ESTIMATION OF ANNUAL AVERAGE DAILY BICYCLE (AADB) TRAFFIC USING ADJUSTMENT FACTORS

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Presentation Outline

- Introduction
- Objectives
- Methodology
- Data Description
- Results
- Conclusions
- Practical Advantages

Introduction

- The annual average daily traffic (AADT)
  - One of the fundamental traffic engineering metrics
  - Used for planning and design purposes
- The annual average daily Bicycle (AADB)
  - The equivalent measure for bicycle traffic
  - Requires the availability of all-around-the-year data of Daily Bicycle Volumes (DBV) at a particular location
- Research done as a part of the development of Vancouver Cycling Data Model (VCDM)

Objectives

- Investigate several issues related to the use of adjustment factors for the estimation of the AADB:
  - Application of monthly factors versus seasonal factors
  - Decomposing error when using daily factors and monthly/ seasonal factors
  - Temporal transferability of monthly/seasonal factors
  - Months representative to the AADB volume

Methodology

- The estimation model components:
  - For a particular day of the week *i*, a particular month of the year *k*, and a facility *j*, the monthly average daily bicycle volume (MADB) is calculated as:

$$MADB_{kj} = DBV_{ikj} \times DF_{ik}$$

  - Annual average daily bicycle volume (AADB)

$$AADB_j = MADB_{kj} \times MF_k$$

Methodology

- Daily factors were calculated at locations where data were available for an entire month

$$DF_{ikj} = \frac{MADB_{kj}}{DBV_{ikj}}$$

- Daily factors were calculated for two levels of weather conditions; wet and dry

- Monthly factors were calculated at locations where full year of bicycle volume data were available such that

$$MF_{kj} = \frac{AADB_{j}}{MADB_{kj}}$$

Methodology

- Two methods of calculating the factors; straight average and harmonic mean
- Monthly factors were calculated for every month while seasonal factors for every season (i.e. three months)
- Error Measurements:

$$MAPE_{Daily\ Factors} = \frac{1}{N}\sum_{i=1}^{N}\left|\frac{MADB_{Actual} - MADB_{Estimated}}{MADB_{Actual}}\right|$$

$$MAPE_{Monthly\ Factors} = \frac{1}{M}\sum_{i=1}^{M}\left|\frac{AADB_{Actual} - AADB_{Estimated}}{AADB_{Actual}}\right|$$

Data Description: Vancouver Cycle Data Model

- Bicycle Network Data
  - **Total length:** 470 km of bicycle routes throughout the city
  - **Facility types:** separated bicycle lanes, local street bikeways, arterial street bike lanes and off-street pathways
- Bicycle Volume Data
  - **Amount:** more than 810,000 hours of bicycle volume data
  - **Period:** 2005 - 2011
- Weather Data
  - Mean Temperature
  - Total Precipitation (mm)
  - Total Snow (cm)
  - Snow on the Ground (cm)

