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Animal and Plant Health Inspection Service

Development of an Animal Health Monitoring System based on Slaughter Condemnation Data

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Eighth Annual Conference
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Wolf Weber
USDA:APHIS:VS:CEAH
Center for Animal Health Information and Analysis

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Introduction

USDA – APHIS - VS – CEAH
Center for Animal Health Information and Analysis
Global Intelligence and Forecasting team

- Monitor for diseases & issues affecting animal agriculture
  - Scan for current disease outbreaks/issues
    - Global scope
  - Produce weekly bulletins, alerts, advisories
  - Produce emerging disease notices, other more extensive studies

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Objective

- Early warning of emerging disease outbreaks
  - Based on animal condemnations at slaughter
  - Build automated monitoring/alerting system
- Analysis of condemnation trends

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Objective

- Use Food Safety & Inspection Service data
  - electronic Animal Disposition Reporting System (eADRS)
    - Reports of ante and post mortem condemnations
    - Total numbers slaughtered
  - APHIS MOU with FSIS to access eADRS database

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eADRS Data

- Captures information for all FSIS-inspected facilities
- Slaughter plant-level data
- New data entered on a weekly time frame
- By species and animal type
- Total number slaughtered, by species/type
- Condemnations determined by trained inspectors
- Iowa swine data used for study
- Condemnation rates used instead of counts

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Condemnation code examples

- Actinomycosis
- Coccidioidal granuloma
- Swine erysipelas
- Misc. infections diseases
- Arthritis
- Metritis
- Pericarditis
- Pneumonia
- Central nervous system disorder
- Moribund
- Pyrexia

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Condemnation codes examined

- Deads
- Miscellaneous inflammatory disease
- Pneumonia
- Septicemia
- Skin conditions
- Swine erysipelas

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Swine erysipelas

- Endemic pathogen of swine
- Zoonosis
- Outbreaks occur periodically
- Can cause substantial losses to producers

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Previous work

- Mark Engle – National Pork Board (2006)
  - Analysis of swine erysipelas outbreak 2001
    - Laboratory and slaughter data
  - Plotted and reviewed ‘erysipelas’ condemnation data
  - Believes the outbreak could have been identified earlier by systematic monitoring of slaughter data

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Current work

- Two methods under consideration
  - Exploratory method
    - Based on historical condemnation baselines
  - Adaptive CUSUM method
    - Dr. Howard Burkom’s ‘Alerting Algorithm’ tool

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Exploratory Method

- Uses plant-level condemnation proportions
  - # condemnations / # slaughtered
- Create baseline period reference data
  - Three years of weekly data
  - Remove outliers
- Different baselines based on plant size

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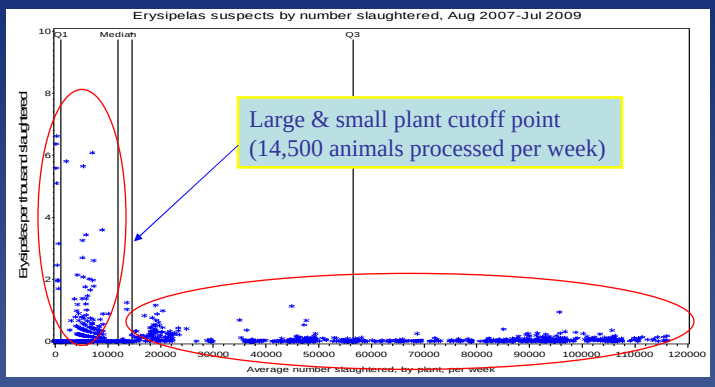
Data distribution: Swine erysipelas



Number of swine erysipelas suspects per thousand by number of swine slaughtered per plant

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Exploratory Method

- Expected values & thresholds by plant size
  - Upper bound (UB) thresholds = EV+4sd
- Account for seasonality
  - Obtain means of condemnation rates by week
  - Smoothed using 5-week moving average
- New data entered weekly compared to UBs
  - Plant level condemnation rates

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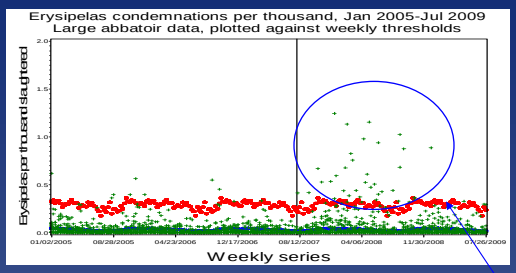
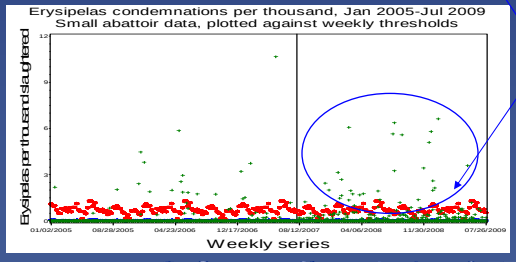
Erysipelas condemnations: exploratory method





Period of focus is August 2007 – July 2009 (to the right of reference line)

Both, large & small plants show increases in erysipelas condemnations beginning in late 2007.

