

## DATA SCIENCE LABOR MARKET ANALYSIS: UNDERSTANDING THE SHIFT TOWARDS REMOTE AND HYBRID WORK

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### ABSTRACT

*It is certain that the pandemic has forced changes in the way work is carried out. Numerous companies, but also many employees have understood that you don't necessarily need to be in the office to be productive. However, now in the post-pandemic era remote work remains a reality or perhaps a necessity. Some employees refuse to come back to fully on-site jobs, especially for those jobs that can be done remotely without hindrances. The aim of this study is to perform an in-depth analysis of the Data Science entry-level job market with the purpose of understanding what graduates in this field are faced with and expected of (in terms of skills required) when first employed. We choose to focus on the data science job market because these roles are expected to be remote-capable jobs, and we chose to analyze entry-level jobs to understand what companies' hiring policy is now, in the post-pandemic era. One of our main findings is that the year 2022 is the richest in fully remote jobs, suggesting the interest for remote jobs is not decreasing, rather the opposite. Hybrid work has also registered increases, this being probably the ideal compromise solution between on-site and remote work, thus avoiding the risks that forcing a return to fully on-site work would involve.*

**KEYWORDS:** *data science, entry-level, hybrid work, remote-capable job.*

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### 1. INTRODUCTION

The last decades have seen a substantial change in the labor market. Employee expectations have changed, skilled employees are more selective, and companies frequently face labor shortages (Listingart, 2022; Maurer, 2021). Moreover, the covid pandemic has put additional pressure on the labor market, companies have been forced to switch to remote work, and now that the pandemic is no longer an obstacle, employees no longer want to return to office work, especially those whose work, due to its specificity, lends itself to remote work (Global HR Manager, 2022). There are companies that try to convince employees through various initiatives to return to the office without forcing them (pizza day, games day etc.). Certainly, the pandemic has produced categorical changes in the workplace and employees who can do their job remotely are „largely anticipating a hybrid office environment going forward” (Wigert, 2022). According to a 2022 Gallup survey, a staggering nine in ten of the remote-capable workers whose job can be done remotely at least part of the time want to be fully remote or hybrid (Brecheisen, Truscott-Smith, & Wigert, 2022).

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The aim of this study is to perform an in-depth analysis of the Data Science entry-level job market with the purpose of understanding what graduates in this field are faced with and expected of (in terms of skills required) when first employed. We choose to focus on the data science job market because these roles are expected to be jobs that can be done remotely. Furthermore, we focused on entry-level jobs to analyze and illustrate what companies' hiring policy is now, post-pandemic, regarding young (new) employees.

## 2. DATA AND DOCUMENTATION

### 2.1. Research design

The aim of this study is to perform an in-depth analysis of the Data Science entry-level job market with the purpose of understanding what graduates in this field are faced with and expected of (in terms of skills required) when first employed. Our paper is developed around two main research questions:

RQ1: How are companies handling the remote-capable job nowadays?

RQ2: Is remote or hybrid work a better solution for remote-capable job?

To solve the two formulated questions, the following steps have been taken:

- Literature review and content analysis. For this we analyzed the most recent publications analyzing the labor market for entry-level employees and graduates from the Web of science Core Collection. For topicality, we focused on publications from the last 5 years (2017-2022).
- Analysis of the data science job market (international and local). We first analyzed the international data science job market, after which we shifted our focus to the Romanian job market. We choose to focus on the data science job market because these roles are expected to be jobs that can be done remotely. Furthermore, we focused on entry-level jobs to analyze and illustrate what companies' hiring policy is now, post-pandemic, regarding young (new) employees. Python (a multi-paradigm dynamic programming language) was used for data analysis and processing in this second part.

### 2.2. Theoretical background

The articles for the literature review and content analysis were selected from Web of Science Core Collection for illustrative purposes and were published from 2017 to 2022. Because there were not prior articles published on data science labor market analysis, we focused on analyzing publications tackling the labor market for entry-level employees and graduates.

Daly et al studied the level of satisfaction perceived by the Pharmacy/MBA Professional, in relationship with their careers. The results of their study showed that a significant majority of the respondents perceived the combination of the degrees as being satisfactory, thinking of themselves as being more competitive in the job market (Daly, Tierney, O'Brien, Fiebelkorn, & Jacobs, 2017).

