# Data Science (Collaborative Specialization)

## Program Requirements

Students enrolled in the Collaborative Specialization in Data Science must meet the requirements of their respective home units as well as those of the Collaborative Specialization. The requirements of the Collaborative Specialization do not, however, add to the number of credits students are required to accumulate by their home unit and the credit value of the degree remains the same. Consult the individual programs for detailed program requirements.

## M.Sc. Biology
### with Specialization in Data Science (5.0 credits)

**Requirements:**

| | | |
|---|---|---:|
| **1. 0.5 credit in** approved coursework | | 0.5 |
| **2. 0.5 credit in:** | | 0.5 |
| DATA 5000 [0.5] | Data Science Seminar | |
| **3. 4.0 credits in:** | | 4.0 |
| BIOL 5909 [4.0] | M.Sc. Thesis | |
| Total Credits | | 5.0 |

## M.A.Sc. Biomedical Engineering
### with Specialization in Data Science (5.0 credits)

**Requirements:**

| | | |
|---|---|---:|
| **1. 0.5 credit in:** | | 0.5 |
| BIOM 5010 [0.5] | Introduction to Biomedical Engineering | |
| **2. 0.5 credit in:** | | 0.5 |
| DATA 5000 [0.5] | Data Science Seminar | |
| **3. 1.0 credit in** BIOM (BMG) courses | | 1.0 |
| **4. 0.5 credit in** elective courses taken either at Carleton University or University of Ottawa with the approval of the OCIBME Director or Associate Director | | 0.5 |
| **5. 2.5 credits in:** | | 2.5 |
| BIOM 5909 [2.5] | M.A.Sc. Thesis | |
| **6. 0.0 credit in:** | | 0.0 |
| BIOM 5800 [0.0] | Biomedical Engineering Seminar | |
| Total Credits | | 5.0 |

## M.B.A. with Concentration in Business Analytics (2.25 credits)

Listed below are the requirements for the Concentration in Business Analytics. For a full description of M.B.A. requirements, visit the Business page.

**Concentration requirements (2.25 credits):**

| | | |
|---|---|---:|
| **1. 1.75 credits in:** | | 1.75 |
| ACCT 5012 [0.25] | Performance Measurement and Control | |
| DATA 5000 [0.5] | Data Science Seminar | |
| FINA 5511 [0.25] | Investments | |
| ITIS 5431 [0.25] | Business Analytics for Managers | |
| ITIS 5432 [0.25] | Business Analytics Methods | |
| TOMS 5303 [0.25] | Managing Projects | |
| **2. 0.5 credit in** elective concentration course from: | | 0.5 |
| BUSI 6905 [0.5] | Advanced Statistical Methods for Business Research | |
| ECON 5027 [0.5] | Econometrics I | |
| ECON 5055 [0.5] | Financial Econometrics | |
| STAT 5602 [0.5] | Analysis of Categorical Data | |
| STAT 5702 [0.5] | Modern Applied and Computational Statistics | |
| STAT 5703 [0.5] | Data Mining | |
| Total Credits | | 2.25 |

## Master of Cognitive Science
### with Specialization in Data Science (5.0 credits)

**Requirements - Thesis Option (5.0 credits)**

| | | |
|---|---|---:|
| **1. 0.5 credit in:** | | 0.5 |
| DATA 5000 [0.5] | Data Science Seminar | |
| **2. 0.5 credit in:** | | 0.5 |
| CGSC 5100 [0.5] | Issues in Cognitive Science | |
| **3. 0.5 credit in:** | | 0.5 |
| CGSC 5101 [0.5] | Experimental Methods and Statistics | |
| **4. 1.0 credit in** CGSC or other approved courses, from two different cognitive disciplines, selected in consultation with the graduate supervisor. | | 1.0 |
| **5. 2.5 credits in:** | | 2.5 |
| CGSC 5909 [2.5] | M. Cog. Thesis (The thesis must be approved as fulfilling the data science requirement and be supervised by a faculty member working in a data science related field.) | |
| 6. Preparation of research for presentation at the Carleton Cognitive Science Spring Conference. | | |
| Total Credits | | 5.0 |

