



## The Three Pillars of Analytics

Rate-making and Product Management Seminar

March 19-21, 2012

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## Agenda

- Motivation
- The Framework
  - New Data
  - Data Exploration
  - Model Design
- Parting Thoughts

## Motivation - The Credit Debate

## Studies Supporting Credit Scoring

- Fair Isaac Loss Ratio Study – December, 1996
- Statement of the American Insurance Association on the Lack of Correlation Between Income and Credit Score Whether Tested Against the Average of Median Score – March 1999
- Predictiveness of Credit History for Insurance Loss Ratio Relativities (Fair Isaac) – November, 1999
- The Impact of Personal Credit History on Loss Performance in Personal Lines (Monaghan Study) – Winter, 2000
- University of Texas Study – March, 2003
- EPIC Actuaries Study – June, 2003
- Texas DOI Study #1 – December, 2004
- Texas DOI Study #2 – January, 2005
- Credit Based Insurance Scores: Impacts on Consumers of Automobile Insurance (FTC Auto Study) – July, 2007
- Federal Reserve Study – August, 2007



## Studies Challenging the Use of Credit

- Arkansas Credit Score Survey – September, 1996
- Georgia Credit Hearings – October, 2001
- Task Force On The Use Of Credit Reports In Underwriting Automobile And Homeowners Insurance – January, 2002
- The Use of Insurance Credit Scoring in Automobile and Homeowners Insurance (Michigan OFIS) – December, 2002
- Effect of Credit Scoring on Auto Insurance Underwriting and Pricing (Washington DOI) – January, 2003
- Insurance Credit Scoring in Alaska – February, 2003
- Insurance-Based Credit Scores: Impact on Minority and Low Income Populations in Missouri – January, 2004
- Report on the Credit Scoring Data of Insurers in Maryland – February, 2004



