# PM – 11: Mileage Based Rating in the Current Auto Insurance Environment

CAS Ratemaking & Product Management Seminar

Huntingdon Beach, CA

*Commitment Beyond Numbers*

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# Discussion Items

- Introduction – Gary Wang
  - Relationship between annual mileage and telematics
- Mileage and Insurance Losses – Matt Moore
- Predicting Annual Mileage – Roosevelt Mosley
  - Use of vehicle history to verify annual mileage
  - Constructing models to predict annual mileage
  - Application to insurance company processes

# Annual Mileage & Telematics

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# The Age Old Issue

- We have always known that annual mileage is an important variables
- Despite many efforts by insurance companies, verification still remains as the issue
  - Customer surveys
  - Picture of odometer
  - Validation when a claim occurs
- Result
  - Removal from class plan
  - Large mileage groupings
  - Reduced discounts/surcharges

# Telematics – the Light at the End of the Tunnel

- Mileage driven
- Driver behavior
- Vehicle information
- Environmental characteristics

# Telematics Adoption

- Current Statistics
  - Over 125M vehicles on the road in the United States
  - Over 250M registered vehicles
  - Progressive – over 1 million telematics customers (February 19, 2013 press release)
- Projections
  - 25 – 30% of insured vehicles by 2019
- Challenges
  - Customer adoption
  - Program design
  - Scale

# Not So Fast

- There will be a significant amount of time before telematics achieves mass adoption
- Due to the voluntary nature, the coverage will likely never be near 100%
- So what do you do about annual mileage?

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# Using Vehicle History to Verify Annual Mileage

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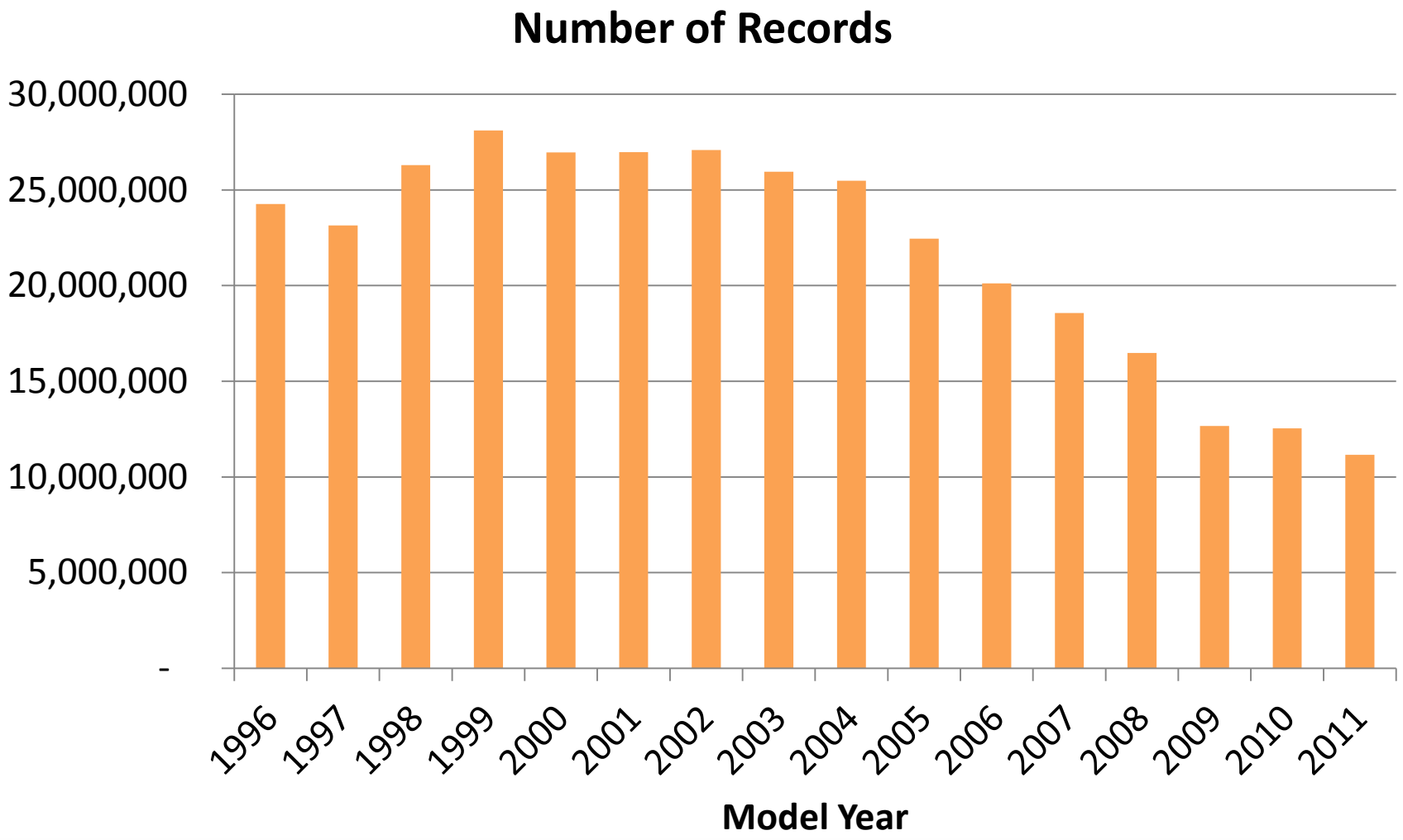
# Mileage Verification Process

- Background
  - CARFAX collects vehicle odometer readings from a variety of sources
  - These odometer readings are collected at different points in time
  - From multiple odometer readings, CARFAX calculates the average annual mileage for the vehicle
  - When there are not enough actual odometer readings, a mileage calculation is not returned
- Objectives of Analysis
  - Use of actual calculated mileage to validate annual mileage
  - Based on the available actual odometer readings, develop a model to predict average annual mileage when an actual annual mileage cannot be calculated

