Supporting Quantitative Analysis for

The Use of Credit Information for Insurance Purposes

Prepared by Baron Insurance Services

For

Canadian Association of Direct Response Insurers

May 2011

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Executive Summary

Credit scoring is used in rating by the majority of the top personal lines companies in the United States and has become increasingly important in recent years to remain competitive. Multiple papers have come to the conclusion that credit score is correlated with and predictive of insurance losses (e.g. Monaghan, *The Impact of Personal Credit History on Loss Performance in Personal Lines*, 2000; Wu and Guszcza, *Does Credit Score Really Explain Insurance Losses? A Multivariate Analysis from a Data Mining Point of View*, 2003). Those papers have relied on US data, providing a good deal of credibility and a proxy for the Canadian industry due to the size of the US industry and similarities between the two. This analysis uses solely Canadian data and reaches the same conclusions, demonstrating a strong correlation between credit score and insurance losses.

Context

The correlation between credit score and insurance losses has been demonstrated in multiple studies; however, these studies have used data primarily from the United States. In defending the use of credit score in insurance rating, CADRI has been requested to provide Canadian data on a nationwide and provincial basis supporting its position. We were selected as an independent third party to protect the confidentiality of the member companies' data.

Scope

This report is prepared to illustrate the results of the analysis performed on credit score data sent to us members (the Companies) of the Canadian Association of Direct Response Insurers (CADRI).

As an independent third party, we are responsible for aggregating and verifying the reasonableness of the data. In addition, we are performing an analysis of the relationship between credit score and various insurance loss metrics. This analysis is intended to show a broad picture of this relationship and, assuming the significance of the findings, justify further studies in more detail. This report does not address many of the political issues surrounding the use of credit score and is put forth simply to show the statistical significance of credit score in insurance.

In preparing this report, we have relied on the Companies' actuaries, who reviewed the data before sending it to us. Although we can evaluate the data's reasonableness to a degree, we have relied on the Companies for its accuracy. Despite the limitations of this analysis, the volume of data is credible enough to demonstrate a relationship of credit scores to insurance losses.

Data

Members of CADRI were requested to fill out a uniform template (shown in Appendix P) containing automobile and property insurance experience for the last three years. The following five members provided data for our analysis:

-   Belair Insurance Company Inc.

- Desjardins General Insurance Group
- RBC Insurance
- TD Insurance Meloche Monnex
- The Co-operators Group Ltd.

The provided template broke down the Companies' insurance history by province, accident year, line of business, credit score and whether or not credit score was used in rating. The data provided was exposures, premiums, number of claims and incurred claims (excluding IBNR provisions). Complications arising from different ways of measuring credit score were addressed by grouping insureds with credit ratings into percentiles. The 10% of insureds with the lowest credit scores were grouped ("P0-P10"), the next 10% were also grouped ("P10-P20"), etc. "Bankruptcy" and "No Hit, No Score, No Consent" were also provided as categories for those policyholders who did not give or have credit scores. Providing data in a uniform manner and eliminating numbers that can vary between companies (method of credit scoring or setting of IBNR) allowed for the summation of relatively homogeneous data. One Company's property data was aggregated by average, as opposed to individual, credit percentile. This Company's data was excluded from the property analyses due to clustering and a non-uniform distribution of credit scores. All remaining data was re-coded when necessary to reach a uniform state and then aggregated. We looked at the trends in the data and determined that it would not materially enhance the usability of the results of the analysis to add in adjustments for trends over the three year period. Also, it would not greater serve the purpose of providing a broad look at the correlation of credit scores to insurance losses by adding trends to a study not intending to specifically quantify such a correlation.

Tables showing the various aggregations of the data are shown in the Appendices along with comparisons of the exposures with credit scores available to those without. The "Bankruptcy" category was not used in the analysis, because of limited exposures in this category, and has been excluded from the Appendices.

Analysis

All analysis contained in this report was done on the aggregation of the Companies' data to protect the confidential nature of the data. Linear regressions were run in Excel showing the relationship between credit score and claim frequency, average claim cost, pure premium and loss ratio. Regressions were performed on the following for each of property and automobile:

- Total of all Canadian data
- By accident year (2007-2009)
- Policies where credit rating was used/not used
- By province (territories combined)

The formulae and R-squared values for the regressions are displayed on the graphs in the appendices. Since the data was regressed against credit score percentile groups of insureds, the significance of the R-squared values is more useful than the formulae themselves. This study is more concerned with displaying a statistically significant correlation than determining the magnitude of that correlation.

Total – Automobile (Appendix A)

On a total basis for Canadian auto, claim frequency shows high correlation with credit score (R^2 = 0.9788). Pure premium and claim cost also show high correlation with R^2 values around 0.9. The range of pure premium from those in the lowest bracket of credit scores to the highest is 323 to 985; for comparison, the average pure premium of those who did not provide credit information and the total average was 572 and 580 respectively. Loss ratios ranged from 43% to 92% around a total average of 62%. Credit score data was available for 59% of the exposures submitted for this analysis. An additional exhibit showing Canadian auto excluding Québec is given. This is effectively the same exhibit as Appendix C – Auto – Credit Score Not Used; however, we believed it would be pertinent to show beside the full Canadian industry exhibit as well. Compared to Canada including Québec, it shows steeper relationships between all four variables and credit score percentiles with similar R^2 values; the loss ratio exhibit, especially, would suggest that Québec's use of credit scores in automobile rating is lowering the difference in loss ratios between good and poor credit scores. Overall, the data supports better credit scores being correlated with lower claim frequency, lower claim cost, lower pure premium and lower loss ratios.

Total – Property (Appendix A)

On a total basis for Canadian property, pure premium shows a high correlation with credit score (R^2 = 0.9128). Claim frequency has a very high correlation with an R^2 of 0.9687 and claim cost less so at 0.7908. The range of pure premium from those in the lowest bracket of credit scores to the highest is 244 to 640; for comparison, the average pure premium of those who did not provide credit information and the total average was 391 and 398 respectively. Loss ratios ranged from 47% to 95% around a total average of 65%. Credit score data was available for 60% of the exposures used in this analysis. The data supports better credit scores being correlated with lower claim frequency, lower claim cost, lower pure premium and lower loss ratios.

Accident Year – Automobile (Appendix B)

The relationship between credit score and claim frequency is virtually the same in the three accident years looked at and highly significant in all (R^2 > 0.97). Pure premium is has a high R^2 (~0.91) for all accident years though the slope of the relationship has a larger absolute value due to higher than normal losses in the worst credit percentile. The significance of the relationship between claim cost and credit score varied between accident years (0.7885 < R^2 < 0.8807). Loss ratio had an R^2 varying through the mid 0.8's and had the same difference as pure premium in accident year 2009. The data supports better credit scores being correlated with lower claim frequency and lower pure premium across different accident years. Lower claim costs and lower loss ratios also appear correlated with better credit scores, but with lower R^2 values.

Accident Year – Property (Appendix B)

Pure premium showed higher levels of correlation to credit score in accident years 2008 (R^2 = 0.9344) and 2009 (R^2 = 0.9121) than in 2007 (R^2 = 0.8218) though still high in all years. Claim frequency showed a very high correlation in all years: 2007 (R^2 = 0.9548), 2008 (R^2 = 0.9506), 2009 (R^2 = 0.9778). The significance of the relationship with claim cost varied from an R^2 of 0.6636 to 0.8866. The R^2 values for

loss ratios were similar but slightly lower than pure premium. The data supports better credit scores being correlated with lower claim frequency, lower loss ratios and lower pure premium across different accident years. Lower claim costs also appear correlated with better credit scores, but with lower R^2 values.

Credit Score Used In Rating (Appendix C)

Quebec is the only province allowed to use credit score in rating automobile insurance. The data shows that although credit scores are used, there is still a significant correlation (R^2 = 0.9641) between credit score and loss ratio, though the magnitude of the relationship is much less compared to other provinces where credit score is not used in rating. Since credit score information is often not gathered for insureds where credit scoring is not used in rating, the level of significance for the regressions run on policies not using credit rating will be lower (more policies will fall under the "No Hit, No Score, No Consent" category).

All insurers in the analysis use credit score for rating property policies; hence, there is not a breakdown of insurers that do and do not used credit score in rating property.

Prince Edward Island (Appendix D)

Appendices for each province have been compiled with descriptions of the findings at the beginning of each appendix. Additionally, Appendix E shows the Atlantic provinces combined

Definitions

Accident Year – grouping of portions of policies that have premium earned and any claims that occurred during a particular calendar year

IBNR – Incurred but Not Reported – estimates on reserves for claims that have occurred but have not been included in the case reserves set by claims adjusters

Pure Premium – the actual cost of settling any claims associated with a particular policy or group of polices before any expenses not associated with individual claims; equal to average claim cost x frequency

R-squared – generally, the portion of variance of the data set that can be explained by a particular model (ie. Linear regression) as opposed to outside factors or randomness

Loss Ratio – loss incurred divided by premiums earned for a given accident year

Average Claim Cost – loss incurred divided by the number of claims

Frequency – number of claims divided by the number of number of cars / properties insured

List of Appendices

Total – All Provinces, All Accident Years – Appendix A

Total – All Provinces, By Accident Year – Appendix B

Total – Credit Score Used/Not Used in Rating – Appendix C

Prince Edward Island – Appendix D

Atlantic Provinces – Appendix E

Template for Data Submission – Appendix F

List of Appendices

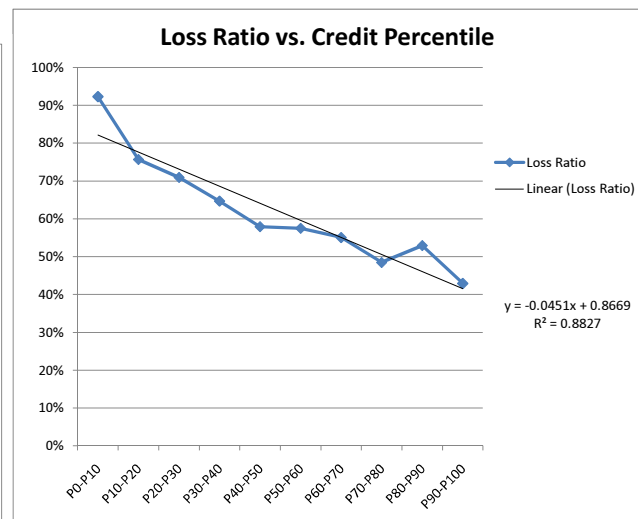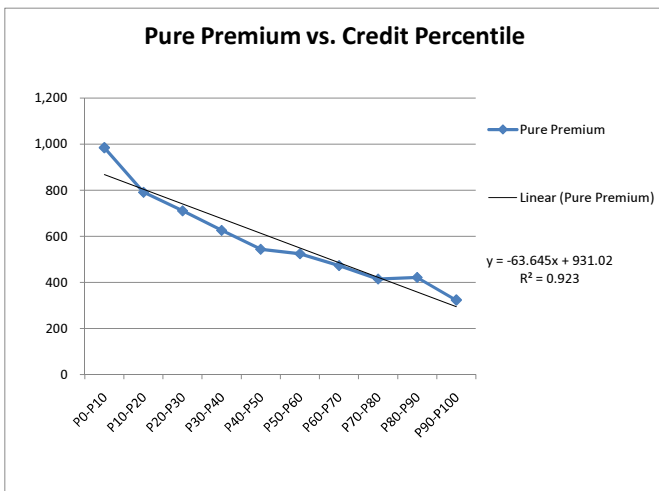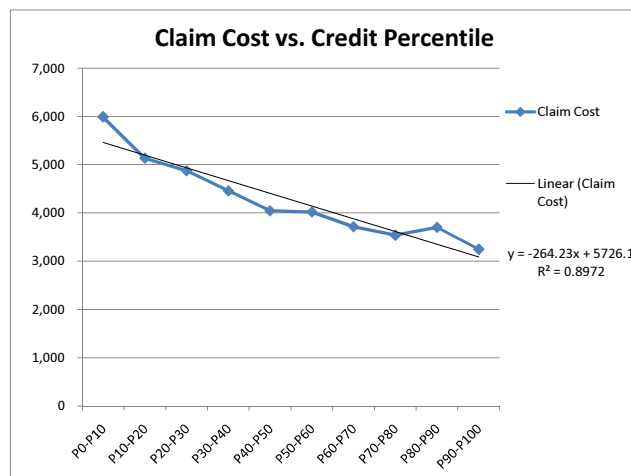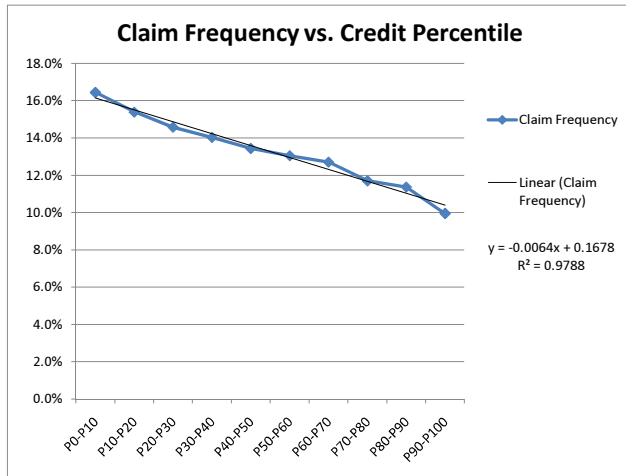This Page Was Intentionally Left Blank

