

UCAS proposed 2016 admission process change

A matching process simulation in STATA

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1 Introduction

The Universities and Colleges Admission Service [UCAS] has been the UK's centrally administered admissions' service process for individuals wishing to enter a higher education institution [HEI]. Initially formed in 1951 (then named UCCA) and although new technologies have been incorporated in its administration through the computerisation of the applications' submission and processing, the matching process itself has remained largely unchanged.

However, changing needs of applicants, as well as the recently differentiated approach on HEIs funding, have altered the environment for both involved parties. Due to this reason, the UCAS board conducted a review of the current matching process, resulting in a set of proposed changes for the latter. Although UCAS has no authority on realising changes in the process, it suggests that these should take place through a phased approach starting in 2014 and reaching complete implementation of the new system by as early as 2016. The aforementioned process review is publicly available through the UCAS

webpage.

In the next section a review of the existing matching process is presented, followed by a review of the proposed changes in it in section 3. In section 4, I present all assumptions and the matching algorithm used in the STATA simulated model, necessary for the quantification of the proposed matching process. All results and relevant discussion upon them follow in section 5, while section 6 includes relevant discussion on the proposed process policy implication as well as suggested improvements according to relevant matching theory and the simulation's results. The final section provides a conclusion for the paper. Finally, a more detailed, but not exhaustive, description of the STATA code is included in the Appendix.

2 Existing matching process

The application process for September enrolment in HEIs opens in September of the previous year. Applicants wishing to apply at Oxford and Cambridge Universities as well as in courses on medicine dentistry and veterinary sciences are required to do so by the 15th of October. All other applicants are advised to complete their applications by the 15th of January to be considered under an “equal consideration” policy, which guarantees that no applicant will get a different treatment by applying late or early. Following this date, HEIs are free to close applications for any courses they wish and therefore reject the possibility of any later applications on these courses.

Applicants can apply at up to five different courses with HEIs having no information on their alternative choices, them also being unranked. Moreover, although in theory one can apply to any of all courses available, in practice this is not entirely feasible. The reason for this is that decisions on the acceptance of UK-educated students (84% of all applicants) is mostly based on the General Education Certificates' [GCE] subjects

chosen during the last 2 years of high school. Therefore, an individual choosing for example history, arts and English literature will be minimising his chances of acceptance for a course in physics. Furthermore, applicants still being school students at the time of application are provided with projected grades, in other word grades estimations, by their school's tutors. These projected grades are the ones used while applying.

By the end of March HEIs have made their decisions and make unconditional or conditional offers at successful applicants, depending on their student status. In case of conditional offers the applicant can accept up to 2 offers (firm and insurance choices) and any applicant that has not received or not accepted an offer from a HEI can reapply, through UCAS Extra. Older applicants receiving unconditional offers accept just one for obvious reasons.

Conditional offers are confirmed or rejected when exams grades are announced, usually at, or near the 15th of August. Unsuccessful applicants can then enter the Clearing process were they are expected to individually come in contact with admissions offices in different HEIs and find matchings depending on their grades, HEIs' criteria and available positions. Finally, if an applicant exceeds the conditions of his (successful) offer he can reapply at a different HEI through the Adjustment process.

Although considered relatively successful, the current system is flawed in a few ways. First of all, the 5-course limit during the application process gives rise in envy between applicants and HEIs since students have to limit their choice. This in effect, increases the chances of not being accepted from a more preferable HEI than the one matched simply due to not applying at it. Secondly, projected grading, which accounts for 60% of applications, is subject at different tutors' beliefs and/or school grading policies. It is no surprise that 7% of grades on a single GCE subject are under predicted, resulting in about 25% of students taking 3 GCEs, this being the average, during the final year, to have at least one of their grades under-predicted. In addition, the unknown and

ever-changing policy of HEIs on accepting or not borderline unsuccessful applications, results in 42% of applicants holding an insurance choice with tougher conditions than their firm one due to beliefs that their tougher second choice will not be so strict on the required conditions. Furthermore, the Clearing process is time dependent since the last places left in HEIs are filled in a very short period of time, by applicants who had to decide on such an important life-changing matter, sometimes even in just a few hours. Finally, as one can realise after reading through this section, the whole process is very complex and perplexes applicants unnecessarily.