Yue, Yue and Zhang documented the allocation of the college-graduated skilled labor force in China over the 2003-2013 period. An interesting conclusion was that the public sector concentrated most of the skilled labor force in contrast to private enterprises (Yue, CJ; Yue, SY; Zhang, J, 2017).

Wiersma and Kappe have concentrated their efforts on the existing differences between extroversion and conscientiousness. Their findings revealed that, in terms of starting salary and salary growth, these two notions are behaving in an opposite way, moreover, "conscientious employees grow their salaries quicker because they are intrinsically motivated and well organized". In the recruiting process, the extroversion is being sought, while in terms of reward, conscientiousness is the key (Wiersma & Kappe, 2017).

Schlee and Karns in their article have explored the relationship between the required skills, knowledge and personal attributes, on one hand, and the different salary levels, on the other (Schlee

& Karns, 2017). The results of the research pointed out that there are some certain changes in the expectations, expressed by the companies' recruiters, regarding the level of the graduates' skills.

Butum and Nicolescu studying globalization, competences and economic competitiveness concluded that employees could have increased abilities due to international education (Butum & Nicolescu, 2018).

Keralis et al have been concerned with the global health job market, finding that the employers are interested in acquiring employees with certain history in the field, illustrated by several years of experience, while young graduates have few to none chance to occupy a position in this sector (Keralis et.al, 2018). Based on the same perspective, of the employability of the recent graduates, regardless of the level, but mostly focused on MBA, Bansal has conducted a research that showed a lack of ability to identify the required skills graduates should possess in order to fill in an entry-level position in a company (Bansal, 2018). Author considers that "Management education today has to address a wide variety of critical issues, one of survival, intense competition, serving the needs of stakeholders, delivering industry employable graduates and in the process of doing all this develop brand equity" (Bansal, 2018). A similar problem is addressed by Seth whose study identifies gaps between the perception regarding "students' workplace skills" (Seth, 2020).

Cherednichenko (2020) on the other hand, performs a comparative analysis of the labor market outcomes i.e., graduates of both college and vocational school level. The problem pointed out in this article is the perceived readiness for the job market of graduates. Some interesting findings are related to the combination between study and work, combination said to provide a competitive advantage in the job market. However, it seems that "about two thirds of college graduates and two fifths of vocational school graduates being mismatched to their jobs". Further, "Over one third of college graduates and over two fifths of mid-level specialists found themselves overeducated in their first jobs" (Cherednichenko, 2020).

A regional perspective is provided by Sehgal and Nasim, who studied the Information Technology Sector in India. Authors have investigated the employers' demands in this sector, providing possible candidates for a job with the possibility to better understand these demands (Sehgal & Nasim, 2020).

Discrimination on the labor market is a current topic even today, with many researchers focusing their attention on this aspect. Moreover, goal 5 of the 17 Sustainable Development Goals refers to gender equality, but considerable efforts must be made worldwide in this regard. The possible occurrence of some discriminatory behavior is discussed by other researchers, such as: Balakrishna (2021) who discusses whether information technology education in India is gender-inclusive or not (Balakrishna, 2021), Mihut (2022) in an article that questions the university prestige as a driver for discrimination (Mihut, 2022); Hendley (2021) who analysis the possible discrimination related to the existence of personal connections and their role in finding a job as a graduate in Russia (Hendley, 2021) and Osten (2021) that scrutinizes Canadian job market through gender differences for new engineer graduates (Osten, 2021).

### **2.3. Results and discussion**

As previously stated, the aim of this study is to perform an in-depth analysis of the Data Science entry-level job market with the purpose of understanding what graduates in this filed are faced with and expected of when first employed. This section will address RQ1: How are companies handling the remote-capable job nowadays? For this, we first analyzed the international data science job market, and then we shifted our focus to the Romanian job market. Phyton was used for data analysis and processing.

#### *International perspectives on the data science job market*

To analyze the international data science job market a public Data science job salaries dataset available on Kaggle was used (Data Science Job Salaries, 2022). The dataset comprises data from

2020 to 2022. In this section aspects like salary, remote/hybrid/on-site ratio jobs, distribution by countries and others.

