Exploring the Skills Needed by the Data Scientist

Kirk Paul Lafler; @sasNerd

Abstract

As 2.5 quintillion bytes (1 with 18 zeros) of new data are created each and every day, the age of big data has taken on new meaning. More and more organizations across industries are embracing Data Science / Computer Research Scientist skills resulting in an emerging demand for qualified and experienced talent. According to the Bureau of Labor Statistics (BLS) the number of data science jobs is expected to grow 19 percent over the next two decades – nearly three times as fast as the average growth rate for all jobs. Energized by this employment outlook, students and professionals across job functions are preparing for tomorrow's growing data science / analytic demands by acquiring a comprehensive skill set. To prepare for this growing demand, many colleges, junior colleges, Universities, and vocational training organizations offer comprehensive degrees and certificate programs to fulfill the increasing demand for analytical skills. This paper and presentation explores the skills needed by the Data Scientist / Analytics professional including non-technical skills such as critical thinking; business acumen and verbal/written communications; and technical skills such as data access; data wrangling; statistics; use of statistical programming languages like Python, R and SAS®; Structured Query Language (SQL); Microsoft Excel; and data visualization.

Introduction

Wikipedia describes data science, "as a multi-disciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from structured and unstructured data." Wikipedia further describes data science, "as the profession to unify statistics, data analysis, mathematics, computer programming, operations research, machine learning and related methods in order to understand and analyze actual phenomena with data and enhance decision making."

Professionals with skills in data science and analytics are a "hot" commodity in the employment marketplace. The Bureau of Labor Statistics (BLS) (accessed on April 9th, 2021) projects that Employment of computer and information research scientists is projected to grow 15 percent from 2019 to 2029, much faster than the average for all occupations. One thing is certain, with the rapid increase in data collection activities by organizations that this will lead to an increased need for services related to data mining, or processing data sets to identify patterns and relationships to solve business problems.

Brian Holak, a site editor at Search Business Analytics, (January 31st, 2019) predicts, "The demand for data scientists continues to grow sharply with more employers than ever looking to hire data scientists. Data Scientists will experience a 29% increase in demand year over year, a 344% increase since 2013, with the supply of "qualified" data scientists lagging demand." Merrimack College projects, "The Federal Government will experience a 19% growth rate in the field of computer and information research scientists by 2026." Also, many employment / career websites (August 2022) offer students, junior professionals, and seasoned professionals with the organizations who are seeking the right candidates to hire amazing employment, contract, and internship opportunities. The exciting world of the Data Scientist is one that is experiencing an exponential rate of growth. But while demand is huge the supply of skilled applicants is still growing at a much slower pace.

Graduate Degree Programs

The majority of Data Scientists hold an undergraduate degree in a quantitative field such as Mathematics, Statistics, Decision Sciences, Computer Science, Management Information Systems, and Economics to name a few. Many also hold graduate degrees and/or certificates in the field of data science. The next table represents a starting point for professionals seeking Colleges and Universities offering graduate degrees in Data Analytics, Big Data Analytics and Data Science. Although this table identifies many academic institutions, it most definitely does not provide a complete list of all the academic institutions offering these prestigious graduate degrees. Readers are encouraged to perform your own search using one or more search engine(s) for a more complete list of all the colleges and universities offering these popular degree programs.

Institutions Offering Graduate Degree Programs in Data Science, Data Analytics and Big Data Analytics (Alphabetical Sampling)