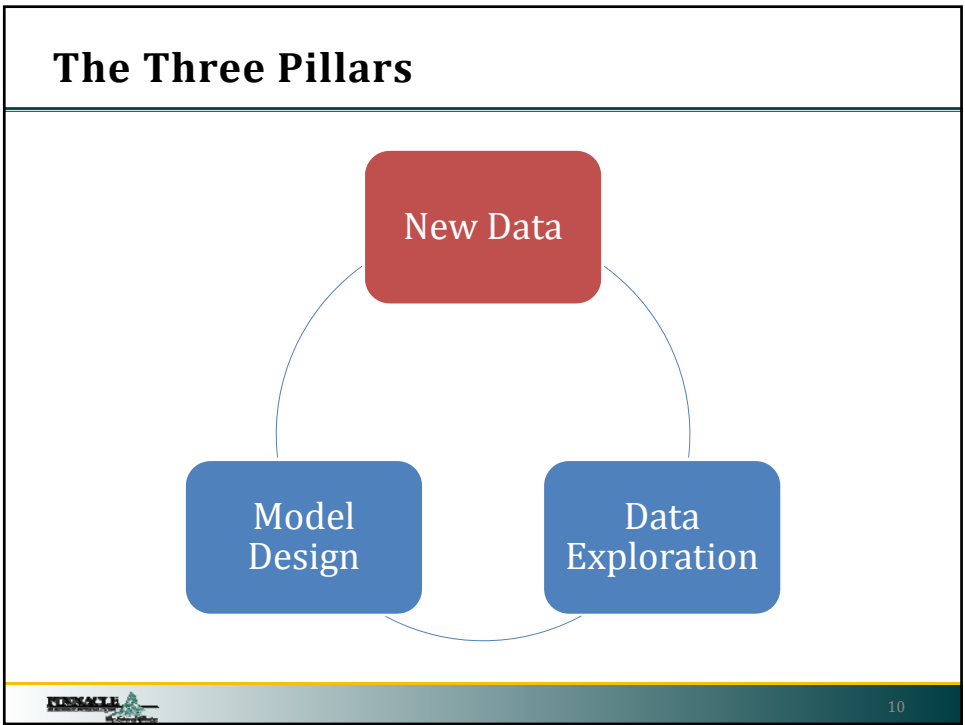
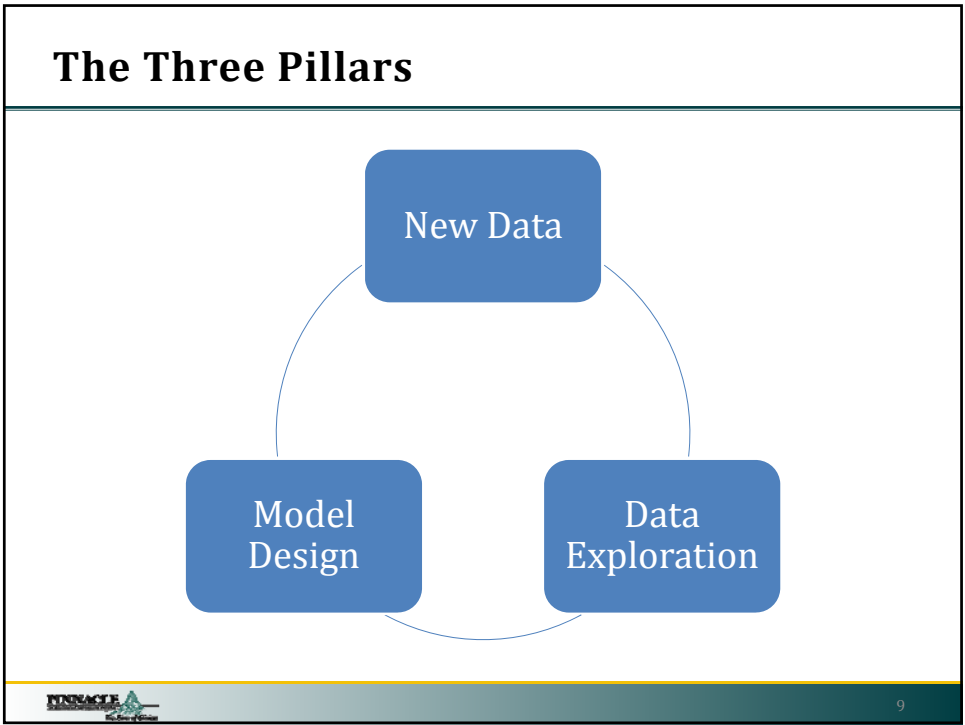
## What Does This All Mean?

