Neighborhood Influences on Use of Urban Trails

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Objectives

- Present new objective measures of trail use/traffic
- Provide additional evidence on covariates of trail use
- Estimate model for forecasting traffic on existing or proposed trails

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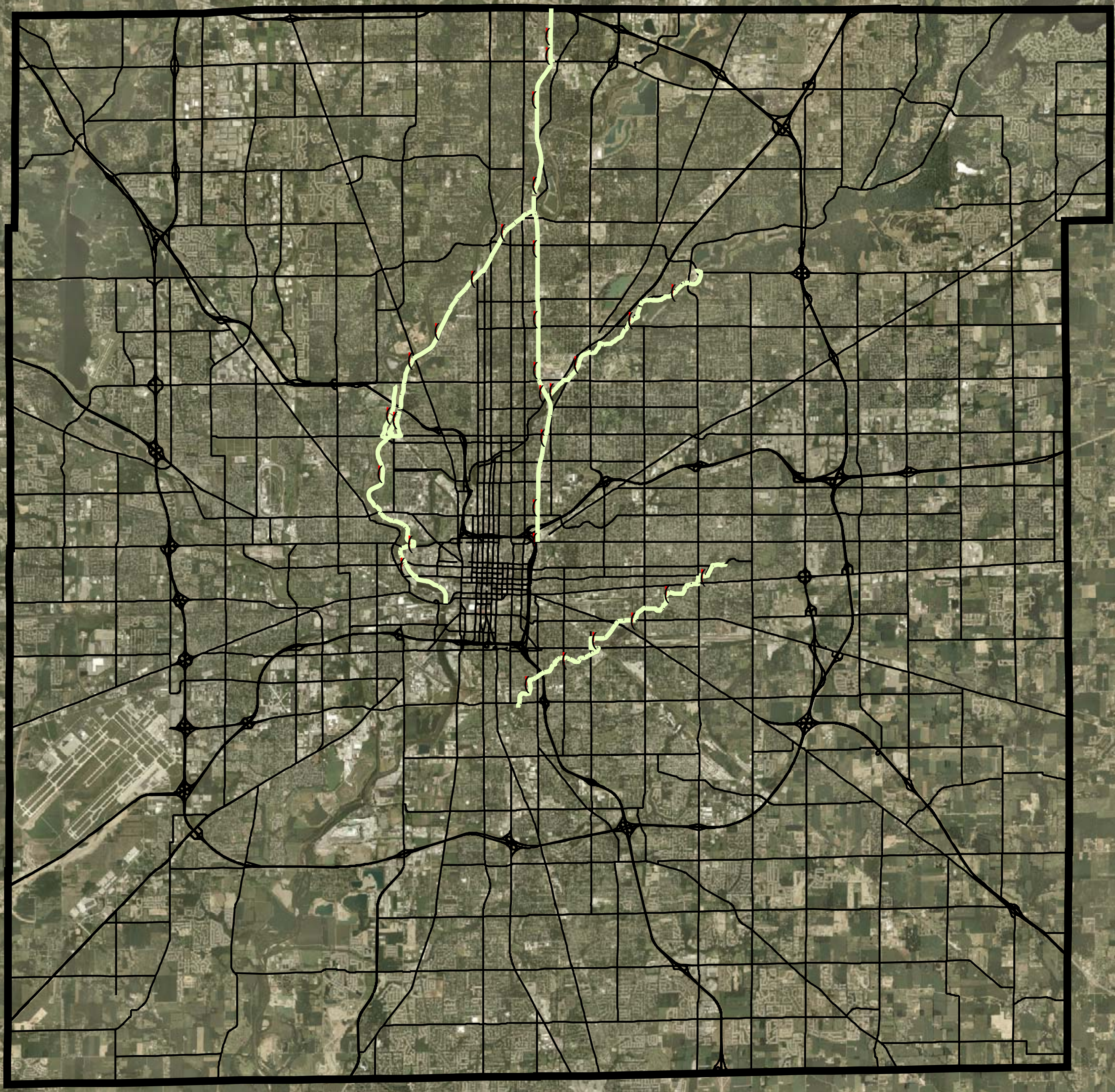
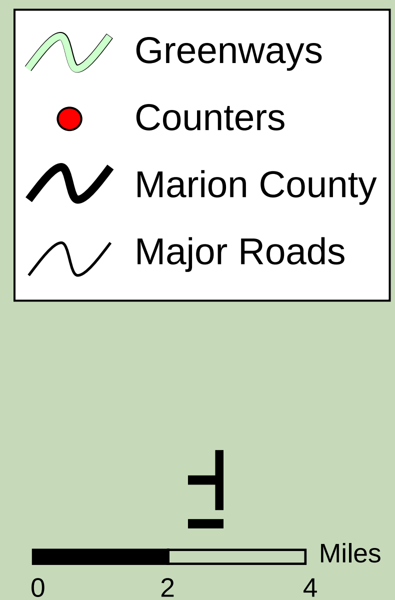
Neighborhood Influences on Use of Urban Trails

