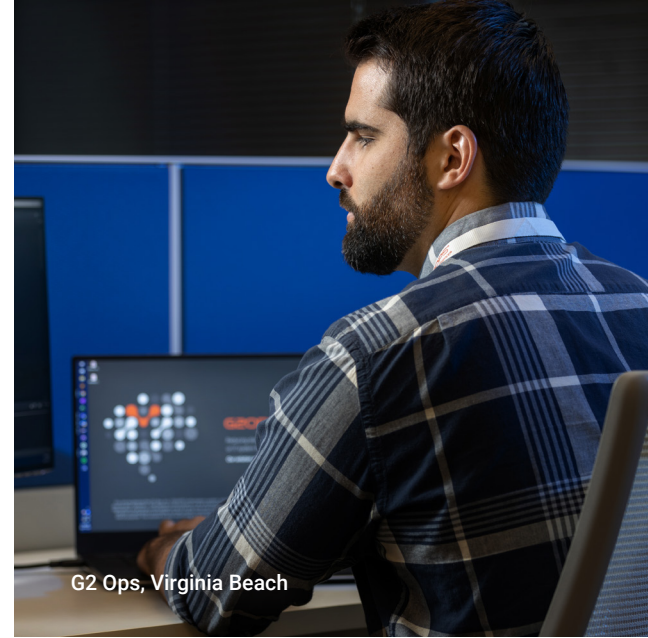James Madison University

G2 Ops, Virginia Beach

Oracle Corporation, Loudoun County

An Analysis of Data Science Occupations, Skills Demand, and Graduate Outcomes in Virginia

March 2025

VOEE | Virginia Office of Education Economics

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Executive Summary

The Virginia Office of Education Economics (VOEE) conducted a comprehensive analysis of the career pathways and labor market dynamics of the field of data science using the Virginia College and Career Outcomes Dataset. This longitudinal dataset includes insights into over 640,000 graduates from Virginia postsecondary institutions between 2008 and 2022. The report explores critical questions about data science, including:

- What are the most common programs of study for individuals working in data science occupations?
- What are the most common occupations for graduates with data science degrees?
- Which industries employ the highest numbers of data science professionals?
- How is the demand for AI-related skills evolving in the job market?

Key Findings

1. Program Growth:

- Virginia's production of data science-related awards grew by 218% from 2008 to 2023, far outpacing the national growth rate of 62%.

2. Educational Backgrounds:

- The most common degree among data science professionals is Computer and Information Sciences – General, followed by Business Administration – Management and Operations. However, a majority of professionals hold degrees outside of data science or business, including over 10% from Liberal Arts and Sciences – General Studies and Humanities programs.

3. Occupations and Career Trajectories:

- Three years post-graduation, most data science degree holders work as Software Developers – Applications.
- Nearly half (43%) of data science professionals transitioning to new jobs stay within the field, demonstrating its retention power.

4. Employment Growth:

- Employment in data science occupations grew by 27% between 2018 and 2023 and is projected to increase by an additional 8% by 2028.
- Data science-related jobs are highly concentrated in Virginia compared to the national average.

5. In-Demand Skills:

- Key skills for data science roles include Computer Science, Agile Methodology, SQL, and Python.
- Demand for AI-related skills surged significantly between May and July 2024, and many professionals highlight AI expertise on their profiles.

6. Industry Insights:

- Data science professionals are predominantly employed in professional, scientific, and technical services, government, management of companies, and information industries.

7. Job Stability:

- Data science professionals maintain an average job tenure of 21.4 months, similar to other occupations.

Conclusion

This research underscores the rapid growth and critical importance of data science occupations, the diverse educational and career trajectories of professionals in the field, and the increasing prominence of AI-related skills. These findings can guide policymakers, educators, and workforce development leaders in aligning academic programs and training initiatives with labor market demands, ensuring Virginia remains a hub for data science talent.

Explore the Data Further

VOEE has launched a dashboard for users to explore the graduate outcomes dataset featured in this report. The Virginia College and Career Outcomes Explorer is an analytical tool that provides insights into the employment and career outcomes of graduates from Virginia's higher education institutions across various fields of study. Aggregating data from over 640,000 alumni from 2008 to 2022, it offers a comprehensive view of the post-graduation employment landscape. Access it at www.voee.org.

Introduction

The Virginia Office of Education Economics (VOEE) is conducting a multi-year, multistage project to evaluate how the education and skills of Virginia college graduates influence their career outcomes over time. As part of the Virginia Skills Initiative (VSI), this effort involves collecting data and performing analyses to explore key questions about graduates' entry into the labor market and their career progression.

This report focuses on the career pathways of two overlapping but distinct groups: graduates of data science-related programs (data science graduates) and graduates employed in data science occupations (data science professionals). While many data science graduates pursue careers in computer and mathematical operations, others transition into fields such as management, business and financial operations, and engineering. Similarly, while most data science professionals hold degrees in computer science, business, or engineering, a significant portion studied social sciences, liberal arts, or mathematics before moving into data science-related roles.

Using VOEE's Career and College Outcomes dataset alongside additional data sources, this analysis addresses critical questions about the educational backgrounds and labor market dynamics of data science graduates and professionals in Virginia.

Trends in Data Science Awards

- How have the numbers of data science-related degrees and certificates changed over time?

Educational Background of Data Science Professionals

- What are the most common programs of study for data science professionals?

Most Common Occupations of Employment for Data Science Graduates

- What are the most common occupations for data science graduates?

Employment Trends in Data Science Occupations

- How has employment in data science occupations changed over time, and what is projected employment?
- What are common labor market indicators for data science professionals in Virginia?
- What are the most commonly advertised job titles, skills, and credentials for data science-related occupations?
- What are the most common industries employing data science professionals?

Job Transitions in Data Science

- What are the most common career transitions for data science professionals?
- What is the average job tenure for data science professionals?

The Importance of Artificial Intelligence (AI) Skills

- What is the demand for AI-related skills in the job market?
- What are the most common occupations and industries for graduates with AI-related skills?
- What are the most common programs of study and institutions for graduates with AI-related skills?

Data Sources

Virginia College and Career Outcomes Dataset

The analyses in this report primarily rely on the Virginia College and Career Outcomes Dataset. Developed in partnership with Lightcast and the State Council of Higher Education of Virginia (SCHEV), this unique dataset contains information about the skills and career pathways of over 640,000 graduates from Virginia postsecondary institutions. By matching data from SCHEV with students' professional social profiles and Unemployment Insurance (UI) wage information, the dataset tracks graduates as they progress from their programs of study into their first jobs and beyond (up to 15 years). This novel dataset includes information about graduates from a wide range of fields from academic and noncredit cohorts spanning 2008–2022. The data include each individual's degrees and credentials, occupations and employers as reported on social profiles, employer industries, location (as of 2022), wages reported to the Virginia Employment Commission for UI purposes, and self-reported skills.

The analyses in this report focus on graduates from data science-related programs (regardless of occupation) and graduates working in data science-related occupations (regardless of program). According to SCHEV, 29 fields of study (Classification of Instructional Programs (CIP)) are related to data science (see Appendix 1). To identify data science-related occupations, VOEE selected occupations within the Bureau of Labor Statistics (BLS) Standard Occupational Classification (SOC) framework based on job duties and critical skills (see Appendix 2 and Appendix 3).

