

Data Science

This section presents the requirements for programs in:

- **Data Science B.D.S. Honours**
- **Concentration in Artificial Intelligence**
- **Concentration in Statistics**

Program Requirements

Course Categories

The following categories of courses are used in defining the program requirements in the Bachelor of Data Science program.

Free Electives

All courses offered by the Faculty of Arts and Social Sciences, the Faculty of Public and Global Affairs, the Sprott School of Business and the Faculty of Science except for courses in the Prohibited Courses category. Free electives can include COMP, CSEC, DATA, MATH and STAT courses.

Prohibited Courses

The following courses cannot be used for credit in the B.D.S. **Please note that any courses cross-listed with those on the list are also prohibited:**

BIOL 3604 [0.5]	Statistics for Biologists
BUSI 1401 [0.5]	Foundations of Information Systems
BUSI 2401 [0.5]	Introduction to Data Analytics
BUSI 2402 [0.5]	Business Applications Development
BUSI 3400 [0.5]	Database Design
CGSC 1005 [0.5]	Computational Methods in Cognitive Science
COMP 1001 [0.5]	Introduction to Computational Thinking for Arts and Social Science Students
COMS 3001 [0.5]	Quantitative Research in Communication
CRCJ 3001 [0.5]	Quantitative Methods in Criminology
ECON 1401/ MATH 1401 [0.5]	Elementary Mathematics for Economics I
ECON 1402/ MATH 1402 [0.5]	Elementary Mathematics for Economics II
ECON 2210 [0.5]	Introductory Statistics for Economics
ECON 3001 [0.5]	Mathematical Methods of Economics
ECON 4001 [0.5]	Mathematical Analysis in Economics
ECON 4002 [0.5]	Statistical Analysis in Economics
ECON 4004 [0.5]	Operations Research: Linear Programming Models
ECON 4706 [0.5]	Econometrics I
ECON 4707 [0.5]	Econometrics II
ECON 4713 [0.5]	Time-Series Econometrics
GEOG 2006 [0.5]	Introduction to Quantitative Research

ECOR 2606 [0.5]	Numerical Methods
GEOG 3003 [0.5]	Quantitative Geography
MATH 1009 [0.5]	Mathematics for Business
MATH 1119 [0.5]	Linear Algebra: with Applications to Business
NEUR 2001 [0.5]	Introduction to Research Methods in Neuroscience
NEUR 2002 [0.5]	Introduction to Statistics in Neuroscience
NEUR 3001 [0.5]	Data Analysis in Neuroscience I
NEUR 3002 [0.5]	Data Analysis in Neuroscience II
PSCI 2702 [0.5]	A Statistical Toolkit for Political Scientists
PSYC 2001 [0.5]	Introduction to Research Methods in Psychology
PSYC 2002 [0.5]	Introduction to Statistics in Psychology
PSYC 3000 [1.0]	Design and Analysis in Psychological Research
SOCI 3000 [0.5]	Descriptive Statistics in Social Research
SOCI 3002 [0.5]	Inferential Statistics in Social Research
SOCI 4009 [0.5]	Advanced Studies in Quantitative Research
SOWK 3001 [0.5]	Introduction to Research Methods in Social Work
SYSC 2510 [0.5]	Probability, Statistics and Random Processes for Engineers

all 0000-level courses

and all courses in BIT, IMD, IRM, MPAD, NET, OSS, PLT and ITEC except for the following: BIT 1000, BIT 1001, BIT 1100, BIT 1101, BIT 1200, BIT 1201, BIT 2000, BIT 2004 (no longer offered), BIT 2005 (no longer offered), BIT 2007 (no longer offered), BIT 2100 (no longer offered), BIT 2300 (no longer offered), MPAD 2501, MPAD 3300, MPAD 3501, MPAD 4001, MPAD 4501, MPAD 4502, MPAD 4503, MPAD 4504.