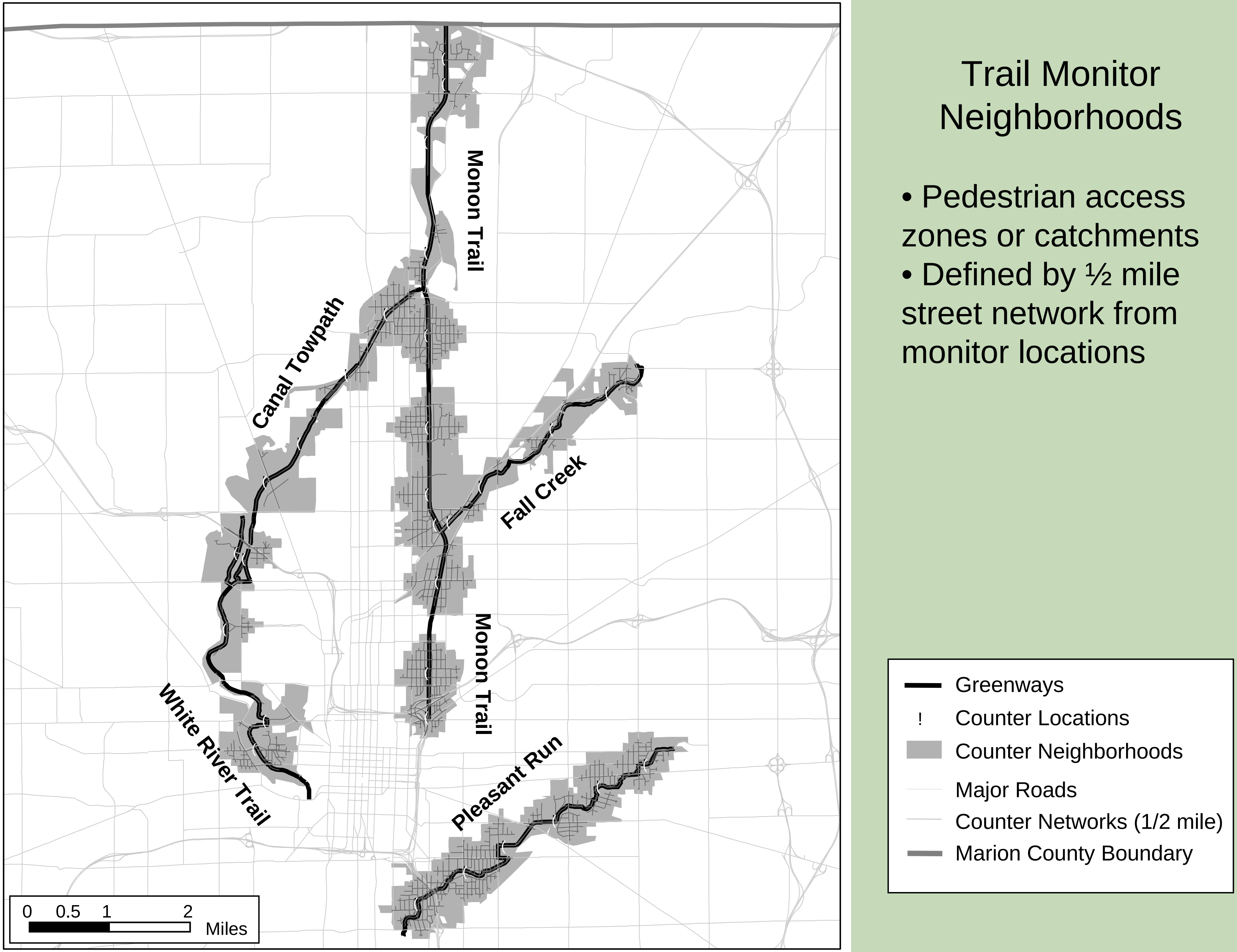
- Motivation
  - Data on use of pedestrian facilities is “poor”; priority for additional data is “high”
  - New interest in built environment and physical activity
- Approach and methods
  - Field observations, infrared monitors, GIS, regression
- Results
  - Descriptive results: user characteristics, trail traffic measures
  - Regression: model for estimating daily trail traffic
- Observations and implications

