

Designing a Bicycle and Pedestrian Traffic Count Campaign in a Small Rural College Town

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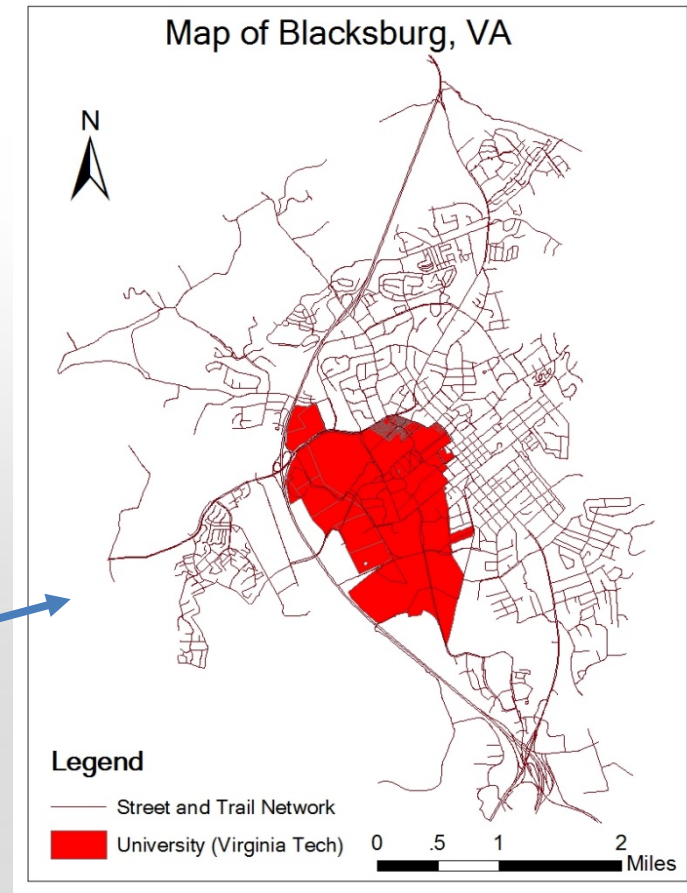
Background

- Benefits: performance measure, project prioritization, environment, health, safety, etc.
- The best way to improve transportation networks for any mode is to **collect and analyze trip data** to optimize investments (FHWA, 2010).

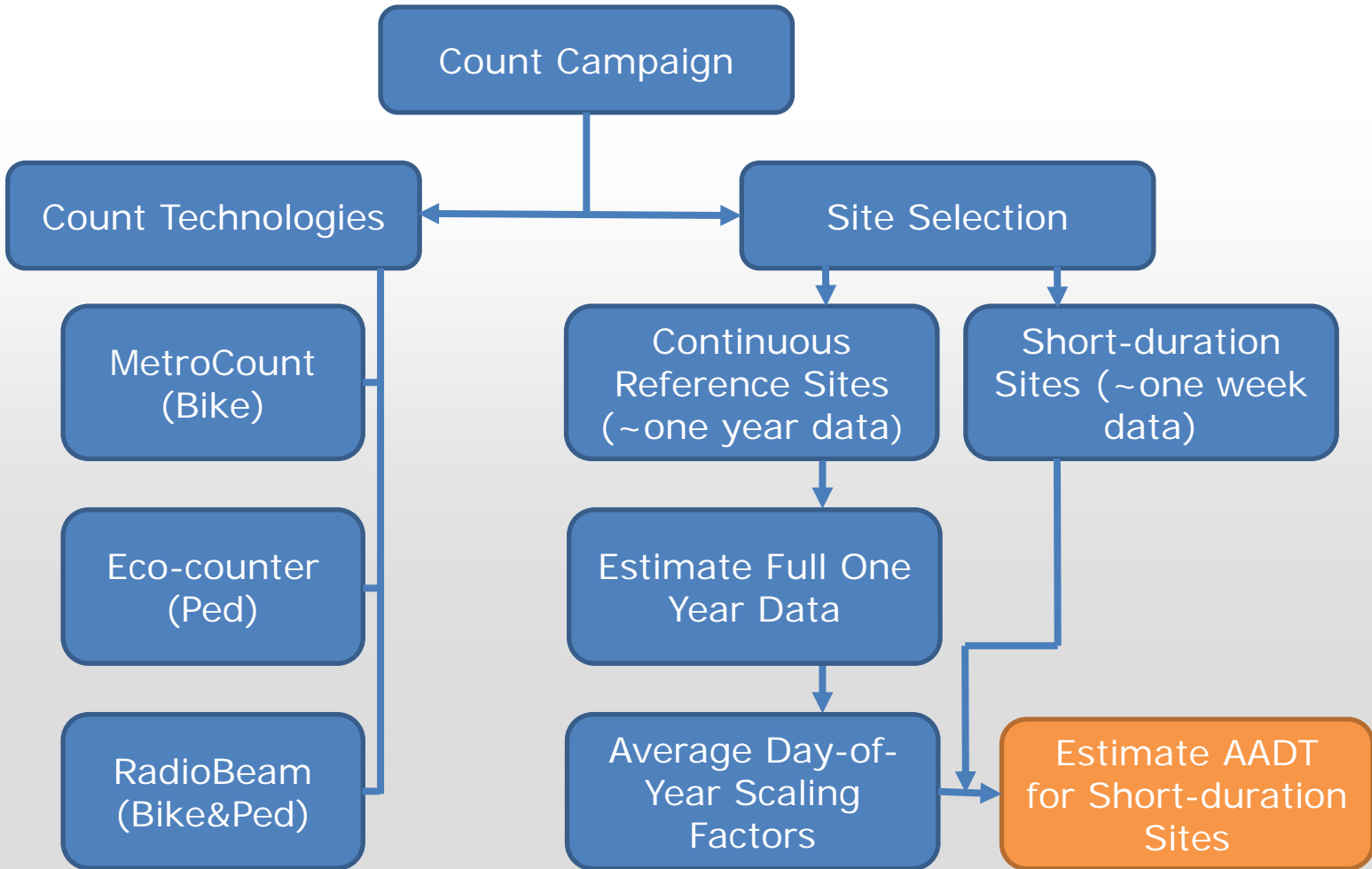


Objective

- Town of Blacksburg: ~50,000 people; 19.7 square miles
- Systematic count campaign
- Entire transportation network
- Scaling factors
- Long-term averages (i.e., AADT)



