

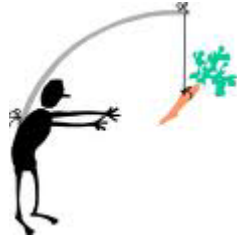


# Average Premium Model Actuarial Research Conference

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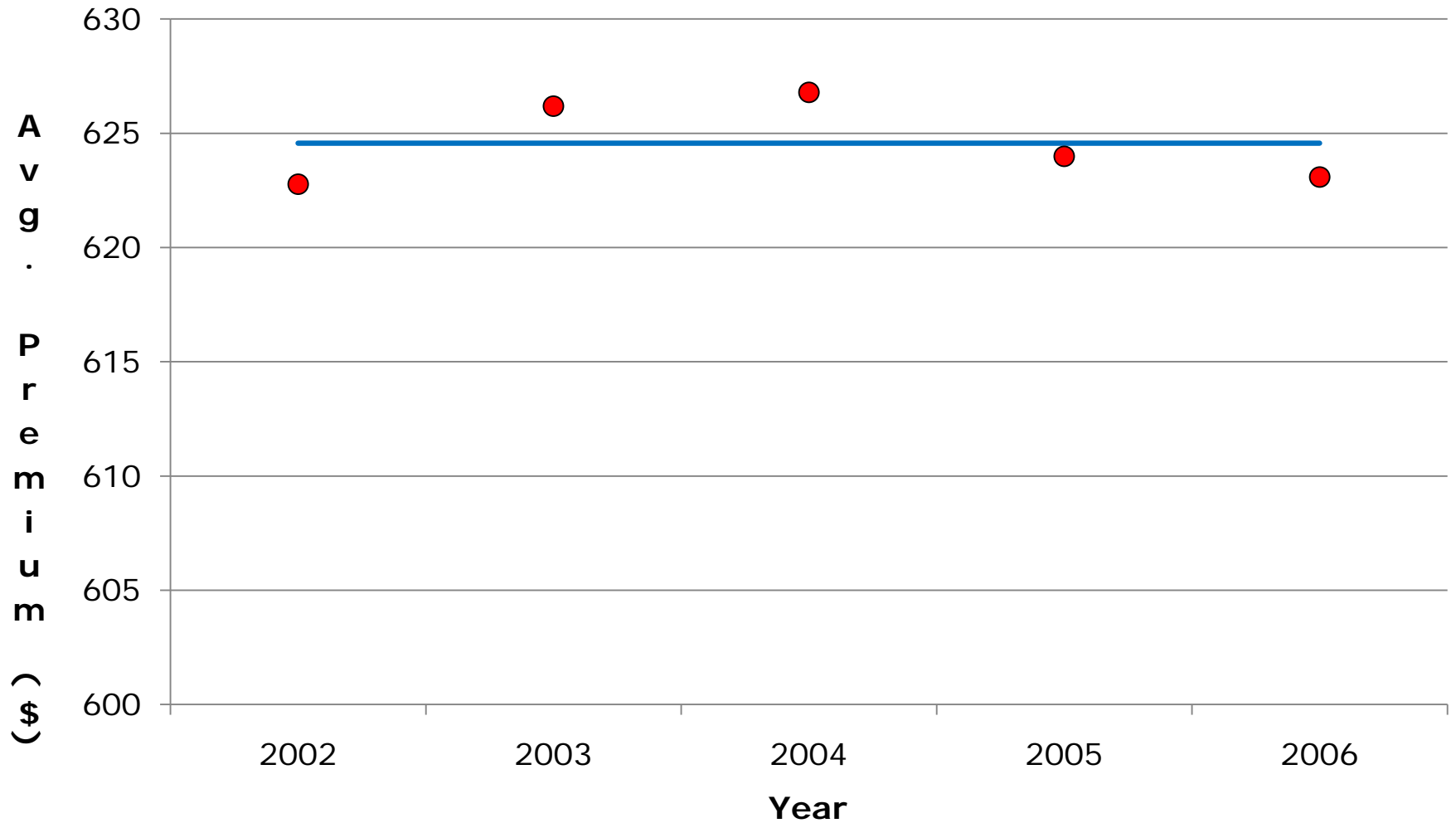
July 27, 2010

