Hrvatsko aktuarsko društvo
Martićeva 73, Zagreb

Individual Claim Development with Machine Learning

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Zagreb, 5.6.2017

Purpose

Machine Learning on Practical Example

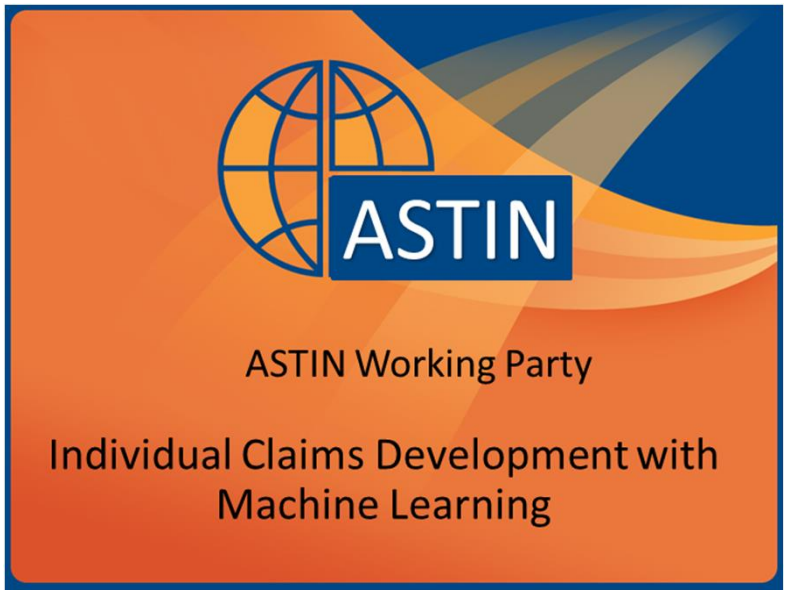
(De)motivation

Artificial neural networks

- Example

Individual Claim Development

- Methodology
- Data
- Results



(De)motivation for Machine Learning

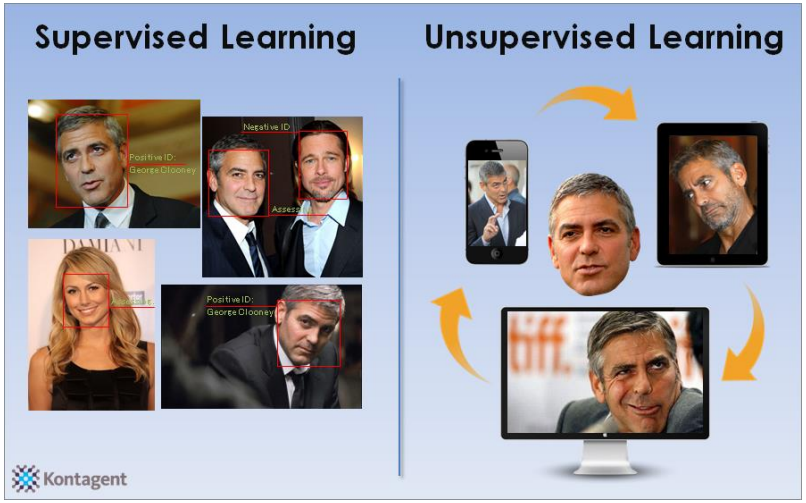
Motivation

- Actuary (statistician):
  - Technical background
  - Big data experiences
- Increasing amount of data
  - New info?
- Competition
- Pioneering, challenge

Demotivation

- Well defined existing methods
- Consistency
- Comfort zone
- New methods need to be learned and explored

