Department of Business and Management
Bachelor in Management and Computer Science

Chair: Database & Big Data

Exploratory Data Analysis of LinkedIn Job Advertisements

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Introduction – Chapter 1:

1.1 Overview of LinkedIn

The well-known employment-focused platform LinkedIn, launched on 5 May 2003[1] by Reid Hoffman and Eric Ly, is currently the world's largest professional network used by millions of people almost all over the world. By simply creating a profile, users can establish professional contacts, look for new job positions or advertise them, participate in online initiatives or organise them, depending on whether they are employees or employers. The social media platform not only offers job seekers the possibility to post CVs, indicating academic achievements, skills and work experiences, but also provides them with different ways of interacting with the business world. As a matter of fact, the wide array of features that the platform offers include, among others, joining interest groups, engaging in professional discussions, sharing multimedia contents, participating in online events, and publishing articles.

In recent years, LinkedIn has focused on enhancing the power of community and discussion within the platform, emphasising how supportive and informative it can be in career development. This process culminated in June 2022 when LinkedIn launched a new advertising campaign with the hashtag #FindYourSpace[2], promoting community, development, and support. The video of this campaign shows a woman moving across different dinner tables and changing seats, in order to join the most interesting conversation for her. The dinner is obviously a metaphor aimed at showing how the platform has evolved over the years in order to provide support to everyone, regardless of personal career situation[3].

The new features that LinkedIn has developed to increase interaction between users, such as audio events and rooms, proves the platform's commitment to meet the needs of the

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[1] *(N., How did linkedin start 2024)*

[2] *(LinkedIn, [video] linkedin on linkedin: Find your space on linkedin 2022)*

[3] *(Faraz, Wherever you are in your career, there is always a space for you 2022)*

evolving professional world and of its users. This user-oriented approach, together with the use of technology, has contributed to the increasing success of LinkedIn which now is a means to establish the criteria of employment and career development for the global network.[4]

In conclusion, through its multiple features and opportunities, users can establish useful professional contacts, follow the company the aim to work at, interact with a large community of experts, deepen the knowledge of their field of competence, and participate in professional events to tailor and promote their career to higher levels.

1.2 Importance of LinkedIn in the Job Market

The importance of LinkedIn nowadays as a tool for professional growth and employment opportunities is also demonstrated by figures and trends. Its user base has in fact considerably increased over the years, rising from 14% in March 2019 to 20% in May 2022. This increase has also contributed to the economic growth of the company, which has generated revenues up to $14.5 billion in 2022[5].

As far as the number of users is concerned, LinkedIn has more than 900 million users worldwide, and they are expected to reach 1 billion by 2025, as a consequence of the evolvement and enhancement that the platform keeps undertaking. In terms of time, the platform has 310 million people using it on a monthly basis for job hunting and 50 million on a weekly basis. According to estimates, every minute 90 job seekers send their application for a position and an average of 8 people get hired every minute. These figures show how often and intensively the social media is being used. Unsurprisingly most of the users' age ranges between 25 and 34 years. To complete the picture, the United States is reported to have the highest number of users, and India follows.[6].

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4 (Knilans, New linkedin features can transform how you engage with customers 2023)

5 (Bondar, Important linkedin statistics data & trends 2024)

[6] (Bondar, Important linkedin statistics data & trends 2024)

The commitment of LinkedIn to become a worldwide company and conquer even more the global market is proved by its presence in different countries, with 36 offices worldwide, and by the important language support offered, with 26 languages available. The importance of the social network depends also on the fact that 17 million opinion leaders and more than 65 million decision-makers are using it, making it a fundamental tool for professional networking and leadership[7].

1.3 Objective of the study:

Analysing job advertisements on LinkedIn can provide new workers or refocused job seekers an entry point into the work environment. The aim of this research is to identify the skills that are needed in different job positions and ensure that job seekers fine-tune their resumes. The results are crucial for whoever is in search of a new job and may need to concentrate on the qualifications that the job market highly values.

In addition, the analysis considers geographic trends of job availability. Analysing the job offers for a range of cities and countries shows in which regions there is high employment demand. For example, knowing in which cities or parts of the world the density of job openings is high within a specific sector can help a person decide on whether or not to make a relocation.

In short, this research helps job seekers to enhance their applications for job positions by tracking the hiring trends and skills that leading companies generally look for.

[7] *(Bondar, Important linkedin statistics data & trends 2024)*

Chapter 2: Data Collection and Data Cleaning

This chapter details the processes used to clean and prepare the data from the LinkedIn job ads datasets downloaded from Kaggle[8]. These fundamental steps ensure an analysis free from inconsistencies so that sensible and correct insights can be presented.

2.1 Preliminary Data Collection

The collection starts by analysing the datasets. For this analysis there are three datasets: job_skills, job_summary, and linkedin_job_posting. Before computing any operation, these files must be cleaned and then they can be analysed through exploratory data analysis (EDA).

The three datasets are composed as follows:

job_skills is made of 1296381 rows and 2 columns;

- job_link: it is composed by URL links to the job posting on LinkedIn.
- job_skills: it is composed by a list of skills for every job.

job_summary is constituted by 1297332 rows and 2 columns;

- job_link: it is composed by URL link to the job posting on LinkedIn.
- job_summary: the description of the job.

linkedin_job_posting has 1348454 rows and 14 columns;

- job_link: it is composed by URL link to the job posting on LinkedIn
- last_processed_time: it is constituted by the timestamp indicating the last time the job was processed.

[8] (*Asaniczka, 1.3M Linkedin Jobs & Skills 2024)*

- got_summary: it indicates whether the job summary was successfully extracted or not. (t/f)
- got_ner: it indicates whether Named Entity Recognition (NER) was performed on the job posting or not. (t/f)
- is_being_worked: it indicates whether the job posting is currently being worked on or not. (t/f)
- job_title: illustrates the title of job listing.
- company: indicates the name of the company that is offering the job position.
- job_location: shows the location of the job, city and state
- first_seen: first time the job was seen on LinkedIn.
- search_city: contains the cities used as a search criterion for collecting the job posting.
- search_country: the country where the job is listed.
- search_position: it indicates the position used as a search criterion for collecting the job postings.
- job_level: the level of job (mid-senior and associate).
- job_type: type of the job (on-site, remote and hybrid).

2.2 Data Cleaning Process

This section starts with the merging of the databases, 'job_skills' into 'linkedin_job_posting' at the primary key, made of ‘job_link’. The datasets have different scale sizes: the 'job_skills' set has 1,294,346 rows, and the 'linkedin_job_posting' 1,348,454. The new data pool of the merged data was re-configured to meet the details of the smaller one. At this moment, there are two remaining data sets, 'linkedin_job_posting' and ‘job_summary’. Since the latter presents a different value for every row, it is not going to be utilised in the analysis.

Continuing with the data cleaning, missing values were checked, revealing 2,035 null entries which have been dropped without bringing any change in the analysis. Afterwards, the text was standardised to lowercase and irrelevant short words or stop words were

filtered from the column ‘job_skills’. All these steps were taken to ensure to have accurate data. Moreover, the lists of ‘job_skills’ strings were split and processed, and by doing so, it was possible to get a new column, ‘skill_count’. The result was a cleaned and organised dataset which was used to perform a meaningful analysis of job market trends, skill requested, and comparative studies between industries and regions.