Data Science

B.D.S. Honours (20.0 credits)

A. Credits Included in the Major CGPA (13.0 credits)

1. 1.5 credits in:		1.5
MATH 1007 [0.5]	Elementary Calculus I	
MATH 1104 [0.5]	Linear Algebra for Engineering or Science	
MATH 2007 [0.5]	Elementary Calculus II	
2. 1.0 credit in:		1.0
DATA 2200 [0.5]	Communication Skills for Data Scientists	
PHIL 2106 [0.5]	Information Ethics	
3. 5.5 credits in:		5.5
COMP 1405 [0.5]	Introduction to Computer Science I	
COMP 1406 [0.5]	Introduction to Computer Science II	
COMP 1805 [0.5]	Discrete Structures I	
COMP 2109 [0.5]	Introduction to Security and Privacy	
COMP 2401 [0.5]	Introduction to Systems Programming	
COMP 2402 [0.5]	Abstract Data Types and Algorithms	

COMP 2404 [0.5]	Introduction to Software Engineering	
COMP 2406 [0.5]	Fundamentals of Web Applications	
COMP 2804 [0.5]	Discrete Structures II	
COMP 3105 [0.5]	Introduction to Machine Learning	
COMP 4107 [0.5]	Neural Networks	
4. 2.0 credit in:		2.0
DATA 1517 [0.5]	Data Modelling I	
DATA 1519 [0.5]	Data Modelling II	
DATA 2500 [0.5]	Data Wrangling in R	
DATA 3500 [0.5]	Statistical Programming in R	
5. 1.5 credits in:		1.5
STAT 1500 [0.5]	Introduction to Statistical Computing	
STAT 3553 [0.5]	Regression Modeling (Honours)	
STAT 4601 [0.5]	Data Mining I (Honours)	
6. 1.0 credit from:		1.0
COMP 4010 [0.5]	Introduction to Reinforcement Learning	
COMP 4102 [0.5]	Computer Vision	
COMP 4115 [0.5]	Introduction to Natural Language Processing	
COMP 4116 [0.5]	Multiagent Systems	
STAT 3504 [0.5]	Analysis of Variance and Experimental Design	
STAT 3507 [0.5]	Sampling Methodology	
STAT 4502 [0.5]	Survey Sampling (Honours)	
STAT 4503 [0.5]	Applied Multivariate Analysis (Honours)	
STAT 4504 [0.5]	Statistical Design and Analysis of Experiments (Honours)	
STAT 4604 [0.5]	Statistical Computing (Honours)	
STAT 4607 [0.5]	Bayesian Statistical Analysis (Honours)	
7. 0.5 credit in COMP or STAT at the 4000-level		0.5
B. Credits Not Included in the Major CGPA (7.0 credits)		
8. 7.0 credits in free electives		7.0
Total Credits		20.0

Concentration in Artificial Intelligence (3.5 credits)

1. 2.0 credit in:		2.0
COMP 2804 [0.5]	Discrete Structures II	
COMP 3005 [0.5]	Database Management Systems	
COMP 3106 [0.5]	Introduction to Artificial Intelligence	
COMP 3804 [0.5]	Design and Analysis of Algorithms I	
2. 1.5 credits from:		1.5
COMP 3801 [0.5]	Algorithms for Modern Data Sets	
COMP 4010 [0.5]	Introduction to Reinforcement Learning	
COMP 4102 [0.5]	Computer Vision	
COMP 4115 [0.5]	Introduction to Natural Language Processing	
COMP 4116 [0.5]	Multiagent Systems	
COMP 4804 [0.5]	Design and Analysis of Algorithms II	
COMP 4905 [0.5]	Honours Project	

COMP 4906 [1.0]	Honours Thesis	
Total Credits		3.5
Concentration in Statistics (4.0 credits)		
1. 2.0 credits in:		2.0
STAT 3210 [0.5]	Inferential Data Science Foundations I	
STAT 3553 [0.5]	Regression Modeling (Honours)	
STAT 4321 [0.5]	Inferential Data Science Foundations II	
STAT 4322 [0.5]	Learning from Big Data	
2. 1.0 credit from:		1.0
STAT 3504 [0.5]	Analysis of Variance and Experimental Design	
STAT 4502 [0.5]	Survey Sampling (Honours)	
STAT 4503 [0.5]	Applied Multivariate Analysis (Honours)	
STAT 4504 [0.5]	Statistical Design and Analysis of Experiments (Honours)	
STAT 4607 [0.5]	Bayesian Statistical Analysis (Honours)	
3. 1.0 credit from:		1.0
DATA 4848 [1.0], or		
STAT 4905 [0.5] and 0.5 credits in STAT at the 4000-level		
Total Credits		4.0

Regulations

In addition to specific program requirements, students must satisfy the University regulations common to all undergraduate students (see the *Academic Regulations of the University* section of this Calendar).

