

STAT 548: PhD Qualifying Paper Guide and Expectations

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Qualifying Papers

The papers listed below are closely related to my research interests in spatial and spatio-temporal statistics. They provide theoretical and methodological perspectives that connect directly to my current work on modeling, fusion, and ensemble forecasting of complex spatial and spatio-temporal data. Additionally, they highlight important approaches such as Gaussian processes, Kalman filters, finite element methods, and neural networks, which could be helpful for your future research.

1. Chen, S. X., Sun, H. X., & Wang, S. (2025). **High dimensional ensemble Kalman filter**. Preprint, arXiv:2505.00283.
 - **Topics:** Spatio-temporal models; Data assimilation; Ensemble Kalman filter
 - **Style:** Theory and Methods
2. (Unavailable) Zhan, W., & Datta, A. (2025). **Neural networks for geospatial data**. *Journal of the American Statistical Association*, 120(549), 535-547.
 - **Topics:** Gaussian processes; Neural networks
 - **Style:** Theory and Methods
3. (Unavailable) Sangalli, L. M. (2021). **Spatial regression with partial differential equation regularisation**. *International Statistical Review*, 89(3), 505-531.
 - **Topics:** Spatial regression models; Partial differential equations; Finite element methods
 - **Style:** Theory and Methods
4. Berchuck, S. I., Medeiros, F. A., & Mukherjee, S. (2019). **Scalable modeling of spatiotemporal data using the variational autoencoder: an application in glaucoma**. Preprint, arXiv:1908.09195.

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- **Topics:** Variational Autoencoder; Neural networks; Spatio-temporal data
- **Style:** Methods and applications

Expectations

Based on the [Faculty Assessment Form](#), please provide a 10-15 page report that address the following assessment points. Ensure that the report clearly reflects your own thinking, ideas, and insights. Beyond the points listed, you are also welcome to include any additional topics you wish to discuss.

1. **General Understanding (50)** – Focus on the Paper Itself

- **Understanding of the Essential Aspects of the Paper (20):**

Provide a clear and well-organized summary of the background, motivation, main contributions, core methodology, simulation results, and conclusions of the chosen paper.

- **Understanding Mathematical / Statistical Theory (20):**

Demonstrate the methodology in your own words, including relevant details and explanations. Summarize the key messages of theorems and clarify why certain assumptions are required.

- **Finding & Correcting Errors / Critical Approach (10):**

Read the paper as a reviewer. Identify any errors, inconsistencies, or typos you encounter while reading. You may also discuss other limitations of the methodology or situations where the assumptions are unrealistic.

2. **Going Beyond / Creative Approach (40)** – Focus on Your Own Ideas

- **New Ideas / Innovative Approach (10):**

Discuss aspects of the methodology, theoretical derivations, algorithms, or coding that you found particularly instructive, insightful, or impressive. Also, discuss the limitations of this work and suggest possible modifications or improvements.

- **Application of the Method (10):**

Discuss possible extensions and applications of the core approach, drawing on your knowledge and, if applicable, your own research interests. Consider whether the method could be combined with other key strategies to become more powerful, or applied to different fields.

- **Computer Implementation of the Method (20):**

Implement the method, or part of it, using either simulated or real data. When implementing, aim to make your code clear, efficient, and well-documented. You are encouraged to explore and use helpful packages where appropriate.

3. Work Habits / Reporting & Communication Skills (10)

- **Timeliness (4):**

Manage your work schedule responsibly and submit your report and code before the deadlines.

- **Report Organization (3):**

See writing suggestions and resources on the [course website](#).

- **Independence (3):**

Demonstrate your ability to work independently and generate your own insights.

4. Short Research Proposal – OPTIONAL

Provide a one-page research proposal motivated by questions raised in this paper.

Others

- **How to Start:**

If you are interested in working on a qualifying paper with me, please email me at yan.song@stat.edu.ca to select a paper and schedule a one-to-one (Zoom) meeting. In this meeting, we can discuss your interests, your ideas or questions about my expectations, details of the chosen paper, and timelines.

- **When to Meet:**

We will meet every two to three weeks so that you can discuss your progress and questions, and I can ensure you are on the right track while staying informed about your development.