While checking for the observation, there were some Boolean (True/False) types of variables: 'got_summary,' 'got_ner,' and 'is_being_worked'. 'Got_summary' and 'got_ner' have almost all true rows, 96% of them; 'is_being_worked' is nearly all false at approximately 100%, these columns were dropped as they do not add any value to the analysis. 'Search_city' was also removed since there was already a better variable: 'job_location.

Ultimately, this pre-processing is aimed at extracting insights for institutions to align with the needs of the job market. Moreover, the analysis is aimed at extrapolating suggestions for students who recently graduated and are looking for entry-level jobs. To achieve this, the binary variable ‘job_level’ has been modified to align with the analysis’s purpose, filtering out all 'mid_seniors' level jobs and considering only the 'associate' ones.

2.3 Standardising Data Formats

Last step to conclude the data preparation was the transformation of the columns 'first_seen' and 'last_processed_time,' into the datetime format, and the computation of a new column, called 'process_duration'.

The values 'last_processed_time' initially provided in this format 2024-01-21 08:08:21.308995+00”, were converted into strings and the excessive text was removed, leaving only year, month and date. After cleaning these data, the 'last_processed_time' was brought to a DateTime format in order to have a proper temporal comparison with 'first_seen.' This allowed to compute now 'process_duration,' representing the difference in day terms between the 'first_seen' and 'last_processed_time', a helpful value in understanding lifecycle of job postings.

Chapter 3: Exploratory Data Analysis (EDA) and Initial Analysis

This chapter investigates the Exploratory Data Analysis (EDA) of LinkedIn job postings by highlighting the transformations and analyses conducted to extract meaningful insights from the data.

3.1 Data Visualisation

The exploration considers as first feature 'search_country'. This variable indicates the country in which the job takes place: United States, United Kingdom, Canada, or Australia.

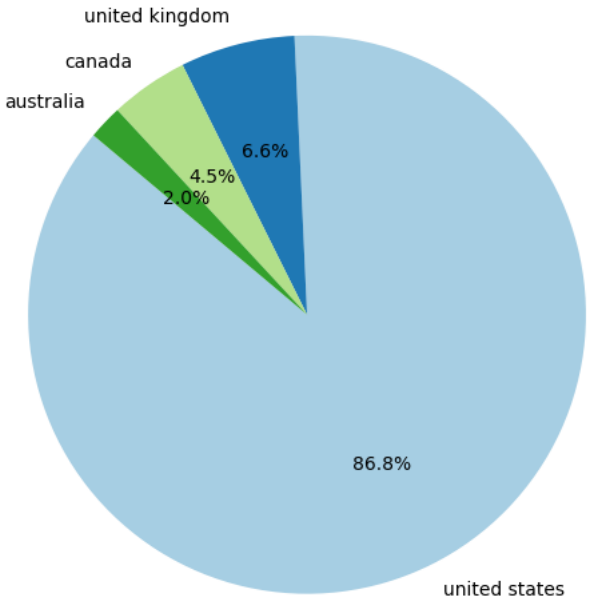

Fig 1: Distribution of Job Postings by Country

Fig 1 shows the *United State*s dominance with a percentage of 86.8%, indicating a significant concentration of job opportunities in the *US*, which reflects its large economy

and robust job market. Following, the *United Kingdom* constitutes 6.6% of the total job opportunities. *Canada* and *Australia* account only for 4.5 and 2.0 percent, respectively, of this pie chart, showing that they have a smaller job market. To conclude, the graph indicates very clearly and understandably where future employees are most likely to find more job opportunities, primarily the *US*.

The next variable, 'job_types', describes how the job is delivered: on-site, hybrid, or remote.

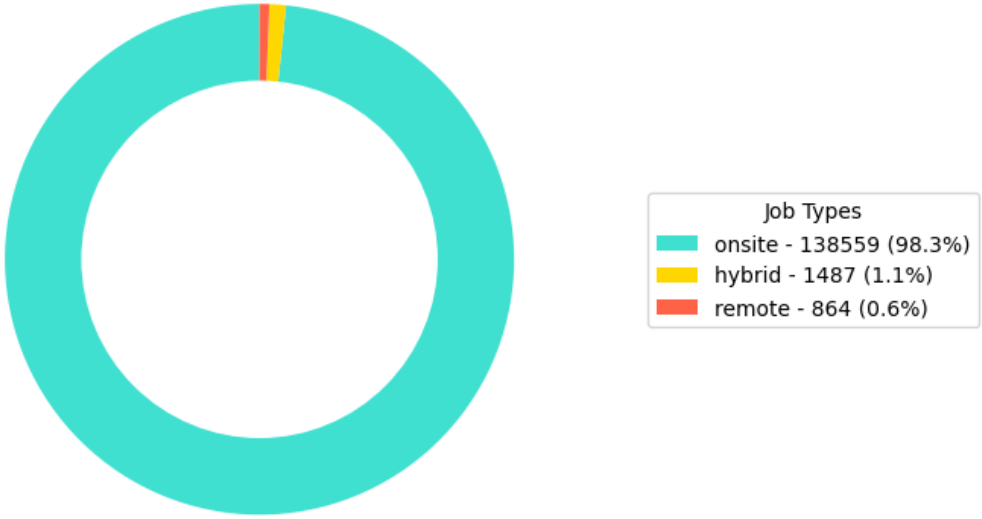

Fig 2: Distribution of Job types across LinkedIn Postings

Fig 2 shows that the request for most of the jobs is largely *on-site*, accounting for 98.3% of the job market. The remaining 1.7% is represented by *hybrid* for 1.1%, and *remote* for 0.6%. These data show that the market has made a full recovery after the pandemic and that remote positions are on the decline. Graduates may not be able to choose which method they prefer more, being the vast majority of opportunities only *on-site*.

Finally, the 'process_duration', as already mentioned, was not a native variable to the dataset but has been obtained from the combination of the two other features. The plot visualizes 'process_duration' against 'number_of_job_postings'.

