HEALTH IMPACTS OF AIR QUALITY

ON THE BISHOP PAIUTE RESERVATION

FOCUS ON PARTICULATE MATTER

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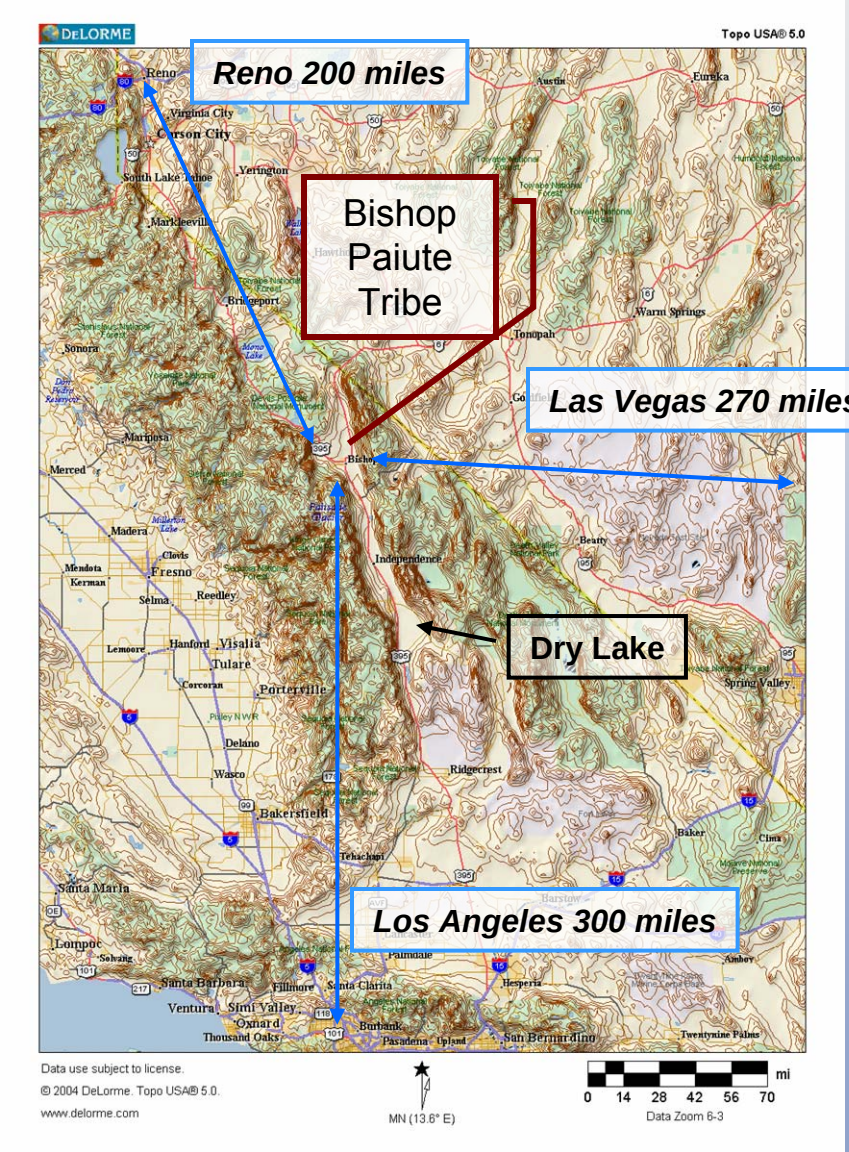
THE BISHOP PAIUTE RESERVATION IS 60 MILES FROM THE LARGEST SOURCE OF PM-10 IN THE NATION
dust
THE OWENS DRY LAKE!

WHERE IS THE BISHOP PAIUTE TRIBE?



- On the California-Nevada Border
- In the “deepest valley” at 4,000ft between the Sierra Nevada and White Mountains
- 200 miles South of Reno
- 270 miles East of Las Vegas
- 300 miles North of Los Angeles

EARLIER STUDY:
Days with the highest PM-10 concentration on the Bishop Paiute Reservation 2003-2006

- Separated high PM-10 days:
  - dry lake probably had an impact on Bishop air quality
  - did not have an impact
- Half the time, high PM-10 concentrations in Bishop were associated with dry lake activity
- **Conclusion: the dry lake has a significant impact on Bishop Reservation air quality**

BISHOP'S PARTICULATE MATTER SOURCES

- PM-10: Dust
  - Owens dry lake
  - Other barren lands
  - Dirt roads and parking lots
- PM-2.5: Smoke
  - Wood smoke for home heating
  - Wildfires
  - Controlled burns

HISTORICAL PARTICULATE CONCENTRATIONS

PM-10 HOURLY MAX

2009	593	Apr 7
2008	1,064	Feb 13
2007	698	Sept 27
2006	370	Nov 11
2005	550	Jun 25
2004	1,220	Oct 19

AQI: PM-10 above 154 is unhealthy

PM-2.5 HOURLY MAX*

2009	74	Jan 1
2008	94	Dec 94
2007	156	Jul 18
2006	96	Jan 28
2005	96	Dec 20
2004	109	Nov 24

AQI: PM-2.5 above 65.4 is unhealthy

** Excludes July 4*

HEALTH STUDY: BACKGROUND

- Few or no studies of the impacts of the dry lake
- No studies of the impact of particulate matter on Reservation populations

WHY?

