Modeling Motorcycles

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Motorcycle Insurance Market

- Growing market
  - Dramatically more fuel-efficient means of transportation
- Highly susceptible to adverse selection
  - Increasing need for pricing sophistication
- Coverages:
  - Liability – BI, PD, and Medical Payments
  - Collision
  - Comprehensive (mostly theft)
  - UM/UIM
  - PIP (where applicable)

Motorcycles Rating Plan

- Goal: create a rating plan to insure private passenger motorcycles

- Action: use GLMs to model pure premium

  – Many risk factors to consider, with significant correlation among risk factors → multivariate analysis critical

  – Minimum bias procedures possible, but:

    – Have several variables that an continuous, and min bias procedures require bucketing

    – Provide no statistical diagnostic tools

    – Little choice in distribution

Motorcycles Rating Plan

- Rating plan factors include:
  - Bike manufacturer
  - Bike type
  - Bike age
  - Engine size
  - MSRP
  - Age of operator
  - Operator history (major and minor convictions)
  - Miscellaneous credits (rider training, anti-theft devices)
  - Territory loss cost
  - Average winter temperature

Bike Type – Cruisers

- Most common type of motorcycle

Bike Type – Sport Bikes

- Fast, cool, and relatively inexpensive

- Highest risk of property damage, bodily injury, and theft

Bike Type – Off-Road Bikes

- Not street legal
- Includes Motocross bikes and dirtbikes

Bike Type – Scooters

- Typically low power, though some can attain highway speeds
- Easy to ride

Bike Type – Choppers

- Extended front fork and no rear suspension, so rider sits low
- Often customized and tend to be expensive

Bike Type – Youth Bikes

- Type of off-road bike that has a small engine and is easy to ride
- Designed to help teach young riders

Challenges and Solutions

- **Challenge**: program is new and has no existing territorial structure
- **Solution**: use territory definitions in the Private Passenger Automobile program and include auto loss costs as variable in Motorcycles models

Challenges and Solutions

- **Challenge**: many records did not contain VIN, so don't know the Bike Type, Bike Age, MSRP, or Engine Size

- **Solution**: build two models – one on all data in order to estimate coefficients for some variables, and offset for those results in a second model that only includes records with accurate VIN

Challenges and Solutions

- **Challenge**: high degree of correlation between MSRP and Engine Size, so shouldn't include both in a model

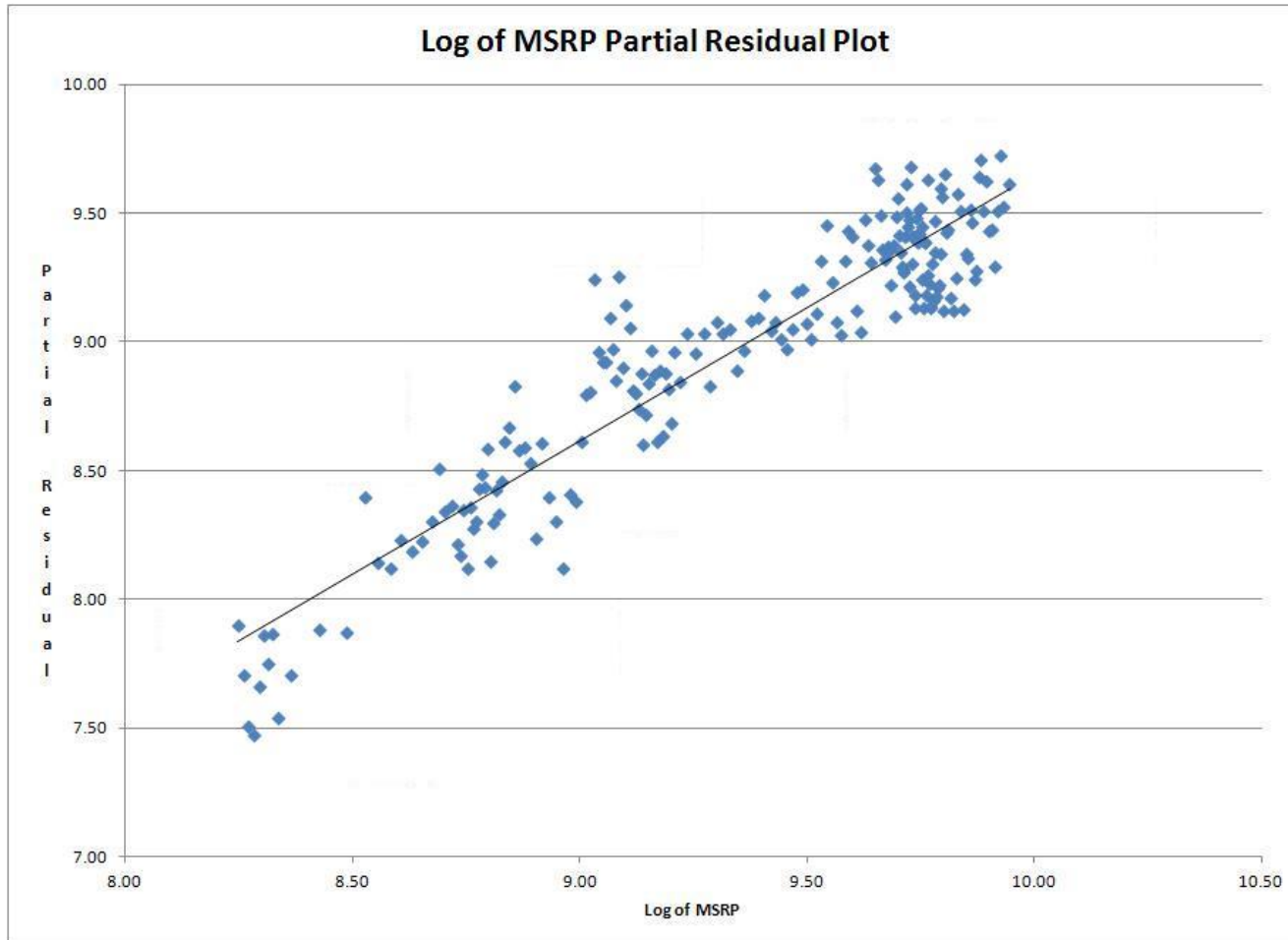- **Solution**: select a coefficient for Engine Size and offset for it

