

**Title of the research project:** High-dimensional and matrix-variate copula modeling

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**Name, affiliation, and contact information for the supervisor and co-supervisor:**

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**Abstract:**

This research project will develop copula-based methods for modeling high-dimensional and matrix variate data. The multivariate Gaussian distribution is still commonly used for modeling high dimensional data due to its mathematical tractability. However, this distribution can be too restrictive to represent certain data types. Copula models provide a means of increasing model flexibility. Properties of copula modeling and estimation have mainly been investigated in lower dimensions. In extending copulas to higher dimensions, a primary goal will be to balance flexibility with parsimony. After extending copulas to high dimensions, matrix-variate extensions of copulas will be investigated.

**Interdisciplinary/applied experience**

Both host universities, McMaster and Dalhousie, have institutes that promote interdisciplinary and industry collaborations (the MacDATA Institute and the Institute for Big Data Analytics, respectively). These collaborations focus on real-world practical problems and will provide the PDF with a wealth of real data experience. Dr. McNicholas also has a well-developed network of collaborators at McMaster who have access to real datasets.

**Teaching/training/education**

In the first year of the fellowship, the successful candidate will teach a three-credit one-semester course at McMaster University. The candidate will also have the opportunity to participate or assist in relevant programs such as the Data Science summer school at the MacDATA Institute at McMaster University. The PDF will also have the option of assisting with supervision of highly qualified personnel (HQP). In the second year of the fellowship, the PDF will be able to participate in events hosted by the Center for Learning and Teaching at Dalhousie University. These events include panel discussions and webinars on topics including graduate supervision, seminars, and online course design. The PDF will again have the opportunity to assist in the supervision of HQP in their second year.

## **Mentoring of the postdoctoral fellow**

The PDF will have committed co-supervisors who will jointly meet once per month and will provide additional support individually or jointly as needed. McNicholas has extensive experience in training PDFs, while Murphy is a new faculty member. As usual, McNicholas will involve the PDF in the (informal) co-supervision of a graduate student and provide experiential learning experiences including vis-à-vis grant writing.

The successful candidate will have many opportunities for EDI training and career preparation. The Equity and Inclusion Office at McMaster University provides training and hosts workshops in accessibility, equity, and inclusion. In addition, Dalhousie University is part of the Center for the Integration of Research, Teaching, and Learning network. This network seeks to influence future science, technology, engineering and mathematics (STEM) faculty by incorporating more inclusive and effective teaching techniques in order to create more diversity in STEM fields and STEM literacy. The network hosts a variety of free online professional development and networking events as well as offering consultations for making classroom environments or curriculums more inclusive.

Collaborations facilitated by the MacDATA Institute and the Institute for Big Data Analytics will be with people and groups with different areas of expertise. Such collaborations will expose the PDF to real-world problems as well as assist them in acquiring clear communications skills and practice disseminating knowledge to non-experts. The PDF will present their research in at least one national and one international conference. These conferences will also provide networking opportunities.

## **A list of qualifications of suitable candidates**

Candidates should have a PhD in Statistics or a closely related field and proficiency with scripting and/or programming languages including R and one of C, C++, Python, Julia, or other relevant languages. Experience with multivariate modeling would be an advantage.

## **Schedule**

The PDF will spend the first year of his/her fellowship at McMaster University in Hamilton, ON, then will spend the second year at Dalhousie University in Halifax, NS. Dr. McNicholas will supervise the PDF's work in the first year with Dr. Murphy co-supervising virtually. In the second year, Dr. Murphy would supervise the progression of work with oversight by Dr. McNicholas. We plan to meet jointly (virtually) for monthly updates and would meet with the PDF individually between these meetings as required.