Estimating BMT and PMT in Washington State

Taylor Phillips, Michael Sellinger, Krista Nordback PhD, PE, Chris Monsere PhD, PE, Paula Reeves AICP CTP

WSDOT · Portland State University · TREC Transportation Research and Education Center

THE QUESTION

How can bicycle and pedestrian miles traveled (BMT & PMT) across a state be calculated accurately?

ABSTRACT

As cities and states strive for greater livability, planners need more accurate estimates of bicycle and pedestrian travel. Using Washington as a case study, we look at three methods to estimate bicycle and pedestrian miles traveled statewide.

You'll learn about:
- Pros and cons of each method
- How to improve data collection for statewide bicycle and pedestrian miles traveled estimates
- Use of the data to inform planning decisions

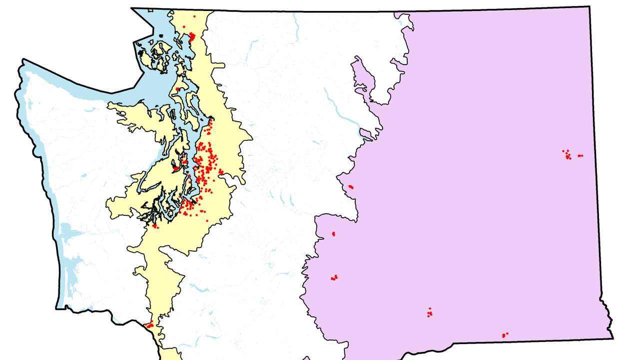
KEY POINTS

- Investigates methods to determine BMT and PMT for the state of Washington
- Looks at three methods
  1) National Household Travel Survey method
  2) Count-based method
  3) Aggregate demand method
- Compares statewide counts for each method
- Looks at pros and cons of each method
- Investigates what needs to be done next in order to improve Washington's state count program

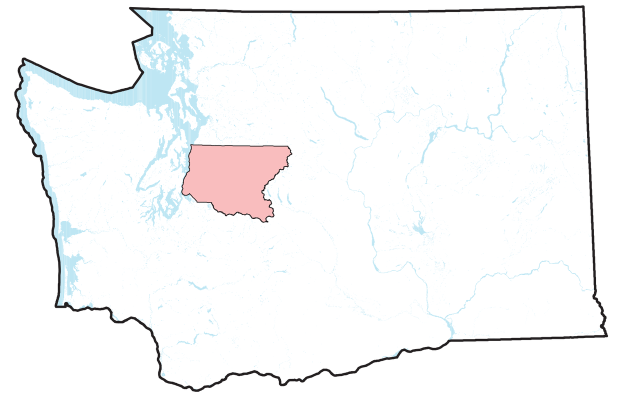
DATA SOURCES

National Household Travel Survey Estimates (All of Washington)

Count-Based Estimates (Puget and Eastern Regions)



Aggregate Demand Estimates (King County)



METHODS

National Household Travel Survey

In order to compare the count-based and aggregate demand methods for estimating bicycle miles traveled (BMT) and pedestrian miles traveled (PMT), a "back of the envelope" computation was made. Using figures derived from Pucher et al. on the National Household Travel Survey in combination with US Census data, PMT and BMT estimates can be produced (Pucher, et al. 2011).

$$BMT = 24.1^{*} \times p$$

$$PMT = 112.4^{*} \times p$$

where

BMT = Bicycle miles traveled in the state
PMT = Pedestrian miles traveled in the state
p = State population

* These numbers were taken from research done by Pucher et al. They represent estimates of national miles biked and walked per capita per year

Limitations

Needs more data to improve accuracy

Limited to a very rough estimate

Count-Based

This method uses count data from automated and manual counts. Count locations are divided into groups by whether they are 1) urban or rural, 2) arterial roads, local roads, or trails and 3) in the Coast Range, Puget Lowlands, Cascades, or Eastern Region. Seasonal, daily and hourly adjustment factors were then determined and applied to short-duration counts for each group to find annual average daily bicyclists and pedestrians (AADB and AADP).