- Can't use standard methods (mortality / hospitalizations) on sparse rural populations

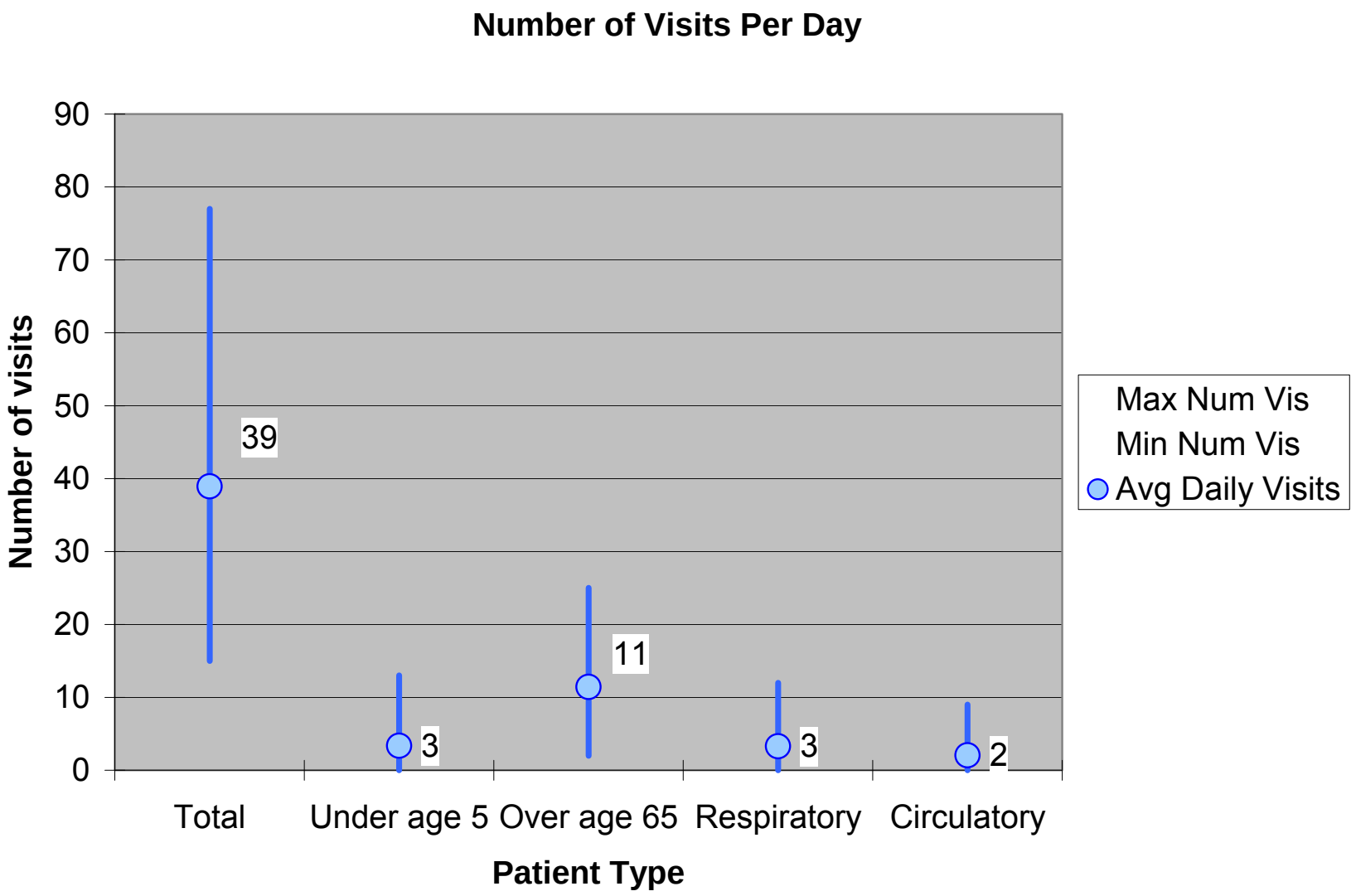
HEALTH STUDY: OUR APPROACH

- Short term impacts: 3-5 days
- Daily clinic visits as a measure of health
  - All visits
  - Under age 5 / age 65 and over
  - Respiratory / circulatory
- Link visits to daily PM-10 and PM-2.5 concentrations
  - Hourly maximum in a 24-hour period
  - 24-hour average
- Data: October 2006 to September 2007