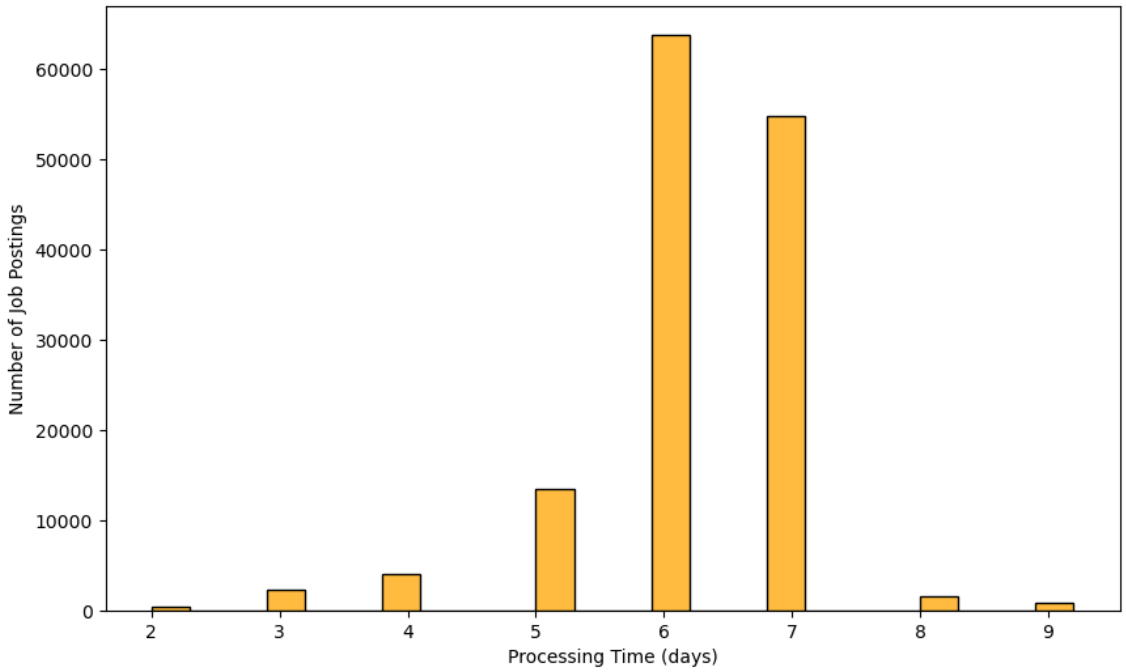

Fig 3: Distribution of Process Duration

The bar chart shows that the processing time of a job is usually *6* or *7* days. Smaller peaks feature indicate *5* days, minor occurrences are at *2* and *9* days.

The review of the processing time for job advertisements revealed that most of the announcements were processed in less than a week, indicating an effective overall system that is encouraging for fresh graduates entering the job market.

3.2 Visualisation of Key Variables

For a more detailed evaluation, the analysis first checks the key features of the dataset. This section begins with the exploration of the "job_title" variable, focusing on the 10 most common jobs as shown in the following bar chart. In order to understand these features, the aim is to extract meaningful insights that could be useful for job seekers to navigate the job market trends on LinkedIn.

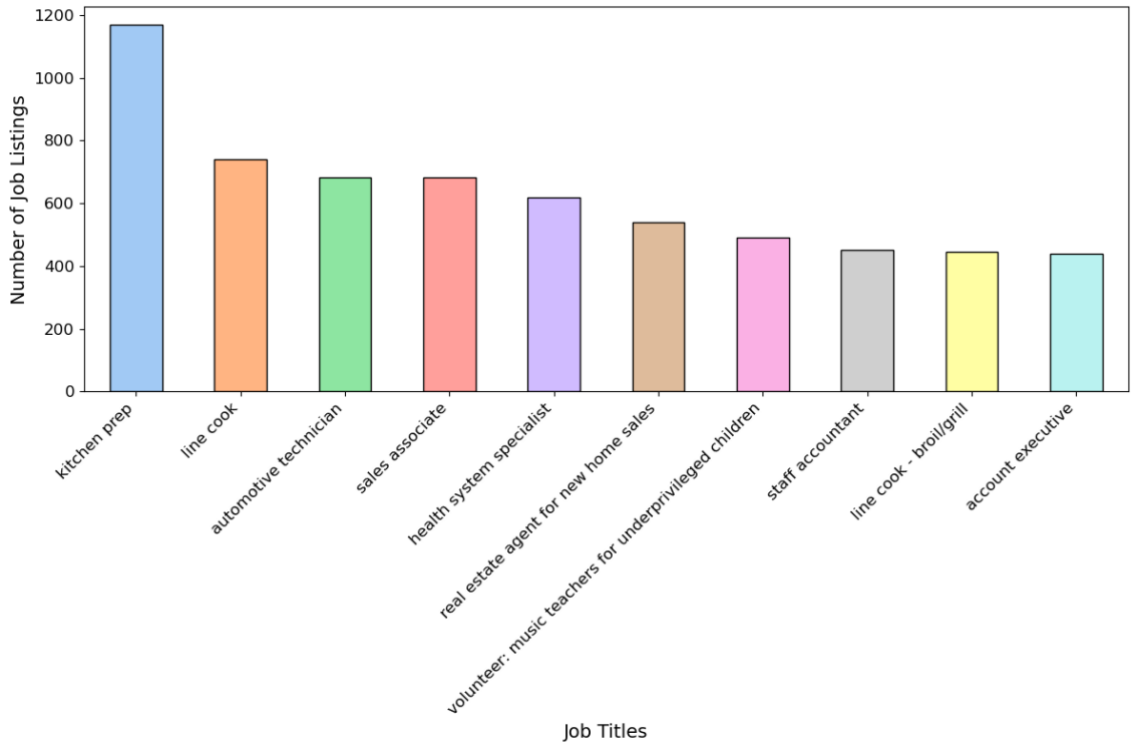

Fig 4: Top 10 Job Titles

Analysing figure 4, which shows the most common job title requested on LinkedIn, it can be seen that there is a high request for individuals in the culinary area due to the number of postings related to *kitchen prep* and *line cook* positions. This can be considered as an up-and-coming trend, underlining the high dependence of the hospitality industry on culinary professionals. Moreover, figure 4 shows that the job titles range from *automotive technicians to health system specialists*, suggesting a broad scope of what the industry demands, with different opportunities in between (all residing in areas of healthcare, automotive, or real estate, among others).

Continuing with the analysis, a new variable is considered: "job_locations". The bar chart associated with this feature represents the cities with the highest number of postings. These insights are going to help to realise the geographical distribution of job opportunities and can be used by individuals when analysing the job market.