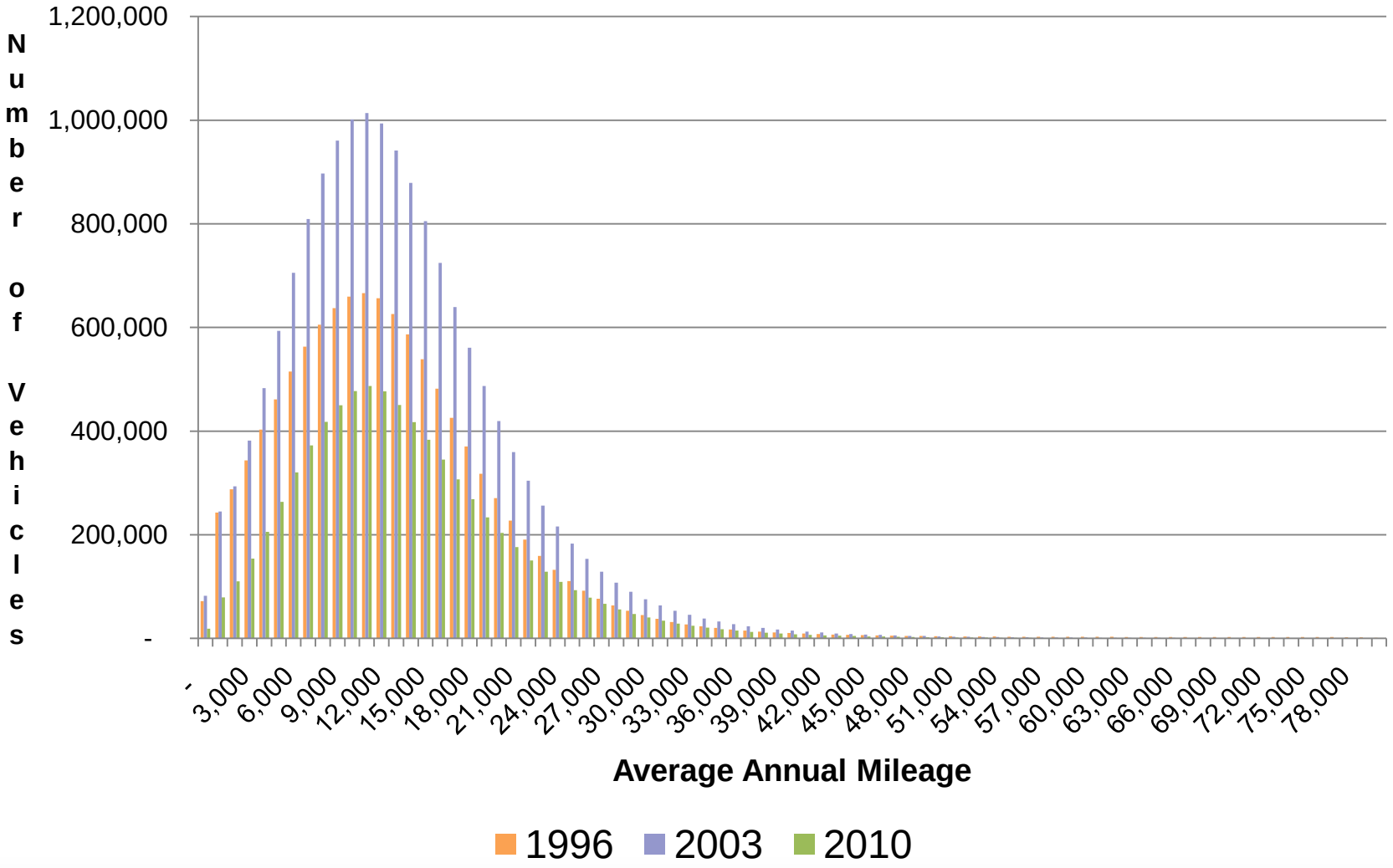
# Data

- Approximately 195MM vehicle/ZIP code combinations with actual mileage calculations
- Database also includes 153MM vehicles/ZIP code combination that have no valid mileage calculations
- Model years 1996 to 2011
- Data elements
  - VIN
  - Vehicle Make
  - Vehicle Series
  - CARFAX Series Name
  - Model Year
  - Body Type
  - Body Style Subtype
  - Owner Number
  - Owner Average Miles
  - ZIP Code