CADRI Credit Score Quantitative Analysis

Appendix A

Total – All Provinces, All Accident Years

Company	(All)
Line of Business	Automobile
Province	(All)
Accident Year	2007-2009
Credit Score used in Rating	(All)

	Values								
Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	3,508,099	3,289,717,819	423,049	2,007,819,336	938	12.1%	4,746	572	61%
P0-P10	518,954	553,680,181	85,340	511,132,155	1,067	16.4%	5,989	985	92%
P10-P20	515,114	538,078,275	79,294	407,183,375	1,045	15.4%	5,135	790	76%
P20-P30	519,052	519,720,750	75,669	368,693,627	1,001	14.6%	4,872	710	71%
P30-P40	518,759	501,479,983	72,780	324,521,560	967	14.0%	4,459	626	65%
P40-P50	536,045	502,661,460	72,024	291,280,119	938	13.4%	4,044	543	58%
P50-P60	507,138	462,527,897	66,154	265,903,351	912	13.0%	4,019	524	57%
P60-P70	549,059	470,809,284	69,800	259,346,989	857	12.7%	3,716	472	55%
P70-P80	501,373	428,250,469	58,665	207,685,533	854	11.7%	3,540	414	48%
P80-P90	521,111	414,146,952	59,225	219,337,740	795	11.4%	3,703	421	53%
P90-P100	460,229	346,456,520	45,781	148,757,845	753	9.9%	3,249	323	43%
Grand Total	8,654,932	8,027,529,591	1,107,781	5,011,661,631	928	12.8%	4,524	579	62%

Claim Frequency vs. Credit Percentile

y = -0.0064x + 0.1678
R² = 0.9788

Claim Cost vs. Credit Percentile

y = -264.23x + 5726.1
R² = 0.8972

Pure Premium vs. Credit Percentile

y = -63.645x + 931.02
R² = 0.923

Loss Ratio vs. Credit Percentile

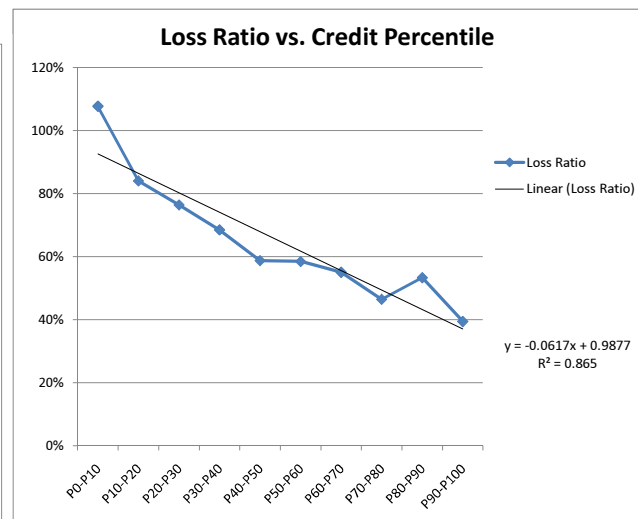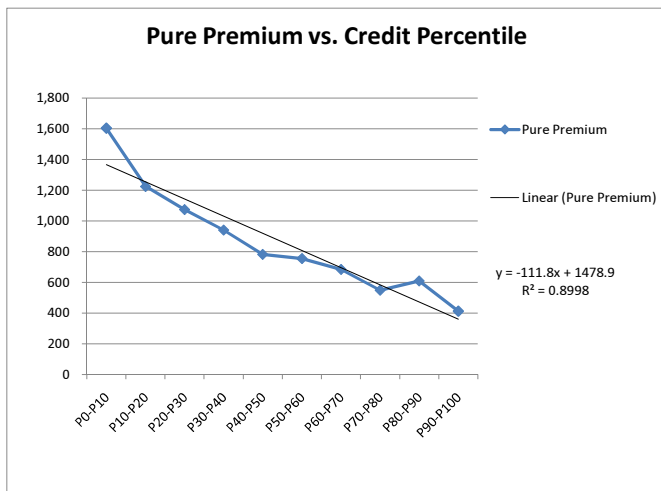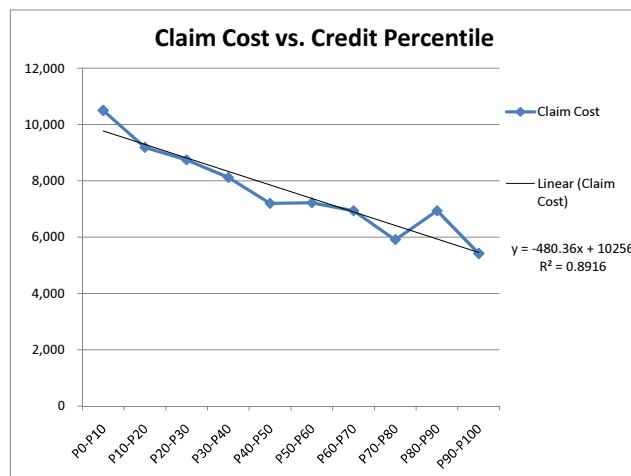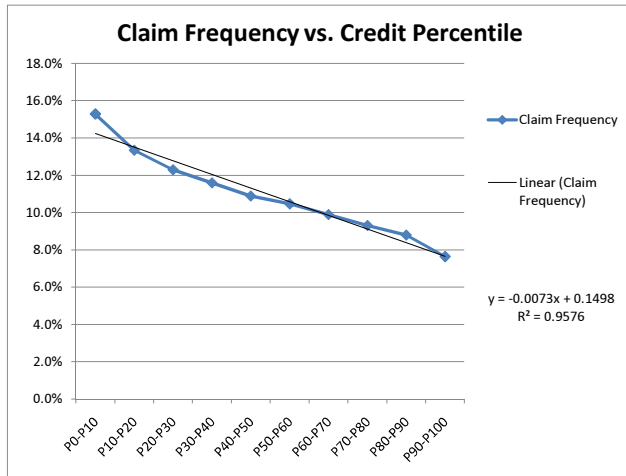y = -0.0451x + 0.8669
R² = 0.8827

Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Average with Credit Score	921	13.3%	4,387	584	63%
Average without Credit Score	938	12.1%	4,746	572	61%

Company	(All)
Line of Business	Automobile
Province	All - excl. Quebec
Accident Year	2007-2009
Credit Score used in Rating	(All)

	Values								
Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	2,136,360	2,546,595,748	211,770	1,577,442,894	1,192	9.9%	7,449	738	62%
P0-P10	244,994	365,121,913	37,442	393,128,449	1,490	15.3%	10,500	1,605	108%
P10-P20	244,109	355,976,271	32,555	299,063,015	1,458	13.3%	9,186	1,225	84%
P20-P30	245,340	344,935,313	30,149	263,476,358	1,406	12.3%	8,739	1,074	76%
P30-P40	242,948	333,534,157	28,147	228,473,466	1,373	11.6%	8,117	940	69%
P40-P50	252,994	337,252,577	27,521	198,050,009	1,333	10.9%	7,196	783	59%
P50-P60	241,574	311,875,799	25,281	182,397,580	1,291	10.5%	7,215	755	58%
P60-P70	247,125	307,592,582	24,427	169,340,853	1,245	9.9%	6,933	685	55%
P70-P80	250,771	296,476,175	23,353	137,876,824	1,182	9.3%	5,904	550	47%
P80-P90	242,453	277,008,204	21,304	147,739,064	1,143	8.8%	6,935	609	53%
P90-P100	228,046	238,926,388	17,413	94,241,785	1,048	7.6%	5,412	413	39%
Grand Total	4,576,714	5,715,295,127	479,362	3,691,230,299	1,249	10.5%	7,700	807	65%

Claim Frequency vs. Credit Percentile

$y = -0.0073x + 0.1498$
$R^2 = 0.9576$

Claim Cost vs. Credit Percentile

$y = -480.36x + 10256$
$R^2 = 0.8916$

Pure Premium vs. Credit Percentile

$y = -111.8x + 1478.9$
$R^2 = 0.8998$

Loss Ratio vs. Credit Percentile

$y = -0.0617x + 0.9877$
$R^2 = 0.865$

		Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Comparison of exposures with credit score to those without						
Average with Credit Score		1,298	11.0%	7,899	866	67%
Average without Credit Score		1,192	9.9%	7,449	738	62%

Company   (Multiple Items)
Line of Business   Property
Province   (All)
Accident Year   2007-2009
Credit Score used in Rating   (All)

Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	1,476,575	951,420,167	75,579	576,832,271	644	5.1%	7,632	391	61%
P0-P10	225,822	152,884,460	16,378	144,544,590	677	7.3%	8,826	640	95%
P10-P20	216,083	141,365,409	14,308	117,859,513	654	6.6%	8,237	545	83%
P20-P30	223,934	140,861,967	13,895	101,042,714	629	6.2%	7,272	451	72%
P30-P40	227,081	140,023,859	13,096	93,917,736	617	5.8%	7,171	414	67%
P40-P50	221,029	132,814,883	12,444	86,499,254	601	5.6%	6,951	391	65%
P50-P60	222,255	130,185,247	11,615	82,271,473	586	5.2%	7,083	370	63%
P60-P70	234,499	134,139,970	12,181	78,014,940	572	5.2%	6,405	333	58%
P70-P80	216,202	121,507,708	10,091	71,152,949	562	4.7%	7,051	329	59%
P80-P90	223,404	121,212,413	10,368	65,324,919	543	4.6%	6,301	292	54%
P90-P100	198,158	103,804,573	7,763	48,419,409	524	3.9%	6,237	244	47%
Grand Total	3,685,041	2,270,220,655	197,718	1,465,879,768	616	5.4%	7,414	398	65%

