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Tools for Success: Their Impact on Salaries in the Data Analytics Job Market

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Abstract

This research examines the data analytics job market, focusing on prominent tools in job advertisements and their salary implications. Analyzing a diverse range of postings for business analysts, data analysts, and other analytics roles, the most sought-after tools were identified: SQL, Tableau, Python, R and Power BI. The study reveals SQL's critical importance for business analysts, data analysts, and business intelligence analysts. Additionally, Tableau surpasses Power BI in popularity, while Python is in higher demand compared to R. The findings also indicate distinct salary trends across specializations. Data analysts witness salary increments for all top five tools. However, for system analysts, these tools do not tend to impact salaries. Data scientist roles prioritize programming, with SQL and Python leading to salary increases. By understanding the current tool trends and their salary implications, stakeholders can strategically position themselves in the data-driven landscape.

Keywords: data analytics, business analytics, analytics tools, salary, online job postings

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Tools for Success: Their Impact on Salaries in the Data Analytics Job Market

Kathleen S. Hartzel and Pinar Ozturk

1. INTRODUCTION

In the era of rapidly growing data collection, companies find themselves grappling with the challenge of harnessing the wealth of information available. The demand for insightful data analysis and informed decision-making has never been greater. As organizations strive to derive value from the vast amounts of data they accumulate, the role of analytics professionals has become increasingly crucial. The Bureau of Labor Statistics projects analytics jobs will grow by about 35% by 2031, much faster than the average position (Seattle Times, 2023).

Notably, the landscape of analytics is evolving, driven by cutting-edge technologies such as machine learning, generative AI, and other AI tools (Lampropoulos 2023; Ooi et al., 2023). These advancements have revolutionized the way data is processed and insights are derived, enabling organizations to unlock previously untapped potential in their data. As a result, the demand for professionals proficient in these AI-driven techniques has surged, further compounding the need for skilled professionals who can leverage such tools effectively.

In response to this increasing demand, colleges and universities have rushed to establish a diverse range of analytics and data science graduate programs (Batistic & van der Laken, 2019). These educational institutions face the formidable challenge of adapting their curricula rapidly to keep pace with the dynamic landscape of analytics and AI tools. The goal is to produce graduates who can meet the ever-changing needs of the data-centric workplace and possess the skills to harness statistics, programming, machine learning, generative AI, and other AI-driven approaches to derive valuable insights.

Despite these endeavors, the shortage of skilled professionals remains a pressing concern, emphasizing the urgent need to align analytics programs with industry requirements effectively. By cultivating a pool of analytics talent well-versed in highly sought-after analytics tools and techniques, educational institutions can play a pivotal role in empowering organizations to make strategic decisions that leverage the full potential of their data. This research aims to explore the evolving requirements for high-demand analytics tools and competencies, providing valuable insights for employers, aspiring analytics professionals and curricula designers seeking to excel in the data-driven world.

2. LITERATURE REVIEW

Studies on analytics knowledge, skills and abilities (KSAs) needed in industries and the extent to which universities meet these needs are not new. However, as the landscape of available tools and technologies evolve and widespread adoption of these capabilities increases the level of competition among organizations, continued assessment of industry needs is essential to ensure skilled employees will be available. Using actual postings from online job advertisement portals, such as Career-Builder, Dice.com, Glassdoor, Indeed, LinkedIn and Monster.com, is the pervasive approach to measuring real employer demands for data analytics KSAs.

Cegielski and Jones-Farmer (2016) as well as Chiang et al. (2012) discuss the development stages of a business analytics (BA) curriculum and identify critical skills, tools, and languages. Their study reveals that technical skills in SAS, structured query language (SQL), and Excel are essential for entry-level jobs. Watson (2012) suggests that communication skills, SQL and query skills, data mining and data warehousing skills, statistical skills, data visualization, text mining, NoSQL skills, and awareness about emerging topics in analytics are also important.

A study, using 2013-2014 data from LinkedIn, Indeed and Monster.com, analyzed 924 data analyst job advertisements and found that SQL, Tableau, and Python were mentioned in only 11.1%, 4.4% and 3.8% of the listing at that time (Luo, 2016). In close temporal proximity, Leon et al. (2018) analyzed 958 U.S.-based positions advertised during 2014-2015 on Monster.com and Indeed.com and found that different analytics job positions require different skill sets. Their work shows how the expected skill sets differ between four groups of job positions, namely business analyst, data analyst, data scientist, and data analytics manager. Data

scientist positions need depth in technical skills, whereas the other positions need more business-oriented skills with a broad knowledge of the technical tool sets in the business analytics area.

Subsequently, Verma et al. (2019) examined a sample of online job ad postings, from 2016-2017, related to professions such as business analyst (BA), business intelligence analyst (BIA), data analyst (DA) and data scientist (DS) using content analysis. They concluded that structured data management skills are relatively more important for BIA compared to BA (SQL in 30% of BA ads versus 75% of BIA ads). There is also a higher demand for skills in statistical software in case of the BIA compared to the BA, with Excel being the most sought-after tool (60% of BIA ads). DS jobs, on the other hand, require significant programming tools: R in 60%, Python in 45% and SAS in 40% of DS ads.

Using 14,495 online job postings from 2019, seven distinct topics, types of jobs delineated by skill sets, emerged when Almgerbi et al. (2022) applied an LDA algorithm. The search terms used to select the job ads were big data, data science, business intelligence, data mining, machine learning and data analytics. The resulting types of jobs were 1) market analyst, 2) business intelligence (BI) analyst, 3) project manager, 4) software developer, 5) data analytics, 6) data engineer, and 7) machine learning. Of particular interest in this paper is the BI analyst whose skill set includes BI, SQL, dashboard, Tableau, database and finance and the data analyst skill set with statistics, data science, mathematics, python, prediction and optimization.

Johnson et al. (2020) scraped 5,257 business analyst entry-level job postings from Indeed in 2018 and extracted the KSAs listed in the job postings. The results were subsequently validated by surveying experts and focus groups. Their results confirmed that SQL, Python and R were key tools. Similarly, Seal et al. (2020) found that SQL is, by far, the most prominent tool for the database programming competency based upon 3,500 U.S.-based business analytics–related job ads posted in 2018-2019. Their analysis further revealed that R and Python meet most of the demand for programming language competency.

Dong and Triche (2020a) analyzed 9,163 job ads from Indeed for jobs posted for data analysts, business analysts and business intelligence analysts from 2014 to 2018. Among other skills, they found an increase between 2014 and 2018 in the percent of ads with demands for SQL (from 10.4% to 17.8%), Tableau (from 5.3% to 18.9%), Python (from 2.3% to 10.7%), R (from 4.5% to 11.8%) and Power BI (from .1% to 1.9). Demands steadily increased each year with the exception of R which had a small decrease in 2015 (Figure 1). Furthermore, looking at 746 Indeed job posts for business intelligence and analytics positions in 2019, they reported a SQL requirement in 56.6%, Python in 31.5% and R in 13.7% of the ads. Thus, showing a continuing increase in the demand for tool skills over time. Tableau and Power BI, though not explicitly mentioned, would have been included in the generalized categories of data visualization and analytical (Dong & Triche, 2020b).

