Maximum Demand Probability of Exceedance (POE) forecasts and weightings - Update

FRG 22 August 2018

Purpose

The purpose of this presentation is to follow up on the presentation given to the June FRG, presenting:

- Outcomes of unserved energy (USE) and Loss of Load Probability (LOLP) using 10% POE, 30% POE and 50% POE forecasts.
- Choice of POE weightings to be used in 2018 Electricity Statement of Opportunities (ESOO).
- Future work planned.

Recap

Historical approach:

1. Assumes Maximum Demand is normally distributed.
2. Weightings will remain the same regardless of USE outcomes, as long as these (as function of Maximum Demand POEs) can be approximated by a relatively low order polynomial function.
3. This gives weightings of 30.44%, 39.12% and 30.44% for the 10%, 50% and 90% POE Maximum Demand outcomes respectively.

- If the 50% POE and 90% POE USE outcomes are very close, then their weightings can be aggregated
  - Then weighting of 10% POE and 50% POE outcomes would be 30.44% and 69.56% respectively.
- Alternatively 90% POE USE outcomes can be assumed to be zero (so no contribution to USE)
  - Weighting of 10% POE and 50% POE outcomes are then 30.44% and 39.12%.
- Main difference will be for cases with significant USE for 50% POE cases. In those cases, the reliability standard is likely to be breached regardless of choice of weighting.

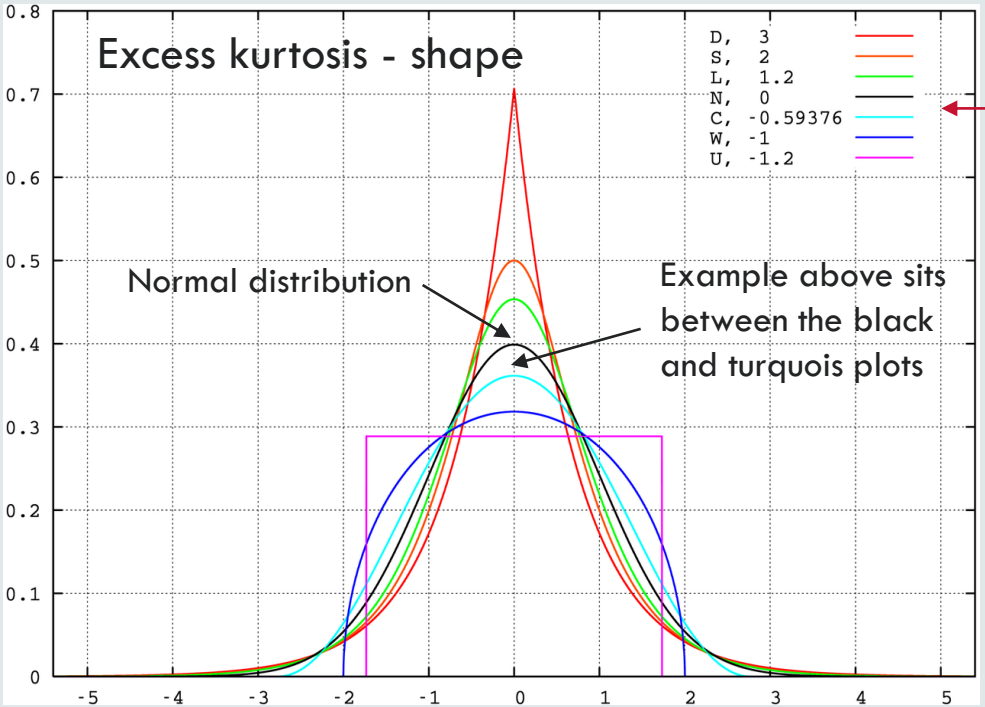
Test for normality

For a distribution to be normal, skewness and excess kurtosis values must both be close to zero.

