

The Research Group

## STOx: Stochastics

has the honor to invite you to the public defense of the PhD thesis of

**Gauthier DIERICKX**

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

A general Darling-Erdős theorem and an integral test for sums of independent and identically distributed random vectors in Euclidean space

### Promotor:

Prof. dr. Uwe Einmahl

The defence will take place on

**Friday August 24 2018 at 15:00h**

in Auditorium D.2.01 at the Campus Humanities, Sciences and Engineering of the Vrije Universiteit Brussel, Pleinlaan 2 - 1050 Elsene, and will be followed by a reception.

### Members of the jury:

Prof. dr. Ann Dooms (chairman)  
Prof. dr. Tetyana Kadankova (secretary)  
Prof. dr. Johan Segers (co-promotor, UCL)  
Prof. dr. Kurt Barbé  
Prof. dr. Jan Van Casteren  
(Universiteit Antwerpen)  
Prof. dr. Yvik Swan (Université de Liège)

### Curriculum vitae

In 2007, Gauthier Dierickx enrolled in the Bachelor in Mathematics at the VUB and in 2012 he obtained his Master in Mathematics. After 4 years as a PhD fellow funded by the Fund for Scientific Research Flanders (FWO) under the supervision of Prof. Uwe Einmahl, he continued for one year as a teaching assistant at the UCL.

The resulting research was published in peer-reviewed journals and has been presented nationally and internationally at conferences and workshops.

### Abstract of the PhD research

Randomness is everywhere around us, meeting an old friend abroad, gambling, the lottery, financial crashes, etc. but also when trying to predict landslides, floods and other natural phenomena. Originally studied to calculate odds of winning gambling games, probability theory has evolved into a mature field of mathematics with many applications.

Since it is not always possible to calculate probabilities precisely one often relies on limit theorems which provide good approximations if the sample size is big enough. The classical example is the central limit theorem. Somewhat less known is the Darling-Erdős theorem. Instead of just looking at normalized sums of random observations, one looks at the maximum of the first  $n$  normalized sums.

In this thesis we make an in depth study of the Darling-Erdős theorem in the classical case of independent and identically distributed random vectors and find optimal conditions for its validity. So we assume our observations are the results of the a same experiment where each outcome of the experiment does not affect the other ones. As a fundamental result in probability theory there is a link with another fundamental theorem, the so-called law of the iterated logarithm. This law describes the largest fluctuations of sums of random observations.

A characterization of so called upper and lower classes for partial sums of random vectors is given. This problem is concerned with classifying non-decreasing sequences of positive real numbers such that almost surely our sum will only be finitely many times larger than this sequence (upper class), or will infinitely many times be larger (lower class). In doing so we generalize important results to the multivariate setting.

Finally, we conclude by a short chapter of open questions and future problems to tackle in order to broaden the domain of applications. Indeed in practical situation one usually observes a dependence structure that can either be weak or strong.