# Data Science (Collaborative Program)

This section presents the requirements for programs in:

- M.Sc. Biology with Specialization in Data Science
- M.A.Sc. Biomedical Engineering with Specialization in Data Science
- M.A.Sc. Biomedical Engineering with Specialization in Data Science
- Master of Cognitive Science with Specialization in Data Science
- M.A. Communication with Specialization in Data Science
- M.A. Economics with Specialization in Data Science
- M.A. History with Specialization in Data Science
- M.A. International Affairs with Specialization in Data Science
- M.A. Psychology with Specialization in Data Science
- M.C.S. Computer Science with Specialization in Data Science
- M.A. Science with Specialization in Data Science
- M.Sc. Electrical and Computer Engineering with Specialization in Data Science
- M.A.Sc. Electrical and Computer Engineering with Specialization in Data Science
- M.A. Geography with Specialization in Data Science
- M.S. Geography with Specialization in Data Science
- M.Sc. Health Sciences with Specialization in Data Science
- M.A. History with Specialization in Data Science
- M.A. International Affairs with Specialization in Data Science
- Master of Information Technology: Digital Media with Specialization in Data Science
- M.Sc. Physics Medical Physics Stream with Specialization in Data Science
- M.Sc. Physics Particle Physics Stream with Specialization in Data Science
- M.A. Psychology with Specialization in Data Science
- Master of Public Policy and Administration with Specialization in Data Science

## Program Requirements

Students enrolled in the Collaborative Program in Data Science must meet the requirements of their respective home units as well as those of the Collaborative Program. The requirements of the Collaborative Program 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**
   - BIOM 5010 [0.5]
   - Introduction to Biomedical Engineering
2. **0.5 credit in:**
   - DATA 5000 [0.5]
   - Data Science Seminar
3. **4.0 credits in:**
   - BIOL 5010
   - BIOM 5909
   - M.A.Sc. Thesis

**Total Credits**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 5909</td>
<td>M.Sc. Thesis</td>
<td>5.0</td>
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</tbody>
</table>

### M.A.Sc. Biomedical Engineering

**with Specialization in Data Science (5.0 credits)**

**Requirements - by coursework:**

1. **0.5 credit in:**
   - BIOM 5010 [0.5]
   - Introduction to Biomedical Engineering
2. **0.5 credit in:**
   - DATA 5000 [0.5]
   - Data Science Seminar
3. **2.0 credits in BIOM (BMG) courses**
4. **2.0 credits in elective courses at either Carleton University or University of Ottawa with the approval of the OCISME Director or Associate Director**
5. **0.0 credit in:**
   - BIOM 5800 [0.0]

**Total Credits**

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</thead>
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<tr>
<td>BIOL 5909</td>
<td>M.Sc. Thesis</td>
<td>5.0</td>
</tr>
</tbody>
</table>

**Note:** for the course work Item 3 and Item 4 above, one 0.5 credit data science elective course must be taken (one of BIOM 5202, BIOM 5400, BIOM 5405, COMP 5100, COMP 5101, COMP 5107, COMP 5108, COMP 5111, COMP 5112, COMP 5204, COMP 5209, COMP 5305, COMP 5306, COMP 5307, COMP 5308, COMP 5401, COMP 5703, COMP 5704, PHYS 5002, SYSC 5001, SYSC 5003, SYSC 5004, SYSC 5007, SYSC 5101, SYSC 5102, SYSC 5103, SYSC 5108, SYSC 5201, SYSC 5207, SYSC 5300, SYSC 5303, SYSC 5306, SYSC 5401, SYSC 5404, SYSC 5405, SYSC 5407, SYSC 5500, SYSC 5703, SYSC 5706).

