Deep Representation Learning using Stacked Autoencoder for General Insurance Loss Reserving

Insurance Data Science Conference ETH Zurich
14th June 2019

Phani Krishna Kandala
Pricing Actuary, Swiss Re

phani_kandala@swissre.com

+91 - 9182472136

Satya Sai Mudigonda
Senior Tech Actuarial Consultant

satyasaibabamudigonda@sssihl.edu.in

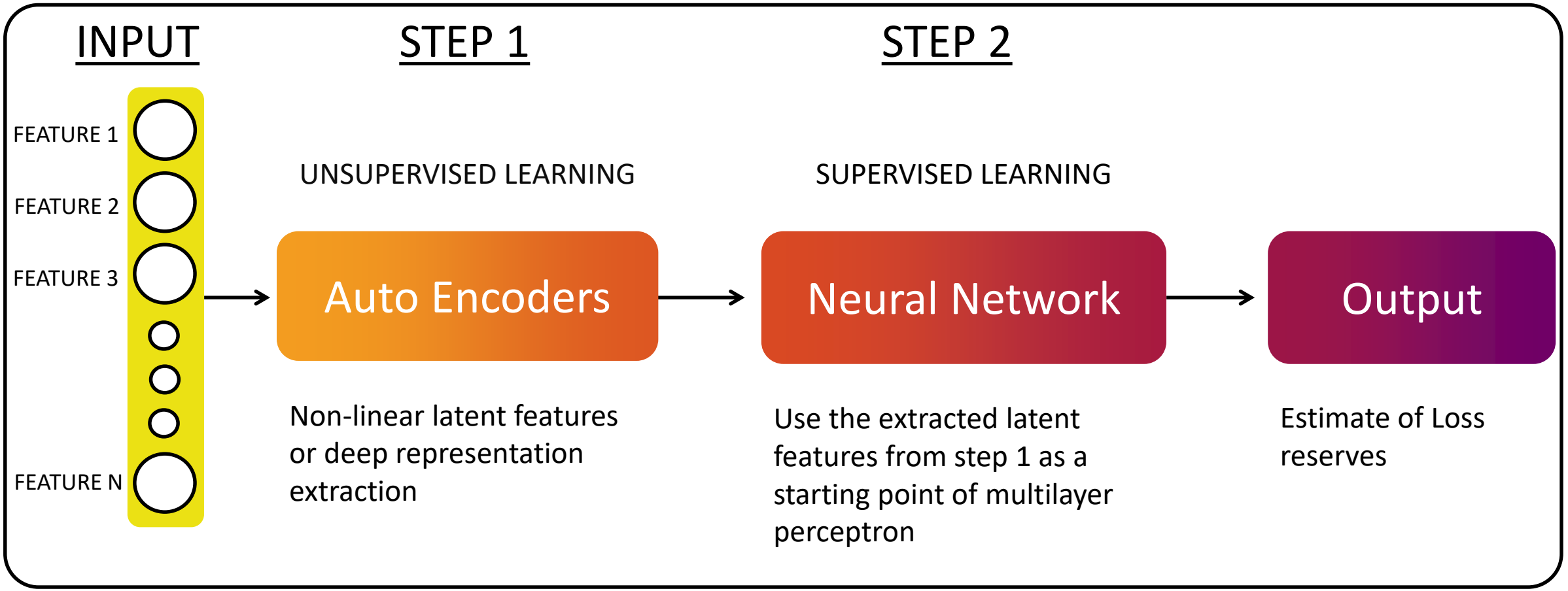
+91 - 9603573032

Agenda

- Introduction
- Key Concepts: Reserving & Neural Networks
- Motivation
- Experimental Setup
- Results
- Next Steps
- Q & A