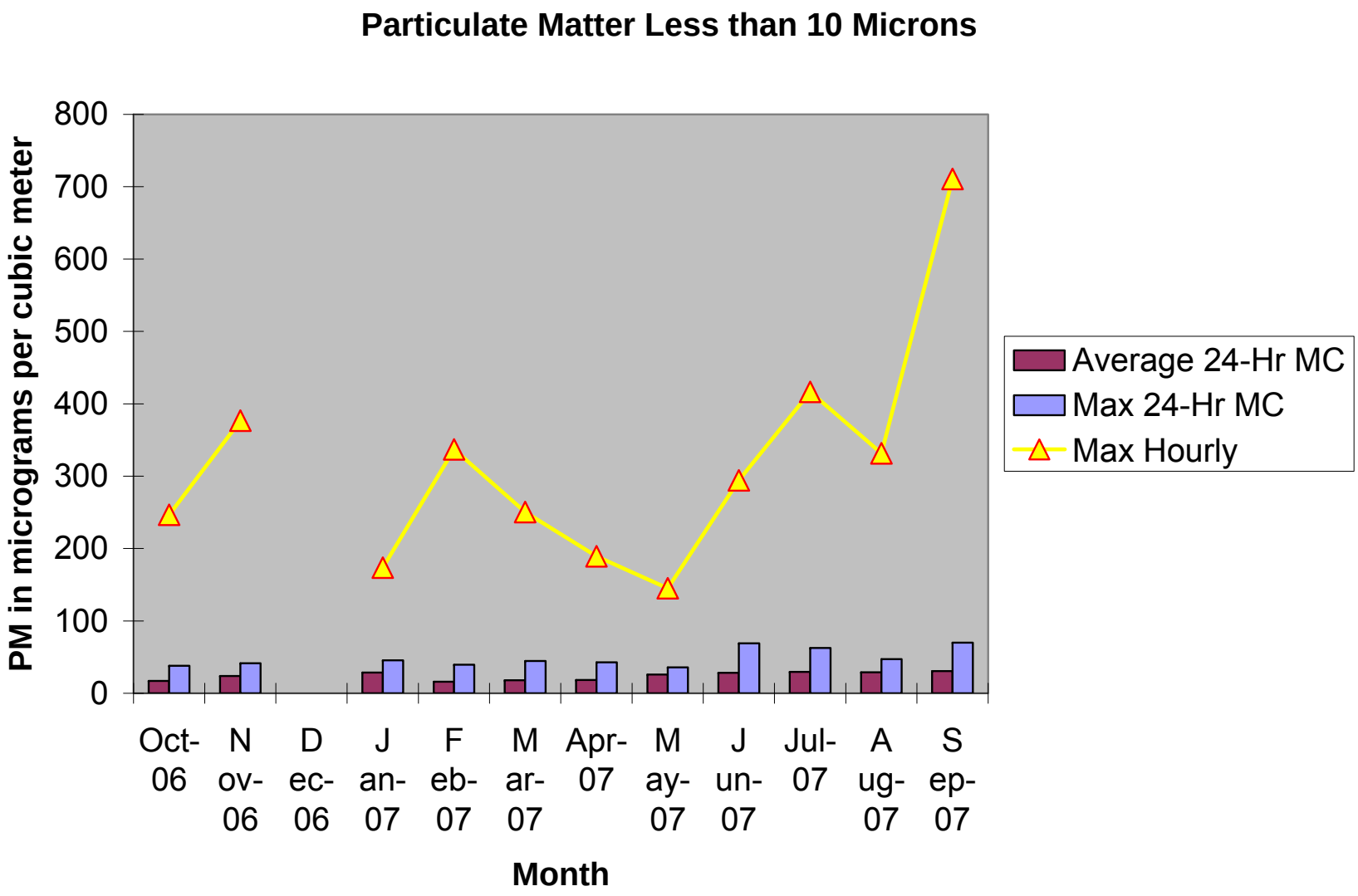
HEALTH STUDY: METHODS

- Descriptive statistics
  - Explore data structure
  - Verify data quality
- Time series correlations
  - Verify relationships among health variables and PM
    - All visits
    - Under age 5 / age 65 and over
    - Respiratory / circulatory
- Modeling
  - Standard time series methods
  - Poisson regression