Clearly, data health is highly important. A quick check in the dataset for empty, “NaN” or corrupted data entries has yielded empty sets. Therefore, the data at hand is healthy and ready for preprocessing.

To get an idea of what the salary dataset looks like, the “head” and “tail” functions have been used exploratorily.

```
[6] #importing dataset from csv
in_data = pd.read_csv('data/ds_salaries.csv')
in_data.head()
```

Unnamed: 0	work_year	experience_level	employment_type	job_title	salary	salary_currency	salary_in_usd	employee_residence	remote_ratio	company_location	company_size
0	2020	MI	FT	Data Scientist	70000	EUR	79833	DE	0	DE	L
1	2020	SE	FT	Machine Learning Scientist	260000	USD	260000	JP	0	JP	S
2	2020	SE	FT	Big Data Engineer	85000	GBP	109024	GB	50	GB	M
3	2020	MI	FT	Product Data Analyst	20000	USD	20000	HN	0	HN	S
4	2020	SE	FT	Machine Learning Engineer	150000	USD	150000	US	50	US	L

```
[7] in_data.tail()
```

Unnamed: 0	work_year	experience_level	employment_type	job_title	salary	salary_currency	salary_in_usd	employee_residence	remote_ratio	company_location	company_size
602	2022	SE	FT	Data Engineer	154000	USD	154000	US	100	US	M
603	2022	SE	FT	Data Engineer	126000	USD	126000	US	100	US	M
604	2022	SE	FT	Data Analyst	129000	USD	129000	US	0	US	M
605	2022	SE	FT	Data Analyst	150000	USD	150000	US	100	US	M
606	2022	MI	FT	AI Scientist	200000	USD	200000	IN	100	US	L

**Figure 1. A first view of the dataset**  
 Source: own elaboration using Python

At first sight (see Figure 1), a few observations can be drawn. One would firstly notice the redundant index column. Moreover, to make the studied dataset more accessible, the values on the “remote\_ratio” column should be replaced with some more suggestive ones. Keeping in mind that 0 = on site, 50 = hybrid and 100 = remote, these substitutions have been performed.

```
[11] in_data.remote_ratio.replace([0, 50, 100], ['on-site', 'hybrid', 'remote'], inplace=True)
in_data.head()
```

work_year	experience_level	employment_type	job_title	salary	salary_currency	salary_in_usd	employee_residence	remote_ratio	company_location	company_size
2020	MI	FT	Data Scientist	70000	EUR	79833	DE	on-site	DE	L
2020	SE	FT	Machine Learning Scientist	260000	USD	260000	JP	on-site	JP	S
2020	SE	FT	Big Data Engineer	85000	GBP	109024	GB	hybrid	GB	M
2020	MI	FT	Product Data Analyst	20000	USD	20000	HN	on-site	HN	S
2020	SE	FT	Machine Learning Engineer	150000	USD	150000	US	hybrid	US	L

**Figure 2. The dataset containing more explicit entries in regard with remote ratio**  
 Source: own elaboration using Python

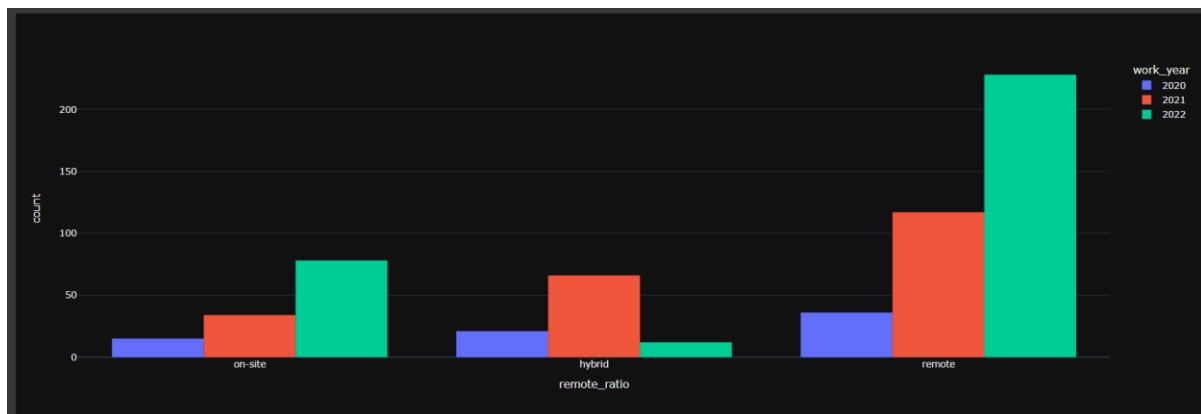
After removing the redundant index column, a quick statistical analysis (see Figure 3) yielded the following results.

```
in_data.describe()
```

