PJM Capacity Performance: Probabilistic Weather Alert Analysis Proposal
Probabilistic Weather Alert Analysis

● Objective
  ✓ Estimate the total number of weather events per season
  ✓ Dec, Jan, Feb and Mar are defined as the winter season and any all other months are considered as the summer season
  ✓ Aggregate these events into yearly basis

● Assumptions
  ✓ Summer and winter weather alert events are random variables generated from different probability distributions. Distributions are independent
  ✓ Alerts in a given month can be seen as a set of discrete events (1,2,3,4...) which can be counted. As alerts are discrete values and always >0 distribution is not normal
  ✓ Alerts are dependent on season and temperature

● Model
  ✓ This particular situation fits the logical requirements of the Poisson Distribution: the occurrence of a weather event is discrete, is never negative and occurs randomly (based on the weather outcome) and independently in time
  ✓ Model is to estimate probability of observing a given count of events (1,2,3,4,..) within a certain period of time given temperature and season (winter/summer) using a Poisson regression
Cold Weather Alerts Analysis

✓ Plot above shows probability density function (blue bars) and cumulative probability function (red curve) for alerts given in the winter season and average monthly winter temperatures
  • Note distribution is asymmetric to the right and bound to zero to the left
✓ The probability/percentile of 224 hours or lower of cold weather alert in a year is 66%
✓ There is 90% probability of having an event less or equal to 455 hours per year or a probability of having an event higher than 455 hours is 10% (P90 = 455 hours)
✓ The probability of having an event lower or equal to 54 hours per year is 20% (P20 = 54 hours)

<table>
<thead>
<tr>
<th>CWA</th>
<th>Probability</th>
<th>Total Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20.00%</td>
<td>53.98</td>
</tr>
<tr>
<td></td>
<td>66.29%</td>
<td>223.87</td>
</tr>
<tr>
<td></td>
<td>90.00%</td>
<td>454.88</td>
</tr>
</tbody>
</table>
Hot Weather Alerts Analysis

✓ Plot above shows probability density function (blue bars) and cumulative probability function (red curve) for alerts given in the summer season and average monthly summer temperatures
  • Note distribution is asymmetric to the right and bound to zero to the left
✓ The probability/percentile of 355 hours or lower of hot weather alert in a year is 67%
✓ There is 90% probability of having an event less or equal to 683 hours per year or a probability of having an event higher than 683 hours is 10% (P90 = 683 hours)
✓ The probability of having an event lower or equal to 87 hours per year is 20% (P20 = 87 hours)
Conclusion

✓ The probability of 579 hours or lower of cold and hot weather alerts in a year is 67%
  • Note that given the skewness to the right of distribution centroid of the distribution is also to the right therefore expectation occurs at levels above 50%

✓ There is 90% probability of having an event less or equal to 1138 hours per year or a probability of having an event higher than 1138 hours is 10% (P90 = 1138 hours)

✓ The probability of having an event lower or equal to 455 hours per year is 20% (P20 = 455 hours)