

European Informatics Retention and Graduation Rate Report



Association for
Computing Machinery



INFORMATICS
EUROPE

European Informatics Retention and Graduation Rate Report

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Executive Summary

This report presents the first pan-European analysis of student retention and graduation rates in bachelor-level Informatics programmes. Conducted jointly by Informatics Europe and ACM Europe, it draws on the Informatics Europe Higher Education (IEHE) Data Portal and examines trends across thirteen European countries over the period 2010 to 2023.

In this report, “Informatics” refers to the overarching academic discipline that covers computer science, software engineering, information systems, data science, cybersecurity and computer engineering; in some countries, information and communication technology (ICT) can be considered to be included.

European countries record data on their higher education system in ways that reflect their priorities. This impacts also the data on Informatics and, data harmonisation across national systems is inherently complex due to inconsistent definitions, classifications, and timeframes. Source data was therefore scrutinized for this analysis. Moreover, the report takes into account the two different types of universities typically exist within Europe: research universities (RUs) and universities of applied sciences (UASs).

The study focuses on three primary research questions:

1. Are there significant overall trends within Europe with respect to retention and graduation in Informatics?
2. Is there a difference between females and males with respect to retention and graduation in European Informatics programmes?
3. Is there a difference between RUs and UASs with respect to retention and graduation in European Informatics programmes?

In carrying out the study, care was taken to select a subset of the data from the IEHE portal deemed to be representative of the wider European scene. The findings can thus be considered to represent the situation in Europe.

Regarding retention rates, Informatics higher education shows overall high numbers (between 80% and 95%). Over half of the countries exhibit high levels (e.g. Switzerland, the Netherlands) and/or rising trends (most notably Norway and Ireland) in student retention, some maintain stable rates (e.g. Portugal) or show a slight decline (e.g. Switzerland). Gender differences in retention are evident but inconsistent; in many countries though, male students drop out from their programmes more frequently than their female counterparts (e.g. Bulgaria or Ireland, with 5 percentage points difference). Research Universities (RUs) and Universities of Applied Sciences (UASs) show similar retention patterns in half of the countries studied, though the smaller student populations at UASs tend to produce more variation in the data.

Graduation rates fluctuate more than retention rates, ranging from 35% to about 80%, and are more sensitive to the length of study programmes and the institutional structures in place. Some countries have made substantial progress in improving graduation outcomes over time, most notably Norway, Portugal and Ireland. The graduation rates for female students are better than those for males in around 75% of countries. This is particularly visible in countries that already perform well overall but also in, for instance, Estonia. While RUs lead in this metric, the situation is reversed in countries where UAS are a strong part of the Higher Education system (e.g. Germany, Austria).

The results are presented graphically and the underlying data is available through tables and links. In conclusion, it is noted that the European higher education in informatics presents both commonalities and unique national characteristics. The findings should offer insights for policymakers and educators seeking to boost Europe in building a resilient, inclusive, and competitive workforce for a high-demand field.

1. Introduction

European higher education is as diverse as the continent's culture and traditions and reaps the benefits of strong connections and mutual influences among individual countries. At the same time, this diversity also means that making analyses and meaningful comparisons across countries can be a complex task. The area of Informatics is no exception.

Until now, there has been no study into the retention and graduation rates across Europe³ focusing on Informatics. Evaluating how successful the higher education institutions are in attracting and retaining students, and how many finally enter the labour market as highly skilled graduates, is especially important in this domain where the demand for professionals is permanently higher than the supply. The European Commission had set a target of 20 million ICT Professionals by 2023 (10% of the workforce); in 2020, the number was 8 million and without ambitious and extraordinary initiatives, the number is predicted to reach only 12 million by 2030⁴. The analysis of the phenomenon is not straightforward; while most European countries collect data and provide analytical reports on student populations and trends, information is not collected in a uniform way throughout Europe. Moreover, the retention rate is not explicitly published in most cases.

Inspired in general by the Taulbee survey report series published by the Computer Research Association (CRA)⁵ – and in particular by the report of Zweben & Tucker [Zwe2022] – Informatics Europe and ACM Europe joined forces in 2024 to undertake an analysis of the student data available for Europe to explore student retention and graduation trends.

The analysis utilises data from the Informatics Europe Higher Education (IEHE) Data Portal⁶, which was launched in 2019 to make available the data on Informatics education in Europe, which the association has been collecting since 2013, with the goal of providing a comprehensive and trustworthy overview of the state of Informatics education in Europe. This information aims to benefit the academic community, policymakers, industry leaders, and other relevant stakeholders. A key feature of the portal is its dataset, which is based on the official data published by each country and allows for comparisons of quantitative data related to informatics studies across different countries and time periods. It includes enrolment figures and data on the degrees awarded at the bachelor (B.Sc.), master (M.Sc.) and doctoral (Ph.D.) levels, along with gender distribution presented in both absolute numbers and percentages, covering research universities (RUs) and universities of applied sciences (UASs). Data available in this portal has been exploited also in [DiN2023] where the performance of RUs and UASs has been analysed and compared.

This report presents the results, showing the retention and graduation rates for bachelor-level studies in Informatics for the period 2010-2023 in 13 countries across Europe.

Regarding retention rates, Informatics higher education shows significant variation across European countries. While some countries exhibit rising trends in student retention, some maintain stable rates, and some show a decline. Gender differences in retention are evident but inconsistent; in some countries, female students remain in their programmes for longer than their male counterparts. Research Universities (RUs) and Universities of Applied Sciences (UASs) generally show similar retention patterns, though the smaller student populations at UASs tend to produce more variation in the data.

Graduation rates tend to fluctuate more than retention rates, and are more sensitive to the length of study programmes and the institutional structures in place. Some countries have made substantial

3 Please note that in this paper with the term "Europe" we refer to the geographical region <https://en.wikipedia.org/wiki/Europe> and not to the institution known as "European Union" https://en.wikipedia.org/wiki/European_Union

4 <https://www.consilium.europa.eu/en/infographics/digital-decade/>

5 <https://cra.org/resources/taulbee-survey/>

6 The data portal is available here <https://www.informatics-europe.org/data-portal/?page=index.html>. The general public has access to the first 5 years, while the members of Informatics Europe can freely access the whole dataset.

progress in improving graduation outcomes over time. The graduation rates for female students are frequently better than the graduation rates for males, a trend particularly visible in countries that already perform well overall. While RUs lead in this metric, UASs match them in some countries.

In the following sections, the report first provides the goals and research questions for the study (Section 2), details on the dataset and methodology used (Section 3), and the results for overall rates as well as comparison by gender and university type, and conclusions (Section 4). The report is augmented with detailed data and notes for the individual countries in the appendix.

A Note on Terminology

In this report, we consistently use the term *Informatics*, used in most European countries, to denote the area of our interest. This area is also called “information and communication technologies” (ICT) or “computer science” in countries outside Europe.

The word “Informatics” in this report refers to the overarching academic discipline encompassing computer science, software engineering, information systems, data science, cybersecurity, and to some extent also ICT and computer (hardware) engineering, much as the term “computing” is used in the ACM and IEEE-CS Computing Curricula 2020, cf. Chapter 2.4 and Chapter 6 of [Cur2020].

Also, for the purpose of this report, some interdisciplinary study programmes – and therefore the related student statistics – may be classified under the *Informatics* umbrella [ISCED-F], e.g. in the fields of health Informatics, bioinformatics, digital humanities, or “*Wirtschaftsinformatik*” in the German-speaking countries. In Section 3, there is a discussion of this in relation to the dataset we used.

2. Goals and Research Questions

The overarching goal of this work is to study student retention and graduation rates in the field of Informatics across Europe. This was motivated by the realisation that none of the official datasets available (national or Europe-wide) makes these statistics available; in general, only the numbers of students enrolled, the total numbers studying, and the numbers who graduated are reported.

Our initial ambition was to investigate similarities and differences between the situation of bachelor degree programmes in Europe and the USA. However, digging deeper into the European situation, we concluded that we first have to better understand the European scenario, which offers greater challenges than the USA one, given both the absence of a real federal government and the wide variety of languages and cultures existing in the continent.

We limited ourselves to the three Research Questions discussed below, examining the overall trend and then focusing on gender and institution types.

First, we are keen to investigate what are the overall trends within Europe, focusing on the bachelor level. Thus, our first research question is:

RQ-1: Are there significant overall trends within Europe with respect to retention and graduation in Informatics?

Secondly, we are interested in investigating the gender differences with respect to graduation and retention in Europe. Thus, our second research question is:

RQ-2: Is there a difference between females and males with respect to retention and graduation in European Informatics programmes?

Finally, we anticipate a difference between research universities (RUs) and universities of applied sciences (UASs) within Europe. Thus, our third research question is:

RQ-3: Is there a difference between RUs and UASs with respect to retention and graduation in European Informatics programmes?

In addition to these research questions, the study also covers more fine-grained topics.

3. Data and Methodology

The study uses, as its dataset, a subset of data available from the Informatics Europe Higher Education (IEHE) Data Portal with the exception of Czech Republic and Italy, where – even though these countries are also covered by IEHE – the data was obtained directly from the respective ministries of education.

Currently, the data (including Informatics students' statistics) contained in the IEHE Data Portal covers 13 years, from 2010/2011 to 2022/2023 for 24 European countries. A useful feature of the portal is the online data visualisation tool, which depicts cross-country and time-series comparisons directly in the European map and bar-chart graphs. By specifying the topic of interest (i.e. first-year students, students from all semesters, degrees awarded), the level of education according to the Bologna system⁷ – bachelor, master, or doctoral (Ph.D.), institution type (RUs or UASs for the countries where these institutions exist), country, and year, users can generate custom maps and graphs to view recent trends in Informatics higher education in Europe.

The IEHE Data Portal is updated annually at the end of the calendar year with the most recent data. In the interest of reliability, the IEHE uses data from countries where a solid and reasonably complete picture could be drawn from official sources such as national statistical offices, educational agencies, or ministries of the analysed countries. The full list of sources can be found in the IEHE section Data Sources⁸. The detailed description on how the national statistics were collected and which definitions they follow can be found on the national websites.

The IEHE follows the definitions and concepts provided by these national agencies and reflects the national situation in the countries considered. Aspects not exposed by the consulted agencies are not part of the data in the IEHE Data Portal. Since each national data repository has its own structure and quite often provides all supporting information in the national language, Informatics Europe integrates and unifies the acquired data by consulting with its members – academics who are active in and knowledgeable about the field from respective countries – to help interpret the statistics available and understand the specificities of the higher education systems in these countries.

3.1 Data subset used

The dataset used for this study, sourced from the IEHE Data Portal and national ministries, consists of statistics of enrolled students and degrees awarded at bachelor level, including the gender distribution. It covers the period of 13 academic years (2010/11 – 2022/23) and the following 13 European countries: Austria abbreviated here ("AT"), Bulgaria ("BG"), Czech Republic ("CZ"), Estonia ("EE"), Finland ("FI"), Germany ("DE"), Ireland ("IE"), Italy ("IT"), the Netherlands ("NL"), Norway ("NO"), Portugal ("PT"), Switzerland ("CH"), and United Kingdom ("UK").

For 11 countries, data was sourced from the IEHE Data Portal. For Italy, the data was from the *Ministero dell'Università e della Ricerca* covering only the students of programmes belonging to "Class L-31 – Scienze e Tecnologie Informatiche" to ensure clean alignment with the Informatics field⁹. For the Czech Republic, the data was from the Ministry of Education, Youth and Sport which uses the ISCED-F nomenclature. Excluded from our study were 11 countries present in the IEHE Data Portal for which complete data covering the studied period was not available.

The selected set of countries represents around 40% of the total European population but is deemed

7 <https://www.unibo.it/en/university/international-outreach/bologna-process>

8 <https://www.informatics-europe.org/data-portal/?page=data-sources.html>

9 See note on Italy in Section 5.1 for a detailed explanation.

to reflect the overall picture. The findings in terms of similarities and differences in their retention and graduation profiles in Informatics can be considered significant enough to represent the situation in Europe.

3.2 How “Informatics” is Defined in the Data

One of the main challenges in integrating the statistical data within Europe is identifying terms used to define the Informatics discipline in different countries. Specifically, there are three approaches used in European countries and these are reflected in the IE dataset.

- A. National agencies, namely Bulgarian Infostat, Czech Ministry of Education, Youth and Sports, Irish Higher Education Authority, and Education Statistics Finland, use the International Standard Classification of Education (ISCED) definition of fields of education where Informatics related programmes are grouped under the “06 - Information and Communication Technologies (ICT)” field;
- B. The national statistical offices and higher education authorities of Germany, Italy, and the UK use their own nomenclature to denote the Informatics field of study, i.e. “*Informatik*” for Germany, “*Scienze e tecnologie informatiche*” for Italy, “*Computing*” for the UK;
- C. For the remaining countries, i.e. Austria, Estonia, Netherlands, Norway, Portugal, Switzerland, the statistics on the students enrolled and degrees awarded is provided per individual bachelor programme per university (e.g. “*Informatics*”, “*Business Informatics*”, “*Artificial Intelligence*”, “*Software Engineering*”, etc.) and in order to count the overall number of students enrolled and degrees awarded in the Informatics field, the data per individual programme pertinent to Informatics is summed up across all universities.

In the last case, the decision of whether a specific programme is counted to be within the Informatics field is taken by Informatics Europe national experts, from respective countries, who are active in and knowledgeable about the field. These experts help screen the programmes and identify which part is pertinent to Informatics. The full list of terms identifying Informatics study programmes in each country can be found in the IEHE Data Portal section Subjects¹⁰.

3.3 Calculating retention and graduation rate

The retention rates presented in this report are approximations, as no dataset from any European country provides this information explicitly. Similarly, while almost all countries report annual graduation numbers, data specifically detailing graduation rates is unavailable.

To approximate retention rates, we assume that all bachelor students in their final year complete their studies and graduate. We know this is less than fully accurate as the actual number of students graduating on time is lower. In reality, some students drop out during their final year or delay graduation, completing their studies a year or even more beyond the expected timeframe. Since the data starts from 2010/11, the retention rate is calculated using the data through to 2013/14, taking into consideration the nominal three years of bachelor study programmes.

The calculation of graduation rates considers a 3-year nominal duration for bachelor programmes, as is typical in many Bologna system countries, but takes into account that this duration does not apply to many universities of applied sciences (UAS), where 4-year bachelor degrees are common, often including 3 years of coursework and 1 year of industry placement. Additionally, as mentioned above, we recognise that a notable number of students do not complete their studies precisely within the standard timeframe due to various factors. Lastly, while some countries report data per academic year, others do so in calendar year terms. We therefore calculate the graduation rate using the numbers of graduates reported for 4 years after starting studies. Thus, sometimes a data point may exceed 100%

10 <https://www.informatics-europe.org/data-portal/?page=subjects/index.html>

when students enrolled 4 or 5 years earlier. For the same reason as with the retention rate, we do not have graduation after 2019/2020.

For more details about the limitations of our calculation, see Section 5: Assumptions and Limitations.

With this in mind, we aim to approximate retention and graduation rates based on our dataset. Below, we outline the method of our calculations.

We use the following notation:

- Let 'X' be the academic year that refers to the period from the beginning of the autumn semester (ca. September-January) of the academic year to the end of summer semester, which is typically when the academic year begins and ends in Europe. (E.g. 2022/23 denotes the year that begins in the autumn of 2022 and ends in the summer of 2023).
- Let R_x be the total number of students enrolled in all semesters in year X.
- Let G_x be the total number of Graduates in year X.
- Let F_x be the number of First year students enrolled in year X.

3.3.1 Retention Rates

Using the above notations:

- $(R_x - G_x)$ represents the number of students expected to enrol in year X+1 since they have not graduated in year X.
- $(R_{x+1} - F_{x+1})$ represents the number of students actually enrolled in year X+1 that are not first year students of year X+1, i.e. the students continuing in X+1 from the previous year

We calculate L_x , the approximation of the number of students Lost (dropping out) during year X, i.e. those who do not continue from year X to year X+1:

$$L_x = (R_x - G_x) - (R_{x+1} - F_{x+1}).$$

From that, we obtain RET_x , the retention rate for year X, defined as:

$$RET_x = 1 - L_x / R_x$$

Example of calculation:

In Norway, in the academic year $X = 2021/22$, there were in total 10,090 bachelor students enrolled in all semesters (R_x) and 2,095 graduates (G_x). The number of first year students and students enrolled in all semesters in the following year, i.e. in 2022/23, was 2,340 (F_{x+1}) and 10,140, respectively (R_{x+1}). Following the proposed calculations, the number of students lost (dropping out) during year 2021/22 is:

$$L_x = (10,090 - 2,095) - (10,140 - 2,340) = 195$$

Therefore, the retention rate for 2021/22 is equal to:

$$RET_x = 1 - 195 / 10,090 = 0.981 \text{ (or 98.1\%)}$$

3.3.2 Graduation Rates

Let $GRAD_x$ represent the **graduation rate** (for the standard length of study, i.e., 3 years).

$GRAD_x$ is computed as the ratio between students graduated [in year $X+3$] and the first year students enrolled [in year X].

$$GRAD_x = G_{x+3} / F_x$$

This ratio is an approximation of how many students graduated after the normal length of the bachelor study programme. In effect, we thus approximate the graduation rate of the cohort of students who entered studies in the year X , assuming that the variations in the numbers of students interrupting or delaying their studies are uniformly spread.

Example of calculation:

In Norway, some 2,100 students graduated from Informatics bachelor programmes (G_{x+3}) in the academic year 2022/23. The number of first year bachelor Informatics students in the year X , i.e., in 2019/20, was 2,380 (F_x). Following the proposed calculation, the graduation rate for the students who started their studies in 2019/20 academic year is:

$$GRAD_x = 2100 / 2380 = 0.882 \text{ (or 88.2\%)}$$

4. Results

In this section, we present the results of the analysis of retention (4.1) and graduation rates (4.2). Since the data points for each country change year by year, sometimes significantly, we use linear regression lines as the main model of approximation and means of presentation for both retention and graduation data in this section.

We use the standard least squares method for computing the slope and intercept of the regression lines, and visually interpolate the data points by these lines. (Linear regression is best fit for the dataset used, unlike polynomial interpolation or other methods, due to the statistical nature and small quantity of the data).