# Motivation

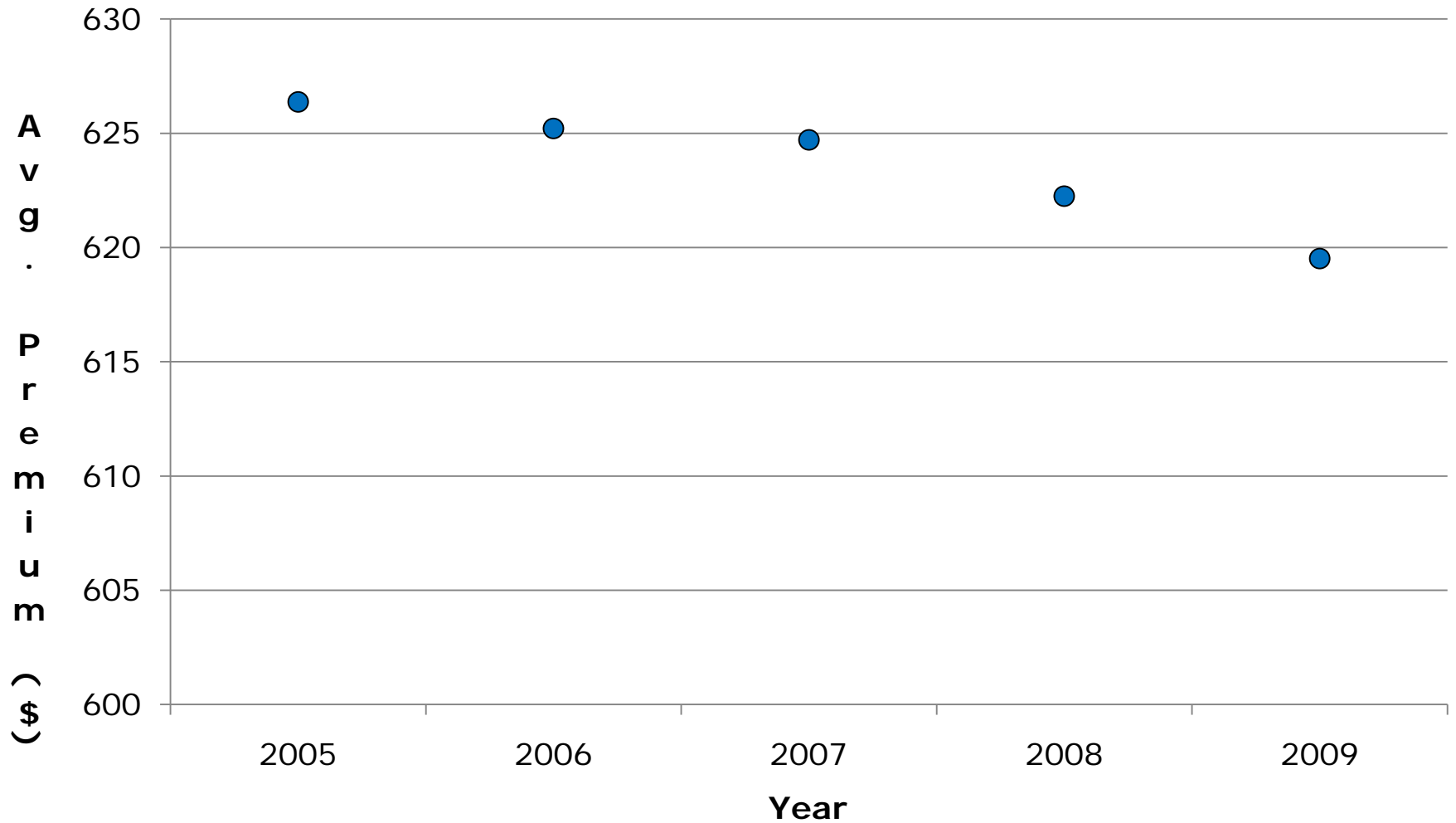


- Revenue Requirements
- Monitoring our book of business

# Basic On-Level Average Premium



# Personal TPL On-Level Avg. Premium



# Overview

PCA

Exposure  
Forecasts

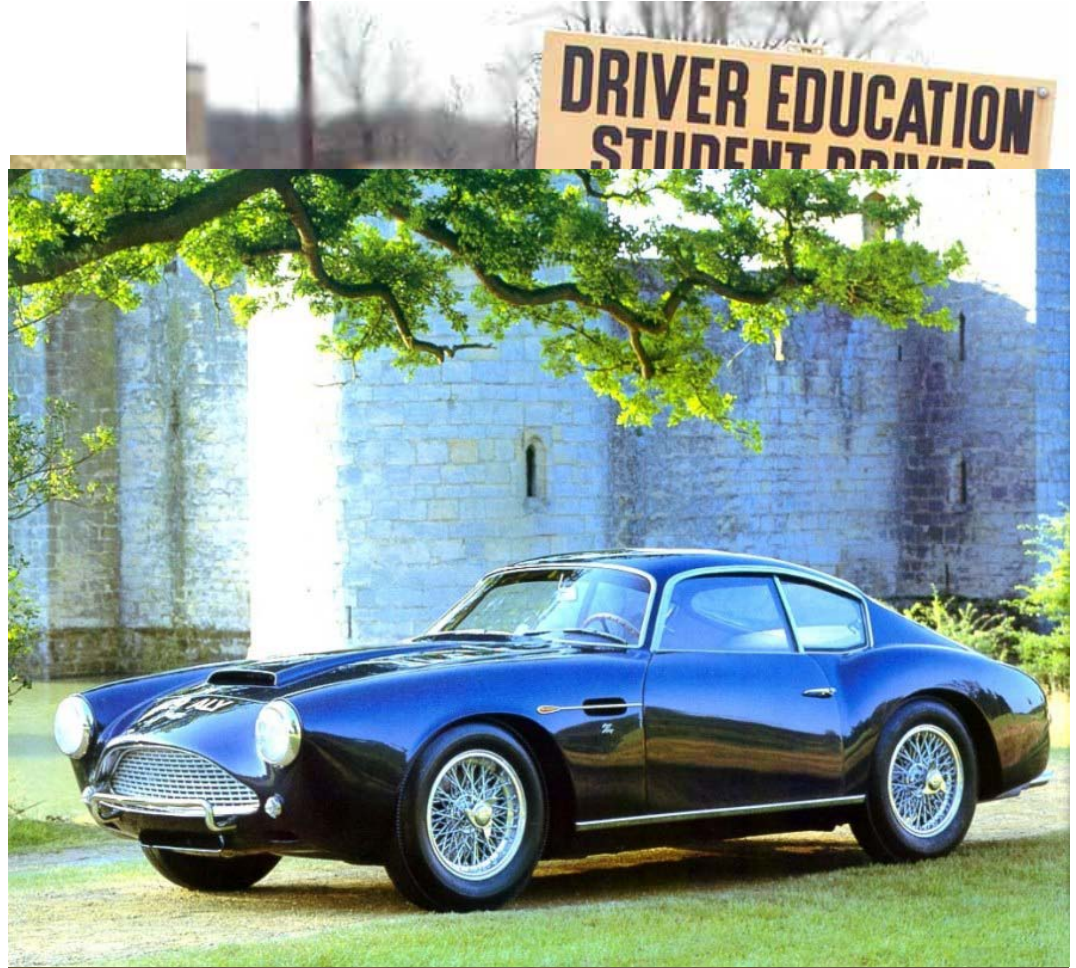
Average  
Premium  
Forecasts

# Exposure Model

- Historical exposure data
  - Split into Personal and Commercial
  - Further split into vehicle use, location, and bonus-malus groups
- An econometric regression model is fit to each group
  - Demographic
  - Economy

# Vehicle Use Groups

- Personal
  - Pleasure
  - Commute
  - Business
  - Senior
  - Motorcycle
  - Motor home
  - Collector