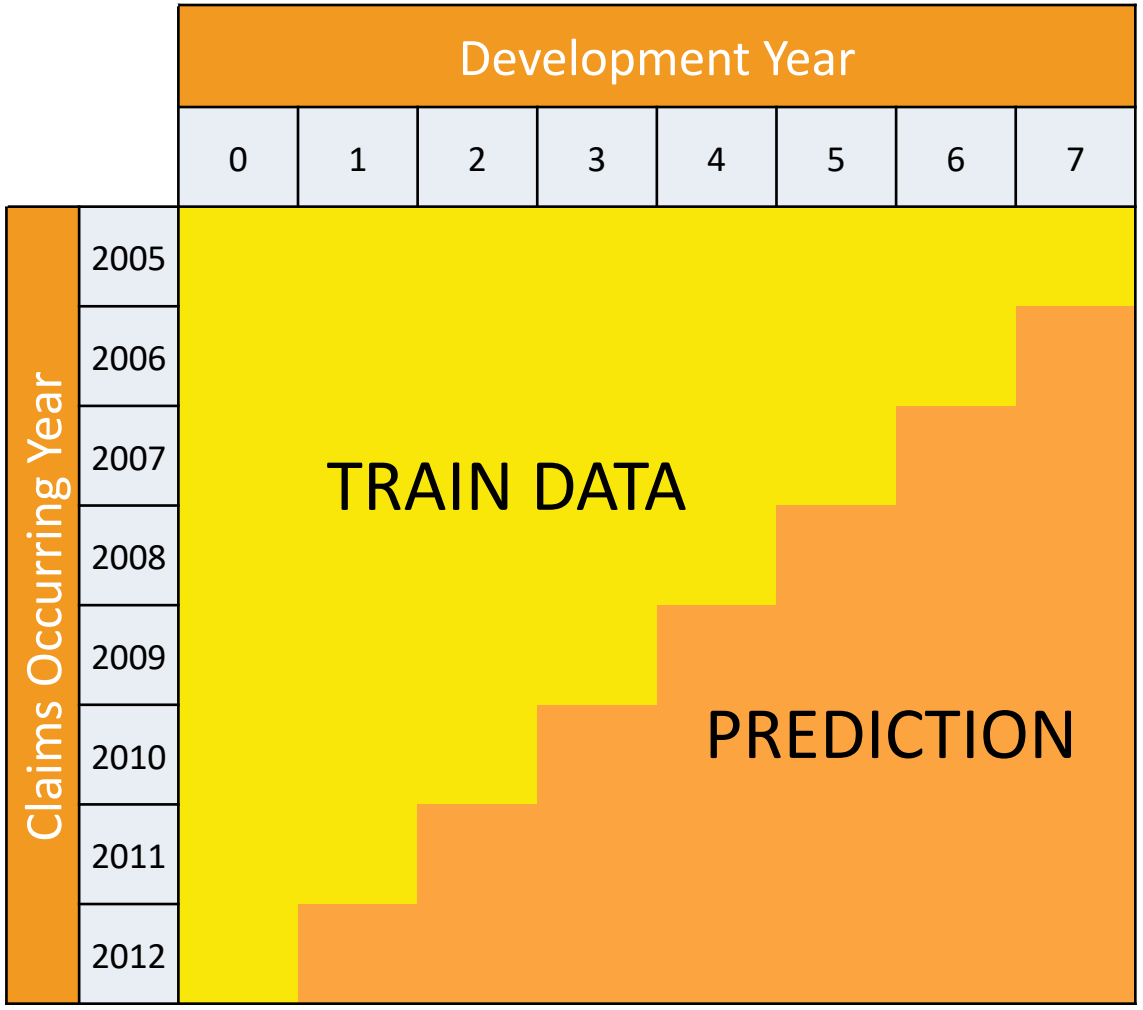
Introduction

A novel approach for loss reserving based on blended unsupervised and supervised deep neural networks.