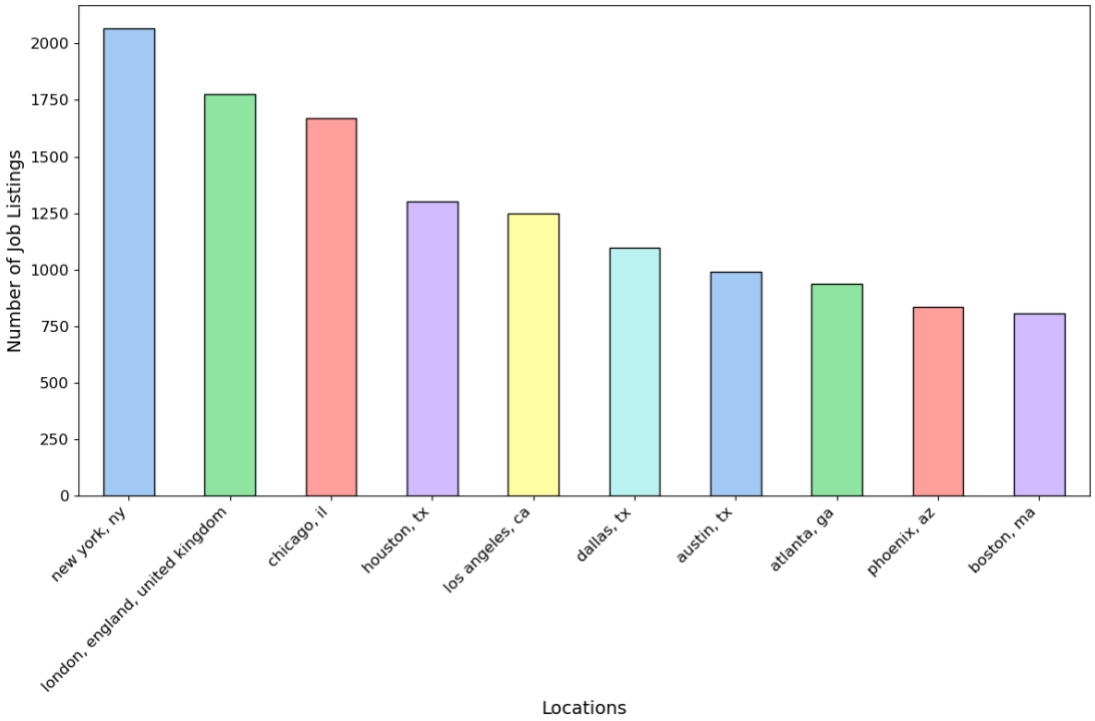

Fig 5: Top 10 Job Locations

Fig 5 gives an absolute number of job postings within various cities, with the highest posting in *New York*, towering at a high peak of around 2,000, closely followed by *London* and *Chicago*. From this, it is clear that these metropolitan cities provide quite a number of job opportunities, hence big employment hubs.

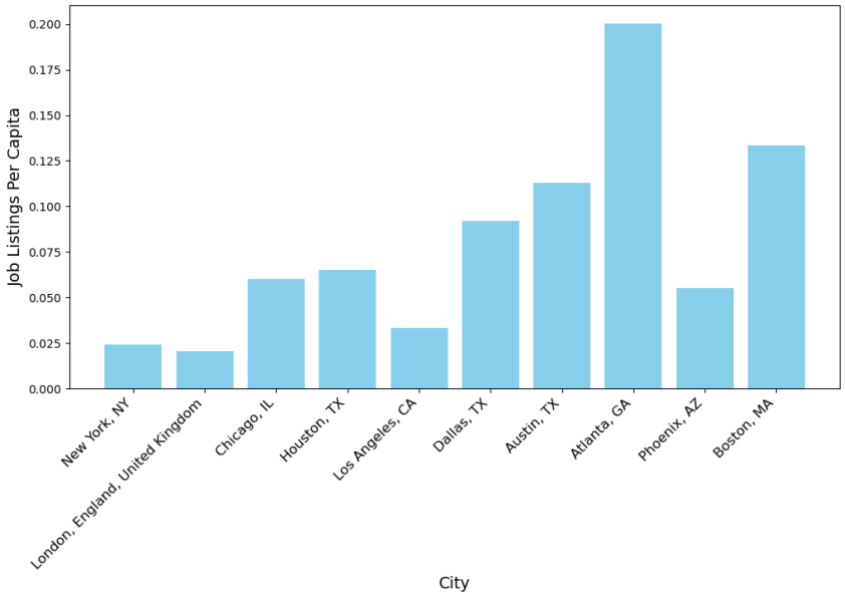

Fig 6: Job Listing Per Capita in the top 10 Job Locations

Fig 6 shows job listings for the 10 most common locations normalised per the population of each city. *Atlanta* has the highest job listings per capita, which indicates that its job market is favourable considering its population size; thus, one is likely to face less competition in searching for jobs in *Atlanta* compared to other cities.

It is also of value to note that *New York* and *London* have the highest absolute job listings but the lowest per capita figures, thus indicating a great rise in job competition. Therefore, even if cities like *Atlanta* and *Austin* offer fewer total job listings, they provide more per capita possibilities; this is what makes them quite desirable destinations for work.
This comparative analysis underscores the importance of both absolute job numbers and capita availability when considering the offers of various cities, in order to understand the true competitiveness of the job market in a specific location.

In the previous part of the report, the attention was focused on the job distribution by location. In this section, instead, the attention moves into the specific companies that are the leaders in job offers. This examination provides further insights into the organisation behind the market dynamics and shows the sectors with high hiring activity.

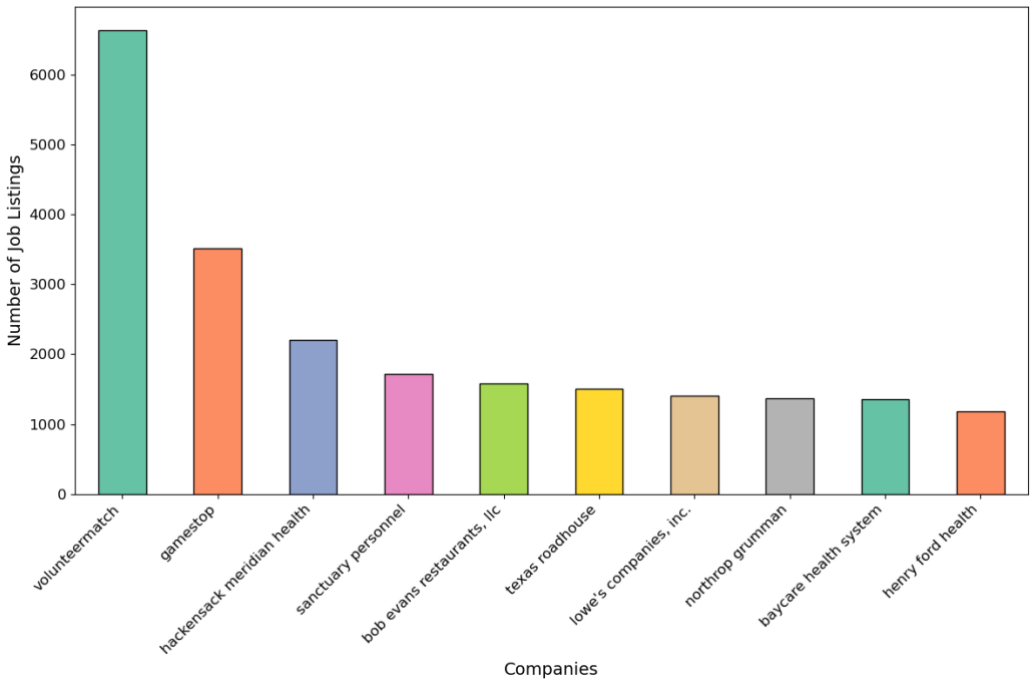

Fig 7: Top 10 Companies

Fig 7 provides an overall view of the companies with the highest number of job postings. On top is *VolunteerMatch*, with 6,000 job postings, suggesting that there is a high need for volunteers. Moreover, *GameStop* is coming close to that figure, with approximately 3,500, job listings, pointing to solid recruiting activity in both retail and gaming. An important remark to be made concerns the healthcare and recruitment industry, with many companies working in this sector, *Hackensack Meridian Health*, *BayCare Health System*, and *Henry Ford Health*, all searching for new collaborators. Lastly, there are considerable job listings in the food servicing and home improvement sectors, with *Bob Evans Restaurants, LLC*, *Texas Roadhouse*, and *Lowe's Companies Inc*. in need of many positions.