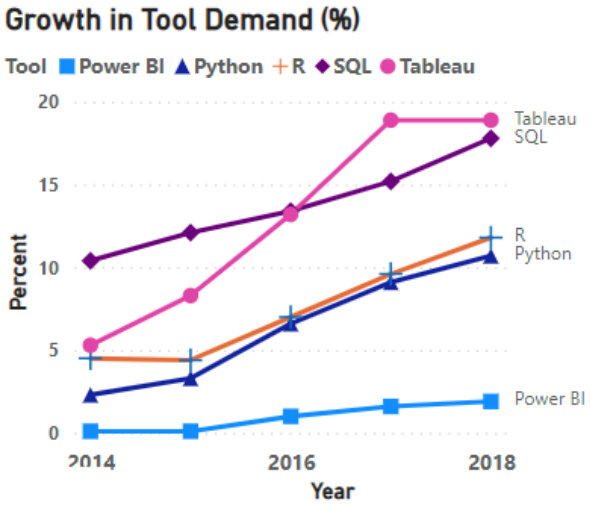

Figure 1: Growth in Tool Demand (adapted from Dong and Triche, 2020a)

Increases in demand could be tied to tool availability. Python was released in 1991, R was introduced in 1993, Tableau was founded in 2003 and Power BI was released as a stand-alone tool in July of 2015.

Stanton and Stanton's (2020) study of over 191,000 LinkedIn job posting during 2019 included a report on the software skill requirements for entry-level positions for data science, data analytic and business analytic jobs. SQL, Tableau, Python and R were found in the top eight most frequency mentioned tools in each job category (Table 1). In each type of position, either SQL or Python had the highest number of occurrences.

	Data Science Positions	Data Analytic Positions	Business Analyst Positions
SQL	23.5%	31.8%	29.9%

Tableau	5.5%	12.0%	12.3%
Python	25.7%	28.1%	24.1%
R	11.4%	16.3%	12.8%

Table 1: 2019 Tools Requirements (Stanton & Stanton, 2020)

A recent LinkedIn analysis of 2,512 ads in 2021, found that SQL, Tableau, Python Power BI and R were the most sought-after data analytics tools. These results highlight the value of resume building skills for emerging data analysts (Zhang et al., 2023).

3. DATA OVERVIEW

The dataset contains 30,569 job advertisements, from Indeed.com, for business analyst-type positions. A Python-based web crawler was used to scrape the web site. All observations were posted during January 2021 and the specific parameters for inclusion were 1) the job ad contains the words 'business' and 'analyst' in the job title and / or detailed description fields and 2) the address listed for the organization is located within 25 miles of a university designated as an R1 research institution.

The dataset includes location information, job titles, company names, job summaries, detailed job descriptions, the length of the job description and when provided salary information

Search Term	Job Category	Number of Ads	Number of Ads with Salary
data analyst	data analyst	764	106
business analyst	business analyst	1,035	132
bi analyst or business intelligence analyst	bi analyst	254	21
systems analyst	systems analyst	170	23
developer	developer	719	84
data scientist	data scientist	482	43
architect	architect	461	59

Table 2: Job Categories

Each job description is categorized as a specific analyst-type position by using keywords. After converting all job titles to lower-case, a conditional statement was used to place each job title into one category based upon the presence or absence of specific words. Distinctive non-analyst titles, such as architect, data scientist, developer, and systems analyst, are also categorized to distinguish among different professions and functions requiring data analytics skills. The search terms and resultant job categories are shown in Table 2.

Out of the 30,569 advertisements 3,143 jobs contain salary data. This salary data is unstructured where some entries are listed as hourly, weekly, monthly or yearly figures. Some of the listings provide a range of salary figures assumedly dependent on the experience of a candidate. The salary information was normalized by converting all figures to a yearly rate based upon the high-end of the salary range when present. Salaries ranged from $16,000 to $500,000 where many of the lower-end jobs are for internship type positions and many of the higher-end jobs are for executive level positions. Although the actual mean salary in the dataset is $94,333, the average across the different job categories, as shown in Figure 2, is $110,300. This difference is attributable to the fact that more salary amounts are provided in the lower paying categories. The highest paying category is architect ($158K), that role is responsible for the data architecture. The data scientist ($125K) has the next highest salaries listed. These individuals are not typically alumni of business school programs. These professions tend to demand more mathematical and technical skills than the analyst categories. Next in salary level are the systems analyst ($108K), developer ($101K) and business intelligence ($100K) ads which describe jobs that traditional information systems and technology programs, often found in the business school, and computer science departments would prepare students to pursue.

The salary difference between the newer analytics roles of business analyst ($98K) and data analyst ($82K) of $16,000 suggests the importance of domain knowledge in understanding data. The data analyst role does not imply the same level of domain expertise. This suggests that tool skills may be necessary to create business value, but not necessarily sufficient. Business experience and understanding are critical in finding insight and value in data analytics. Figure 2 summarizes the job category salary information.

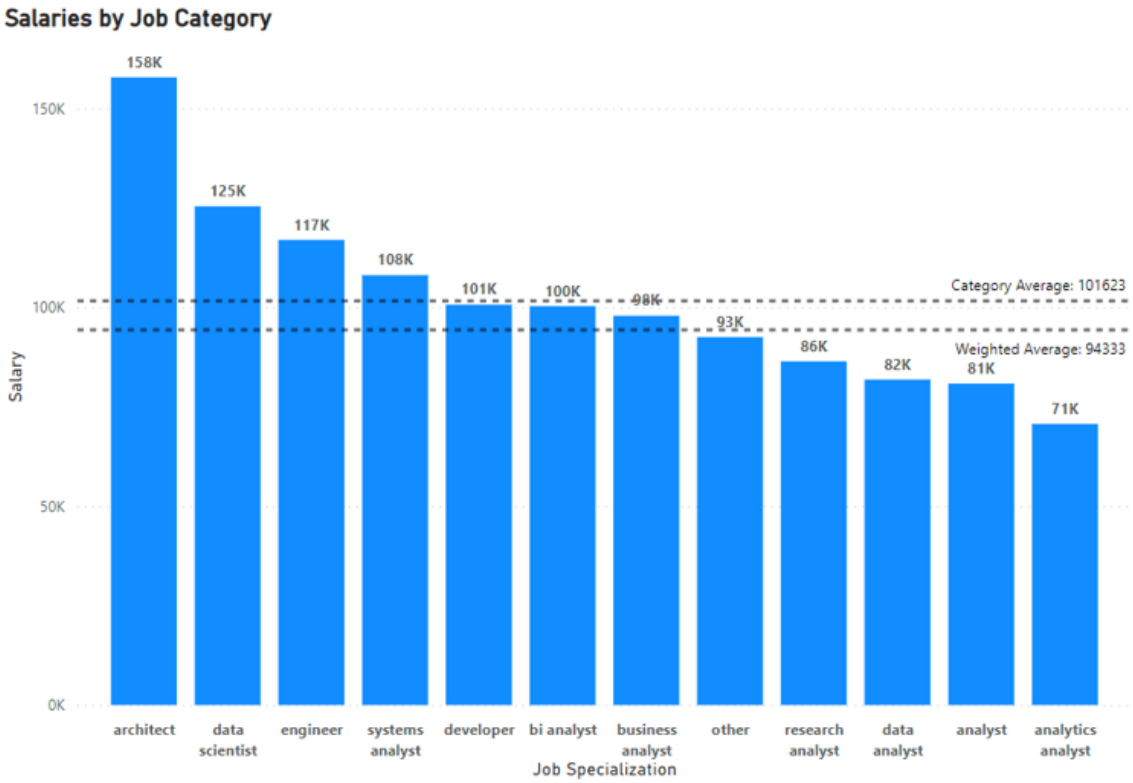

Figure 2: Salaries by Job Categorization

In addition to the salary information, the required (desired) business analytic tools were extracted from the detailed description when available. Required software tools skills are explicitly mentioned in 13,281 (43.4%) of the listings. No specific tools were mentioned in the other 17,288 job ads.

