

How to create exceedance Monte Carlo model

Tutorial Summary:

Learn how to create the exceedance model needed for calculating production losses (other than wake loss). Performance factor curves are used to define both the loss and uncertainty associated with various loss factors. Choose from 17 performance curves to define. Run a Monte Carlo model which combines all performance factors to produce the overall composite P-table. The P50 value of the composite table is used to calculate the turbine net energy production.

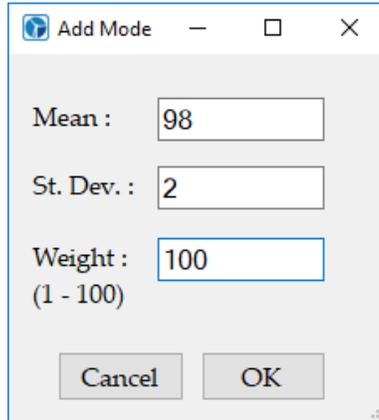
- 1) Create gross turbine energy estimates
 - See tutorial
- 2) Define Exceedance Curves
 - Each exceedance (or performance factor) curve defines the energy loss/gain (if any) and uncertainty of a parameter associated with the model creation.
 - There are 17 exceedance curve categories that may be defined in Continuum which include:
 - Turbine Availability – Owner/Operator
 - Turbine Availability – OEM
 - Power Curve
 - Power Curve Degradation
 - Electrical
 - Wind Rose Sensitivity
 - Data Measurement
 - Balance of Plant
 - Annual Wind Variability
 - Extreme Wind
 - Icing
 - Grid
 - Catastrophic Event
 - Short-Term MCP
 - Shear Extrapolation
 - Wind Flow Model
 - Wake Loss Model
 - Curves may be added, edited, or imported, or default curves may be used. Each of these options is explained in the following subsections.

Add Curve

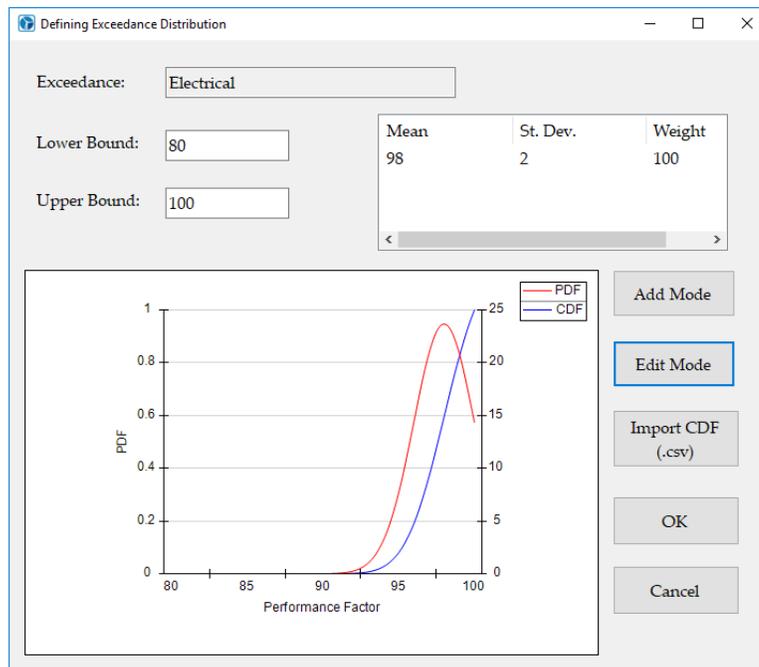
- Click “Add Curve” on the Exceedance Modeling tab.
- Select an exceedance curve from the dropdown list.
- Specify the lower and upper bounds of the curve.

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- For example, the electrical performance factor has a physical upper limit and should be set to 100.
- Add a mode and specify the mean, standard deviation, and weight.
- Multiple modes may be added to form multi-modal distributions.
- Enter the values as percentages:



- After successfully adding a mode, the probability density function (PDF) and cumulative distribution function (CDF) are displayed as shown below.



Edit Curve

- A curve that has been defined will be listed in the “Summary of Defined Exceedance Curves” table.
- To edit a curve, select one from the list and click “Edit Curve”.