**Requirements - Research Project Option (5.0 credits)**

| | | |
|---|---|---:|
| **1. 0.5 credit in:** | | 0.5 |
| DATA 5000 [0.5] | Data Science Seminar | |
| **2. 0.5 credit in:** | | 0.5 |
| CGSC 5100 [0.5] | Issues in Cognitive Science | |
| **3. 0.5 credit in:** | | 0.5 |
| CGSC 5101 [0.5] | Experimental Methods and Statistics | |
| **4. 1.5 credits from:** | | 1.5 |
| CGSC 5001 [0.5] | Cognition and Artificial Cognitive Systems | |
| CGSC 5002 [0.5] | Experimental Research in Cognition | |
| CGSC 5003 [0.5] | Cognition and Language | |
| CGSC 5004 [0.5] | Cognition and Conceptual Issues | |
| CGSC 5005 [0.5] | Cognition and Neuroscience | |
| **5. 1.0 credit in** CGSC or other approved courses selected in consultation with the graduate supervisor. | | 1.0 |
| **6. 1.0 credit in:** | | 1.0 |

| | | |
|---|---|---|
| CGSC 5908 [1.0] | Research Project (Project must be approved as fulfilling the data science requirement and be supervised by a faculty member working in a data science related field.) | |

7. Preparation of research for presentation at the Cogntive Science Spring Conference.

| Total Credits | 5.0 |
|---|---|

## M.A. Communication
## with Specialization in Data Science (5.0 credits)

### Requirements - Coursework Option (5.0 credits)

| | | |
|---|---|---|
| **1. 0.5 credit in:** | | **0.5** |
| DATA 5000 [0.5] | Data Science Seminar | |
| **2. 1.0 credit in:** | | **1.0** |
| COMS 5101 [1.0] | Foundations of Communication Studies | |
| **3. 0.5 credit in:** | | **0.5** |
| COMS 5605 [0.5] | Approaches to Communication Research | |
| **4. 0.5 credit in:** | | **0.5** |
| COMS 5225 [0.5] | Critical Data Studies | |
| **5. 0.5 credit from:** | | **0.5** |
| COMS 5203 [0.5] | Communication, Technology, Society | |
| COMS 5221 [0.5] | Science and the Making of Knowledge | |
| COMS 5224 [0.5] | Internet, Infrastructure, Materialities | |
| **6. 2.0 credits in electives** | | **2.0** |
| Total Credits | | 5.0 |

### Requirements - Research Essay Option (5.0 credits)

| | | |
|---|---|---|
| **1. 0.5 credit in:** | | **0.5** |
| DATA 5000 [0.5] | Data Science Seminar | |
| **2. 1.0 credit in:** | | **1.0** |
| COMS 5101 [1.0] | Foundations of Communication Studies | |
| **3. 0.5 credit in:** | | **0.5** |
| COMS 5605 [0.5] | Approaches to Communication Research | |
| **4. 0.5 credit in:** | | **0.5** |
| COMS 5225 [0.5] | Critical Data Studies | |
| **5. 1.0 credit in:** | | **1.0** |
| COMS 5908 [1.0] | Research Essay | |

Research Essay on a Data Science topic approved by the Advisory Board representative from Communication in consultation with the graduate Committee of the Institute of Data Science.

| | | |
|---|---|---|
| **6. 1.5 credits in electives.** | | **1.5** |
| Total Credits | | 5.0 |

### Requirements - Thesis Option (5.0 credits)

| | | |
|---|---|---|
| **1. 0.5 credit in:** | | **0.5** |
| DATA 5000 [0.5] | Data Science Seminar | |
| **2. 1.0 credit in:** | | **1.0** |
| COMS 5101 [1.0] | Foundations of Communication Studies | |
| **3. 0.5 credit in:** | | **0.5** |
| COMS 5605 [0.5] | Approaches to Communication Research | |
| **4. 0.5 credit in:** | | **0.5** |
| COMS 5225 [0.5] | Critical Data Studies | |
| **5. 2.0 credits in:** | | **2.0** |
| COMS 5909 [2.0] | M.A. Thesis | |

M.A. Thesis on a Data Science topic approved by the Advisory Board representative from Communication in consultation with the Graduate Committee of the Institute of Data Science.

| | | |
|---|---|---|
| **6. 0.5 credit in electives** | | **0.5** |
| Total Credits | | 5.0 |