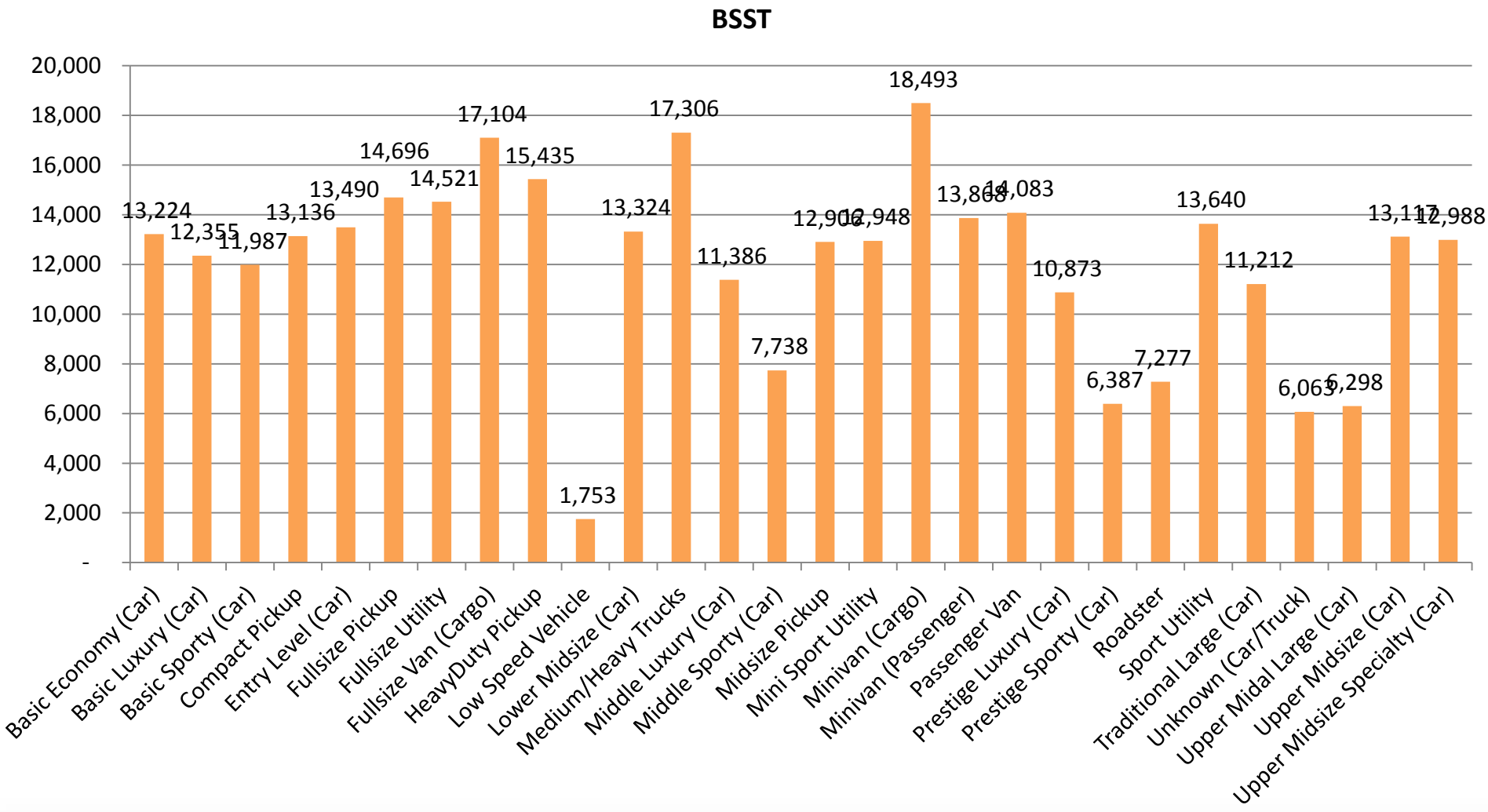
# Analysis Dataset – Records



# Calculated Annual Mileage



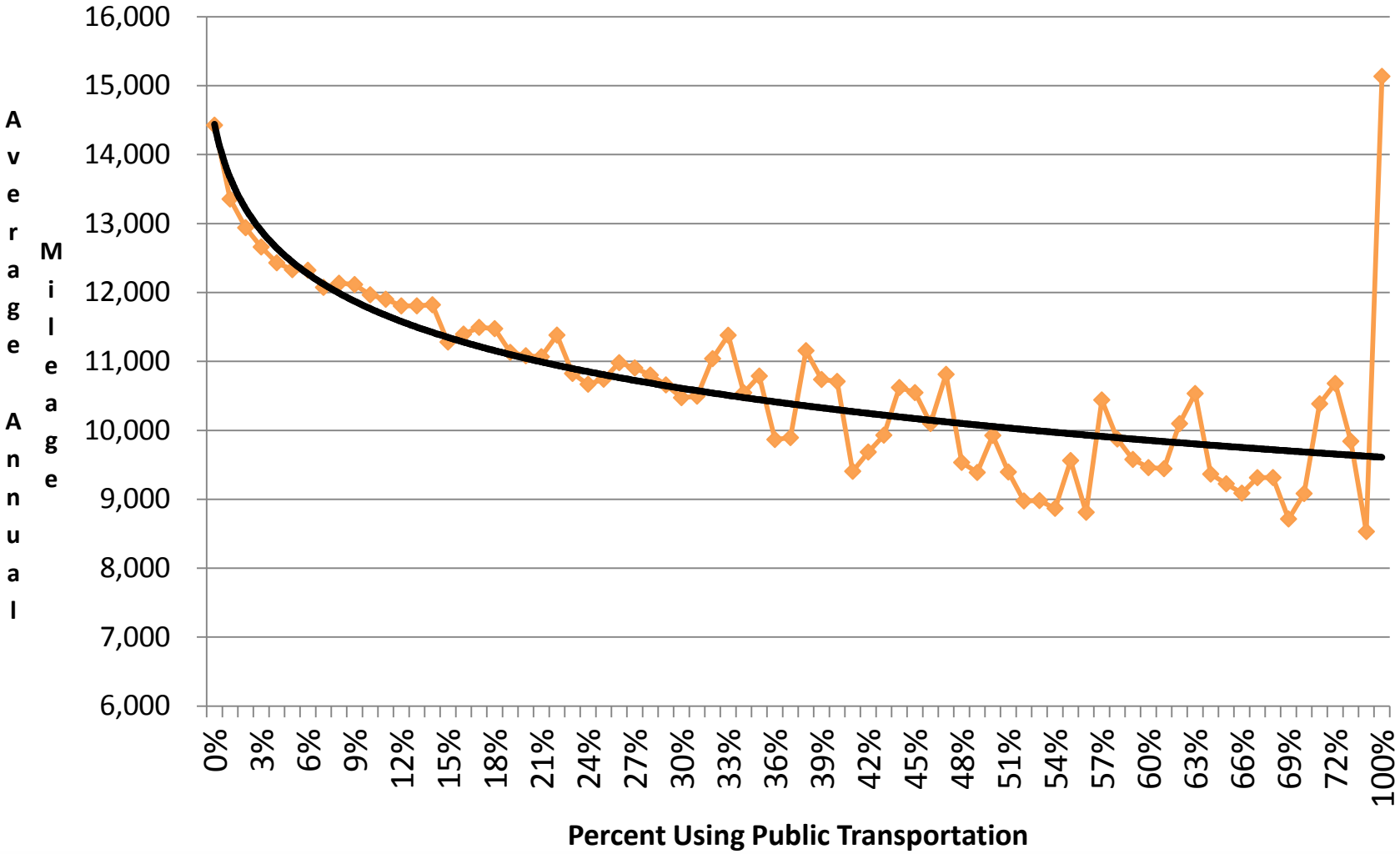
# Average Mileage by BSST



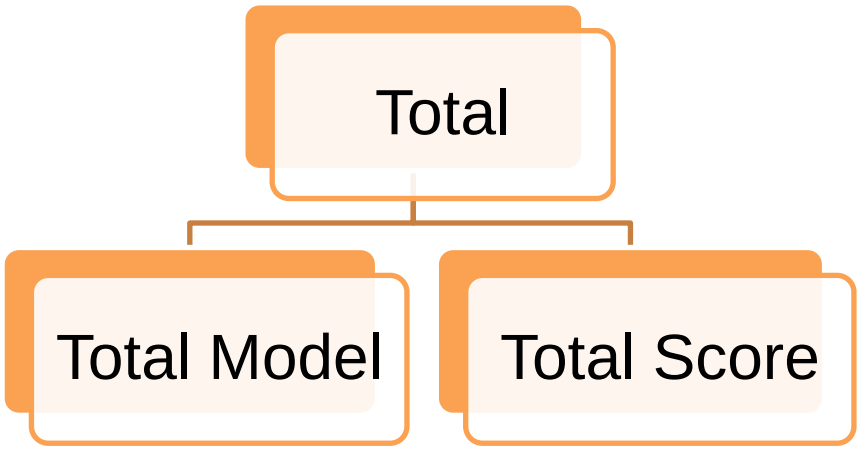
# External Data

- United States Census Bureau data
- 2010 ZIP code level data
- Data elements included
  - Population density
  - Housing density
  - Gender
  - Age
  - Occupancy/vacancy ratio
  - Owner/renter ratio
  - Mortgage ratios
  - Education
  - Employment
  - Occupation
  - Commute times
  - Incomes

# Percent Commute by Public Transportation



# Analysis Dataset Structure




- Total: complete file including all model years
- Total Model: records with valid average annual mileage calculation
- Total Score: records without valid average annual mileage calculation

# Constructing Models to Predict Average Annual Mileage

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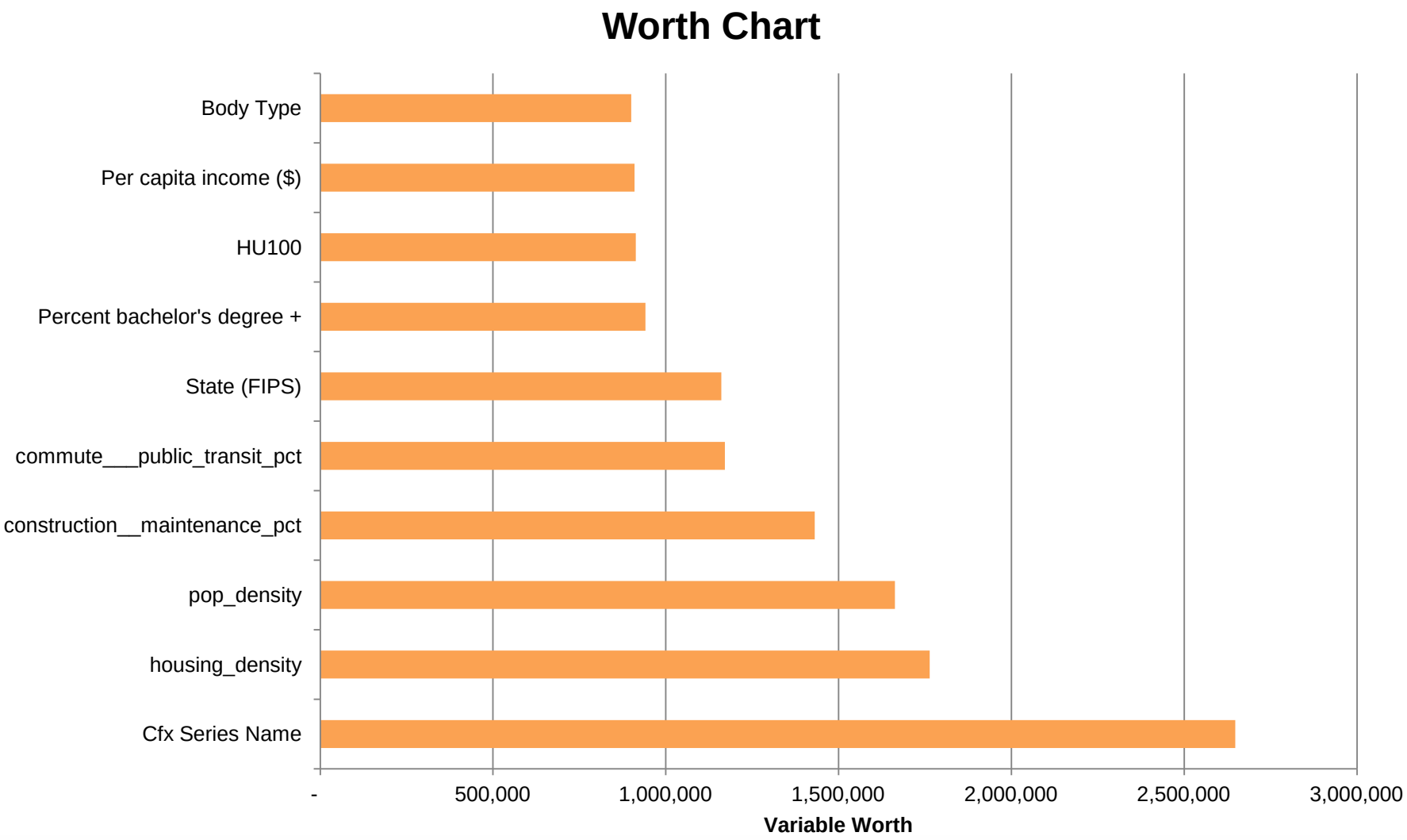
# Data Partition

- Randomly split the model dataset into train, validation, and test datasets
- Train
  - Used for preliminary model fitting
  - 40%
- Test
  - used to obtain a final, unbiased estimate of the generalization error of the model
  - 30%
- Validation
  - Used to compare results of different model types to select best predictor
  - 30%

# Preliminary Model Exploration

- Data Exploration
  - Determines initial predictive power of each variable
  - Variable worth is determined by the decrease in the prediction error when that variable is used to predict the average annual miles
- Data Transformations
  - Normalization of target variable
  - Limits placed on extreme values of census data elements