1. AEMO has tested if simulated maximum demand (and minimum demand) outcomes follow a normal distribution (Jarque-Bera test).
2. As expected, the tests show it is not a normal distribution, though often the values are not too far off.

Example: South Australia Summer Max Demand

1. Skewness: 0.039 (distribution symmetry)
2. Excess kurtosis: -0.233 (the width of the tails)

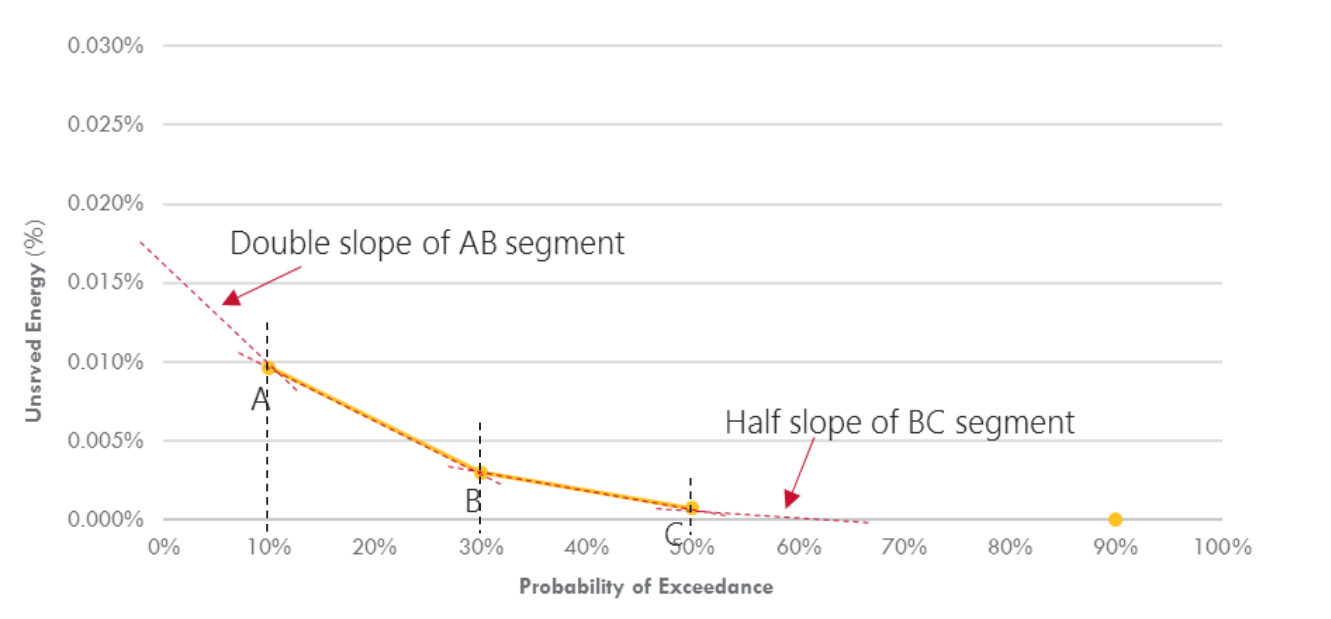


Empirical testing – approach

- Based on ESOO 2018 simulations, supplemented by simulations for 30% POE outcomes, AEMO has tested the accuracy and robustness of the weightings for all regions and for a number of forecast years. As shown on the figure next slide:
  - USE outcomes for 10%, 30% and 50% POE maximum demand were assessed
  - Zero USE for 90% POE outcomes was assumed
  - Between 10%, 30% and 50% POE, USE is estimated by linear interpolation
  - For POEs <10%, assume double the slope seen between 10% and 30% POE.
  - For POEs >50%, assume half the slope seen between 30% and 50% POE.

