

# BIRDSTRIKES

An analysis of NAOMS birdstrike data patterns, trends, and structures over the 2001 thru 2003 timeframe yielding useful insights on workable statistical approaches for NAOMS data

# Purposes of this Exercise

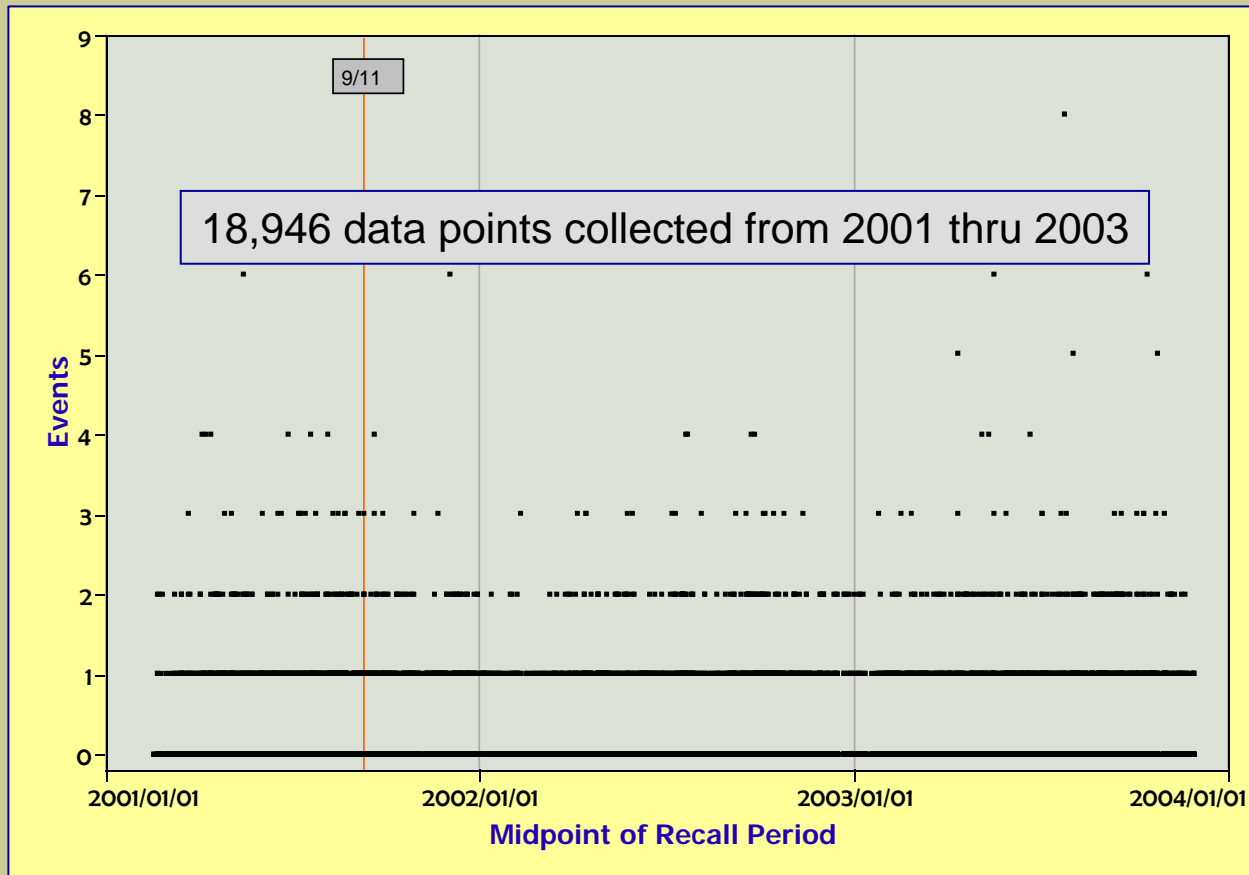
1. Provide a case example of NAOMS rate and trend development
2. Demonstrate the internal consistency and plausibility of NAOMS data
3. Develop a fuller understanding of birdstrike event rates and the factors that influence them

# NAOMS Birdstrike Question

## Section B, Question AC1:

“During the last 60 days, how many times did an aircraft in which you were a crewmember experience a bird strike?”