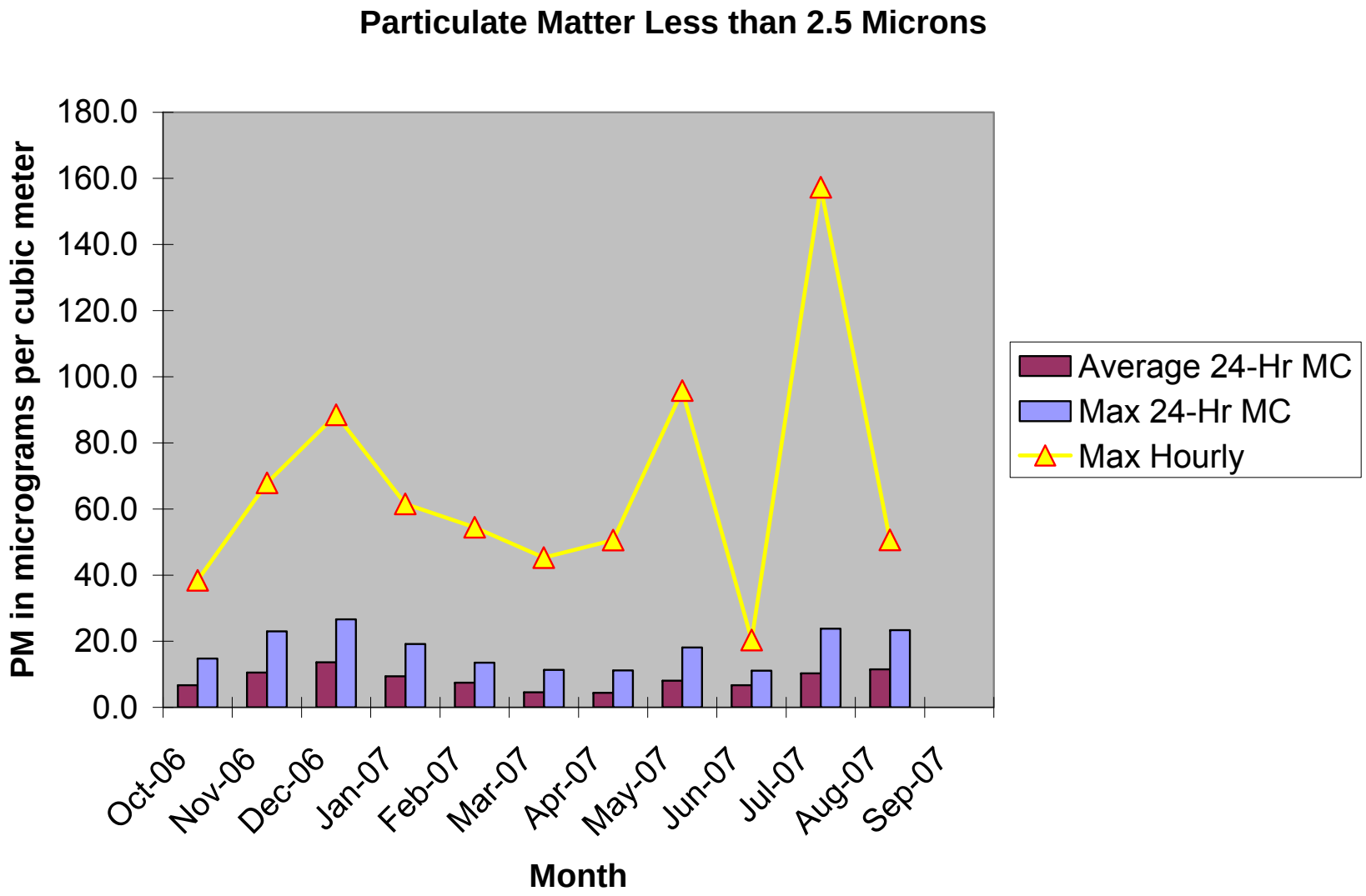
DESCRIPTIVE STATISTICS: VISITS



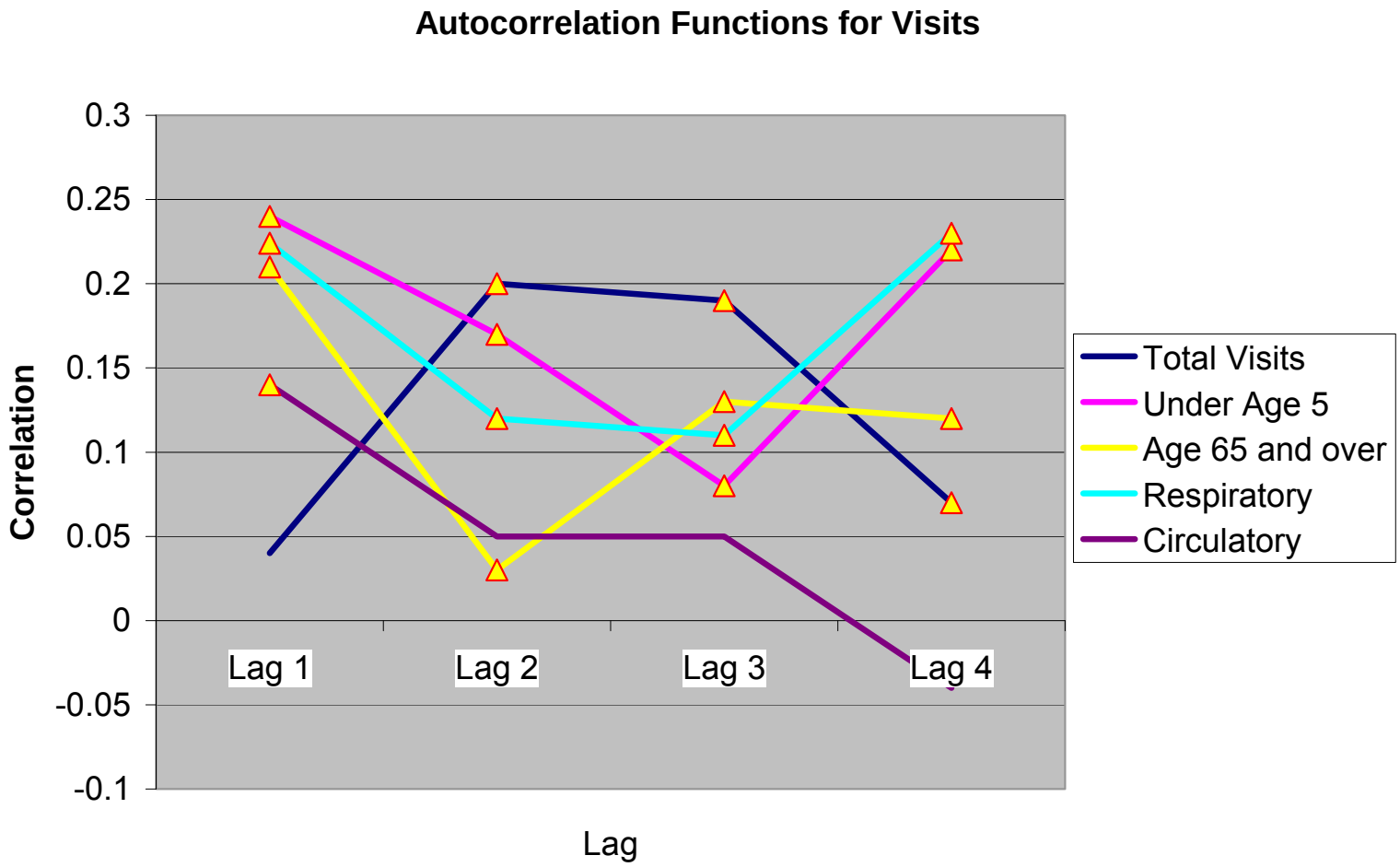
DESCRIPTIVE STATISTICS: PM-10



