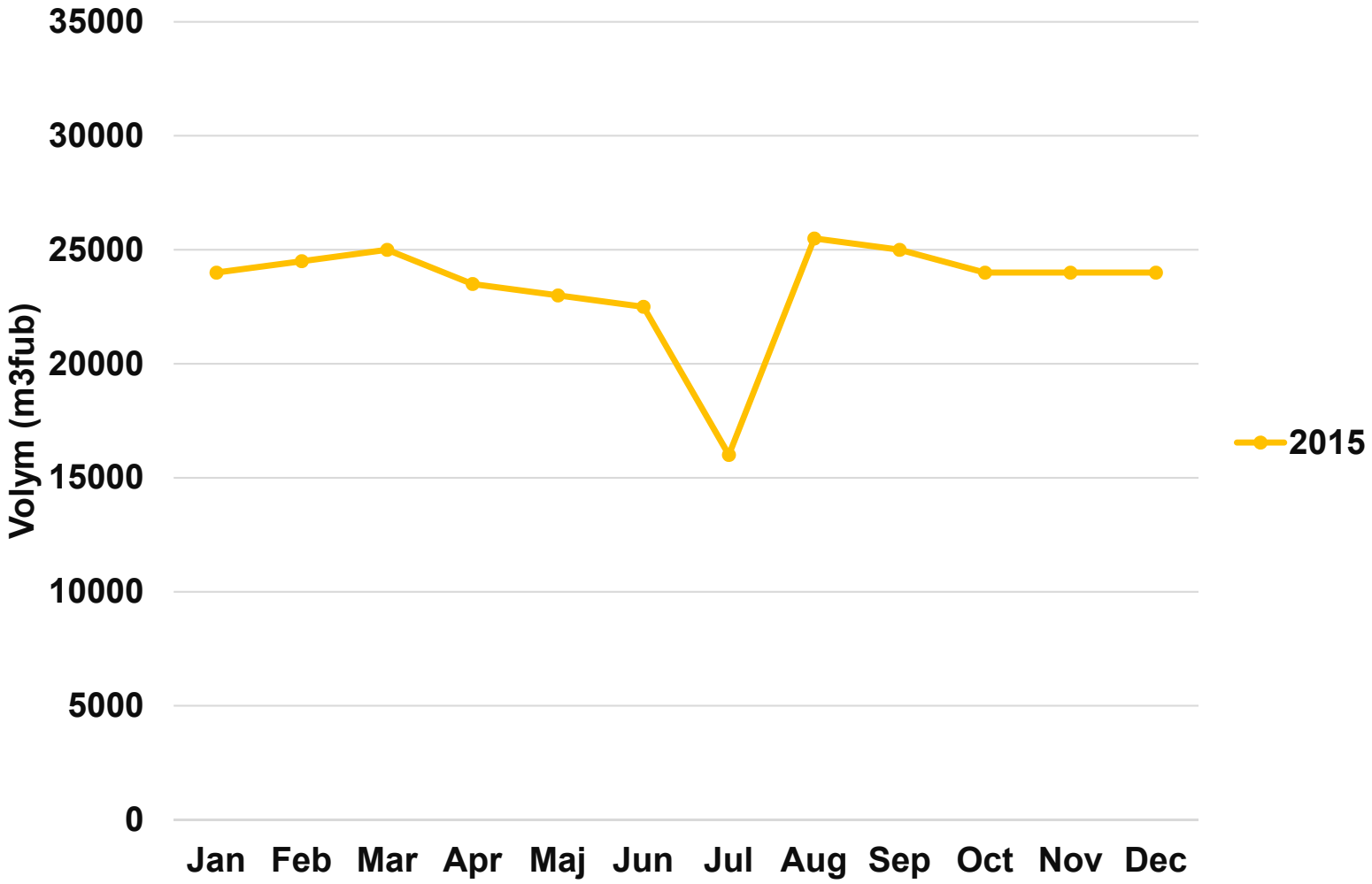
PREDICTION MODEL FOR VARIATIONS IN HARVESTER PRODUCTION

Victor Asmoarp, Aron Davidsson and Petrus Jönsson
The Forestry Research Institute of Sweden