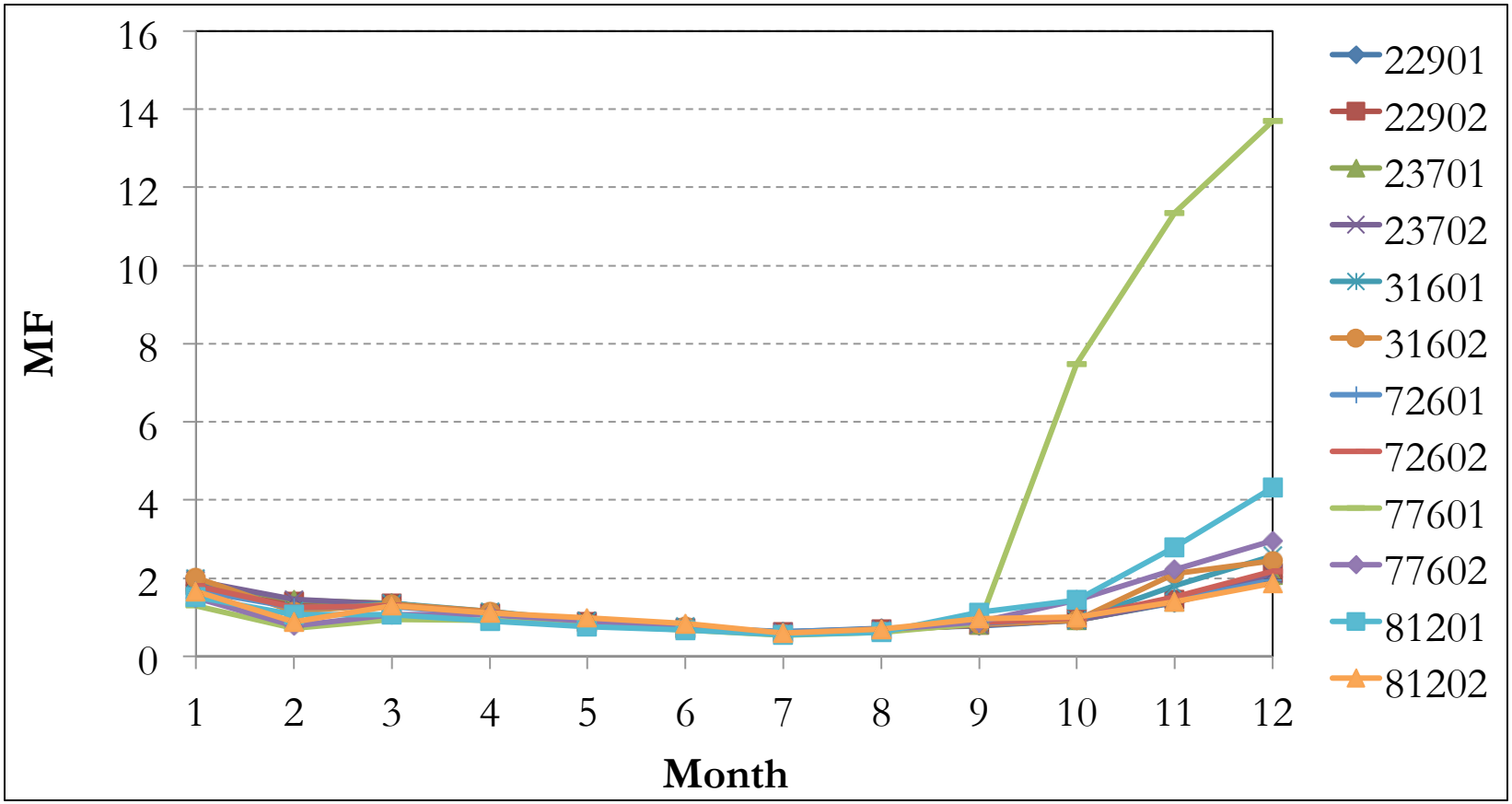
Data Description

- Calibration/development data
  - Annual daily bicycle volumes at twelve count locations in 2010
- Validation data
  - Data from thirteen locations where daily bicycle volumes were available for at least 335 days, which is equivalent to eleven months

Location ID	Year	# of days	AADB
72601	2009	339	394
72602	2009	349	412
65501	2010	356	166
65502	2010	357	152
22901	2011	359	375
31601	2011	362	1449
31602	2011	363	1421
44801	2011	348	642
44902	2011	341	597
95201	2011	335	305
95202	2011	342	578
102401	2011	350	780
102402	2011	354	583