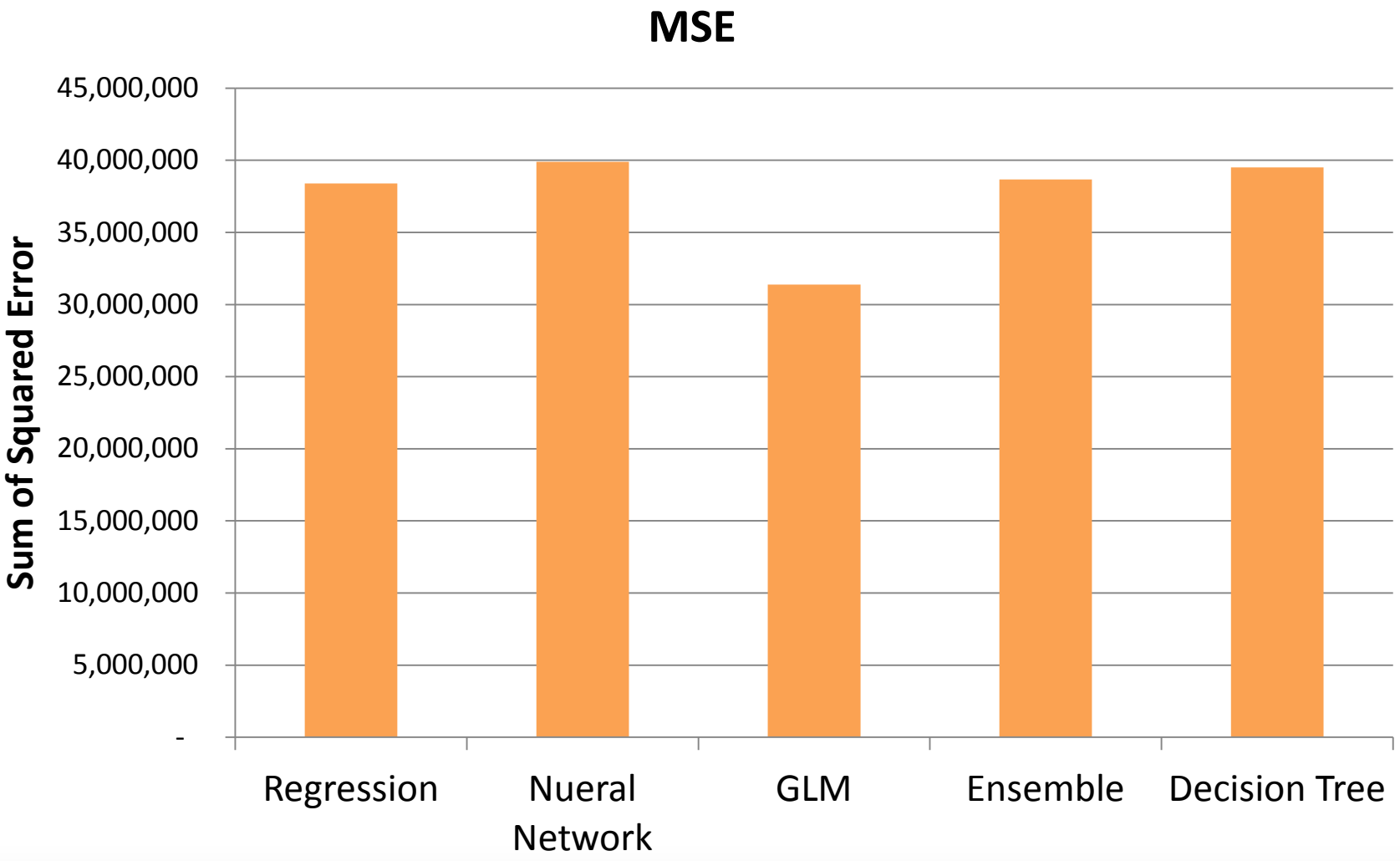
# Initial Top 10 Predictive Variables



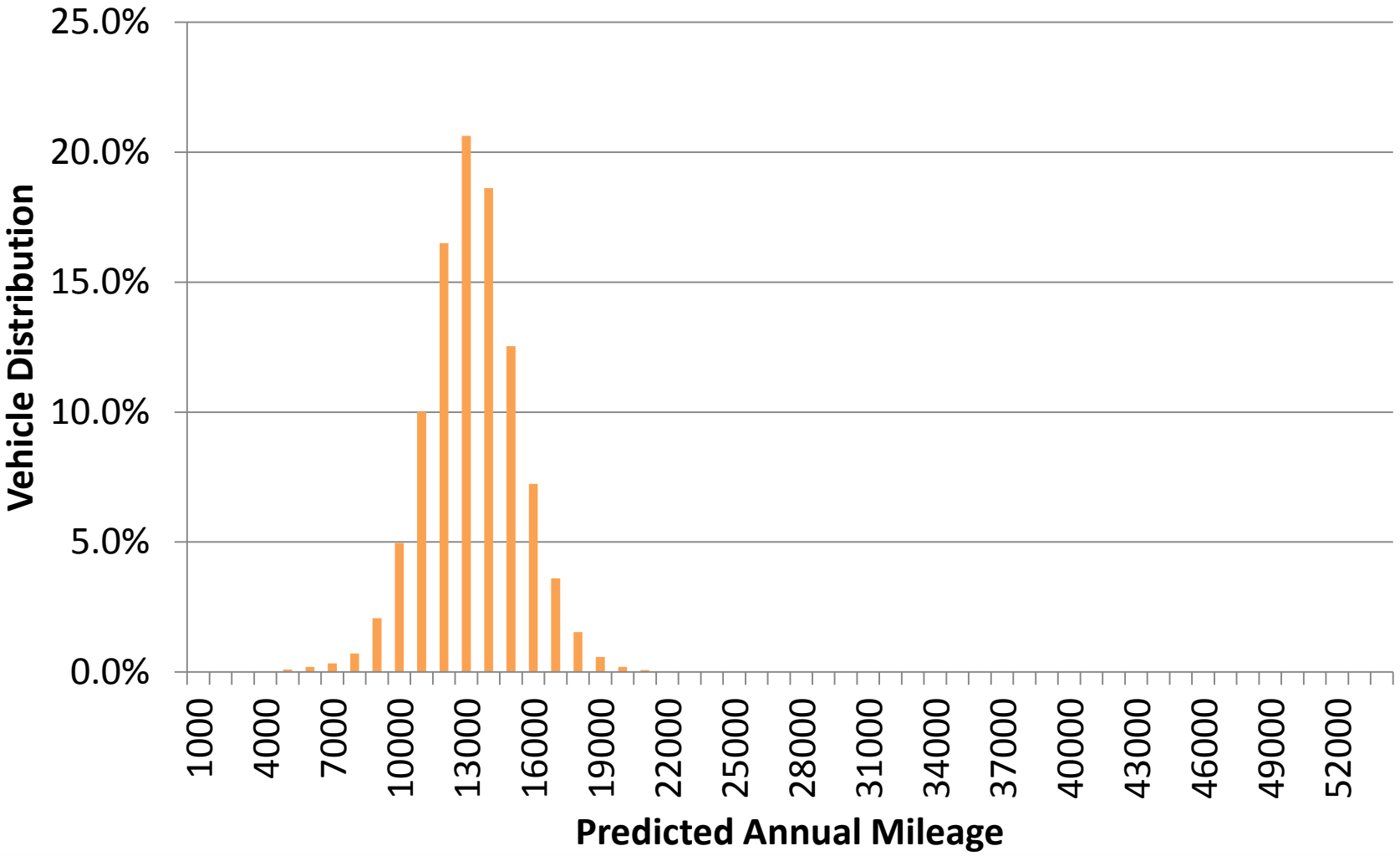
# Model Investigated

- Linear Regression
- Generalized Linear Model
- Decision Trees
- Gradient Boosting
- Neural Networks
- Custom Ensemble