DESCRIPTIVE STATISTICS: PM-2.5

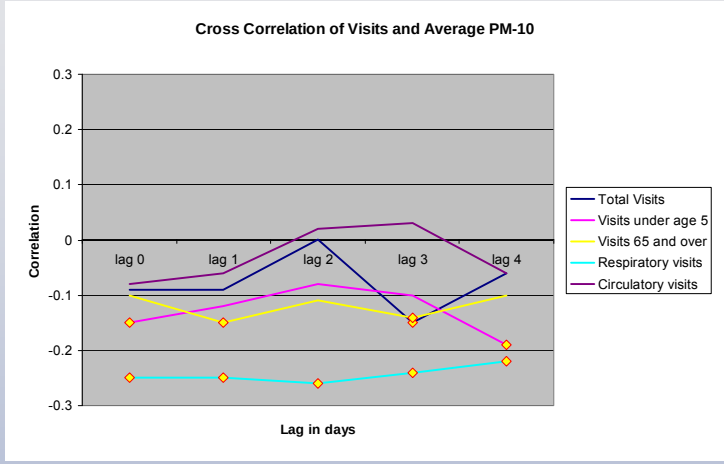


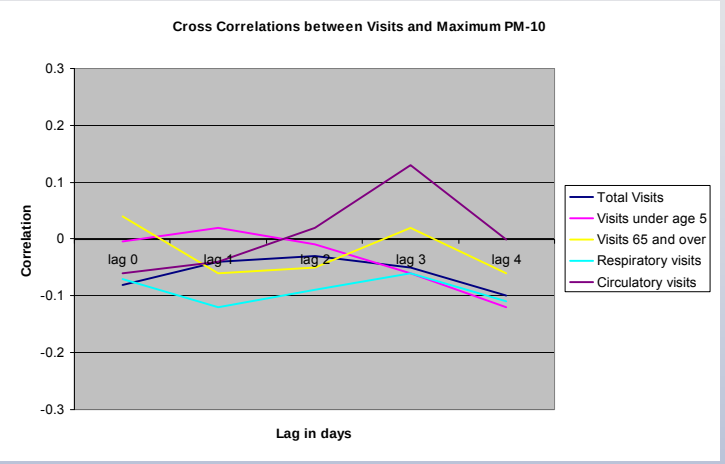
DESCRIPTIVE STATISTICS: autocorrelations for visits