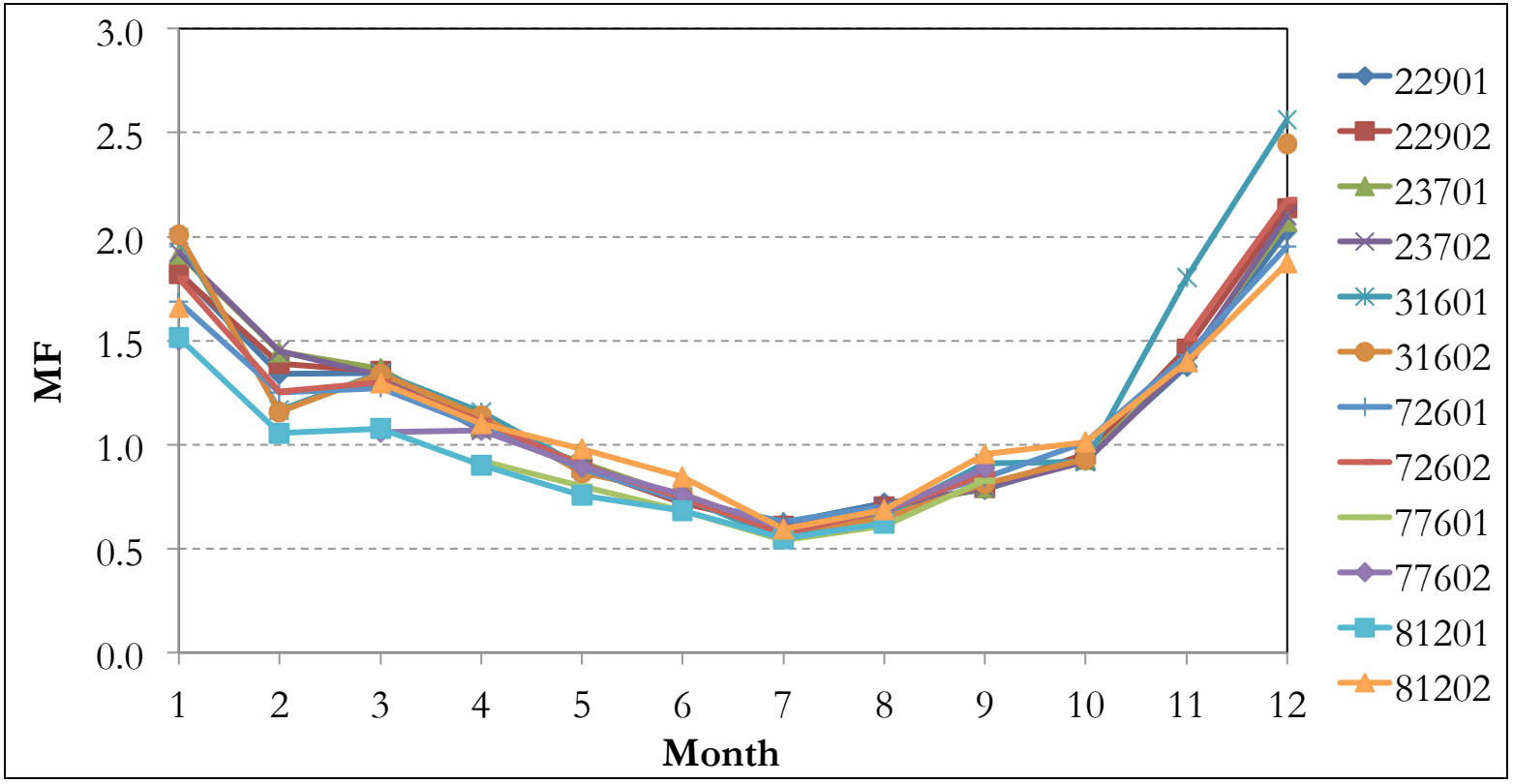
Results: Calculation of the Monthly Factors

- Initial calculations



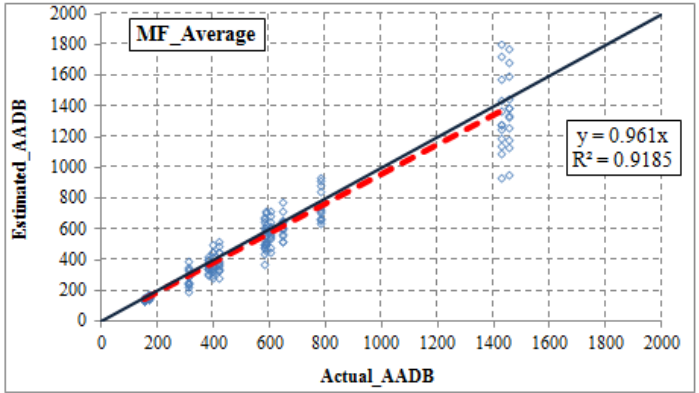
Results: Calculation of the Monthly Factors

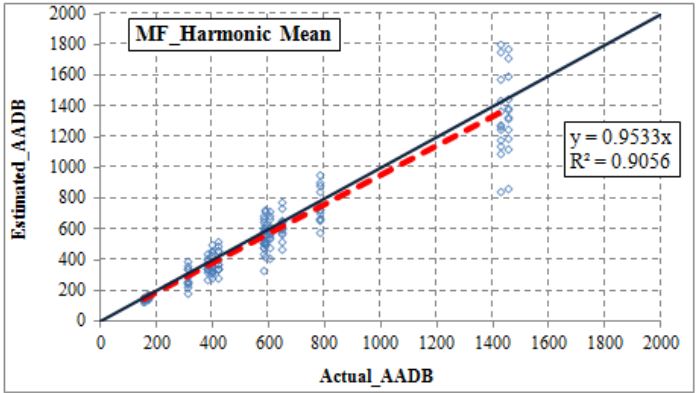
- Monthly factors that were ±25% from the general average monthly factor were removed and considered outliers