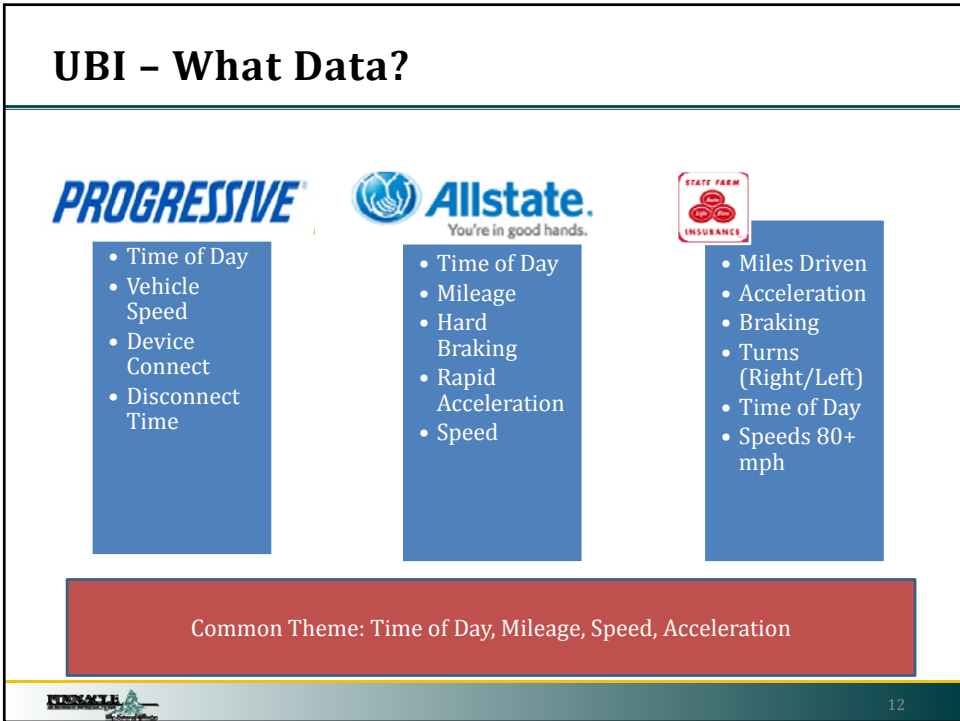
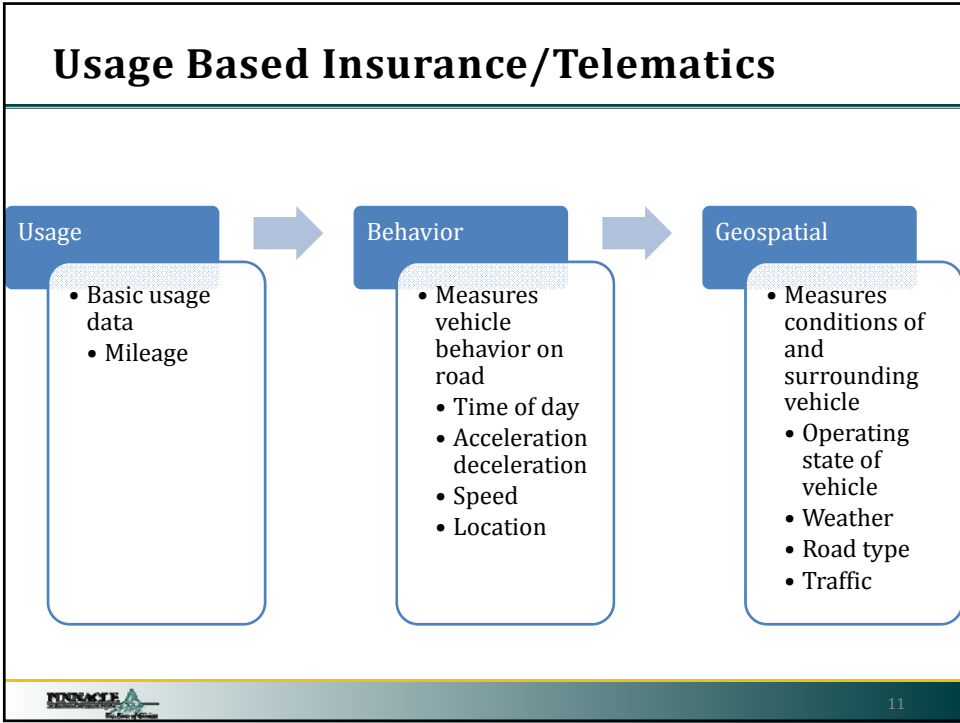
- Credit debate will continue
  - Public perception is a difficult issue to overcome
  - At least 49 credit scoring bills introduced in 24 states in 2009
  - NAIC hearings
  - MI OFIS court case
  - Lawsuits
  - Economic crisis
  
- What will be the outcome?
  - Across the board solution – either completely allow or ban the use of credit scoring
  - Some version of what we have today