Of the almost 1.7 million total graduates from Virginia institutions during the 2008–2022 period, approximately 38% were matched to social media profiles. Table 1 includes information about match rates for all graduates. Table 2 includes the same information for graduates from data science-related programs. Match rates were higher for graduates at the bachelor's degree level and above and for graduates of data science-related programs compared to other fields of study. This suggests that the College and Career Outcomes dataset is more representative of these groups.

Table 1

Representation of Virginia Graduates in College and Career Outcomes Dataset by Award Level in All Programs at All Institutions from 2008–2022

Award Level	Total Graduates	Graduates in College and Career Outcomes Dataset	Graduates in College and Career Outcomes Dataset (%)
Certificate	217,148	41,077	19
Associate	271,445	60,879	22
Bachelor's	805,120	376,617	47
Master's	304,044	127,570	42
First Professional	45,263	20,009	44
Doctorate	42,070	19,478	46
Total	**1,685,090**	**645,630**	**38**

Source: SCHEV report *C01A2: Completions, Program Detail;* Virginia College and Career Outcomes dataset

Table 2

Representation of Virginia Graduates in Data Science Fields of Study in College and Career Outcomes Dataset by Award Level at All Institutions from 2008−2022

Award Level	Total Graduates	Graduates in College and Career Outcomes Dataset	Graduates in College and Career Outcomes Dataset (%)
Certificate	5,752	2,141	37
Associate	14,977	5,004	33
Bachelor's	57,731	31,353	54
Master's	18,806	1,484	60
Doctorate	2,485	9,270	49
Total	**99,751**	**49,252**	**49**

Source: SCHEV report C01A2: Completions, *Program Detail;* Virginia College and Career Outcomes dataset

Other Data Sources

The analyses in this report also rely on supplemental data from SCHEV and Lightcast. Data on degrees in data science programs come from the SCHEV report "C01A2: Completions, Program Detail," accessed on research.schev.edu in August 2024. Labor market and job posting data are based on Lightcast's 2023 Q4 datarun.

Data Limitations

While the College and Career Outcomes Dataset includes records for a substantial portion of graduates, the sample may not be representative of the overall population of graduates. Graduates from different programs and institutions may have different rates of both labor force participation and engagement with social media profiles.

Also, a large minority (39%) of Virginia graduates in the dataset listed additional degrees earned in other states in their professional profiles. This report only includes degrees from institutions that report to SCHEV, meaning out-of-state degrees are not included in the analysis, as VOEE cannot independently verify them.

Finally, career data are based on self-attested job titles, and how people describe their jobs on social media may not be consistent.

Trends in Data Science Awards

What are the trends in data science degrees and certificates?

Graduation from data science programs has grown substantially since 2008. The combined growth rate of data science programs at all postsecondary institutions statewide (218%) far exceeded the combined growth rate of all other programs (59%) during the 2008–2023 period.

Between 2008 and 2023, data science programs at Virginia institutions grew by 218%, compared to 62% nationally.

Table 3

Postsecondary Data Science Program Growth in Virginia, 2008–2023

Program	Change (%) (All Awards, all Virginia Institutions)	Change (%) (All Awards, all Institutions Nationwide)
Data Science	218	62
All Other Programs	59	31

Source: SCHEV report *C01A2: Completions, Program Detail, IPEDS 2008, 2023 Completions Survey*

Figure 1

Data Science Graduates by Year at All Virginia Institutions
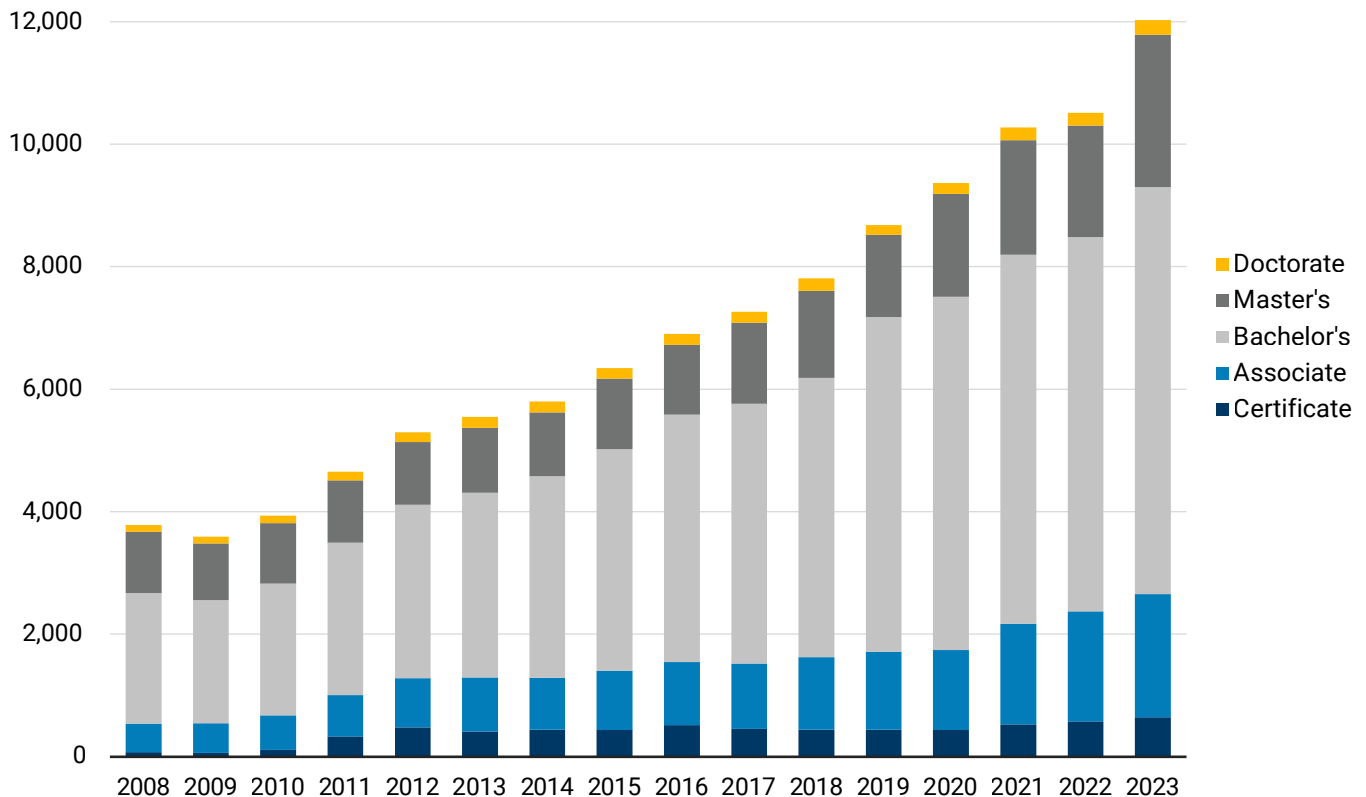
Source: SCHEV report C01A2: *Completions, Program Detail*

Educational Background of Data Science Professionals

The following section uses the College and Career Outcomes Dataset to explore the programs completed by Virginia alumni who worked in a data science occupation at any point between graduation and 2022. While many jobs use data science skills, these analyses focus on 14 core data science occupations, as identified based on job duties and critical skills. A list of the top self-disclosed certifications and skills for data science professionals can be found in Appendix 5.

What are the most common programs of study for data science professionals?