Understanding the skills that are more popular for the different job titles is the key into creating custom graphs that take into account location or position as well. By specialising and finding out the generic skills needed for every job, graduates can learn which competencies are most desired. Such knowledge helps the job seeker to tailor his résumé better since it explicates his relevant experiences.

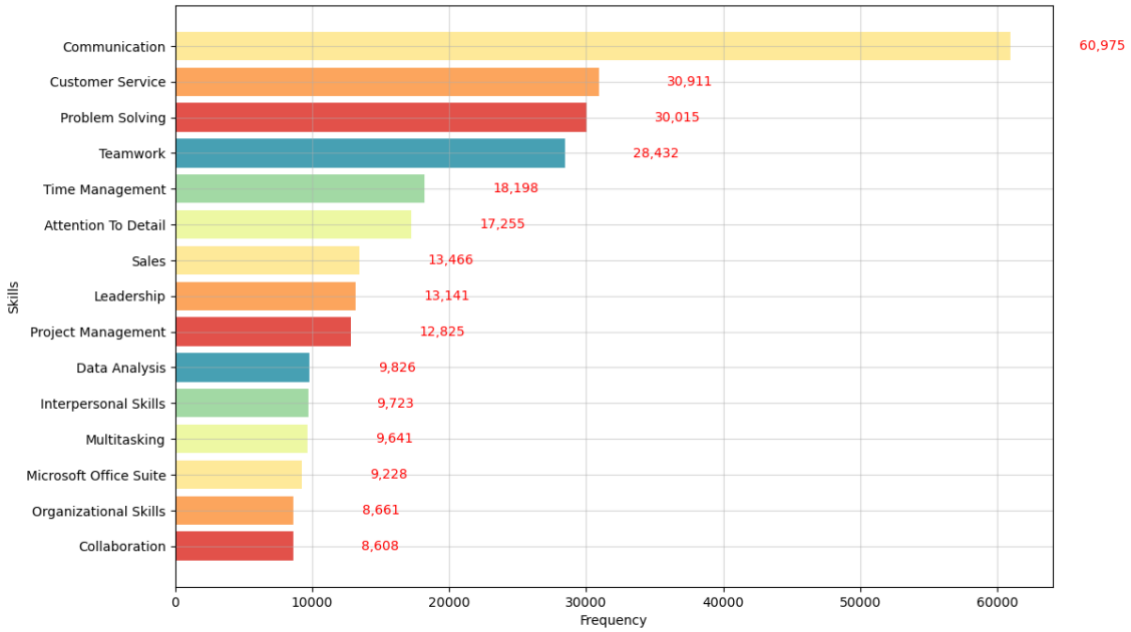

Fig 8: Top 15 Required Skills on LinkedIn

The bar chart is titled "Top 15 Required Skills in LinkedIn"; indeed, it displays the most frequently required skills without any filtering on LinkedIn; later in the evaluation, some KPIs are going to be used for a more precise analysis. Overall, the most sought-after skill is *communication*, with 60,975 mentions, followed by *customer service* (30,911) and *problem solving* (30,015). Other highly demanded skills include *teamwork*, *communication skills*, *time management*, and *attention to detail.*

These skills are critical in practically all job profiles, and hence, a broad notion of their relevance and importance is crucial when approaching the job market. In particular, job seekers may go under a general view about elements that could give them an upper hand in securing employment. It is for such an occasion that recruiters may use such information to fine-tune their criteria in search of the most relevant skills.

3.3 Insights and Observations

From this section, the analysis focuses on the study of combined variables; the first two features considered are ‘job_title’ and ‘search_country’, the latter representing the four countries of this analysis. For practical reasons, these locations have been divided into two graphs, the first representing the *US* and *UK*, while the second showing *Canada* and *Australia*. The graphs provide insights into specific roles in each country, helping job seekers to make a conscious decision when selecting the location where to work.

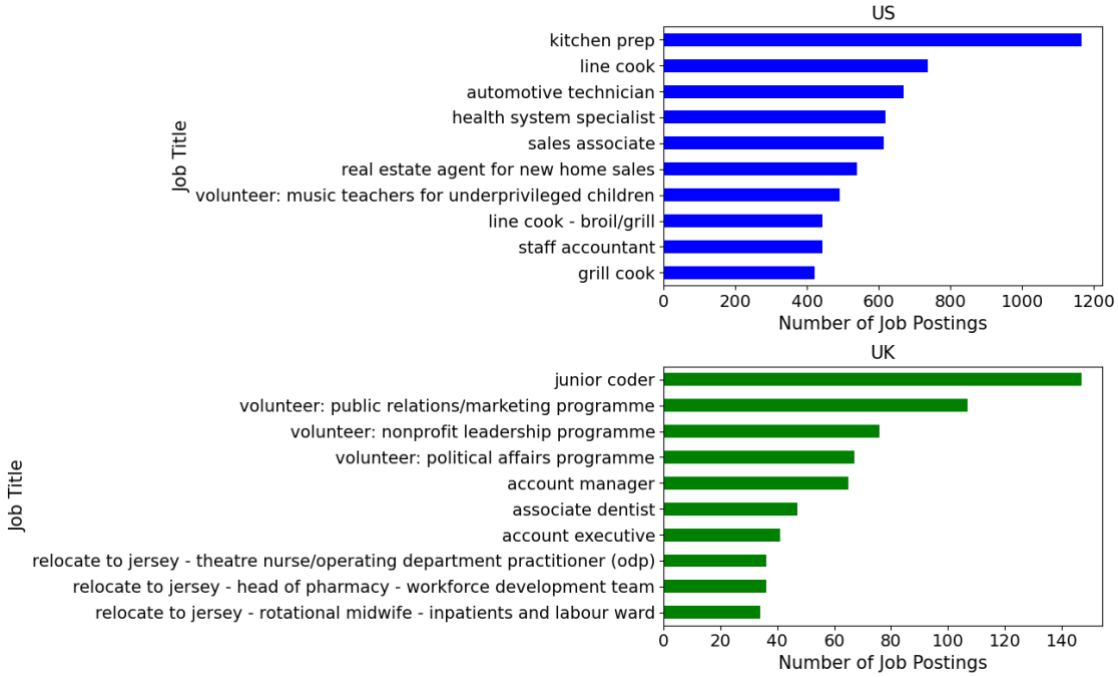

Fig 9: Most demanded Jobs in US and UK

As shown in the chart, the *US* and *UK* have two very diverse job markets. First of all, it should be noted the disparity of the overall number of job postings present in the two countries, even though this difference might depend on their population size. Secondly, attention should be drawn to the types of job, the *US* for example needs more 'practical jobs' such as kitchen prep or line cook, which appear to be on top of the list. In this country, indeed, the need for food-related positions is highly demanded, reflecting what is shown in Fig 4. These results, as already theorised, might prove the fact that the data in the overall job titles might be skewed towards American needs.

On the other hand, the *UK* has a more traditional job request, with scientific subjects playing an important role; as a matter of fact, junior coders and account managers/executives have a quite high request. Finally, volunteering positions in the *UK* are more accessible than in other countries, with more than three different programmes they can apply for.

The following section compares the top job titles in *Australia* and *Canada*. Visualising these remaining regions results in a better understanding of the dataset, and conclusions about job demands in specific locations can be drawn.