## M.C.S. Computer Science
## with Specialization in Data Science (5.0 credits)

### Requirements - Thesis Option (5.0 credits)

| | | |
|---|---|---|
| **1. 0.5 credit in:** | | **0.5** |
| DATA 5000 [0.5] | Data Science Seminar | |
| **2. 1.0 credit from:** | | **1.0** |
| COMP 5100 [0.5] | Topics in Artificial Intelligence | |
| COMP 5101 [0.5] | Distributed Databases and Transaction Processing Systems | |
| COMP 5107 [0.5] | Statistical and Syntactic Pattern Recognition | |
| COMP 5108 [0.5] | Algorithms in Bioinformatics | |
| COMP 5111 [0.5] | Data Management for Business Intelligence | |
| COMP 5112 [0.5] | Algorithms for Data Science | |
| COMP 5204 [0.5] | Computational Aspects of Geographic Information Systems | |
| COMP 5209 [0.5] | Visual Analytics | |
| COMP 5305 [0.5] | Advanced Database Systems | |
| COMP 5306 [0.5] | Data Integration | |
| COMP 5307 [0.5] | Knowledge Representation | |
| COMP 5308 [0.5] | Topics in Medical Computing | |
| COMP 5401 [0.5] | Electronic Commerce Technologies | |
| COMP 5703 [0.5] | Algorithm Analysis and Design | |
| COMP 5704 [0.5] | Parallel Algorithms and Applications in Data Science | |
| **3. 1.0 credit in** course work | | **1.0** |
| **4. 2.5 credits in:** | | **2.5** |
| COMP 5905 [2.5] | M.C.S. Thesis | |
| Total Credits | | 5.0 |

**Notes:**

1. Course selections must include a minimum of 1.5 credits of OCICS courses in three different research areas, and must include at least (see OCICS course listing): 0.5 credit in software engineering, 0.5 credit in the theory of computing, and 0.5 credit in either computer applications or computer systems.

2. M.C.S. Thesis must be in an area of Data Science and requires approval from the Department. Each candidate submitting a thesis will be required to undertake an oral defence of the thesis.

## M.A. Economics
## with Specialization in Data Science (4.0 credits)

### Requirements - Coursework option (4.0 credits)

| 1. 1.5 credits in: | | 1.5 |
|---|---|---|
| ECON 5020 [0.5] | Microeconomic Theory | |
| ECON 5021 [0.5] | Macroeconomic Theory | |
| ECON 5027 [0.5] | Econometrics I | |
| **2. 0.5 credit in:** | | 0.5 |
| DATA 5000 [0.5] | Data Science Seminar | |
| **3. 0.5 credit in:** | | 0.5 |
| ECON 5029 [0.5] | Methods of Economic Research | |
| including a research paper on a data science related topic | | |
| **4. 1.0 credit in** ECON approved by the M.A. Supervisor of the Department of Economics, including at least 0.5 credit from ECON 5055, ECON 5361, ECON 5362, ECON 5700, ECON 5712, ECON 5713 | | 1.0 |
| **5. 0.5 credit in** Data Science elective (which may be an additional course from the preceding list) approved by the M.A. Supervisor of the Department of Economics | | 0.5 |
| Total Credits | | 4.0 |

**Requirements - Thesis option (4.0 credits)**

| 1. 1.5 credits in: | | 1.5 |
|---|---|---|
| ECON 5020 [0.5] | Microeconomic Theory | |
| ECON 5021 [0.5] | Macroeconomic Theory | |
| ECON 5027 [0.5] | Econometrics I | |
| **2. 0.5 credit in:** | | 0.5 |
| DATA 5000 [0.5] | Data Science Seminar | |
| **3. 1.5 credit in:** | | 1.5 |
| ECON 5909 [1.5] | M.A. Thesis | |
| on a data science topic approved by the Data Science governance committee | | |
| **4. 0.5 credit from:** | | 0.5 |
| ECON 5055 [0.5] | Financial Econometrics | |
| ECON 5361 [0.5] | Labour Economics I | |
| ECON 5362 [0.5] | Labour Economics II | |
| ECON 5700 [0.5] | Social and Economic Measurement | |
| ECON 5712 [0.5] | Micro-Econometrics | |
| ECON 5713 [0.5] | Time-Series Econometrics | |
| Total Credits | | 4.0 |