Using the regression line slope coefficient, we further split the countries with comparable characteristics in terms of the trend in the respective rates, for analysis and presentation purposes. Specifically, countries are classified into three groups according to whether their rates showed an **increasing**, **stable**, or **decreasing** trend, where “stable trend” is defined as one for which the slope is within 10% of the (*min slope*, *max slope*) interval around zero¹¹.

Put differently, these clusters represent countries with overall improving, stable, or declining patterns in retention and respectively graduation rates (which may not be directly visible from the data points themselves). We note that the clusters differ for the two rates, as a result of the data: countries where the rates exhibit different characteristics are Czech Republic, Germany, Bulgaria, Italy, Portugal, Switzerland, and the UK.

For both retention and graduation, we present the results for all countries together to provide an overview, before showing the groupings. We also provide a gender-based analysis and an analysis comparing RUs and UASs institutions.

¹¹ That is, we take the range of slope values of linear regression lines for all the countries in the retention resp. graduation data, get $S = 0.1$ fraction of this range size as a threshold, and limit the countries with the trend called “stable” to those where the regression slope value is within this $[-S, +S]$ interval.

4.1 Retention Rates

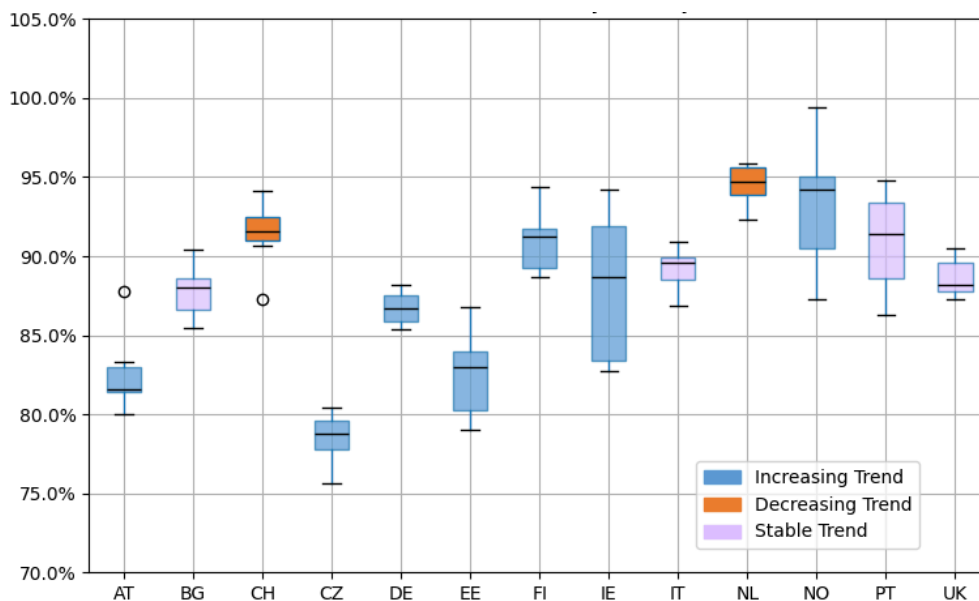
4.1.1 Overall findings

First, we present a comparison between countries in terms of student retention, aggregated for the whole period. To facilitate better comparison among countries, we use box plots¹² separately for each country, accumulating data in the range from 2013/14 to 2021/22 academic year. The graphs use 105% for the y-axis maximum value, since data for Norway and Ireland provide rounded values which cross the 100% threshold.

As mentioned before in subsection 3.3, the dataset provides the number of enrolments and graduations starting from 2010/11. Retention rate, however, cannot be calculated until 2013/14, taking into account the nominal three years of bachelor study programmes. For the same reason, we do not have graduation after 2019/20.

The overall retention rate for the whole set of countries studied is 88.7% (median).

Figure 1: Retention rates of Informatics bachelor students by country at RU plus UAS from 2013/14 to 2021/22



The Netherlands has the highest retention rate (94.7% median value over the studied period) and Norway comes as a close second with 94.2% and an increasing trend. Ireland and Norway exhibit the greatest variation in retention rates over the studied periods, most other countries' interquartile range of the rate is within ca. 3 percentage points.

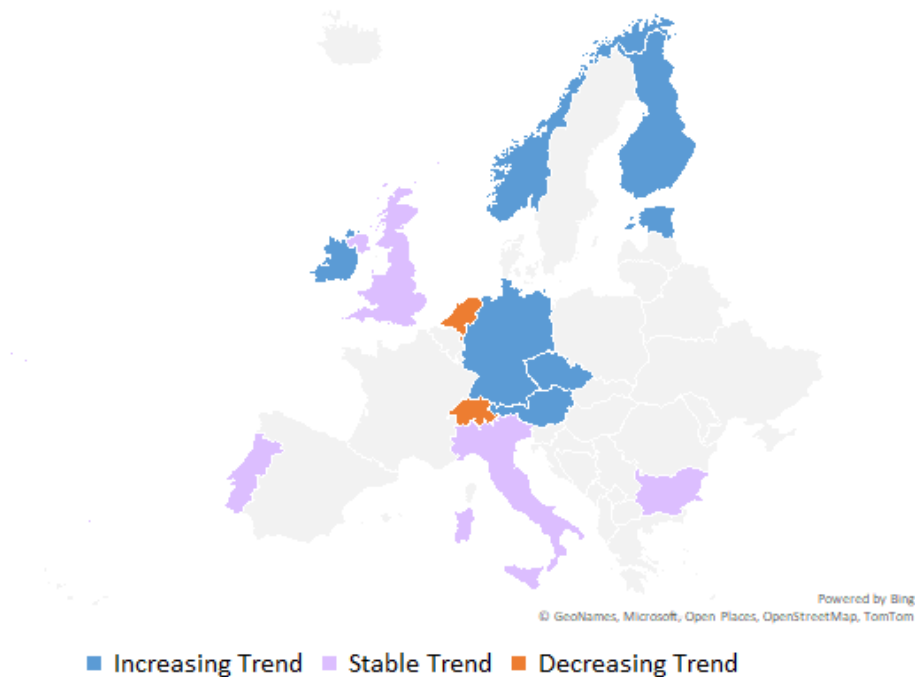
¹² The boxplots are created using the Python `pandas.DataFrame.boxplot()` function and follow the established standard (cf. https://en.wikipedia.org/wiki/Box_plot): The box extends from the first quartile (Q1) to the third quartile (Q3) of the data, with a line at the median. The whiskers extend from the box to the farthest data point lying within 1.5x the interquartile range (IQR) from the box. Outlier points, marked by small circles, are those past the end of the whiskers.

4.1.2 Comparison of Trends

The set of countries we analysed is split using the trend of retention rate over the years, as described at the start of this chapter. We get the following three clusters:

- Countries with increasing trend – Austria (AT), Czech Republic (CZ), Estonia (EE), Germany (DE), Finland (FI), Ireland (IE), Norway (NO);
- Those showing the stable trend – Bulgaria (BG), Italy (IT), Portugal (PT), United Kingdom (UK);
- Countries with decreasing trend – Netherlands (NL), Switzerland (CH).

Figure 2: Retention rates of Informatics bachelor students by country at RU plus UAS from 2013/14 to 2021/22 – Country grouping



The following graphs show the retention trends in the 3 groups, showing the actual data (dotted line markers) and lines of the linear regression (solid lines). All graphs have a y-axis from 70% to 100+%, despite some white space, to facilitate comparison.

The detailed characteristics of the dataset are in Appendix A in Table 1.

Figure 3: Retention rates of Informatics bachelor students by country at RU plus UAS – Increasing trend

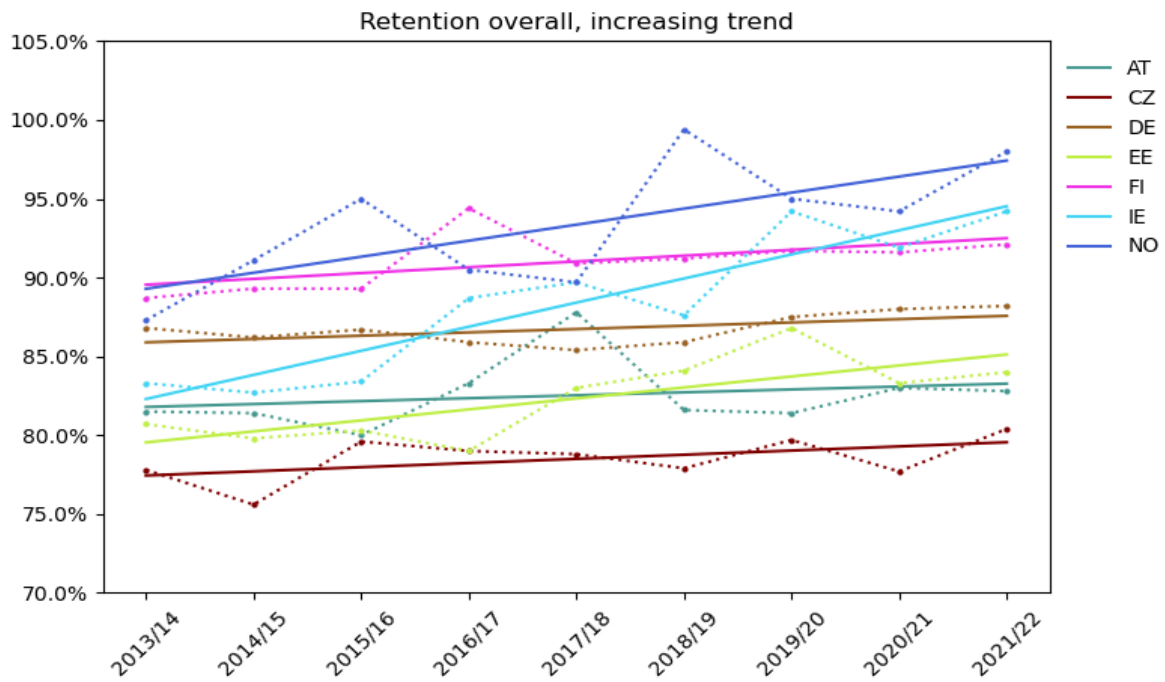


Figure 4: Retention rates of Informatics bachelor students by country at RU plus UAS – Stable trend

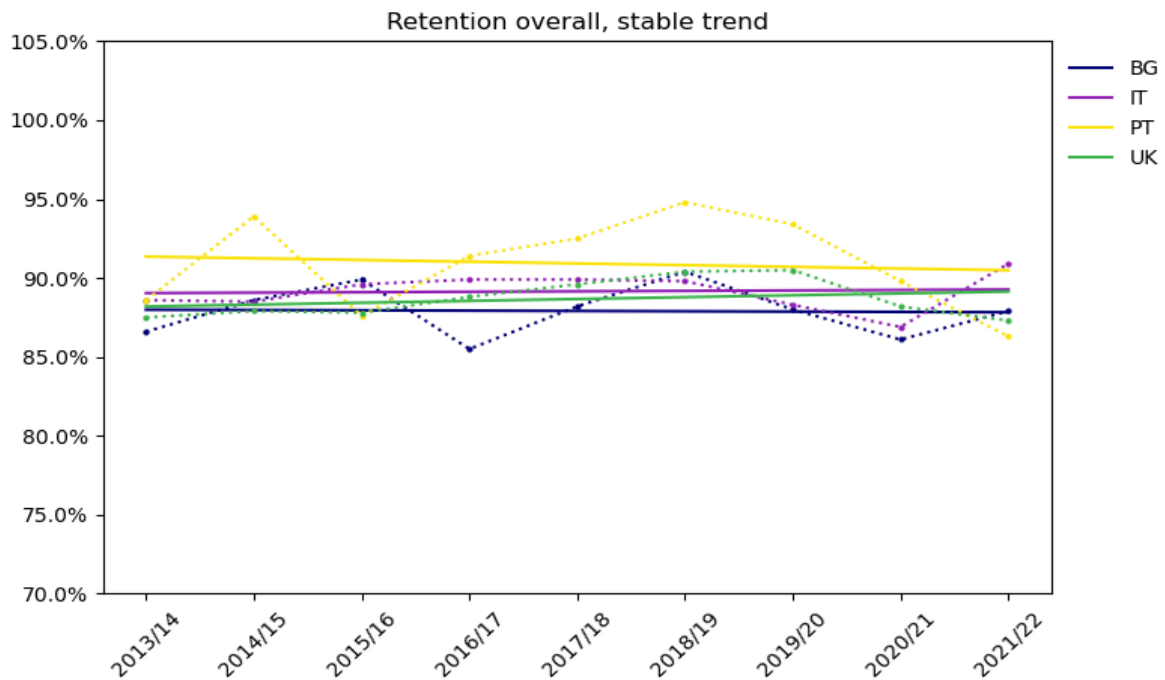
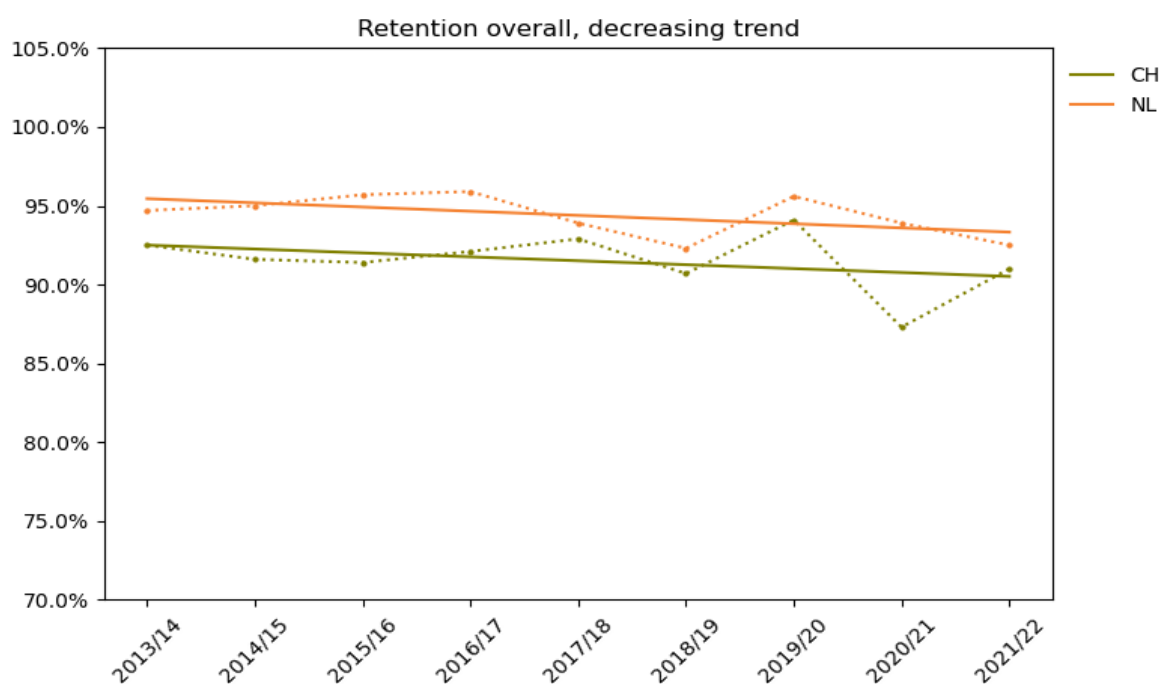


Figure 5: Retention rates of Informatics bachelor students by country at RU plus UAS – Decreasing trend



The above graphs show variation between countries in retention rates. In more detail:

- The calculated retention rates vary across countries, ranging from 75% to 100%, with the Czech Republic showing the lowest rates and the Netherlands and Norway the highest.
- The best performers are able to retain 90 - 95% of students from year to year, even in the case of decreasing trend (Finland, the Netherlands, Norway, Portugal, Switzerland, and recently Ireland).
- Overall, retention is within the [75-100]% interval; just 3 countries have retention below 85%, Czech Republic has the lowest absolute value and even if it is increasing, the trend is mild (change by 2.6 percentage points).
- Overall trend is positive, “increasing” in the majority of countries, “decreasing” in only 2 countries (and this decrease is relatively mild, 2.2 percentage points for the Netherlands, 1.5 p.p. for Switzerland)
- The absolute value of retention is as important as the trend, e.g. for the Netherlands, while the trend is decreasing, the absolute value is the second highest in the whole dataset.
- The COVID pandemic affected Informatics students’ ability to stay in their studies across Europe, and so the academic year 2020/21 exhibits a one-time drop in retention rate in all but 4 countries (Austria, Germany, Finland, the Netherlands).

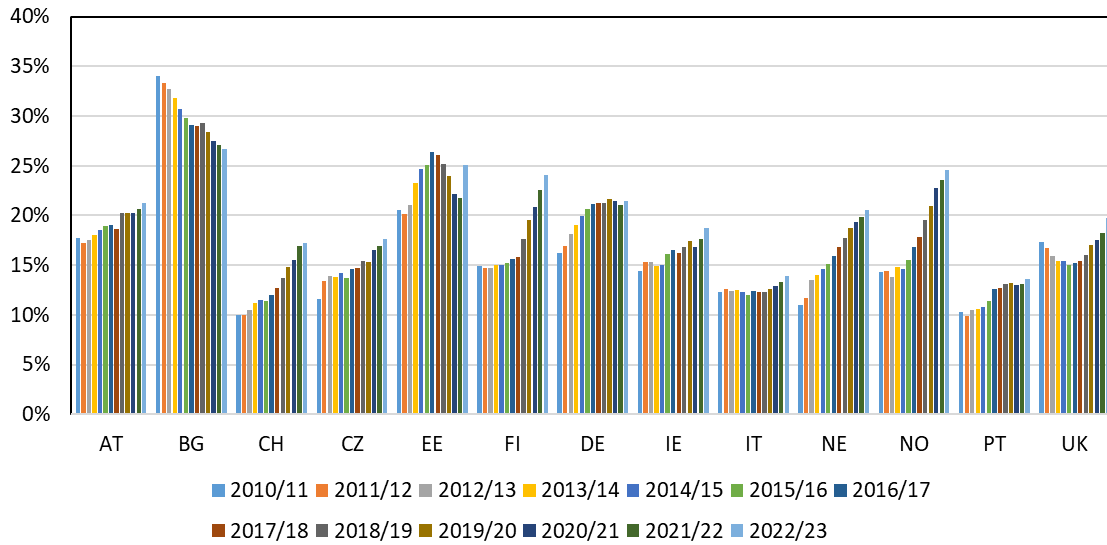
For future studies, it would be interesting to analyse the reasons behind the very steep increase in the cases of Ireland and Norway. It would also be interesting to understand if there are some common motivations for countries which cause the increasing trends in this situation e.g. the economic situation, educational policies, demographic changes, labour market demands, political priorities, etc.