## How Should We Respond?





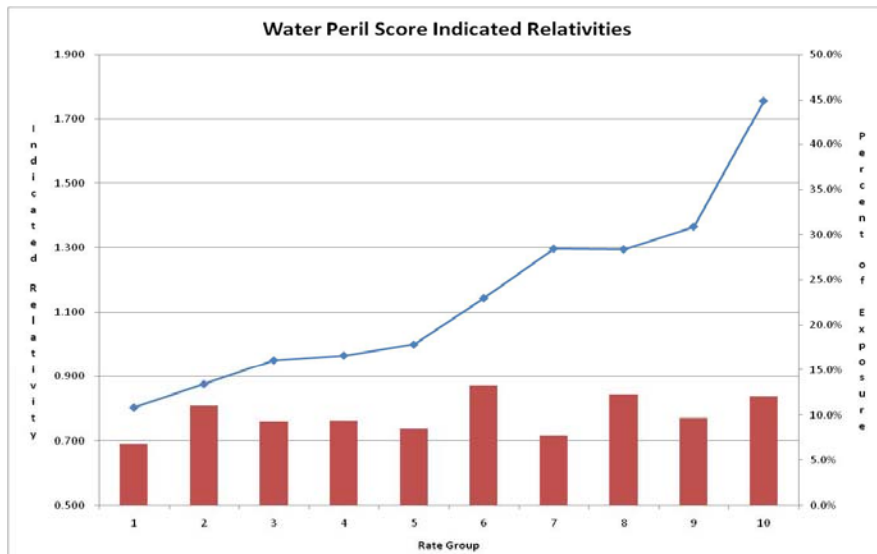


## Property Characteristics

- Property
  - Total Living Area
  - Year Built
  - Number of Stories/Style
  - Number of Families
  - Foundations
  - Finished Basements
  - Exterior Wall
  - Roofing
  - Number of Baths
  - Fireplaces
  - Swimming pools
  - Trampolines
- Real Estate elements
  - Mortgage value
  - Market value
  - Interest Rates
  - Loan terms
- Hazard Elements
  - Distance to Fire Station
  - Distance to Coast
  - Flood zone
  - Brush Fire
  - Earthquake
  - Elevation
  - Sink hole



## Property Characteristics



## Vehicle Characteristics

### Data

- Daytime running lights
- ESC/DSC
- Weight
- Engine size
- Segmentation
- CID
- Body type
- Cylinders
- Driving wheels
- High performance code
- Transmission
- Wheel base
- Height
- Width



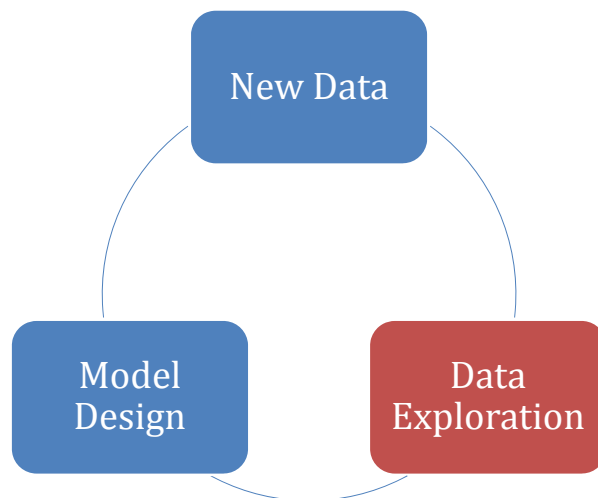
## Territory Data

- Supplementing Experience Data
  - HLDI
  - ISO
  - Weather/Catastrophe Models
- Understanding the Territories
  - Weather
  - Crime
  - Census
  - Demographics





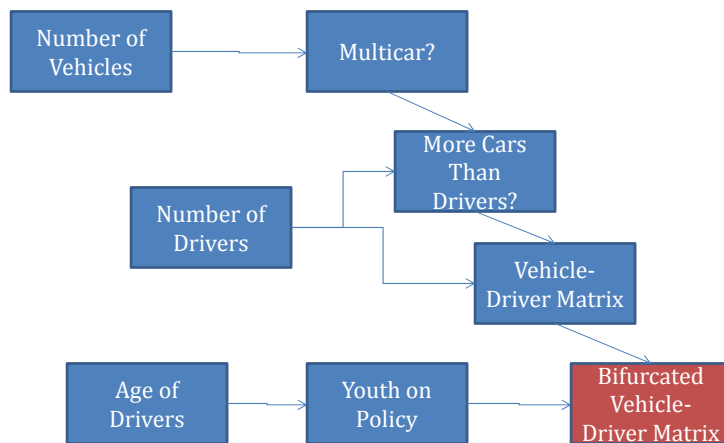
## The Three Pillars



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## The Evolution of a Discount

- Consider the case of the multi-car discount:



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## Telematics – The New Data Challenge

- Data Volume
  - Over a thirty day period, a single vehicle may produce
    - An average of 80 trips
    - Over 50,000 distinct records
  
- When comparing behavior between vehicles
  - Variability in
    - Number of trips taken
    - Time on the road
    - Miles driven
    - ...



