# Spatiotemporal Probabilistic Scenarios

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# Overview

# Progress check

## New

- Spatial modelling
- Model estimates
- PC fitting

## Next Steps

- OOS validation
- Add case study to overleaf
- Address other comments

# Spatial modelling for probabilistic scenarios

# Model shapes

New models are modifications of the Normalised Error with Normal distribution (NEN)

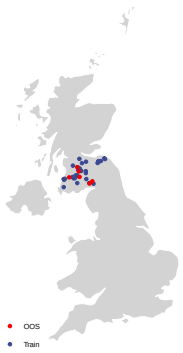
- Model list
  - ST-PR-NEN
  - Power Ramp (PR-NEN)
  - AR1 (PR-AR1-NEN)
  - Matern-AR1 (ST-NEN)
- Pending
  - ST-RS-PR-NEN

# Data

- For US data:
  - Length: 18 months
  - Resolution: hourly
  - Locations: 1 region aggregated
- UK data:
  - Length: 1 to 3 months
  - Resolution: hourly
  - Locations 10 Scottish wind farms

Trying to keep fit time $< 60$min

10 Scottish wind farms



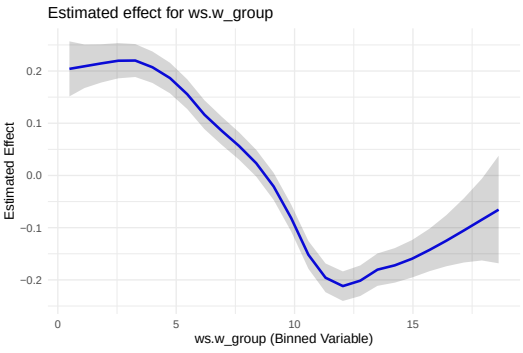
# ST-PR-NEN model

Parameters summary

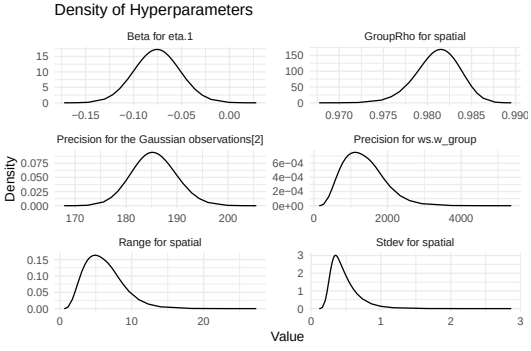
| X | intercept | Gaussian...tau. | Wind...tau. | Range | Spatial...sigma. | AR..rho | PR.effect |
|---|---|---|---|---|---|---|---|
| mean | -0.04 | 185.47 | 1350.78 | 6.15 | 0.47 | 0.98 | -0.08 |
| sd | 0.01 | 4.39 | 551.67 | 2.65 | 0.20 | 0.00 | 0.02 |
| 0.025quant | -0.07 | 177.07 | 485.89 | 2.13 | 0.22 | 0.98 | -0.12 |
| 0.5quant | -0.04 | 185.39 | 1275.85 | 5.74 | 0.43 | 0.98 | -0.08 |
| 0.975quant | -0.02 | 194.34 | 2598.63 | 12.32 | 0.99 | 0.99 | -0.03 |
| mode | -0.04 | 185.15 | 1119.36 | 4.91 | 0.35 | 0.98 | -0.08 |

# Posterior distributions

## Effects




## Hyperparameters



# PR-NEN model

Parameters summary

Effects
Hyperparameters

# PR-AR1-NEN model

Parameters summary

Effects
Hyperparameters

# ST-NEN model

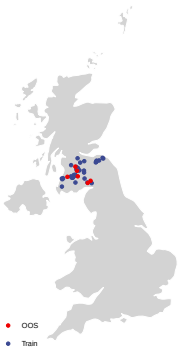
Parameters summary

Effects
Hyperparameters

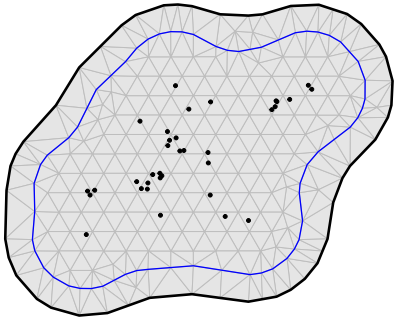
# Appendix

# Map and mesh

Map of wind farm samples




Mesh



# Power Curve fitting

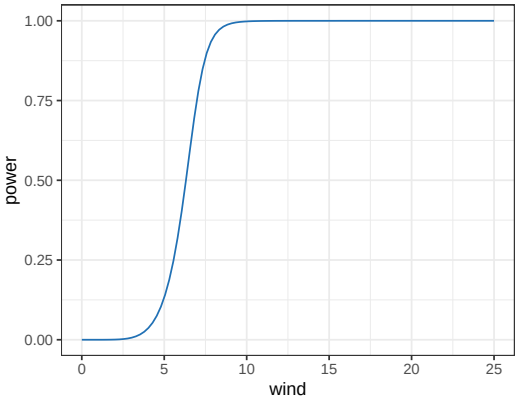
# Classic parametric shape

The five-parameter formula (Lydia et.al, 2013):

$$P(u) = D + \frac{A - D}{(1 + (u/C)^B)^G}$$

where: $A$ and $D$ are the upper and lower asymptotes, $C$ controls the inflection point, $B$ is related to the slope at inflection point, and $G$ controls the asymmetry.

5 parameters power curve



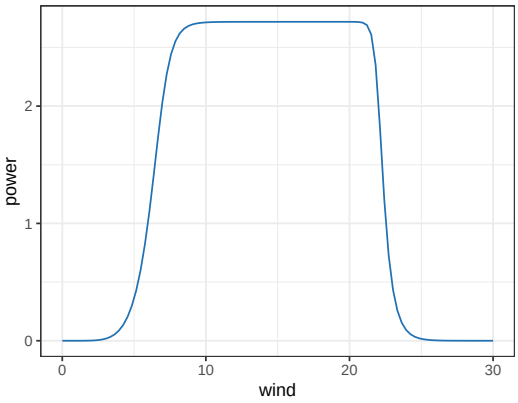
# Parametric shape for cut-off

Adding extra parameters we can model de decay after cut-off:

$$P(u) = D + \frac{A - D}{(1 + (u/C_1)_1^B)^G (1 + (u/C_2)_2^B)^G}$$

where: $A$ and $D$ are the upper and lower asymptotes, $C_1$ is the first inflection point, $C_2$ is related to the cut-off, $B_1$ is related to the slope at inflection point, $B_2$ to the slope during cut-off, and $G$ controls the asymmetry.

7 parameters power curve



# Parametric fit for Scottish wind farms

- We can fit the parametric shape using optim
- As long as there is a reasonable amount of points showing the cut-off optim can converge

Estimates from data

| par | estimate |
|---|---|
| A | 1.00 |
| B1 | -11.99 |
| C1 | 8.00 |
| D | 0.00 |
| G | 1.00 |
| C2 | 22.00 |
| B2 | 35.98 |