# Location Groups

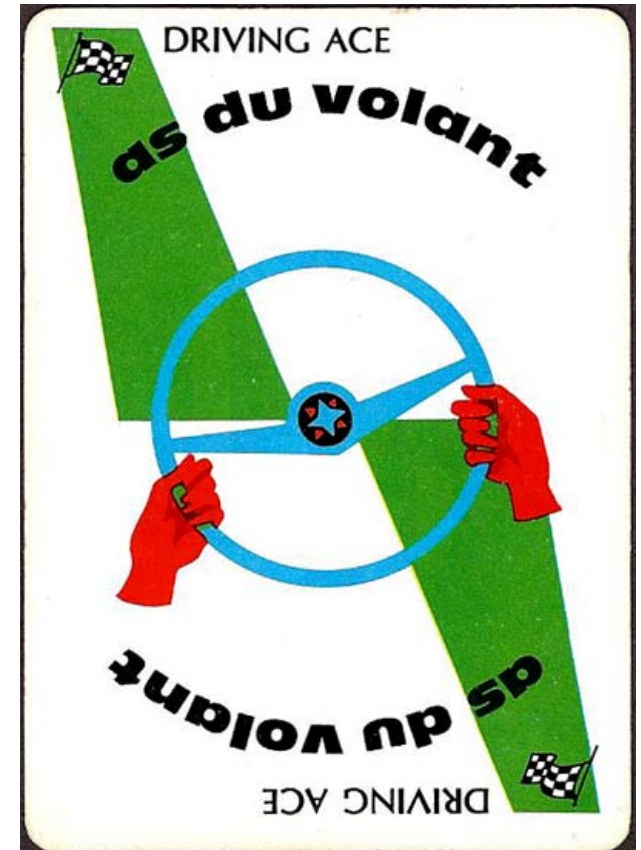
- Lower Mainland
- Ridge Meadows
- Fraser Valley
- Squamish/Whistler
- Pemberton/Hope
- Okanagan
- Kootenays
- Cariboo
- Prince George
- Peace River
- North Coast
- South Island
- Mid Island
- North Island



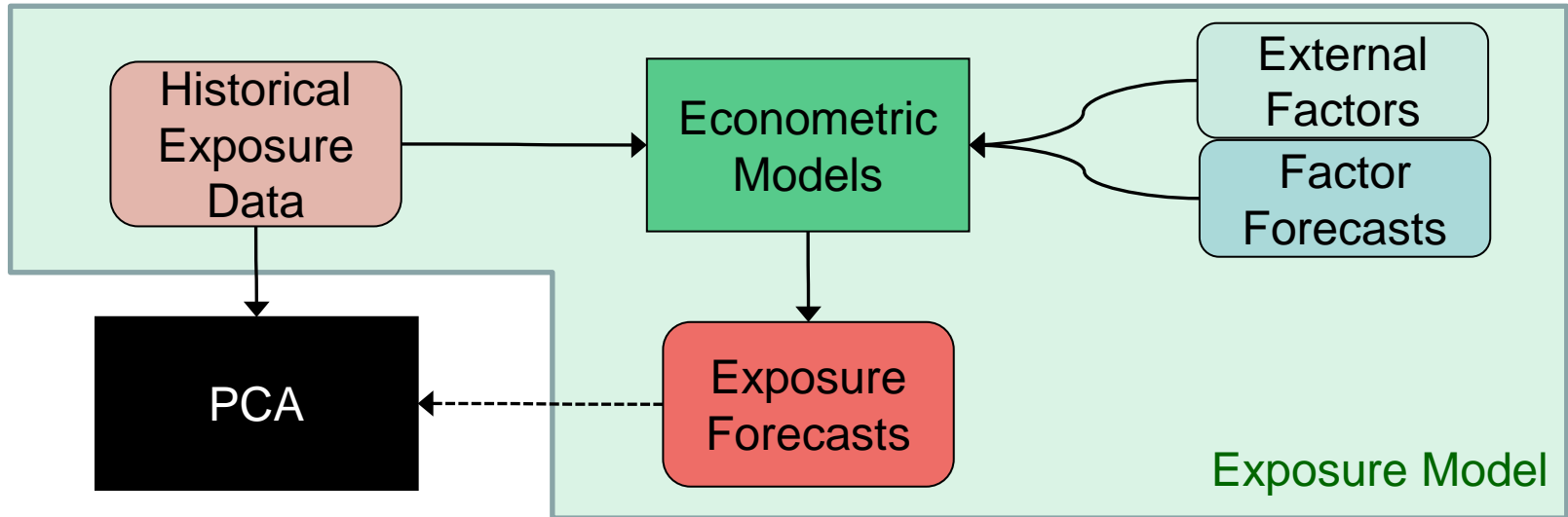


# Bonus-Malus Groups

- Claim Rated Scale
  - Roadstar (43% discount)
  - 25% to 40% discount
  - 5% to 20% discount
  - Base or surcharge