Approach



Count technologies



MetroCount pneumatic tube counter



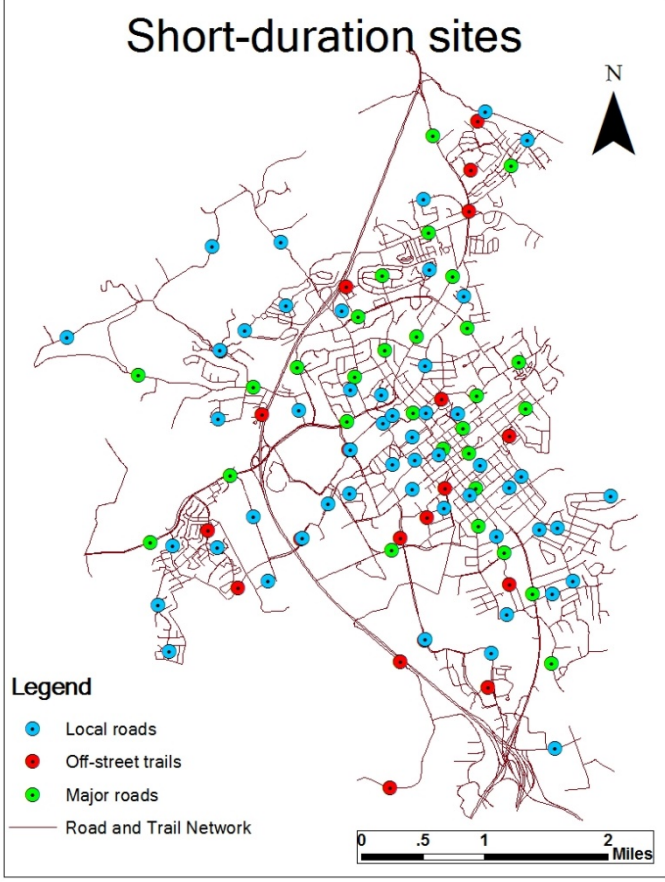
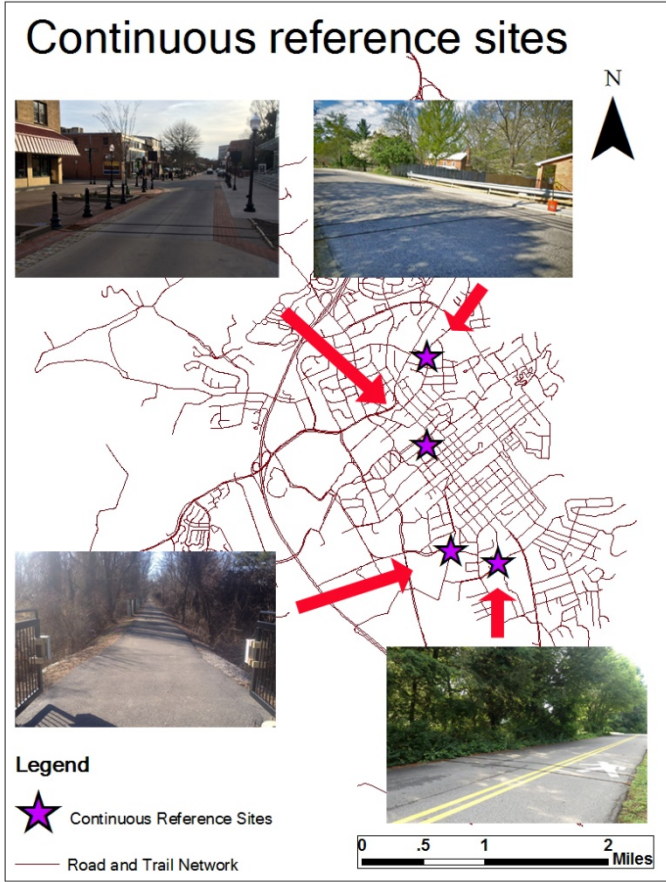
Eco-counter Pyro passive infrared counter