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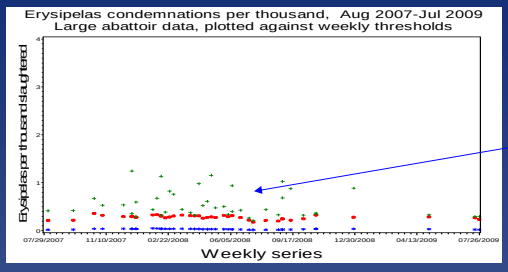
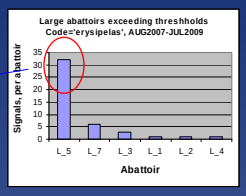
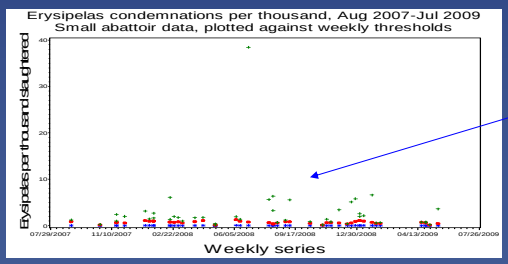
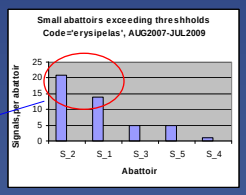
Distribution of signals – exploratory method









Frequency of weekly signals distributed across plants

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CUSUM details

- McCusum.xls tool used for comparison
- Parameters
  - Baseline length = 3 weeks
  - Baseline lag = 1 week
  - K = 0.5
  - Alerting threshold = 5

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Comparison summary

- Three of 9 Plants account for 75% of signals using exploratory method
- Same 3 Plants comprise 35% of signals using CUSUM
- CUSUM: 37 signals where no signals for exploratory
- Exploratory: 43 signals where no signals for CUSUM
- Both methods signaled 41 times during same period

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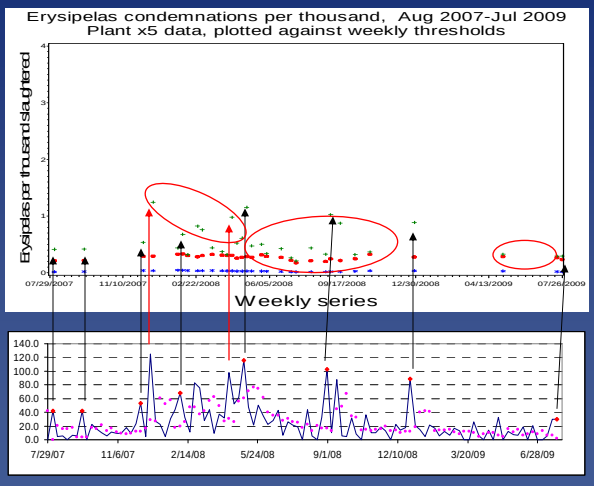
Comparison examples



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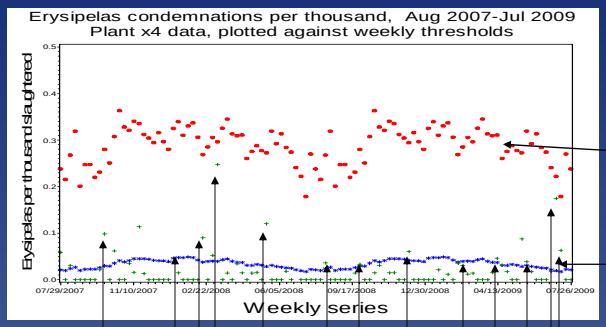
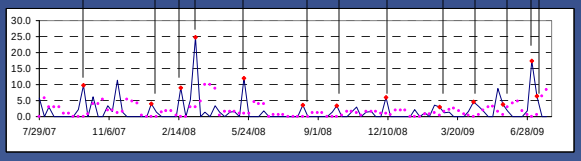
Comparison examples





Upper bounds in red.

Expected value in blue

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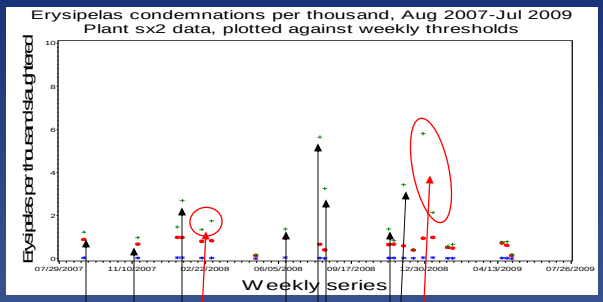
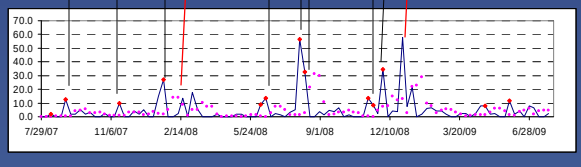
Comparison examples





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Future work

- Further explore CUSUM routines
  - Vary parameters
  - Incorporate historical data in addition to recent baselines
- Explore regression-based methods
  - Base signals on deviance from predicted values

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