4. DATA ANALYTICS TOOL SETS

The analytics-related tools are presented in Appendix A. A total of 76 different tools are referenced in the dataset. However, these 76 tools are found in 2,238 combinations throughout the 13,281 observations. Some listings mention only one tool and others more. One job ad listed 18 different tools.

SQL, alone and in combination with other tools, is by far the most frequently occurring tool with 7,414 observations. The next four most frequently occurring tools are Tableau (4,682) Python (4,192), R (2,926) and Power BI (1727).

To understand what 'toolsets' are in high demand, the frequency of unique combinations of tools is analyzed. The 20 most frequently occurring single tools, pairs of tools and sets of three co-occurring tools are listed in Table 3. The five most frequently occurring tools, SQL, Tableau, Python, R, and Power BI, are becoming more commonly taught in business school programs. The next few tools, JAVA, C, JavaScript and Perl, are more geared toward development activity rather than analytics, as are the top five tools.

Counting the occurrences of two tools coupled within a single job ad reveals 67,955 distinct tool-pairs. Examining the tool-pairs, the top seven most frequently occurring tool-pairs are composed of tools found in only the five most frequently occurring tools (SQL, Tableau, Python, R, and Power BI). Suggesting that despite 76 different tools, a limited number of tools and combinations of tools dominates the dataset. Furthermore, despite a large number of tools explicitly mentioned by employers, a smaller core of associated tools meets the vast portion of employers' stated requirements. This is an important pattern for employers, individuals and educators, who are responsible for developing the workforce, to consider when they are assessing both the relative importance among tool skills and also the level of expertise required for each tool.

Single Skills		Paired Skills		3 Skill Sets	
Tool	**frequency**	**Tool**	**frequency**	**Tool**	**frequency**
sql	7414	***python, sql***	3157	***python, r, sql***	1847
tableau	4682	***sql, tableau***	3039	***python, sql, tableau***	1520
python	4192	***python, r***	2375	***python, r, tableau***	1206
r	2926	***r, sql***	2154	***r, sql, tableau***	1163
power bi	1727	***python, tableau***	1799	***power bi, sql, tableau***	756
java	1698	***r, tableau***	1419	java, python, sql	681
c	1424	***power bi, sql***	1169	java, javascript, sql	576
javascript	1030	java, sql	1072	power bi, python, sql	551
perl	967	power bi, tableau	1017	python, spark, sql	538
spark	936	java, python	941	hadoop, python, sql	516
sap	907	java, javascript	940	power bi, python, tableau	477
hadoop	810	hadoop, sql	686	qlik, sql, tableau	412
qlik	669	spark, sql	677	power bi, python, r	411
sas	616	python, spark	631	java, javascript, python	406
vba	506	c, sql	626	power bi, r, sql	398
hive	444	power bi, python	622	power bi, r, tableau	372
nosql	421	javascript, sql	593	c, python, sql	367
spss	420	hadoop, python	572	c, java, python	356
ms access	358	qlik, tableau	548	hadoop, spark, sql	356
informatica	319	c, python	518	c, java, sql	345

Table 3: Most Frequently Occurring Tools

Ordinal Tool Acquisition

Merely examining the frequency count of co-listed tool requirements is limiting, because it doesn't facilitate the prioritization of tool skills or the degree of expertise one should possess with tools both individually and conjointly. In developing a program of study to address the demands of the business analytics job market, an individual or institution needs to establish a practical pathway toward identifying and building robust tool skill sets. This section of the paper, presents a series of tree diagrams, using a data-driven approach, that illustrates the actual number of most frequently occurring four-tool sets. There are five diagrams, each one starting with a node representing one of the top five most frequently occurring tool mentions. Given Microsoft Excel's ubiquity in organizations and business schools' curriculum, Excel has been excluded from this analysis.

Each tree diagram models the number of occurrences of specific tools combinations within the data. The number under the tool node represents how many times that tool and any preceding tools on a particular branch occurs in the dataset. For example, in Figure 3, the SQL tree, SQL is found in 7,414 ads. In the second tier, SQL and Python occur together in 3,157 ads. The third tier indicates that SQL, Python and R occur together in 1,874 ads. Finally, the fourth tier shows that SQL, Python, R and Tableau are jointly listed in 1,017 job ads.

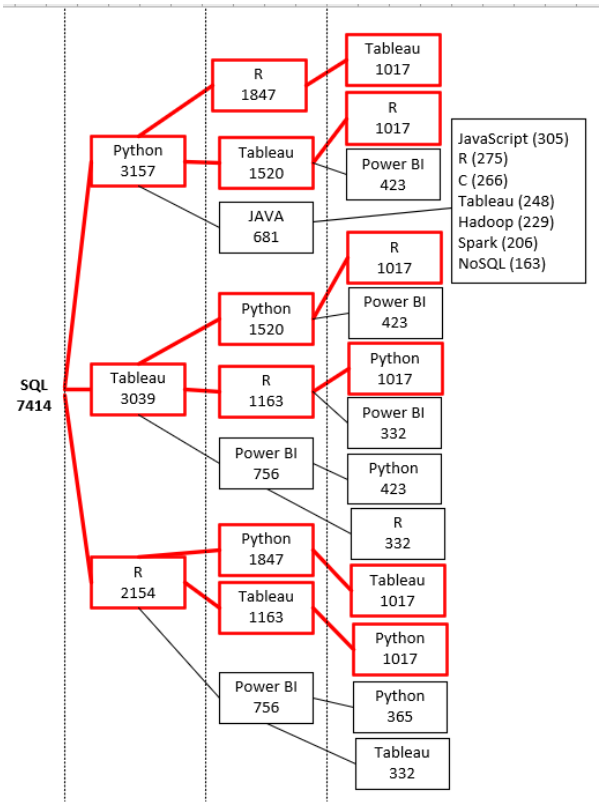

Figure 3: SQL Tree

The heuristic for inclusion on the tree diagrams

requires that the number of occurrences for a node on a specific branch must be at least 20% of the number of occurrences of the previous tier's node. For added clarity, the branches are assembled so that within a specific branch, the more frequently occurring tools are shown higher on the diagram.