### M.Eng. Biomedical Engineering

**with Specialization in Data Science (5.0 credits)**

**Requirements - by coursework:**

1. **0.5 credit in:**
   - BIOM 5010 [0.5]
   - Introduction to Biomedical Engineering
2. **0.5 credit in:**
   - DATA 5000 [0.5]
   - Data Science Seminar
3. **2.0 credits in BIOM (BMG) courses**
4. **2.0 credits in elective courses at either Carleton University or University of Ottawa with the approval of the OCISME Director or Associate Director**
5. **0.0 credit in:**
   - BIOM 5800 [0.0]

**Total Credits**

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<tr>
<td>BIOL 5909</td>
<td>M.Sc. Thesis</td>
<td>5.0</td>
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</tbody>
</table>

**Note:** for the course work Item 3 and Item 4 above, three 0.5-credit data science elective courses must be taken (three of BIOM 5400, BIOM 5405, COMP 5100, COMP 5101, COMP 5107, COMP 5108, COMP 5111, COMP 5112, COMP 5204, COMP 5209, COMP 5305, COMP 5306, COMP 5307, COMP 5308, COMP 5401, COMP 5703, COMP 5704, PHYS 5002, SYSC 5001, SYSC 5003, SYSC 5004, SYSC 5007, SYSC 5101, SYSC 5102, SYSC 5103, SYSC 5108, SYSC 5201, SYSC 5207, SYSC 5300, SYSC 5303, SYSC 5306, SYSC 5401, SYSC 5404, SYSC 5405, SYSC 5407, SYSC 5500, SYSC 5703, SYSC 5706).
Master of Cognitive Science with Specialization in Data Science (5.0 credits)

Requirements - by project:
1. 0.5 credit in:
   - SYSC 5407  Introduction to Biomedical Engineering 0.5

2. 0.5 credit in:
   - DATA 5000  Data Science Seminar 0.5

3. 1.5 credits in SYSC (BMG) courses 1.5

4. 1.0 credit in elective courses at either Carleton University or University of Ottawa with the approval of the OCIBME Director or Associate Director 1.0

5. 0.0 credit in:
   - SYSC 5500  Biomedical Engineering Seminar 0.0

6. 1.5 credit in:
   - SYSC 5401  Biomedical Engineering Project 1.5

Total Credits 5.0

Note: for the course work Item 3 and Item 4 above, three 0.5-credit data science elective courses must be taken (three of SYSC 5400, SYSC 5401, SYSC 5402, COMP 5100, COMP 5101, COMP 5102, COMP 5107, COMP 5108, COMP 5111, COMP 5112, COMP 5204, COMP 5209, COMP 5305, COMP 5306, COMP 5307, COMP 5308, COMP 5401, COMP 5703, COMP 5704, PHYS 5002, SYSC 5001, SYSC 5003, SYSC 5004, SYSC 5007, SYSC 5101, SYSC 5102, SYSC 5103, SYSC 5108, SYSC 5201, SYSC 5207, SYSC 5300, SYSC 5303, SYSC 5306, SYSC 5401, SYSC 5404, SYSC 5405, SYSC 5407, SYSC 5500, SYSC 5703, SYSC 5706)

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

Requirements - Coursework Option (5.0 credits)
1. 0.5 credit in:
   - DATA 5000  Data Science Seminar 0.5

2. 1.0 credit in:
   - COMS 5101  Foundations of Communication Studies 1.0

3. 0.5 credit in:
   - COMS 5605  Approaches to Communication Research 0.5

4. 0.5 credit in:
   - COMS 5225  Critical Data Studies 0.5

5. 0.5 credit from:
   - COMS 5203  Communication, Technology, Society 0.5
   - COMS 5221  Science and the Making of Knowledge 0.5
   - COMS 5224  Internet, Infrastructure, Materialities 0.5

6. 2.0 credits in electives 2.0

Total Credits 5.0

Requirements - Research Essay Option (5.0 credits)
1. 0.5 credit in:
   - DATA 5000  Data Science Seminar 0.5

