de Monsaraz; Almeirim; Arraiolos; Santarém.
Algarve: Faro; São Brás de Alportel.

Other relevant individuals to interpret this axis:
Norte: Torre de Moncorvo; Vila Nova de Cerveira; Trofa; Penafiel; Espinho; Ribeira de Pena; Vila Nova de Gaia.
Centro: Santa Comba Dão; Peniche; Tábua; Sobral de Monte Agraço; Penalva do Castelo.
Alentejo: Almodôvar.

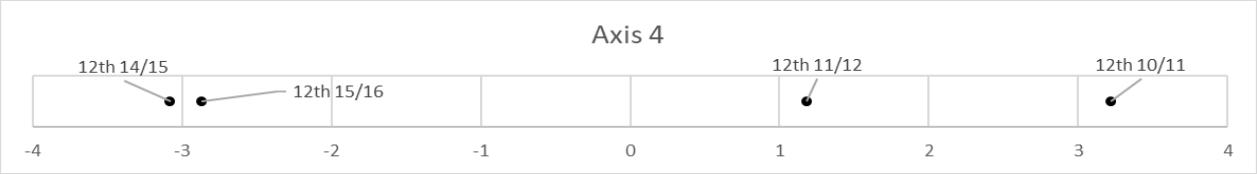


Figure 15 – Axis 4

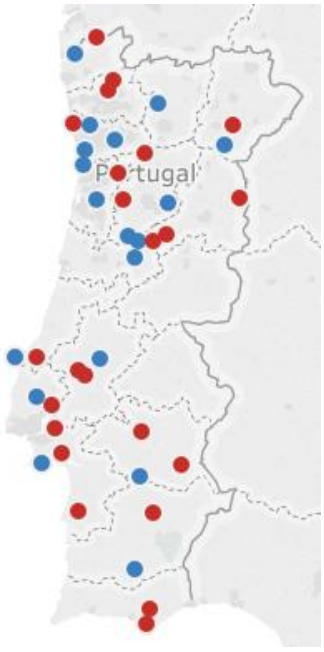


Figure 16 – Geographic distribution of the municipalities in PC4

Although there is not a clear opposition between north and south there are differences between municipalities that are geographically close that are interesting to remark. For example, Alfândega da Fé, where retention rates worsened in 12th grade (in red) and Torre de Moncorvo, that recovered (in blue).

The same opposition happens between Seia and Oliveira do Hospital (got worse) and Santa Comba Dão, Tábua and Arganil. These five municipalities are all close to each other but present different trends. Again, it would be interesting to understand what is happening there.

4.1.5. Fifth principal component (PC5)

Again, on PC5 the variables related to high school stand out. This axis represents 3% of the variance associated with the data.

The school years that contribute the most to explain the inertia associated with this axis are, on one side of the axis, 12th grade in 2010/2011, 2012/2013 and 2015/2016. And, on the other, 12th grade in 2013/2014 and 10th in 2010/2011 and 2013/2014. Nevertheless, only one is well explained in this axis: it is 12th grade in 2013/2014.

For the 43 municipalities better explained by this axis, the school year of 2013/2014 was either one where they did exceptionally well in terms of retention or exceptionally bad. For Miranda do Douro, Almeirim and Santiago do Cacém the retention rates in this school year and level were much higher than those of Montemor-o-Novo and Évora. Together, these municipalities explain 57% of the inertia associated with this axis.

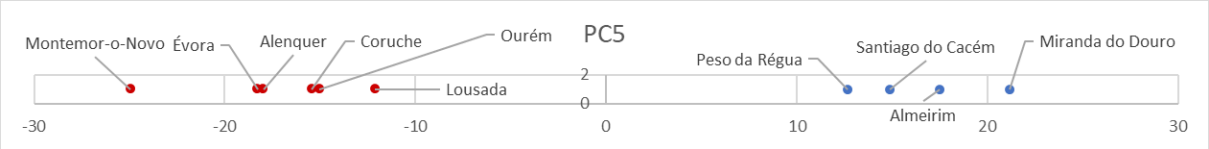


Figure 17 – Principal Component 5

Other relevant individuals to interpret this axis:
Norte: Melgaço; Arcos de Valdevez; Terras de Bouro; Murça.
Centro: Ourém; Alenquer; Pombal; Mealhada; Anadia.
Área Metropolitana de Lisboa: Alcochete
Alentejo: Chamusca
Algarve: Lagos; Faro.

Other relevant individuals to interpret this axis:
Norte: Valença; Lamego; Matosinhos; Moimenta da Beira; Vila Nova de Gaia; Valongo; Valpaços; Carrazeda de Ansiães; Cinfães.
Centro: Celorico da Beira; Nelas; Estarreja; Penacova; Óbidos; Caldas da Rainha; Cadaval; Torres Vedras.
Alentejo: Grândola; Moura.
Algarve: São Brás de Alportel.

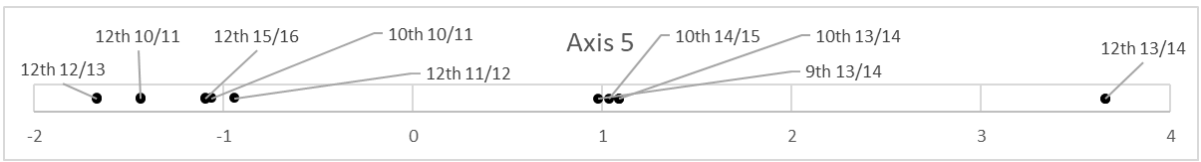


Figure 18 – Axis 5

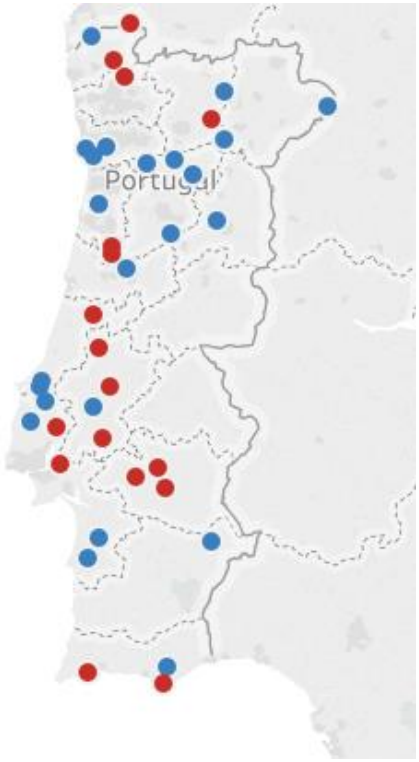


Figure 19 – Geographic distribution of the municipalities in PC5

There does not seem to exist a particular distribution to this axis. Nevertheless, it is worse noting that among the municipalities in the North explained by this axis, only four (Murça, Terras de Bouro, Arcos de Valdevez, and Melgaço) had better results in 12th grade in 2013/2014 (in red). All others (such as Vila Nova de Gaia, Valogo, Matosinhos, Miranda do Douro, Valença, Carrazeda de Ansiães, and Valpaços) reach a peak in retention rates in the year under analysis (in blue).

4.1.6. Sixth principal component (PC6)

This axis represents 2.5% of the variance associated with the data. The municipalities better explained by this axis also contribute to explain 50% of the inertia associated with it.

In this dimension, the municipalities that come across are the ones that have a higher/lower retention rate in 12th grade 2012/2013 than in the other variables that contribute the most to explain the inertia associated with this axis (12th 2010/2011, 2014/2015 and 2015/2016, and 9th grade 2011/2012). Nevertheless, much like in the previous component, there is only one variable that is well represented in this axis: 12th grade in 2012/2013.

In this case, Seia, Lourinhã and Braga, for example, have a higher retention rate in 12th grade in 2012/2013 than Almodôvar, Montalegre, and Alcanena.

What this shows is a very specific situation in this school year. If this is an exception, it might be interesting for the people responsible at the municipal level to identify the reasons behind the relative success or unsuccess achieved in this particular school year and level. Was it a specific group of students? An outstanding teacher?

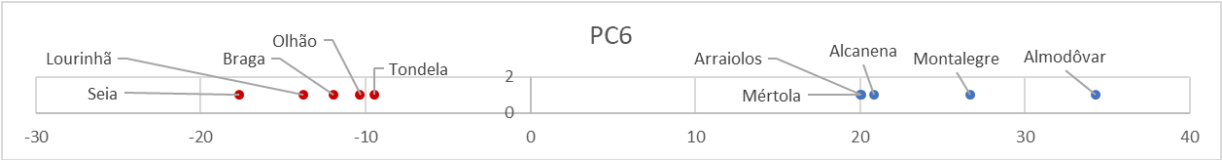


Figure 20 – Principal Component 6

Other relevant individuals to interpret this axis:
Norte: Trofa; Felgueiras; Valença; Carrazeda de Ansiães; Gondomar.
Centro: Figueira de Castelo Rodrigo; Vagos; Ourém; Alenquer.
Área Metropolitana de Lisboa: Palmela.
Alentejo: Estremoz; Benavente; Santarém.
Algarve: Olhão.

Other relevant individuals to interpret this axis:
Norte: Tarouca; Baião; Amares; Vila Verde.
Centro: Penacova; Mealhada; Torres Vedras.
Algarve: Portimão.

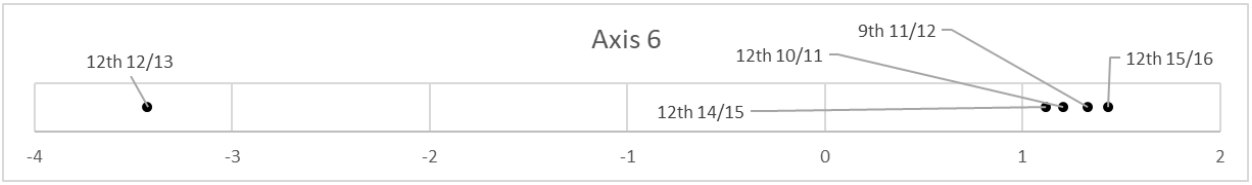


Figure 21 – Axis 6

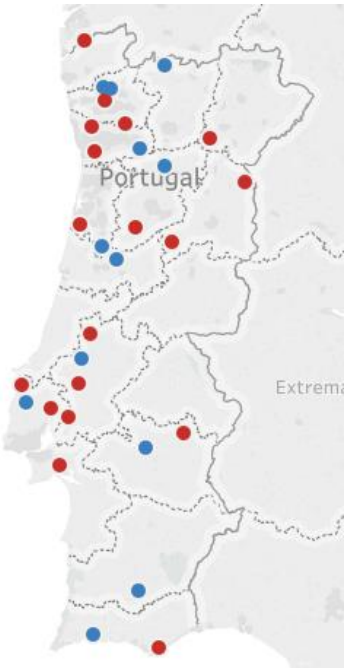


Figure 22 – Geographic distribution of the municipalities in PC6

Here, there are interesting geographic trends to take into account.

In the axis regarding principal component number 5, almost all the municipalities in the North of the country that was explained by that axis had a particularly high retention rate in 12th grade in 2013/2014. Now, the ones that are well explained in this one have a particularly high retention rate in 2012/2013. Valença is an example of a municipality that had high retention rates in both years. The same happens with Santarém, for example.

4.1.7. Seventh principal component (PC7)

This seventh dimension represents 2.1% of the variance associated with the data.

The school years that contribute the most to explain the inertia associated with this axis are, on one side of the axis, 12th grade in 2010/2011 and 2015/2016, and 10th grade in 2015/2016. And, on the other, 10th grade in 2010/2011 and 9th grade in 2011/2012.

A closer look at the variables CTR shows very clearly that what is at stake in this component is the evolution of the retention rates in 10th grade from the beginning of the decade to 2015/2016. What it also shows is that, in certain municipalities, the retention rate was higher in 10th and 9th grade at the beginning of the decade than in 10th grade in 2014/2015 and 2015/2016. In some cases, the retention rates are even higher in 10th grade in 2010/2011.

The municipalities on the positive side of this axis have higher retention in 10th grade in 2010/2011 and improved in the last year under analysis. For the others, it worsened.

The municipalities better explained by this axis only explain 37% of the inertia associated with the axis.

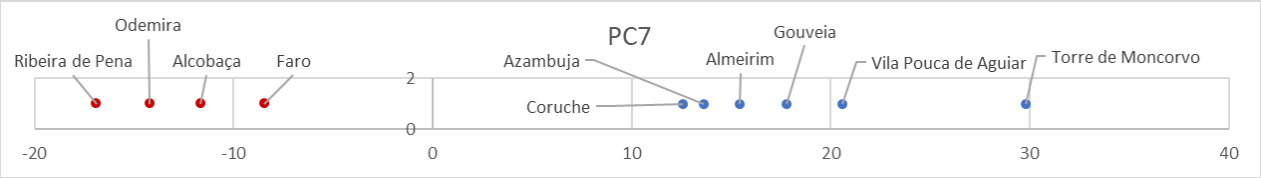


Figure 23 – Principal Component 7

Other relevant individuals to interpret this axis:
Norte: Ribeira de Pena; Vizela; Vila do Conde.
Centro: Proença-a-Nova; Figueira de Castelo Rodrigo; Pombal.
Alentejo: Odemira; Arraiolos; Viana do Alentejo.
Algarve: Silves.

Other relevant individuals to interpret this axis:
Norte: Baião; Porto; Felgueiras; Vila Verde; Valongo.
Centro: Celorico da Beira; Mealhada; Almeida; Penacova; Sabugal.

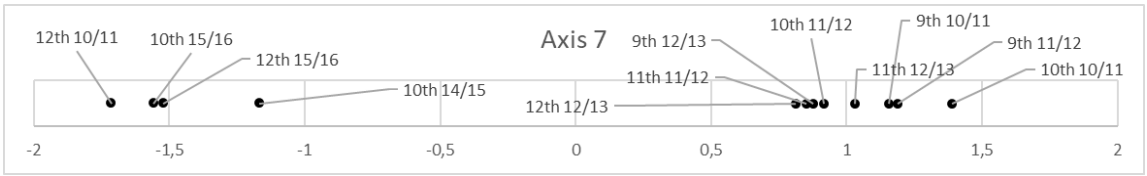


Figure 24 – Axis 7

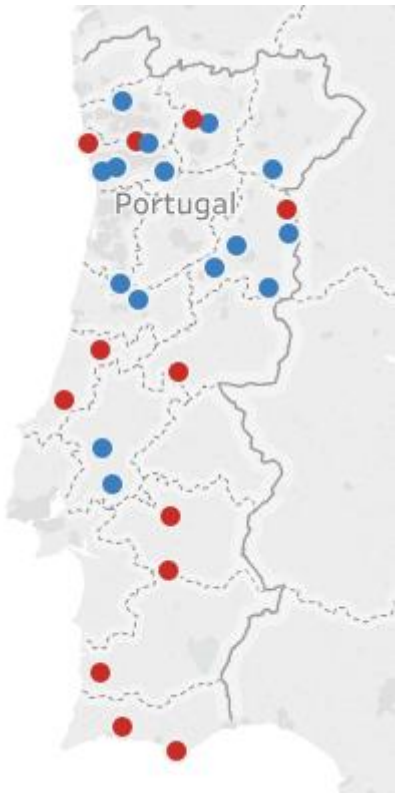


Figure 25 – Geographic distribution of the municipalities in PC7

Geographically, there is a clear predominance of municipalities on the negative side of the axis in the south of the country (in orange), shown in figure 25. While the ones located in the north (in blue) are mostly on the positive side. In spite of that, Almeirim and Coruche are the two municipalities in blue further south. Which means, again, that the variables that have improved are in the north. And then the municipalities with the worst performance (that get worse) are in the south.

There is, though, some clear oppositions between neighboring territories. That is the case with Ribeira de Pena and Vila Pouca de Aguiar and between Felgueiras and Vizela.

4.1.8. Eighth principal component (PC8)

This dimension represents 2% of the variance associated with the data.

What it is really at stake in this axis are the retention rates in 2012/2013 and 2013/2014 for 9th and 10th grade. The municipalities on the positive side of this axis peaked in retention rates in these years. The other ones had comparably lower retention rates.

The variables in the positive side of the axis represent the end of middle school and the beginning of high school, so we can say that the unsuccess is prolonged through the same level along the years but it also spreads to the next school level. This might mean that the students that had to repeat one level on 9th grade had to do it again on 10th grade but that is impossible to know (for now) because there is no information on individual students.

The municipalities that are better explained by this axis explain 43% of its inertia.

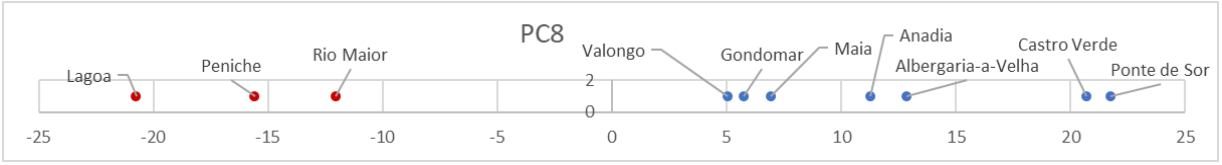


Figure 26 – Principal Component 8

Other relevant individuals to interpret this axis:
Centro: Cantanhede; Guarda; Penacova.

Other relevant individuals to interpret this axis:
Norte: Alfândega da Fé; Vale de Cambra; Lamego; Paredes; Valença; Baião; Vila Verde.
Centro: Cadaval; Sátão; Estarreja; Oleiros; Tábua.
Alentejo: Estremoz.

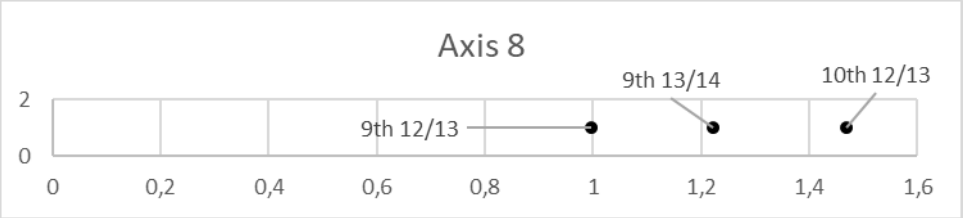


Figure 27 – Axis 8

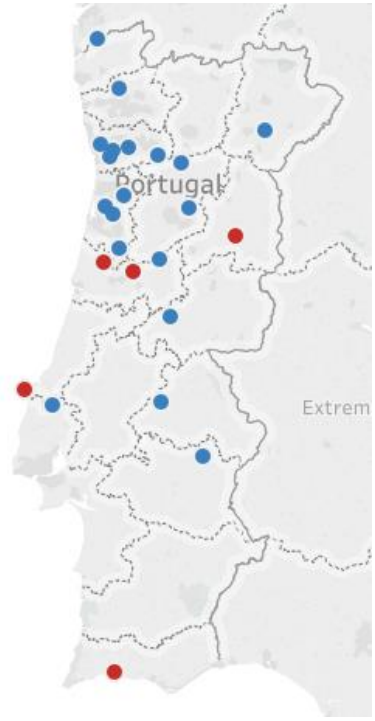


Figure 28 – Geographic distribution of the municipalities in PC8

In this case, there is a very clear concentration of the municipalities better explained in this axis in the north of the country, and mainly by the sea.

Most of the municipalities here represented are on the positive side of the axis, meaning they have had high retention rates in 9th and 10th grade in the years under analysis. The exceptions are (from further south to the north), Lagos, Estremoz, Ponte de Sor, Cadaval and Peniche.

4.1.9. Ninth principal component (PC9)

This axis represents 1.9% of the variance associated with the data.

The high school years have controlled much of the analysis because it is, in fact, when the retention rates tend to increase. They are still present in this axis (the opposition between 12th grade in 2014/2015 and in 2015/2016) when we look at what variables best represent it. Nevertheless, the variables that are better explained by this axis are the ones regarding 9th grade as opposed to 7th grade in 2014/2015.

The municipalities better explained here – that explain 42% of the inertia associated with the axis - are either the ones who have a bigger retention rate in 7th grade 2014/2015 but lower in 9th grade (Celorico da Beira, Vagos, Cartaxo, for example). Or the other way around (Lagoa, Baião, Penafiel, for example).

Figure 29 – Principal Component 9

Other relevant individuals to interpret this axis:
Norte: Vila Verde; Vila Nova de Gaia; Amares.
Centro: Tomar; Figueira de Castelo Rodrigo; Sabugal; Oleiros; Vila Nova de Paiva.
Área Metropolitana de Lisboa: Alcochete.
Alentejo: Ponte de Sor.

Other relevant individuals to interpret this axis:
Norte: Terras de Bouro; Vieira do Minho; Vila do Conde.
Algarve: Lagoa.

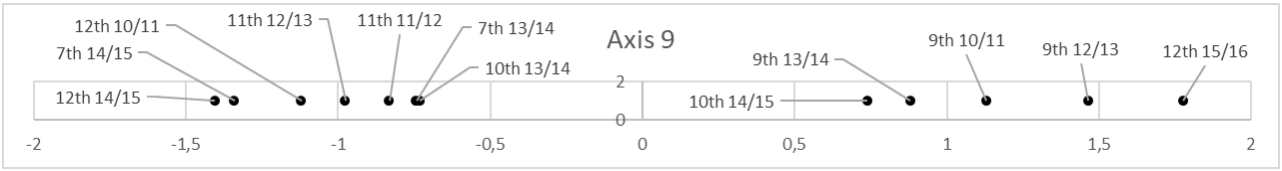


Figure 30 – Axis 9

Figure 31 – Geographic distribution of the municipalities in PC9

In this dimension, there is also a clear geographical distribution. The municipalities that are on the negative side of the axis (in red) range from Lisboa to Viseu creating a diagonal line of places that are worse in 7th grade 2014/2015 than in the 9th grade, especially 2010/2011, 2012/2013 and 2013/2014.

But there are a few, the ones on the positive half (in blue) that are concentrated in Porto and Vila Real, as the figure 31 shows, that are worse in 9th grade than in 7th.

4.1.10. Tenth principal component (PC10)

This axis represents 1.7% of the variance associated with the data. In it, there is an obvious opposition between 7th and 8th grade, that shows by looking both at the variables CTA and CTR. Matosinhos and Silves, for example, have worse performance in 7th grade in 2014/2015 and 2015/2016 than in 7th and 8th grade in 2010/2011 and 2011/2012. The municipalities on the other side have improved from the beginning of the decade to more recent years. The municipalities that are better explained in this axis also explain 37% of the variance associated with this axis.

Figure 32 – Principal Component 10

Other relevant individuals to interpret this axis:
Norte: Celorico de Basto.
Centro: São Pedro do Sul.
Alentejo: Coruche; Moura.

Other relevant individuals to interpret this axis:
Norte: Porto; Tarouca.
Centro: Vagos.
Alentejo: Beja

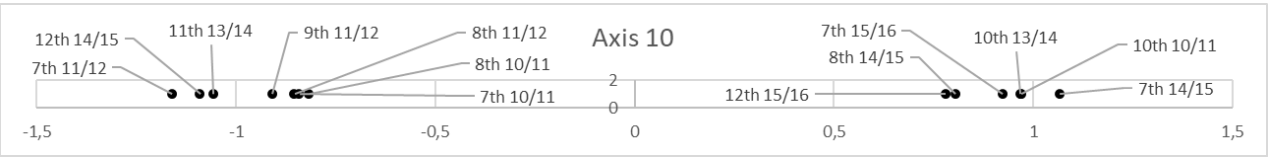


Figure 33 – Axis 10

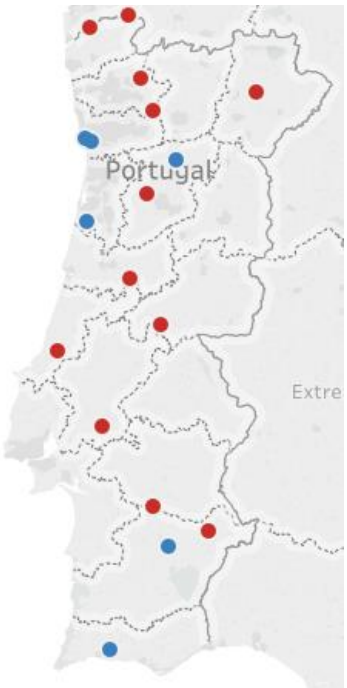


Figure 34 – Geographic distribution of the municipalities in PC10

Although there is no clear geographic trend, what is interesting to see here is that the majority of the municipalities explained by this axis are on the negative side. Meaning that they had retention rates higher in the early years of 7th grade than in 2014/2015 and 2015/2016. Although, that does not happen in Silves, Matosinhos, Porto, Tarouca, Vagos, and Beja.

4.2. CLUSTER ANALYSIS

With the outputs from PCA, a cluster analysis of the data was performed.

As it was explained in the methodology section, a combination of hierarchical and non-hierarchical methods was applied. After running the methods in SAS, using the results from the PCA, the R^2 from the different methods – which is a measure that represents the proportion of variance accounted for by the clusters – were compared and the "elbow rule" was applied. The image below shows that the Ward's method is the most effective, which means that a smaller number of clusters have a bigger R^2 than all the other options. Taking that into account and also by analyzing the dendrogram (an output from Ward's method), seven clusters (with an R^2 of almost 0.5) were considered for the k-means method.

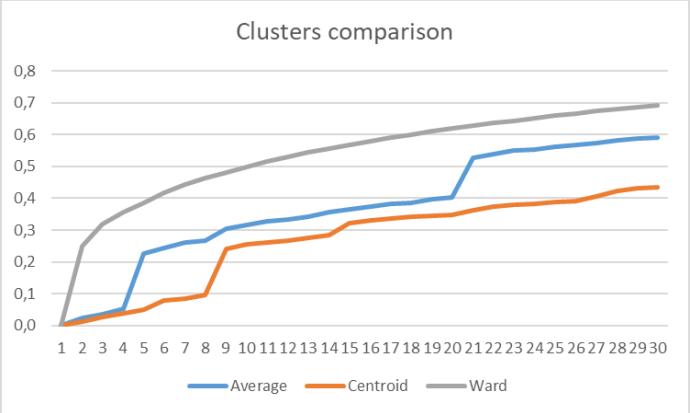


Figure 35 – Clustering methods comparison

This information was then used to perform the clustering by using the k-means method. The output is seven clusters with the following characteristics.

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Nearest Cluster	Distance Between Cluster Centroids
1	55	5.73	44.39	3	19.27
2	31	8.94	46.57	5	22.02
3	21	8.78	44.62	1	19.27
4	14	8.88	42.33	6	24.14
5	75	7.73	48.41	2	22.02
6	19	8.56	43.86	4	24.14
7	16	10.03	46.21	1	22.36

Table 4 – Cluster statistics (part I)

Variable	Total STD	Within STD	R-Square	RSQ/(1-RSQ)
PC1	21.06	9.89	0.78	3.63
PC2	10.42	8.91	0.28	0.39
PC3	9.32	8.07	0.26	0.37
PC4	9.13	7.81	0.28	0.39
PC5	7.57	7.27	0.10	0.11

PC6	8.12	7.42	0.18	0.23
PC7	7.24	7.11	0.05	0.06
PC8	6.61	6.54	0.04	0.04
PC9	6.64	6.54	0.05	0.05
PC10	6.04	6.00	0.03	0.03
OVER-ALL	10.11	7.64	0.44	0.79

Table 5 – Cluster statistics (part II)

The median and quartile retention rates in each year for each cluster highlights the differences among them (see table 8 annexed). In figure 36 the graphics show the evolution of the clusters' trimean along the years under analysis.

In cluster one, for example, the median retention rate in middle and high school is neither the highest nor the lowest.

In cluster two, the retention rates are some of the lowest in middle school, but then, particularly in 12th grade in 2010/2011 and in 2011/2012, it has some of the highest values among all clusters.

With cluster three, retention rates in middle school are also some of the lowest among all clusters, but then reach a peak in 12th grade in 2013/2014.

In cluster four, retention rates are particularly high in the first years of 7th grade, and in 9th grade (2011/2012, 2012/2013 and 2014/2015) and they remain high, particularly in 10th and 11th grade when compared with the other clusters. It is somewhat similar to cluster six, but in 12th grade, the retention rates decrease (something that does not happen as obviously in cluster six).

In cluster five there are the best performing municipalities. And in cluster six the worse ones.

In cluster seven, there are the municipalities that have especially high retention rates in 8th and 9th grade but recover in 2014/2015. There are also the ones that have had high retention rates in high school, but managed to recover. Particularly in the final years of high school.

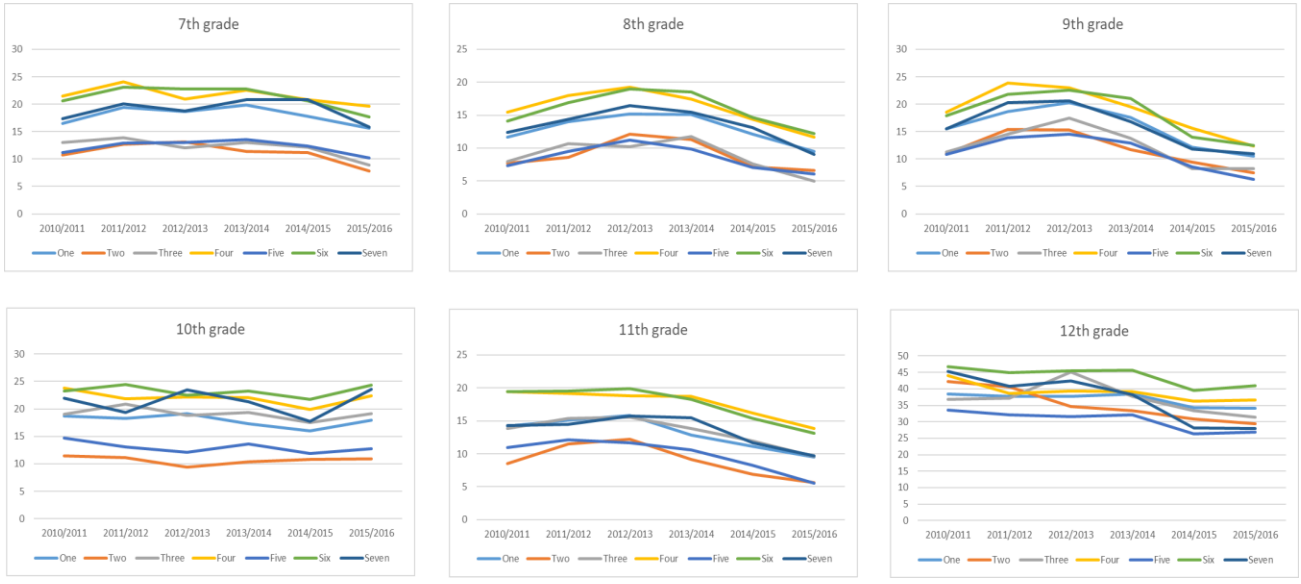


Figure 36 – Distribution of retention rates trimean along the years in each cluster

4.2.1. Cluster one: the not so good and not so bad

With 55 observations, this is one of the most populated clusters. None of the individuals in this cluster is well explained in the first dimension. And there is also no particular dimension that explains the majority of them.

What can be said about this cluster is that the retention rates in the municipalities that fit in this group are neither the highest nor the lowest between 7th and 9th grade. This is where the municipalities with retention rates on 7th grade higher than the ones on 12th grade are. Which is the case for Caldas da Rainha, Lourinhã and Oliveira do Hospital, for example.

What we may also take from this cluster, is that it is populated both by municipalities where retention rates are bad in 7th grade (worse than on 12th grade). But also by many where, between 10th grade and 12th, the retention rates worsen. That is precisely why Castelo de Paiva, Ílhavo and Tabuaço stand out: their retention rates have worsened from 10th grade at the beginning of the decade, to 12th grade in 2015/2016. In Vila do Conde and Vila Franca de Xira, the retention rates have gotten worse, specifically in 12th grade in the most recent years.

Montemor-o-Novo, Lousada e Coruche are also part of this cluster. In these three places, the retention rates are high at the beginning of the decade and by 2015/2016.

The municipalities in this cluster are distributed throughout the country and, at first sight, there does not seem to exist a particular geography that explains this distribution. Lisboa does not integrate this cluster, but Porto does. And there is also a considerable amount of municipalities that happen to be the ones that surround these two big cities. In 2015/2016, of students in middle and high school were enrolled in schools in these municipalities.