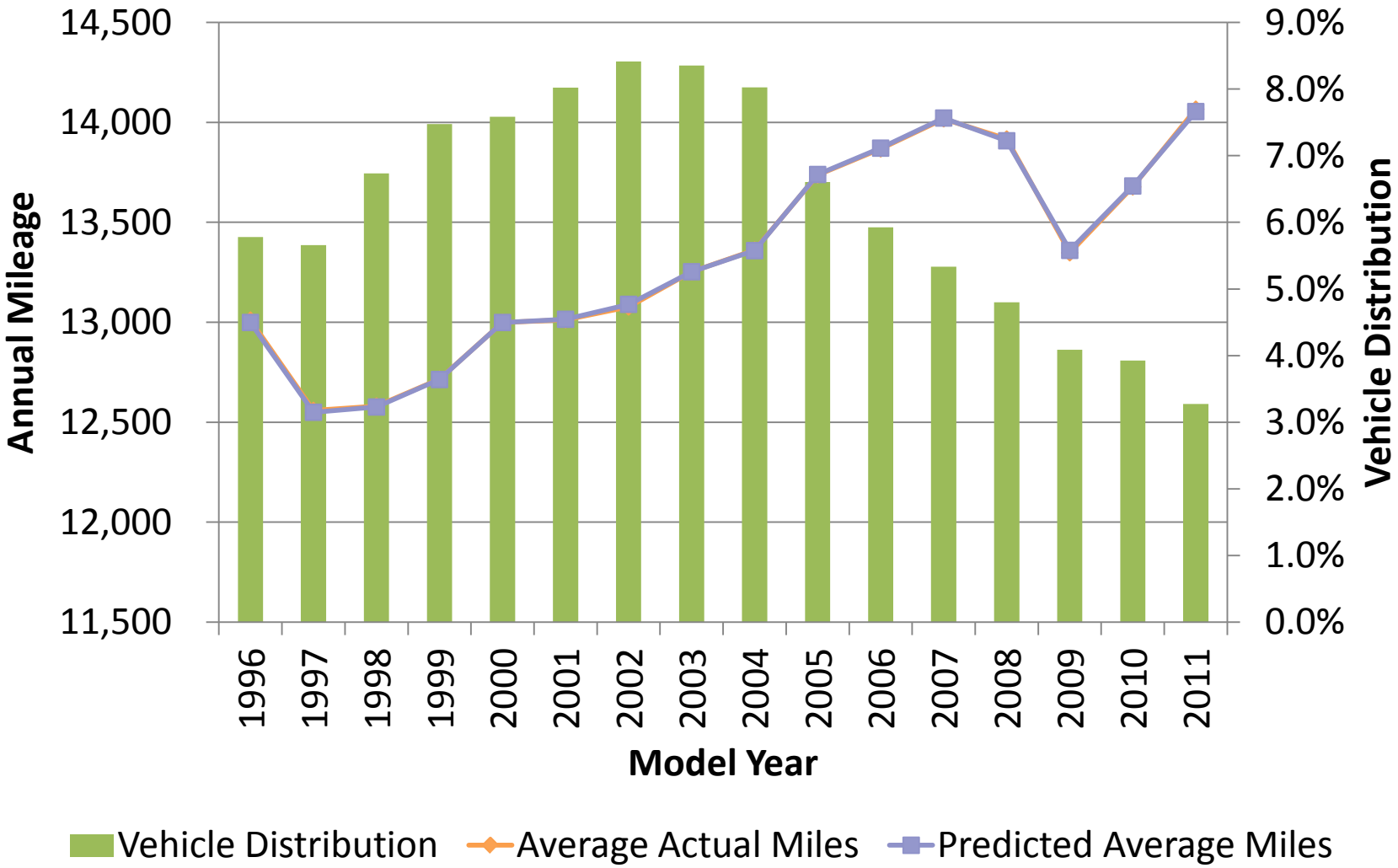
# Mean Squared Error



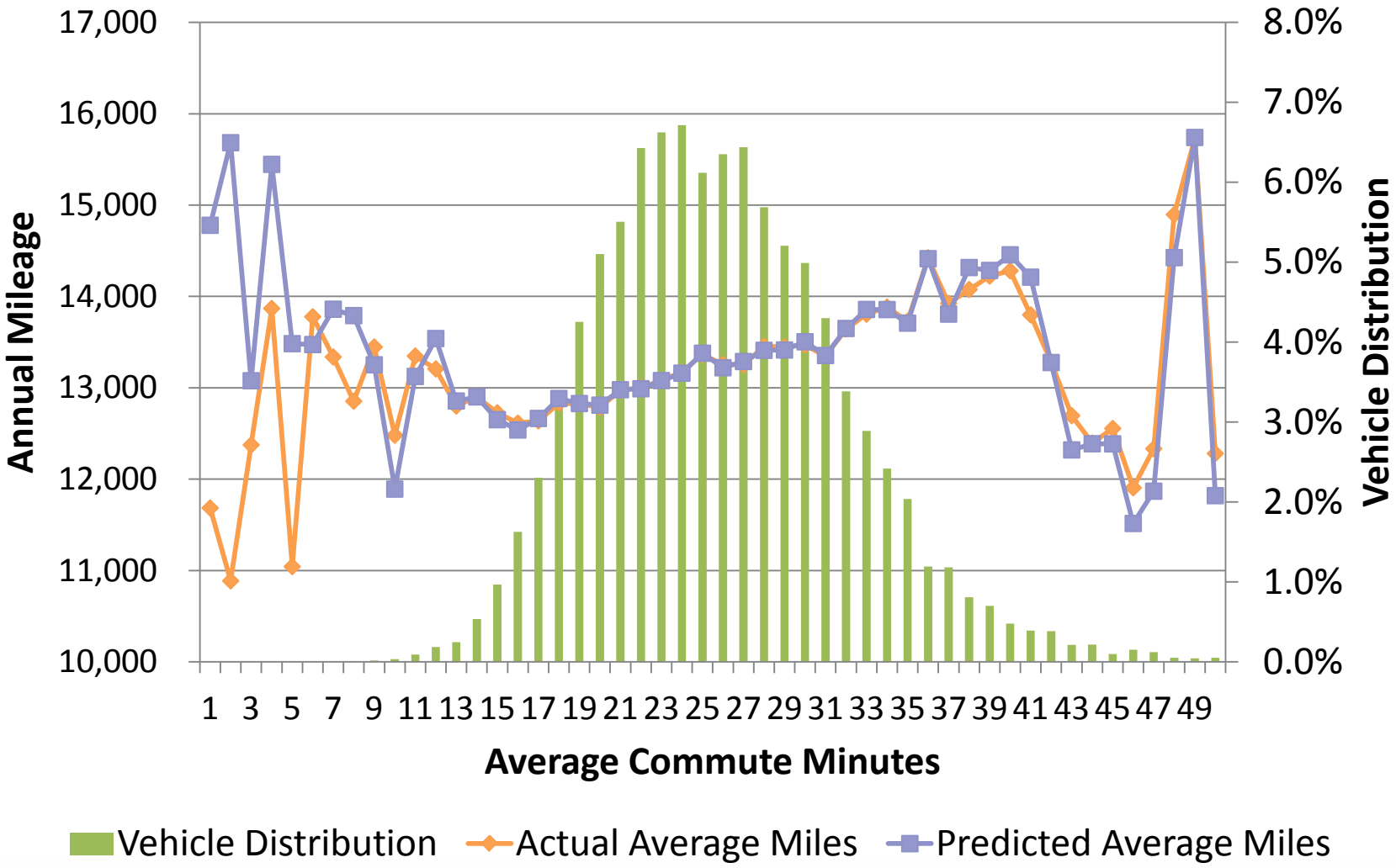
# Predicted Annual Mileage



# Average vs. Predicted – Model Year



# Average vs. Predicted – Average Commute Minutes



# Company Implementation

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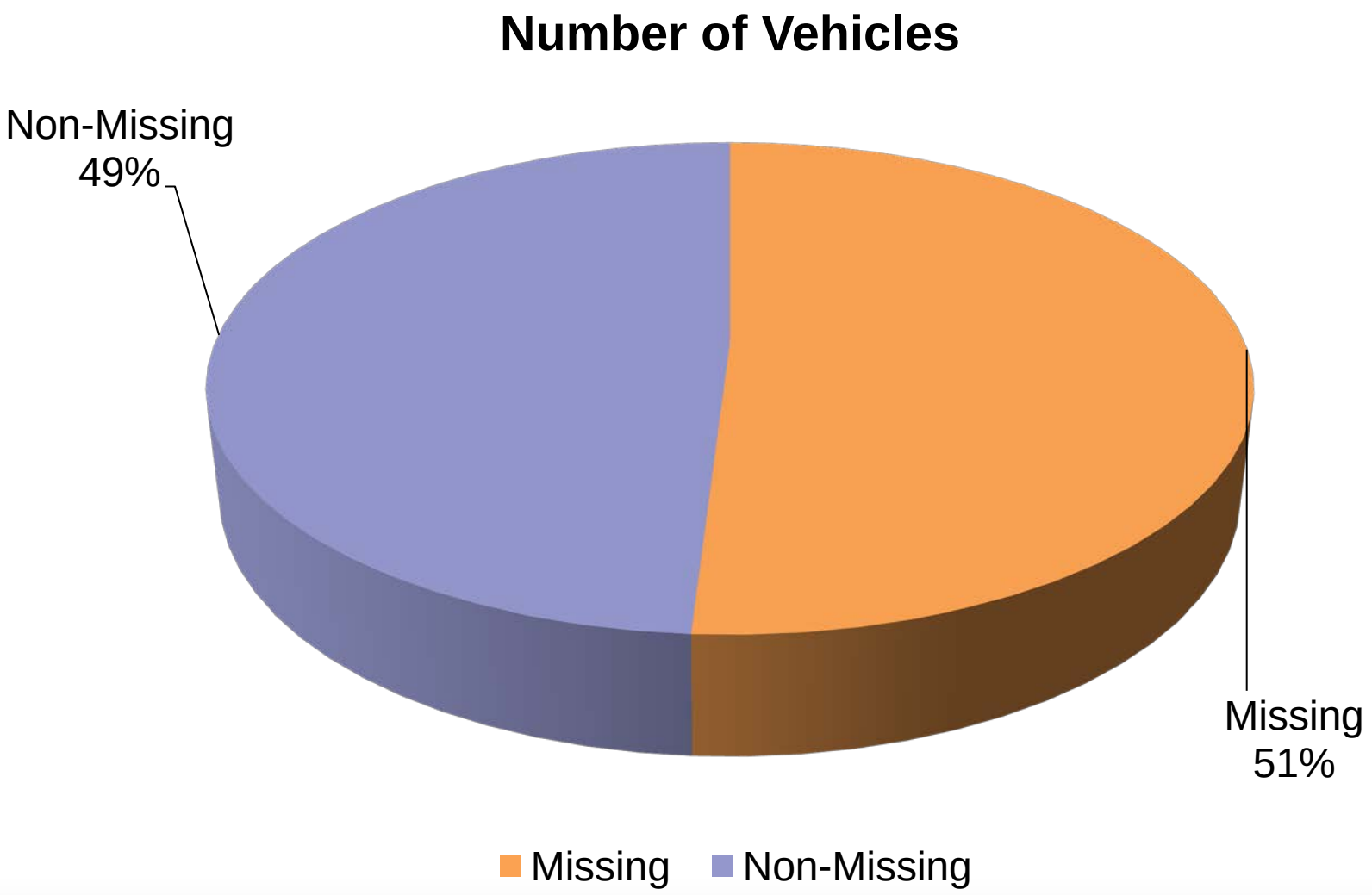
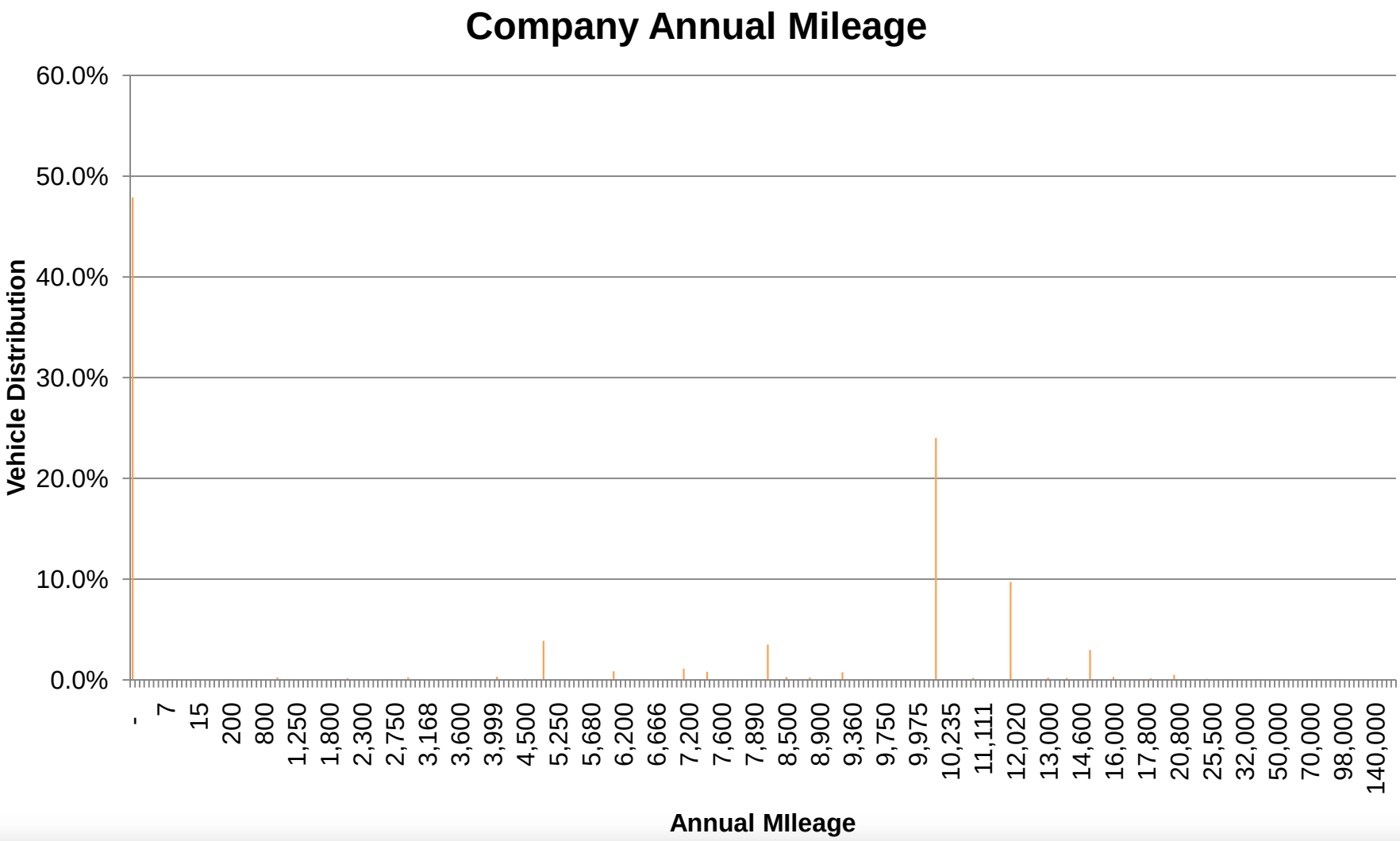
