Spatiotemporal Probabilistic Scenarios

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Overview

Progress check

New

- PC fitting
- Spatial modelling
- Model estimates

Next Steps

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

Power Curve fitting

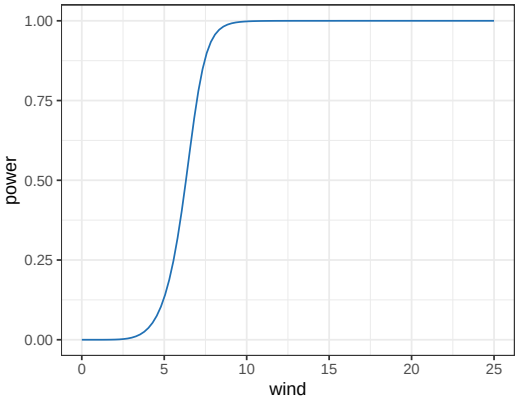
Classic parametric shape

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



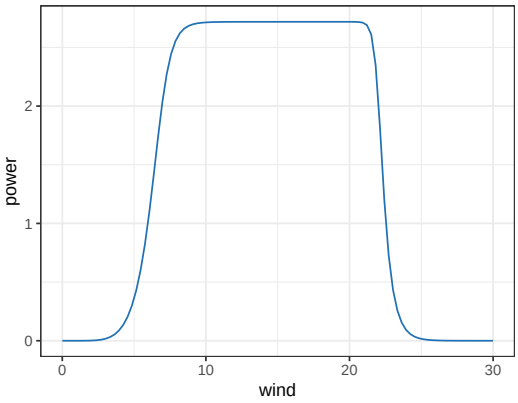
Parametric shape for cut-off

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

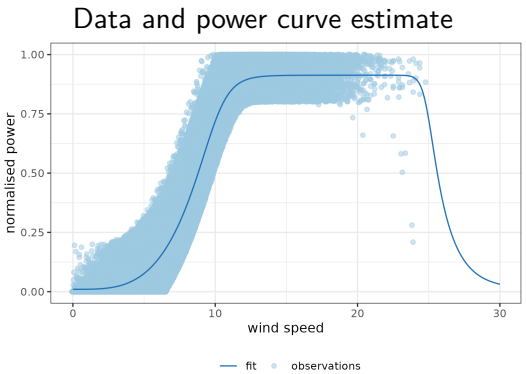


Parametric fit for Scotish wind farms

- 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	0.91
B1	-14.90
C1	10.38
D	0.01
G	0.24
C2	24.85
B2	82.98



Spatial modelling

Parametric fit for Scotish 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

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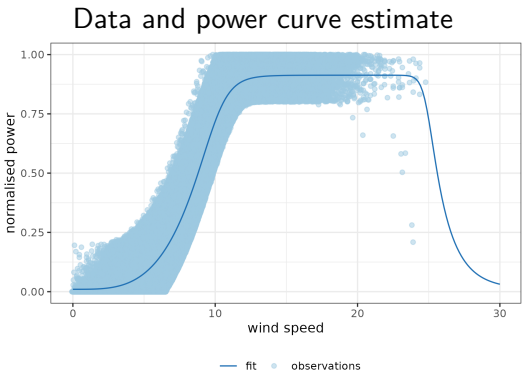


Spatial modelling for probabilistic scenarios

Model shapes

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

- Model list
  - Power Ramp (PR-NEN)
  - AR1 (PR-AR1-NEN)
  - Matern-AR1 (ST-NEN)
- Pending
  - ST-PR-NEN
  - 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 Scotish wind farms

Trying to keep fit time < 10min

10 Scotish wind farms

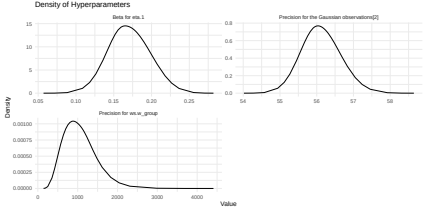
PR-NEN model

Parameters summary

	Intercept	Gau prec	Wind RW prec	PR effect
mean	-0.08	56.1	1064	0.17
sd	0.00	0.5	420	0.03
0.025quant	-0.09	55.1	421	0.12
0.5quant	-0.08	56.1	1003	0.17
0.975quant	-0.08	57.2	2043	0.23
mode	-0.08	56.0	885	0.17

Effects

Hyperparameters



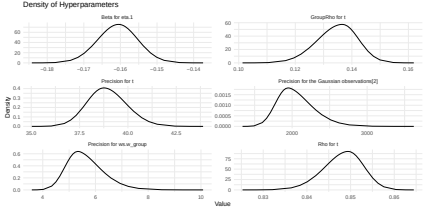
PR-AR1-NEN model

Parameters summary

	Intercept	Gau prec	Wind RW prec	AR prec	Rho T	Group Rho	PR effect
mean	-0.12	2059	5.64	38.94	0.85	0.13	-0.16
sd	0.01	247	0.70	1.03	0.00	0.01	0.01
0.025quant	-0.13	1659	4.50	37.04	0.84	0.12	-0.17
0.5quant	-0.12	2032	5.56	38.90	0.85	0.13	-0.16
0.975quant	-0.10	2626	7.25	41.08	0.86	0.15	-0.15
mode	-0.12	1948	5.33	38.76	0.85	0.14	-0.16

Effects

Hyperparameters

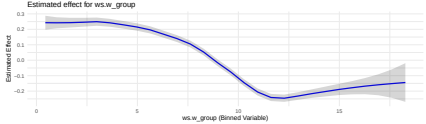


ST-NEN model

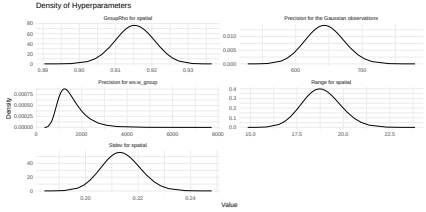
Parameters summary

	Intercept	Gau prec	Wind RW prec	Range	Spat sd	Rho t
mean	-0.09	644	1574	18.8	0.21	0.92
sd	0.01	29	604	1.0	0.01	0.01
0.025quant	-0.11	588	753	16.9	0.20	0.90
0.5quant	-0.09	644	1457	18.8	0.21	0.92
0.975quant	-0.08	703	3088	21.0	0.23	0.93
mode	-0.09	643	1246	18.7	0.21	0.92

Effects



Hyperparameters

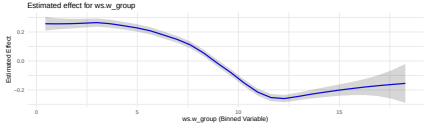


ST-PR-NEN model

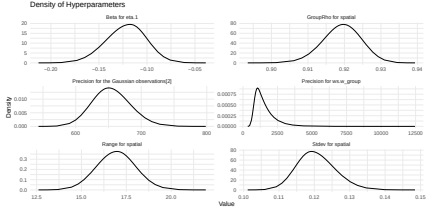
Parameters summary

	Intercept	Gau prec	Wind RW prec	Range	Spat sd	Rho t	PR effect
mean	-0.05	655	1563	16.9	0.12	0.92	-0.12
sd	0.00	30	775	1.1	0.01	0.01	0.02
0.025quant	-0.06	600	687	14.8	0.11	0.91	-0.16
0.5quant	-0.05	654	1372	16.9	0.12	0.92	-0.12
0.975quant	-0.04	716	3612	19.1	0.13	0.93	-0.08
mode	-0.05	650	1056	17.0	0.12	0.92	-0.12

Effects



Hyperparameters



Appendix

Map and mesh

Map of wind farm samples

Mesh