2. 1.0 credit in:
   - COMS 5101  Foundations of Communication Studies 1.0

3. 0.5 credit in:
   - COMS 5605  Approaches to Communication Research 0.5

4. 0.5 credit in:
   - COMS 5225  Critical Data Studies 0.5

5. 1.0 credit in:
   - COMS 5908  Research Essay 1.0

Total Credits 5.0

6. Preparation of research for presentation at the Carleton Cognitive Science Spring Conference.
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:
   DATA 5000 [0.5] Data Science Seminar
2.  1.0 credit in:
   COMS 5101 [1.0] Foundations of Communication Studies
3.  0.5 credit in:
   COMS 5605 [0.5] Approaches to Communication Research
4.  0.5 credit in:
   COMS 5225 [0.5] Critical Data Studies
5.  2.0 credits in:
   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:
   DATA 5000 [0.5] Data Science Seminar
2.  2.0 credits in course work. Course work must include a minimum of 1.5 credits of OCICS courses in at least three different research areas. See OCICS course listing by research areas.
3.  2.5 credits in:
   COMP 5905 [2.5] M.C.S. Thesis (M.C.S. Thesis must be in an area of Data Science and requires approval from the Institute of Data Science. Each candidate submitting a thesis will be required to undertake an oral defence of the thesis.)

Total Credits  5.0

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

Requirements - Coursework option (4.0 credits)
1.  1.5 credits in:
   ECON 5020 [0.5] Microeconomic Theory
   ECON 5021 [0.5] Macroeconomic Theory
   ECON 5027 [0.5] Econometrics I
2.  0.5 credit in:
   DATA 5000 [0.5] Data Science Seminar
3.  0.5 credit in:
   ECON 5029 [0.5] Methods of Economic Research including a research paper on a data science related topic
4.  0.5 credit from:
   ECON 5055 [0.5] Financial Econometrics

Total Credits  5.0

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

5.  0.5 credit in ECON approved by the M.A. Supervisor of the Department of Economics
6.  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

Total Credits  4.0

Requirements - Thesis option (4.0 credits)
1.  1.5 credits in:
   ECON 5020 [0.5] Microeconomic Theory
   ECON 5021 [0.5] Macroeconomic Theory
   ECON 5027 [0.5] Econometrics I
2.  0.5 credit in:
   DATA 5000 [0.5] Data Science Seminar
3.  1.5 credit in:
   ECON 5909 [1.5] M.A. Thesis
   on a data science topic approved by the Data Science governance committee
4.  0.5 credit from:
   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:
   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

2021-2022 Carleton University Graduate Calendar  3
Data Science Seminar

System Engineering Project

Computer Systems

Analytical Performance Models of Systems

Integrated Database and Cloud Systems

Designing Secure Networking and Networks

Experiment Design

Pattern Classification and Experiment Design

Planning and Design of Computer Networks

Designing Secure Networking and Computer Systems

Integrated Database and Cloud Systems

Analytical Performance Models of Computer Systems

M.A. Thesis (in the specialization and including oral examination of the thesis)

Masters Research Workshop

Approaches to Geographical Inquiry

in the area of data science

Overview of the Collaborative Program in Data Science

MSc. in Data Science (Collaborative Program)

M.Sc. Geography

with Specialization in Data Science (5.0 credits)

Requirements:

1. 0.5 credit in:
   - DATA 5000 [0.5] Data Science Seminar

2. 1.0 credit from data science elective courses:
   - 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 and Cloud Systems
   - SYSC 5706 [0.5] Analytical Performance Models of Computer Systems

3. 2.5 credits in courses

4. 0.5 credit in:
   - SYSC 5900 [0.5] Systems Engineering Project

Total Credits

4.5

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

Requirements:

1. 0.5 credit in:
   - DATA 5000 [0.5] Data Science Seminar

2. 0.5 credit in:
   - GEOG 5000 [0.5] Approaches to Geographical Inquiry

3. 2.5 credits in:
   - GEOG 5909 [2.5] M.A. Thesis (in the specialization and including oral examination of the thesis)

4. 0.5 credit in:
   - GEOG 5905 [0.5] Masters Research Workshop

5. 1.0 credit in approved graduate-level electives

6. In addition to the formal requirements, M.A. students are required to attend the Departmental Seminar series, and the Graduate Field Camp.