Reserving – Key Concepts

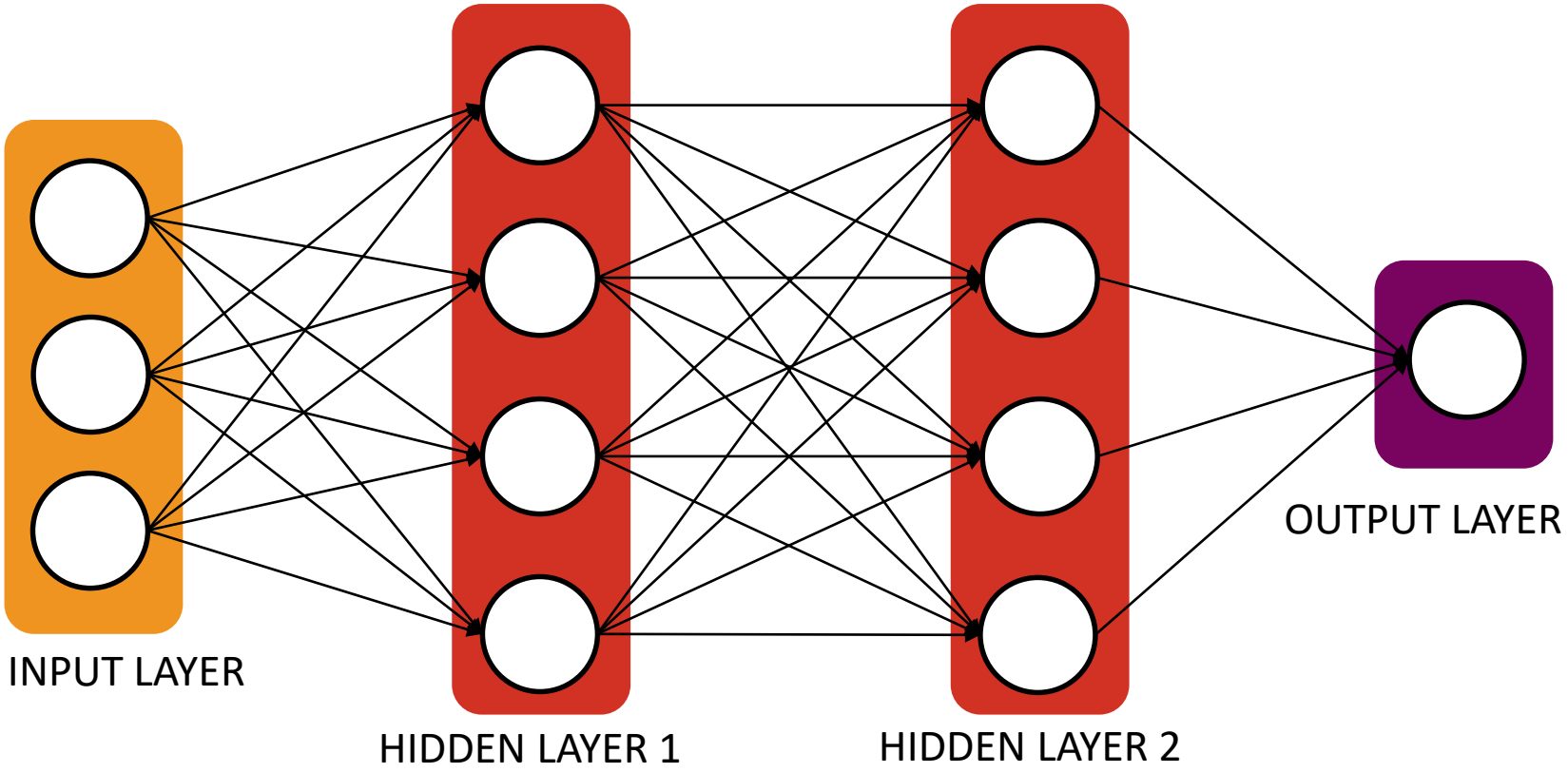
- To determine liabilities to be shown in accounts
- To check adequacy of reserves
- To evaluate business performance
- To measure profitability of business currently being written
- To calculate loss ratios and combined ratios
- To perform insurance valuation



Neural Network – Key Concepts

INPUT LAYER

- Inputs information for the neural network to process
- Each circle represents one feature