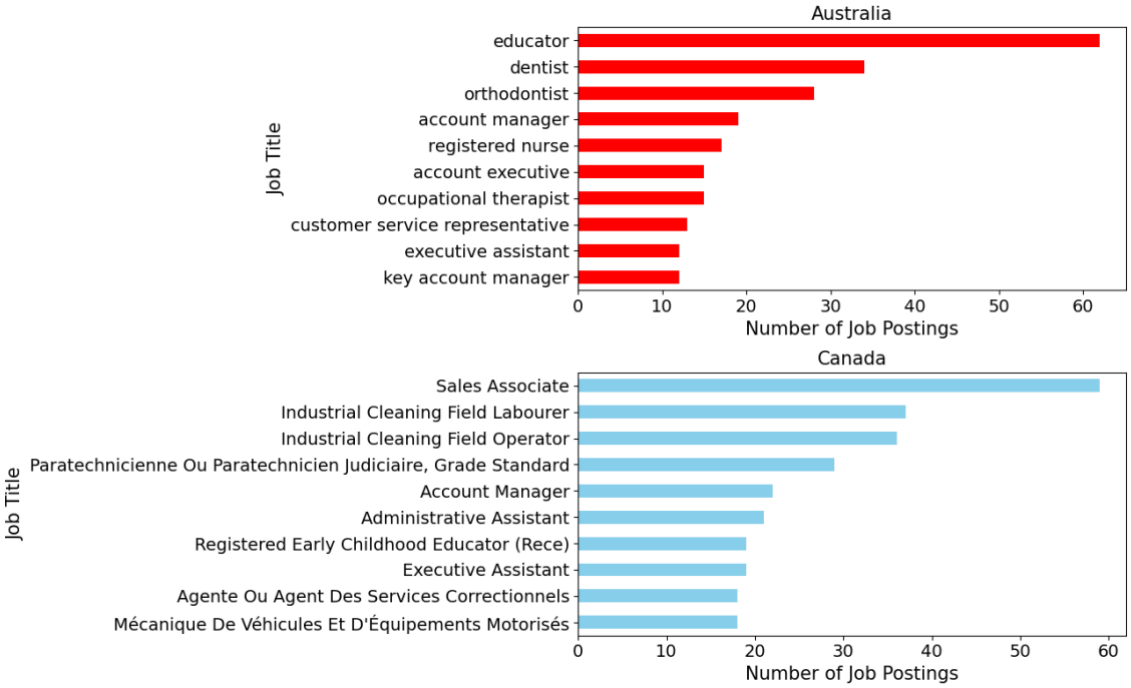

Fig 10: Most demanded Jobs in Australia and Canada

Fig 10 represents the job market distribution in the two above-mentioned countries. It is important to notice that compared to Fig 9 these new variables include a smaller number of jobs, this difference could somehow be expected after analysing Fig 1. In *Australia* the professional roles of *educators*, *doctors* and *nurse* are needed, while in *Canada, sales associate* are by far the most requested positions.

The following plots provide an in-depth analysis of the dataset through the exploration of major cities. For a more comprehensive examination, due to the numerous locations present in the dataset, the investigation focuses only on the four cities that offer more jobs. Following this text, there are two graphs: the first considers the job title, and the second the companies offering placement as a parameter.

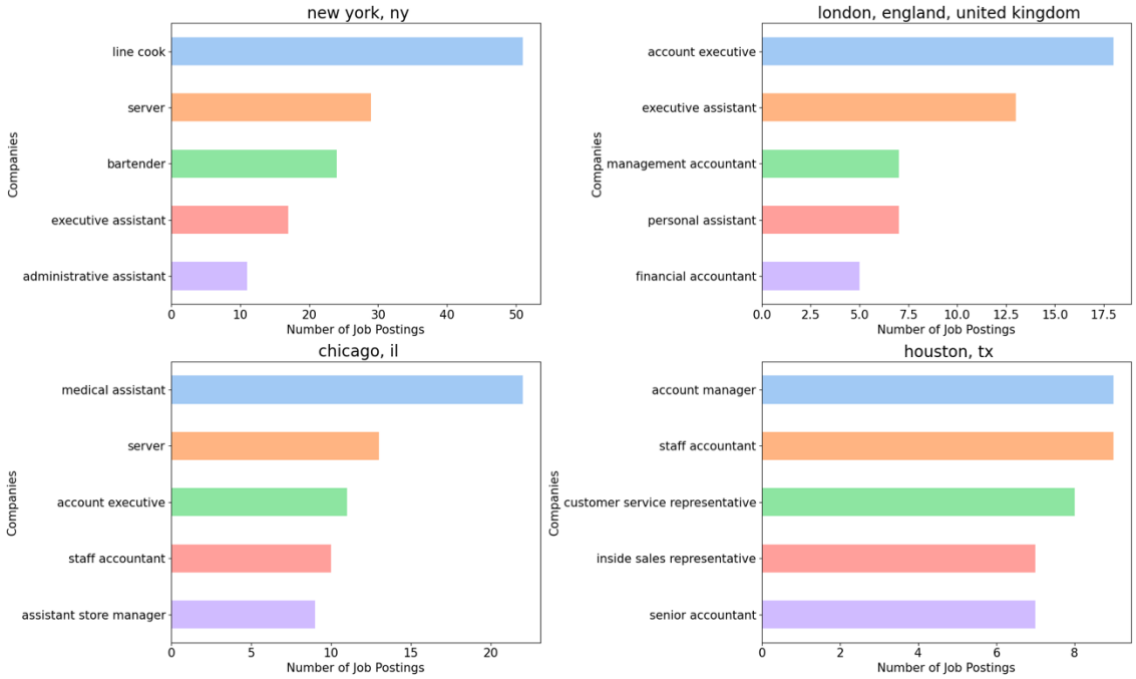

Fig11: Most common job titles per top city

The graphs illustrate the job titles most common in each of the city with the highest number of job postings on LinkedIn: *New York, London, Chicago, and Houston*.

New York results to be the city with more job postings, where the most required job is *line cook*. This result is a bit in contrast with the result of Fig 9, which had *kitchen prep* as the most requested profession. Indeed, the figure *kitchen prep*, the first one in Fig 9, does not come at all in this graph, neither in *New York* nor in the other American cities. This might indicate that even if this position is highly requested, the people searching for it must be scattered across the country. Moreover, two of the most required jobs in *New York* result being *server* and *bartender*; this might be related to the high cost of living of this city where people have a second job to get by. Another important remark is that the profession of *assistant* and *accountant* are required across different industries in all the cities taken into consideration.

The companies operating in a country may differ from city to city; this aspect might reflect the special needs of a metropolis in comparison to another. By analysing the following graph, new insights emerge.