# NAOMS Raw Birdstrike Data



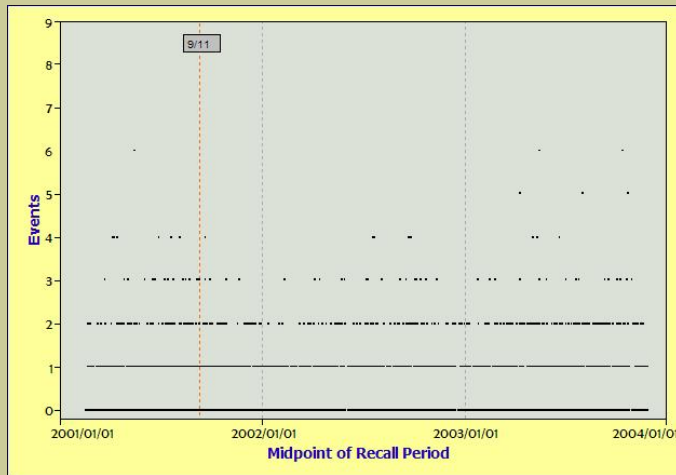
## Observations:

- Very difficult to see patterns and trends in raw data
- Need different visualization approach
- Data may need to be grouped or accumulated to be meaningfully analyzed.

**Preliminary Analysis Subject to Validation and Correction**

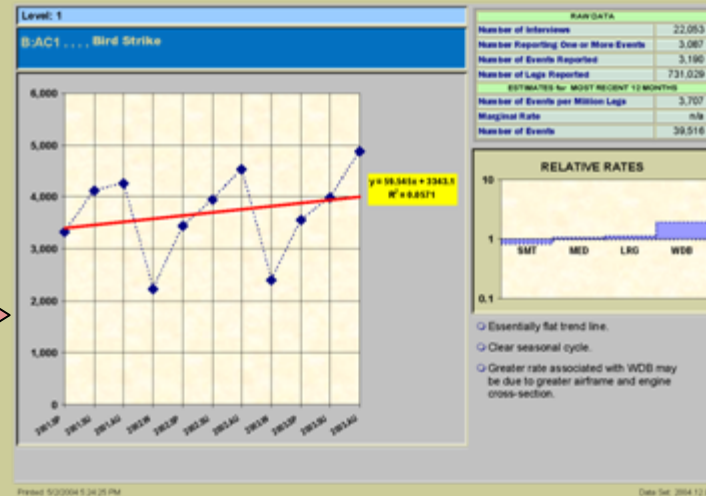
# We need to get from . . .