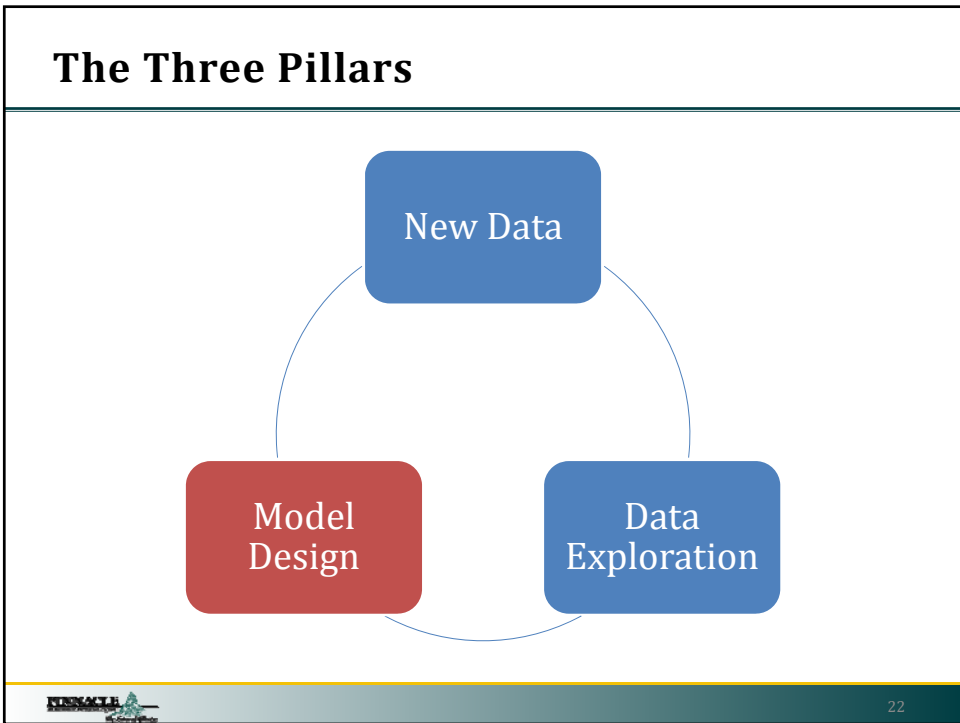
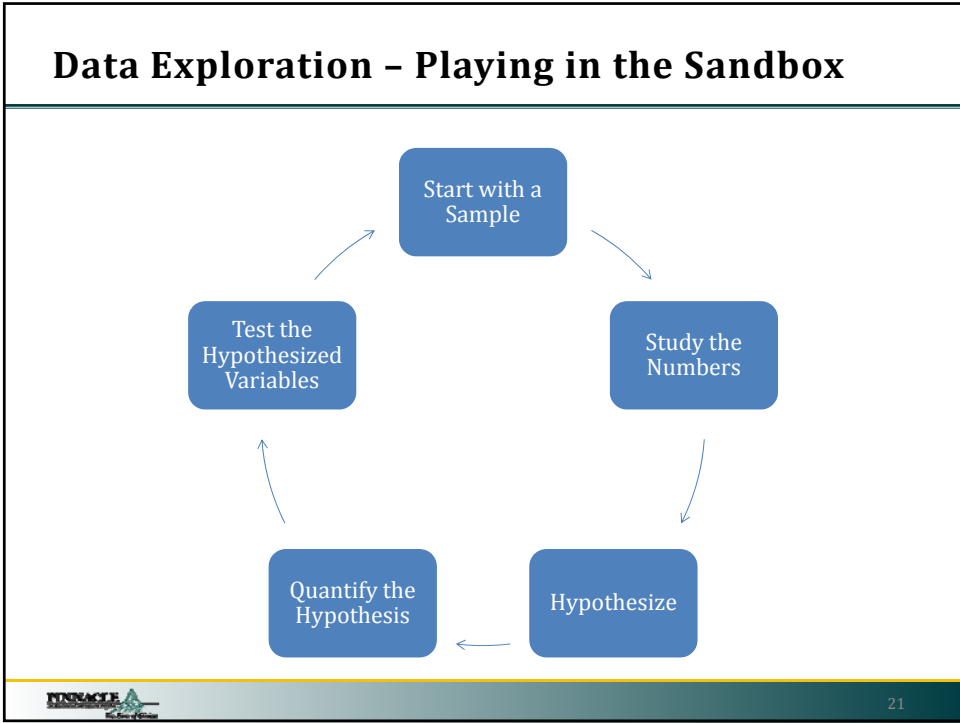
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## Data Exploration – Normalizing the Data