# Overview



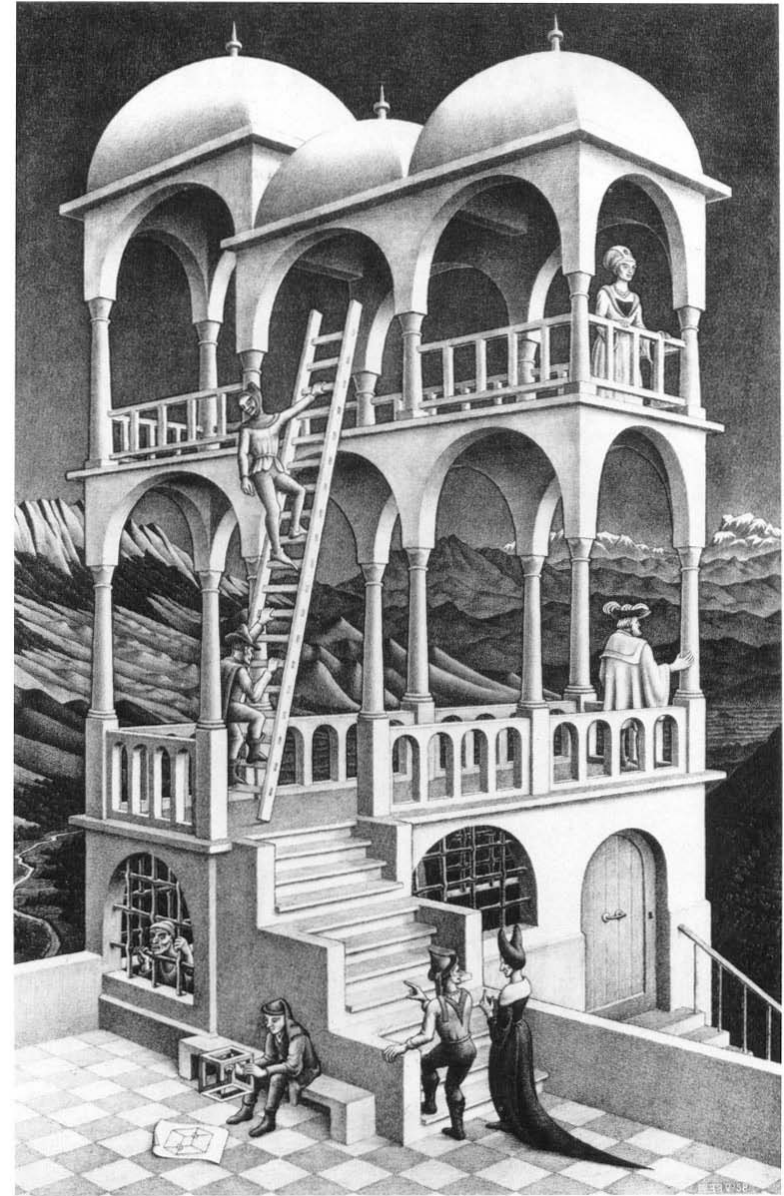
Average  
Premium  
Forecasts

# Historical Exposure Data

- Too many groups for the average premium model
- Need a dimension reduction technique
- Want to keep all of the groups
- Linear dependencies exist

# What is PCA?

- It transforms a number of correlated variables into a smaller number of uncorrelated variables
- Uses linear algebra



# PCA Notation

$$A = \frac{1}{n} (Z^T \cdot Z)$$

$$A \cdot V = \lambda V$$

$$B = V \cdot L^{-1/2}$$

$$P = Z \cdot B$$

$$S = V \cdot L^{1/2} = B \cdot L$$

$$C = T \cdot T^T$$

# Eigen Decomposition

- Linear algebra problem
- Done on correlation matrix of explanatory variables
- Eigenvectors are new explanatory variables (i.e. principal components)
- Each associated eigenvalue represents variability of eigenvector (or PC)

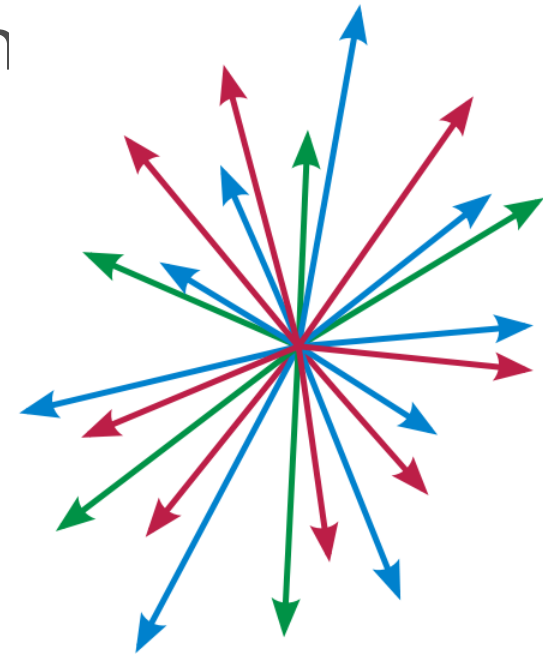
# PCA Resolves the Issues

- Number of dimensions reduced
- All groups 'retained'
- Linear dependencies eliminated