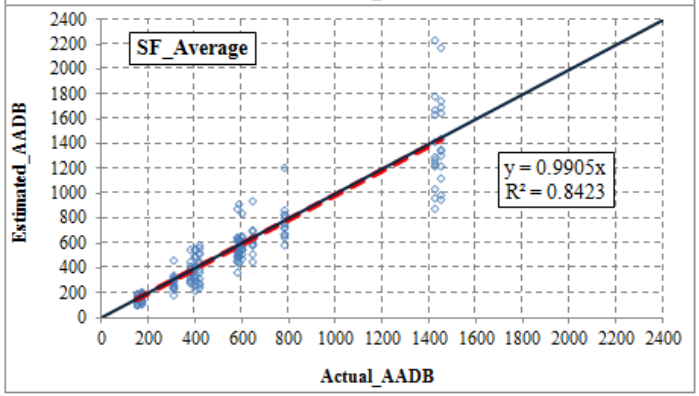


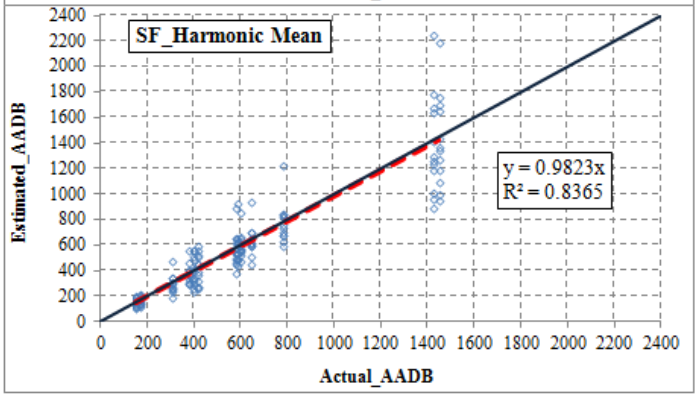
Results: Monthly Vs. Seasonal Factors

- Actual and estimated AADBs were plotted using different monthly and seasonal factors