	work_year	salary	salary_in_usd
count	607.000000	6.070000e+02	607.000000
mean	2021.405272	3.240001e+05	112297.869852
std	0.692133	1.544357e+06	70957.259411
min	2020.000000	4.000000e+03	2859.000000
25%	2021.000000	7.000000e+04	62726.000000
50%	2022.000000	1.150000e+05	101570.000000
75%	2022.000000	1.650000e+05	150000.000000
max	2022.000000	3.040000e+07	600000.000000

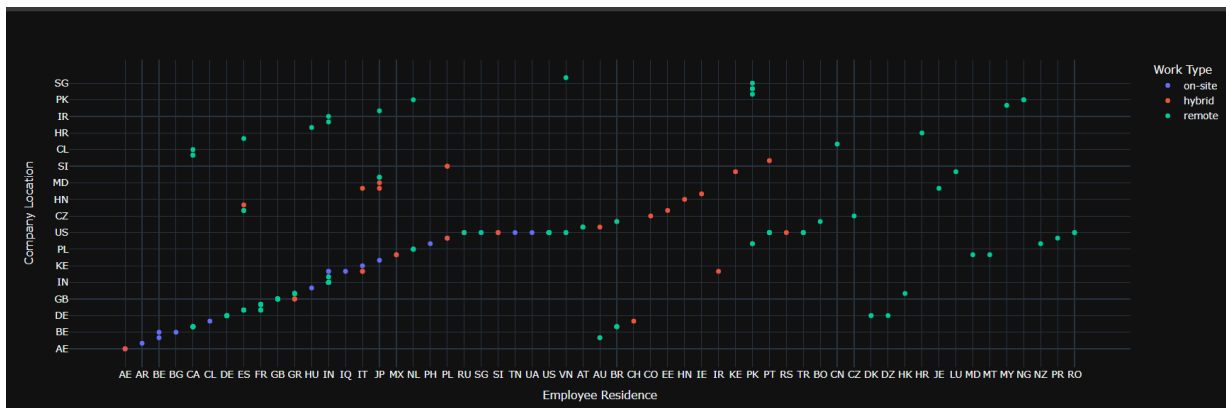
**Figure 3. An initial statistical description of the studied data**  
Source: own elaboration using Python

A few observations can be drawn from this analysis. Firstly, the “salary” column is useless to the present study since the given amounts are in different currencies. Therefore, all the focus shall be directed towards the salaries given in USD. Moreover, given the present middle quartile, it can be concluded that about half of the salaries in the present dataset are above 100,000 USD. Moving on with the data analysis, during the relatively recent Covid pandemic, the number of hybrid or fully remote jobs skyrocketed. Therefore, an interesting aspect to study is the distribution (see Figure 4) of different work regimes (on-site, hybrid, or remote).