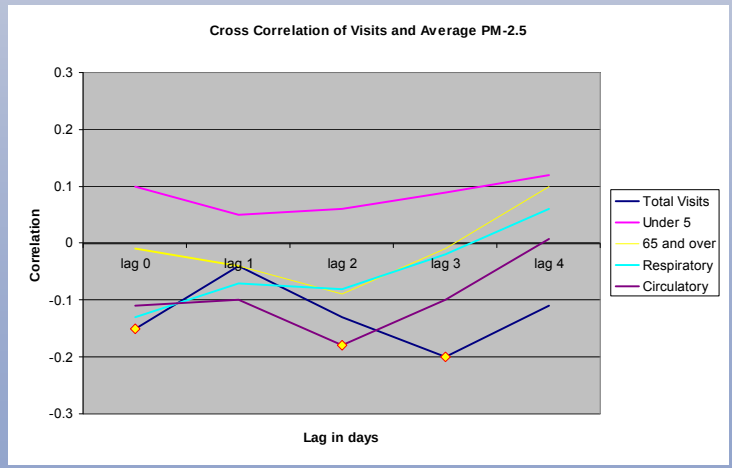
DESCRIPTIVE STATISTICS: cross correlations

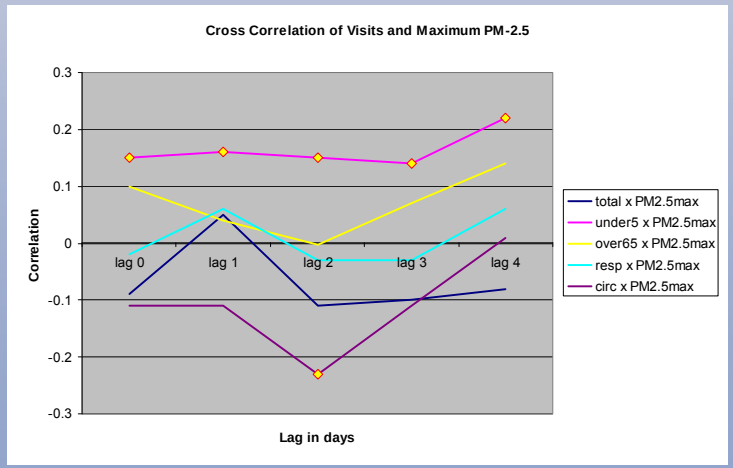
PM-10





PM-2.5





24-hour average

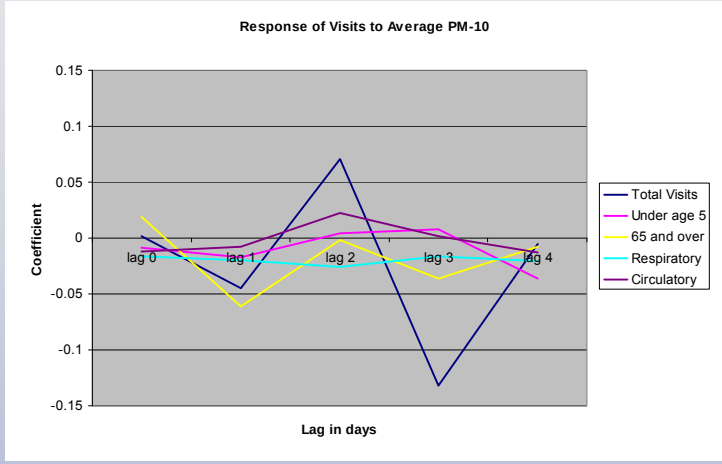
Daily hourly maximum

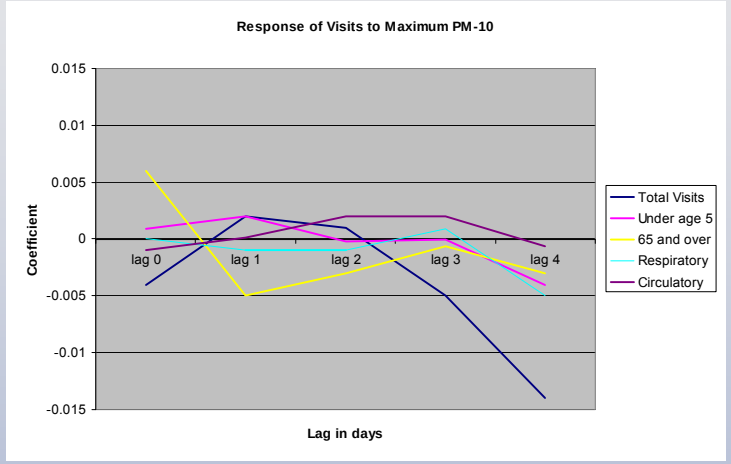
PRELIMINARY MODELING: time series methods