Indianapolis Greenway Monitoring Network



Greenways and monitor locations overlaid on 2003 aerial photograph of Indianapolis / Marion County, Indiana.





Trail Monitor Neighborhoods

- Pedestrian access zones or catchments
- Defined by ½ mile street network from monitor locations

Monitoring Trail Traffic

- Five trails, 33 miles network, in Indianapolis
- 30 locations
  - Four locations: 02/2001 – 11/2004
  - Two locations: 06/2002 – 11/2004
  - 24 locations: 05/2004 – 11/2004
- 24 hours/day,7 days/week
- Total daily traffic counts (N= 11,272)
- Traffic = users past point, not individual users or trips

Infrared Trail Monitor

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Field Observations of Trail Use

- Objectives
  - Develop correction equations for infrared counters
  - Obtain data on trail activity or mode and other user characteristics
  - Validate pedestrian crosswalk models (Davis, King, and Robertson 1991, Lindsey and Lindsey 2004)
- Field monitoring
  - June 2003: two trails, six locations, 166 hours
  - June & July 2004: five trails, 28 locations, 442 hours

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Correction Equations for Infrared Counters

- Estimated count =

(-0.0205 + X + 1.04563*Sqrt (Monitor Count))^2

X = 0	if 0<Monitor Traffic<=60
X = 0.2287	if 60<Monitor Traffic<=110
X = 0.3938	if 110<Monitor Traffic<=200
X = 0.4551	if Monitor Traffic>200

Adj. R^2 = .99

Activity Patterns Generally Consistent across Five Trails*

- Cyclists: 46% - 61% of observed users
- Walkers: 19% - 37% of observed users
- Runners: 5% - 23% of observed users
- Skaters and other: 1% - 10% of observed users