Figure 2 visualizes the degree and certificate programs completed by Virginia graduates who worked as data science professionals at some point between their graduation and 2022. Academic disciplines are collapsed to the broad two-digit CIP level,[1] and the underlying data are weighted by job tenure so that the program areas of graduates with longer work histories in data science appear proportionally larger. For example, a graduate who worked in a data science occupation for six years would contribute twice as much to the chart section corresponding to their field of study than would a graduate who worked in a data science occupation for only three years. The most common programs of study for data science professionals were Computer and Information Sciences and Support Services programs, followed closely by Business, Management, Marketing, and Related Support Services Programs.

Figure 2

Programs of Study Pursued by Virginia Graduates Working as Data Science Professionals, 2008–2022, Weighted by Job Tenure

Computer and Information Sciences and Support Services
49,545

Other
46,427

Business, Management, Marketing, and Related Support Services
46,400

Engineering
30,923

Social Sciences
18,666

Liberal Arts and Sciences, General Studies and Humanities
9,912

Mathematics and Statistics
8,860

Psychology
5,868

Multi/Interdisciplinary Studies
5,194

Source: Virginia College and Career Outcomes dataset

[1]For job holders with multiple degrees, the first degree earned in a data science field is included. Degrees earned outside of Virginia are not considered in this analysis.

Table 4 includes counts of the number of graduates from specific four-digit CIP programs who ever worked in a data science occupation. The most common program of study for data science professionals was Computer and Information Sciences – General, followed closely by Business Administration – Management and Operations, but a majority of professionals have degrees from programs unrelated to data science or business. Over 10% graduated from programs in Liberal Arts and Sciences – General Studies and Humanities programs.

The most common program of study for data science professionals was Computer and Information Sciences – General, followed closely by Business Administration – Management and Operations.

Table 4

Top Programs of Study of Virginia Alumni Working as Data Science Professionals, 2008-2022

Program	Number of Graduates
11.01 Computer and Information Sciences, General	7,659
52.02 Business Administration, Management and Operations	7,117
24.01 Liberal Arts and Sciences, General Studies and Humanities	3,446
45.06 Economics	1,860
27.01 Mathematics	1,838
42.01 Psychology, General	1,817
52.08 Finance and Financial Management Services	1,785
14.09 Computer Engineering	1,760
45.10 Political Science and Government	1,707
11.04 Information Science/Studies	1,644
52.13 Management Sciences and Quantitative Methods	1,595
45.09 International Relations and National Security Studies	1,559
11.07 Computer Science	1,490
52.03 Accounting and Related Services	1,385
26.01 Biology, General	1,151
14.19 Mechanical Engineering	1,018
54.01 History	1,017
52.01 Business/Commerce, General	1,012
14.10 Electrical, Electronics, and Communications Engineering	996
14.27 Systems Engineering	866

Source: Virginia College and Career Outcomes dataset

Occupations of Data Science Graduates

As Table 4 indicates, most data science professionals in the College and Career Outcomes Dataset did not pursue a data science-related program of study as defined by SCHEV. Similarly, data science graduates may enter occupations outside of data science. This section examines the occupations of Virginia alumni who received a degree or certificate in a data science field of study.

What are the most common occupations for data science graduates?

Figure 3 visualizes the occupational families of data science graduates. It includes all observed occupations for a graduate, and the underlying data are weighted by job tenure. For example, a graduate who worked eight years in Business and Financial Occupations and four years in Computer and Mathematical Occupations would contribute twice as much area to Business and Financial Occupations as to Computer and Mathematical Occupations. Accounting for both the number of graduates and job tenure, data science graduates spent about half of their documented working years in Computer and Mathematical Occupations.

Figure 3

Top Occupational Families of Employment for Virginia Data Science Graduates, 2008–2022, Weighted by Job Tenure

Computer and Mathematical Occupations
38,243,372

Management Occupations
8,126,296

Business and Financial Operations Occupations
7,204,414

Architecture and Engineering Occupations
5,735,429

Education, Training, and Library Occupations
4,014,607

Other
2,777,397

Life, Physical, Social Science Occupations
1,387,880

2,026,573

1,391,700

1,038,526

Office and Administrative Support Occupations

Sales and Related Occupations
1,391,700

Arts, Design, Entertainment, Sports, and Media Occupations

Source: Virginia College and Career Outcomes dataset

Table 5 lists the top occupations for data science graduates three years post-graduation.[2] The most common occupation by far was Software Developer – Applications.

> Three years post-graduation, many data science graduates were working as Software Developers – Applications.

Table 5

Top 20 Occupations Held During Third Calendar Year Following Graduation for 2008–2019 Graduates of Data Science Programs in Virginia

Occupation	Graduates Employed in Occupation in Year Three after Graduation
15-1132 Software Developers, Applications	6,551
15-1151 Computer User Support Specialists	1,513
13-1111 Management Analysts	1,337
15-1121 Computer Systems Analysts	1,276
15-1142 Network and Computer Systems Administrators	1,230
15-1122 Information Security Analysts	1,220
15-1199 Computer Occupations, All Other	881
15-1134 Web Developers	680
17-2071 Electrical Engineers	648
17-2199 Engineers, All Other	457
15-1111 Computer and Information Research Scientists	452
15-1133 Software Developers, Systems Software	434
13-1161 Market Research Analysts and Marketing Specialists	390
11-3021 Computer and Information Systems Managers	348
11-9199 Managers, All Other	335
19-4099 Life, Physical, and Social Science Technicians, All Other	313
13-2011 Accountants and Auditors	294
17-2112 Industrial Engineers	283
25-2031 Secondary School Teachers, Except Special and Career/Technical Education	280
17-2072 Electronics Engineers, Except Computer	279