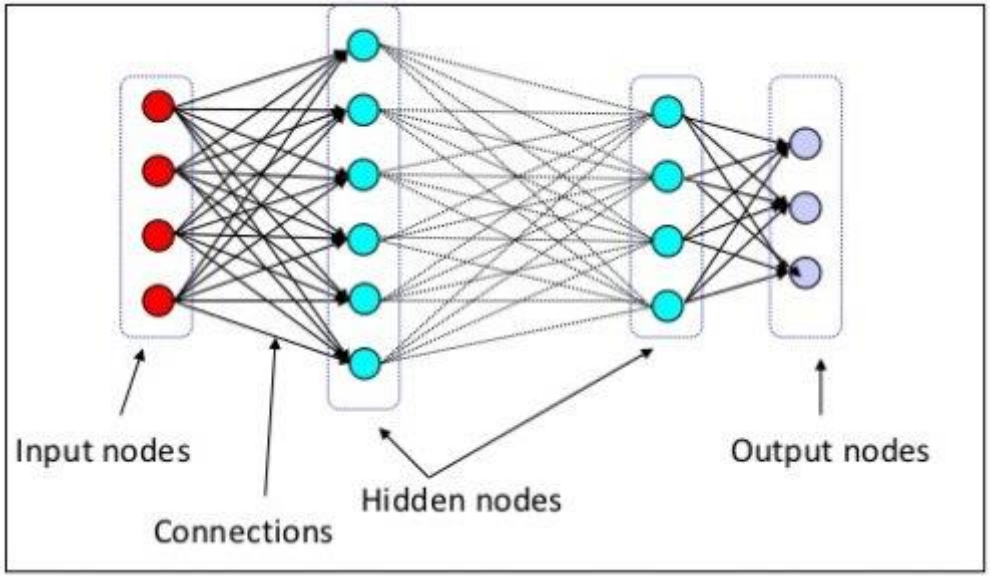
Artificial neural networks



Artificial neural networks

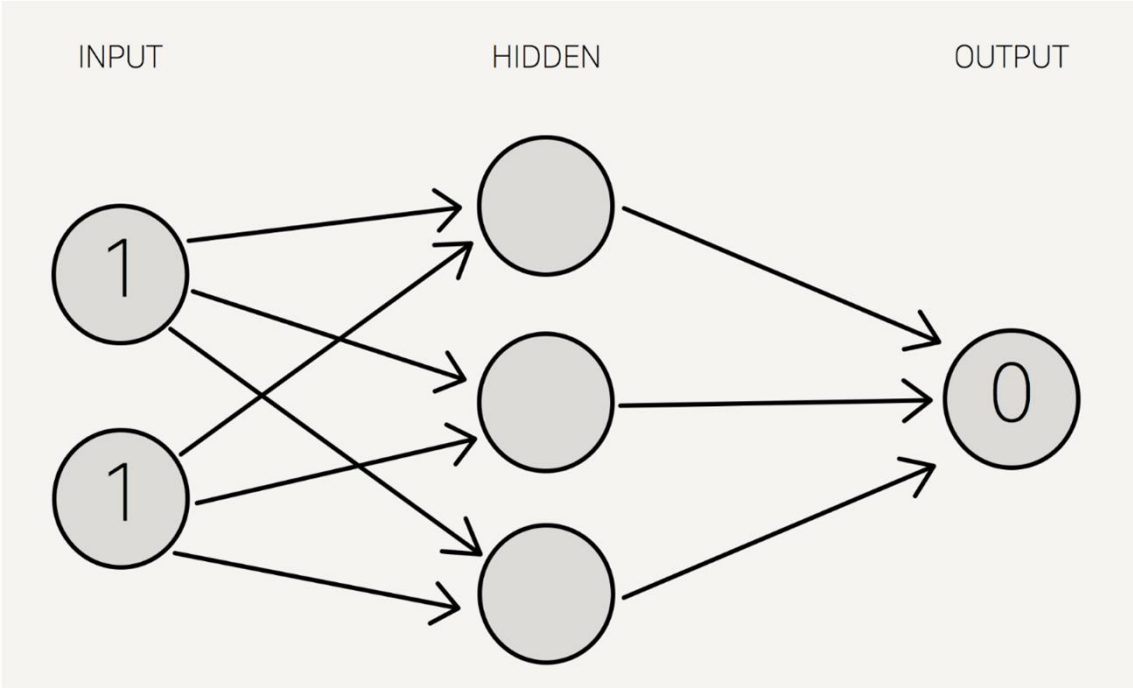
Typically defined with:

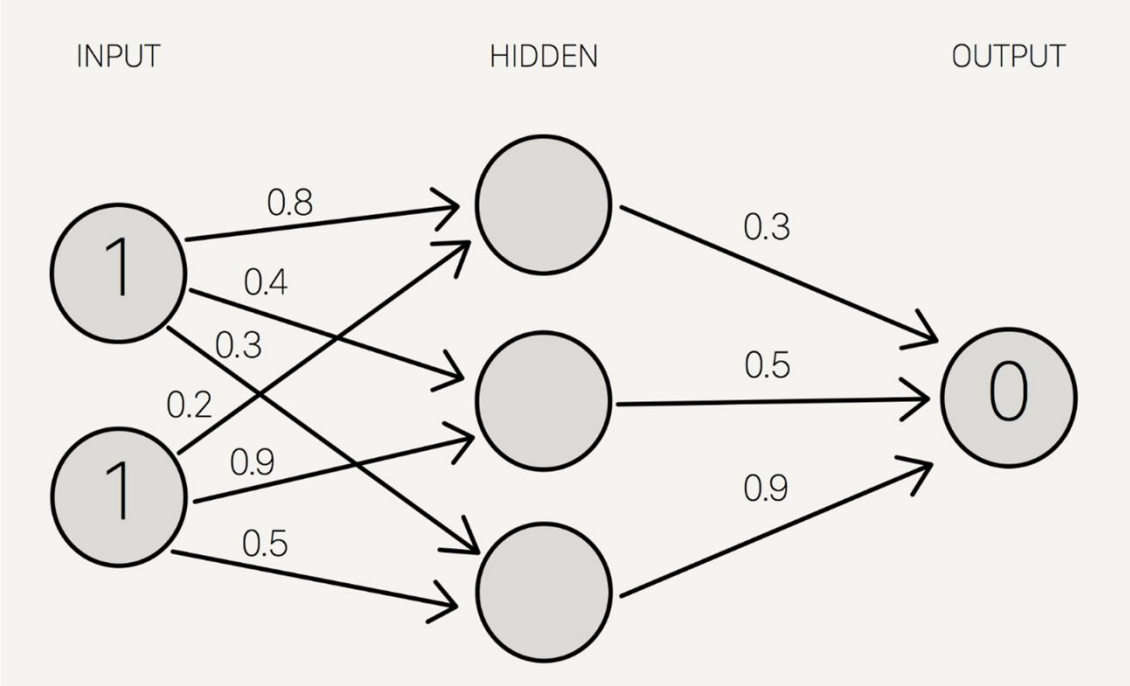
- Network of connections
- Weights on connections
- Activation function