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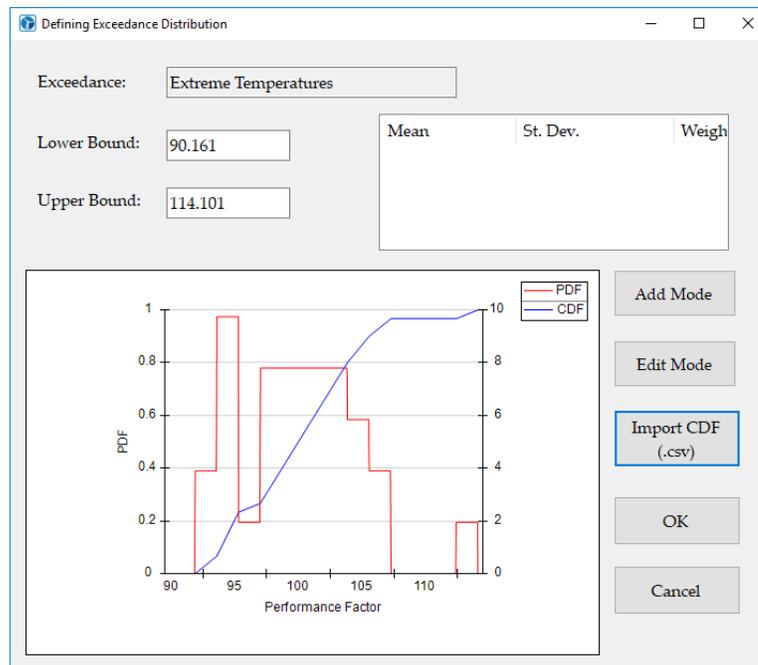
- Select a mode to edit and click “Edit Mode”.

Import Curves

- Create a CDF and save file as a .csv.
- The file must contain two columns: Performance Factors and CDF.

	A	B	C
1	90.16068	0	
2	91.87069	0	
3	93.58069	0.066667	
4	95.2907	0.233333	
5	97.00071	0.266667	
6	98.71071	0.4	
7	100.4207	0.533333	
8	102.1307	0.666667	
9	103.8407	0.8	
10	105.5507	0.9	
11	107.2607	0.966667	
12	108.9708	0.966667	
13	110.6808	0.966667	
14	112.3908	0.966667	
15	114.1008	1	
16			
17			
18			

- Click “Add Curve” or select a defined curve and click “Edit Curve”.
- Click “Import CDF (.csv)” and select .csv file with defined CDF.



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Set to Default Curves

- Click "Set to Default" to use the default exceedance curves.

Import/Export All Curves

- Click "Export Curves" to create a .csv file containing all defined exceedance curves.
- Click "Import Curves" to read defined exceedance curves.

3) Run Monte Carlo model

- Click "Do Monte Carlo" on the Exceedance Modeling tab.
- When the model is complete, the composite exceedance P-Values are displayed as shown below. The P50 1-year composite value is used to estimate the P50 net energy estimate.

P Value	1 yr PF	1yr AEP	10 yr PF	10yr AEP	20 yr PF	20yr AEP
<input type="checkbox"/> P1	1.095		0.963		0.946	
<input type="checkbox"/> P10	1.007		0.936		0.927	
<input type="checkbox"/> P50	0.903		0.904		0.904	
<input type="checkbox"/> P90	0.805		0.873		0.882	
<input type="checkbox"/> P99	0.728		0.847		0.864	

- Create a wake model in the Net Turbine Ests tab. The P-Value distributions for the selected turbine will be displayed as shown below.

P Value	1 yr PF	1yr AEP	10 yr PF	10yr AEP	20 yr PF	20yr AEP
<input type="checkbox"/> P1	1.095	4112	0.963	3618.11	0.946	3554.38
<input type="checkbox"/> P10	1.007	3783.17	0.936	3517.52	0.927	3482.9
<input type="checkbox"/> P50	0.903	3390.95	0.904	3396.82	0.904	3397.68
<input type="checkbox"/> P90	0.805	3025.24	0.873	3278.24	0.882	3313.6
<input type="checkbox"/> P99	0.728	2735.65	0.847	3181.08	0.864	3245.29