UNIVERSITÉ DE STRASBOURG

Numéro :

# DOCTORAT DE L'UNIVERSITÉ

# DE STRASBOURG

## RAPPORT de PRESENTATION de la THÈSE

**FORMULAIRE A RENVOYER OBLIGATOIREMENT AVEC LE RAPPORT**

**15 jours avant la soutenance sous peine de report de celle-ci**

Nom du candidat : **M. Gilles STUPFLER**

**Titre de la thèse** : Un modèle de Markov caché en assurance et Estimation de frontière et de point terminal

Composition du jury de soutenance :

Directeur(s) de thèse :
Mme A. GUILLOU
M. S. GIRARD
Rapporteurs :

Mme I. GIJBELS
**M. H. ALBRECHER**
Autre(s) membres du jury :
M. S. LOISEL
M. J-N. BACRO
M. L. GARDES

Rapport de **M. H. ALBRECHER**

### 1° ÉVALUATION GÉNÉRALE

Par comparaison avec des thèses de Doctorat récentes soutenues dans votre Université, ou dont vous avez eu connaissance personnellement, cette thèse est-elle à votre avis digne d'être soutenue en vue du Doctorat ?

**OUI** [X] **NON** [ ] (*)

(*)le refus d'attribution du grade de docteur devra toujours faire l'objet d'un rapport circonstancié.

Dans l'affirmative et avant soutenance, cette thèse est-elle d'un niveau scientifique :

**SATISFAISANT** [ ] **BON** [ ] **TRÈS BON** [ ] **EXCEPTIONNEL** [X]

*Vu et autorisation de soutenance*
*Le Président de l'Université*

*Date :*

*Signature du Rapporteur :*

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Lausanne, October 14, 2011

**Subject: Rapport scientifique pour la thèse en vue de l'obtention du Doctorat par Gilles Stupfler**

The submitted thesis of Mr. G. Stupfler is divided into three major parts, that will be described separately in the following:

*Part One : Estimation of the parameters of a Markov-modulated loss process in insurance*

In insurance risk modelling, over the last years there have been various efforts to appropriately model the occurrence of claims that affect several lines of business at the same time. Among those, models with a common Markov-modulated environment which triggers common claims according to the state of the environment (finite-state space) Markov process are particularly well-suited for analytical considerations. Here the Markov modulation influences both the concrete set of business lines affected by a claim instance as well as its distribution in the respective lines. It is now a particular challenge to estimate the unknown parameters for the transition intensity matrix of the Markov process, the probabilities for which lines of business will be affected in each state and the distribution of the jump characteristics, from the observed values of the jumps in the respective lines. This Hidden Markov Model problem is addressed in Part One of the thesis. A maximum-likelihood estimator (MLE) is shown to be consistent (by adapting an earlier proof of Rydén). Further an Expectation-Maximization (EM) algorithm for the computation of the MLE is developed and a reconstruction of the states of the Markov process by virtue of the Viterbi algorithm is proposed. Finally, numerical illustrations are given for the estimation with a two- and three-state Markov environment process (in one dimension for both a non-life and a life insurance data set, in three dimensions for a simulated data set).

*Part Two : Endpoint estimation with high order moments*

The second part of the thesis addresses the estimation of the right (finite) endpoint of a distribution from an i.i.d sample of observations. This is done by using high order moments. First, the analysis is done for a positive underlying random variable, and the consistency and asymptotic normality of a proposed estimator can be shown in the Weibull max-domain of attraction. In a second step, the assumption on the positivity of the underlying random variable is dropped and still the same type of results can be obtained by a clever

transformation of the random variables. Subsequently this high order estimate is compared to the extreme-value moment estimator of Aarssen and de Haan and turns out to have essentially the same optimal rate of convergence. At the end of the chapter, some distributions are discussed for which the assumptions involved in the high order estimates hold, and detailed numerical illustrations and comparisons to other estimators are given for a number of cases.

*Part Three : Frontier estimation with high order moments*

In the last part of the thesis, the above approach with high order estimates is extended to the estimation of the frontier for two-dimensional data from a given bivariate i.i.d. sample. First it is shown that another estimator of Girard and Jacob does not show asymptotic normality in the general case, then under some conditions consistency and asymptotic normality are established for the high order estimate. Finally, a simulation study is given for a couple of situations.

In addition, the thesis contains a comprehensive and well-written introduction, which relates the results to the up-to-date research literature. In the end, some possible directions for related future research are outlined.

The thesis is well-written and deals with several interesting problems of statistics. With this thesis, Mr. Stupfler has clearly demonstrated a solid understanding of probability and statistics, the capability of assessing results from this research field, and subsequently in particular the capability of deriving significant new results. The scientific level of the thesis is excellent and I have no doubt that the submitted publications resulting from the work on the thesis will be accepted in peer-reviewed journals of the field.

With the present thesis, Mr. Stupfler has demonstrated that he is a promising young researcher in the field of actuarial and extreme-value statistics and I strongly recommend this thesis to be defended.

With best regards,

Hansjörg Albrecher

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