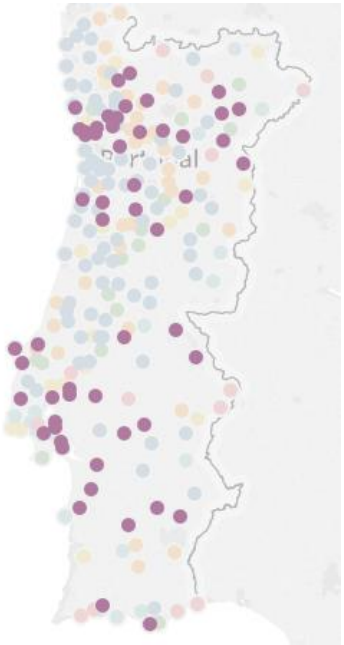


Figure 37 – Cluster 1

Municipalities that populate this cluster:

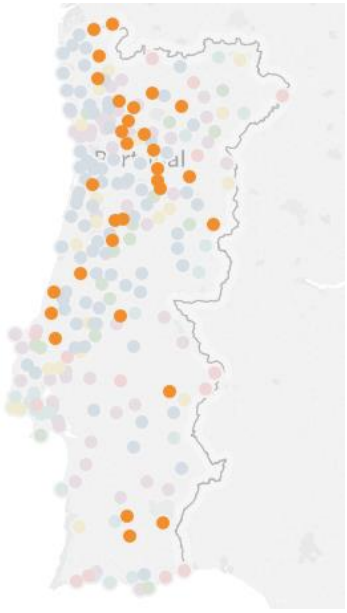
Norte: Alijó; Baião; Castelo de Paiva; Felgueiras; Gondomar; Lousada; Matosinhos; Mirandela; Mondim de Basto; Paços de Ferreira; Paredes; Peso da Régua; Porto; Póvoa de Lanhoso; Tabuaço; Valongo; Vieira do Minho; Vila do Conde; Vila Flor; Vila Nova de Foz Côa; Vila Nova de Gaia.
Centro: Abrantes; Aguiar da Beira; Anadia; Caldas da Rainha; Figueira de Castelo Rodrigo; Fornos de Algodres; Ílhavo; Lourinhã; Oliveira do Hospital; Peniche; Tondela; Vouzela.
Área Metropolitana de Lisboa: Alcochete; Barreiro; Mafra; Montijo; Palmela; Setúbal; Vila Franca de Xira.
Alentejo: Alcácer do Sal; Aljustrel; Arraiolos; Beja; Benavente; Coruche; Grândola; Montemor-o-Novo; Nisa; Portalegre; Salvaterra de Magos; Santiago do Cacém; Serpa.
Algarve: Faro; Silves.

4.2.2. Cluster two: the peak in 12th grade between 2010/2011 and 2011/2012

There are 31 municipalities in this cluster, where only 6% of the students were enrolled in 2015/2016.

This is the cluster where the municipalities have a low retention rate on 7th grade and it gets worse, specifically on 12th grade in 2010/2011 and 2011/2012. But the great majority manages to recover, at least a little, since the beginning of the decade. Mortágua, Amarante, Marco de Canaveses, Monção, Marinha Grande, are some of the municipalities best represented in this cluster. One interesting case, that is not reflected in the whole cluster is that of Melgaço, which was able to improve its retention rate on 7th grade throughout the time.

What might be interesting to understand is why do these municipalities have such relatively high retention rates (almost exclusively) on 12th grade. We have seen before that making students repeat one school year is not seen as something that works for the student. But do they make life easier for students who end up failing the exams necessary to conclude high school? What is lacking? At the same time, there are signs that they are at least improving. But is it enough?



Municipalities that populate this cluster:

Norte: Amarante; Arcos de Valdevez; Celorico de Basto; Cinfães; Fafe; Marco de Canaveses; Melgaço; Mesão Frio; Monção; Murça; Ribeira de Pena; Tarouca; Vila Verde.
Centro: Albergaria-a-Velha; Alcobaça; Marinha Grande; Mortágua; Penalva do Castelo; Pombal; Sabugal; Santa Comba Dão; Sardoal; Sátão; Trancoso; Vila Nova de Paiva; Vila Nova de Poiares.
Alentejo: Almodôvar; Castro Verde; Estremoz; Mértola; Rio Maior.

Figure 38 – Cluster 2

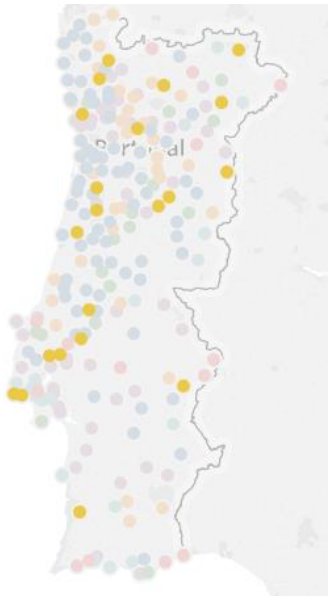
4.2.3. Cluster three: the peak in 12th grade in 2012/2013 and 2013/2014

There are 21 municipalities in this cluster, where 11% of the students are enrolled. The situation on the cluster can be described by lower retention on 7th grade that gets much higher on 12th. However, in this cluster, retention rates in middle school are also some of the lowest among all clusters, but then the increase occurs especially in 12th grade in 2012/2013, and it decreases from 2013/2014 onwards.

The median retention rate for this cluster reaches a peak in 12th grade in 2012/2013 (44.86%). But the evolution of this indicator is not exactly equal in all territories. For example, in Braga, Seia, and

Montemor-o-Velho, there was a peak in the retention rate of 12th grade 2012/2013, higher than the years before and after. But in Almeirim, on the other hand, this happened in 2013/2014.

Similarly to what happens in all other clusters, the municipalities grouped in cluster number 3 tend to have better retention rates by 2015/2016 than they did in 2010/2011.



Municipalities that populate this cluster:

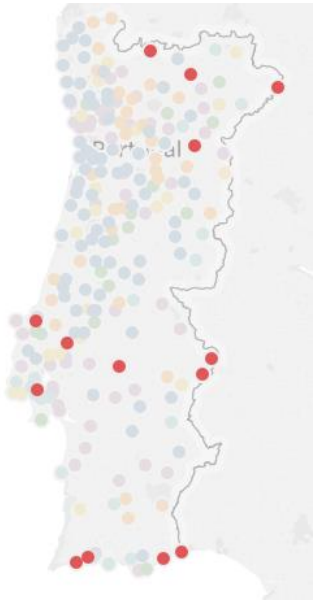
Norte: Alfândega da Fé; Braga; Bragança; Maia; Resende; Terras de Bouro; Vila Pouca de Aguiar.
Centro: Águeda; Alenquer; Almeida; Gouveia; Mealhada; Montemor-o-Velho; Seia; Torres Novas.
Área Metropolitana de Lisboa: Cascais; Oeiras.
Alentejo: Almeirim; Azambuja; Odemira; Vila Viçosa.

Figure 39 – Cluster 3

4.2.4. Cluster four: bad in 10th and in 12th grade

There are 14 municipalities in this cluster. It is the smallest one. And only 8% of the total students in public schools in the universe under analysis.

As previously said, in cluster four, retention rates are particularly high in the first years of 7th grade, and in 9th grade (2011/2012, 2012/2013 and 2013/2014) and they remain high, particularly in 10th and 11th grade when compared with the other clusters. Some of the municipalities in this cluster have something very interesting in common: they have retention rates on 10th grade that are much closer to those on 12th than usual, which is something rather unusual. Curiously, Lisboa is one of those. Regarding the evolution of retention rate, these territories are all performing badly, especially in 12th grade, but with some improvements since the beginning of the decade.



Municipalities that populate this cluster:

Norte: Miranda do Douro; Montalegre; Valpaços.
Centro: Mêda; Óbidos.
Área Metropolitana de Lisboa: Lisboa.
Alentejo: Campo Maior; Cartaxo; Elvas; Mora.
Algarve: Lagos; Portimão; Tavira; Vila Real de Santo António.

Figure 40 – Cluster 4

4.2.5. Cluster five: the best performing municipalities

There are 75 municipalities in this cluster, which represents 28% of the students.

These are the ones with the best results. Almost half of the municipalities in this cluster are well represented by the first principal component (where they are positioned on the negative side of the axis), which represents the global results.

Some interesting cases are those of Viana do Alentejo, Vila Nova de Cerveira and Sertã. They have all recovered very much from their high retention rates on 12th grade at the beginning of the decade. Those territories are not close to each other so it might be interesting to understand if they have done anything in order to address this problem.

On the other hand, Évora stands out but because of the lower retention rates in one year (when compared to all others). It was a particular drop in retention rate on 12th grade 2013/2014. But It is hard to know if anything was done in that year. It might have been a particular group of students or a more dynamic professor. The same happened in Alcanena in 2012/2013.

Something remarkable about this cluster (that has already been noticed when the geographic distribution of the municipalities in each dimension of the PCA was analyzed) is that the majority of the municipalities in this cluster is in the northern part of the country and more concentrated by the sea. There are none in the Lisboa area and they are very sparse in the south.

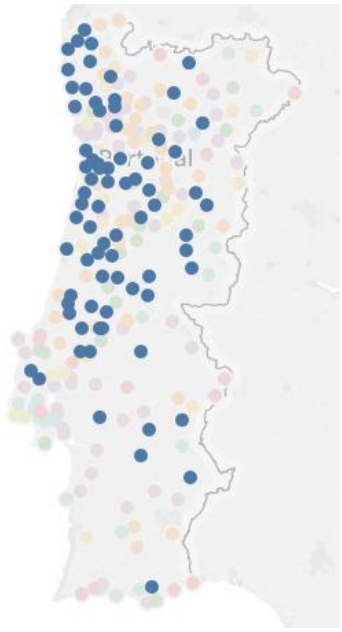


Figure 41 – Cluster 5

Municipalities that populate this cluster:

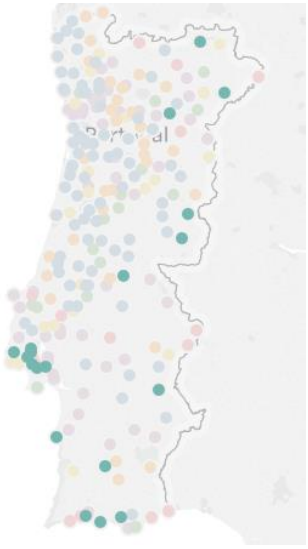
Norte: Amares; Arouca; Barcelos; Caminha; Carrazeda de Ansiães; Chaves; Espinho; Esposende; Guimarães; Lamego; Moimenta da Beira; Oliveira de Azeméis; Paredes de Coura; Penafiel; Ponte de Lima; Póvoa de Varzim; Santa Maria da Feira; Santo Tirso; São João da Madeira; Vale de Cambra; Valença; Viana do Castelo; Vila Nova de Cerveira; Vila Nova de Famalicão; Vila Real; Vizela.
Centro: Alcanena; Ansião; Aveiro; Batalha; Cantanhede; Carregal do Sal; Castelo Branco; Castro Daire; Celorico da Beira; Coimbra; Condeixa-a-Nova; Covilhã; Entroncamento; Estarreja; Figueira da Foz; Figueiró dos Vinhos; Fundão; Guarda; Leiria; Mira; Miranda do Corvo; Nelas; Oleiros; Oliveira de Frades; Oliveira do Bairro; Ourém; Ovar; Penacova; Porto de Mós; Proença-a-Nova; São Pedro do Sul; Sertã; Sever do Vouga; Sobral de Monte Agraço; Soure; Tomar; Torres Vedras; Vagos; Vila Nova da Barquinha; Viseu.
Alentejo: Alpiarça; Évora; Moura; Ponte de Sor; Redondo; Santarém; Vendas Novas; Viana do Alentejo.
Algarve: São Brás de Alportel.

4.2.6. Cluster six: the worst performing municipalities

There are 19 municipalities in this cluster, which represent 15% of the total number of students enrolled in the school levels under analysis.

To put it simply, these are the ones with the highest retention rates of all on 12th grade. They are distributed between Lisboa, Algarve and some of the districts in the interior of Portugal. This has already been seen when the distribution of the municipalities in the PCA dimensions was analyzed.

Something that happens in this cluster, although very slightly, is that the retention rate in 12th grade worsens between 2014/2015 and 2015/2016. Although this also occurs in cluster four and seven it is not a generalized trend. So it might be something to keep under observation by policymakers.



Municipalities that populate this cluster:

Norte: Mogadouro; São João da Pesqueira; Vinhais.
Centro: Idanha-a-Nova; Mação; Penamacor.
Área Metropolitana de Lisboa: Almada; Amadora; Loures; Moita; Odivelas; Seixal; Sintra.
Alentejo: Ourique; Reguengos de Monsaraz; Sines.
Algarve: Albufeira; Lagoa; Loulé.

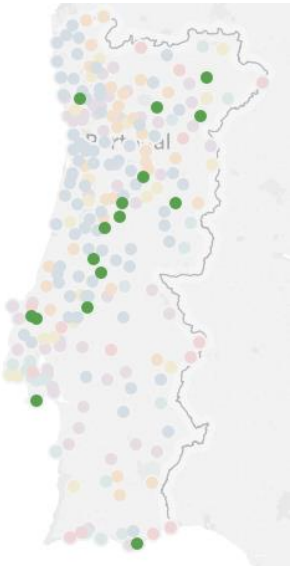
Figure 42 – Cluster 6

4.2.7. Cluster seven: peak in 8th and 9th grade

There are 16 municipalities in this cluster. Only 3% of the students enrolled in the municipalities go to school in these territories.

These are the municipalities that had especially high retention rates in 8th and 9th grade but recover in 2014/2015. Additionally, these are territories where the percentage of retained students is also relatively high in high school (especially in 11th and 12th grade) at the beginning of 2010 but improves in the final years under analysis. In 10th grade, the municipalities in this cluster remain with relatively high retention rates throughout the years.

There is a string of municipalities in this cluster concentrated in the center of Portugal. It is composed by Ferreira do Zêzere, Alvaiázere, Lousã, Arganil, Tábua.



Municipalities that populate this cluster:

Norte: Macedo de Cavaleiros; Sabrosa; Torre de Moncorvo; Trofa.
Centro: Alvaiázere; Arganil; Belmonte; Bombarral; Cadaval; Ferreira do Zêzere; Lousã; Mangualde; Tábua.
Área Metropolitana de Lisboa: Sesimbra.
Alentejo: Chamusca.
Algarve: Olhão.

Figure 43 – Cluster 7

4.2.8. Additional data

As explained before, there are factors that might be useful to have a deeper understanding of what is causing higher or lower retention rates. Those are, for example, the number of school students in a given municipality with social support (it translates in free or discounted meals, books, and other school supplies); the number of teachers with a permanent contract; or the average number of students per class.

Clusters	Social support	Teachers with a permanent contract	Average number of students per class (medium school)	Average number of students per class (high school)
1	39.88	81.82	21.00	24.00
2	46.24	80.00	19.90	22.10
3	34.96	85.19	19.50	24.70
4	41.05	74.29	21.35	24.15
5	38.50	85.11	20.60	23.90
6	38.43	74.36	21.80	23.30
7	43.88	82.24	19.70	23.00

Table 6 – Additional data (median rates in 2015/2016)

The boxplots for each of the variables show the distribution of the variables explained above. On the left superior corner, the distribution of social support for the municipalities in each cluster; on the

right superior corner, the distribution of teacher with a permanent cornet; on left and right inferior corners, the distribution of students per class in middle and high school, respectively.

Interestingly, the clusters generated by the analysis performed above can be distinguished by the average number of teachers with a permanent contract. This means that in cluster five, where the municipalities with lower retention rates are grouped this number is higher, and in cluster three, where there is a recovery in retention rates in 2015/2016. But in cluster six, where there are the highest retention rates of all on 12th grade, it is lower.

In cluster five the number of students with school social support is one of the lowest but so is it in cluster number six.

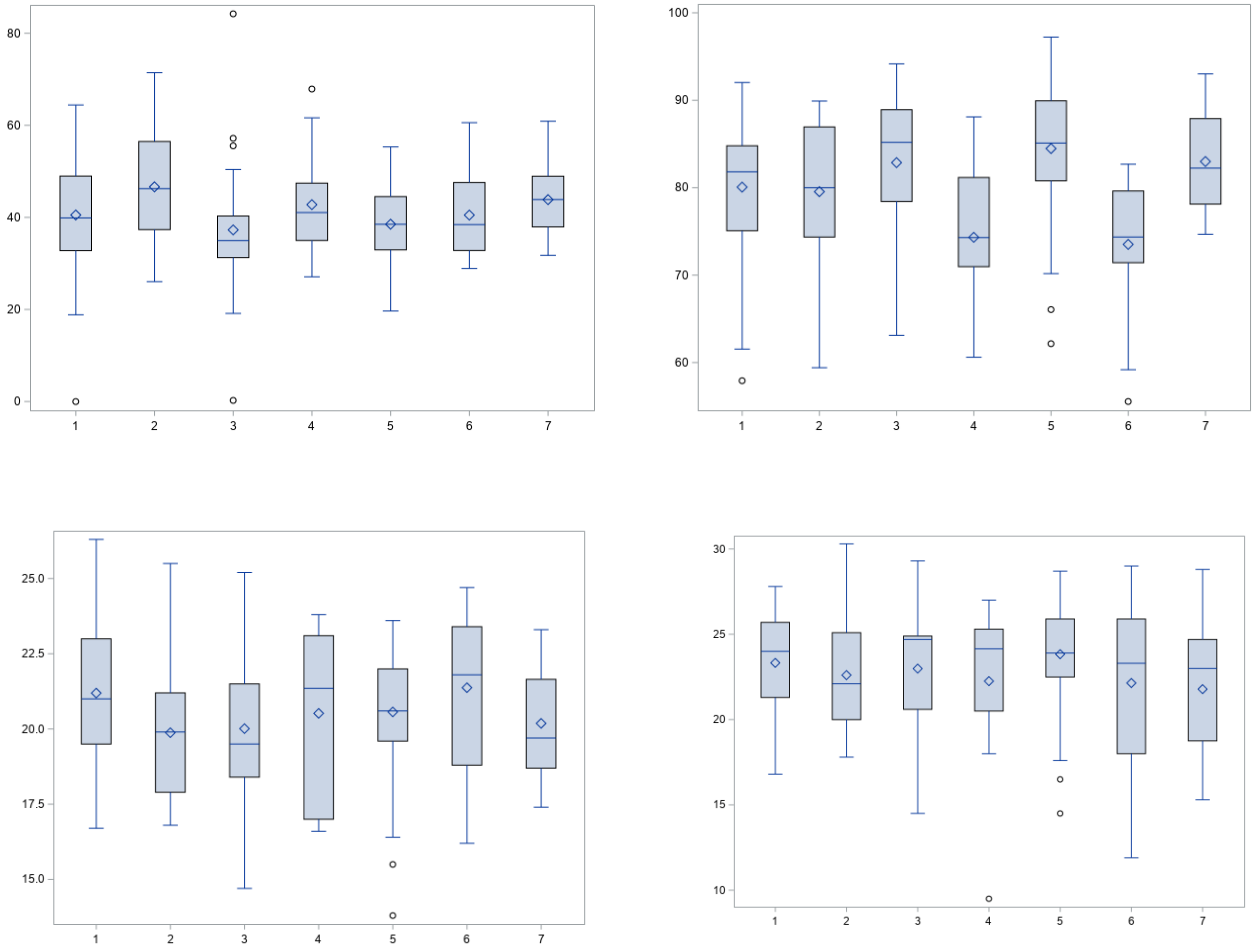


Figure 44 – Boxplots for additional data

4.2.9. A closer look into each territory

One of the most advantageous exercises that can be made by comparing the retention rates in the Portuguese municipalities is to try to understand how neighbor territories relate. It is rather obvious, from the results presented before, that there is a relation. The municipalities that are closer to each other tend to group in similar clusters. And there are plenty of examples. Melgaço, Monção and Arcos de Valdevez (cluster two); Vila Nova de Cerveira, Viana do Castelo, Caminha and Ponte de Lima (cluster five); Loures, Almada, Amadora and Odivelas (cluster six).

That is why it makes sense to understand the behavior of the municipalities in each NUT III – this is a division of the territory made for statistical purposes.

In Portugal, the municipalities that belong to a given NUT III are grouped into something called "Comunidades Intermunicipais", a body that has certain administrative competencies.

Overall, the coefficient of variation of retention rates in the NUTs III range between 0.45 (Área Metropolitana de Lisboa) and Alto Minho (0.75). The global results for the weighted coefficients for each NUT III can be seen in table 8 and for each year under analysis in the annexed tables 6 and 7. This means that in Lisboa, the retention rates for each municipality are closer than in Alto Minho. Apart from Lisboa, the other NUTs that perform worse, which are Área Metropolitana do Porto and Algarve also have the smallest coefficients of variation.

The highest coefficients of variation occur in the middle school years and tend to be higher in the last years of the analysis (2014/2015 and 2015/2016). The lowest happen in 12th grade, which means that, although the retention rates are higher in this particular school year the performance of the municipalities in each NUT is closer to each other.

NUTIII	Coefficient of Variation
Alentejo Central	0.60
Alentejo Litoral	0.51
Algarve	0.47
Alto Alentejo	0.53
Alto Minho	0.75
Alto Tâmega	0.61
Área Metropolitana de Lisboa	0.45
Área Metropolitana do Porto	0.51
Ave	0.58
Baixo Alentejo	0.55
Beira Baixa	0.52
Beiras e Serra da Estrela	0.66
Cávado	0.64
Douro	0.70
Lezíria do Tejo	0.56
Médio Tejo	0.64
Oeste	0.52
Região de Aveiro	0.60
Região de Coimbra	0.61
Região de Leiria	0.66
Tâmega e Sousa	0.60
Terras de Trás-os-Montes	0.60
Viseu Dão Lafões	0.59

Table 7 – Weighted coefficients of variation for the NUTs III

4.2.9.1. Alentejo Central

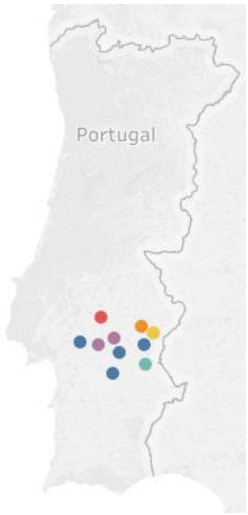


Figure 45 – Alentejo Central

Alentejo Central is a NUT with very different municipalities. We have, on one hand, places like Évora, Viana do Alentejo, Redondo – which was one of the univariate outliers left out of the PCA – and Vendas Novas, that belong to cluster five where the results are the best. On the other hand, there is, for example, Reguengos de Monsaraz, a municipality where retention rates are the worse; Montemor-o-Novo and Arraiolos, where the numbers are neither the best nor the worse; Vila Viçosa, that shows some improvements when compared to earlier years; and Mora that is performing particularly bad in 7th, 9th, 10th and 11th grade.

One aspect that is notorious is the geographic proximity between territories that are part of the same cluster. Although other NUTs in Alentejo have some of highest median retention rates, it is not the case in Alentejo Central. Here, this value is not amongst the highest nor the lowest.

The global weighted coefficient of variation for this NUT is 0.60. But it changes throughout the years under analysis (it ranges from 0.17 to 0.69). The retention rates in these municipalities are closer in 7th, 11th and 12th grade in 2011/12, and in 12th grade in 2010/11 and 2014/15. But differ more in 9th and 8th grade in 2015/16.

4.2.9.2. Alentejo Litoral

Figure 46 – Alentejo Litoral

Alentejo Litoral has the highest median retention rates throughout the years analyzed. There are some similarities between the municipalities. Namely in Alcácer do Sal, Grândola and Santiago do Cacém. Those belong to cluster number one and are among those that have neither the best nor the worst retention rates. Sines is part of cluster six, populated by the worst performing municipalities. Odemira, which is a more rural and isolated territory, is part of another cluster. Here, the retention rates in middle school are also some of lowest among all clusters, then there is an increase in 12th grade in 2012/2013 and 2013/2014 but they improve slightly in the coming years.

The global weighted coefficient of variation for this NUT is 0.51 – ranging between 0.10 and 0.64. The retention rates in this municipalities are closer in 9th grade in 2015/2016, 12th in 2011/2012 and in 10th grade in 2013/2014. The biggest variations occur in the early years of the analysis, mainly in 11th grade 2011/2012 and 8th and 11th grade in 2010/2011.

4.2.9.3. Algarve

Figure 47 – Algarve

The group of municipalities that are part of Algarve have some of the worst results – something that is confirmed by the fact that it has the third highest median retention rate – but are distributed into five different clusters. The global coefficient of variation for this NUT is also among the lowest (0.47), particularly explained by the closeness of retention rate for some more populated municipaltity.

Lagos, Portimão, Tavira and Vila Real de Santo António are part of cluster number four. Their retention rates are particularly high in the first years of 7th grade, and in 9th grade (2011/2012, 2012/2013 and 2014/2015) and they remain high, particularly in 10th and 11th grade when compared with the other clusters.

Then, Loulé, Albufeira and Lagoa are part of cluster number six, which means that they have the worst results in this NUT.

São Brás de Alportel is the good example. It is the only municipality in Algarve that belongs to cluster five (where the territories with lower retentions are). Additionally, Olhão, in cluster seven, must be seen as a study case. That is where the retention rates have improved a lot since the beginning of the decade.

Throughout the years the coefficient of variation range from 0.11 to 0.32. The lowest values happen in the middle school years in 2010/11. The highest in 11th grade 2010/11 and 2012/13 and in 9th grade 2014/15.

4.2.9.4. Alto Alentejo

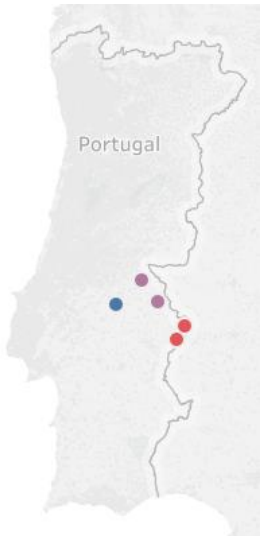


Figure 48 – Alto Alentejo

The good example in Alto Alentejo is Ponte de Sor, but, overall, this NUT does not do so well. It ranks 4th among those with an higher retention rate.

Aside from that, Nisa – which was one of the univariate outliers left out of the PCA – and Portalegre (cluster one) are examples of places where, in certain years, retention rates are really close or above those of 12th grade. And are also territories where the difference in the unsuccess rate of the students is much steeper.

Campo Maior and Elvas are part of cluster four. In this case, Campo Maior is an example of a place where, in certain years retention rates for 10th grade are higher than those for 12th grade. A question that arises is: What happens to this students?

The coefficient of variation in this NUT is 0.53. This statistic is lower in almost all the years for 12th grade (it only increases in 2015/16). On the other hand, it is higher in 7th and 8th grade in 2015/16, in 10th grade 2013/14 and in 11th 2010/11.

4.2.9.5. Alto Minho

Figure 49 – Alto Minho

Alto Minho is an interesting case.

On one side, by the sea, we have the municipalities that do particularly well. It is a group comprised by Viana do Castelo, Paredes de Coura, Caminha, Vila Nova de Cerveira, Valença and Ponte de Lima.

On the other there is Monção, Melgaço and Arcos de Valdevez. The retention rates in these municipalities there are some of the lowest in middle school, but then, particularly in 12th grade in 2010/2011 and 2011/2012 it has some of the highest values among all clusters

Either way, it this the NUT with the lowest median retention rate: around 9%.

Because of the differences between this municipalities, the coefficient of variation is one of the highest 0.75. The differences are steeper in 10th grade 2011/2012 and in 9th and 10th grade in 2015/2016. But they are less dispersed in all the 12th grade years except from 2014/2015.

4.2.9.6. Alto Tâmega

Figure 50 – Alto Tâmega

As we have seen before, there is a higher retention rate in the southern part of the country and in the interior of Portugal. Alto Tâmega is one of those territories in the North that has some of the worst performances.

Alto Tâmega, much like all the other territories already seen, is very diverse. Here geographical proximity does not seen to have a significant role. There is Chaves, which has the best results. Then Vila Pouca de Aguiar, that although it is not the best, has also been able to reduce its retention rate both in middle school and in high school.

Then, there is Valpaços and Montalegre, retention rates are particularly high in the first years of 7th grade, and in 9th grade (2011/2012, 2012/2013 and 2014/2015) and they remain high, particularly in 10th and 11th grade when compared with the other clusters. Ribeira de Pena is the only municipality where retention rates are increasing.

The coefficient of variation in this NUT is among the highest 0.61. The dispersion is higher in 10th grade 2011/12, 8th grade in 2010/11 and in 11th in 2015/16. And it is lower in 12th grade between 2010 and 2013. Although in other NUTs the lowest values for the coefficient of variation occur in all (or almost all) of the years for the 12th grade, that does not happen in Alto Tâmega. That might mean that there is a tendency for wider dispersion and therefore better results for some and worse for others in the more recent years.

4.2.9.7. Área Metropolitana de Lisboa

Figure 51 – Área Metropolitana de Lisboa

Diversity is also something that is not lacking in Lisboa's retention rates. Nevertheless, Área Metropolitana de Lisboa is the worst performing NUT.

Not surprisingly, Loures, Odivelas, Amadora, Sintra, Almada, Seixal and Moita are all in the same group, which is that of the worst retention rates. Lisboa is not on the same cluster because it manages to have a slightly lower retention rate. The specific case of Lisboa and Porto is something that is going to be studied in the coming pages.

Cascais and Oeiras are part of the cluster number three, where retention rates in middle school are also some of lowest among all clusters, reach a peak in 12th grade in 2012/2013 and then improve.

Setúbal is part of cluster seven. It has especially high retention rates in 8th and 9th grade but recover in 2014/2015. There is also the ones that have had high retention rates in high school, but managed to recover. Particularly in the final years of high school.

The coefficient of variation in this NUT is one of the lowest: 0.45. Zooming in each school level and year under analysis, it is in 12th grade (from 2010 to 2016) that the dispersion is smaller. On the other hand, it is in the late years of middle school that the range broadens, namely in 7th and 8th grade in 2015/16 and in 7th, 8th and 9th grade in 2014/15.

4.2.9.8. Área Metropolitana do Porto

Figure 52 – Área Metropolitana do Porto

The results are particularly better in the municipalities in the south and in the north of the NUT. In the center – Paredes, Gondomar, Valongo, Porto, Vila Nova de Gaia, Matosinhos and Vila do Conde – the rates on middle school are high; on 10th grade they have worsened but have gotten better on 12th grade.

The coefficient of variation in this NUT is 0.51. The lowest values for this statistic of dispersion occur – much like in other NUTs – in the 12th grade. But it is higher in 10th grade in 2010/11, 2011/12 and 2014/15 and in 11th grade in 2011/12, 2014/15 and in 2015/16.

4.2.9.9. Ave

Figure 53 – Ave

In the Ave, Guimarães, Vila Nova de Famalicão and Vizela are the better performing municipalities. Fafe is not the best but has managed to recover in most recent years.

Mondim de Basto, Póvoa de Lanhoso and Vieira do Minho have high retention rates in middle school (that they managed to control); and high retention rates on 12th grade (they reach peak in 2012/2013 and 2013/2014).

The coefficient of variation in this NUT is 0.58. The dispersion in this municipalities is smaller in all the 12th grade years and in 7th grade in 2014/15 and in 8th grade from 2012 to 2014. It is higher in the beginning and end of 8th and 9th grade and in 11th grade in 2015/16.

4.2.9.10. Baixo Alentejo

Figure 54 – Baixo Alentejo

In Baixo Alentejo there are also some differences.

Ourique is the municipality with the worst retention rates (there have been some improvements, but not enough to make it fit on any other group). Then, Almodôvar, Mértola and Castro Verde were able to reduce their unsuccess rate since the beginning of the decade. With the lowest values in 2012/2013 and 2013/2014. In Serpa, Beja and Aljustrel there are some examples of retention rates very high on 7th grade.

Moura is the best performing municipality.

The coefficient of variation in this NUT is one of the highest 0.55. The trend of this statistic in each school year and level is similar to the ones seen above. Lowest in 12th grade and higher in 9th (especially 2015/2016) and 11th grade (2010/2011 and 2012/2013).

4.2.9.11. Beira Baixa

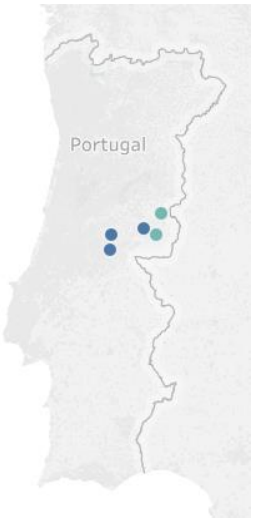


Figure 55 – Beira Baixa

In Beira Baixa the differences are very steep. This is the only territory where we see a clear opposition between the best and worst performing municipalities.

We have, on one side, Oleiros, Proença-a-Nova and Castelo Branco, with clearly better results.

And on the other side, there is Penamacor and Idanha-a-Nova, with relatively high retention rates. And none of them has been able to improve.

The coefficient of variation in this NUT is 0.52. Contrary to the trend we have seen until now, the 12th grade years are not clearly the ones where there are the lowest values for dispersion. It does happen but is not as straightforward. The lowest coefficients of variation happen in 11th grade 2013/2014, 7th 2011/12 and 2014/15 and in 12th grade in 2010/11 and 2014/15. The highest ones are in 10th grade 2010/11 and 8th and 9th grade in 2014/15.

4.2.9.12. Beiras e Serra da Estrela

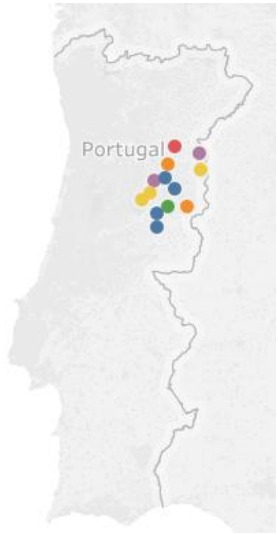


Figure 56 – Beiras e Serra da Estrela

In Beiras e Serra a Estrela there is, again, more diversity.