Total Credits

5.0

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

Requirements:

1. 0.5 credit in:
   - DATA 5000 [0.5] Data Science Seminar

2. 0.5 credit in:
   - GEOG 5001 [0.5] Modeling Environmental Systems

3. 0.5 credit in:

   - GEOG 5002 [0.5] Geographic Information Systems

   - GEOG 5003 [0.5] Geostatistics

   - GEOG 5004 [0.5] Remote Sensing

   - GEOG 5005 [0.5] GIS Applications

Total Credits

5.0
### M.A. History with Specialization in Data Science (4.5 credits)

**Requirements:**

1. **0.5 credit in:**  
   HIST 5003 [0.5] Historical Theory and Method  
   
2. **1.5 credits in:**  
   HIST at the graduate level of which only 0.5 credit may be taken in a designated public history course; with departmental permission, up to 0.5 credit of courses with historical content may be taken from another unit at Carleton University, at the University of Ottawa, or at another accredited institution.  
   
3. **0.5 credit in:**  
   HIST 5706 [0.5] Digital History  
   
4. **0.5 credit in:**  
   0.5  

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

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

**Requirements - Thesis pathway:**

1. **0.5 credit in:**  
   DATA 5000 [0.5] Data Science Seminar  
   
2. **1.0 credit in:**  
   INAF 5016 [0.5] Statistical Analysis for International Affairs  
   INAF 5017 [0.25] International Policymaking in Canada: Structure and Process  
   INAF 5018 [0.25] Law and International Affairs  
   
3. **0.5 credit in Economics, successfully completed by the end of the second term from:** (see Note 1, below)  
   INAF 5009 [0.5] International Aspects of Economic Development  
   INAF 5205 [0.5] Economics of Conflict  
   INAF 5214 [0.5] Economics for Defence and Security  
   INAF 5308 [0.5] International Trade: Theory and Policy  
   INAF 5309 [0.5] International Finance: Theory and Policy  
   INAF 5600 [0.5] The Economics of Human Development  
   INAF 5703 [0.5] International Public Economics  
   
4. **2.0 credits in:**  
   INAF 5909 [2.0] M.A. Thesis (in the specialization)  
   
5. **1.0 credit in:**  
   Field or Elective courses  
   
6. Successful completion of second language proficiency examination (See Note 4, below)

**Total Credits**  

5.0

### M.A. Research Essay with Specialization in Data Science (5.5 credits)

**Requirements - Research essay pathway:**

1. **0.5 credit in:**  
   DATA 5000 [0.5] Data Science Seminar  
   
2. **1.0 credit in:**  
   INAF 5016 [0.5] Statistical Analysis for International Affairs  
   INAF 5017 [0.25] International Policymaking in Canada: Structure and Process  
   INAF 5018 [0.25] Law and International Affairs  
   
3. **0.5 credit in Economics, successfully completed by the end of the second term from:** (see Note 1, below)  
   INAF 5009 [0.5] International Aspects of Economic Development  
   INAF 5205 [0.5] Economics of Conflict  
   INAF 5214 [0.5] Economics for Defence and Security  
   INAF 5308 [0.5] International Trade: Theory and Policy  
   INAF 5309 [0.5] International Finance: Theory and Policy  
   
4. **2.0 credits in:**  
   INAF 5909 [2.0] M.A. Thesis (in the specialization)  
   
5. **1.0 credit in:**  
   Field or Elective courses  
   
6. Successful completion of second language proficiency examination (See Note 4, below)

**Total Credits**  

5.5

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

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### M.A. History with Specialization in Data Science (4.5 credits)

**Requirements:**

1. **0.5 credit in:**  
   HIST 5003 [0.5] Historical Theory and Method  
   
2. **1.5 credits in:**  
   HIST at the graduate level of which only 0.5 credit may be taken in a designated public history course; with departmental permission, up to 0.5 credit of courses with historical content may be taken from another unit at Carleton University, at the University of Ottawa, or at another accredited institution.  
   