3 Proposed matching process

HEIs are expected to post minimum entry requirements for each course available. Students that have not achieved, or will not achieve, these minimum grades will not be able to apply.

Applicants who already have their grades (mature students or foreigners) will be able to apply between September and June at a maximum of 2 HEIs at a time [Apply 1]. These applicants are expected to receive an answer in a timely manner. Furthermore, if they receive no offers, they will be able to reapply.

Applicants in the last year of high school will be able to apply at 2 HEIs between the start of July and early September, after receiving their exam results [Apply 2]. An “equal consideration” deadline is scheduled to be set around the middle of July. Finally, any students left unmatched will have a last chance between mid September and early October right before semester starts [Apply 3] at one HEI at a time.

The proposed change effectively tackles the problems related with the use of projected grades and conditional offers discussed in section 2. Nonetheless, the introduction of 2 different main apply windows could introduce discrimination between older and high

school applicants, it being the main flaw of interest in the model simulation. Furthermore, the drastic reduction on the number of course applications from 5 to 2 will not only massively increase envious HEIs and applicants but could also upsurge unsuccessful applications due to reduced choice. However, it should be noted that the magnitude of this increase should not be so great if one takes into account the abolishment of grade prediction issues.

4 Assumptions and algorithm

A total number of 1000 applicants was used for the simulation, 25% of them applying during Apply 1. All of the applicants were assigned a normally distributed grade between 0 and 100.

A total of 20 HEIs each offering one identical “average” course with 50 available places were modelled, therefore enabling all applicants to be possibly matched. However, one could consider the last 6 courses (30% of total places) as unsuccessful applications.

All 20 HEIs were ranked from hardest to easiest to be accepted using a normal distribution. Thus, the hardest, to get in HEI [best], posted a minimum entry grade equivalent to the 95th percentile of a normal distribution $\mathcal{N}(50, \frac{50}{3})$, with the second best posting one equivalent to the 90th percentile etc.

All applicants and HEIs are sharing strict and common preferences, with all applicants viewing a better HEI as more favourable than a worse one. Similarly, HEIs view applicants with higher grades as better than ones with lower grades.

All applicants, upon receiving their grades, apply at the best 2 HEIs they can, according to the HEIs’ posted entry requirements.

Applicants of the Apply 1 window cannot apply more than once, in contrast to what is

being considered in reality. Moreover, the universities form un-posted entry requirements for their private use, accepting all applicants attaining equal or higher grades than these requirements as long as there are places available. These un-posted requirements use a 0.75 weight of posted requirements and a 0.25 weight of the actual grade distribution of Apply 1 applicants. This can be thought as an average of past grades, which should be expected to follow $\mathcal{N}(50, \frac{50}{3})$ and the actual grades of students during Apply 1.

Apply 2 applications are treated in a similar fashion, only change being that HEIs' un-posted grade requirements use a 0.75 weight of Apply 2 applicants' grades and a 0.25 weight of Apply 1 applicants' grades. In other words, these un-posted requirements are based on the actual 1000 applications' distribution.

During Apply 3 all unmatched students apply at the first 3 HEIs they can do so. However, the posted and un-posted minimum entry requirements are identical and equal to the Apply 2 un-posted ones. This results from the fact that applicants are now expected to individually come in contact with admissions offices before applying. It should be noted however that the information of whether there are places available remains private for the HEIs and is not passed down to applicants due to programming difficulties.

Concerning the matching algorithm used, it is very simple in its implementation. Specifically, during each of the 3 waves the best HEI is considered first, checking all available applicants (i.e. Apply 1,2 or 3 applicants) from best to worst. Afterwards, the second best HEI is considered checking again all available applicants. The process is continued until the worst HEI has checked all available applicants. A successful match is one where the applicant has applied to the HEI in consideration, this HEI accepts (and has available positions) and the applicant has not been accepted by a better HEI that he applied at.