There is Celorico da Beira, Guarda, Fundão and Covilhã, that have clearly better results. Then there is Belmonte, that has managed to improve dramatically.

Figueira de Castelo Rodrigo and Fornos de Algodres seem to have a problem at hands with 7th grade retention. Altough they are part of cluster number one, they have some of the highest retention rates in this NUT and do not seem to be improving.

The coefficient of variation in this NUT is one of the highest 0.66. In Beiras and Serra da Estrela, the highest values occur in 10th grade from 2011 to 2013 and in 7th between 2013 and 2015. On the other hand, the smaller dispersions are in 12th grade an in 10th in 2010/2011 and in 2013/2014.

4.2.9.13. Cávado

Figure 57 – Cávado

In the Cávado, all the municipalities do relatively well in middle school.

The differences come across in high school. Amares, Esponsende and Barcelos perform really better. But the same is not true for Terras de Bouro and Braga that have an aggravation of the retention rates in high school.

The coefficient of variation in this NUT is among the highest 0.64. The higher values occur in 9th grade in 2010/11, 2011/12 and 2014/15 and in 11th grade in 2014/15. The lowest happen in 7th and 12th grade.

4.2.9.14. Douro

Figure 58 – Douro

The Douro region is very diverse. There is, on one side, Lamego, Moimenta da Beira, Carrazeda de Ansiães and Vila Real, the best performing ones. On the opposite side, we have São João da Pesqueira, the worst performing one.

Then there are slighter differences. Vila Nova de Foz Côa, Peso da Régua, Alijó and Tabuaço have some of the highest retention in middle school in this NUT.

The coefficient of variation in this cluster is 0.70. The dispersion in Douro is very significant in 8th grade in 2015/16 reaching almost 1. And is also over 0.75 in 7th grade in 2014/15 and in 8th in 2010/11. The lower values happen in 12th grade.

4.2.9.15. Lezíria do Tejo

Figure 59 – Lezíria do Tejo

In Lezíria do Tejo there are two of the best performing municipalities: Santarém and Alpiarça. This two have managed to even decrease their retention rates, especially in 12th grade in the most recent years.

There is Almeirim and Azambuja, two places where retention rates in middle school are also relatively low but then increase in 2012/2013 and 2013/2014 and slight decrease in the years after; Coruche, Salvaterra de Magos and Benavente, the average ones; Rio Maior, where the retention rates are some of the lowest in middle school, but then, particularly in 12th grade in 2010/2011 and 2011/2012 the rates are high; Chamusca, with particularly high retention rates in the final years of middle school and a significant improvement in high school; Cartaxo, where retention rates are high in the first years of 7th grade, and in 9th grade (2011/2012, 2012/2013 and 2014/2015) and then remain high, particularly in 10th and 11th grade when compared with the other clusters.

The coefficient of variation in this cluster is 0.56 and it follows the generic trend regarding the dispersion in each school year – higher in 8th and 10th grade and lower in 12th.

4.2.9.16. Médio Tejo

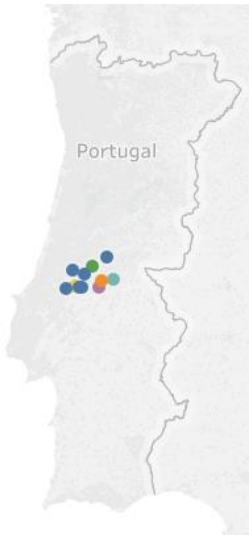


Figure 60 – Médio Tejo

The most predominant cluster in Médio Tejo is the one populated by the municipalities with the best performances. Half of the territories in this NUT (Alcanena, Entroncamento, Ourém, Sertã, Tomar, Vila Nova da Barquinha) are part of this cluster.

As for the others, Mação is the one with the worst results. In spite of that, a closer look to this municipality allows to conclude that there were significant improvements in most recent years.

The others, Abrantes, Sardoal, Torres Novas and Ferreira do Zêzere, are spread across the other clusters.

Médio Tejo is neither amongst the best nor the worst retention rate performances. The coefficient of variation in this cluster is 0.64. In this case, the dispersion is lower in 9th grade in 2011/12, 12th grade in 2010/11, 10th in 2015/16 and 8th grade in 2013/14. But it is higher in 10th grade in 2012/13 and in 9th and 11th grade in 2015/16.

4.2.9.17. Oeste

Figure 61 – Oeste

In Oeste, much like in the other NUTs, there are more than one cluster. None is better represented than the other, though.

What it is remarkable is that Sobral de Monte Agraço and Torres Vedras show a similar trend – among the best performances. Curiously, this two municipalities are the ones further south in the Oeste NUT and they are still part of the Lisboa district.

Also, Peniche, Caldas da Rainha show the same trend (they are neither the best nor the worst); Alcobaça shows improvements in the last years and so does Alenquer.

Here the coefficient of variation is of 0.52. The dispersion is higher in 10th grade in 2011/11 and 2013/14 and in 11th grade 2013/14. And it is lower in 12th grade 2010/11, 8th grade 2012/13 and 10th 2015/16.

4.2.9.18. Região de Aveiro

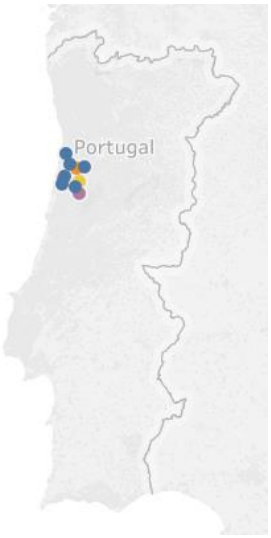


Figure 62 – Região de Aveiro

Aveiro, Estarreja, Oliveira do Bairro, Ovar, Sever do Vouga and Vagos are more than half of the municipalities that are part of the NUT Região de Aveiro. They are all some of the best performing municipalities. The median retention rate in this region is 14%.

In the context of this NUT, Ílhavo and Anadia, are the ones with a worst performance. Even though they populate cluster number one.

Albergaria-a-Velha, in cluster two, has a peak in 2010/2011 and 2011/2012. Águeda, in cluster three, is where retention rates in middle school are also some of lowest among all clusters, but then the increase occurs in 12th grade in 2012/2013 and 2013/2014 and they remain high in the coming high school levels.

The coefficient of variation in this cluster is 0.60. The school year of 2015/2016 is one of high dispersion in certain school levels, namely 8th, 9th and 10th grade. Again, 12th grade in all school years presents the lowest coefficients of variation.

4.2.9.19. Região de Coimbra

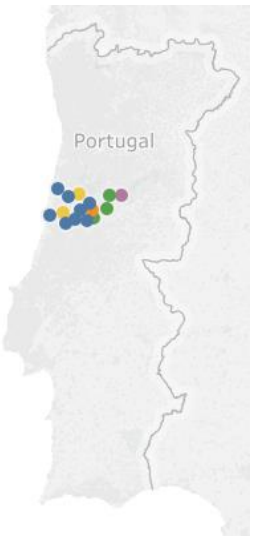


Figure 63 – Região de Coimbra

Similarly to Aveiro, Coimbra is a NUT with a predominance of municipalities populating the cluster with the best performances - Cantanhede, Coimbra, Condeixa-a-Nova, Figueira da Foz, Mira, Miranda do Corvo, Penacova and Soure.

The others are distributed along cluster one, two, three and seven. There is none from the cluster representing the worst performances.

One interesting case is that of Mortágua. This municipality has the lowest median retention rate in this NUT. Nevertheless it is part of the cluster number two. This is because the retention rates are very low in middle school but then skyrocket particularly in 12th grade.

The coefficient of variation is 0.61. Without a surprise, 12th grade in all school years presents the lowest coefficients of variation. And it is highest in 7th, 8th and 9th grade from 2013 to 2016.

4.2.9.20. Região de Leiria

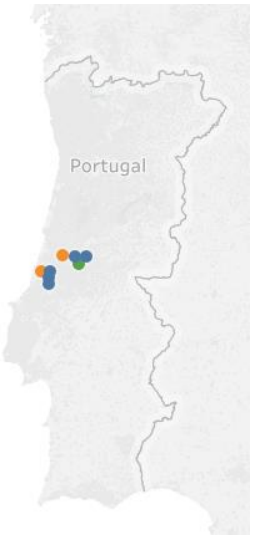


Figure 64 – Região de Leiria

Região de Leiria has the second lowest median retention rate: 11.6%.

Two thirds of the municipalities in this NUT - Ansião, Batalha, Figueiró dos Vinhos, Leiria and Porto de Mós - have some of the best performances in the country.

The others, Marinha Grande and Pombal, have very low retention rates in middle school but an increase in high school, specifically in the beginning of the decade.

Alvaiázere is the worst performer. It has some of the highest retention rates both in middle and high school.

The coefficient of variation is 0.66. The dispersion is higher in 11th grade from 2014 to 2016 and in 9th grade from 2013/14. And lower in 12th grade but also in 7th in 2012/13 and 8th in 2015/16.

4.2.9.21. Tâmega e Sousa

Figure 65 – Tâmega e Sousa

There is only one of the best performing municipalities in Tâmega e Sousa. It is Penafiel. But there is none of the worsts.

All the others are split between cluster number one (the ones that perform the worst in the NUT) and number two.

Resende, that had a significant peak in 12th grade in 2014/2015 is the exception.

The coefficient of variation in this cluster is 0.60. The higher values for the coefficient of variation happen in 11th grade in 2010/11 and between 2013 and 2016. And the lowest in 12th grade.

4.2.9.22. Terras de Trás-os-Montes

Figure 66 – Terras de Trás-os-Montes

Terras de Trás-os-Montes ranks second among the NUTs with the highest median retention rates. In fact, there are two of the worst performing municipalities in this NUT: Mogadouro and Vinhais.

In this context, Bragança is the best performing municipality.

Vila Flor and Mirandela perform averagely. In some years, the retention rates in middle school in this territories are higher than those in 12th grade.

The coefficient of variation is 0.60. The dispersion is higher in all years in 8th grade and lower in 12th especially in the later years.

4.2.9.23. Viseu Dão Lafões

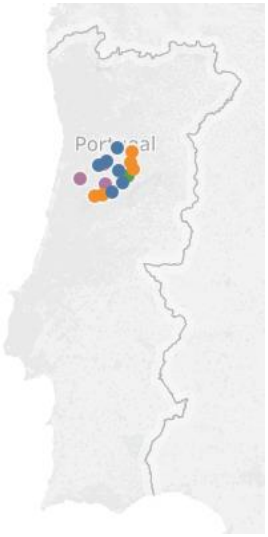


Figure 67 – Viseu Dão Lafões

Similarly to the other NUTs in the center of Portugal, Viseu has a significant proportion of municipalities performing very well: Carregal do Sal, Castro Daire, Nelas, Oliveira de Frades, São Pedro do Sul and Viseu. None is among the worst performances.

Aguiar da Beira, Vouzela and Tondela are part of the same group: those with a retention rate that is neither among the best nor the worst.

Santa Comba Dão, Penalva do Castelo, Sátão and Vila Nova de Paiva are the four municipalities that had significantly high retention rates in the beginning of the decade, but managed to recover.

The coefficient of variation is 0.60. In this case, again, the variation is lower in 12th grade. The higher values occur in 7th grade in 2012/2013 and 2015/2016 and in 11th grade in 2013/2014.

4.3. ZOOM IN LISBOA AND PORTO

The public schools in Lisboa, Porto and the municipalities that border these two cities – Amadora, Loures, Odivelas and Oeiras (Lisboa) and Gondomar, Maia, Matosinhos, Valongo, Vila Nova de Gaia (Porto) – had, in 2015/2016, 23% of the total number of students in the country enrolled in middle

school and in high school. That is one of the reasons why it is so important to study them more deeply. By doing so we understand what is happening to a significant portion of the Portuguese children in school age.

The procedure used to focus on these territories was the same that was applied in the analysis at the municipal level – PCA. In this case, though, we are not using the data aggregated by the municipality, but the school level data. This offers a deeper look into the data and has the potential for more interesting conclusions. The analysis was also divided between middle school and high school because most of the times there are different schools for each level.

Regarding the data, there were no severe outliers. Retention rates range from 0% to 78%. The median retention rate is higher in Lisboa than in Porto both in middle school and in high school.

There were some schools with missing values, and the option was towards a listwise deletion. That decision was supported by the fact that this happened in a few schools. It is worth saying that the absence of data for a given year or group of years most certainly has to do with the fact that the school did not have students enrolled.

The differences between schools are striking. There are schools within mere meters of each other that have remarkably distinctive retention rates. There are also pockets of schools with very good and very bad results that are worth understanding (something that goes outside the scope of this dissertation).

4.3.1. Lisboa in middle school

Taking aside the schools with missing values, the analysis of middle school retention rates in Lisboa is comprised by 90 schools (the full PCA results can be seen in annex) that were grouped in three different clusters.

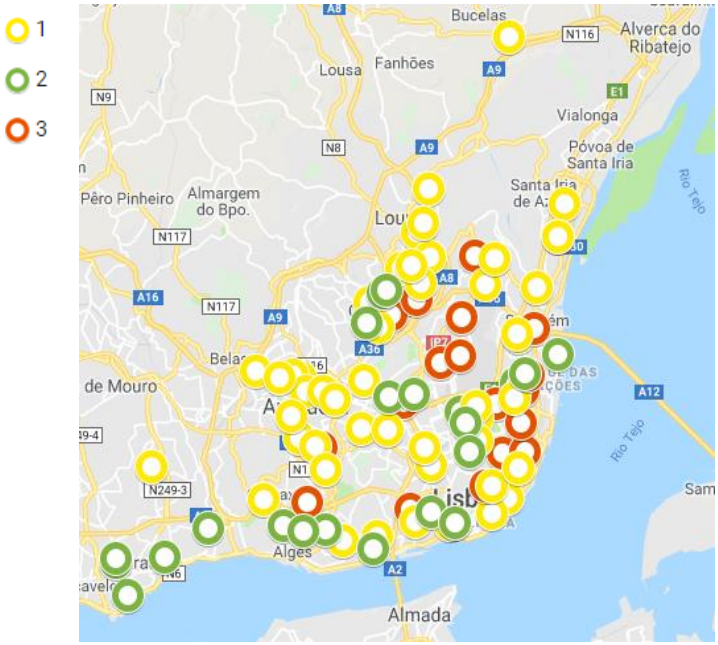


Figure 68 – Retention rates in Lisboa's middle schools

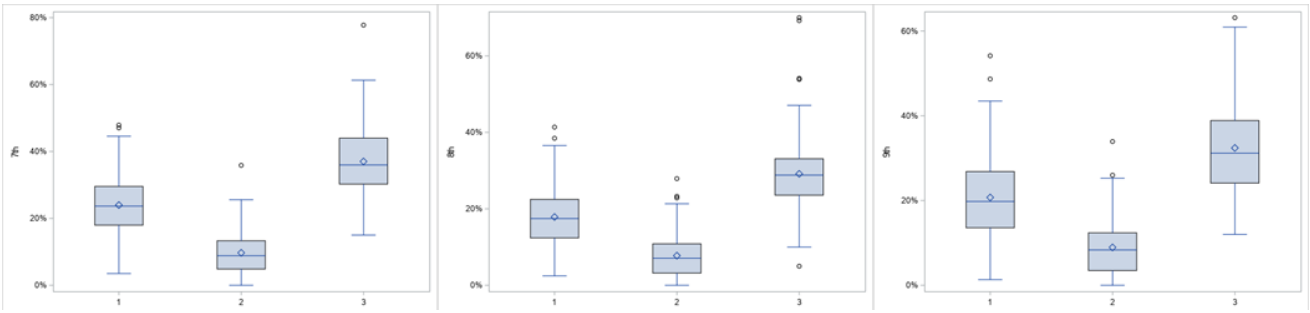


Figure 69 – Boxplot for retention rates in Lisboa's middle schools in each cluster and school level from 7th (left) to 9th (right).

Cluster 1 is that of the schools that do "so-so". They are neither the best or the worst performing. There are some other aspects that help to paint a picture of their performance. For a group of schools that is composed by Escola Básica e Secundária Dr. Azevedo Neves, Damaia, Amadora; Escola Básica Patrício Prazeres, Lisboa; Escola Básica D. Dinis, Odivelas; Escola Básica e Secundária Passos Manuel, Lisboa; Escola Básica Almirante Gago Coutinho, Lisboa; Escola Básica e Secundária Josefa de Óbidos, Lisboa; Escola Básica e Secundária Aquilino Ribeiro, Leião, Oeiras; Escola Básica do Bairro Padre Cruz, Lisboa; Escola Básica Prof. Delfim Santos, Lisboa; and Escola Básica de São João da Talha, Bairro do Estacal Novo, Loures the evolution from 9th grade in 2010/2011, 2011/2012 and 2012/2013 to 7th grade in 2014/2015 is significantly positive. In this group, all of the schools have improved in 7th grade. On the other hand, in Escola Básica de Santa Iria de Azóia, Loures; Escola Secundária do Arco-Íris, Portela, Loures; Escola Básica do Catujal, Loures; and Escola Básica Almeida Garrett, Alfragide, Amadora the contrary has happened. Here, in cluster 1, are also the schools that have peaked in retention rates in 7th, 8th and 9th grade in 2011/2012 and 7th grade 2013/2014, but that prior and after had lower retention rates. The concentration of this type of schools is higher in Amadora, Odivelas, and Loures.

The other two clusters, as the colors were chosen to represent them indicate, are the best and worst performing schools, as shown in figure 68.

Figure 70 – The case of Oeiras

And if the "so so" schools are more broadly expanded in the territory, the same does not happen in these two groups. The schools in cluster 2, are in Oeiras, Odivelas, and Lisboa. The ones in cluster 3 are in all the municipalities analyzed.

It is worth remarking that there are two different types of distribution of the clustered schools. On one hand, there are pockets of schools that belong to one cluster and that are all alone in one certain place. That is the example of the schools in

Oeiras, near the sea, or the ones in Amadora. But on the other hand, there are schools side by side that belong to opposite clusters. This happens very clearly in Telheiras, Olivais and in Avenidas Novas, all within Lisboa. We will look closer to those cases.

The case of Oeiras is shown in figure 70. Although these are not the only schools in the municipality there is clearly a pocket of relatively well-performing ones. This group is composed by Escola Básica de São Bruno, Escola Básica Conde de Oeiras, Escola Secundária da Quinta do Marquês, Escola Básica de São Julião da Barra and Escola Secundária Luís de Freitas Branco.

Here, in the best performing schools, the median retention rates go from 1% to 13%, while on the other three schools in the municipality it goes from 12% to 31%.

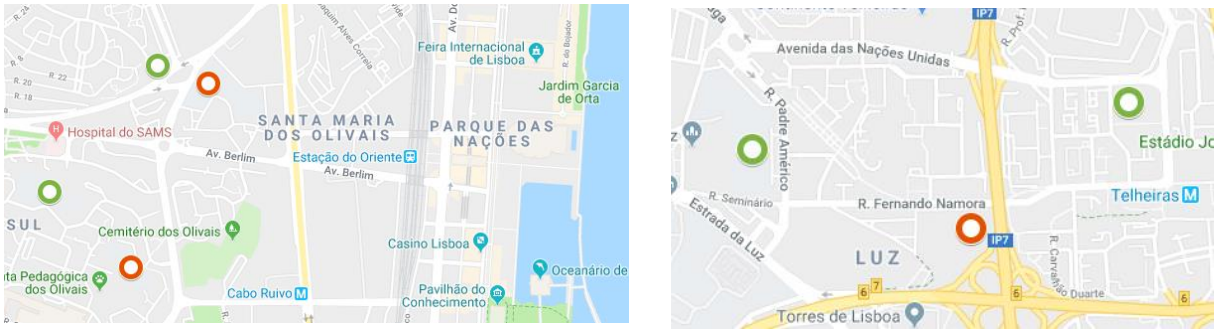


Figure 71 – The case of Olivais and Telheiras

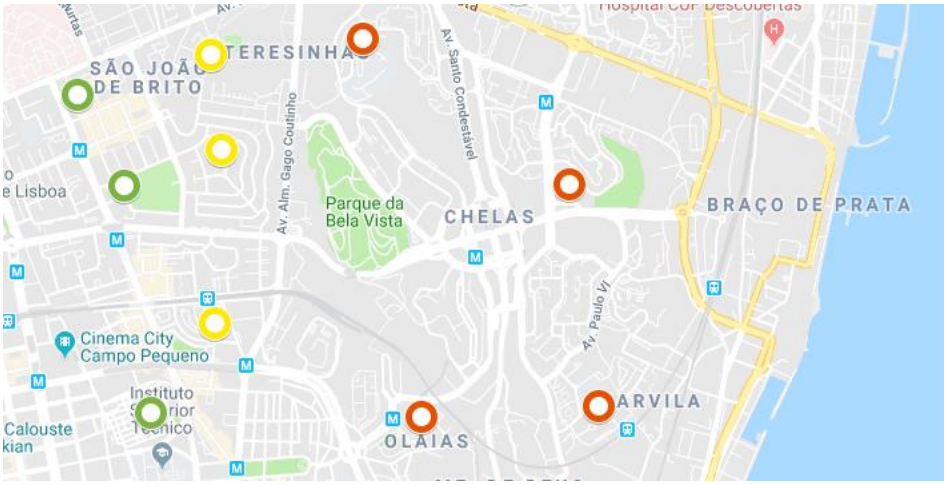


Figure 72 – Great diferences in the center of Lisboa

In Olivais, there is a clear example of four schools that are very close in distance, but worlds apart in terms of its student's success. Escola Secundária Eça de Queirós and Escola Secundária António Damásio are the two red dots in the image on the left in figure 71. Escola Básica de Piscinas and Escola Básica Fernando Pessoa are the green ones. This translates into a median retention rate of 11% and 12% in the best performing schools and 32% in the worst performing.

Another glaring example is that of the schools in Telheiras (on the right side of figure 71). While there are two schools (Escola Secundária Vergílio Ferreira and Escola Básica de Telheiras) that perform well

enough to fit into cluster 2, there is one that does not (Escola de São Vicente/Telheiras) and is, in fact, one of the worst-performing schools. The differences are significant. While the two "good" schools have media retention rates between 5% and 10%, the other one more than triples that value: 33%.

The image in figure 72 bears another example of the differences between schools that are geographically close and have different results. In green, Escola Básica Eugénio dos Santos, Escola Básica e Secundária D. Filipa de Lencastre and Escola Secundária Rainha D. Leonor. In yellow, Escola Secundária Padre António Vieira, Escola Básica Almirante Gago Coutinho, and Escola Básica Luís de Camões. Finally, in red, Escola Básica Damião de Góis and Escola Básica das Olaias. These schools are all within a three-kilometer radius of each other.

4.3.2. Lisboa in high school

The number of high schools is lower than that of middle schools. For Lisbon and its bordering municipalities, 45 public schools were taken into account.

Figure 73 – Retention rates in Lisboa's high schools

In this case, as shown in figure 74, it is the overall performing of the schools that is determinant for the distribution within the four different groups. Clusters 1 and 2 are the relatively worst-performing school. Clusters 3 and 4 are the relatively better-performing ones. Cluster 3 is the one that presents the best results.

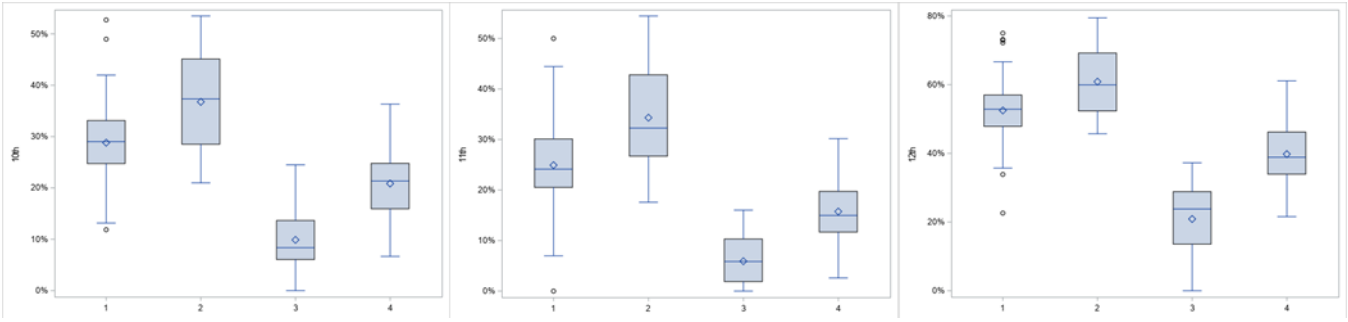


Figure 74 – Boxplot for retention rates in Lisboa's high schools in each cluster and school level from 10th (left) to 12th (right).

The best performing schools are Escola Secundária da Quinta do Marquês, Oeiras, Colégio Militar, Lisboa, Escola Secundária do Restelo and Escola Secundária Vergílio Ferreira, Oeiras. While the worst performing schools are Escola Secundária do Lumiar, Escola Básica e Secundária Passos Manuel, Escola Secundária de Sacavém and Escola Secundária Seomara da Costa Primo.

Regarding the geographic distribution, there are some similarities between the results in the middle schools and the high schools in Lisboa. With the riverside area from Oeiras to Belém showing relatively better results, and then relatively worse from there.

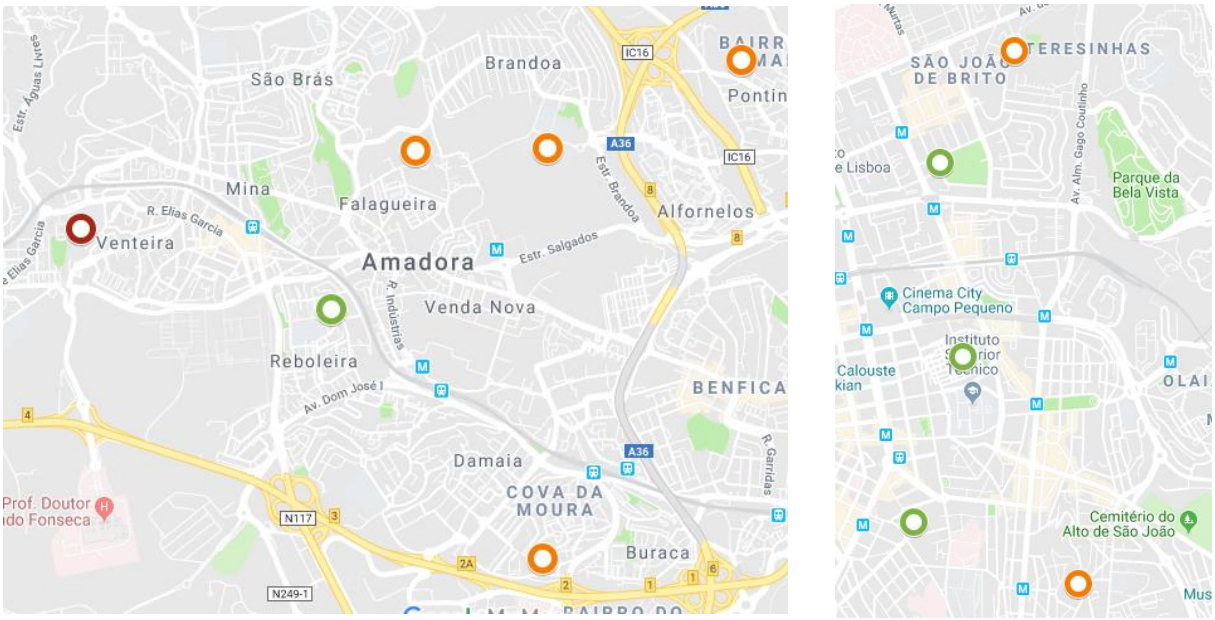


Figure 75 – The case of Amadora and the center of Lisboa

And the patterns repeat as well, specifically in the schools that are close to each other but have very different results. Namely, Escola Básica e Secundária D. Filipa de Lencastre, Escola Secundária Rainha D. Leonor and Escola Secundária Camões as opposed to Escola Secundária D. Luísa de Gusmão and Escola Secundária Padre António Vieira (on the right in figure 75). And also, Escola Secundária da Amadora as opposed to Escola Secundária Fernando Namora, Escola Básica e Secundária D. João V, Damaia, Escola Secundária Braancamp Freire, Pontinha, Escola Básica e Secundária Mães de Água, Falagueira and Escola Secundária Seomara da Costa Primo (on the left in figure 75).

4.3.3. Porto in middle school

Regarding the distribution of retention rates in Porto and its border municipalities, 81 schools were taken into account. Most of them are divided by there different performances over the years analyzed. But in some cases is the evolution (positive or negative from some years to others that defines the clusters).

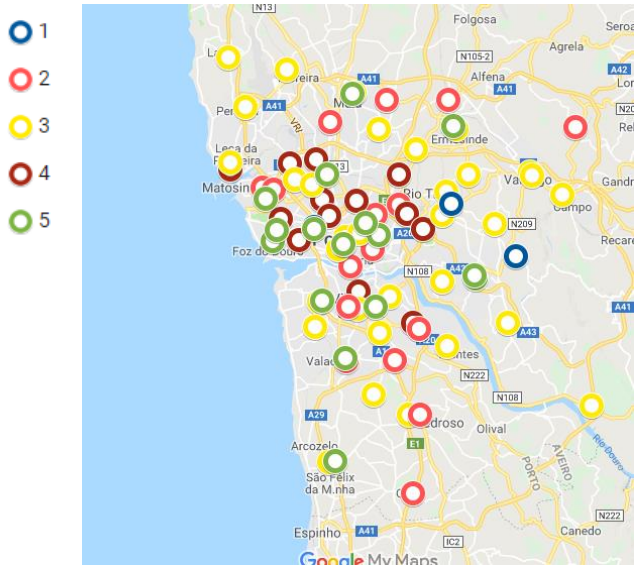


Figure 77 – Retention rates in Porto's middle schools

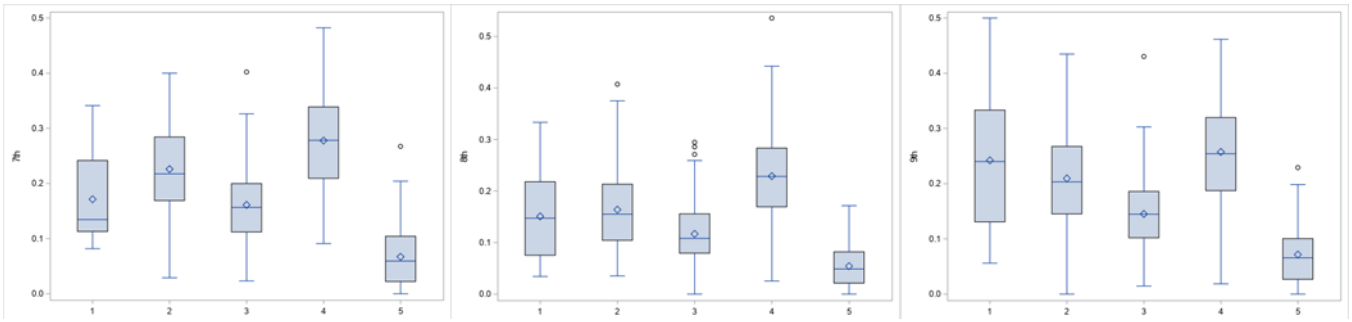


Figure 76 – Boxplot for retention rates in Porto's middle schools in each cluster and school level from 7th (left) to 9th (right).

In this case, clusters 4 and 2 represent the worst performing school. Most of the worst performing ones (in cluster 4) are located above the Douro river. As for the better performing, the distribution is wider but does not go beyond the borders of Porto, Vila Nova de Gaia, Matosinhos, and Gondomar.

In clusters 2 and 3, the differences are less obvious. But it is notorious from figure 77 that the median retention rate is higher in cluster 2 for every school level under analysis.

Cluster 3 is populated by the schools that have had a relatively positive performance in the years under analysis. But here, are also schools that have had worst results in 7th grade in 2014/2015 when compared with 9th grade retention rates in 2010/2011, 2011/2012 and 2012/2013. Namely, Escola Básica Adriano Correia de Oliveira, Avintes, Vila Nova de Gaia, Escola Secundária António Sérgio, Vila Nova de Gaia, Escola Básica da Madalena, Vila Nova de Gaia, and Escola Básica Marques Leitão, Valbom, Gondomar.

Escola Secundária António Sérgio, Escola Básica da Madalena, both in Vila Nova de Gaia, and Escola Básica Marques Leitão, Valbom, Gondomar, are also three examples of schools where results were worse in 9th grade 2010/2011, 8th and 9th in 2013/2014 and 8th and 7th in 2014/2015.

At the same time, cluster 3 is populated by the schools that have improved from retention rates in 7th and 8th grade in 2010/2011 and 7th grade in 2011/2012 when compared with 8th grade in

2012/2013 and 2013/2014 and 9th grade in 2012/2013 and 2013/2014. These are Escola Básica Soares dos Reis, Vila Nova de Gaia, Escola Básica e Secundária de Canelas, Vila Nova de Gaia, and Escola Básica Escultor António Fernandes Sá, Gervide, Vila Nova de Gaia.