4.1.3 Gender comparison

The absolute numbers of students enrolled in all semesters per country, including the gender distribution, can be found in the IEHE Data Portal section Statistics¹³.

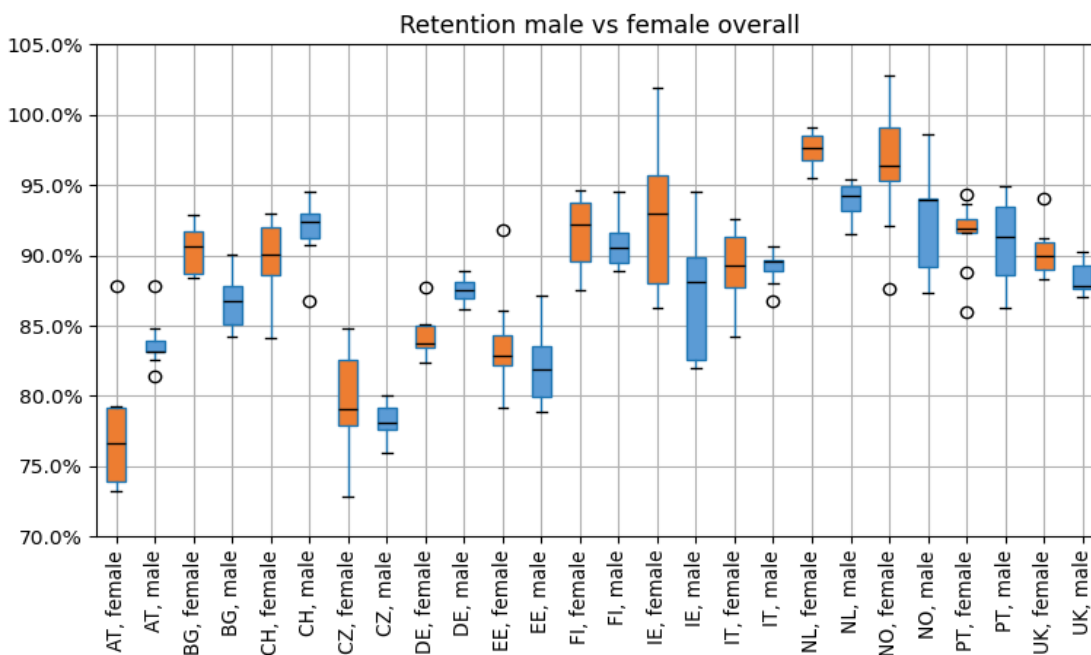
13 https://www.informatics-europe.org/data-portal/?page=statistics/bachelor_all_semesters_total.html for total number of

Figure 6: Percentage of female Informatics bachelor students enrolled at all semesters by country (at RU plus UAS)



UAS don't exist in Italy and the UK, so only RU data is shown for these countries.

Figure 7: Retention rates of female vs male Informatics bachelor students by country (at RU plus UAS from 2013/14 to 2021/22)



Plotting retention rates for both males and females leads to a graph that is too cluttered to read. We therefore separate the retention rates presentation into several separate views.

First, we show female and male trend graphs in three groups: for the case where overall retention rates are increasing, stable and decreasing respectively (i.e. we take the first group of countries from Figure 3

students; https://www.informatics-europe.org/data-portal/?page=statistics/bachelor_all_semesters_female.html for female students only.

in the above Subsection 4.1.2, and show their retention trends of female resp. male students).

Figure 8a: Retention rates of female Informatics bachelor students in countries showing increasing overall trend at RU plus UAS

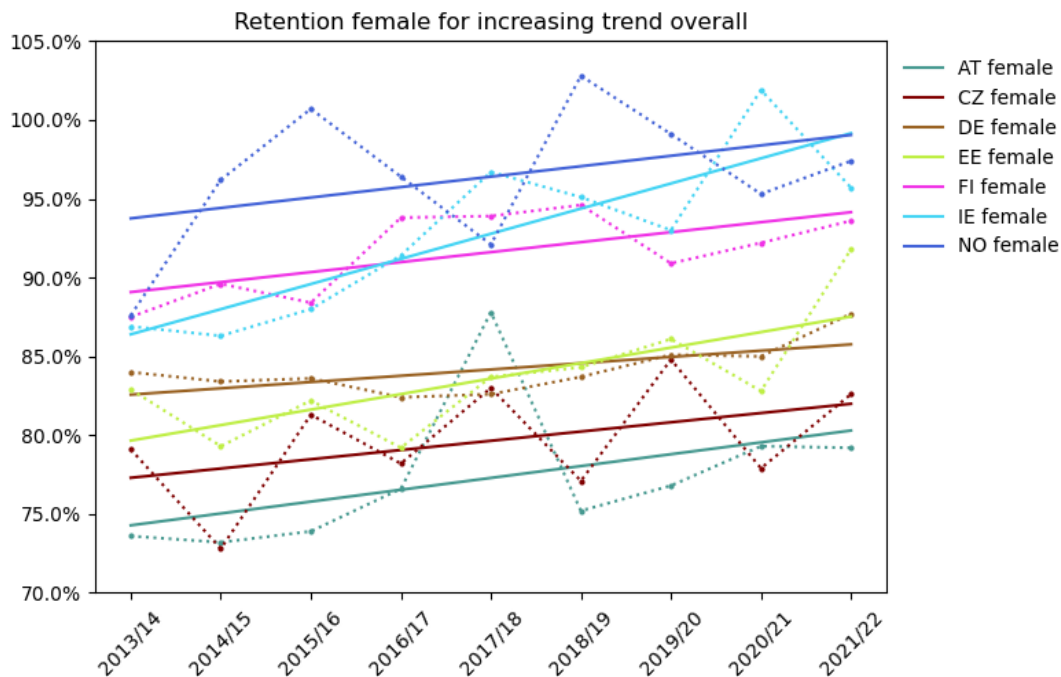
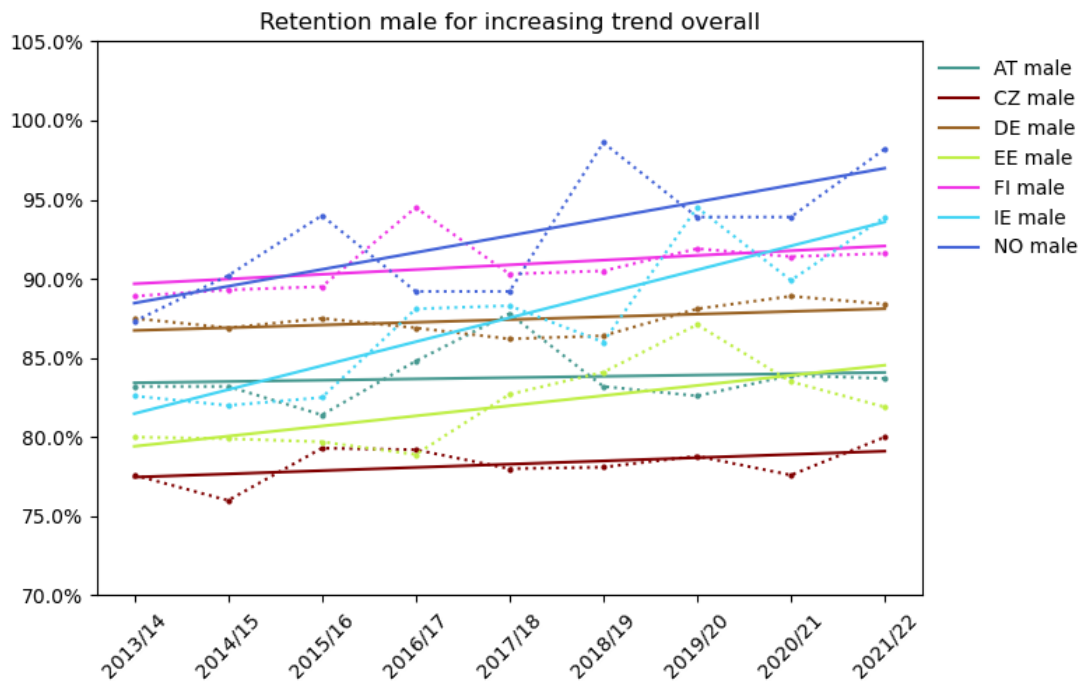


Figure 8b: Retention rates of male Informatics bachelor students in countries showing increasing overall trend at RU plus UAS



Next are graphs for cases where the overall rates are stable and decreasing.

Figure 9a: Retention rates of female Informatics bachelor students in countries showing stable overall trend at RU plus UAS

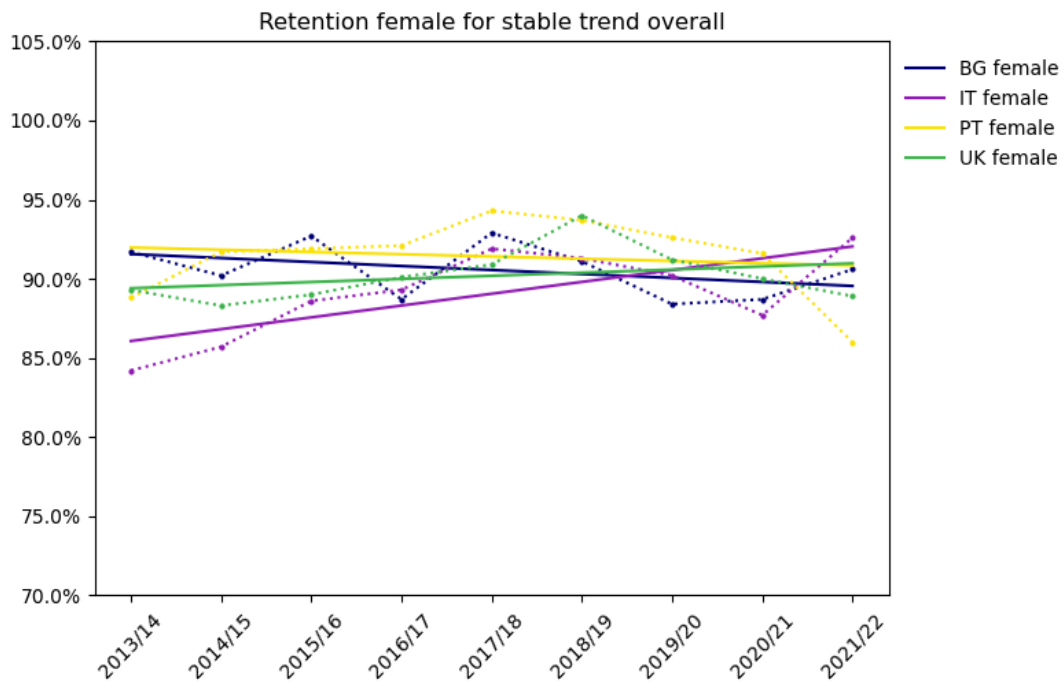


Figure 9b: Retention rates of male Informatics bachelor students in countries showing stable overall trend at RU plus UAS

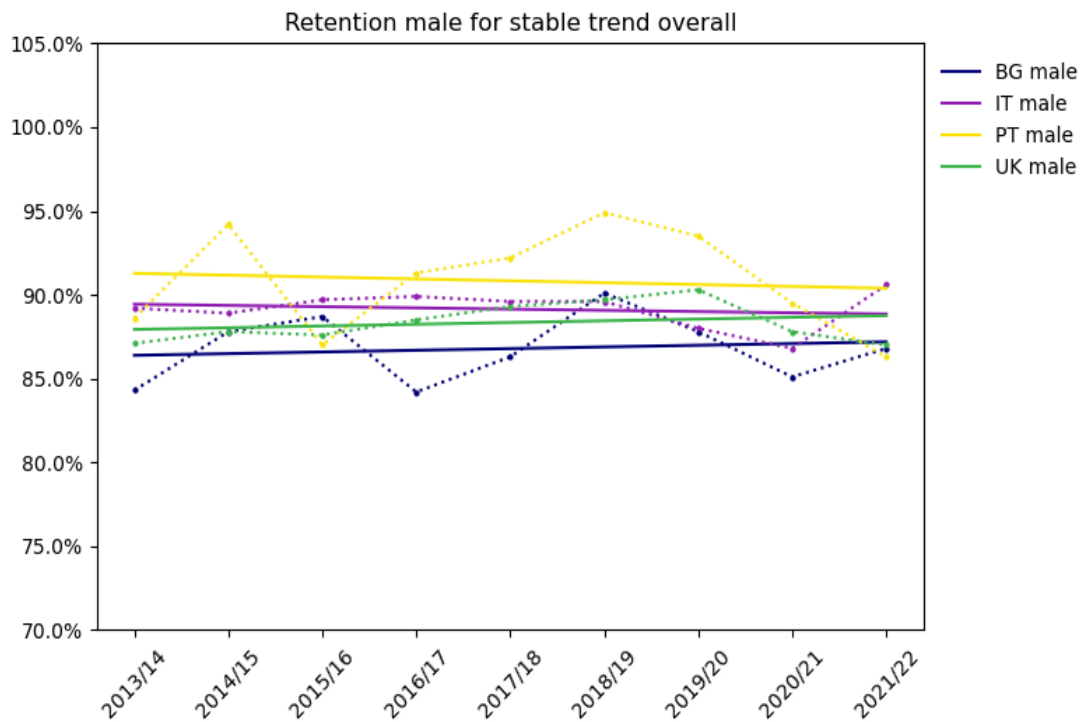


Figure 10a: Retention rates of female Informatics bachelor students in countries showing decreasing overall trend at RU plus UAS

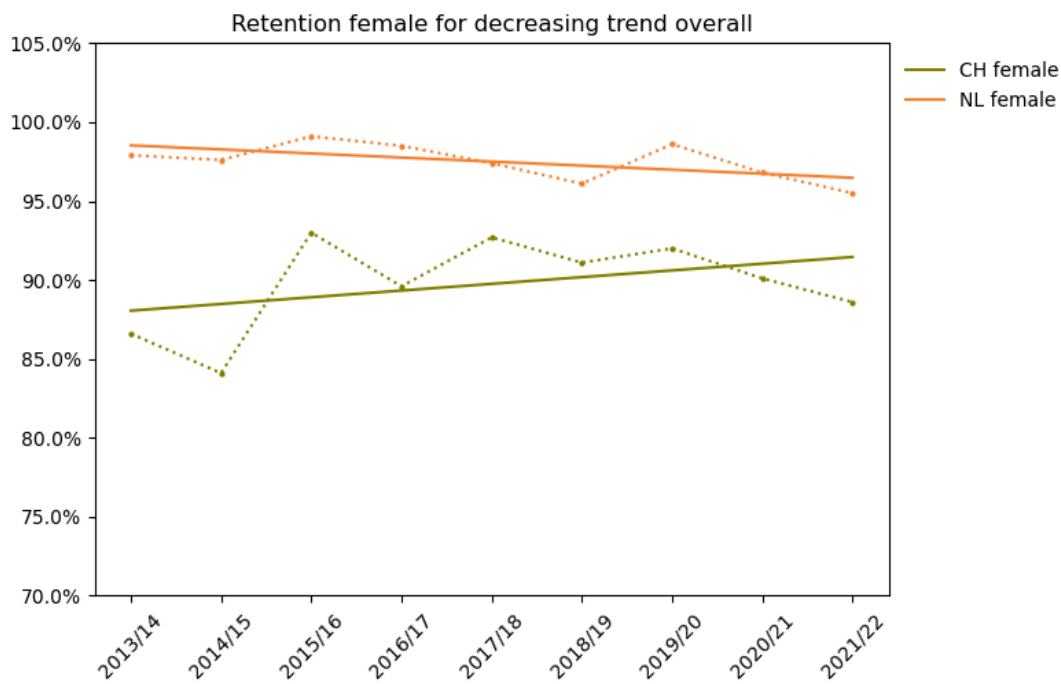
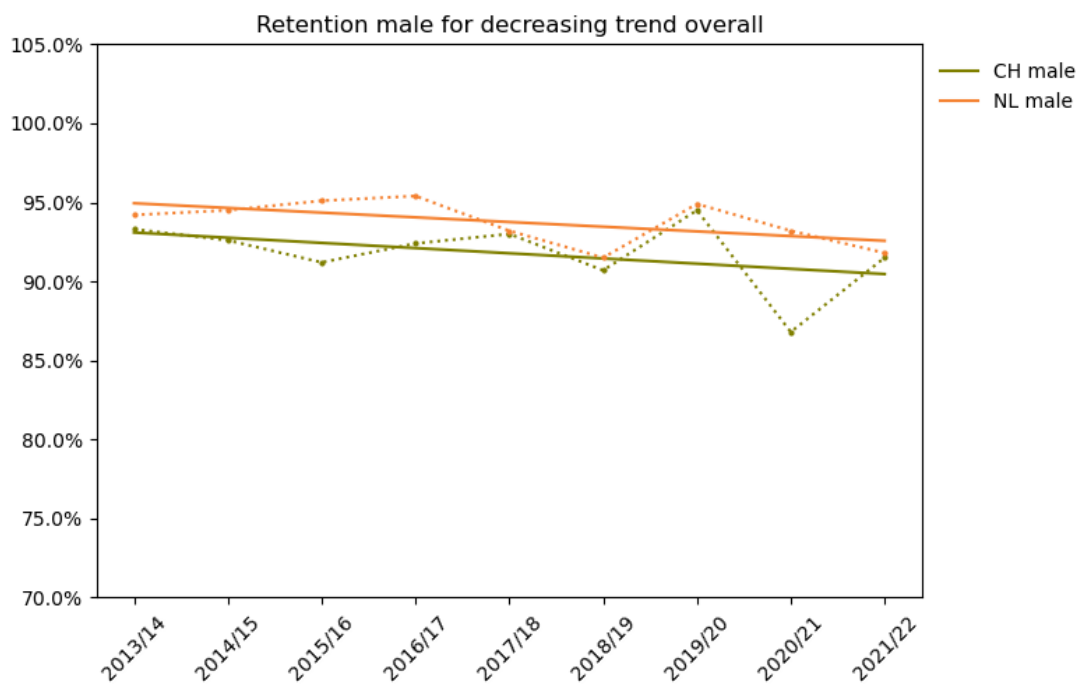