5 Results

After performing a 1,000 iterations Monte Carlo simulation of the matching algorithm described in section 4, the results that are presented below were gathered.

As one can see in Table 1, there were about 16 applicants left unmatched on average (1.6%) all of which belonged in the second application window. The reason for this is that applicants in Apply 1 were too few, compared to the number of seats available, to be left unmatched. Moreover, not a single student was matched through the Apply 3 matching window. This is explained by the average grade of these applicants, which is a modest 11.35. Hence, if the last HEI had already filled up its places, these low-achieving applicants were unable to apply elsewhere. This can be also seen from Figures 1 and 2 where as the minimum entry grade gets reduced not only the number of filled places increases, but also this numbers' variance gets smaller. This "congestion at the bottom" is a result of applicants applying at 2 HEIs at a time, since those rejected at their first choice effectively impose pressure to individuals achieving lower grades.

Concerning envious HEIs it can be seen from Table 1 that on average 13 out of 20 institutions (65%) could have enrolled a better applicant if there was only one application window (in which case there would exist no envy). Moreover, the fact that the average entry requirement of envious HEIs is below 50 should be attributed to congestion at the bottom, especially if one takes into account that the worst HEI cannot be envious. Furthermore, as shown in Figure 3, greater grade differences should be expected for institutions being further away from the average. Finally, the greater occurrence of envious HEIs as the entry requirements get smaller should again be accredited at congestion at the bottom.

There are 45.7 envious applicants on average, on average achieving a lower than 50 grade. This is not only due bottom congestion but also since applicants accepted at the top

	Mean	Standard Deviation	Minimum	Maximum
Apply 1 Unmatched	0	0	0	0
Apply 2 Unmatched	16.24	9.98	0	52
Apply 3 Matches	0	0	0	0
Total Unmatched	16.24	9.98	0	52
Number of Envious HEIs	13	2.57	5	19
Envious HEIs entry requirements (based on Apply 2 requirements)	47.18	13.63	19.01	80.61
Envious HEIs maximum applicants' grade difference	0.84	0.77	0	6
Number of Envious Students	45.7	19.18	9	118
Envious applicants' grades	42.44	15.99	0	80.61
HEI where envious applicants should have been accepted	12.5	5	1	20
Apply 3 grades	11.35	7.19	0	64.14

Table 1: Results' Summury

HEI cannot be envious. This can be also seen in Figure 4.

6 Discussion

In my view, the proposed UCAS matching process reform performs well in abolishing the use of projected grades, which not only are subject to different schools policies and tutors beliefs, but also impose excess and unnecessary stress at final school year students. These students are expected to make decisions for their future before getting their exam results and hence are prone to applying for courses above or below their actual capabilities, especially if one also considers the small number of courses one can apply for.

On the other hand, the reform moves in the opposite way by further reducing the number