# Company Implementation Possibilities

- Applications
  - Validation of reported annual mileage
  - Fill in missing  annual mileage information
  - Predict annual mileage for rating
- Implementation can combine
  - Actual mileage
  - Calculated annual mileage
  - Predicted annual mileage
  - Company adjusted predicted annual mileage

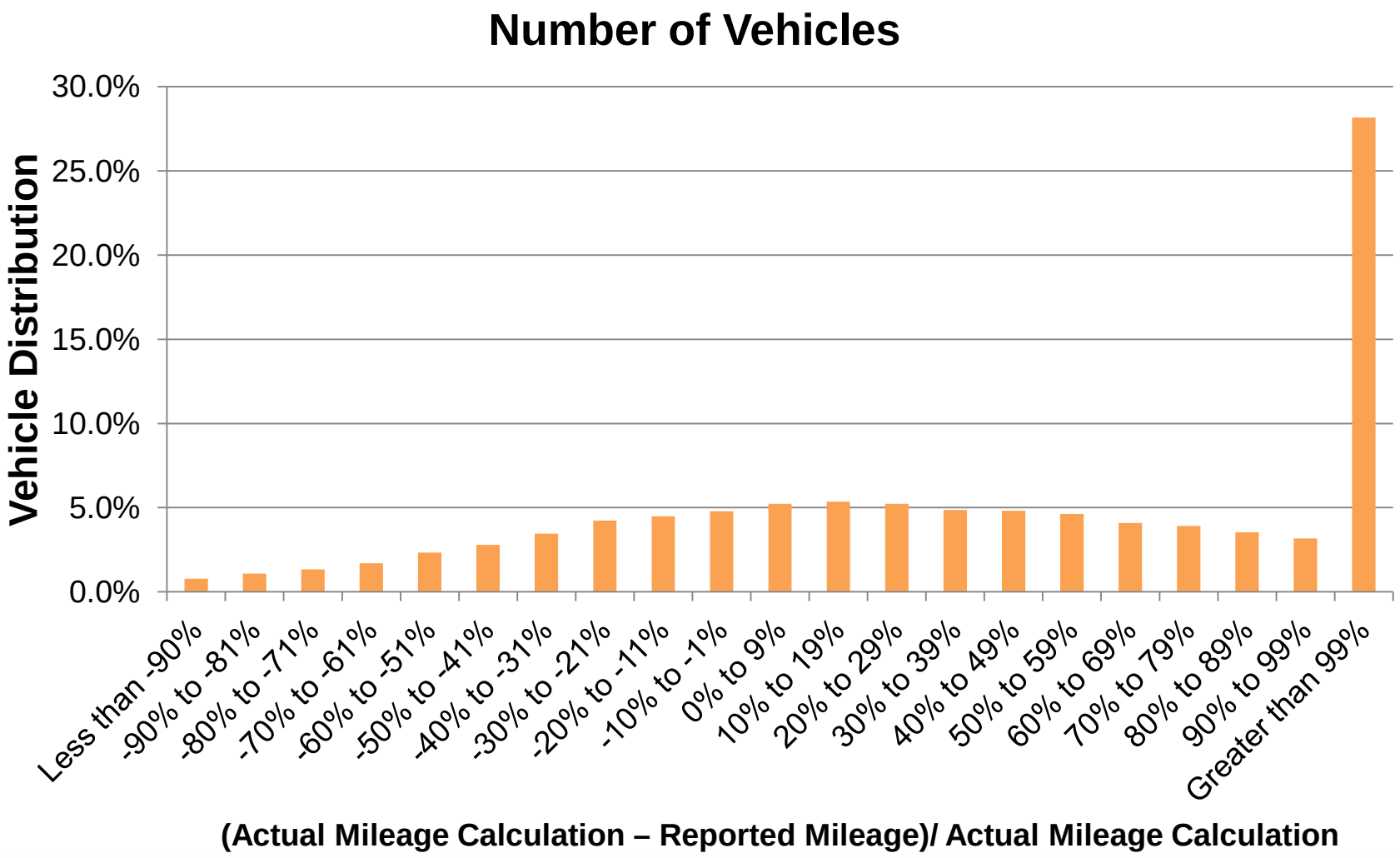
# Missing Annual Mileage – Example Company Data