3. **0.5 credit in:**  
   HIST 5706 [0.5] Digital History  
   
4. **0.5 credit in:**  
   0.5

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

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

**Requirements (5.5 credits)**

1. **1.0 credit in:**  
   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:**  
   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:**  
   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**  

5.0

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

**Requirements - Thesis pathway:**

1. **0.5 credit in:**  
   DATA 5000 [0.5] Data Science Seminar  
   
2. **1.0 credit in:**  
   INAF 5016 [0.5] Statistical Analysis for International Affairs  
   INAF 5017 [0.25] International Policymaking in Canada: Structure and Process  
   INAF 5018 [0.25] Law and International Affairs  
   
3. **0.5 credit in Economics, successfully completed by the end of the second term from:** (see Note 1, below)  
   INAF 5009 [0.5] International Aspects of Economic Development  
   INAF 5205 [0.5] Economics of Conflict  
   INAF 5214 [0.5] Economics for Defence and Security  
   INAF 5308 [0.5] International Trade: Theory and Policy  
   INAF 5309 [0.5] International Finance: Theory and Policy  
   INAF 5600 [0.5] The Economics of Human Development  
   INAF 5703 [0.5] International Public Economics  
   
4. **2.0 credits in:**  
   INAF 5909 [2.0] M.A. Thesis (in the specialization)  
   
5. **1.0 credit in:**  
   Field or Elective courses  
   
6. Successful completion of second language proficiency examination (See Note 4, below)

**Total Credits**  

5.0

Note: The final research seminar presentation must be completed within one month of the thesis defence.
<table>
<thead>
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<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>INAF 5600 [0.5]</td>
<td>The Economics of Human Development</td>
</tr>
<tr>
<td>INAF 5703 [0.5]</td>
<td>International Public Economics</td>
</tr>
<tr>
<td><strong>4. 1.0 credit in:</strong></td>
<td><strong>1.0</strong></td>
</tr>
<tr>
<td>INAF 5908 [1.0]</td>
<td>Research Essay (in the specialisation)</td>
</tr>
<tr>
<td><strong>5. 2.0 credits in:</strong></td>
<td><strong>2.0</strong></td>
</tr>
<tr>
<td>Field or Elective Courses (See Note 3, below)</td>
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<tr>
<td><strong>6. Successful completion of second language proficiency examination (See Note 4, below)</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits**: 5.0

**Requirements - Coursework pathway:**

1. **0.5 credit in:**
   - DATA 5000 [0.5] Data Science Seminar

2. **1.0 credit in:**
   - INAF 5016 [0.5] Statistical Analysis for International Affairs
   - INAF 5017 [0.25] International Policymaking in Canada: Structure and Process
   - INAF 5018 [0.25] Law and International Affairs

3. **0.5 credit in specialty:** (see Note 1, below) **0.5**
   - INAF 5904 [0.5] Quantitative Research Methods
   - INAF 6002 [0.5] Quantitative Research Methods

4. **0.5 credit in:** Economics, successfully completed by the end of the second term, from: (see Note 2, below) **0.5**
   - INAF 5009 [0.5] International Aspects of Economic Development
   - INAF 5205 [0.5] Economics of Conflict
   - INAF 5214 [0.5] Economics for Defence and Security
   - INAF 5308 [0.5] International Trade: Theory and Policy
   - INAF 5309 [0.5] International Finance: Theory and Policy
   - INAF 5600 [0.5] The Economics of Human Development
   - INAF 5703 [0.5] International Public Economics