Source: Virginia College and Career Outcomes dataset

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[2]In the case of graduates who earned multiple data science degrees, the date of the first degree awarded is used. The third year is defined as the third calendar year post-graduation.
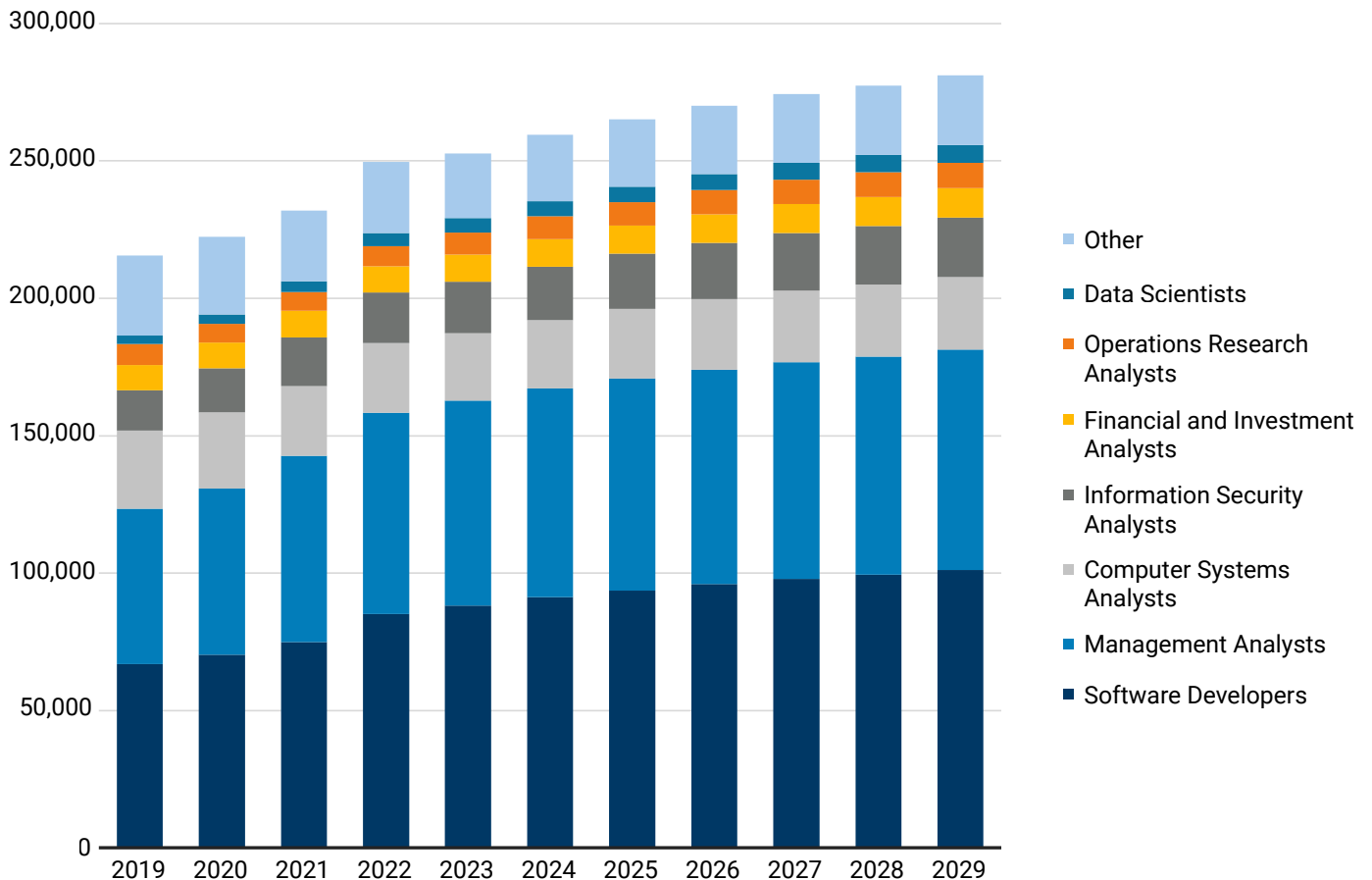
Employment Trends in Data Science Occupations

The labor market for data science professionals is dynamic and has changed over time. Drawing on data from job postings, professional social profiles, and the College and Career Outcomes dataset, this section examines the employment, labor market indicators, job postings, and skills for data science occupations.

How has employment in data science occupations changed over time, and what is projected employment?

VOEE identified 17 occupations from the 2018 SOC codes that represent core roles involved in data science. These selected occupations make use of quantitative analytical tools, database management systems, and relevant software. Occupations included in the list share a similar skill profile with the core occupation of 'data scientist' (SOC 15-2051). Figure 4 summarizes historical and projected growth in these occupations for the period 2018-2028. Employment in these occupations in Virginia grew by 27% from 2018-2023 and is projected to grow another 8% by 2028.

> Between 2018 and 2023, data science employment grew by 27%. It is expected to continue growing, but at a slower rate, between now and 2028.

Figure 4

Historical and Projected Data Science Employment in Virginia by Year and Occupation

Legend:
- Other
- Data Scientists
- Operations Research Analysts
- Financial and Investment Analysts
- Information Security Analysts
- Computer Systems Analysts
- Management Analysts
- Software Developers

Source: Lightcast 2024 Q3 datarun

What are common labor market indicators (total employment, earnings, employment and posting concentration) for data science professionals in Virginia?

Table 6 highlights selected labor market indicators for data science-related occupations in Virginia. Employment concentration is calculated by dividing the percentage of Virginia's workforce employed in an occupation by the percentage of the United States workforce employed in that same occupation. Similarly, posting concentration is calculated by dividing the percentage of unique job postings for a given occupation in Virginia by the percentage of national job postings for that same occupation. An employment concentration greater than 1.0 indicates that the concentration of workers in Virginia for that occupation is above the national average. A posting concentration greater than 1.0 would similarly represent a higher-than-average concentration of job postings by employers in Virginia. Software Developer was the most common data science-related occupation in Virginia in 2023. These 88,229 workers were also one of the highest-paid groups of data science professionals, with a median salary of $124,969. Compared to the national average, most data science-related occupations are highly concentrated in Virginia, both in terms of employment and job postings.

> Data science-related occupations are highly concentrated in Virginia, compared to the national average.

Table 6

Selected Labor Market Indicators for Data Science-Related Occupations in Virginia, 2023

SOC	Description	Employment	Median Annual Earnings ($)	Employment Concentration	Posting Concentration
15-1252	Software Developers	88,229	134,969	1.94	1.57
13-1111	Management Analysts	74,559	144,278	2.66	1.65
15-1211	Computer Systems Analysts	24,507	108,418	1.76	1.73
15-1212	Information Security Analysts	18,808	133,479	3.78	3.76
13-2051	Financial and Investment Analysts	9,798	102,970	1.06	1.27
15-2031	Operations Research Analysts	8,093	117,365	2.44	1.77
15-2051	Data Scientists	5,141	135,816	0.97	1.53
15-1242	Database Administrators	4,716	102,552	2.26	1.91
15-1243	Database Architects	4,546	138,218	2.81	1.59
15-1251	Computer Programmers	3,169	97,269	0.87	1.68
13-2031	Budget Analysts	2,948	102,898	2.11	3.38
15-1221	Computer and Information Research Scientists	2,483	143,749	2.38	1.63
13-2041	Credit Analysts	2,182	98,238	1.10	0.69
13-2054	Financial Risk Specialists	1,485	109,319	0.93	1.31
15-2041	Statisticians	1,262	103,907	1.39	0.96
15-2011	Actuaries	650	117,669	0.75	1.00
43-9111	Statistical Assistants	214	51,079	0.92	0.98

Source: Lightcast 2024 Q3 datarun

What are the most commonly advertised job titles, skills, and credentials for data science-related occupations?

The BLS defines a 'job' as a set of work activities performed by an individual and an 'occupation' as a collective description of several similar individual jobs performed, with minor variations, in different establishments (2018 SOC User Guide). Several job titles may relate to the same occupation. Table 7 includes statistics for the most commonly advertised job titles in data science-related occupations in Virginia. The posting concentrations for these jobs indicate that they are in relatively high demand in Virginia, compared to the national average.

Table 7

Top Advertised Job Titles in Data Science-Related Occupations in Virginia, 2023−2024

Job Title	Unique Postings, Aug 23−Jul 24	Median Advertised Salary ($)	Posting Concentration
Software Engineers	2,614	139,008	1.96
Unclassified	1,898	129,920	1.23
Data Scientists	1,873	141,824	3.22
Business Analysts	1,762	105,728	2.05
Software Developers	1,480	129,792	3.41
Financial Analysts	1,324	89,856	1.40
Data Analysts	1,304	95,488	2.27
Data Engineers	1,145	123,648	2.11
Solutions Architects	1,019	161,280	2.86
DevOps Engineers	990	136,704	2.94
Program Analysts	964	120,064	6.53
Full Stack Developers	956	139,776	3.73
Java Developers	720	132,608	2.26
Software Development Engineers	694	169,472	2.66
Business Systems Analysts	668	105,216	1.96
.NET Developers	627	124,672	2.45
Cybersecurity Analysts	589	125,184	4.64
Systems Analysts	570	97,536	2.67
Information Systems Security Officers	548	123,392	5.94
Full Stack Java Developers	543	124,416	3.68

Source: Lightcast 2024 Q3 datarun

Tables 8 through 11 show the top skills for data science occupations. To identify these skills, VOEE used the Lightcast Open Skills Taxonomy to tag both job postings and professional social profiles in Virginia for the period August 2023 – July 2024. Importantly, the profile data were sourced from *all* available profiles, not just those matched with Virginia graduates in the College and Career Outcomes dataset.