*2004 data; 442 hours of observation

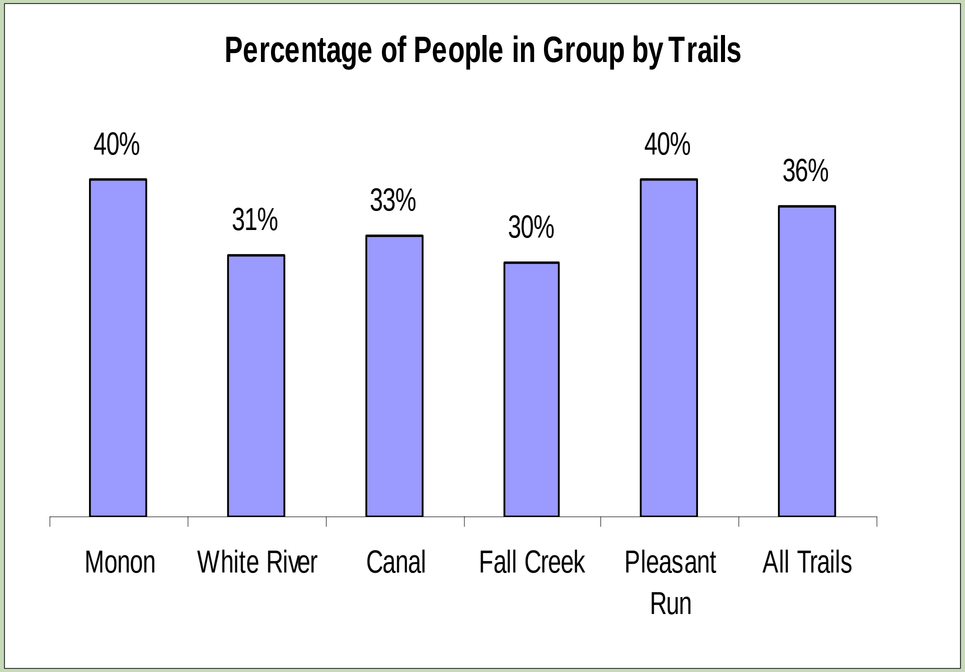
Variation in Observed User Demographics

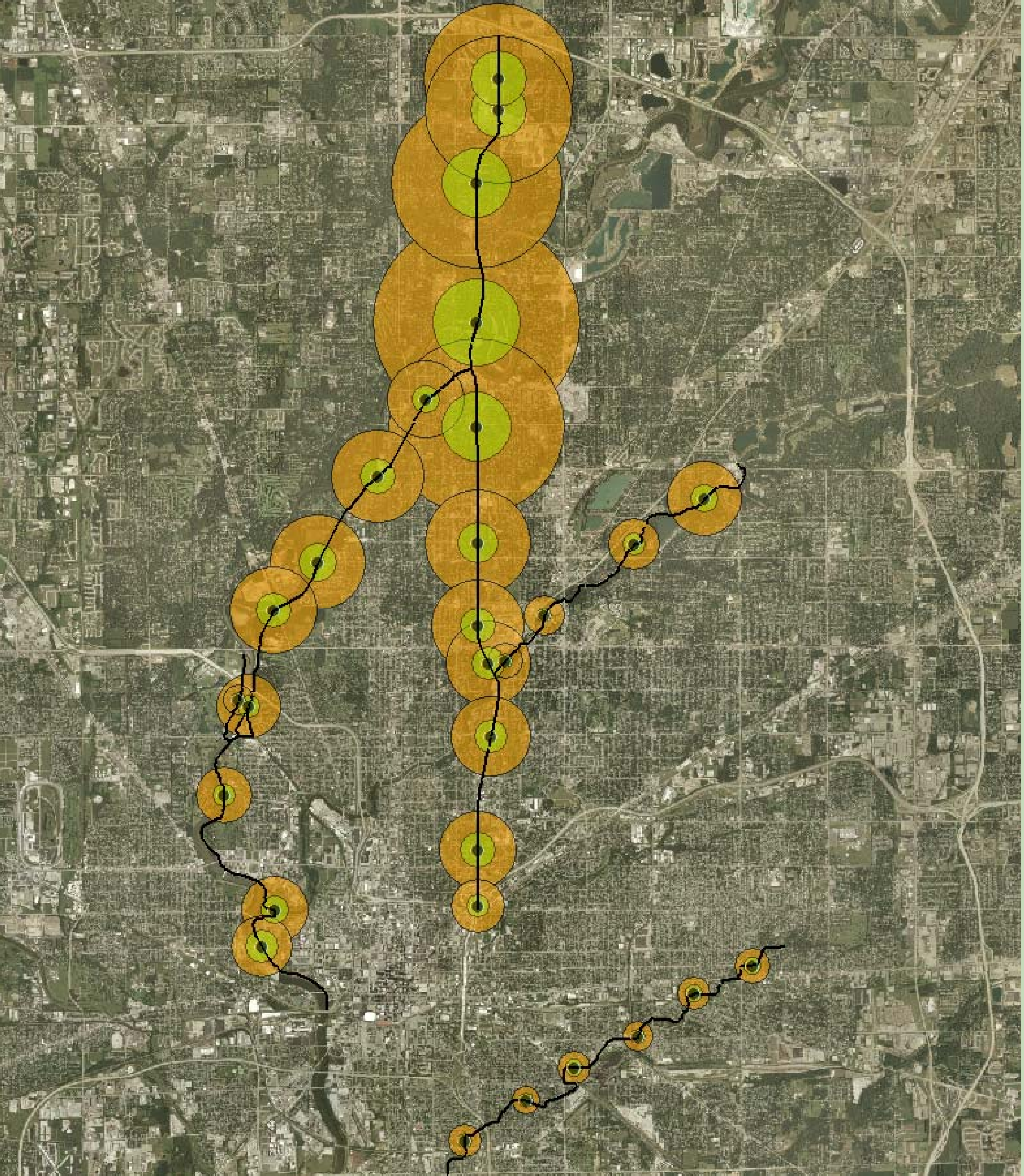
	Male	Female	White	Black	Other
Monon Trail	57%	43%	87%	11%	2%
White River	75%	25%	84%	12%	3%
Canal Towpath	56%	44%	93%	6%	2%
Fall Creek	59%	41%	58%	37%	5%
Pleasant Run	73%	27%	80%	15%	5%

People in groups (n ≥ 2) account for 30% - 40% of observed users.