Here



to Here

## NAOMS EVENT RATE TRENDS

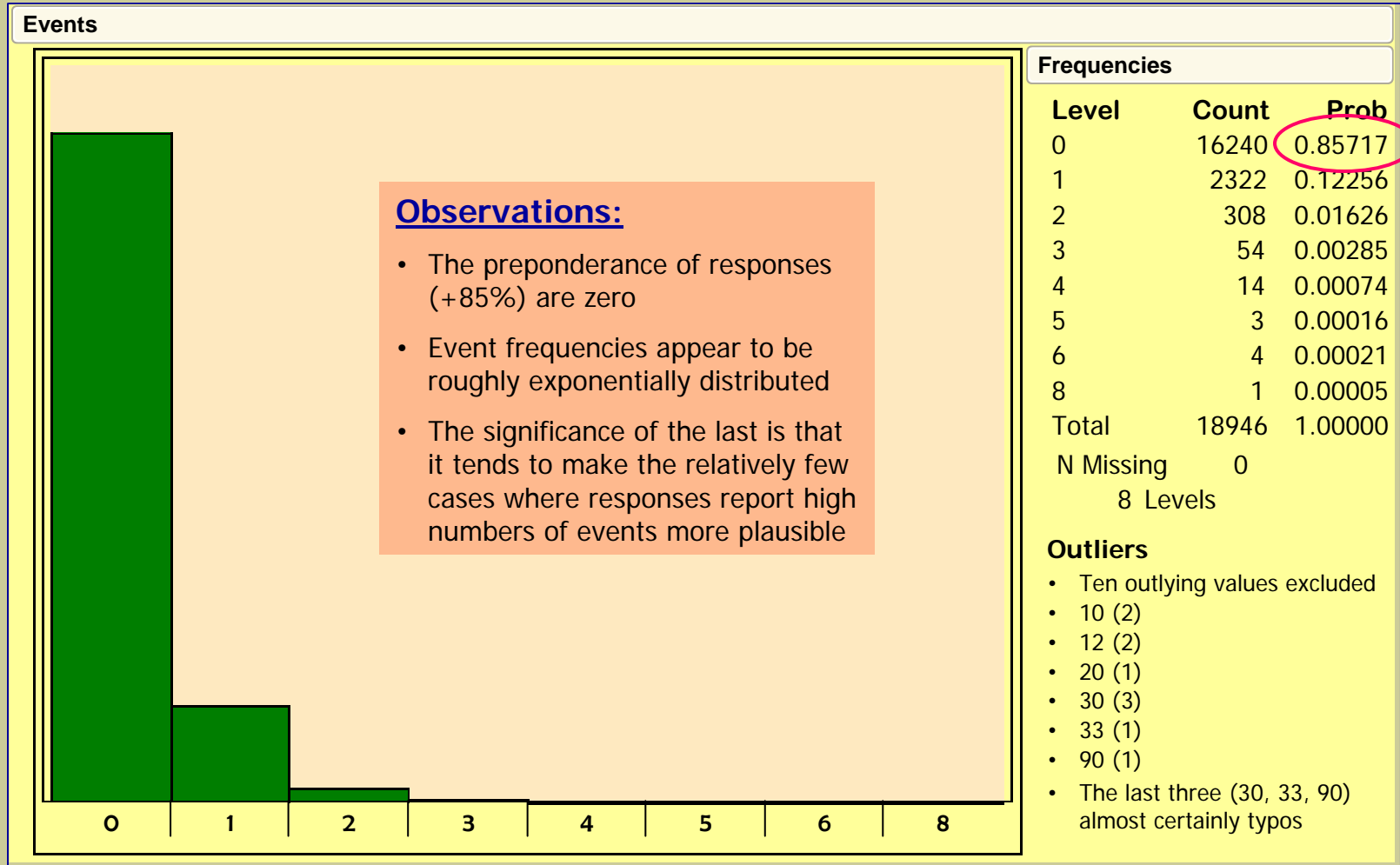


and Beyond

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# Birdstrike Frequencies

(based on a 60-day interviewee recall period)