**Figure 4. Remote ratio distribution across the three studied years**  
Source: own elaboration using Python

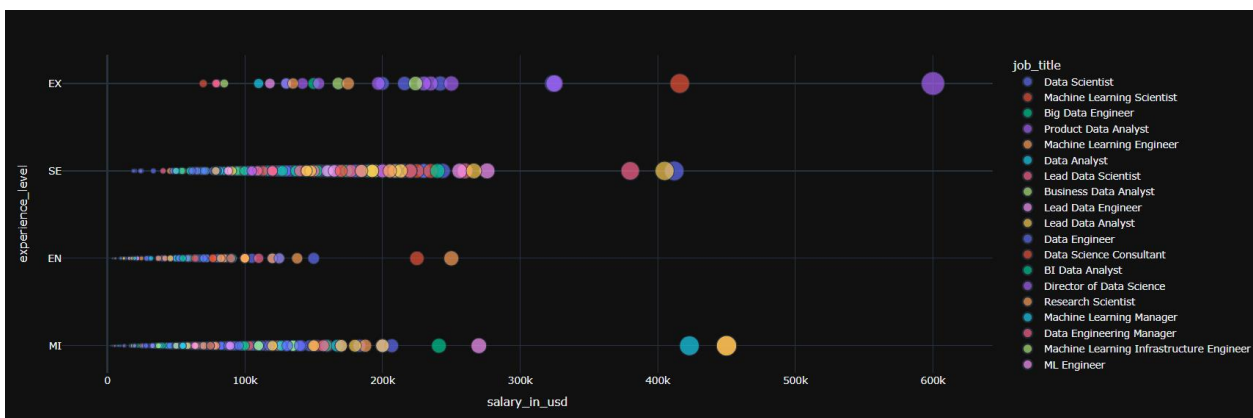
The one aspect that sticks out is that out is that, even though 2022 is generally considered to be the first “post-pandemic” year, *it is the richest in fully remote jobs*. This may be viewed as a direct reflection of the fact that a traditional office environment is not necessary when pursuing a Data Science career. On the same note, most hybrid jobs have been registered in 2021. While this year was technically still a “pandemic year”, the rise in hybrid jobs could be (and most certainly is) a direct implication of the fact that the first batches of Covid vaccines have been distributed then. The next step of this study is to scatter the “employee\_residence” and “company\_location” columns (see Figure 5).



**Figure 5. A scatter plot of employee locations vs company locations**  
 Source: own elaboration using Python

As illustrated in Figure 5, most companies rely on hybrid and remote work, while some have on-site working employees. This emphasizes even more that remote work, hybrid work and fully on-site work coexist. And certainly, the way work is organized in a company is and will be a selection criterion for employees.

Moving on to the study of salaries at hand, a distribution of “salary\_in\_usd” in relation to “experience\_level” and colored by “job\_title” (see Figure 6) has been plotted yielding the following result.



**Figure 6. A scatter of salary in USD vs the level of experience**  
 Source: own elaboration using Python

A valuable piece of the study at hand, this scatter allows one to concretely observe the evolution of salaries based on experience levels and job title. While the spectrum of job titles is immensely wide and certain outliers can be observed (e.g., the yellow dot on the Junior/Mid-level line which is farther to the right than some Senior and Executive-level dots), the “experience ladder” is more than present. To put the mind at ease, however, the outliers and discrepancies noticed in the above salary distribution is to be credited to the dataset’s international nature – different countries have different perceptions of “high” salaries and experience levels.

A next step in the present study is to identify minimums and maximums for each of the given experience levels: Entry (EN), Junior/Mid (MI), Senior (SE) and Executive (EX). Applying specific queries to the dataset at hand has yielded that the Entry-level minimum is 4,000 USD, registered in Vietnam in 2021 for a “Data Scientist” on-site and full-time job. Following that, the Entry-level maximum is 250,000 USD, recorded in the United States of America in 2020 for a “Machine Learning Engineer” hybrid and full-time job.

Moving on to the Junior/Mid-level salaries, the minimum is 2.859 USD, recorded in Mexico in 2021 for a "Data Scientist" on-site and full-time job. The maximum for the same experience level is 450,000 USD and has two entries assigned:

The first one recorded in the United States of America in 2020 for a "Research Scientist" on-site and full-time job.

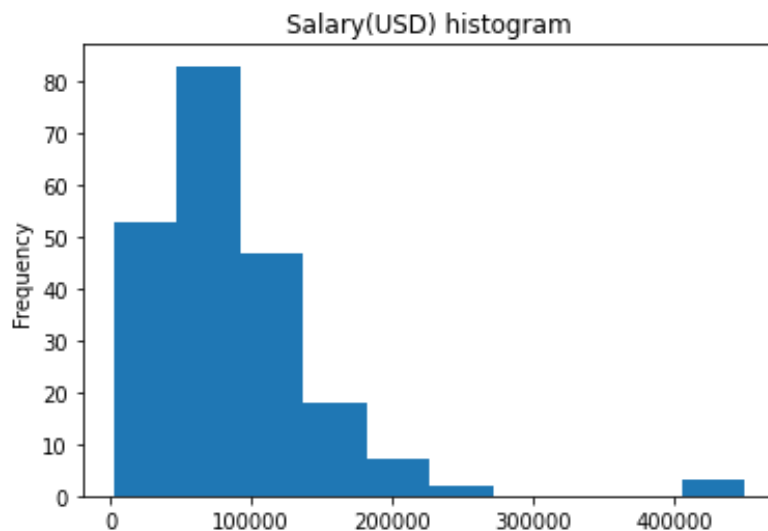
The second one also recorded in the United States of America, in 2021, for a "Financial Data Analyst" remote and full-time job.