5. **2.5 credits in:** Field or Elective courses (See Note 3, below) **2.5**

6. **Successful completion of second language proficiency examination (see Note 4, below)**

**Total Credits**: 5.0

**Notes:**

1. The course must include at least one major assignment with a significant data science component. The selected course must be approved by the School and Institute for Data Science. An accepted data science specialization course from outside the School can be used for this requirement with approval.
2. All students must complete the 0.5 credit economics course for their designated field, or an approved alternate economics course. For students in the IEP field both INAF 5308 and INAF 5309, or approved equivalent, must be completed.
3. For elective courses, 1.5 credits of the total required 5.0 credits may be selected from courses offered in other departments, with a maximum of 1.0 credit from a single department and a maximum of 1.0 credit selected from fourth year undergraduate courses. Any course not identified as an INAF 5000-level course must be approved by the M.A. Program Supervisor.
4. Students must successfully complete an examination in second language proficiency administered by Carleton University’s School of Linguistics and Language Studies, or meet the equivalent standard as determined by the School of Linguistics and Language Studies. Details of the language requirement are provided on the School website.

**Master of Information Technology: Digital Media with Specialization in Data Science (5.0 credits)**

**Requirements:**

1. **0.5 credit in:**
   - DATA 5000 [0.5] Data Science Seminar

2. **0.5 credit in:**
   - ITEC 5002 [0.5] Fundamentals of Information Technology Research

3. **1.0 credit from core courses:** **1.0**
   - ITEC 5200 [0.5] Entertainment Technologies
   - ITEC 5201 [0.5] Computer Animation Technologies
   - ITEC 5202 [0.5] Visual Effects Technologies
   - ITEC 5203 [0.5] Game Design and Development Technologies
   - ITEC 5204 [0.5] Emerging Interaction Techniques
   - ITEC 5209 [0.5] Selected Topics in Digital Media

4. **0.5 credit in:** electives, which may include ITEC courses or any other 5000- or 4000-level courses from other departments or programs selected in consultation with the supervisor. **0.5**

5. **2.5 credits in:**
   - ITEC 5909 [2.5] Master’s Thesis (in the specialization)

**Total Credits**: 5.0

**Note:** No additional IT seminar requirements for this stream.

**M.Sc. Physics**

**Medical Physics Stream with Specialization in Data Science (5.0 credits)**

**Requirements:**

1. **0.5 credit in:**
   - DATA 5000 [0.5] Data Science Seminar

2. **0.5 credit in:**
   - PHYS 5002 [0.5] Statistical Data Analysis Techniques for Physics (or equivalent course in computing physics)

3. **0.5 credit in:**
   - PHYS 5203 [0.5] Medical Radiation Physics

4. **0.5 credits from:**
   - PHYS 5204 [0.5] Physics of Medical Imaging (for imaging)
   - PHYS 5206 [0.5] Medical Radiotherapy Physics (for therapy)
   - PHYS 5207 [0.5] Radiobiology (for biophysics)

5. **0.5 additional credit in PHYS or PHYJ. With approval, an appropriate graduate-level course in engineering, computer science, business or law can be used.** **0.5**
### M.Sc. Physics
#### Particle Physics Stream with Specialization in Data Science (5.0 credits)

**Requirements:**

1. **0.5 credit in:**
   - DATA 5000 [0.5] Data Science Seminar

2. **0.5 credit in:**
   - PHYS 5002 [0.5] Statistical Data Analysis Techniques for Physics (or equivalent course in computing physics) or Professional Development Courses listed in Item 4

3. **1.5 credit in:**
   - PHYS 5602 [0.5] Physics of Elementary Particles
   - PHYS 5701 [0.5] Intermediate Quantum Mechanics with Applications
   - PHYS 5702 [0.5] Relativistic Quantum Mechanics

4. **2.5 credits in:**
   - PHYS 5909 [2.5] M.Sc. Thesis (on a data science topic approved by the Data Science governance committee and defended at an oral examination)

Total Credits: 5.0

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

**Requirements:**

1. **1.0 credit in:**
   - PSYC 5410 [0.5] Advanced Analysis of Variance
   - PSYC 5411 [0.5] Advanced Regression

2. **0.5 credit in:**
   - DATA 5000 [0.5] Data Science Seminar

3. **0.5 credit in:**
   - PSYC at the 5000 level, excluding the elective statistics courses listed below. These credits must be approved by the Data Science specialization.