Binghamton University

Boston College

Boston University

California State University

Cal Poly

Carnegie Mellon University

Clarkson University

Clemson University

Columbia University – New York

Cornell University

DePaul University

Dominican University of California

Drake University

Drexel University

Duke University

Elon University

Florida State University

Franklin University

Georgetown University

George Washington University

Georgia State University

Georgia Tech

Harvard University, Extension School

Hofstra University

Indiana University

Johns Hopkins University

Kansas State University

Kennesaw State University

Lehigh University

Louisiana State University

Michigan State University

New Mexico State University

New York University

North Carolina Agriculture and Technical State University

North Carolina State University

Oakland University

Ohio University

Oklahoma State University

Old Dominion University

Pace University

Penn State Great Valley

Purdue University

Rice University

San Diego State University

San Jose State University

Seton Hall University

Stanford University

Texas A&M University

Tulane University

University of Alabama at Birmingham

University of Arizona

University of Bridgeport

University of California – Berkeley

University of California, Irvine

University of California San Diego MSBA

University of California San Diego DS

University of Chicago

University of Colorado, Boulder

University of Illinois at Urbana-Champaign

University of Kentucky

University of Massachusetts at Dartmouth

University of Miami

University of Minnesota

University of Michigan at Ann Arbor

University of Nevada, Reno

University of North Carolina at Charlotte

University of North Carolina at Greensboro

University of North Carolina at Wilmington

University of Notre Dame

University of San Diego

University of San Francisco

University of South Dakota

University of Southern California

University of Southern Maine

University of Texas at Austin

University of Virginia

University of Washington

University of Wisconsin Madison

Utah State University

Vanderbilt University

Villanova University

Walden University

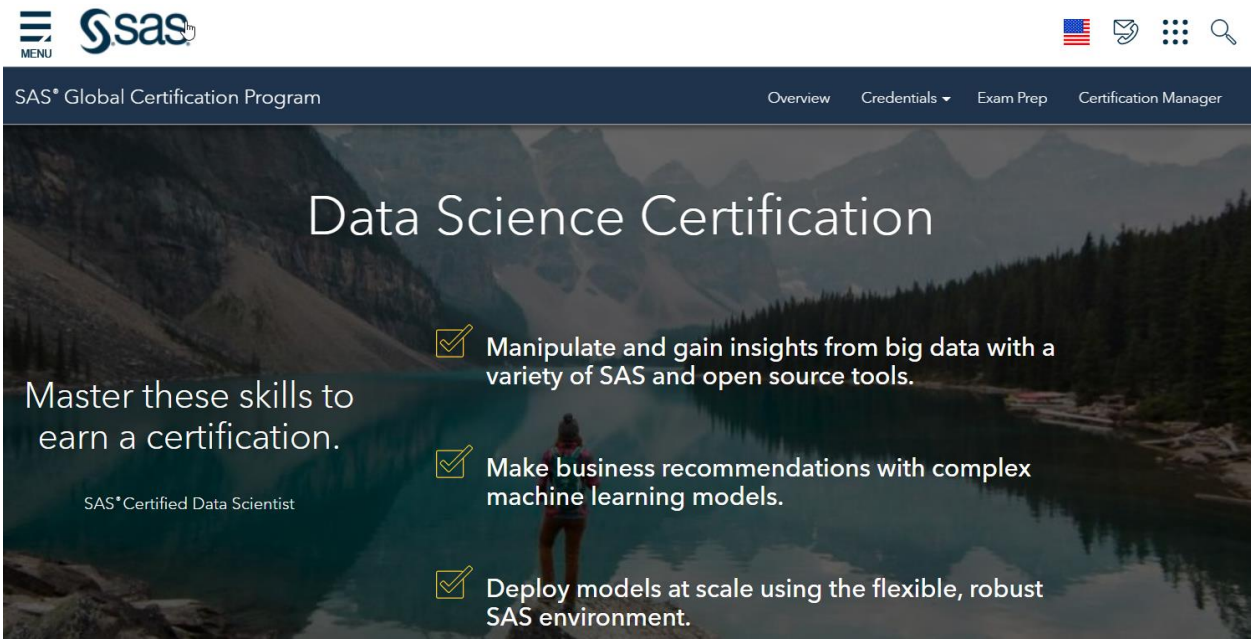
Wharton University

Willamette University

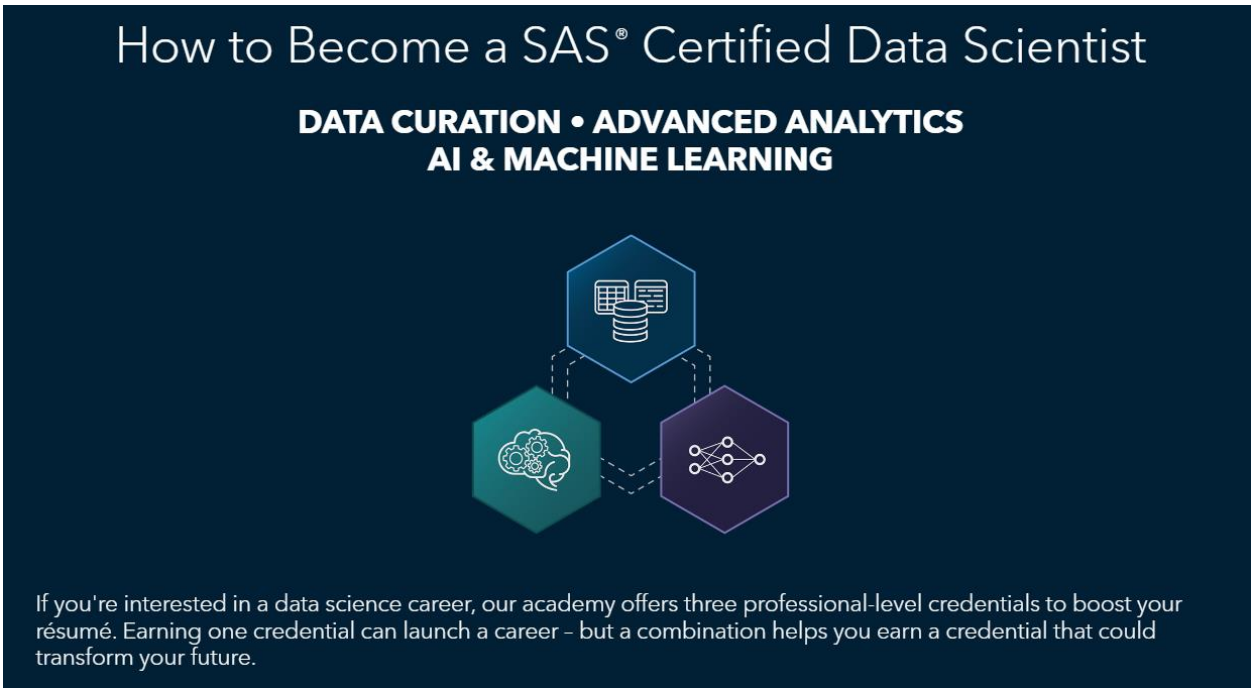
Worcester Polytechnic Institute

Globally Recognized SAS Certifications

SAS Institute offer users with a globally recognized certification process that can help boost your prospects for success and validate your skills to employers. SAS certification testing is available in many areas and particularly for those who are interested in a Data Science career with a combination of credentials including: Data Curation, Advanced Analytics, and AI & Machine Learning. Click here for more information about SAS Institute's Data Science certification.



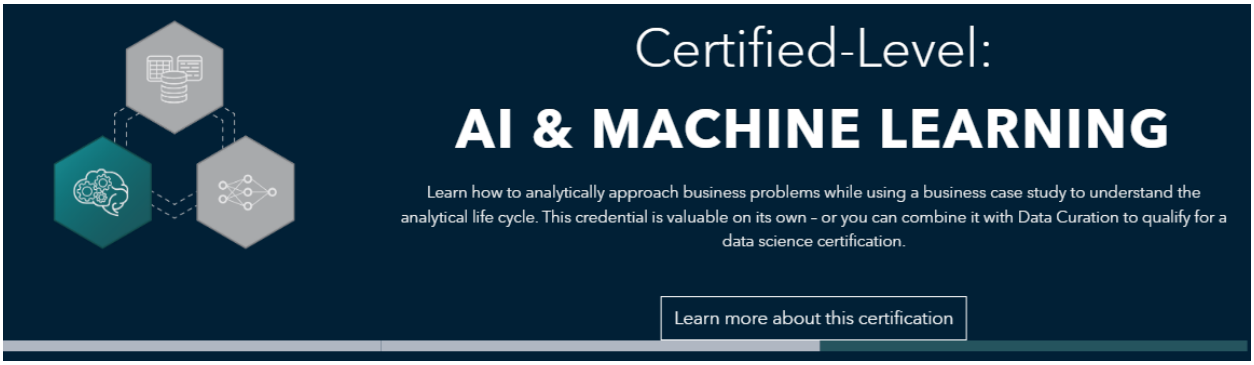
Source: Image captured from SAS Institute's website, copyright 2022 by SAS Institute Inc.



Source: Image captured from SAS Institute's website, copyright 2022 by SAS Institute Inc.

Source: Image captured from SAS Institute's website, copyright 2022 by SAS Institute Inc.

Source: Image captured from SAS Institute's website, copyright 2022 by SAS Institute Inc.



Source: Image captured from SAS Institute's website, copyright 2022 by SAS Institute Inc.

Projections, Outlook, and Findings

Employment of Data Scientists is projected to grow 36 percent from 2021 to 2031, much faster than the average for all occupations. The most in-demand technical skills for data science careers are Python and SQL. The average data scientist salary in the U.S. is $125,242 / year.