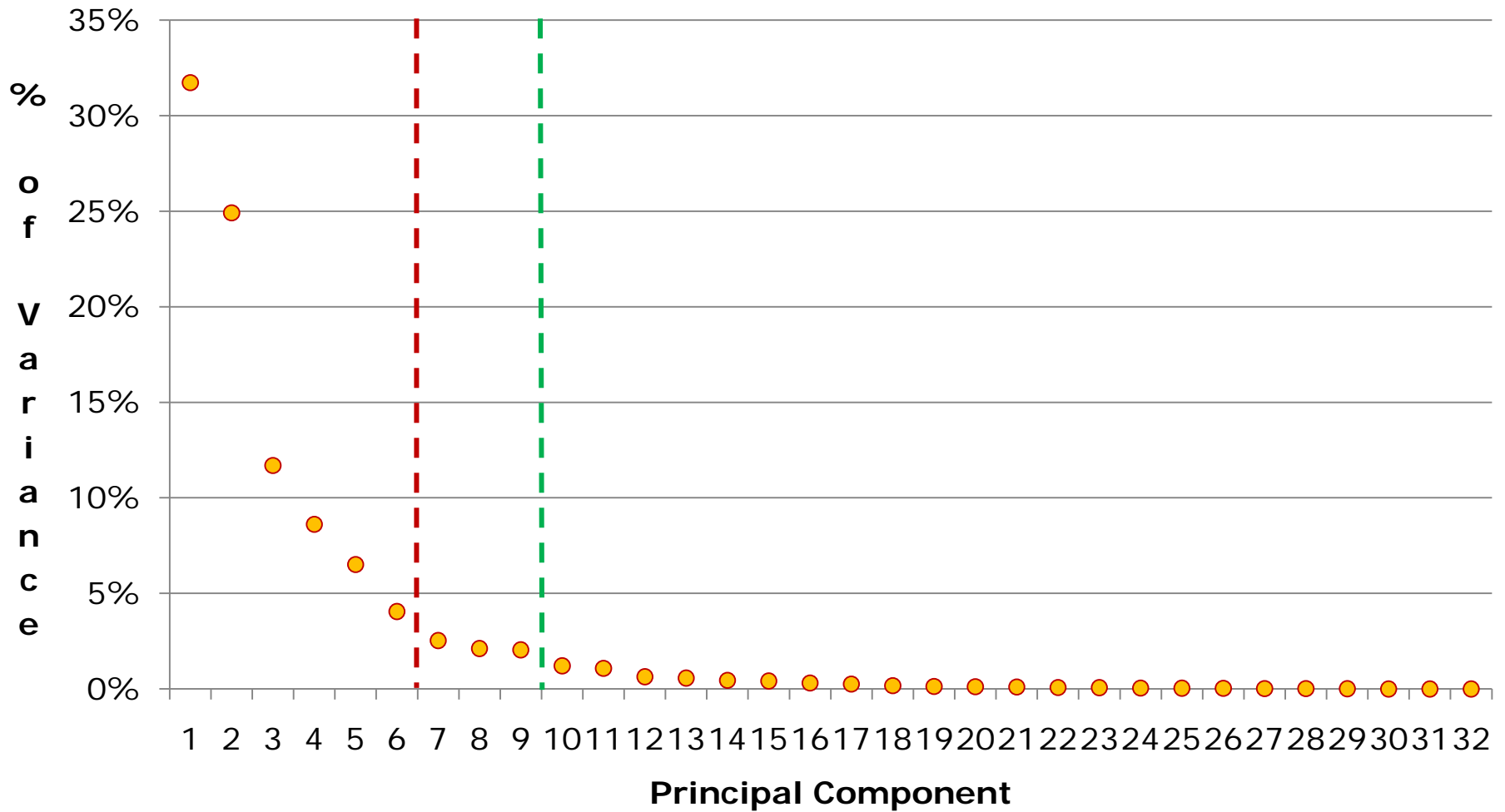
# PCA Process

- Step 1: Create new set of explanatory variables
- Step 2: Determine how many new explanatory variables to retain

