ECE 588

Fall 2018
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Homework 1

due Thursday, September 20, 2018

1. Consider a multi-state model for the availability of a generating unit. For example, for a 3-state unit we have

$$\underset{\sim}{A}_i = \begin{cases} c_i & \text{with probability } p_i \\ d_i & \text{with probability } s_i \\ 0 & \text{with probability } (1 - p_i - s_i) \end{cases}$$

Here, d_i is a derated or partial capacity of the unit, where $0 < d_i < c_i$. A k–state representation with $k > 2$ will have $k - 2$ derated or partial capacities with associated probabilities. Thus,

$$\underset{\sim}{A}_i = \begin{cases} c_i & \text{with probability } p_i \\ d_i^1 & \text{with probability } s_i^1 \\ d_i^2 & \text{with probability } s_i^2 \\ \vdots & \\ d_i^{k-2} & \text{with probability } s_i^{k-2} \\ 0 & \text{with probability } 1 - \sum_{j=1}^{k-2} s_i^j - p_i \end{cases}$$

Here, d_i^j, $j = 1,2, \ldots, k-2$ are the derated or partial capacities with $0 < d_i^{k-2} < d_i^{k-3} < \ldots d_i^1 < c_i$.

Derive the convolution formula for the multi-state unit representation, i.e., the formula for evaluating $P\left\{\sum_{i=1}^{n} \underset{\sim}{A}_i \le x\right\}$ where $\underset{\sim}{A}_i$ is the available capacity *r.v.* of a k–state unit i.

2. **Compute** the available capacity table using the convolution formula for the 3-unit system with the following parameters:

i	c_i (MW)	p_i
1	400	.99
2	500	.98
3	600	.97

3. **Compute** the *LOLP* for a week for the daily peak load forecast given below. Assume that the supply system consists of the units in problem 2.

day	*Sun*	*Mon*	*Tue*	*Wed*	*Thur*	*Fri*	*Sat*
daily peak *MW*	600	1,100	1,200	1,100	1,200	1,200	800

What units is the weekly *LOLP* expressed in? Please **interpret** the result, i.e., **explain** what the *LOLP* value means.

4. **Develop** a relationship between hourly *LOLE* and daily *LOLE*.

5. **Compute** the contribution to the *EUE* of the daily peak loads for the weekly load in problem 3. Assume that each daily peak has a 1-*hour* duration.