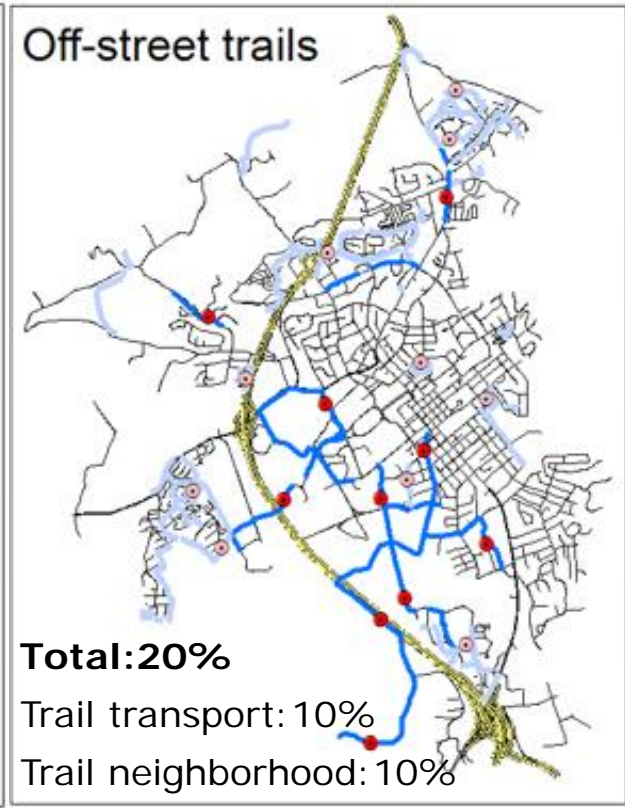
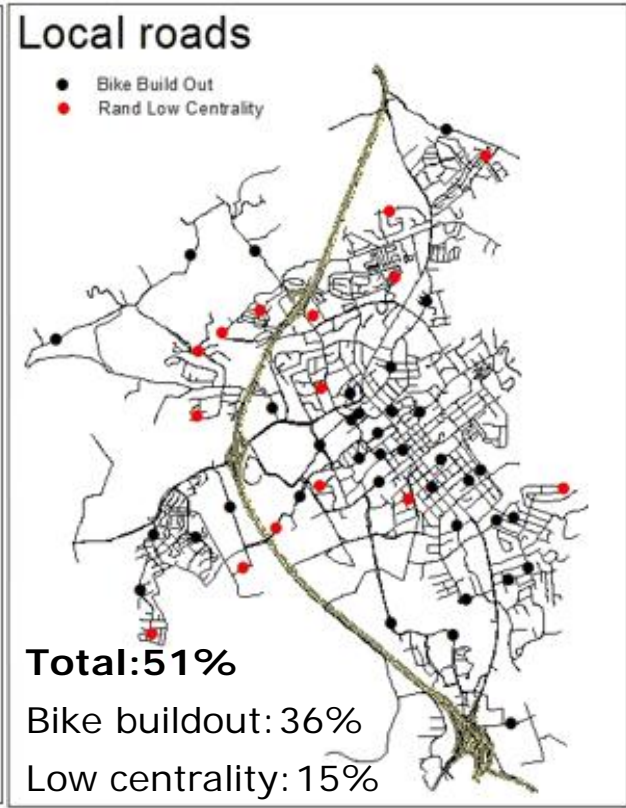
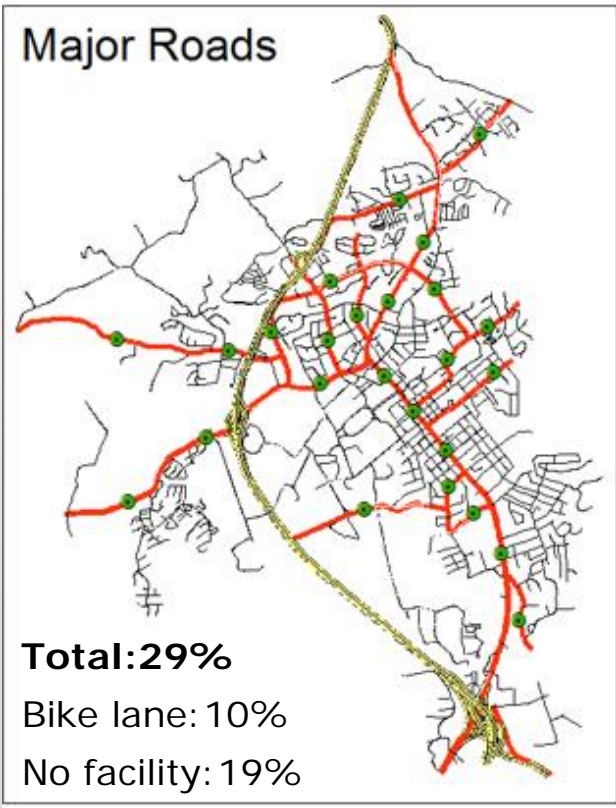
RadioBeam bicycle-people counter

Site selection

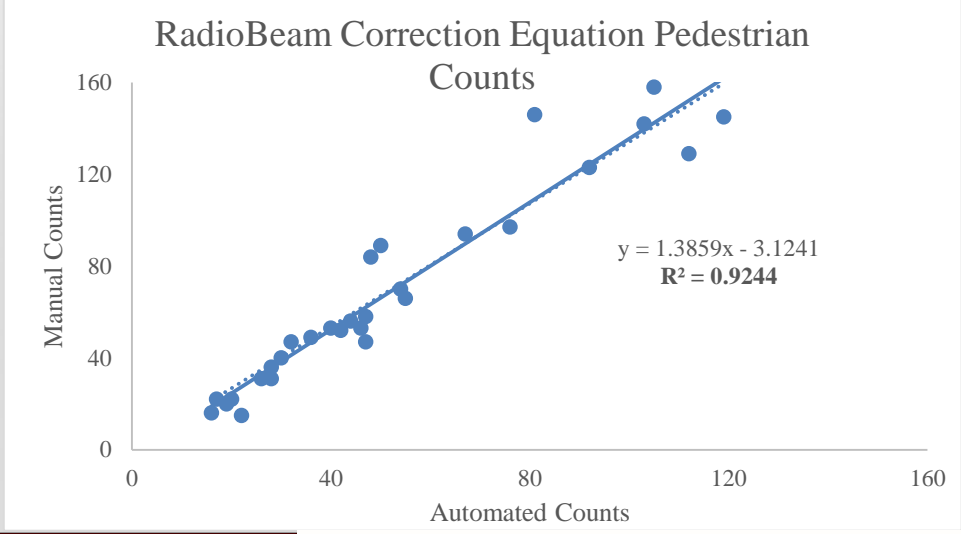
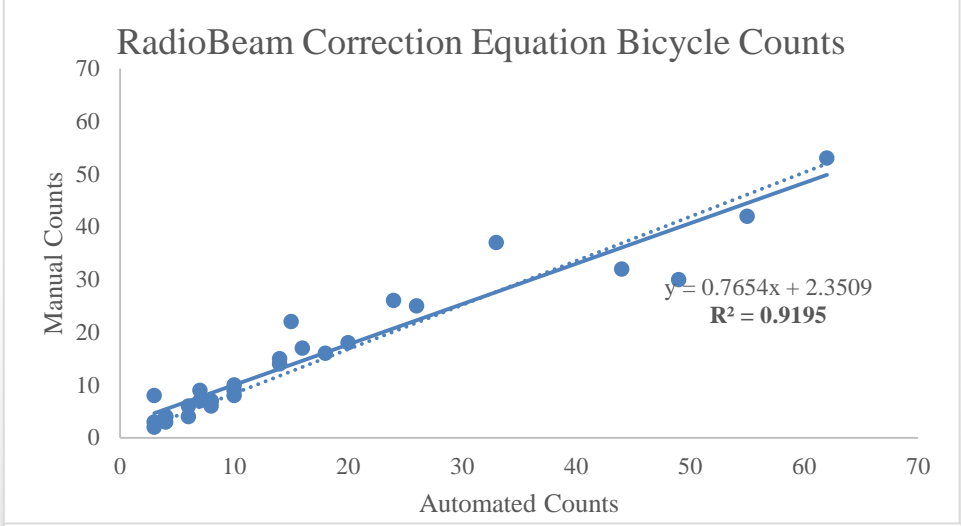
