# Gaussian Markov random fields, 7.5 hp

**Course period:**
January 19-March 22, 2015

**Last day for application:**
January 20

**Course leader / Address for applications:**
David Bolin / david.bolin@chalmers.se

**Course description (Advertisement for Ph.D. students):**
The aim of this course is to give an introduction to the classical theory of Gaussian Markov random fields (GMRFs) as well as some modern results on links between Gaussian random fields on continuous domains and GMRFs. We will give emphasis to the strong connection between numerical methods for sparse matrices and GMRFs, and outline various applications of GMRFs to statistical inference.

We will meet twice a week for seven weeks. There will be project assignments during the course and an oral exam at the end of the course. The exact schedule will be agreed with the participants at the first meeting.

**Responsible department and other participation departments/organisations:**
Mathematics Department

**Teachers:**
David Bolin (Course leader and main contact).
Other teachers may be involved

**Examiner:**
David Bolin

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**1. Confirmation**
The syllabus was confirmed by the Head of the Department of XXX 200X-XX-XX, 200X-XX-XX.

Disciplinary domain: Science
Department in charge: Department of Mathematical Sciences
Main field of study: Mathematical statistics

**2. Position in the educational system**
Elective course; third-cycle education

**3. Entry requirements**
The student should have a solid background in mathematical statistics. Some experience with scientific computing is helpful but not essential.

**4. Course content**
The aim of this course is to give an introduction to the classical theory of Gaussian Markov random fields (GMRFs) as well as some modern results on links between Gaussian random fields on continuous domains and GMRFs. We will give emphasis to the strong connection between numerical methods for sparse matrices and GMRFs, and outline various applications of GMRFs to statistical inference.

**5. Outcomes**

After completion of the course the Ph.D. student is expected to be able to ...

- Understand the central parts of the classical theory for GMRFs.
- Understand the link to numerical methods for sparse matrices as well as the connection to Gaussian random fields.
- Formulate statistical models involving GMRFs.
- Utilize methods for sparse matrices when using GMRFs for inference.

**6. Required reading**
The main source will be the book Gaussian Markov Random Fields: Theory and Applications by Håvard Rue and Leonhard Held. Various articles, supplied on a reading list separate to the syllabus, will also be used.

**7. Assessment**
Passing grade requires a passing grade on the project assignments and the final oral exam. The projects can be done individually or in pairs of two students. The final oral exam is individual.

A Ph.D. student who has failed a test twice has the right to change examiners, if it is possible. A written application should be sent to the Department.

The number of examinations is to be limited to five occasions and the number of placements is to be limited to two occasions.

In cases where a course has been discontinued or major changes have been made a Ph.D. should be guaranteed at least three examination occasions (including the ordinary examination occasion) during a time of at least one year from the last time the course was given.

**8. Grading scale**
The grading scale comprises Fail, (U), Pass (G)

**9. Course Evaluation**
The course evaluation is carried out together with the Ph.D. students at the end of the course, and is followed by an individual, anonymous survey. The results and possible changes in the course will be shared with the students who participated in the evaluation and to those who are beginning the course.

**10. Language of instruction**
The language of instruction is English.