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Scuola Superiore Sant'Anna

Profiling eating trajectories of students using university canteens during their master courses

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Objective

The present study aims at identifying trajectories related to eating habits of students using university canteens applying regression models and latent class analysis to data about food consumed automatically recorded by cashiers when accessing the canteens all over the duration of their courses (3-years).

Methods

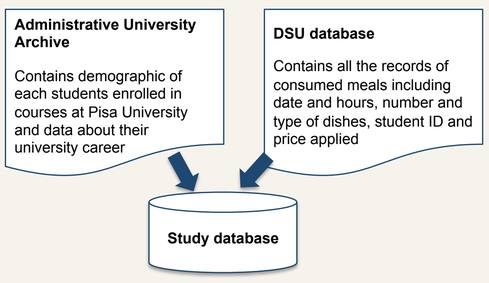
Study population

The population under study is composed of students enrolled in courses at Pisa University who access the canteens serving the university of interest in the academic years from 2010-11 to 2013-14. In order to observe the behaviour over a sufficient period of time only students enrolled in first-degree courses and accessing the canteen at least once over three years were considered. Although limiting the size of the population and its representativeness, these criteria allow for the evaluation of eating behaviour trajectories and prevent the inclusion in the analysis of subjects with diverse observation period and/or right censored for diverse and unknown reasons that could led to biases.

Data sources and variables

Analyses were performed merging two different sources of data: the administrative archive of the University of Pisa and the database of Azienda Regionale per il Diritto allo Studio Universitario (DSU).

The two source of data were merged by the anonymous student ID and analysis of eating profile was allowed by the fact that one of the canteens serving the University is equipped with an automatic system that allow for the recording of all details about consumed meals. All these data are collected into a dedicated Oracle database owned by the DSU that whose used in the present analysis to extract records about meal consumption.



Demographics and data about students' career available at individual level from the university administrative archive comprise age, gender, place of birth, year of registration in the degree course (a categorical variable taking the value 1, 2 and 3 depending on the year of course) and university department. In the present analysis departments were grouped on the basis of the main subject of study, distinguishing from Department of Humanistic/Social sciences and Scientific/Medical. The DSU database, contains, for each transaction (i.e. a meal), date and time, details of all dishes selected and tariff applied. Eating habits of students were analysed based on items automatically recorded from cashiers' transactions at university canteens. On the basis of dish details, foods were classified according the main dish components.

The frequency of different food-groups consumption was described in terms of the number of times the specific food group is selected over the total number of access.

Data analysis

The proportion of the different food-groups over years were evaluated using a zero- and one-inflated beta regression. In particular, zero- and one-inflated beta regression is a mixture of a continuous distribution bounded in the interval comprised between 0 and 1 and of a degenerate distribution that assign a non-negative probability to 0 and 1 (Ospina & Ferrari, 2012).

This class of models are suitable for analysing continuous dependent variables taking on values in the closed interval [0,1] when the number of zeros and/or ones is not negligible, as in the present study.

Methods (cont'd)

In particular, for each type of meals, the zero- and one-inflated regression model consists of three submodels, describing respectively: 1) the proportion of each type of food-group consumed; 2) the probability of not choosing a specific food-group; 3) the probability of always choosing a specific food-group.

The logit link function and the same set of covariates were used for estimating all the zero- and the one-inflated submodels.

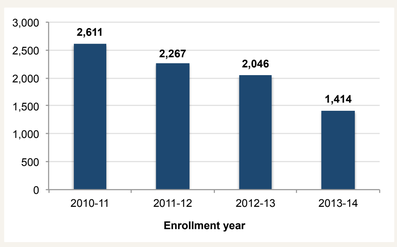
In all the models robust-clustered standard errors were used to control for heteroskedasticity and clustered data (White, 1980), respectively.

Latent class analysis was then used to explore the dynamics of eating habits considering data from each enrollment year.

Results

Overall 36,402 students enrolled in their first year master class accessed at lest once one of the canteens serving Pisa University for three consecutive years in the six academic years of the analysis; among these 8,338 were students with a number of access over 5% of the distribution in all the three consecutive years after the enrolment.

Food-group consumption by enrolment cohort and year of enrolment, median values and 25-75th percentile



The table below shows the frequency of food-groups consumption by enrolment cohort and year of enrolment.

Food-group consumption by enrolment cohort and year of enrolment, median values and 25-75th percentile