Wood demand



Wood demand per month during one year in a wood supply area

Rolling plan

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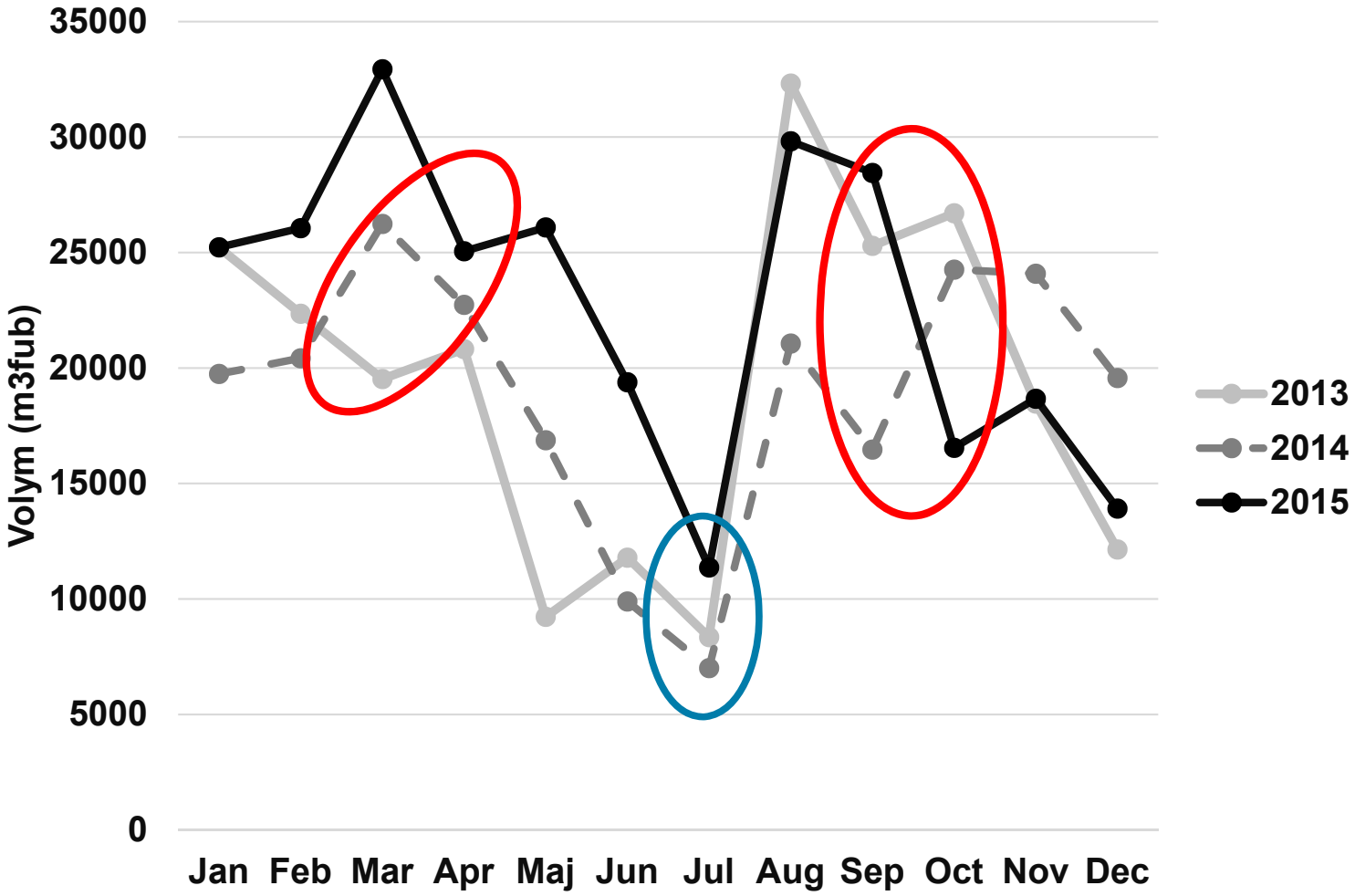
	SP	FW	ST	HP	P	PT	Total
Mars	7100	1500	8100	3800	0	4500	25000
April	6900	1300	7400	3400	0	4500	23500
May	6400	1200	7100	3700	0	4600	23000
Totalt	20400	4000	22600	10900	0	13600	71500

