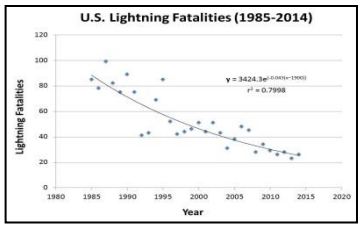
Predicting the Expected Number of U.S. Lightning Fatalities for a Year and for a Date within that Year

William P. Roeder *(wroeder@cfl.rr.com)*
Private Meteorologist
Rockledge, FL

Curve-fitting of U.S. Annual Lightning Fatality Rate is Updated and Refined

Update to Annual Model: Curve-fitting needed since 30-Yr & 10-Yr running means overestimate lightning fatality rate

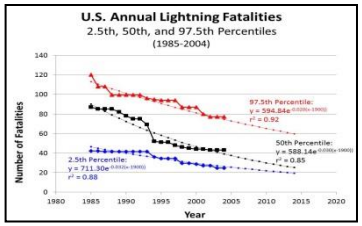
- **New Period of Record (1985-2014)**
  - Previous POR (1941-2010)
    - -- 1941-1984 not used to make curve more representative of present time
  - 2011-2014 added
- **Added 2.5th and 97.5th percentiles to previous percentiles**
  - Allows 2-tail hypothesis testing at 95% significance level
- **Applications:** Expected annual lightning fatalities and hypothesis testing
  - 2014 Expected Median = 23.0 deaths, 95% Confidence Interval = 18.5 to 60.8 deaths
    - -- Observed = 26 deaths. Slightly more than expected, but well within the 95% error bar
    - -- Broke pattern of 6 consecutive years (2008-2013) of less than expected fatalities, but barely
  - 2015 Expected Median = 22.0 deaths, 95% Confidence Interval = 17.9 to 59.6 deaths



Expected Median:

$y = 4889.1e^{-0.047(x-1900)}$

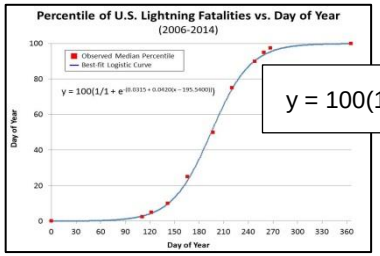
$r^2 = 0.93$



Percentile	Equation	r^2
2.5th	$y = 711.30e^{-0.032(x-1900)}$	0.90
5th	$y = 588.14e^{-0.030(x-1900)}$	0.85
10th	$y = 1148.90e^{-0.036(x-1900)}$	0.83
25th	$y = 3013.30e^{-0.045(x-1900)}$	0.87
50th (median)	$y = 4889.10e^{-0.047(x-1900)}$	0.92
mean	$y = 2283.00e^{-0.038(x-1900)}$	0.99
75th	$y = 3605.60e^{-0.041(x-1900)}$	0.88
90th	$y = 1814.50e^{-0.033(x-1900)}$	0.80
95th	$y = 759.41e^{-0.023(x-1900)}$	0.88
97.5th	$y = 594.84e^{-0.020(x-1900)}$	0.92

Update to Within-Year Model:

- **New Period of Record (2006-2014)**
  - Previous POR (2006-2011); 50% larger sample size
- **Added 2.5th and 97.5th percentiles to previous percentiles**
- **Best-fit logistic curve for percentile by day-of-year**
- **Applications:** Expected lightning fatalities by day of year and hypothesis testing
  - Median of U.S. Lightning Fatality Season is 15 July
  - Expected Median U.S. Lightning Fatalities through 4 Jul 2015 = 8.8 deaths, 95% C.I. = 7.2 to 23.8
  - EXCEL Tool: enter date, get expected deaths for year, that date, and 95% confidence interval



$y = 100(1/(1 + e^{-(0.0315 + 0.0420(x - 195.5400))}))$

Percentile	Median Date
0	1 Jan
2.5th	25 Apr
mean (standard deviation)	15 Jul (45.6 days)
75th	9 Aug
90th	5 Sep
95th	18 Sep
97.5th	26 Sep
100th	31 Dec