In cluster 2, there are two schools worth naming. These are Escola Básica de São João do Sobrado, Sobrado, Valongo, and Escola Básica Dr. Costa Matos, Vila Nova de Gaia. The retention rates peaked in these schools in 7th grade in 2011/2012 and 2013/2014. But have improved.

Cluster 1 is populated by the schools that are an exception. These are Escola Básica Fontes Pereira de Melo, in Porto, Escola Básica de São Pedro da Cova and Escola Básica e Secundária de Rio Tinto, both in Gondomar. These three schools, unlike the others, are not well represented by their broad performance. They are better explained by the evolution from 9th grade retention rates in 2010/2011, 2011/2012 and 2012/2013 to 7th grade 2014/2015. In other words, they have improved significantly in these years. So these might be seen as an example.

Similarly to Lisboa, there are remarkable results in Porto. And again, schools close to each other are sometimes worlds apart. Others are in worlds of their own. Starting by the ones that are apart, there is the case of the schools in Foz do Porto. On one hand, there is Escola Básica Francisco Torrinha and Escola Secundária Garcia de Orta, both with relatively low retention rates. On the other hand, there is Escola Básica Manoel de Oliveira and Escola Básica Leonardo Coimbra Filho, both with high retention rates (on the left in figure 78). The same thing happens between Escola Básica Eugénio de Andrade – high retention rates – and Escola Secundária Filipa de Vilhena and Escola Secundária Aurélia de Sousa (on the right in figure 78).

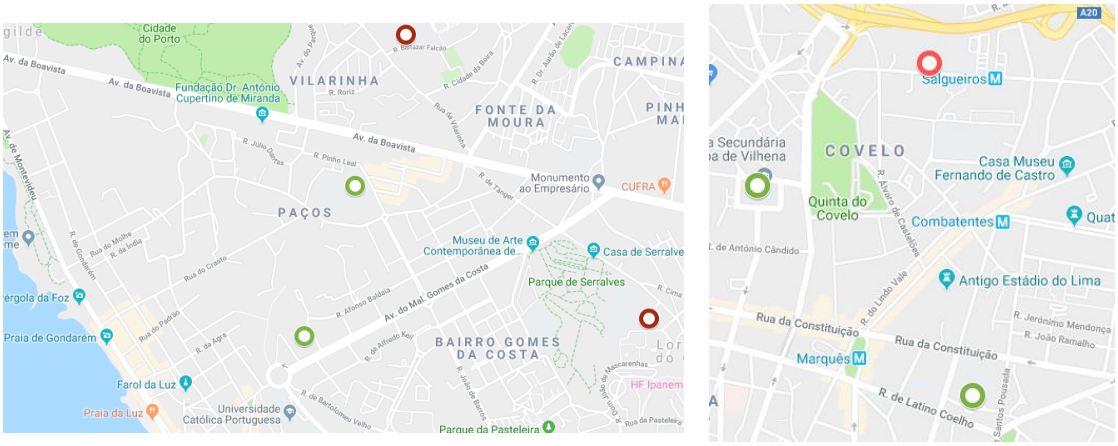


Figure 78 – The case of Foz do Porto and Covelo

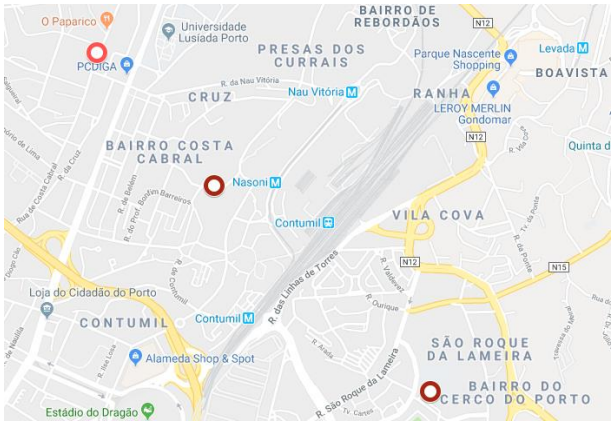


Figure 79 – The case of Bairro do Cerco

Apart from the discrepancies between schools that are close to each other, there are also groups of schools with similar behaviors. This is the case, for example, with Escola Básica da Areosa, Escola Básica Nicolau Nasoni and Escola Básica e Secundária do Cerco.

4.3.1. Porto in high school

In Porto, 35 schools were regarded in the analysis of retention rates in high school. That can be divided into 4 clusters.

Again, the performance of schools over the years is decisive for the division into the four clusters. Only two schools are part of cluster 1, the worst performing: Escola Secundária António Nobre and Escola Básica e Secundária Fontes Pereira de Melo.

Then, in cluster 2 are the ones that are bad, but not so much. Only one of those is below the Douro river. Here is also Escola Secundária de Gaia Nascente, Vila Nova de Gaia, that is worse in 12th grade in 2010/2011 and 2011/2012 than in 10th grade in 2010/2011, 2011/2012, 2012/2013, 2013/2014 and 2014/2015. Escola Básica e Secundária do Cerco and Escola Secundária da Boa Nova, Leça da Palmeira are also represented in this cluster. In the first, there is an improvement in 12th grade in 2013/2014 when compared with 11th grade 2011/2012 and 12th grade 2014/2015. In the other, it is the contrary.

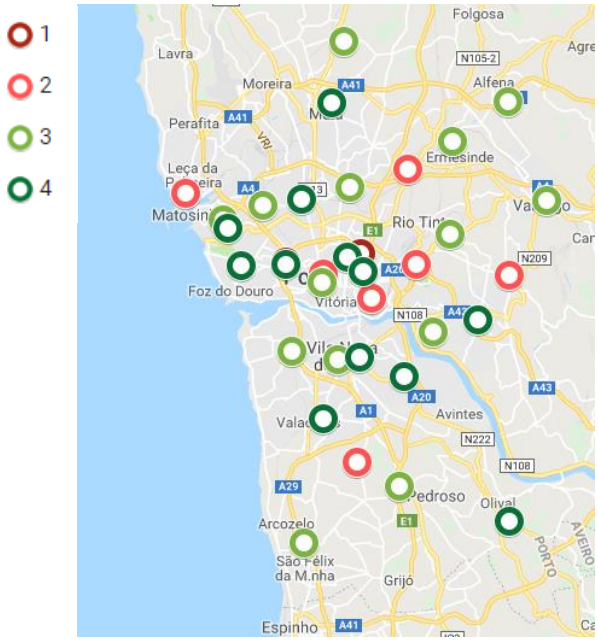


Figure 80 – Retention rates in Porto's high schools

Clusters 3 and 4 are populated by better performing schools. In cluster 4 are the best-performing ones. They are spread through the territory.

In cluster 3, are the ones with a not great but medium performance. Here are some of the schools that have improved in 10th grade in 2010/2011, 2011/2012, 2012/2013, 2013/2014 and 2014/2015 when compared with 12th grade in 2010/2011 and 2011/2012.

Similarly to what has happened in all the clustering procedures described above, there are some geographical patterns that are worth remarking. First of all, there is the case of Escola Secundária Filipa de Vilhena, Escola Secundária Aurélia Sousa and Escola Secundária António Nobre (pictured in the left in figure 82). The three are located in the Covelo area but they do not have much more in

common. The first two are among the best performing and the last one is one of the worst performers. They are a 20 minutes' walk away. The pattern repeats in middle school.

Another example is that of the opposition between Escola Básica Fontes Pereira de Melo and Escola Básica e Secundária Carolina Michaelis (in clusters 1 and 2 respectively) and Escola Secundária Clara de Resende and Escola Básica e Secundária Rodrigues de Freitas (in clusters 4 and 3).

At last, there is an example similar to that found in Oeiras, Lisboa, but in Vila Nova de Gaia (bottom image in figure 82), where there are four schools (Escola Secundária de Inês de Castro, Escola

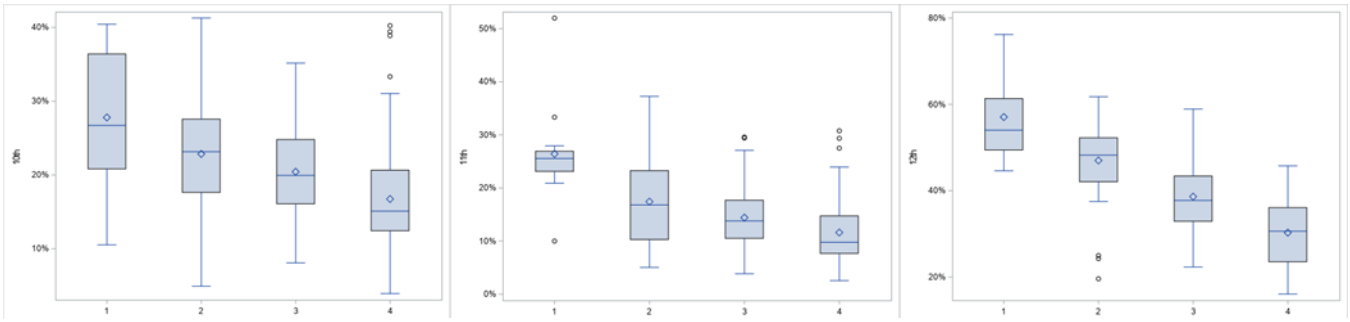


Figure 81 – Boxplot for retention rates in Porto's high schools in each cluster and school level from 10th (left) to 12th (right).

Secundária António Sérgio, Escola Secundária Almeida Garret and Escola Secundária Dr. Joaquim Gomes Ferreira Alves). None is part of the clusters with worst-performing schools.

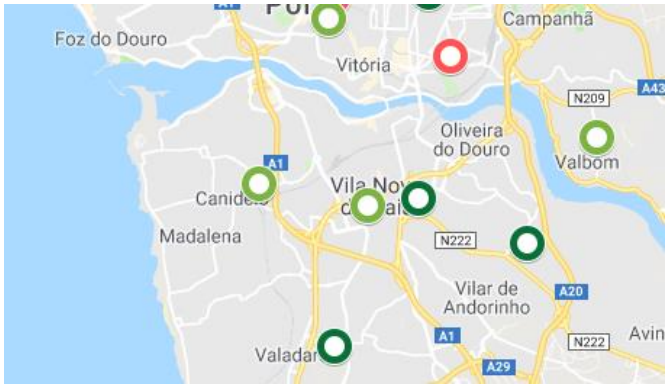


Figure 82 – The case of Covelo, Boavista and Vila Nova de Gaia

4.4. TEIP SCHOOLS

In Porto, Lisboa and their bordering territories there are several groups of schools – the Portuguese educational system is mostly organized in groups of schools in a certain municipality that offers different levels of teaching – integrating the TEIP program. In Porto, there are 19 and in Lisboa, there are 28 (DGE, 2016).

Although, as previously seen, the TEIP schools are those that are in "economically and socially disadvantaged areas, marked by poverty and social exclusion, where violence, indiscipline, abandonment, and school failure are most evident" (DGE, 2016) not all of those have particularly negative performances regarding retention rates. Although the performance regarding retention rates is not the only success metric in a school, it is useful to analyze it in order to understand if anything different was done in these particular schools and replicate it in others.

Focusing first in Lisboa, there are 12 schools that under the TEIP program and also populate the clusters that perform worse either in middle school, high school or both. Those are Escola Secundária José Cardoso Pires (Amadora), Escola Secundária Seomara Costa Primo (Amadora), Escola Básica e Secundária Mães de Água (Amadora), Escola Básica e Secundária D. João V (Amadora), Escola Básica das Olaias (Lisboa), Escola Secundária D. Dinis (Lisboa), Escola Básica Manuel da Maia (Lisboa), Escola Básica do Alto do Lumiar (Lisboa), Escola Básica Pintor Almada Negreiros (Lisboa), Escola Secundária de Sacavém (Loures), Escola Básica da Apelação (Loures), Escola Secundária de Camarate (Loures), Escola Básica e Secundária Aquilino Ribeiro (Oeiras) e Escola Básica Sophia de Mello Breyner Andersen (Oeiras).

Nevertheless, there are good examples. For instance, Escola Básica Fernando Pessoa, Escola Básica de Piscinas, and Escola Secundária José Gomes Ferreira are all in Lisboa and are all TEIP schools. But they populate the clusters with better results.

In Porto, the situation is very different. Almost all the schools that are integrated into the TEIP program populate the worst performing clusters. And contrarily to what happens in Lisboa, in Porto, there are some schools that seem to improve between middle school and high school, where they jump to the best performing clusters. The only school that is under the TEIP program and populates a cluster with better performance is Escola Básica D. Pedro I, in Vila Nova de Gaia.

The Ministry of Education publishes information about the year each school group became part of the TEIP program. According to the available data, the first ones entered in 2006/2007 and the latest to be part of the program started in 2012/2013 – it is not possible to know if any of these schools has stopped being a TEIP in the meantime. With the information on recency, it is possible to try to understand if a school has improved or gotten worse and if that happened before or after becoming part of the program.

The tables below illustrate how the results in each TEIP school changed between 2010/2011 and 2015/2016 in each of the school years under analysis. Regarding middle school, the retention rates worsened between 2010 and 2016 in 15 schools in 7th grade, in 17 in 8th grade and in 12 in 9th grade. More than half of the students (55%) in TEIP schools in Lisboa and Porto belong to one where retention rates worsened in at least one of the school levels.

As for high school, the retention rates worsened between 2010 and 2016 in five schools in 10th grade, in two in 11th grade and in seven in 12th grade. There are 69% of students in TEIP in schools in Lisboa and Porto belong to one where retention rates worsened in at least one of the school levels.

Municipality	School name	7th	8th	9th	% in the total students enrolled in TEIP schools in the Lisboa and Porto area in 2015/2016
Porto					
Gondomar	E.B. Santa Bárbara	+	=	=	3.31
Gondomar	E.B. de São Pedro da Cova	-	+	-	3.08
Gondomar	E.B. Marques Leitão	-	-	-	2.07
Maia	E.B. de Pedrouços	+	=	-	3.35
Matosinhos	E.B. de Perafita	+	-	=	2.62
Matosinhos	E.B. Professor Óscar Lopes	+	+	+	1.05
Matosinhos	E.B. de Matosinhos	+	-	+	2.09
Porto	E.B. do Viso	+	+	=	1.45
Porto	E.B. e Secundária Rodrigues de Freitas	-	-	=	2.91
Porto	E.B. Manoel de Oliveira	+	+	+	1.48
Porto	E.B. da Areosa	+	+	+	1.41
Porto	E.B.S. do Cerco	+	+	-	3.19
Porto	E.B. Pêro Vaz de Caminha	+	+	-	2.08
Porto	E.B. Leonardo Coimbra Filho	-	-	-	1.24
Vila Nova de Gaia	E.B. D. Pedro I, Canidelo	-	=	=	2.55
Vila Nova de Gaia	E.B. de Vila D`Este	-	+	-	2.53
Vila Nova de Gaia	E.S. Inês de Castro	-	-	-	5.06
Lisboa					
Amadora	E.B.S. D. João V	-	+	=	1.70
Amadora	E.B. Cardoso Lopes	-	-	=	2.01
Amadora	E.B. Sophia de Mello Breyner Andresen	-	+	+	1.55
Amadora	E.B. José Cardoso Pires	-	=	-	2.29
Amadora	E.B. Prof. Pedro D´Orey da Cunha	=	+	-	3.19
Amadora	E.B. e Secundária de Mães D´Água	+	-	-	1.51
Amadora	E.B. Miguel Torga	-	-	-	2.78

Amadora	E.B.S. Dr. Azevedo Neves	-	-	-	2.26
Amadora	E.B. D. Francisco Manuel Melo	-	-	-	3.30
Lisboa	E.B. de Piscinas	+	+	=	3.28
Lisboa	E.B. das Olaias	=	+	+	1.90
Lisboa	E.B. Fernando Pessoa	+	+	+	3.35
Lisboa	E.B. Manuel da Maia	+	-	+	2.36
Lisboa	E.B. Patrício Prazeres	-	-	+	1.75
Lisboa	E.B. Marquesa de Alorna	-	-	+	3.13
Lisboa	E.B. do Alto do Lumiar	-	=	-	1.56
Lisboa	E.S. D. Dinis	=	-	-	3.03
Lisboa	E.B. Francisco de Arruda	=	-	-	1.72
Lisboa	E.B. do Bairro Padre Cruz	-	-	-	1.44
Lisboa	E.B. Pintor Almada Negreiros	-	-	-	1.21
Lisboa	E.B.S. Passos Manuel	-	-	-	3.04
Loures	E.B. de Apelação	+	-	+	0.54
Loures	E.S. de Camarate	-	=	-	1.88
Loures	E.S. de Sacavém	-	+	-	2.75
Loures	E.B. de Camarate	-	-	-	2.29
Oeiras	E.B.S. Aquilino Ribeiro	-	+	+	2.73

Table 8 – Evolution of TEIP schools in middle school levels between 2010 and 2016

Municipality	**School name**	**10th**	**11th**	**12th**	**% in the total students enrolled in TEIP schools in the Lisboa and Porto area in 2015/2016**
Porto					
Porto	E.S. António Nobre	+	+	+	5.68
Porto	E.S. Alexandre Herculano	-	-	+	5.81
Porto	E.B.S. do Cerco	-	-	+	4.88
Gondomar	E.S. de Valbom	-	-	-	4.49
Vila Nova de Gaia	E.S. de Inês de Castro	-	-	+	9.35
Porto	E.B.S. Rodrigues de Freitas	+	-	-	10.93

Lisboa					
Amadora	E.B.S. Mães de Água, Falagueira	=	-	=	2.84
Lisboa	E.S. D. Dinis, Lisboa	=	-	=	8.40
Amadora	E.B.S. D. João V, Damaia	-	=	-	4.78
Oeiras	E.B.S. Aquilino Ribeiro	+	-	-	1.81
Loures	E.S. de Camarate	+	+	+	2.97
Lisboa	E.B.S. Passos Manuel	-	-	+	4.78
Amadora	E.S. Seomara da Costa Primo	-	-	-	7.47
Loures	E.S. de Sacavém	=	-	-	3.05
Lisboa	E.S. de José Gomes Ferreira	+	-	+	22.76

Table 9 – Evolution of TEIP schools in high school levels between 2010 and 2016

5. CONCLUSIONS

School retention rates in Portugal are still significantly high when compared to other countries. The latest data from the International Program for Student Assessment (PISA, 2015), indicates that Portugal is the third country in the OECD where more 15-year-olds report having been retained at least once. Ahead of Portugal, there is only Belgium and Spain. This was our starting point. The questions that we meant to answer were: How do the public schools in each municipality perform? Are territories close to each other more similar in their performance? What happens in specifics parts of the country?

Regarding the first question, we have seen that there are great discrepancies in the performances of the municipalities across the country. For some, such as Ponte de Lima, Sever do Vouga or Santo Tirso the results are globally good. Lisboa, Amadora, and Loures, for example, fall in the other end of the spectrum. We came to realize that retention rates are much worse in high school, especially in 12th grade, and also that, in some municipalities, the peak retention rate happened in 2012/2013 and 2014/2015 – during/in the years following the economic crisis. It was also clear that there were improvements in retention rates during the more recent years, but there are situations where the numbers are still high.

A curious outcome of this dissertation project was the realization that there are evident geographic discrepancies. First between the North and South and litoral and interior of the country. The northern municipalities have globally smaller retention rates than the ones in the south.

And then among the municipalities that are part of each NUT. The most obvious example is that of Beira Baixa. In this territory, there are two groups of municipalities: one, composed by Oleiros, Proença-a-Nova, and Castelo Branco, with very good results. And another populated by Penamacor and Idanha-a-Nova, with opposite results. There was also obvious similarities between municipalities closer to each other. For example, Viana do Castelo, Paredes de Coura, Caminha, Vila Nova de Cerveira, Valença, and Ponte de Lima, all performing particularly well.

When zooming in Lisboa and Porto, we came to the conclusions that the two municipalities with the biggest proportion of studentized population (and their bordering municipalities) are also the set of significant discrepancies. There are two main trends: the pockets of schools that have either the best or worst performances; and the schools that stand out (positively or negatively) from the other ones around it.

When crossing the information from the analysis with the list of schools that are under the TEIP program, it became clear that most of those schools are among the worst-performing schools. But there were ones that did not. Namely, Escola Básica Fernando Pessoa, Escola Básica de Piscinas, and Escola Secundária José Gomes Ferreira, in Lisboa, and Escola Básica D. Pedro I, Vila Nova de Gaia.

6. LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORKS

The data analyzed does not go further than 2015/2016, which is the data that was available when the dissertation started being produced). Certain schools may have improved in the meantime, and others may have gotten worse regarding their students' unsuccess. So the picture presented does not go beyond that point. It is advisable to complete the analysis of retention rate data for the coming years.

That said, these results show the trend for the first six years since 2010 and should be taken into consideration by municipalities and central power. There are clear focal points where action should be taken and others that might be regarded as references for good practices.

It would also be interesting to compare these trends with that of private schools, particularly in the last year of each study cycle.

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8. APPENDIX

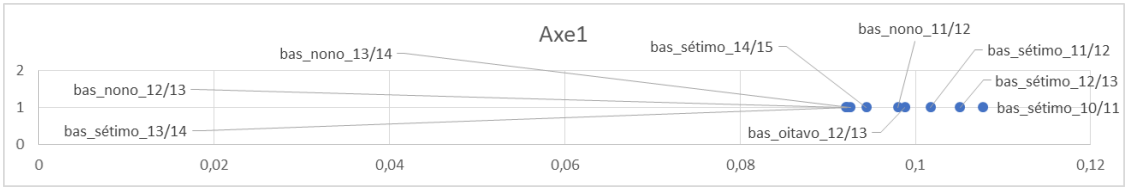
PCA in Lisboa's middle schools

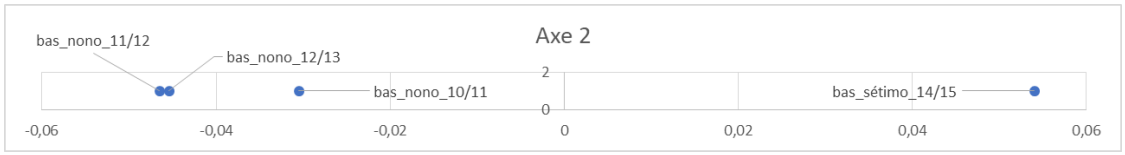
In this case, the first four principal components were retained. Together they represent 78% of the total inertia associated with the data.

	Eigenvalue	Variance (%)	Cumulative variance (%)
λ.1	0.1345	65.05	65.05
λ.2	0.0113	5.46	70.51
λ.3	0.0084	4.07	74.59
λ.4	0.0073	3.55	78.13

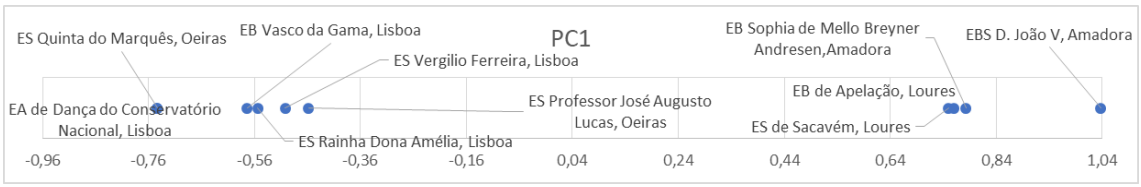
There are 20 schools (22% of the total) that are not well explained by the components retained (the CTR sum is inferior to 50%).

The position of the variables in the four axes:

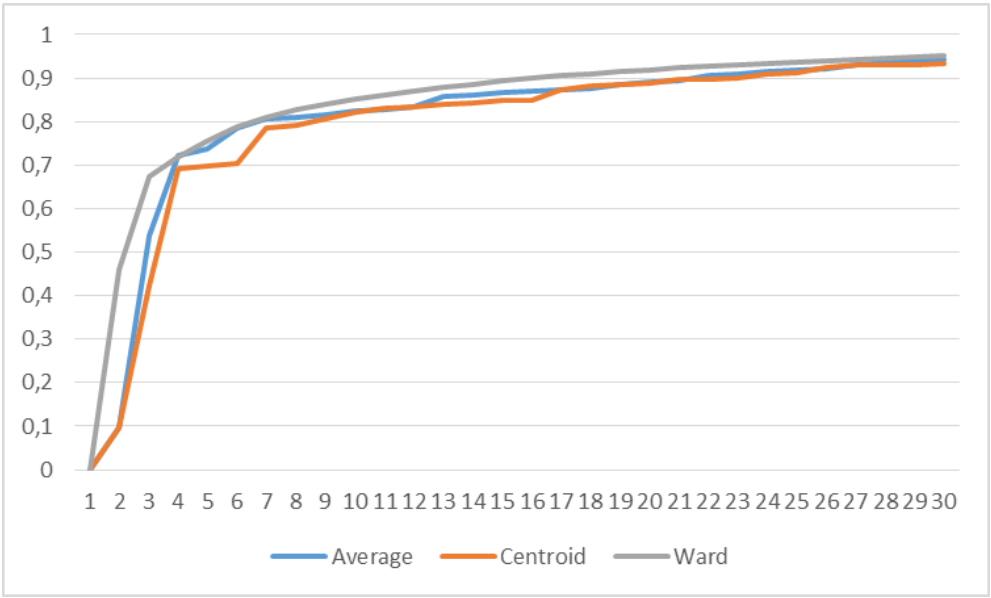




The position of the individuals in the four principal components:



Regarding the clustering process, the output is below. The number of clusters chosen to perform k-means was three.



The cluster statistics are as follows.

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Nearest Cluster	Distance Between Cluster Centroids
1	66	0.0995	0.3715	2	0.5169
2	23	0.1072	0.3799	1	0.5169
3	19	0.1362	0.4038	1	0.5227

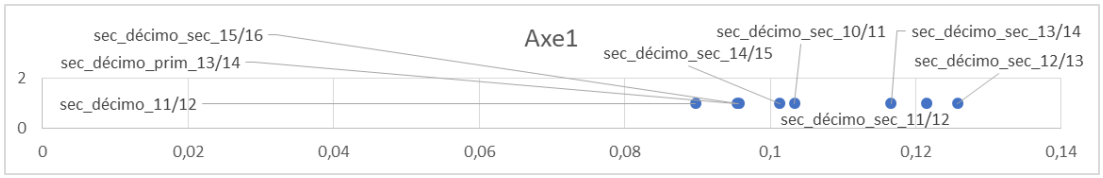
PCA in Lisboa's high schools

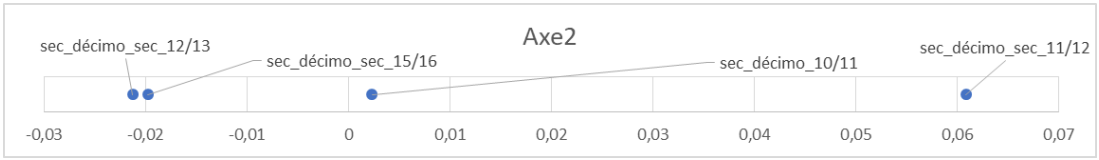
In this case, the first two principal components were retained. Together they represent 74.6% of the total inertia associated with the data.

	Eigenvalue	Variance (%)	Cumulative variance (%)
λ.1	0.1444	66.66	66.66
λ.2	0.0173	8.01	74.67

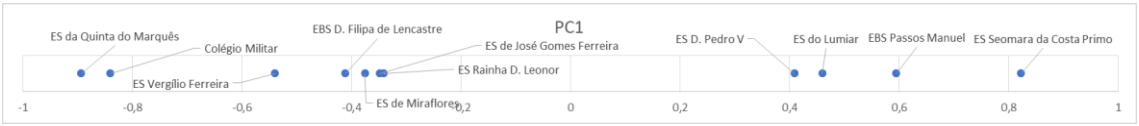
There are 17 schools (37% of the total) that are not well explained by the components retained (the CTR sum is inferior to 50%).

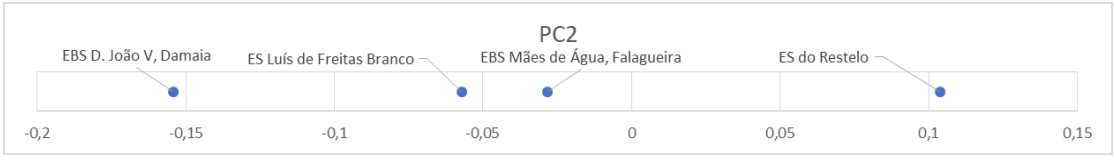
The position of the variables in the two axes:



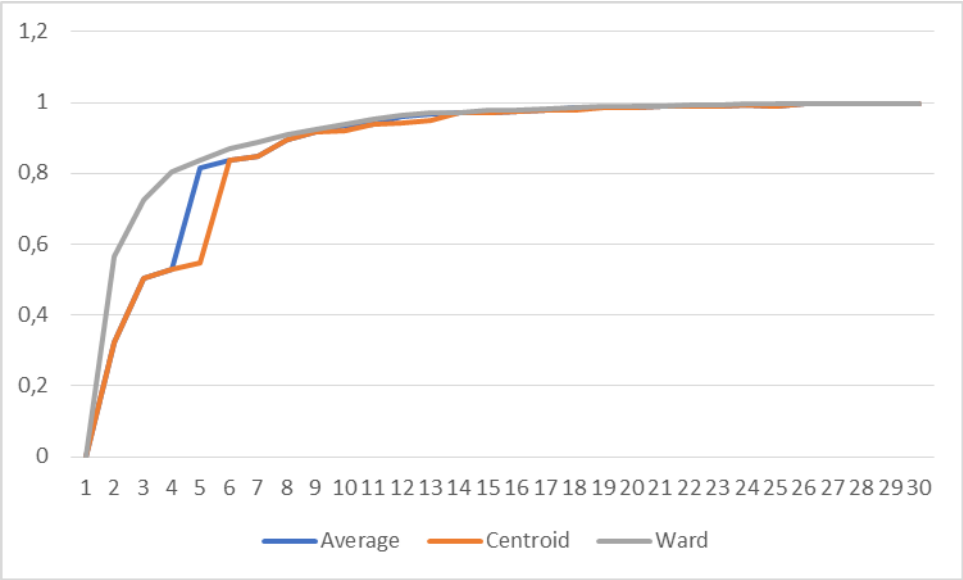


The position of the individuals in the two principal components:





Regarding the clustering process, the output is below. The number of clusters chosen to perform k-means was four.



The cluster statistics are as follows.

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Nearest Cluster	Distance Between Cluster Centroids
1	19	0.1150	0.3254	4	0.3035
2	4	0.1711	0.2559	1	0.4049
3	4	0.2092	0.3798	4	0.7003
4	36	0.1387	0.3997	1	0.3035

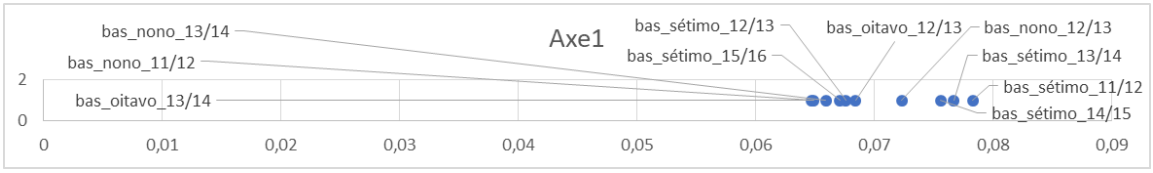
PCA in Porto's middle schools

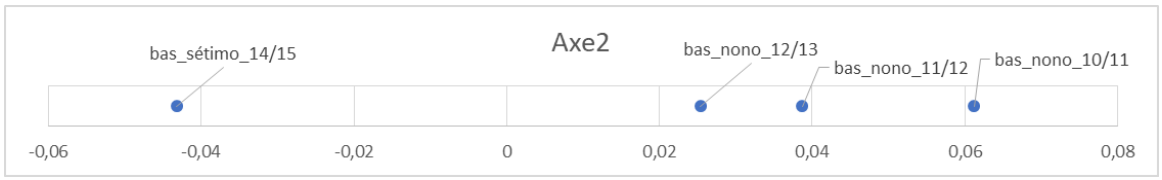
In this case, the first two principal components were first considered. But after close analysis, it was clear that there was a significant number that was not well represented by only retaining the said two dimensions. So, the third and fourth principal components were added to the analysis. Together they represent 73.4% of the total inertia associated with the data.

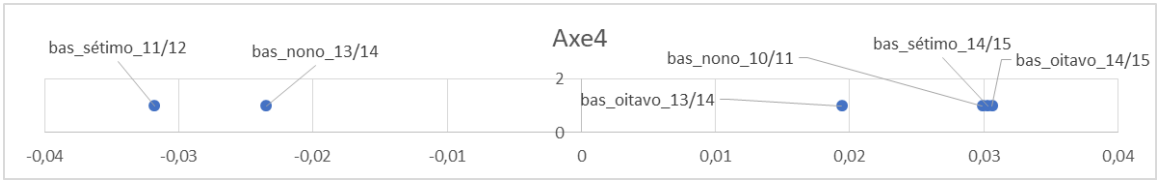
	Eigenvalue	Variance (%)	Cumulative variance (%)
λ.1	0.0692	55.32	55.32
λ.2	0.0099	7.93	63.24
λ.3	0.0072	5.72	68.97
λ.4	0.0056	4.50	73.47

There are 23 schools (28% of the total) that are not well explained by the components retained (the CTR sum is inferior to 50%).