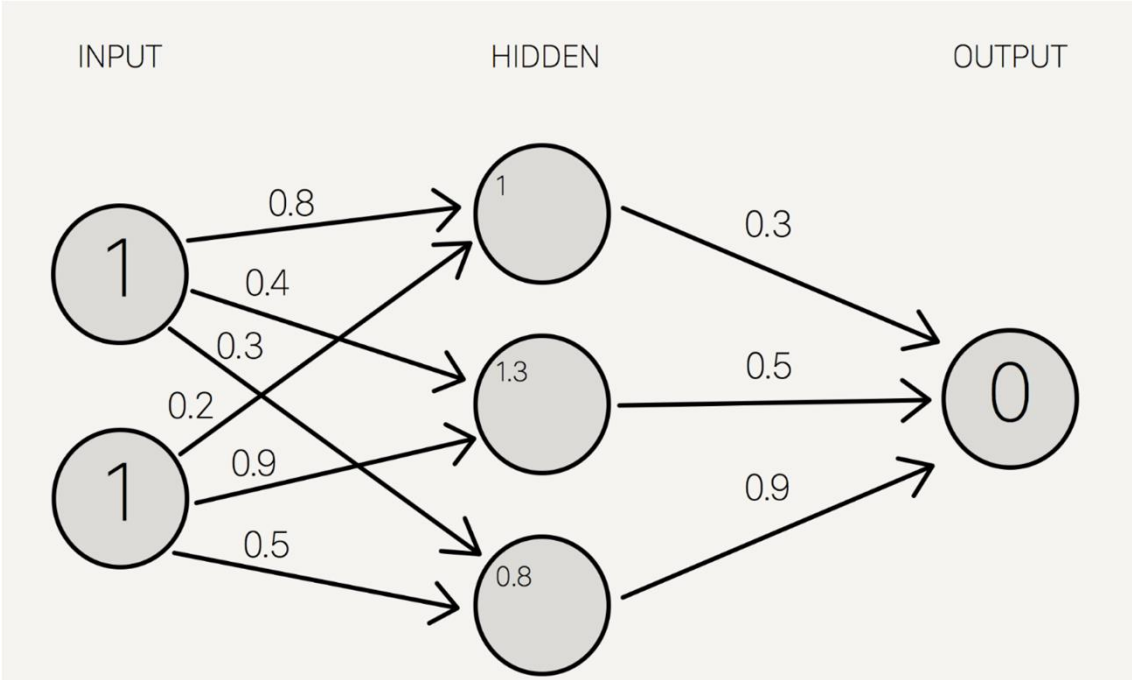
Deep learning

Example of ANN

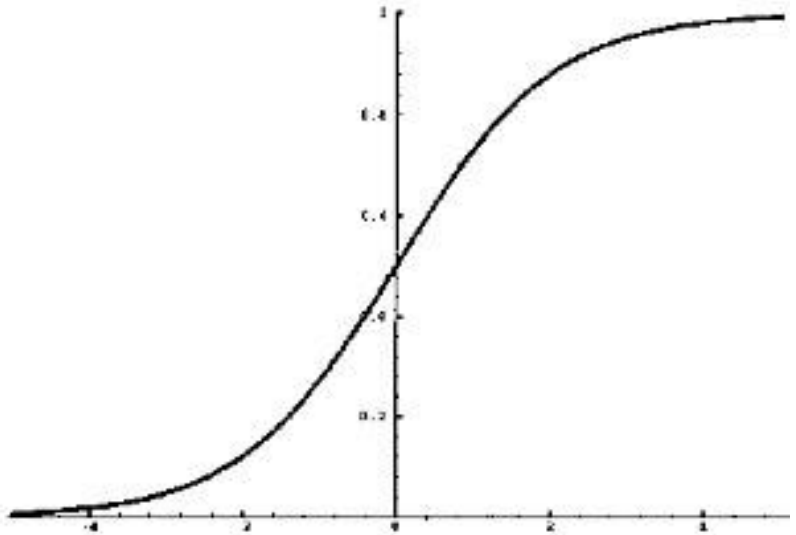




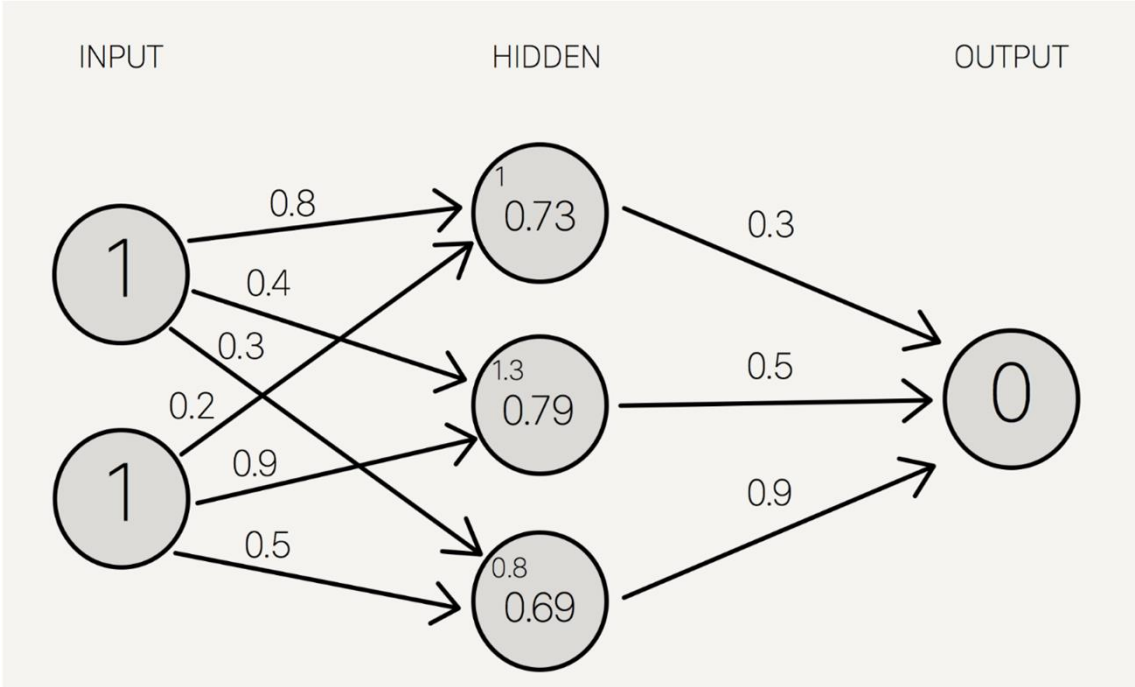
1 * 0.8 + 1 * 0.2 = 1
1 * 0.4 + 1 * 0.9 = 1.3
1 * 0.3 + 1 * 0.5 = 0.8