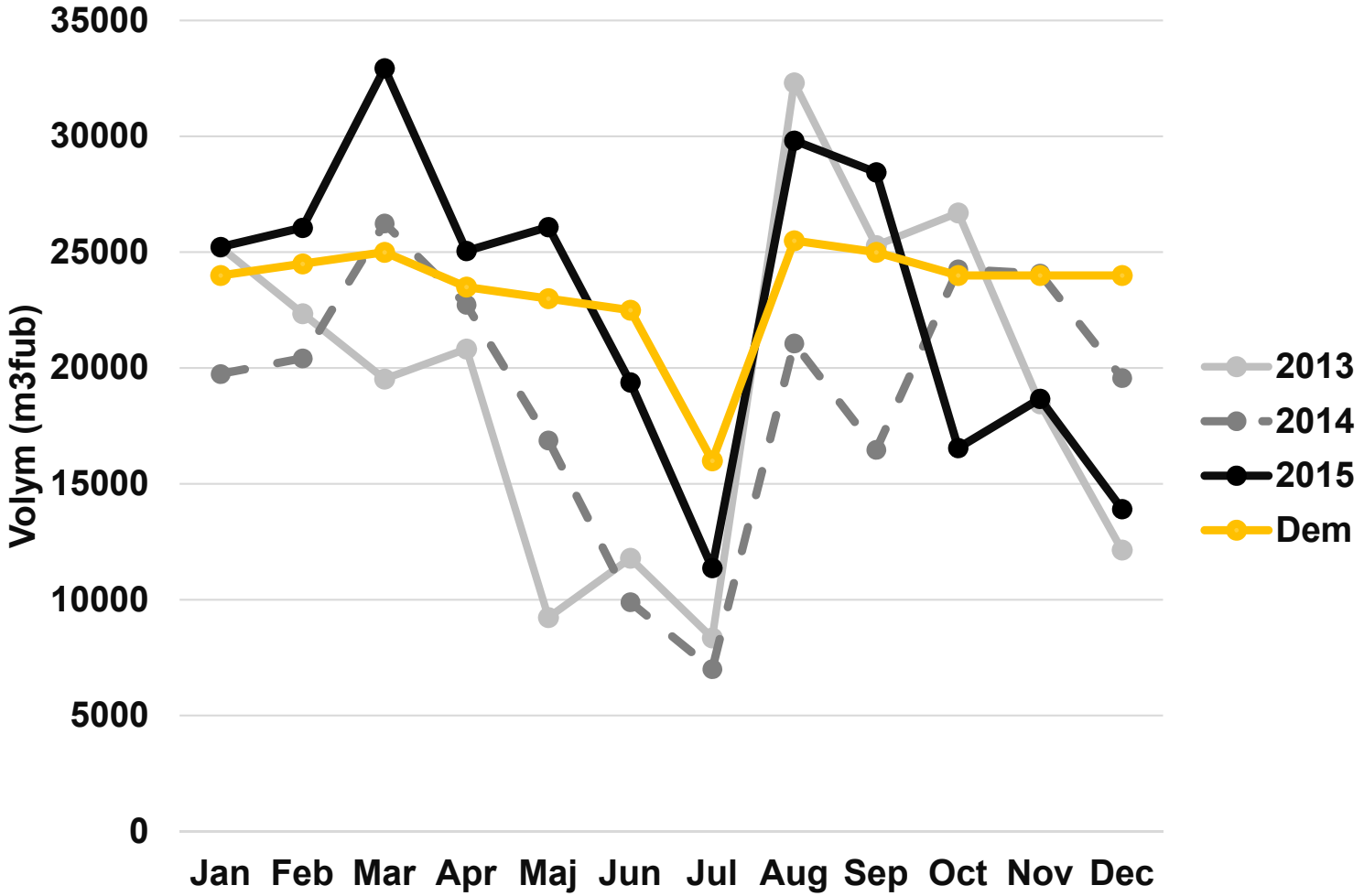
- Wood manager productions plan to meet demand
- Three-month rolling production plan every month
- First month is sharp

Historical production



Total harvest production per month in three years in a wood supply area.

Historical production



Total harvest production per month in three years in a wood supply area.