The skills listed in Tables 8 and 9 are based on those identified in job postings. The metric percent of total postings refers to the percentage of online job postings for any of the 17 data science occupations that mention a specific data science skill (e.g., computer science).[3] Lightcast's projection of skill growth relative to the market is calculated by dividing the forecasted two-year change in national demand for a given skill by the forecasted

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[3]Lightcast attempts to count multiple advertisements for the same job as a single posting.

two-year change in national demand for all skills. Lightcast's projections are based on well-defined skills that are observed in the labor market through job postings and professional profiles. Lightcast projections are also weighted towards long-term trends and are comparatively unresponsive to short-term changes to skills requested in job postings.

Table 8 lists the top specialized skills occurring in job postings. These skills are primarily related to a specific subset of occupations or tasks. Table 9 focuses on the narrower category of top software skills.

Based on job postings, the most in-demand specialized skills for data science-related occupations are Computer Science, Agile Methodology, SQL, and Python. At least 20% of postings mentioned each of these skills. The top software skills were SQL, Python, Amazon Web Services, and Java, which were included in at least 15% of postings.

> The most in-demand skills for data science-related occupations include Computer Science, Agile Methodology, SQL, and Python.

Table 8
Top Specialized Skills Requested in Postings for Data Science-Related Occupations in Virginia, August 2023 – July 2024

Skill	Total Postings (%)	Projected Skill Growth (%)	Skill Growth Relative to Market
Computer Science	25	27	Rapidly Growing
Agile Methodology	23	20	Rapidly Growing
SQL	22	6	Stable
Python	21	24	Rapidly Growing
Amazon Web Services	19	24	Rapidly Growing
Data Analysis	16	26	Rapidly Growing
Java	15	17	Growing
Software Development	15	23	Rapidly Growing
Project Management	14	20	Rapidly Growing
Automation	13	30	Rapidly Growing
JavaScript	12	19	Growing
Software Engineering	12	23	Rapidly Growing
Microsoft Azure	11	29	Rapidly Growing
Workflow Management	11	18	Growing
Business Process	10	23	Rapidly Growing
API	10	9	Growing
Scripting	9	8	Stable
Finance	9	27	Rapidly Growing
DevOps	9	24	Rapidly Growing
Linux	9	9	Growing

Source: Lightcast 2024 Q3 datarun

Table 9

Top Software Skills in Data Science-Related Occupations in Virginia, 2023–2024

Skill	Total Postings (%)	Projected Skill Growth (%)	Skill Growth Relative to Market
SQL	22	6	Stable
Python	21	24	Rapidly Growing
Amazon Web Services	19	24	Rapidly Growing
Java	15	17	Growing
Microsoft Excel	12	18	Growing
JavaScript	12	19	Growing
Microsoft Azure	11	29	Rapidly Growing
Microsoft Office	10	19	Growing
API	10	9	Growing
Linux	9	9	Growing
Microsoft PowerPoint	8	26	Rapidly Growing
JIRA	7	24	Rapidly Growing
Git	7	11	Growing
Docker	7	20	Rapidly Growing
Dashboard	7	25	Rapidly Growing
Kubernetes	6	22	Rapidly Growing
Power BI	6	20	Rapidly Growing
Angular Web Framework	6	22	Rapidly Growing
C#	6	16	Growing
Jenkins	6	16	Growing

Source: Lightcast 2024 Q3 datarun

Tables 10 and 11 include skills disclosed on the professional social profiles of data science professionals. Table 10 lists the top specialized skills; Table 11 lists the top software skills. 'Total Profiles (%)' refers to the percentage of profiles in Virginia that mention the listed skill. Projected Skill Growth and Skill Growth Relative to Market are calculated the same as for Tables 9 and 10.

The most frequently listed specialized skills for data science professionals were Project Management (16%), SQL (15%), and Software Engineering (15%). The most common software skills listed on social profiles were Microsoft Office (18%), Microsoft Excel (16%), and SQL (15%).

Table 10

Top Specialized Skills Identified in Professional Profiles of Workers in Data Science-Related Occupations in Virginia, August 2023 – July 2024

Skill	Total Profiles (%)	Projected Skill Growth (%)	Skill Growth Relative to Market
Project Management	16	20	Rapidly Growing
SQL	15	6	Stable
Software Engineering	15	23	Rapidly Growing
Data Analysis	13	26	Rapidly Growing
Software Development	12	23	Rapidly Growing
Java	11	17	Growing
Python	10	24	Rapidly Growing
JavaScript	9	19	Growing
Agile Methodology	9	20	Rapidly Growing
HTML	9	11	Growing
Systems Engineering	8	21	Rapidly Growing
Linux	7	9	Growing
Process Improvement	7	27	Rapidly Growing
Finance	6	27	Rapidly Growing
Amazon Web Services	6	24	Rapidly Growing
Auditing	6	22	Rapidly Growing
Automation	6	30	Rapidly Growing
Accounting	6	24	Rapidly Growing
Cyber Security	5	14	Growing
Scrum (Software Development)	5	15	Growing

Source: Lightcast 2024 Q3 datarun

Table 11

Top Software Skills Identified in Professional Profiles of Workers in Data Science-Related Occupations in Virginia, August 2023 – July 2024

Skill	Total Profiles (%)	Projected Skill Growth (%)	Skill Growth Relative to Market
Microsoft Office	18	19	Growing
Microsoft Excel	16	18	Growing
SQL	15	6	Stable
Java	11	17	Growing
Microsoft PowerPoint	11	26	Rapidly Growing
Python	10	24	Rapidly Growing
JavaScript	9	19	Growing
HTML	9	11	Growing
Linux	7	9	Growing
Microsoft SQL Servers	7	12	Growing
C++	7	10	Growing
Amazon Web Services	6	24	Rapidly Growing
Cascading Style Sheets (CSS)	6	21	Rapidly Growing
Unix	6	14	Growing
Microsoft SharePoint	5	2	Lagging
Microsoft Access	5	4	Lagging
Extensible Markup Language (XML)	5	14	Growing
MySQL	5	17	Growing
C#	5	16	Growing
Operating Systems	4	23	Rapidly Growing

Source: Lightcast 2024 Q3 datarun

What are the most common industries for data science professionals?

Data science professionals work in diverse industries as categorized by the North American Industry Classification System (NAICS). Each employer belongs to an industry that most closely represents its outputs, and these industries are classified into a five-level hierarchy ranging from industry sectors (two-digit NAICS) to national industry (six-digit NAICS). The top industry sectors employing data science professionals in 2023–2024 include professional, scientific, and technical services; government; management of companies and enterprises; and information. A detailed breakdown of the top industries within each of these sectors is provided in Table 12, which highlights the specific five-digit NAICS industry where data science professionals are employed.