Following that, a glance over the Senior-level salaries has yielded that the minimum for said experience level is 18,907 USD, recorded in Brazil in 2021 for a "Computer Vision Engineer" on-site and full-time job. The maximum salary for the same experience level is 412,000 USD, recorded in the United States of America in 2020 for a "Data Scientist" remote and full-time job.

Lastly, the minimum salary for Executive-level jobs is 69,741 USD, recorded in France in 2021, for a "Data Science Consultant" remote and full-time job. The maximum salary for the studied experience level is 600,000 USD, recorded in the United States of America in 2021, for a "Principal Data Scientist" remote and full-time job.

As the data suggests, it follows that the United States of America are currently leading the Data Science market salary-wise, on every experience level. With the abundance of fully remote jobs, one searching for a job in the field ought to be prioritizing these US-based companies.

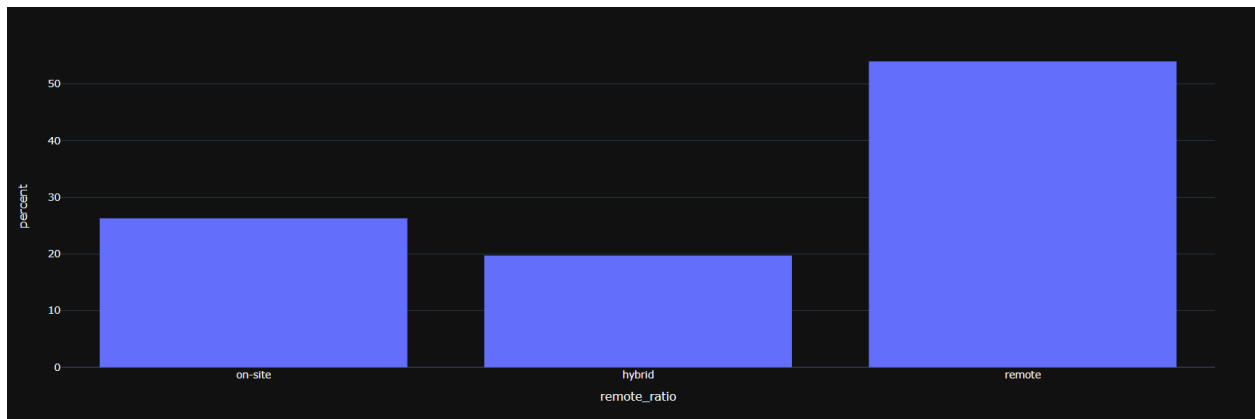
While the entirety of the Data Science market is of utmost relevance, the current section aims to focus on the entry-level/junior level job market. Therefore, applying certain queries on the studied data, the following salary distribution has yielded.



**Figure 7. Salary distribution for the entry/junior experience level**

*Source: own elaboration using Python*

Notice that while most entry-level/junior level salaries dwell below the 300,000 USD mark, some outliers may certainly be found (see Figure 7). Moreover, studying the remote ratio of the current selection, the following distribution has yielded.