In Aleksandra Yosifova's April 6th, 2023 report, The Data Scientist Job Outlook in 2023 – Research on 1,000 LinkedIn Job Postings, researched 1,000 LinkedIn job postings to answer questions about the Data Scientist job outlook in 2023. The report attempts to answer the following questions:

- Is data science still the sexiest job of the 21st century?
- Where do data scientists work?
- How much do they earn?
- What skills are required for a successful data science career?
- What are the next in-demand tools and techniques in the field?

Data Science / Analytics Annual Base Salaries

With massive quantities of data being collected at astounding rates by organizations worldwide, the demand for Data Scientists and Analytics professionals to collect, analyze and interpret all this data is growing rapidly. The annual base salaries for all this talent are impressive as well. In a July 28, 2022 Indeed.com article, the highest paying cities for Data Scientists appear, below.

Highest Paying Salaries by City (Indeed.com)			
Los Angeles, CA	$167,921 / year	San Francisco, CA	$131,425 / year
Houston, TX	$159,289 / year	Austin, TX	$127,883 / year
New York, NY	$153,603 / year	Atlanta, GA	$120,049 / year
Washington, DC	$139,768 / year	San Diego, CA	$118,342 / year
Chicago, IL	$135,593 / year		

Salary Information from www.Indeed.com (Source: https://www.indeed.com/career/data-scientist/salaries)

In Rick Chen's (April 7, 2022; TeamBlind.com) article the average salaries by city for Data Scientists are shown, below.

Annual Average Salaries by City (TeamBlind.com)					
Los Gatos, CA	$447,916	New York, NY	$143,926	St. Louis, MO	$122,671
Los Angeles, CA	$196,892	Bellevue, WA	$143,097	Bentonville, AR	$122,285
Sunnyvale, CA	$173,178	Redmond, WA	$142,438	Dallas, TX	$122,017
Cupertino, CA	$166,712	Seattle, WA	$141,741	Chicago, IL	$121,975
Menlo Park, CA	$165,761	Washington, DC	$141,306	Wilmington, DE	$120,800
Santa Monica, CA	$164,272	Newark, NJ	$139,311	Hartford, CT	$120,491
San Francisco, CA	$163,670	Boston, MA	$137,567	McLean, VA	$120,066
San Jose, CA	$161,090	Palo Alto, CA	$137,327	Atlanta, GA	$118,977
Mountain View, CA	$157,767	Portland, OR	$136,992	Raleigh, NC	$117,774
Cambridge, MA	$151,500	Kansas City, MO	$135,363	Minneapolis, MN	$115,918
Santa Clara, CA	$150,943	San Diego, CA	$133,190	Columbus, OH	$115,781
San Mateo, CA	$149,046	Redwood City, CA	$131,791	Philadelphia, PA	$114,963
Boulder, CO	$148,989	Irvine, CA	$129,872	Tampa, FL	$114,750
Fort Lauderdale, FL	$148,400	Denver, CO	$128,348	Phoenix, AZ	$113,975
Miami, FL	$148,250	Jersey City, NJ	$124,638	San Antonio, TX	$112,571
Charlotte, NC	$145,885	Pittsburgh, PA	$123,855	Baltimore, MD	$110,857
Oakland, CA	$144,625	Austin, TX	$123,167		

Average Salaries (Source: https://www.teamblind.com/blog/index.php/2022/04/07/best-paying-cities-data-scientist-2022/)

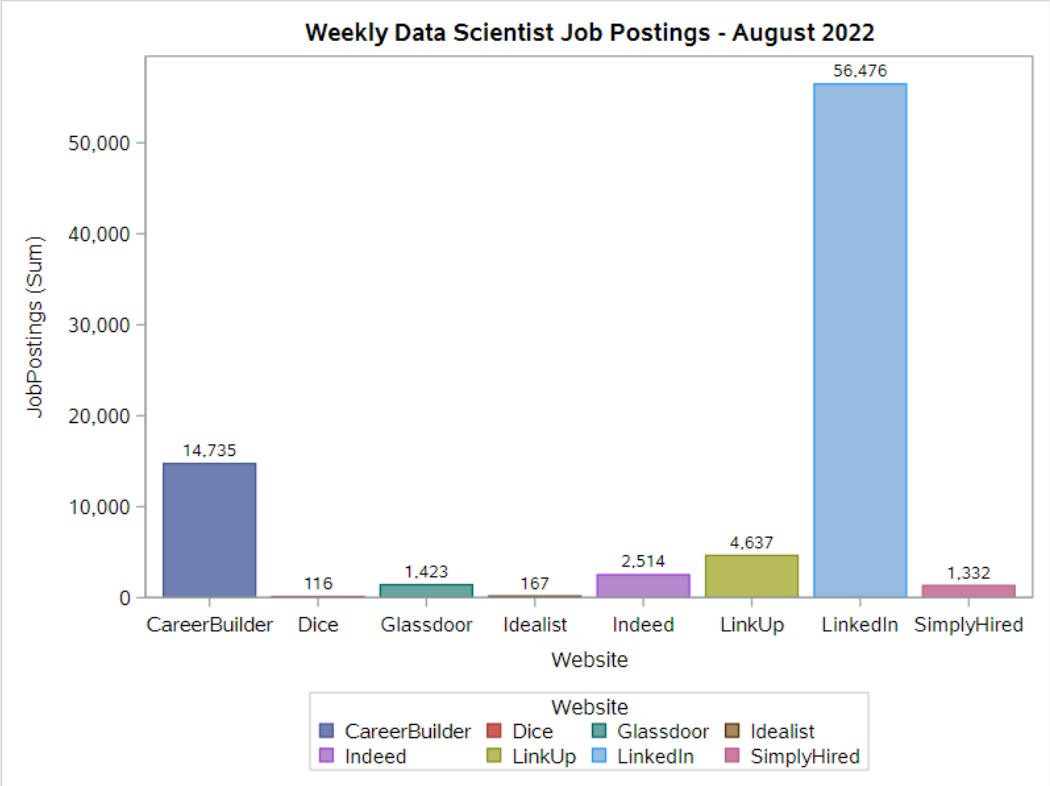
Data Scientist / Analytics Employment / Career Opportunities

There appears to be considerable demand for "Data Scientists" when searching the various employment / career websites. Although cross-postings do exist, an exact match search for data scientist jobs was performed to ensure the results were relevant and the search keyword was processed similarly. The following VBAR chart shows the number of data scientist job postings by job listing website for the week of August 8th, 2022.