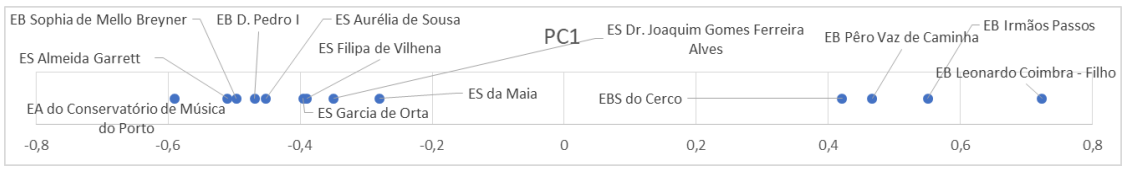
The position of the variables in the four axes:

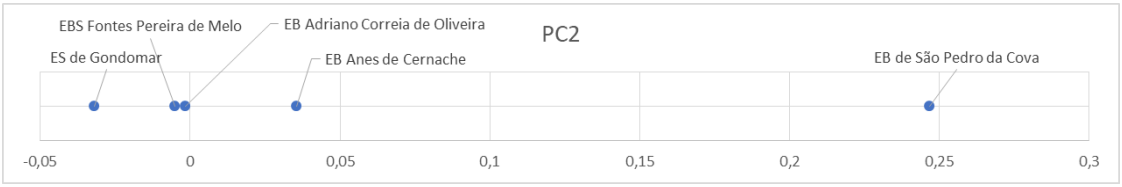


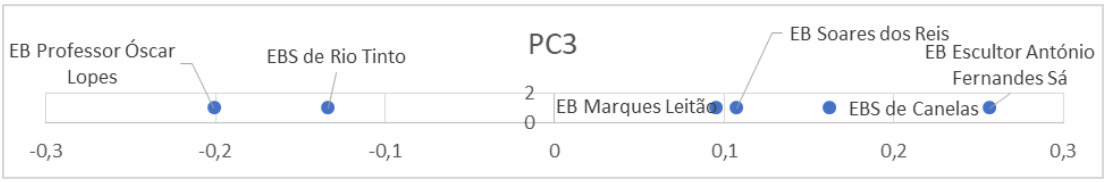


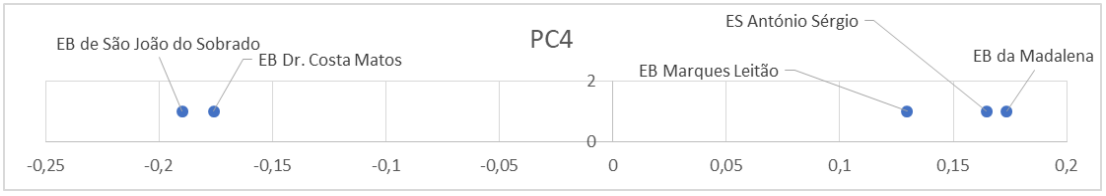


The position of the individuals in the four principal components:

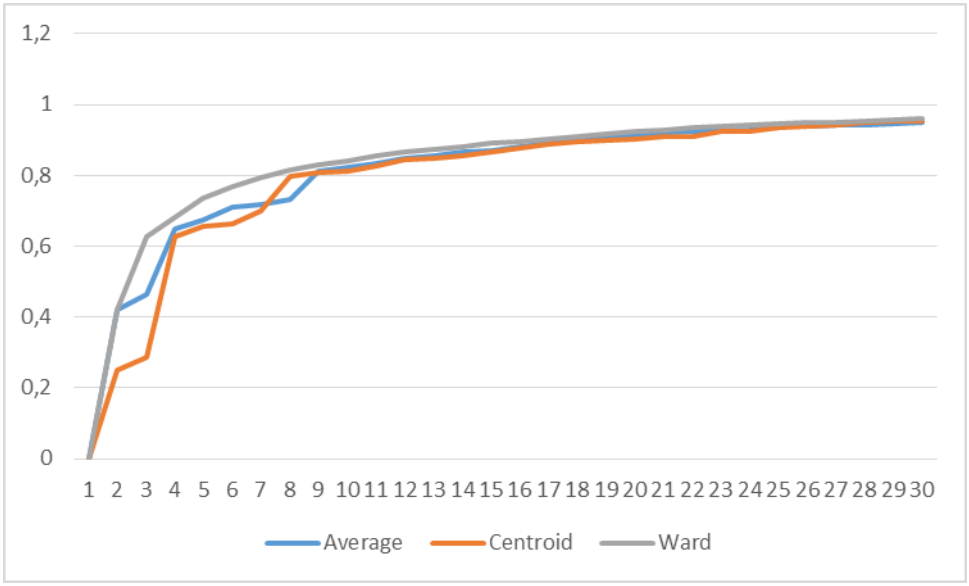








Regarding the clustering process, the output is below. The number of clusters chosen to perform k-means was five.



The cluster stats are as follows.

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Nearest Cluster	Distance Between Cluster Centroids
1	3	0.1401	0.3540	3	0.3340
2	16	0.0898	0.2716	3	0.2595
3	51	0.0674	0.2926	2	0.2595
4	13	0.1103	0.3582	2	0.2785
5	16	0.0840	0.2575	3	0.3558

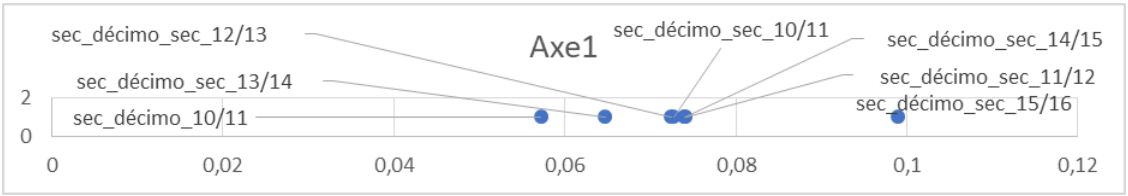
PCA in Porto's high schools

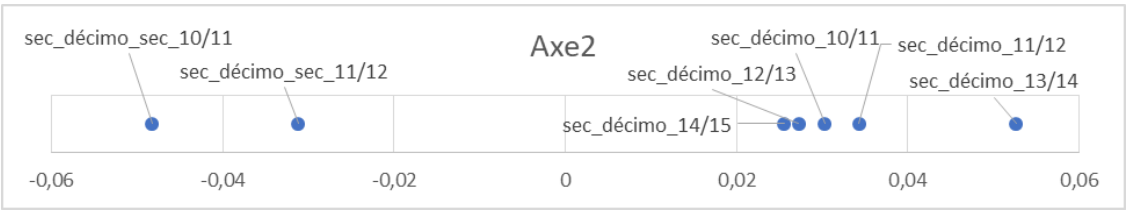
In this case, the first four principal components were retained. Together they represent 76.2% of the total inertia associated with the data.

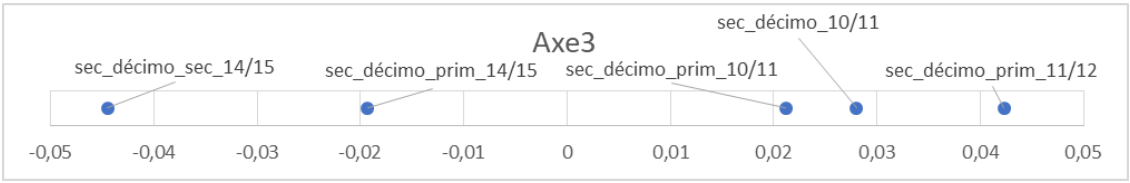
	Eigenvalue	Variance (%)	Cumulative variance (%)
λ.1	0.0558	53.54	53.54
λ.2	0.0115	11.05	64.59
λ.3	0.0068	6.55	71.15
λ.4	0.0053	5.06	76.20

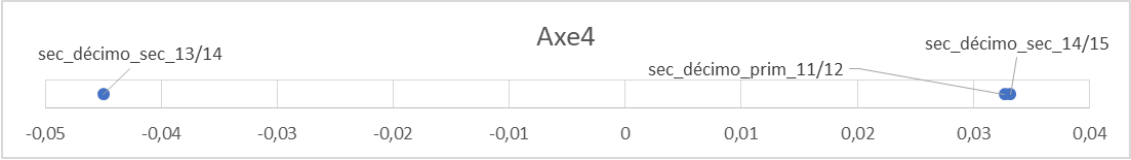
There are 7 schools (20% of the total) that are not well explained by the components retained (the CTR sum is inferior to 50%).

The position of the variables in the four axes:

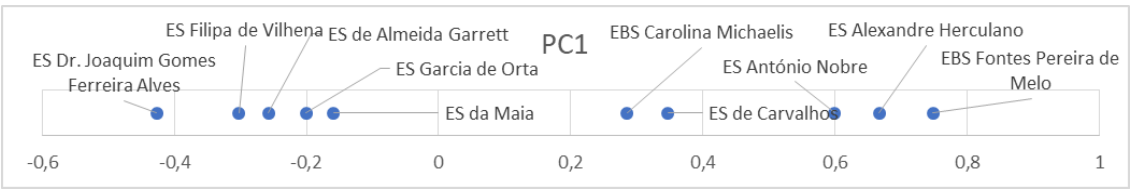


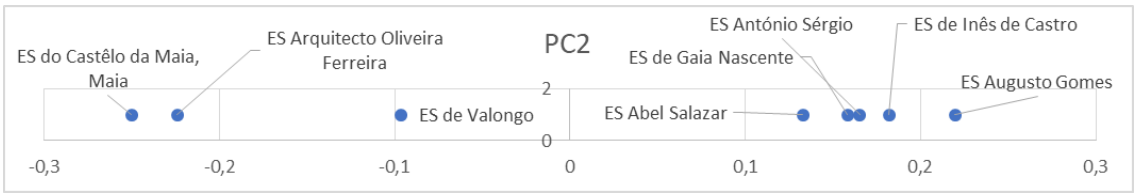


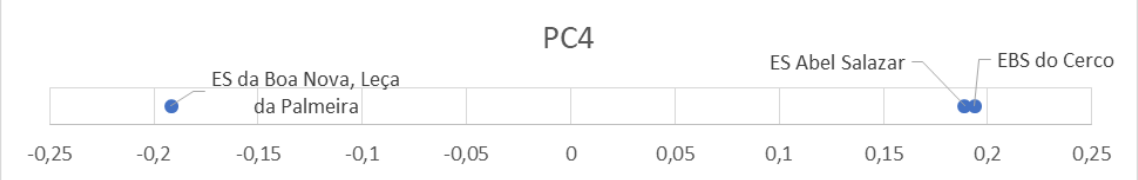




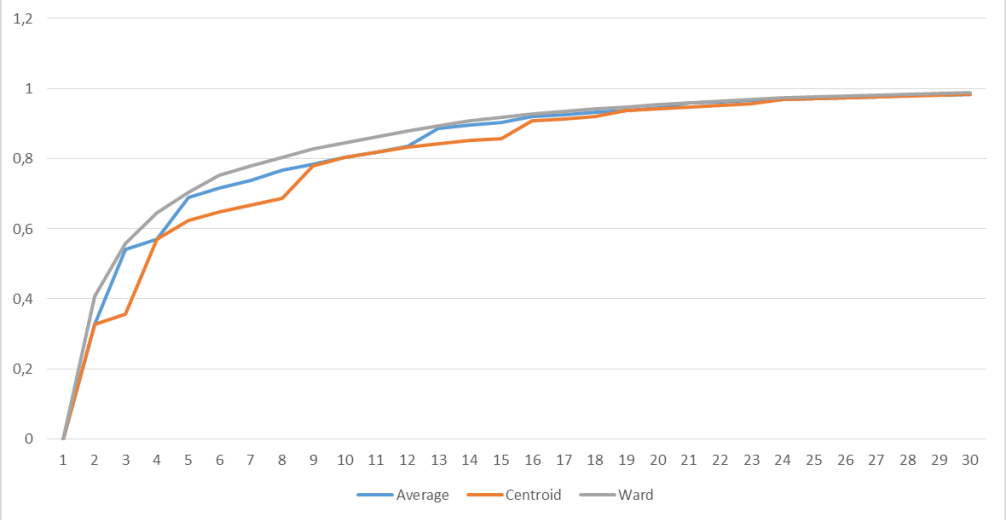
The position of the individuals in the four principal components:







Regarding the clustering process, the output is below. The number of clusters chosen to perform k-means was four.



The cluster statistics are as follows.

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed to Observation	Nearest Cluster	Distance Between Cluster Centroids
1	2	0.0662	0.0936	2	0.3935
2	7	0.1180	0.2913	3	0.2981
3	32	0.0633	0.2503	4	0.2358
4	12	0.1061	0.3377	3	0.2358

9. ANNEXES

Table 1 – Correlations between variables and principal components

School year/level	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
7th 10/11	0.81	0.30	-0.13	0.00	-0.05	-0.09	-0.01	-0.14	-0.04	-0.16
7th 11/12	0.79	0.40	-0.08	0.03	-0.08	-0.07	-0.03	-0.14	-0.02	-0.21
7th 12/13	0.75	0.38	-0.10	0.06	0.07	-0.03	-0.08	-0.15	-0.05	-0.12
7th 13/14	0.72	0.49	0.02	-0.14	-0.09	-0.09	0.09	-0.06	-0.13	0.03
7th 14/15	0.72	0.44	-0.01	-0.09	-0.06	-0.15	-0.04	0.01	-0.25	0.20
7th 15/16	0.71	0.43	-0.03	-0.15	-0.05	-0.17	-0.15	0.04	-0.08	0.19
8th 10/11	0.76	0.33	-0.06	0.04	-0.05	0.05	0.04	-0.03	0.10	-0.21
8th 11/12	0.75	0.32	-0.02	0.07	-0.03	0.02	-0.06	-0.05	0.07	-0.19
8th 12/13	0.71	0.33	-0.12	-0.02	0.00	0.01	-0.11	0.09	-0.02	0.15
8th 13/14	0.78	0.30	-0.07	-0.04	0.04	-0.18	0.09	0.10	-0.01	0.12
8th 14/15	0.75	0.29	-0.07	0.03	0.02	-0.13	-0.06	0.16	0.03	0.20
8th 15/16	0.69	0.31	-0.13	-0.01	-0.07	0.03	-0.08	-0.01	0.10	0.16
8th 10/11	0.69	0.20	-0.11	0.10	-0.06	0.13	0.26	0.09	0.25	-0.08
8th 11/12	0.73	0.17	-0.09	0.19	0.00	0.26	0.23	0.06	0.12	-0.18
8th 12/13	0.71	0.11	-0.11	0.05	0.10	0.05	0.18	0.21	0.30	0.12
8th 13/14	0.70	0.15	-0.02	0.05	0.22	0.06	0.07	0.28	0.20	-0.06
8th 14/15	0.65	0.18	-0.18	-0.13	0.11	0.04	0.07	0.14	0.16	0.15
8th 15/16	0.69	0.14	-0.08	0.02	0.05	0.05	0.04	0.16	0.15	0.08
10th 10/11	0.66	-0.04	0.45	0.17	-0.19	0.11	0.24	-0.13	0.08	0.17
10th 11/12	0.77	-0.15	0.34	0.05	-0.11	0.05	0.15	0.02	-0.10	-0.09
10th 12/13	0.73	-0.10	0.33	0.10	0.14	-0.01	-0.02	0.26	-0.01	0.07
10th 13/14	0.70	-0.17	0.37	-0.01	0.20	0.02	-0.09	0.16	-0.14	0.18
10th 14/15	0.72	-0.20	0.26	0.04	0.20	-0.12	-0.23	0.05	0.15	-0.09

10th 15/16	0.72	-0.11	0.31	0.14	0.08	-0.16	-0.28	-0.02	0.12	-0.11
11th 10/11	0.70	-0.11	0.25	0.11	-0.18	0.15	-0.03	-0.21	-0.01	0.12
11th 11/12	0.71	-0.23	0.11	0.00	-0.14	0.17	0.17	-0.22	-0.17	0.10
11th 12/13	0.73	-0.16	0.13	-0.11	0.08	0.09	0.21	-0.10	-0.20	0.00
11th 13/14	0.69	-0.09	0.26	-0.01	0.17	0.03	-0.06	-0.07	-0.09	-0.23
11th 14/15	0.69	-0.16	0.26	-0.15	0.11	0.07	-0.17	-0.08	-0.05	-0.09
11th 15/16	0.70	-0.07	0.23	0.02	0.08	0.01	-0.12	-0.08	0.08	-0.16
12th 10/11	0.65	-0.20	-0.30	0.47	-0.21	0.18	-0.25	0.12	-0.16	0.02
12th 11/12	0.66	-0.38	-0.35	0.19	-0.15	-0.05	0.04	-0.02	0.03	0.07
12th 12/13	0.65	-0.47	-0.07	-0.06	-0.23	-0.48	0.11	0.04	0.07	-0.06
12th 13/14	0.69	-0.27	-0.32	0.08	0.50	-0.04	0.08	-0.22	-0.04	0.09
12th 14/15	0.71	-0.27	-0.19	-0.43	-0.01	0.16	0.04	0.24	-0.20	-0.15
12th 15/16	0.73	-0.20	-0.09	-0.40	-0.15	0.20	-0.21	-0.17	0.25	0.11

Table 2 – Individuals PCA (Principal components 1 to 5)

Região	COORD1	CTA1	CTR1	COORD2	CTA2	CTR2	COORD3	CTA3	CTR3	COORD4	CTA4	CTR4	COORD5	CTA5	CTR5
Alentejo															
Alentejo Central															
Arraiolos	-11.147	0.000	0.052	8.161	0.001	0.028	6.296	0.001	0.017	-12.861	0.003	0.070	-16.521	0.006	0.115
Estremoz	-15.640	0.001	0.266	-0.235	0.000	0.000	-8.032	0.002	0.070	-2.552	0.000	0.007	-4.244	0.001	0.020
Évora	-16.261	0.004	0.346	3.966	0.001	0.021	4.683	0.003	0.029	-4.094	0.003	0.022	-18.264	0.077	0.437
Montemor-o-Novo	2.800	0.000	0.004	18.282	0.006	0.177	6.766	0.001	0.024	-0.614	0.000	0.000	-24.924	0.031	0.330
Reguengos de Monsaraz	28.461	0.002	0.435	-7.172	0.001	0.028	-7.392	0.002	0.029	-13.879	0.007	0.103	-7.172	0.002	0.028
Vendas Novas	-18.235	0.001	0.239	2.659	0.000	0.005	4.752	0.001	0.016	-1.663	0.000	0.002	0.245	0.000	0.000
Viana do Alentejo	-14.399	0.000	0.102	1.954	0.000	0.002	0.405	0.000	0.000	23.847	0.011	0.280	-2.208	0.000	0.002
Vila Viçosa	12.438	0.000	0.089	-17.014	0.005	0.167	-15.498	0.007	0.139	-5.504	0.001	0.018	-7.168	0.002	0.030
Alentejo Litoral															

Alcácer do Sal	5.879	0.000	0.027	13.770	0.003	0.148	-0.911	0.000	0.001	-3.311	0.000	0.009	0.266	0.000	0.000
Grândola	14.660	0.001	0.095	21.337	0.008	0.202	-6.921	0.001	0.021	3.133	0.000	0.004	19.025	0.016	0.161
Odemira	12.395	0.001	0.137	-12.017	0.003	0.128	7.547	0.002	0.051	2.580	0.000	0.006	4.170	0.001	0.016
Santiago do Cacém	-3.954	0.000	0.013	6.190	0.001	0.032	7.442	0.003	0.047	-11.581	0.011	0.114	14.861	0.021	0.187
Sines	45.025	0.006	0.601	-0.977	0.000	0.000	-1.463	0.000	0.001	-4.877	0.001	0.007	3.487	0.001	0.004
Alto Alentejo															
Elvas	13.830	0.001	0.174	1.377	0.000	0.002	2.672	0.000	0.007	4.234	0.001	0.016	8.016	0.006	0.058
Ponte de Sor	-19.231	0.001	0.239	3.315	0.000	0.007	0.779	0.000	0.000	1.293	0.000	0.001	6.812	0.003	0.030
Portalegre	-5.441	0.000	0.066	9.172	0.004	0.187	-2.295	0.000	0.012	-2.800	0.001	0.017	3.503	0.002	0.027
Baixo Alentejo															
Almodôvar	-9.987	0.000	0.024	-15.695	0.002	0.058	-19.748	0.005	0.092	22.745	0.009	0.122	0.149	0.000	0.000
Beja	6.134	0.000	0.059	7.396	0.003	0.086	10.380	0.009	0.169	-10.502	0.013	0.173	-2.569	0.001	0.010
Castro Verde	-17.904	0.001	0.122	-0.186	0.000	0.000	-0.564	0.000	0.000	-3.497	0.000	0.005	-4.799	0.001	0.009
Mértola	-15.753	0.000	0.103	6.127	0.000	0.016	-12.693	0.002	0.067	5.664	0.001	0.013	-6.786	0.001	0.019
Moura	-11.262	0.000	0.071	20.829	0.010	0.243	7.301	0.002	0.030	-3.617	0.001	0.007	11.962	0.008	0.080
Serpa	13.272	0.001	0.122	20.737	0.008	0.297	-8.437	0.002	0.049	1.832	0.000	0.002	5.768	0.002	0.023
Lezíria do Tejo															
Almeirim	-2.907	0.000	0.007	-11.749	0.004	0.115	-2.043	0.000	0.004	-9.910	0.007	0.082	17.482	0.025	0.256
Alpiarça	-13.300	0.000	0.067	-5.809	0.000	0.013	-7.185	0.001	0.020	-16.490	0.005	0.104	0.915	0.000	0.000
Azambuja	7.818	0.000	0.048	-1.520	0.000	0.002	8.022	0.003	0.051	-10.069	0.005	0.080	3.702	0.001	0.011
Benavente	23.292	0.004	0.371	16.560	0.012	0.187	-10.627	0.008	0.077	-4.397	0.002	0.013	-7.395	0.006	0.037
Cartaxo	18.487	0.002	0.326	-7.988	0.002	0.061	-1.166	0.000	0.001	2.746	0.001	0.007	7.460	0.005	0.053
Chamusca	8.377	0.000	0.020	10.735	0.001	0.033	-5.376	0.000	0.008	40.212	0.032	0.460	-18.734	0.008	0.100
Coruche	-8.825	0.000	0.075	6.741	0.001	0.044	-2.885	0.000	0.008	4.380	0.001	0.018	-15.433	0.014	0.228
Rio Maior	-8.364	0.000	0.069	1.264	0.000	0.002	-11.408	0.006	0.129	1.137	0.000	0.001	-0.292	0.000	0.000
Salvaterra de Magos	9.754	0.000	0.130	6.997	0.002	0.067	-5.015	0.001	0.034	0.659	0.000	0.001	-2.063	0.000	0.006
Santarém	-10.351	0.001	0.334	1.440	0.000	0.007	-4.073	0.002	0.052	-4.362	0.004	0.059	0.285	0.000	0.000
Algarve															
Algarve															

Albufeira	34.732	0.013	0.659	6.432	0.003	0.023	6.936	0.005	0.026	-5.391	0.004	0.016	1.637	0.000	0.002
Faro	1.771	0.000	0.008	1.315	0.000	0.004	-9.909	0.016	0.235	-8.581	0.016	0.176	-5.569	0.008	0.074
Lagoa	24.480	0.002	0.213	-22.101	0.012	0.174	9.582	0.004	0.033	1.584	0.000	0.001	-3.750	0.001	0.005
Lagos	24.176	0.004	0.558	-2.763	0.000	0.007	6.143	0.003	0.036	-4.607	0.002	0.020	-11.287	0.016	0.122
Loulé	36.009	0.018	0.768	-8.588	0.007	0.044	-3.049	0.001	0.006	-3.685	0.003	0.008	1.676	0.001	0.002
Olhão	17.963	0.003	0.432	-5.588	0.002	0.042	-2.199	0.000	0.007	5.926	0.004	0.047	0.705	0.000	0.001
Portimão	14.669	0.003	0.417	-3.202	0.001	0.020	8.243	0.011	0.132	-5.473	0.006	0.058	0.560	0.000	0.001
São Brás de Alportel	-16.163	0.001	0.162	14.972	0.003	0.139	9.040	0.002	0.051	-10.054	0.003	0.063	12.073	0.006	0.091
Silves	8.445	0.000	0.106	5.923	0.001	0.052	7.121	0.003	0.075	-2.200	0.000	0.007	1.089	0.000	0.002
Tavira	9.525	0.001	0.087	-4.563	0.001	0.020	-4.148	0.001	0.017	8.563	0.006	0.070	0.314	0.000	0.000
Vila Real de Santo António	38.365	0.008	0.561	16.984	0.010	0.110	-8.171	0.004	0.026	-2.919	0.001	0.003	5.777	0.003	0.013
Área Metropolitana de Lisboa															
Área Metropolitana de Lisboa															
Alcochete	10.092	0.001	0.102	-7.960	0.002	0.064	-4.934	0.001	0.024	-9.822	0.007	0.097	-8.897	0.007	0.079
Almada	25.316	0.026	0.849	4.677	0.006	0.029	-4.240	0.008	0.024	0.192	0.000	0.000	-1.451	0.001	0.003
Amadora	53.649	0.080	0.914	-5.626	0.006	0.010	-1.929	0.001	0.001	4.224	0.007	0.006	-7.716	0.028	0.019
Barreiro	14.839	0.005	0.428	-3.628	0.002	0.026	-6.486	0.009	0.082	1.794	0.001	0.006	1.136	0.000	0.003
Cascais	10.251	0.004	0.150	-21.042	0.104	0.632	6.866	0.018	0.067	0.910	0.000	0.001	1.039	0.001	0.002
Lisboa	26.200	0.079	0.877	6.790	0.035	0.059	3.580	0.015	0.016	1.550	0.004	0.003	-0.608	0.001	0.001
Loures	42.931	0.064	0.899	8.259	0.015	0.033	-3.735	0.005	0.007	2.244	0.002	0.003	0.724	0.000	0.000
Mafra	5.538	0.000	0.062	7.831	0.005	0.123	-7.190	0.007	0.104	2.876	0.002	0.017	5.218	0.006	0.055
Moita	30.894	0.012	0.656	-8.503	0.006	0.050	-2.110	0.001	0.003	-6.449	0.007	0.029	-6.154	0.008	0.026
Montijo	10.391	0.001	0.280	-6.312	0.003	0.103	-0.227	0.000	0.000	-0.483	0.000	0.001	4.263	0.003	0.047
Odivelas	42.157	0.057	0.907	-9.024	0.017	0.042	-0.920	0.000	0.000	-0.686	0.000	0.000	3.733	0.008	0.007
Oeiras	-6.029	0.002	0.151	-10.791	0.032	0.483	4.000	0.007	0.066	-0.633	0.000	0.002	-2.081	0.003	0.018
Palmela	3.062	0.000	0.035	-5.552	0.003	0.116	-4.091	0.003	0.063	-1.397	0.000	0.007	1.380	0.000	0.007
Seixal	25.793	0.021	0.813	0.711	0.000	0.001	-7.500	0.019	0.069	-1.807	0.001	0.004	-2.365	0.003	0.007
Sesimbra	12.920	0.002	0.262	-9.749	0.008	0.149	2.415	0.001	0.009	13.119	0.030	0.270	-0.405	0.000	0.000
Setúbal	13.709	0.006	0.419	5.403	0.006	0.065	-6.178	0.012	0.085	-9.508	0.039	0.202	-0.324	0.000	0.000

Sintra	26.342	0.060	0.821	-8.226	0.038	0.080	2.751	0.007	0.009	3.919	0.018	0.018	1.789	0.005	0.004
Vila Franca de Xira	13.736	0.005	0.265	10.189	0.020	0.146	8.247	0.020	0.096	-13.981	0.080	0.274	-5.234	0.013	0.039
Centro															
Beira Baixa															
Castelo Branco	-8.625	0.001	0.122	7.912	0.005	0.103	11.895	0.017	0.233	3.827	0.002	0.024	5.935	0.007	0.058
Oleiros	-28.518	0.001	0.234	8.567	0.000	0.021	21.963	0.003	0.139	8.266	0.001	0.020	-6.390	0.000	0.012
Proença-a-Nova	-30.193	0.001	0.357	-0.661	0.000	0.000	0.209	0.000	0.000	9.557	0.002	0.036	-9.114	0.002	0.033
Beiras e Serra da Estrela															
Almeida	-4.120	0.000	0.005	-20.061	0.003	0.126	-21.211	0.005	0.140	-21.074	0.007	0.139	8.110	0.001	0.021
Celorico da Beira	-7.635	0.000	0.024	5.379	0.000	0.012	-4.434	0.000	0.008	-5.836	0.001	0.014	19.203	0.009	0.150
Covilhã	-28.015	0.008	0.810	-3.514	0.001	0.013	3.097	0.001	0.010	0.317	0.000	0.000	-0.417	0.000	0.000
Figueira de Castelo Rodrigo	17.261	0.000	0.073	25.654	0.004	0.161	-12.778	0.001	0.040	5.855	0.000	0.008	3.434	0.000	0.003
Fornos de Algodres	-8.426	0.000	0.029	12.621	0.001	0.066	6.146	0.000	0.016	-16.508	0.003	0.113	6.613	0.001	0.018
Fundão	-40.956	0.008	0.720	10.629	0.003	0.049	8.526	0.004	0.031	4.186	0.001	0.008	0.776	0.000	0.000
Gouveia	-0.670	0.000	0.000	-8.916	0.001	0.065	-13.677	0.004	0.154	-5.046	0.001	0.021	4.120	0.001	0.014
Guarda	-26.401	0.007	0.638	3.986	0.001	0.015	1.094	0.000	0.001	3.677	0.002	0.012	-1.355	0.000	0.002
Meda	16.116	0.000	0.105	6.125	0.000	0.015	-1.373	0.000	0.001	2.226	0.000	0.002	-0.441	0.000	0.000
Sabugal	-10.492	0.000	0.056	-19.735	0.003	0.199	-11.676	0.002	0.070	1.955	0.000	0.002	7.251	0.001	0.027
Seia	-10.982	0.000	0.068	0.668	0.000	0.000	13.013	0.006	0.095	-22.182	0.025	0.277	7.817	0.004	0.034
Trancoso	-21.413	0.001	0.226	-17.846	0.004	0.157	-21.777	0.010	0.234	-8.917	0.002	0.039	-11.151	0.004	0.061
Médio Tejo															
Abrantes	8.721	0.001	0.113	4.283	0.001	0.027	-2.743	0.001	0.011	-10.701	0.013	0.170	-7.118	0.007	0.075
Alcanena	-18.213	0.001	0.181	14.822	0.003	0.120	-4.900	0.001	0.013	-6.283	0.001	0.022	-2.303	0.000	0.003
Entroncamento	-43.473	0.010	0.598	15.760	0.008	0.079	9.649	0.005	0.030	-9.692	0.007	0.030	5.162	0.002	0.008
Ferreira do Zêzere	-4.149	0.000	0.005	-9.724	0.001	0.027	3.954	0.000	0.005	27.576	0.013	0.220	7.262	0.001	0.015
Ourém	-19.722	0.002	0.368	-3.080	0.000	0.009	4.102	0.001	0.016	-3.589	0.001	0.012	-15.031	0.021	0.214
Sardoal	-14.581	0.000	0.087	-2.252	0.000	0.002	-2.645	0.000	0.003	16.378	0.003	0.110	-13.873	0.003	0.079
Sertã	-16.549	0.001	0.187	6.594	0.001	0.030	3.783	0.000	0.010	15.698	0.008	0.168	-6.279	0.002	0.027
Tomar	-16.522	0.003	0.446	-1.306	0.000	0.003	-2.515	0.001	0.010	1.266	0.000	0.003	0.136	0.000	0.000