Trail*	% People in Group (≥ 2)
Monon	40%
White River	31%
Canal	33%
Fall Creek	30%
Pleasant Run	40%
All Trails	36%

*2004 data; 442 hours of observation



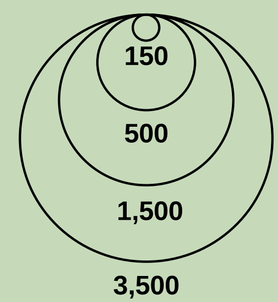


Spatial and Temporal Variation in Trail Use

Example of spatial and temporal variability in trail use depicting mean counts for week days and weekend days in September 2004.

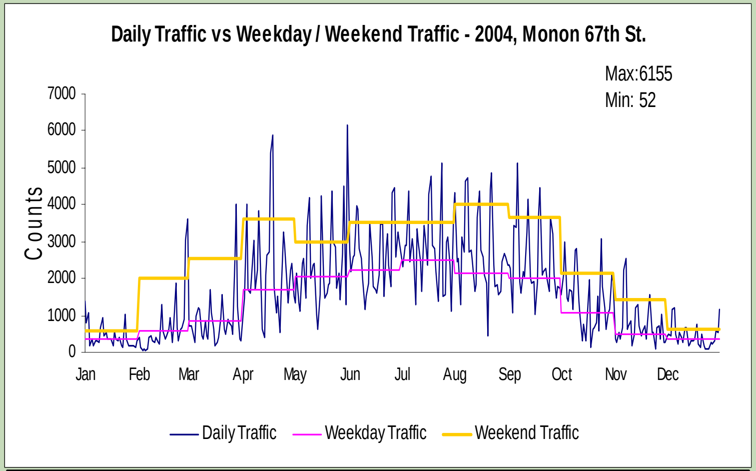
	Min	Max	Mean
Week Days	79	2,017	436
Weekend Days	105	3,670	834