- Data Structure: 2nd order autoregressive process with indicator for days following a weekend or holiday
  - $Visits_t = \alpha + \beta\ weekend/holiday + \mu_t$
    - $Where\ \mu_t = \rho_1 \mu_{t-1} + \rho_2 \mu_{t-2} + \varepsilon_t$
- Distributed Lag Model
  - $Visits_t = \alpha + \beta\ PM_t + \beta_1\ PM_{t-1} + \beta_2\ PM_{t-2} + \beta_3\ PM_{t-3} + \beta_4\ PM_{t-4} + \beta_5\ weekend/holiday + \mu_t$
    - $Where\ \mu_t = \rho_1 \mu_{t-1} + \rho_2 \mu_{t-2} + \varepsilon_t$
    - *And t indexes days*

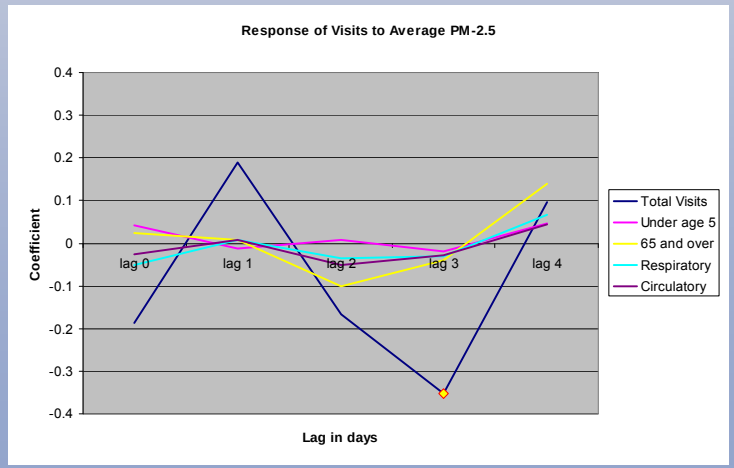
TIME SERIES RESULTS: response of visits to PM

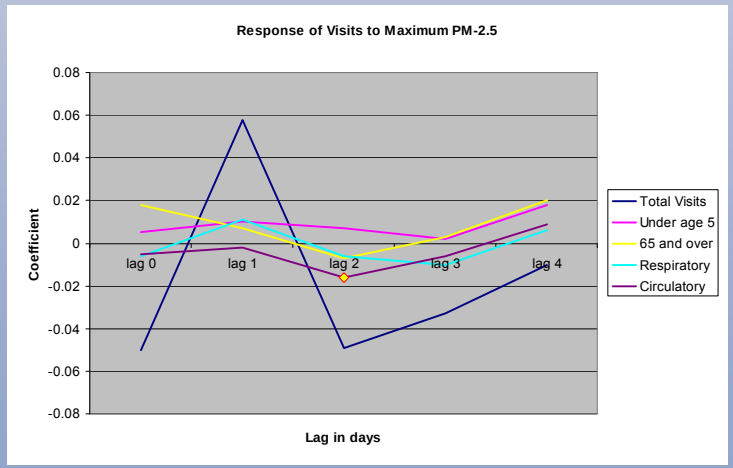
PM-10





PM-2.5





24-hour average

Daily hourly maximum

FINAL MODELING: Poisson Regression

- The number of visits follows a Poisson distribution with clustering within weeks
  - $Visits_{wt} = exposure_t\ (exp\ (\beta\ PM_t + \beta_1\ PM_{t-1} + \beta_2\ PM_{t-2} + \beta_3\ PM_{t-3} + \beta_4\ PM_{t-4} + \mu_{wt}$