Code:

```
data Weekly_DataScientist_Jobs ;
  input @1 Website $15.
        @16 JobPostings comma8. ;
  format JobPostings comma8. ;
datalines ;
LinkedIn        56,476
Indeed          2,514
Dice            116
Glassdoor       1,423
SimplyHired     1,332
CareerBuilder   14,735
Idealist        167
LinkUp          4,637
;
run ;


proc sgplot data=Weekly_DataScientist_Jobs ;
  title1 "Weekly Data Scientist Job Postings - August 2022" ;
  vbar Website / response=JobPostings group=Website datalabel ;
run ;
```

Results:



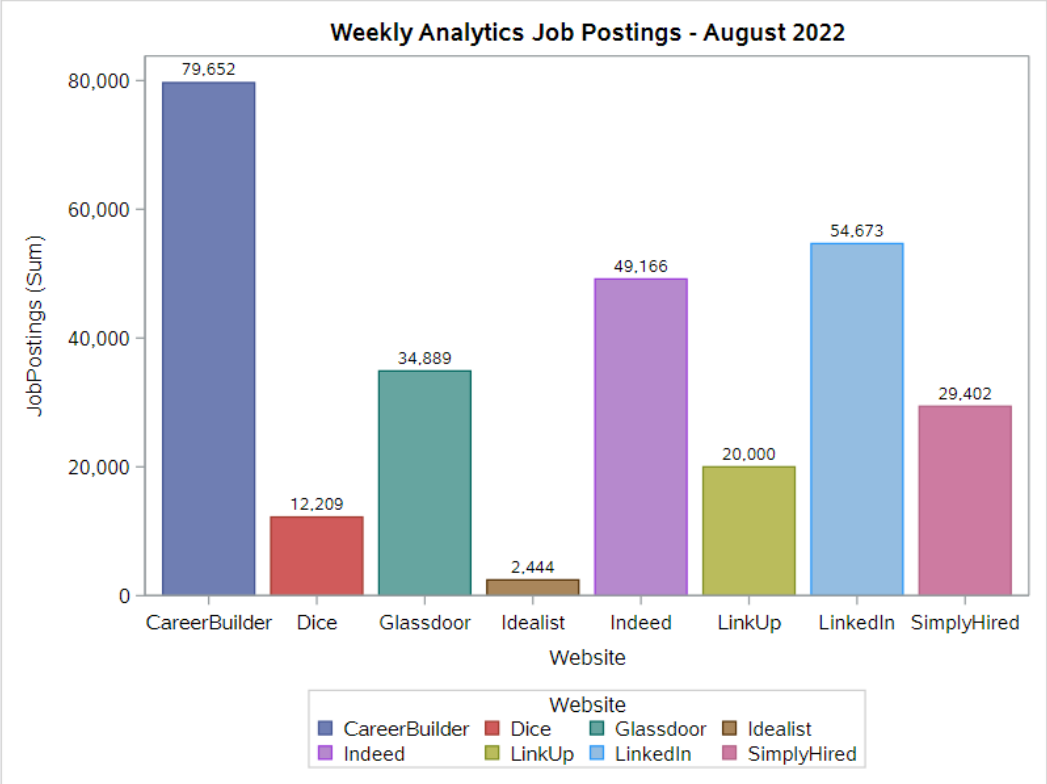
Using an exact match search, job posting results are displayed using a VBAR chart for “analytics” to show the number of analytics job postings for the week of August 8th, 2022.

Code:

```
data Weekly_Analytics_Jobs ;
  input @1 Website $15.
```

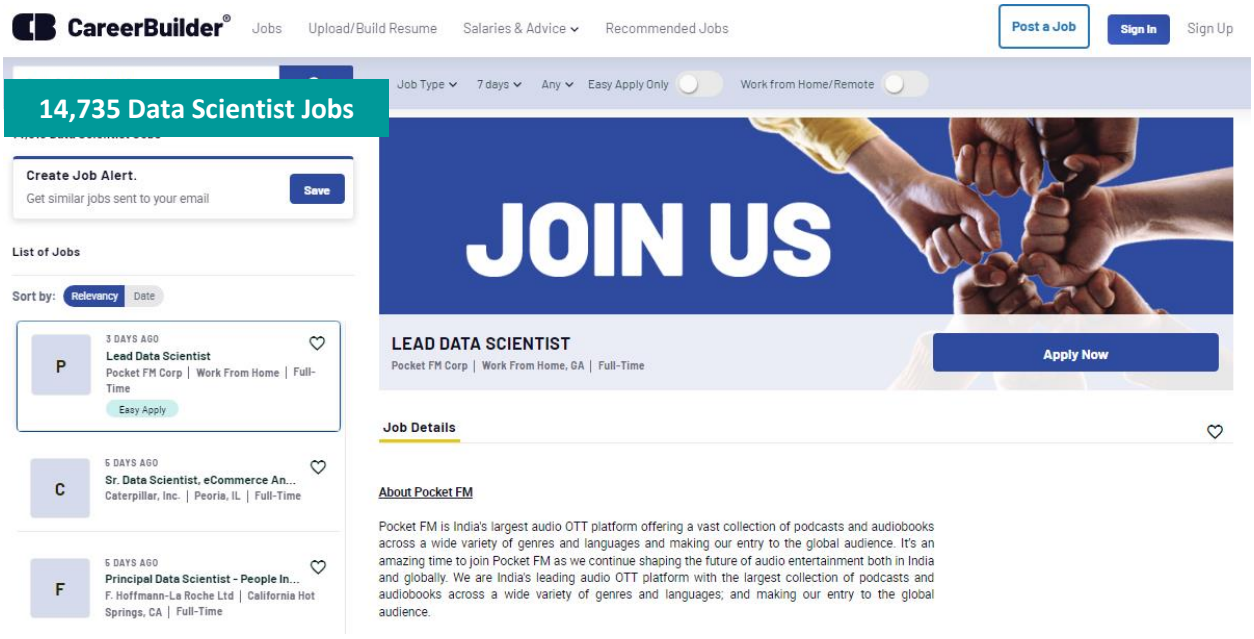
```
      @16 JobPostings comma8. ;
  format JobPostings comma8. ;
datalines ;
LinkedIn        54,673
Indeed          49,166
Dice            12,209
Glassdoor       34,889
SimplyHired     29,402
CareerBuilder   79,652
Idealist        2,444
LinkUp          20,000
;
run ;

proc sgplot data=Weekly_Analytics_Jobs ;
  title1 "Weekly Analytics Job Postings - August 2022" ;
  vbar Website / response=JobPostings group=Website datalabel ;
run ;
```

Results:

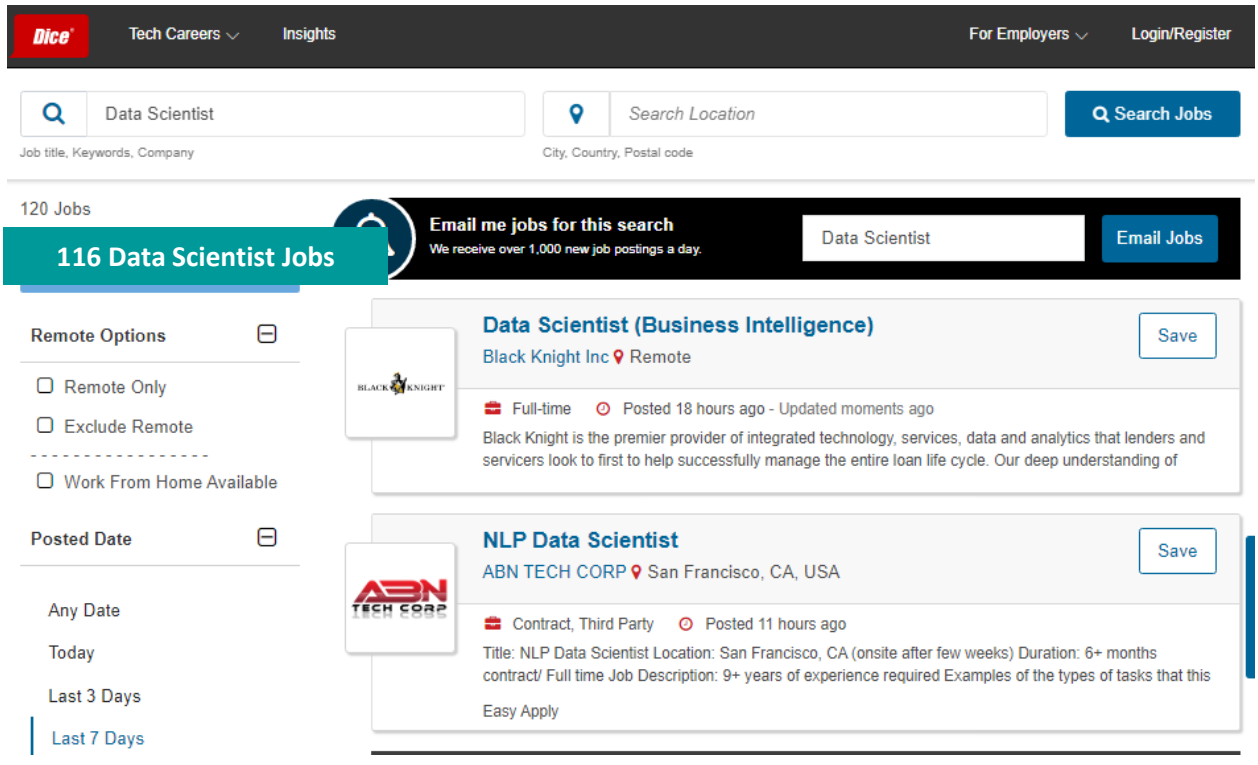


Data Scientist Job Postings on Employment / Career Websites

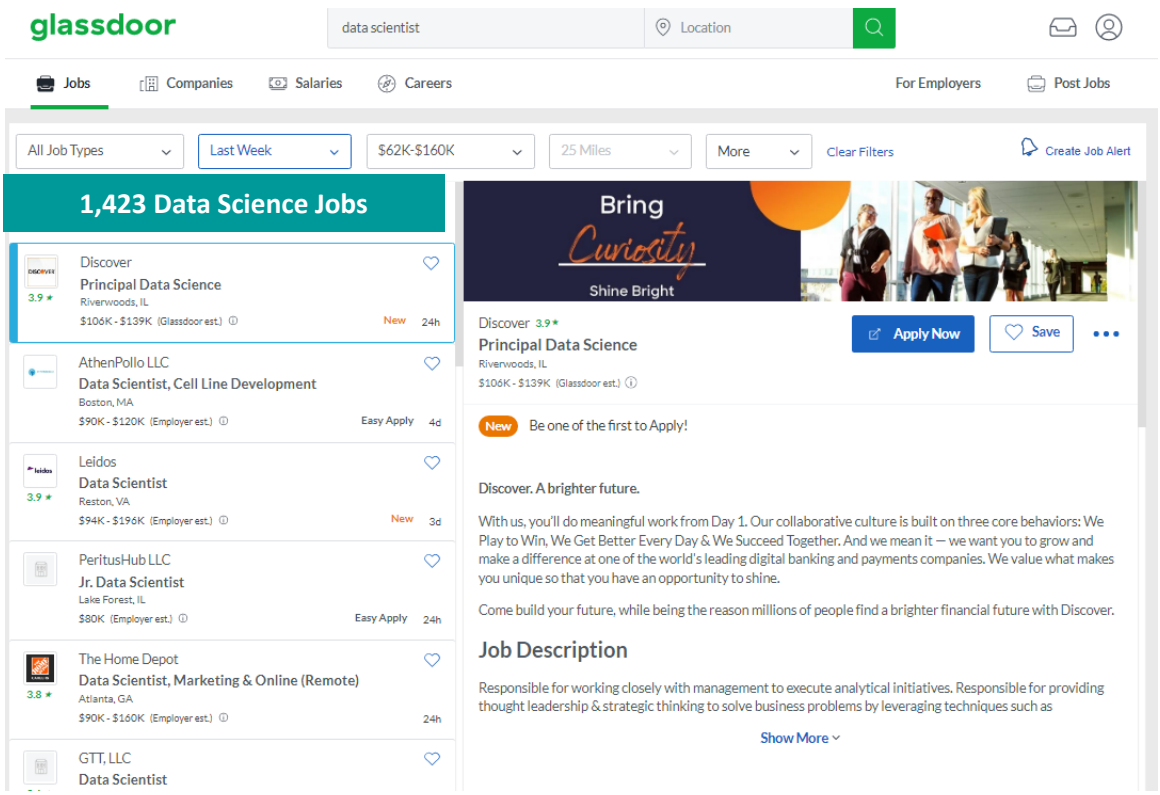
Job postings on employment / career websites for "Data Scientist" are displayed, below, for the week of August 8th, 2022.



