GENERATING WATER VALUE FUNCTIONS WITH A STOCHASTIC SHORT-TERM MODEL

Marte Fodstad, Hans Ivar Skjelbred, Christian Naversen, Jiehong Kong

SINTEF Energi, MultiSharm project
Background

Long-term & seasonal planning

Short-term scheduling
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Long-term & seasonal planning

Short-term scheduling

• SDDP/SDP
• Weekly resolution of water values/cuts
• ProdRisk, VanSimTap

• Nonconvex, MILP
• Deterministic (stochastic)
• Hourly/quarterly resolution
• SHOP / SHARM
Why water values from a short-term model?

1. Computation time
2. Water values for mid-week days
3. Water values from a more detailed model
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   - Small reservoirs
   - Long cascades with strong dependencies between plants
   - Large head effects
Why water values from a short-term model?

1. Computation time
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3. Water values from a more detailed model
   - Small reservoirs
   - Long cascades with strong dependencies between plants
   - Large head effects
1. Run 2-days model to generate water values at end of day 1
2. Run day 1 with generated water values for end reservoir valuation
3. Run day 2 with start reservoir level given from previous 1-day run
Topology

- Flat reservoir
- No head loss
- 100% generator efficiency
- 100% turbine efficiency
- P_min at 0 MW
- P_max estimated at Q_max
- No start- nor stop costs
Price and inflow

**Price**

**Inflow**

Water value at the end of day $2 < \text{price}$

Mean inflow $h_{1-h24}: 30 \text{ m}^3/\text{s}$

Random deviation from mean
Results - Reservoir trajectories

48h integrated

Sequential
Results

2-day stochastic model run – represents the target solution

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<tr>
<th>Model</th>
<th>End volume day 1</th>
<th>Expected profit</th>
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<tbody>
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<td>48h stochastic</td>
<td>5.327</td>
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Sequential model run for day 1 and day 2 using water values

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Benchmark – alternative mode

• **Multi-deterministic** model runs to generate water values
• Reduced computation time, easy to parallelize
• Use expected water value
Results – Multi-deterministic

48h integrated

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# Results

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*Coefficient from binding cut
Benchmark – alternative modes

• **Multi-deterministic** model runs to generate water values
• Reduced computation time, easy to parallelize
• Use expected water value

• **Multiple cuts** by starting the stochastic model with different start reservoir levels
• Improved water value approximation
Results - Multiple cuts
## Results

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<td>51 802.1</td>
<td>563 222</td>
<td>-51 / -0.009%</td>
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<td>Multi-deterministic</td>
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<td>52 073.8</td>
<td>563 122</td>
<td>-151 / -0.027%</td>
</tr>
<tr>
<td>Multi-cut, stochastic</td>
<td>5.240</td>
<td>51 802.1*</td>
<td>563 264</td>
<td>-9 / -0.002%</td>
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*Coefficient from binding cut
Summary

• Water values from a stochastic short-term scheduling model, SHARM

• Simplified 2-day test setup

• Observations (from single case!)
  • Water values captures that value of day 2 exceeds water value beyond day 2
    • Indicates that weekday correction might be possible
  • Stochasticity adds value relative to multi-deterministic
    • No single obvious way to define the water value from the multi-deterministic approach
  • Multiple cuts improves result

• More testing to be done
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