OUTPUT LAYER

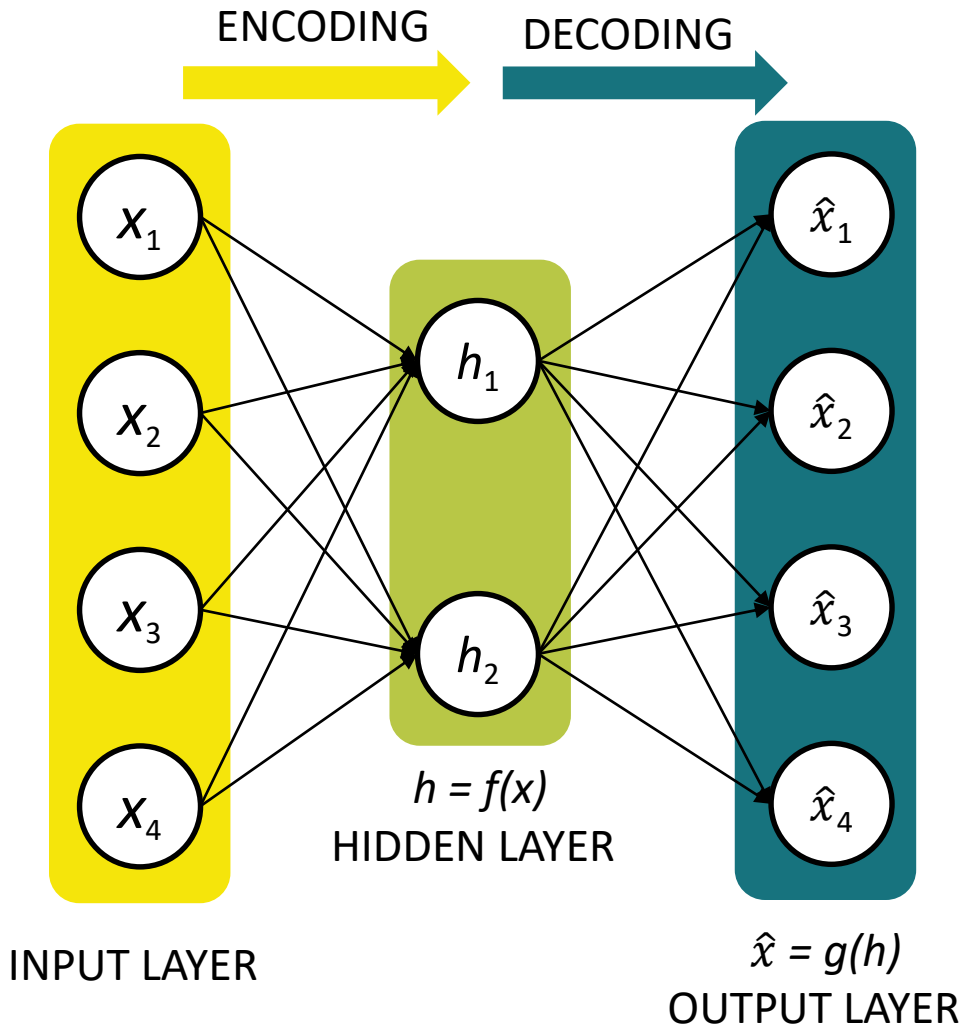
- Brings together the information from the hidden layer
- Contains all the information needed for the program

HIDDEN LAYER

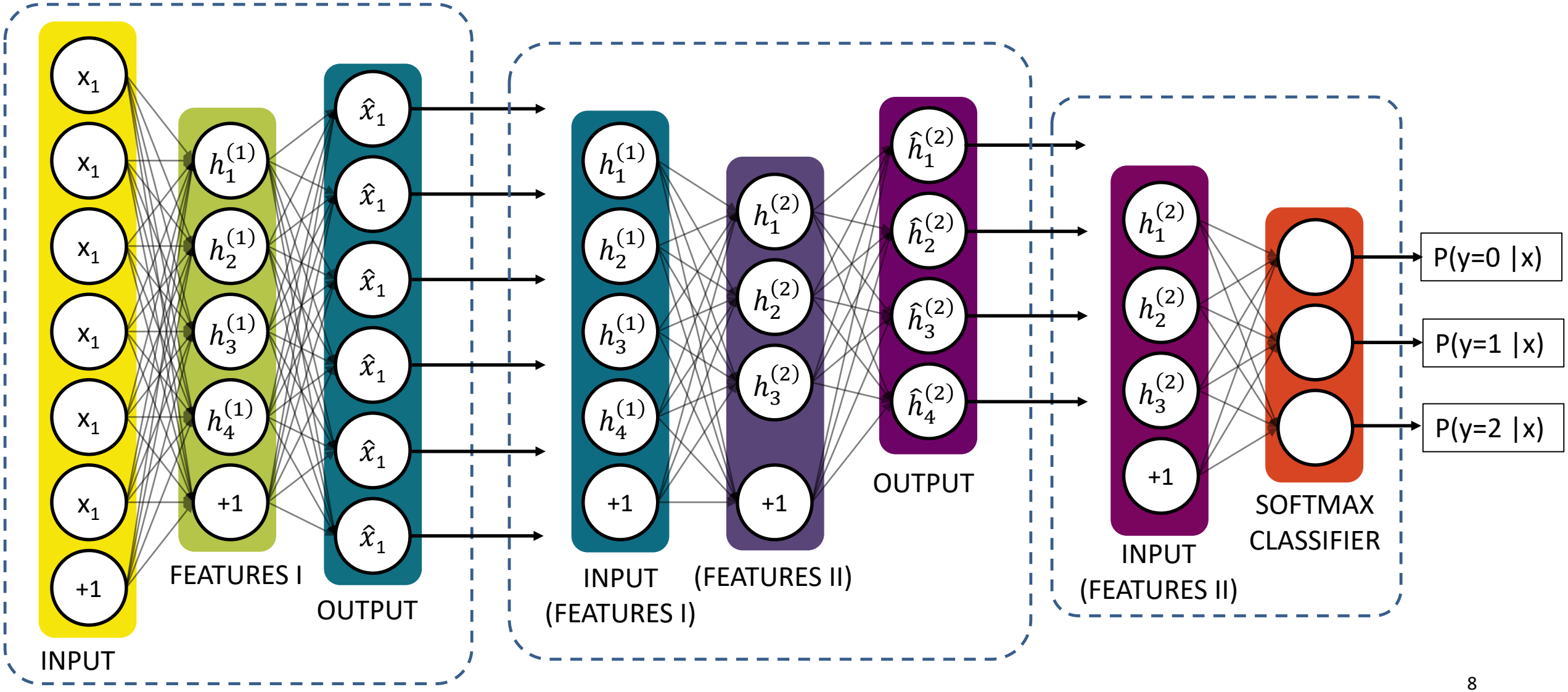
- These layers do all the processing for neural networks
- Higher hidden layers higher accuracy of neural network
- Each layer consists of nodes that mimic our brains' neurons
- Nodes receive information from the previous layer's node
- Nodes are multiplied with weights and bias is added to it

