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A Study on Career as a Data Scientist: Challenges and Opportunities

Shivam Sharma

Student, Dept. of Instrumentation Engineering, Ramrao adik institute of technology, Mumbai, Maharashtra, India

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Abstract – Data science is a highly technical field which involves processing digital information and problems in analysis. It combines a high level of data mining and statistical methods with data processing approaches when dealing with a huge volume of data, data development and design methods and AI approaches to work with data. Data science is known as one of the most promising, highly paid, and lucrative positions since the 2010s. There are different job responsibilities and requirements in different organizations looking for data scientists. Sometimes, data scientists are required to perform the roles of data analysts. But their jobs are mostly too technical as compared to that of data analysts.

Since the positions and roles vary according to the industry, the skill requirements and experience of data scientists cannot be the same. Considering the increasing demand for data scientists in various industries like retail, healthcare, IT, food processing, etc., the skills, training, and education required are likely to change according to market needs.

This study may benefit career aspirants pursuing their break into the field of data science by explaining challenges and opportunities that come with lucrative offers and salaries. It may also help organizations to understand the key skills that are often neglected when hiring the deserving candidates. However, further research is needed to deepen the understanding of some challenges associated with it.

Key Words: data science, data scientist, data analyst, challenges and opportunities, data science career

1. INTRODUCTION

A data scientist is usually the professional who has skills to extract and interpret data, which needs both methods and tools from machine learning, statistics, and humans. A data scientist spends most of their time cleaning, collecting, and filtering data and it needs statistics, persistence, and software engineering skills. These skills are important to debug logging output from the code and understand biases in data. Simply put, a data scientist is responsible to analyze data for actionable details [1]. Here are some of the specific tasks –

- Recognizing data analytics issues for the organization
- Collection of huge chunks of unstructured and structured data from different sources
- Determining the right variables and data sets
- Validating and cleaning data for completeness, accuracy and uniformity
- Analyzing data to recognize trends and patterns
- Applying and devising algorithms and models for mining big data
- Data interpretation to discover opportunities and solutions
- Communicating stakeholders with the results through visualization and other methods

More than 2.5 quintillion bytes of information are processed globally in each passing day. A data scientist is responsible to analyze and organize this much amount of information for organizations to generate a lot of opportunities. For example, data science can help a company to remind their customers for their regular purchases. Suppose a customer buys the same postpaid plan every month, a network provider may remind them every month about the latest offers and prompt them to buy quickly. Data analysis is helpful for most companies and data scientists have great demand in IT and other important sectors like logistics, FMCG, etc. Over 50% of data scientists in the world are hired by five leading tech companies, namely Amazon, Google, Apple, Facebook, and Microsoft.

In order to make a career in data science, an aspirant should have a bachelor's degree in the same field. It is recommended to have a certification course in data science to become a data scientist. An aspirant with Statistics and Mathematics background is given preference in this field. However, students from completely different fields like Commerce can become

a data scientist. Their condition is that they should have coding skills and learning commitment [2].

There are different skills required to become a data scientist. According to the Bureau of Labor Statistics, here are some of the skills that are especially important [3] –

- **Analysis** – Data scientists should have organized thinking and they should be able to analyze results about their research to come out with desired conclusions, according to the BLS.
- **Logical and Critical Thinking** – Critical thinking is very important to ensure business success as data scientists are able to work on complex issues as it is a talent for depending on logic and reasoning.
- **Mathematical Skills** – It usually goes without saying that data scientists should have advanced technical and math skills that are important for computing, according to the BLS.
- **Communication** – Data scientists usually have to work with managers and programmers. Hence, they have to report to the superiors and collaborate with the subordinates.
- **Innovation** – Innovative thinking is very important to solve complex bugs. Data scientists need to solve problems with ingenuity, especially when their concepts don't work as expected.
- **Coding skills** – Data scientists should also be excellent in software and coding skills. According to Glassdoor, there are different programs they should learn, such as SQL, R, and Python.
- **Deep Learning, Machine Learning, and AI** – Increased connectivity, computing power, and huge chunks of data being processed are moving industries really fast. So, a data scientist has to stay ahead in their research and know the right technology to apply in the right cases. They should have deep knowledge about the problem.
- **Statistical skills** – These are also valuable but often overlooked by employers because of the easy availability of open source software and automated tools. But to comprehend the assumptions made by these tools and programs, statistical skills are very important. A data analyst has to know the right data preparation techniques to boost the performance of a model and understand the statistics to choose the right algorithm for any project. A data scientist should also have cleared the basics in software engineering [4].