Challenges and Solutions

- **Challenge**: several continuous variables in model, and unclear if single curve fits variables
- **Solution**: examine partial residual plots to look for possible break points

Univariate MSRP Plot
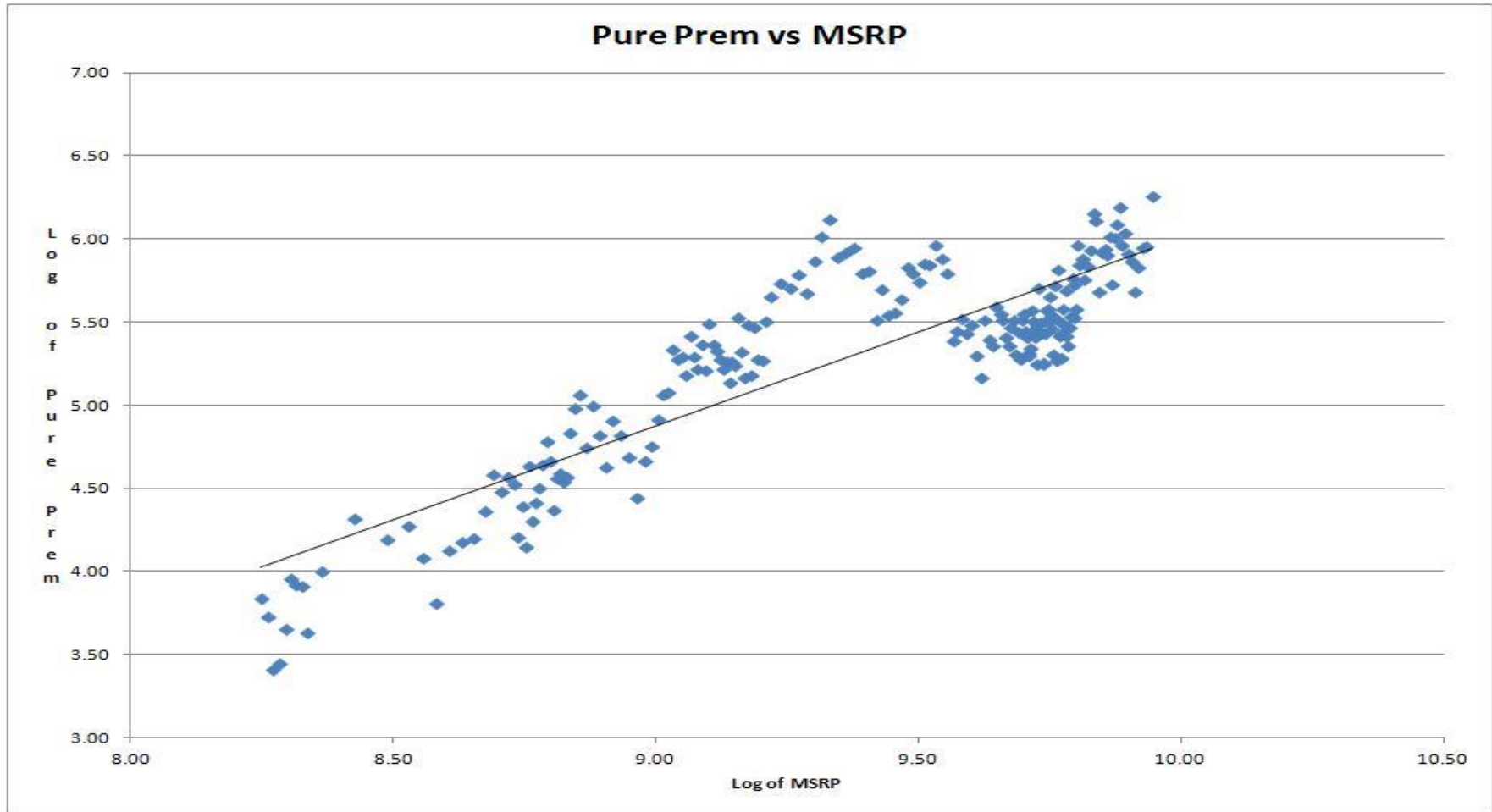
MSRP Partial Residual Plot

Important Conclusions

- Sport bikes are dangerous!
- Significant bike age effect – pure premium much higher for new bikes than for older ones
- Winter temperature significant
  - Powerful proxy for usage
- Harleys behave differently from non-Harley bikes

Questions?