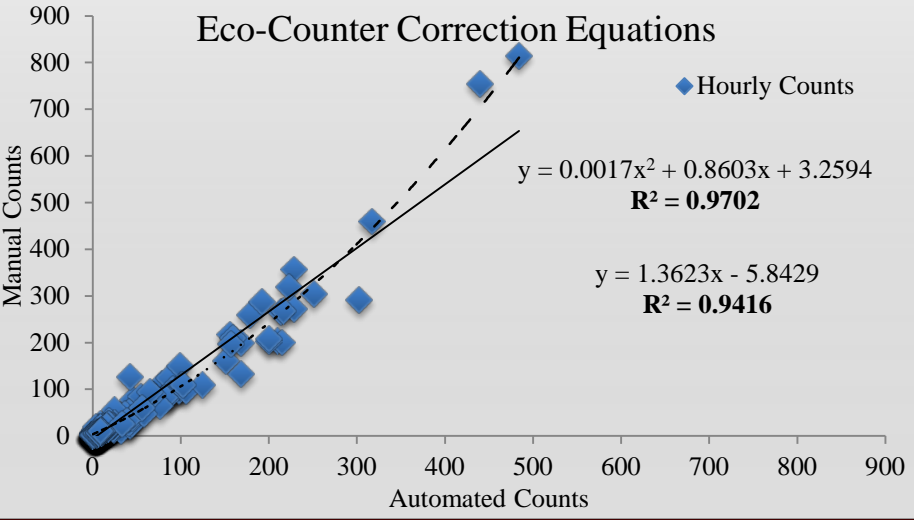
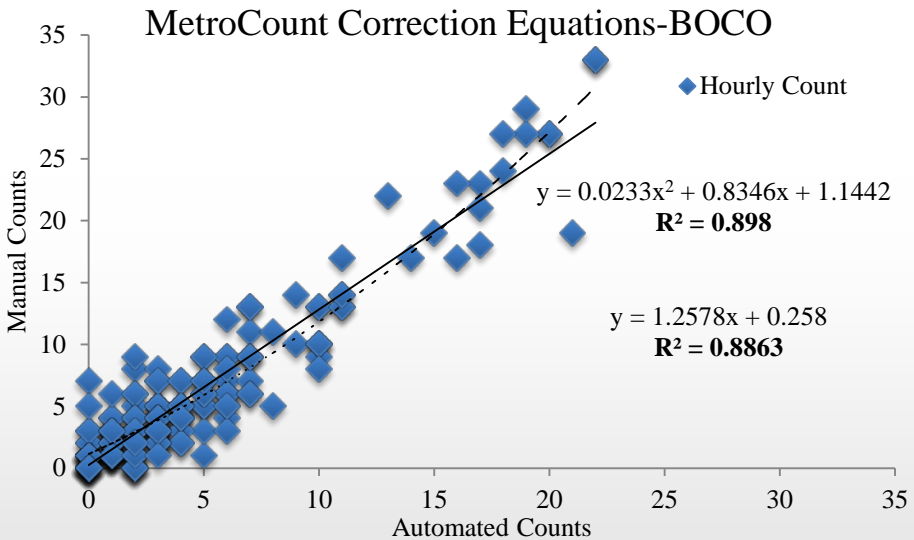
- **Continuous reference sites:** 4 sites for ~ 1 full year
- **Short-duration sites:** 97 sites for ~ 1 week between April and September



