Doctor of Economics

# Advancing Model Uncertainty Assessment to Address Actuarial Modelling Challenges. All models are wrong, but how wrong can they be?

Rodrigue Kazzi

Supervisors: prof. Carole Bernard, PhD and prof. Steven Vanduffel, PhD

Abstract

Decisions such as setting premiums or capital requirements (Basel IV, Solvency II) are driven by risk measures of the portfolio loss distributions. However, the inherent uncertainty in the adopted model can lead to significant changes in the value of a risk measure. A common way to assess this uncertainty is to determine the upper and lower risk bounds, that is, the largest and smallest possible values the risk measure can reach over a set of models that satisfy certain distributional assumptions.

The literature has so far offered risk bounds that may be deemed impractical for many actuarial applications. This impracticality arises because either a limited set of distributional assumptions are considered—leading to overly wide risk bounds—or some assumptions are difficult to trust, rendering the bounds unsuitable for many scenarios of interest. This thesis aims to derive risk bounds encompassing a broader set of distributional assumptions pertinent to actuarial modelling.

In this work, the assumptions considered regarding the shape of loss distribution include unimodality, right-skewness, symmetry, and unimodality and/or symmetry following a concave transformation (e.g., log transformation or some power transformations) to the loss distribution. We also allow for the inclusion of additional assumptions about the loss distribution, including the moments, the range of potential loss values, moments on the distribution following a concave transformation, quantile-based information (e.g., knowledge of a particular quantile, the interquartile range, or quantile measures of shape), trimmed moments, and tail-heaviness.

While the primary focus of the thesis is the risk bounds for the Range Value-at-Risk (of which the Value-at-Risk and Tail Value-at-Risk are limiting cases), we also show how to calculate bounds for several other measures, including distortion risk measures, expected utilities, and probability inequalities. Furthermore, we show the use of risk bounds in developing best practices. Ultimately, this thesis offers a quantitative model risk assessment that aims to be practical and tailored for actuarial modelling.