ACTIVE TRANSPORTATION PLAN DEMAND FORECAST TOOLS

Purpose

This paper describes two tools developed to assist local jurisdictions in forecasting the number of bicycle and pedestrian trips resulting from implementation of a Bicycle Master Plan, Pedestrian Master Plan, and/or Active Transportation Plan. Per the most recent state guidance on Active Transportation Plans, Plans should include:

> The estimated number of existing bicycle trips and pedestrian trips in the plan area, both in absolute numbers and as a percentage of all trips, and the estimated increase in the number of bicycle trips and pedestrian trips resulting from implementation of the plan.

The bicycle and pedestrian demand forecasting tools described within this paper are intended to provide reasonable estimates of increases in mode share to satisfy state requirements while utilizing only publically available data sources and requiring efforts commensurate with typical Active Transportation Plan development process to apply.

Overview of Tools

Bicycle Mode Share Tool

This tool uses a national level study from peer-reviewed literature by Buehler and Pucher (2012) on the relationship between level of bicycle infrastructure in a city/community and the level of bicycle commuting. This study estimated the elasticity of bicycle mode share with respect to density of bicycle lanes and bicycle paths. These elasticities are used to project increases in bicycle commuters from increased mileage of bicycle lanes and paths. A ratio of bicycle commute mode share to overall bicycle mode share is then used to translate the projected increase into the required estimate for all trips.

The bicycle mode share methodology captures increases in mode share resulting from improvements in the quantity and quality of bicycle infrastructure. The methodology does not capture any changes in mode share resulting from investments in education/encouragement programs, demographic changes, land use changes, changes in attitudes/preferences, or any other factors.

Pedestrian Mode Share Tool

This tool uses a statistical model of the relationship between walking mode share and land use and demographic variables to predict changes in walking mode share at a fine-grained geographic level. Specifically, a regression model was developed that predicts walking mode share of a small geographic zone as a function of percentage of zero vehicle households, population density, service/retail job density, and proximity to rail stations and ferry terminals.

This model was estimated using data from the California Household Travel Survey and the EPA's Smart Location Factors Database. The model is then applied using data from the Alameda CTC Travel Demand Model land use file to predict walking mode share at a Traffic Analysis Zone (TAZ) level for a base year (2010) and horizon year (2040). Walking mode share for base and horizon years have been pre-calculated for all TAZs in Alameda County.

The pedestrian demand forecast tool predicts increases in walking that are likely to result during the typical implementation horizon of an Active Transportation Plan as a result of changes in land use and demographics. The tool does not directly relate specific projects or programs in the plan to predicted increases in level of walking.

Technical Documentation

Bicycle Mode Share Tool

The bicycle mode share tool uses estimated elasticities of bicycle commuters per 10,000 population with respect to bicycle lanes and bicycle paths per 100,000 population. These elasticities are taken from "Cycling to work in 90 large American cities: new evidence on the role of bike paths and lanes" by Ralph Buehler and John Pucher. In this paper, the authors estimate a series of models of bicycle commute mode share with respect to bike lanes and paths as well as various other control variables. Table 1 below provides the estimated statistical models from this paper. The most basic model (excluding all control variables) is used for this application due to inability to forecast control variables. The model is a log-log model meaning the coefficients from the model can be directly used as elasticities.

Walking Mode Share Tool

The walking mode share tool consists of a multiple regression model of walking mode share as a function of demographic and land use variables. This model was estimated using a dataset of all Census Tracts in the nine county San Francisco Bay Area. Walking mode share was obtained using the 2012 California Household Travel Survey and demographic and land use information were obtained from the EPA's Smart Location Factors database. Table 2 below summarizes the dataset used to estimate the model and provides definitions of variables. The model was estimated using standard linear regression techniques with variables excluded from the model on the basis of statistical significance and illogical signs.

Table 3 presents the final estimated model. The model has reasonable explanatory power, and all variables are statistically significant at the 85th percentile level. The model predicts that walking mode share in a tract (or similar size unit of geography) will increase with increasing non-auto owning population living in the tract, with increasing population density, with increased levels of retail or service workers employed in the tract, or with the addition of a fixed transit station within a quarter-mile of the tract.

The estimated model was applied to predict the walking mode share for all Traffic Analysis Zones in Alameda County, using the fine-grained TAZ structure from the Alameda CTC travel demand model. Auto ownership and population and job density information were taken from travel model inputs and intermediate outputs. Transit proximity information was assembled using a GIS analysis of TAZ proximity to existing and future transit. The walking mode share regression model

was applied for the travel model's base and horizon years (2010 and 2040) and the change in mode share is then computed.

Table 1: Bicycle Commute Mode Share Models from Buehler and Pucher (2012)

Table 4 Multiple regression analysis of bike commuters per 10,000 population and bike commute share (continues on next page)

