LOSS RATIO MODELING FOR COMMERCIAL AUTO LINE OF BUSINESS

15TH FEBRUARY, 2012

PRESENTATION OUTLINE

- Introduction
- Goals and Objectives
- Exploratory Analysis
- Data Preparation
- Modeling Process
  - Model Design
  - Model Fitting
  - Testing and Adjusting Model
- Key Results
- Conclusions
- Future Considerations
- Acknowledgements

INTRODUCTION

Background on Project:

- Worcester Polytechnic Institute Final Project
- Past usage of credit scores in Personal Lines
- Recent shift to usage in Commercial Lines

Business Issue:

How can credit scores be used to improve the predictive ability of the current Hanover Commercial Auto pricing model?

Proposed Solution:

Model that implements a credit score variable to predict loss ratio for each policy and provide a recommendation on appropriate credit factor.

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PROJECT GOALS AND OBJECTIVES

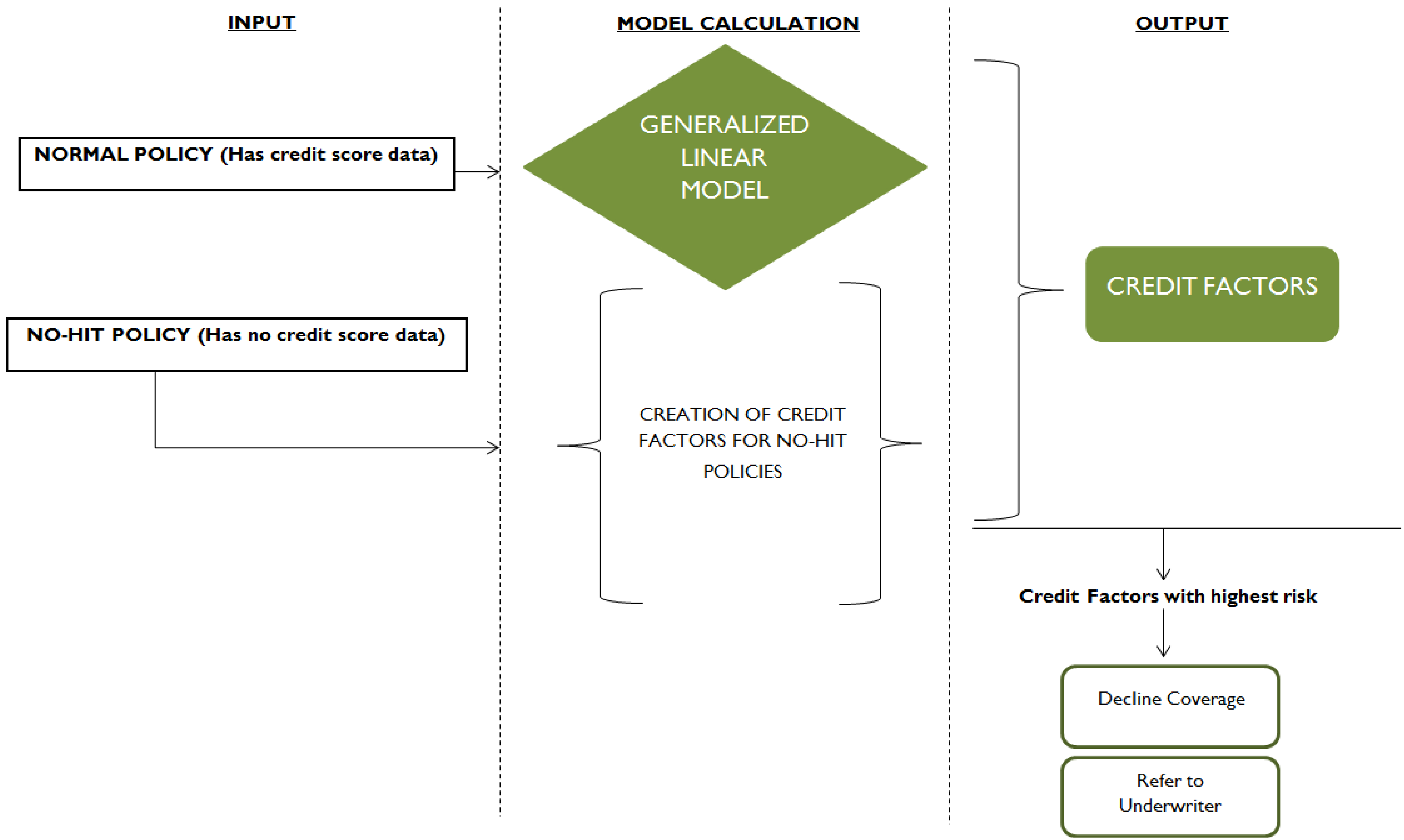
1. Identify a base set of risk factors for commercial auto.

2. Use these risk factors to calculate predicted loss ratios for each policy.

3. Use the predicted loss ratios to develop credit factors for each policy.

4. Assess current pricing and underwriting techniques to determine how best to incorporate credit factors into current calculations.

PROPOSED PROCESS OVERVIEW



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EXPLORATORY ANALYSIS

We outlined three primary goals:

1. **Familiarize ourselves with the data set and composition of various data fields.**
   - Graphical representations of make-up of data variables.
   - Statistical analysis on data variables

2. **Observe relationships between various data fields and loss ratio as well as relationships amongst variables.**
   - Univariate analysis by plotting variables against loss ratios.
   - Correlation between C points and F points

3. **Identify changes necessary to improve the data set.**
   - Identification of invalid, missing or inconsistent data
   - Loss ratio analysis to identify outliers.

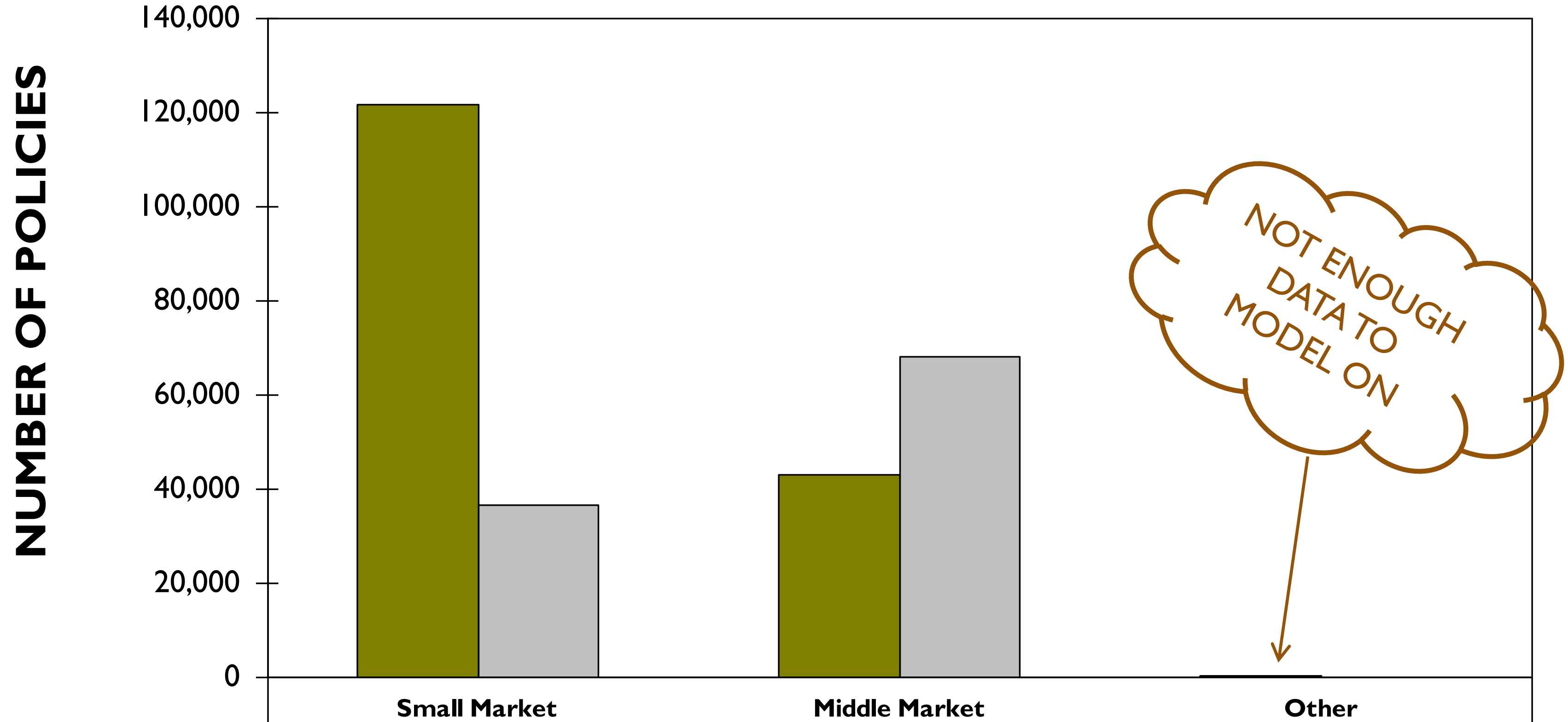
EXPLORATORY ANALYSIS

There were 165,142 policies over the period 2005-2011

Numeric Data	• Histograms for numeric variables • Scatter plots of loss ratio vs. variables. • Box and whisker plots
Categorical Data	• Bar graphs to show make-up of categories • Frequency tables showing percentage breakup.
Invalid, Missing or Inconsistent Data	• 35.3% policies have no credit information. • 3.5% policies have no premiums. • 3.4% manually written policies • 2.7% policies have premium below $500 • <0.1% policies have negative incurred losses.

EXPLORATORY ANALYSIS

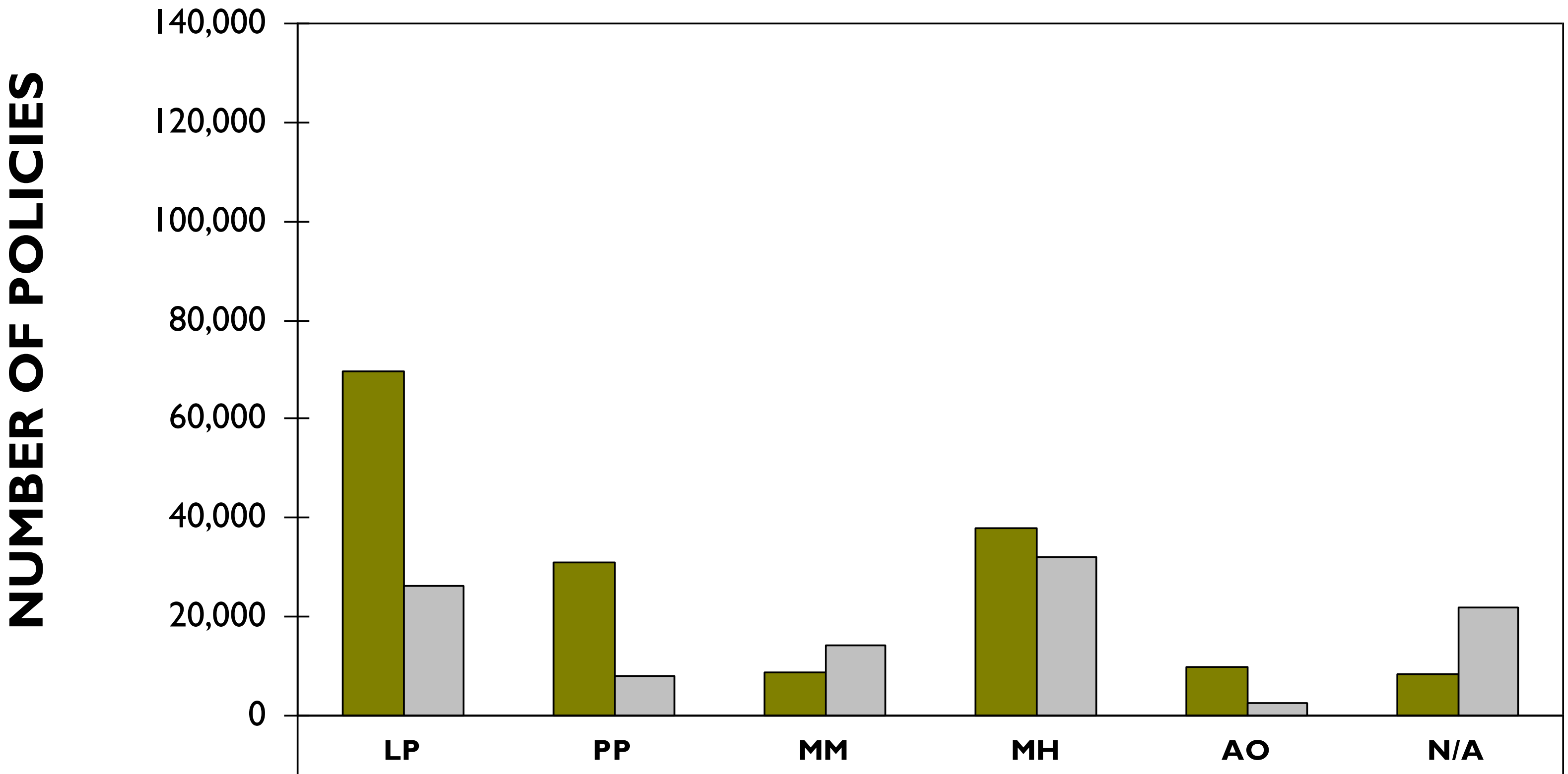
DISTRIBUTION BY MARKET SEGMENT



	Small Market	Middle Market	Other
Policy count	121,813	43,021	308
Premium (x10,000)	$36,632	$68,234	$109
Percentage (Policy count)	73.76%	26.05%	0.19%

EXPLORATORY ANALYSIS

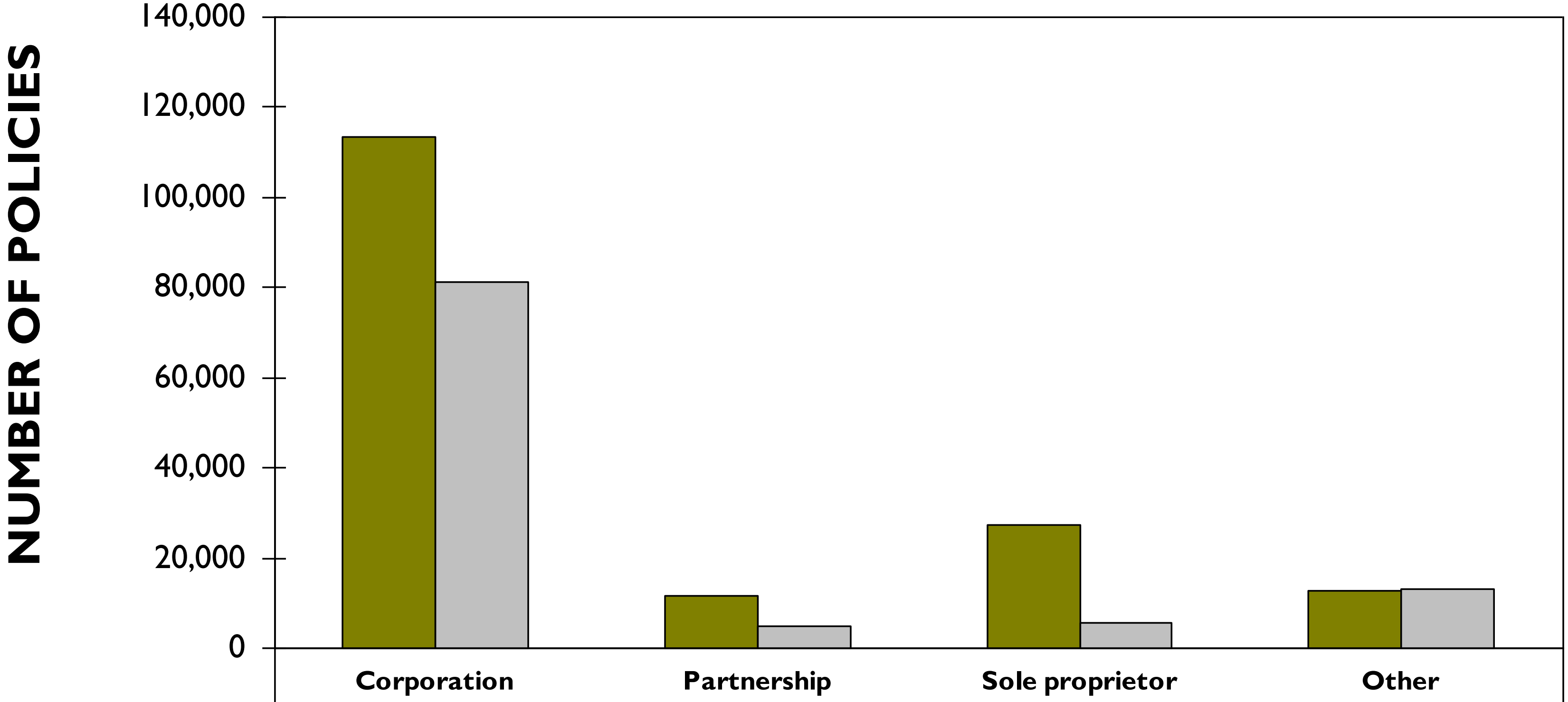
DISTRIBUTION BY POLICY TYPE



	LP	PP	MM	MH	AO	N/A
Policy count	69,528	31,057	8,734	37,735	9,738	8,350
Premium (x10,000)	$26,281	$7,958	$14,228	$32,085	$2,563	$21,860
Percentage (Policy Count)	42.09%	18.81%	5.29%	22.85%	5.90%	5.06%

EXPLORATORY ANALYSIS

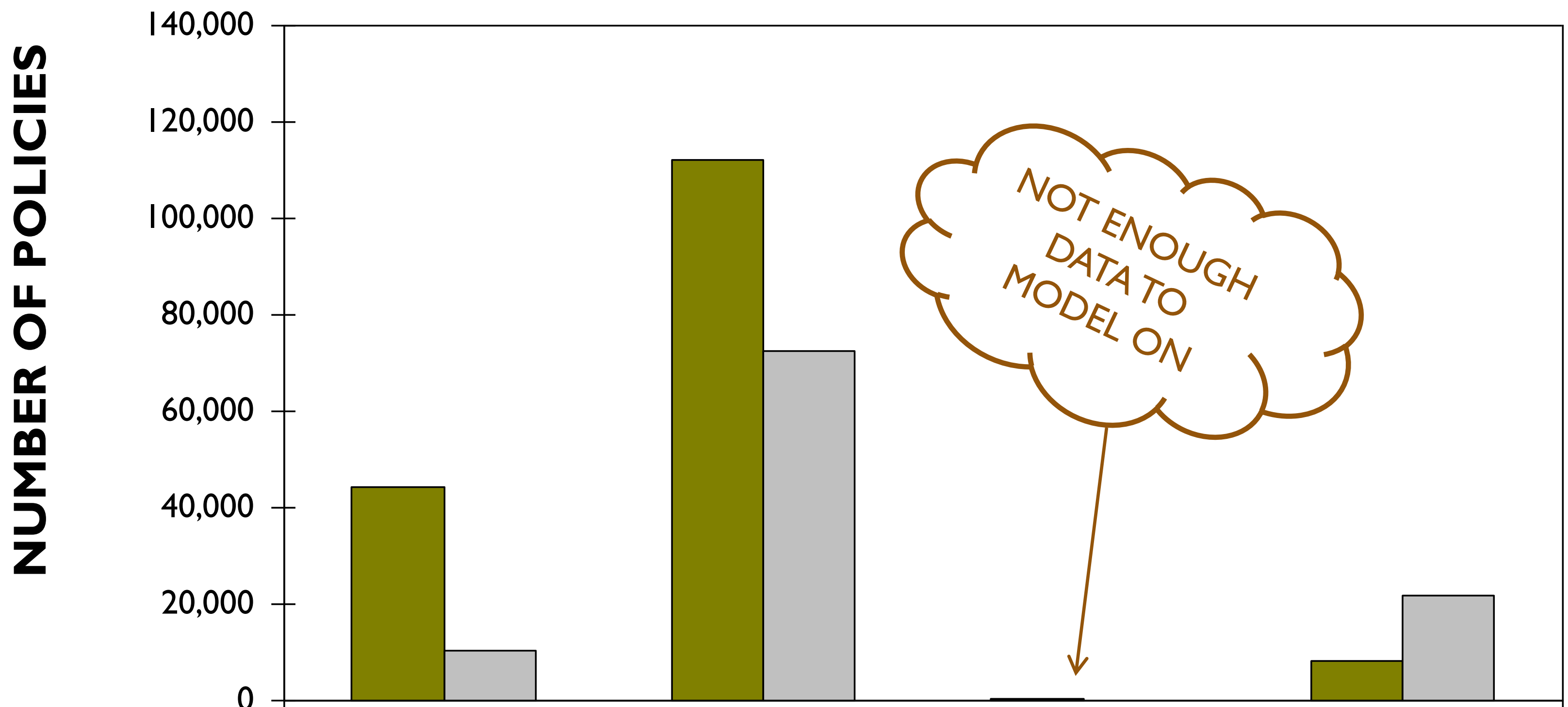
DISTRIBUTION BY BUSINESS TYPE



	Corporation	Partnership	Sole proprietor	Other
Policy count	113,302	11,695	27,333	12,812
Premium(x10,000)	$81,155	$4,966	$5,628	$13,226
Percentage (Policy Count)	68.61%	7.08%	16.55%	7.76%