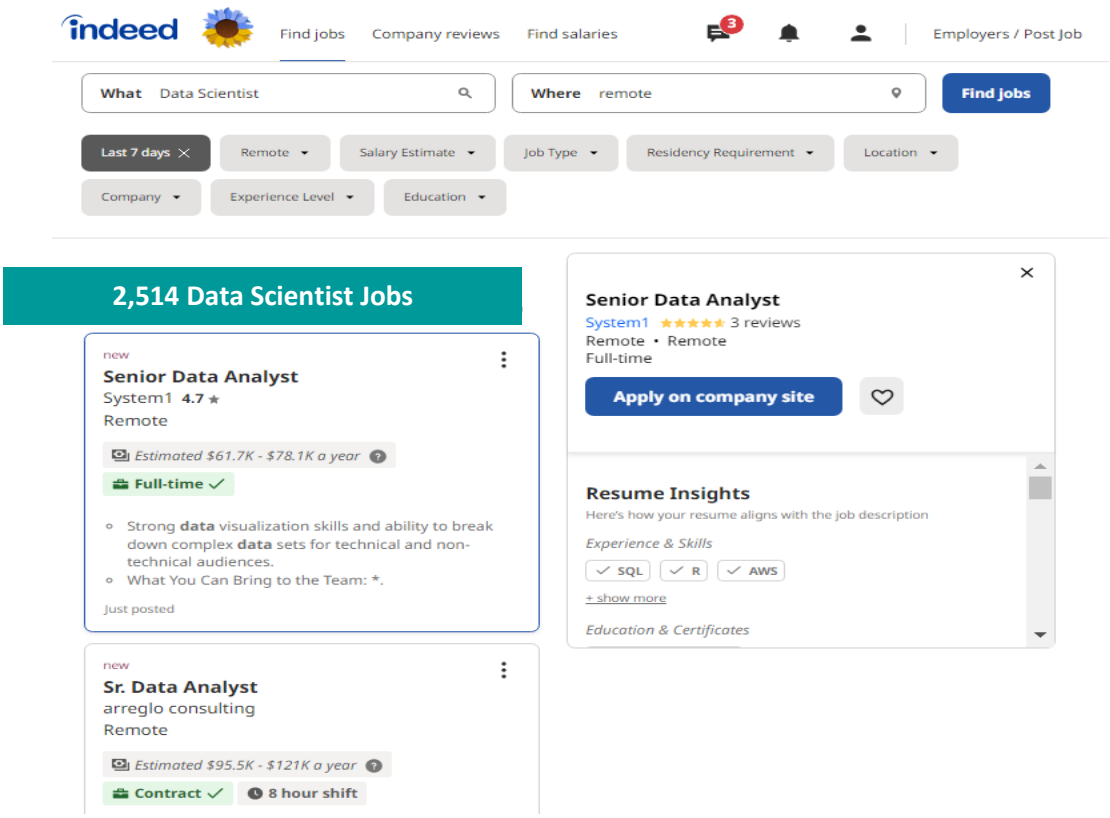
Source: Image captured from CareerBuilder.com's website.



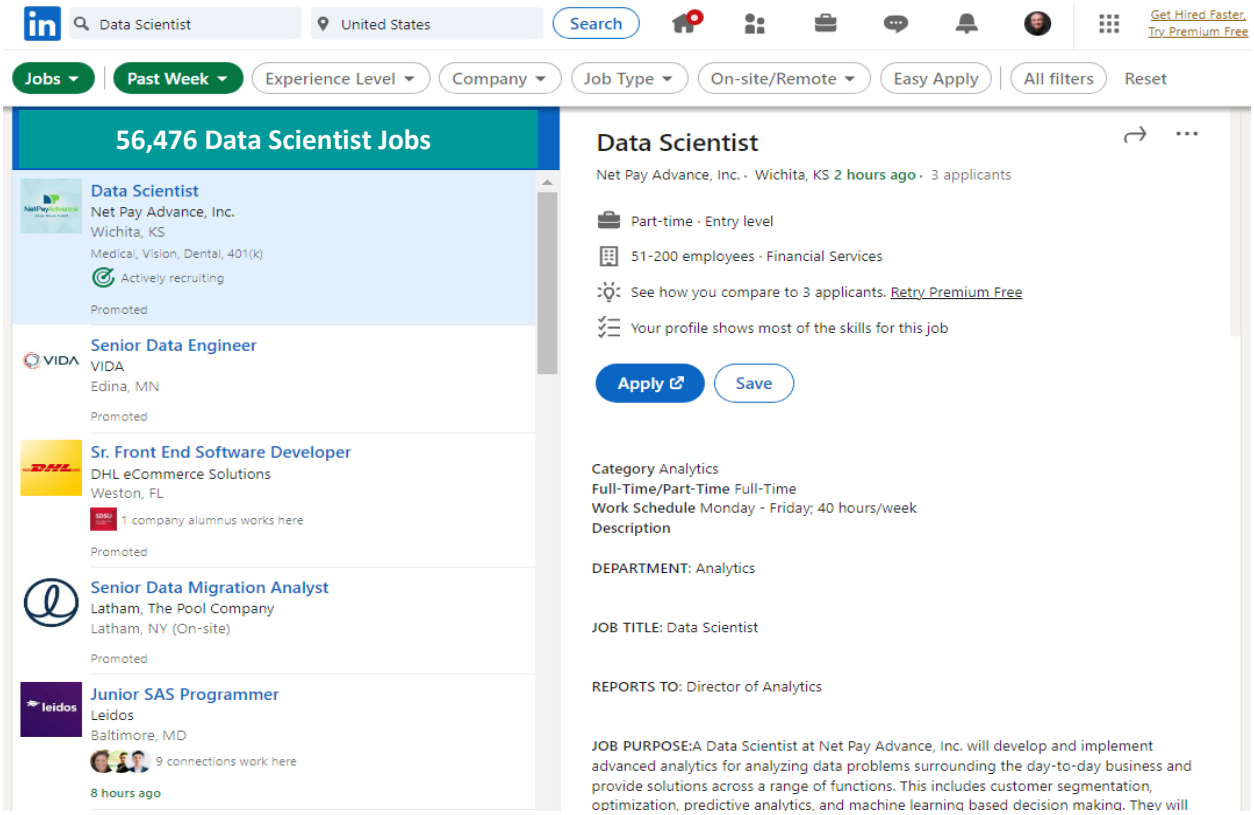
Source: Image captured from Dice.com's website.