As shown in the Figure 3, SQL was found 7,414 times in the job ads. Thus, SQL is mentioned in 47% of the job ads requiring tools. Following the 20% rule, the tools paired with SQL must occur at least 1,483 times (7,414 * .2) for inclusion as a second-tier node. Python, Tableau and R meet this criterion. In the third tier, SQL, Python, Tableau and R, continue to dominate. Java and Power BI are the only major new entries onto the tree diagram. The only new tools shown on the fourth-tier stem from the Java branch. Given the SQL-Python-Java branch is relatively low in observations (681), the 20% heuristic requires only 136 observations to be included. JavaScript, R, C, Tableau, Hadoop, Spark, and NoSQL are added to this branch. The six highlighted branches each occur 1017 times. These branches are identical in content except for the order in which the tools (SQL, Python, Tableau and R) are introduced into the model.

Figure 3: SQL Tree

As shown in the other tree diagrams, Figures 4 through 6, the Python, R, and Tableau trees exhibit virtually the same pattern except for the order by which the tools are introduced in the initial seeding of the tree. The tree seeded by Power BI (Figure 7), exhibits a different pattern. In the Power BI tree, tier two contains the same four dominate tools observed in the previously discussed diagrams (SQL, Tableau, Python, and R). However, the early commitment to Power BI, a less dominant tool in the 2021 dataset, leads to a significantly a smaller number of occurrences of tool combinations on all subsequent tiers. The only additional tool meeting the 20% requirement is Qlik, a business analytics platform.

Moving beyond the five most frequently occurring tools, the pattern in the data changes. For example, the sixth tool on the most frequently referenced list is Java (Figure 8). The tree diagram appears to be more geared toward big data and development activity, than business analytics skills that would be most characteristic of business professionals.