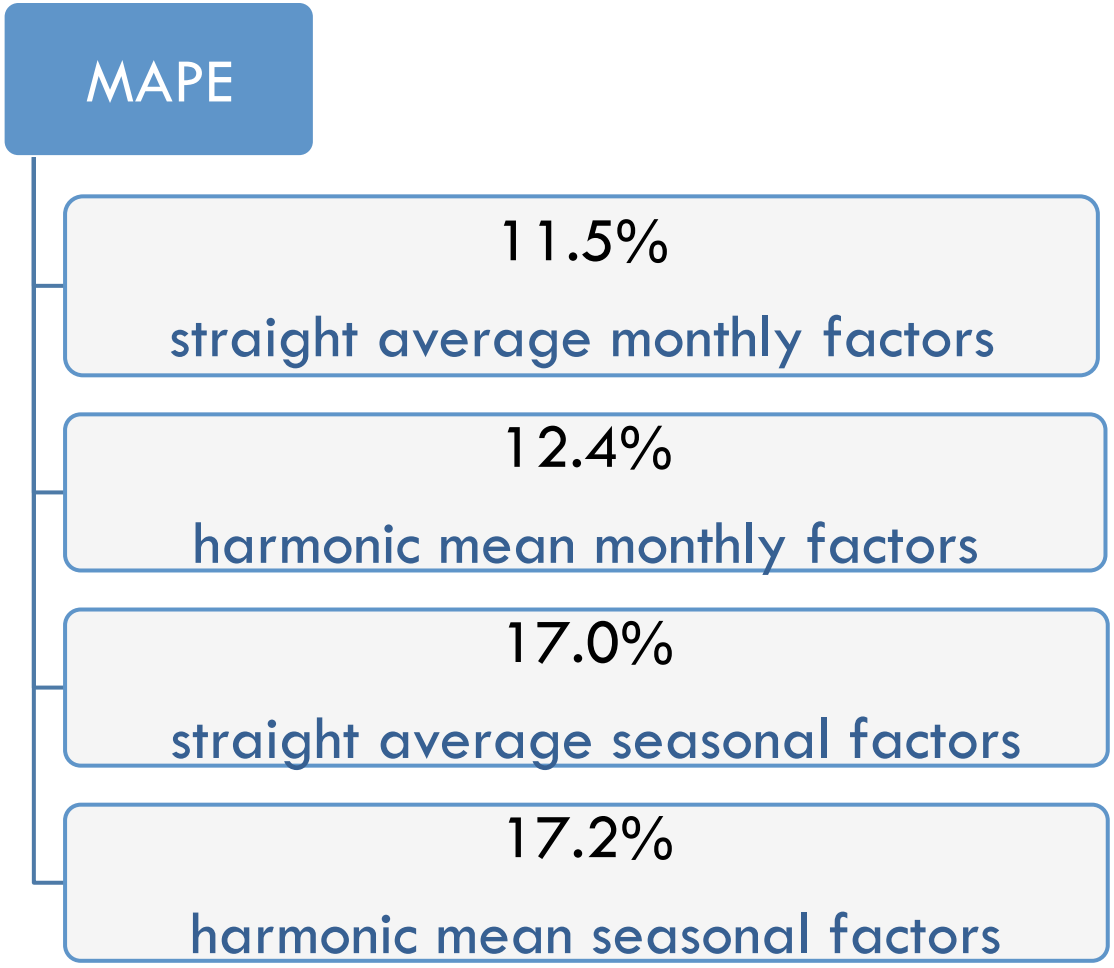




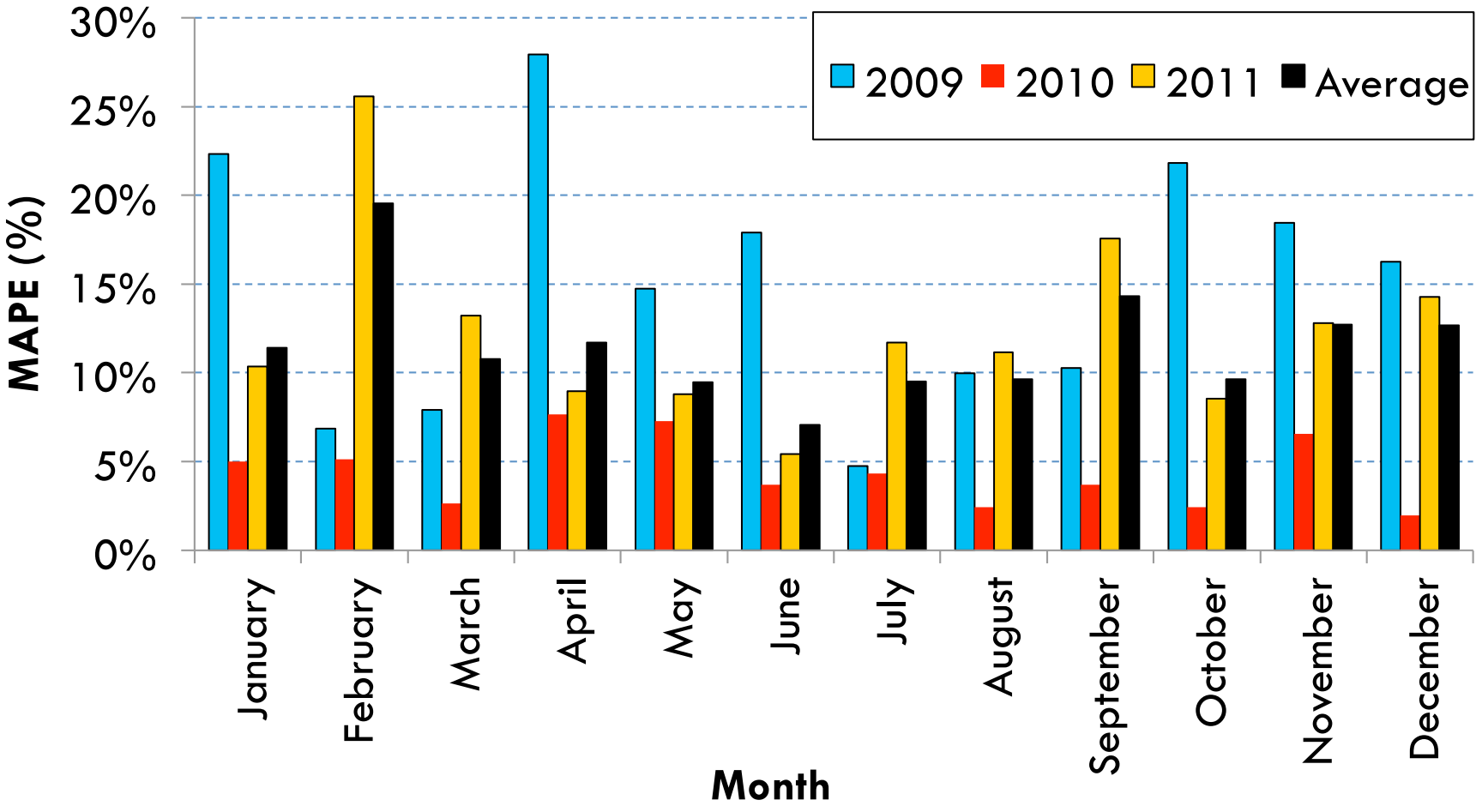




Results: Monthly Vs. Seasonal Factors

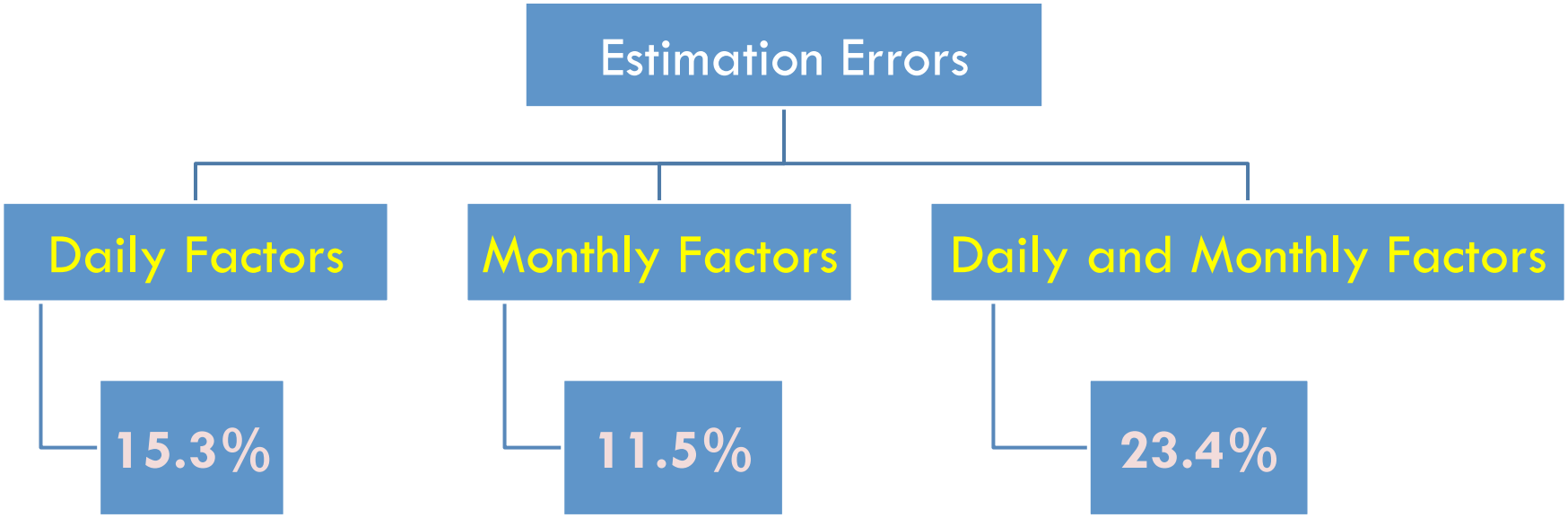


Results: Detailed Error Analysis



Results: Error Decomposition

- Magnitude of error attributable to the use of daily and monthly adjustment factors



Results: Error Decomposition

- 70% of all the validation records had an error component of 15% or less that is attributable to the use of DFs
- The MAPE of the estimated AADB by daily and monthly factors was a minimum; **12%,** when using daily cycling volume of weekdays (i.e. Tuesdays to Fridays) in August