The job roles of data scientists are often confused with that of data analysts. While data analysts analyze and organize collected data like logistics, sales figures, or R&D in an organization, a data scientist uses strong business acumen and abilities to communicate their findings to both IT leaders and businesses to determine how an organization can make it their opportunities. Data scientists may perform different functions as per the sector/industry they are performing in. For example, Facebook may hire a data scientist to analyze the types of pages most "Liked" by the users and use this insight to choose the types of ads to target the user on their Facebook account. They combine their analytical skills with maths and coding skills.

Data scientists and analysts rely on Python, SQL, R, SAS with their background on Ruby, Perl, C/C++ and Java for data mining. Data scientists have a great demand across the world by governments and organizations to collect or mine a huge chunk of data and analyze the same, i.e. big data [5]. A data scientist is usually responsible for –

- Gathering data from different sources
- Using strong business skills and abilities to mine big data and communicate findings for actionable insights.
- Using those details to influence the approach of an organization in business challenges
- Making the most of combined knowledge of computer applications and science, statistics, modeling, maths and analytics for problem solving.
- Communicating important insights and information to IT leaders and businesses
- Sifting and analyzing data from different angles and looking for trends to highlight opportunities

Here are some work areas where data scientists are highly required –

- Government organizations
- Research institutions and universities
- Banks
- FMCG companies
- Leading retail chains
- Airlines
- Marketing departments and agencies

- Leading IT companies like Facebook, Google, Microsoft etc.

Since data scientists have great demand worldwide, they also get a handsome pay. According to Payscale.com[1], the average base pay is Rs. 500,779 per year for a data analyst in India, including bonus. This figure can rise up to Rs. 1 million per year, as per additional skills, employer, location, and experience. A data analyst may start with around Rs. 3.50 lakh per year with less than one year of experience. Expected salary may be Rs. 5 lakhs per year with 1 to 4 years of experience, according to Glassdoor. With over 5-9 years of experience, analysts can make around 7.20 lakhs per year. With over 10-19 years of experience, experienced candidates can make up to Rs. 12.75 lakhs per year. Experience does have a great impact on salary.

Beginner	1-4 years of experience	5-9 years of experience	10-19 years of experience
3.50 lakhs/year	5 lakh/year	7.20 lakh/year	12.75 lakh/year

Table 1 – Data Analysts' Payscale with Experience

Proficiency also plays a vital role in professional growth. With statistical skills, a data scientist can make up to Rs. 4.80 lakh per year. A data analyst may earn up to Rs. 3.89 Lakh per year with proficiency in MS Excel. Data analysis is a very important skill along with SQL and MS Excel [2].

According to this graph, A data analyst can make $55,933 (including bonus, tips, and overtime) per year on the basis of 2360 salaries on an entry level with <1 year of experience. With 1-4 years of experience, a data analyst can earn $60,822 on an average of 13,262 salaries. With 5-9 years of experience, a data analyst can expect $68,852 on an average of 3201 salaries. With over 10-19 years of experience, a pro-level data analyst can expect $71,330 on the basis of 1401 salaries. With over 20 years of experience, they can expect $73,225 in their late career [6].

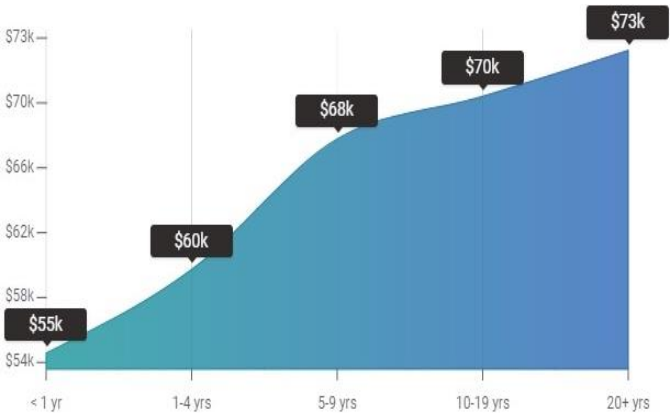

Fig. 1 – Data Analysts Salary Growth with Experience (Source: Payscale[2])

LITERATURE REVIEWS

Mauricius Munhoz de Medeiros et al. (2020) explain the benefits of data science for business and highlight the opportunities and challenges related to it. The authors present empirical data collected through online interviews with a sample of 211 respondents who are highly experienced in medium and large companies from various economic sectors. To make business more valuable and turn data into information, organizations have to put certain efforts to change the executive mindset, formulate governance mechanisms and formulate strategies to renew workflow competencies and allocate investments in the IT sector.