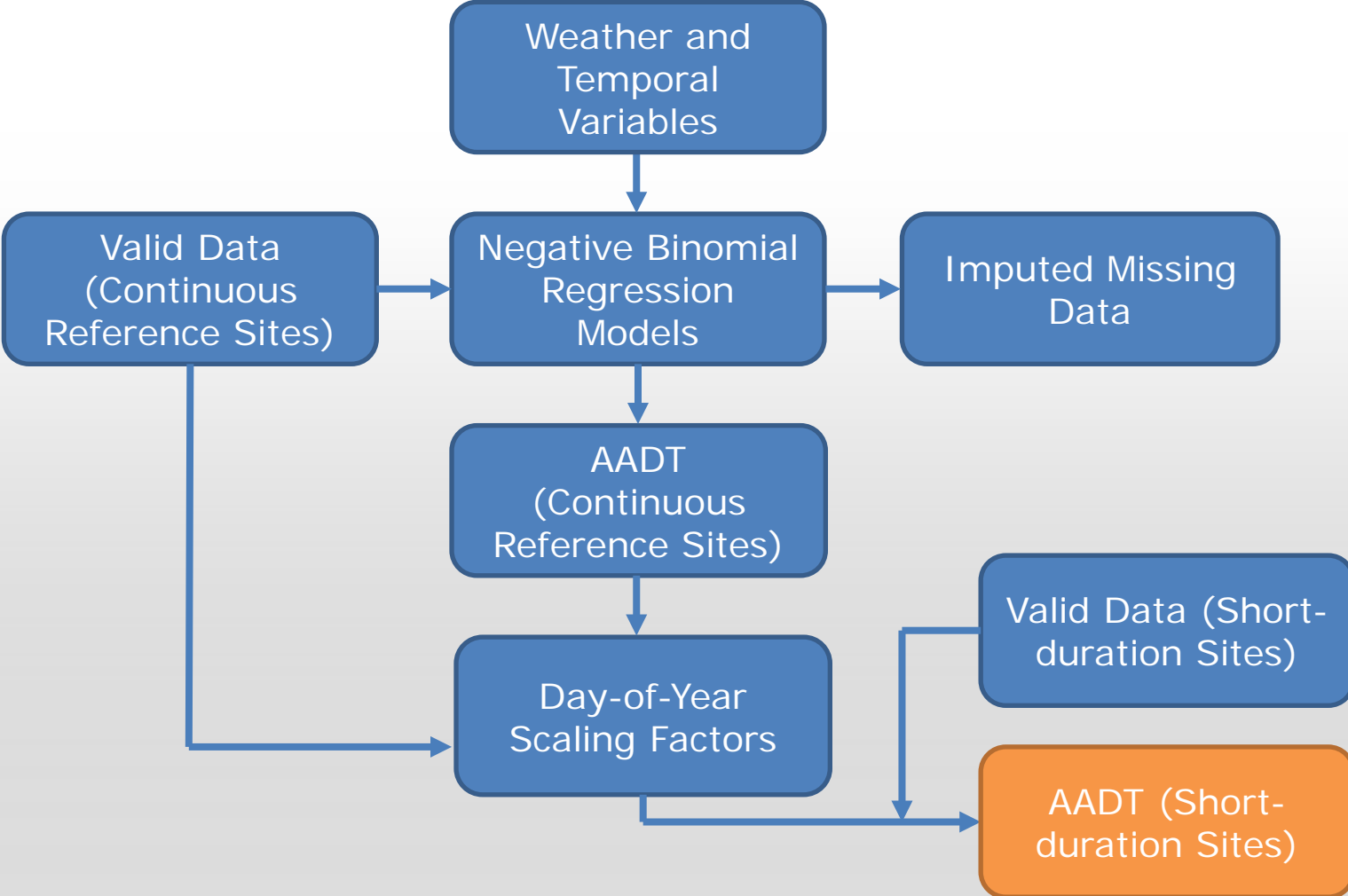
Final short-duration site selection



Adjusting and correcting count data



Imputing missing data



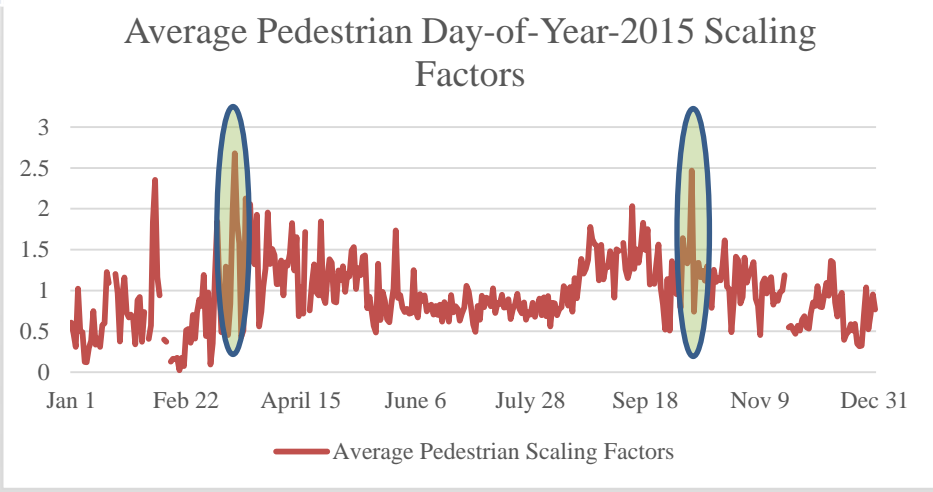
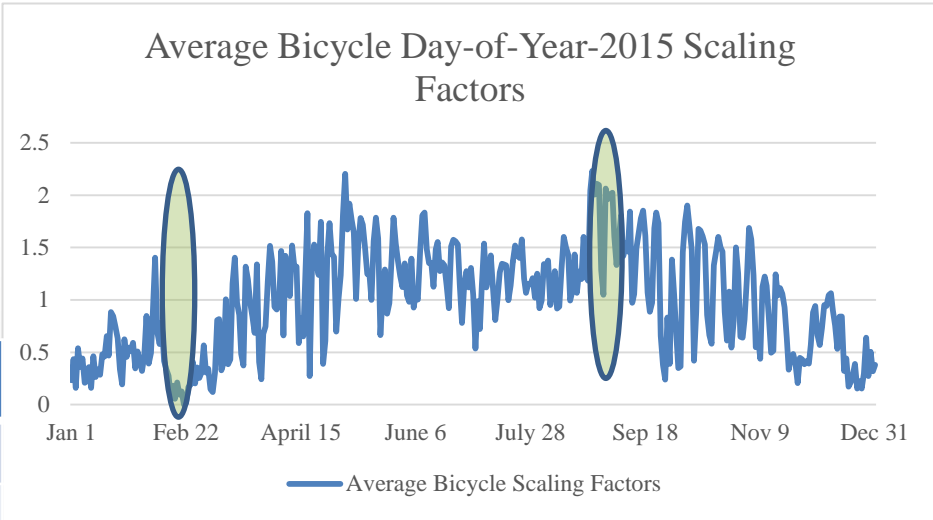
Average day-of-year scaling factors

Estimated AADT for continuous reference sites

AADT	Draper	College	Giles	Huckleberry
Bicycle AADT	21	54	55	179
Pedestrian AADT	98	4232	289	518

Scaling factor = $\frac{\text{Average traffic on a specific day}}{\text{AADT}}$

- Noticeable weather and temporal patterns



AADT Estimation for short-duration sites

AADT Estimate = Average Adjusted Counts / Average Scaling Factors

Sampled Bicycle AADT estimate for short-duration sites

2-SUNRIDGE		Bicycle		
Data	Adj count	Scaling factor	AADT Estimate	Number of reference sites
May 5	42	2.20	19	4
May 6	28	1.67	17	4
May 7	34	1.92	18	4
May 8	49	1.77	28	4
May 9	37	1.64	23	4
May 10	34	1.01	34	3
May 11	41	1.54	27	4
Average	38	1.68	24	4