Conclusions

- The use of monthly factors in estimating the AADB is superior to the use of seasonal factors (i.e. 11.5% vs.17.0% error)
- Almost15% of the estimation error of the AADB was attributed to the use of DFs while 11% was attributed to the use of MFs
- The overall error of using the two factors together was 23%
- The lowest estimation errors were attained when applying the developed factors to the data of 2010 (same year of development data)
- It is preferred not to transfer the factors from one year to another unless factors for the same year are unavailable

Practical Advantages

- Improved models using less data
  - Few days of data can be used to obtain the annual averages
  - Optimum utilization of data collection resources (i.e. specification of the best days for collecting data)
- Assessment of the temporal transferability of the factors
- Calculation of estimation accuracy
  - Decomposition of error between daily and monthly adjustment factors

Thank You - Questions?

Data Description: Bicycle Network Data

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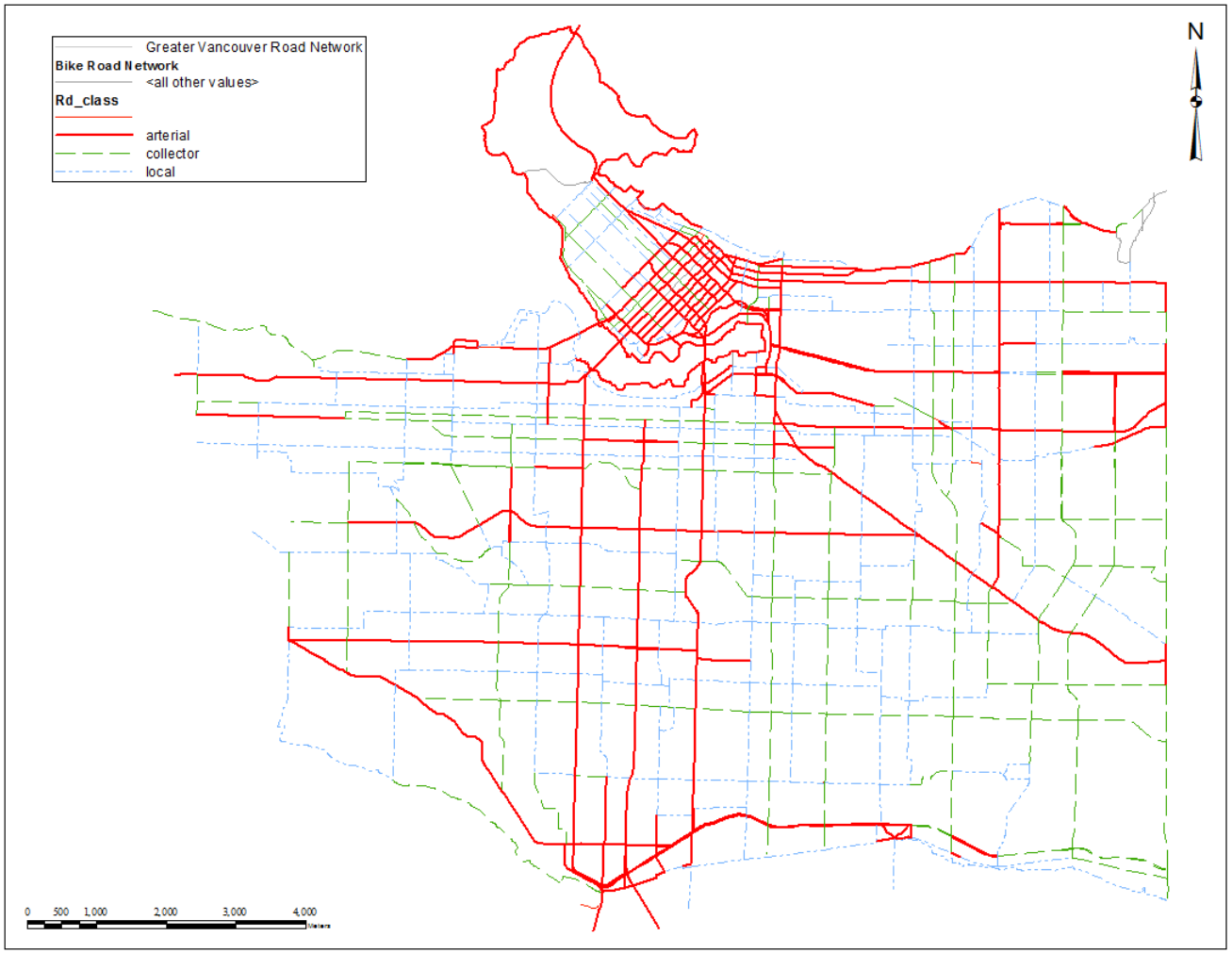