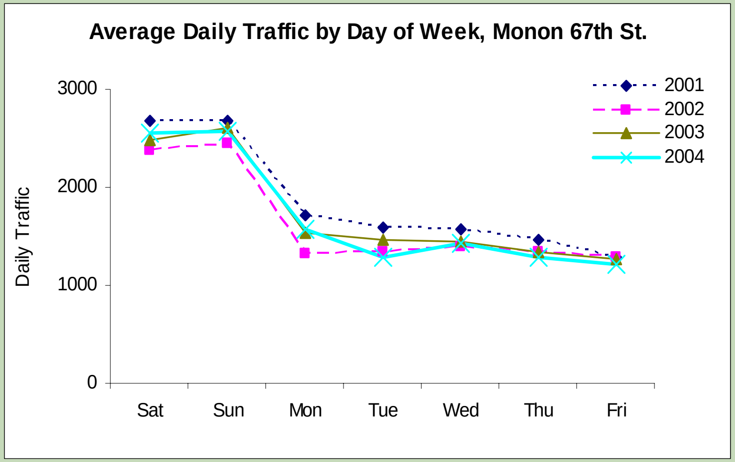
Mean Daily Count

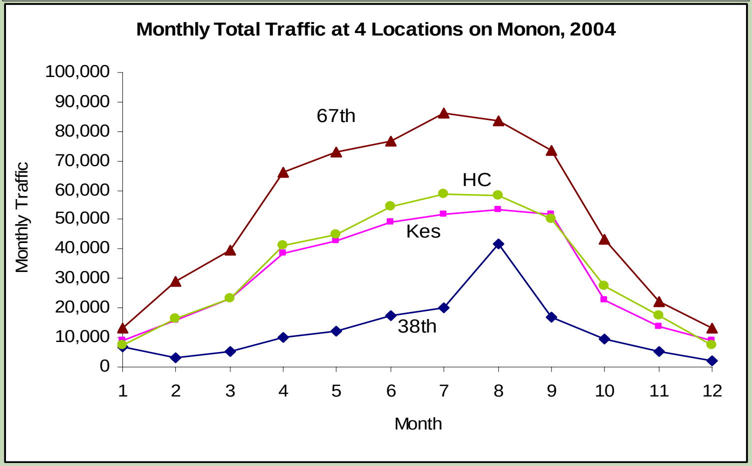


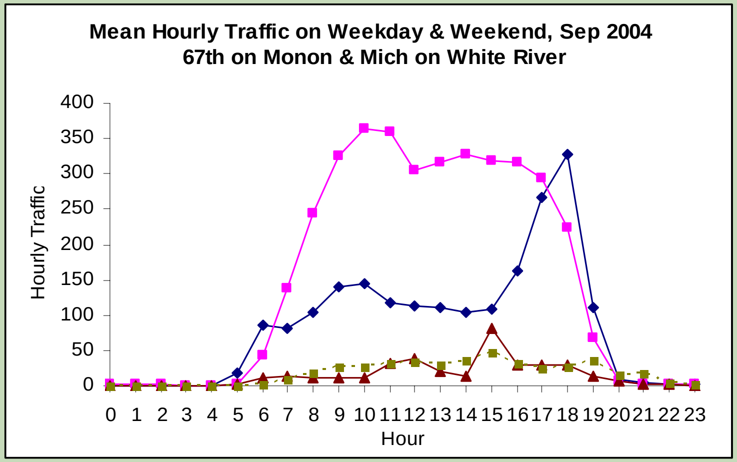
Spatial and Temporal Variation in Use

Traffic varied daily across seasons, locations, and days-of-week, but remained stable across years.









Modeling Approach

- Daily trail traffic estimated as function of:
  - Weather (control variables)
  - Time (control variables)
  - Neighborhood socio-demographic characteristics
  - Measures of neighborhood built form and physical environment
- Use standard multiple linear regression techniques

Dependent and Control Variables

- Dependent variable
  - Log daily count
    - Add 1 count to days with zero measured trail use
- Control variables
  - Weather: deviation from long term daily mean
    - Temperature: degrees Fahrenheit
    - Squared temperature
    - Precipitation: inches
    - Snow: inches
    - Sunshine: percent
  - Time
    - Monthly dummy variables (relative to December)
    - Weekend dummy variable
    - StateFair dummy variable: interaction term for August and M38 location on days when Fair in session

Neighborhood Socio-demographic Measures

- Age (youngold)
  - Percent of residents less than 5 or greater than 64
- Ethnicity
  - Percent of black; other
- Education
  - Percent of residents older than 25 with college degree
- Income
  - Log of mean of median household income
  - Squared income term
- Measures estimated from Census data using GIS to identify block groups in trail monitor neighborhoods

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Measures of Neighborhood
Urban Form

- Population density
  - People/square kilometer
- Land use
  - Percent of trail neighborhood in commercial use
  - Log of area (square feet) in parking lot
- Accessibility
  - Log of average length of street network segments
- Vegetation density and condition
  - Mean NDVI in trail neighborhood (June 6, 2000; Landstat Thematic Mapper)
- Measures estimated from Census and other local databases using GIS for trail monitor neighborhoods

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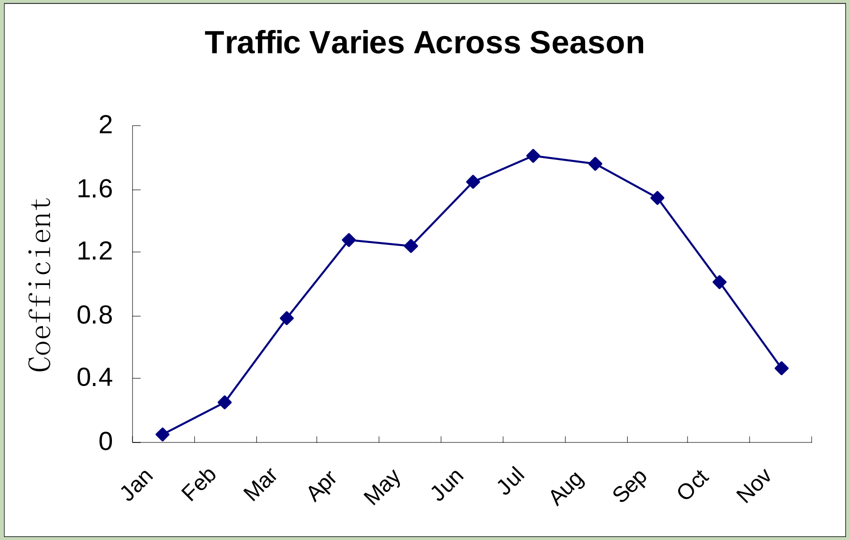
A Trail Traffic Model