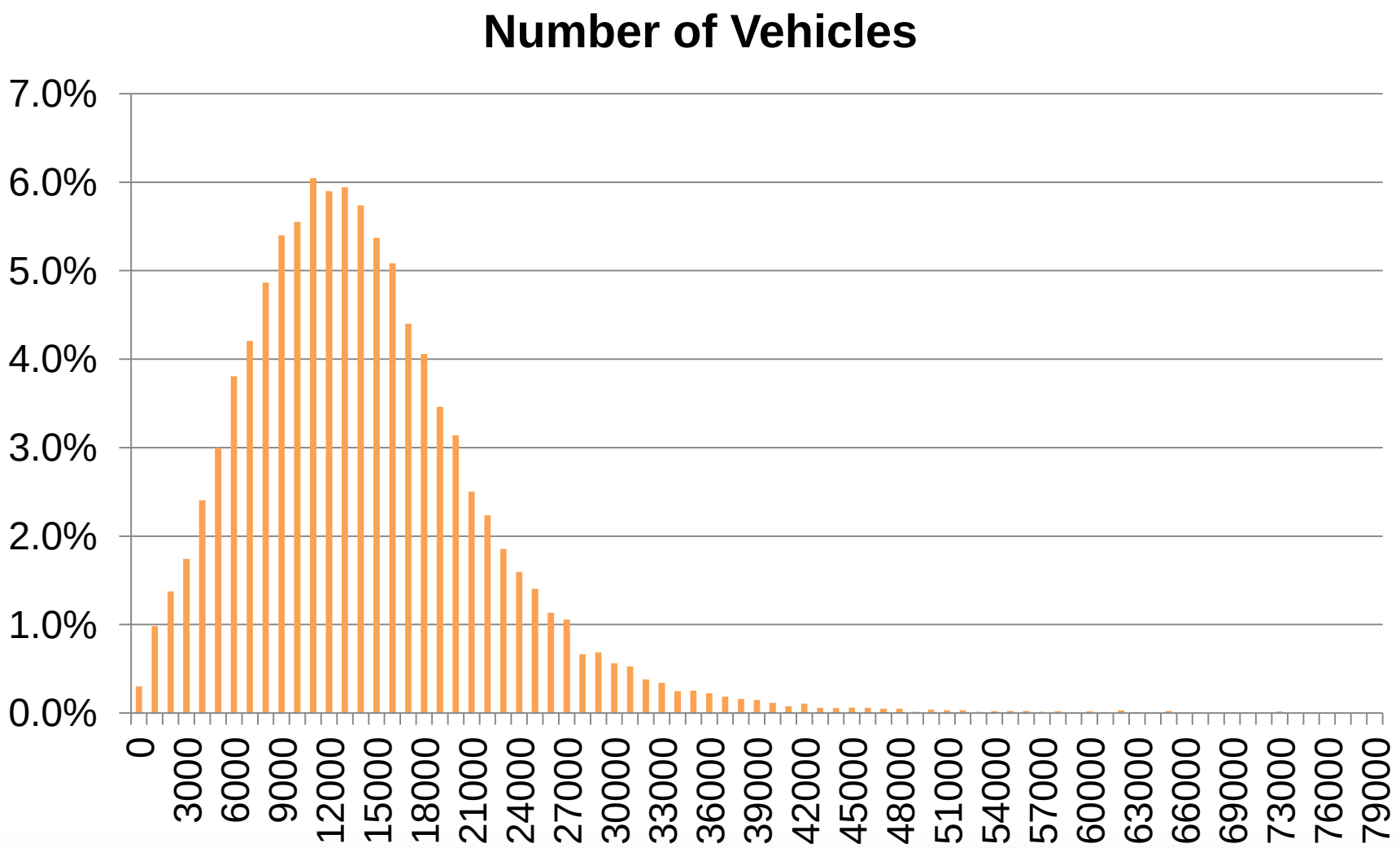
# Company Annual Mileage Distribution



# Comparison of Annual Mileage Calculation to Company Reported Annual Mileage



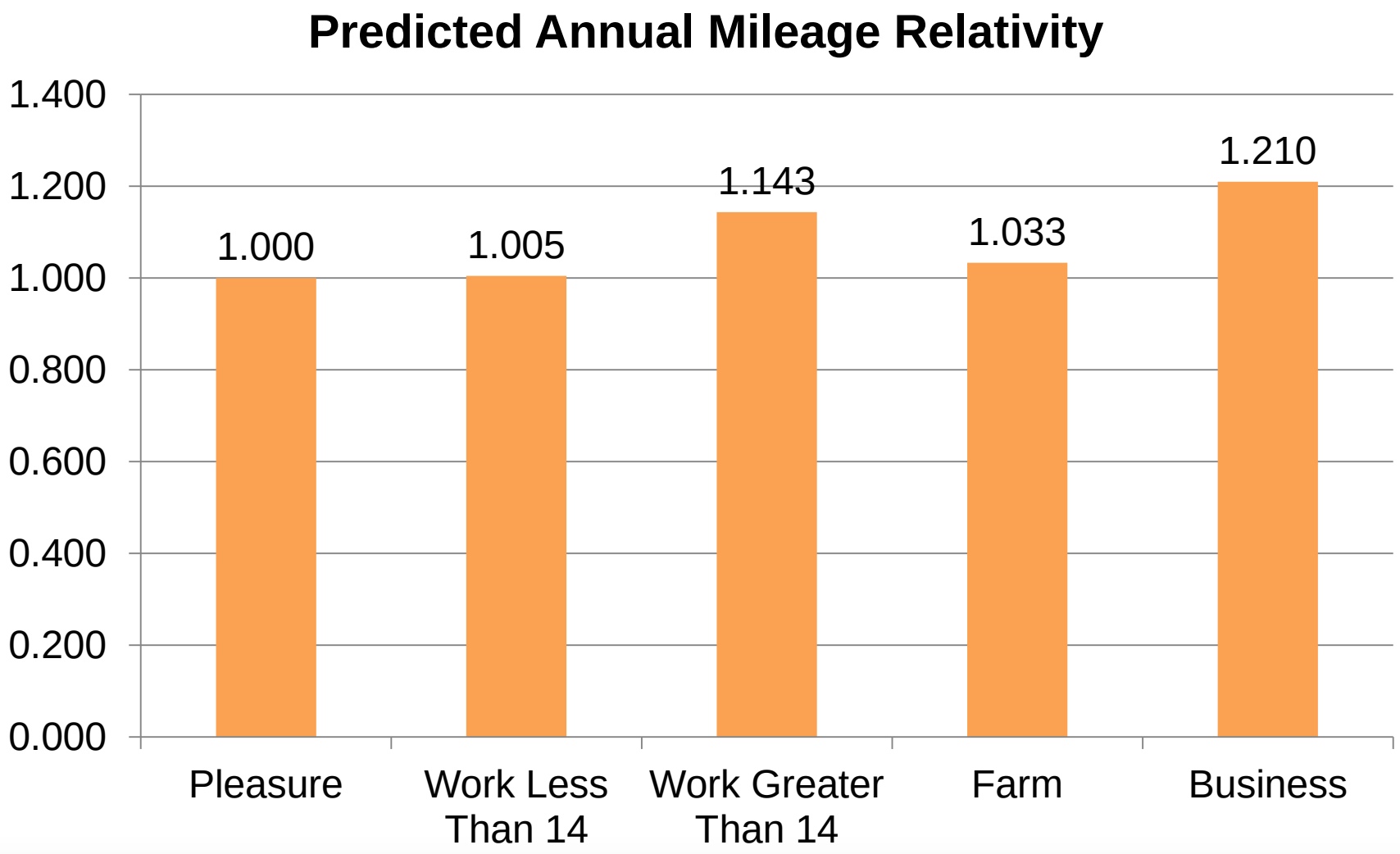
# Calculated Actual Mileage: Missing Reported Mileage