Torres Novas	-5.693	0.000	0.038	-9.274	0.005	0.100	-6.274	0.003	0.046	-5.329	0.003	0.033	8.674	0.010	0.088
Vila Nova da Barquinha	-10.585	0.000	0.050	6.444	0.000	0.018	-1.113	0.000	0.001	-4.610	0.000	0.009	-4.183	0.000	0.008
Oeste															
Alcobaça	-6.062	0.000	0.055	-5.735	0.002	0.050	-12.910	0.014	0.251	-3.312	0.001	0.017	1.111	0.000	0.002
Alenquer	-1.320	0.000	0.001	7.796	0.004	0.032	34.202	0.111	0.624	-5.356	0.004	0.015	-17.980	0.050	0.173
Bombarral	17.393	0.001	0.138	19.232	0.006	0.168	4.437	0.001	0.009	9.364	0.003	0.040	-2.555	0.000	0.003
Cadaval	30.459	0.002	0.315	5.362	0.000	0.010	-13.206	0.004	0.059	12.616	0.005	0.054	14.673	0.008	0.073
Caldas da Rainha	-0.880	0.000	0.001	15.683	0.017	0.413	2.353	0.001	0.009	1.046	0.000	0.002	7.092	0.009	0.085
Lourinhã	4.668	0.000	0.022	18.951	0.012	0.362	-10.723	0.006	0.116	2.198	0.000	0.005	-3.643	0.001	0.013
Óbidos	31.810	0.002	0.247	-11.252	0.002	0.031	-5.774	0.001	0.008	-24.353	0.017	0.145	21.455	0.016	0.112
Peniche	-2.238	0.000	0.006	11.887	0.005	0.155	3.205	0.001	0.011	11.875	0.011	0.155	3.175	0.001	0.011
Sobral de Monte Agraço	-32.934	0.002	0.265	31.703	0.015	0.245	20.195	0.009	0.100	24.596	0.019	0.148	3.937	0.001	0.004
Torres Vedras	-7.085	0.001	0.200	-1.404	0.000	0.008	-0.648	0.000	0.002	-1.830	0.001	0.013	4.241	0.005	0.072
Região de Aveiro															
Águeda	-9.670	0.001	0.132	-17.048	0.016	0.409	8.977	0.007	0.114	3.977	0.002	0.022	5.405	0.004	0.041
Albergaria-a-Velha	-4.461	0.000	0.018	-2.268	0.000	0.005	-7.376	0.002	0.048	20.792	0.024	0.382	-7.646	0.004	0.052
Anadia	7.067	0.000	0.087	4.982	0.001	0.043	3.581	0.000	0.022	1.161	0.000	0.002	-7.274	0.003	0.092
Aveiro	-21.595	0.010	0.666	-5.906	0.005	0.050	5.848	0.007	0.049	4.372	0.006	0.027	-2.560	0.002	0.009
Estarreja	-13.319	0.001	0.158	8.691	0.003	0.067	11.921	0.007	0.126	4.250	0.001	0.016	12.452	0.013	0.138
Ílhavo	0.017	0.000	0.000	4.694	0.001	0.047	-10.608	0.008	0.242	-0.742	0.000	0.001	-3.192	0.001	0.022
Oliveira do Bairro	-14.942	0.001	0.143	14.603	0.004	0.136	-7.158	0.001	0.033	7.416	0.002	0.035	-8.325	0.003	0.044
Ovar	-20.820	0.005	0.560	-2.041	0.000	0.005	1.645	0.000	0.004	-4.365	0.003	0.025	6.072	0.008	0.048
Sever do Vouga	-48.710	0.007	0.869	-4.618	0.000	0.008	3.245	0.000	0.004	-0.083	0.000	0.000	-0.714	0.000	0.000
Vagos	-13.736	0.000	0.131	5.766	0.001	0.023	-5.344	0.001	0.020	4.050	0.001	0.011	6.790	0.002	0.032
Região de Coimbra															
Arganil	-7.419	0.000	0.023	9.666	0.001	0.040	19.056	0.008	0.155	25.376	0.019	0.274	-6.632	0.002	0.019
Cantanhede	-20.394	0.002	0.497	-3.943	0.001	0.019	5.089	0.002	0.031	0.044	0.000	0.000	4.978	0.002	0.030
Coimbra	-20.312	0.011	0.795	-5.518	0.005	0.059	1.172	0.000	0.003	1.984	0.001	0.008	-1.220	0.001	0.003
Condeixa-a-Nova	-29.578	0.002	0.456	5.494	0.001	0.016	10.163	0.003	0.054	3.574	0.000	0.007	4.229	0.001	0.009

Figueira da Foz	-32.763	0.014	0.821	3.472	0.001	0.009	5.593	0.004	0.024	1.929	0.001	0.003	-0.696	0.000	0.000
Lousã	16.764	0.001	0.157	7.255	0.001	0.029	9.132	0.003	0.047	4.510	0.001	0.011	-2.868	0.001	0.005
Mealhada	-10.412	0.000	0.085	-6.638	0.001	0.034	7.556	0.002	0.045	-2.872	0.000	0.006	-12.609	0.009	0.124
Mira	-29.449	0.002	0.419	13.555	0.002	0.089	2.925	0.000	0.004	8.675	0.002	0.036	8.158	0.002	0.032
Miranda do Corvo	-17.080	0.001	0.240	-1.430	0.000	0.002	3.559	0.000	0.010	-0.285	0.000	0.000	-4.672	0.001	0.018
Montemor-o-Velho	-4.393	0.000	0.023	-5.406	0.001	0.034	0.214	0.000	0.000	-7.008	0.003	0.058	7.637	0.004	0.069
Mortágua	-54.821	0.006	0.727	-23.510	0.007	0.134	-7.462	0.001	0.014	-8.089	0.002	0.016	-6.352	0.001	0.010
Oliveira do Hospital	5.642	0.000	0.018	27.921	0.024	0.437	14.217	0.010	0.113	-16.927	0.019	0.161	4.082	0.001	0.009
Penacova	-14.905	0.000	0.129	13.523	0.003	0.106	-0.068	0.000	0.000	1.539	0.000	0.001	14.933	0.008	0.129
Soure	-41.368	0.003	0.584	11.114	0.001	0.042	9.528	0.002	0.031	3.837	0.000	0.005	-12.322	0.005	0.052
Tábua	28.805	0.002	0.267	8.705	0.001	0.024	-2.184	0.000	0.002	21.886	0.014	0.154	-13.109	0.006	0.055
Região de Leiria															
Alvaiázere	5.192	0.000	0.009	-6.989	0.000	0.016	-2.282	0.000	0.002	19.651	0.005	0.122	17.711	0.005	0.099
Ansião	-35.184	0.003	0.546	8.632	0.001	0.033	1.246	0.000	0.001	9.364	0.003	0.039	2.575	0.000	0.003
Batalha	-25.621	0.002	0.327	24.873	0.011	0.309	7.210	0.001	0.026	4.818	0.001	0.012	2.866	0.000	0.004
Figueiró dos Vinhos	-26.874	0.001	0.278	12.208	0.001	0.057	-3.755	0.000	0.005	2.199	0.000	0.002	5.209	0.001	0.010
Leiria	-22.425	0.012	0.702	-2.137	0.001	0.006	1.144	0.000	0.002	-5.472	0.010	0.042	1.756	0.001	0.004
Marinha Grande	-37.042	0.013	0.685	-3.282	0.001	0.005	-16.165	0.026	0.131	8.562	0.010	0.037	-6.471	0.007	0.021
Pombal	-15.349	0.002	0.322	-5.222	0.001	0.037	-1.126	0.000	0.002	4.165	0.002	0.024	-10.434	0.013	0.149
Porto de Mós	-37.536	0.004	0.646	2.357	0.000	0.003	4.710	0.001	0.010	-2.463	0.000	0.003	4.022	0.001	0.007
Viseu Dão Lafões															
Carregal do Sal	-6.751	0.000	0.027	14.840	0.003	0.129	0.128	0.000	0.000	9.564	0.002	0.054	11.778	0.004	0.081
Castro Daire	-28.445	0.002	0.463	7.712	0.001	0.034	-14.536	0.006	0.121	-7.623	0.002	0.033	-1.745	0.000	0.002
Nelas	-35.010	0.003	0.478	11.392	0.002	0.051	16.046	0.008	0.101	4.003	0.001	0.006	19.363	0.018	0.146
Oliveira de Frades	-23.197	0.001	0.287	17.716	0.004	0.167	-0.172	0.000	0.000	-11.103	0.004	0.066	-9.837	0.003	0.052
Penalva do Castelo	-15.423	0.000	0.101	8.017	0.001	0.027	-20.910	0.006	0.185	11.593	0.002	0.057	4.532	0.000	0.009
Santa Comba Dão	-23.424	0.001	0.270	-7.147	0.001	0.025	-12.108	0.003	0.072	17.926	0.010	0.158	-10.112	0.004	0.050
São Pedro do Sul	-30.366	0.003	0.432	-10.215	0.002	0.049	1.311	0.000	0.001	3.309	0.000	0.005	11.861	0.008	0.066
Sátão	-18.469	0.001	0.183	-23.254	0.010	0.290	-10.066	0.003	0.054	10.100	0.004	0.055	-3.388	0.001	0.006

Tondela	-7.437	0.000	0.095	11.925	0.005	0.245	-0.931	0.000	0.002	-1.062	0.000	0.002	-0.316	0.000	0.000
Vila Nova de Paiva	5.307	0.000	0.011	-3.133	0.000	0.004	-31.587	0.012	0.382	12.967	0.003	0.064	-3.030	0.000	0.004
Viseu	-23.435	0.013	0.761	6.890	0.008	0.066	1.380	0.000	0.003	-0.361	0.000	0.000	-1.382	0.001	0.003
Vouzela	-1.349	0.000	0.001	0.353	0.000	0.000	0.170	0.000	0.000	3.414	0.000	0.009	-10.286	0.003	0.080
Norte															
Alto Minho															
Arcos de Valdevez	-29.036	0.003	0.569	-7.247	0.001	0.035	-14.280	0.008	0.138	-4.596	0.001	0.014	-13.720	0.012	0.127
Caminha	-55.439	0.005	0.695	-17.470	0.004	0.069	17.718	0.006	0.071	3.161	0.000	0.002	-4.395	0.001	0.004
Melgaço	-21.188	0.001	0.159	-19.017	0.004	0.128	-4.148	0.000	0.006	10.869	0.002	0.042	-20.284	0.010	0.146
Monção	-46.945	0.007	0.661	-12.108	0.003	0.044	-12.855	0.005	0.050	-20.036	0.018	0.120	-4.381	0.001	0.006
Paredes de Coura	-45.243	0.003	0.685	-7.126	0.000	0.017	-2.824	0.000	0.003	-8.677	0.002	0.025	0.312	0.000	0.000
Ponte de Lima	-46.416	0.022	0.942	-0.133	0.000	0.000	-2.906	0.001	0.004	-1.159	0.000	0.001	2.191	0.001	0.002
Valença	-11.528	0.000	0.088	-10.838	0.002	0.078	-6.606	0.001	0.029	9.004	0.003	0.054	15.371	0.009	0.157
Viana do Castelo	-36.142	0.025	0.928	2.684	0.001	0.005	-0.020	0.000	0.000	2.590	0.002	0.005	1.352	0.001	0.001
Vila Nova de Cerveira	-36.081	0.002	0.431	-8.533	0.001	0.024	11.452	0.002	0.043	24.789	0.013	0.203	-3.755	0.000	0.005
Alto Tâmega															
Chaves	-24.365	0.005	0.621	-0.964	0.000	0.001	-1.968	0.000	0.004	2.083	0.001	0.005	-5.009	0.004	0.026
Montalegre	31.780	0.002	0.264	5.806	0.000	0.009	21.974	0.008	0.126	-4.605	0.000	0.006	-5.801	0.001	0.009
Ribeira de Pena	-10.518	0.000	0.061	-9.774	0.001	0.052	-5.519	0.000	0.017	13.242	0.003	0.096	-1.944	0.000	0.002
Valpaços	24.431	0.001	0.258	13.725	0.003	0.082	-15.996	0.006	0.111	1.155	0.000	0.001	14.120	0.008	0.086
Vila Pouca de Aguiar	-9.021	0.000	0.065	-6.522	0.001	0.034	5.723	0.001	0.026	6.505	0.001	0.034	-0.481	0.000	0.000
Área Metropolitana do Porto															
Arouca	-31.141	0.005	0.510	-10.156	0.003	0.054	-7.278	0.003	0.028	-15.338	0.017	0.124	9.125	0.007	0.044
Espinho	-28.356	0.009	0.639	6.341	0.003	0.032	7.189	0.006	0.041	11.289	0.020	0.101	4.895	0.005	0.019
Gondomar	1.394	0.000	0.013	-3.743	0.003	0.094	-4.096	0.005	0.113	1.799	0.001	0.022	0.406	0.000	0.001
Maia	-3.916	0.000	0.072	-4.740	0.004	0.106	-1.813	0.001	0.016	0.916	0.000	0.004	-0.145	0.000	0.000
Matosinhos	12.083	0.005	0.337	5.219	0.006	0.063	9.473	0.032	0.207	-0.178	0.000	0.000	6.700	0.026	0.104
Oliveira de Azeméis	-32.685	0.014	0.769	3.878	0.001	0.011	-8.794	0.011	0.056	-8.211	0.012	0.049	-3.083	0.002	0.007
Paredes	8.964	0.002	0.208	8.523	0.010	0.188	-5.889	0.008	0.090	2.779	0.002	0.020	2.451	0.002	0.016

Porto	8.440	0.003	0.339	1.339	0.001	0.009	4.013	0.008	0.077	0.685	0.000	0.002	-2.543	0.005	0.031
Póvoa de Varzim	-15.590	0.005	0.583	-0.666	0.000	0.001	4.555	0.004	0.050	0.316	0.000	0.000	3.453	0.004	0.029
Santa Maria da Feira	-24.313	0.013	0.534	18.524	0.048	0.310	-4.356	0.004	0.017	-0.214	0.000	0.000	-3.104	0.004	0.009
Santo Tirso	-34.180	0.016	0.859	1.973	0.000	0.003	-4.611	0.003	0.016	-1.559	0.000	0.002	-2.916	0.002	0.006
São João da Madeira	-42.130	0.017	0.911	-1.824	0.000	0.002	-0.033	0.000	0.000	8.463	0.010	0.037	-1.794	0.001	0.002
Trofa	-6.489	0.000	0.034	21.465	0.024	0.371	8.681	0.006	0.061	13.841	0.021	0.154	-1.961	0.001	0.003
Vale de Cambra	-28.928	0.004	0.502	15.956	0.007	0.153	-2.785	0.000	0.005	-8.895	0.005	0.047	-6.397	0.003	0.025
Valongo	0.439	0.000	0.001	-3.238	0.001	0.072	-3.867	0.003	0.103	-0.591	0.000	0.002	3.717	0.005	0.095
Vila do Conde	-5.491	0.001	0.077	-0.506	0.000	0.001	-3.469	0.002	0.031	-10.759	0.027	0.296	4.592	0.006	0.054
Vila Nova de Gaia	-1.566	0.000	0.024	4.224	0.006	0.174	1.447	0.001	0.020	2.951	0.007	0.085	3.125	0.009	0.095
Ave															
Fafe	-21.524	0.006	0.490	-4.172	0.001	0.018	-13.078	0.022	0.181	-2.129	0.001	0.005	-5.584	0.006	0.033
Guimarães	-17.301	0.011	0.704	-1.080	0.000	0.003	-4.077	0.006	0.039	2.197	0.002	0.011	3.831	0.009	0.035
Póvoa de Lanhoso	-1.804	0.000	0.005	6.721	0.002	0.069	-0.646	0.000	0.001	7.671	0.004	0.090	5.561	0.003	0.047
Vieira do Minho	-2.208	0.000	0.004	7.745	0.001	0.049	-16.260	0.008	0.216	-0.991	0.000	0.001	-4.637	0.001	0.018
Vila Nova de Famalicão	-29.903	0.019	0.827	5.740	0.005	0.031	0.999	0.000	0.001	-7.106	0.015	0.047	2.725	0.003	0.007
Vizela	-12.007	0.001	0.204	8.621	0.003	0.105	-2.590	0.000	0.010	4.494	0.002	0.029	2.937	0.001	0.012
Cávado															
Amares	-12.181	0.001	0.126	-6.595	0.001	0.037	7.864	0.002	0.053	-9.300	0.005	0.074	6.496	0.003	0.036
Barcelos	-30.121	0.021	0.906	2.487	0.001	0.006	0.681	0.000	0.001	1.290	0.001	0.002	-3.510	0.005	0.012
Braga	-16.225	0.012	0.318	-16.524	0.081	0.330	9.388	0.042	0.106	-2.816	0.005	0.010	-3.431	0.009	0.014
Esposende	-27.208	0.006	0.736	1.764	0.000	0.003	-4.835	0.002	0.023	1.912	0.000	0.004	1.621	0.000	0.003
Terras de Bouro	-7.691	0.000	0.015	-23.120	0.005	0.136	25.142	0.009	0.161	-20.081	0.008	0.103	-19.267	0.009	0.095
Vila Verde	-5.268	0.000	0.045	-11.217	0.008	0.205	-5.989	0.003	0.058	-0.758	0.000	0.001	3.294	0.002	0.018
Douro															
Carrazeda de Ansiães	-33.708	0.001	0.296	-1.757	0.000	0.001	-18.549	0.004	0.090	6.977	0.001	0.013	17.310	0.005	0.078
Lamego	-18.492	0.002	0.281	-17.076	0.013	0.240	3.868	0.001	0.012	0.470	0.000	0.000	12.691	0.019	0.132
Mesão Frio	-28.059	0.001	0.191	-15.122	0.002	0.056	-29.133	0.010	0.206	11.326	0.002	0.031	-7.228	0.001	0.013
Moimenta da Beira	-40.526	0.005	0.606	-5.651	0.001	0.012	4.119	0.001	0.006	-8.880	0.003	0.029	16.300	0.013	0.098

Murça	-33.284	0.001	0.362	-16.523	0.002	0.089	-8.486	0.001	0.024	-5.825	0.001	0.011	-14.626	0.005	0.070
Peso da Régua	3.617	0.000	0.017	5.675	0.001	0.042	-0.216	0.000	0.000	0.488	0.000	0.000	12.677	0.011	0.212
Sabrosa	2.352	0.000	0.002	-2.591	0.000	0.002	10.523	0.001	0.034	10.637	0.002	0.035	12.366	0.003	0.047
Tabuaço	9.212	0.000	0.033	6.160	0.000	0.015	-23.909	0.006	0.220	1.010	0.000	0.000	-9.129	0.002	0.032
Tarouca	2.220	0.000	0.003	-18.489	0.004	0.194	-13.836	0.003	0.109	0.503	0.000	0.000	0.806	0.000	0.000
Torre de Moncorvo	31.240	0.001	0.186	5.691	0.000	0.006	3.878	0.000	0.003	33.823	0.019	0.218	4.044	0.000	0.003
Vila Real	-32.235	0.013	0.736	-8.436	0.006	0.050	10.283	0.014	0.075	2.206	0.001	0.003	4.395	0.004	0.014
Tâmega e Sousa															
Amarante	-36.270	0.010	0.725	2.404	0.000	0.003	-16.005	0.021	0.141	-0.208	0.000	0.000	-1.950	0.001	0.002
Baião	1.900	0.000	0.003	1.111	0.000	0.001	-5.084	0.001	0.020	-5.830	0.002	0.027	-8.312	0.005	0.054
Castelo de Paiva	9.844	0.000	0.104	-6.100	0.001	0.040	-20.706	0.021	0.462	2.774	0.001	0.008	5.661	0.003	0.035
Celorico de Basto	-9.844	0.000	0.099	3.477	0.000	0.012	-16.477	0.011	0.276	3.103	0.001	0.010	5.310	0.002	0.029
Cinfães	-17.061	0.001	0.171	-10.354	0.003	0.063	-16.646	0.012	0.163	-1.649	0.000	0.002	11.375	0.009	0.076
Felgueiras	-3.946	0.000	0.034	8.012	0.006	0.140	-8.794	0.012	0.168	-3.319	0.002	0.024	2.538	0.002	0.014
Lousada	-3.273	0.000	0.020	1.067	0.000	0.002	-4.400	0.003	0.035	3.439	0.002	0.022	-12.107	0.031	0.268
Marco de Canaveses	-28.645	0.011	0.720	-3.005	0.001	0.008	-9.569	0.013	0.080	5.670	0.006	0.028	-2.991	0.002	0.008
Paços de Ferreira	4.687	0.000	0.054	8.783	0.008	0.188	-8.535	0.011	0.177	0.123	0.000	0.000	-3.244	0.003	0.026
Penafiel	-21.004	0.008	0.436	-2.488	0.001	0.006	-1.511	0.000	0.002	10.445	0.028	0.108	-2.033	0.001	0.004
Resende	13.866	0.000	0.074	-26.823	0.007	0.275	-12.320	0.002	0.058	-13.519	0.004	0.070	-0.347	0.000	0.000
Terras de Trás-os-Montes															
Alfândega da Fé	20.720	0.000	0.117	-17.442	0.002	0.083	-8.693	0.001	0.021	-31.002	0.012	0.261	4.404	0.000	0.005
Bragança	-12.526	0.001	0.183	-14.824	0.011	0.256	6.738	0.004	0.053	-6.882	0.005	0.055	0.042	0.000	0.000
Macedo de Cavaleiros	16.251	0.001	0.120	16.911	0.005	0.130	16.721	0.008	0.127	7.706	0.002	0.027	-4.377	0.001	0.009
Miranda do Douro	26.745	0.001	0.292	-10.085	0.001	0.042	-0.907	0.000	0.000	-2.297	0.000	0.002	21.167	0.010	0.183
Mirandela	6.943	0.000	0.050	-5.279	0.001	0.029	-7.668	0.002	0.061	-11.700	0.008	0.143	3.416	0.001	0.012
Mogadouro	44.352	0.003	0.514	-25.196	0.006	0.166	-14.581	0.003	0.056	3.867	0.000	0.004	-8.701	0.002	0.020

Table 3 – Individuals PCA (Principal components 6 to 10)

Região	COORD6	CTA6	CTR6	COORD7	CTA7	CTR7	COORD8	CTA8	CTR8	COORD9	CTA9	CTR9	COORD10	CTA10	CTR10
Alentejo															
Alentejo Central															
Arraiolos	20.080	0.011	0.170	-16.252	0.008	0.111	0.688	0.000	0.000	6.087	0.001	0.016	10.171	0.004	0.044
Estremoz	-10.864	0.008	0.128	-5.468	0.003	0.033	8.441	0.006	0.077	-3.479	0.001	0.013	-0.665	0.000	0.001
Évora	1.133	0.000	0.002	-0.796	0.000	0.001	2.456	0.002	0.008	-0.332	0.000	0.000	-5.006	0.010	0.033
Montemor-o-Novo	-8.191	0.004	0.036	1.975	0.000	0.002	7.933	0.005	0.033	0.543	0.000	0.000	9.109	0.007	0.044
Reguengos de Monsaraz	-7.872	0.003	0.033	-7.278	0.003	0.028	-2.997	0.001	0.005	10.009	0.007	0.054	-5.045	0.002	0.014
Vendas Novas	4.133	0.001	0.012	9.564	0.007	0.066	-8.867	0.006	0.057	10.492	0.009	0.079	2.320	0.000	0.004
Viana do Alentejo	-1.294	0.000	0.001	-12.036	0.005	0.071	8.064	0.002	0.032	-10.616	0.004	0.055	-14.147	0.009	0.098
Vila Viçosa	0.465	0.000	0.000	4.537	0.001	0.012	6.574	0.003	0.025	5.201	0.002	0.016	-4.371	0.002	0.011
Alentejo Litoral															
Alcácer do Sal	-6.348	0.002	0.031	-3.228	0.001	0.008	2.762	0.000	0.006	-0.511	0.000	0.000	-10.402	0.007	0.084
Grândola	-4.550	0.001	0.009	10.012	0.006	0.045	5.206	0.002	0.012	0.244	0.000	0.000	8.221	0.005	0.030
Odemira	-3.899	0.001	0.014	-14.221	0.017	0.180	-3.109	0.001	0.009	-1.928	0.000	0.003	-2.843	0.001	0.007
Santiago do Cacém	-6.931	0.006	0.041	2.988	0.001	0.008	4.853	0.003	0.020	7.064	0.008	0.042	8.698	0.013	0.064
Sines	-6.031	0.002	0.011	5.638	0.002	0.009	-8.956	0.005	0.024	-3.312	0.001	0.003	5.773	0.003	0.010
Alto Alentejo															
Elvas	7.638	0.006	0.053	7.799	0.007	0.055	3.819	0.002	0.013	-3.308	0.001	0.010	-8.594	0.011	0.067
Ponte de Sor	5.108	0.002	0.017	7.384	0.005	0.035	21.727	0.041	0.305	-13.712	0.017	0.121	-3.656	0.001	0.009
Portalegre	-4.081	0.003	0.037	2.472	0.001	0.014	-5.201	0.005	0.060	-2.379	0.001	0.013	-4.782	0.005	0.051
Baixo Alentejo															
Almodôvar	34.321	0.029	0.278	-3.405	0.000	0.003	-7.675	0.002	0.014	-9.667	0.003	0.022	14.457	0.008	0.049
Beja	0.700	0.000	0.001	0.454	0.000	0.000	-1.035	0.000	0.002	-0.599	0.000	0.001	6.634	0.011	0.069
Castro Verde	10.269	0.003	0.040	-15.790	0.009	0.095	20.671	0.017	0.163	-5.053	0.001	0.010	7.782	0.003	0.023
Mértola	20.000	0.009	0.166	-0.259	0.000	0.000	6.267	0.001	0.016	-11.613	0.004	0.056	-6.132	0.001	0.016
Moura	4.022	0.001	0.009	0.501	0.000	0.000	2.393	0.000	0.003	-1.307	0.000	0.001	-11.017	0.012	0.068

Serpa	-7.688	0.003	0.041	-1.132	0.000	0.001	2.058	0.000	0.003	-6.293	0.003	0.027	-7.081	0.004	0.035
Lezíria do Tejo															
Almeirim	-4.661	0.002	0.018	15.440	0.027	0.199	1.010	0.000	0.001	-3.918	0.002	0.013	-6.356	0.006	0.034
Alpiarça	-11.100	0.004	0.047	-2.474	0.000	0.002	-12.612	0.006	0.061	-4.926	0.001	0.009	-4.600	0.001	0.008
Azambuja	-6.763	0.003	0.036	13.612	0.017	0.147	-1.692	0.000	0.002	11.130	0.012	0.098	-2.850	0.001	0.006
Benavente	-11.346	0.017	0.088	-2.278	0.001	0.004	2.079	0.001	0.003	-1.879	0.001	0.002	2.047	0.001	0.003
Cartaxo	1.134	0.000	0.001	-3.948	0.002	0.015	6.098	0.005	0.036	-11.599	0.019	0.128	7.607	0.009	0.055
Chamusca	-7.025	0.001	0.014	10.406	0.004	0.031	7.974	0.002	0.018	4.636	0.001	0.006	7.497	0.002	0.016
Coruche	0.286	0.000	0.000	12.576	0.013	0.152	-1.739	0.000	0.003	1.132	0.000	0.001	-8.685	0.008	0.072
Rio Maior	-7.566	0.005	0.057	-2.853	0.001	0.008	-12.035	0.015	0.144	-6.011	0.004	0.036	-7.265	0.007	0.052
Salvaterra de Magos	1.714	0.000	0.004	0.245	0.000	0.000	-5.505	0.004	0.041	-6.412	0.005	0.056	-6.899	0.007	0.065
Santarém	-4.305	0.005	0.058	-0.073	0.000	0.000	-0.620	0.000	0.001	-2.348	0.002	0.017	-1.004	0.000	0.003
Algarve															
Algarve															
Albufeira	-0.034	0.000	0.000	-5.438	0.007	0.016	-2.020	0.001	0.002	7.098	0.014	0.028	10.049	0.031	0.055
Faro	-3.424	0.004	0.028	-8.446	0.027	0.171	-1.620	0.001	0.006	-4.282	0.008	0.044	-0.119	0.000	0.000
Lagoa	4.299	0.001	0.007	8.998	0.007	0.029	-20.742	0.040	0.153	21.260	0.044	0.161	3.065	0.001	0.003
Lagos	8.126	0.010	0.063	5.288	0.005	0.027	0.651	0.000	0.000	-2.035	0.001	0.004	0.660	0.000	0.000
Loulé	0.458	0.000	0.000	0.942	0.000	0.001	-6.408	0.014	0.024	-3.963	0.006	0.009	5.623	0.013	0.019
Olhão	-10.316	0.020	0.143	-3.464	0.003	0.016	4.675	0.005	0.029	-0.007	0.000	0.000	3.576	0.003	0.017
Portimão	8.119	0.020	0.128	1.694	0.001	0.006	-1.535	0.001	0.005	-1.079	0.000	0.002	3.930	0.007	0.030
São Brás de Alportel	-1.850	0.000	0.002	8.957	0.004	0.050	-7.423	0.003	0.034	1.794	0.000	0.002	-5.714	0.002	0.020
Silves	-0.019	0.000	0.000	-8.162	0.009	0.099	1.708	0.000	0.004	-0.509	0.000	0.000	10.902	0.021	0.176
Tavira	12.029	0.017	0.138	-6.741	0.006	0.044	-5.737	0.005	0.032	-5.123	0.004	0.025	-7.505	0.010	0.054
Vila Real de Santo António	7.860	0.007	0.024	3.430	0.001	0.005	-0.368	0.000	0.000	-13.417	0.026	0.069	-0.470	0.000	0.000
Área Metropolitana de Lisboa															
Área Metropolitana de Lisboa															
Alcochete	2.949	0.001	0.009	3.399	0.001	0.012	-2.746	0.001	0.008	-11.100	0.017	0.124	5.032	0.004	0.025
Almada	-2.978	0.007	0.012	0.807	0.001	0.001	-1.681	0.003	0.004	1.525	0.003	0.003	-2.753	0.009	0.010

Amadora	-3.166	0.006	0.003	7.694	0.039	0.019	-2.976	0.006	0.003	-3.697	0.010	0.004	-0.645	0.000	0.000
Barreiro	0.920	0.000	0.002	-0.810	0.000	0.001	-4.128	0.009	0.033	3.565	0.007	0.025	-5.585	0.020	0.061
Cascais	5.021	0.018	0.036	0.521	0.000	0.000	-0.956	0.001	0.001	1.662	0.003	0.004	-5.442	0.032	0.042
Lisboa	2.102	0.010	0.006	-1.948	0.010	0.005	0.502	0.001	0.000	0.864	0.002	0.001	-0.984	0.003	0.001
Loures	0.641	0.000	0.000	-1.399	0.002	0.001	-6.158	0.033	0.019	0.470	0.000	0.000	-4.051	0.017	0.008
Mafra	0.764	0.000	0.001	-2.628	0.002	0.014	-7.117	0.017	0.102	-2.003	0.001	0.008	-0.255	0.000	0.000
Moita	3.650	0.003	0.009	2.232	0.001	0.003	-1.007	0.000	0.001	-10.405	0.035	0.074	8.431	0.026	0.049
Montijo	0.619	0.000	0.001	-2.809	0.002	0.021	0.567	0.000	0.001	1.772	0.001	0.008	-2.635	0.002	0.018
Odivelas	-0.382	0.000	0.000	-1.712	0.002	0.002	2.234	0.004	0.003	-0.084	0.000	0.000	-1.277	0.002	0.001
Oeiras	-1.830	0.003	0.014	2.178	0.005	0.020	-1.563	0.003	0.010	-1.562	0.003	0.010	-1.961	0.005	0.016
Palmela	-4.438	0.006	0.074	-1.347	0.001	0.007	0.969	0.000	0.004	7.830	0.024	0.231	-2.853	0.004	0.031
Seixal	-1.430	0.001	0.003	0.068	0.000	0.000	-3.997	0.013	0.020	2.429	0.005	0.007	3.253	0.010	0.013
Sesimbra	-3.653	0.003	0.021	-4.521	0.006	0.032	-0.366	0.000	0.000	0.134	0.000	0.000	3.388	0.004	0.018
Setúbal	2.468	0.004	0.014	3.612	0.010	0.029	0.720	0.000	0.001	1.690	0.002	0.006	0.781	0.001	0.001
Sintra	0.844	0.001	0.001	-5.215	0.055	0.032	1.761	0.007	0.004	1.164	0.003	0.002	1.009	0.003	0.001
Vila Franca de Xira	3.086	0.006	0.013	-5.272	0.019	0.039	3.873	0.011	0.021	-0.348	0.000	0.000	-3.038	0.008	0.013
Centro															
Beira Baixa															
Castelo Branco	-3.557	0.003	0.021	-3.129	0.003	0.016	3.015	0.003	0.015	-1.340	0.001	0.003	0.443	0.000	0.000
Oleiros	6.830	0.001	0.013	1.234	0.000	0.000	17.331	0.005	0.086	-16.643	0.005	0.080	-5.238	0.001	0.008
Proença-a-Nova	-11.035	0.003	0.048	-15.960	0.007	0.100	4.521	0.001	0.008	-9.875	0.003	0.038	-20.714	0.016	0.168
Beiras e Serra da Estrela															
Almeida	-10.293	0.002	0.033	20.618	0.012	0.133	-4.497	0.001	0.006	12.772	0.005	0.051	-8.264	0.002	0.021
Celorico da Beira	-6.978	0.001	0.020	18.963	0.012	0.147	8.464	0.002	0.029	-18.867	0.013	0.145	3.972	0.001	0.006
Covilhã	4.561	0.004	0.022	0.804	0.000	0.001	-4.085	0.004	0.017	2.746	0.002	0.008	4.334	0.005	0.019
Figueira de Castelo Rodrigo	-22.322	0.009	0.122	-17.479	0.006	0.075	-7.723	0.001	0.015	-18.519	0.008	0.084	-0.867	0.000	0.000
Fornos de Algodres	-10.607	0.002	0.047	5.101	0.000	0.011	13.699	0.004	0.078	3.663	0.000	0.006	-2.477	0.000	0.003
Fundão	-1.383	0.000	0.001	-4.072	0.002	0.007	3.620	0.002	0.006	1.694	0.000	0.001	-4.612	0.003	0.009
Gouveia	-4.539	0.001	0.017	17.799	0.017	0.260	2.793	0.000	0.006	-1.328	0.000	0.001	4.051	0.001	0.014