Claim Frequency vs. Credit Percentile

$y = -0.0033x + 0.073$
$R^2 = 0.9687$

Claim Cost vs. Credit Percentile

$y = -243.18x + 8490.9$
$R^2 = 0.7908$

Pure Premium vs. Credit Percentile

$y = -37.62x + 607.95$
$R^2 = 0.9128$

Loss Ratio vs. Credit Percentile

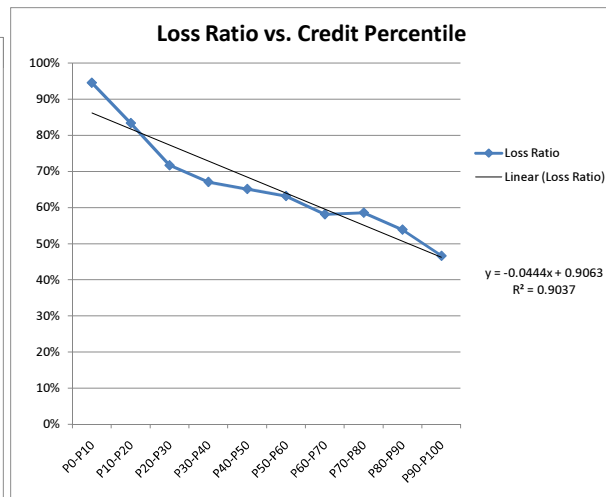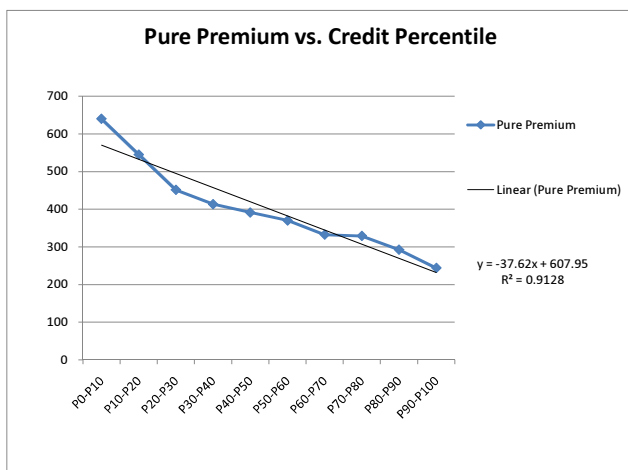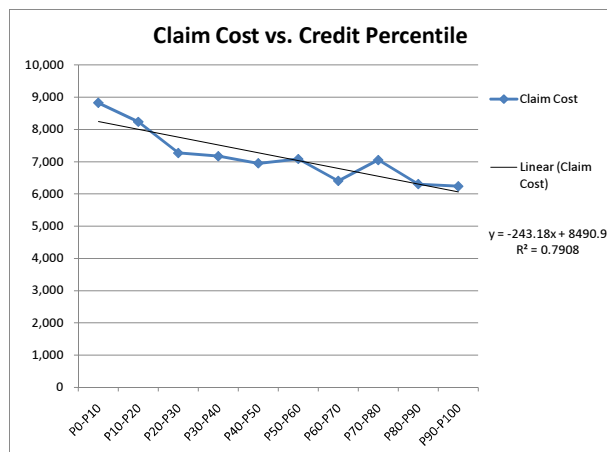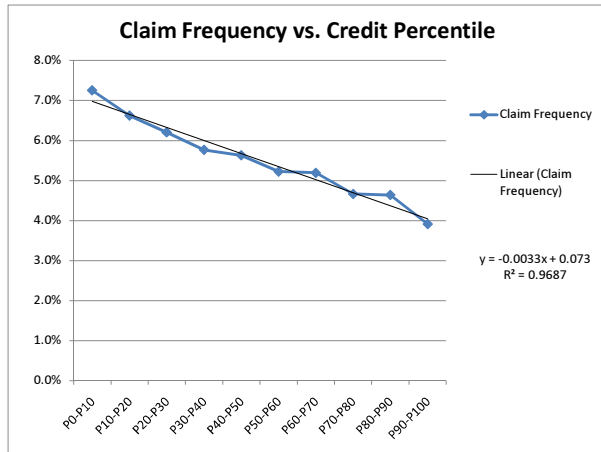$y = -0.0444x + 0.9063$
$R^2 = 0.9037$

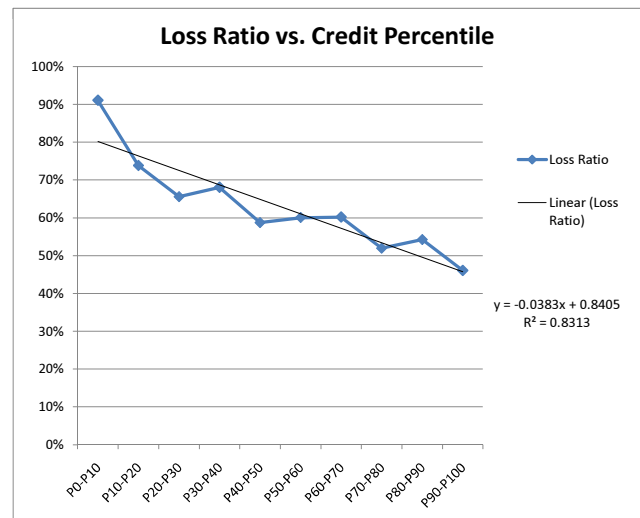| Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Average with Credit Score	597	5.5%	7,279	403	67%
Average without Credit Score	644	5.1%	7,632	391	61%

CADRI Credit Score Quantitative Analysis

Appendix B

Total – All Provinces, By Accident Year

Company	(All)	
Line of Business	Automobile	
Province	(All)	
Accident Year	2007	
Credit Score used in Rating	(All)	

	Values						Average Cost per		
Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	1,421,938	1,314,881,171	177,043	827,330,905	925	12.5%	4,673	582	63%
P0-P10	135,555	143,095,666	22,183	130,327,143	1,056	16.4%	5,875	961	91%
P10-P20	134,760	140,981,911	20,528	104,061,816	1,046	15.2%	5,069	772	74%
P20-P30	136,361	137,267,000	19,335	89,990,699	1,007	14.2%	4,654	660	66%
P30-P40	138,495	134,747,608	19,035	91,693,903	973	13.7%	4,817	662	68%
P40-P50	143,125	135,933,810	19,024	79,791,274	950	13.3%	4,194	557	59%
P50-P60	131,257	121,863,708	16,679	73,162,125	928	12.7%	4,386	557	60%
P60-P70	147,105	127,823,086	18,384	76,928,069	869	12.5%	4,185	523	60%
P70-P80	123,276	106,829,283	14,117	55,507,009	867	11.5%	3,932	450	52%
P80-P90	144,836	116,240,825	16,337	63,053,678	803	11.3%	3,860	435	54%
P90-P100	124,159	92,970,367	12,185	42,807,313	749	9.8%	3,513	345	46%
Grand Total	2,780,868	2,572,634,434	354,850	1,634,653,934	925	12.8%	4,607	588	64%
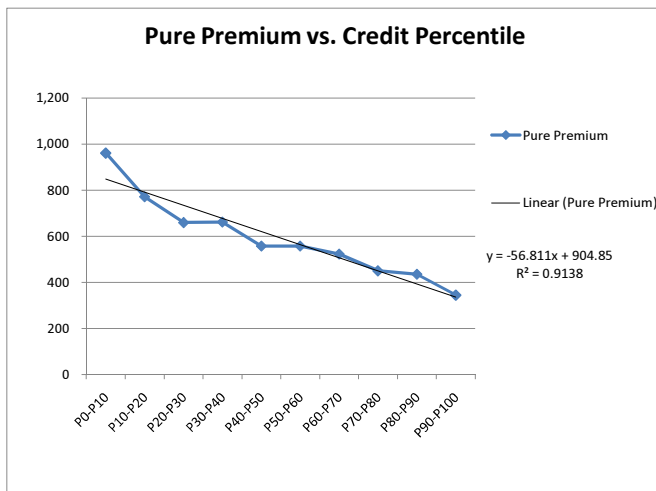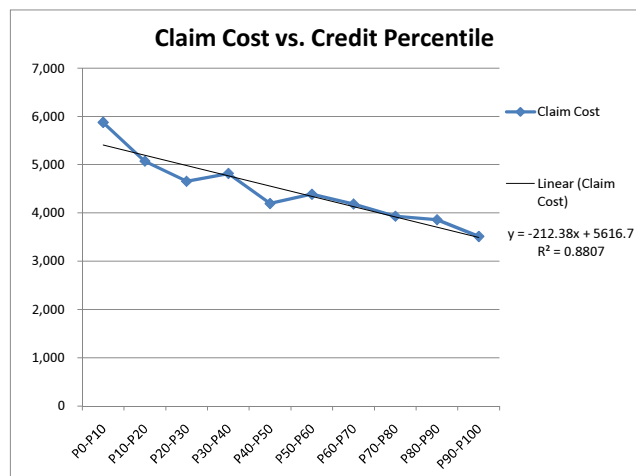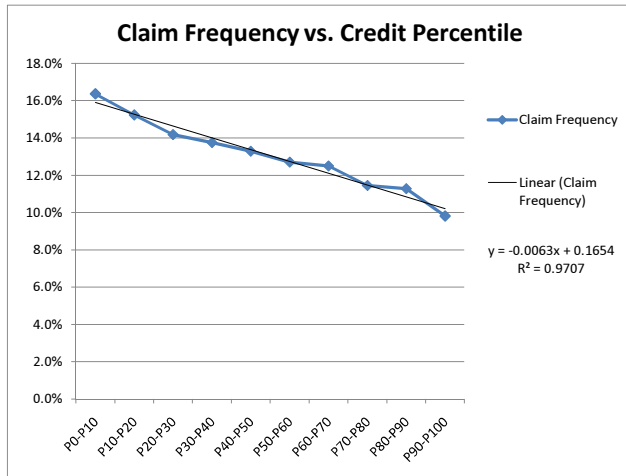
Claim Frequency vs. Credit Percentile

$y = -0.0063x + 0.1654$
$R^2 = 0.9707$

Claim Cost vs. Credit Percentile

$y = -212.38x + 5616.7$
$R^2 = 0.8807$

Pure Premium vs. Credit Percentile

$y = -56.811x + 904.85$
$R^2 = 0.9138$

Loss Ratio vs. Credit Percentile

$y = -0.0383x + 0.8405$
$R^2 = 0.8313$
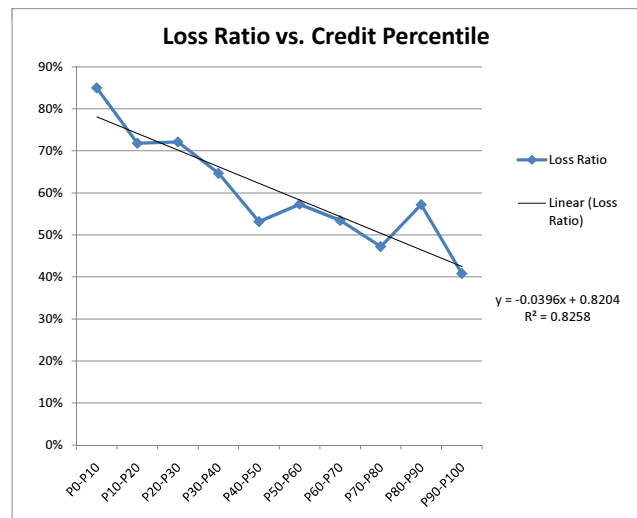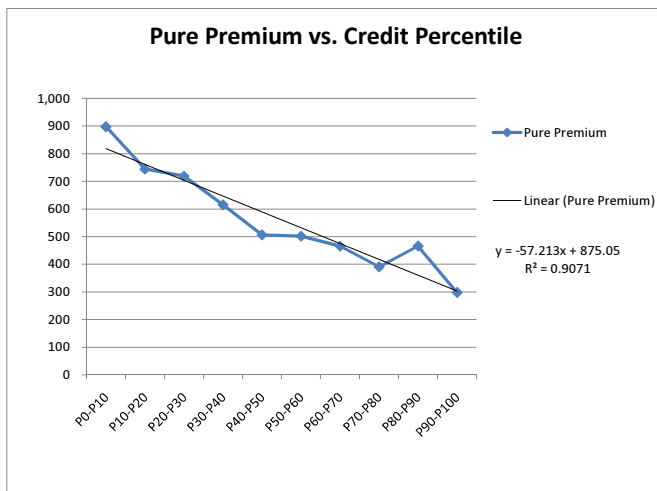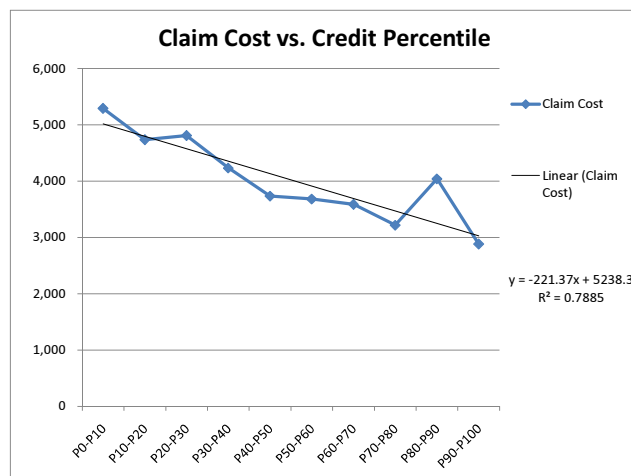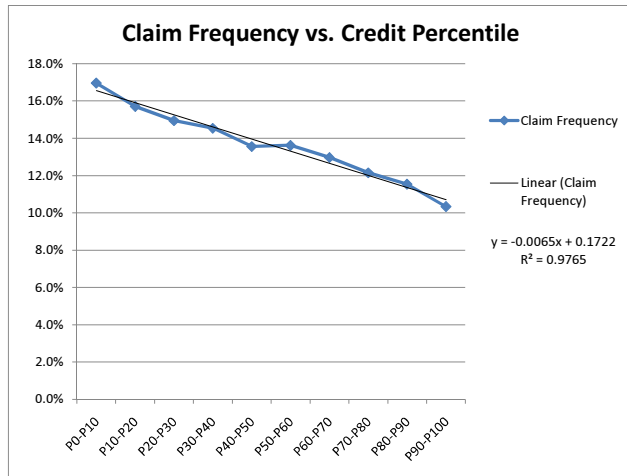
			Average Cost per		
Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
Average with Credit Score	926	13.1%	4,540	594	64%
Average without Credit Score	925	12.5%	4,673	582	63%