- Types of summarization
  - Accumulation
    - 31.6 hours
    - 924.5 miles driven
    - 172 trips
  - Statistics
    - 29.3 miles per hour
    - 11.0 minutes per trip
    - 5.4 miles per trip
  - Flags/Percentages
    - 20.88% time over 45 mph
    - No incidents over 80 mph

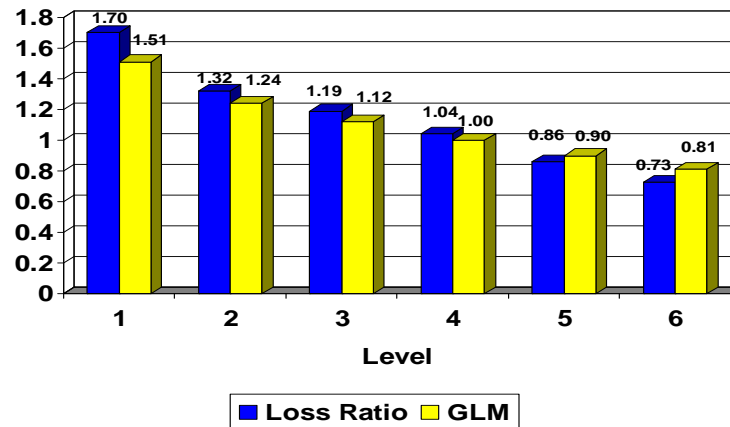


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## The Case for Multivariate Analysis

Pure Premium Relativities



## GLM - The Current Standard

- The traditional linear regression model:
  - $y = w_0 + w_1x_1 + \dots + w_nx_n$
  - $y$  is normally distributed
  
- GLM generalizes this by allowing
  - a transformation on  $y$ , called a link function
  - a different distribution structure for  $y$

## GLM - The Current Standard

Response Variable	Error Function	Link Function
Linear (traditional)	Normal	Identity Function
Claim Frequency	Poisson	$\ln()$
Claim Severity	Gamma	$\ln()$
Risk Premium	Tweedie	$\ln()$
Probability	Binomial	$\ln(p/(1-p))$ , aka Logit Function



## Decision Trees - Split Search

Pinnacle Terminal Server (TSG) - BLMTS - Remote Desktop

Miner Tree Desktop Application - [Tree - EMWS1.Tree3\_BROWSETREE]

```

Statistic   Training
0:          95%
1:           5%
N in node: 30992
  
```



## Decision Trees - Split Search

Statistic Training  
0: 95%  
1: 5%  
N in node: 30992

Variable	-Log(p)	Branches
HSPRTLX	698	2
HIGHINJ	538	2
UNABLEDY	483	2
DISABLE	446	2
DAYSLOST	255	2

## Decision Trees - Split Search

Statistic Training  
0: 95%  
1: 5%  
N in node: 30992

HSPRTLX

3, 5...