Guarda	-7.906	0.013	0.057	-6.698	0.011	0.041	-10.410	0.027	0.099	-2.173	0.001	0.004	4.209	0.005	0.016
Meda	11.572	0.002	0.054	1.874	0.000	0.001	-1.648	0.000	0.001	-11.159	0.003	0.050	-8.121	0.002	0.027
Sabugal	8.921	0.002	0.041	9.999	0.003	0.051	1.242	0.000	0.001	-12.553	0.005	0.081	-3.297	0.000	0.006
Seia	-17.665	0.023	0.176	7.467	0.005	0.031	-10.442	0.010	0.061	-0.428	0.000	0.000	-3.238	0.001	0.006
Trancoso	-2.793	0.000	0.004	3.954	0.001	0.008	-1.231	0.000	0.001	6.655	0.002	0.022	1.816	0.000	0.002
Médio Tejo															
Abrantes	-3.682	0.002	0.020	6.126	0.007	0.056	0.955	0.000	0.001	3.495	0.003	0.018	-0.594	0.000	0.001
Alcanena	20.871	0.020	0.238	-3.364	0.001	0.006	-2.873	0.000	0.005	7.054	0.003	0.027	1.833	0.000	0.002
Entroncamento	4.282	0.002	0.006	-10.973	0.015	0.038	-0.208	0.000	0.000	-0.321	0.000	0.000	0.172	0.000	0.000
Ferreira do Zêzere	-16.463	0.007	0.078	-4.481	0.001	0.006	7.577	0.002	0.017	-0.670	0.000	0.000	-1.315	0.000	0.001
Ourém	-8.936	0.009	0.076	2.747	0.001	0.007	7.253	0.007	0.050	1.495	0.000	0.002	-0.710	0.000	0.001
Sardoal	0.655	0.000	0.000	6.774	0.001	0.019	-7.616	0.001	0.024	-12.290	0.003	0.062	6.876	0.001	0.019
Sertã	-7.980	0.003	0.044	-1.790	0.000	0.002	-0.569	0.000	0.000	2.915	0.001	0.006	-2.310	0.000	0.004
Tomar	-3.201	0.002	0.017	1.550	0.001	0.004	2.105	0.001	0.007	-7.617	0.014	0.095	-0.500	0.000	0.000
Torres Novas	-8.852	0.013	0.091	-2.421	0.001	0.007	-3.482	0.002	0.014	1.333	0.000	0.002	1.835	0.001	0.004
Vila Nova da Barquinha	17.191	0.008	0.131	11.890	0.005	0.063	-7.735	0.002	0.027	-14.404	0.008	0.092	-5.239	0.001	0.012
Oeste															
Alcobaça	-6.012	0.006	0.055	-11.656	0.027	0.205	-5.361	0.006	0.043	1.289	0.000	0.003	-8.137	0.017	0.100
Alenquer	-10.152	0.019	0.055	1.145	0.000	0.001	2.972	0.002	0.005	-1.157	0.000	0.001	-5.965	0.010	0.019
Bombarral	-3.089	0.000	0.004	13.544	0.011	0.084	-2.714	0.000	0.003	6.590	0.003	0.020	-2.171	0.000	0.002
Cadaval	1.204	0.000	0.001	-9.332	0.005	0.030	19.391	0.021	0.128	6.666	0.003	0.015	8.003	0.004	0.022
Caldas da Rainha	0.958	0.000	0.002	2.475	0.002	0.010	-4.492	0.005	0.034	-2.674	0.002	0.012	2.385	0.002	0.010
Lourinhã	-13.751	0.020	0.191	1.450	0.000	0.002	-4.318	0.002	0.019	0.403	0.000	0.000	-2.271	0.001	0.005
Óbidos	7.692	0.002	0.014	-5.019	0.001	0.006	0.352	0.000	0.000	-0.453	0.000	0.000	-7.835	0.004	0.015
Peniche	-3.451	0.001	0.013	2.048	0.001	0.005	-15.558	0.034	0.266	3.395	0.002	0.013	-4.923	0.004	0.027
Sobral de Monte Agraço	-8.703	0.003	0.019	-3.335	0.001	0.003	4.151	0.001	0.004	11.711	0.008	0.034	-1.963	0.000	0.001
Torres Vedras	4.867	0.008	0.094	2.408	0.002	0.023	-0.604	0.000	0.001	-5.942	0.015	0.140	-3.846	0.007	0.059
Região de Aveiro															
Águeda	0.253	0.000	0.000	-1.568	0.000	0.004	5.043	0.005	0.036	5.136	0.006	0.037	-3.783	0.004	0.020

Albergaria-a-Velha	5.037	0.002	0.022	-9.476	0.009	0.079	12.858	0.017	0.146	-2.999	0.001	0.008	7.308	0.006	0.047
Anadia	3.530	0.001	0.022	-2.457	0.001	0.011	11.265	0.012	0.221	2.944	0.001	0.015	3.618	0.001	0.023
Aveiro	1.837	0.001	0.005	3.613	0.006	0.019	-2.953	0.005	0.012	-5.873	0.019	0.049	0.610	0.000	0.001
Estarreja	-4.307	0.002	0.017	3.238	0.001	0.009	10.020	0.013	0.089	-8.662	0.010	0.067	-2.722	0.001	0.007
Ílhavo	-1.746	0.000	0.007	4.014	0.003	0.035	4.148	0.003	0.037	-7.675	0.010	0.127	-0.523	0.000	0.001
Oliveira do Bairro	-6.605	0.002	0.028	0.667	0.000	0.000	-6.294	0.003	0.025	-0.173	0.000	0.000	7.042	0.004	0.032
Ovar	2.279	0.001	0.007	-4.490	0.006	0.026	5.022	0.008	0.033	-2.702	0.002	0.009	7.071	0.018	0.065
Sever do Vouga	0.430	0.000	0.000	0.531	0.000	0.000	-5.002	0.002	0.009	-1.876	0.000	0.001	-2.865	0.001	0.003
Vagos	-10.646	0.006	0.078	-6.435	0.003	0.029	2.900	0.001	0.006	-16.007	0.017	0.177	11.277	0.010	0.088
Região de Coimbra															
Arganil	3.445	0.001	0.005	0.580	0.000	0.000	4.355	0.001	0.008	1.507	0.000	0.001	-9.043	0.005	0.035
Cantanhede	-4.634	0.003	0.026	-1.848	0.000	0.004	-8.996	0.012	0.097	-0.255	0.000	0.000	1.220	0.000	0.002
Coimbra	0.620	0.000	0.001	0.813	0.000	0.001	-2.385	0.004	0.011	-4.956	0.017	0.047	0.819	0.001	0.001
Condeixa-a-Nova	8.668	0.004	0.039	-7.199	0.003	0.027	2.944	0.001	0.005	-5.548	0.002	0.016	-8.914	0.006	0.041
Figueira da Foz	6.663	0.012	0.034	1.521	0.001	0.002	-3.089	0.003	0.007	-1.592	0.001	0.002	-1.274	0.001	0.001
Lousã	-8.487	0.005	0.040	6.088	0.003	0.021	-4.725	0.002	0.012	-6.904	0.005	0.027	-17.380	0.033	0.168
Mealhada	8.390	0.005	0.055	13.559	0.015	0.144	4.243	0.002	0.014	1.236	0.000	0.001	-1.840	0.000	0.003
Mira	-8.517	0.003	0.035	-1.417	0.000	0.001	-9.264	0.004	0.041	-4.115	0.001	0.008	-5.421	0.002	0.014
Miranda do Corvo	0.839	0.000	0.001	-11.507	0.008	0.109	4.203	0.001	0.015	2.895	0.001	0.007	-8.588	0.006	0.061
Montemor-o-Velho	-10.879	0.009	0.139	-7.696	0.005	0.070	-3.838	0.001	0.017	-4.184	0.002	0.021	-2.289	0.001	0.006
Mortágua	5.353	0.001	0.007	-10.137	0.005	0.025	-6.714	0.002	0.011	2.004	0.000	0.001	2.458	0.000	0.002
Oliveira do Hospital	4.377	0.002	0.011	3.883	0.002	0.008	-2.634	0.001	0.004	-4.324	0.002	0.011	3.562	0.002	0.007
Penacova	10.474	0.005	0.064	10.851	0.006	0.068	-14.694	0.012	0.125	3.995	0.001	0.009	0.181	0.000	0.000
Soure	-8.026	0.002	0.022	-0.193	0.000	0.000	-5.485	0.001	0.010	-14.470	0.010	0.071	-7.018	0.003	0.017
Tábua	-5.832	0.001	0.011	-6.502	0.002	0.014	15.934	0.013	0.082	11.191	0.007	0.040	-8.694	0.005	0.024
Região de Leiria															
Alvaiázere	-0.022	0.000	0.000	-9.390	0.002	0.028	-16.894	0.007	0.090	4.299	0.000	0.006	6.493	0.001	0.013
Ansião	-4.735	0.001	0.010	0.887	0.000	0.000	-1.436	0.000	0.001	-8.207	0.004	0.030	-3.462	0.001	0.005
Batalha	3.862	0.001	0.007	0.721	0.000	0.000	5.887	0.002	0.017	-5.839	0.002	0.017	-11.832	0.012	0.070

Figueiró dos Vinhos	10.579	0.003	0.043	0.368	0.000	0.000	9.108	0.002	0.032	4.505	0.001	0.008	-5.053	0.001	0.010
Leiria	2.939	0.004	0.012	-3.634	0.007	0.018	-6.956	0.028	0.068	0.207	0.000	0.000	-3.554	0.009	0.018
Marinha Grande	5.966	0.007	0.018	-1.167	0.000	0.001	-6.839	0.011	0.023	-3.475	0.003	0.006	-4.780	0.007	0.011
Pombal	-0.293	0.000	0.000	-6.585	0.008	0.059	1.044	0.000	0.002	0.104	0.000	0.000	3.495	0.003	0.017
Porto de Mós	1.396	0.000	0.001	-6.602	0.003	0.020	-11.704	0.010	0.063	-3.738	0.001	0.006	0.501	0.000	0.000
Viseu Dão Lafões															
Carregal do Sal	-8.916	0.003	0.047	15.742	0.011	0.145	-1.612	0.000	0.002	0.198	0.000	0.000	0.440	0.000	0.000
Castro Daire	2.846	0.000	0.005	0.168	0.000	0.000	-8.676	0.005	0.043	3.169	0.001	0.006	7.574	0.005	0.033
Nelas	1.230	0.000	0.001	2.289	0.000	0.002	-2.980	0.001	0.004	-8.118	0.005	0.026	-3.921	0.001	0.006
Oliveira de Frades	-2.607	0.000	0.004	5.367	0.001	0.015	2.290	0.000	0.003	4.813	0.001	0.012	1.227	0.000	0.001
Penalva do Castelo	-7.893	0.002	0.026	10.905	0.004	0.050	-6.003	0.001	0.015	-3.048	0.000	0.004	8.811	0.003	0.033
Santa Comba Dão	6.998	0.002	0.024	-4.674	0.001	0.011	5.107	0.001	0.013	-0.186	0.000	0.000	-5.346	0.002	0.014
São Pedro do Sul	1.182	0.000	0.001	5.649	0.002	0.015	7.243	0.004	0.025	-9.705	0.008	0.044	-13.756	0.018	0.089
Sátão	2.381	0.000	0.003	12.065	0.010	0.078	14.796	0.015	0.118	5.913	0.003	0.019	5.611	0.003	0.017
Tondela	-9.454	0.010	0.154	5.096	0.003	0.045	2.847	0.001	0.014	-2.208	0.001	0.008	5.508	0.005	0.052
Vila Nova de Paiva	-12.818	0.004	0.063	-8.128	0.002	0.025	0.172	0.000	0.000	-13.567	0.006	0.070	-12.634	0.006	0.061
Viseu	4.258	0.009	0.025	4.118	0.010	0.024	-2.469	0.004	0.008	-0.637	0.000	0.001	2.511	0.005	0.009
Vouzela	7.803	0.002	0.046	-2.878	0.000	0.006	-8.402	0.003	0.054	-11.197	0.006	0.095	8.288	0.004	0.052
Norte															
Alto Minho															
Arcos de Valdevez	1.843	0.000	0.002	-2.940	0.001	0.006	-0.512	0.000	0.000	-3.146	0.001	0.007	0.223	0.000	0.000
Caminha	-1.541	0.000	0.001	2.966	0.000	0.002	-15.802	0.011	0.057	5.042	0.001	0.006	8.590	0.004	0.017
Melgaço	5.628	0.001	0.011	-11.351	0.005	0.046	-5.752	0.001	0.012	1.682	0.000	0.001	-20.131	0.018	0.144
Monção	5.003	0.002	0.008	-9.671	0.007	0.028	5.654	0.003	0.010	2.544	0.001	0.002	-3.715	0.001	0.004
Paredes de Coura	9.372	0.003	0.029	9.749	0.003	0.032	-2.720	0.000	0.003	0.160	0.000	0.000	-7.128	0.002	0.017
Ponte de Lima	1.026	0.000	0.001	-0.460	0.000	0.000	0.627	0.000	0.000	4.976	0.007	0.011	-3.338	0.003	0.005
Valença	-11.576	0.006	0.089	0.833	0.000	0.001	11.073	0.007	0.081	2.265	0.000	0.003	-13.464	0.012	0.120
Viana do Castelo	1.833	0.001	0.002	-5.099	0.012	0.019	-2.155	0.002	0.003	4.002	0.008	0.011	-0.946	0.001	0.001
Vila Nova de Cerveira	13.072	0.005	0.057	11.417	0.005	0.043	-3.681	0.000	0.005	0.723	0.000	0.000	2.867	0.000	0.003

Alto Tâmega															
Chaves	-0.396	0.000	0.000	0.232	0.000	0.000	5.109	0.006	0.027	3.700	0.003	0.014	4.353	0.005	0.020
Montalegre	26.706	0.023	0.186	9.726	0.004	0.025	2.619	0.000	0.002	12.886	0.007	0.043	-9.322	0.004	0.023
Ribeira de Pena	7.877	0.002	0.034	-16.900	0.009	0.157	-8.286	0.002	0.038	5.140	0.001	0.015	8.375	0.003	0.039
Valpaços	11.307	0.006	0.055	11.353	0.007	0.056	7.108	0.003	0.022	8.793	0.005	0.034	0.200	0.000	0.000
Vila Pouca de Aguiar	4.963	0.001	0.020	20.564	0.023	0.337	3.379	0.001	0.009	2.700	0.000	0.006	-2.097	0.000	0.004
Área Metropolitana do Porto															
Arouca	-10.566	0.011	0.059	10.017	0.012	0.053	2.692	0.001	0.004	1.403	0.000	0.001	-4.115	0.003	0.009
Espinho	-4.344	0.004	0.015	1.474	0.001	0.002	1.143	0.000	0.001	8.607	0.022	0.059	-3.513	0.004	0.010
Gondomar	-3.043	0.006	0.062	0.816	0.000	0.005	5.744	0.025	0.222	-1.149	0.001	0.009	1.874	0.003	0.024
Maia	-2.144	0.003	0.022	-2.529	0.004	0.030	6.914	0.035	0.225	3.007	0.007	0.043	0.014	0.000	0.000
Matosinhos	3.815	0.010	0.034	1.331	0.001	0.004	0.788	0.001	0.001	-0.879	0.001	0.002	6.777	0.046	0.106
Oliveira de Azeméis	-3.145	0.003	0.007	1.542	0.001	0.002	-2.540	0.002	0.005	2.038	0.001	0.003	0.545	0.000	0.000
Paredes	-2.737	0.003	0.019	4.319	0.010	0.048	5.750	0.018	0.086	1.624	0.002	0.007	-1.233	0.001	0.004
Porto	2.999	0.009	0.043	4.557	0.024	0.099	-0.225	0.000	0.000	1.336	0.002	0.009	4.414	0.028	0.093
Póvoa de Varzim	-0.377	0.000	0.000	2.595	0.003	0.016	-1.518	0.001	0.006	-1.927	0.002	0.009	1.491	0.001	0.005
Santa Maria da Feira	-0.183	0.000	0.000	-0.694	0.000	0.000	0.378	0.000	0.000	3.172	0.006	0.009	2.834	0.005	0.007
Santo Tirso	3.805	0.004	0.011	1.985	0.001	0.003	-3.746	0.005	0.010	-1.317	0.001	0.001	2.249	0.002	0.004
São João da Madeira	0.344	0.000	0.000	1.386	0.000	0.001	1.289	0.000	0.001	-0.247	0.000	0.000	1.870	0.001	0.002
Trofa	-13.001	0.027	0.136	0.504	0.000	0.000	0.848	0.000	0.001	-6.503	0.009	0.034	5.839	0.008	0.027
Vale de Cambra	-0.355	0.000	0.000	4.202	0.002	0.011	12.413	0.017	0.092	-3.530	0.001	0.008	-6.280	0.005	0.024
Valongo	-0.666	0.000	0.003	3.107	0.005	0.066	5.034	0.014	0.174	1.695	0.002	0.020	0.213	0.000	0.000
Vila do Conde	0.439	0.000	0.001	-5.849	0.014	0.088	2.959	0.004	0.022	5.672	0.014	0.082	-1.010	0.001	0.003
Vila Nova de Gaia	0.587	0.000	0.003	-1.532	0.003	0.023	-0.896	0.001	0.008	-2.924	0.012	0.083	-0.268	0.000	0.001
Ave															
Fafe	5.331	0.007	0.030	1.900	0.001	0.004	0.261	0.000	0.000	-2.946	0.003	0.009	0.012	0.000	0.000
Guimarães	-1.079	0.001	0.003	-0.948	0.001	0.002	-1.649	0.002	0.006	-0.562	0.000	0.001	4.863	0.025	0.056
Póvoa de Lanhoso	0.791	0.000	0.001	3.607	0.002	0.020	1.206	0.000	0.002	11.543	0.019	0.204	-1.000	0.000	0.002
Vieira do Minho	1.801	0.000	0.003	3.729	0.001	0.011	-5.942	0.003	0.029	10.642	0.009	0.093	-11.559	0.011	0.109

Vila Nova de Famalicão	1.494	0.001	0.002	-4.219	0.009	0.017	-0.134	0.000	0.000	3.276	0.006	0.010	0.908	0.001	0.001
Vizela	0.522	0.000	0.000	-8.641	0.010	0.106	5.210	0.004	0.038	-3.263	0.002	0.015	3.207	0.002	0.015
Cávado															
Amares	10.705	0.009	0.097	-7.606	0.005	0.049	-0.780	0.000	0.001	-7.755	0.006	0.051	1.423	0.000	0.002
Barcelos	5.770	0.015	0.033	0.148	0.000	0.000	0.909	0.000	0.001	0.337	0.000	0.000	0.291	0.000	0.000
Braga	-11.943	0.131	0.172	0.135	0.000	0.000	-1.058	0.001	0.001	-1.734	0.004	0.004	2.264	0.007	0.006
Esposende	4.736	0.004	0.022	-4.290	0.004	0.018	4.731	0.005	0.022	-0.734	0.000	0.001	-1.501	0.001	0.002
Terras de Bouro	-13.190	0.005	0.044	0.303	0.000	0.000	9.569	0.003	0.023	19.598	0.014	0.098	1.655	0.000	0.001
Vila Verde	6.788	0.009	0.075	7.041	0.011	0.081	6.630	0.010	0.071	-7.505	0.014	0.092	-0.049	0.000	0.000
Douro															
Carrazeda de Ansiães	-17.158	0.006	0.077	14.021	0.005	0.051	-8.833	0.002	0.020	-1.787	0.000	0.001	-2.135	0.000	0.001
Lamego	1.075	0.000	0.001	2.718	0.001	0.006	10.226	0.018	0.086	7.544	0.010	0.047	0.603	0.000	0.000
Mesão Frio	13.379	0.004	0.044	4.284	0.000	0.005	7.123	0.001	0.012	-12.426	0.005	0.038	14.104	0.007	0.048
Moimenta da Beira	-8.472	0.004	0.027	-13.729	0.013	0.070	-0.056	0.000	0.000	-6.502	0.003	0.016	-3.115	0.001	0.004
Murça	3.782	0.000	0.005	-10.119	0.003	0.034	10.224	0.003	0.034	5.213	0.001	0.009	6.875	0.002	0.015
Peso da Régua	7.474	0.004	0.074	-5.812	0.003	0.045	-6.940	0.005	0.064	0.784	0.000	0.001	0.873	0.000	0.001
Sabrosa	7.461	0.001	0.017	15.405	0.006	0.072	0.607	0.000	0.000	-2.919	0.000	0.003	-14.695	0.007	0.066
Tabuaço	3.046	0.000	0.004	0.385	0.000	0.000	4.602	0.001	0.008	5.894	0.001	0.013	1.789	0.000	0.001
Tarouca	15.623	0.009	0.138	-3.231	0.000	0.006	8.076	0.003	0.037	2.046	0.000	0.002	11.246	0.007	0.072
Torre de Moncorvo	-15.547	0.006	0.046	29.821	0.024	0.169	-2.518	0.000	0.001	-8.581	0.002	0.014	12.159	0.005	0.028
Vila Real	3.024	0.002	0.007	5.469	0.009	0.021	-0.303	0.000	0.000	-2.051	0.001	0.003	-2.541	0.002	0.005
Tâmega e Sousa															
Amarante	-0.291	0.000	0.000	-3.620	0.002	0.007	2.870	0.002	0.005	2.204	0.001	0.003	1.251	0.000	0.001
Baião	12.707	0.013	0.126	13.211	0.017	0.137	9.766	0.010	0.075	15.366	0.026	0.185	-4.304	0.002	0.015
Castelo de Paiva	1.813	0.000	0.004	-0.982	0.000	0.001	-0.031	0.000	0.000	-3.873	0.002	0.016	-3.188	0.001	0.011
Celorico de Basto	2.386	0.000	0.006	-1.760	0.000	0.003	5.498	0.003	0.031	5.733	0.003	0.033	-7.341	0.006	0.055
Cinfães	-7.443	0.005	0.033	7.001	0.005	0.029	6.395	0.004	0.024	5.145	0.003	0.016	0.868	0.000	0.000
Felgueiras	-7.753	0.018	0.131	6.340	0.014	0.088	4.988	0.009	0.054	5.551	0.012	0.067	1.231	0.001	0.003
Lousada	2.972	0.002	0.016	3.267	0.003	0.020	5.081	0.008	0.047	-3.714	0.005	0.025	0.342	0.000	0.000

Marco de Canaveses	5.267	0.008	0.024	2.516	0.002	0.006	3.221	0.004	0.009	2.525	0.002	0.006	1.382	0.001	0.002
Paços de Ferreira	-1.707	0.001	0.007	-3.790	0.005	0.035	0.319	0.000	0.000	0.198	0.000	0.000	-0.287	0.000	0.000
Penafiel	0.651	0.000	0.000	1.286	0.001	0.002	-7.169	0.024	0.051	15.103	0.111	0.225	5.644	0.017	0.032
Resende	2.773	0.000	0.003	-6.788	0.002	0.018	6.044	0.001	0.014	-9.957	0.004	0.038	-7.111	0.002	0.019
Terras de Trás-os-Montes															
Alfândega da Fé	-6.917	0.001	0.013	-3.521	0.000	0.003	21.246	0.010	0.123	-0.766	0.000	0.000	13.745	0.005	0.051
Bragança	4.107	0.003	0.020	-0.176	0.000	0.000	-3.656	0.003	0.016	0.980	0.000	0.001	-1.966	0.001	0.005
Macedo de Cavaleiros	-2.444	0.000	0.003	1.731	0.000	0.001	12.267	0.010	0.068	6.151	0.003	0.017	-20.372	0.032	0.189
Miranda do Douro	5.550	0.001	0.013	11.339	0.004	0.053	6.050	0.001	0.015	6.361	0.001	0.017	-12.992	0.006	0.069
Mirandela	2.662	0.001	0.007	5.256	0.003	0.029	1.059	0.000	0.001	-1.715	0.000	0.003	-1.575	0.000	0.003
Mogadouro	-11.368	0.004	0.034	6.403	0.001	0.011	-0.916	0.000	0.000	-12.343	0.006	0.040	5.048	0.001	0.007

Table 4 – Variables PCA (Principal components 1 to 5)

School year/level	COORD1	CTA1	CTR1	COORD2	CTA2	CTR2	COORD3	CTA3	CTR3	COORD4	CTA4	CTR4	COORD5	CTA5	CTR5
7th 10/11	4.20	0.035	0.657	1.56	0.032	0.090	-0.68	0.010	0.017	-0.01	0.000	0.000	-0.27	0.002	0.003
7th 11/12	4.38	0.038	0.622	2.21	0.064	0.159	-0.42	0.004	0.006	0.19	0.001	0.001	-0.43	0.006	0.006
7th 12/13	3.98	0.031	0.566	2.00	0.052	0.142	-0.54	0.006	0.010	0.31	0.003	0.004	0.37	0.004	0.005
7th 13/14	4.14	0.034	0.524	2.79	0.101	0.238	0.12	0.000	0.000	-0.77	0.017	0.018	-0.51	0.009	0.008
7th 14/15	3.77	0.028	0.514	2.31	0.069	0.193	-0.03	0.000	0.000	-0.47	0.006	0.008	-0.33	0.004	0.004
7th 15/16	3.48	0.024	0.502	2.12	0.058	0.186	-0.15	0.000	0.001	-0.71	0.014	0.021	-0.24	0.002	0.002
8th 10/11	3.03	0.018	0.583	1.31	0.022	0.110	-0.24	0.001	0.004	0.18	0.001	0.002	-0.21	0.001	0.003
8th 11/12	3.29	0.021	0.556	1.43	0.027	0.105	-0.10	0.000	0.001	0.32	0.003	0.005	-0.12	0.001	0.001
8th 12/13	3.09	0.019	0.500	1.45	0.027	0.110	-0.55	0.006	0.016	-0.07	0.000	0.000	0.02	0.000	0.000
8th 13/14	3.39	0.023	0.612	1.29	0.022	0.089	-0.30	0.002	0.005	-0.16	0.001	0.001	0.16	0.001	0.001
8th 14/15	3.04	0.018	0.567	1.17	0.018	0.084	-0.28	0.002	0.005	0.10	0.000	0.001	0.10	0.000	0.001
8th 15/16	2.36	0.011	0.473	1.08	0.015	0.099	-0.44	0.004	0.016	-0.02	0.000	0.000	-0.24	0.002	0.005

8th 10/11	3.11	0.019	0.477	0.89	0.010	0.039	-0.48	0.005	0.011	0.44	0.005	0.010	-0.27	0.002	0.004
8th 11/12	3.78	0.028	0.538	0.87	0.010	0.029	-0.48	0.005	0.009	0.96	0.026	0.035	0.02	0.000	0.000
8th 12/13	3.45	0.024	0.506	0.54	0.004	0.013	-0.53	0.006	0.012	0.23	0.001	0.002	0.47	0.007	0.009
8th 13/14	3.05	0.019	0.488	0.65	0.006	0.022	-0.07	0.000	0.000	0.23	0.001	0.003	0.98	0.032	0.050
8th 14/15	2.46	0.012	0.422	0.69	0.006	0.033	-0.70	0.010	0.034	-0.48	0.006	0.016	0.41	0.006	0.011
8th 15/16	2.42	0.012	0.476	0.48	0.003	0.019	-0.27	0.001	0.006	0.07	0.000	0.000	0.19	0.001	0.003
10th 10/11	3.77	0.028	0.441	-0.24	0.001	0.002	2.53	0.132	0.199	0.95	0.025	0.028	-1.06	0.038	0.035
10th 11/12	4.68	0.044	0.600	-0.89	0.010	0.022	2.03	0.085	0.113	0.32	0.003	0.003	-0.66	0.015	0.012
10th 12/13	4.18	0.035	0.539	-0.56	0.004	0.010	1.88	0.072	0.109	0.54	0.008	0.009	0.81	0.022	0.020
10th 13/14	3.78	0.028	0.491	-0.91	0.011	0.029	1.98	0.081	0.136	-0.08	0.000	0.000	1.09	0.040	0.041
10th 14/15	3.61	0.026	0.512	-1.00	0.013	0.039	1.31	0.036	0.068	0.20	0.001	0.002	1.03	0.036	0.042
10th 15/16	4.02	0.032	0.513	-0.61	0.005	0.012	1.75	0.063	0.097	0.80	0.018	0.020	0.44	0.006	0.006
11th 10/11	3.31	0.022	0.484	-0.51	0.003	0.011	1.19	0.029	0.063	0.54	0.008	0.013	-0.87	0.025	0.033
11th 11/12	3.46	0.024	0.503	-1.14	0.017	0.055	0.52	0.005	0.011	0.02	0.000	0.000	-0.70	0.016	0.020
11th 12/13	3.53	0.025	0.534	-0.79	0.008	0.027	0.61	0.008	0.016	-0.52	0.008	0.012	0.40	0.005	0.007
11th 13/14	3.17	0.020	0.479	-0.41	0.002	0.008	1.21	0.030	0.070	-0.04	0.000	0.000	0.79	0.021	0.030
11th 14/15	2.92	0.017	0.480	-0.68	0.006	0.026	1.08	0.024	0.066	-0.62	0.011	0.022	0.47	0.007	0.012
11th 15/16	2.59	0.013	0.496	-0.27	0.001	0.006	0.86	0.015	0.055	0.07	0.000	0.000	0.30	0.003	0.007
12th 10/11	4.40	0.039	0.418	-1.39	0.025	0.041	-2.05	0.086	0.090	3.22	0.287	0.223	-1.44	0.069	0.045
12th 11/12	4.18	0.035	0.432	-2.39	0.074	0.141	-2.25	0.104	0.126	1.18	0.039	0.035	-0.94	0.030	0.022
12th 12/13	4.62	0.042	0.417	-3.38	0.149	0.224	-0.50	0.005	0.005	-0.42	0.005	0.004	-1.67	0.094	0.055
12th 13/14	5.07	0.051	0.474	-1.99	0.052	0.073	-2.38	0.116	0.104	0.61	0.010	0.007	3.66	0.450	0.247
12th 14/15	5.08	0.051	0.509	-1.89	0.047	0.071	-1.38	0.039	0.037	-3.08	0.263	0.187	-0.07	0.000	0.000
12th 15/16	5.21	0.054	0.540	-1.45	0.027	0.042	-0.61	0.008	0.007	-2.87	0.229	0.164	-1.10	0.040	0.024

Table 5 – Variables PCA (Principal components 6 to 10)

School level/year	COORD6	CTA6	CTR6	COORD7	CTA7	CTR7	COORD8	CTA8	CTR8	COORD9	CTA9	CTR9	COORD10	CTA10	CTR10
7th 10/11	-0.44	0.008	0.007	-0.07	0.000	0.000	-0.74	0.027	0.020	-0.18	0.002	0.001	-0.84	0.042	0.026
7th 11/12	-0.39	0.006	0.005	-0.16	0.001	0.001	-0.78	0.030	0.020	-0.11	0.001	0.000	-1.16	0.080	0.044
7th 12/13	-0.16	0.001	0.001	-0.45	0.009	0.007	-0.81	0.033	0.024	-0.25	0.003	0.002	-0.62	0.023	0.014
7th 13/14	-0.54	0.011	0.009	0.52	0.013	0.008	-0.36	0.006	0.004	-0.74	0.029	0.017	0.19	0.002	0.001
7th 14/15	-0.80	0.025	0.023	-0.22	0.002	0.002	0.06	0.000	0.000	-1.34	0.094	0.065	1.07	0.067	0.041
7th 15/16	-0.81	0.026	0.027	-0.74	0.026	0.023	0.18	0.002	0.001	-0.38	0.008	0.006	0.92	0.050	0.035
8th 10/11	0.18	0.001	0.002	0.16	0.001	0.002	-0.11	0.001	0.001	0.41	0.009	0.011	-0.82	0.039	0.042
8th 11/12	0.08	0.000	0.000	-0.27	0.003	0.004	-0.23	0.003	0.003	0.29	0.004	0.004	-0.85	0.043	0.037
8th 12/13	0.05	0.000	0.000	-0.48	0.011	0.012	0.39	0.008	0.008	-0.08	0.000	0.000	0.64	0.024	0.021
8th 13/14	-0.78	0.024	0.033	0.41	0.008	0.009	0.42	0.009	0.009	-0.05	0.000	0.000	0.51	0.015	0.014
8th 14/15	-0.52	0.011	0.017	-0.23	0.003	0.003	0.65	0.021	0.026	0.14	0.001	0.001	0.81	0.038	0.040
8th 15/16	0.09	0.000	0.001	-0.28	0.004	0.007	-0.03	0.000	0.000	0.36	0.007	0.011	0.55	0.018	0.026
8th 10/11	0.58	0.013	0.017	1.16	0.063	0.066	0.43	0.009	0.009	1.13	0.067	0.063	-0.38	0.008	0.007
8th 11/12	1.33	0.071	0.067	1.19	0.066	0.053	0.32	0.005	0.004	0.59	0.018	0.013	-0.91	0.049	0.031
8th 12/13	0.23	0.002	0.002	0.88	0.036	0.033	1.00	0.049	0.042	1.46	0.113	0.091	0.58	0.020	0.014
8th 13/14	0.28	0.003	0.004	0.29	0.004	0.004	1.22	0.074	0.078	0.88	0.041	0.041	-0.25	0.004	0.003
8th 14/15	0.15	0.001	0.002	0.28	0.004	0.005	0.54	0.014	0.020	0.61	0.020	0.026	0.57	0.019	0.023
8th 15/16	0.16	0.001	0.002	0.15	0.001	0.002	0.56	0.016	0.026	0.53	0.015	0.023	0.29	0.005	0.007
10th 10/11	0.64	0.016	0.013	1.39	0.091	0.060	-0.71	0.025	0.016	0.46	0.011	0.007	0.97	0.056	0.029
10th 11/12	0.30	0.004	0.003	0.92	0.040	0.023	0.12	0.001	0.000	-0.62	0.020	0.010	-0.52	0.016	0.007
10th 12/13	-0.05	0.000	0.000	-0.12	0.001	0.000	1.47	0.107	0.067	-0.04	0.000	0.000	0.38	0.008	0.004
10th 13/14	0.09	0.000	0.000	-0.49	0.011	0.008	0.88	0.038	0.027	-0.73	0.028	0.018	0.97	0.055	0.032