EXPLORATORY ANALYSIS

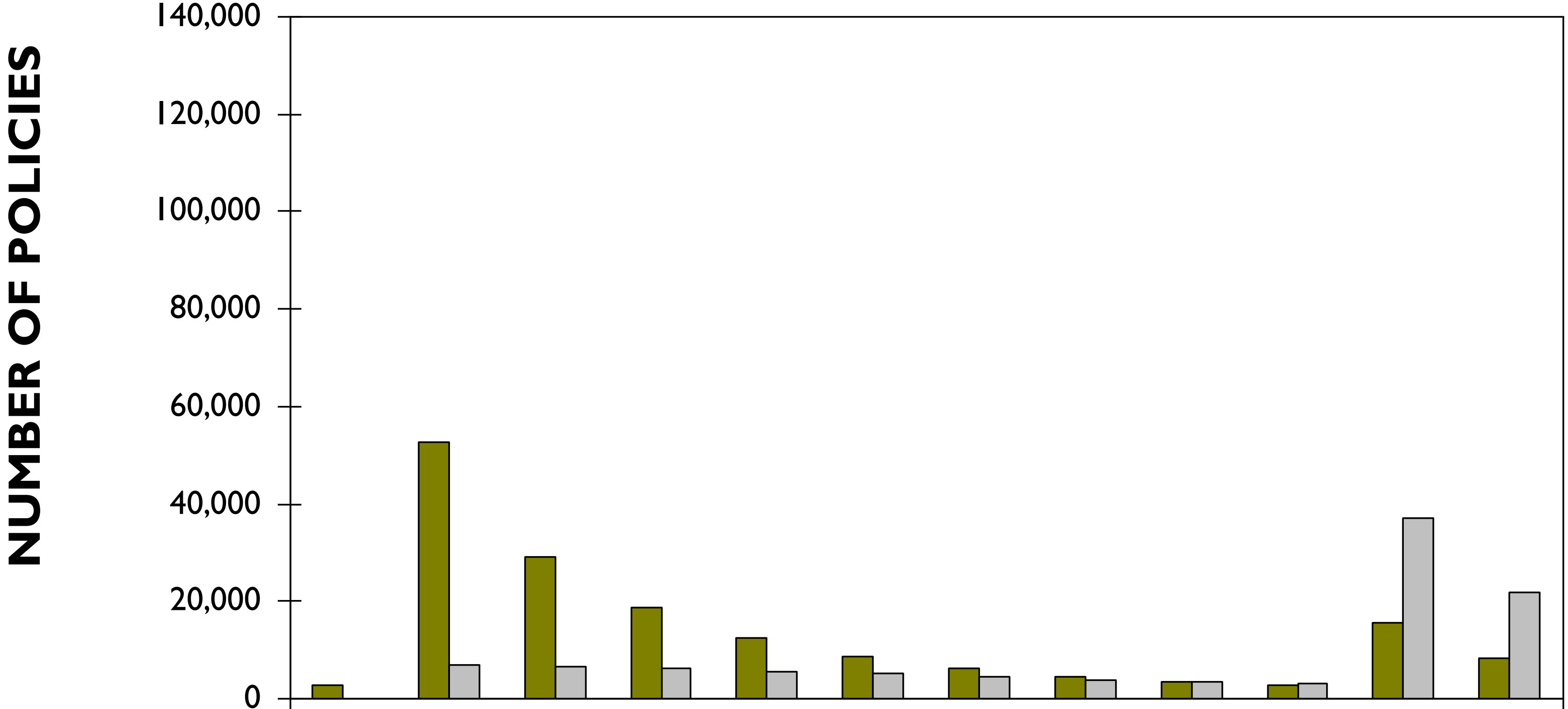
DISTRIBUTION BY LIABILITY GROUP



	< $1M coverage	≥ $1M coverage	no coverage	N/A
Policy count	44,414	112,048	322	8,358
Premium(x10,000)	$10,462	$72,631	$22	$21,860
Percentage (Policy Count)	26.89%	67.85%	0.20%	5.06%

EXPLORATORY ANALYSIS

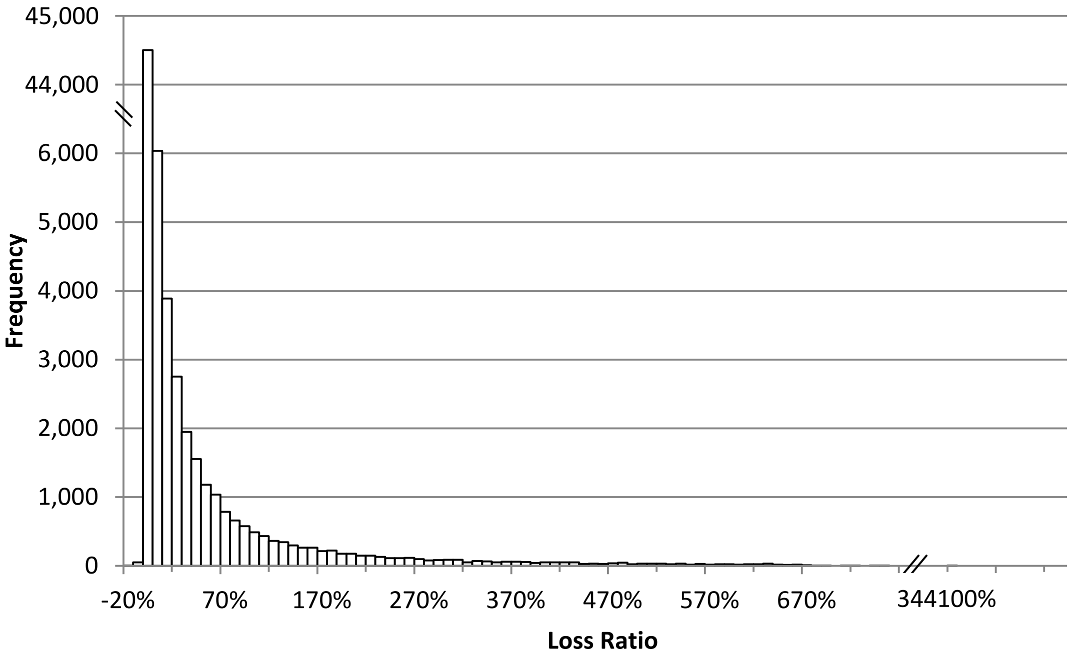
DISTRIBUTION BY FLEET SIZE

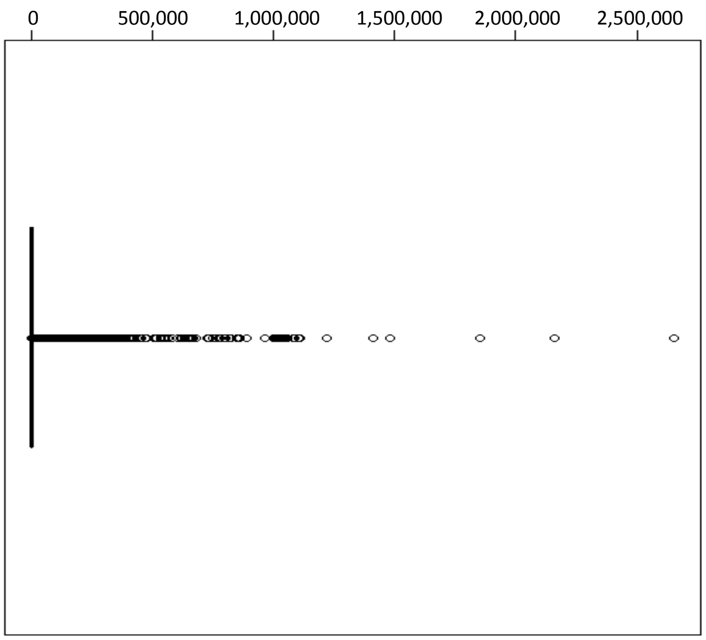


	0	1	2	3	4	5	6	7	8	9	≥10	N/A
Policy count	2,812	52,672	29,174	18,575	12,554	8,621	6,144	4,566	3,456	2,761	15,467	8,350
Premium(x10,000)	$91	$6,839	$6,752	$6,175	$5,655	$5,227	$4,507	$3,793	$3,602	$3,274	$37,199	$21,860
Percentage (Policy count)	1.70%	31.89%	17.67%	11.25%	7.60%	5.22%	3.72%	2.76%	2.09%	1.67%	9.37%	5.06%

EXPLORATORY ANALYSIS

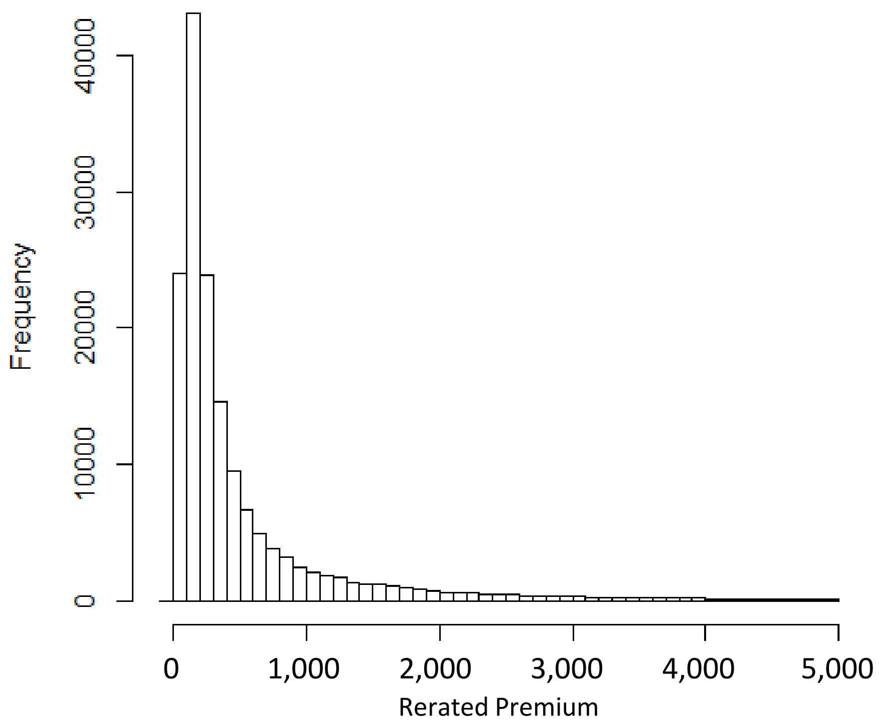
DISTRIBUTION OF INCURRED LOSSES

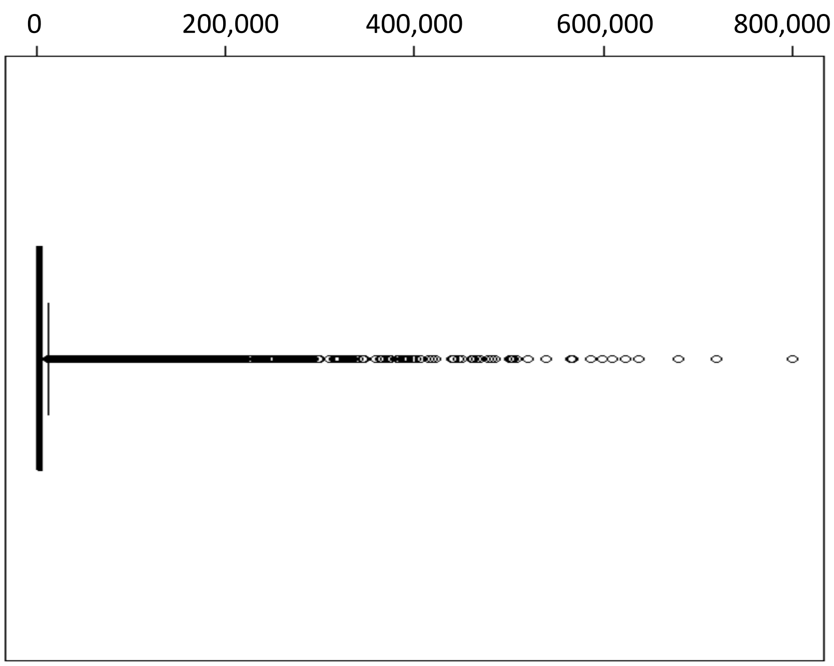




EXPLORATORY ANALYSIS

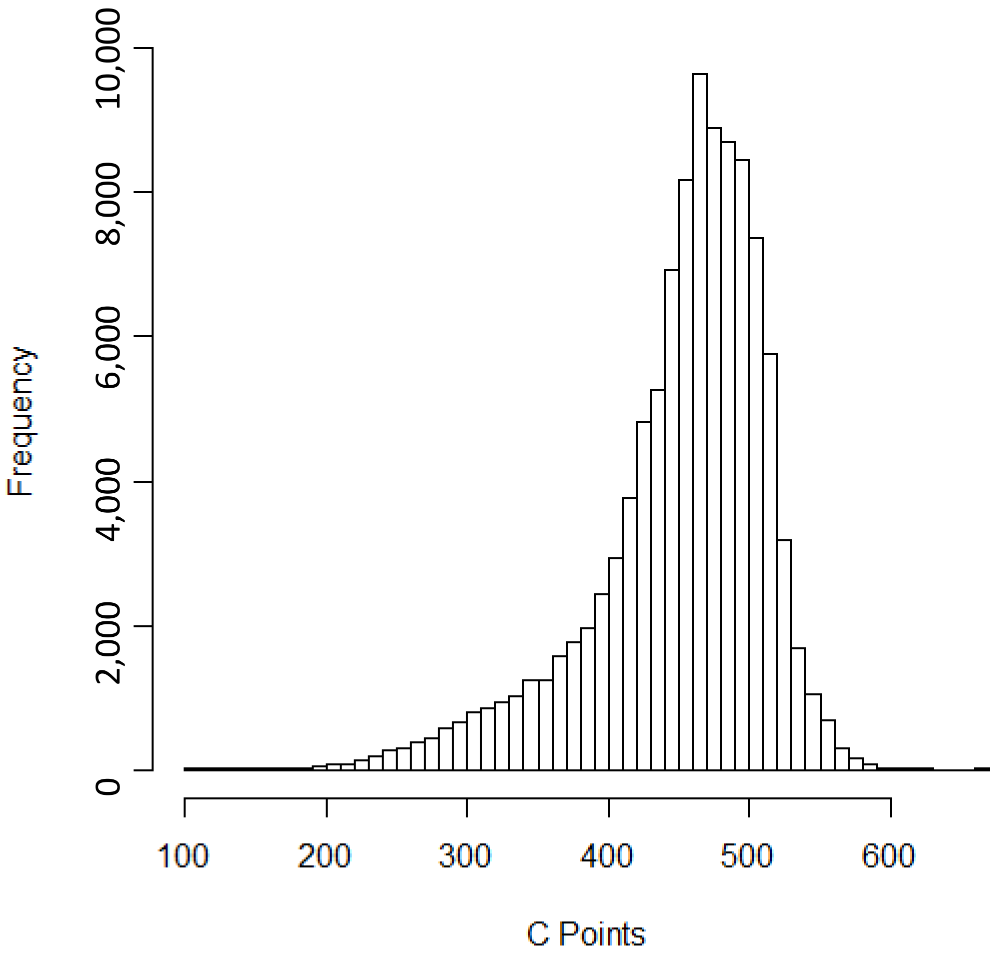
DISTRIBUTION OF RERATED PREMIUM





EXPLORATORY ANALYSIS

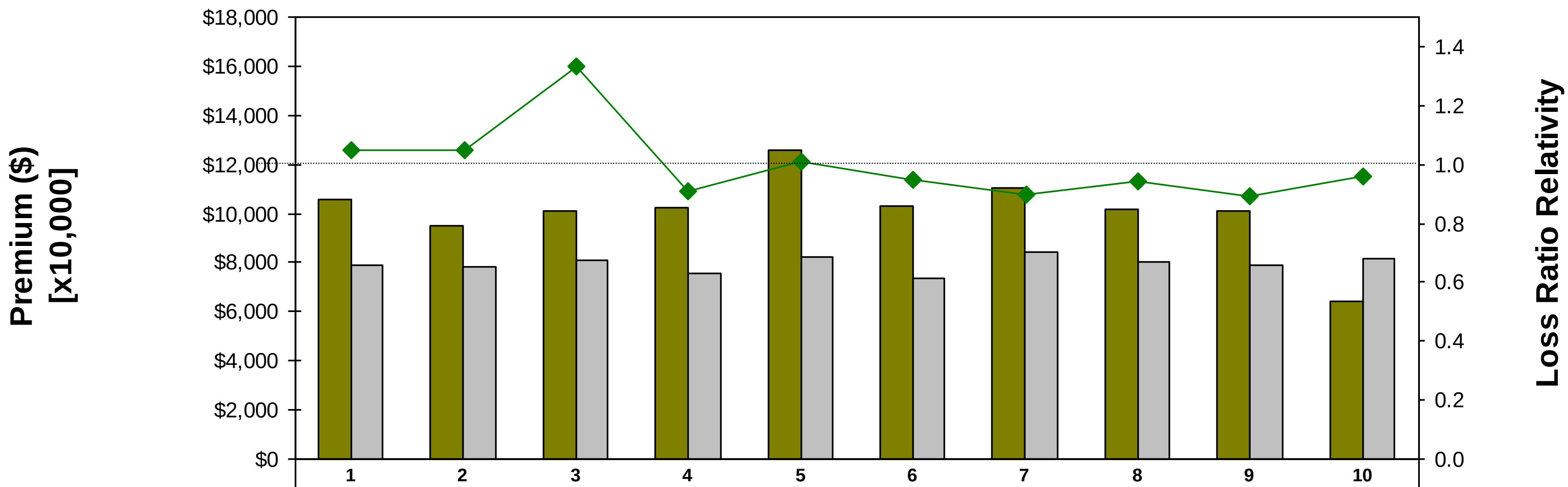
DISTRIBUTION OF C POINTS (risk of credit default)



EXPLORATORY ANALYSIS

C POINTS (risk of credit default)

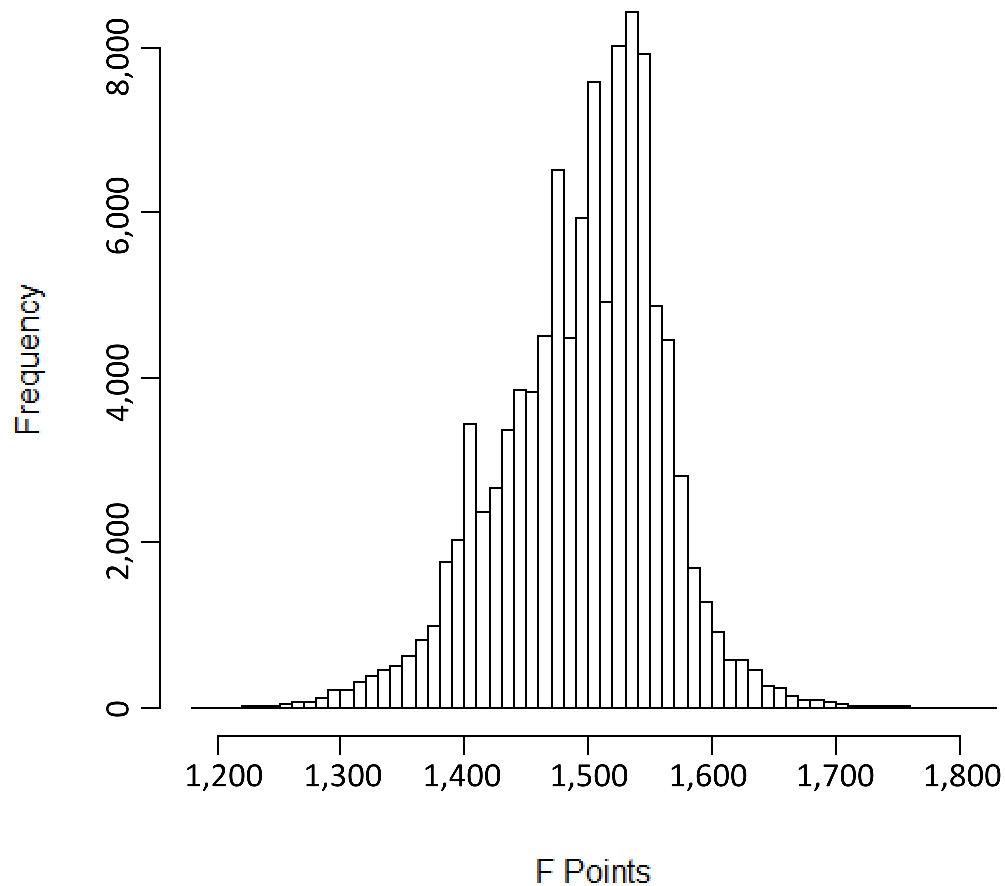
LR Relativities by C Points



	1	2	3	4	5	6	7	8	9	10
Policy Count	10,601	9,498	10,088	10,265	12,609	10,315	11,050	10,141	10,101	6,433
Premium (x 10,000)	$7,907	$7,828	$8,071	$7,588	$8,212	$7,385	$8,427	$8,004	$7,882	$8,173
LR Relativity	1.05	1.05	1.33	0.91	1.01	0.95	0.90	0.94	0.89	0.96
Lower Limit	101	372	414	436	452	467	479	492	505	523
Upper Limit	372	414	436	452	467	479	492	505	523	670

EXPLORATORY ANALYSIS

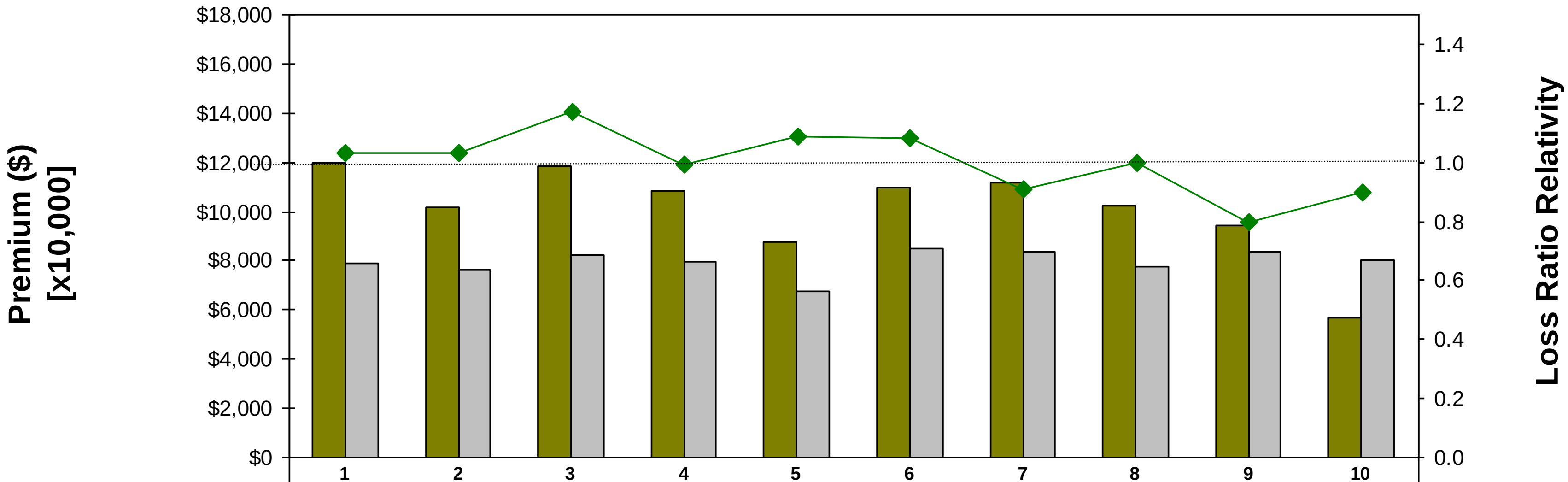
DISTRIBUTION OF F POINTS (risk of financial stress)



EXPLORATORY ANALYSIS

F POINTS (risk of financial stress)