INPUT
HIDDEN
OUTPUT
1
1
0.8
0.4
0.3
0.2
0.9
0.5
1
1.3
0.8
0.3
0.5
0.9
0

Activation function - sigmoid

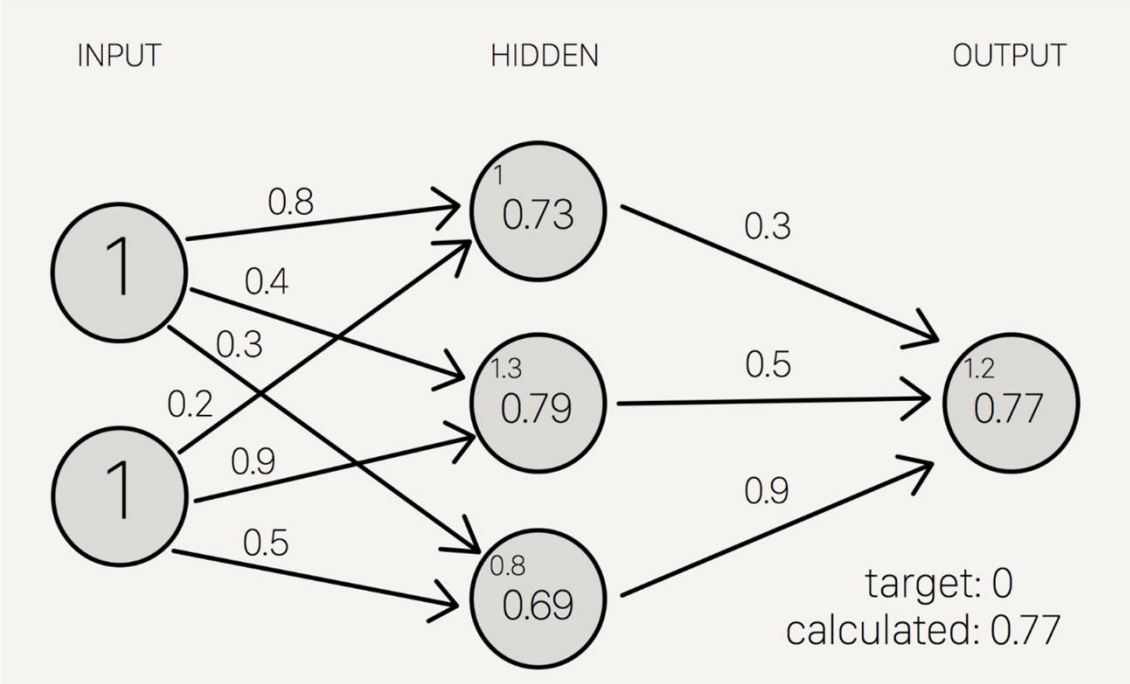


S(1.0) = 0.73
S(1.3) = 0.79
S(0.8) = 0.69



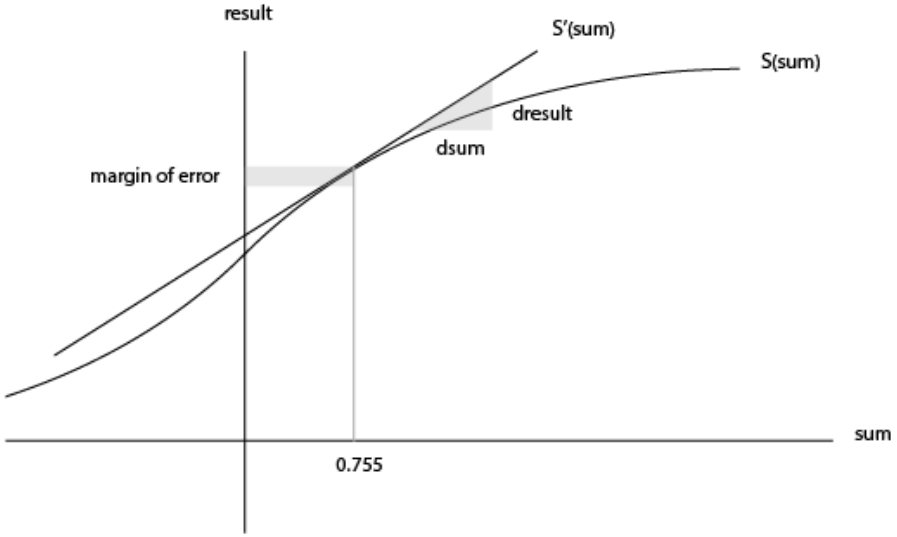
0.73 * 0.3 + 0.79 * 0.5 +
0.69 * 0.9 = 1.235