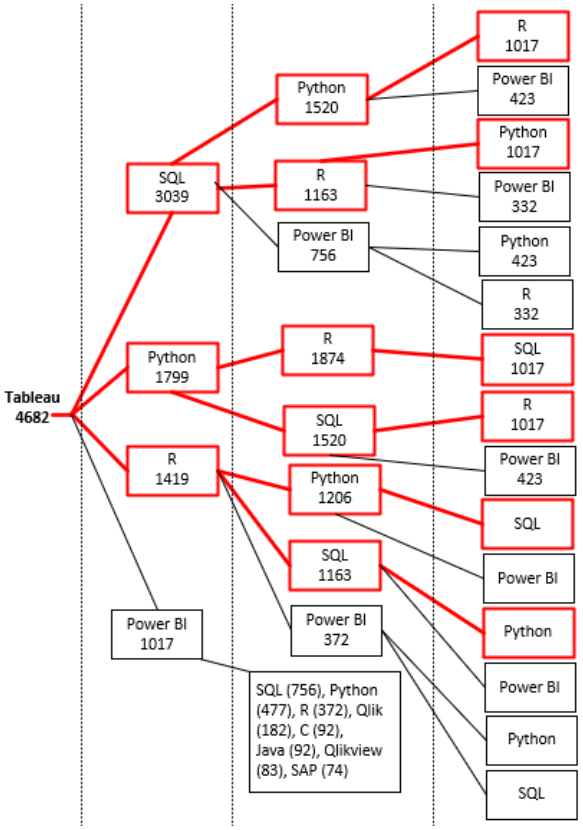

Figure 4: Tableau Tree

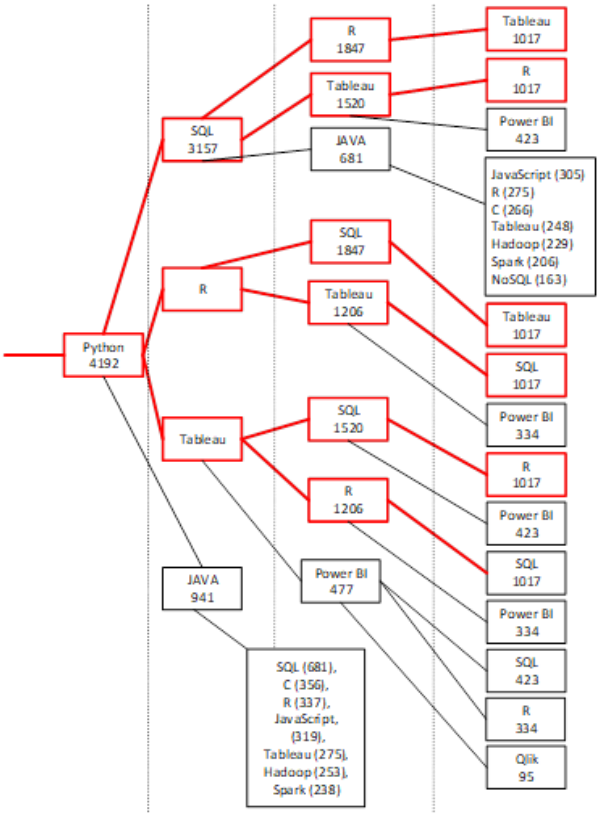

Figure 5: Python Tree

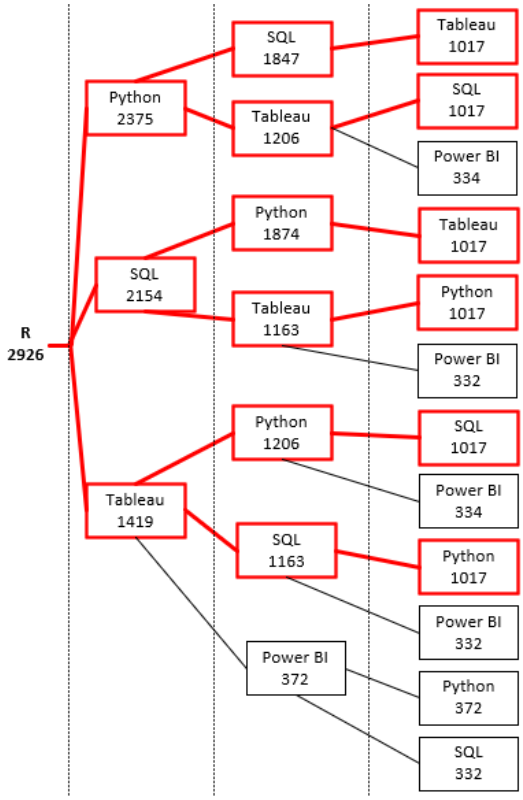

Figure 6: R-Tree

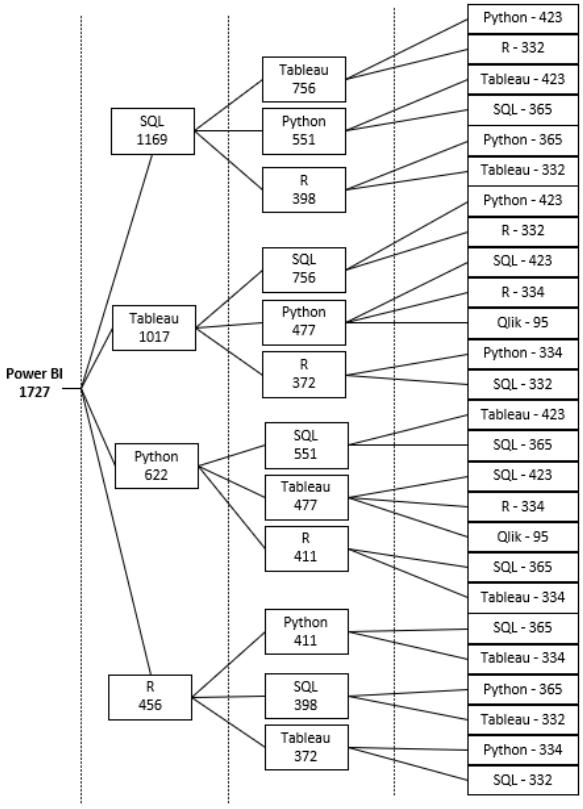

Figure 7: Power BI Tree

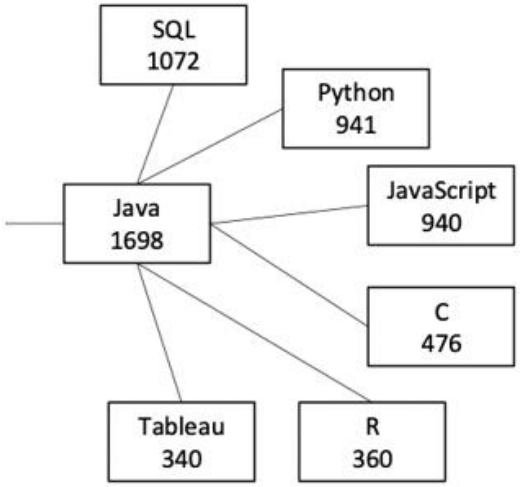

Figure 8: Java Tree

Rank	4-Tool Set	# of Job Ads
1	python-r-sql-tableau	1017
2	power bi-python-sql-tableau	423
3	power bi-python-r-sql	365
4	power bi-python-r-tableau	334
5	power bi-r-sql-tableau	332
6	java-javascript-python-sql	305
7	hadoop-python-r-sql	289
8	hadoop-python-spark-sql	281
9	java-python-r-sql	275
10	c-java-python-sql	266
11	python-r-spark-sql	265
12	java-python-sql-tableau	248
13	hadoop-java-python-sql	229
14	python-qlik-sql-tableau	221
15	hadoop-python-sql-tableau	215
16	java-python-spark-sql	206
17	hadoop-hive-spark-sql	203
18	hadoop-hive-python-sql	201
19	hive-python-spark-sql	193
20	c-python-r-sql	187

Table 4: Most Frequency Occurring 4-Tool Sets

Given the 20% heuristic, this tree's expansion is stunted at two tiers. Java's second tier includes SQL, Python, JavaScript, C, R and lastly Tableau. Tableau, with the smallest number of

Salary Amount #Ads (Ads w/ Salary)	SQL	Tableau	Python	R	Power BI
SQL	$105.9K 7414 (633)	$108.1K 3039(243)	$109.4K 3157(234)	$115.5K 2154(191)	$111.1K 1169(114)
Tableau		$102.1K 4682(374)	$112.7K 1799(137)	$117.5K 1409(124)	$111.2K 1017(108)
Python			$109.1K 4129(298)	$112.3K 2375(190)	$121.0K 622 (62)
R				$110.0K 2926(249)	$127.6K 456(52)
Power BI					$101.2K 1723(171)

Table 6: Average Salaries with Two Most Common Tools

occurrences, is the only exclusive business intelligence, big data, visualization tool in this tool group. SQL is a query language and the other four nodes are all programming languages.

Absence any context, the acquisition of skills for a four-tool set, SQL, Python, R, and Tableau, seems to be the clear choice. As shown in Table 4, this most frequently occurring 4-tool set occurs at a frequency of 2.4 times more than the second most frequently occurring 4-tool set. However, the five most frequently occurring 4-tool sets contain only the five most frequent tools in the data set in every combination possible (SQL, Tableau, Python, R, and Power BI). As observed in the tree diagram analyses, the trees seed with the SQL, Tableau, Python, and R node had little variation. However, the tree originating with the Power BI has more branches signifying the pervasiveness of the tool across a more diverse platform of tools.

The next six most frequent 4-tool sets do not contain Tableau or Power BI. These sets each continue to include python. Additionally, they introduce one or two lower-level programming languages such C or Java. This suggests that the required skill sets may be more technical or big data skills and less applied business analytics.

5. TOOLS AND SALARY

Out of the 3,143 ads with salary data, 1,230 ads list the tools that are required for that position. The average salary for ads with tools is $97,446 which is $5,115 higher than the average of $92,331 calculated for the 1,913 jobs with no tools specified. The inclusion of requirements for the five most frequently mentioned tools seems to have a positive effect on the posted salary level.

Table 5 shows the average of the salary posted when only one of the top five tools is mentioned. Although interesting, the exceptional low number of instances with salary where only Python or R is mentioned suggests that this information alone is not definitive.

Stand Alone Tool Mentions	Avg Salary	n	n with Salary
SQL	$98.1K	1215	109
Tableau	$93.4K	838	76
Python	$96.2K	92	4
R	$55.3K	78	3
Power BI	$71.2K	225	18

Table 5: Average Salaries for One Tool Ads

Table 6 shows how the top tools contribute to overall salary averages when they are combined with another tool. Example, if SQL is included in an ad regardless of any number of other required tools, the average for the ads is $105.9. However, if both SQL and Tableau are mentioned in the ads, the average increases to $108.1K. In all cases, the inclusion of two of the five most frequently mentioned tools is greater than the average of ads referencing only one of the top five skills. This indicates that any combination of the two tools should increase both potential salary offers and the number of ads that match a candidate's skill set.

Tool and Job Category

To understand the distribution patterns of the tool usage and salary trends, the data is sliced based on the job categories that were shown in Table 2. Figures 9 through 15 show how the average salary for each job category varies with and without the mention of the five most frequently required tools. These also show how many job ads request a tool and how many of those that carry salary information for each job category and tool.

Salary information is available for 132 of the

1,035 business analyst ads in the dataset. Figure 9 shows the average salary per requirement varies from $77K for ads requiring R to $108K for ads requiring Power BI. Ten (117-107=10) of the 132 ads with salary information specifically ask for Power BI experience. Those 10 ads looking for Power BI experience carry an $11K premium moving the average from $97K without Power BI mention to $108K with Power BI mention. SQL and Tableau also seem to have a positive impact on salary level. SQL registers a $6K gain and Tableau yields $11K. On other hand, Python and R are associated with a decline in the salary offers for business analysts of $20K and $23K respectively.

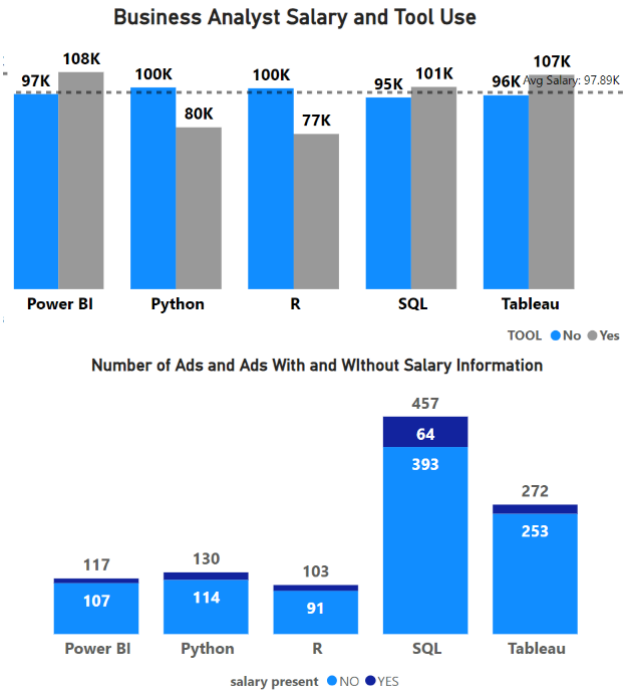

Figure 9: Business Analyst Overview

The BI analyst category occurs a total of 254 times with 21 of those ads carrying salary data. Power BI, Python and Tableau, occur with salary data nine, five and 11 times, with observed decreases of $17K, $17K, and $13K respectively. R, with only three ads with salary data, and SQL, with 18 salary observations, exhibited increases in the average salary of 2K and 33K (Figure 10).