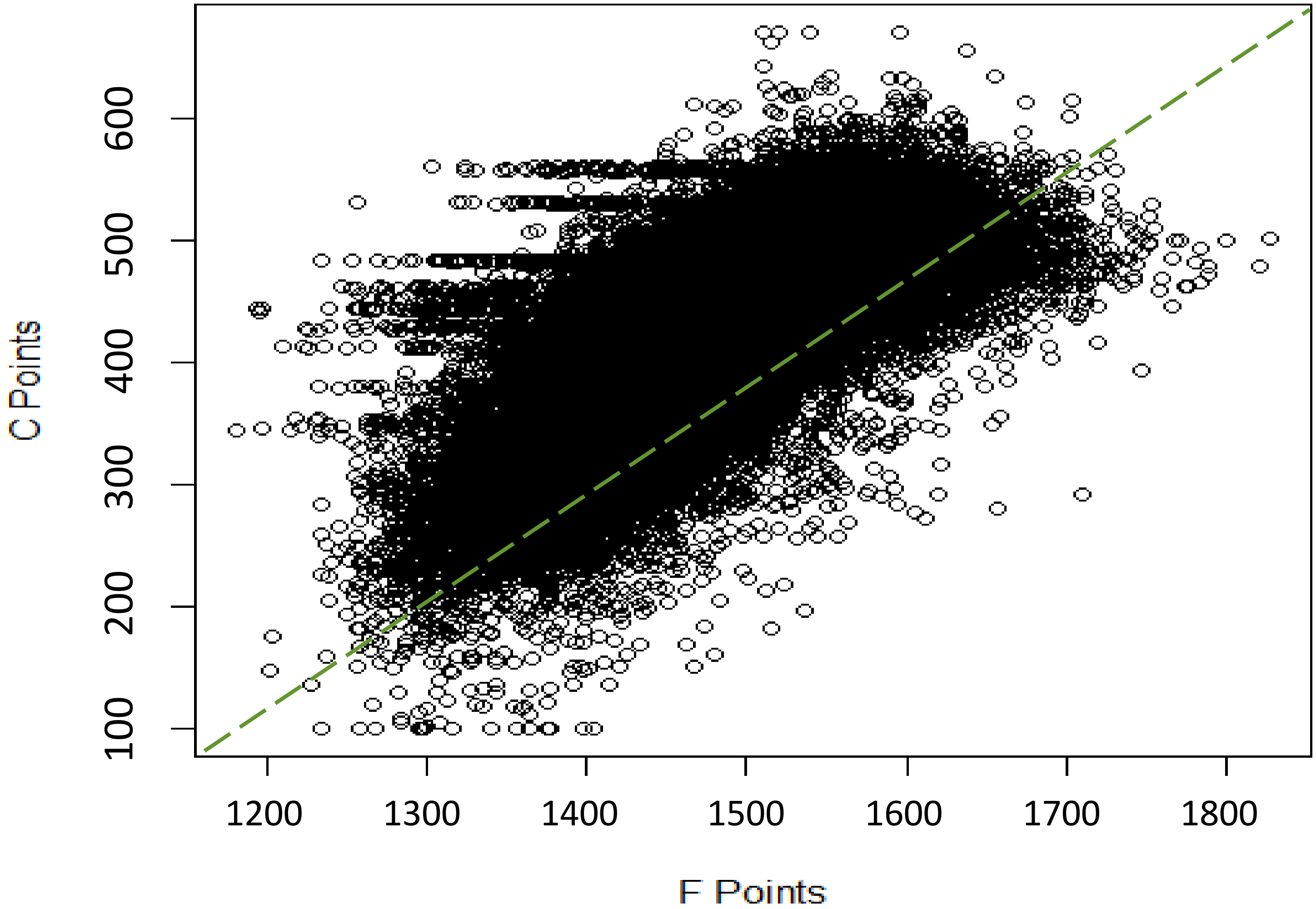
LR Relativities by F Points



	1	2	3	4	5	6	7	8	9	10
Policy Count	12,003	10,157	11,824	10,813	8,793	10,973	11,197	10,257	9,412	5,672
Premium (x10,000)	$7,884	$7,640	$8,209	$7,975	$6,762	$8,515	$8,383	$7,734	$8,332	$8,044
LR Relativity	1.03	1.03	1.17	0.99	1.09	1.08	0.91	1.00	0.80	0.90
Lower Limit	1,198	1,413	1,450	1,474	1,496	1,510	1,527	1,542	1,559	1,586
Upper Limit	1,413	1,450	1,474	1,496	1,510	1,527	1,542	1,559	1,586	1,827

EXPLORATORY ANALYSIS

C POINTS VS. F POINTS – SCATTER PLOT



EXPLORATORY ANALYSIS (SUMMARY)

- 35.3% of policies were missing credit score information.

- Noticed unexpected values for some variables:
  - Rerated premiums (below $500, the minimum premium amount)
  - Incurred losses (below $0)

- Many policies had data given as N/A: fleet size, liability group, policy type and incurred loss.

- We noticed a number of extreme values in rerated premiums, incurred losses and incurred loss ratios.

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DATA PREPARATION (INITIAL STEPS)

1. We began with <u>165,142</u> policies
2. We removed the following
   - 5,728 policies with no premium
   - 58,309 polices with no credit information ("no-hits")
   - 5,599 manually written policies
   - 330 policies with market segment of "Other" (207) and policies with no liability coverage (123)
   - 3 duplicated records

	Original data	Remove No-premiums	Remove No-hits	Cleaned data
Incurred Loss Ratio	36.02%	34.09%	36.59%	36.72%
Number of Policies	165,142	159,414	101,105	95,173

DATA PREPARATION

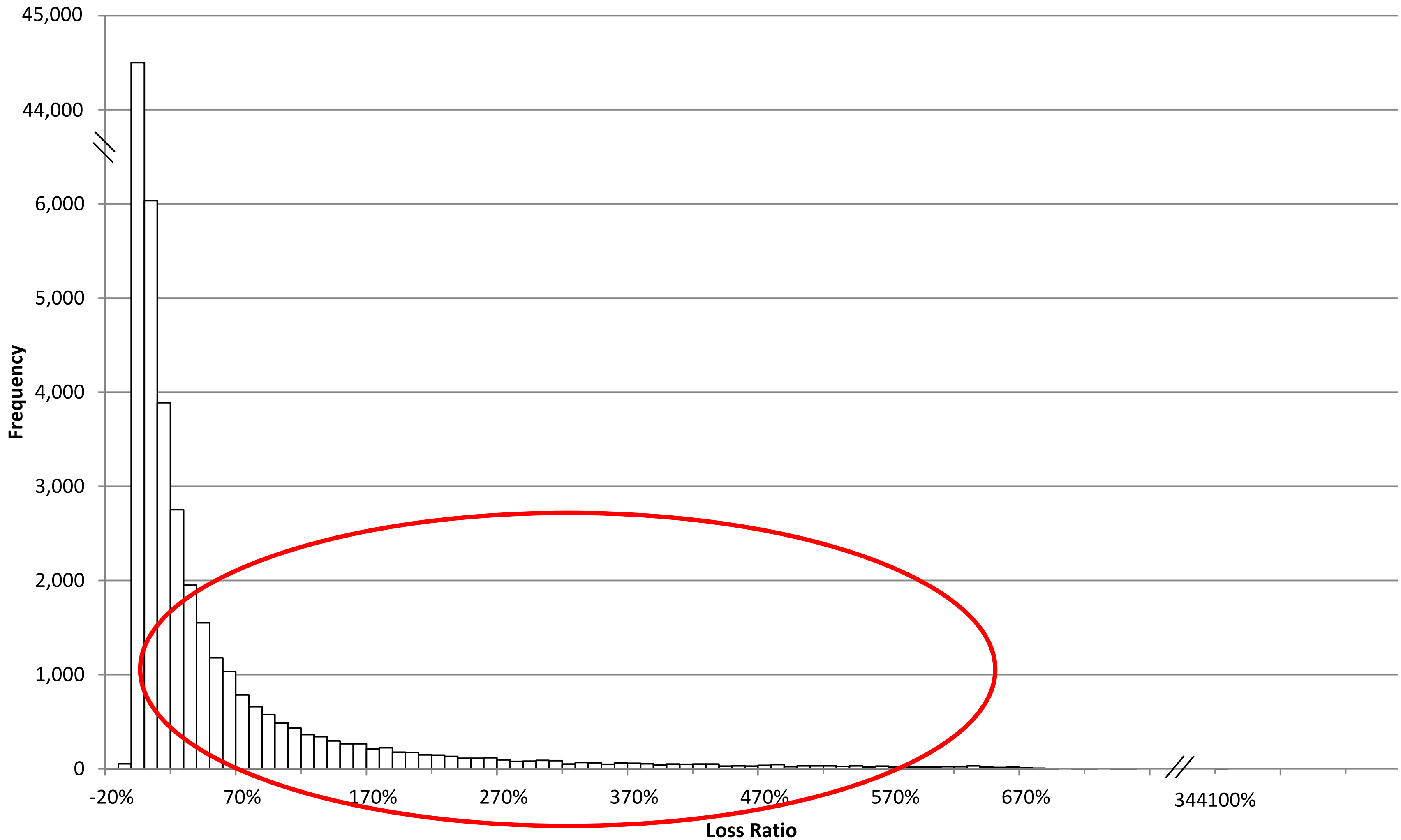
Once we reduced the data to 95,173 policies, we made additional adjustments:

1. A minimum $500 premium was imposed, impacting 4,514 policies.
2. Policies with negative losses were set to zero, impacting 51policies.
3. The top 1% of incurred loss ratios were capped to the 99th percentile (622%), impacting 952 policies.

	LR before any adjustments	$500 minimum premium	No negative losses	Capping top 1% of LR's
Incurred Loss Ratio	36.72% →	36.65% →	36.65% →	27.57%

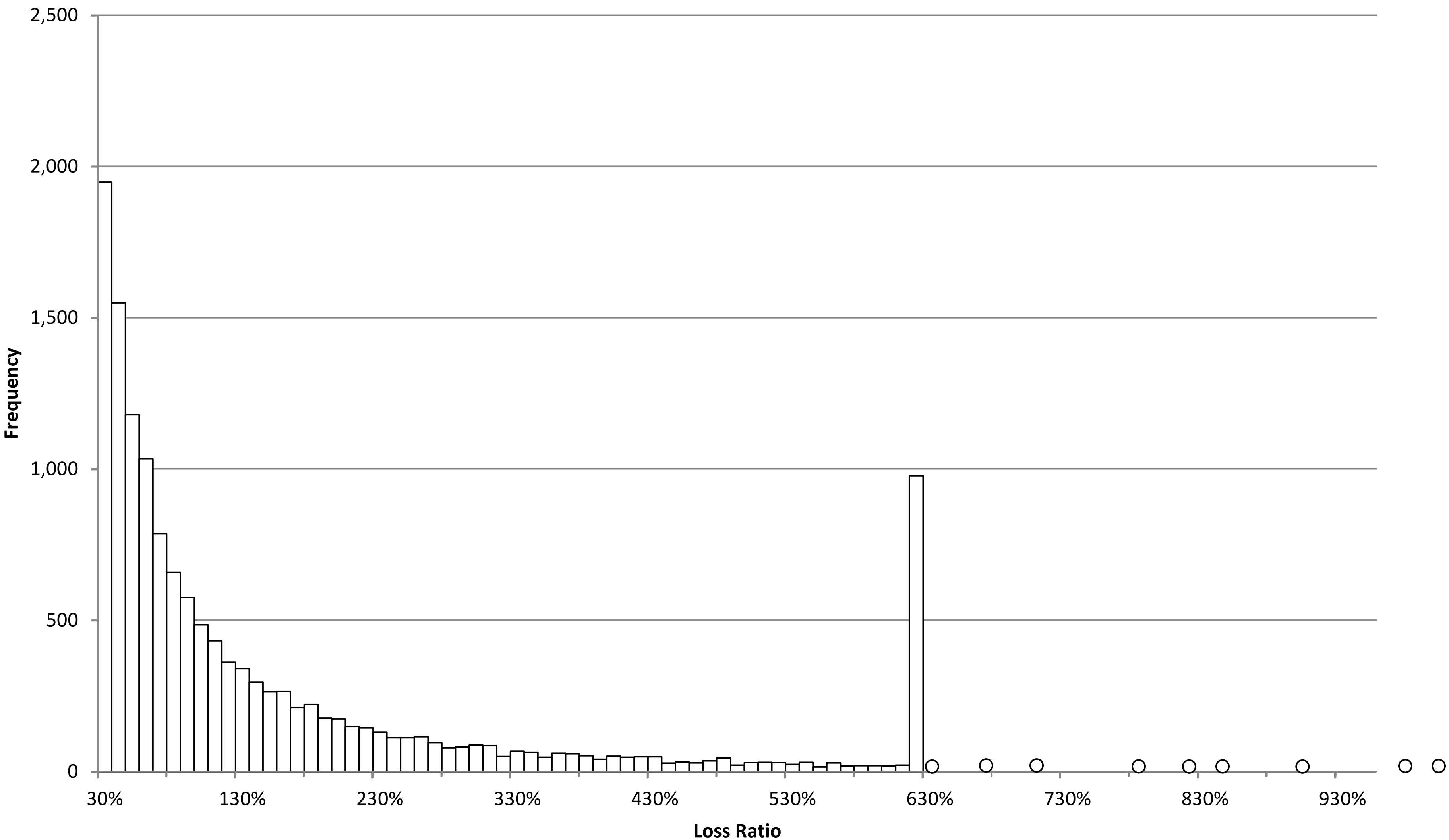
DATA PREPARATION

LOSS RATIO DISTRIBUTION - UNADJUSTED



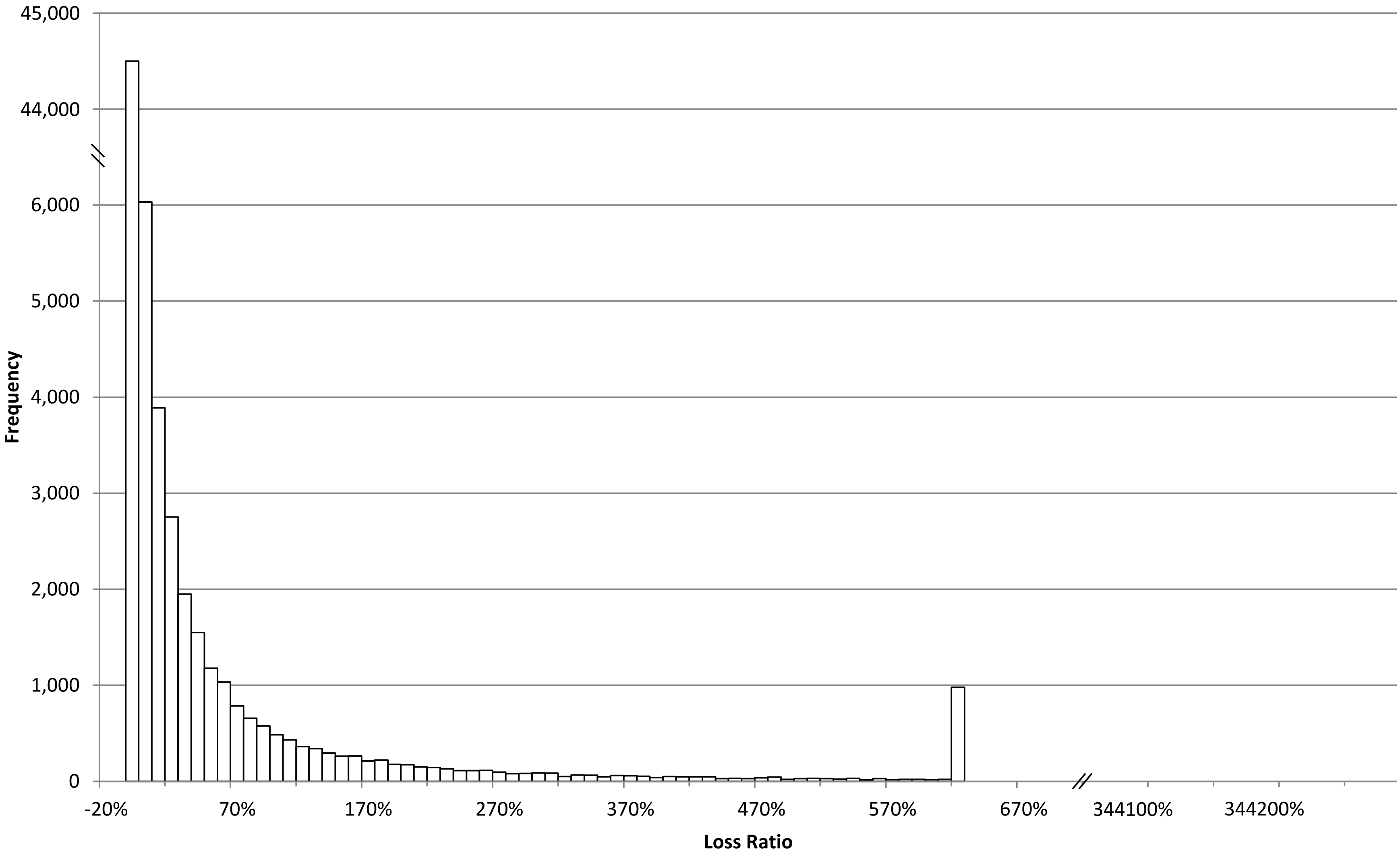
DATA PREPARATION

LOSS RATIO DISTRIBUTION (ZOOMED)



DATA PREPARATION

LOSS RATIO DISTRIBUTION - ADJUSTED



DATA PREPARATION

- After cleaning and adjusting the data, we had to determine the appropriate variables to use in the model.

- Based on exploratory analysis, we found that C points and F points were correlated which had to be corrected.

- Factor Analysis:
  - enabled analysis of multi-collinearity among variables.
  - an uncorrelated factor was created as a weighted sum of the standardized variables (C Points and F Points).
  - this factor was named Financial Stability and used as an input variable.

DATA PREPARATION (SUMMARY)

1. Deleted policies with missing, invalid or inconsistent data (e.g., policies with no credit information, missing rerated premium and manually written policies).

2. Data Adjustments:
   - Negative incurred losses were set to zero
   - Incurred loss ratios were capped
   - Rerated premiums were set to at least $500

3. Used factor analysis to create a new credit variable (Financial Stability) and assigned this variable to each policy.

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MODEL DESIGN

<u>Response variable</u>: Incurred loss ratio

<u>Model distribution</u>: Tweedie (member of exponential family)

<u>Model type</u>: Generalized linear model (GLM)

<u>Input variables</u>:

- Policy type
- Business type
- Market segment
- Fleet size
- Financial stability
- Policy effective age (current year minus effective year)

MODEL DESIGN

$$\log(E[loss\ ratio]) = \beta_0 + \beta_1 \times Policy\ Type + \beta_2 \times Fleet\ Size + \beta_3 \times Financial\ Stability + \cdots + \mathcal{E}$$

Components of GLM:

– Random component- a group of n independent observations with a distribution from the exponential family.

– Systematic component- a linear predictor $\eta = \beta\mathbf{X}$ is used to weight the predictor variables for each individual observation.

– Link function- a logarithmic link function was used which set the predictor above ($\eta = \beta\mathbf{X}$) equal to log (μ) where μ represents the predicted incurred loss ratio.

MODEL FITTING

1. **Create random sample**: 80% build sample, 20% for validation sample.
   - Assigned random number to each policy
   - Ordered the policies from lowest to highest
   - Chose top 80% for build sample

2. **Model using software:** Used GLM method in R software to model Loss Ratios with Tweedie family.

3. **Rerun on Full Sample:**
   - Model created using the build sample, then run on validation sample.
   - After optimal model was achieved, model was run on full sample.

TESTING AND ADJUSTING MODEL

Before we were able to analyze results we performed tests to determine goodness of model fit:

- Analysis of Variance (ANOVA) with Chi-Squared test P-value
  - Measures the significance of each input variable to the overall model fit.
- Akaike Information Criteria (AIC)
  - Measures the relative fit of a candidate model fit compared to other candidates.
- Lift Charts
  - Breaks data into groups based on variable being measured.
  - Calculates and plots actual and predicted incurred loss ratio relativities.