- Resampling
 - University in session
- Mean percent error:
bicycle: **16%**

pedestrian: **11%**

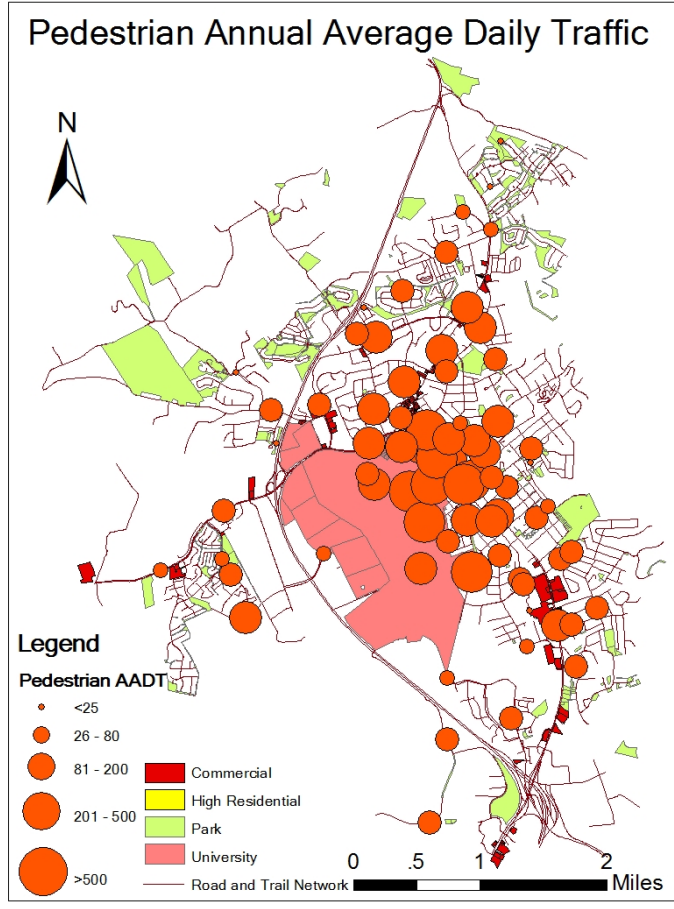
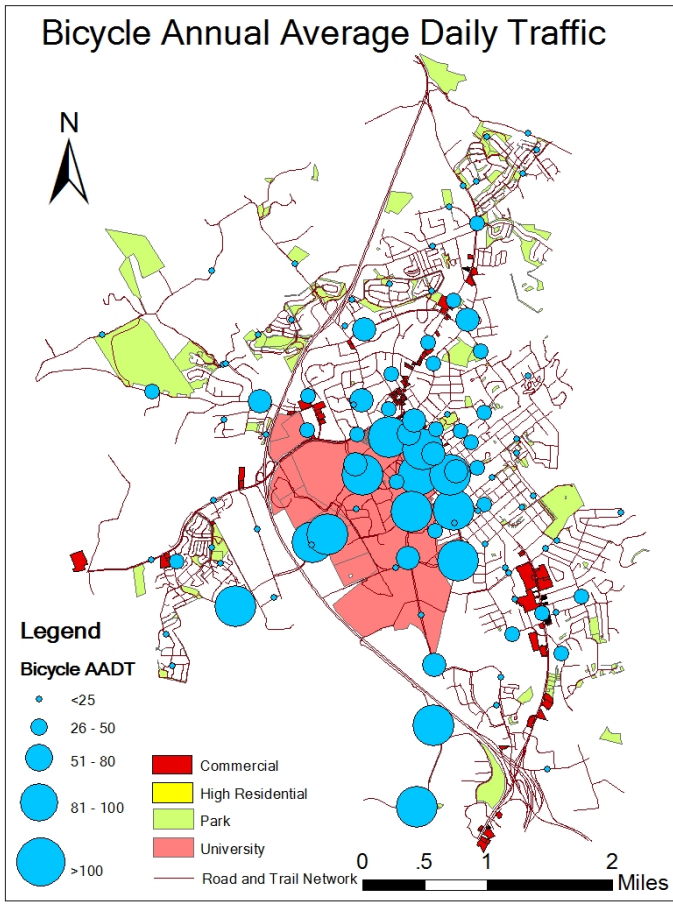
Median percent error:
bicycle: **3%**

pedestrian: **9%**



AADT Maps

- Downtown areas
- Existing bicycle trails or segmented trails
- University area



Road type and bike facility

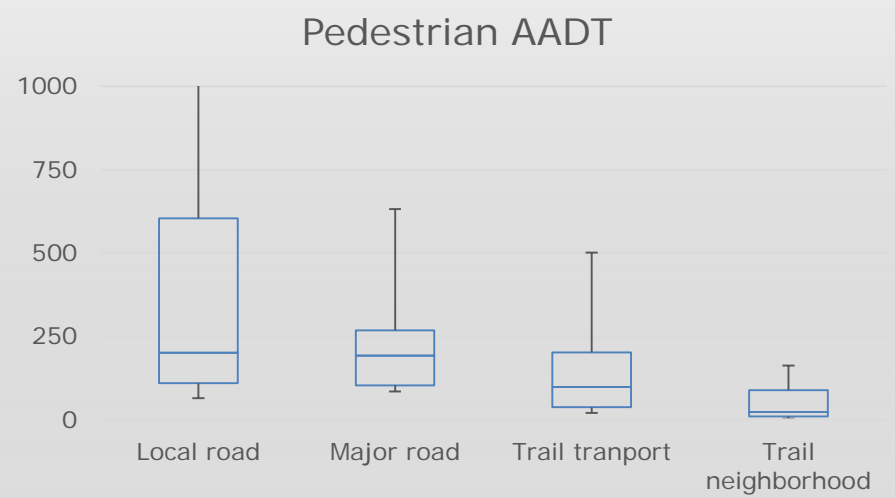
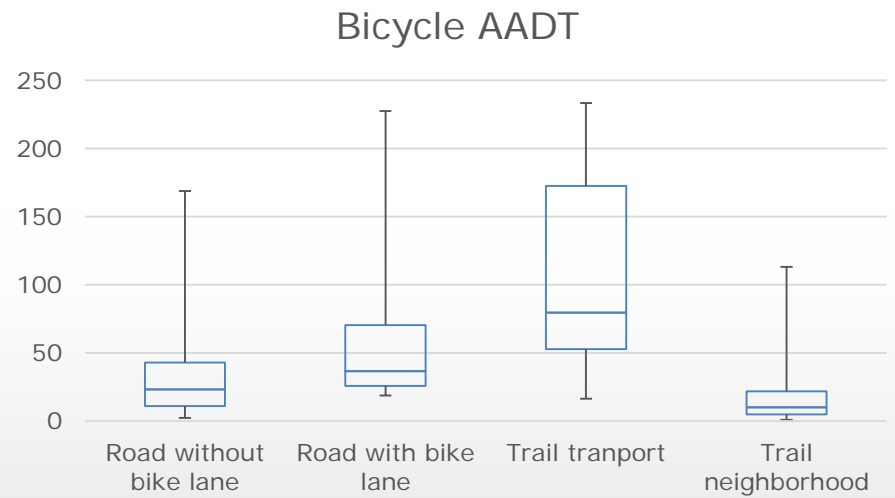
- **Bicycle AADT ($p < 0.05$):**
Road without bike lane (mean: 30)
Road with bike lane (mean: 72)

Road without bike lane (mean: 30)
Trail transport (mean: 111)

- **Pedestrian AADT ($p < 0.05$):**
Local road (mean: 693)
Major road (mean: 236);

Local road (mean: 693)
Trail transport (mean: 162);

Local road (mean: 693)
Trail neighborhood (mean: 55)