	OLS regression of ln(bike commuters per 10,000 population)						Binary logit proportions model for share of bike commuters[a]	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Elasticity at mean
ln (bike lanes per 100,000 population)	**0.361**	**0.310**	**0.305**	**0.299**	**0.314**	**0.311**	**0.404**	**0.250**
	(5.85)**	(3.78)**	(3.76)**	(3.69)**	(3.78)**	(5.14)**	(5.65)**	(6.19)**
ln (bike paths per 100,000 population)	**0.267**	**0.245**	**0.302**	**0.181**	**0.251**	**0.230**	**0.147**	**0.091**
	(2.75)**	(2.88)**	(3.55)**	(2.26)**	(2.98)**	(2.90)**	(2.09)**	(2.08)**
ln (fatality rate per 10,000 bike commuters)		**−0.366**		**−0.397**	**−0.412**	**−0.277**	**−0.514**	**−0.320**
		(2.30)**		(2.45)*	(2.51)**	(1.97)*	(4.35)**	(4.35)**
ln (percent of students in population)		**0.859**	**0.904**	**0.863**	**0.808**	**0.879**	**0.544**	**0.340**
		(3.70)**	(3.74)**	(3.49)**	(3.53)**	(4.39)**	(2.52)**	(2.50)**
ln (percent of households without car)		**0.339**	**0.370**		**0.378**	**0.300**	**0.499**	**0.310**
		(2.55)**	(2.77)**		(2.80)**	(2.72)**	(3.57)**	(3.52)**
ln (sprawl index)		**0.362**	**0.436**	**0.426**		**0.353**	**0.340**	**0.210**
		(2.29)**	(2.55)*	(2.84)**		(2.13)**	(2.46)**	(2.33)**
ln (transit revenue miles of service per capita)		−0.106	−0.064	0.028	−0.070		−0.266	−0.140
		(0.58)	(0.33)	(0.17)	(0.37)		(1.63)	(1.39)
ln (state gas retail price)		**5.161**	**6.655**	**5.752**	**4.544**	**5.166**	**4.905**	**3.000**
		(1.76)*	(2.17)**	(1.92)*	(1.65)*	(2.14)**	(2.18)**	(2.19)**
ln (annual number of days above 90°F)		0.025	−0.049	0.005	0.022		0.01	−0.010
		(0.28)	(0.59)	(0.05)	(0.25)		(0.14)	(0.14)
ln (annual number of days below 32°F)		−0.048	−0.025	−0.029	−0.048		−0.026	−0.020
		(1.60)	(0.77)	(1.00)	(1.55)		(0.93)	(0.09)
ln (annual inches of precipitation)		0.105	−0.032	0.212	0.106		0.233	0.140
		(0.58)	(0.19)	(1.20)	(0.57)		(1.50)	(1.52)
Constant	−0.265	−31.843	−41.186	−36.061	−27.026	−32.639	−34.669	
	(1.24)	(1.94)*	(2.40)**	(2.16)**	(1.69)*	(2.39)**	(2.74)**	
Observations	90	90	90	90	90	90	90	
Adjusted R^2	0.33	0.65	0.62	0.63	0.63	0.64	Pseudo LL (Intercept): −9.048	
F-statistic	27.44	18.14	16.31	17.00	18.37	26.00	Pseudo LL(Full): −3.399	
	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**	Pseudo R^2(McFadden): 0.62	

Note coefficients of statistically significant variables shown in bold print

Absolute value of robust *t*/*z* statistics in parentheses

[a] Logistic regression estimated via STATA GLM (generalized linear models) with logit link function, binomial distribution, and robust standard errors

* Significant at 10%

** Significant at 5%

Table 2: Dataset for Estimating Walking Mode Share Model

Variable	Description	Mean	Median	Standard Deviation	5th Percentile	95th Percentile
PCTZEROVEH	Percent of households owning zero vehicles	0.09	0.05	0.13	0.00	0.35
PCTTWOVEH	Percent of households owning two or more vehicles	0.59	0.62	0.21	0.18	0.87
POPDEN	Population density (people per acre)	15.98	11.47	19.38	0.55	46.44
EMPDEN	Job density (jobs per acre)	6.99	1.91	26.03	0.08	20.90
RETSEREMPDEN	Retail, service, office, and entertainment** job density (jobs per acre)	6.18	1.62	24.11	0.06	18.35
PCTLOWWAGE	Percent of workers living in tract earning < $1250/month	0.21	0.20	0.04	0.14	0.28
JOBPERHH	Jobs per household (measure of land use mixing)	1.55	0.42	8.75	0.09	4.54
TRNFREQDEN	Aggregate frequency of transit service per square mile	1.68	0.02	5.91	0.00	8.56
PCTSENIOR75	Percent of population aged 75 or older	0.06	0.05	0.05	0.01	0.13
PCTSENIOR85	Percent of population aged 85 or older	0.02	0.02	0.02	0.00	0.05
TRNHALFMI	Tract is substantially located within half-mile of rail station or ferry terminal	0.35	0.00	0.48	0	1
TRNQRTMI	Tract is substantially located within quarter-mile of rail station or ferry terminal	0.24	0.00	0.43	0	1
WALKSHARE	Walking mode share**	0.16	0.10	0.18	0.00	0.53

*Retail = LEHD category CNS07; Service = LEHD categories CNS12, CNS14,CNS15, CNS16, and CNS19; Office = LEHD categories cns09, CNS10, CNS11, CNS13, and CNS20; Entertainment = LEHD categories CNS17 and CNS18
**Walking mode share is based on the CHTS activity file with no trip or tour construction conducted. Thus, access and egress movements get counted as separate trips. For instance, walking to a transit station and then taking transit to a destination would be counted as two separate trips. The expansion factors calculated as part of the CHTS are used.

Table 3: Final Estimated Walking Mode Share Model

Variable	Coefficient	Std. Err.	t-stat	p-value
Constant	.0683673	.0049306	13.87	0.000
PCTZEROVEH	.4319413	.0494274	8.74	0.000
POPDEN	.002409	.0002871	8.39	0.000
RETSEREMPDEN	.0002763	.0001836	1.51	0.133
TRNQRTMI	.0301064	.0090592	3.32	0.001
Num. of Obs.	1529			
R-Squared	0.3492			