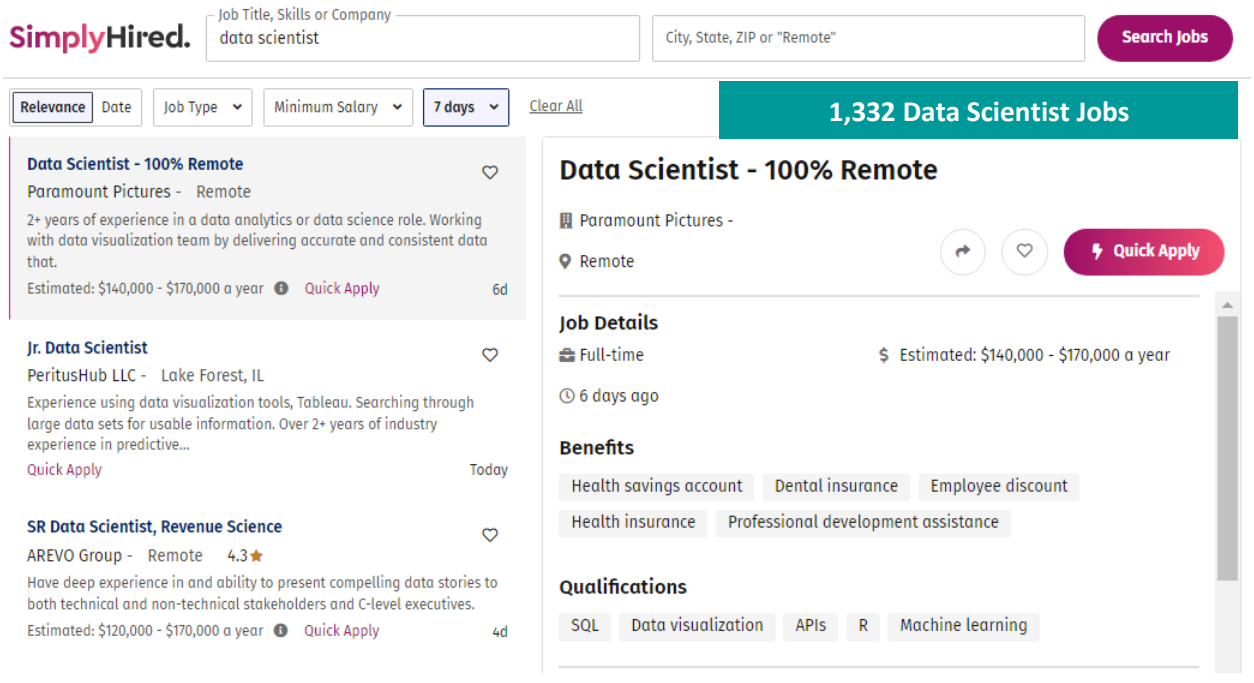
Source: Image captured from Glassdoor.com's website.



Source: Image captured from Indeed.com's website.



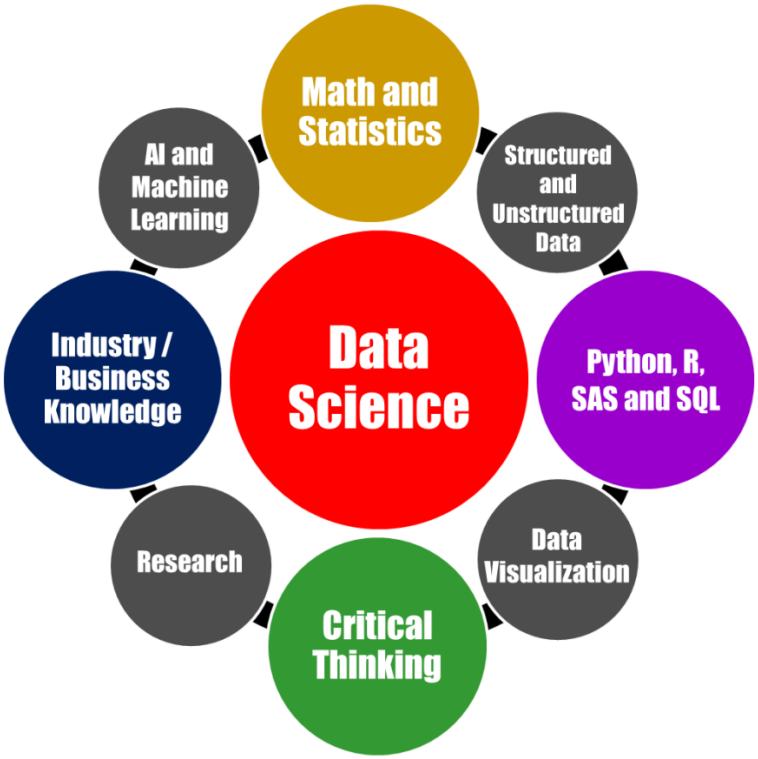
Source: Image captured from LinkedIn.com's website.



Source: Image captured from SimplyHired.com's website.

Data Science / Analytics Skills

Data Science / Analytics skills are all encompassing and requires in-depth knowledge and experience in many technical and non-technical areas.



The table, below, presents "key" areas where skills are needed by the data science / analytics community of professionals.

Technical Skills	Non-Technical Skills
SAS, Python and R	Critical Thinking
SQL and RDBMS techniques	Intellectual Curiosity
Excel	Business Acumen
Cloud Computing Services (aka, SaaS)	Verbal / Written Communication
Statistics – Descriptive and Inferential	Storytelling
Artificial Intelligence (AI)	Ability to Work in a Team
Machine Learning (ML)	
Structured and Unstructured Data	
Data Wrangling techniques	
Analytical techniques	
Data Visualization techniques	

Software: Programming, Database, Statistical, Visualization, Spreadsheet, and Cloud Computing Services

SAS Software

SAS is a statistical software suite of products developed by SAS Institute Inc. for advanced analytics, multivariate analysis, business intelligence, data management, predictive analytics, and criminal investigation. SAS runs on all important platforms and supports object-oriented and structured programming along with other programming paradigms. Developed by Dr. James Goodnight, Anthony Barr, John Sall and Jane T. Helwig. The SAS software suite has more than 200 components including Base SAS, SAS/STAT, SAS/GRAPH, SAS/OR, SAS/ETS, SAS/IML, SAS/AF, SAS/QC, SAS/INSIGHT, SAS/PH, Enterprise Miner, Enterprise Guide, SAS/EBI, and SAS Grid Manager.

SQL

Structured Query Language (SQL) is a relational database language that is used in programming relational database management systems (RDBMS). It is specifically useful in handling structured data. SQL comprises many types of statements including a data query language (DQL), a data definition language (DDL), a data control language (DCL), and a data manipulation language (DML). There are several types of SQL implementations including SAS' PROC SQL, Microsoft's SQL-Server, Oracle, and IBM. SQL was originally developed by Edgar Frank "Ted" Codd, Donald D. Chamberlin, and Raymond F. Boyce in the early 1970s.

Python

Python is an open-source programming language that is available under a free software license. It supports object-oriented and structured programming along with other programming paradigms. Developed by Guido van Rossum in the late 1980s, Python is designed to be an "easy to read language" with numerous third-party modules to interact with other languages; extensive support libraries such as web service tools; text processing; string operations; internet protocols; a powerful scripting language; an extensive user community; and many other features.

R

R is a powerful open-source programming language and is used for statistical computing, graphics and data analysis. Available under a free software license, R runs on all important platforms and is used by statisticians, data miners and thousands of major corporations and institutions worldwide. Developed by Ross Ihaka and Robert Gentleman at the University of Auckland, New Zealand, their initial version of R was released in 1995 with a stable beta version in 2000. R boasts an extensive array of packages including data wrangling; data analysis; plotting; graphing; reporting; statistics; an extensive user community; and many other features.