For the data analyst category (Figure 11), there are 106 ads with salary data out of 764 job ads for the category. Each of the five tools is associated with a positive impact on salary. Tableau in the lowest salary number at $85K. At the high-end of the continuum, both Power BI and R average compensation of $90K.

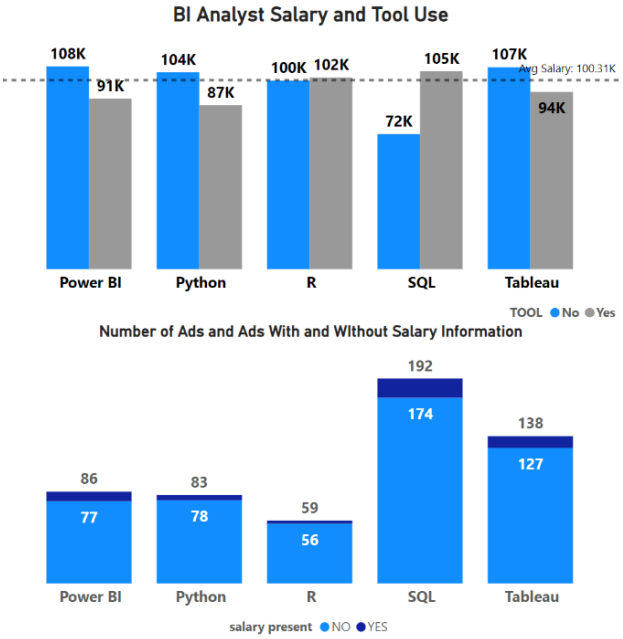

Figure 10: BI Analyst Overview

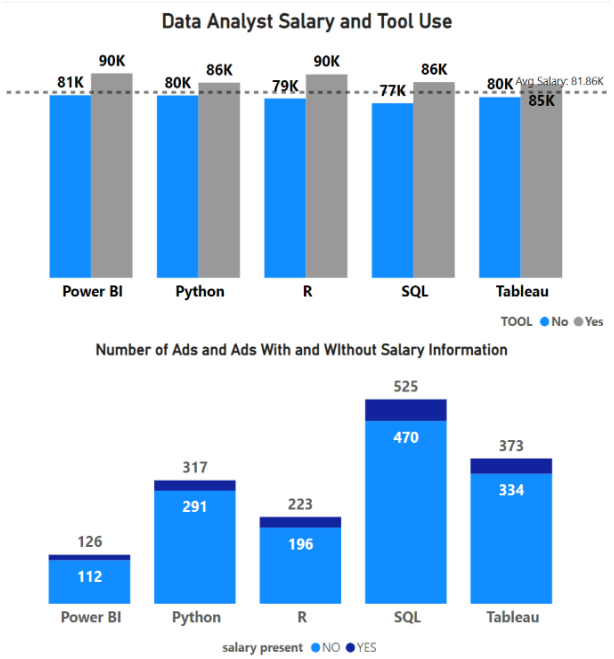

Figure 11: Data Analyst Overview

The 482 job ads in the data scientist category contain 43 listing with salary data (Figure 12). In this category, Power BI (5 ads with salary data and 21 ads without salary data), R, and Tableau are associated with lower salary levels. Python and SQL do carry premiums. Although the Python differential is significant, $22K, the

SQL difference is marginal at $2K.