4. **0.5 credit from the following professional development courses:**
   - PSYC 5002 [0.5] Ethics in Psychology
   - PSYC 5003 [0.5] Open Science and Methodological Improvements
   - PSYC 5004 [0.5] Knowledge Translation
   - PSYC 5802 [0.5] Special Topics: Professional Development
   - PSYC 5903 [0.5] Practicum in Psychology

5. **Completion of:**
   - PSYC 5906 [0.0] Pro-Seminar in Psychology

6. **2.5 credits in:**

Total Credits: 5.0

### Master of Public Policy and Administration
#### with Specialization in Data Science (7.0 credits)

**Requirements - Course work pathway:**

1. **4.5 credits in core courses:**
   - PADM 5120 [0.5] Modern Challenges to Governance
   - PADM 5121 [0.5] Policy Analysis: The Practical Art of Change
   - PADM 5122 [0.5] Public Management: Principles and Approaches
   - PADM 5123 [0.5] Public Management in Practice
   - PADM 5124 [0.5] Law and Ethics
   - PADM 5125 [0.5] Qualitative Methods for Public Policy
   - PADM 5127 [0.5] Microeconomics for Policy Analysis
   - PADM 5128 [0.5] Macroeconomics for Policy Analysis
   - PADM 5129 [0.5] Capstone Course

2. **1.5 credits in data science core courses:**
   - DATA 5000 [0.5] Data Science Seminar
   - PADM 5126 [0.5] Quantitative Methods for Public Policy
   - PADM 5218 [0.5] Analysis of Socio-economic Data

3. **0.5 credit from data science electives:**
   - COMP 5111 [0.5] Data Management for Business Intelligence
   - COMP 5209 [0.5] Visual Analytics
   - COMP 5305 [0.5] Advanced Database Systems
   - COMP 5306 [0.5] Data Integration
   - PADM 5219 [0.5] Advanced Statistical Policy Analysis
   - PADM 5372 [0.5] Policy Seminar (Data Science Specialization)
   - PADM 5391 [0.5] Directed Studies (Data Science Specialization)

4. **0.5 credit in approved elective**

Total Credits: 7.0

**Requirements - Research essay pathway:**

1. **4.5 credits in core courses:**
   - PADM 5120 [0.5] Modern Challenges to Governance
   - PADM 5121 [0.5] Policy Analysis: The Practical Art of Change
   - PADM 5122 [0.5] Public Management: Principles and Approaches
   - PADM 5123 [0.5] Public Management in Practice
   - PADM 5124 [0.5] Law and Ethics
   - PADM 5125 [0.5] Qualitative Methods for Public Policy
   - PADM 5127 [0.5] Microeconomics for Policy Analysis

Total Credits: 5.0

Notes:
1. Students must receive a minimum grade of A in each of the courses included in the Specialization.
2. Courses for each research area are listed on the departmental website: carleton.ca/psychology.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PADM 5128</td>
<td>Macroeconomics for Policy Analysis</td>
</tr>
<tr>
<td>PADM 5129</td>
<td>Capstone Course</td>
</tr>
</tbody>
</table>

2. 1.5 credits in data science core courses: 1.5
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA 5000</td>
<td>Data Science Seminar</td>
</tr>
<tr>
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</tr>
<tr>
<td>PADM 5218</td>
<td>Analysis of Socio-economic Data</td>
</tr>
</tbody>
</table>