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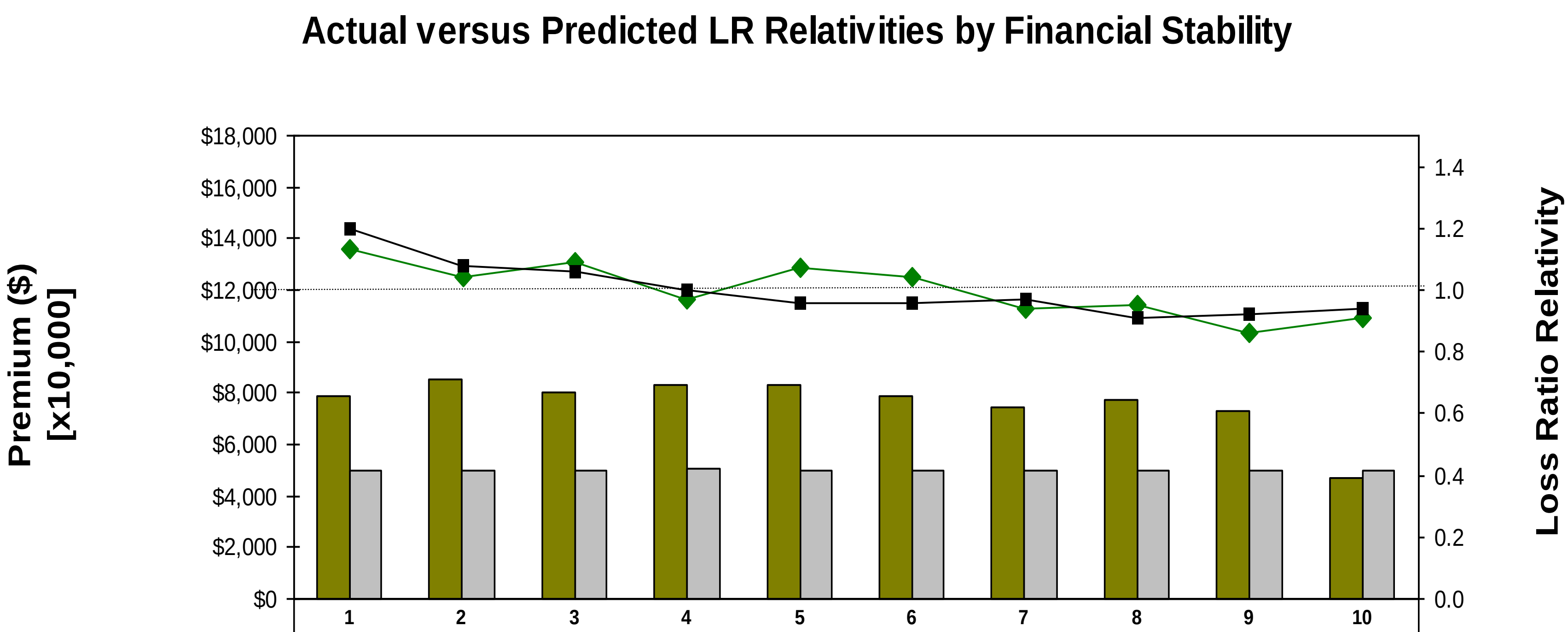
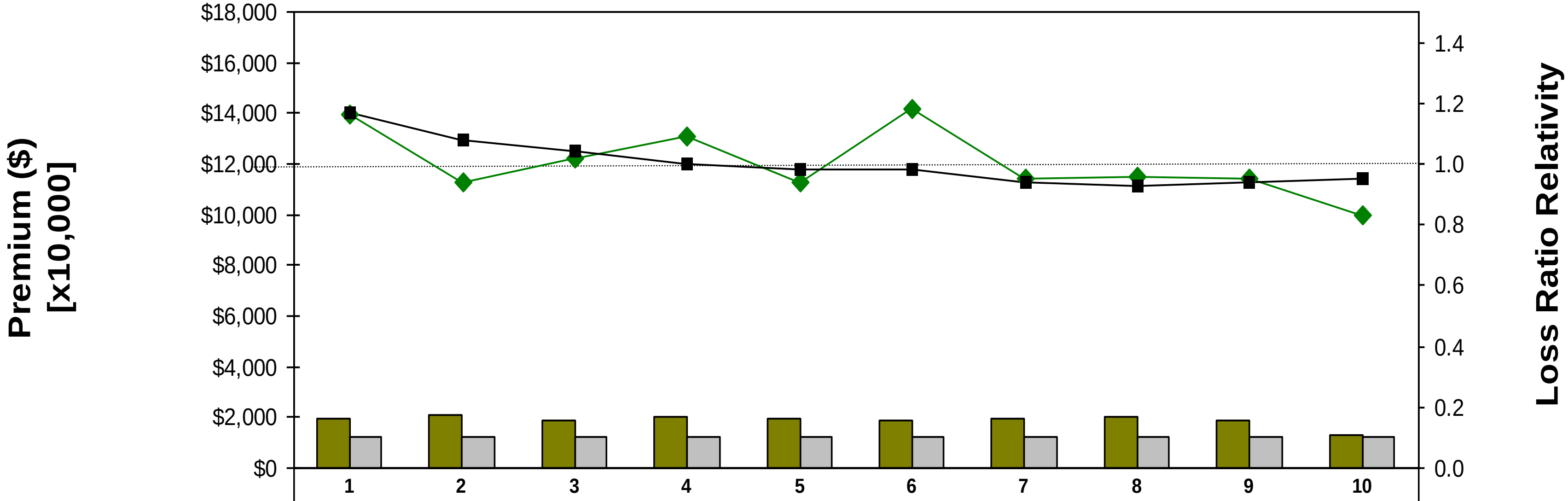
CREDIT MODEL LIFT BY FINANCIAL STABILITY (BUILD SAMPLE)



	1	2	3	4	5	6	7	8	9	10
Policy Count	7,880	8,518	7,993	8,348	8,287	7,900	7,452	7,710	7,322	4,727
Premium (x 10,000)	$5,008	$5,010	$4,999	$5,028	$4,994	$5,014	$5,009	$5,007	$5,008	$5,010
Act LR Relativity	1.13	1.04	1.09	0.97	1.07	1.04	0.94	0.95	0.86	0.91
Pred LR Relativity	1.20	1.08	1.06	1.00	0.96	0.96	0.97	0.91	0.92	0.94
Lower Limit	-4.84	-1.30	-0.72	-0.29	0.00	0.27	0.50	0.72	0.94	1.21
Upper Limit	-1.30	-0.72	-0.29	0.00	0.27	0.50	0.72	0.94	1.21	3.17

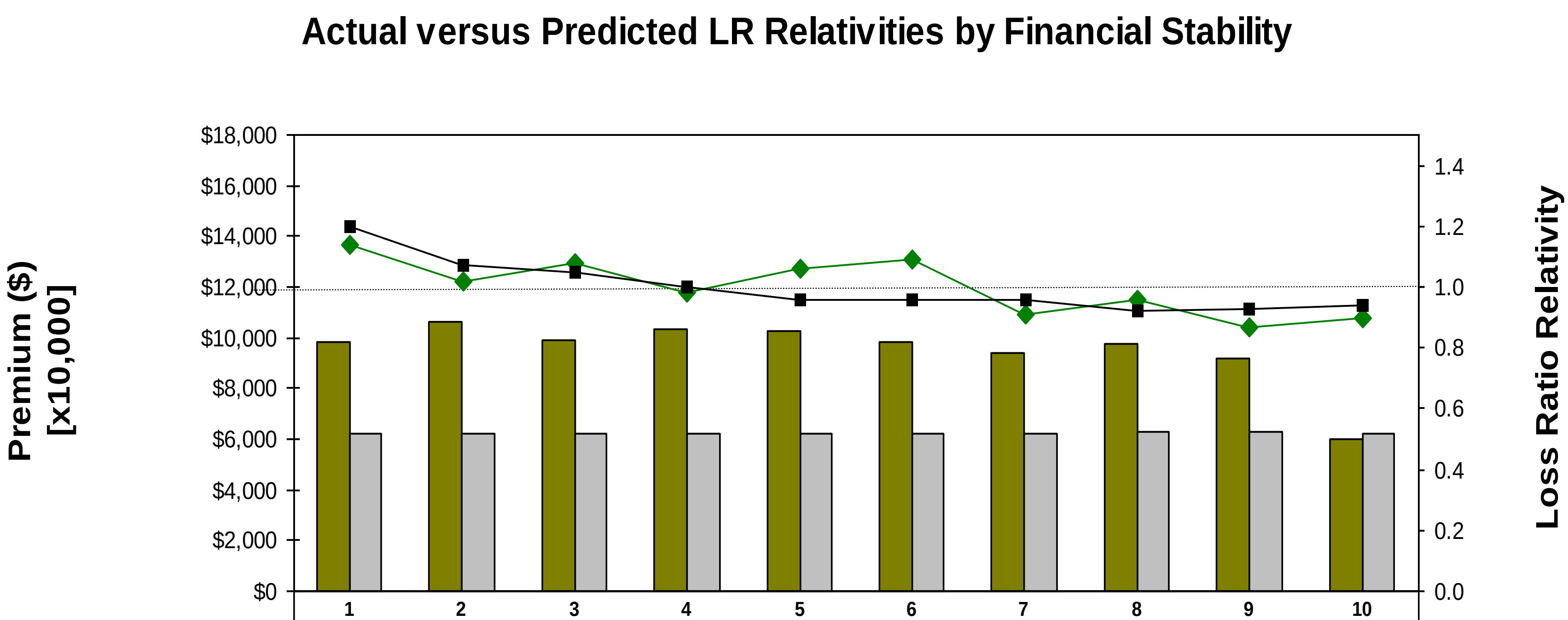
CREDIT MODEL LIFT BY FINANCIAL STABILITY (VALIDATION SAMPLE)

Actual versus Predicted LR Relativities by Financial Stability



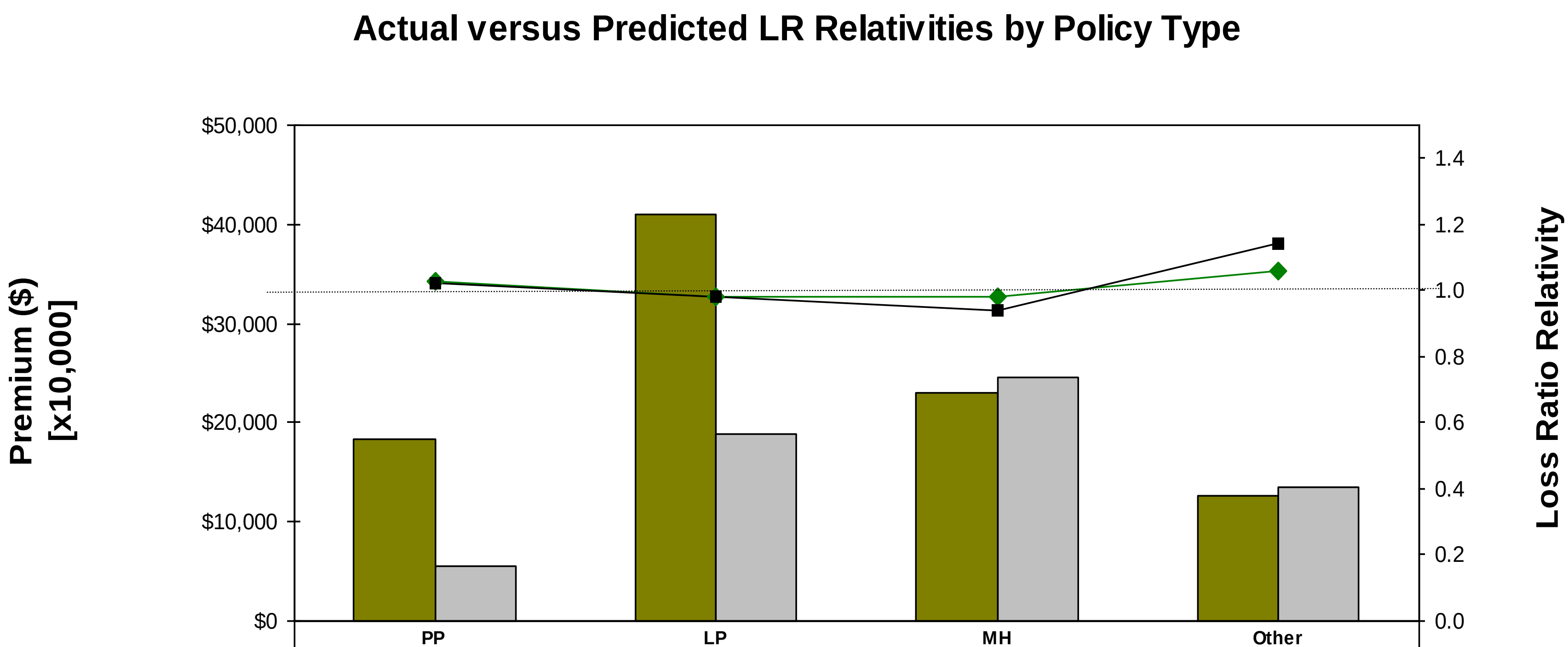
	1	2	3	4	5	6	7	8	9	10
Policy Count	1,975	2,115	1,906	2,041	1,973	1,880	1,951	2,037	1,886	1,272
Premium (x 10,000)	$1,231	$1,231	$1,248	$1,236	$1,237	$1,237	$1,235	$1,231	$1,236	$1,246
Act LR Relativity	1.16	0.94	1.02	1.09	0.94	1.18	0.95	0.96	0.95	0.83
Pred LR Relativity	1.17	1.08	1.04	1.00	0.98	0.98	0.94	0.93	0.94	0.95
Lower Limit	-4.58	-1.32	-0.73	-0.31	-0.03	0.22	0.45	0.69	0.91	1.18
Upper Limit	-1.32	-0.73	-0.31	-0.03	0.22	0.45	0.69	0.91	1.18	3.02

CREDIT MODEL LIFT BY FINANCIAL STABILITY (FULL SAMPLE)



	1	2	3	4	5	6	7	8	9	10
Policy Count	9,839	10,648	9,931	10,334	10,278	9,837	9,372	9,733	9,169	6,032
Premium (x 10,000)	$6,246	$6,239	$6,247	$6,246	$6,245	$6,242	$6,227	$6,261	$6,256	$6,246
Act LR Relativity	1.14	1.02	1.08	0.98	1.06	1.09	0.91	0.96	0.87	0.9
Pred LR Relativity	1.20	1.07	1.05	1.00	0.96	0.96	0.96	0.92	0.93	0.94
Lower Limit	-5.03	-1.31	-0.73	-0.29	0.00	0.26	0.49	0.72	0.93	1.20
Upper Limit	-1.31	-0.73	-0.29	0.00	0.26	0.49	0.72	0.93	1.20	3.17

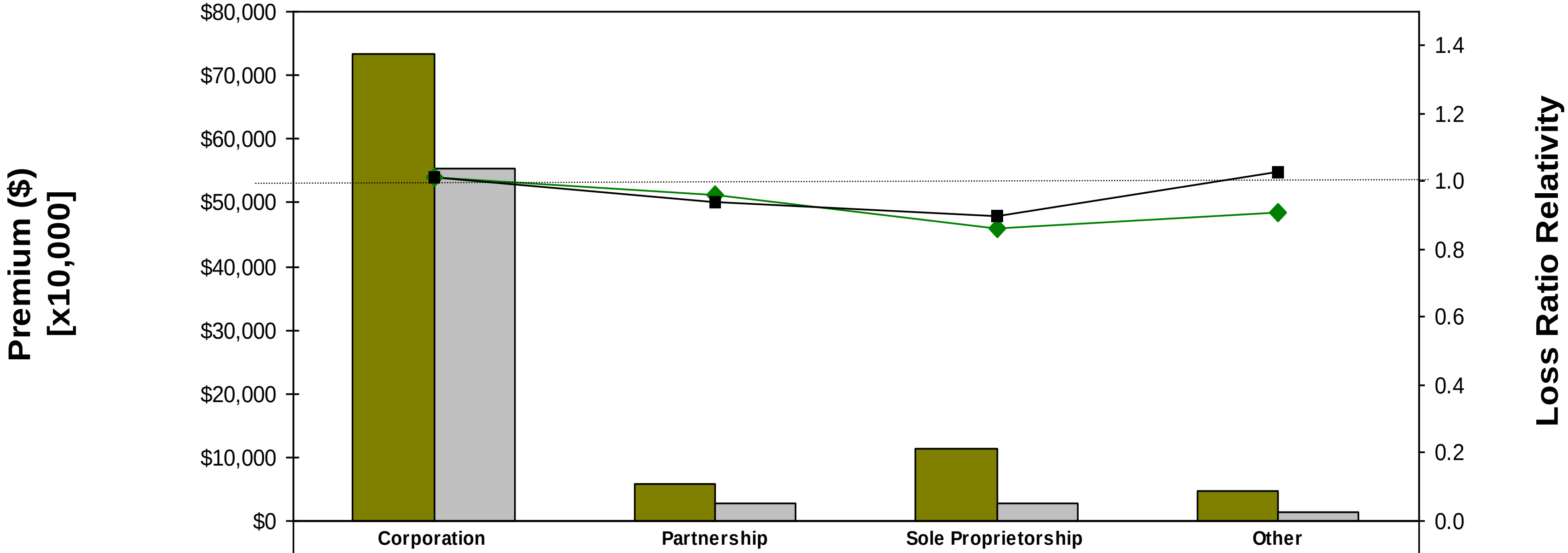
CREDIT MODEL LIFT BY POLICY TYPE (FULL SAMPLE)



	PP	LP	MH	Other
Policy Count	18,401	41,043	23,075	12,654
Premium (x 10,000)	$5,465	$18,925	$24,593	$13,473
Act LR Relativity	1.03	0.98	0.98	1.06
Pred LR Relativity	1.02	0.98	0.94	1.14

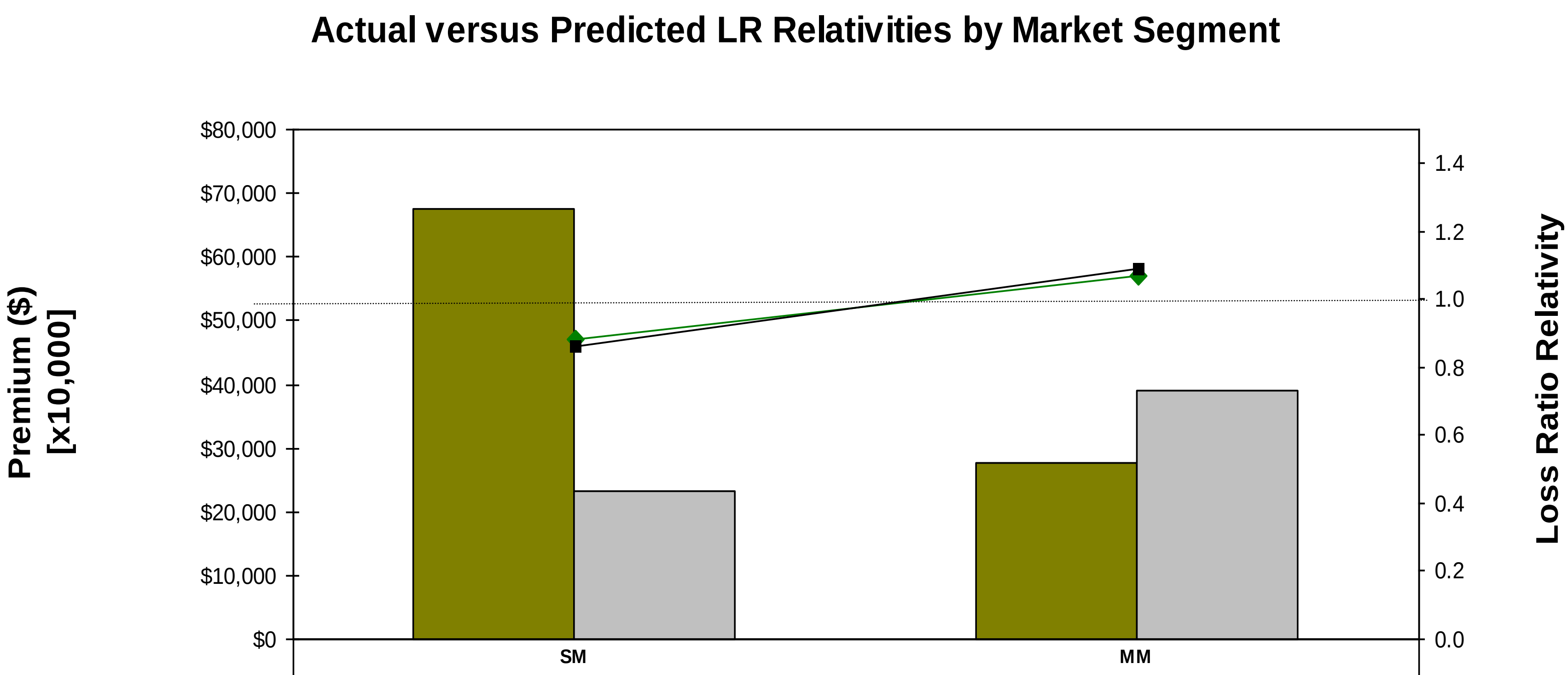
CREDIT MODEL LIFT BY BUSINESS TYPE (FULL SAMPLE)

Actual versus Predicted LR Relativities by Business Type



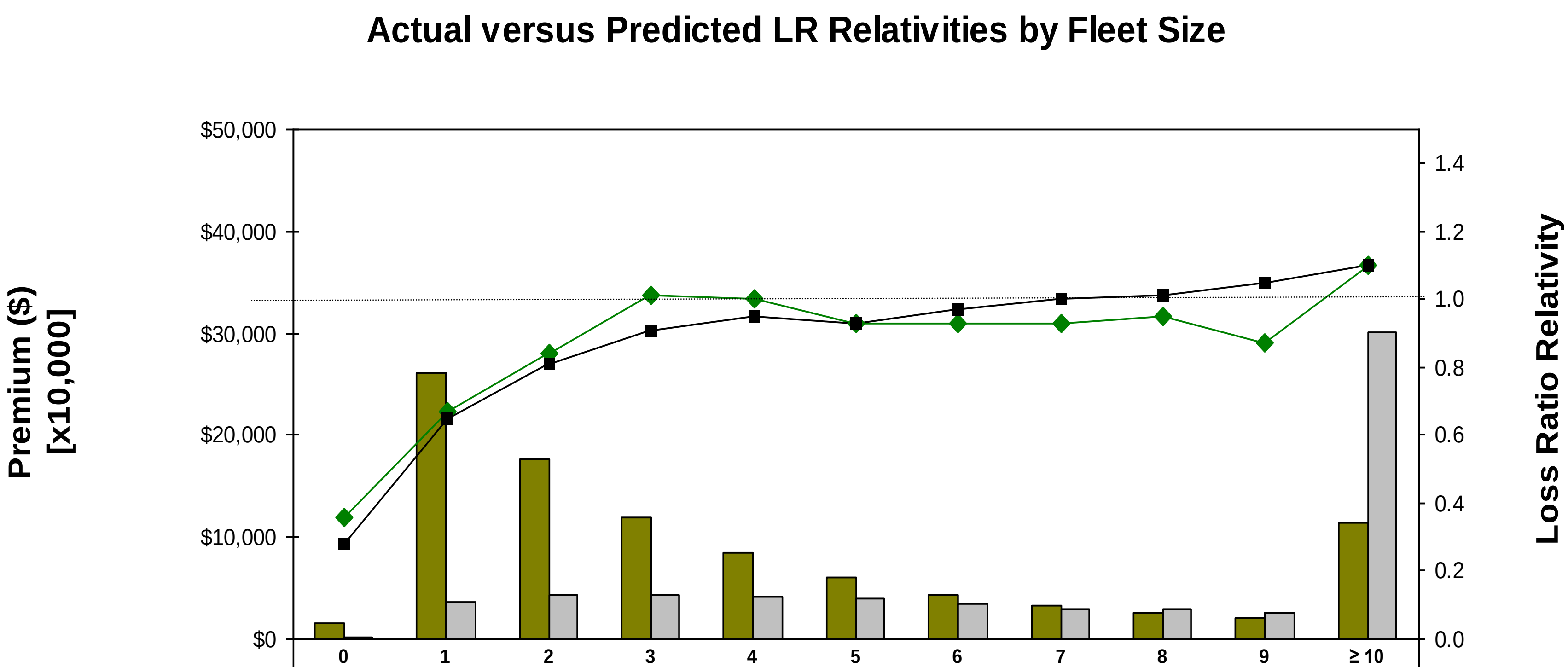
	Corporation	Partnership	Sole Proprietorship	Other
Policy Count	73,435	5,859	11,274	4,605
Premium (x 10,000)	$55,383	$2,846	$2,748	$1,478
Act LR Relativity	1.01	0.96	0.86	0.91
Pred LR Relativity	1.01	0.94	0.90	1.03

CREDIT MODEL LIFT BY MARKET SEGMENT (FULL SAMPLE)