Students should consult with the Institute for Data Science when planning their program and selecting courses.

Academic Continuation Evaluation for Bachelor of Data Science (Honours)

Students in the B.D.S. (Honours) follow the continuation requirements for Honours programs, as described in Section 3.2.6 of the *Academic Regulations of the University*, with the following addition:

- Students with 15.5 or more program credits completed, but who have a Major CGPA less than 6.00, will be required to leave the B.D.S. program with the decision *Required to Withdraw for Two Terms* (WT).

Co-operative Education

For more information about how to apply for the Co-op program and how the Co-op program works please visit the Co-op website.

All students participating in the Co-op program are governed by the Undergraduate Co-operative Education Policy.

Undergraduate Co-operative Education Policy

Admission Requirements

Students can apply to Co-op in one of two ways: directly from high school, or after beginning a degree program at Carleton.

If a student applies to a degree program with a Co-op option from high school, their university grades will be reviewed two terms to one year prior to their first work term to ensure they meet the academic requirements after their first or second year of study. The time at which the evaluation takes place depends on the program of study. Students will automatically receive an admission decision via their Carleton email account.

Students who did not request Co-op at the time they applied to Carleton can request Co-op after they begin their university studies. To view application instructions and deadlines, please visit carleton.ca/co-op.

To be admitted to Co-op, a student must successfully complete 5.0 or more credits that count towards their degree, meet the minimum CGPA requirement(s) for the student's Co-op option, and fulfil any specified course prerequisites. To see the unique admission and continuation requirements for each Co-op option, please refer to the specific degree programs listed in the Undergraduate Calendar.

Participation Requirements

Co-op Participation Agreement

All students must adhere to the policies found within the Co-op Participation Agreement.

COOP 1000

Once a student has been admitted to the Co-op Program, they will be given access to register in COOP 1000. This zero-credit online course must be completed at least two terms prior to the student's first work term.

Communication with the Co-op Office

Students must maintain contact with the Co-op Office during their job search and while on a work term. All email communication will be conducted via the students' Carleton email account.

Employment

Although every effort is made to ensure a sufficient number of job postings for all Co-op students, no guarantee of employment can be made. The Co-op job search process is competitive, and success is dependent upon factors such as current market conditions, academic performance, skills, motivation, and level of commitment to the job search. It is the student's responsibility to apply for positions via the Co-op job board in addition to actively conducting a self-directed job search. Students who do not obtain a co-op work term are expected to continue with their academic studies. It should be noted that hiring priority for positions within the Federal Government of Canada is given to Canadian citizens.

Registration

- Students must be registered as full-time during all fall and winter study terms beginning the term in which they enroll in COOP 1000.
- Students will be registered in a Co-op Work Term course while at work. This course does not carry academic course credit, but is noted on academic transcripts.

- Students may register in a 0.5 credit during a work term, provided the course is offered during the evening or is offered asynchronously online.
- Students must have at least one term of full-time studies left to complete following their final co-op work term. Students cannot end their degree on a work term.

Work Term Assessment and Evaluation

Work Term Evaluation

Employers are responsible for submitting to Carleton University final performance evaluations for their Co-op students at the end of their work terms.

Work Term Assessment

In order to successfully complete the co-op work term, students must receive a Satisfactory (SAT) grade on their Co-op Work Term Report, which they must submit at the completion of each four-month work term.

Graduation with the Co-op Designation

In order to graduate with the Co-op Designation, students must satisfy all requirements of the degree program in addition to the successful completion of three or four work terms (the number is dependent upon the student's academic program). Students found in violation of the Co-op Participation Agreement may have the Co-op Designation withheld.

Note: Participation in the co-op option will add up to one additional year for a student to complete their degree program.