$$BMT = 365x\sum_{p=0}^{16}\left(\frac{L_p}{m_p}\sum_{q=0}^{m} AADB_{pq}\right)$$

$$PMT = 365x\sum_{p=0}^{16}\left(\frac{L_p}{m_p}\sum_{q=0}^{m} AADP_{pq}\right)$$

where

BMT = Bicycle miles traveled in the state
PMT = Pedestrian miles traveled in the state
AADB = Estimated annual average daily bicyclists at a given count site q in group p
AADP = Estimated annual average daily pedestrians at a given count site q in group p
L_p = the total centerline miles for each group p
m_p = the number of count sites in group p
p = a counting variable indicating one of the 16 groups into which the roads, pathsand count sites of the state have been divided by region, urbanity and facility type as described above
q = a counting variable indicating one of the counting sites in group p

Limitations

Not quite as useful for pedestrians because of their unpredictable nature

Needs more representative data

Aggregate Demand

This method uses the AADB and AADP estimations calculated from manual and automated count data. Each AADB and AADP estimation was then associated with the variables found in the following equations.

The equation for the bicycle model is:

$$\log(AADB + 1) = 0.620 + (1.766 \times 10^{-5})x_1 + 0.010x_2 + 0.009x_3 + 0.212x_4 + 0.625x_5 + 0.635x_6$$

The equation for the pedestrian volume model is:

$$\log(AADP + 1) = 1.342 + (3.784 \times 10^{-5})x_1 + 0.012x_2 + 0.001x_3 + 0.095x_4 + 0.187x_5 + 0.117x_6$$

where

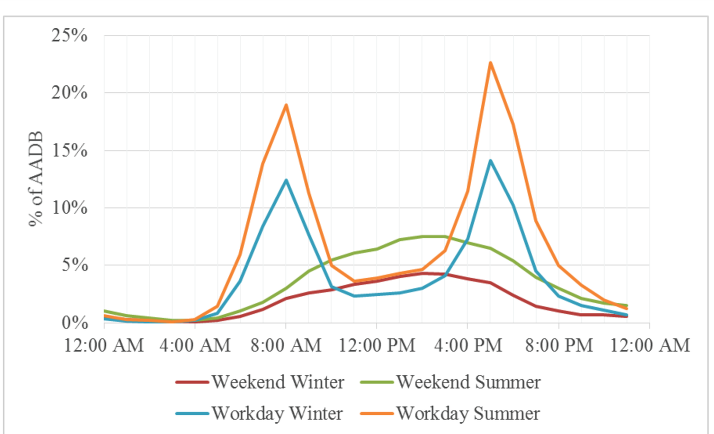
x_1=Population density (people/square mile)
x_2=Percent of the population between 18 and 54
x_3=Percent of the population with a four-year degree
x_4=Arterial (1 if count site is located on an arterial, 0 otherwise)
x_5=Bridge (1 if count site is located on a bridge, 0 otherwise)
x_6=Trail (1 if count site is located on a trail, 0 otherwise)

Limitations

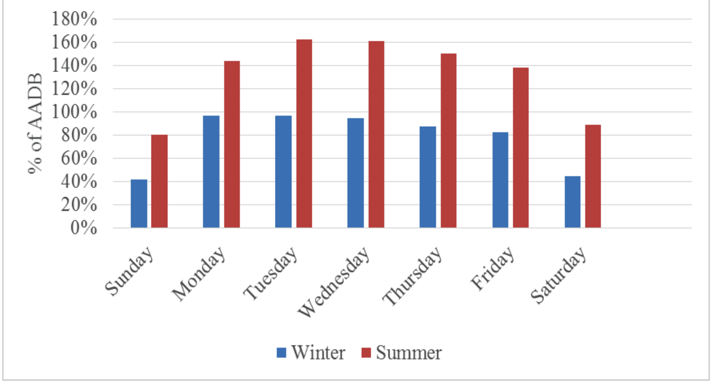
Difficult to apply statewide without more data

DATA

Fremont Bridge counts were used to create seasonal adjustment factors. These factors were then used to calculate AADB and AADP.