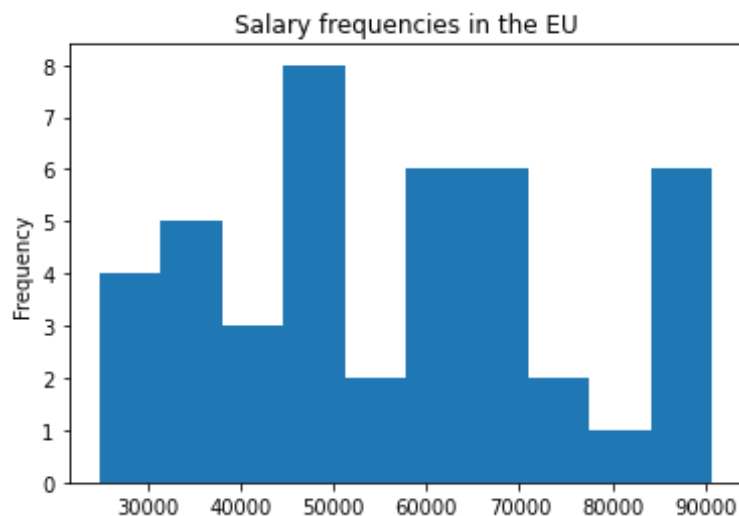


**Figure 8. Remote ratio percentages for entry/junior level jobs**

*Source: own elaboration using Python*

As the graph clearly shows, while most entry-level/junior level jobs are remote, the number of on-site jobs is greater than the number of hybrid ones (see Figure 8).

Next, given that the intellectual origin of the present study is EU-based, the spotlight shall henceforth focus on the data entries based in the European Union. Therefore, a query on said entries has yielded the following salary distribution (see Figure 9).



**Figure 9. Salary frequencies in the EU**

*Source: own elaboration using Python*

Notice that while most salaries dwell between 40,000 and 50,000 USD, the second most can be found in the 60,000-70,000 and 80,000-90,000 USD intervals.

Lastly, the European Union study shall be concluded with a “Top 5 best paying EU countries for Junior Data Scientists” list. Therefore, after applying certain specific queries, the following list has been obtained:

1. Germany
2. Belgium
3. Spain
4. Austria
5. France

Therefore, when getting into the European Data Science market, entry-level/junior level candidates should seek out companies based in these countries for maximizing their income.



Note that there is a hint of noise present in the above word cloud (i.e., that lonesome “s” above the word “experience”), given the fact that the job requirements were untampered with (to achieve maximum accuracy in the present depiction of the market). From this, it is apparent that a Bachelor’s degree, MS Office and analytical skills are a few of the musts when applying for an Entry-level Data Science job. The fact that experience is one of the most frequent requirements in the recruitment ads in Romania is paradoxical considering that the present analysis was based only on those jobs ads that were marked as entry-level.

### 3. CONCLUSIONS

As seen in the above study, the Data Science market is not only flourishing, but metaphorically spilling over with opportunities for all levels of experience. While, rather unsurprisingly, the United States are market leaders, certain European countries are outstanding employers for Entry/Junior-level Data Scientists. Said countries are, listed in descending order: Germany, Belgium, Spain, Austria, and France.

When addressing RQ1: How are companies handling the remote-capable job nowadays? the one aspect that sticks out is that out is that 2022 is the richest in fully remote jobs, even though it is the first post-pandemic year. This might suggest that remote work for remote-capable jobs is nowhere at the end. On the same note, most hybrid jobs have been registered in 2021. Even now, there are numerous companies hiring on fully remote jobs, with this being a trending search criterion of many people looking for a new job.

In Romania, among the most required skills for entry-level data science jobs: experience (which is ironic for entry level jobs that should not typically require prior experience), Bachelor’s degree, MS Office knowledge, analytical skills, good communication skills and English skills.

The way we see the need to be in the office to work has changed for good. But is remote or hybrid work a better solution for remote-capable job? This was the second research question of this paper.

Even if it is expected that the share of fully remote work will decrease, companies must accept the reality that remote-capable employees do not want to return fully on-site. Modes of operation of hybrid work that combine remote work with on-site work in different proportions will have to be identified.

The risks of forcing the return to full onsite work are certain, even if the impact of such forcing cannot be estimated with certainty at this moment. The main impact may be on employee engagement. According to a Gallup study, „employees who don't work in their preferred location have significantly lower employee engagement, alongside higher burnout and desire to quit” (Wigert & Agrawa, 2022). And this could further inflict on a already worrisome labor shortage. Of course, the present research has its limitations. For a clearer picture of the labor market in Romania, it would have been useful to group/codify the job requirements formulated in the analyzed recruitment announcements. Also, in the international analysis, the records for some countries were less numerous compared to others, which may have influenced the results of the analysis.

Further research is needed to identify what the employees' expectations are regarding remote or hybrid work. At the same time, we are aware that there are many factors that can influence the preference for remote or hybrid work, such as the age of the employees, the size of the company, national or organizational culture, etc. Of course, hybrid or remote work involves new challenges related to shaping effective HR policies.

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