- Good statistical fit
  - Adjusted R^2 = 0.80
  - 27 of 29 variables are significant at 1% level
    - Snow and January are not significant

Temporal controls account for 18% of variation in daily trail traffic

- Weekend traffic is on average 1.5 times weekday traffic
- July has the largest effect, Dec. has lowest traffic
- StateFair is highly significant



Variables	Coefficient
Weekend	**0.435**
Jan	0.0492
Feb	0.2576
Mar	0.7853
Apr	1.2732
May	1.2466
Jun	1.6411
Jul	**1.8107**
Aug	1.7637
Sep	1.5522
Oct	1.0199
Nov	0.4772

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Weather controls account for 7% of variation in daily trail traffic

- Precipitation reduces traffic: one inch above average reduces traffic by 29%
- Sunshine associated with increases in traffic: 10% increase above average increases traffic by 7%
- The effect of temperature diminish as the magnitude of the deviation increases (negative sign on squared temperature term)
- Snow is not significant

Variable	Coefficient
DevT	0.02289
sqDevt	-0.00016894
DevP	-0.34451
DevS (not sig.)	-0.01949
DevSH	0.00716

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Neighborhood socio-demographic variables account for 24% of variation in daily traffic

- Education: 1% increase percent college-educated population associated with 7% increase in traffic
- Age: 1% increase of young-old residents associated with 1.5% decrease in traffic
- Ethnicity: % black and %other ethnicity have positive and negative effects, respectively, relative to % white
- Income: has positive effect but effect diminishes as income increases.

Variable	Coefficient
Pct > 25 Col_Grad	0.07014
Log_Ave_ MHH Inc	24.89396
sqLog_Ave_ MHH_Inc	-1.26211
pctYoungOld	-0.0151
pctBlack	0.00764
pctOtherTtl	-0.00639

Neighborhood urban form variables account for 31% of variation in daily traffic

- Mean-NDVI has positive effect
- Increase in density of 100 persons/km^2 associated with an increase in traffic of 1%
- 1% increase commercial land use associated with a 4.6% increase in traffic
- Increases in area of parking lots associated with statistically significant but practically small effect
- 1% increase in average segment length associated with very small decrease in traffic (0.088%)

Variable	Coefficient
mean_ndvi_06-06-00	1.5008
Pop_density	0.00009825
PctCom	0.04601
log_PrkLot	0.04256
log_NetSeg AvgLgth	-0.09287

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An Example

- Forecast traffic at M67 location on January 28, 2005
  - Mean temperature was 23F, 4 degrees below average
  - Sunshine was 14% below average
  - No precipitation, snowfall
- Estimated daily traffic with model: 274
- Adjusted monitor count: 263
- Model will be useful for estimating traffic on trail

Observations and Conclusions

- Objective Measures of Trail Traffic
  - Activity patterns, modes of use generally appear to be consistent across trails
  - Trail users appear to be disproportionately male
  - Trail use may be social activity for large proportions of users
  - Traffic varies consistently by month, day of week, and hour of day

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Observations and Conclusions

- Covariates explain 80% of variation in trail traffic
- Trail traffic is highly correlated with:
  - Weather and temporal control variables
  - Socioeconomic status of trail neighborhoods
  - Percent of neighborhood population that is young and old (inverse relationship)
  - Dimensions of urban form hypothesized to increase pedestrian activity: population density, shorter block lengths, more vegetation, mixed (commercial) land use

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Observations and Conclusions

- Implications for research, management, and policy
  - Take activity patterns into consideration in design of interventions to increase physical activity
  - Use model to estimate traffic for facility design, evaluations of project alternatives, or needs assessments for traffic safety improvements or maintenance
  - Design more efficient sampling strategies for trail user surveys
  - Evaluate policies and management actions (e.g., reductions in pedestrian activity on ozone action days)

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Need for Additional Research

- Additional research can address limitations of study
  - Count data are limited; provide no insight into variation in mode of use
  - Model currently does not include measures for specific trail characteristics or areas outside trail monitor neighborhoods that might affect use
  - New measures for trail monitor neighborhoods can be developed (e.g., use LIDAR to develop measures of visual quality of trail segments)
  - Surveys of users will provide better understanding of preferences and patterns of use (spring-summer 2005) and permit new modeling approaches