Statistic	Training
0:	57%
1:	43%
N in node:	1549

1

Statistic	Training
0:	97%
1:	3%
N in node:	29443

## Decision Trees - Split Search

Statistic Training  
0: 95%  
1: 5%  
N in node: 30992

HSPPLTX

Statistic Training  
0: 97%  
1: 3%  
N in node: 29443

Variable	-Log(p)	Branches
HIGHIND	336	2
DISABLE	279	2
UNABLEDY	248	2
LAWSUIT	207	2
DAYSLOST	160	2

## Decision Trees - Split Search

Statistic Training  
0: 95%  
1: 5%  
N in node: 30992

HSPPLTX

3, 5...

Statistic Training  
0: 57%  
1: 43%  
N in node: 1549

Statistic Training  
0: 97%  
1: 3%  
N in node: 29443

HIGHIND

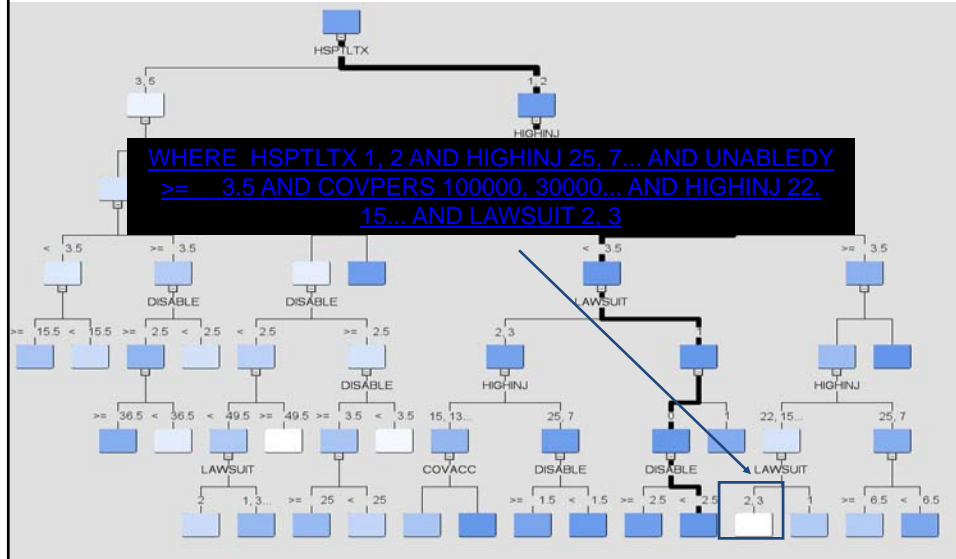
11, 12...

Statistic Training  
0: 72%  
1: 28%  
N in node: 1098

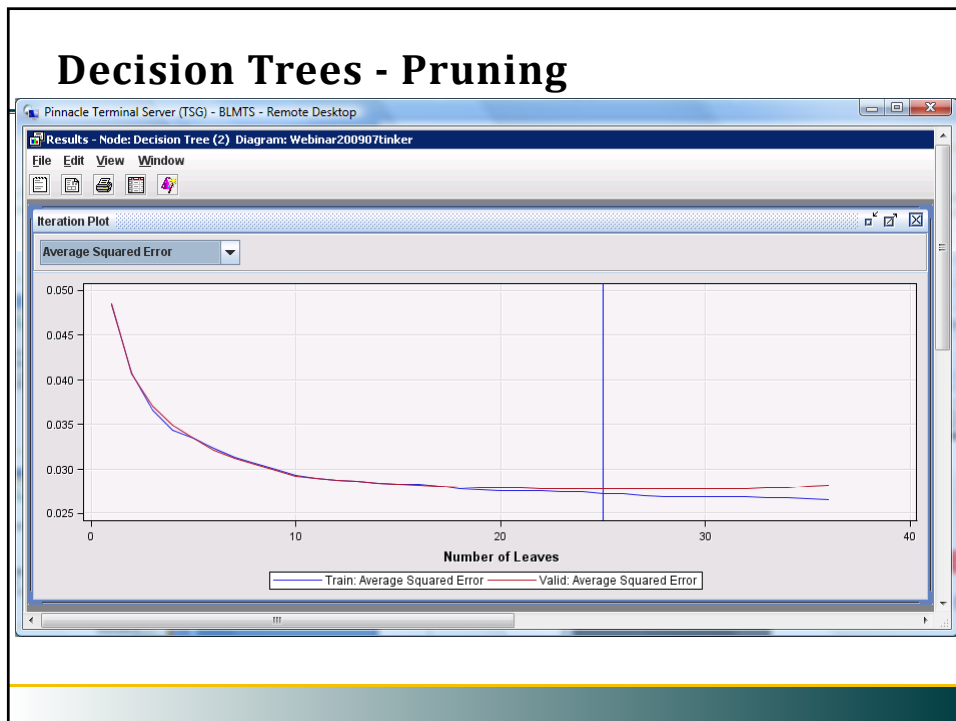
25, 7...