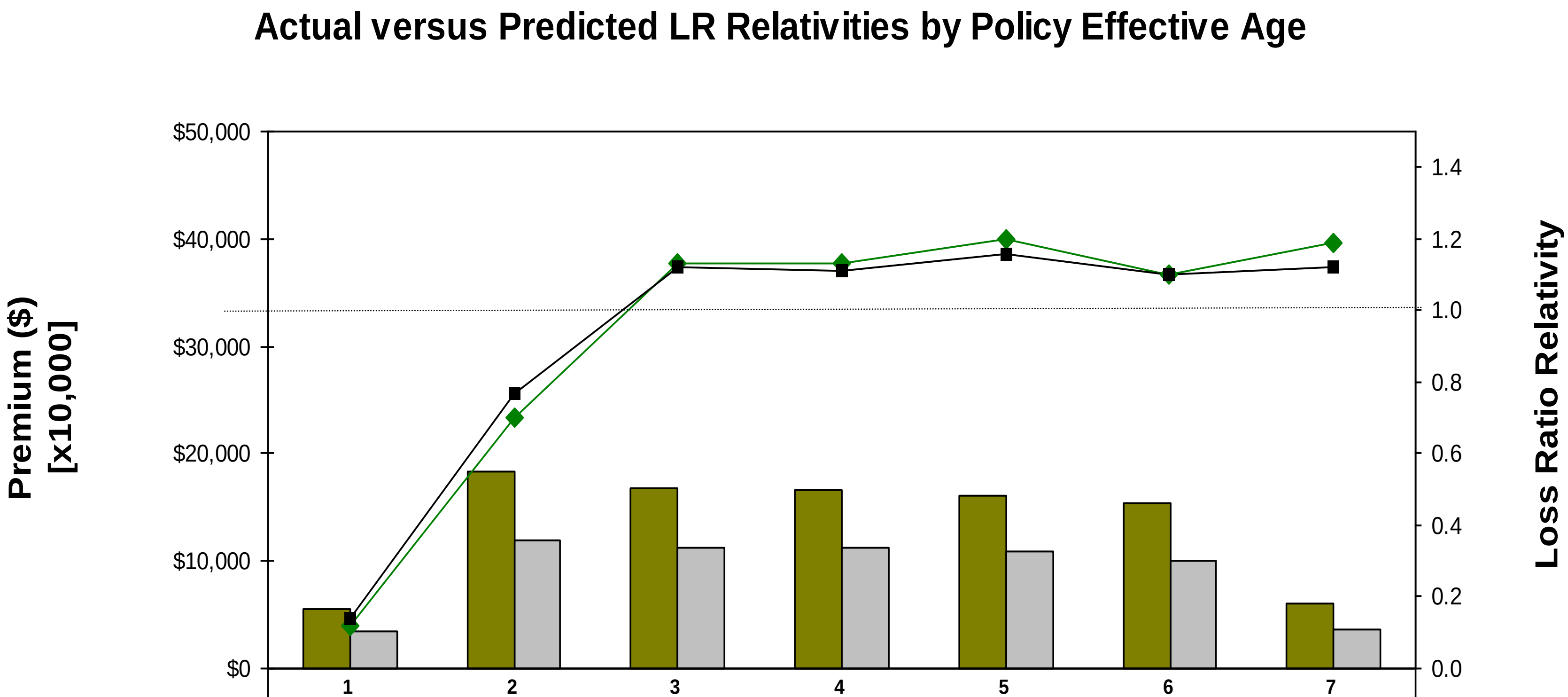
	SM	MM
Policy Count	67,476	27,697
Premium (x 10,000)	$23,375	$39,080
Act LR Relativity	0.88	1.07
Pred LR Relativity	0.86	1.09

CREDIT MODEL LIFT BY FLEET SIZE (FULL SAMPLE)



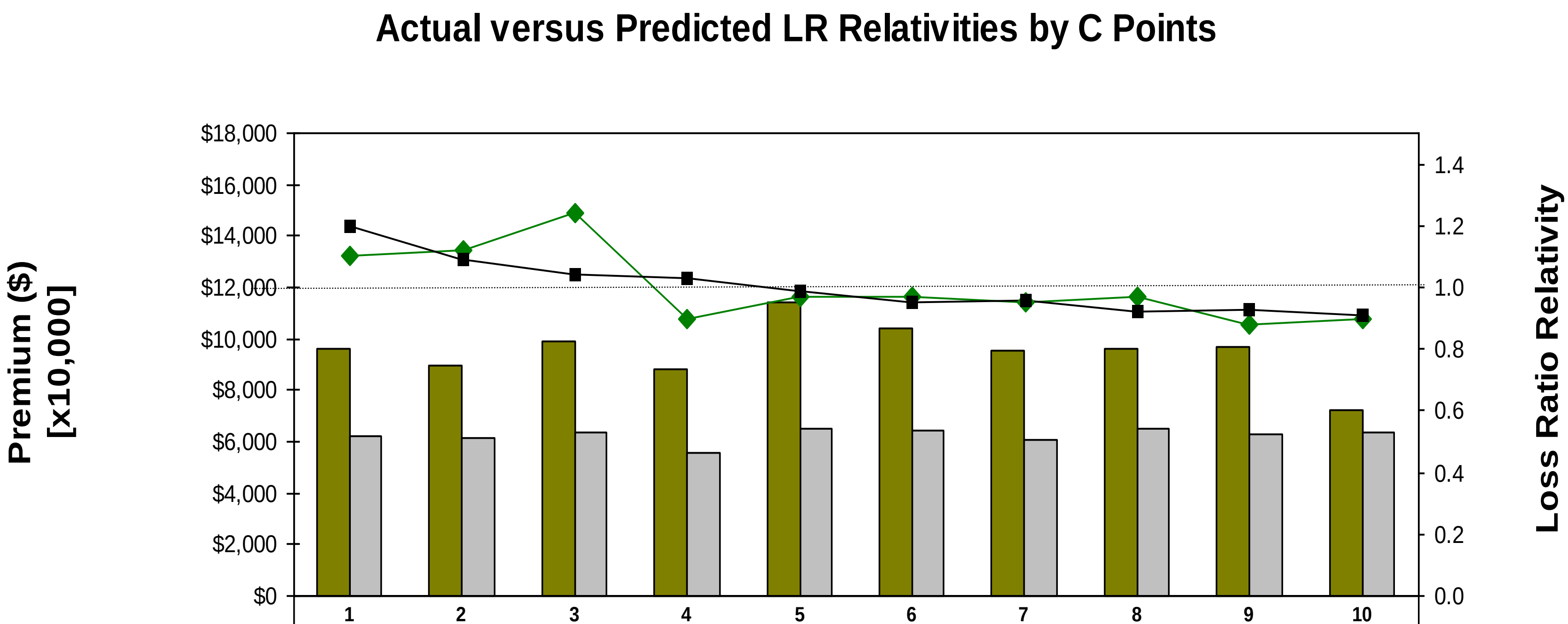
	0	1	2	3	4	5	6	7	8	9	≥ 10
Policy Count	1,485	26,157	17,626	11,900	8,547	6,007	4,313	3,224	2,517	2,000	11,397
Premium (x 10,000)	$89	$3,659	$4,342	$4,274	$4,157	$3,930	$3,424	$2,919	$2,891	$2,605	$30,166
Act LR Relativity	0.36	0.67	0.84	1.01	1.00	0.93	0.93	0.93	0.95	0.87	1.10
Pred LR Relativity	0.28	0.65	0.81	0.91	0.95	0.93	0.97	1.00	1.01	1.05	1.10

CREDIT MODEL LIFT BY POLICY EFFECTIVE AGE (FULL SAMPLE)



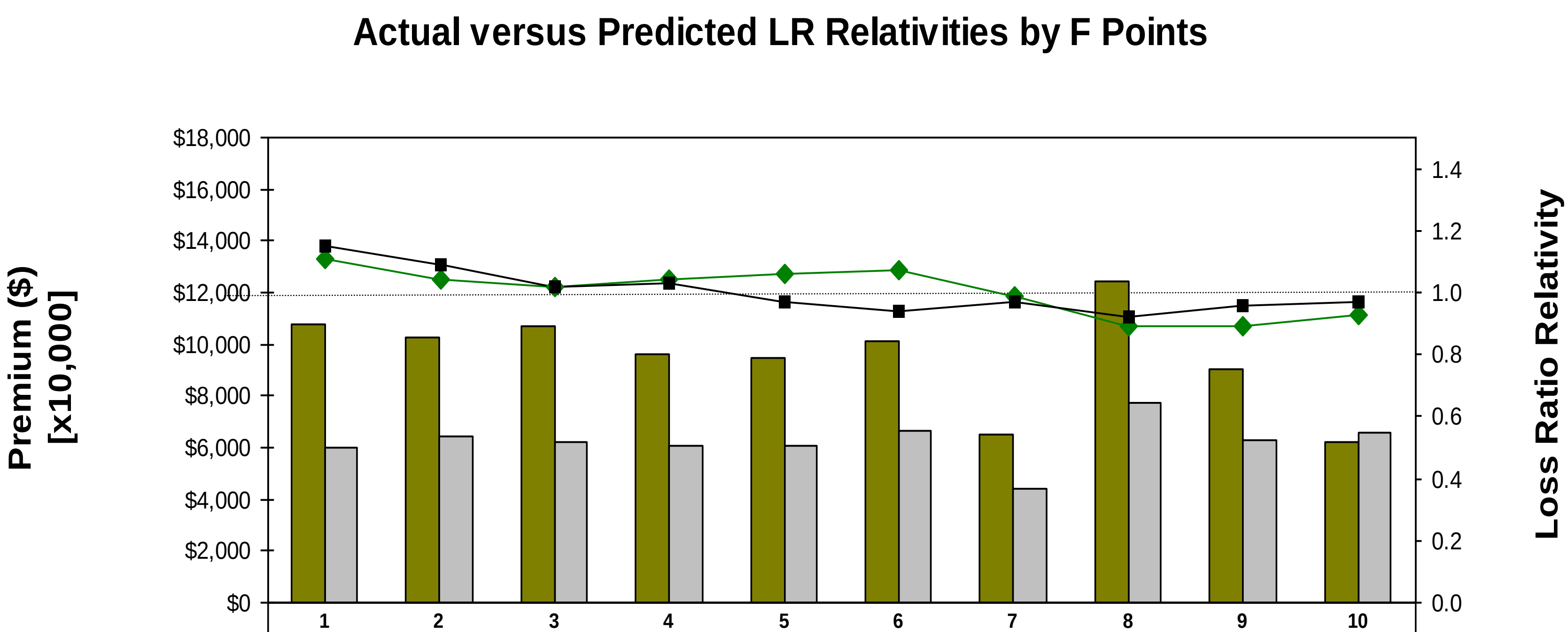
	1	2	3	4	5	6	7
Policy Count	5,575	18,403	16,830	16,694	16,118	15,416	6,137
Premium (x 10,000)	$3,444	$12,007	$11,210	$11,209	$10,924	$10,065	$3,596
Act LR Relativity	0.12	0.70	1.13	1.13	1.20	1.10	1.19
Pred LR Relativity	0.14	0.77	1.12	1.11	1.16	1.10	1.12

CREDIT MODEL LIFT BY C POINTS (FULL SAMPLE)



	1	2	3	4	5	6	7	8	9	10
Policy Count	9,594	8,939	9,869	8,793	11,434	10,437	9,551	9,642	9,716	7,198
Premium (x 10,000)	$6,213	$6,141	$6,376	$5,577	$6,475	$6,447	$6,076	$6,475	$6,295	$6,380
Act LR Relativity	1.10	1.12	1.24	0.90	0.97	0.97	0.95	0.97	0.88	0.90
Pred LR Relativity	1.20	1.09	1.04	1.03	0.99	0.95	0.96	0.92	0.93	0.91
Lower Limit	101	369	412	435	451	465	478	490	503	519
Upper Limit	369	412	435	451	465	478	490	503	519	655

CREDIT MODEL LIFT BY F POINTS (FULL SAMPLE)



	1	2	3	4	5	6	7	8	9	10
Policy Count	10,784	10,265	10,665	9,631	9,442	10,139	6,510	12,467	9,038	6,232
Premium (x 10,000)	$6,026	$6,403	$6,188	$6,096	$6,059	$6,645	$4,436	$7,732	$6,299	$6,571
Act LR Relativity	1.11	1.04	1.02	1.04	1.06	1.07	0.99	0.89	0.89	0.93
Pred LR Relativity	1.15	1.09	1.02	1.03	0.97	0.94	0.97	0.92	0.96	0.97
Lower Limit	1,198	1,410	1,450	1,473	1,493	1,510	1,526	1,538	1,554	1,579
Upper Limit	1,410	1,450	1,473	1,493	1,510	1,526	1,538	1,554	1,579	1,827

PRESENTATION OUTLINE

- Introduction
- Goals and Objective
- Exploratory Analysis
- Data Preparation
- Modeling Process
  - Model Design
  - Model Fitting
  - Testing and Adjusting Model
- Key Results
- **Conclusions**
- Future Considerations
- Acknowledgements

CONCLUSIONS

- The credit variable Financial Stability is a powerful predictor of future loss ratio of a policy.

- Implementation of a credit factor will allow for better differentiation of risk, ultimately improving underwriting profit.

- Usage will ensure that Hanover's underwriting and pricing techniques are competitive and more advanced.

PRESENTATION OUTLINE

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FUTURE CONSIDERATIONS

There are adjustments that could be made to improve the usability of the model:

Creating Credit Factors

- Break down Financial Stability scores into predicted loss ratio groups.
- Assign each tier a credit factor for application in pricing.

Policy Underwriting

- Determine rules for policy to be referred or declined.
- Implement corresponding rules.

Options for handling No-Hits

1. Do not change the policies; assign them a credit factor of 1.
2. Take average of the actual loss ratios for no-hits and determine appropriate credit factor range.

PRESENTATION OUTLINE

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ACKNOWLEDGEMENTS

The WPI Team would like to thank all the persons that invested time to help shape the direction and outcome of our project:

Isin Ozaksoy

Jaris Wicklund

Andrew Evans

Marc Cournoyer

Professor Jon Abraham

And everyone else at Hanover and Worcester Polytechnic Institute that made this project possible!

THANK YOU!

QUESTIONS?

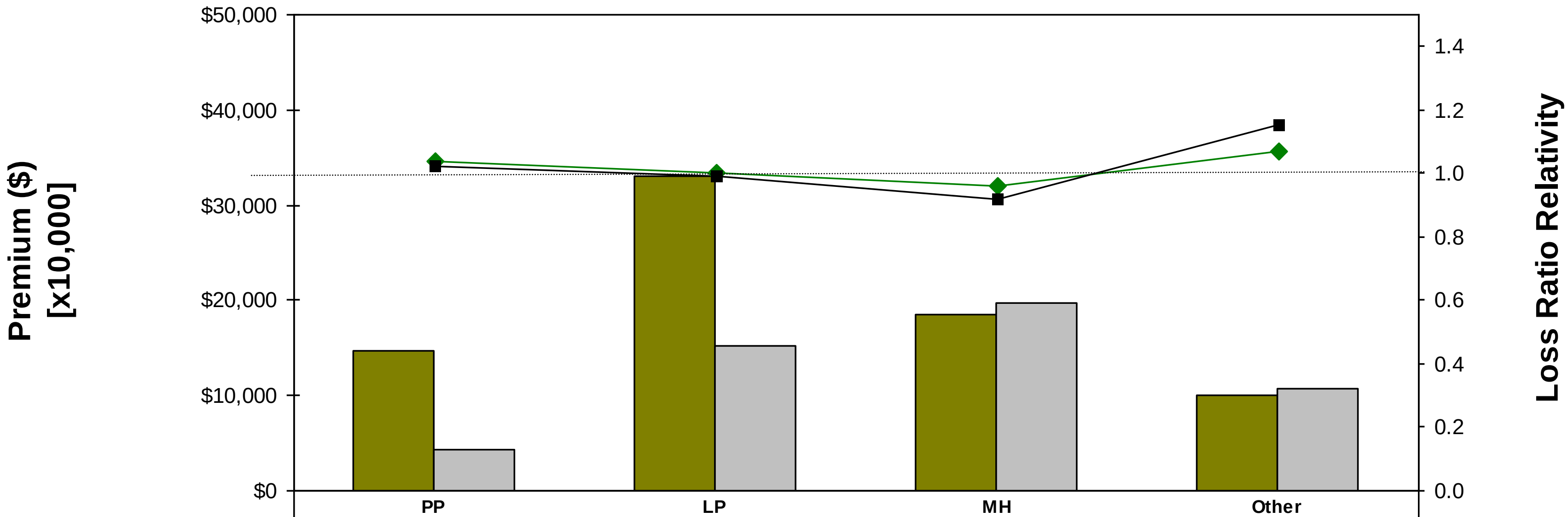
APPENDIX

This Section is broken up into the following sections:

– Lift Charts (Build Sample, Validation Sample and Full Sample)
– Final Model Coefficient results

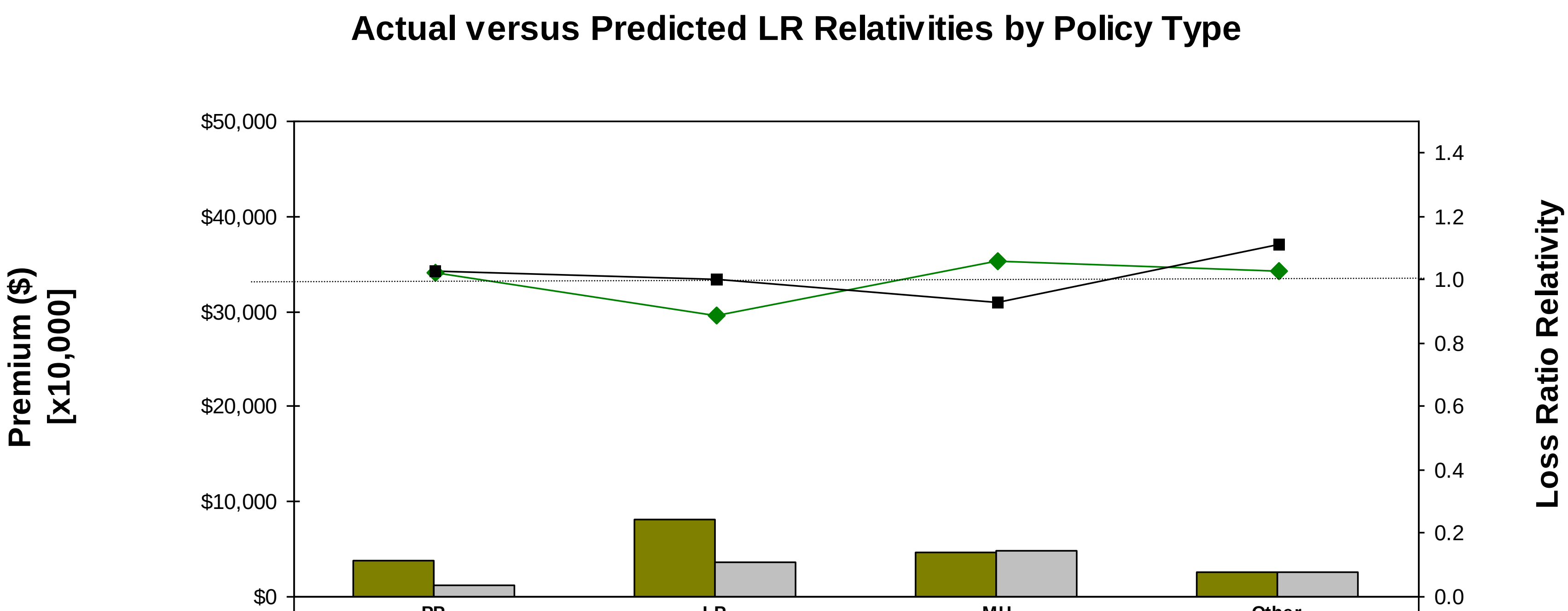
CREDIT MODEL LIFT BY POLICY TYPE (BUILD SAMPLE)

Actual versus Predicted LR Relativities by Policy Type



	PP	LP	MH	Other
Policy Count	14,652	32,980	18,457	10,048
Premium (x 10,000)	$4,325	$15,218	$19,753	$10,791
Act LR Relativity	1.04	1.00	0.96	1.07
Pred LR Relativity	1.02	0.99	0.92	1.15

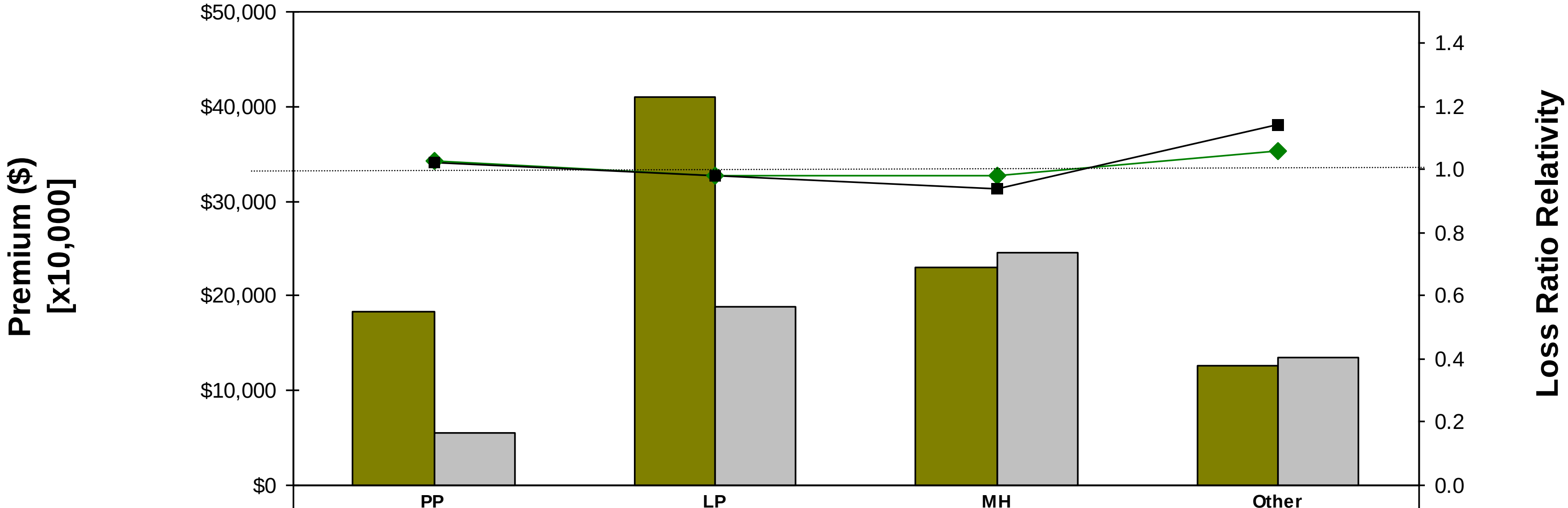
CREDIT MODEL LIFT BY POLICY TYPE (VALIDATION SAMPLE)



	PP	LP	MH	Other
Policy Count	3,749	8,063	4,618	2,606
Premium (x 10,000)	$1,140	$3,707	$4,840	$2,682
Act LR Relativity	1.02	0.89	1.06	1.03
Pred LR Relativity	1.03	1.00	0.93	1.11