Summary

Key findings

- **Recommended count campaign**
- Budget: equipment (~\$60,000); labor: 20hr/week Research Assistant for 1.5 years
- Reliable counter correction equations and easy counter installations
- **Systematic** count campaign including a **combination** of counters to develop scaling factors to estimate AADT

- **Traffic patterns**
- Noticeable temporal and weather patterns
- Bike facilities are associated with cycling activities

Limitations and future research

- More continuous reference sites may capture more information
- Monitoring pedestrian volumes where sidewalks are not available
- Spatial factors including other variables (e.g., land use variables) may be useful

**Thank you!
Questions?**



Supplemental Materials

Budgets

Equipment	Usage	Quantity	Cost per unit	Total cost
Pneumatic tube counter	MetroCount	12	\$ 2,975	\$ 35,700
Passive infrared counter	Eco-counter	10	\$ 1,000	\$ 10,000
RadioBeam counter	Chambers	3	\$ 4,500	\$ 13,500
Extra pneumatic tubes	MetroCount	4	\$ 245	\$ 980
Installation accessories	All	1	\$ 500	\$ 500
Chains & locks	MetroCount	12	\$ 50	\$ 600
Concrete stanchions	Eco-counter & Radiobeam	12	\$ 50	\$ 600
Transport	All	1	\$ 750	\$ 750
Total				\$ 62,630

- **Labor:** 20hr/week Research Assistant for 1.5 years

Short-duration site selection

- **Centrality:** magnitude of bicycle trip potential between a specific subset of O-D pairs that can be reasonably reached by cyclists; high centrality reveals high volume
- **Location type:** Major roads, local roads and off-street trails

Summary of counts by location type

Location Type	Count locations	% of count locations	Potential segments	% sampled	Sample type
Major Roads					
Bike lanes	10	10%	45	22%	Systematic
No facility	19	19%	121	16%	Systematic
Off-street trails					
Transport	10	10%	15	67%	Systematic
Neighborhood	10	10%	26	38%	Random
Local roads					
Bike buildout	36	36%	976	4%	Systematic
Low centrality	15	15%	976	2%	Random

Summary of share and centrality of count locations vs. Blacksburg

	Share of locations		Mean (IQR) O-D centrality	
	Count Locations	Town of Blacksburg	Count Locations	Town of Blacksburg
Total Locations	100	1,848	-	-
Road Type				
Major Road	29%	14%	48,000 (14,900-64,000)	43,000 (6,700-55,000)
Local Road	51%	72%	87,500 (1,100-121,000)	33,500 (1,300-26,400)
Trail	20%	14%	252,400 (8,500-369,000)	68,800 (1,000-66,400)
Bike facility type				
On-street	15%	6%	103,000 (27,562-136,000)	76,300 (12,600-121,000)
Trail	20%	14%	252,400 (8,500-369,000)	68,800 (1,000-66,400)
None	65%	81%	110,000 (2,400-98,000)	32,200 (1,400-26,700)
Streets with sidewalks				
< 100m away	80%	76%	86,800 (18,100-125,800)	49,500 (2,800-52,400)
> 100m away	20%	24%	46,500 (1,000-39,000)	15,900 (700-11,000)

Scheme comparisons

Time Interval	ARX Cycle		BOCO		Bicycle 15		MetroCount Scheme	Axle Base	Axle Count
	Average Percent Error	Average Absolute Error	Average Percent Error	Average Absolute Error	Average Percent Error	Average Absolute Error			
15-minute	-20.3%	43.5%	-25.7%	41.0%	-19.1%	47.7%	ARX Cycle	≤ 1.22 meters	2
30-minute	-13.3%	42.2%	-19.8%	39.0%	-12.9%	42.9%	BOCO	0.88 – 1.22 meters	Varies
60-minute	-5.2%	40.2%	-17.5%	38.1%	-4.4%	40.4%	Bicycle 15	≤ 1.16 meter	2

Time Interval	ARX Cycle			BOCO			Bicycle 15		
	Polynomial Correction R ²	Linear Correction R ²	Linear Slope	Polynomial Correction R ²	Linear Correction R ²	Linear Slope	Polynomial Correction R ²	Linear Correction R ²	Linear Slope
15-minute	0.69	0.68	1.07	0.71	0.71	1.08	0.51	0.50	0.92
30-minute	0.81	0.81	1.21	0.81	0.81	1.19	0.80	0.80	1.22
60-minute	0.895	0.885	1.29	0.898	0.886	1.26	0.897	0.882	1.31

QA/QC

Valid monitoring days	Continuous reference sites							
	Bicycle				Pedestrian			
Sites	Draper	College	Giles	Huckleberry	Draper	College	Giles	Huckleberry
Valid days of calendar year (2015)	257/365	247/365	246/365	350/365	263/365	229/365	102/365	336/365
Valid percent of calendar year (2015)	70%	68%	67%	96%	72%	63%	28%	92%
Valid days during counter deployed	257/257	247/275	246/257	350/365	263/275	229/275	102/133	336/365
Valid percent during counter deployed	100%	90%	96%	96%	96%	83%	77%	92%
Short-duration count period	200							
Flagged data	N/A	No data retrieved; suspicious vehicle data	No data retrieved; abrupt bicycle change	No data retrieved; no battery	Abrupt bicycle change	No data retrieved; abrupt bicycle change	counter moved or vandalized	No data retrieved; no battery