Statistic Training  
0: 98%  
1: 2%  
N in node: 28405

## Decision Trees - After a Few Split Searches



## Decision Trees - Pruning



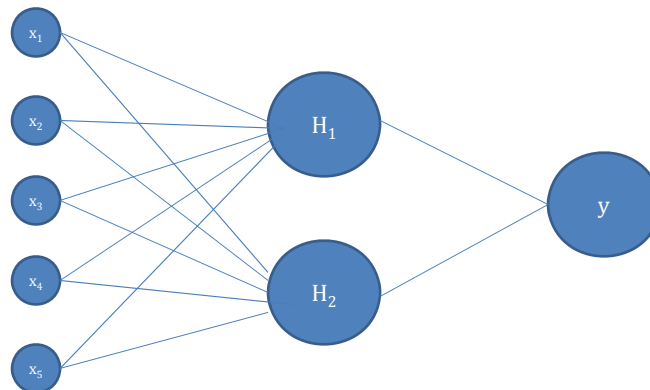


## Neural Networks in TWO slides...

- $y = w_{00} + w_{01}H_1 + w_{02}H_2$ 
  - $H_1 = \tanh(w_{10} + w_{11}x_1 + w_{12}x_2 + \dots + w_{15}x_5)$
  - $H_2 = \tanh(w_{20} + w_{21}x_1 + w_{22}x_2 + \dots + w_{25}x_5)$



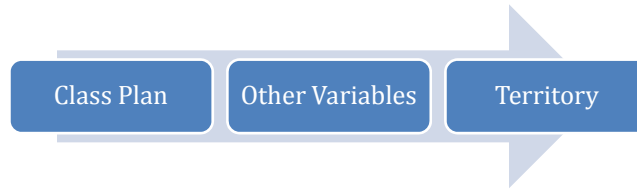
## Neural Networks - in a Nutshell



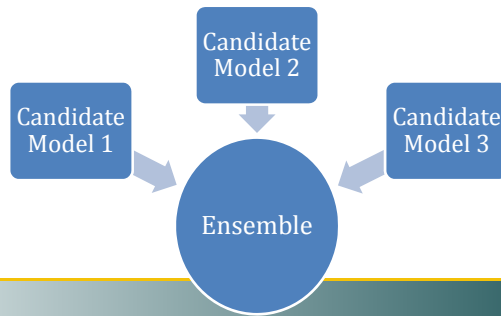
$y$  is a linear combination of  $H_1$  and  $H_2$ , each of which is a linear combination of the  $x$ 's... with a twist.

## A Model is a Building Block

- Series



- Parallel



## Parting Thoughts



## Life Beyond Credit: What Happened in Maryland

- Insurance score used in auto and homeowners until...
- Banned from homeowners rating effective October 1, 2002
- Outcome
  - Removal of credit from rating plans – rate inequities
  - Rate innovation – as companies adjusted to life without credit
  - Result – overall market adapted, and...



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## ...A Few Companies are Differentiating Themselves

DWP Growth - Years Better Than Industry	Incurred Loss Ratio - Years Better Than Industry					
	0	1	2	3	4	5
0	0	1	2	3	2	4
1	2	0	1	1	7	2
2	0	2	3	7	2	2
3	0	3	0	2	1	2
4	0	0	1	3	1	3
5	2	2	0	2	1	0



## Parting Thought

Find your worst piece,  
and improve it!



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**Thank You for Your Attention**

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