Motivation of the paper

Auto Encoders - Overview



Stacked Auto Encoders - Overview



Key Research Contribution from the Past

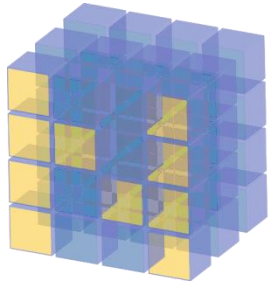
Neural Network embedding of the ODP reserving model - Mario Wuthrich[1]

Insights from Inside Neutral Networks: Switzerland Actuaries Association[2]

1. Gabrielli, A., Richman, R., W¨uthrich, M.V. (2018). Neural network embedding of the overdispersed Poisson reserving model. SSRN Preprint
2. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3226852

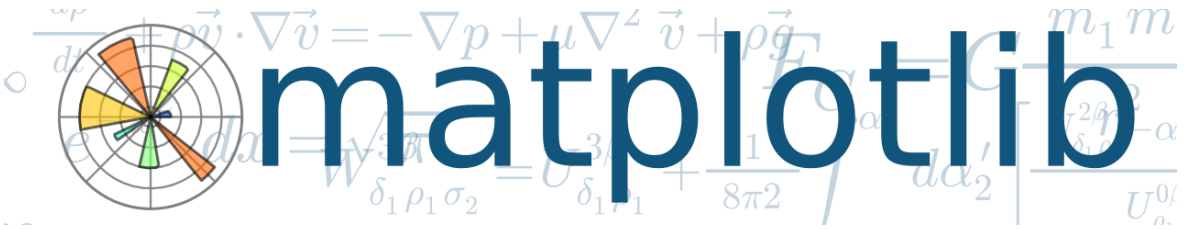
Experimental Setup

Data: Data has been taken from Bjorn Weindorfer[1] paper



NumPy

theano

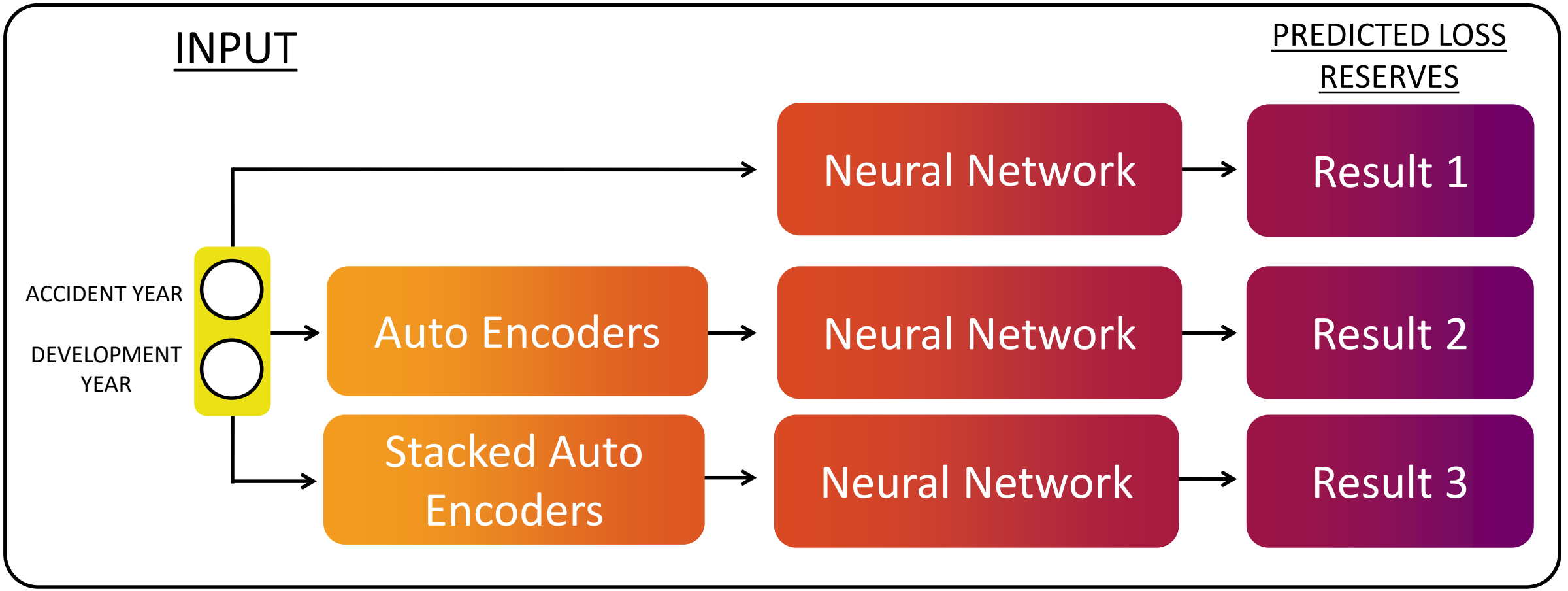


Pandas

1 - https://www.uio.no/studier/emner/matnat/math/STK4540/h18/course-material/chainladder.pdf

Loss Reserve Predictions

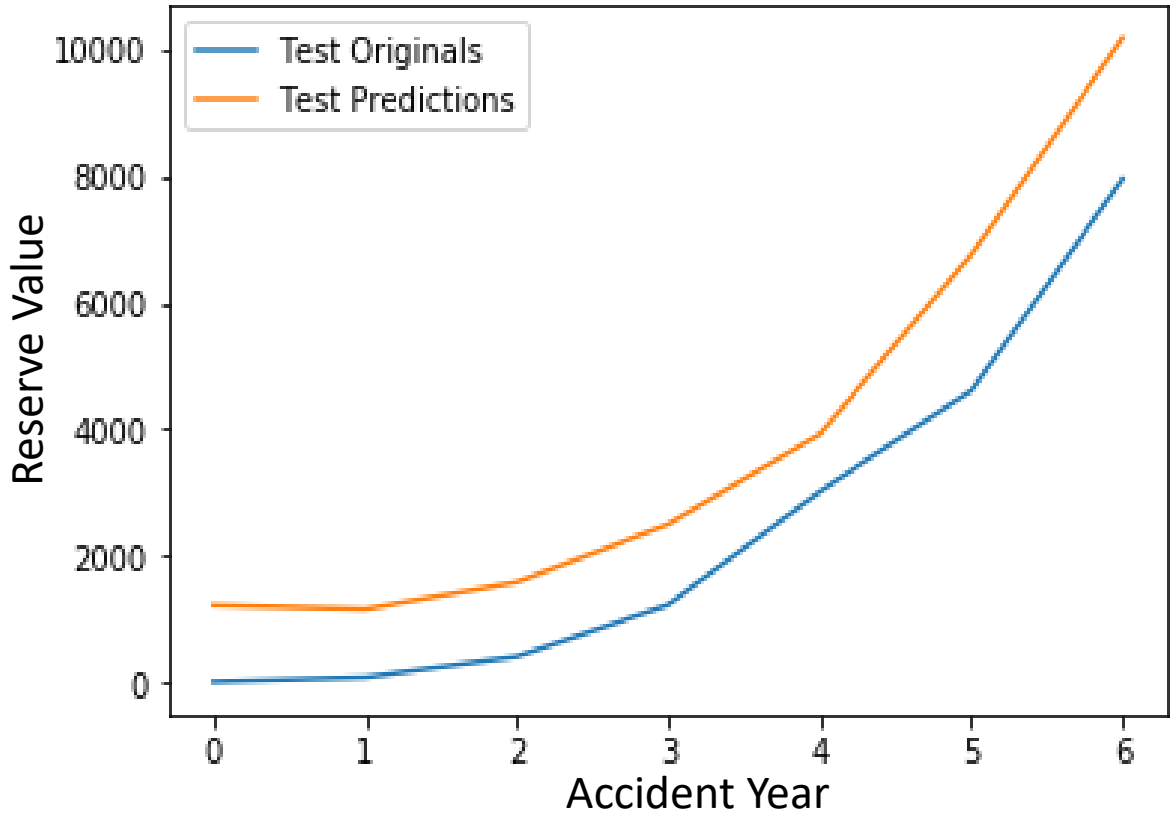
Three different approaches have been compared with respect to Loss Reserve Predictions