    where $corr\ (\mu_{wt}, \mu_{vs}) = \rho$ *if* $v=w$

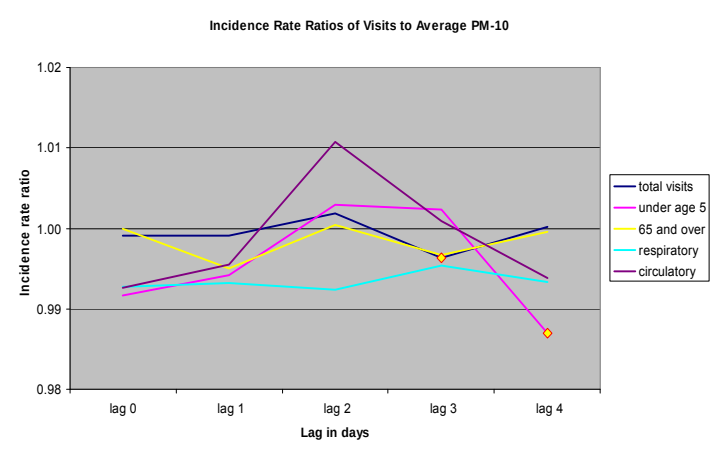
    $= 0$ *otherwise*

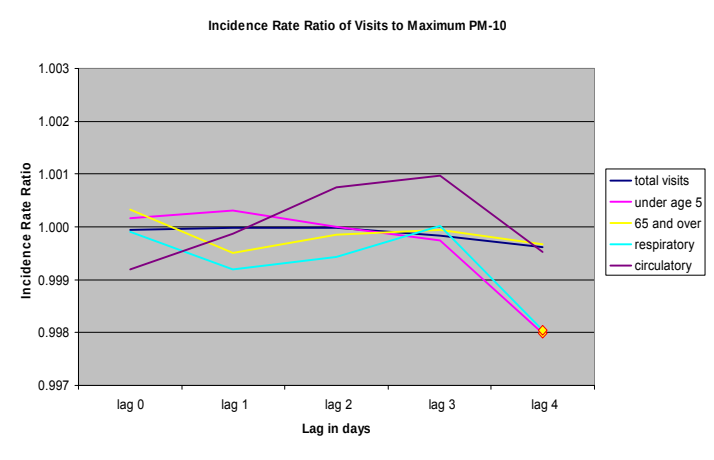
    t indexes days and w indexes weeks

    and $exposure_t = 1$ *(unknown) by assumption*
- The coefficients expβ compare the ratio of visits on days where PM increased by 1 microgram to those where it did not. Values >1 indicate a positive effect.

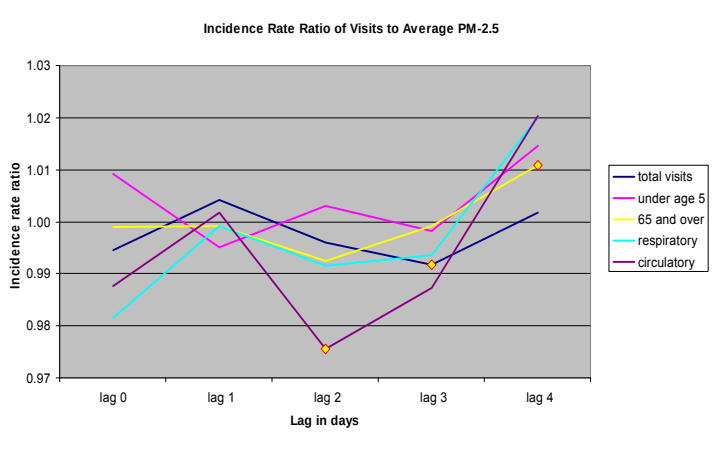
POISSON MODEL RESULTS: response of visits to PM

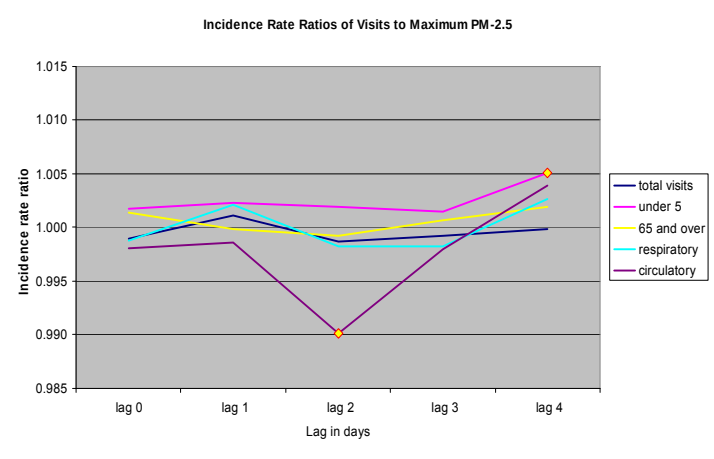
PM-10





PM-2.5





24-hour average

Daily hourly maximum

LESSONS LEARNED

- Pilot study → are clinic visits a measure of health that responds to air quality?
- Two approaches: time series and Poisson models
- Results broadly consistent across models
- **Some evidence of impact of PM-10 for circulatory visits**
- **Modest evidence of impact of PM-2.5 for pediatric visits**

NEXT STEPS

- Small sample size due to clinic closures and missing PM data (about 180 observations)
- **Next step: obtain another year of data**