Many data science professionals work in professional, scientific, and technical services industries; the government; management of companies and enterprises industries; and information industries.

Table 12

Top Industries (by five-digit NAICS) of Employment for Data Science Occupations, 2023–2024

Industry	Data Science Jobs in Industry (2023)	Data Science Jobs in Industry (2024)	Change (%) (2023−24)	Data Science Workers in Industry (%) (2023)	Industry Jobs in Data Science Field (%) (2023)
Computer Systems Design and Related Services	80,107	82,178	3	31.7	44.5
Management Consulting Services	29,421	30,066	2	11.6	33.4
Federal Government, Civilian, Excluding Postal	17,804	18,242	2	7.0	9.0
Management of Companies and Enterprises	15,771	16,259	3	6.2	18.0
Data Processing, Hosting, and Related Services	6,554	6,904	5	2.6	34.7
Engineering Services	5,647	5,730	1	2.2	11.1
State Government, Excluding Education and Hospitals	5,609	5,735	2	2.2	9.5
Research and Development in the Physical, Engineering,	5,051	5,211	3	2.0	19.2
Accounting, Tax Preparation, Bookkeeping, and Payroll	4,697	4,743	1	1.9	10.9
Software Publishers	3,938	4,168	6	1.6	42.8
Local Government, Excluding Education and	3,889	3,953	2	1.5	2.5
Commercial Banking	3,796	3,887	2	1.5	15.2
Education (State Government)	3,652	3,809	4	1.4	4.2
Other Scientific and Technical Consulting	3,589	3,642	1	1.4	34.6
Temporary Help Services	3,253	3,320	2	1.3	5.2

Source: Lightcast 2024 Q3 datarun

Job Transitions in Data Science

What are the most common career transitions for data science professionals?

The College and Career Outcomes dataset allows for a deeper understanding of the career progression of Virginia alumni working in data science. Tables 13 and 14 explore the job transitions of people working in data science fields.[4] Table 13 includes transitions by graduates *from* data science occupations; Table 14 includes transitions by graduates *into* data science occupations. Among the 82,000 instances of data science professionals in our dataset transitioning to a new job, 32% involved transitions to another job in the same occupation (as defined by the SOC framework). Overall, 43% of job transitions were to other jobs in the data science field (as defined in Appendix 3). The most common transition *into* a data science occupation was from Web Developer to Software Developer – Applications, followed by Computer Systems Analyst to Management Analyst.

> When transitioning to a new job, 43% of data science professionals remained in the data science field.

Table 13

Top Transitions of Virginia Graduates from Data Science-Related Occupations, 2008−2022

Reference Occupation	Next Occupation	Number of Transitions	Transitions From Occupation (%)
Management Analysts	Computer Systems Analysts	1,573	6
Management Analysts	Managers, All Other	1,407	6
Management Analysts	Market Research Analysts and Marketing Specialists	1,005	4
Management Analysts	Computer Occupations, All Other	911	4
Software Developers, Applications	Computer Occupations, All Other	823	4
Financial Analysts	Financial Managers	780	9
Financial Analysts	Management Analysts	766	8
Management Analysts	Financial Analysts	757	3
Management Analysts	Marketing Managers	729	3
Management Analysts	Business Operations Specialists, All Other	662	3
Software Developers, Applications	Web Developers	602	3
Management Analysts	General and Operations Managers	554	2
Computer Programmers	Software Developers, Applications	524	27
Financial Analysts	Accountants and Auditors	509	6
Management Analysts	Software Developers, Applications	458	2

Source: Virginia College and Career Outcomes dataset

[4] A job transition is defined as a worker ending employment at one job and beginning employment at a subsequent job no sooner than 30 days before and no later than one year after leaving the previous job.

Table 14

Top Occupational Transitions of Virginia Graduates into Data Science-Related Occupations, 2008–2022

Reference Occupation	Prior Occupation	Number of Transitions	Transitions Into Occupation (%)
Software Developers, Applications	Web Developers	1,508	6
Management Analysts	Computer Systems Analysts	1,397	5
Management Analysts	Market Research Analysts and Marketing Specialists	1,107	4
Management Analysts	Managers, All Other	963	3
Financial Analysts	Accountants and Auditors	883	9
Software Developers, Applications	Computer Systems Analysts	868	3
Management Analysts	Business Operations Specialists, All Other	855	3
Software Developers, Applications	Computer User Support Specialists	794	3
Software Developers, Applications	Computer Occupations, All Other	781	3
Management Analysts	Financial Analysts	762	3
Software Developers, Applications	Life, Physical, and Social Science Technicians, All Other	752	3
Management Analysts	Computer User Support Specialists	746	2
Financial Analysts	Management Analysts	743	8
Software Developers, Applications	Network and Computer Systems Administrators	691	3
Information Security Analysts	Computer User Support Specialists	689	8

Source: Virginia College and Career Outcomes dataset

What is the typical job tenure for data science professionals?

Table 15 includes information about typical job tenure for data science occupations. On average, data science professionals in the College and Career Outcomes dataset remained in a job for 21.4 months, just under the average duration of 23.3 months for occupations unrelated to data science. Importantly, workers sometimes change jobs while remaining at the same employer.

Data science professionals maintain an average job tenure of 21.4 months, similar to other occupations.

Table 15
Average and Median Length of Employment in Jobs of Virginia Graduates in Data Science Occupations, 2008–2022

Occupation	Average Duration (Months)	Median Duration (Months)	Number of Observations
Actuaries	24	19	304
Software Developers, Systems Software	23	18	2,371
Budget Analysts	23	18	630
Software Developers, Applications	21	17	22,943
Statisticians	21	15	910
Information Security Analysts	21	16	7,254
Database Administrators	20	14	1,352
Credit Analysts	20	16	1,254
Management Analysts	19	15	29,236
Computer and Information Research Scientists	19	13	3,448
Financial Analysts	18	15	10,614
Operations Research Analysts	18	13	4,040
Computer Programmers	14	9	2,419
Statistical Assistants	13	9	89

Source: Virginia College and Career Outcomes dataset

Note: An occupation change does not necessarily indicate an employer change. Some workers change jobs while remaining at the same employer.

The Importance of Artificial Intelligence Skills

The advent of Artificial Intelligence (AI) is having a profound impact on higher education programming and the labor market at large. AI-related skills are becoming increasingly important for all occupations, including those related to data science. Appendix 4 includes a list of AI skills, as defined by the Lightcast Open Skills Taxonomy. The following analyses use Lightcast job postings data and the College and Career Outcomes Dataset to examine the job market for AI skills and the career pathways of graduates with AI skills.

What is the demand for AI-related skills in the job market?

Prior to 2014, the demand in Virginia for the AI skills identified in Appendix 4 was minimal, with AI skills appearing in fewer than 70 job postings per month. However, as shown in Figure 5, job postings referencing AI skills have grown substantially in the past decade. In February 2025, AI skills were mentioned in nearly 24 times as many job postings as in February 2015. Between February 2024 and February 2025, postings increased by over 75%.

> The demand for AI-related skills increased by over 75% between February 2024 and February 2025.