Company	(All)
Line of Business	Automobile
Province	(All)
Accident Year	2008
Credit Score used in Rating	(All)

| | Values | | | | | | Average Cost per | | |
Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	1,140,317	1,066,285,834	138,090	628,722,816	935	12.1%	4,553	551	59%
P0-P10	175,238	185,152,463	29,724	157,302,105	1,057	17.0%	5,292	898	85%
P10-P20	175,103	181,493,010	27,516	130,332,529	1,036	15.7%	4,737	744	72%
P20-P30	176,064	175,585,883	26,321	126,600,736	997	14.9%	4,810	719	72%
P30-P40	177,597	168,980,666	25,819	109,257,595	951	14.5%	4,232	615	65%
P40-P50	173,226	164,929,990	23,490	87,668,243	952	13.6%	3,732	506	53%
P50-P60	188,181	164,655,608	25,635	94,351,161	875	13.6%	3,681	501	57%
P60-P70	173,539	151,134,514	22,510	80,758,446	871	13.0%	3,588	465	53%
P70-P80	184,696	152,705,932	22,442	72,149,477	827	12.2%	3,215	391	47%
P80-P90	158,758	129,283,270	18,316	73,980,184	814	11.5%	4,039	466	57%
P90-P100	163,079	119,010,970	16,867	48,622,034	730	10.3%	2,883	298	41%
Grand Total	2,885,797	2,659,218,140	376,730	1,609,745,327	921	13.1%	4,273	558	61%

Claim Frequency vs. Credit Percentile

y = -0.0065x + 0.1722
R² = 0.9765

Claim Cost vs. Credit Percentile

y = -221.37x + 5238.3
R² = 0.7885

Pure Premium vs. Credit Percentile

y = -57.213x + 875.05
R² = 0.9071

Loss Ratio vs. Credit Percentile

y = -0.0396x + 0.8204
R² = 0.8258

| | | | Average | | Average Cost per | | |
Comparison of exposures with credit score to those without			Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
Average with Credit Score			913	13.7%	4,111	562	62%
Average without Credit Score			935	12.1%	4,553	551	59%

Company	(All)							
Line of Business	Automobile							
Province	(All)							
Accident Year	2009							
Credit Score used in Rating	(All)							

	Values							
	Sum of Total	Sum of Total	Sum of Number	Sum of Incurred			Average Cost per	
Row Labels	Exposure	Premium	of claims	claims	Average Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	945,844	908,550,815	107,916	551,765,616	961	11.4%	5,113	583	61%
P0-P10	208,161	225,432,052	33,433	223,502,906	1,083	16.1%	6,685	1,074	99%
P10-P20	205,250	215,603,353	31,250	172,789,031	1,050	15.2%	5,529	842	80%
P20-P30	206,627	206,867,868	30,013	152,102,192	1,001	14.5%	5,068	736	74%
P30-P40	202,666	197,751,708	27,926	123,570,063	976	13.8%	4,425	610	62%
P40-P50	219,694	201,797,660	29,510	123,820,601	919	13.4%	4,196	564	61%
P50-P60	187,700	176,008,581	23,840	98,390,065	938	12.7%	4,127	524	56%
P60-P70	228,415	191,851,685	28,906	101,660,474	840	12.7%	3,517	445	53%
P70-P80	193,400	168,715,254	22,106	80,029,046	872	11.4%	3,620	414	47%
P80-P90	217,517	168,622,857	24,572	82,303,877	775	11.3%	3,349	378	49%
P90-P100	172,991	134,475,183	16,729	57,328,498	777	9.7%	3,427	331	43%
Grand Total	2,988,267	2,795,677,016	376,201	1,767,262,369	936	12.6%	4,698	591	63%

Claim Frequency vs. Credit Percentile

y = -0.0063x + 0.1656
R² = 0.9739

Claim Cost vs. Credit Percentile

y = -330.99x + 6214.8
R² = 0.861

Pure Premium vs. Credit Percentile

y = -73.152x + 994.12
R² = 0.9049

Loss Ratio vs. Credit Percentile

y = -0.0541x + 0.9219
R² = 0.8871
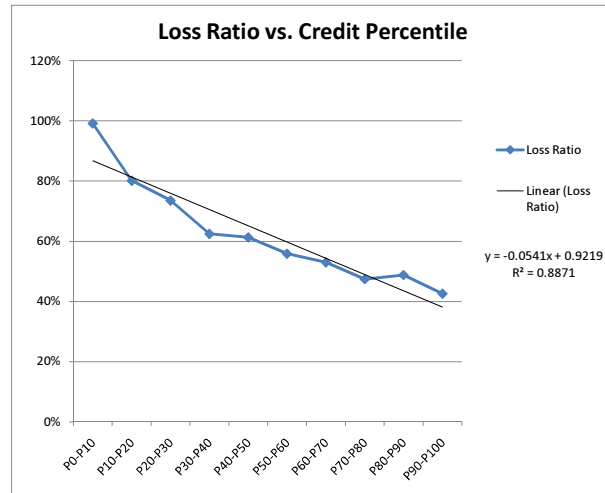
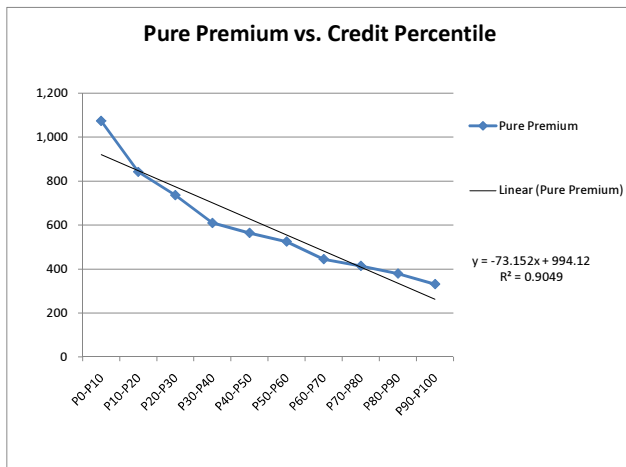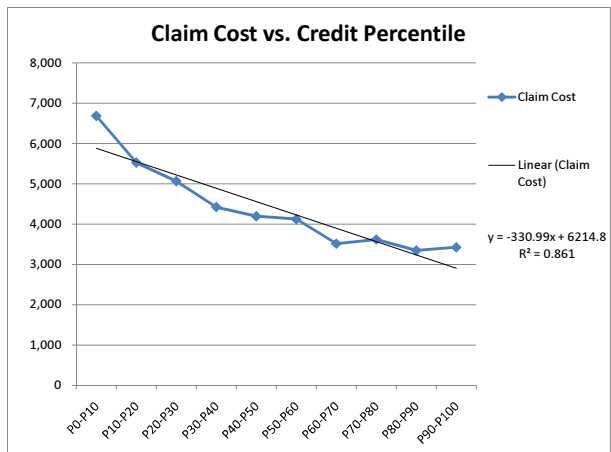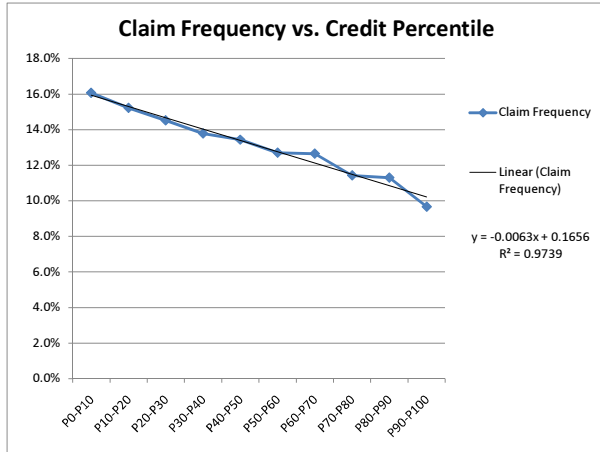|			Average Cost per		
Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
Average with Credit Score	924	13.1%	4,531	595	64%
Average without Credit Score	961	11.4%	5,113	583	61%

Company	(Multiple Items)								
Line of Business	Property								
Province	(All)								
Accident Year	2007								
Credit Score used in Rating	(All)								

	Values								
	Sum of Total	Sum of Total	Sum of Number	Sum of Incurred	Average		Average Cost per		
Row Labels	Exposure	Premium	of claims	claims	Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	604,904	365,051,933	29,078	208,436,344	603	4.8%	7,168	345	57%
P0-P10	56,617	35,379,159	3,314	31,975,767	625	5.9%	9,649	565	90%
P10-P20	54,146	32,964,429	2,941	26,098,752	609	5.4%	8,874	482	79%
P20-P30	56,480	33,347,588	2,969	20,959,193	590	5.3%	7,059	371	63%
P30-P40	55,187	31,859,193	2,534	16,828,037	577	4.6%	6,641	305	53%
P40-P50	54,692	30,824,570	2,511	16,774,065	564	4.6%	6,680	307	54%
P50-P60	58,410	32,328,351	2,637	17,747,634	553	4.5%	6,730	304	55%
P60-P70	57,777	31,127,848	2,517	15,816,762	539	4.4%	6,284	274	51%
P70-P80	52,615	28,050,416	2,101	14,191,357	533	4.0%	6,755	270	51%
P80-P90	53,314	27,742,956	1,982	12,469,621	520	3.7%	6,291	234	45%
P90-P100	53,324	26,879,935	1,946	11,502,205	504	3.6%	5,911	216	43%
Grand Total	1,157,466	675,556,377	54,530	392,799,736	584	4.7%	7,203	339	58%

Claim Frequency vs. Credit Percentile

$$y = -0.0024x + 0.0589$$
$$R^2 = 0.9548$$

Claim Cost vs. Credit Percentile

$$y = -328.88x + 8896.3$$
$$R^2 = 0.6853$$

Pure Premium vs. Credit Percentile

$$y = -33.222x + 515.36$$
$$R^2 = 0.8218$$

Loss Ratio vs. Credit Percentile

$$y = -0.0445x + 0.8286$$
$$R^2 = 0.7878$$

		Average		Average Cost per		
Comparison of exposures with credit score to those without		Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
Average with Credit Score		562	4.6%	7,244	334	59%
Average without Credit Score		603	4.8%	7,168	345	57%