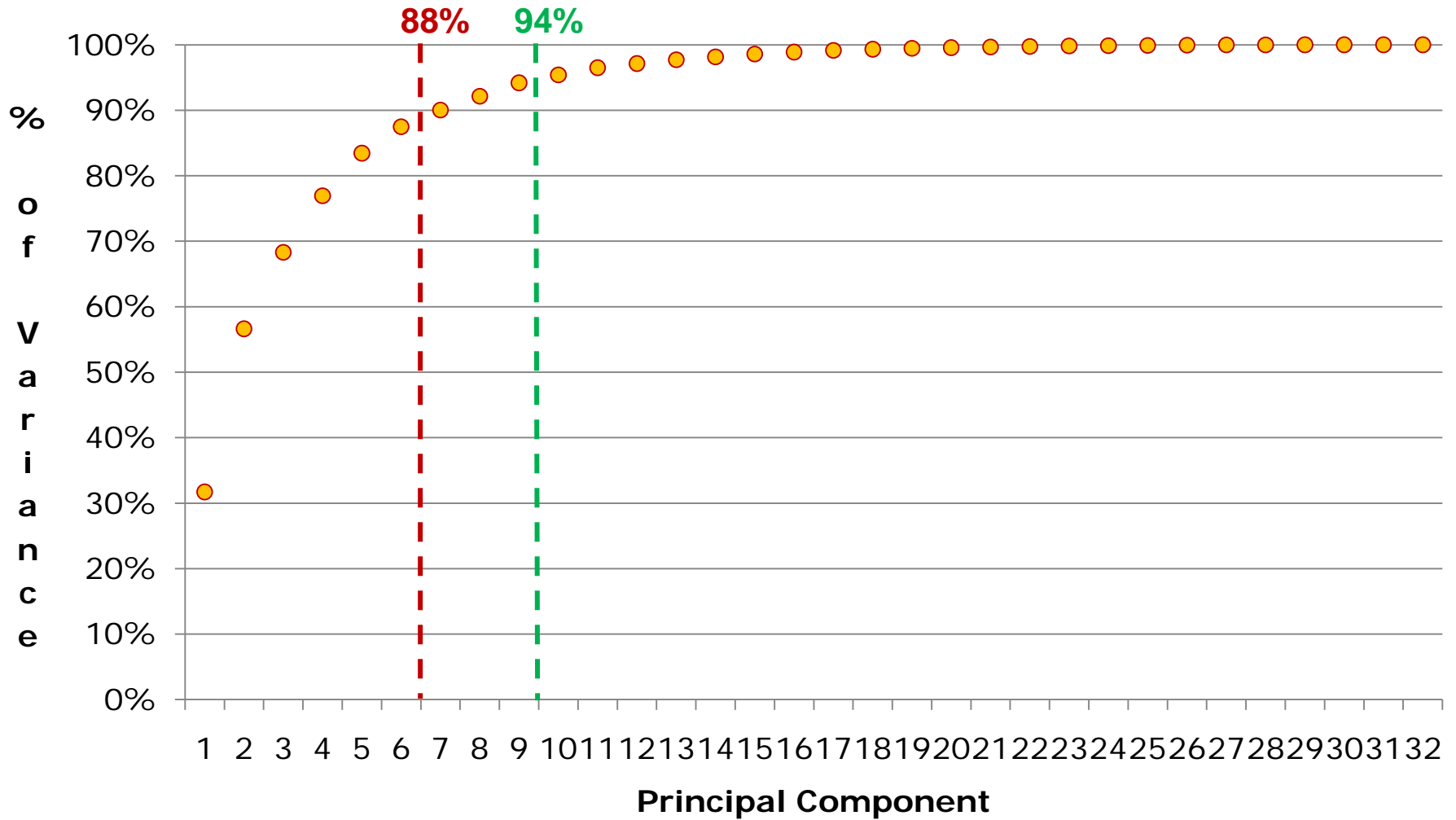




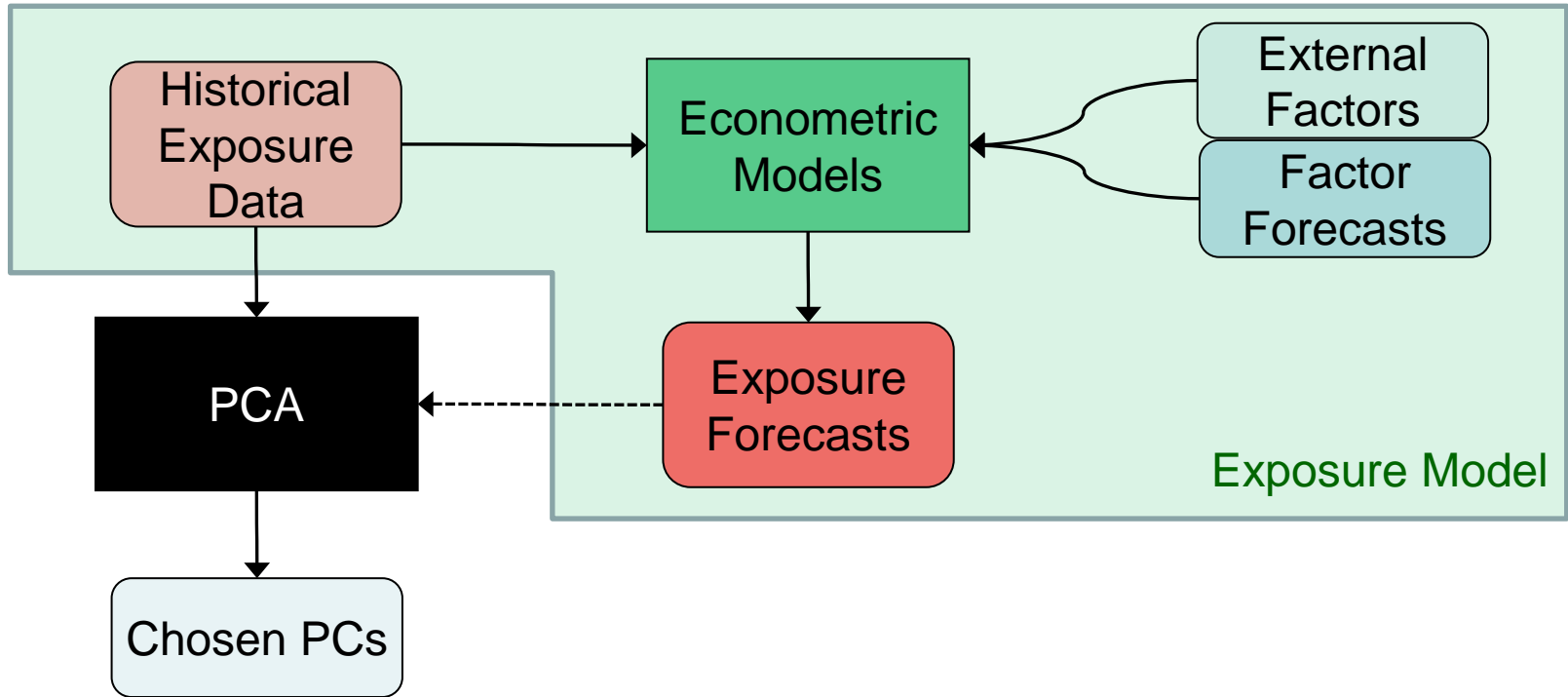
# How many components?