Figure 10b: Retention rates of male Informatics bachelor students in countries showing decreasing overall trend at RU plus UAS

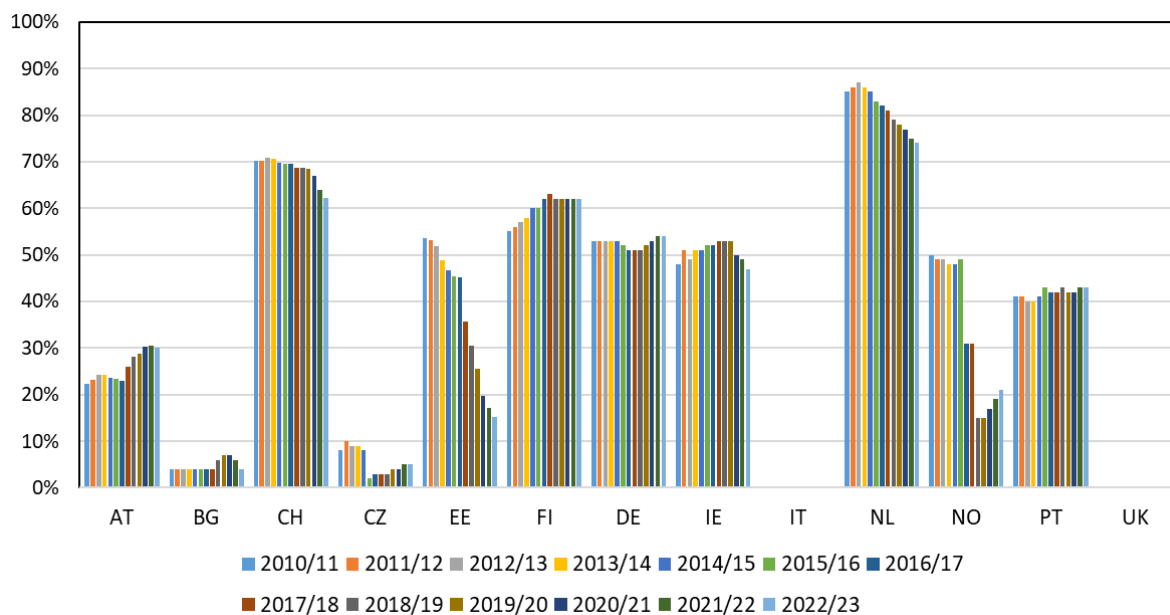


Key points that we draw from the graphs:

- Due to the proportion of female students not exceeding 35% of the total, it is clear that the male trend drives the overall trend.
- While both overall and female retention rates trends are the same for the “overall increasing retention” cases, in some countries (Czech Republic, Finland, Germany) the female retention rate increase is more dynamic.
- In Austria, Germany, Italy and Switzerland, while the retention rate for males is decreasing or stable, the female retention rate shows an increasing trend and could be a driver of potential retention rate growth (compare to Figure 8a).

4.1.4 Comparison between RU and UAS

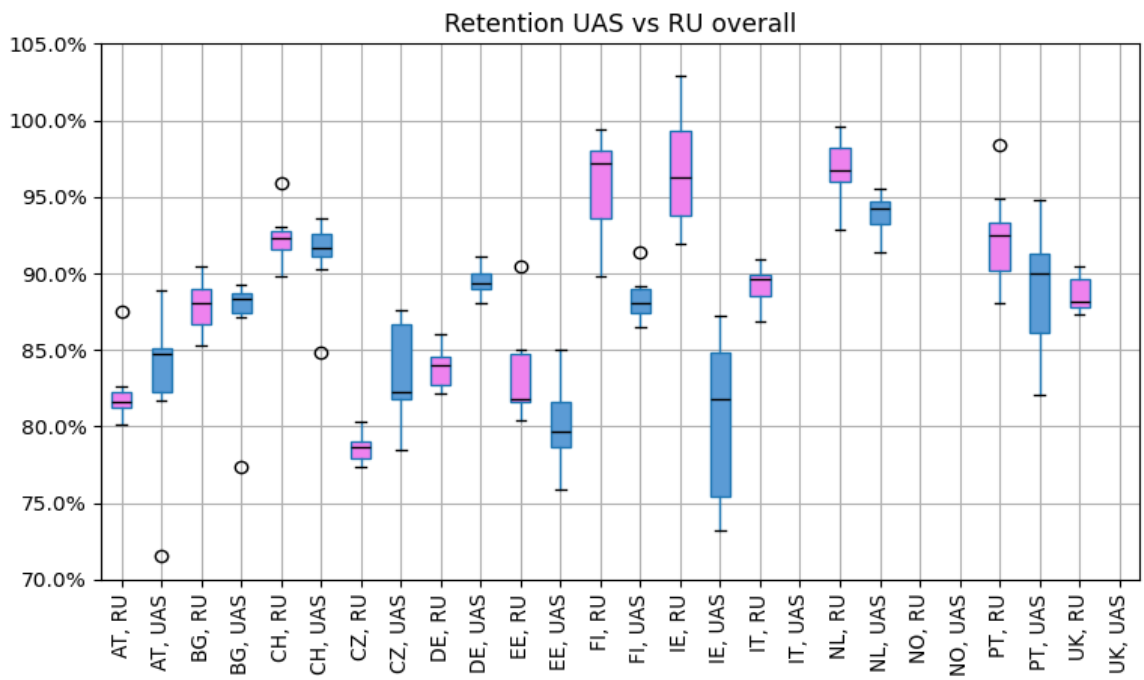
Figure 11: Percentage of UAS Informatics bachelor students enrolled in all semesters by country



A context is provided by Figure 11 for the graphs below by showing how big the influence is of UAS Informatics students on the overall situation in the respective countries, in terms of student populations. In countries where UASs are an official part of the higher education system, they are on a par with research universities (i.e. the systems are balanced), with the exception of Finland, the Netherlands and Switzerland where UASs play a much more significant role in educating Informatics bachelor students. Studying the UAS retention/graduation rates separately is therefore useful for Austria, Finland, Germany, Ireland, the Netherlands, Portugal and Switzerland.

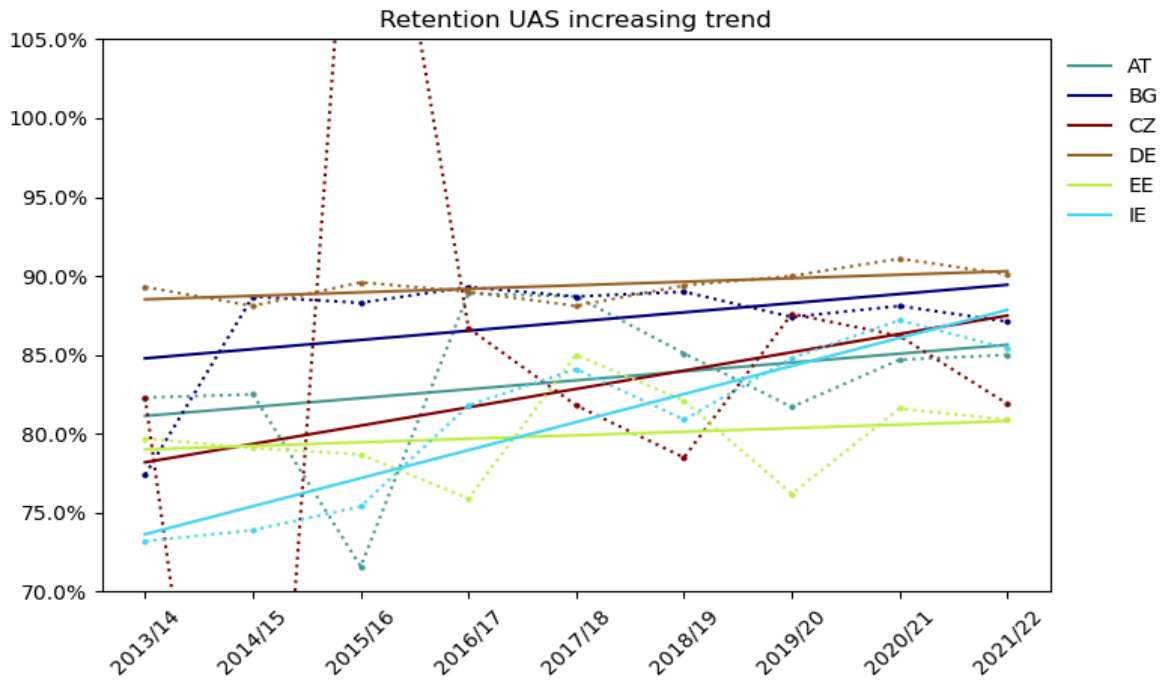
On the other hand, in Bulgaria, Czech Republic, and recently Estonia and Norway, their influence on the Informatics profession is very small, and the graphs in the other parts of this report should be read with this in mind. (In Norway and Estonia, there were changes in the higher education system related to several mergers between RUs and UASs, leading to the apparent drop. For the Netherlands and Switzerland, the change is caused by a significant increase in the number of RU students, which led to the percentage declining.)

Figure 12: Retention rates of Informatics bachelor students at RU vs UAS by country (from 2013/14 to 2021/22)



In Italy and the UK, there are no UASs, in the case of Norway we excluded the data from the analysis altogether because of changes in the higher education system related to several mergers between RUs and UASs.

Figure 13: Retention rates of Informatics bachelor students at UAS – Increasing trend



Significant variations in the UAS retention rates for Bulgaria and Czech Republic can be better understood by noting that the number of students enrolled in bachelor programmes at UASs in these countries is relatively small. As a result, even minor changes in absolute numbers can lead to large percentage variations.

Figure 14: Retention rates of Informatics bachelor students at UAS – Stable trend

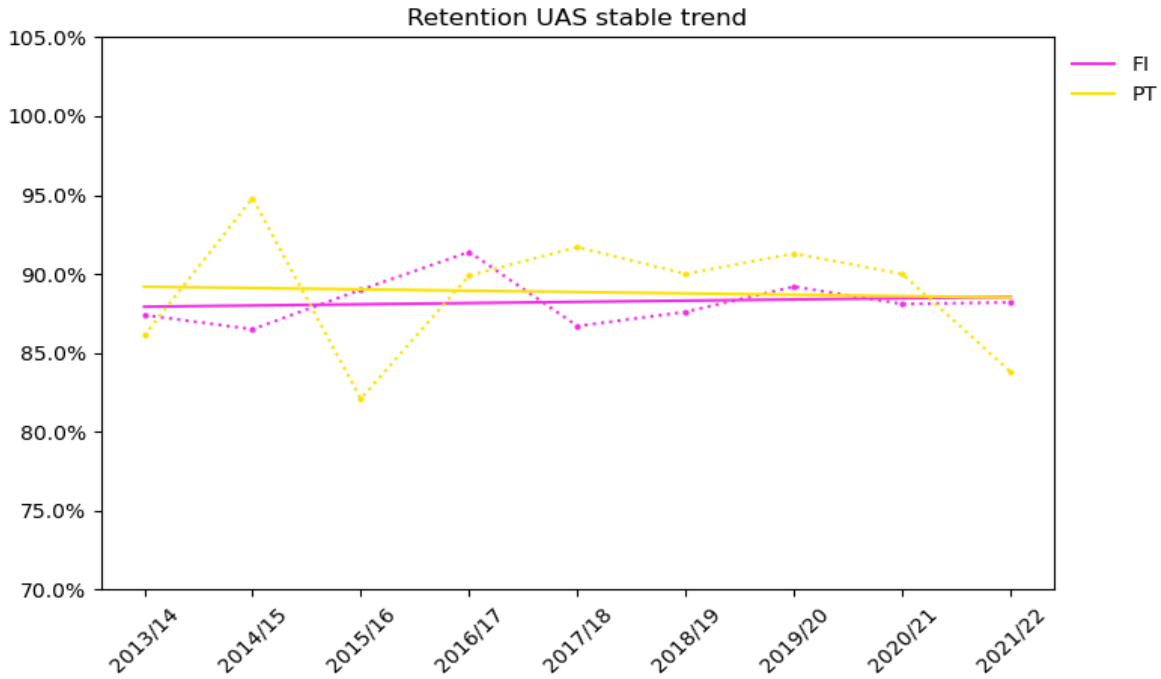
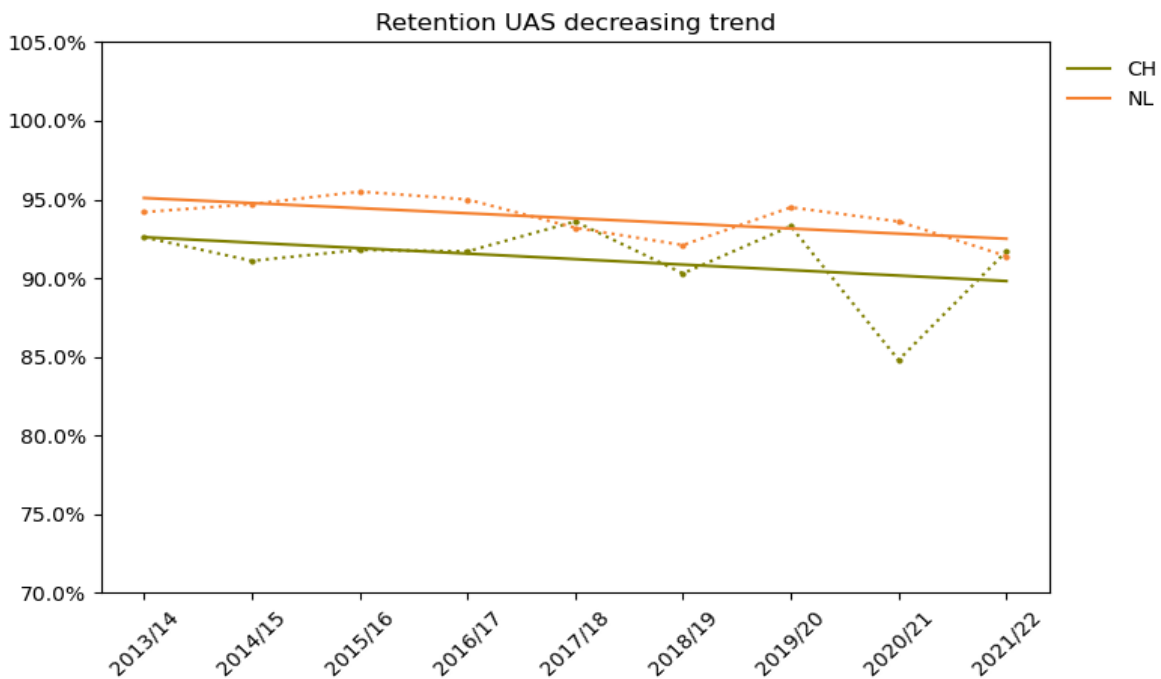


Figure 15: Retention rates of Informatics bachelor students at UAS – Decreasing trend



Key points of comparison between RUs and UASs:

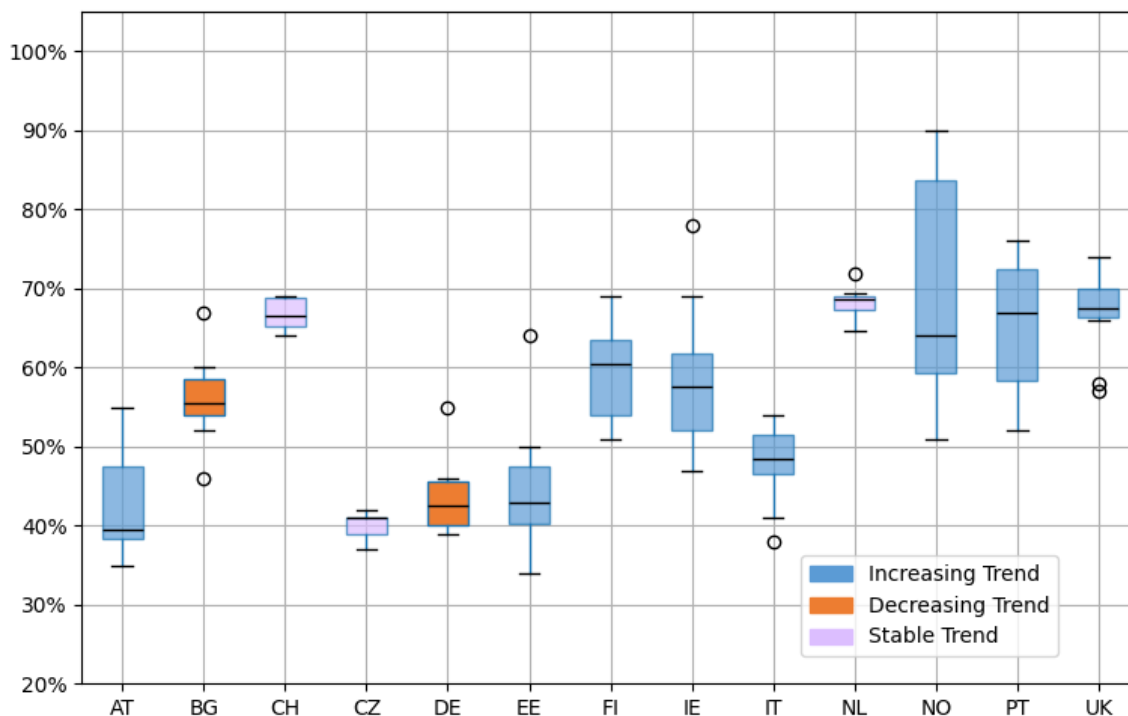
- In most countries that differentiate between research universities and universities of applied sciences, RUs exhibit equal or higher retention rates compared to UASs. The exceptions are Austria, Czech Republic, and Germany, where UAS demonstrate relatively higher retention rates than RUs. Note that findings for Czech UASs should be interpreted with caution, as the small number of students can cause large changes in percentages that may not reflect real trends.
- In general, retention rate trends for UASs align with those described above in section 4.1.2 (where both RUs and UASs are shown) with a few exceptions. Thus, while the overall retention trend in Finland is increasing (Figure 3), retention rates at UASs show the stable pattern (Figure 14). Conversely, in Bulgaria, the overall trend is stable, whereas retention rates at UASs are increasing. Note that findings for Bulgarian UASs should be interpreted with caution, as the small number of students can cause large changes in percentages that may not reflect real trends.