Company	(Multiple Items)
Line of Business	Property
Province	(All)
Accident Year	2008
Credit Score used in Rating	(All)

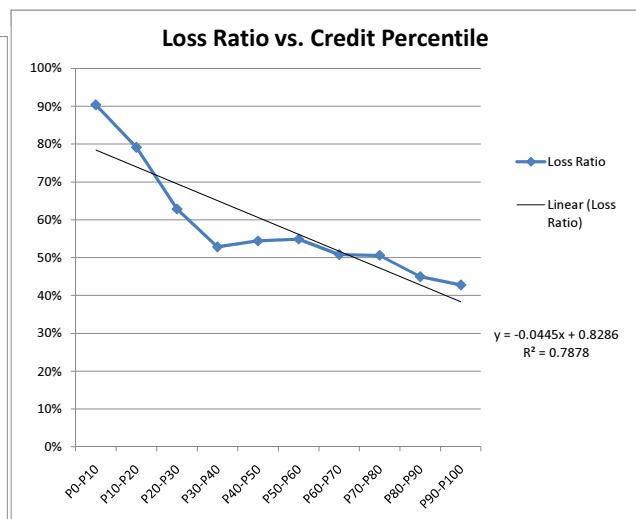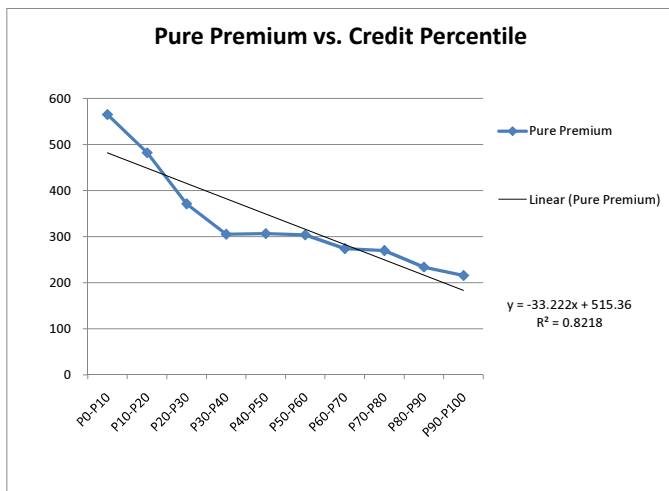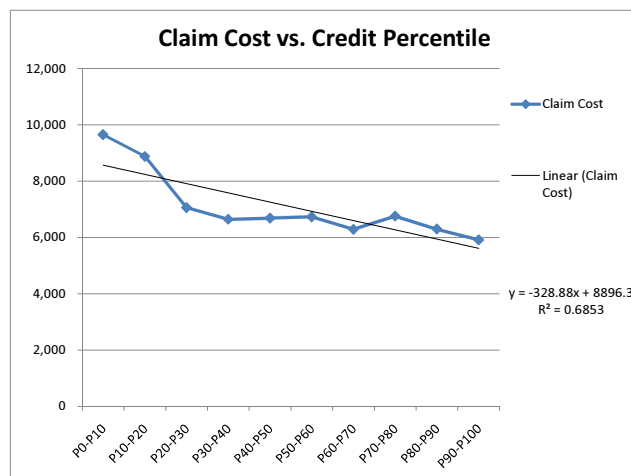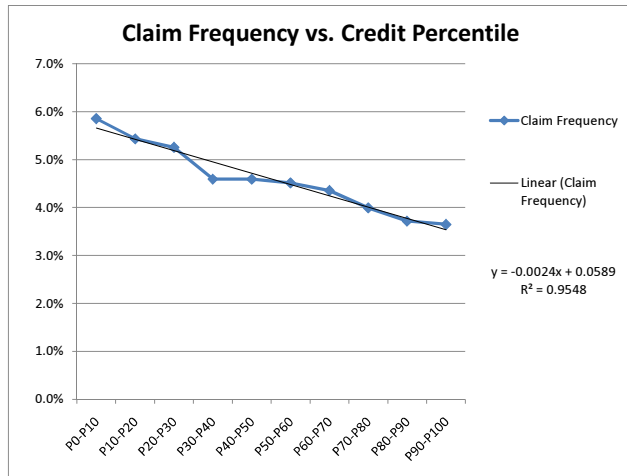| | Values | | | | | | Average Cost per | | |
Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	462,337	307,347,834	27,833	211,771,637	665	6.0%	7,609	458	69%
P0-P10	75,062	50,794,657	6,726	52,723,424	677	9.0%	7,839	702	104%
P10-P20	73,540	48,004,650	5,982	43,502,119	653	8.1%	7,272	592	91%
P20-P30	75,118	47,039,418	5,726	38,984,525	626	7.6%	6,808	519	83%
P30-P40	74,131	45,360,035	5,327	34,545,234	612	7.2%	6,485	466	76%
P40-P50	76,296	45,538,338	5,325	33,477,508	597	7.0%	6,287	439	74%
P50-P60	73,418	42,833,959	4,712	30,470,508	583	6.4%	6,467	415	71%
P60-P70	77,444	44,219,143	5,032	30,958,100	571	6.5%	6,152	400	70%
P70-P80	68,714	38,359,467	3,927	23,579,032	558	5.7%	6,004	343	61%
P80-P90	83,459	44,965,790	4,913	27,885,500	539	5.9%	5,676	334	62%
P90-P100	61,775	32,024,481	2,871	16,549,148	518	4.6%	5,764	268	52%
Grand Total	1,201,294	746,487,773	78,374	544,446,734	621	6.5%	6,947	453	73%

Claim Frequency vs. Credit Percentile

y = -0.004x + 0.0903
R² = 0.9506

Claim Cost vs. Credit Percentile

y = -210.2x + 7631.5
R² = 0.8866

Pure Premium vs. Credit Percentile

y = -41.298x + 674.9
R² = 0.9344

Loss Ratio vs. Credit Percentile

y = -0.0483x + 1.009
R² = 0.9304

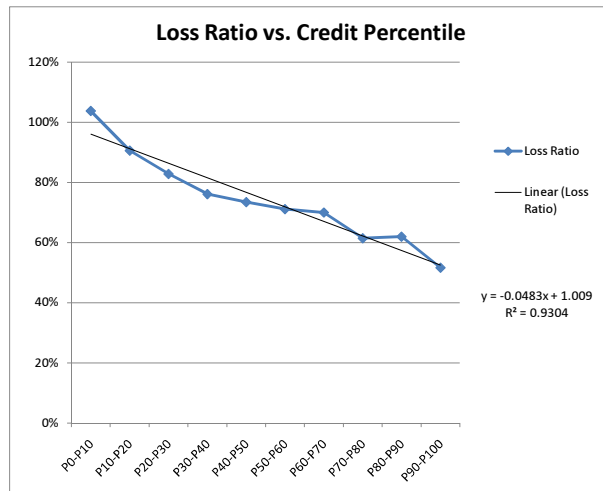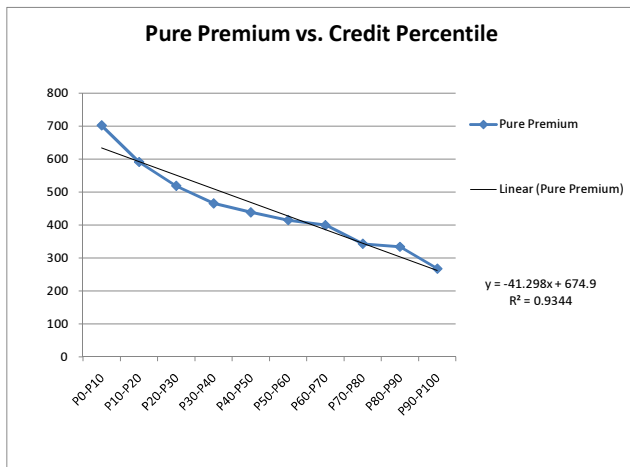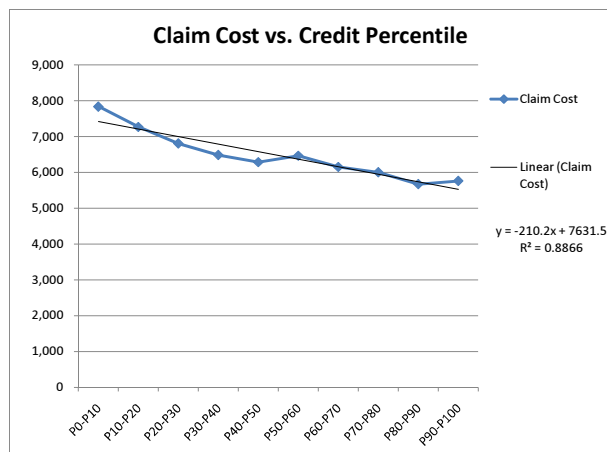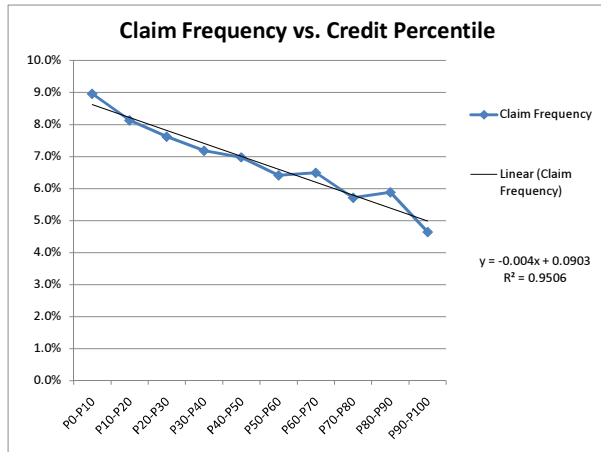|			Average Cost per		
Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
Average with Credit Score	594	6.8%	6,582	450	76%
Average without Credit Score	665	6.0%	7,609	458	69%

Company	(Multiple Items)
Line of Business	Property
Province	(All)
Accident Year	2009
Credit Score used in Rating	(All)