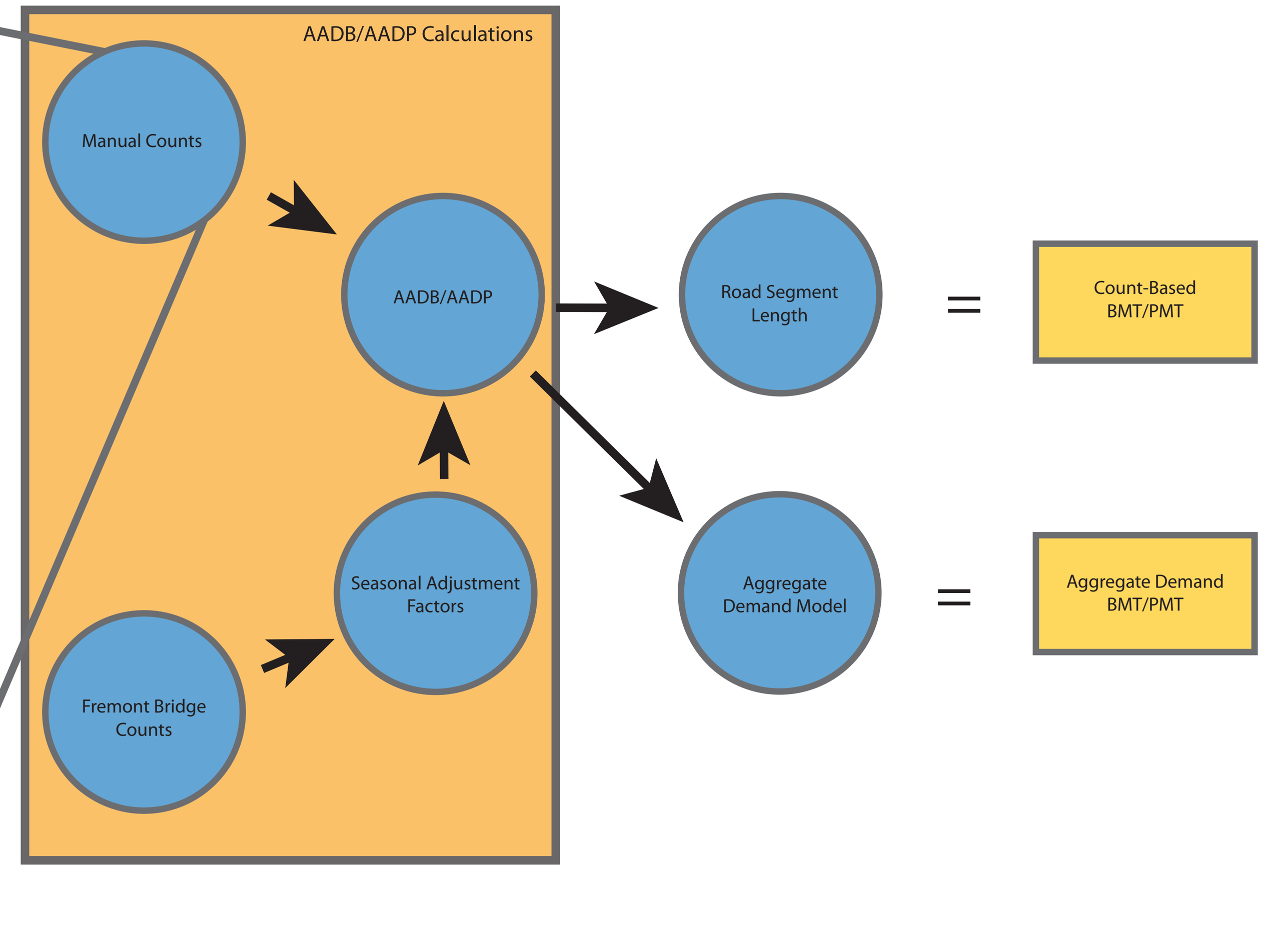


Seattle Fremont Bridge hourly patterns in 2013

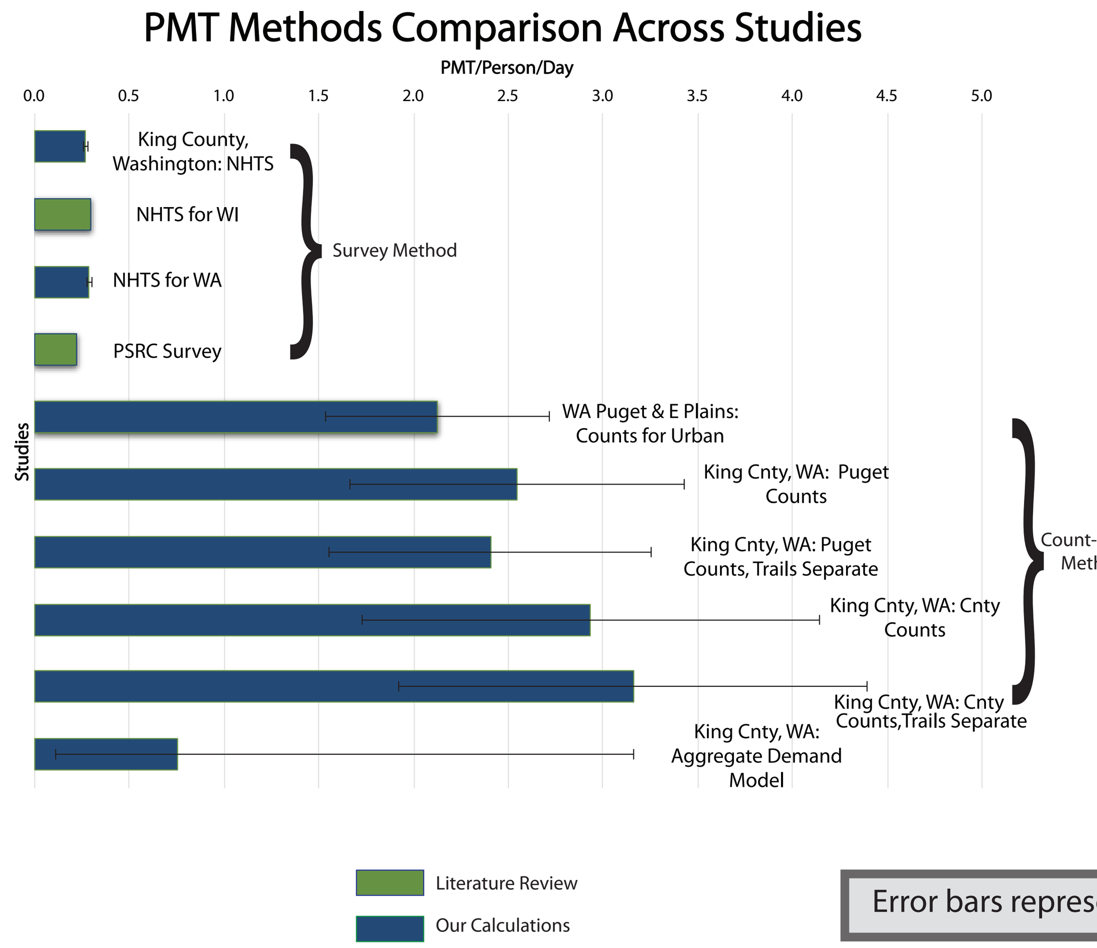


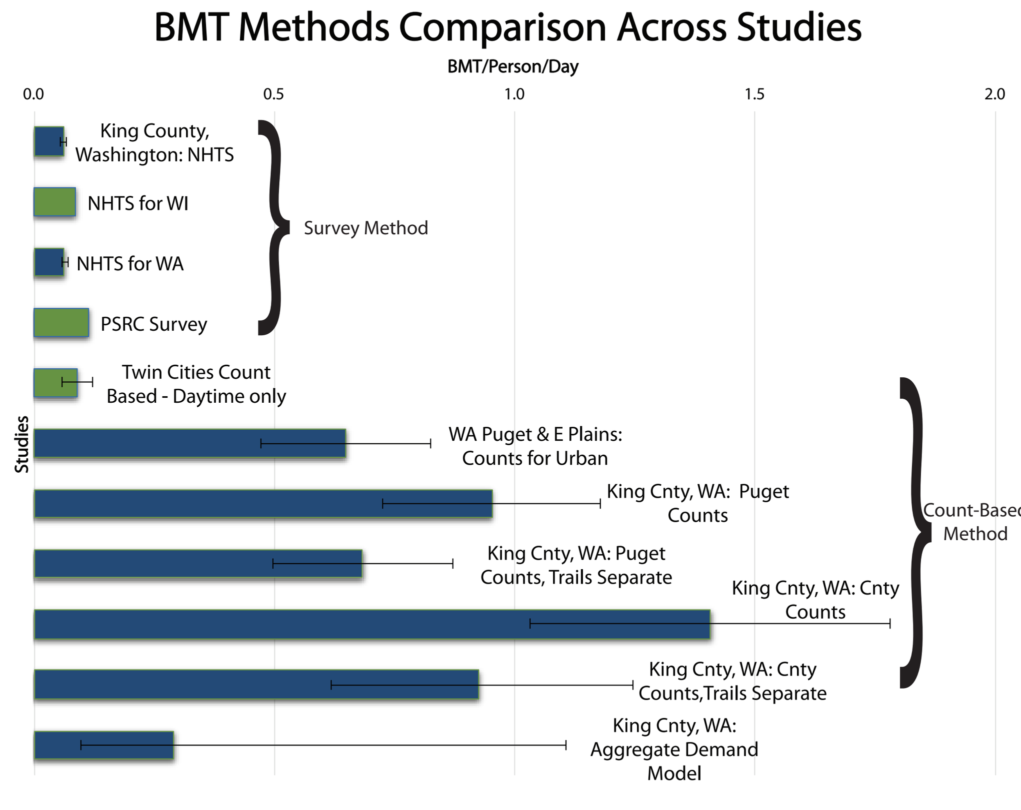
Seattle Fremont Bridge daily patterns in 2013

CALCULATIONS



RESULTS





Error bars represent highest and lowest possible estimates based on available data

CONCLUSIONS

Approach	Pros	Cons	Recommended Data Improvements
State-wide survey	Expanding existing dataset is easier than creating new dataset.	Data are not at the facility level.	Fund an oversampling of the next NHTS.
Count-based	Data are at the facility level.	- Data tend to be biased towards high count locations. - It is more difficult to sample pedestrian locations.	Expand count program to allow for a statewide representative sample.
Aggregate Demand Method	More accurate estimate of PMT and BMT.	Difficult to do at the state level.	Expand count program to allow for a statewide representative sample.

NEXT STEPS

While these methods of calculating BMT and PMT have the potential to yield rough estimates, much more data is necessary in order to accurately estimate these measures statewide. It is recommended that WSDOT broaden their count program geographically, randomly select count locations, and more permanent counters. WSDOT plans to add numerous permanent automated bicycle counters to their facilities as a result of this research.

ACKNOWLEDGEMENTS

This work was funded through the Washington State Department of Transportation (WSDOT)'s research program with matching funds provided by the National Institute for Transportation and Communities, a university transportation center at Portland State University. We are grateful for the interest and assistance of Paula Reeves, Ed Spilker, Kathy Lindquist and Charlotte Claybrooke of WSDOT and Ian Macek formerly of WSDOT, currently with the city of Seattle as well as Jeff Aken of the Cascade Bicycle Club. We are also grateful for the data provided by Craig Moore and Rafael Zuniga of the City of Seattle as well as Timothy Rosner from the Rails to Trails Conservancy. Jennifer Dill and the staff at the Transportation Research and Education Center (TREC) have also been a tremendous resource during the course of this work.