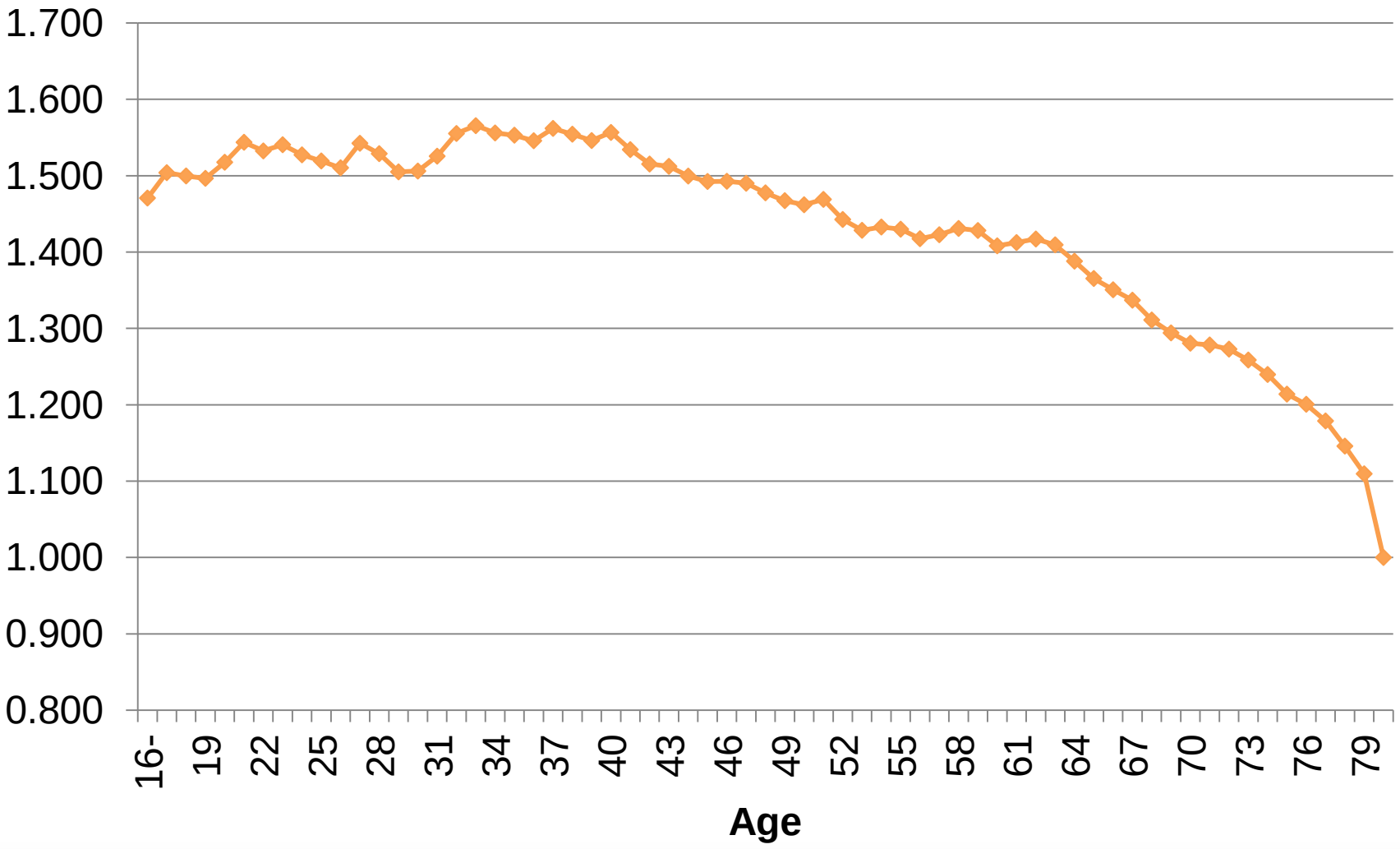
# Company Adjusted Predicted Annual Mileage

- General mileage predictor incorporates
  - Vehicle information
  - Location information
  - Ownership data
- Can customize based on specific policy information
  - Driver information
  - Policy information
  - Household structure
- Customization process: use actual mileage information as a target, policy characteristics and other relevant information as predictor variables

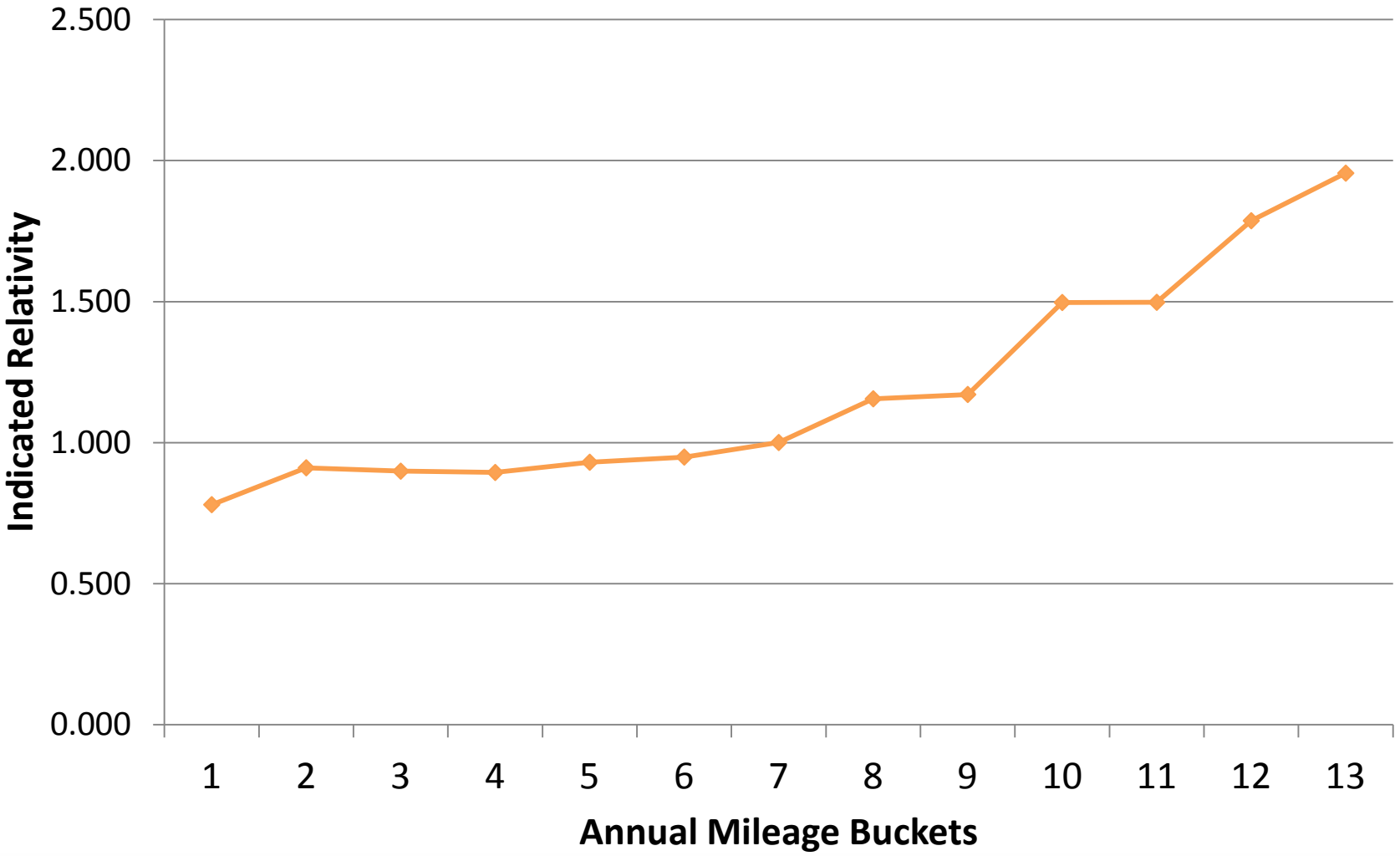
# Predicted Annual Mileage Relativity - Vehicle Use



# Predicted Annual Mileage Relativity - Age



# Final Class Plan GLM – Indicated Loss Cost Relativities



# Concluding Thoughts

- It will be some time before telematics solves the mileage issue
- There is vehicle history information that can be used to assist in validating annual mileage
- Models consisting of industry and company data can be developed to incorporate a more accurate measure of annual mileage in rating and underwriting

# Thank You for Your Attention

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