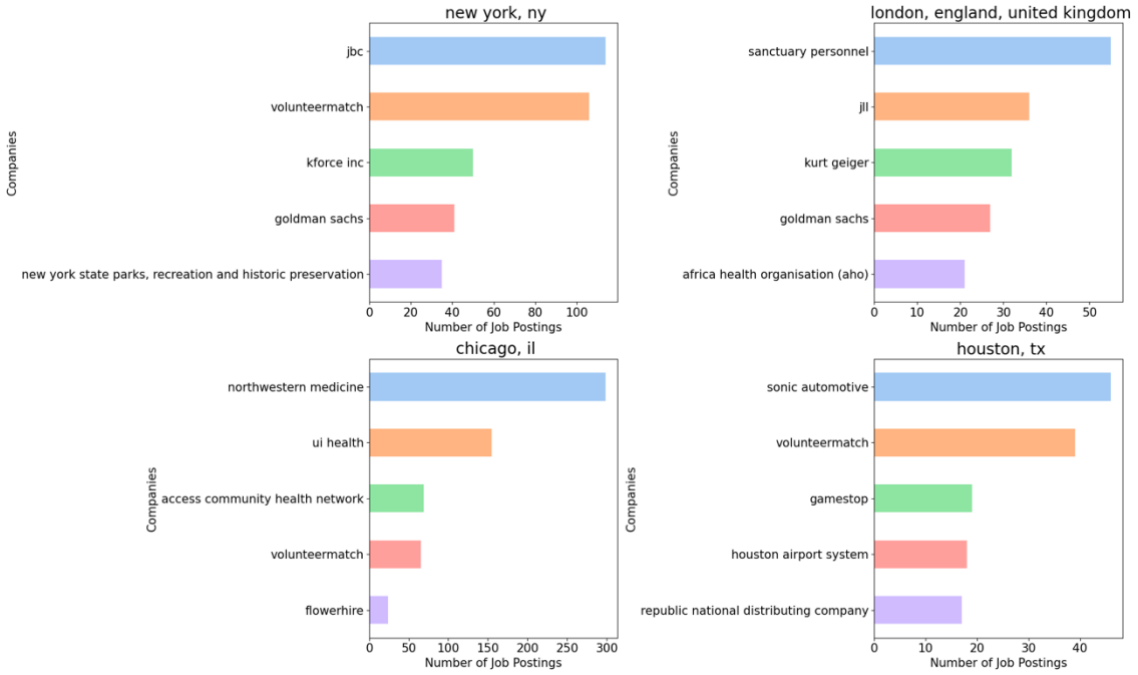

Fig12: Companies titles per top city

Contrary to Fig 11, in Fig 12, *New York* does not come on top, with *Chicago* having results up to three times higher with respect to the former city. This does not necessarily mean that in the latter city, more companies are present, but only that some corporations offer more jobs. As a matter of fact, *Northwestern medicine* seeks to employ three hundred people in *Chicago*, while *Jbc*, the major company in *New York*, needs only a hundred employees. In the Big Apple, two companies stand out: *Volunteermatch* and *Goldman Sachs*. The first can be observed in other two American cities, *Chicago* and *Houston*, with *Chicago*, having roughly the same amount of posting, that might suggest that this business operates only in the US. Furthermore, *Goldman Sachs*, a leader in the banking sector, appears only in the two cities of *New York* and *London*, meaning that the company has an interest in their financial districts and, allegedly, also other financial institutions do. Job seekers interested in finance and baking and wishing to work in the anglosphere[9] should take into consideration these results.

[9] ***(HarperCollins Publishers, Anglosphere definition in American English | collins english dictionary)***

The following graph examines three jobs[10]: *financial analyst*, *business analyst* and *product manager* in order to allow candidates to make a conscious decision when applying for one of these positions.

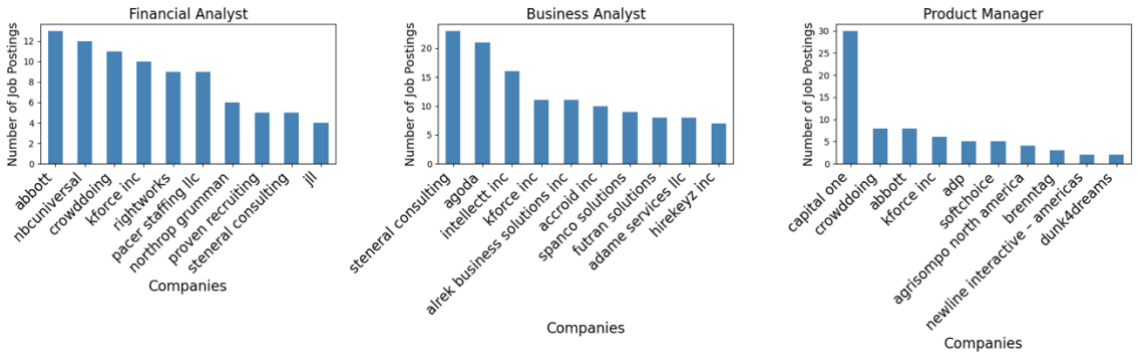

Fig 13: Specific job titles per companies

The first job, *financial analyst*, is needed in several sectors, in fact the demand goes from *Abott*, a pharmaceutical company, to *NBC*, an American broadcasting network. The same goes for *the business analyst* role, a job required both in *Steneral Consulting* and *Agoda*, an online travel agent, both companies need this position in order to optimise their work and improve customer experience. Finally, the position of *product manager* is requested by *Capital One*, a major US bank and also by *Crowddoing*, an organisation focused on innovation.

A peculiar aspect of the graphs is that *Abbot* and *Crowddoing*, two companies working in completely different sectors, are both in need of a *financial analyst* and *product managers*. By analysing Fig 13, it results that the demand for financial professionals, as well as manager positions, is important in both traditional and innovative sectors.

The focus variable in this last part of the analysis shifts from the companies to the skills. An introduction has already been provided when visualising Fig 8; the key difference is that in the former graph the plot was made only for the overall skills, while in the following graph, the parameter is combined with the cities. This more complete approach gives valuable information to all the people who are interested in a specific city. For better

[10] The three jobs have been selected as a sample; they were chosen to represent an ideal candidate interested in one of these positions.

clarity, due to the numerous locations present in the dataset, the cities chosen were the four ones that offered more jobs.