Enrolment cohort	Year	Sweets	Fruits	Vegetables	Grains	Soups	Meats	Fish	Pulses	Pizza/sandwich	Fried foods	Pie/omelette	Potatoes
2010-11	**1**	10[2-24]	63[37-85]	65[47-84]	41[15-70]	0[0-1]	14[4-30]	0[0-3]	3[0-9]	4[0-9]	11[3-21]	4[0-9]	12[4-22]
	2	7[1-19]	1[19-66]	73[52-90]	34[10-64]	0[0-1]	10[3-24]	0[0-3]	3[0-8]	4[0-9]	10[2-22]	3[0-8]	9[2-19]
	3	5[0-16]	0[16-75]	76[57-92]	30[7-58]	0[0-3]	10[1-24]	0[0-2]	3[0-8]	2[0-8]	7[0-18]	3[0-7]	7[1-16]
2011-12	**1**	11[2-25]	2[25-54]	66[46-85]	43[15-73]	0[0-1]	14[3-27]	0[0-3]	3[0-9]	4[0-10]	14[4-26]	5[1-9]	11[3-21]
	2	6[0-18]	0[18-72]	75[55-92]	30[7-62]	0[0-2]	10[2-25]	0[0-2]	2[0-8]	2[0-8]	8[1-18]	3[0-8]	7[1-16]
	3	4[0-14]	0[14-78]	78[58-93]	27[6-57]	0[0-3]	9[1-25]	0[0-3]	2[0-8]	2[0-8]	4[0-12]	2[0-7]	5[0-12]
2012-13	**1**	8[1-21]	1[21-64]	68[49-85]	42[16-70]	0[0-2]	15[4-31]	0[0-3]	3[0-8]	3[0-8]	12[4-23]	4[0-9]	10[3-18]
	2	4[0-13]	0[13-76]	77[58-92]	30[8-59]	0[0-2]	12[2-27]	0[0-3]	3[0-8]	2[0-7]	4[0-12]	3[0-7]	5[1-13]
	3	1[0-5]	0[5-81]	79[59-94]	20[3-52]	0[0-4]	8[0-25]	0[0-3]	2[0-7]	2[0-8]	3[0-11]	2[0-7]	4[0-12]
2013-14	**1**	7[1-18]	1[18-71]	70[50-88]	38[11-67]	0[0-1]	14[3-31]	1[0-4]	2[0-8]	2[0-8]	6[0-14]	4[0-8]	8[2-15]
	2	1[0-6]	0[6-78]	78[57-93]	22[5-53]	0[0-2]	9[1-25]	0[0-3]	2[0-6]	2[0-8]	4[0-12]	3[0-8]	5[0-13]
	3	0[0-2]	0[2-92]	91[76-99]	4[0-16]	0[0-0]	1[0-9]	0[0-1]	0[0-1]	2[0-8]	0[0-7]	0[0-2]	0[0-5]

In general, compared to the year of registration, in the following years there was an increase in the frequency of choice of fruit, vegetables, soups, fish, legumes and pizza/ sandwiches in the following years.

On the other hand, in the years following the year of registration, the frequency of choice of cakes, flours/greens and potato dishes decreased.

In order to assess a possible change in students' eating habits, classes of students with similar consumption habits were identified and the results were then compared over the 3 years of analysis to understand if and how food choice habits change.

To this end and separately for each of the 3 years, the analysis of the latent classes was used, a multivariate statistical technique that, on the basis of observed variables identifies theoretical constructs not observed (the latent classes).

The analysis was carried out considering a plausible range of latent classes and the optimal number of classes that best describes the data was selected out on the basis of statistical indices suggestive of the adaptation of the model (Akaike's Information Criterion, Bayes' Information Criterion, Chi-square).

In the following elaborations the analysis of the latent classes has been carried out considering as observable and suggestive variables of a theoretical construct not observable the subdivision into percentiles of the frequencies of consumption of the different foods.

Importing Tables & Graphs

In all the three years considered, the analysis carried out showed optimal results in correspondence with a number of latent classes equal to 4.

We identified 4 latent construct related to the "consumption profile" that were homogeneous over the 3 years. The first class describes the 'health', it is observed that the probability of belonging to CL1 is high for those who have a high consumption of fruit and vegetables (over the 66th percentile), but also for students who consume "frequently" fish and grasses and choose, in line with the median frequency, potatoes, fries, meat, legumes and sweets.

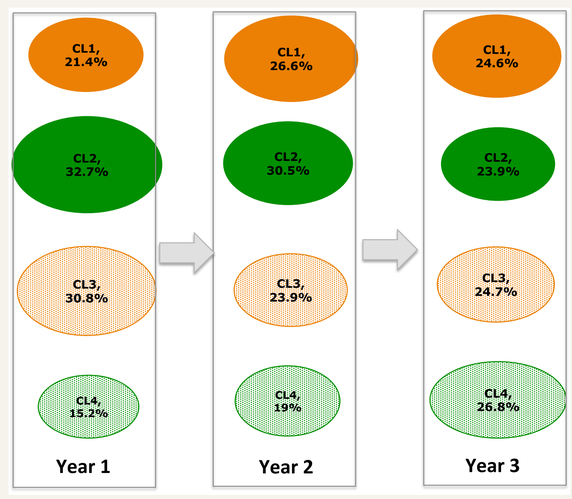
The probability of belonging to latent class 2 is high for those who eat little fish, sandwiches and legumes but has a high frequency of choice of sweets, potatoes and legumes and that we could call class of "greedy". In this class the consumption of fried, flour/grass and meat is in line with or above the median trend.

The third class is represented by students who prefer fried / processed dishes or sandwiches accompanied by dessert, there is in fact a high probability of belonging to this latent class for students who have frequent consumption (over the 66th percentile) of fried / processed, sandwiches and desserts and that we will identify as "crapuloni".

The fourth latent class represents the students who make a reduced meal consisting frequently of flour/grass and vegetables "selective eaters".

Figure below shows the percentage distribution (based on the modal a posteriori probability estimated by the model) of students in relation to the latent class and for each of the three years. The classes are represented by ovals whose size varies, in proportion to the percentage of students. In this way it can be observed how, passing from the first to the third year, the percentage of students in latent classes 2 and 3 decreases, while the percentage of students in class 4 increases with time.

Posterior probability of belonging to the different latent class over years



Conclusions

The evolution of eating habits seems to suggest a tendency, over the years after enrollment, to favor starchy foods / grasses and vegetables and to decrease the choice of elaborate dishes or sandwiches.This can also be explained in the light of acquiring maturity and awareness with respect to the choice of foods that leads students to "abandon" the consumption of commonly labeled as unhealthy.

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