4.2 Graduation Rates

4.2.1 Overall findings

The graduation rates for all countries in the dataset in the data range from 2010/11 to 2019/20 academic year are depicted together in the following graph. (For an explanation of the visualization, see Subsection 4.1.1 above). As mentioned in Subsection 3.3.2 above, the graduation rate for 2019/20 refers to students who began their studies in that year – reported for 2019 – and graduated in year X+3 (i.e. in the 2022/23 academic year, reported in 2023).

Figure 16: Graduation rates of Informatics bachelor students by country at RU plus UAS from 2010/11 to 2019/20



Graduation rates overall show a slightly complicated picture. The Netherlands, the UK and Portugal come on top in terms of the median value (between 67% and 68.6%), while Norway's maximum and third quartile values (84% and upwards) are far higher. Also, Finland and Ireland come close to – or over – this top median in their best values.

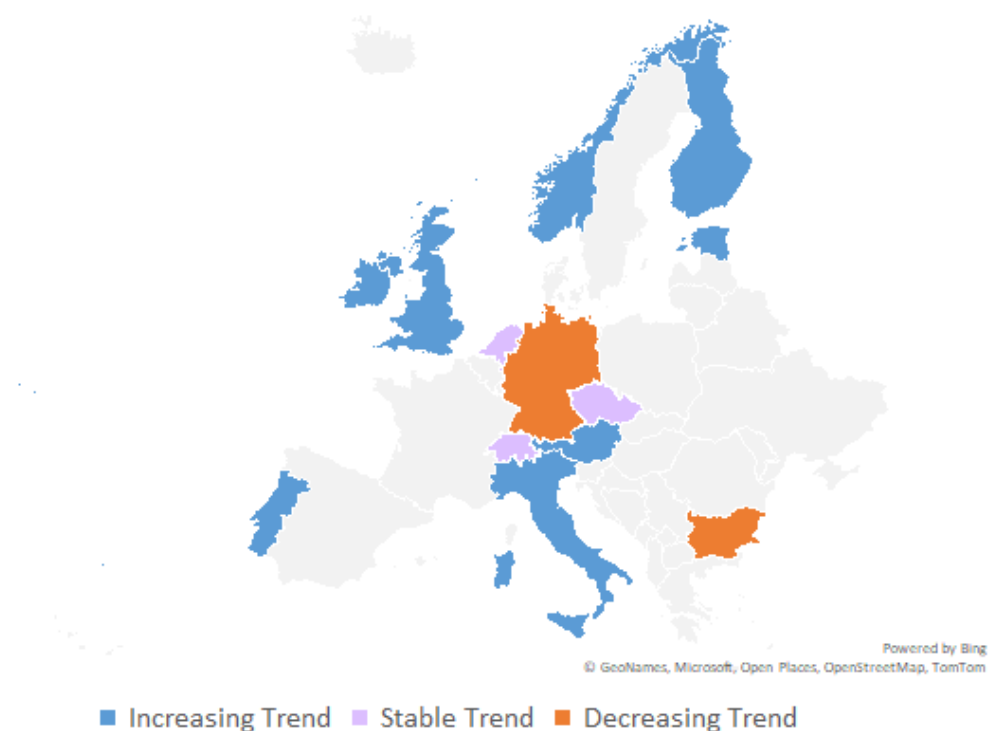
4.2.2 Comparison of Trends

Just as for retention, the set of countries is split into three clusters according to the trend of graduation rates over the years.

- Countries with increasing trend – Austria, Estonia, Finland, Ireland, Italy, Norway, Portugal, and the UK;
- Those showing the stable trend – Czech Republic, the Netherlands, and Switzerland;
- Those with (mostly) at or below threshold graduation rates – Bulgaria, Germany.

The overall graduation rate of informatics' bachelors for the whole set of countries studied is 57.5% (median).

Figure 17: Graduation rates of Informatics bachelor students by country at RU plus UAS from 2010/11 to 2019/20 – Country grouping



The following graphs show the trends in the 3 groups, showing the actual data (dotted lines markers) and interpolated trend lines (solid lines). All graphs have y-axis from 20% to 100%, despite the resulting whitespace, to facilitate comparison. Detailed characteristics of the dataset are in Appendix A Table 3.

Figure 18: Graduation rates of Informatics bachelor students by country at RU plus UAS – Increasing trend

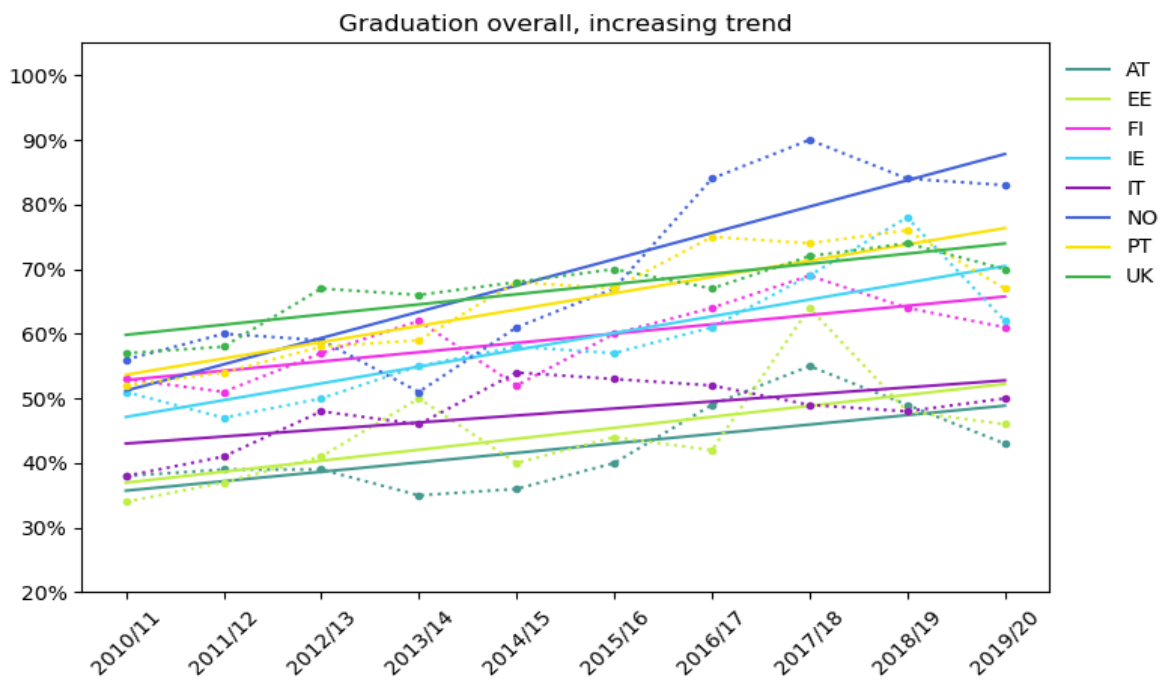


Figure 19: Graduation rates of Informatics bachelor students by country at RU plus UAS – Stable trend

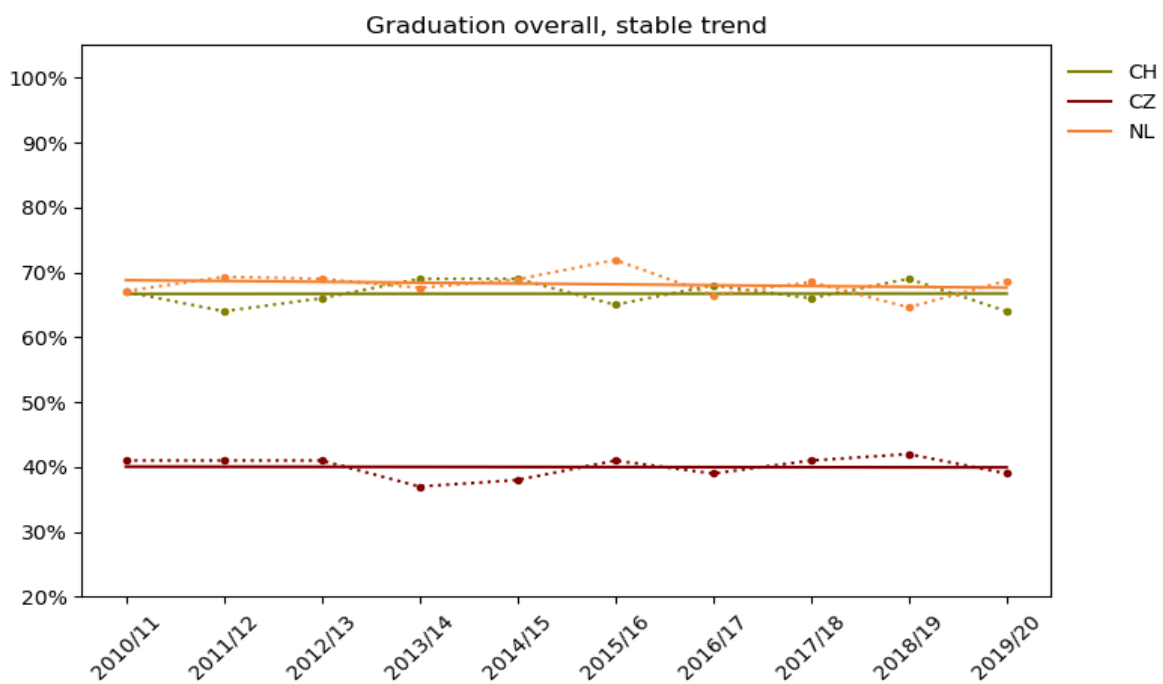
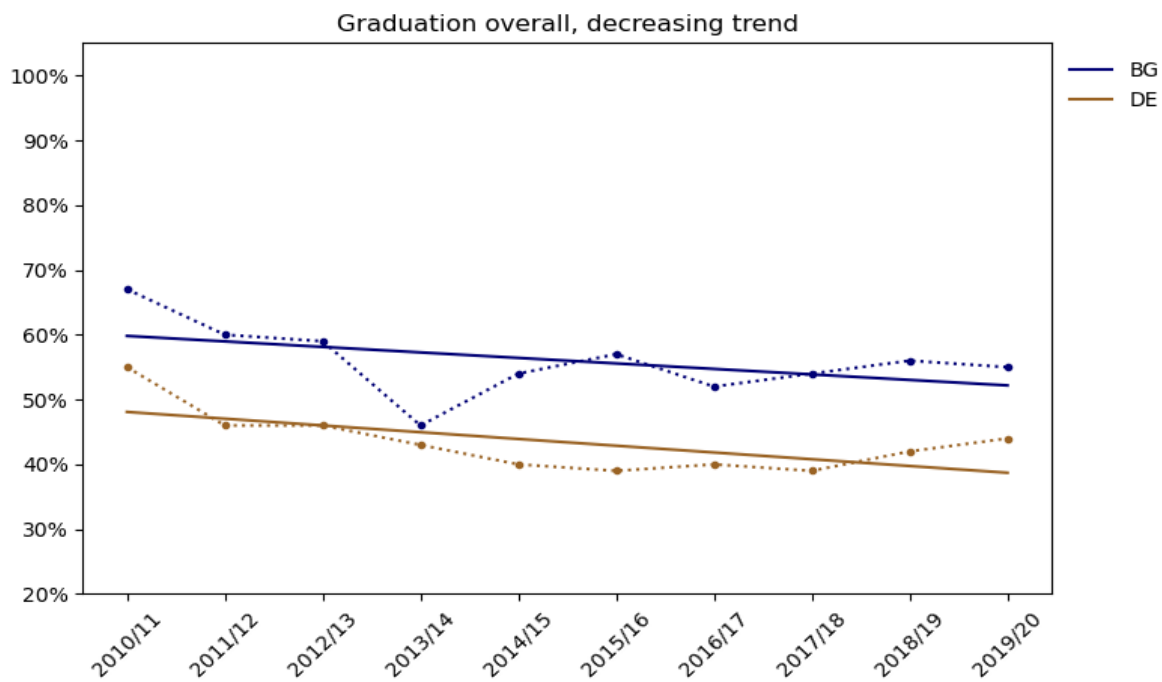


Figure 20: Graduation rates of Informatics bachelor students by country at RU plus UAS – Decreasing trend



From the above three graphs, we can conclude the following:

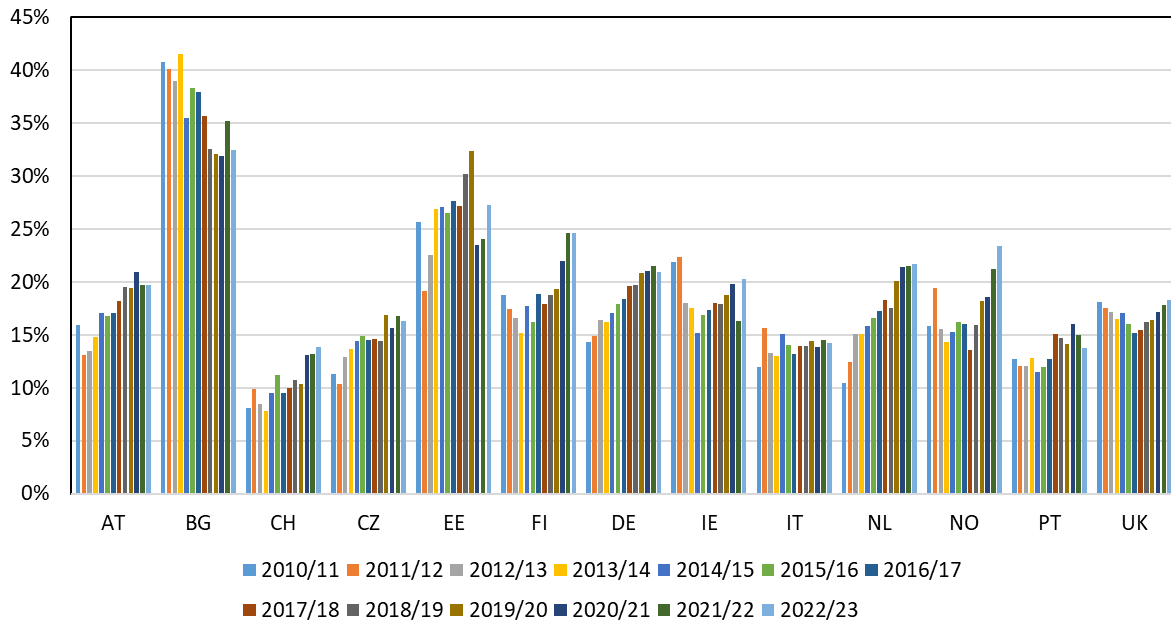
- While the variation in retention rates among the countries studied was relatively small — ranging from 75% to 100% — graduation rates vary much more widely, from 30% to 90%.
- Best performers graduate at least two-thirds of the students who entered studies (the Netherlands, Norway, Portugal, Switzerland plus the UK which is runner-up in retention); Finland and Ireland which are top in “retention” are runners-up here.
- In the worst cases, on the other hand, the national higher education system loses about two-thirds of informatics students during their bachelor studies (Czech Republic, Germany, also Austria and Estonia where, however, the situation has improved).
- The rapid improvement in Norway, Portugal and Ireland would call for a deeper investigation of the underlying causes.

4.2.3 Gender comparison

The absolute numbers of bachelor graduates per country, including the gender distribution, can be found in the IEHE Data Portal section Statistics¹⁴.

¹⁴ https://www.informatics-europe.org/data-portal/?page=statistics/bachelor_degrees_awarded_total.html for total number of graduates; https://www.informatics-europe.org/data-portal/?page=statistics/bachelor_degrees_awarded_female.html for female graduates only.

Figure 21: Percentage of female Informatics bachelor students enrolled at all semesters by country (at RU plus UAS)



UAS don't exist in Italy and the UK, so only RU data is shown for these countries.

