

## DIRECTED RISK RESEARCH PROPOSAL

<b>Risk Theme</b>	Operational Risk
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**Client Info:** *(only applicable if proposal is in response to a client problem statement)*

<b>Problem Title</b>	Parameter dependence in collective risk models				
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<b>University</b>		<b>Classification</b>	
<b>Problem Nr.</b>	PS16005	<b>Type</b>	
<b>Proposal Nr.</b>	RP16004	<b>Date</b>	28 July 2016

**PROJECT TITLE:** Parameter dependence in collective risk models

**PROJECT GOAL:**

Develop the necessary theory and investigate the uses of collective risk models with dependence structures based on the dependence of the parameters of the underlying distributions and compare this approach to commonly used approaches.

**PROJECT SCOPE**

Collective risk models are commonly used to model risks where it is useful to model the frequency and severity distributions separately. For a portfolio of  $n$  risk groups, we may model the frequency and severity of losses in each risk group separately (a common example of this is a compound Poisson model). In order to determine the joint distribution of the aggregate losses (the sum of the losses across all risk groups), we need to determine the dependence structure between the risk groups. The joint distribution is necessary to simulate aggregate losses from the portfolio of risks for example to determine a value at risk.

The most common approach in the literature to model the dependence structure between the risk groups is to fit a copula on the losses between different risk groups.

The aim of this project is to investigate an alternative approach to modeling the dependence structure which assumes that the dependence structure can be modeled by assuming the parameters of the underlying distributions are dependent.

The model can be used to simulate aggregate losses from a portfolio of dependent risks. This may be useful in a number of different applications for example determining a VaR in operational risk models where it is necessary to determine a dependence structure.

It can also be used to simulate losses for dependent portfolios of insurance risks, for example between a Motor and Property book or for a reinsurer who wishes to model the joint losses of Company A and Company B whose losses are correlated.

Using a parameter dependence approach may be natural in operational risk and insurance loss modeling. Although individual losses may not be caused by the same event, the mean losses from

various risk groups for a given period may be related if the same factors contributed to the frequency and / or severity of losses in the risk groups for a particular period.

## **PROJECT OBJECTIVES**

The objective of this project is to investigate an alternative approach to modeling the dependence structure in collective risk models. We will investigate the various types of dependence that may exist between the parameters of the individual frequency and severity distributions for example:

1. Dependence between the frequency parameters (in particular the mean) of losses in the different risk groups
2. Dependence between the severity parameters of losses in the different risk groups
3. Dependence of frequency and severity parameters within a particular risk group
4. Dependence between frequency and severity parameters across different risk groups

In each of these cases, we will investigate methods that can be used to detect whether each type of dependence is present in a data set and what approaches can be used to fit a dependence structure between the parameters of the underlying distributions.

We will also determine whether a parameter dependence approach is useful for modeling the dependence between certain types of risks and what value that can be derived from this approach in practical applications (in particular for operational risk and insurance loss modeling). We will also compare the merits of this approach to other common approaches.

## **RESEARCH OUTPUTS / DELIVERABLES**

<b>PUBLICATIONS:</b>	<b>Name(s) / Title(s)</b>
Articles	1

## **APPROACH TO BE FOLLOWED**

- 1) Study relevant literature
- 2) Develop the methodology and the necessary theory to detect and fit a model based on parameter dependence
- 3) Compare the parameter dependence approach with other commonly used approaches (for example the copula approach)

## **STRATEGIC VALUE TO DIRECTED RISK RESEARCH**

This research will contribute conceptually and materially towards competency in the financial services industry in South Africa.