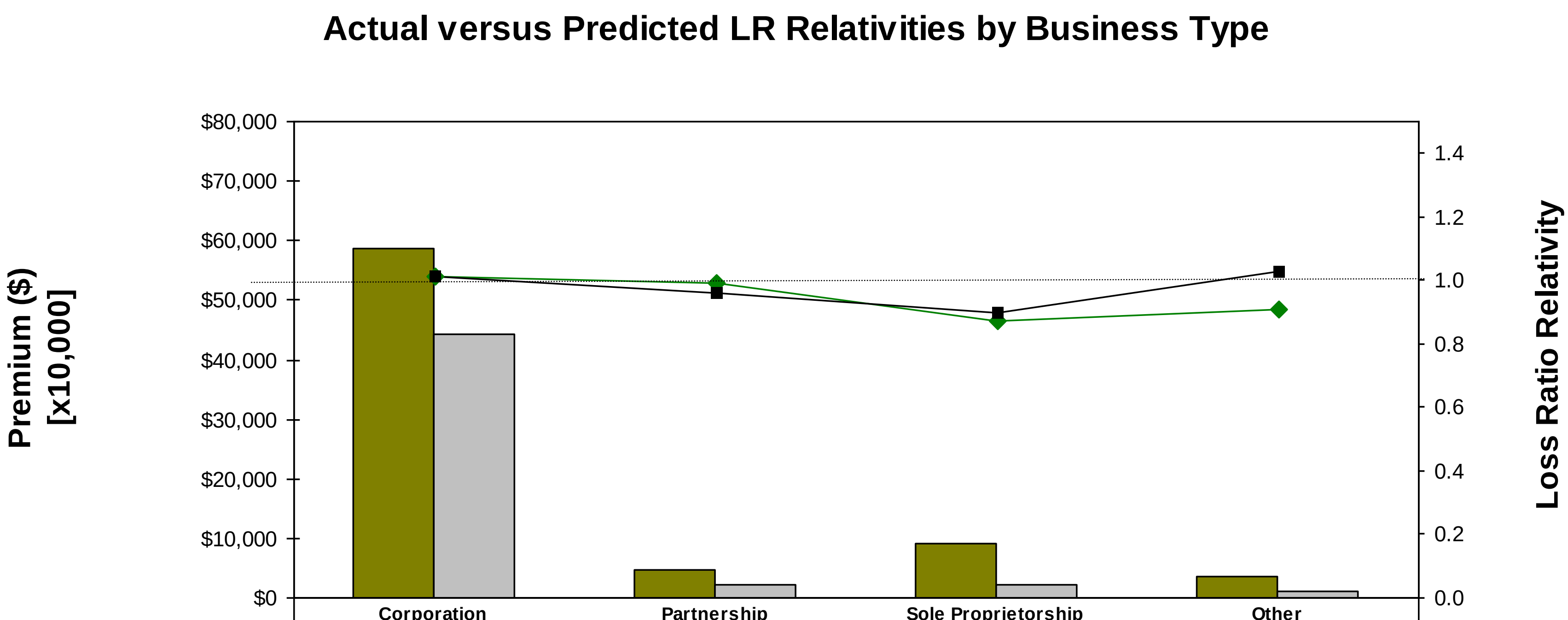
CREDIT MODEL LIFT BY POLICY TYPE (FULL SAMPLE)

Actual versus Predicted LR Relativities by Policy Type



	PP	LP	MH	Other
Policy Count	18,401	41,043	23,075	12,654
Premium (x 10,000)	$5,465	$18,925	$24,593	$13,473
Act LR Relativity	1.03	0.98	0.98	1.06
Pred LR Relativity	1.02	0.98	0.94	1.14

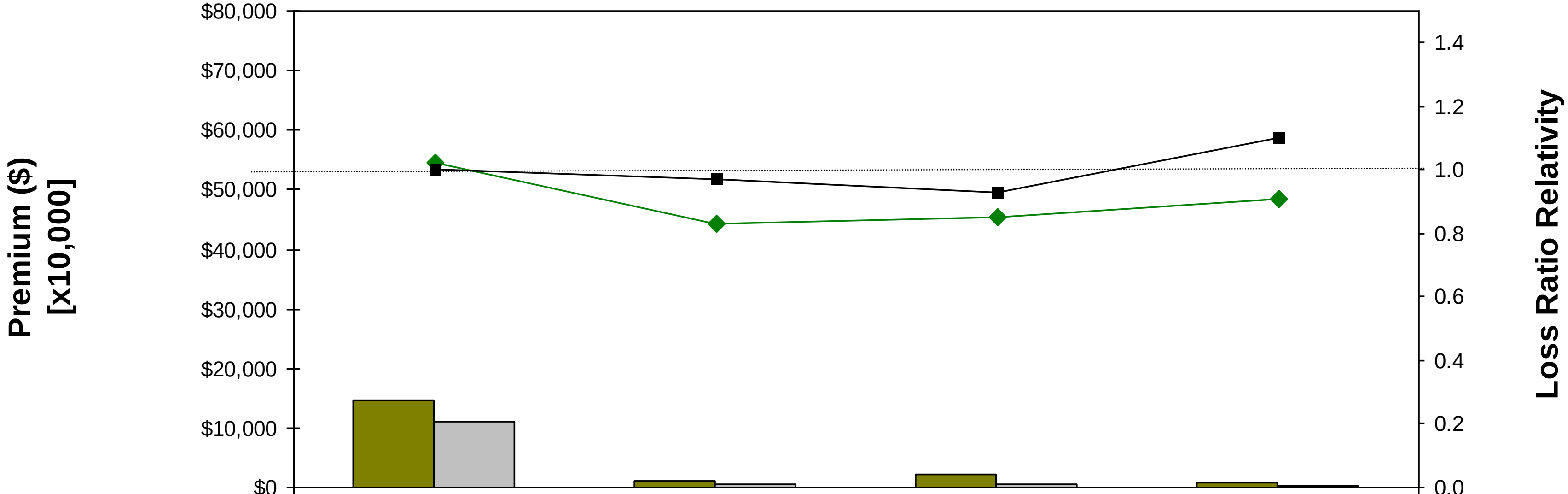
CREDIT MODEL LIFT BY BUSINESS TYPE (BUILD SAMPLE)



	Corporation	Partnership	Sole Proprietorship	Other
Policy Count	58,756	4,680	9,040	3,661
Premium (x 10,000)	$44,425	$2,271	$2,206	$1,185
Act LR Relativity	1.01	0.99	0.87	0.91
Pred LR Relativity	1.01	0.96	0.90	1.03

CREDIT MODEL LIFT BY BUSINESS TYPE (VALIDATION SAMPLE)

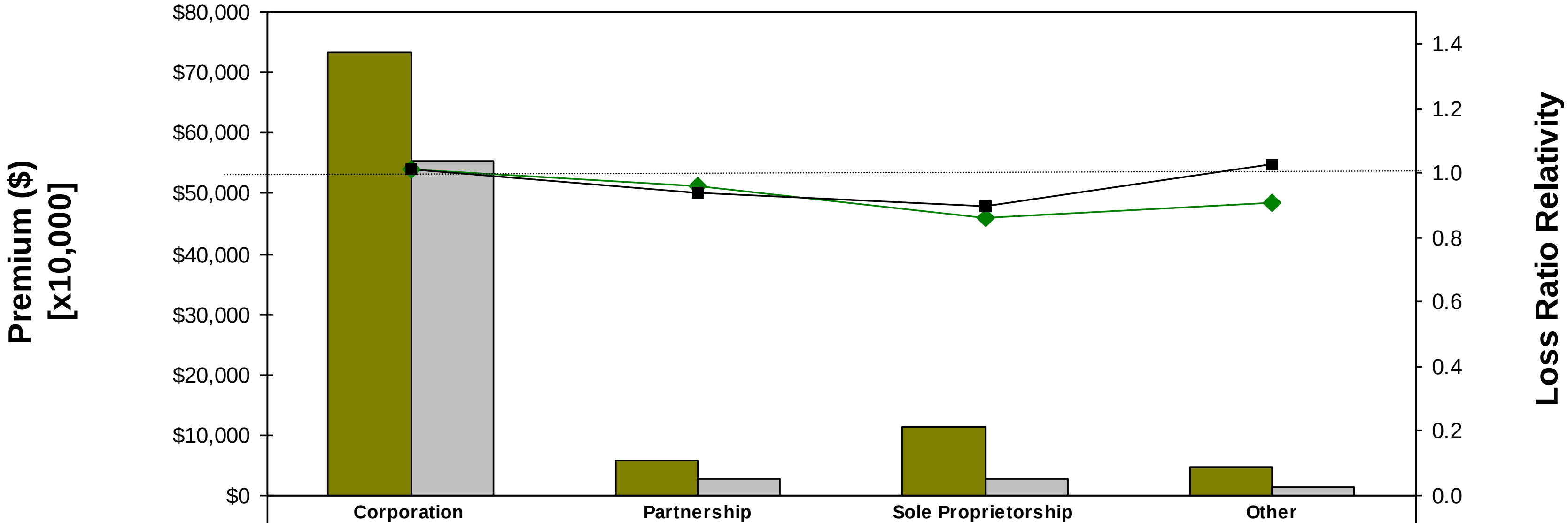
Actual versus Predicted LR Relativities by Business Type



	Corporation	Partnership	Sole Proprietorship	Other
Policy Count	14,679	1,179	2,234	944
Premium (x 10,000)	$10,958	$575	$542	$294
Act LR Relativity	1.02	0.83	0.85	0.91
Pred LR Relativity	1.00	0.97	0.93	1.10

CREDIT MODEL LIFT BY BUSINESS TYPE (FULL SAMPLE)

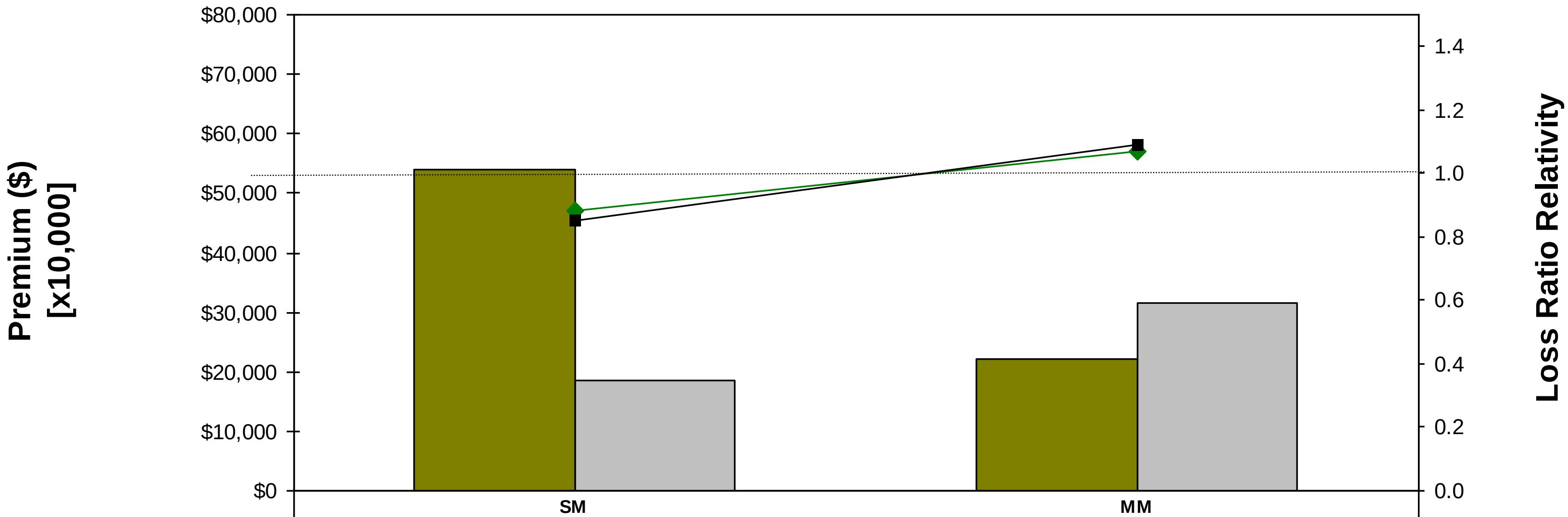
Actual versus Predicted LR Relativities by Business Type



	Corporation	Partnership	Sole Proprietorship	Other
Policy Count	73,435	5,859	11,274	4,605
Premium (x 10,000)	$55,383	$2,846	$2,748	$1,478
Act LR Relativity	1.01	0.96	0.86	0.91
Pred LR Relativity	1.01	0.94	0.90	1.03

CREDIT MODEL LIFT BY MARKET SEGMENT (BUILD SAMPLE)

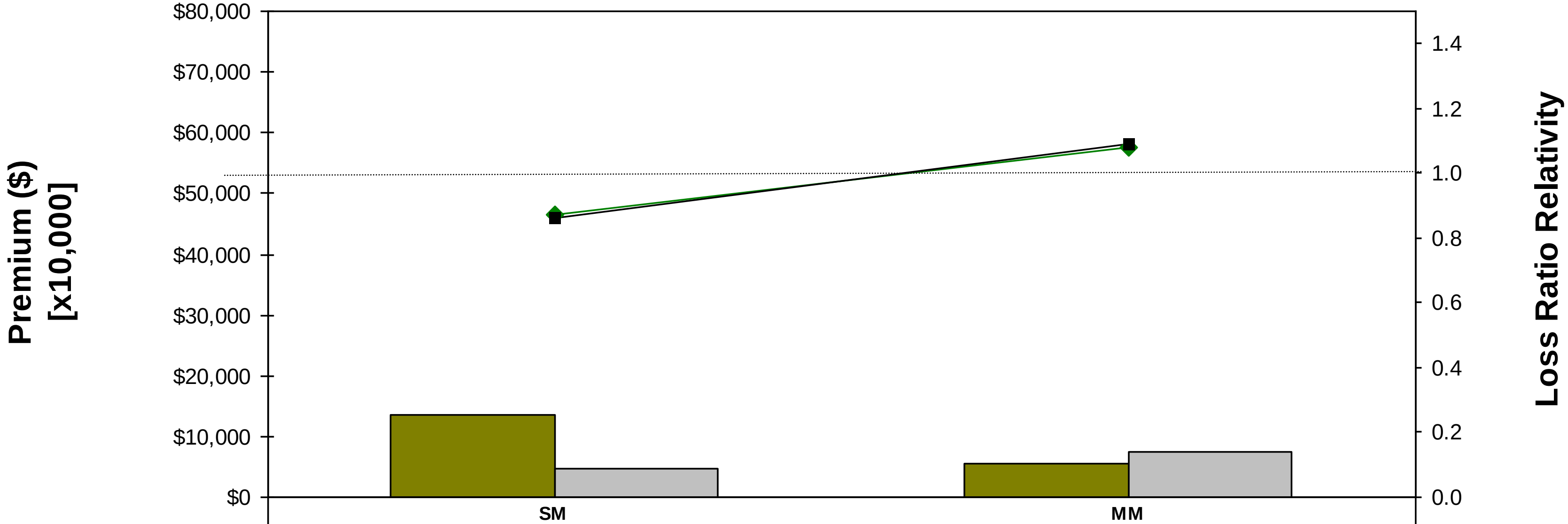
Actual versus Predicted LR Relativities by Market Segment



	SM	MM
Policy Count	53,927	22,210
Premium (x 10,000)	$18,581	$31,505
Act LR Relativity	0.88	1.07
Pred LR Relativity	0.85	1.09

CREDIT MODEL LIFT BY MARKET SEGMENT (VALIDATION SAMPLE)

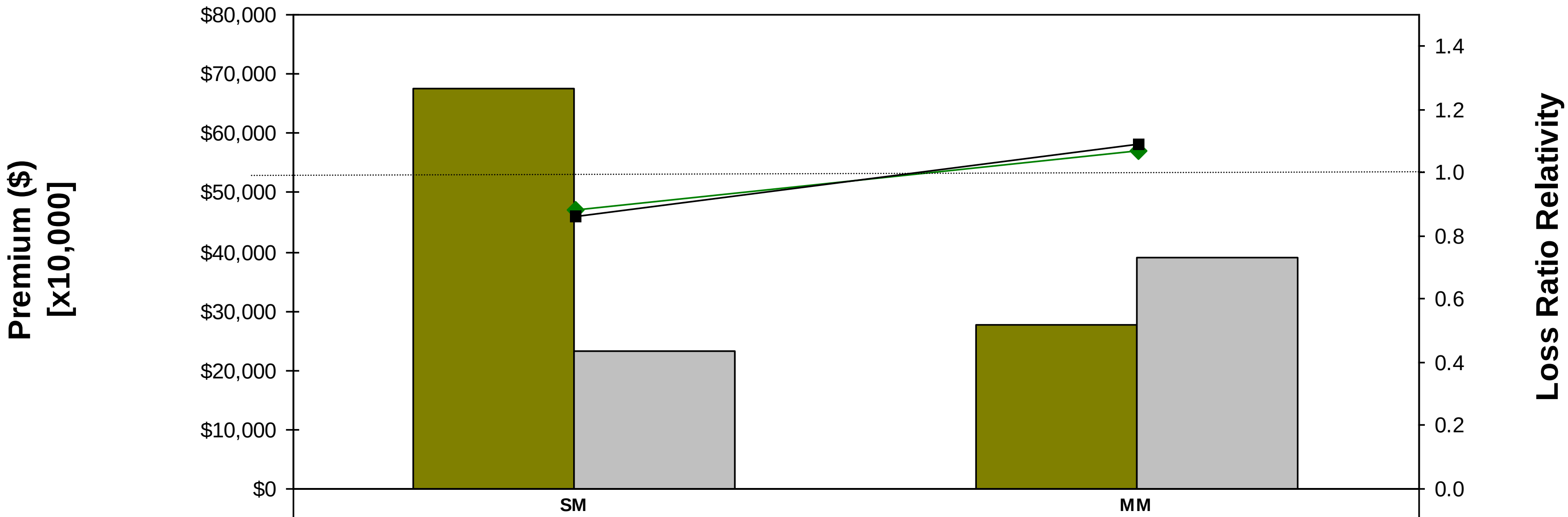
Actual versus Predicted LR Relativities by Market Segment



	SM	MM
Policy Count	13,549	5,487
Premium (x 10,000)	$4,794	$7,575
Act LR Relativity	0.87	1.08
Pred LR Relativity	0.86	1.09

CREDIT MODEL LIFT BY MARKET SEGMENT (FULL SAMPLE)

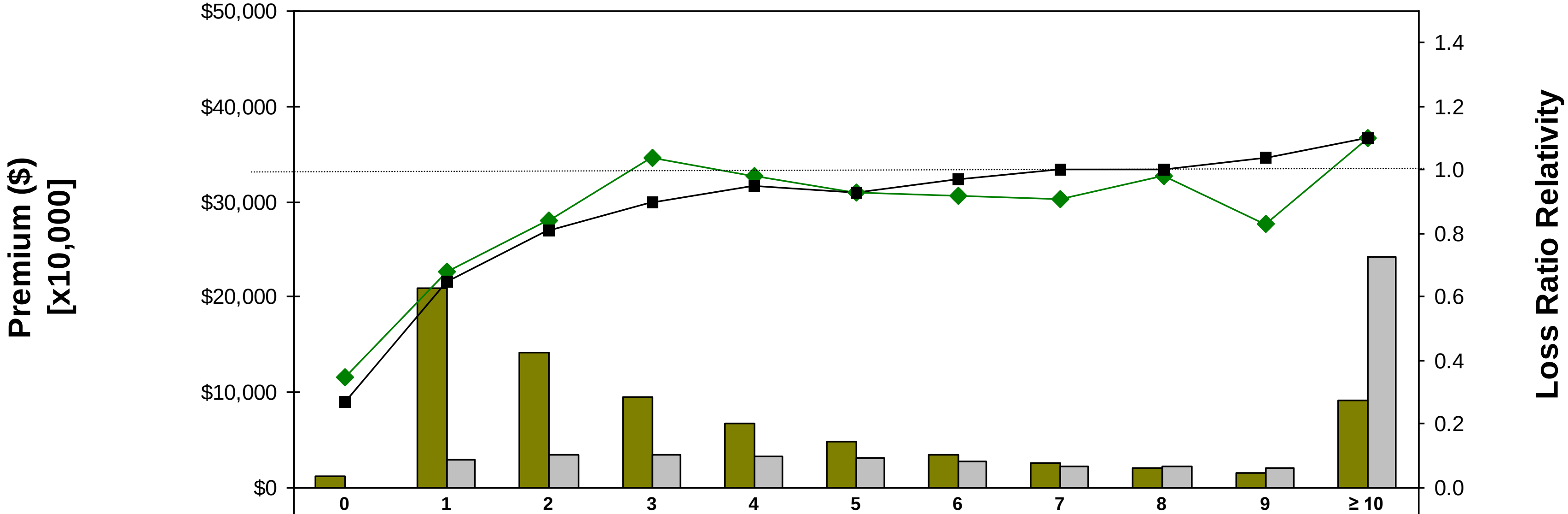
Actual versus Predicted LR Relativities by Market Segment



	SM	MM
Policy Count	67,476	27,697
Premium (x 10,000)	$23,375	$39,080
Act LR Relativity	0.88	1.07
Pred LR Relativity	0.86	1.09

CREDIT MODEL LIFT BY FLEET SIZE (BUILD SAMPLE)

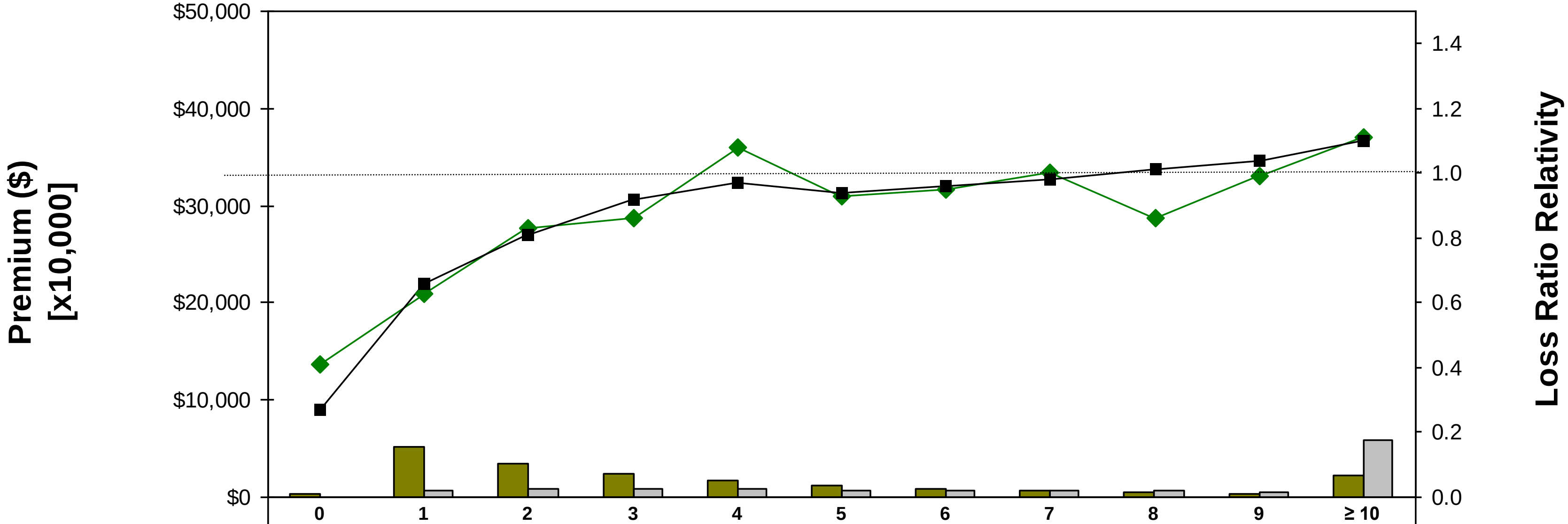
Actual versus Predicted LR Relativities by Fleet Size