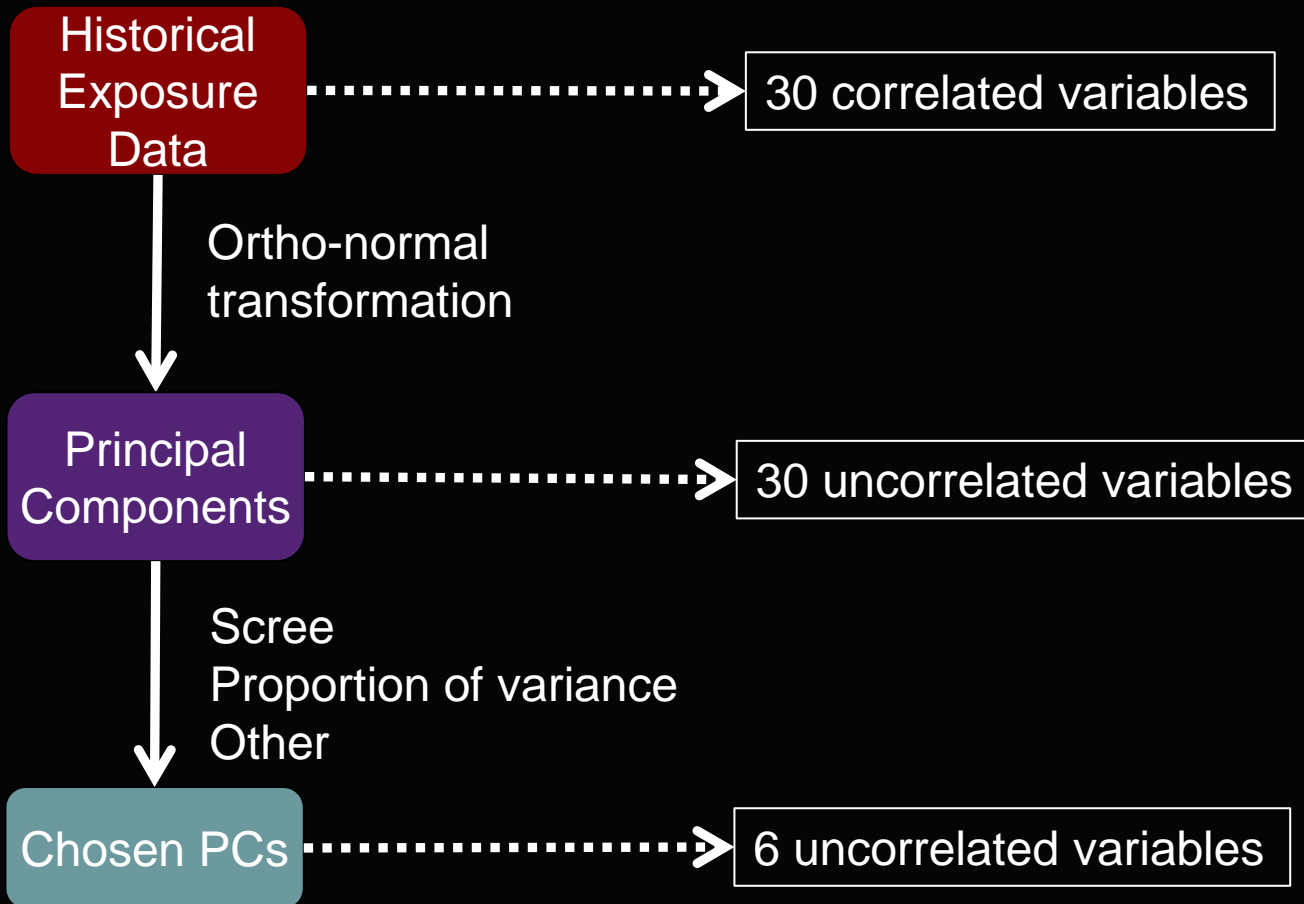


# How many components?

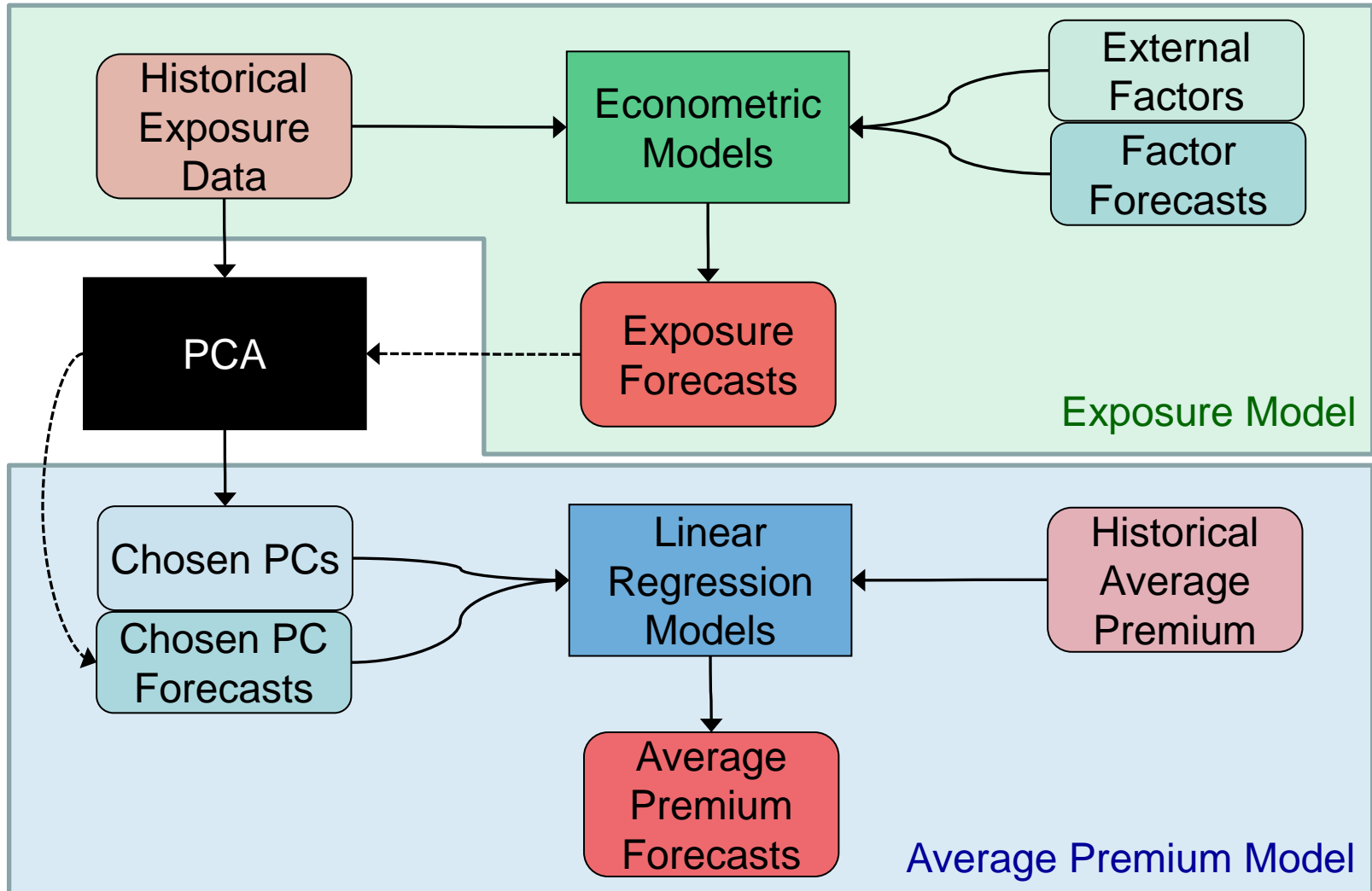


# Overview

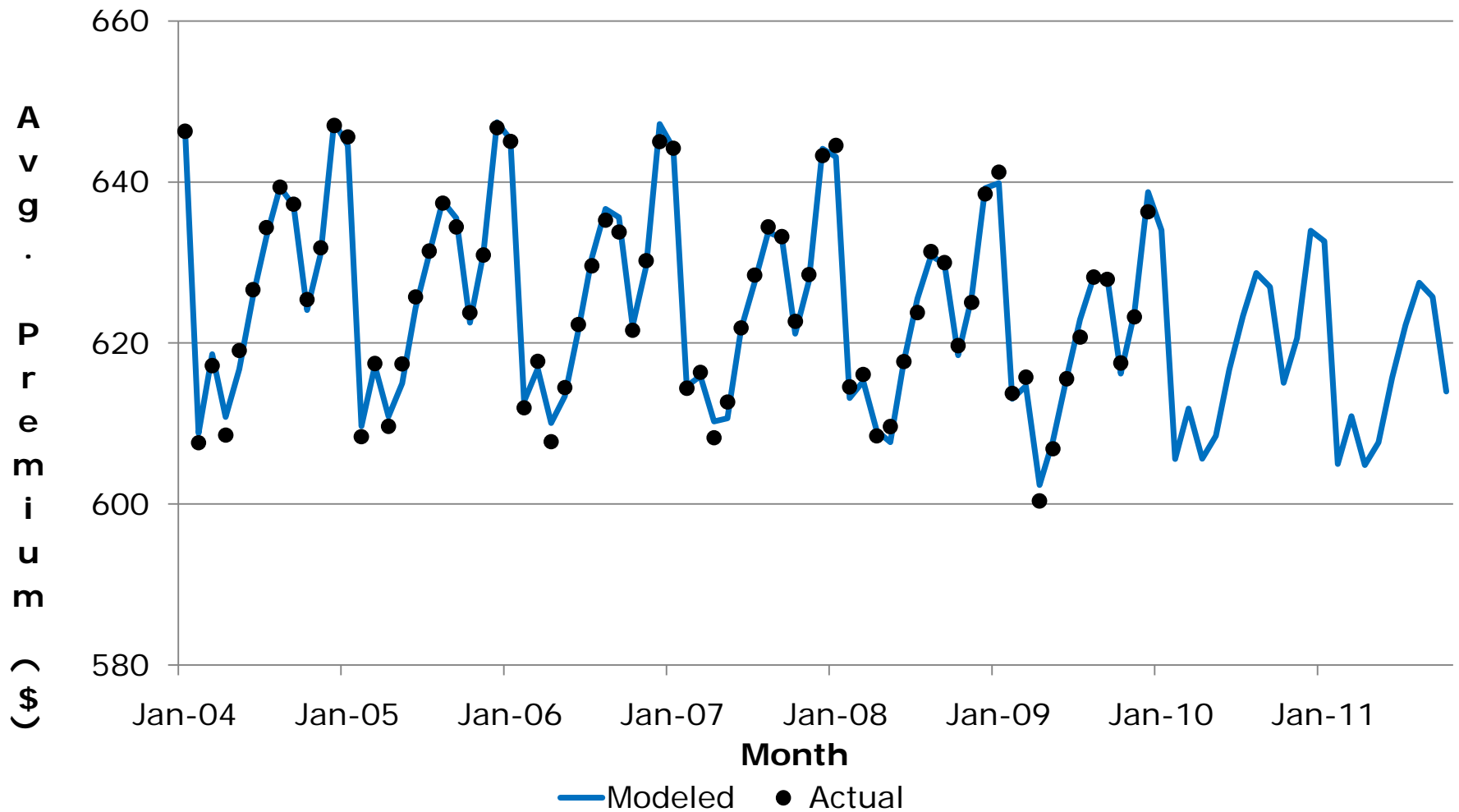




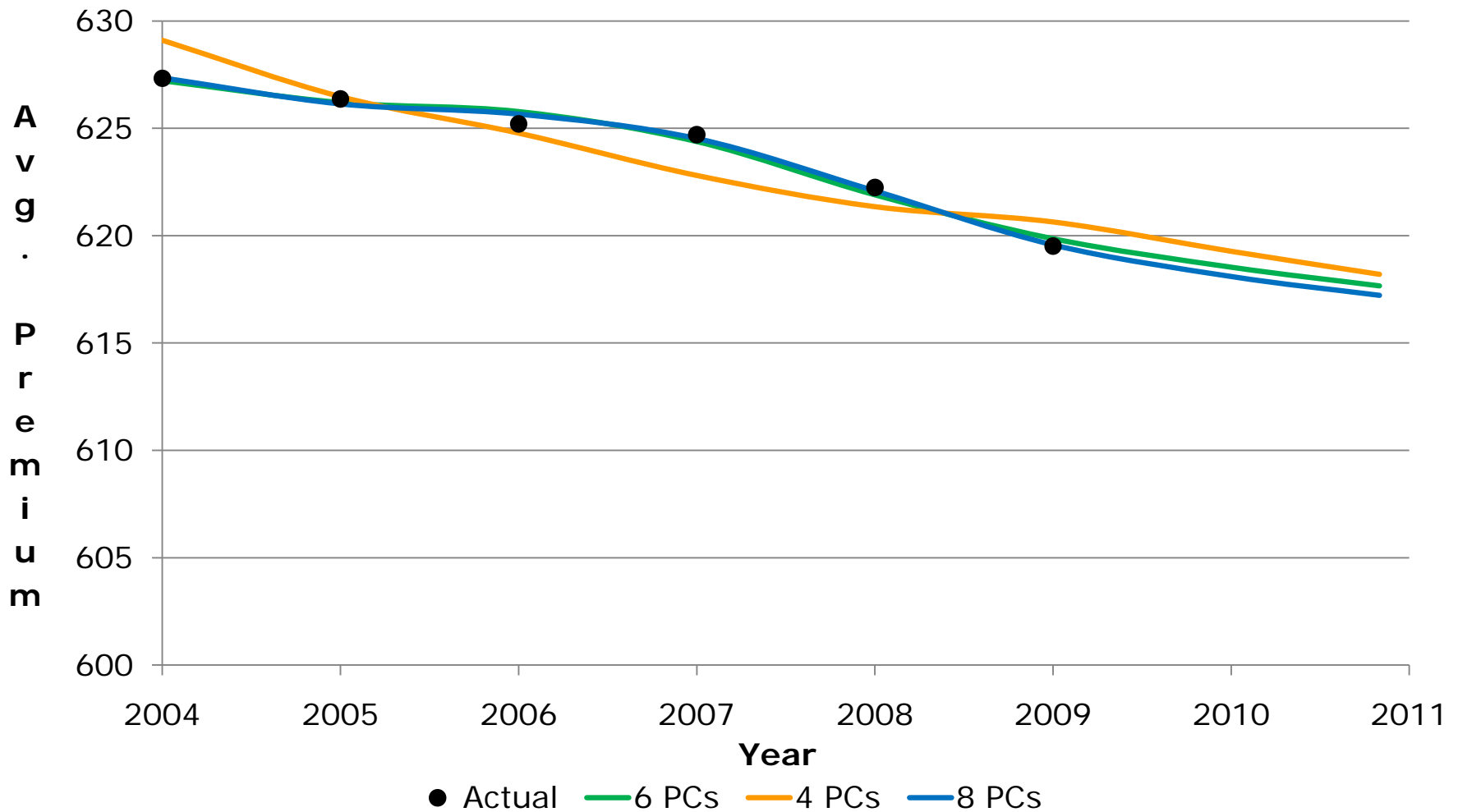
# Overview



# Modeled vs. Actual – Personal TPL



# Modeled vs. Actual – Personal TPL



# Recap - Advantages

- PCs uncorrelated
- PCs organized to reduce dimensionality
- Keeps most of original information
- Determine contribution of each variable



# Recap - Disadvantages

- PCA process not familiar
- PCs can be hard to interpret
- PC weights may change upon updating

# Is PCA Right For You?

- Does multi-collinearity roll off your tongue too easily?
- Are you confident in the set of explanatory variables?
- Do you want to reduce dimensionality without throwing away information?
- Have you been modeling for more than 4 consecutive hours?



# For More Information

- CAS Discussion Paper
  - PCA and Partial Least Squares: Two Dimension Reduction Techniques for Regression
    - <http://www.casact.org/pubs/dpp/dpp08/08dpp76.pdf>