Voluntary Withdrawal from the Co-op Option

Students who are currently on a co-op work term or who have already committed to a co-op work term either verbally or in writing may not leave the position and/or withdraw from the co-op option until they have completed the work term and all related requirements.

Involuntary or Required Withdrawal from the Co-op Option

Students may be removed from the Co-op Program for any of the following reasons:

1. Failure to achieve a grade of SAT in COOP 1000;
2. Failure to attend all interviews for positions to which the student has applied;
3. Declining more than one job offer during the job search;
4. Reneging on a co-op position that the student has accepted either verbally or in writing;
5. Continuing a job search after accepting a co-op position;
6. Dismissal from a work term by the co-op employer;
7. Leaving a work term without approval from the Co-op Management Team;
8. Receipt of an unsatisfactory work term evaluation;
9. Receiving a grade of UNS on the work term report.

International Students

All international students are required to possess a Co-op Work Permit issued by Immigration, Refugees and

Citizenship Canada before they can begin working. The Co-operative Education Office will provide students with a letter of support to accompany their Co-op Work Permit application. Students are advised to discuss the application process and application requirements with the International Student Services Office.

Co-op Fees

All participating Co-op students are required to pay Co-op fees. For full details, please see the Co-op website.

Bachelor of Data Science: Co-op Admission and Continuation Requirements

- Maintain full-time status in each study term;
- Be eligible to work in Canada (for off-campus work);
- Have successfully completed COOP 1000 .

In addition to the following:

1. Registered as a full-time student in the B.D.S. program;
2. Successfully completed 5.0 or more credits;
3. Obtained an Overall CGPA of at least 8.00 and a Major CGPA of at least 8.00. These CGPAs must be maintained throughout the duration of the degree.

B.D.S. students must successfully complete four (4) work terms to obtain the Co-op Designation.

Co-op Work Term Course: DATA 3999

Work/Study Pattern:

Year 1		Year 2		Year 3		Year 4		Year 5	
Term	Pattern	Term	Pattern	Term	Pattern	Term	Pattern	Term	Pattern
Fall	S	Fall	S	Fall	W	Fall	S	Fall	S
Winter	S	Winter	S	Winter	S	Winter	W	Winter	S
Summer		Summer	W	Summer	W	Summer	W		

Legend

S: Study

W: Work

Admissions Information

Admission Requirements are for the 2025-26 year only, and are based on the Ontario High School System. Holding the minimum admission requirements only establishes eligibility for consideration. The cut-off averages for admission may be considerably higher than the minimum. See also the **General Admission and Procedures** section of this Calendar. An overall average of at least 70% is normally required to be considered for admission. Some programs may also require specific course prerequisites and prerequisite averages and/or supplementary admission portfolios. Higher averages are required for admission to programs for which the demand for places by qualified applicants exceeds the number of places available. The overall average required for admission is determined each year on a program by program basis. Consult admissions.carleton.ca for further details.

Note: Courses listed as *recommended* are not mandatory for admission. Students who do not follow the recommendations will not be disadvantaged in the admission process.

Admissions Information

Admission requirements are based on the Ontario High School System. Prospective students can view the admission requirements through the Admissions website at admissions.carleton.ca. The overall average required for admission is determined each year on a program-by-program basis. Holding the minimum admission requirements only establishes eligibility for consideration; higher averages are required for admission to programs for which the demand for places by qualified applicants exceeds the number of places available. All programs have limited enrolment and admission is not guaranteed. Some programs may also require specific course prerequisites and prerequisite averages and/or supplementary admission portfolios. Consult admissions.carleton.ca for further details.

Note: If a course is listed as recommended, it is not mandatory for admission. Students who do not follow the recommendations will not be disadvantaged in the admission process.

Degree

- Bachelor of Data Science (B.D.S.) (Honours)

Admission Requirements

First Year

The Ontario Secondary School Diploma (OSSD) or equivalent, including a minimum of six 4U or M courses. The six 4U or M courses must include Advanced Functions, and Calculus and Vectors.

Advanced Standing

Applications for admission beyond first year will be assessed on their merits. Students must typically present a minimum CGPA of 7.00 (B-) in order to be considered for admission. Advanced standing will be granted only for those subjects assessed as being appropriate for the program and the stream selected. Students will not receive credit for courses graded below C-.