Melanie A. Meyer (2018) analyzes job postings of data scientists in the healthcare sector as well as the skills, job roles, and qualification requirements. Data scientists have great demand in the healthcare industry considering the expansion of big data and its possible impact. Healthcare settings can use big data to improve efficiency, treatment quality, bring innovation, and control costs. The author examines skills and qualification requirements in US healthcare organizations for job roles of data scientists. They conduct a content analysis of such job postings with an inductive approach to categorize and capture core data for each posting. There is a huge range of healthcare data scientist requirements on the basis of job level, focus area, and type of hiring organization. This study may help deepen the understanding of skills and

1 https://www.payscale.com/research/IN/Job=Data_Analyst/Salary/9dc430d9/Data-Mining

2 https://www.payscale.com/research/US/Job=Data_Analyst/Salary

qualification requirements for such job positions and also organizations to identify knowledge and skills that are often overlooked in hiring.

Michael R. Berthold (2019) explores different types of data science positions in an organization considering recent claims that data science is accessible to non-data scientists using simple tools or can be completely automated. The author also explains the skill sets required to become a successful data scientist and how to achieve those skills. This study concludes that both vast experience in data science projects and detailed understanding of important methods are required for data science. Data science projects still need proper training and experience, with exception of some areas where tools and automation are used.

Маков, С.О. (2020) studies the career in the field of data science. The author chooses data science because it is a vast field with problems of analysis and digital representation of data. It is the combination of data processing approaches in cases where a high level of statistical methods, parallelism, data mining methods and AI applications are required to work with data. Since the 2010s, data science has been known to be the most highly paid, lucrative, and promising career option. There are different job roles and responsibilities in data scientist positions in various companies.

Mina, M.A.E. and Barzola (2018) provide general information as literature reviews about data scientists. Over the years, a huge chunk of data has been accumulated in production and commercial activities. Hence, a professional agent is always required for the interpretation of data and generating information for valuable conclusions and results. The author presents a systematic literature review to spot the career and work profile of data scientists as a new field.

RESEARCH QUESTIONS

Q. What are the challenges of a career as a Data Scientist?

Q. What are the opportunities of a career as a Data Scientist?

METHODOLOGY

In order to find the answers of above research questions, secondary data is collected from trusted sources like authentic news portals, research journals based on data science as a career, job portals for gathering information like job roles, payscale, etc. and other resources. This paper is aimed to provide all the important insights about scope of data science as a career option and to make aspirants aware of the potential challenges and opportunities before choosing this career. By collecting all the data, this study is also aimed to help organizations to consider required skills and knowledge fields that are often overlooked during the hiring process.

Q. What are the challenges of a career as a Data Scientist?

Data is truly an attractive and interesting field because it has a lot of demand for potential data professionals. However, data science, like any other career, has its challenges. This way, Laurence Bradford [12] attempts to explore the true challenges in this field according to the experts and managers in this field.

First of all, companies expect them to be specialists – Instead trying their hands on everything, data scientists have to narrow their focus down to a specific field. This way, the author in [12] explains that data science is a vague and a broad term like medicine that covers different practices. With different engineering skills, data scientists can gain experience in different tools and platforms. The key here is mastering the basics when it comes to learning to be a data scientist. It is up to the aspirant as what tools, areas, and platforms they want to specialize in.

Data scientists are expected to spend most of their time cleaning and sorting data – It is another major challenge when it comes to looking at technical standpoint. The way data scientists use the data, clean it, extract it, analyze, and get insights from it is the major challenge. It is very important to have a vast domain expertise in Python, R, SQL, and other coding languages to become a data scientist. Most of the data scientists remain busy gathering important information and clean up a data set before applying any statistical models or machine learning algorithm. It is almost an art and one of the most important parts of the job [12].