	Values								
	Sum of Total	Sum of Total	Sum of Number	Sum of Incurred	Average		Average Cost per		
Row Labels	Exposure	Premium	of claims	claims	Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	409,333	279,020,400	18,668	156,624,290	682	4.6%	8,390	383	56%
P0-P10	94,144	66,710,644	6,338	59,845,399	709	6.7%	9,442	636	90%
P10-P20	88,397	60,396,330	5,385	48,258,642	683	6.1%	8,962	546	80%
P20-P30	92,336	60,474,961	5,200	41,098,996	655	5.6%	7,904	445	68%
P30-P40	97,763	62,804,631	5,235	42,544,465	642	5.4%	8,127	435	68%
P40-P50	90,041	56,451,975	4,608	36,247,681	627	5.1%	7,866	403	64%
P50-P60	90,426	55,022,937	4,266	34,053,332	608	4.7%	7,982	377	62%
P60-P70	99,278	58,792,978	4,632	31,240,078	592	4.7%	6,744	315	53%
P70-P80	94,873	55,097,826	4,063	33,382,561	581	4.3%	8,216	352	61%
P80-P90	86,631	48,503,667	3,473	24,969,798	560	4.0%	7,190	288	51%
P90-P100	83,060	44,900,157	2,946	20,368,056	541	3.5%	6,914	245	45%
Grand Total	1,326,281	848,176,505	64,814	528,633,298	640	4.9%	8,156	399	62%
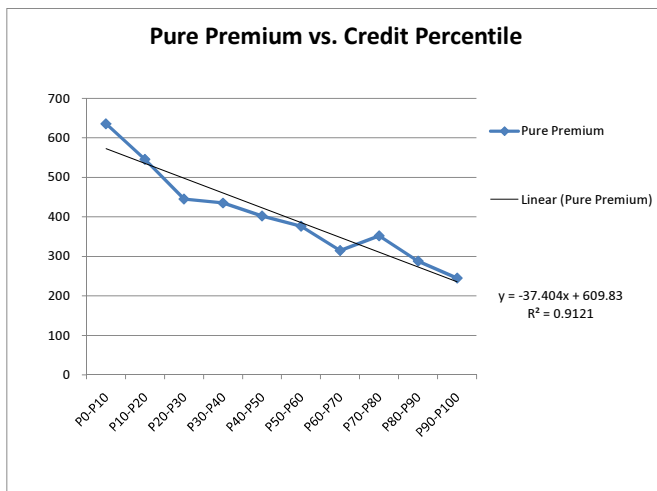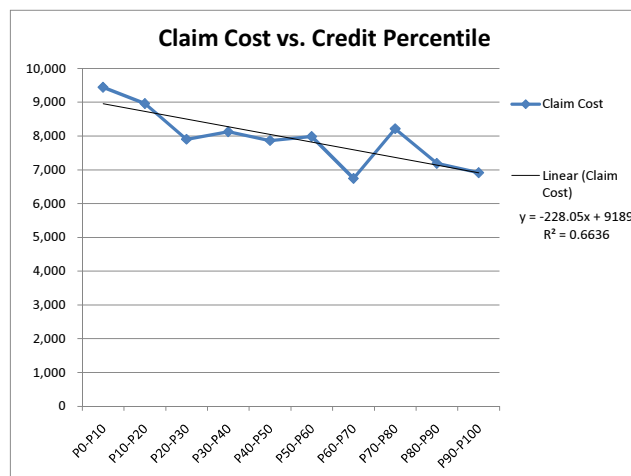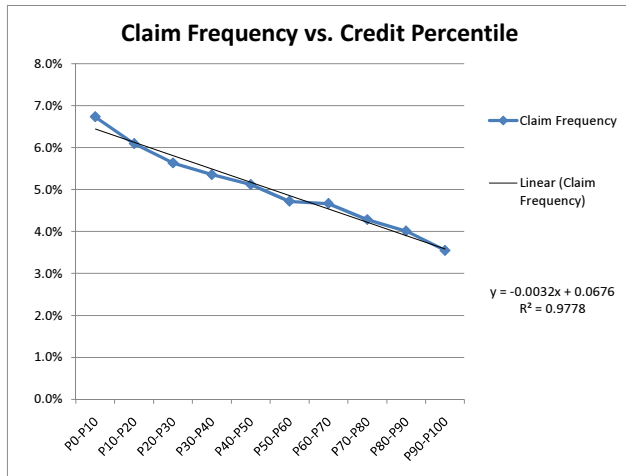
Claim Frequency vs. Credit Percentile

y = -0.0032x + 0.0676
R² = 0.9778

Claim Cost vs. Credit Percentile

y = -228.05x + 9189
R² = 0.6636

Pure Premium vs. Credit Percentile

y = -37.404x + 609.83
R² = 0.9121

Loss Ratio vs. Credit Percentile

y = -0.0413x + 0.869
R² = 0.8889

		Average		Average Cost per		
Comparison of exposures with credit score to those without		Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
Average with Credit Score		621	5.0%	8,062	406	65%
Average without Credit Score		682	4.6%	8,390	383	56%

CADRI Credit Score Quantitative Analysis

Appendix C

Credit Scores Used/Not Used in Rating

Company	(All)	
Line of Business	Automobile	
Province	(All)	
Accident Year	2007-2009	
Credit Score used in Rating	Y	

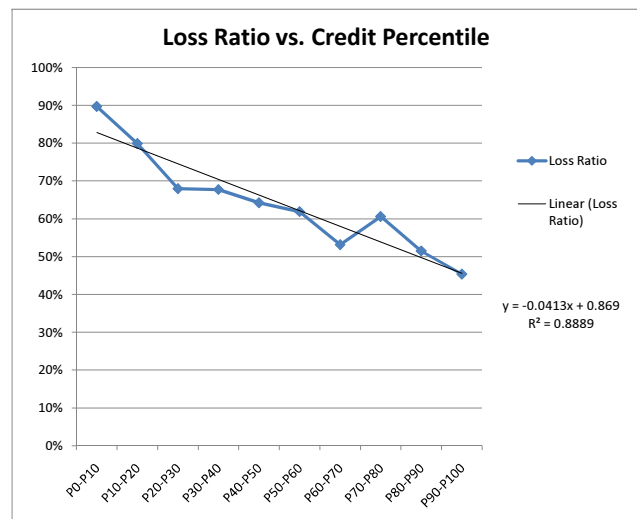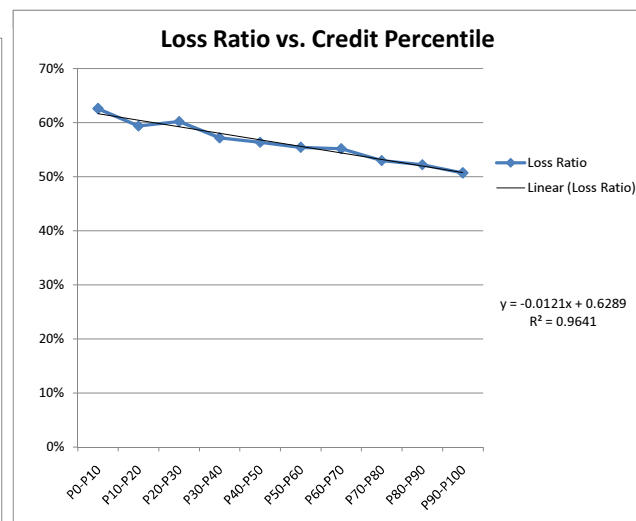|	Values								
Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	1,371,739	743,122,071	211,279	430,376,442	542	15.4%	2,037	314	58%
P0-P10	273,960	188,558,268	47,898	118,003,705	688	17.5%	2,464	431	63%
P10-P20	271,004	182,102,004	46,739	108,120,360	672	17.2%	2,313	399	59%
P20-P30	273,711	174,785,437	45,520	105,217,269	639	16.6%	2,311	384	60%
P30-P40	275,811	167,945,825	44,633	96,048,094	609	16.2%	2,152	348	57%
P40-P50	283,051	165,408,884	44,503	93,230,110	584	15.7%	2,095	329	56%
P50-P60	265,564	150,652,098	40,873	83,505,771	567	15.4%	2,043	314	55%
P60-P70	301,934	163,216,702	45,373	90,006,135	541	15.0%	1,984	298	55%
P70-P80	250,602	131,774,294	35,312	69,808,708	526	14.1%	1,977	279	53%
P80-P90	278,658	137,138,747	37,921	71,598,676	492	13.6%	1,888	257	52%
P90-P100	232,183	107,530,132	28,368	54,516,060	463	12.2%	1,922	235	51%
Grand Total	4,078,218	2,312,234,463	628,419	1,320,431,331	567	15.4%	2,101	324	57%
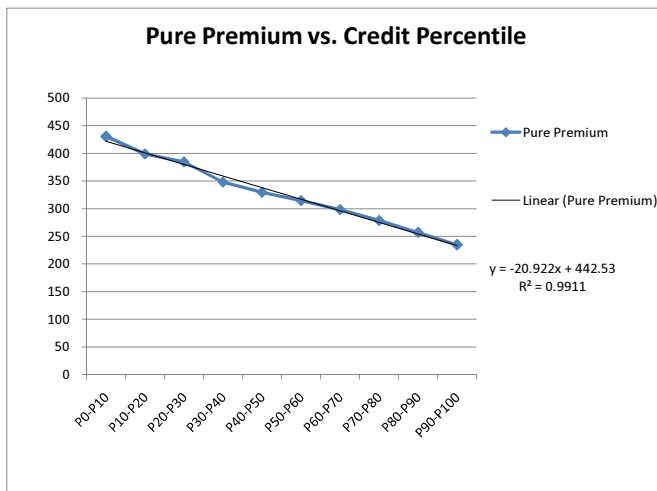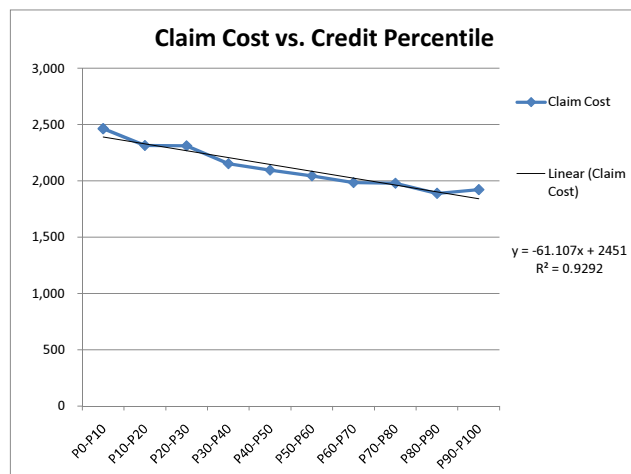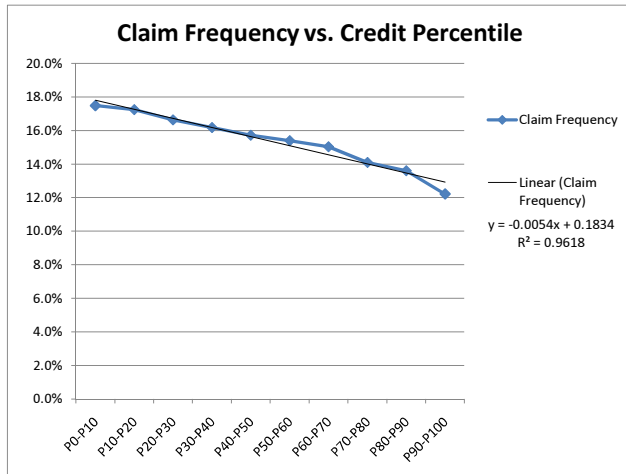
Claim Frequency vs. Credit Percentile

y = -0.0054x + 0.1834
R² = 0.9618

Claim Cost vs. Credit Percentile

y = -61.107x + 2451
R² = 0.9292

Pure Premium vs. Credit Percentile

y = -20.922x + 442.53
R² = 0.9911

Loss Ratio vs. Credit Percentile

y = -0.0121x + 0.6289
R² = 0.9641

	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Comparison of exposures with credit score to those without					
Average with Credit Score	580	15.4%	2,134	329	57%
Average without Credit Score	542	15.4%	2,037	314	58%

Company   (All)
Line of Business   Automobile
Province   (All)
Accident Year   2007-2009
Credit Score used in Rating   N

Row Labels	Values Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	2,136,360	2,546,595,748	211,770	1,577,442,894	1,192	9.9%	7,449	738	62%
P0-P10	244,994	365,121,913	37,442	393,128,449	1,490	15.3%	10,500	1,605	108%
P10-P20	244,109	355,976,271	32,555	299,063,015	1,458	13.3%	9,186	1,225	84%
P20-P30	245,340	344,935,313	30,149	263,476,358	1,406	12.3%	8,739	1,074	76%
P30-P40	242,948	333,534,157	28,147	228,473,466	1,373	11.6%	8,117	940	69%
P40-P50	252,994	337,252,577	27,521	198,050,009	1,333	10.9%	7,196	783	59%
P50-P60	241,574	311,875,799	25,281	182,397,580	1,291	10.5%	7,215	755	58%
P60-P70	247,125	307,592,582	24,427	169,340,853	1,245	9.9%	6,933	685	55%
P70-P80	250,771	296,476,175	23,353	137,876,824	1,182	9.3%	5,904	550	47%
P80-P90	242,453	277,008,204	21,304	147,739,064	1,143	8.8%	6,935	609	53%
P90-P100	228,046	238,926,388	17,413	94,241,785	1,048	7.6%	5,412	413	39%
Grand Total	4,576,714	5,715,295,127	479,362	3,691,230,299	1,249	10.5%	7,700	807	65%