	0	1	2	3	4	5	6	7	8	9	≥ 10
Policy Count	1,163	20,948	14,106	9,515	6,805	4,810	3,484	2,540	1,995	1,623	9,148
Premium (x 10,000)	$70	$2,928	$3,454	$3,433	$3,300	$3,158	$2,768	$2,294	$2,278	$2,105	$24,298
Act LR Relativity	0.35	0.68	0.84	1.04	0.98	0.93	0.92	0.91	0.98	0.83	1.10
Pred LR Relativity	0.27	0.65	0.81	0.90	0.95	0.93	0.97	1.00	1.00	1.04	1.10

CREDIT MODEL LIFT BY FLEET SIZE (VALIDATION SAMPLE)

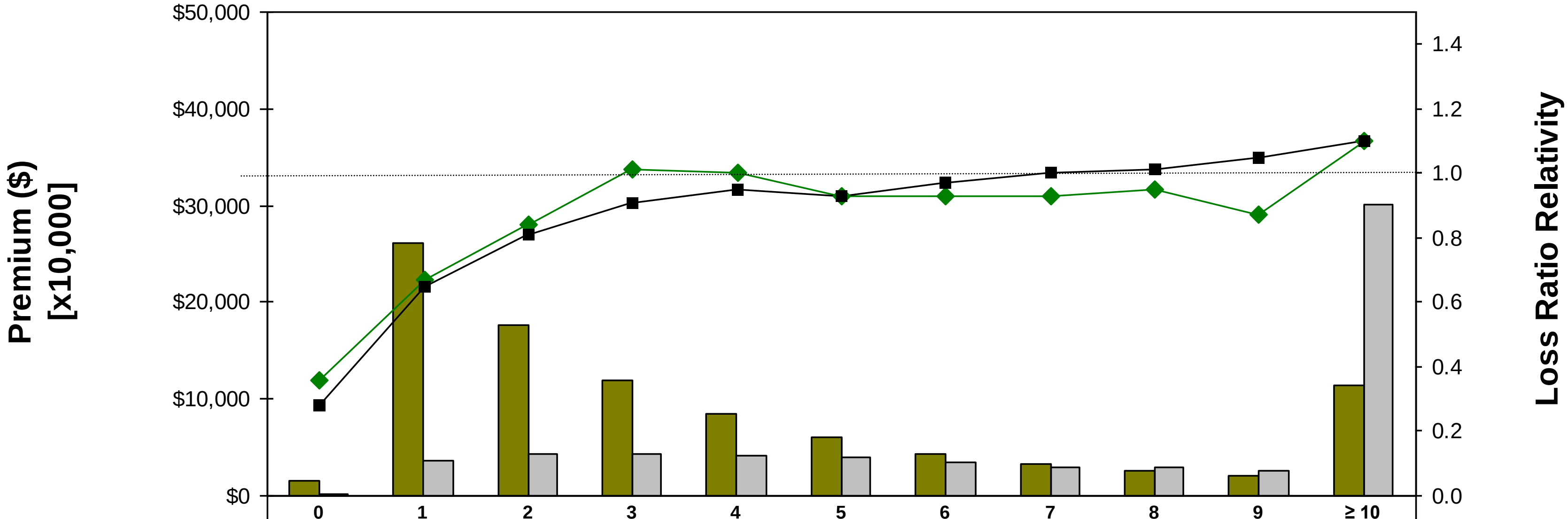
Actual versus Predicted LR Relativities by Fleet Size



	0	1	2	3	4	5	6	7	8	9	≥ 10
Policy Count	322	5,209	3,520	2,385	1,742	1,197	829	684	522	377	2,249
Premium (x 10,000)	$19	$730	$888	$841	$857	$772	$656	$625	$613	$500	$5,868
Act LR Relativity	0.41	0.63	0.83	0.86	1.08	0.93	0.95	1.00	0.86	0.99	1.11
Pred LR Relativity	0.27	0.66	0.81	0.92	0.97	0.94	0.96	0.98	1.01	1.04	1.10

CREDIT MODEL LIFT BY FLEET SIZE (FULL SAMPLE)

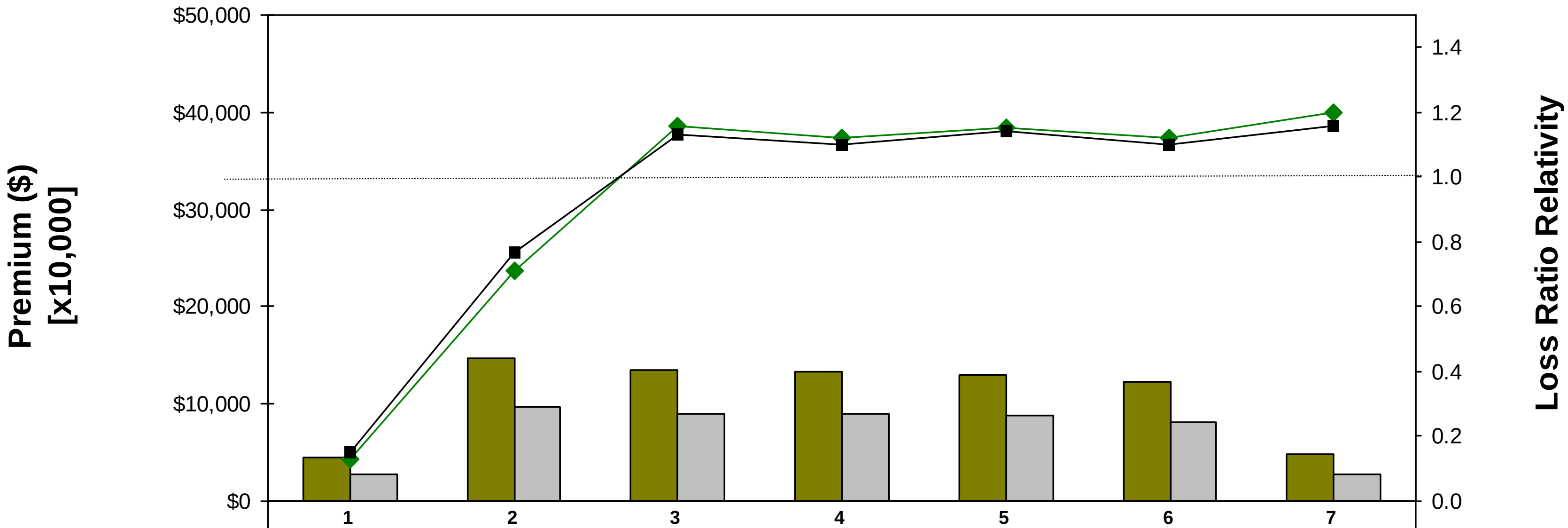
Actual versus Predicted LR Relativities by Fleet Size



	0	1	2	3	4	5	6	7	8	9	≥ 10
Policy Count	1,485	26,157	17,626	11,900	8,547	6,007	4,313	3,224	2,517	2,000	11,397
Premium (x 10,000)	$89	$3,659	$4,342	$4,274	$4,157	$3,930	$3,424	$2,919	$2,891	$2,605	$30,166
Act LR Relativity	0.36	0.67	0.84	1.01	1.00	0.93	0.93	0.93	0.95	0.87	1.10
Pred LR Relativity	0.28	0.65	0.81	0.91	0.95	0.93	0.97	1.00	1.01	1.05	1.10

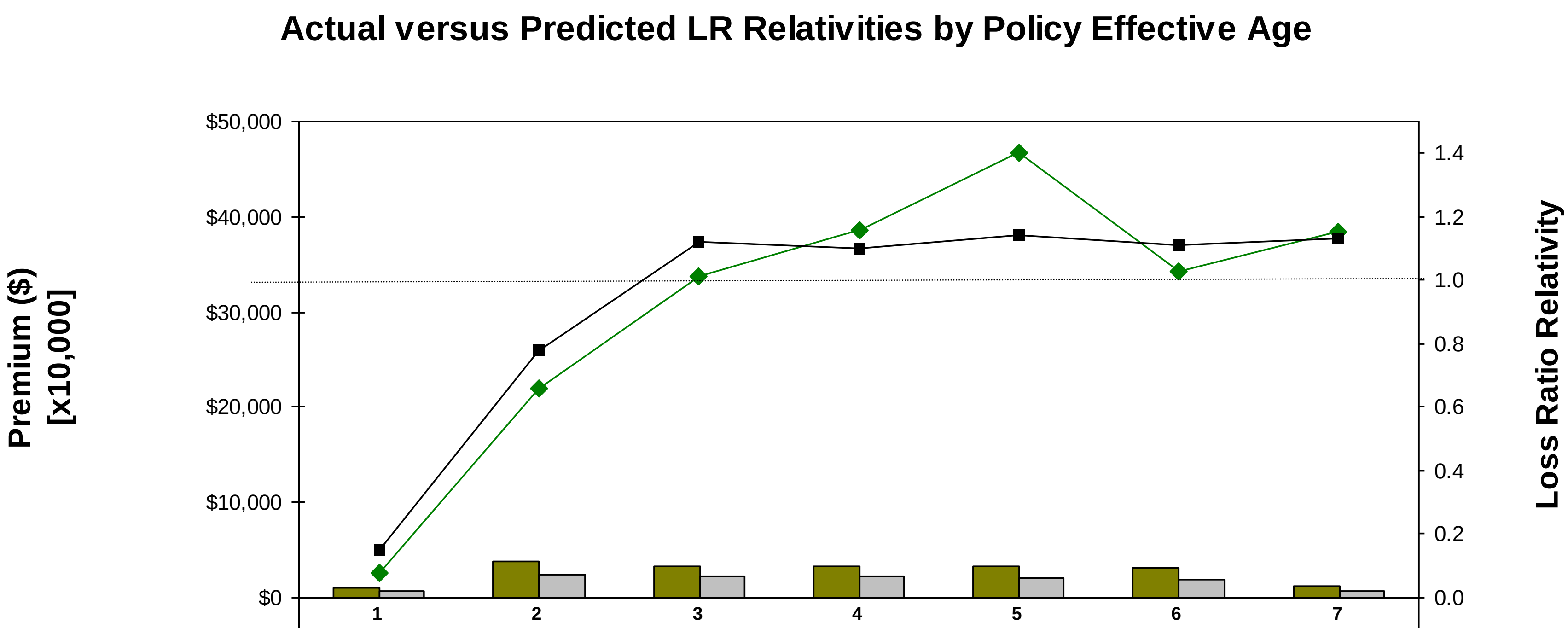
CREDIT MODEL LIFT BY POLICY EFFECTIVE AGE (BUILD SAMPLE)

Actual versus Predicted LR Relativities by Policy Effective Age



	1	2	3	4	5	6	7
Policy Count	4,451	14,666	13,487	13,385	12,904	12,360	4,884
Premium (x 10,000)	$2,782	$9,606	$8,988	$8,968	$8,786	$8,109	$2,848
Act LR Relativity	0.13	0.71	1.16	1.12	1.15	1.12	1.20
Pred LR Relativity	0.15	0.77	1.13	1.10	1.14	1.10	1.16

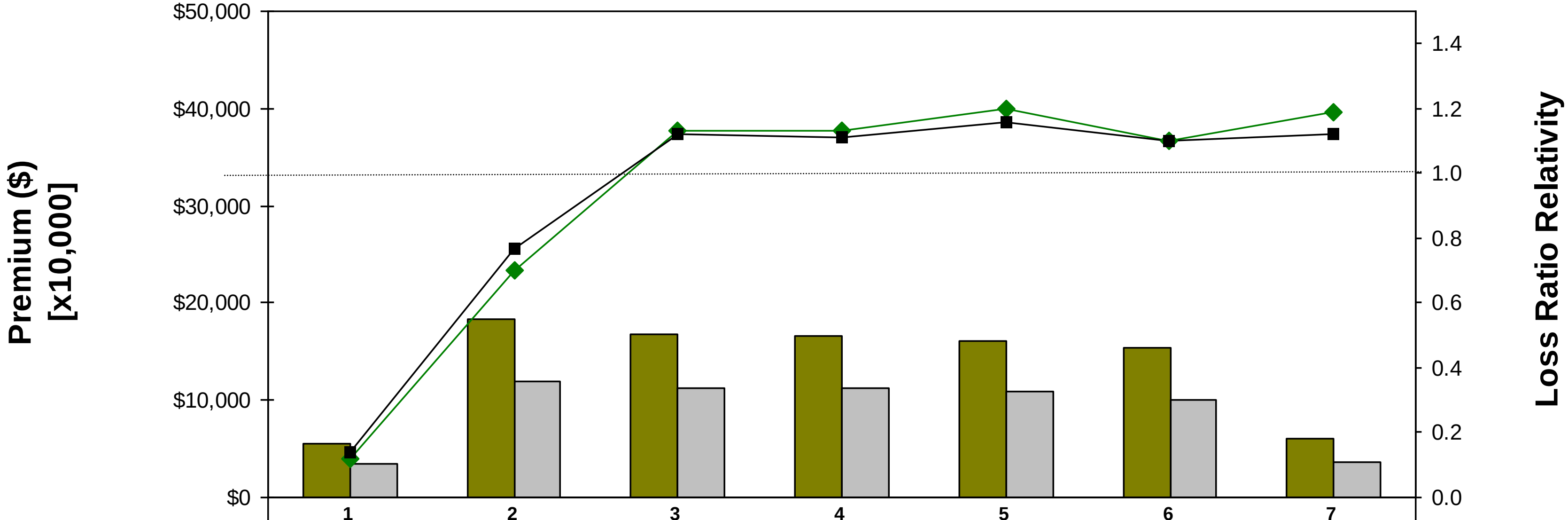
CREDIT MODEL LIFT BY POLICY EFFECTIVE AGE (VALIDATION SAMPLE)



	1	2	3	4	5	6	7
Policy Count	1,124	3,737	3,343	3,309	3,214	3,056	1,253
Premium (x 10,000)	$663	$2,402	$2,222	$2,241	$2,138	$1,956	$748
Act LR Relativity	0.08	0.66	1.01	1.16	1.40	1.03	1.15
Pred LR Relativity	0.15	0.78	1.12	1.10	1.14	1.11	1.13

CREDIT MODEL LIFT BY POLICY EFFECTIVE AGE(FULL SAMPLE)

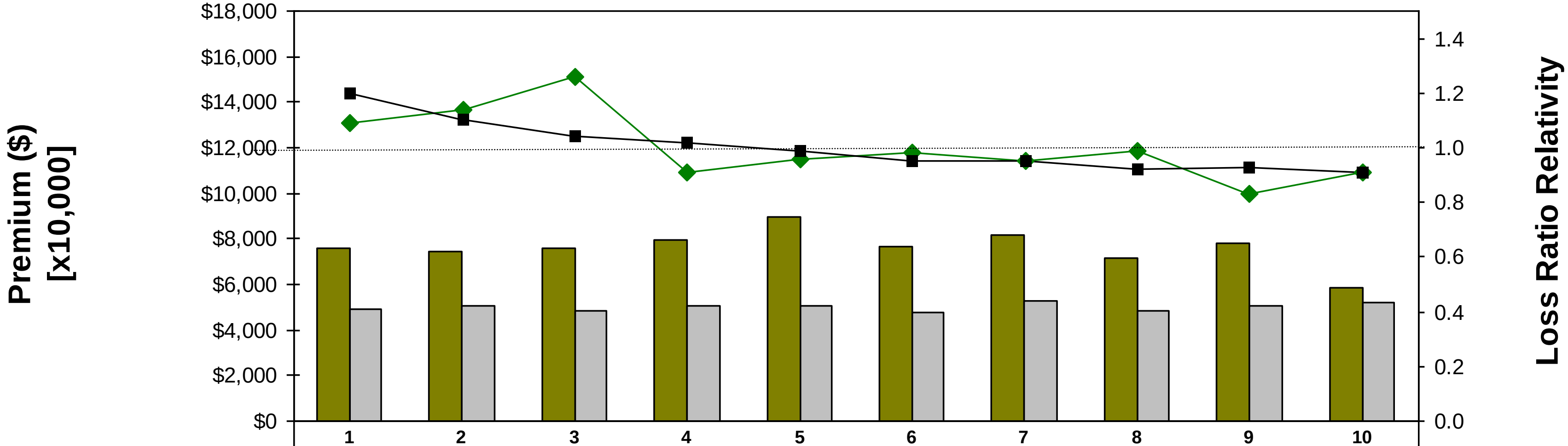
Actual versus Predicted LR Relativities by Policy Effective Age



	1	2	3	4	5	6	7
Policy Count	5,575	18,403	16,830	16,694	16,118	15,416	6,137
Premium (x 10,000)	$3,444	$12,007	$11,210	$11,209	$10,924	$10,065	$3,596
Act LR Relativity	0.12	0.70	1.13	1.13	1.20	1.10	1.19
Pred LR Relativity	0.14	0.77	1.12	1.11	1.16	1.10	1.12

CREDIT MODEL LIFT BY C POINTS (BUILD SAMPLE)

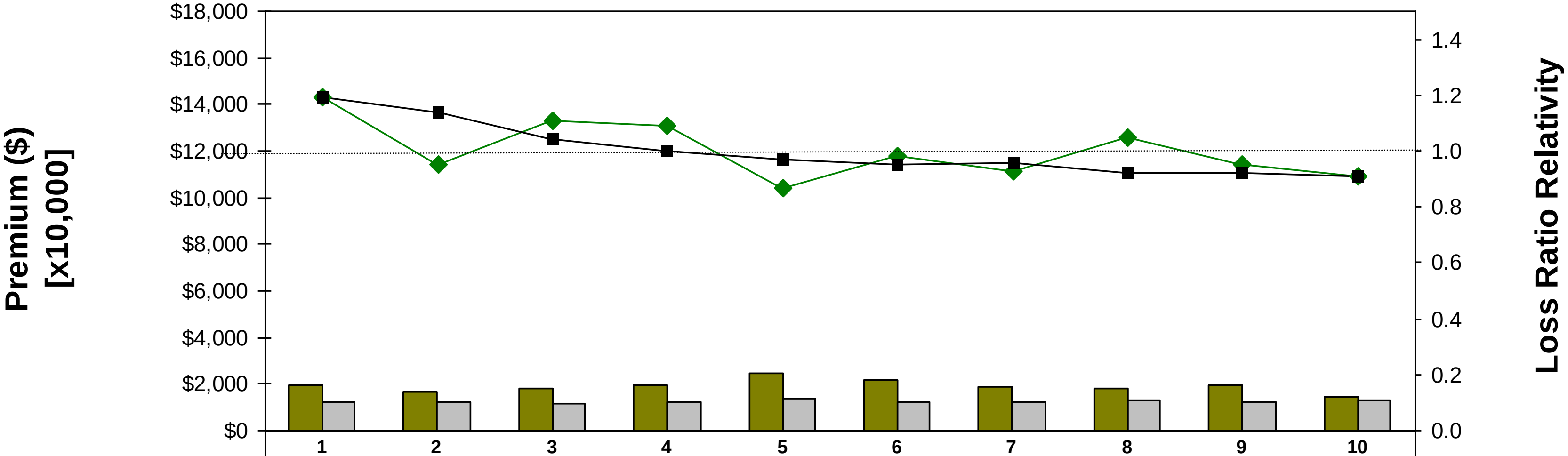
Actual versus Predicted LR Relativities by C Points



	1	2	3	4	5	6	7	8	9	10
Policy Count	7,581	7,471	7,600	7,936	9,000	7,637	8,133	7,175	7,783	5,821
Premium (x 10,000)	$4,939	$5,043	$4,860	$5,035	$5,069	$4,738	$5,298	$4,853	$5,049	$5,202
Act LR Relativity	1.09	1.14	1.26	0.91	0.96	0.98	0.95	0.99	0.83	0.91
Pred LR Relativity	1.20	1.10	1.04	1.02	0.99	0.95	0.95	0.92	0.93	0.91
Lower Limit	101	368	413	435	452	466	478	491	503	519
Upper Limit	368	413	435	452	466	478	491	503	519	655

CREDIT MODEL LIFT BY C POINTS (VALIDATION SAMPLE)

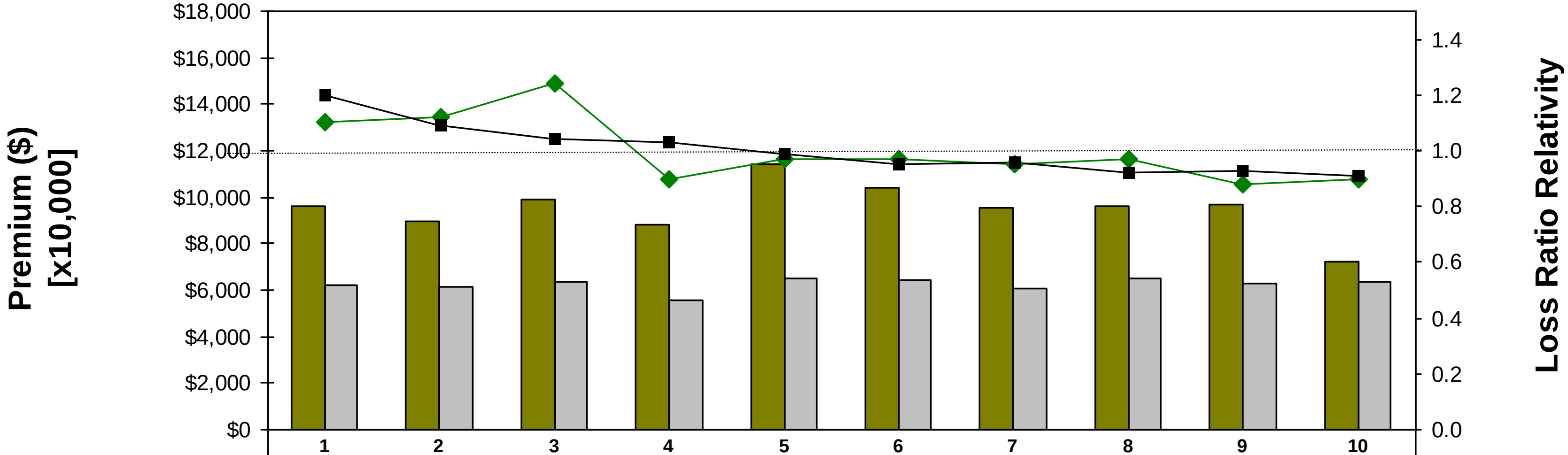
Actual versus Predicted LR Relativities by C Points