Data Description: Bicycle Volume Data

Year	Total no. of hourly data sessions	No of links
2005	4,536	608
2006	3,012	428
2007	1,964	284
2008	27,218	879
2009	86,660	858
2010	274,792	464
2011	412,450	1,202
Sum	810,632	4,723

Methodology: Methods of Calculating DF/MF

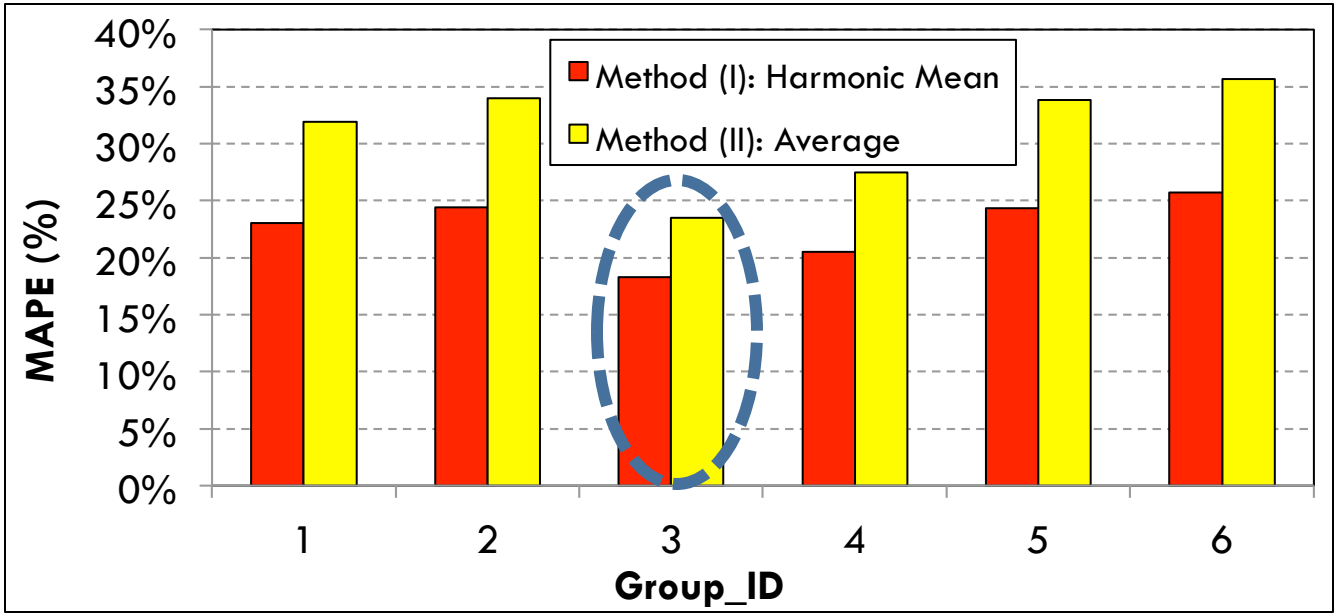
- Harmonic Mean

$$DF_i = \frac{1}{\frac{1}{n}\sum_{i=1}^{n}\frac{1}{DF_{ij}}} = \frac{1}{\frac{1}{n}\sum_{i=1}^{n}\frac{DBV_{ij}}{MADB_j}} = \frac{1}{\frac{1}{n \times MADB_j}\sum_{i=1}^{n} DBV_{ij}}$$

- Straight average

$$DF_i = \frac{1}{n}\sum_{i=1}^{n} DF_{ij}$$

Results: Daily Adjustment Factors



Group ID	Development Criteria	Calculation Method
1	Day of the week	I***, II****
2	Weekdays/Weekends	I, II
3	Day of the week, weather*	I, II
4	Weekdays/Weekends, weather	I, II
5	Day of the week, road class**	I, II
6	Weekdays/Weekends, road class	I, II

Results: Detailed Error Analysis