There is a big gap between expectations and reality – The author in [13] addresses one of the most common challenges in the field of data science. There are so many reasons behind and they may vary professional to professional. Level of experience means a lot in this field. For example, most of the aspiring data scientists have usually learned from online courses and books and are usually self-learned. According to the author [13], they have no idea about real-world datasets and projects and other concepts like –

- How to use an ML pipeline to a company's advantage?
- Why is data cleaning important? And whether it takes most of the time
- What does it mean to deploy a model or put it into production?
- Why is software engineering important for the overall skills of a data scientist?

The opportunity to try a hand on world-class frameworks and futuristic machine learning tools attracts too many freshers to this field. But the industry and reality are too different from their expectations. Most companies expect their aspirants to know how to gather and store big data, conduct version control properly, and deploy their model in production.

Office Politics – If an aspirant still believes that having knowledge of plenty of ML algorithms will make them an excellent data scientist and most valuable asset to the company, they should consider the above point. According to the author in [14], superiors in this field with higher positions should have a good impression on a data scientist. It may mean they have to do unplanned work a lot like delivering the right numbers to the right people from the database on a timely basis and constantly taking simple projects to have the right perception from the right people. This lack of flexibility is especially true in large organizations. However, medium-scale and startups have other challenges.

Lack of Clear Benchmarking in Payouts – Salary is the main reason why so many professionals want to make data science a full-time job. We have discussed reports from Glassdoor and Payscale.com above about the lucrative average salaries for these professionals. These reports have quoted numbers that have turned many heads. For a data scientist's salary, the sky's the limit. There have been many reports when experienced data scientists are being hired by Facebook, Google, Apple, etc. Data scientists who are performing very well in their fields usually get opportunities from the leading Fortune 500 companies offering handsome salaries while small and medium organizations are unable to offer that much.

This way, the author in [13] believes that some benchmark or standard should be set for compensation. A clear demarcation of salary is important even in medium-scale organizations for highly-skilled freshers and experienced data scientists with the same set of skills. This is because lack of benchmarking often results in poor work performance even from a highly paid employee and employees also start telling each other to look for other opportunities where they can get higher pay.

Lack of Implementation of Open-Source Tools – According to a report [15], Python is an open-source programming language used by around 75% of data scientists in their jobs. Despite having such a great popularity of this open-source language in the field of data science, around 30% people in this report added that their employers are not focusing on the open-source pipeline. Respondents prefer open-source software because it is more suitable, faster, and more innovative to meet their needs. According to a software firm, Anaconda, organizations are not that interested to adopt open-source platforms because of security reasons. It is time for organizations to take a proactive approach and have their development pipeline with open-source solutions. This way, employees don't have to rely on other tools that are beyond their company policy [16].

Gap between academics and organizations – There are many layers of issues here. First of all, what educational institutions teach and what students learn usually don't match with what companies expect from upcoming data scientists. Engineering skills and big data management are the most common skill gaps in organizations, which don't even fall under the most popular skills that universities provide to their data science aspirants.

Employee retention is another major challenge in the field of data science. According to [16], it is closely connected to the way data scientists can prove their worth. Around 44% of such professionals seek other opportunities in just one year. Here are some recommendations according to the tech firm, Anaconda –

- Companies should have holistic plans for data science retention, such as helping employees to improve the value of their work and offering opportunities for professional growth and training.
- Businesses should work with universities to ensure that students are getting skills that are actually needed in the job market.
- Data scientists must get the opportunities of cross-training to improve their worth.

Struggle to Convince Management – This is another major challenge in the career of a data scientist. A recent study[3] suggests that around 2/3rd of top-level managers usually depend on intuition rather than data. And the rest of them who rely on data come from mid-level positions are not always in the authority to influence strategic decisions on a large scale. Hence, it is all up to the data scientists to convince the management about the value of a recent project and act on their data.

According to [17], communication skills are very important for any data science position especially in this case. Analytical skills are important but they are not enough to make a significant impact on the bottom line of the company unless a data scientist convinces the management to consider those results. Clear communication is important to be convincing, visualize the data properly, and keep it simple. In case data scientists are not sure about their convincing strength, they may present their data to anyone who does not have any statistical or technical skills. They may praise it well but data scientists have to consider the questions they ask and the conclusions they come up with the data. It may give a great insight to the areas where improvement is needed.