Claim Frequency vs. Credit Percentile

$y = -0.0073x + 0.1498$
$R^2 = 0.9576$

Claim Cost vs. Credit Percentile

$y = -480.36x + 10256$
$R^2 = 0.8916$

Pure Premium vs. Credit Percentile

$y = -111.8x + 1478.9$
$R^2 = 0.8998$

Loss Ratio vs. Credit Percentile
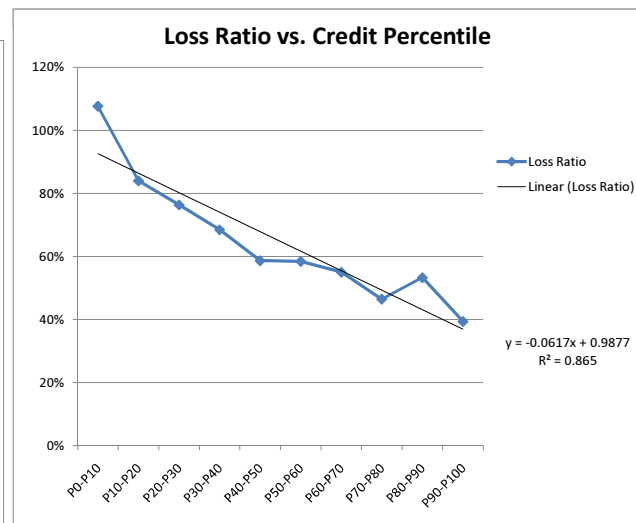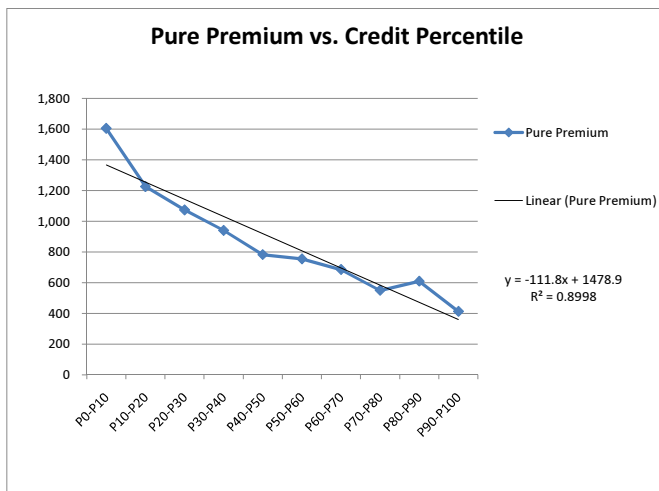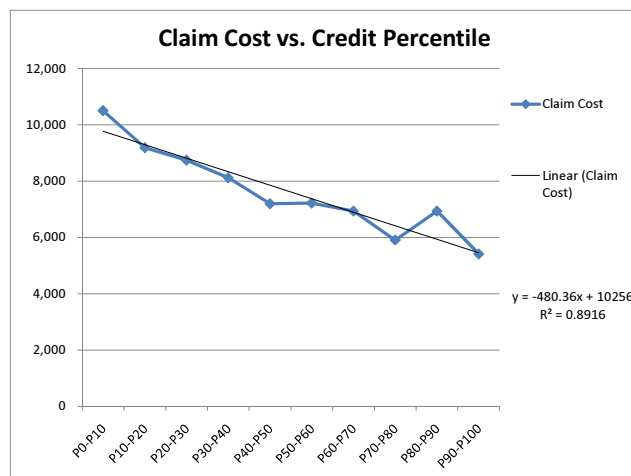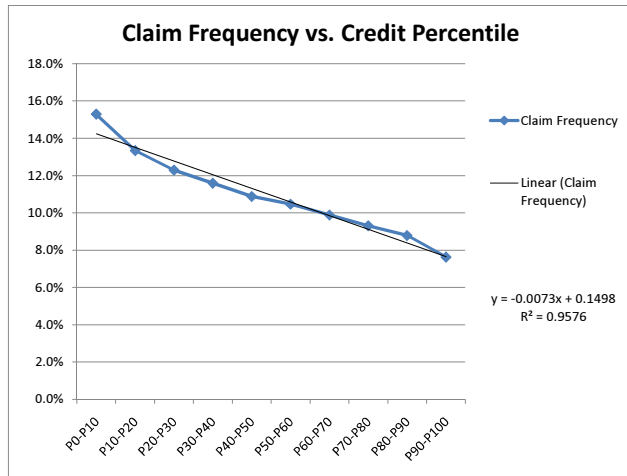
$y = -0.0617x + 0.9877$
$R^2 = 0.865$

Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Average with Credit Score	1,298	11.0%	7,899	866	67%
Average without Credit Score	1,192	9.9%	7,449	738	62%

CADRI Credit Score Quantitative Analysis

Appendix D

Prince Edward Island

<u>Appendix D – Prince Edward Island</u>

<u>Automobile</u>

Swings due to limited data resulted in low R-squared values for the regressions. Credit score data was available for almost 53% of the exposures submitted for analysis. Additional data is available for the Atlantic Provinces in Appendix O. Data was not parsed further into accident years because of limited exposures.

<u>Property</u>

Limited data prevented meaningful regressions from being performed on the data. Large individual losses skew the results and the analyses experienced low R-squared values. The data was not separated further into accident years because of this. Credit score data was available for 60% of the exposures submitted for analysis.

Company	(All)							
Line of Business	Automobile							
Province	PE							
Accident Year	2007-2009							
Credit Score used in Rating	(All)							

Row Labels	Values Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	13,682	9,638,508	1,151	3,101,930	704	8.4%	2,695	227	32%
P0-P10	1,538	1,231,387	173	522,468	801	11.2%	3,020	340	42%
P10-P20	1,568	1,270,886	139	307,604	811	8.9%	2,213	196	24%
P20-P30	1,495	1,196,082	183	555,628	800	12.2%	3,036	372	46%
P30-P40	1,546	1,217,640	119	214,014	788	7.7%	1,798	138	18%
P40-P50	1,589	1,248,689	181	441,208	786	11.4%	2,438	278	35%
P50-P60	1,493	1,172,809	168	279,637	786	11.3%	1,665	187	24%
P60-P70	1,626	1,262,285	157	345,555	776	9.7%	2,201	213	27%
P70-P80	1,495	1,100,773	129	235,027	736	8.6%	1,822	157	21%
P80-P90	1,626	1,189,723	149	241,841	732	9.2%	1,623	149	20%
P90-P100	1,291	937,952	100	175,618	727	7.7%	1,756	136	19%
Grand Total	28,949	21,466,735	2,649	6,420,531	742	9.2%	2,424	222	30%
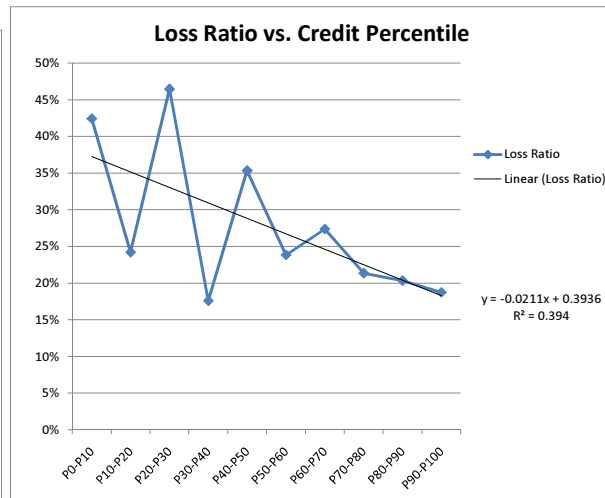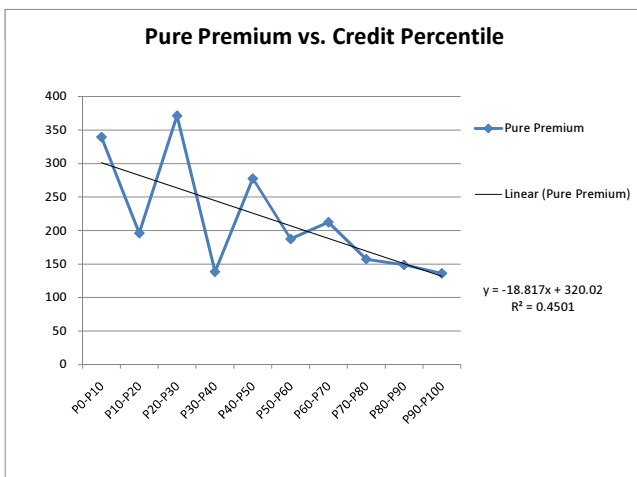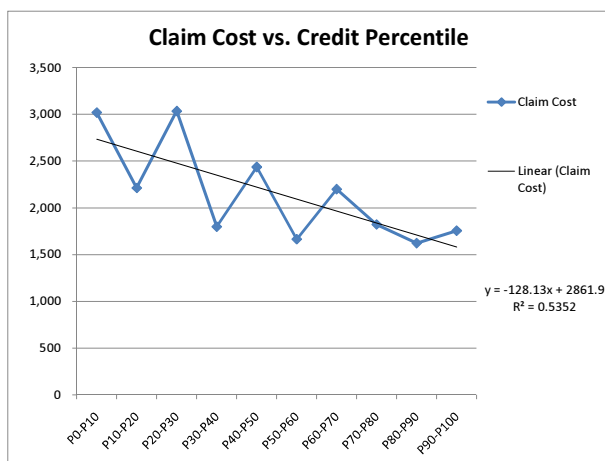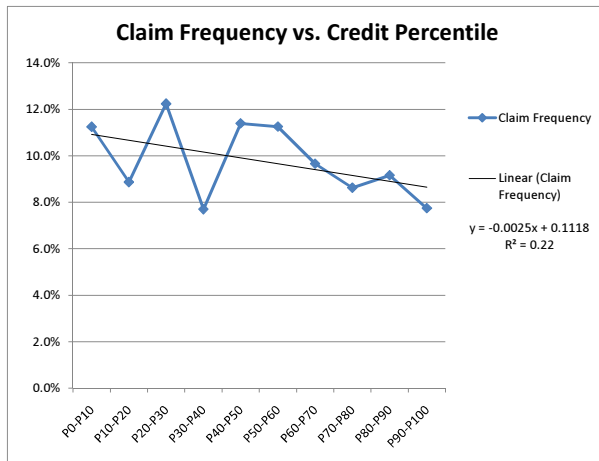
Claim Frequency vs. Credit Percentile

$y = -0.0025x + 0.1118$
$R^2 = 0.22$

Claim Cost vs. Credit Percentile

$y = -128.13x + 2861.9$
$R^2 = 0.5352$

Pure Premium vs. Credit Percentile

$y = -18.817x + 320.02$
$R^2 = 0.4501$

Loss Ratio vs. Credit Percentile

$y = -0.0211x + 0.3936$
$R^2 = 0.394$

Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Average with Credit Score	775	9.8%	2,215	217	28%
Average without Credit Score	704	8.4%	2,695	227	32%

Company	(Multiple Items)								
Line of Business	Property								
Province	PE								
Accident Year	2007-2009								
Credit Score used in Rating	(All)								

Row Labels	Values Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	1,947	1,106,520	111	915,196	568	5.7%	8,245	470	83%
P0-P10	293	173,161	20	158,027	591	6.8%	7,901	540	91%
P10-P20	293	174,595	16	191,652	597	5.5%	11,978	655	110%
P20-P30	290	162,002	19	181,238	560	6.6%	9,539	626	112%
P30-P40	286	155,064	15	55,507	542	5.2%	3,700	194	36%
P40-P50	314	169,334	24	129,491	539	7.6%	5,395	412	76%
P50-P60	283	152,147	17	132,935	537	6.0%	7,820	469	87%
P60-P70	315	162,866	21	169,275	517	6.7%	8,061	538	104%
P70-P80	299	148,884	16	58,525	497	5.3%	3,658	195	39%
P80-P90	273	136,130	13	472,710	498	4.8%	36,362	1,729	347%
P90-P100	244	119,519	7	37,642	490	2.9%	5,377	154	31%
Grand Total	4,838	2,660,221	279	2,502,199	550	5.8%	8,968	517	94%