Figure 5
Unique New Job Postings in Virginia Referencing AI Skills, 2010–2025
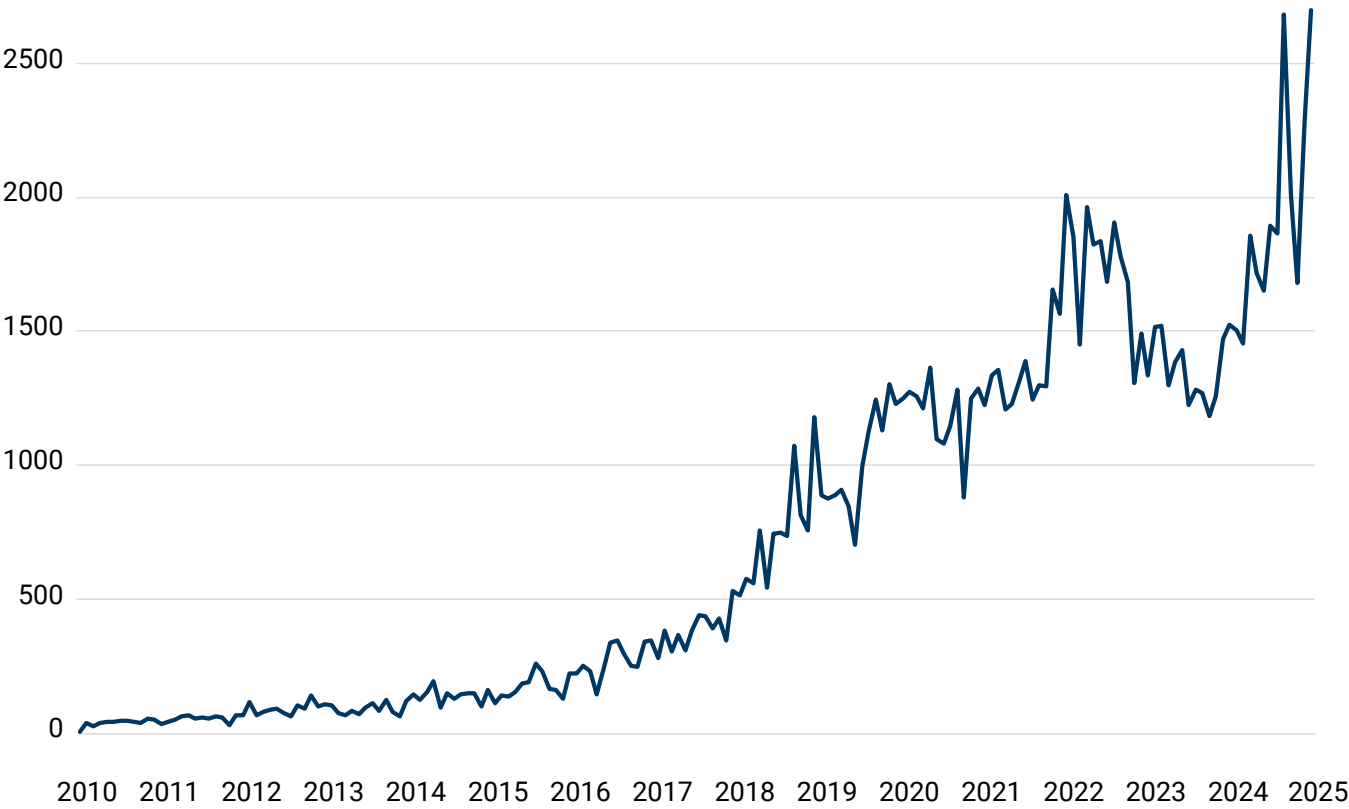
Source: Lightcast Job Posting Analytics, 2024 Q3 datarun

What are the most common occupations and industries for graduates with AI-related skills?

Self-disclosed skills information from graduates' social profiles was used to identify common occupations (Table 16) and industries (Table 17) for graduates with AI skills. Importantly, these data only include graduates through 2022 and do not include the most recent alumni and professionals with AI skills. The top occupations for graduates with AI skills were Software Developer – Applications, followed by Computer and Information Research Scientist. The most common industry for these graduates was Colleges, Universities, and Professional Schools.

Table 16

Most Recent Occupations of Virginia Graduates Attesting to One or More Core AI-Related Skills in Social Profile

Occupation	Number of Workers
15-1132 Software Developers, Applications	429
15-1111 Computer and Information Research Scientists	310
17-2141 Mechanical Engineers	100
11-2021 Marketing Managers	97
13-1111 Management Analysts	66
15-1199 Computer Occupations, All Other	60
11-3021 Computer and Information Systems Managers	56
13-1161 Market Research Analysts and Marketing Specialists	53
19-4099 Life, Physical, and Social Science Technicians, All Other	49
11-9041 Architectural and Engineering Managers	48
11-1011 Chief Executives	40
25-1199 Postsecondary Teachers, All Other	34
15-1121 Computer Systems Analysts	33
25-1191 Graduate Teaching Assistants	30
19-1042 Medical Scientists, Except Epidemiologists	27
11-2022 Sales Managers	27
15-1133 Software Developers, Systems Software	25
41-3099 Sales Representatives, Services, All Other	25
11-1021 General and Operations Managers	22
17-2199 Engineers, All Other	22

Source: Virginia College and Career Outcomes dataset

Table 17
Most Recent Industries of Employment of Virginia Graduates Attesting to One or More Core AI-Related Skills in Social Profile

Industry	Workers in Industry
Colleges, Universities, and Professional Schools	185
Software Publishers	116
All Other Information Services	101
Electronic Shopping and Mail-Order Houses	89
Administrative Management and General Management Consulting Services	80
Custom Computer Programming Services	74
Commercial Banking	71
Computer Systems Design Services	54
Data Processing, Hosting, and Related Services	45
Engineering Services	43
All Other Professional, Scientific, and Technical Services	42
Other Computer Related Services	41
Semiconductor and Related Device Manufacturing	32
Research and Development in the Physical, Engineering, and Life Sciences	31
Electronic Computer Manufacturing	27
Offices of Certified Public Accountants	24
Other Scientific and Technical Consulting Services	22
Research and Development in the Social Sciences and Humanities	22
Guided Missile and Space Vehicle Manufacturing	22
Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System	21

Source: Virginia College and Career Outcomes dataset

What are the most common programs of study and institutions for graduates with AI-related skills?

Many graduates report AI skills on their professional profiles. Table 18 highlights the top fields of study among Virginia graduates who listed at least one core AI skill. Table 19 details the top institutions attended by these graduates, including those with AI-related degrees earned out-of-state, as identified in professional social profiles. The most common fields of study for graduates with AI skills were Computer and Information Sciences – General, and Computer Science, suggesting that AI skills and knowledge have primarily been taught within broader computer and mathematical disciplines. Virginia Tech, the University of Virginia, and George Mason University produced the most graduates who listed AI skills.

Many graduates listed AI-related skills on their professional social profiles. The most common fields of study for these graduates were Computer and Information Sciences – General and Computer Science.