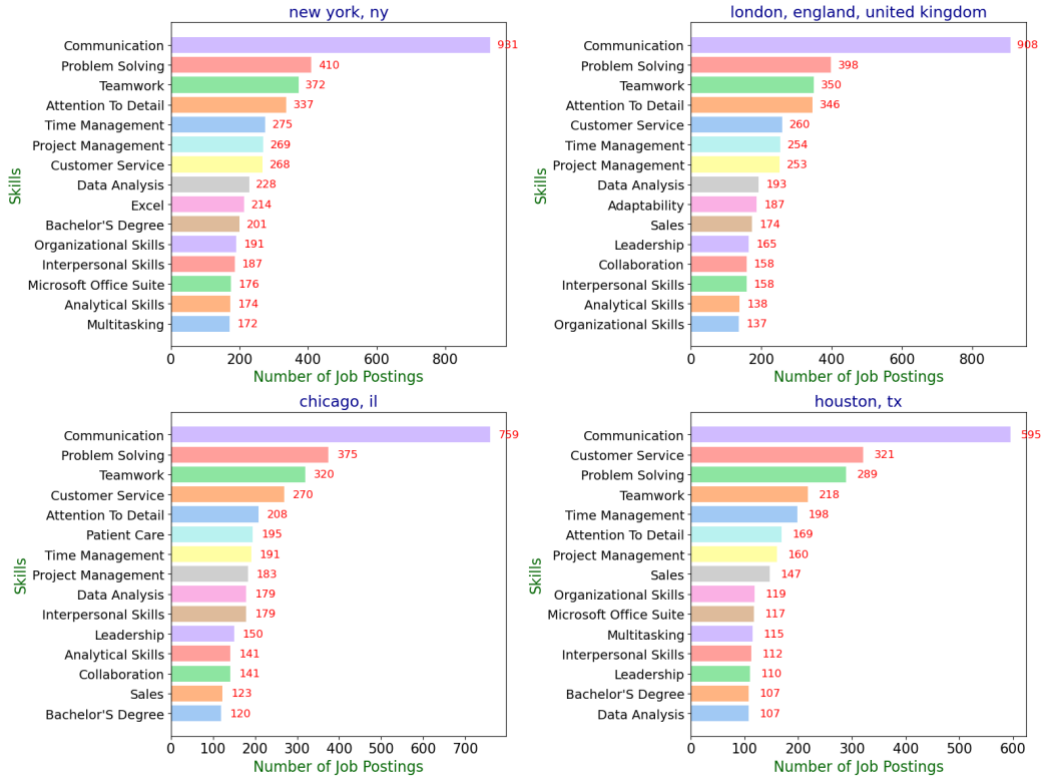

Fig 14: Top skills in different cities

Fig 14 illustrates the top skills required in the four cities with the highest number of job postings on LinkedIn: *New* York, *London*, *Chicago*, and *Houston*.

Analysis of skills demand in major metropolitan areas reveals that *communication*, *problem-solving*, and *teamwork* are the most demanded key skills in many cities. Notably, these findings show that *communication* comes out as the most required skill, which testifies the crucial role of this skill in the labour market. This is vividly demonstrated by the global need for effective *communication* in professional roles. Similarly, the importance of *problem-solving* and *teamwork* abilities scattered across all the regions studied marks the relevance of collaborative and analytic competencies in today's workplace.

Moreover, there are regional distinctions in the demand for specific skills; for example, *customer service* is highly prioritised in *Houston* but only seventh in *New York* and fifth in *London* and *Excel* use is only required in *New York*.

The research, on the other hand, provides job-seekers with a strategic framework to identify and prioritise skill development based on employer priorities. These results are in line with overriding trends from the LinkedIn data set, and they do allow for the heterogeneity of skill demands across different geographical job markets.

To conclude the analysis, a last graph is taken into consideration. This new plot combines the skills previously analysed with the job chosen in Fig 13.

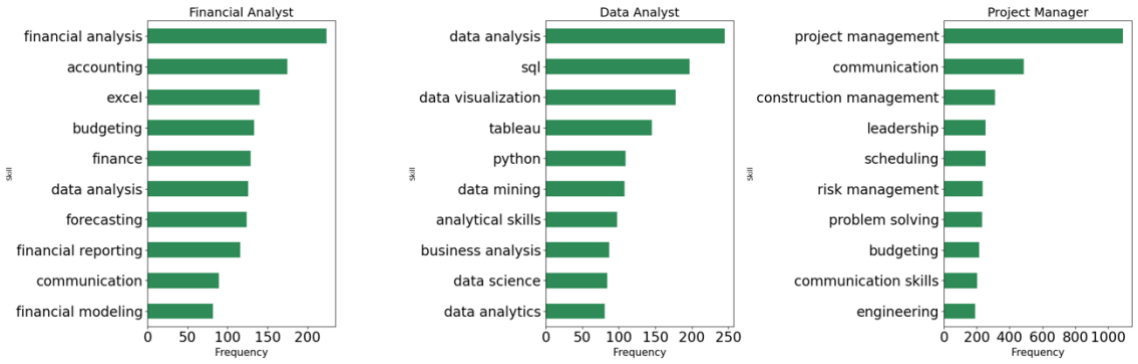

Fig 15: Most common skills by job position

Previously, the analysis focused on the companies hiring for these particular positions, while now the focus is shifted to the skills required for each job, starting from the *financial analyst* role. As it could be expected the most important skill for this position is *financial analysis*, important abilities are also *accounting and Excel*, followed by other financial skills such as *finance* and *financial reporting*.

Furthermore, for the *data analyst* role, the most required skill is *data analysis*, here the competencies revolve around both the knowledge on data manipulation such as *data mining, python and sql,* as well as analytical capabilities such as *data visualization, analytical skills* and *business analytics*.

In the last job, *project manager*, the most requested skills are *project management* and *communication*, both part of the overall skill plot in Fig 8, as well as *leadership* and

problem-solving. Therefore, the figure shows that it is more important to have soft-skills rather than more specific ones.

In conclusion, from the above analysis it appears that for *financial analyst* and *data analyst* the skills needed are more horizontal, specialised in a specific sector. On the other hand, for *project manager* the required skills are vertical, capable to adapt in different environments.

Chapter 4: Conclusion

To recapitulate, this analysis has uncovered different trends going on LinkedIn, which can help recent graduates to successfully thrive in the complexity of the professional world.

Those trends consist of the *US* having a flourishing job market with respect to the other countries analysed, with its best cities to work in being *New York* and *Chicago*. Despite, *London* resulted having different working opportunities, the speculated reason why the *UK* has such smaller employment numbers is due to the fewer metropolises of the country and thus smaller number of people. An important notice goes to *Atlanta*, which has come out on top as the city with the most jobs per capita; therefore, it is favourable for candidates wanting to start a successful career in the *US*.

Moreover, the research indicates that graduates can no longer freely choose between remote or on-site jobs since most works are not *hybrid* but in person. In addition, applicants need to have essential skills, as seen in various graphs, such as *communication*, *problem-solving* and *teamwork*. The recommendation is that even for candidates searching for a job that requires horizontal abilities, possessing these soft-skills may improve their applications.

The last suggestion for job seekers is to always monitor job postings and quickly apply for them since, on average, it has been estimated that a post vacancy lasts less than a week on the social network.

Before concluding the analysis, some disclaimers must be made. Firstly, when analysing the countries, visa regulations were not considered, so candidates may not freely choose where to work but must consider also their personal situation. For instance, job seekers who do not own a permit to work in America might face some legal and financial troubles to obtain the right permissions. Furthermore, the dataset analysed only a limited selection of countries and not all major work-hubs were taken into account. So, candidates interested in other markets should take this analysis with a grain of salt.

In addition, even if LinkedIn is the biggest and most global platform, it may not represent the entire job market; some professions might be excluded, some countries may utilise other forms of job employment services, or they may prefer competitors' websites. The last limitation of this analysis is the volatility of the job market, which can be easily influenced by external factors thus rapidly change. Relevant data might therefore not reflect future conditions.

The analysis, despite the above-mentioned limitations, still provides useful insights into the job market trends, highlighting the most valued skills, industries and the locations with most opportunities. As a matter of fact, candidates can still gain from these findings, the recommendation is to create personalised strategies based on the study limitation, which may vary from case to case. In short, this analysis is only a guide that must be properly interpreted.

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