Result 1

Reserve Prediction with Neural Network

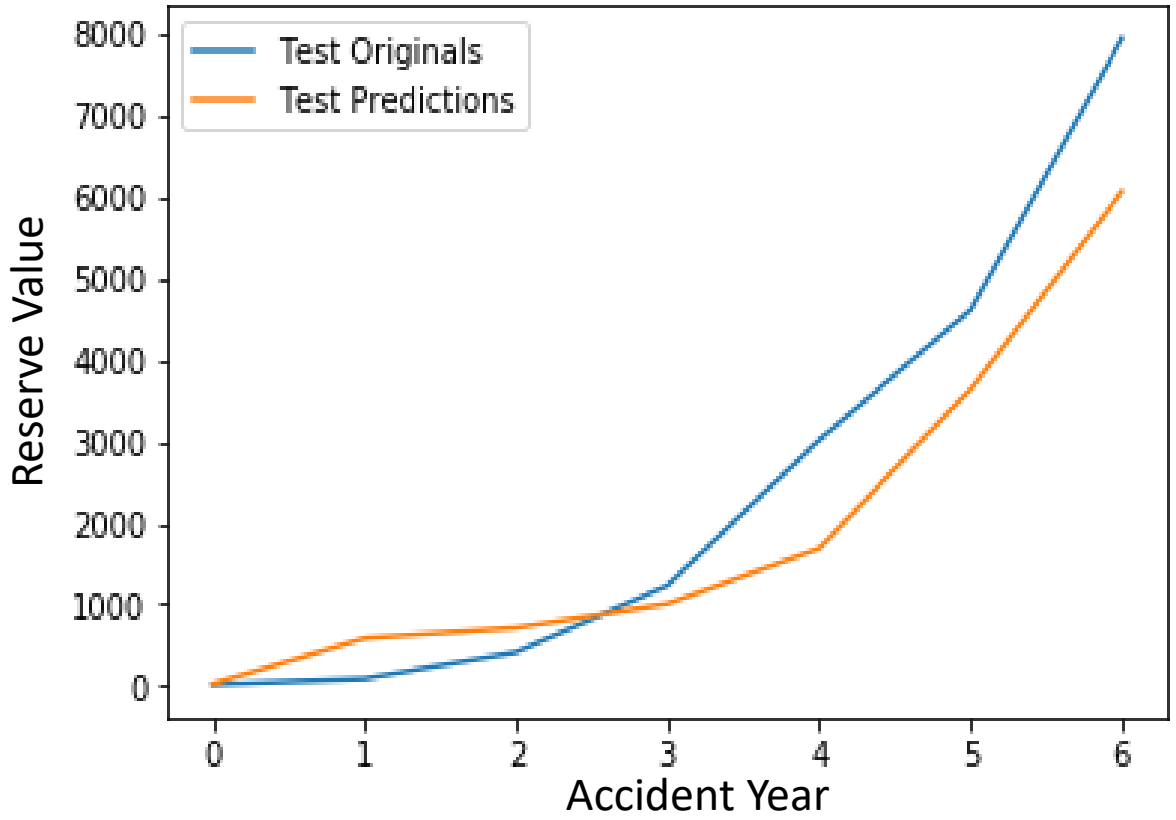
True Reserve	Predicted Reserve	Bias	Bias Percentage
17352	27365.64	10013.64	57.71