3. 1.0 credit in:
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PADM 5908</td>
<td>Research Essay (on a Data Science topic approved by the MPPA Graduate Supervisor and the Data Science governance committee)</td>
</tr>
</tbody>
</table>

Total Credits 7.0

Master of Public Policy and Administration with Specialization in Data Science (Advanced completion, 5.0 credits)

Requirements - Course work pathway (Advanced completion, 5.0 credits - see Note, below):
1. 3.0 credits from core courses: 3.0
   - PADM 5120 [0.5] Modern Challenges to Governance
   - PADM 5121 [0.5] Policy Analysis: The Practical Art of Change
   - PADM 5122 [0.5] Public Management: Principles and Approaches
   - PADM 5123 [0.5] Public Management in Practice
   - PADM 5124 [0.5] Law and Ethics
   - PADM 5125 [0.5] Qualitative Methods for Public Policy
   - PADM 5127 [0.5] Microeconomics for Policy Analysis
   - PADM 5128 [0.5] Macroeconomics for Policy Analysis
   - PADM 5129 [0.5] Capstone Course

2. 1.0 credit from data science core courses: 1.0
   - DATA 5000 [0.5] Data Science Seminar
   - PADM 5126 [0.5] Quantitative Methods for Public Policy
   - PADM 5218 [0.5] Analysis of Socio-economic Data

3. 0.5 credit from data science electives: 0.5
   - COMP 5111 [0.5] Data Management for Business Intelligence
   - COMP 5209 [0.5] Visual Analytics
   - COMP 5305 [0.5] Advanced Database Systems
   - COMP 5306 [0.5] Data Integration
   - PADM 5219 [0.5] Advanced Statistical Policy Analysis
   - PADM 5372 [0.5] Policy Seminar (Data Science Specialization)
   - PADM 5391 [0.5] Directed Studies (Data Science Specialization)

4. 0.5 credit in approved elective 0.5
   Note: additional credits may be required, as specified on offer of admission.

Total Credits 5.0

Requirements - Research essay pathway (Advanced completion, 5.0 credits - See Note, below):
1. 3.0 credits from core courses: 3.0
   - PADM 5120 [0.5] Modern Challenges to Governance
   - PADM 5121 [0.5] Policy Analysis: The Practical Art of Change
   - PADM 5122 [0.5] Public Management: Principles and Approaches
   - PADM 5123 [0.5] Public Management in Practice
   - PADM 5124 [0.5] Law and Ethics
   - PADM 5125 [0.5] Qualitative Methods for Public Policy
   - PADM 5127 [0.5] Microeconomics for Policy Analysis
   - PADM 5128 [0.5] Macroeconomics for Policy Analysis
   - PADM 5129 [0.5] Capstone Course

2. 1.0 credit from data science core courses: 1.0
   - DATA 5000 [0.5] Data Science Seminar
   - PADM 5126 [0.5] Quantitative Methods for Public Policy
   - PADM 5218 [0.5] Analysis of Socio-economic Data

3. 1.0 credit in:
   - PADM 5908 [1.0] Research Essay (on a Data Science topic approved by the MPPA Graduate Supervisor and the Data Science governance committee)

Note: additional credits may be required, as specified on offer of admission

Total Credits 5.0

Regulations

See the General Regulations section of this Calendar, as well as regulations pertaining to the specific collaborative programs offering the data science specialization.

Admission

Students who are enrolled in a master's program in one of the participating units may apply to the Data Science governance committee for admission to the Collaborative Program. Admission to the program is determined by the governance committee and will normally take place before the end of October the year of admittance in one of the participating master's programs.

Admission requirements to the Collaborative Master's with Specialization in Data Science are:

- Registration in the master's program of one of the participating units
- Approval of a student's program of study by the Data Science governance committee and the student's home department. Students in a thesis program will be expected to choose a thesis topic that is directly related to Data Science. Students in an approved course work program will be required to take some elective courses in designated or approved courses with significant Data Science content.