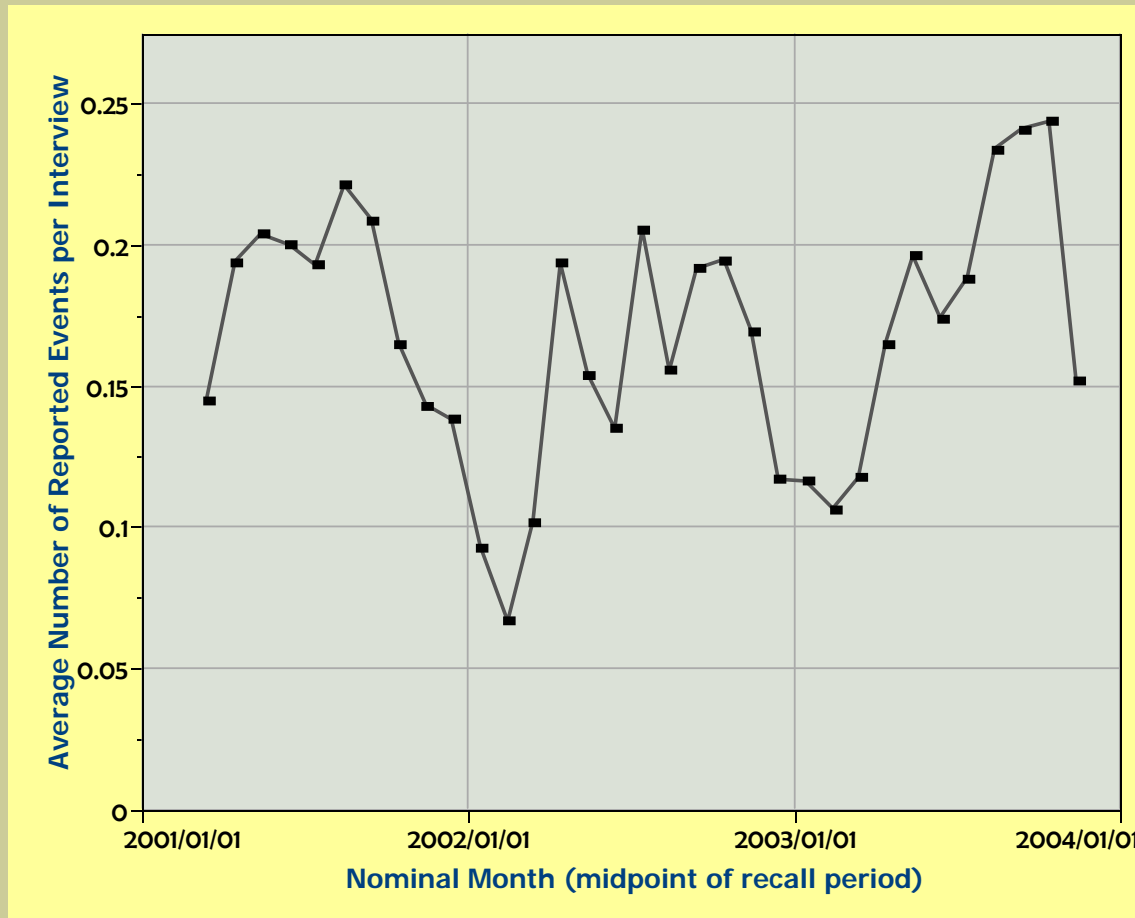


Note: Based on NAOMS data collected through 2003/12/31

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# Birdstrike Data Grouped by Month



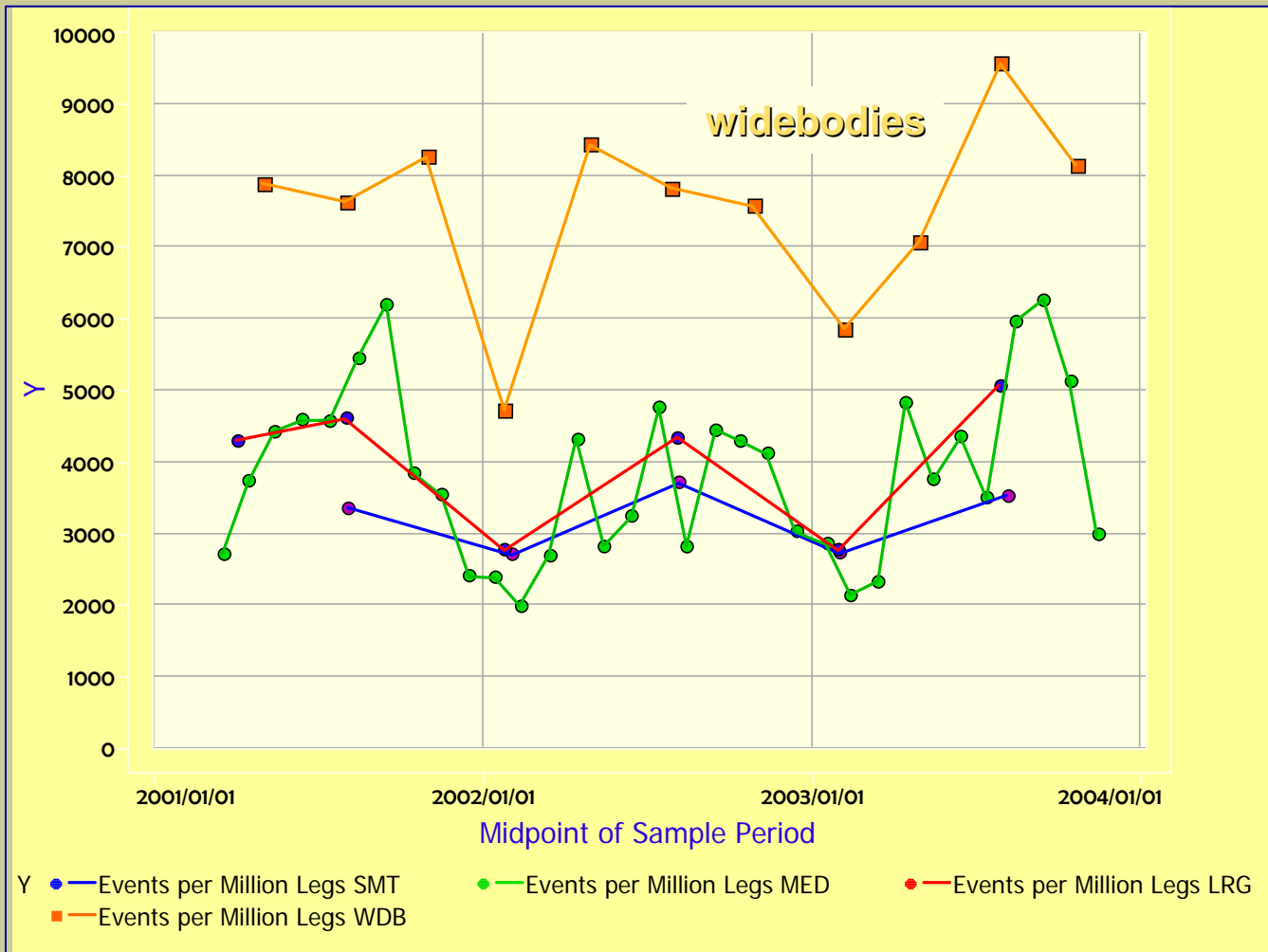
## Observations:

- Pronounced seasonal pattern
- Great deal of variability in the data
- Calculating rate as reported events per survey interview not operationally meaningful

Note: Based on NAOMS data collected through 2003/12/31

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# Grouped Birdstrike Rates by Aircraft Size



## Observations:

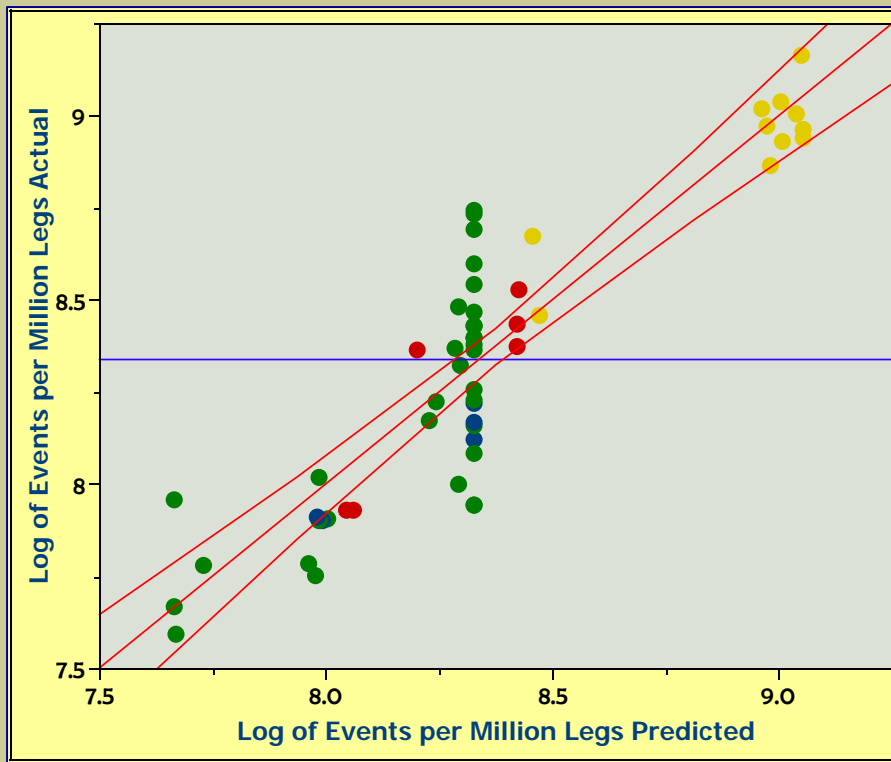
- Widebody rate distinctly higher than rates for other aircraft size category
- Pronounced seasonal pattern evident for all aircraft weight categories

Note: Based on NAOMS data collected through 2003/12/31

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# Results of Model Analysis

The rate data were logarithmically transformed and then analyzed using standard regression techniques.



## Summary of Fit

RSquare	0.810704
RSquare Adj	0.803423
Root Mean Square Error	0.177291
Mean of Response	8.339799
Observations (or Sum Wgts)	55

## Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	8.3252386	0.031627	263.23	<.0001
Legs_WDB_pct	0.7590829	0.063441	11.97	<.0001
Winter Pct	-0.701932	0.079508	-8.83	<.0001

## Observations:

- Eighty percent of statistical rate variation explained
- All retained parameters highly significant from both operational and statistical perspectives
- Significant amount of variability involving MED sized aircraft remains unexplained.