Excel

Microsoft Excel is widely used spreadsheet software operating under Windows, macOS, Android and iOS platforms to allow users to format, organize, manipulate, and calculate data in spreadsheets. Common Excel uses include the collection and storage of data, business analysis, data analysis, statistical analysis, accounting and budgeting, account management, project management, performance reporting, administrative and managerial management, operations management, and office administration. Users can arrange data in a spreadsheet using graphical tools, formulas, and pivot tables to work with large quantities of data to identify sums, averages, percentages, unique values, minimum and maximum values, ranges, outliers, and other needs.

Cloud Computing Services

Cloud computing is the delivery of computing services (aka, SaaS) including software, databases, servers, storage, networking, analytics, and intelligence over the Internet to offer users improved and affordable computing speed, flexibility, and scale. From my own experience using a few cloud services and from reviewing an article on cloud service providers (Peterson, Richard. July 26, 2022) cloud services are offered by SAS Institute Inc., Amazon Web Services (AWS), Microsoft, IBM, Google, ServerSpace, Adobe, Kamatera, VMware, Rackspace, Red Hat, Salesforce, Oracle, SAP, Verizon, Linode, HostPapa, DigitalOcean, ScalaHosting, OVHcloud, LiquidWeb, Vultr, CloudSigma, LimeStone, Navisite, and Dropbox.

Conclusion

Professionals with skills in data science and analytics are a "hot" commodity in the employment marketplace. With the Bureau of Labor Statistics (BLS) employment projections estimating growth of 15 percent from 2019 to 2029, data science careers are poised to accelerate greatly. Wikipedia mentions that, as a multi-disciplinary field that uses scientific methods, processes, algorithms, and systems to extract knowledge and insights from structured and unstructured data," data science "is the profession to unify statistics, data analysis, mathematics, computer programming, operations research, machine learning and related methods to analyze and better understand actual phenomena with data and enhanced decision making."

This paper and e-poster has attempted to share the many ways that students, junior professionals, and those who are already pursuing a career as a Data Scientist can acquire greater knowledge as well as the ability to hone your skills for this exciting profession. From obtaining an advanced degree in data science, analytics, or big data analytics from one of the many distinguished universities and organizations; pursuing a certification offered by SAS Institute and others; and enhancing essential skills using the "free" SAS OnDemand for Academics (ODA) software; anyone seeking to enhance their skills to become a "skilled" data scientist. We also explored the many employment / career websites (August 2022) that are available to students, junior professionals, and seasoned professionals with the many organizations who are seeking the right candidates to hire for amazing employment, contract, and internship opportunities. The exciting world of the Data Scientist is one that is experiencing an exponential rate of growth, but while demand is huge the supply of skilled applicants is still growing at a much slower pace.

References

Bureau of Labor Statistics (BLS) (accessed on April 9th, 2021), BLS Employment Projections for Computer and Information Research Scientists from 2019 to 2029.

Chen, Rick. (April 7th, 2022). The Top 50 Best-Paying Cities for Data Scientists in the United States.

Granville, Vincent (August 25th, 2018), "Demand for Data Scientists is Booming and will only Increase."

Holak, Brian (January 31st, 2019). "Demand for Data Scientists is Booming and will only Increase."

Indeed.com. (July 28th, 2022). Highest paying cities for Data Scientists in the United States.

Lafler, Kirk Paul (2022), *"Exploring the Skills Needed by the Data Scientist",* Proceedings of the Western Users of SAS Software (WUSS) Conference – 2022.

Lafler, Kirk Paul (2022), *"Exploring the Skills Needed by the Data Scientist",* Proceedings of the SouthEast SAS Users Group (SESUG) Conference – 2022.

Lafler, Kirk Paul (2021), *"Exploring the Skills Needed by the Data Scientist",* Proceedings of the SouthEast SAS Users Group (SESUG) Conference – 2021.

Lafler, Kirk Paul (2019), *"Exploring the Skills Needed by the Data Scientist",* Proceedings of the MidWest SAS Users Group (MWSUG) Conference – 2019.

Lafler, Kirk Paul (2019). *PROC SQL: Beyond the Basics Using SAS, Third Edition*, SAS Institute Inc., Cary, NC, USA.

Lafler, Kirk Paul (2016), *"What's Hot – Skills for SAS Professionals",* Proceedings of the SouthEast SAS Users Group (SESUG) Conference – 2016.

Lafler, Kirk Paul (2016), *"What's Hot – Skills for SAS Professionals",* Proceedings of the Pharmaceutical SAS Users Group (PharmaSUG) Conference – 2016.

Peterson, Richard (July 26, 2022 Update). "17 Top Cloud Service Providers (2022 Updated)," guru99.com.

Acknowledgments

The author wishes to thank the 2023 IowaSUG 2023 Conference Committee for accepting my paper; the 2023 IowaSUG 2023 Executive Committee for organizing and supporting a "live" conference event; SAS Institute Inc. for providing SAS users with wonderful software; and SAS users everywhere for being the nicest people anywhere!

Trademark Citations

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

Author Information

Kirk Paul Lafler is an educator, developer, programmer, consultant, and data analyst; and works as an adjunct professor at San Diego State University; an advisor and adjunct professor at the University of California San Diego Extension; and an educator teaching SAS, SQL, Python, Excel, and cloud-based technology courses, workshops, and webinars to users around the world. Kirk has nearly 50 years of programming experience and specializes in SAS software, SQL, RDBMS technologies (Oracle, SQL-Server, Teradata, DB2), Python, and other languages and productivity tools. As an author, Kirk's most recent and/or upcoming books include Exploratory Data Analysis (EDA) By Example (PB&J Press. Summer 2023), Python ETL By Example (PB&J Press, Spring 2024), PROC SQL: Beyond the Basics Using SAS, Third Edition (SAS Press. 2019), and other books along with numerous papers and articles on a variety of SAS, SQL, and Python topics. Kirk is actively involved with international, regional, and local SAS, SQL, and Python user groups and conferences as an Invited speaker, educator, keynote, and section leader; and is the recipient of 27 "Best" contributed paper, hands-on workshop (HOW), and poster awards.

Comments and suggestions can be sent to:

Kirk Paul Lafler, sasNerd
SAS® / SQL / Python Consultant, Application Developer, Programmer, Data Analyst, Educator and Author
E-mail: KirkLafler@cs.com
LinkedIn: https://www.linkedin.com/in/KirkPaulLafler/
Twitter: @sasNerd