Co-op Option

Direct Admission to the First Year of the Co-op Option

Applicants must:

1. meet the required overall admission cut-off average and prerequisite course average. These averages may be higher than the stated minimum requirements;
2. be registered as a full-time student in the Bachelor of Data Science Honours program;
3. be eligible to work in Canada (for off-campus work placements).

Meeting the above requirements only establishes eligibility for admission to the program. The prevailing job market may limit enrolment in the co-op option.

Note: continuation requirements for students previously admitted to the co-op option and admission requirements for the co-op option after beginning the program are described in the Co-operative Education Regulations section of this Calendar.

Data Science (DATA) Courses

DATA 1517 [0.5 credit]

Data Modelling I

Introduction to formulating statistical problems and analyzing data using open-source software. Graphical and numerical descriptives. combinatorial formulae, Bayes' Theorem, probability, Discrete and continuous distributions, means and variances. Point and interval estimates, and hypothesis tests for one- and two-samples using Central Limit Theorem, and permutation tests. Precludes additional credit for BIT 2000, BIT 2009, BIT 2100 (no longer offered), BIT 2300 (no longer offered), ECON 2201 (no longer offered), ECON 2210, ENST 2006, GEOG 2006, STAT 2507, STAT 2601, STAT 2606 (no longer offered), and STAT 3502. May not be counted for credit in any program if taken after successful completion of STAT 2655.

Prerequisite(s): An Ontario Grade 12 university-preparation Mathematics or equivalent, or permission of the Institute for Data Science.

Lectures three hours a week, laboratory one hour a week.

DATA 1519 [0.5 credit]

Data Modelling II

Introduction to modelling real phenomena from planning data collection or gathering observational data to analyzing and providing insights. Topics include experimental design from first principles and simulating the data generating process, linear regression and correlation, one- and two-way Analysis of Variance using open-source statistical software.

Precludes additional credit for ECON 2202, ECON 2220, STAT 2509, STAT 2559, STAT 2602.

Prerequisite(s): DATA 1517 or (STAT 1500 and STAT 2507) or (STAT 1500 and STAT 2655) or (STAT 1500 and STAT 3502); or permission of the Institute for Data Science.

Lectures three hours a week, laboratory one hour a week.

DATA 2200 [0.5 credit]

Communication Skills for Data Scientists

Technical communication and data visualization skills for data science majors, concentrating on writing and orally presenting scientific papers and technical reports. Principles of clarity and precision in writing and oral communication. Practical exercises and readings from recent technical publications will be used.

Prerequisite(s): DATA 1517 or STAT 2507 or STAT 2559.

Lectures three hours a week.

DATA 2500 [0.5 credit]

Data Wrangling in R

Reproducible workflows from acquisition, to cleaning, manipulation, and visualization. Data are acquired from databases, APIs, and web scraping. Cleaning and manipulating Numeric, categorical, date, and text data are introduced including regular expressions. Data visualization and report generation using dynamic tools are emphasized.

Prerequisite(s): (COMP 1005 or COMP 1405), STAT 1500, and one of (DATA 1517, STAT 2507, or STAT 2655).

Lectures three hours a week, laboratory one hour a week.

DATA 3500 [0.5 credit]

Statistical Programming in R

Modern coding practices in R including running simulations, workflows for common statistical models, retrieving diagnostics and model estimates, and presenting and visualizing results. Emphasis on modern, reproducible workflows and version control.

Prerequisite(s): DATA 2500.

Lectures three hours a week, laboratory one hour a week.

DATA 3999 [0.0 credit]

Co-operative Work Term

On completion of each work term, the student must submit to the Institute for Data Science a written report on the work performed. Graded SAT or UNS.

Includes: Experiential Learning Activity

Prerequisite(s): registration in the Co-operative Education Option, and permission of the Institute for Data Science.

DATA 4848 [1.0 credit]

Consulting Project

This course is designed to give students some practical experience as a data science consultant through classroom discussion of issues in consulting and participation in real consulting projects.

Includes: Experiential Learning Activity

Prerequisite(s): fourth-year standing in the Bachelor of Data Science program.