It is also true that management may need to consider other factors along with the data and it is not important that data results will win. Here is a high-profile example presented by The Wall Street Journal in this context [18] -

According to the data research team in Netflix, the promo images of "*Grace & Frankie*" performed well even without featuring Jane Fonda, the show's star. Then, executives considered the potential benefits of that data, i.e. more views on the show, rather than bearing costs of approaching Jane Fonda in future promotions.

Q. What are the opportunities of a career as a Data Scientist?

In this day and age, technology is not the only sector where data scientists are needed. However, an advanced education is required for such an advanced job. Around 88% of data scientists have a master's degree and 46% have PhDs. To gain an in-depth knowledge as a data scientist, an expert must have an impressive educational background [20]. Here are some of the top career opportunities in the field of data science and average salaries according to Glassdoor [19] -

- **Data Scientist (Avg. Salary: $139,840)** – Data scientists are responsible to detect, organize and clean the data for their organizations. They must be capable of analyzing a huge amount of processed and raw data and find the right ones for their company to make informed decisions. Their job is a lot more technical than data analysts.
- **Data Analyst (Avg. Salary: $62,453)** – They are responsible to manipulate and turn large data sets according to the analysis required for the companies. They may also be assigned to analyze A/B testing and track web analytics for companies. They also prepare reports for top management about insights and trends to help in decision making.
- **Machine Learning Engineer ($114,826) –** They are responsible to provide software solutions by creating data funnels. Usually, strong programming and statistical skills with proper knowledge in software engineering are required in this job. They also have to run tests to keep track of functionality and performance of machine learning programs after building and designing them.
- **Machine Learning Scientist ($114,121)** - They are responsible to use unsupervised, supervised, and deep learning methods to research and use new algorithms and data approaches in adaptive systems. They are also known as Research Engineers or Research Scientists.
- **Enterprise Architect ($110,663)** – They are responsible to align the strategy of an organization with the required technology to fulfill its objectives. They should have proper knowledge of the technology and business needs to design the architecture needed for those needs.
- **Applications Architect ($113,757)** – They track application behavior in the business and the way they interact between the devices and users. They design application architecture and build user interfaces.

RESULTS

Data science plays a vital role in influencing purchase decisions of the customers but there is much importance of gathering data. Data science is not at all limited to technology. It can also be used in healthcare, i.e. by wearable gadgets to improve public health and

[3] Massey University - https://phys.org/news/2019-04-senior-distrust-big.html

encourage people to adopt healthy habits and alert people about major health issues. Data can help finding cures, improve diagnostic procedures, and also prevent the spread of viruses. Scientists could track the spread of Ebola virus and predict the most vulnerable areas in 2014 and contain the virus before it becomes a global pandemic [21].

Data science also plays a vital role in other industries. For example, farmers can use the data for proper food delivery and agriculture, food suppliers can use data to reduce food waste, and NGOs can use data to predict where funding will be required and empower their fundraising efforts. Apart from being a high-paying and lucrative job, data science also plays a vital role in the whole economy.

Data scientists have great demand in virtually every field, be it a dating app or a government organization. Big data is the most important factor for most government departments and businesses and to improve their services for customers. There is a great demand for data science careers and this trend will continue. There are different ways to prepare and break into this field for taking exciting and challenging roles. Despite some small and big challenges discussed in this study, data science is still a lucrative and high paying job.

This study helps in expansion of knowledge about challenges and opportunities in the field of data science. It sheds light on the need for change in medium and small organizations about executive mindset in data-driven culture and formulating mechanisms and strategies for standards. The information was collected from a lot of trusted sources and job portals but this study still leaves further research paths. Further studies may help improve awareness of the challenges in the field of data science and also help the academicians and aspirants about what to expect before entering this field

3. CONCLUSIONS

The field of data science is not just limited to programming, but it also includes statistics and applied mathematics, machine learning, business intelligence, and data analysis. One can become a data researcher through different ways, but a bachelor's degree is the most effective way. It goes without saying that data researchers mostly have a master's degree. But there are different ways to gain important skills. The key here is to know what tools, skill sets, and software programs are needed before joining any job position.

The job roles of a data scientist also vary according to the industry. So, an aspirant must gain proper skills required in the subject area before pursuing career opportunities. For example, skills needed are completely different in business, education, and marketing from that of public sector, science, or healthcare. Today, there are many vocational training courses and interactive classes available to obtain the required knowledge. Hence, this study reflects on the emergence of the data science field along with its challenges and opportunities.

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