## M.A.Sc. Electrical and Computer Engineering with Specialization in Data Science (5.0 credits)

**Requirements - by Thesis (5.0 credits)**

| 1. 0.5 credit in: | | 0.5 |
|---|---|---|
| DATA 5000 [0.5] | Data Science Seminar | |
| **2. 0.5 credit from** data science elective courses: | | 0.5 |
| SYSC 5001 [0.5] | Simulation and Modeling | |
| SYSC 5003 [0.5] | Discrete Stochastic Models | |
| SYSC 5004 [0.5] | Optimization for Engineering Applications | |
| SYSC 5101 [0.5] | Design of High Performance Software | |
| SYSC 5103 [0.5] | Software Agents | |
| SYSC 5104 [0.5] | Methodologies For Discrete-Event Modeling And Simulation | |
| SYSC 5201 [0.5] | Computer Communication | |
| SYSC 5207 [0.5] | Distributed Systems Engineering | |
| SYSC 5300 [0.5] | Advanced Health Care Engineering | |
| SYSC 5303 [0.5] | Interactive Networked Systems and Telemedicine | |
| SYSC 5306 [0.5] | Mobile Computing Systems | |

| SYSC 5401 [0.5] | Adaptive and Learning Systems | |
|---|---|---|
| SYSC 5404 [0.5] | Multimedia Compression, Scalability, and Adaptation | |
| SYSC 5405 [0.5] | Pattern Classification and Experiment Design | |
| SYSC 5407 [0.5] | Planning and Design of Computer Networks | |
| SYSC 5500 [0.5] | Designing Secure Networking and Computer Systems | |
| SYSC 5703 [0.5] | Integrated Database Systems | |
| SYSC 5706 [0.5] | Analytical Performance Models of Computer Systems | |
| **3. 1.5 credits in** courses | | 1.5 |
| **4. 2.5 credits in:** | | 2.5 |
| SYSC 5909 [2.5] | M.A.Sc. Thesis | |
| in the area of data science (each candidate submitting a thesis will be required to undertake an oral defence of the thesis) | | |
| Total Credits | | 5.0 |

## M. Sc. Geography with Specialization in Data Science (5.0 credits)

**Requirements**

| 1. 0.5 credit in: | | 0.5 |
|---|---|---|
| DATA 5000 [0.5] | Data Science Seminar | |
| **2. 0.5 credit in:** | | 0.5 |
| GEOG 5001 [0.5] | Modeling Environmental Systems | |
| **3. 0.5 credit in:** | | 0.5 |
| GEOG 5905 [0.5] | Masters Research Workshop | |
| **4. 1.0 credit in** Physical Geography selected from: | | 1.0 |
| GEOG 5002 [0.5] | Quantitative Analysis for Geographical Research | |
| GEOG 5103 [0.5] | Hydrologic Principles and Methods | |
| GEOG 5104 [0.5] | Advanced Biogeography | |
| GEOG 5107 [0.5] | Field Study and Methodological Research | |
| GEOG 5303 [0.5] | Geocryology | |
| GEOG 5307 [0.5] | Soil Resources | |
| GEOG 5803 [0.5] | Seminar in Geomatics | |
| GEOG 5804 [0.5] | Geographic Information Systems | |
| GEOG 5900 [0.5] | Graduate Tutorial | |
| up to 0.5 credit in GEOG or GEOM at the 4000 level, with departmental approval | | |
| **5. 2.5 credits in:** | | 2.5 |
| GEOG 5906 [2.5] | M.Sc. Thesis (Thesis must be in the area of Data Science, defended at an oral examination) | |
| Total Credits | | 5.0 |

## M.Sc. Health Sciences with Specialization in Data Science (5.5 credits)

**Requirements (5.5 credits)**

| 1. 1.0 credits in: | | 1.0 |
|---|---|---|
| HLTH 5901 [0.5] | Advanced Topics in Interdisciplinary Health Sciences | |
| HLTH 5902 [0.5] | Seminars in Interdisciplinary Health Sciences for MSc | |
| **2. 0.5 credits in:** | | 0.5 |
| DATA 5000 [0.5] | Data Science Seminar | |

**3. Completion of:**

| | |
|---|---|
| HLTH 5905 [0.0] | Final Research Seminar Presentation for MSc |

**4. 4.0 credits in:** 4.0

| | |
|---|---|
| HLTH 5909 [4.0] | MSc Thesis |

5. Twice-yearly meetings with the thesis Graduate Advisory Committee, with students meeting a level of progress as determined by the Committee.

| | |
|---|---|
| Total Credits | 5.5 |

Note: The final research seminar presentation must be completed within one month of the thesis defence.