10th 14/15	-0.59	0.014	0.014	-1.17	0.064	0.053	0.23	0.003	0.002	0.74	0.029	0.021	-0.48	0.013	0.009
10th 15/16	-0.87	0.031	0.024	-1.56	0.115	0.077	-0.11	0.001	0.000	0.69	0.025	0.015	-0.63	0.023	0.013
11th 10/11	0.71	0.020	0.022	-0.13	0.001	0.001	-0.98	0.048	0.043	-0.05	0.000	0.000	0.58	0.020	0.015
11th 11/12	0.82	0.027	0.029	0.85	0.034	0.030	-1.09	0.059	0.050	-0.83	0.036	0.029	0.49	0.014	0.010
11th 12/13	0.43	0.007	0.008	1.03	0.050	0.046	-0.46	0.011	0.009	-0.98	0.050	0.041	0.00	0.000	0.000
11th 13/14	0.14	0.001	0.001	-0.26	0.003	0.003	-0.34	0.006	0.005	-0.40	0.009	0.008	-1.06	0.066	0.053
11th 14/15	0.28	0.003	0.005	-0.70	0.023	0.028	-0.36	0.006	0.007	-0.22	0.003	0.003	-0.38	0.009	0.008
11th 15/16	0.02	0.000	0.000	-0.43	0.009	0.014	-0.28	0.004	0.006	0.28	0.004	0.006	-0.57	0.019	0.024
12th 10/11	1.21	0.058	0.031	-1.71	0.138	0.063	0.85	0.036	0.016	-1.12	0.066	0.027	0.11	0.001	0.000
12th 11/12	-0.33	0.004	0.003	0.26	0.003	0.002	-0.14	0.001	0.001	0.21	0.002	0.001	0.45	0.012	0.005
12th 12/13	-3.43	0.470	0.230	0.81	0.031	0.013	0.25	0.003	0.001	0.48	0.012	0.005	-0.40	0.009	0.003
12th 13/14	-0.31	0.004	0.002	0.62	0.018	0.007	-1.65	0.135	0.050	-0.31	0.005	0.002	0.63	0.023	0.007
12th 14/15	1.12	0.050	0.025	0.28	0.004	0.002	1.69	0.142	0.057	-1.40	0.104	0.039	-1.09	0.070	0.023
12th 15/16	1.43	0.082	0.041	-1.52	0.109	0.046	-1.19	0.070	0.028	1.78	0.165	0.063	0.78	0.036	0.012

Table 6 – Coefficients of variation for each NUT III (part 1)

School level/year	Alentejo Central	Alentejo Litoral	Algarve	Alto Alentejo	Alto Minho	Alto Tâmega	Área Metropolitana de Lisboa	Área Metropolitana do Porto	Ave	Baixo Alentejo	Beira Baixa	Beiras e Serra da Estrela
7th 10/11	33.32	39.48	12.71	29.49	41.62	21.83	17.49	19.72	17.00	27.55	33.15	40.89
7th 11/12	16.92	41.46	17.82	24.22	27.56	38.32	19.77	17.94	19.99	46.13	14.97	38.39
7th 12/13	33.88	32.00	23.74	26.16	37.28	30.91	20.02	21.30	19.01	35.57	17.71	32.31
7th 13/14	27.24	23.49	17.76	6.12	44.00	44.62	20.96	19.68	14.20	23.44	18.76	51.73
7th 14/15	60.71	19.78	24.91	37.10	33.18	25.81	21.58	21.71	10.60	36.47	16.63	50.04
7th 15/16	35.76	31.75	22.47	58.95	37.78	43.51	25.28	26.08	21.13	39.19	40.80	39.01

8th 10/11	46.44	58.76	14.65	26.23	47.87	75.67	19.21	22.96	41.14	28.31	35.09	40.64
8th 11/12	27.35	39.12	22.51	39.07	34.39	63.44	18.26	19.22	32.77	27.74	44.03	39.92
8th 12/13	35.76	16.25	24.79	33.64	28.45	41.90	21.06	18.52	10.41	48.05	43.06	32.63
8th 13/14	40.43	21.94	25.42	23.34	45.98	31.04	18.73	20.15	8.96	44.85	35.98	46.76
8th 14/15	50.99	43.78	25.44	17.95	41.50	31.59	21.12	24.23	27.09	38.14	65.73	29.08
8th 15/16	69.09	49.06	25.02	51.18	34.82	65.17	26.24	26.28	35.25	39.60	41.43	44.30
8th 10/11	30.44	39.59	11.07	20.77	28.77	42.76	17.03	20.31	31.61	36.47	31.18	47.85
8th 11/12	29.43	41.74	26.59	21.32	27.27	42.35	13.83	18.54	21.85	39.08	34.04	41.70
8th 12/13	36.92	29.50	25.02	24.10	26.37	30.76	10.75	17.53	25.16	24.04	26.65	29.38
8th 13/14	25.84	23.95	17.52	39.65	29.03	27.84	18.65	15.11	21.10	37.78	22.98	45.25
8th 14/15	23.82	35.12	31.79	22.96	29.84	48.36	21.80	21.73	42.11	41.04	73.84	46.66
8th 15/16	63.75	10.02	30.18	41.30	57.33	58.53	17.32	24.18	32.48	68.17	32.08	44.24
10th 10/11	31.61	54.43	29.94	44.04	47.41	27.86	16.31	28.09	17.34	43.35	51.59	23.02
10th 11/12	28.75	29.16	23.56	47.24	64.72	65.48	18.78	27.36	29.52	31.57	28.72	48.91
10th 12/13	29.12	27.51	24.21	33.95	39.99	37.59	14.49	24.63	26.73	38.65	33.70	61.89
10th 13/14	40.18	13.87	23.95	56.70	39.14	17.64	13.00	25.15	31.27	42.65	24.56	21.66
10th 14/15	37.01	37.53	22.97	31.21	32.25	55.29	16.53	28.45	18.98	28.44	17.07	42.29
10th 15/16	28.86	37.19	22.02	22.58	31.10	48.47	15.16	24.00	22.20	39.83	24.40	45.95
11th 10/11	38.10	24.43	30.36	52.46	31.77	47.54	15.55	25.20	28.21	49.99	34.27	27.65
11th 11/12	17.68	64.82	16.59	34.67	38.74	30.06	17.23	32.74	28.81	35.54	38.95	41.03
11th 12/13	29.90	19.26	31.87	25.94	45.48	34.52	14.64	23.96	26.87	59.42	29.61	46.67
11th 13/14	33.24	17.39	28.80	41.52	29.40	42.49	17.47	22.69	30.79	31.84	7.32	37.68
11th 14/15	44.02	36.12	17.98	48.05	39.64	24.92	16.41	29.56	33.27	29.41	29.80	39.71
11th 15/16	46.08	18.91	22.25	32.32	49.28	77.92	18.09	38.93	43.15	32.76	50.14	26.61
12th 10/11	21.86	32.55	15.74	17.10	18.82	14.44	10.25	12.30	13.07	30.46	10.55	32.32
12th 11/12	19.74	10.42	17.52	15.38	16.73	9.23	10.50	10.80	12.76	20.07	26.26	25.92
12th 12/13	23.10	18.12	13.59	10.71	17.86	12.82	10.51	11.39	11.41	29.48	31.40	21.36

12th 13/14	42.35	15.85	12.15	16.35	14.87	27.50	11.95	13.76	13.64	22.20	28.86	25.37
12th 14/15	21.57	16.31	11.12	11.81	32.92	28.45	9.26	19.56	10.88	14.36	15.59	36.07
12th 15/16	30.58	17.22	15.23	33.80	21.79	18.86	9.09	15.98	6.78	19.38	35.57	23.81

Table 7 – Coefficients of variation for each NUT III (part 2)

School level/year	Cávado	Douro	Lezíria do Tejo	Médio Tejo	Oeste	Região de Aveiro	Região de Coimbra	Região de Leiria	Tâmega e Sousa	Terras de Trás-os-Montes	Viseu Dão Lafões
7th 10/11	15.05	65.98	28.98	37.71	23.99	23.79	35.53	25.02	29.21	44.85	53.12
7th 11/12	8.53	62.81	27.34	25.95	24.11	31.43	37.07	24.85	34.04	31.49	30.87
7th 12/13	18.87	67.31	27.05	32.39	23.73	37.04	44.08	16.22	24.20	39.99	46.10
7th 13/14	11.46	61.01	23.70	26.16	19.96	30.77	48.07	34.83	29.25	42.82	36.80
7th 14/15	14.07	81.62	35.49	30.72	21.67	32.38	41.53	26.86	35.84	42.32	41.05
7th 15/16	8.40	73.64	41.82	40.23	26.33	35.67	43.08	29.51	43.18	45.21	55.33
8th 10/11	18.45	87.40	39.75	38.03	25.42	32.23	43.98	35.58	24.48	70.40	48.45
8th 11/12	24.24	53.10	29.05	36.92	23.20	42.55	30.76	22.21	26.65	62.88	28.38
8th 12/13	18.86	57.07	21.79	31.95	18.63	35.30	39.56	39.65	25.20	48.97	51.99
8th 13/14	24.29	45.28	30.56	23.15	28.29	35.53	45.53	34.36	21.07	56.26	32.23
8th 14/15	18.64	52.38	42.08	44.51	35.74	39.92	42.82	36.68	39.05	76.31	54.53
8th 15/16	29.65	98.51	38.82	40.03	24.26	69.25	48.60	14.58	35.24	72.00	33.26
8th 10/11	32.08	42.39	37.78	53.68	30.71	26.68	60.42	43.26	19.54	60.73	26.88
8th 11/12	33.91	46.70	19.65	10.08	27.43	32.08	36.77	28.69	32.54	58.56	26.23
8th 12/13	14.12	38.75	23.52	32.63	35.63	23.61	30.46	33.97	14.98	34.19	45.56
8th 13/14	22.41	51.03	20.82	31.79	27.63	25.58	30.69	44.87	27.54	26.91	19.54

8th 14/15	36.63	58.14	35.91	42.99	33.22	34.39	38.22	35.48	31.25	24.85	44.85
8th 15/16	28.12	66.94	35.05	59.79	35.23	47.85	71.59	41.22	30.41	34.62	37.45
10th 10/11	14.90	43.06	47.69	29.69	35.74	23.32	26.29	30.92	33.17	33.29	24.97
10th 11/12	30.74	46.80	32.74	29.87	28.82	20.17	34.09	24.16	31.84	37.98	35.86
10th 12/13	29.97	42.79	33.08	55.32	30.04	15.91	39.62	42.70	32.54	30.10	70.16
10th 13/14	22.75	34.13	39.62	31.50	37.94	26.02	33.05	29.11	25.02	44.51	23.16
10th 14/15	24.39	46.26	41.42	46.80	28.53	25.22	35.99	36.67	21.24	24.68	40.89
10th 15/16	28.82	32.21	27.67	22.75	19.72	42.90	37.41	36.95	27.38	25.44	27.63
11th 10/11	21.28	59.67	37.03	38.06	32.34	30.85	27.67	23.84	47.70	27.75	28.31
11th 11/12	18.44	35.09	30.85	42.87	24.43	23.97	31.56	26.06	23.66	28.84	37.34
11th 12/13	29.17	43.18	31.48	50.05	32.27	20.58	30.08	22.89	22.26	35.52	39.11
11th 13/14	12.92	34.28	27.56	42.47	38.72	28.71	29.93	30.37	42.58	39.51	57.96
11th 14/15	33.86	51.14	46.41	46.36	30.01	30.87	39.69	44.57	41.46	31.92	29.72
11th 15/16	27.26	55.87	41.49	63.05	28.81	38.75	38.41	46.09	46.23	35.39	37.03
12th 10/11	9.83	25.86	22.39	17.47	14.84	18.88	19.44	17.11	12.01	19.65	23.25
12th 11/12	10.24	24.64	12.12	35.47	22.95	11.71	21.07	21.42	11.03	28.70	18.95
12th 12/13	26.57	13.81	8.98	29.00	21.20	10.00	24.80	14.87	13.96	17.79	20.65
12th 13/14	13.14	21.43	16.91	29.96	33.76	7.76	20.54	15.30	16.12	25.75	17.44
12th 14/15	13.39	25.23	17.72	24.14	31.53	19.13	18.81	16.70	32.80	18.96	17.77
12th 15/16	12.97	34.07	13.70	25.10	25.07	21.46	17.87	23.18	13.87	20.57	26.70

Table 8 – Median and quartile retention rate for each cluster in each school year and level

How to interpret?
Q1 Q3 Median

Variable	1	2	3	4	5	6	7
7th grade (2010/2011)	15.08 18.63 16.20	7.50 12.58 11.38	9.03 14.79 14.12	21.46 21,46 21.46	9,56 12,47 11.23	18,03 22,65 20.96	16,07 19,28 17.07
7th grade (2011/2012)	16.85 21.57 19.61	9.89 14.03 13.49	11.26 15.00 14.59	22.03 24,71 24.71	10,92 15,36 12.67	20,18 26,61 22.72	16,24 26,27 18.80
7th grade (2012/2013)	16.12 20.52 19.02	9.95 15.15 13.80	10.38 14.36 11.64	20.97 20,97 20.97	10,68 15,90 12.82	20,87 24,69 22.79	17,14 23,56 17.16
7th grade (2013/2014)	17.57 22.85 19.59	9.91 14.52 10.52	10.61 15.56 12.93	22.55 22,55 22.55	11,06 15,85 13.60	19,11 25,11 23.39	15,66 24,78 21.33
7th grade (2014/2015)	16.06 19.86 17.64	8.73 13.70 11.11	9.68 12.97 12.93	18.73 21,47 21.47	9,46 15,14 12.39	17,58 24,17 20.32	17,55 26,88 19.45
7th grade (2015/2016)	13.27 18.25 15.41	5.39 10.24 7.82	6.76 10.57 9.22	19.62 19,62 19.62	7,95 12,68 9.98	15,01 19,55 17.99	12,26 20,60 15.21
8th grade (2010/2011)	10.34 13.50 11.38	6.56 9.57 7.23	5.64 9.69 8.17	15.41 15,41 15.41	5,88 8,85 7.24	12,73 15,66 13.98	9,59 17,82 11.14
8th grade (2011/2012)	12.29 16.35 13.72	6.84 11.69 8.01	6.38 12.66 11.84	14.55 19,16 19.16	8,49 10,89 9.38	14,60 19,57 16.71	12,50 17,14 13.97
8th grade (2012/2013)	13.57 16.77 15.14	10.21 14.02 12.07	9.25 11.52 10.05	18.88 19,42 19.42	9,18 12,93 11.30	16,95 21,50 18.82	14,58 17,53 16.85

8th grade (2013/2014)	14.01 16.11 15.12	9.57 13.31 11.08	9.87 13.40 11.95	15.78 18,04 18.04	8,31 11,52 9.81	16,08 20,88 18.54	11,78 17,72 16.19
8th grade (2014/2015)	9.89 13.76 12.44	4.49 10.77 6.64	6.64 9.24 7.31	13.81 14,53 14.53	5,95 8,34 7.01	13,75 16,27 14.36	10,16 15,38 13.42
8th grade (2015/2016)	8.59 10.66 9.36	5.32 9.21 5.98	4.39 6.35 4.65	11.67 11,67 11.67	4,55 7,69 5.94	10,50 13,19 12.60	7,54 13,27 7.65
9th grade (2010/2011)	13.31 17.65 15.55	9.68 12.10 11.11	6.18 15.74 11.64	18.52 18,62 18.62	9,24 13,02 10.51	15,89 19,38 18.22	12,43 21,11 14.24
9th grade (2011/2012)	15.88 20.61 19.01	13.81 16.90 15.55	9.28 17.69 15.52	23.82 23,82 23.82	12,96 15,20 13.69	20,67 23,55 21.39	15,99 23,10 21.05
9th grade (2012/2013)	18.36 22.08 20.42	11.40 19.64 15.17	14.48 21.08 17.20	22.97 22,97 22.97	12,85 16,96 14.13	20,49 24,22 22.83	17,95 23,73 20.29
9th grade (2013/2014)	16.84 18.68 17.36	9.26 16.18 10.78	10.39 16.36 14.29	18.97 19,70 19.70	11,20 15,25 12.56	19,94 22,20 21.08	12,50 21,05 16.90
9th grade (2014/2015)	10.71 14.01 11.98	6.81 12.08 9.36	7.83 9.35 7.90	15.59 15,67 15.67	7,06 9,90 8.76	12,88 15,69 13.60	8,55 17,16 10.84
9th grade (2015/2016)	9.23 11.36 10.74	5.93 9.27 7.45	5.82 9.14 9.06	11.74 12,64 12.64	5,15 7,89 6.10	11,67 13,81 12.28	8,96 16,67 9.04
10th grade (2010/2011)	16.55 21.83 18.15	7.52 14.22 12.11	17.39 23.16 17.74	23.83 23,83 23.83	11,56 17,95 14.62	21,09 24,59 23.63	17,97 25,86 22.02
10th grade (2011/2012)	15.80 21.43 18.01	8.92 16.46 9.59	18.87 23.11 20.67	21.87 21,87 21.87	9,66 15,43 13.69	23,02 27,19 23.82	18,18 20,63 19.30
10th grade (2012/2013)	15.66 20.87 20.02	5.98 12.68 9.47	16.36 21.38 18.74	22.23 22,23 22.23	9,06 14,62 12.28	20,34 25,68 22.01	21,05 25,00 23.87
10th grade	14.91 18.59	8.41 14.58	18.33 22.23	22.08 22,08	11,25 16,76	18,68 24,74	16,53 23,68

(2013/2014)	17.90	9.26	18.50	22.08	13.28	24.74	22.58
10th grade (2014/2015)	15.07 17.26 15.87	9.31 13.48 10.27	16.13 20.27 16.74	16.96 20,83 20.83	10,15 13,40 12.03	17,58 24,45 22.47	10,00 21,36 19.77
10th grade (2015/2016)	16.25 19.42 18.15	6.36 15.13 11.11	17.22 22.22 18.65	21.29 22,71 22.71	10,66 15,47 12.35	20,48 26,69 25.21	18,00 28,13 24.21
11th grade (2010/2011)	10.42 17.29 14.52	6.94 11.47 7.73	13.16 14.93 13.59	19.48 19,48 19.48	8,93 12,96 10.96	17,37 21,38 19.44	12,33 16,22 14.24
11th grade (2011/2012)	13.08 17.85 14.79	8.70 13.59 11.76	11.86 17.38 16.21	19.08 19,28 19.08	8,94 14,61 12.50	16,64 21,30 20.15	9,04 17,17 15.92
11th grade (2012/2013)	13.10 17.86 16.15	9.26 17.07 11.23	13.08 20.00 14.50	18.77 18,77 18.77	9,58 14,50 11.37	17,39 23,45 19.36	14,78 16,10 15.98
11th grade (2013/2014)	11.08 14.84 12.79	6.81 12.27 8.78	11.74 16.88 13.41	18.68 18,68 18.68	8,71 11,83 10.84	16,70 21,04 17.60	13,95 18,18 14.94
11th grade (2014/2015)	9.62 12.83 11.03	4.55 9.68 6.61	9.79 15.00 11.42	16.23 16,23 16.23	6,20 10,50 8.18	14,80 16,97 14.90	8,70 13,36 12.22
11th grade (2015/2016)	8.09 10.29 9.84	2.50 9.71 5.10	8.33 12.44 8.74	13.20 14,04 14.04	4,37 6,73 5.57	11,54 13,80 13.63	7,83 12,05 9.33
12th grade (2010/2011)	35.12 41.49 38.60	39.08 45.24 42.25	32.47 40.79 37.02	44.10 44,10 44.10	31,07 36,34 33.50	45,09 47,46 47.34	39,75 49,08 46.30
12th grade (2011/2012)	34.82 39.90 38.01	38.04 41.80 41.16	34.68 40.00 37.05	38.60 38,60 38.60	29,50 35,52 31.88	43,81 45,70 45.08	33,33 46,52 41.67
12th grade (2012/2013)	34.08 40.40 38.08	29.57 39.58 34.77	42.81 48.21 44.86	38.78 39,63 39.63	28,24 34,75 31.49	43,63 47,98 45.02	36,77 45,95 43.37
12th grade (2013/2014)	35.75 40.85 38.72	30.00 40.54 31.31	33.64 42.12 37.40	39.24 39,24 39.24	28,72 34,94 32.53	44,36 49,45 44.36	30,18 43,07 40.00

12th grade (2014/2015)	31.73 37.55 34.09	26.42 35.06 31.03	29.55 36.12 33.87	35.85 37,35 35.85	22,87 29,45 26.40	37,33 43,75 38.45	21,05 34,15 28.63
12th grade (2015/2016)	29.05 38.56 34.29	24.67 33.85 29.59	29.08 35.36 30.49	36.62 36,62 36.62	24,14 30,24 26.48	39,01 43,24 40.81	20,00 32,21 29.65

Table 9 – TEIP schools in middle school

School name	Municipality	School group	Phase of entrance in the TEIP program*
Escola Básica e Secundária Dr. Azevedo Neves, Damaia, Amadora	Amadora	Agrupamento de Escolas Dr. Azevedo Neves	1
Escola Básica Patrício Prazeres, Lisboa	Lisboa	Agrupamento de Escolas Patrício Prazeres	4
Escola Básica Miguel Torga, São Brás, Amadora	Amadora	Agrupamento de Escolas Miguel Torga	3
Escola Básica Marquesa de Alorna, Lisboa	Lisboa	Agrupamento de Escolas Marquesa de Alorna	4
Escola Básica e Secundária Passos Manuel, Lisboa	Lisboa	Agrupamento de Escolas Baixaâ€Chiado	3
Escola Básica José Cardoso Pires, São Brás, Amadora	Amadora	Agrupamento de Escolas José Cardoso Pires	1
Escola Básica e Secundária de Mães D´Água, Falagueira, Amadora	Amadora	Agrupamento de Escolas Mães D'Água	3

Escola Básica e Secundária Aquilino Ribeiro, Leião, Oeiras	Oeiras	Agrupamento de Escolas Aquilo Ribeiro	3
Escola Básica Francisco de Arruda, Lisboa	Lisboa	Agrupamento de Escolas Francisco Arruda	2
Escola Básica do Bairro Padre Cruz, Lisboa	Lisboa	Agrupamento de Escolas do Bairro Padre Cruz	2
Escola Básica de Camarate, Loures	Loures	Agrupamento de Escolas de Camarate - D. Nuno Ã lvares Pereira	3
Escola Básica Prof. Pedro D´Orey da Cunha, Damaia, Amadora	Amadora	Agrupamento de Escolas da Damaia	1
Escola Básica Cardoso Lopes, Amadora	Amadora	Agrupamento de Escolas José Cardoso Lopes	1
Escola Básica D. Francisco Manuel Melo, Venteira, Amadora	Amadora	Agrupamento de Escolas Amadora Oeste	4
Escola Básica de São Pedro da Cova, Gondomar	Gondomar	Agrupamento de Escolas São Pedro da Cova	3
Escola Básica de Matosinhos	Matosinhos	Agrupamento de Escolas de Matosinhos	1
Escola Básica Professor Óscar Lopes, Matosinhos	Matosinhos	Agrupamento de Escolas Professor Óscar Lopes	1
Escola Básica da Areosa, Porto	Porto	Agrupamento de Escolas António Nobre	1
Escola Básica de Vila D`Este, Vilar de Andorinho, Vila Nova de Gaia	Vila Nova de Gaia	Agrupamento de Escolas de Vila D'Este	1
Escola Básica de Perafita, Matosinhos	Matosinhos	Agrupamento de Escolas de Perafita	1

Escola Secundária Inês de Castro, Canidelo, Vila Nova de Gaia	Vila Nova de Gaia	Escola Secundária com 3.o Ciclo Inês de Castro	1
Escola Básica e Secundária Rodrigues de Freitas, Porto	Porto	Agrupamento de Escolas Rodrigues Freitas	1
Escola Básica Marques Leitão, Valbom, Gondomar	Gondomar	Agrupamento de escolas de Valbom	4
Escola Básica Santa Bárbara, Fânzeres, Gondomar	Gondomar	Agrupamento de Escolas Santa Bárbara, Fânzeres	1
Escola Básica Manoel de Oliveira, Porto	Porto	Agrupamento de Escolas Manoel de Oliveira	3
Escola Básica do Viso, Porto	Porto	Agrupamento de Escolas do Viso	1
Escola Básica e Secundária do Cerco, Porto	Porto	Agrupamento de Escolas do Cerco	1
Escola Básica Pêro Vaz de Caminha, Porto	Porto	Agrupamento de Escolas Pêro Vaz de Caminha	1
Escola Básica de Pedrouços, Maia	Maia	Agrupamento de Escolas de Pedrouços	1
Escola Básica Leonardo Coimbra Filho, Porto	Porto	Agrupamento de Escolas Leonardo Coimbra Filho	1
Escola Básica D. Pedro I, Canidelo, Vila Nova de Gaia	Vila Nova de Gaia	Agrupamento de Escolas de D. Pedro I	1
Escola Básica Fernando Pessoa, Lisboa	Lisboa	Agrupamento de Escolas Fernando Pessoa	3
Escola Básica de Piscinas, Lisboa	Lisboa	Agrupamento de Escolas Piscinas, Olivais	1

Escola Básica e Secundária D. João V, Damaia, Amadora	Amadora	Agrupamento de Escolas D. João V	3
Escola Básica Manuel da Maia, Lisboa	Lisboa	Agrupamento de Escolas Manuel da Maia	1
Escola Básica Sophia de Mello Breyner Andresen, Brandoa, Amadora	Amadora	Agrupamento de Escolas de Carnaxide -Portela	1
Escola Básica das Olaias, Lisboa	Lisboa	Agrupamento de Escolas das Olaias	3
Escola Básica de Apelação, Loures	Loures	Agrupamento de Escolas da Apelação	1
Escola Básica do Alto do Lumiar, Lisboa	Lisboa	Agrupamento de Escolas do Alto do Lumiar	3
Escola Secundária D. Dinis, Lisboa	Lisboa	Agrupamento de Escolas D. Dinis, Lisboa	3
Escola Secundária de Camarate, Loures	Loures	Escola Secundária de Camarate	3
Escola Secundária de Sacavém, Loures	Loures	Agrupamento de Escolas Eduardo Gageiro	1
Escola Básica Pintor Almada Negreiros, Lisboa	Lisboa	Agrupamento de Escolas Pintor Almada Negreiros	1

Table 9 – TEIP schools in high school

School name	Municipality	School group	Phase of entrance in the TEIP program*

Escola Secundária António Nobre	Porto	Agrupamento de Escolas António Nobre	1
Escola Secundária Alexandre Herculano	Porto	Agrupamento de Escolas Alexandre Herculano	1
Escola Básica e Secundária do Cerco	Porto	Agrupamento de Escolas do Cerco	1
Escola Secundária de Valbom	Gondomar	Agrupamento de escolas de Valbom	4
Escola Secundária de Inês de Castro	Vila Nova de Gaia	Escola Secundária com 3.o Ciclo Inês de Castro	1
Escola Básica e Secundária Rodrigues de Freitas	Porto	Agrupamento de Escolas Rodrigues Freitas	1
Escola Básica e Secundária Mães de Água, Falagueira	Amadora	Agrupamento de Escolas Mães D'Água	3
Escola Secundária D. Dinis, Lisboa	Lisboa	Agrupamento de Escolas D. Dinis, Lisboa	3
Escola Básica e Secundária D. João V, Damaia	Amadora	Agrupamento de Escolas D. João V	3
Escola Básica e Secundária Aquilino Ribeiro	Oeiras	Agrupamento de Escolas Aquilo Ribeiro	3
Escola Secundária de Camarate	Loures	Escola Secundária de Camarate	3
Escola Básica e Secundária Passos Manuel	Lisboa	Agrupamento de Escolas Baixa-Chiado	3

Escola Secundária Seomara da Costa Primo	Amadora	Agrupamento de Escolas Amadora Oeste	4
Escola Secundária de Sacavém	Loures	Agrupamento de Escolas Eduardo Gageiro	1
Escola Secundária de José Gomes Ferreira	Lisboa	Agrupamento de Escolas de Benfica	1

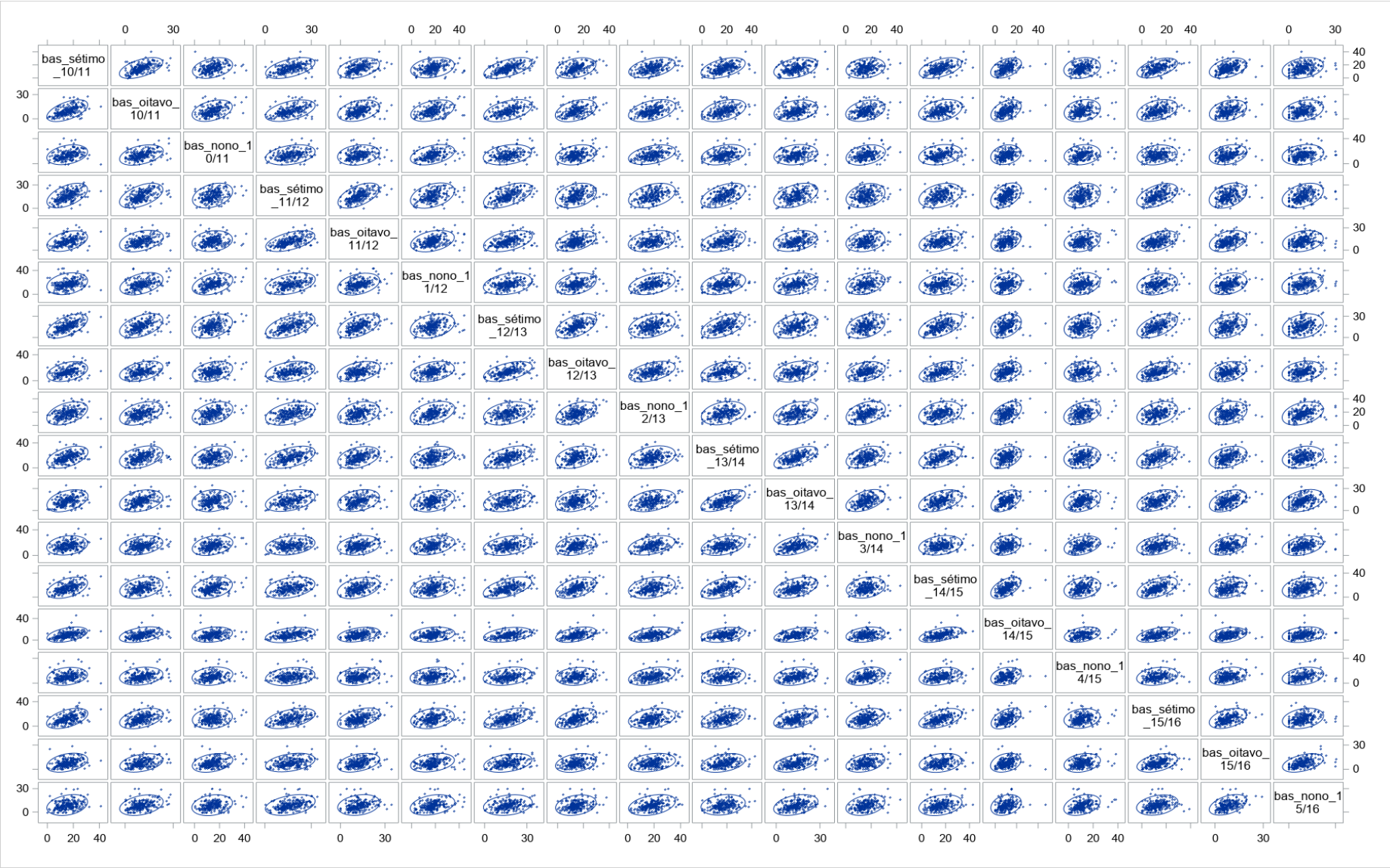
* 1 - During the school year 2006/07

2 - At the beginning of 2009/10

3 - During the school year 2009/10

4 - During the school year 2012/13

Scatter plots for 7th, 8th and 9th grade



Scatter plots for 10th, 11th and 12th grade