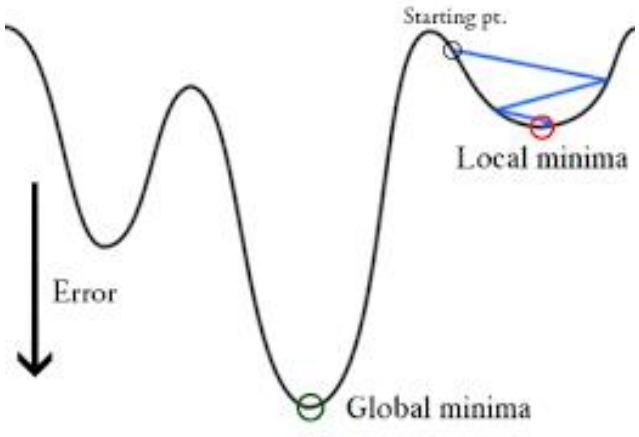
S(1.235) = 0.77469



Target = 0
Calculated = 0.77
Target - calculated = -0.77

Gradient descent

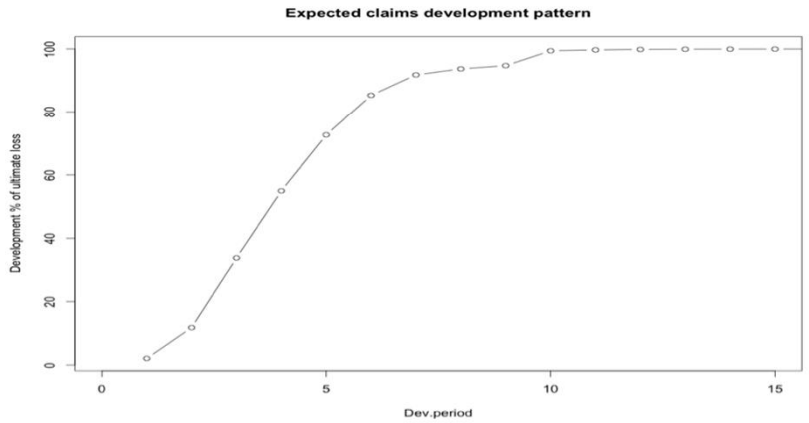




Individual Claim Development

Chain-ladder develops aggregate claim development

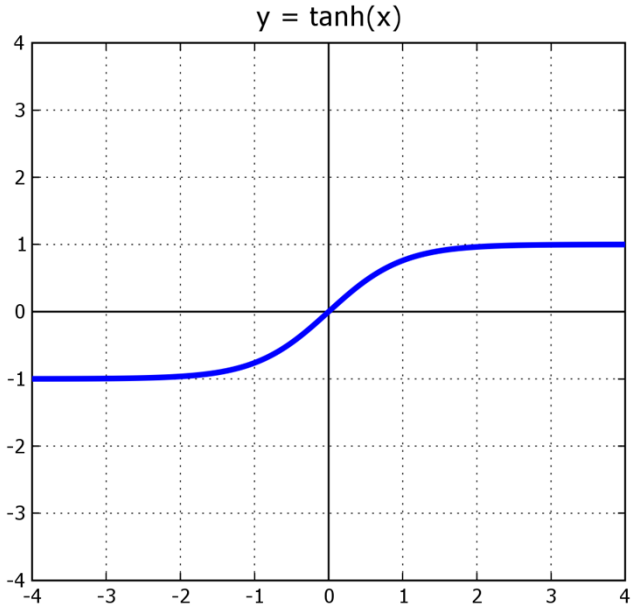
Accident Year	Development year									
	1	2	3	4	5	6	7	8	9	10
1988	233	887	2548	4353	6210	7542	8133	8177	8295	8706
1989	142	828	2758	4412	6060	7448	8208	8555	8622	
1990	189	927	3304	6019	7463	8942	9366	9506		
1991	142	1043	2299	3764	4799	5380	5842			
1992	98	1284	3813	5995	7117	7846				
1993	164	824	2723	4090	6216					
1994	164	1238	3010	4603						
1995	285	1227	3149							
1996	213	858								
1997	163									



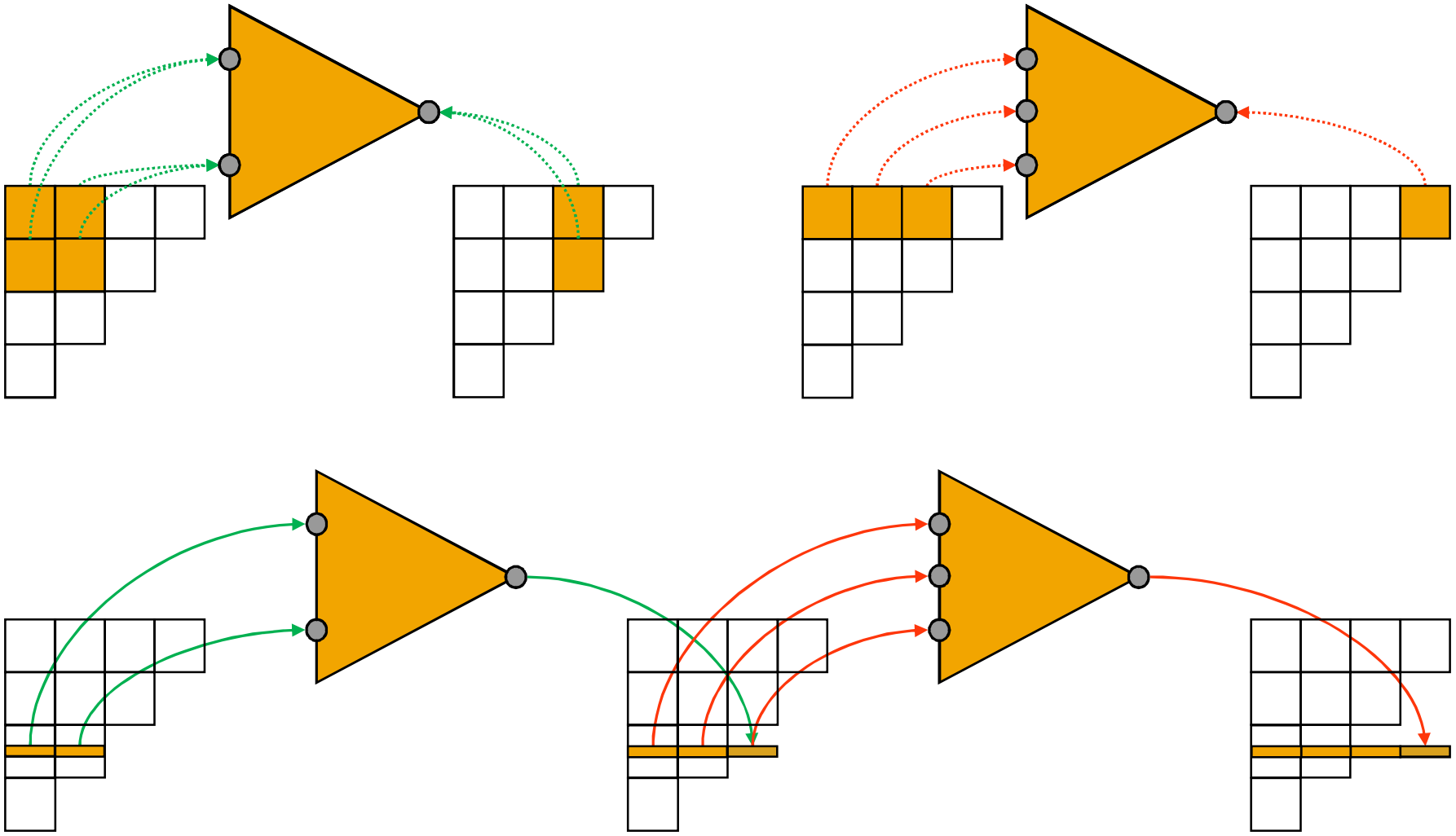
Goal: develop individual pattern

Implementation of ANN

- Implementation
  - Inputs
    - Paids
    - Paids + outs
  - Three layers
    - Optimal number of neurons
  - Activation function:
    - Hyperbolical tangent