Figure 22: Graduation rates of female vs male Informatics bachelor students by country (at RU plus UAS from 2010/11 to 2019/20)

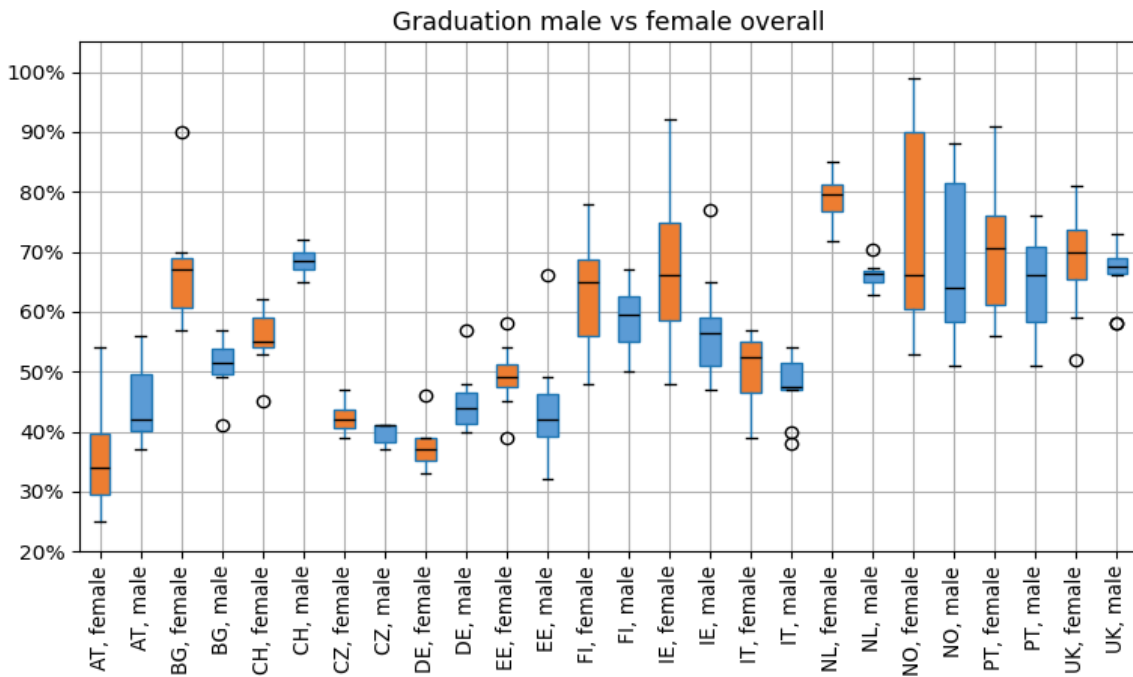


Figure 23a: Graduation rates of female Informatics bachelor students in countries showing increasing overall trend at RU plus UAS

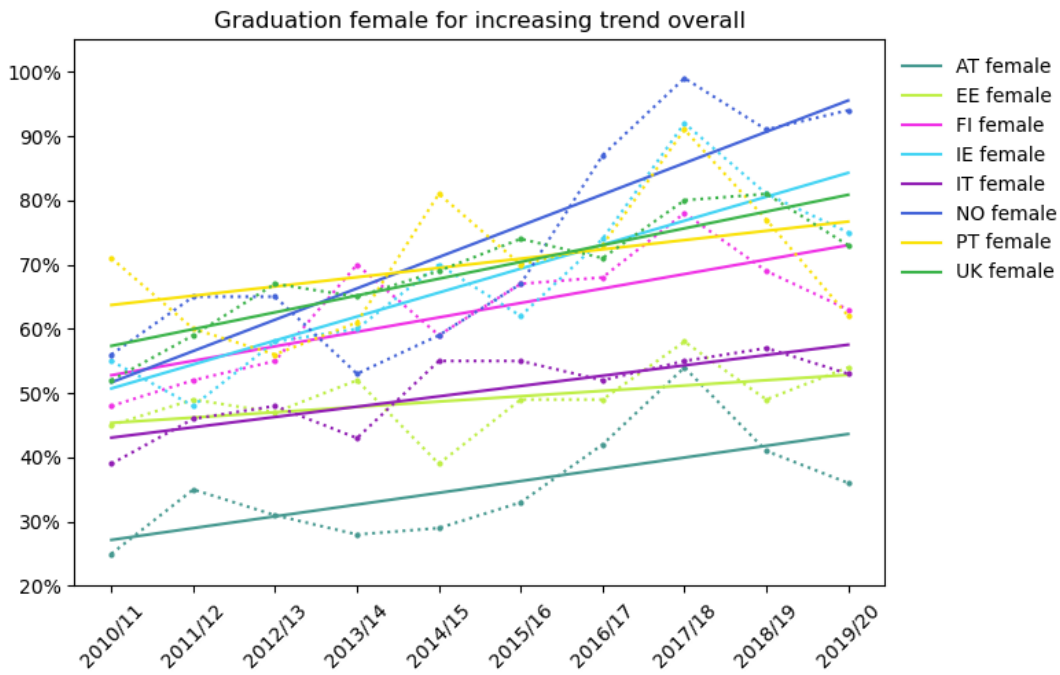


Figure 23b: Graduation rates of male Informatics bachelor students in countries showing increasing overall trend at RU plus UAS

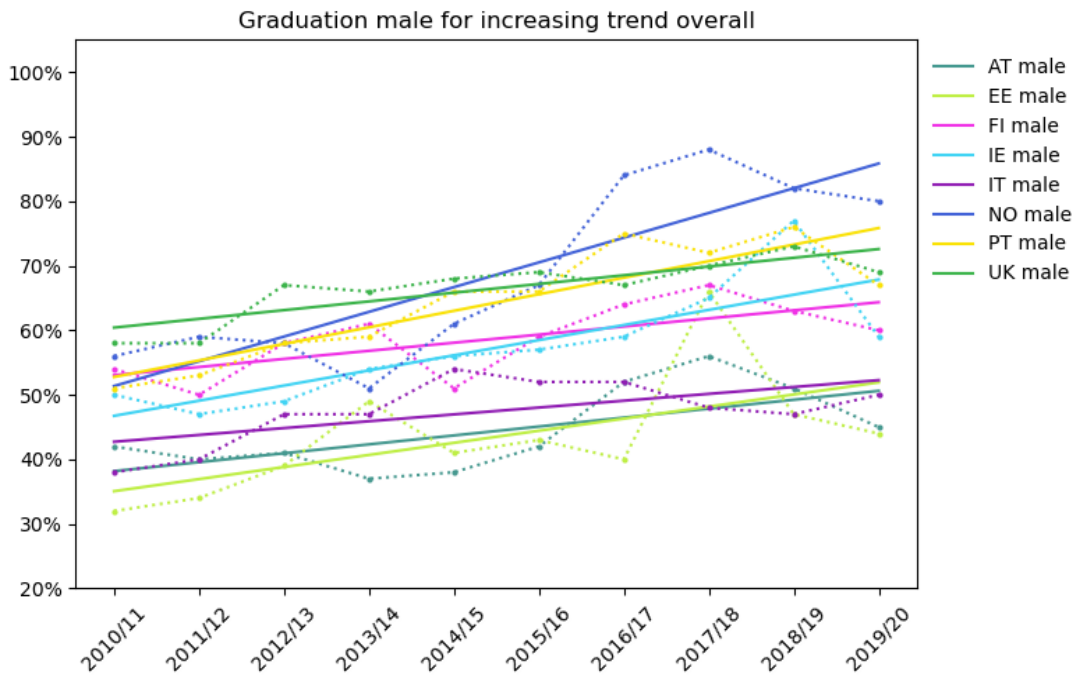


Figure 24a: Graduation rates of female Informatics bachelor students in countries showing stable overall trend at RU plus UAS

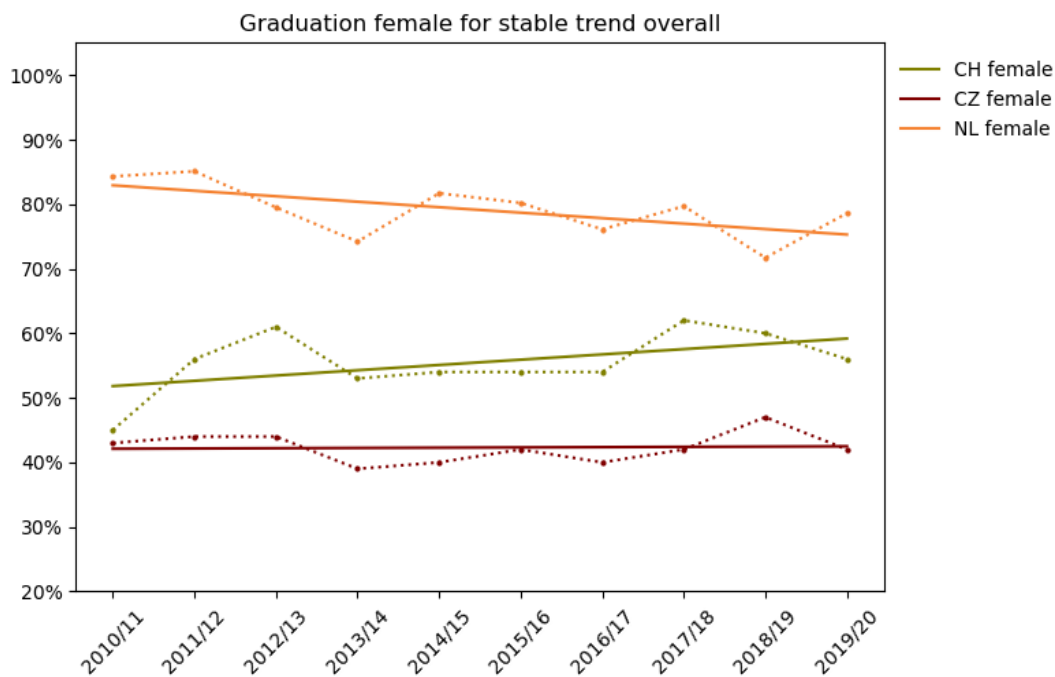


Figure 24b: Graduation rates of male Informatics bachelor students in countries showing stable overall trend at RU plus UAS

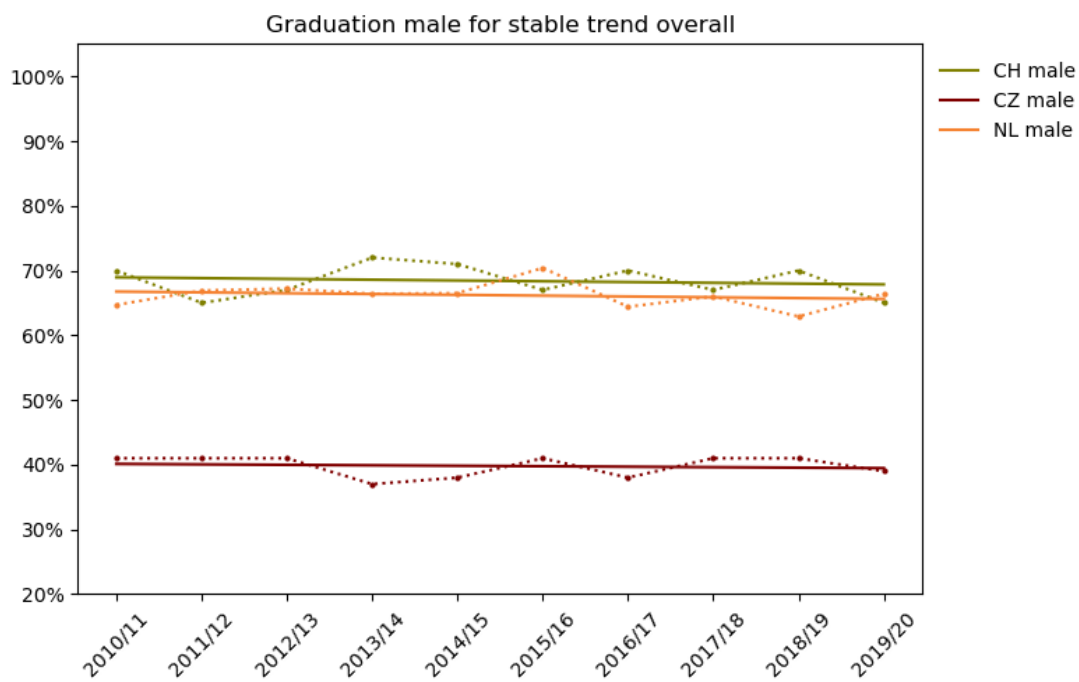


Figure 25a: Graduation rates of female Informatics bachelor students in countries showing decreasing overall trend at RU plus UAS

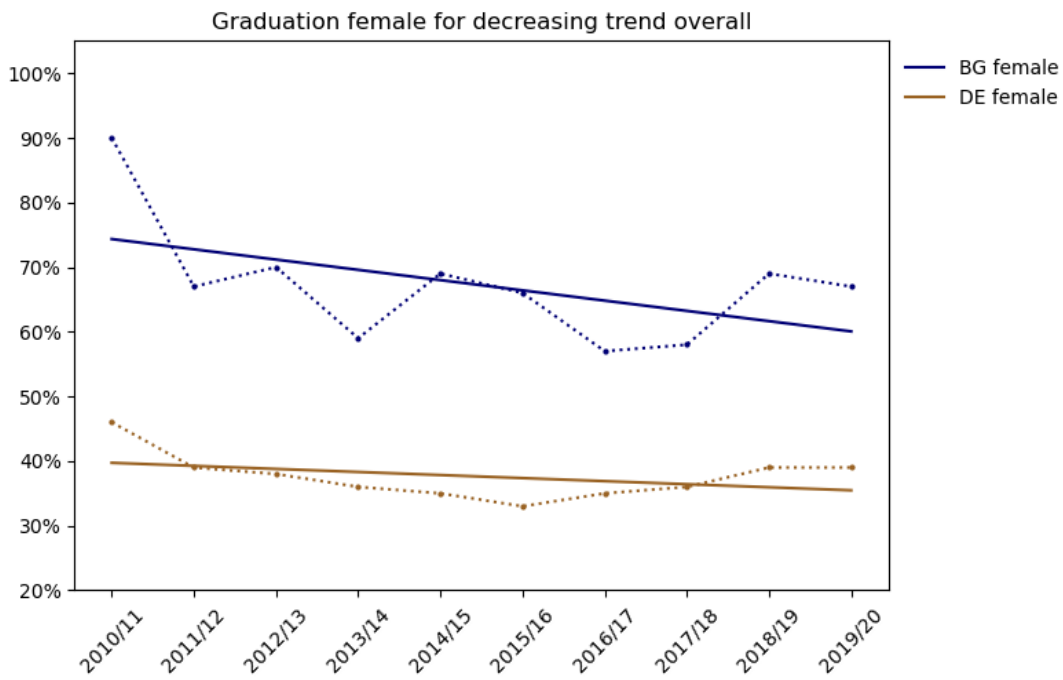
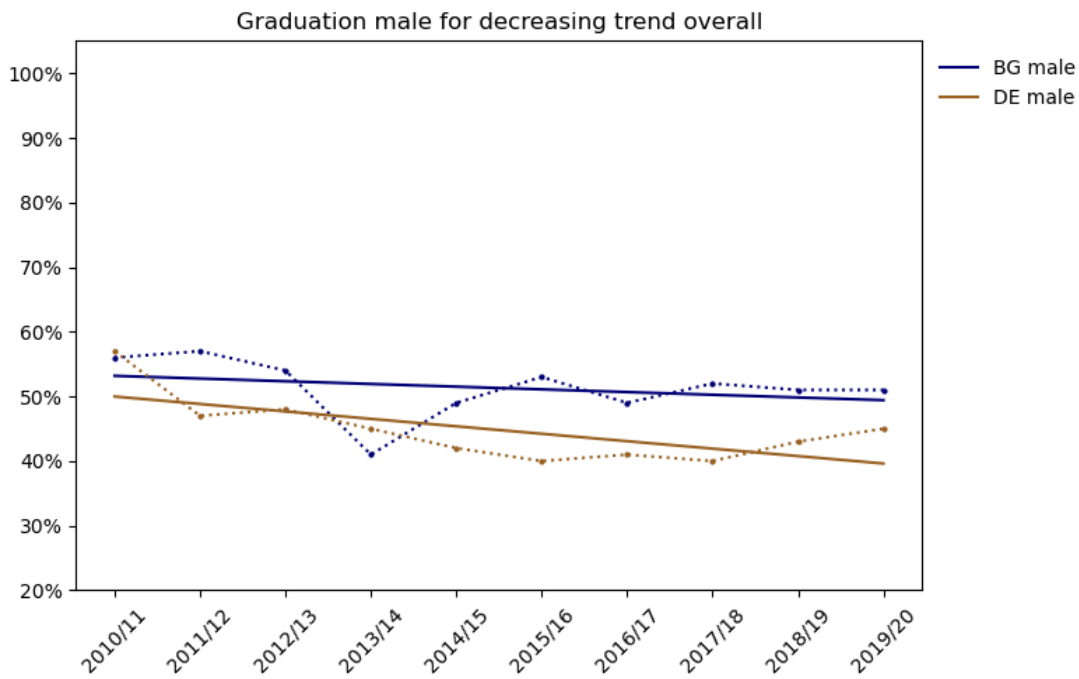


Figure 25b: Graduation rates of male Informatics bachelor students in countries showing decreasing overall trend at RU plus UAS



While the lack of females in STEM and Informatics disciplines is an issue world wide, it is interesting to find that in most countries, except Austria, Germany, Switzerland, female graduation rates are higher than those of male students (Figure 22). In Switzerland, however, the trend shows improvement: the graduation rate for female students has been steadily increasing over the years (Figure 24a), while the rate for male students has remained relatively stable (Figure 24b). Norway’s female graduation rate is outstanding.

Gender trends mostly align with the overall picture. The trend for female graduates in the Netherlands is decreasing while overall it is stable, but (as noted with retention rates) their graduation rate is the highest one from the dataset.

Next, we turn to the two types of universities.

4.2.4 Comparison between RU and UAS

Figure 26: Percentage of UAS graduates from Informatics bachelor programmes by country

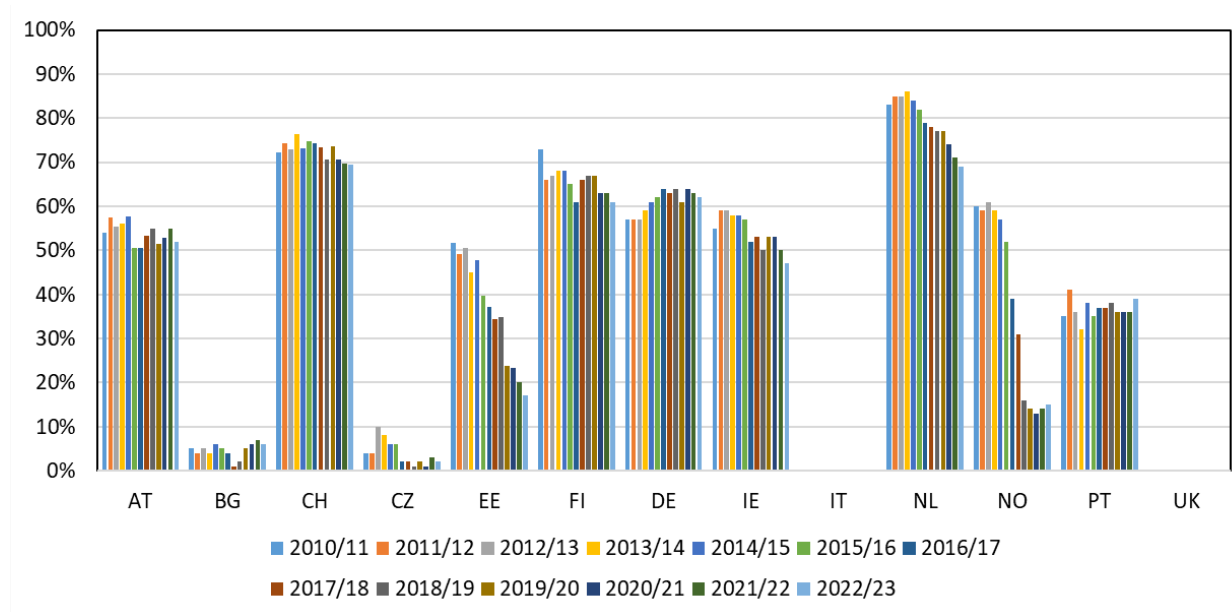


Figure 27: Graduation rates of Informatics bachelor students at RU vs UAS by country (from 2010/11 to 2019/20)