Purpose and aim

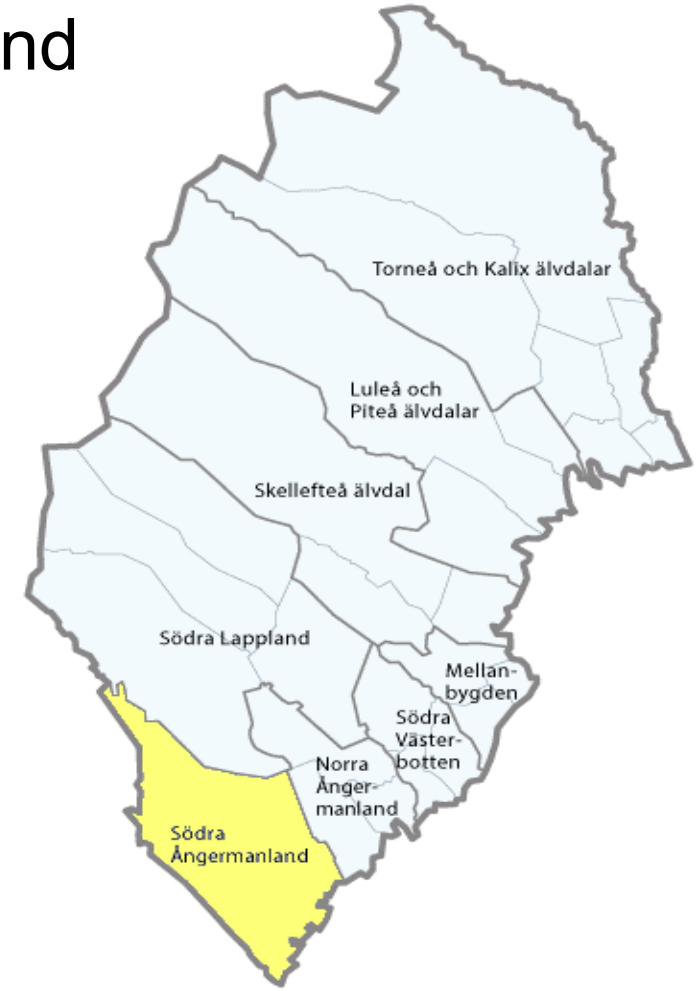
- The purpose of this study was to build models that support Norra wood supply managers in their work with the three-month rolling production plan.
- The aim was to validate the model on a small area during a limited time period.

Data and study area

- Wood supply area Södra Ångermanland

- Historical harvester data from
  - 2013-2015
  - 27 harvester in three sizes
    small, medium and large
  - 734 000 m^3 produced volume

- Working days per month
- Wheather data
- Information about harvested objects



Approach

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- Build a regression-model on historical data
- Test how different parameters affecting the respondents, outcome of volume and assortments.
- The prediction model was split in two parts
  - the first estimate produced volume per machine and month
  - the second estimate the percentage of an assortment in a specific month for a specific machine.
- This two models combined together will estimate the volume per machine, assortment and month.

Model for production

$$V_{mt} = \beta_0 + \beta_1 * A + \beta_t * N + \beta_m * M_t$$

R^2 of 77 %

Variables:

(A)	Percentage final fellings of total harvesting objects
(N)	Norm production (m^3/month), contracted volume per year divided with the number of productive month
(M)	Average stem (m^3/stem), calculated as an average over planed harvesting objects a specific month.

Index:

(m)	Machine-class (Small, Medium, Large)
(t)	Time period (Jan, …, Dec)

Parameters:

(β_0)	5.4
(β_1)	728.2

Machine-class (m)	Small	Medium	Large
(βm)	3247.3	1872.6	3755.9

Month(t)	Jan	Feb	Mar	April	Maj	June	July	Aug	Sep	Oct	Nov	Dec
(βt)	0.834	0.890	0.954	0.782	0.535	0.305	0.159	1.022	0.835	0.735	0.615	0.502

Model for assortment

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$\bar{P}_{amt}$ Percantage of assortment a for machine-class m in time period t

The combined prediction model

(V_{amt}) per assortment (a), machine-class (m) and month (t) can then be formulated as:

$$V_{amt} = \bar{P}_{amt} * \mathrm{V}_{mt}$$

Validation

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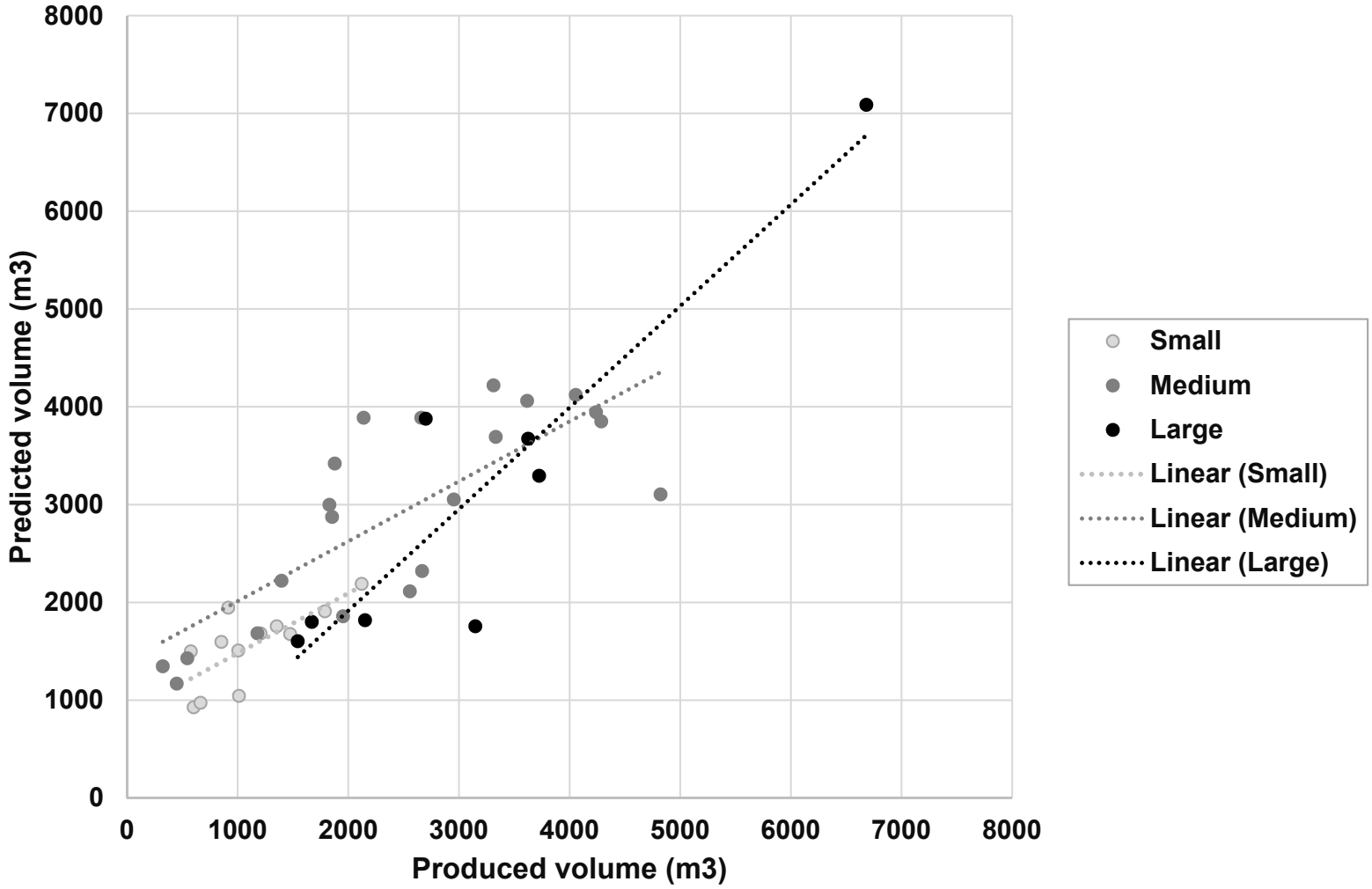
- The models were validated with data from
  - Wood supply are Södra Ångermanland
  - Period of January to April 2016
  - 12 harvesters operating.

- Estimated a total volume ~118 000 m^3
- Actual produced volume ~100 000 m^3

Production model



Assortment model

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	Assortments					
	Softwood pulp	**Fire wood**	**Spruce timber**	**Hardwood pulp**	**Poles**	**Pine timber**
Predicted	31%	5%	31%	19%	2%	12%
Produced	36%	7%	27%	19%	0%	11%

- The model for proportion of assortment per machine and month estimated the assortments fairly good.
- The model
  - underestimated softwood pulp and fire wood
  - overestimated spruce timber, pine timber and poles.

Conclusion

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- It’s possible to use historical harvester data to predict the produced volume per assortment and month for a wood supply area.
- The small overestimation is most probably due to bad input data about mean steam volume from field inventory.
- With bigger data set to calibrate this model with there will probably be better predictions.

Further work

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- Increase the accuracy of models
  - Remove temporal producing machines
- Develop models for the 7 other wood supply areas

Thanks for listening

aron.davidsson@skogforsk.se
The Forestry Research Institute of Sweden