Comparison of a deterministic and a stochastic optimisation model for weekly planning of hydropower

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Agenda

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- Method
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- Results
- Conclusion

Background

Hydropower is of large importance for the world's energy need. It is the leading renewable source for electricity generation globally supplying 71% of all renewable electricity.

Modern planning techniques can improve the utilization of energy.

In particular, ***weekly planning of hydropower***, is becoming more interesting as increasing amount of wind and solar power are installed in the power system and at the same the electricity market is developed.

Research question

The aim of the project is to find suitable models for weekly planning of hydropower.

Method for the project

Two linear optimisation models for a three week planning horizon.

Deterministic optimisation model

- Profit

Two-stage stochastic optimisation model

- Expected profit

The models are implemented in GAMS and tested on a case study.

Deterministic optimisation model

Description of linear optimisation problem

Maximise	The income of sold electricity and the value of stored water
Subject to	Hydrological constraints,
	Constraints in discharge capacity,
	Variable limits

Deterministic optimisation model

- Price uncertainties are not taken into account.

- Historic time-series data of electricity prices are used (SE1 in Sweden September 2016).

Stochastic two-stage optimisation model

Maximise	The ***expected*** income of sold electricity and the ***expected*** value of stored water
Subject to	Hydrological constraints,
	Constraints in discharge capacity,
	Variable limits

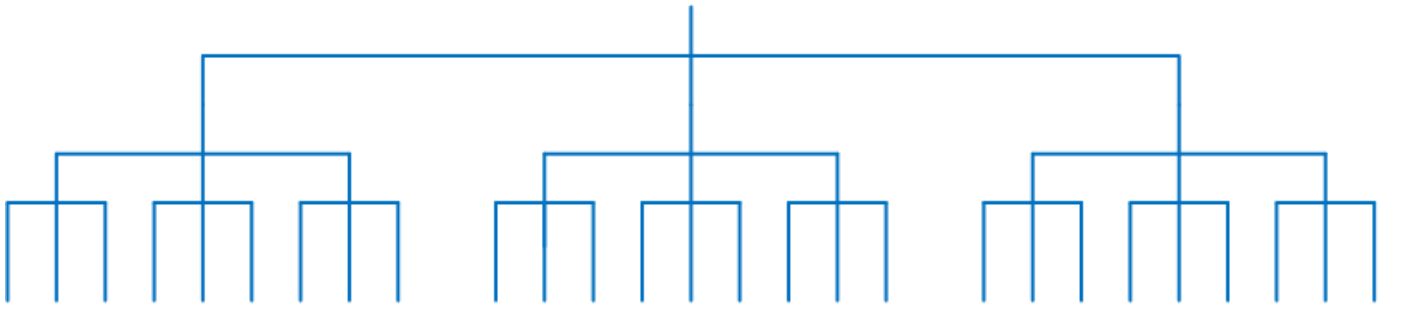
The electricity price is assumed to be stochastic.

The constraints and variable limits remain the same as in the deterministic model except for the fact that all variables are scenario dependent.

Stochastic two-stage optimisation model

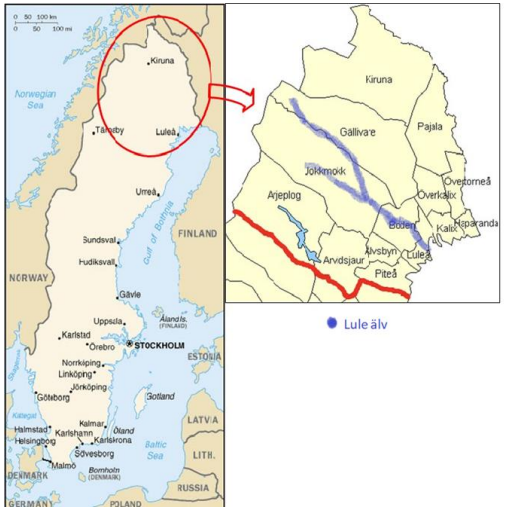
The plan is updated after one day or one week and a new schedule is used for the rest of the planning period.

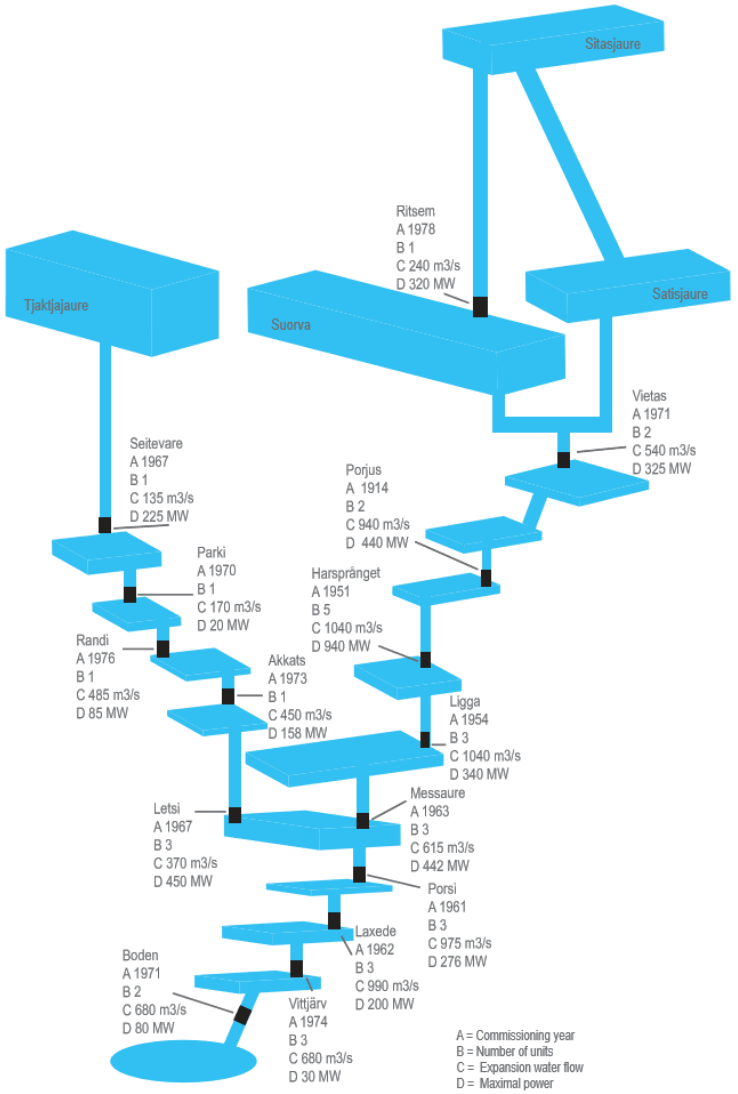
Historic time-series data of the electricity prices from 2015, 2016 and 2017 in September in SE1 Sweden.



Case study

River Lule älv





Results

Planning method	Expected value of profit
Deterministic. 2016	3688 [MSEK]
Wait-and-see	3718 [MSEK]
Stochastic two-stage, 1 day	3710 [MSEK]
Stochastic two-stage, 1 week	3707 [MSEK]

Conclusion

Computation of EVPI (expected value of perfect information)

EVPI = WS – RP

Shows that the stochastic planning model gives a result close to the best possible planning (WS).

The stochastic model performs well and further studies are interesting.

References

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Thank you!