Table 18

Top Programs of Study of Virginia Graduates Attesting to Core AI-Related Skills in Social Profile

Program of Study	Graduates
11.0101 Computer and Information Sciences, General	502
11.0701 Computer Science	407
14.1001 Electrical and Electronics Engineering	270
27.0101 Mathematics, General	254
52.0201 Business Administration and Management, General	221
14.0901 Computer Engineering, General	212
14.0101 Engineering, General	178
40.0801 Physics, General	151
14.1901 Mechanical Engineering	128
52.0101 Business/Commerce, General	113
24.0101 Liberal Arts and Sciences/Liberal Studies	110
45.0601 Economics, General	106
14.2701 Systems Engineering	96
27.0501 Statistics, General	84
14.3501 Industrial Engineering	81
42.0101 Psychology, General	76
14.0801 Civil Engineering, General	63
30.7001 Data Science, General	61
26.0101 Biology/Biological Sciences, General	59
14.0501 Bioengineering and Biomedical Engineering	54

Source: Virginia College and Career Outcomes dataset

Table 19

Top Institutions of Study of Virginia Graduates Attesting to Core AI-Related Skills in Social Profile

Institution	Graduates
Virginia Tech	780
University of Virginia	696
George Mason University	448
Old Dominion University	165
William & Mary	160
Virginia Commonwealth University	156
James Madison University	111
Georgia Institute of Technology	86
Liberty University	67
Northern Virginia Community College	63
University of Richmond	48
University of Maryland, College Park	38
Johns Hopkins University	35
Udacity	33
Mason School of Business	27
Carnegie Mellon University	25
Massachusetts Institute of Technology	23
University of Mary Washington	22
Radford University	22
Sharif University of Technology	21

Source: Virginia College and Career Outcomes dataset

Conclusion

In summary, this research report provides an analysis of data science graduates and professionals in Virginia, highlighting trends in educational attainment, employment, and skills demand within data science-related occupations. The findings reveal significant growth in data science-related degree completions, outpacing other fields of study. They also underscore the diverse career trajectories of data science graduates, who often transition into roles beyond traditional computer and mathematical occupations.

Additionally, most data science professionals in the College and Career Outcomes Dataset had not pursued a data science-related program of study as defined by SCHEV. Many completed programs in Liberal Arts and Sciences – General Studies, Economics, Psychology, and Political Science and Government.

Employment in data science occupations has shown sustained and continuing growth, particularly for key occupations such as software development, management analysis, and information/cybersecurity. The report also highlights the increasing importance of artificial intelligence (AI), which is becoming critical across various industries and job roles.

These insights provide important context for understanding the evolving landscape of data science employment and education in Virginia. Policymakers, educators, and workforce development professionals may use these findings to better align educational programs with labor market needs, ensuring that Virginia's workforce remains competitive in this rapidly advancing field.

Appendices

Appendix 1: SCHEV-Identified Data Science Fields of Study

11.0101 Computer and Information Sciences, General

11.0103 Information Technology

11.0199 Computer and Information Sciences, Other

11.0201 Computer Programming/Programmer, General

11.0401 Information Science/Studies

11.0501 Computer Systems Analysis/Analyst

11.0701 Computer Science

11.0801 Web Page, Digital/Multimedia and Information Resources Design

11.0802 Data Modeling/Warehousing and Database Administration

11.0901 Computer Systems Networking and Telecommunications

11.1003 Computer and Information Systems Security/Auditing/Information Assurance

11.1005 Information Technology Project Management

11.1006 Computer Support Specialist

11.1099 Computer/Information Technology Services Administration and Management, Other

11.9999 Computer and Information Sciences and Support Services, Other

14.0901 Computer Engineering, General

14.0903 Computer Software Engineering

14.1001 Electrical and Electronics Engineering

27.0101 Mathematics, General

27.0301 Applied Mathematics, General

27.0501 Statistics, General

27.0502 Mathematical Statistics and Probability

27.0503 Mathematics and Statistics

27.9999 Mathematics and Statistics, Other

30.7001 Data Science, General

52.1201 Management Information Systems, General

52.1206 Information Resources Management

52.1301 Management Science

52.1399 Management Sciences and Quantitative Methods, Other

Appendix 2: VOEE-Identified Data Science Occupations Based on 2010 Standard Occupational Classification (SOC) Codes, Used for Alumni Career Data

13-1111 Management Analysts

13-2031 Budget Analysts

13-2041 Credit Analysts

13-2051 Financial Analysts

15-1111 Computer and Information Research Scientists

15-1122 Information Security Analysts

15-1131 Computer Programmers

15-1132 Software Developers, Applications

15-1133 Software Developers, Systems Software

15-1141 Database Administrators

15-2011 Actuaries

15-2031 Operations Research Analysts

15-2041 Statisticians

43-9111 Statistical Assistants

Appendix 3: VOEE-Identified Data Science Occupations Based on 2018 SOC Framework, Used for Labor Market Data

13-1111 Management Analysts

13-2031 Budget Analysts

13-2041 Credit Analysts

13-2051 Financial and Investment Analysts

13-2054 Financial Risk Specialists

15-1211 Computer Systems Analysts

15-1212 Information Security Analysts

15-1221 Computer and Information Research Scientists

15-1242 Database Administrators

15-1243 Database Architects

15-1251 Computer Programmers

15-1252 Software Developers

15-2011 Actuaries

15-2031 Operations Research Analysts

15-2041 Statisticians

15-2051 Data Scientists

Appendix 4: VOEE-Identified Artificial Intelligence-Related Skills from Lightcast Open Skills Taxonomy

Abstract State Machine Language (ASML)

Adversarial Machine Learning

AIOps (Artificial Intelligence for IT Operations)

Applications of Artificial Intelligence

Artificial Consciousness

Artificial General Intelligence

Artificial Intelligence

Artificial Intelligence Development

Artificial Intelligence Markup Language (AIML)

Artificial Intelligence Risk

Artificial Intelligence Systems

Artificial Neural Networks

Automated Machine Learning

Boltzmann Machine

CatBoost (Machine Learning Library)

Conversational AI

Ethical AI

Explainable AI (XAI)

Generative Artificial Intelligence

Language Model

Large Language Modeling

Machine Learning

Machine Learning Algorithms

Machine Learning Methods

Machine Learning Model Monitoring And Evaluation

Machine Learning Model Training

Machine Vision

Operationalizing AI

PyTorch (Machine Learning Library)

Reinforcement Learning

Torch (Machine Learning)

Transformer (Machine Learning Model)

Turing Machine

Virtual Reality Modeling Language

Appendix 5: Top Self-Attested Certifications and Skills of Virginia Graduates Who Are Data Science Professionals, 2008–2022

Top Certifications	Number Attesting to Skill	Attesting to Skill (%)
Security Clearance	3,410	5
CompTIA Certification	1,835	3
CompTIA Security+	1,775	3
Project Management Professional Certification	1,742	3
Top Secret-Sensitive Compartmented Information	1,116	2
Certified Information Systems Security Professional	926	1
Certified Scrum Master	867	1
ITIL Certifications	745	1
ITIL Foundation Certification	704	1
Chartered Financial Analyst	591	1

Top Common Skills		
Research	32,386	48
Microsoft Office	29,971	45
Microsoft Excel	28,855	43
Leadership	28,334	42
Management	28,172	42
Customer Service	25,038	37
Microsoft PowerPoint	22,057	33
Public Speaking	20,100	30
Microsoft Word	20,019	30
Operations	17,598	26

Top Specialized Skills		
Data Analysis	21,818	32
Marketing	12,557	19
Project Management	10,590	16
Financial Analysis	10,156	15
Event Planning	9,679	14
Finance	9,608	14
SQL (Programming Language)	9,167	14
Accounting	7,181	11
Python (Programming Language)	6,990	10
Auditing	6,550	10