Note: Based on NAOMS data collected through 2003/12/31

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# Final Model

## Structural Model

$$\frac{\text{Birdstrikes}}{\text{Legs}} = \text{BaseRate} \bullet \text{WDBadj}^{\text{WidebodyPct}} \bullet \text{WinterAdj}^{\text{WinterPct}}$$

## Parameterized Model

$$\frac{\text{Birdstrikes}}{\text{Legs}} = 4126.7 \bullet 2.14^{\text{WidebodyPct}} \bullet 0.496^{\text{WinterPct}} / 1000000$$

## Example: Estimated Birdstrikes by Widebodies during CY03

Season	Legs*	Formula	Result
Winter	148,000	148,000 x 4126.7 x 2.14 x 0.496 / 1,000,000	650
Spring	130,000	130,000 x 4126.7 x 2.14 / 1,000,000	1,145
Summer	89,000	89,000 x 4126.7 x 2.14 / 1,000,000	788
Autumn	118,000	118,000 x 4126.7 x 2.14 / 1,000,000	1,043
<b>TOTAL</b>	<b>485,428</b>		<b>3,626</b>

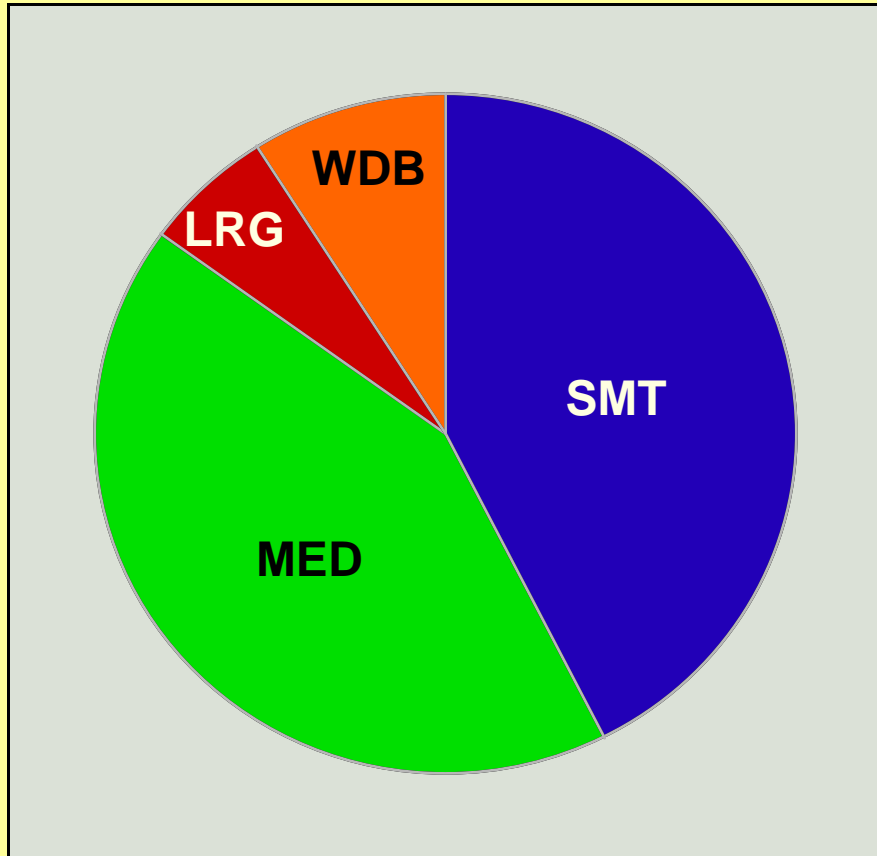
Note: Based on NAOMS data collected through 2003/12/31 \* Approximations derived from BTS data.

**Preliminary Analysis Subject to Validation and Correction**



# Projection to All Aircraft Sizes

Predicted Birdstrikes



Aircraft Size	Predicted Birdstrikes	Pct
SMT	17,175	43%
MED	17,146	42%
LRG	2,475	6%
WDB	3,626	9%
<b>Total</b>	<b>40,422</b>	<b>100%</b>

Note: Based on NAOMS data collected through 2003/12/31

**Preliminary Analysis Subject to Validation and Correction**

# Summary

## 1. Approach

- A workable approach to modeling and trending NAOMS data was described
- The process is visually rich and statistically robust
- It can be implemented with standard statistical tools.

## 2. Internal consistency and plausibility of NAOMS birdstrike data

- Consistent seasonal cycles are evident in birdstrike data
- The raw data appeared coherent and did not have any obvious discontinuities.

## 3. Fuller understanding of birdstrike events

- A model was developed that explained 80% of birdstrike rate variability
- The model is operationally plausible
- It can be used to predict future birdstrike event rates
- After external validation.

**Next Step: Validation against external data sources.**