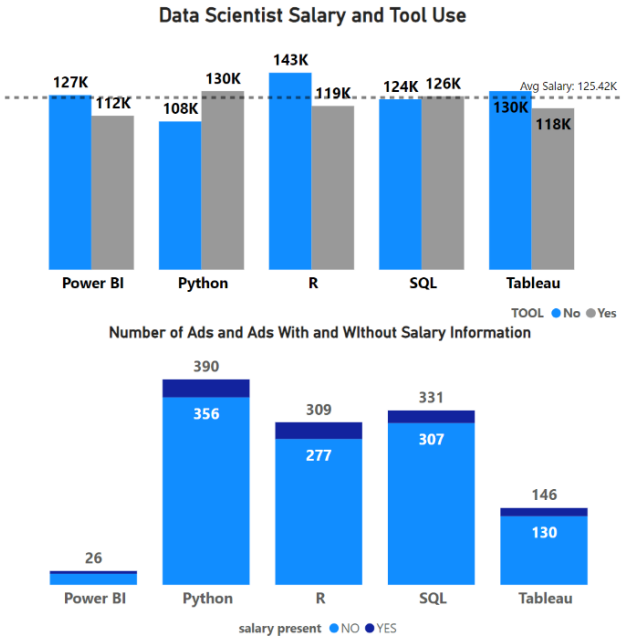

Figure 12: Data Scientist Overview

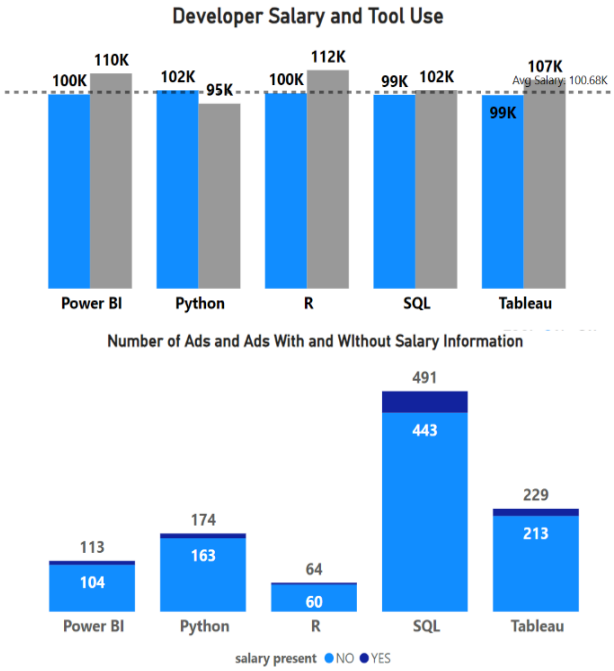

Figure 14: Developer Overview

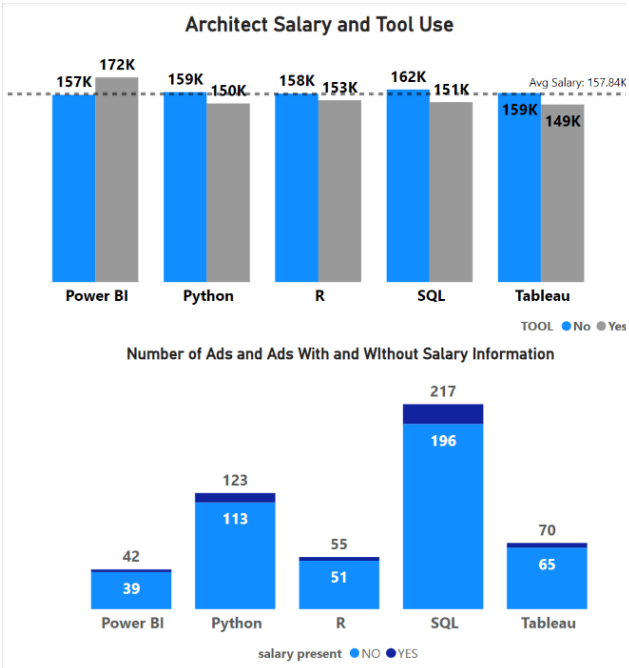

Figure 13: Architect Overview

For the data architect, 59 of the 461 job ads carry salary data (Figure 13). Only the Power BI tools yield a premium. The $15K boost is calculated on only 3 salaried observations. This suggests that data analytics tools are not important to the data architect.

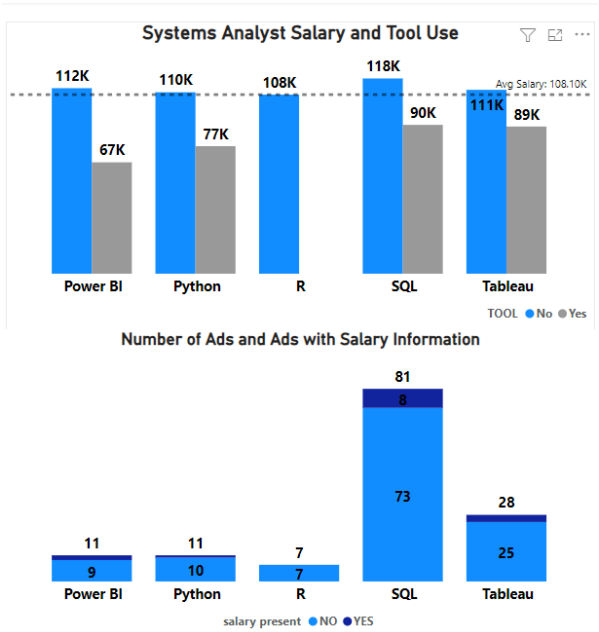

Figure 15: Systems Analyst Overview

Figure 14 shows that Power BI, R, SQL and Tableau all lead to higher salary averages for the developer. Python alone did not suggest a premium for the systems developer.

Finally, the systems analyst category (Figure 15) exhibited a pattern in this dataset that suggests

data analytics tools are not valued in that type of position.

Job Category	Without AI-ML		With AI-ML	
	Salary	n	Salary	n
business analyst	$98K	129	$90K	2
BI analyst	$100K	19	$108K	2
data analyst	$81K	97	$88K	7
data scientist	$83K	4	$130	25
developer	$102K	80	$83	4
systems analyst	$108K	23	-	0
architect	$151K	52	$210K	7

Table 7: Salary and AI-ML Mentions

The job descriptions were also searched for any mention of artificial intelligence, machine learning or deep learning. Table 7 shows the averages with and without the AI-ML mention for each job category. The business analyst and developer averages were higher when AL-MI was not present. The BI analyst, data analyst, data scientist and architect averages were higher when AI-ML was present in the description. The number of data scientist ads mentioning AI-ML is higher than the number of ads not mentioning the technology. This is the only instance where a specific skill is mentioned in more ads than it isn't. Also, the systems analyst category is not in the table because this category contains no mentions of artificial intelligence, machine learning or deep learning.

6. DISCUSSION

Job ads for business analysts and data analysts are the most common positions in the dataset. The dataset also included ads for positions in various roles, such as BI analysts, data scientists, data architects, systems analysts, and software developers.

With the present emphasis on analytics, it is intriguing to observe how the stated demands for the most requested tools vary across the job titles such as business analyst, data analyst, BI analysts and data science (Figure 16). SQL emerges as the dominant tool with the highest percentage of mentions in each of the job categories, except for the data scientist, where Python is mentioned in 81% of the ads with tools. Tableau was in higher demand than Power BI in all job categories. The data scientist had twice as many mentions of Python and R than any other job category. This aligns with the expectation that the data science would involve the use of more powerful, versatile tools that are less user friendly.

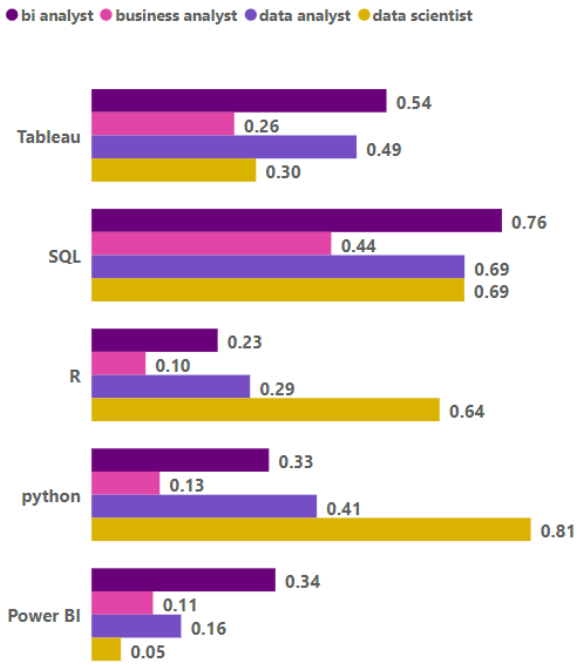

Figure 16: Analytic Roles - Top 5 Tools

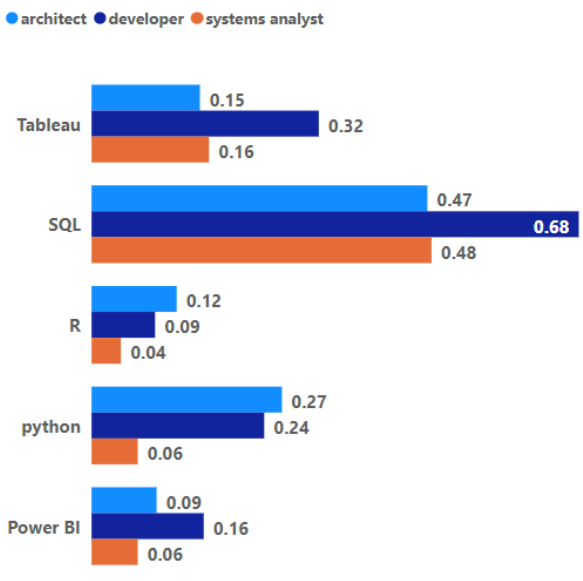

Figure 17: Non-Analytic Roles - Top 5 Tools

The non-analytic roles of architect, developer and systems analyst exhibit a generally lower percentage of jobs requesting these specific tools (Figure 17). However, SQL stands out as a notable exception with continued high demand for SQL skills.