	1	2	3	4	5	6	7	8	9	10
Policy Count	1,944	1,669	1,774	1,987	2,456	2,140	1,846	1,793	1,970	1,455
Premium (x 10,000)	$1,245	$1,259	$1,144	$1,240	$1,383	$1,251	$1,228	$1,285	$1,249	$1,278
Act LR Relativity	1.19	0.95	1.11	1.09	0.87	0.98	0.93	1.05	0.95	0.91
Pred LR Relativity	1.19	1.14	1.04	1.00	0.97	0.95	0.96	0.92	0.92	0.91
Lower Limit	101	368	410	433	451	466	479	491	503	519
Upper Limit	368	410	433	451	466	479	491	503	519	628

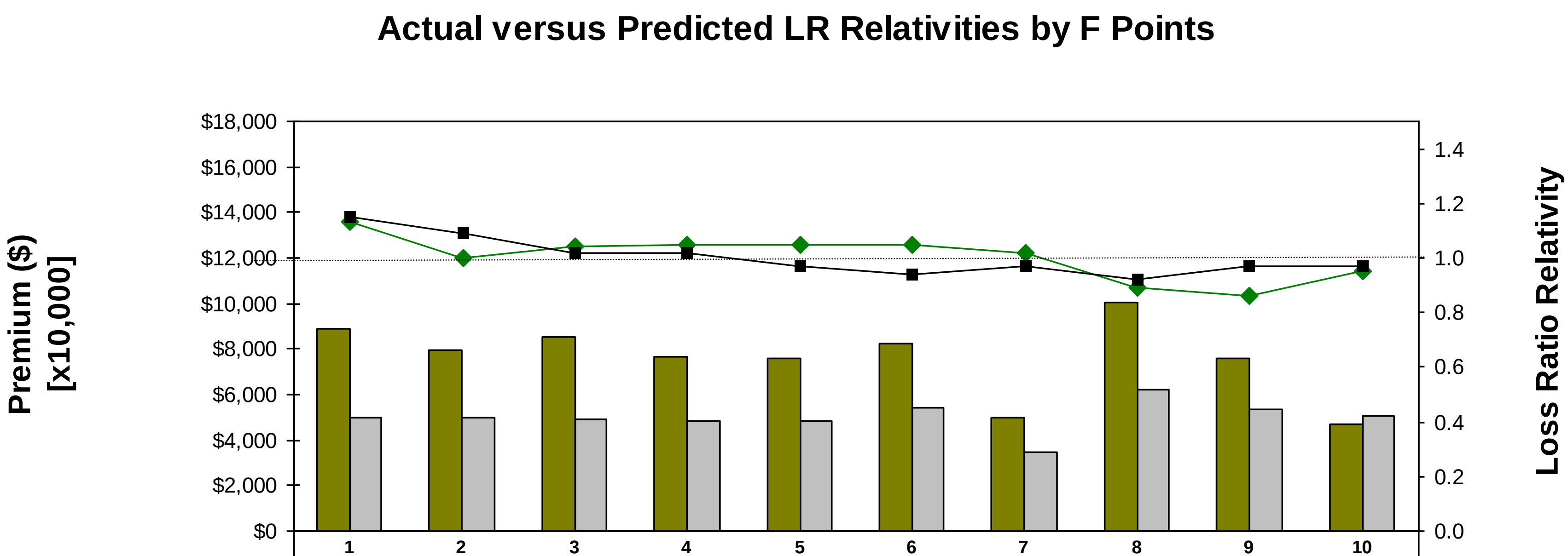
CREDIT MODEL LIFT BY C POINTS (FULL SAMPLE)

Actual versus Predicted LR Relativities by C Points



	1	2	3	4	5	6	7	8	9	10
Policy Count	9,594	8,939	9,869	8,793	11,434	10,437	9,551	9,642	9,716	7,198
Premium (x 10,000)	$6,213	$6,141	$6,376	$5,577	$6,475	$6,447	$6,076	$6,475	$6,295	$6,380
Act LR Relativity	1.10	1.12	1.24	0.90	0.97	0.97	0.95	0.97	0.88	0.90
Pred LR Relativity	1.20	1.09	1.04	1.03	0.99	0.95	0.96	0.92	0.93	0.91
Lower Limit	101	369	412	435	451	465	478	490	503	519
Upper Limit	369	412	435	451	465	478	490	503	519	655

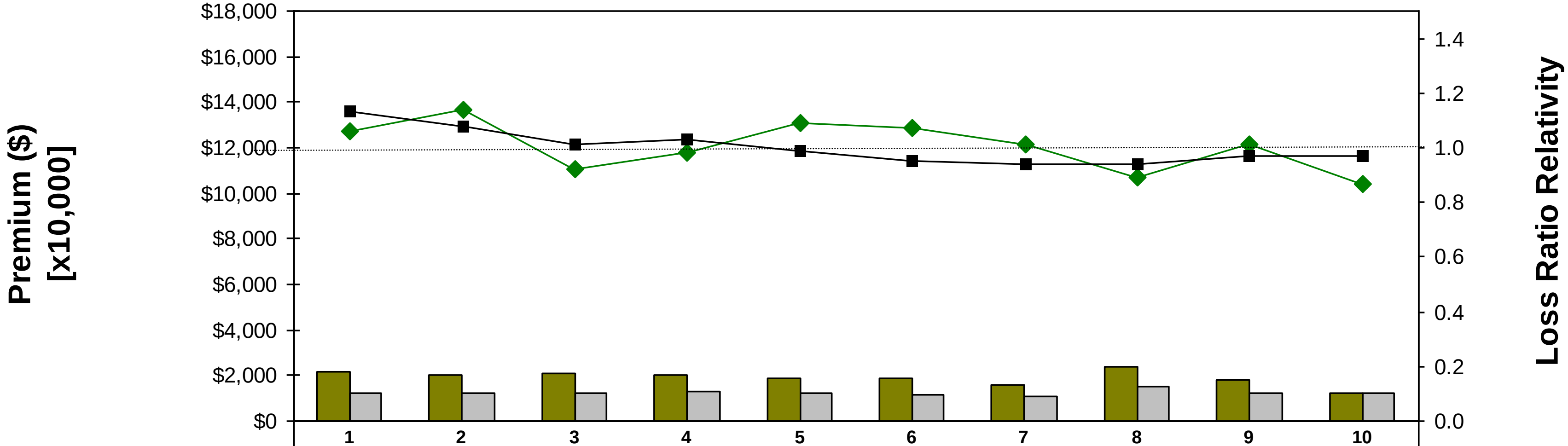
CREDIT MODEL LIFT BY F POINTS (BUILD SAMPLE)



	1	2	3	4	5	6	7	8	9	10
Policy Count	8,889	7,949	8,538	7,669	7,569	8,234	4,998	10,016	7,562	4,713
Premium (x 10,000)	$4,991	$4,963	$4,951	$4,866	$4,838	$5,435	$3,442	$6,199	$5,362	$5,039
Act LR Relativity	1.13	1.00	1.04	1.05	1.05	1.05	1.02	0.89	0.86	0.95
Pred LR Relativity	1.15	1.09	1.02	1.02	0.97	0.94	0.97	0.92	0.97	0.97
Lower Limit	1,210	1,411	1,450	1,473	1,493	1,510	1,527	1,538	1,554	1,580
Upper Limit	1,411	1,450	1,473	1,493	1,510	1,527	1,538	1,554	1,580	1,827

CREDIT MODEL LIFT BY F POINTS (VALIDATION SAMPLE)

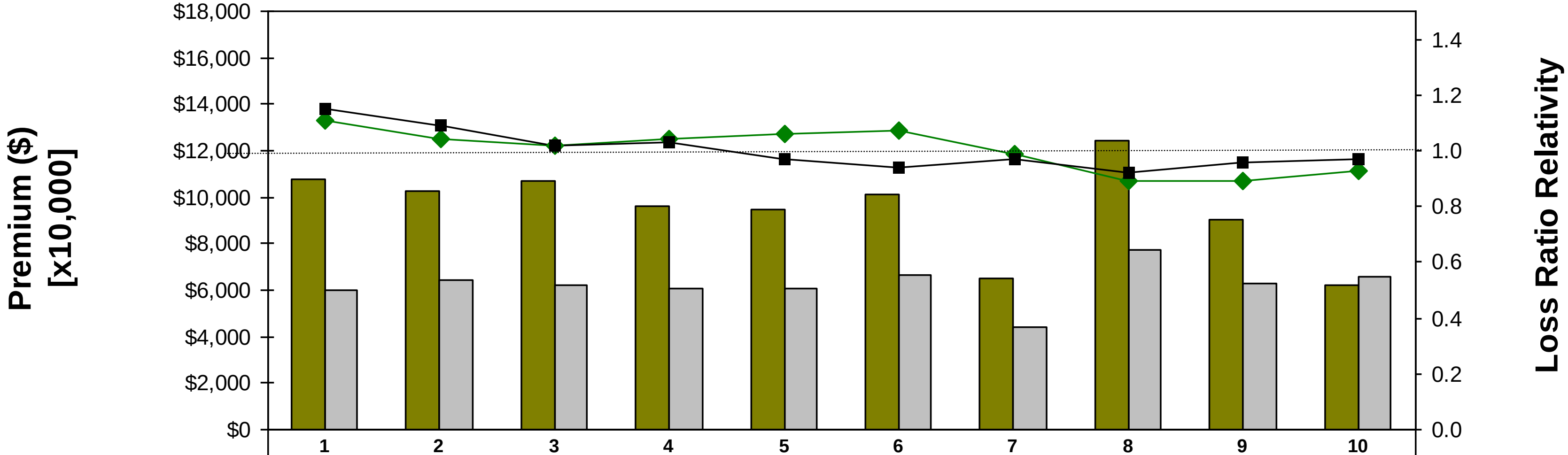
Actual versus Predicted LR Relativities by F Points



	1	2	3	4	5	6	7	8	9	10
Policy Count	2,165	1,997	2,108	2,030	1,873	1,845	1,572	2,420	1,788	1,238
Premium (x 10,000)	$1,220	$1,210	$1,225	$1,287	$1,221	$1,137	$1,067	$1,510	$1,242	$1,250
Act LR Relativity	1.06	1.14	0.92	0.98	1.09	1.07	1.01	0.89	1.01	0.87
Pred LR Relativity	1.13	1.08	1.01	1.03	0.99	0.95	0.94	0.94	0.97	0.97
Lower Limit	1,198	1,410	1,449	1,472	1,493	1,510	1,524	1,538	1,553	1,578
Upper Limit	1,410	1,449	1,472	1,493	1,510	1,524	1,538	1,553	1,578	1,799

CREDIT MODEL LIFT BY F POINTS (FULL SAMPLE)

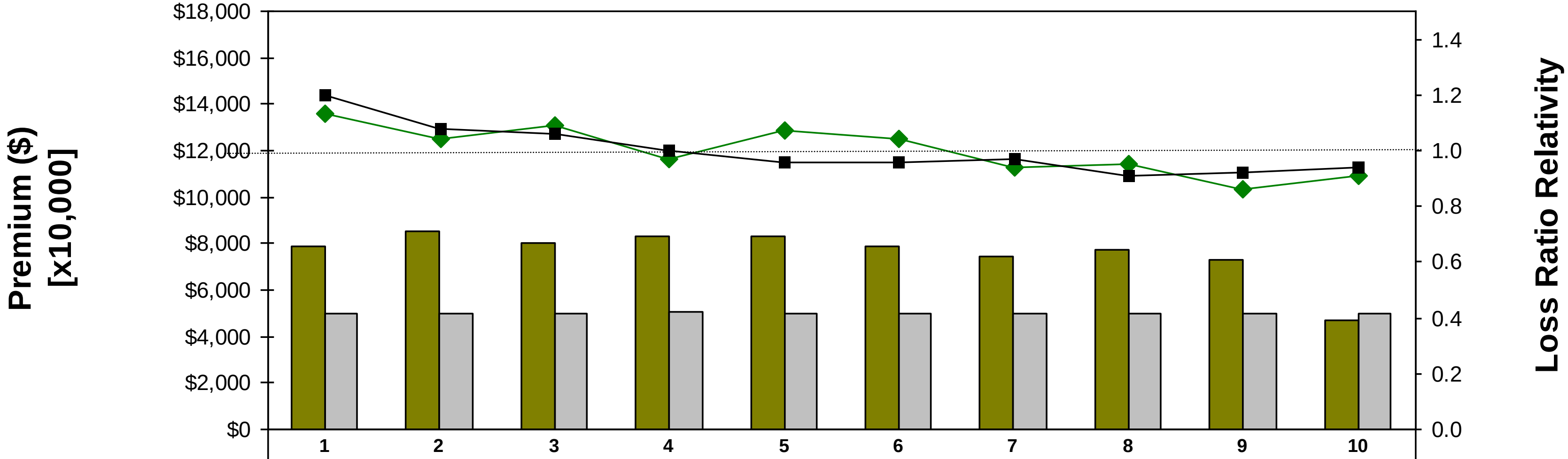
Actual versus Predicted LR Relativities by F Points



	1	2	3	4	5	6	7	8	9	10
Policy Count	10,784	10,265	10,665	9,631	9,442	10,139	6,510	12,467	9,038	6,232
Premium (x 10,000)	$6,026	$6,403	$6,188	$6,096	$6,059	$6,645	$4,436	$7,732	$6,299	$6,571
Act LR Relativity	1.11	1.04	1.02	1.04	1.06	1.07	0.99	0.89	0.89	0.93
Pred LR Relativity	1.15	1.09	1.02	1.03	0.97	0.94	0.97	0.92	0.96	0.97
Lower Limit	1,198	1,410	1,450	1,473	1,493	1,510	1,526	1,538	1,554	1,579
Upper Limit	1,410	1,450	1,473	1,493	1,510	1,526	1,538	1,554	1,579	1,827

CREDIT MODEL LIFT BY FINANCIAL STABILITY (BUILD SAMPLE)

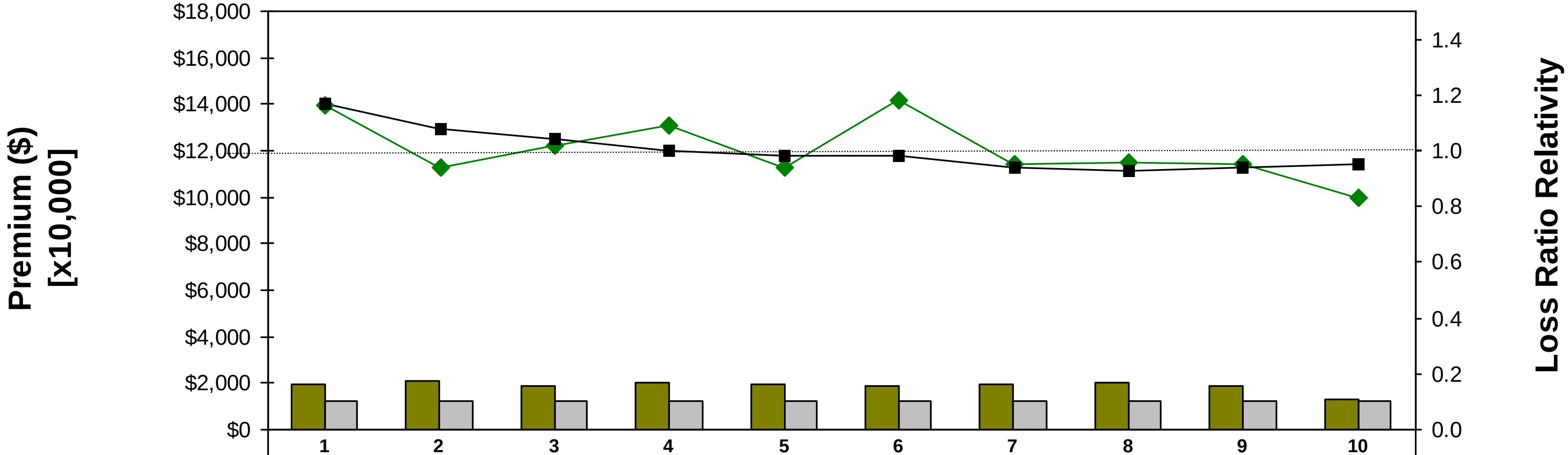
Actual versus Predicted LR Relativities by Financial Stability



	1	2	3	4	5	6	7	8	9	10
Policy Count	7,880	8,518	7,993	8,348	8,287	7,900	7,452	7,710	7,322	4,727
Premium (x 10,000)	$5,008	$5,010	$4,999	$5,028	$4,994	$5,014	$5,009	$5,007	$5,008	$5,010
Act LR Relativity	1.13	1.04	1.09	0.97	1.07	1.04	0.94	0.95	0.86	0.91
Pred LR Relativity	1.20	1.08	1.06	1.00	0.96	0.96	0.97	0.91	0.92	0.94
Lower Limit	-4.84	-1.30	-0.72	-0.29	0.00	0.27	0.50	0.72	0.94	1.21
Upper Limit	-1.30	-0.72	-0.29	0.00	0.27	0.50	0.72	0.94	1.21	3.17

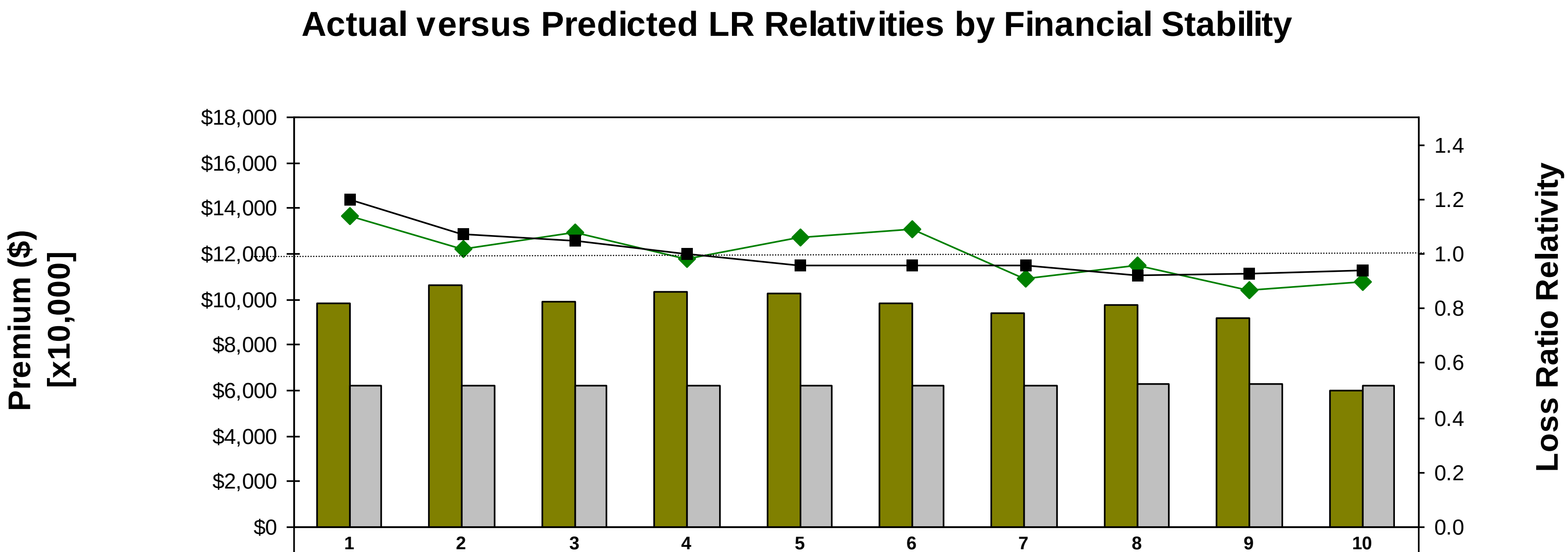
CREDIT MODEL LIFT BY FINANCIAL STABILITY (VALIDATION SAMPLE)

Actual versus Predicted LR Relativities by Financial Stability



	1	2	3	4	5	6	7	8	9	10
Policy Count	1,975	2,115	1,906	2,041	1,973	1,880	1,951	2,037	1,886	1,272
Premium (x 10,000)	$1,231	$1,231	$1,248	$1,236	$1,237	$1,237	$1,235	$1,231	$1,236	$1,246
Act LR Relativity	1.16	0.94	1.02	1.09	0.94	1.18	0.95	0.96	0.95	0.83
Pred LR Relativity	1.17	1.08	1.04	1.00	0.98	0.98	0.94	0.93	0.94	0.95
Lower Limit	-4.58	-1.32	-0.73	-0.31	-0.03	0.22	0.45	0.69	0.91	1.18
Upper Limit	-1.32	-0.73	-0.31	-0.03	0.22	0.45	0.69	0.91	1.18	3.02

CREDIT MODEL LIFT BY FINANCIAL STABILITY (FULL SAMPLE)



	1	2	3	4	5	6	7	8	9	10
Policy Count	9,839	10,648	9,931	10,334	10,278	9,837	9,372	9,733	9,169	6,032
Premium (x 10,000)	$6,246	$6,239	$6,247	$6,246	$6,245	$6,242	$6,227	$6,261	$6,256	$6,246
Act LR Relativity	1.14	1.02	1.08	0.98	1.06	1.09	0.91	0.96	0.87	0.90
Pred LR Relativity	1.20	1.07	1.05	1.00	0.96	0.96	0.96	0.92	0.93	0.94
Lower Limit	-5.03	-1.31	-0.73	-0.29	0.00	0.26	0.49	0.72	0.93	1.20
Upper Limit	-1.31	-0.73	-0.29	0.00	0.26	0.49	0.72	0.93	1.20	3.17

Variable Coefficients

Variable	Coefficient	Chi-Squared	AIC
Intercept	-3.944		
Financial Stability	-0.106	1.746e-07	
Corp. Indicator	-0.015	0.0002085	
Policy Type 2 (LP)	-0.352	0.0002984	
Policy Type 3 (MM)	-1.358		
Policy Type 4 (MH)	-0.451		
Policy Type 5 (AO)	-0.573		
Market Segment (MM)	0.151	< 2.2e-16	

Variable Coefficients (Continued)

Variable	Coefficient	Chi-Squared	AIC
Policy Effective Age (2)	1.648	< 2.2e-16	
Policy Effective Age (3)	2.020		
Policy Effective Age (4)	2.005		
Policy Effective Age (5)	2.042		
Policy Effective Age (6)	2.003		
Policy Effective Age (7)	2.049		
Fleet Size	-0.273	< 2.2 e-16	
Fleet Size^2	0.007	4.291e-05	
Ln(Fleet Size + 1)	1.185	< 2.2e-16	
Fleet Size : Policy Type 2	0.035	1.216e-09	
Fleet Size : Policy Type 3	0.129		
Fleet Size : Policy Type 4	0.029		
Fleet Size : Policy Type 5	0.137		126180.3