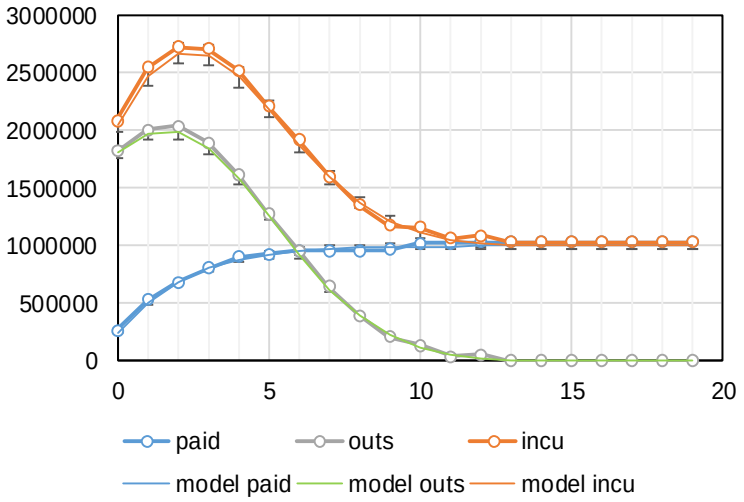


Methodology

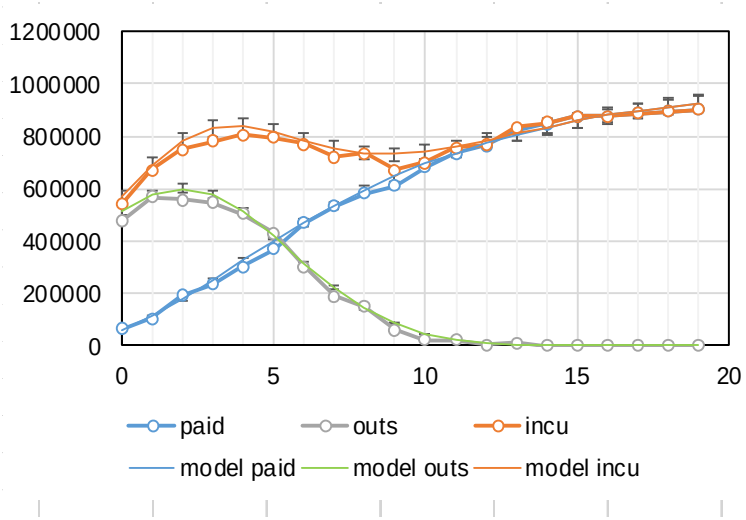


Simulated data

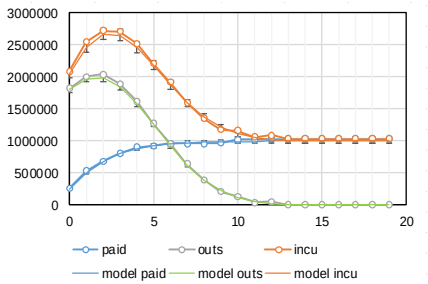
6000 claims, 20 AY

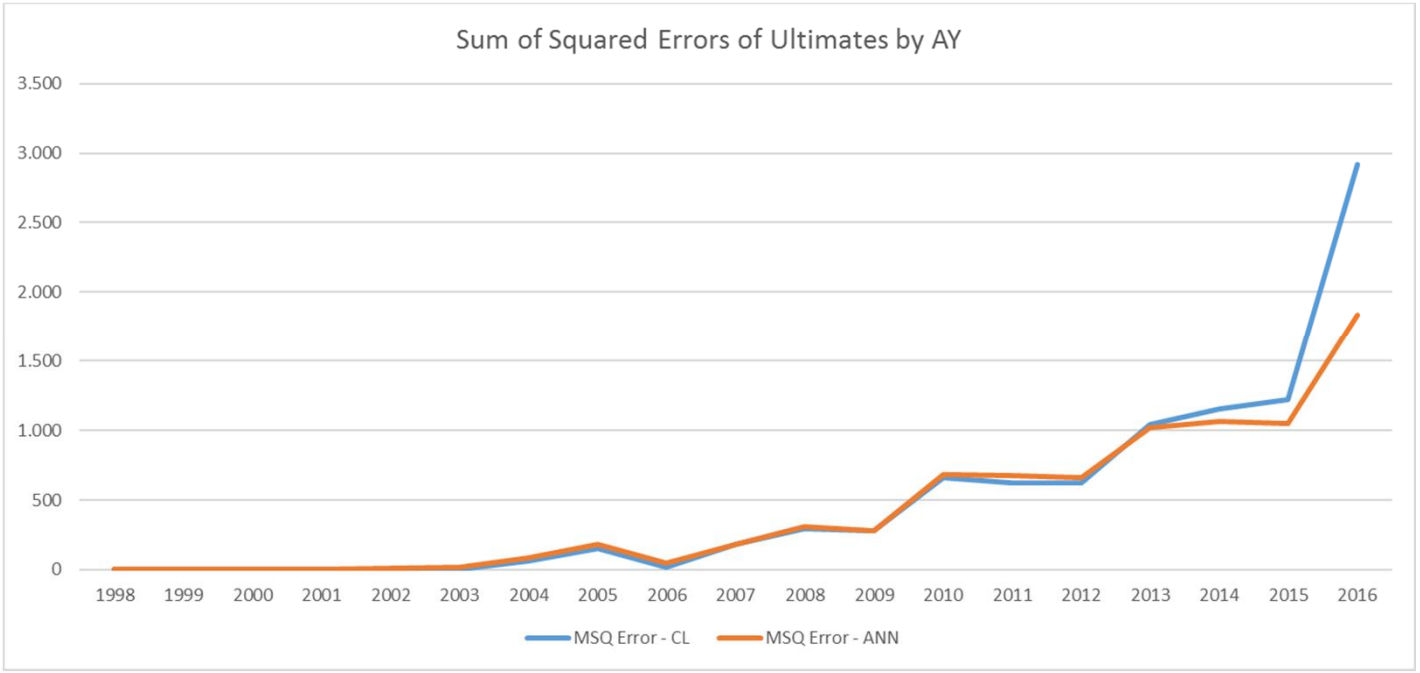


4000 claims, 20 AY

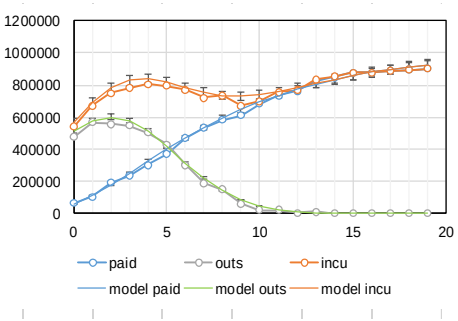


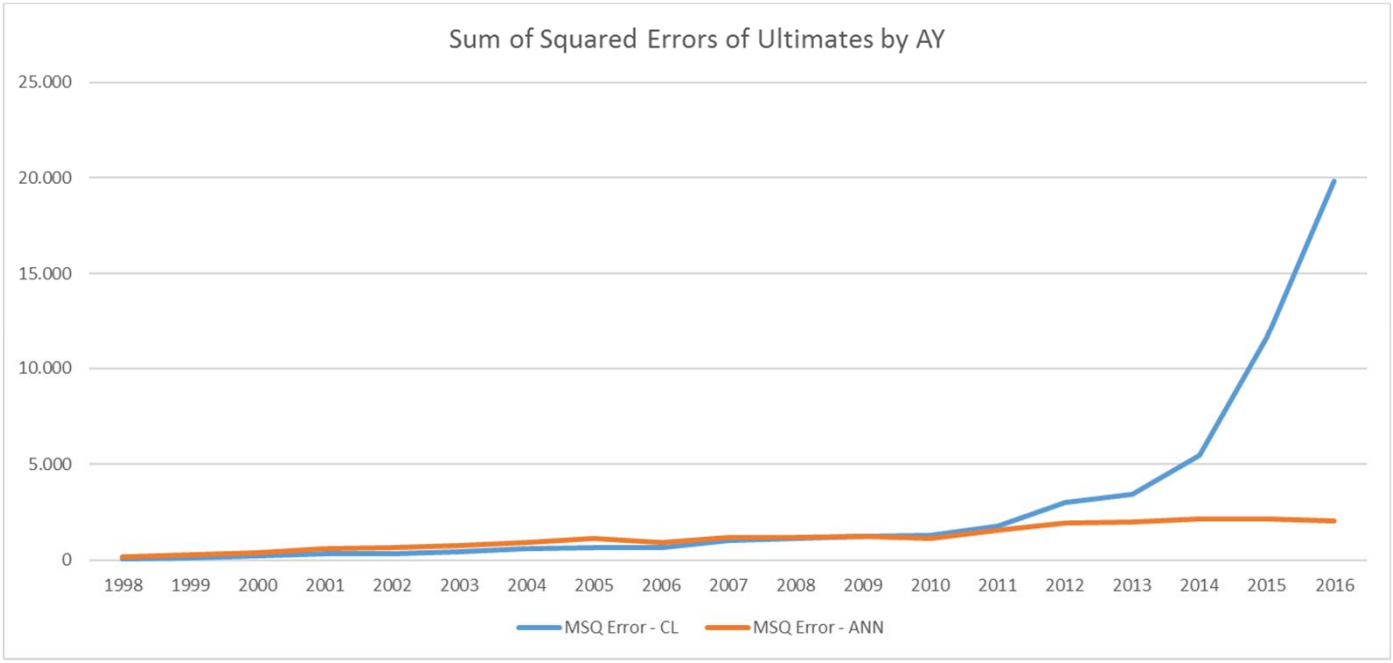