The next four most frequently listed tools are Java, C, JavaScript and Perl. These tools are

primarily geared toward development rather than analytics. Figures 18 and 19 show that demand for these tools is higher for the non-analytical categories of jobs. The demand in the analytics job categories is under 10% of the ads in all instances except for the data scientist with a Java requirement.

Among the non-analytics job categories, developer has the highest mentions of these tools. Among the programming languages, Java and JavaScript were more in demand than C. Perl was only mentioned in 3% to 4% of these listings.

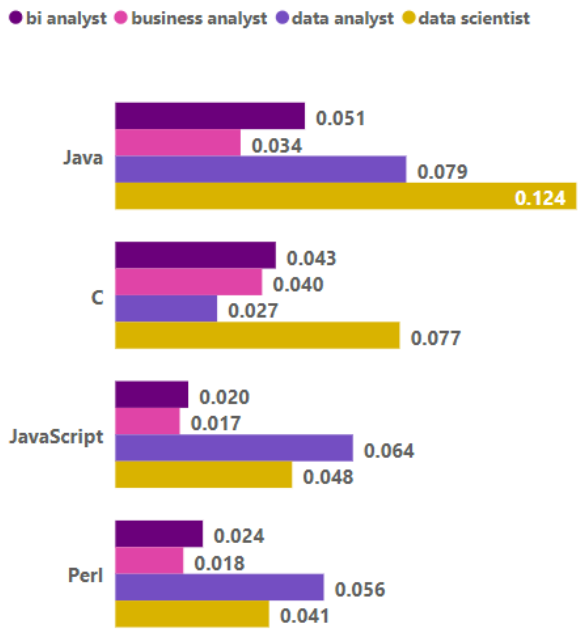

Figure 18: Analytic Roles – Tools 6 to 9

Generally, the mention of tools tends to raise salary expectations. However, this effect is moderated or sometimes reversed when the job category is introduced. Table 8 shows that all five most frequently mentioned tools correlate with an increase in salary for the data analyst exclusively. despite having the lowest salary of $82,000.

Within an average salary of $98,000, the business analyst does not benefit from ads listing R or Python. Likewise, the BI analyst ($100,000) and data scientist ($125,000) only have 2 tools which seem to positively impact their salaries.

It is important to note that the absence of a tool mention in an ad does not imply that a candidate with that tool on their resume would not be desirable or valued if selected. It simply means that a specific tool is not the primary skill sought for that particular role. However, as salary increases it may be more likely that skill sets may be assumed and not explicitly stated in the ad, with a candidate's knowledge and domain experience taking precedence.

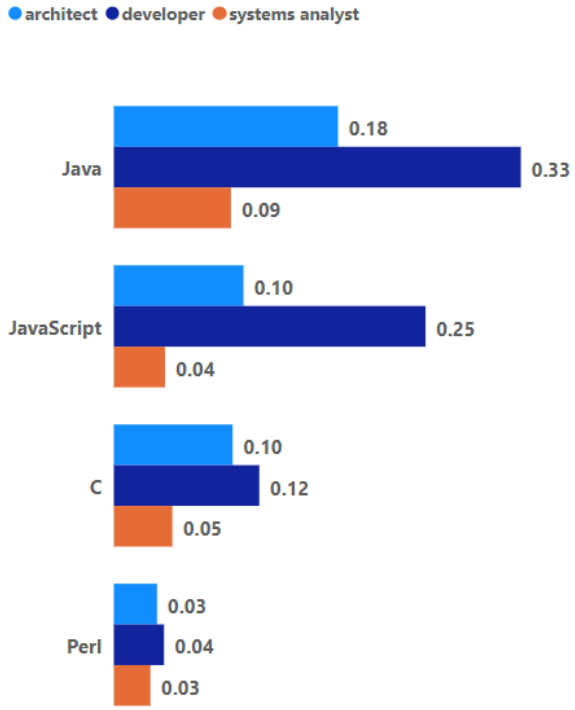

Figure 19: Non-Analytic Roles – Tools 6 to 9

	SQL	Power BI	Tableau	R	Python
Data Analyst	+	+	+	+	+
Business Analyst	+	+	+	-	-
BI Analyst	+	+	-	-	-
Data Scientist	+	-	-	-	+
Developer	+	+	+	+	-
Data Architect	-	+	-	-	-
Systems Analyst	-	-	-	-	-

Table 8: Salary Impacts

Given the salary difference between the business analyst and data analyst categories ($98,000 vs $82,000), the importance of business context cannot be overstated. Business analysts must be prepared to both ask and answer insightful business questions, while the data analyst category may lean more toward providing analysis (and visualization) as a service.

7. CONCLUSION

This study's foundation assumes that job advertisements reasonably represent human resource demand in organizations and provide insights into the specific skills and competencies required in the marketplace. However, it's essential to recognize that not all job advertisements may accurately reflect the true skills needed. Organizations may not always fully understand the precise competencies required, leading to the inclusion of multiple competencies in a single position with the hope of finding a candidate possessing some subset of those skills.

A comprehensive examination, of the data analytics tools found in job advertisements is performed to gain valuable insights into the job market for various type jobs, such as business analysts, data analysts, and more. By examining a wide range of job postings, the study addresses questions, such as the prevalence of tools across different job categories and their potential association with higher salaries.

The findings revealed the most common tools associated with each job category, providing valuable guidance for aspiring professionals seeking to enter or advance within the analytics field. Moreover, the analysis sheds light on the potential relationship between specific tools and higher salary offerings in ads. This crucial insight can assist job seekers in understanding which skills may yield greater earnings potential and can aid employers in tailoring their hiring strategies to attract top talent. These findings are also valuable to educators when considering analytics program design.

This dataset, with over 30,000 listing from Indeed.com, shows that SQL is a critical skill for business analyst, data analyst and business intelligence analyst. Additionally, Tableau is more popular that Power BI, and Python is more sought after than R.

As the job market and analytics domain continue to evolve, it is essential for both job seekers and employers to stay informed about the latest trends in tools and their impact on job roles and compensation. This research serves as a valuable resource, providing actionable information for both employers and candidates to make informed decisions in the dynamic landscape of analytics careers, fostering a thriving analytics ecosystem.

Future research is necessary to observe how the demand and monetary value of specific tools are changing over time. Further research should also assess whether certain tools listed on a resume might signal someone could be overqualified.

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APPENDIX A
Business/Data Analytics-Related Tools

apache storm	informatica	obiee	ruby
c	java	octave	sap
ca7	javascript	oracle analytics	sas
caffe	jmp	oracle analytics cloud	scala
cart	json	oracle r	scikit
databricks	julia	otbi	shiny
datawatch	kafka	pandas	spark
django	keras	perl	spss
domo	knime	php	sql
gis	map reduce	pig	sqoop
green plum	matlab	postgresql	swift
hadoop	matplotlib	power bi	tableau
hana edw	microsoft access	python	tensorflow
hcm cloud	modelbuilder	pytorch	teradata
hdfs	mxnet	qlik	trillium
hdinsights	netezza	qlikview	vba
hive	nodejs	r	vmware
hyperion essbase	nosql	rapidminer	weka
ibm watson	numpy	rdbms	yarn