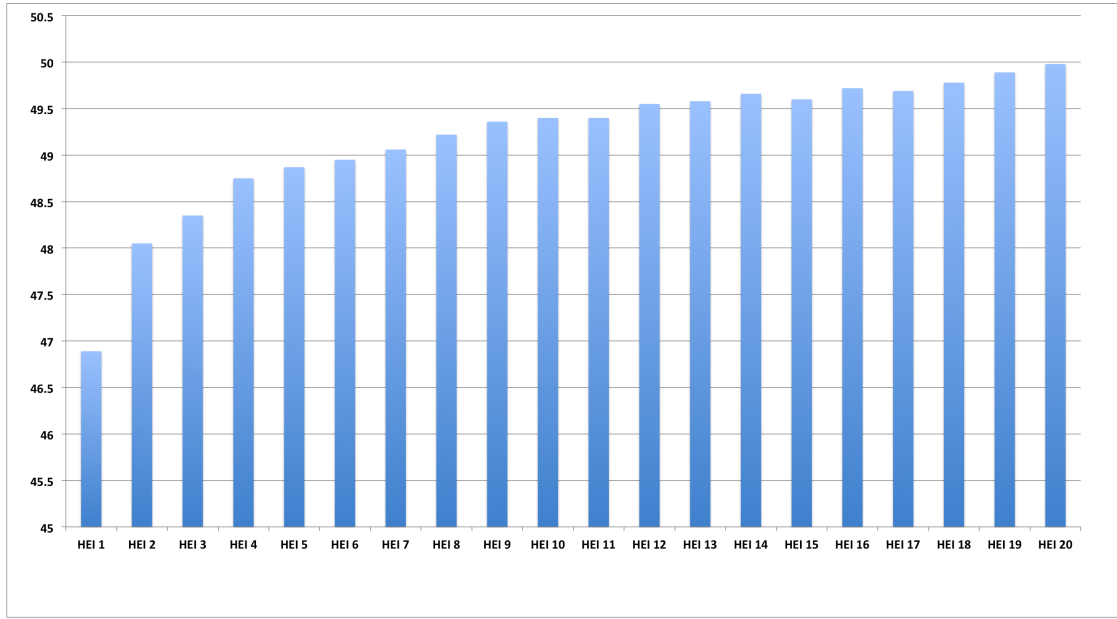


Figure 1: Filled capacity (HEI 1 best)

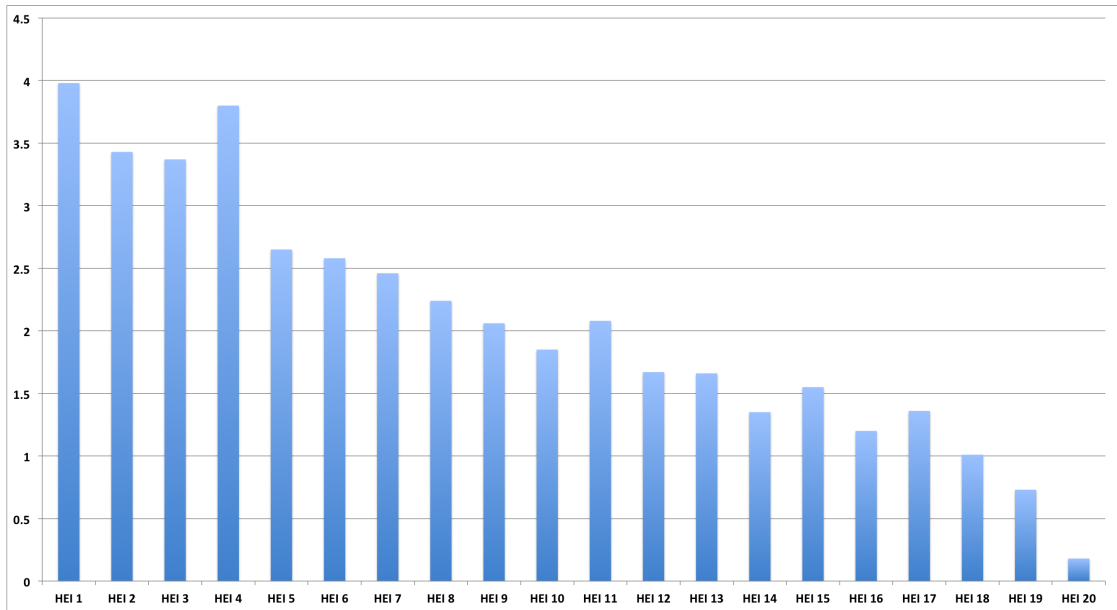


Figure 2: Standard Deviation of filled capacity (HEI 1 best)

of courses one can apply at and most importantly by creating 2 different apply windows that, as seen in the simulation, can introduce envy and increase the number of unmatched