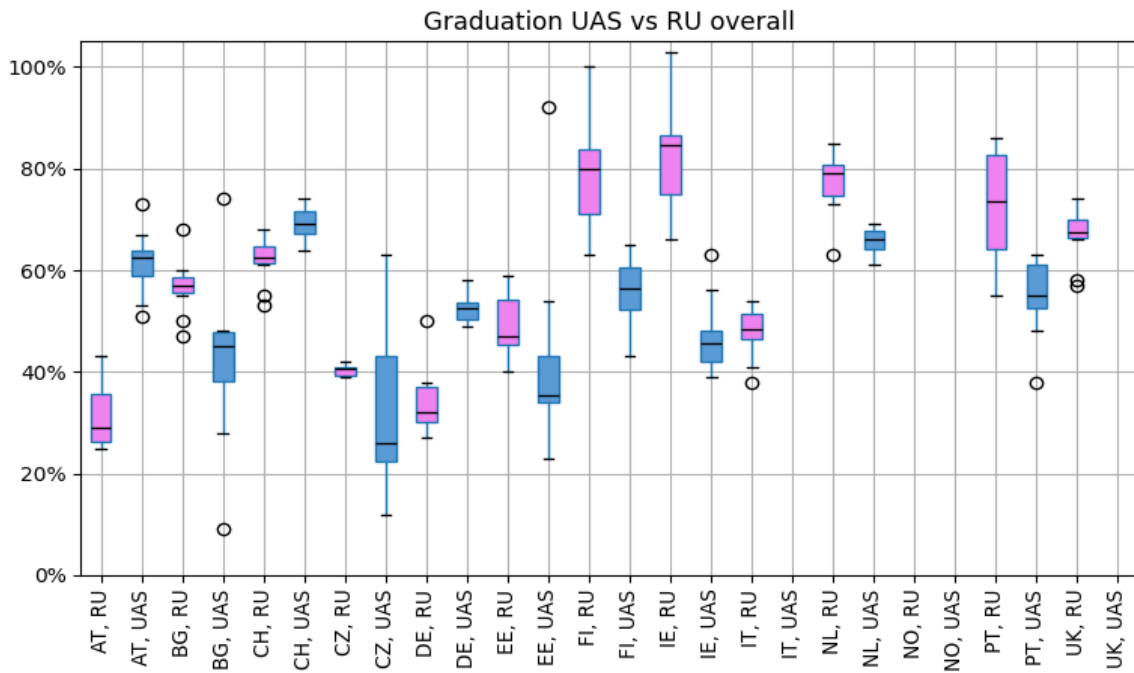


Figure 28: Graduation rates of Informatics bachelor students at UAS – Increasing trend

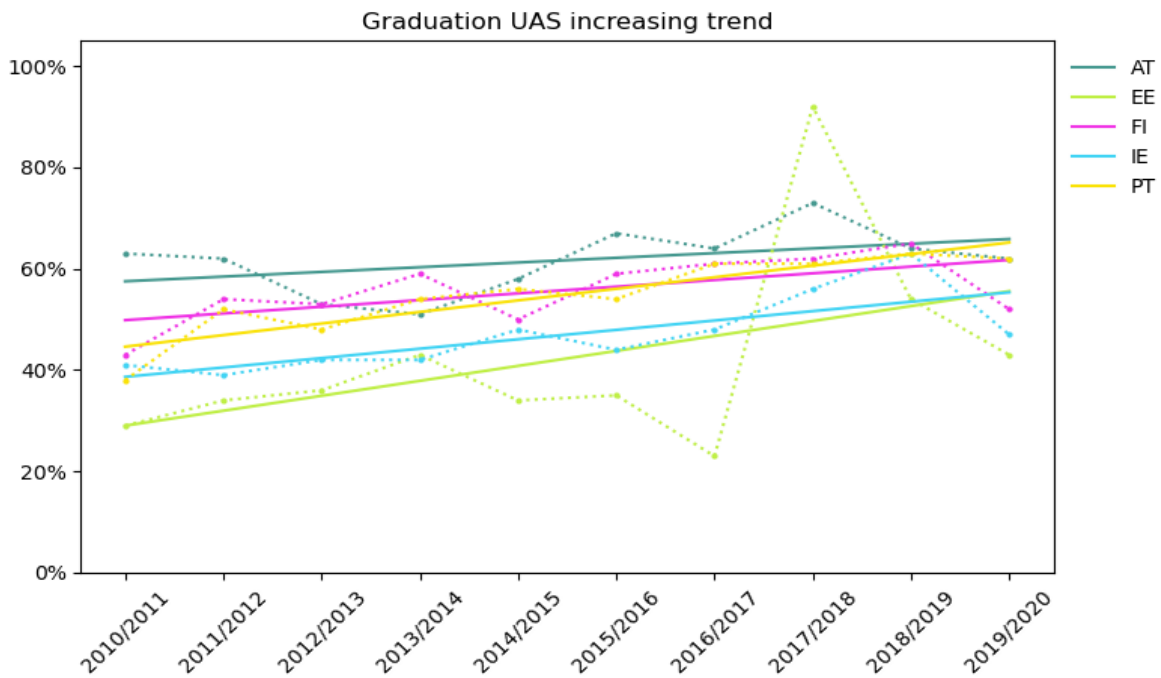


Figure 29: Graduation rates of Informatics bachelor students at UAS – Stable trend

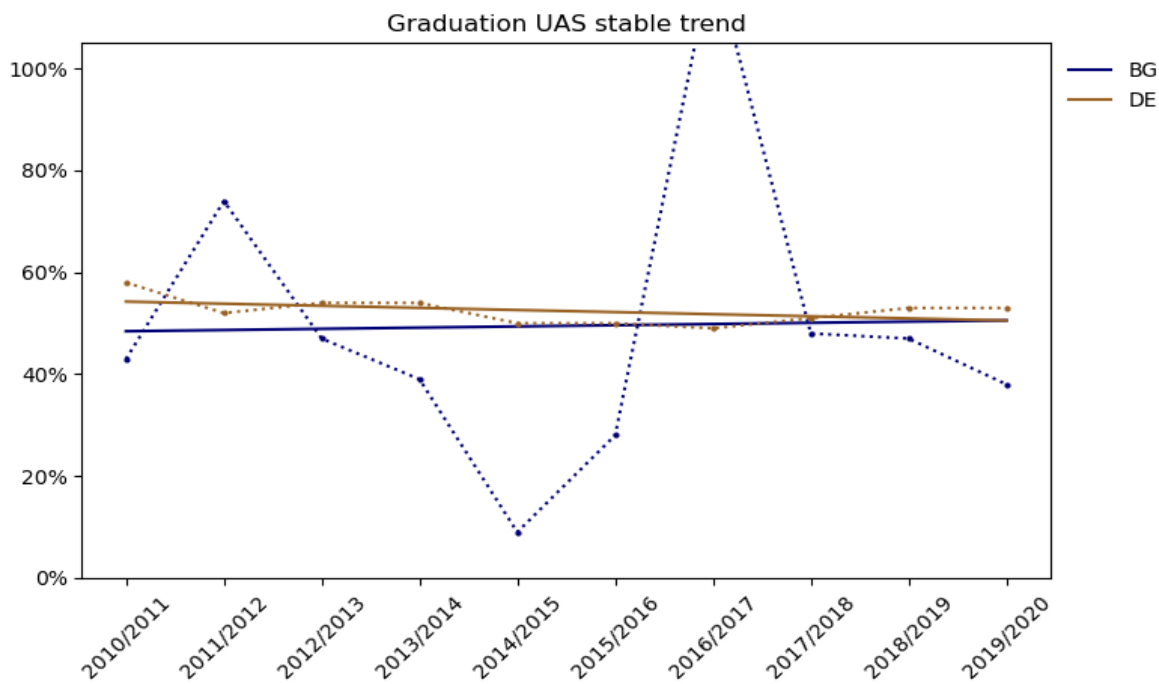
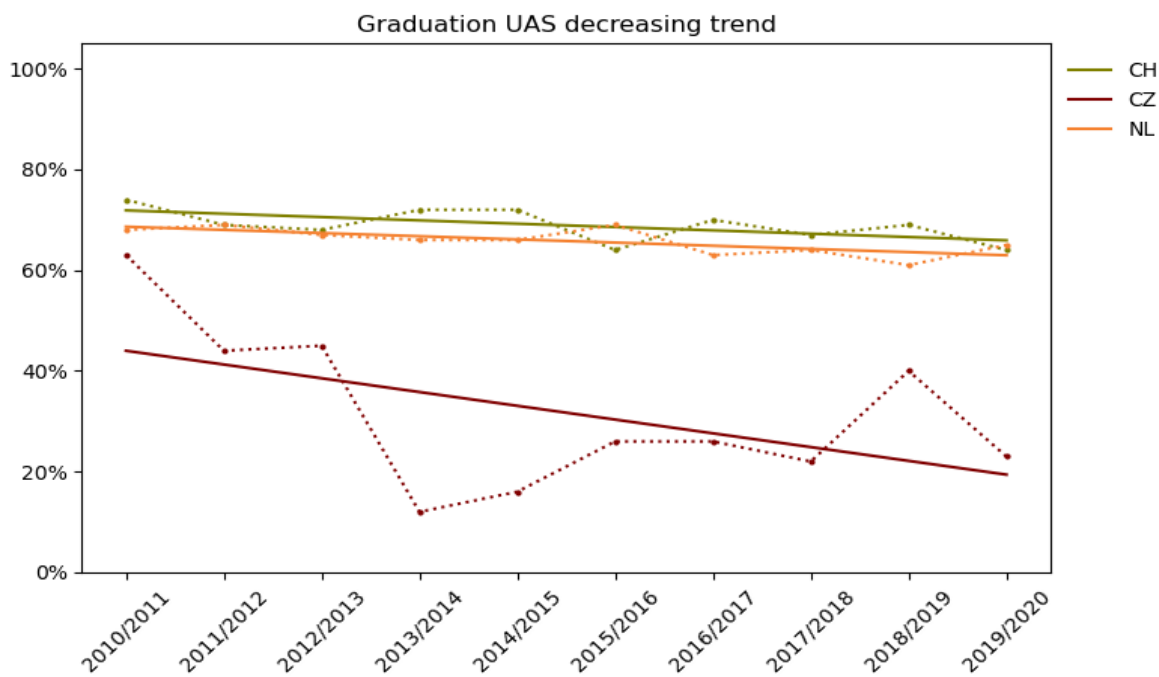


Figure 30: Graduation rates of Informatics bachelor students at UAS – Decreasing trend



Significant variations in the UAS retention rates for Bulgaria and Czech Republic can be better understood by noting that the number of bachelor graduates at UASs in these countries is relatively small. As a result, even minor changes in absolute numbers can lead to large percentage variations.

Key points of comparison between RUs and UAS:

- Similar to the retention rate trends, in most countries that distinguish between RUs and UASs, RUs tend to have equal or higher graduation rates compared to UASs. The exceptions are Austria, Switzerland, and Germany, where UASs show higher retention rates than RUs.
- While Switzerland, the Czech Republic, and the Netherlands show an overall stable trend in graduation rates (Figure 19), UASs in these countries exhibit a decreasing pattern (Figure 30). In contrast, UASs in Bulgaria and Germany show stable graduation rate trends, whereas the overall graduation rates in these countries are decreasing (Figure 20).

5. Assumptions and Limitations

Calculating retention and graduation rates is not as straightforward as it would seem to be. Although great care was taken to understand and clean the data, there are some assumptions about, and inherent limitations to, both the data and the method used to compute these statistics.

On the general level and as noted in the Introduction, we are not aware of any other similar study covering the European Higher Education area. This means that, while we took several measures to avoid bias or errors in both the employed data and the calculations, we were not able to validate the results against an independent dataset or study.

5.1 Data limitations

Higher education systems in individual European countries differ, sometimes rather substantially (despite the fact that the Bologna system is being used everywhere). Consultations with national experts are therefore needed before the data is entered into the dataset and interpreted. Based on those consultations, the IEHE Data Portal provides detailed information on each country data¹⁵.

Several of these data limitations are important in this study:

- With respect to separate RUs vs UASs treatment, not all countries distinguish these two types of HE institutions. Some systems do not have UASs at all (Italy, the UK), in some (Bulgaria, Czech Republic, Norway, Ireland) there are HE institutions which do not necessarily fit into the “applied sciences” category but have been included as such due to their overall focus on more practical education. In the UK, former “polytechnics” (which would fit into the UAS category) were changed after 1992 into universities, but “many have retained their original ethos by focusing on teaching for professional practice”¹⁶ and so the RU data of the UK may be influenced by this status.
- Some national statistics offices use the ISCED-F classification to structure the fields of HE, whereas in several countries a specific classification scheme is used (e.g. Germany, the UK), and in the third set of countries data is available per study programme and no official nomenclature is used (Estonia, the Netherlands, Portugal, Norway, etc.). In the last case, we relied on expert classification of the data before including them in the dataset. Even for the countries which do use ISCED-F, assignment of individual study programmes to the appropriate class is done by different methodologies in different countries. This makes it somewhat difficult to align the data between these groups (see the details in Section 3.2) and therefore comparisons between countries should be made with caution.
- Another data limitation is related to the definition of the year of study enrolment and degree

¹⁵ See footnotes on the “Statistics” pages of the Data Portal.

¹⁶ [https://en.wikipedia.org/wiki/Polytechnic_\(United_Kingdom\)](https://en.wikipedia.org/wiki/Polytechnic_(United_Kingdom))

completion. While statistical offices of some countries report the numbers of students and graduates based on the calendar year (i.e. Czech Republic, Denmark, Finland, Norway, the Netherlands), the offices of other countries use either academic years (starting in autumn of a given year and finishing in summer of the next year, i.e. Estonia, Portugal, the UK) or a mix of both academic (when reporting the number of students enrolled) and calendar years (when reporting the graduates' numbers), like Austria, Bulgaria, Germany, Ireland, and Switzerland. This should not affect the overall trends significantly, but again the comparison between countries should be made with caution, especially for the graduation rates.

- There are several country-specific limitations in the dataset.
 - For Bulgaria's retention data, the data point for year 2021/2022 was missing; for the purpose of creating unified graphs in this report, we used the average of all available years (2013 to 2020) for these values.
 - In Italy, Informatics degree programmes exist both in Science faculties and in Engineering faculties. For Science faculties, the bachelor degree in Informatics is represented in the Italian statistical office as "*Class L-31 – Scienze e Tecnologie Informatiche*". For Engineering faculties, the bachelor degree in Informatics Engineering falls within a larger group of degree programmes which are collectively represented in the Italian statistical office as "*Class L-08 – Ingegneria dell'Informazione*", which includes, beyond Informatics Engineering, also other kinds of bachelor degrees: in Electronic Eng., Electric Eng., Telecommunication Eng., Automation Eng., Management Eng., and so on, which later – at the master level – have different master degree programmes. Therefore, to precisely understand what each actual degree programme in class L-08 is about one should look at the actual name of the programme: however, even this might not be enough, if the actual name of the programme remains the generic label "*Ingegneria dell'Informazione*". For this reason, our analysis for Italy has considered data only for "*Class L-31 – Scienze e Tecnologie Informatiche*" and therefore does not represent the full population of Informatics students in Italy.
- For some countries, it was not possible to perform the study due to (some) data not being available – this is the case of e.g. Belgium, France or Greece. Details on the reasons can be found in the notes on the IE dataset.

5.2 Assumptions and Limitations of the Methodology

As explained in Section 3, both the retention and graduation rates are an approximation. There is no direct data on student retention or the retention rate for our field of study in any of the country datasets, and similarly for graduation rate (although all the countries report the number of students graduating each year).

Our calculation of retention rate is based on the assumption (see the formulas in Section 3) that all students in the final year of study actually graduate. This is an over-approximation – in reality, the number of "in time graduating" students is smaller than G_x – since there certainly are students quitting the study in the final year, not graduating, and students who prolong their study and graduate a year (or more) later. The retention rates may in reality thus be slightly higher than the ones reported here.

The graduation rate calculation uses 4 years as the period which represents the length of study in the dataset, which is a simplification – see Section 3.3.2 for details as well as the Higher Education Systems page¹⁷ of the IEHE Data Portal.

Furthermore, some country data report on "students finishing their studies" – rather than "students graduating" – and this includes students graduating with a diploma and students quitting their studies prematurely. The calculations could not take these differences into account.

17 <https://www.informatics-europe.org/data-portal/?page=higher-education-systems/index.html>

Likewise, the “number of first-year students” (F_x) is sometimes defined, in the source datasets, varyingly as the number of students entering the given level of study for the first time or, which is not the same, as the number of students enrolling in the first year of a study programme. The reason is that students who had dropped from a (same or different) programme and entered a new (Informatics) one are not included in the former number. The F_{x+1} used in our calculations is, therefore, for some countries, a lower bound of first-year informatics students.

All these factors contribute to potentially imprecise retention and graduation rate figures, as reported here. We are unfortunately not aware of any directly collected statistics of actual retention and graduation rates, e.g. for a given country, that would enable us to understand the difference and at least partially correct the results.

6. Conclusions

This report provides a first-of-its-kind pan-European analysis of enrolment, retention, and graduation rates in bachelor-level Informatics programmes across 13 countries from 2010 - 2023, based on data taken from the Informatics Europe Higher Education (IEHE) Data Portal which was launched in 2019. The findings highlight insights into Europe’s capacity to attract and retain students in Informatics, a field where the demand for skilled professionals continues to outpace supply.

The available dataset covers 23 European countries for the past 13 academic years (2010/11 - 2022/23). Our analysis covers 13 countries and shows distinct trends based on country groupings, gender, institution type, and regional variations. This reveals that European higher education institutions are influenced by both commonalities and unique national characteristics.

The gender-based retention data is interesting. It indicates that the gap between women and men depends on the countries. There exist countries where women’s retention is higher than men’s retention almost continuously. However, there exist countries for which men show better retention than women. Moreover, differences between research universities (RUs) and universities of applied sciences (UASs) underscore diverse educational pathways across Europe, reflecting varying institutional goals and student career trajectories.

This study is limited by the diversity of definitions and classification systems used across countries, as well as inherent differences in national educational structures, all of which necessitate careful interpretation of cross-national comparisons. Nevertheless, the findings in this report shed light on the state of Informatics education in Europe, offering valuable insights and incentives for further analysis to policymakers, educators, and institutions.

We hope our work will contribute to strengthening Europe’s academia and technological workforce and supporting policies that help students in successfully completing their studies on time. Further studies could refine these results by validating findings against national reports, expanding the dataset to include additional countries and variables, and looking more deeply into the causes of the particular values and/or trends in retention or graduation in selected countries.