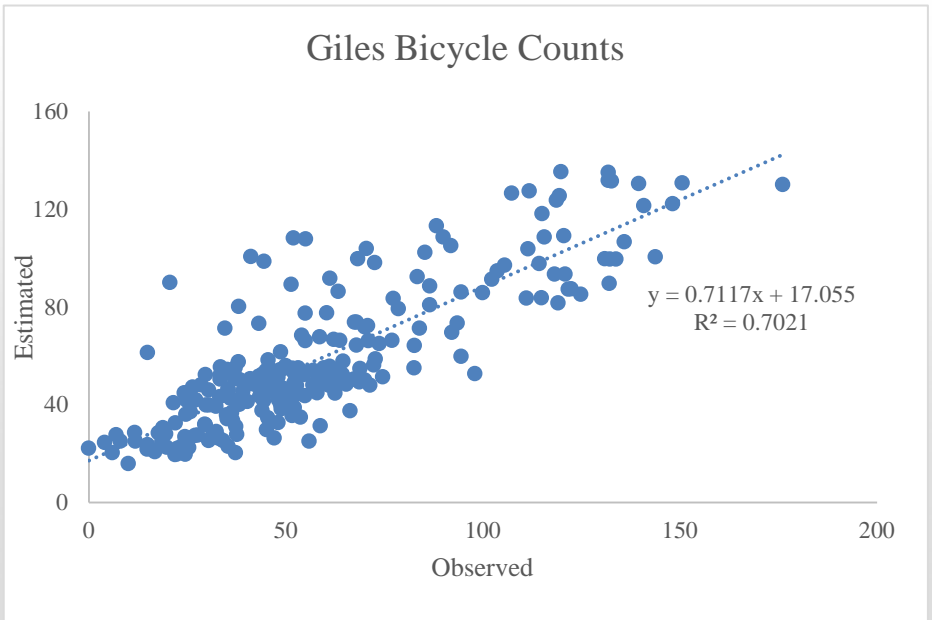
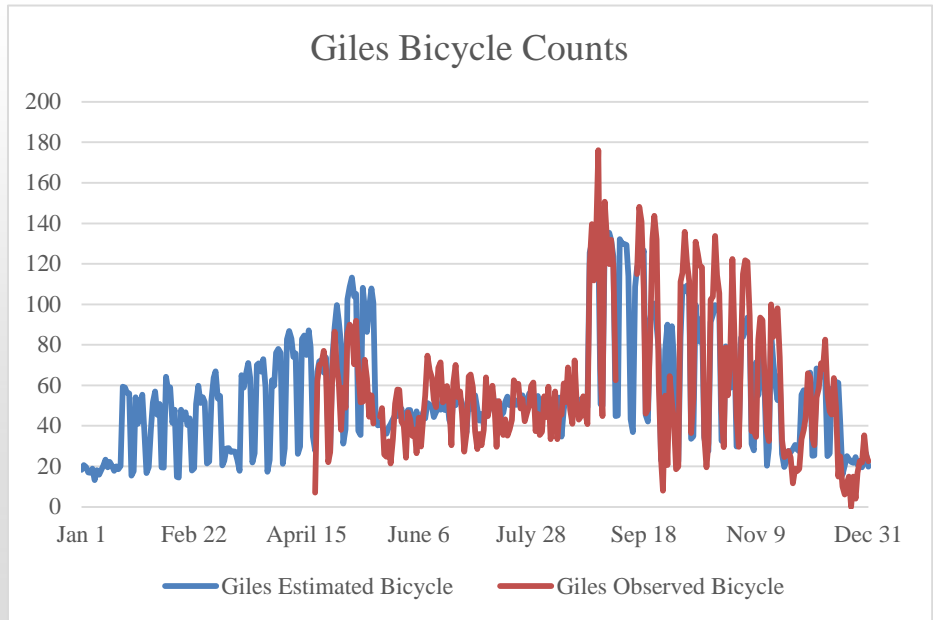
Estimate missing data (negative binomial regression)

	Bicycle Model				Pedestrian Model			
	Draper	College	Giles	Huckleberry	Draper	College	Giles	Huckleberry
Observation	257	247	246	350	263	225	102	336
Pseudo R²	0.067	0.11	0.12	0.082	0.026	0.031	0.055	0.022
Constant	1.9	2.6	3.01	4.03	4.2	7.4	6.05	5.5
Weather and temporal variables								
tmaxdev	-0.052***	-0.051***	-0.030***	-0.021***	-0.017***	-0.0054	0.017*	-0.0064
tmax	0.062***	0.062***	0.038***	0.059***	0.021***	0.018***	-0.036***	0.030***
precipitation	0.0081**	-0.0031	0.0064***	0.0080***	-0.0035*	-0.0015	-0.0018	-0.0044*
windspeed	-0.0069	-0.020	-0.039***	-0.028***	-0.0028	0.0085	-0.019*	-0.018*
weekend	-0.36***	-0.097*	-0.090*	0.11**	-0.14***	0.62***	0.64	0.41***
university in session	0.22***	0.66***	0.92***	0.18***	0.21***	0.83***	0.25***	0.38***

Note: dispersion factor p of each model is smaller than 0.05. Chi-square tests (p < 0.05). *** denotes p-value < 0.01; ** denotes p-value < 0.05; * denotes p-value < 0.10.



Estimate missing data (Validation Sample)



AADT estimation comparison

Sites	AADT University not in session		AADT University in session		Percent error		Absolute error		Error	
	Bicycle	Pedestrian	Bicycle	Pedestrian	Bicycle	Pedestrian	Bicycle	Pedestrian	Bicycle	Pedestrian
2-SUNRIDGE	25	74	24	90	-7%	21.8%	7%	22%	-2	16
6-HARDWOOD	3	N/A	3	N/A	-4%	N/A	4%	N/A	0	N/A
8-GROVE	6	N/A	4	N/A	-41%	N/A	41%	N/A	-2	N/A
19-PLANTATION	34	N/A	24	N/A	-28%	N/A	28%	N/A	-10	N/A
20-SMITHFIELD	114	N/A	125	N/A	9%	N/A	9%	N/A	11	N/A
27-TURNER	27	1126	53	1223	96%	8.6%	96%	9%	26	97
31-WILLARD	5	72	11	86	120%	19.5%	120%	20%	6	14
32-PALMER	21	91	37	128	76%	41.0%	76%	41%	16	37
33-EHEART	13	132	7	122	-47%	-7.7%	47%	8%	-6	-10
39-RESEARCH CENTER	25	N/A	34	N/A	34%	N/A	34%	N/A	9	N/A
46-TOMS CREEK	22	N/A	21	N/A	-7%	N/A	7%	N/A	-1	N/A
47-PROGRESS	36	286	67	249	86%	-13.0%	86%	13%	31	-37
48-GILES	38	142	33	153	-13%	7.6%	13%	8%	-5	11
85-PROGRESS	42	224	48	N/A	15%	N/A	15%	N/A	6	N/A
96-COUNTRY CLUB	78	120	20	88	-74%	-27.0%	74%	27%	-58	-32
99-NORTH MAIN	35	219	50	323	41%	47.1%	41%	47%	14	103
Average	33	249	35	273	16%	11%	44%	21%	2	22
Median	26	137	29	128	3%	9%	37%	20%	3	14