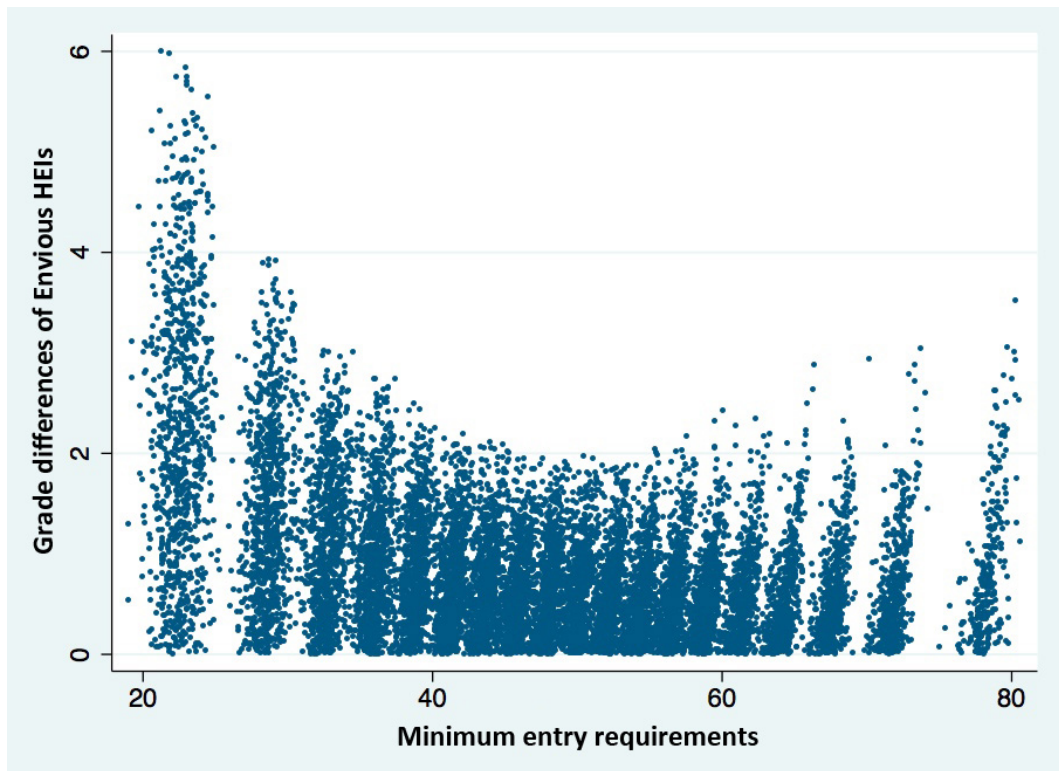


Figure 3:

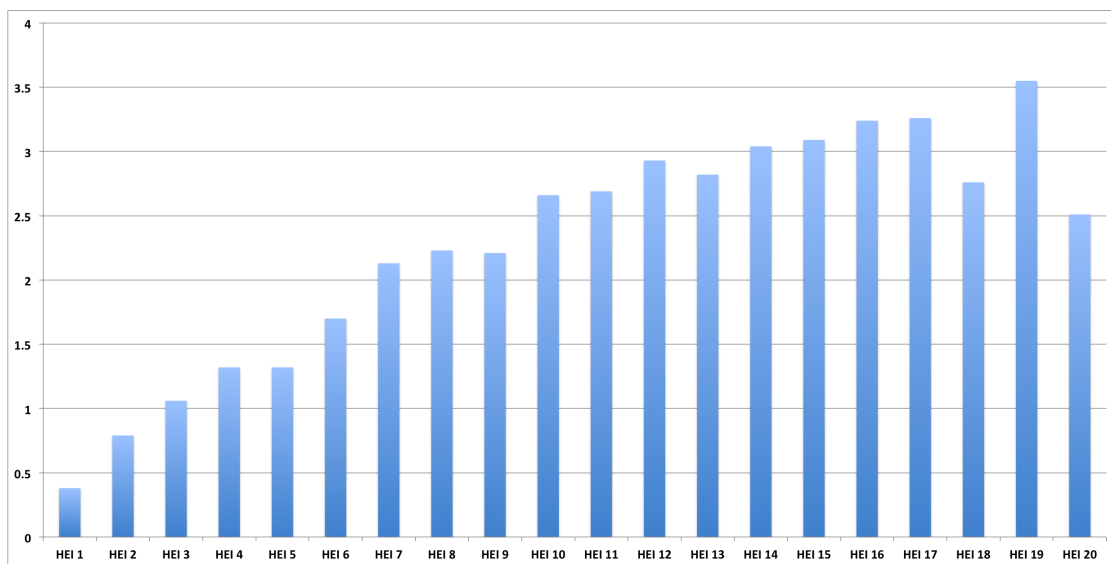


Figure 4: HEI that envious students should have been enrolled at (HEI 1 best)

applicants.

Concerning the first drawback the reasoning offered by UCAS for this reduction is related with central and HEI-related administration costs. However, if one takes into account the vast increase of tuition fees during previous years that an undergraduate student has to provide, the associated costs of a modest increase in maximum number of courses one can apply at could be incorporated in the UCAS application or the tuition fees, possible in the form of an extra cost for applicants wishing to extend their number of choices. Nonetheless, it should be noted that applying after exam results are announced will effectively decrease the number of courses one will wish to apply at.

Regarding the introduction of a second main application window my view is that possible reasons behind this decision justify it. Specifically, Apply 1 offers international applicants, who also pay higher tuition fees if they are not E.U. citizens, the chance to be accepted for studies in the UK long before the course itself starts, therefore providing applicants with greater security. This should not only increase the number of international applicants choosing to study in the UK but should also provide long-term positive effects. These effects arise if one considers that UK-educated foreigners are more likely to start working in the UK, assuming they don't return at their country of origin, which will allow the UK to take greater advantage of foreign brain-drain. Furthermore, the introduction of a second apply window could in the future enable the introduction of different policies on the number of non-UK educated as well as older applicants. This could easily be done by imposing restrictions centrally or by institution on the number and/or required grades achieved by these 2 groups of individuals. This capability of the proposed matching process to cater for these issues could prove very valuable in a fast and ever-changing world environment and could possibly be the single most important reason behind this matching process change.

7 References

All facts and figures presented in this paper not being derived from the STATA model's simulation were taken from UCAS Admissions Process Review Consultation, publicly available for download at <http://www.pages02.net/ucas-charitynek/apr>.

Appendix - STATA code in more detail

- The code allows for an almost full customisation of the process. In lines 21-26 one can enter the number of repetitions the code will do “monte”, the number of colleges “colleges” and their respective number of places “seats” as well as the total number of applicants “applicants”. Also, the percentage of individuals applying through Apply 1 can be entered “older”. Finally, “weight” indicates the weight that should be given in Apply 1 grades when forming the un-posted entry requirements. Apply 2 entry requirements are unchanged. It should be noted that if one introduces far too many applicants or far too many places compared to applicants, STATA will produce an error.
- The matching algorithm when college i and applicant j are being checked is the following. Match if and only if:
 - (i) Student applied at HEI as a 1st choice AND HEI accepts him AND has free positions OR,
 - (ii) Student applied at HEI as a 2nd choice AND HEI accepts him AND has free positions AND [1st choice HEI didn't accept him for grade OR no empty places reasons]

The algorithm used during Apply 3 is conceptually the same if one allows application to a 3rd university.

- To identify envious HEIs a very simple method is being used. Specifically, if the worst student enrolled in HEI i has a lower grade than the best student enrolled in HEI $i+1$ (i.e. a worse HEI) then this HEI is considered to be envious.
- The same process is implemented to report envious applicants as well. However, if the worst student of HEI i has a worse grade than the best student of HEI $i+1$,

the worse student of i replaces the better student in $i+1$ and the better (envious student) is deleted from the data since he had been accounted for. The process is repeated for HEI i until $i+1$'s best student grade minus i 's worst student grade difference is no longer positive (which indicates envy). Upon indication that the difference is less than or equal to zero the next HEI down the line gets under consideration.