Based on the experiences we gained through the work on this report, we would also recommend that European countries validate with relevant organisations the definition of Informatics used when collecting the national statistics, and align the fields-of-study classifications among countries on the European level.

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Appendix

Tabular data for the graphs presented in Section 4. The following country abbreviations are used: AT = Austria, BG = Bulgaria, CZ = Czech Republic, EE = Estonia, FI = Finland, DE = Germany, IE = Ireland, IT = Italy, NL = the Netherlands, NO = Norway, PT = Portugal, CH = Switzerland, UK = the United Kingdom.

Table 1: Computed Retention Rate (in%, at both RU and UAS)

		2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
AT	total	81.5	81.4	80	83.3	87.8	81.6	81.4	83	82.8
	male	83.2	83.2	81.4	84.8	87.8	83.2	82.6	83.9	83.7
	female	73.6	73.2	73.9	76.6	87.8	75.2	76.8	79.3	79.2
BG	total	86.6	88.6	89.9	85.5	88.2	90.4	88	86.1	n.a.
	male	84.3	87.8	88.7	84.2	86.3	90.1	87.8	85.1	n.a.
	female	91.7	90.2	92.7	88.7	92.9	91.1	88.4	88.7	n.a.
CZ	total	77.8	75.6	79.6	79	78.8	77.9	79.7	77.7	80.4
	male	77.6	76	79.3	79.2	78	78.1	78.8	77.6	80
	female	79.1	72.8	81.3	78.2	83	77.1	84.8	77.9	82.6
EE	total	80.7	79.8	80.3	79	83	84.1	86.8	83.3	84
	male	80	79.9	79.7	78.9	82.7	84.1	87.1	83.5	81.9
	female	82.9	79.3	82.2	79.2	83.7	84.3	86.1	82.8	91.8
FI	total	88.7	89.3	89.3	94.4	90.9	91.2	91.7	91.6	92.1
	male	88.9	89.3	89.5	94.5	90.3	90.5	91.9	91.4	91.6
	female	87.5	89.6	88.4	93.8	93.9	94.6	90.9	92.2	93.6
DE	total	86.8	86.2	86.7	85.9	85.4	85.9	87.5	88	88.2
	male	87.5	86.9	87.5	86.9	86.2	86.4	88.1	88.9	88.4
	female	84	83.4	83.6	82.4	82.6	83.7	85.1	85	87.7
IE	total	83.3	82.7	83.4	88.7	89.7	87.6	94.2	91.9	94.2
	male	82.6	82	82.5	88.1	88.3	86	94.5	89.9	93.9
	female	86.9	86.3	88	91.4	96.7	95.1	93	101.9	95.7

IT	total	88.6	88.5	89.6	89.9	89.9	89.8	88.3	86.9	90.9
	male	89.2	88.9	89.7	89.9	89.6	89.6	88	86.8	90.6
	female	84.2	85.7	88.6	89.3	91.9	91.3	90.2	87.7	92.6
NL	total	92.5	93.9	95.6	92.3	93.9	95.9	95.7	95.0	94.7
	male	91.8	93.2	94.9	91.5	93.2	95.4	95.1	94.5	94.2
	female	95.5	96.8	98.6	96.1	97.4	98.5	99.1	97.6	97.9
NO	total	87.3	91.1	95	90.5	89.7	99.4	95	94.2	98
	male	87.3	90.2	94	89.2	89.2	98.6	93.9	93.9	98.2
	female	87.6	96.2	100.7	96.4	92.1	102.8	99.1	95.3	97.4
PT	total	88.6	93.9	87.6	91.4	92.5	94.8	93.4	89.8	86.3
	male	88.6	94.2	87	91.3	92.2	94.9	93.5	89.5	86.3
	female	88.8	91.7	91.9	92.1	94.3	93.7	92.6	91.6	86
CH	total	92.5	91.6	91.4	92.1	92.9	90.7	94.1	87.3	91
	male	93.3	92.6	91.2	92.4	93	90.7	94.5	86.8	91.5
	female	86.6	84.1	93	89.6	92.7	91.1	92	90.1	88.6
UK	total	87.5	87.9	87.8	88.8	89.6	90.4	90.5	88.2	87.3
	male	87.1	87.8	87.6	88.5	89.3	89.7	90.3	87.8	87
	female	89.3	88.3	89	90.1	90.9	94	91.2	90	88.9

Table 2: Computed Retention Rate (in%, RU vs UAS)

		2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
AT	RU	81.2	81	82.6	81.6	87.5	80.1	81.3	82.3	81.8
	UAS	82.3	82.5	71.6	88.9	88.7	85.1	81.7	84.7	85
BG	RU	87	88.6	90	85.3	88.2	90.5	88	85.9	n.a.
	UAS	77.4	88.7	88.3	89.3	88.7	89	87.4	88.1	n.a.
CZ	RU	77.4	79.0	78.5	78.8	78.7	77.9	79.4	77.4	80.3
	UAS	82.3	33.1	127.5	86.7	81.8	78.5	87.6	86.2	81.9
EE	RU	81.6	80.4	81.7	81.5	81.8	85	90.5	83.8	84.7
	UAS	79.7	79.1	78.7	75.9	85	82.1	76.2	81.6	80.9
FI	RU	90.4	93.6	89.8	99.4	98	97.2	95.6	97.4	98.4
	UAS	87.4	86.5	89	91.4	86.7	87.6	89.2	88.1	88.2
DE	RU	84	84.2	83.6	82.7	82.6	82.2	84.8	84.6	86
	UAS	89.3	88.1	89.6	89	88.1	89.4	90	91.1	90.1
IE	RU	93.8	91.9	91.9	96.3	96	99.3	100.5	96.7	102.9
	UAS	73.2	73.9	75.4	81.8	84.1	80.9	84.8	87.2	85.4
IT	RU	88.6	88.5	89.6	89.9	89.9	89.8	88.3	86.9	90.9
	UAS	98.2	96.5	96.7	99.6	97.3	92.9	99.5	94.6	96
NL	RU	98.2	96.5	96.7	99.6	97.3	92.9	99.5	94.6	96
	UAS	94.2	94.7	95.5	95.0	93.2	92.1	94.5	93.6	91.4
PT	RU	90.2	93.3	91.7	92.5	93	98.4	94.9	89.6	88.1
	UAS	86.1	94.8	82.1	89.9	91.7	90	91.3	90	83.8
CH	RU	92.3	92.8	90.3	93	91.6	91.6	95.9	92.3	89.8
	UAS	92.6	91.1	91.8	91.7	93.6	90.3	93.3	84.8	91.7
UK	RU	87.5	87.9	87.8	88.8	89.6	90.4	90.5	88.2	87.3

Table 3: Computed Graduation Rate (in%, at both RU and UAS)

		2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
AT	total	38.2	39.3	39.2	35.3	36.2	40	49.5	55.3	48.6	43
	male	42	40.3	41.2	37.4	38.4	42	51.7	55.6	51	45.1
	female	25	35.3	31.3	27.9	28.9	33.3	41.9	53.9	40.9	36.2
BG	total	66.6	60	59.4	46.3	54.5	56.9	51.5	54.1	56.4	55.4
	male	56.2	56.6	54.5	41	48.7	53.4	49.3	52.3	51.3	51.2
	female	90.3	67.2	69.6	58.5	69.2	65.8	57.1	58.3	69	66.6
CZ	total	40.9	41.3	41	37.3	38.4	41	38.7	41	41.9	39.3
	male	40.7	40.9	40.5	37	38.2	40.9	38.3	40.7	41	38.7
	female	42.7	43.7	44.2	39.3	39.7	41.8	40.4	42.5	47	42.4
EE	total	34.4	36.9	41.1	49.8	40.4	44.3	42.1	64	47.8	46
	male	31.7	33.9	39.5	48.9	40.8	42.7	39.6	66	47.4	43.6
	female	44.9	48.5	46.6	52.2	39.2	48.6	48.5	58.2	49.1	53.7
FI	total	52.9	50.6	57.3	62.3	52.3	60.5	64.4	69.1	64.2	60.8
	male	54	50.3	57.7	60.8	51.1	59.1	63.6	67	62.6	60.1
	female	47.7	51.9	55.4	69.9	58.7	67.1	68.1	77.8	69.3	63
DE	total	54.6	45.6	46.1	43	40.2	38.6	39.5	39.3	42.3	43.8

	male	56.6	47.1	48.3	45	41.8	40.4	41	40.4	43.1	45.3
	female	46.4	39.2	38.2	36.1	34.7	32.7	34.7	35.6	39.5	38.8
IE	total	50.8	47.2	49.9	55.1	58.4	57.5	61.2	68.9	77.8	61.7
	male	50	47.1	48.6	54.1	56.3	56.7	58.9	64.8	77.2	59.1
	female	55.3	47.8	57.5	60.4	70.1	61.6	73.5	92	80.7	74.7
IT	total	38.5	40.8	47.5	46.3	54.5	52.9	52.1	49.3	48.5	50.3
	male	38.4	40	47.5	46.8	54.4	52.5	52.1	48.5	47.3	50
	female	39.1	45.8	47.8	42.8	55.1	55.4	52.2	54.9	57	52.6
NL	total	68.7	64.6	68.5	66.5	71.9	68.9	67.6	69	69.3	67.1
	male	66.4	62.9	66.	64.4	70.4	66.5	66.4	67.2	66.9	64.7
	female	78.6	71.7	79.7	76.1	80.2	81.7	74.2	79.5	85.1	84.3
NO	total	55.8	59.9	58.7	51.5	60.5	66.8	84.4	89.6	83.7	82.7
	male	55.8	59.1	57.7	51.2	60.7	66.8	83.9	87.8	81.8	79.8
	female	55.8	64.9	64.5	52.9	59.4	67.1	86.8	98.8	91.2	93.6
PT	total	52.5	53.6	57.5	59.3	68.4	66.5	74.9	74.2	76.2	66.7
	male	50.6	52.9	57.8	59.1	66.5	66	75.1	71.6	76.1	67.5
	female	70.7	59.7	55.8	60.5	81.4	69.8	73.5	91.4	77.1	62.3
CH	total	67.5	64.5	66	69.4	68.7	65.2	67.6	66	68.5	63.7
	male	70.4	65.5	66.7	71.8	70.8	66.9	69.6	66.8	70	65.1
	female	45.3	56	60.9	52.8	54.4	53.8	54.1	61.7	60.4	56.4
UK	total	57.3	58.4	66.9	66.1	68.5	69.6	67.2	71.9	74.1	69.6
	male	58.4	58.4	66.8	66.2	68.4	68.9	66.6	70.4	72.9	69.0
	female	52.3	58.6	67.5	65.5	68.9	73.7	70.7	80.2	80.6	72.9

Table 4: Computed Graduation Rate (in%, RU vs UAS)

		2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
AT	RU	25.4	26.1	30.9	26.8	25.4	26.7	39.8	43.3	37.5	32.2
	UAS	62.8	62.2	53.1	51.2	58	67.5	64.2	73.5	64.2	62.3
BG	RU	68.1	59.3	60.2	46.7	57.3	58.3	49.9	54.5	57.3	57.1
	UAS	42.6	73.6	47.2	38.7	9.2	28.4	121.7	47.5	46.8	38.3
CZ	RU	39.7	41.1	40.8	38.6	39.3	41.3	39	41.5	41.9	39.8
	UAS	63.2	44	44.5	12.1	16.3	26.2	26.2	22.1	39.9	23.1
EE	RU	39.8	40.3	45.7	55.4	44.8	51.5	57.6	58.6	46.5	46.8
	UAS	29.5	33.7	35.7	42.5	33.9	35.1	22.6	91.8	54	42.5
FI	RU	70.5	62.7	78.2	99.5	70.3	74	81.9	99.7	84	82.8
	UAS	42.8	53.6	53.4	59.3	50.3	58.6	61.4	62.1	64.8	52.1
DE	RU	50.4	37.8	37.6	31.7	30.1	27.5	30.1	27.4	31.8	33.9
	UAS	58	52.5	53.5	53.9	50.1	50	49.3	51.5	52.5	53
IE	RU	74.4	65.6	66.9	84.9	78.5	84.3	86.8	92.4	103.1	84.6
	UAS	41.3	39.2	41.9	41.7	47.8	43.7	48.4	56.2	62.5	47.3
IT	RU	38.4	40.8	47.5	46.3	54.5	52.9	52.1	49.3	48.5	50.3
NL	RU	63.1	73.3	77.8	76.6	80.7	82.3	80.4	85.2	74	80.4
	UAS	67.8	68.6	67.3	65.6	66.1	69.3	62.7	64	61.4	64.5
PT	RU	64.3	54.8	65	62.9	79.1	77	85.6	84.4	86	69.9

	UAS	37.9	51.6	47.5	54.1	55.5	54.3	61.2	61.2	63.3	62.3
CH	RU	52.8	54.7	60.8	63.1	61.7	67.2	62	64.9	68	64.2
	UAS	73.8	68.9	68	71.9	71.7	64.4	69.8	66.5	68.7	63.5
UK	RU	57.3	58.4	66.9	66.1	68.5	69.6	67.2	71.9	74.1	69.6

Table 5: Descriptive statistics for the Retention data

	AT	BG	CH	CZ	DE	EE	FI	IE	IT	NL	NO	PT	UK
slope	0.002	0.000	-0.002	0.003	0.002	0.007	0.004	0.015	0.000	-0.003	0.010	-0.001	0.001
intercept	0.818	0.880	0.925	0.774	0.859	0.795	0.895	0.823	0.890	0.954	0.893	0.914	0.882
min	0.800	0.855	0.873	0.756	0.854	0.790	0.887	0.827	0.869	0.923	0.873	0.863	0.873
avg	0.825	0.879	0.915	0.785	0.867	0.823	0.910	0.884	0.892	0.944	0.934	0.909	0.887
median	0.816	0.880	0.916	0.788	0.867	0.830	0.912	0.887	0.896	0.947	0.942	0.914	0.882
max	0.878	0.904	0.941	0.804	0.882	0.868	0.944	0.942	0.909	0.959	0.994	0.948	0.905
slope, male	0.001	0.001	-0.003	0.002	0.002	0.006	0.003	0.015	-0.001	-0.003	0.011	-0.001	0.001
intercept, male	0.834	0.864	0.931	0.775	0.867	0.794	0.897	0.815	0.894	0.949	0.885	0.913	0.879
min, male	0.814	0.842	0.868	0.760	0.862	0.789	0.889	0.820	0.868	0.915	0.873	0.863	0.870
avg, male	0.838	0.868	0.918	0.783	0.874	0.820	0.909	0.875	0.891	0.938	0.927	0.908	0.883
median, male	0.832	0.868	0.924	0.781	0.875	0.819	0.905	0.881	0.896	0.942	0.939	0.913	0.878
max, male	0.878	0.901	0.945	0.800	0.889	0.871	0.945	0.945	0.906	0.954	0.986	0.949	0.903
slope, female	0.008	-0.003	0.004	0.006	0.004	0.010	0.006	0.016	0.007	-0.003	0.007	-0.001	0.002
intercept, female	0.743	0.916	0.881	0.773	0.826	0.797	0.891	0.864	0.861	0.985	0.938	0.920	0.894
min, female	0.732	0.884	0.841	0.728	0.824	0.792	0.875	0.863	0.842	0.955	0.876	0.860	0.883
avg, female	0.773	0.906	0.898	0.796	0.842	0.836	0.916	0.928	0.891	0.975	0.964	0.914	0.902
median, female	0.766	0.906	0.901	0.791	0.837	0.829	0.922	0.930	0.893	0.976	0.964	0.919	0.900
max, female	0.878	0.929	0.930	0.848	0.877	0.918	0.946	1.019	0.926	0.991	1.028	0.943	0.940

Table 6: Descriptive statistics for the Graduation data

	AT	BG	CH	CZ	DE	EE	FI	IE	IT	NL	NO	PT	UK
slope	0.015	-0.008	0.000	0.000	-0.010	0.017	0.014	0.026	0.011	-0.001	0.041	0.025	0.016
intercept	0.357	0.598	0.667	0.401	0.481	0.370	0.528	0.471	0.430	0.688	0.512	0.537	0.598
min	0.350	0.460	0.640	0.370	0.390	0.340	0.510	0.470	0.380	0.646	0.510	0.520	0.570
avg	0.423	0.560	0.667	0.400	0.434	0.446	0.593	0.588	0.479	0.682	0.695	0.650	0.669
median	0.395	0.555	0.665	0.410	0.425	0.430	0.605	0.575	0.485	0.686	0.640	0.670	0.675
max	0.550	0.670	0.690	0.420	0.550	0.640	0.690	0.780	0.540	0.719	0.900	0.760	0.740
slope, male	0.014	-0.004	-0.001	-0.001	-0.012	0.019	0.013	0.023	0.011	-0.001	0.038	0.026	0.014
intercept, male	0.382	0.532	0.689	0.401	0.500	0.351	0.531	0.467	0.427	0.667	0.514	0.528	0.604
min, male	0.370	0.410	0.650	0.370	0.400	0.320	0.500	0.470	0.380	0.629	0.510	0.510	0.580
avg, male	0.444	0.513	0.684	0.398	0.448	0.435	0.587	0.573	0.475	0.662	0.686	0.643	0.665
median, male	0.420	0.515	0.685	0.410	0.440	0.420	0.595	0.565	0.475	0.664	0.640	0.660	0.675
max, male	0.560	0.570	0.720	0.410	0.570	0.660	0.670	0.770	0.540	0.704	0.880	0.760	0.730
slope, female	0.018	-0.016	0.008	0.000	-0.005	0.008	0.022	0.037	0.016	-0.008	0.049	0.014	0.026
intercept, female	0.272	0.743	0.518	0.421	0.397	0.454	0.528	0.507	0.431	0.829	0.517	0.637	0.573
min, female	0.250	0.570	0.450	0.390	0.330	0.390	0.480	0.480	0.390	0.717	0.530	0.560	0.520
avg, female	0.354	0.672	0.555	0.423	0.376	0.491	0.629	0.675	0.503	0.791	0.736	0.702	0.691
median, female	0.340	0.670	0.550	0.420	0.370	0.490	0.650	0.660	0.525	0.796	0.660	0.705	0.700
max, female	0.540	0.900	0.620	0.470	0.460	0.580	0.780	0.920	0.570	0.851	0.990	0.910	0.810

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