Result 2

Reserve Prediction with Auto-Encoder + Neural Network

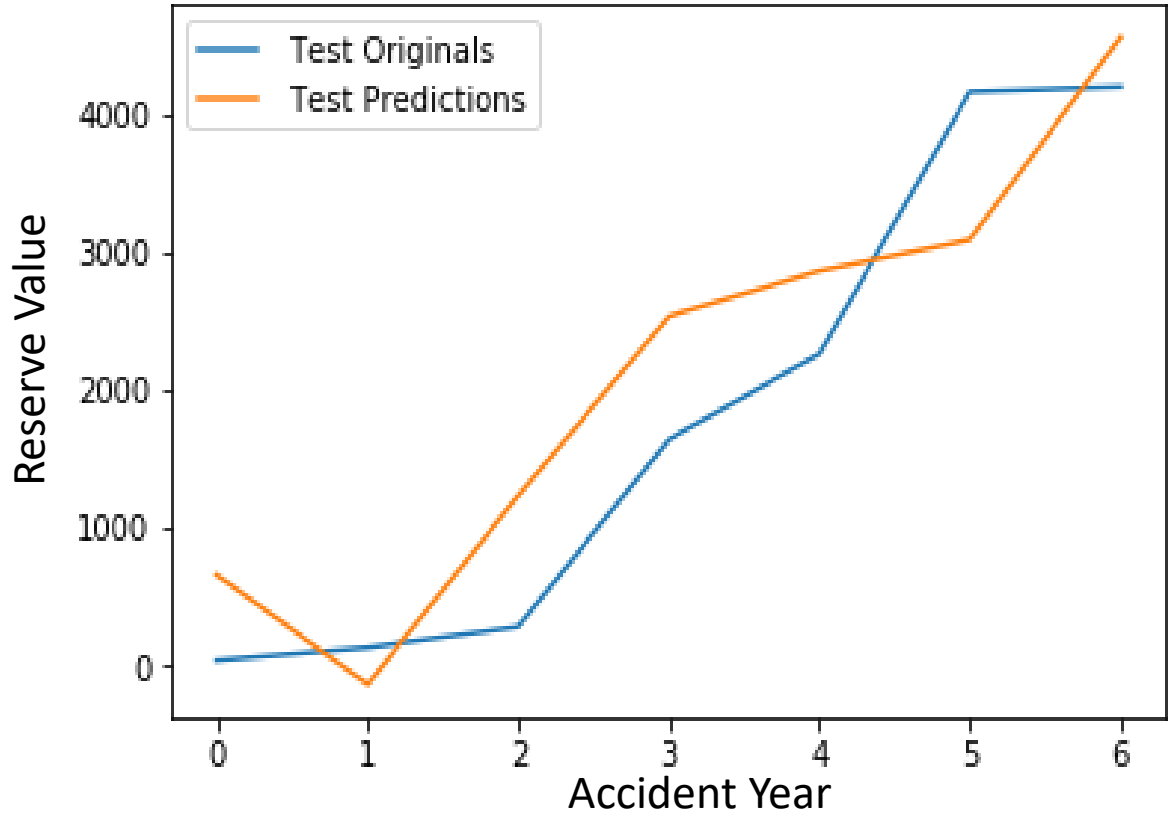
True Reserve	Predicted Reserve	Bias	Bias Percentage
17352	13750.39	-3601.61	20.75



Result 3

Reserve Prediction with Stacked Auto-Encoder + Neural Network

True Reserve	Predicted Reserve	Bias	Bias Percentage
17352	14737.26	-2614.74	15.06



Potential Benefits to Insurer

Fastens the process of prediction by identifying the most important features

Useful to learn the 2 way and 3 way interactions in the claims data. For example: Claim type and cause of claim

Highlights the main reasons for claims reserves increase/ decrease

Next Steps

Reduction in bias by optimising the Neural network and Autoencoders.

Working on different LoBs without any embedding function(s)

Working on individual claims data to automatically highlight the predominant features increasing/decreasing the reserves.

- Adequate capital allocation.
- Suitable Reinsurance product(s) selection.
- Efficient Risk Management on insurance risk front.

Q & A

- What is novel about this idea?
- What functions of insurance company will be able to use this idea?
- What are the benefits to insurance companies?
- Are you using any proprietary software/packages?
- Is this approach used in any other industry?
- How this approach can be improved further?
- What are the limitations of this approach?
- What reserve prediction methods does this idea support?
- How this approach is superior to using Neural Networks on stand alone basis?

Acknowledgements

- SSSIHL for providing Technology Labs and Actuarial Support
- Dr. Pallav Kumar Baruah, Department of Mathematics and Computer Science
- Arun Kumar K
- Nikhil Rai, M.Tech
- Rohan Yashraj Gupta, Actuarial Research Scholar