# Mandatory assignment STK 4540 Autumn 2015

In Norway all buildings and all accessories with insurance policies that cover fire are also automatically insured against natural catastrophes. This is a consequence of Norwegian legislation. The arrangement is managed by ‘Norsk Naturskadepool’ (Norwegian Pool for Natural Catastrophes) where all Norwegian insurance companies are members. This arrangement guarantees that the consumer receives compensation in the event of a natural catastrophe.

All Norwegian insurance companies pay premium to Norsk Naturskadepool to ensure that its funds are adequate in the event of future natural catastrophes.

Norsk Naturskadepool has a large data set contains all Norwegian natural catastrophes since 1980. The catastrophe types include storm, stormflood, flood, avalanche, earthquake and volcanic eruptions.

Now they hire you to explain them the uncertainties inherent in these catastrophe types.

Due to their economic insignificance in Norway earthquake and volcanic eruptions are excluded in this assignment.

The ultimate objective is to understand the total uncertainty of all natural disasters in Norway. This knowledgde is important when the premium charged to Norwegian insurance companies is assessed.

*About the assigments: Each assignment should contain a written report as well as R code. The preferred format for the report is computer written (word etc) but hand written is acceptable if the hand writing is neat. Students may discuss problems and solutions with each other but each student must deliver one package each (i.e., report and code).*

***The assignment is mandatory so you need an approved assignment to be able to participate on the exame. The assignment is delivered to Nils F. Haavardsson personally or to The Expedetition, Department of Mathematics, Nils Henrik Abel’s Building 7th floor, no later than November 6th, 2014.***

# Problem 1

Import the datafiles Storm2015, Stormflood2015, Flood2015, Avalance2015 and TotalND2015. The structure of the files are

Column 1 Claim date

Column 2 index adjusted claim estimate

The files contain total claim size *per event day*. Thus, it only contains entries for those days in the past 34 years when natural catastrophes have occurred.

Familiarize yourself with the five files and present tables with percentiles for the claim distribution in each case.

# Problem 2

The ultimate objective in this assignment is to describe the distribution of the risk premium of natural disasters. To obtain this objective one often creates a model for claim frequency and a model for claim severity.

Natural catastrophes do not occur so often and when they do they occur in clusters. The claim frequency models presented in STK 4540 will most likely not suffice for modelling of claim frequency of natural disasters.

Therefore we omit claim frequency modelling and focus on claim size modelling. We are interested in calculating the economic impact of a natural disaster for a given year. But we need to take into account that natural disasters do not occur every single day. We also need to take into account that natural disasters are of very different severity. Some natural disasters are light, some are of medium severity and some are extremely violent.

Present a simple technique to calculate the distribution of the risk premium given these constraints.

# Problem 3

Now you are ready to start on the main task.

Use your strategy that you sketched in Problem 2.

For each of the catastrophe types (i.e., flood, storm, stormflood and avalanche) try to develop a model for claim size distribution. Remove records with claims estimate that are less than or equal to 0. Try first to fit one or several models for small and medium sized claims (say up to the 98th percentile). Try some parametric models like log-normal, gamma, Pareto and Weibull and try the non-parametric. For the parametric models use the maximum likelihood to estimate parameters. Evaluate the quality of the models by using for example qq plot, density plots and comparisons of percentiles in tables.

When you are satisfied with your model(s) for small and medium sized claims try to make models for the large claims.

Repeat the drill for the file Total2015.

# Problem 4

Do the natural disaster types occur independent of each other?

If this is the case the percentiles of each distribution of each catastrophe type should add up to the percentile of the total claim distribution. To state this more precisely, let be the percentile of catastrophe i, and be the percentile of the total distribution.

If natural disaster types occur independent of each other then



Examine whether this is the case for the 95th up to the 99th percentile.

Discuss your results.

# Problem 5

In light of your results in Problem 4 what do you propose – an analysis of each catastrophe type separately?

Or is it just as well to analyse the total claim distribution directly?

Discuss.

Finally present estimates of expected claim size, standard deviation of expected claim size and the 95th percentile as well as the 99th percentile for the total distribution of natural disasters. You may use the method you select above, analysing the total distribution directly or using the results from the analysis of each separate disaster type.