Results


3000000
2500000
2000000
1500000
1000000
500000
0
0
5
10
15
20
paid
outs
incu
model paid
model outs
model incu

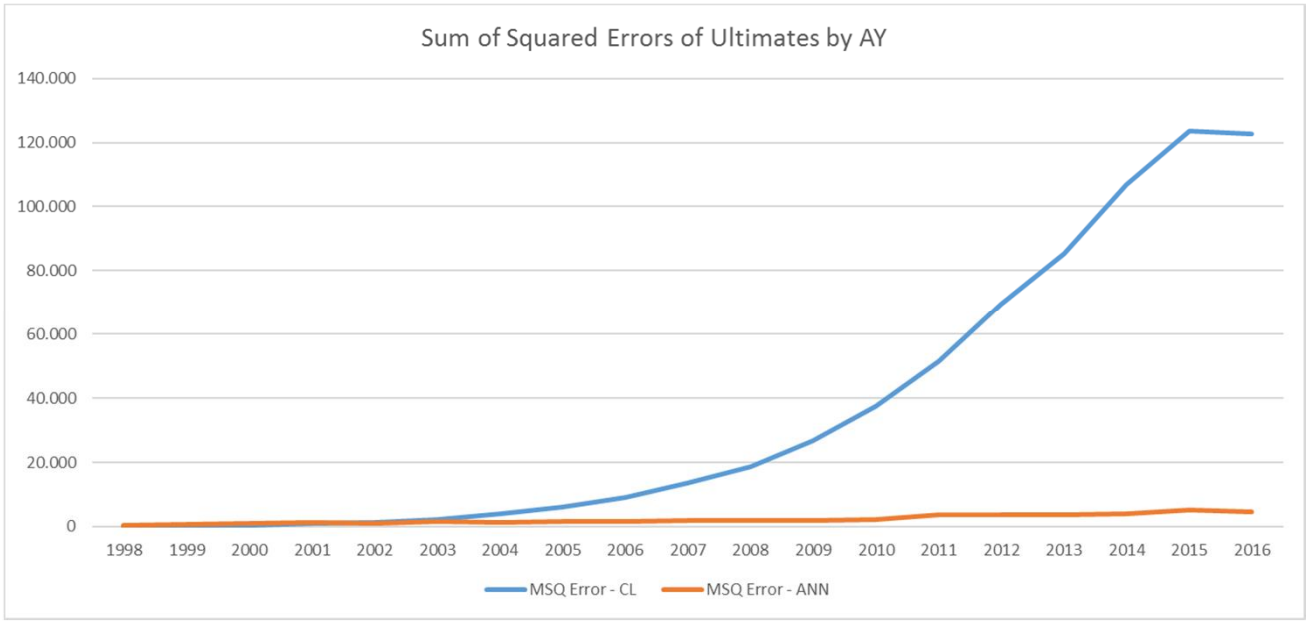

Sum of Squared Errors of Ultimates by AY
3.500
3.000
2.500
2.000
1.500
1.000
500
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
MSQ Error - CL
MSQ Error - ANN