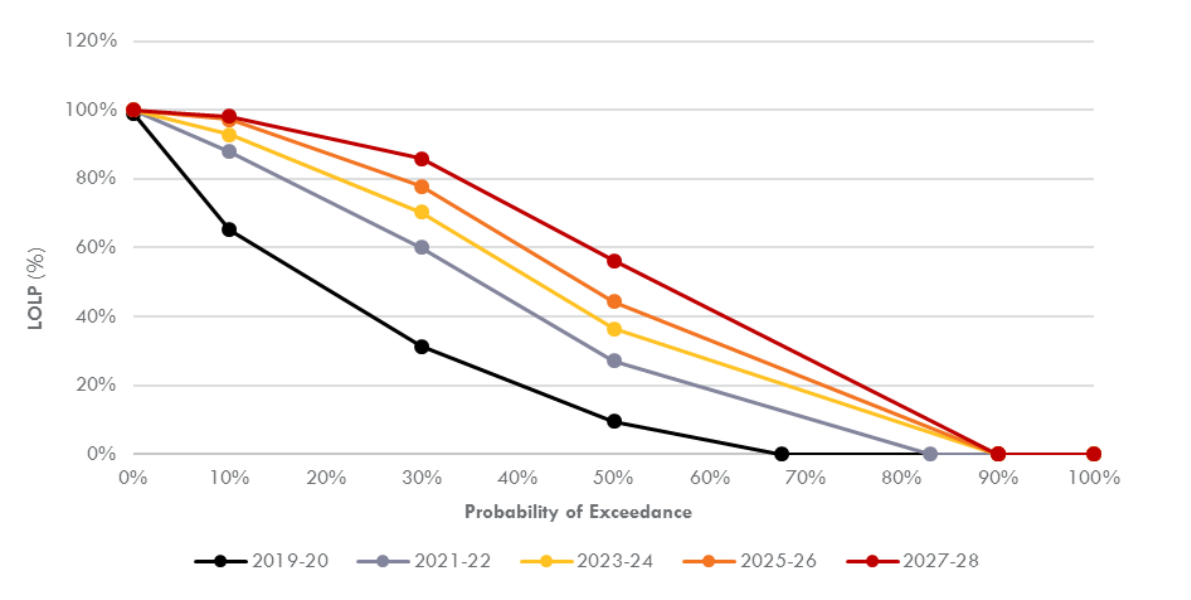
- Expected USE is calculated as the area under the curve.

Empirical testing – USE example



Method	Expected USE	Absolute difference
Empirical estimate (area under curve)	0.00299%	-
Weighting 10% POE outcomes 30.44%, 50% POE outcomes 39.12%	0.00323%	0.00024%
Weighting 10% POE outcomes 30.44%, 50% POE outcomes 69.56%	0.00346%	0.00047%

Empirical testing – LOLP example



Method	LOLP	Absolute difference
Empirical estimate (area under curve)	43.92%	-
Weighting 10% POE outcomes 30.44%, 50% POE outcomes 39.12%	42.49%	-1.43%
Weighting 10% POE outcomes 30.44%, 50% POE outcomes 69.56%	53.55%	9.63%

Conclusions

- **General observation**
  - Either set of weightings give consistent results across regions and forecast years.

- **Expected USE**
  - For USE, 10% and 50% POE weightings of 30.44% and 39.12% is performing reasonably well, noting that our comparison is against an approximation, not actual USE (as we only know three points).
  - In all cases considered, it is superior to the former 30.44% and 69.56% weighting, though less so, when there's minimal USE at 50% POE.

- **LOLP**
  - For LOLP, weightings of 30.44% and 39.12% appears to be performing best as well.
  - In some cases it is underestimating LOLP against the empirical approximation.
  - Shape varies significantly from year to year (S-shape – sometimes mainly convex, sometimes concave). Need further analysis to give confidence it will always do well.

Recommendation

- Based on analysis, AEMO has changed its approach, now using:

30.44% weighting of 10% POE and 39.12% weighting of 50% POE outcomes (with a remaining 30.44% weighting attributed to a 90% POE that is assumed to lead to zero USE and therefore not modelled).