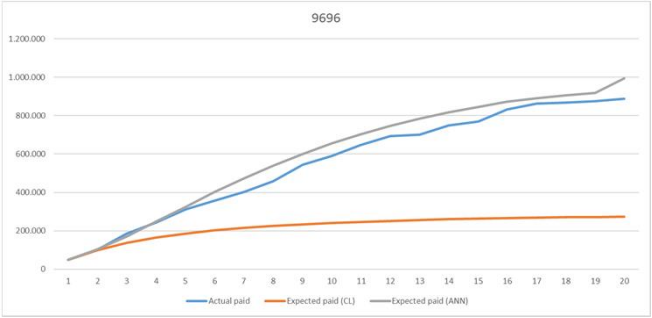
Results

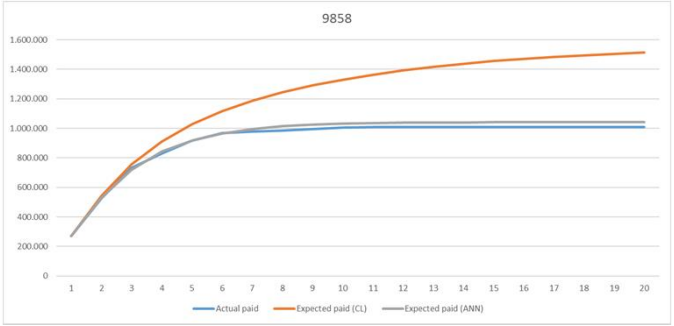

1200000
1000000
800000
600000
400000
200000
0
0
5
10
15
20
paid
outs
incu
model paid
model outs
model incu


Sum of Squared Errors of Ultimates by AY
25.000
20.000
15.000
10.000
5.000
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
MSQ Error - CL
MSQ Error - ANN

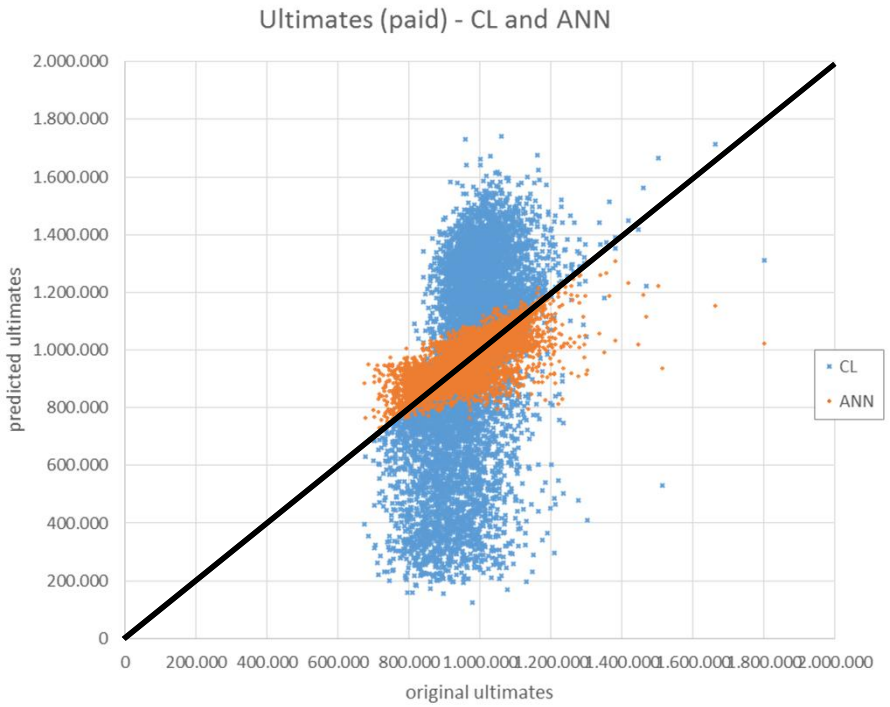
Results together

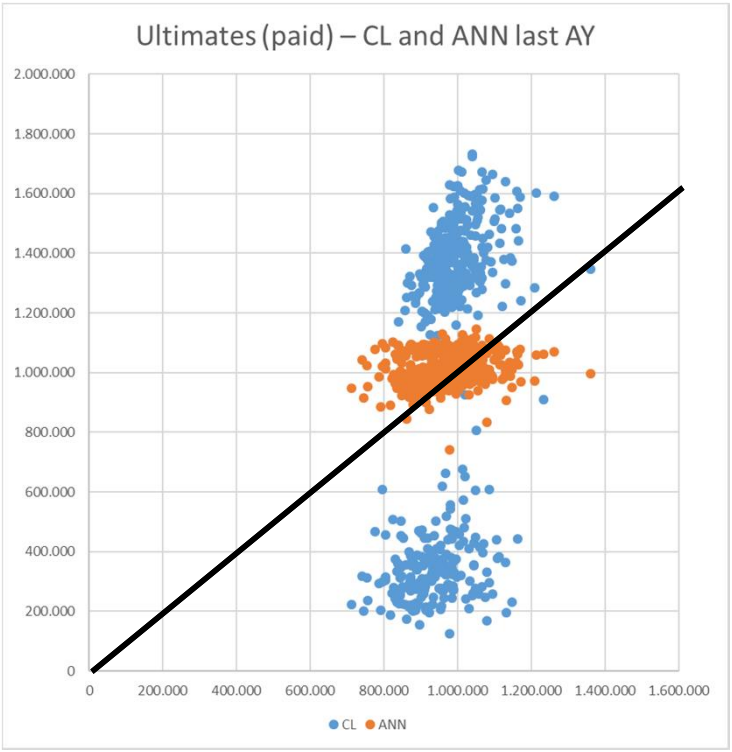






Ultimates simulated vs predicted





Open issues

- Optimal structure of ANN
- Real data analysis
- Adjusted methodology – one ANN
- New parameters

Thank you!

Vse bo v redu.

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