Claim Frequency vs. Credit Percentile

y = -0.0027x + 0.0721
R² = 0.3659

Claim Cost vs. Credit Percentile

y = 812.56x + 5510.1
R² = 0.0653

Pure Premium vs. Credit Percentile

y = 18.112x + 451.67
R² = 0.0147

Loss Ratio vs. Credit Percentile

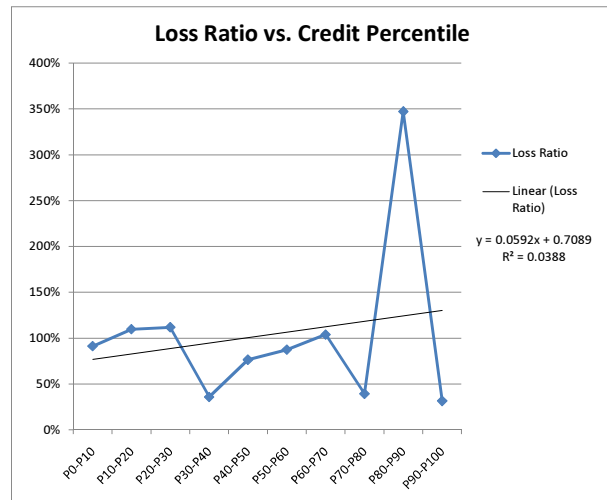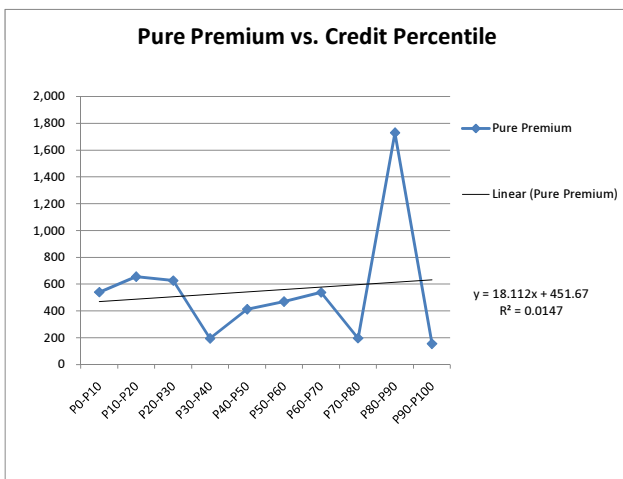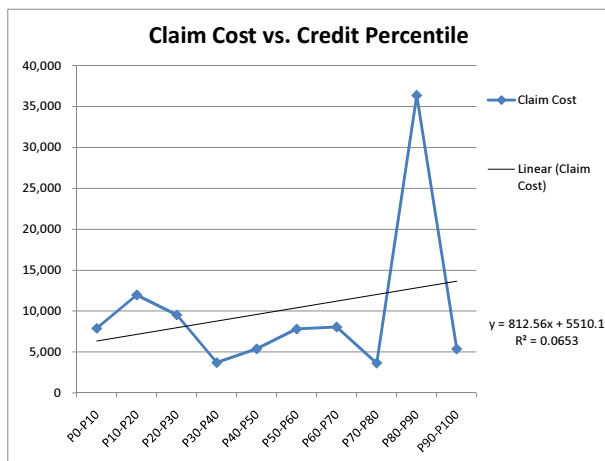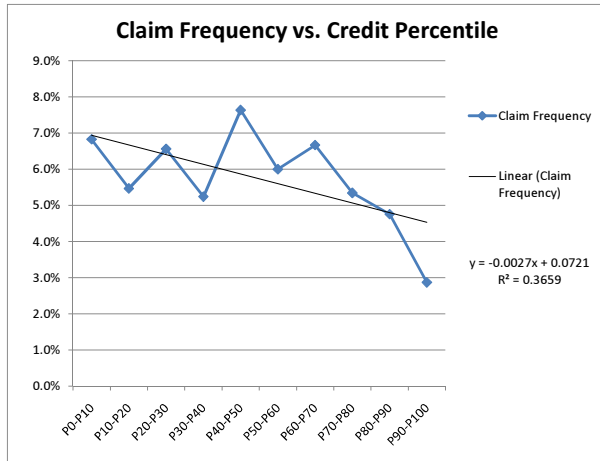y = 0.0592x + 0.7089
R² = 0.0388

Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Average with Credit Score	538	5.8%	9,446	549	102%
Average without Credit Score	568	5.7%	8,245	470	83%

<u>Appendix E – Atlantic Provinces (NB, NS, NF, PE)</u>

<u>Automobile</u>

Combined, the Atlantic Provinces showed a high correlation between claim frequency, pure premium and loss ratio and credit score (R^2 = 0.9549, 0.8622, 0.8043). Pure premium ranged from 228 to 530 over the best to worst credit percentiles around an average of 343. Loss ratios ranged from 30% to 58% around an average of 41%. Claim cost showed a less significant correlation (R^2 = 0.4585), but was affected by swings in the data. Credit score data was available for 49% of the exposures submitted for analysis.

Across accident years 2007-2009, claim frequency consistently showed correlation with credit score. Pure premium and loss ratio regressions varied in their R-squared values, but also showed support for the fact that better credit scores are associated with lower pure premiums and lower loss ratios. Claim cost regressions had R-squared values all under 0.3.

<u>Property</u>

Regressions showed support for better credit scores being correlated with lower claim frequency, lower pure premium and lower loss ratios. On a total of accident years 2007-2009 the R-squared values were 0.8716, 0.6552 and 0.579 for the regressions of claim frequency, pure premium and loss ratio respectively. Credit score data was available for 52% of exposures submitted for analysis.

Accident years 2007 and 2009 showed large swings in the data. 2008 was the smoothest of the individual years with R-squared values of 0.8472 and 0.8175 for the regressions of pure premium and loss ratio. In this year, pure premiums ranged from 345 (lowest was 316 in the 70-80th percentile) to 128 for those with the best to those with the worst credit scores (average of 547). Loss ratios ranged from 60% to 128% (50% in the 70-80th percentile) for those same credit scores (average of 81%). The data warrants further analysis, but does support better credit scores being correlated with lower claim frequency, lower pure premium and lower loss ratios.
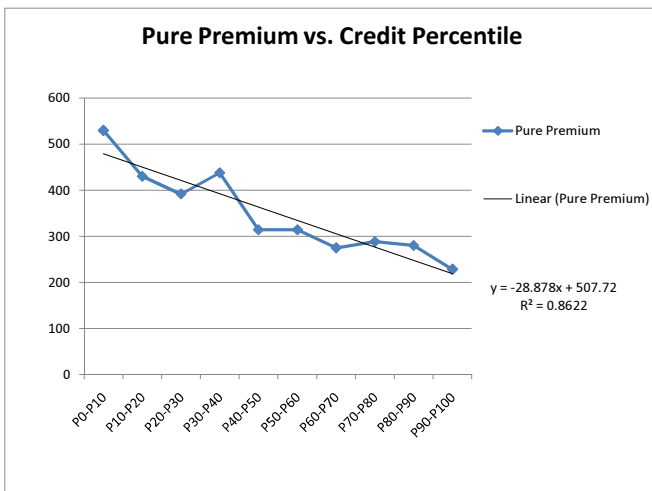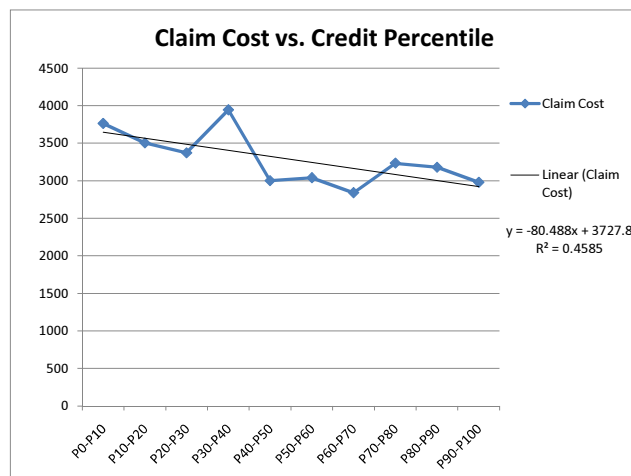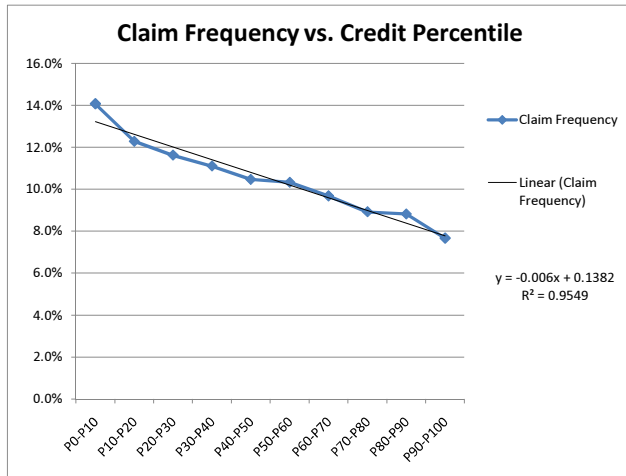
Company	(All)
Line of Business	Automobile
Province	Atlantic
Accident Year	2007-2009
Credit Score used in Rating	(All)

	Values							
Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	174,181	145,977,596	16,501	57,209,604	838	9.5%	3467	328	39%
P0-P10	17,397	15,808,399	2,448	9,212,704	909	14.1%	3763	530	58%
P10-P20	17,196	15,415,316	2,112	7,397,060	896	12.3%	3502	430	48%
P20-P30	17,134	15,160,839	1,991	6,710,104	885	11.6%	3370	392	44%
P30-P40	17,164	15,029,931	1,905	7,514,857	876	11.1%	3945	438	50%
P40-P50	17,865	15,333,943	1,870	5,608,158	858	10.5%	2999	314	37%
P50-P60	17,072	14,443,775	1,763	5,359,688	846	10.3%	3040	314	37%
P60-P70	17,731	14,619,724	1,716	4,873,600	825	9.7%	2840	275	33%
P70-P80	17,288	13,948,610	1,542	4,985,051	807	8.9%	3233	288	36%
P80-P90	17,225	13,620,989	1,519	4,827,307	791	8.8%	3178	280	35%
P90-P100	15,683	11,988,237	1,202	3,582,051	764	7.7%	2980	228	30%
Grand Total	345,937	291,347,361	34,569	117,280,184	842	10.0%	3393	339	40%
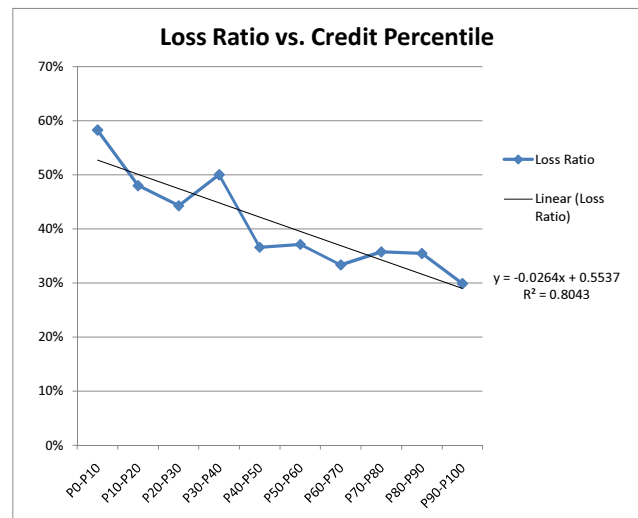
Claim Frequency vs. Credit Percentile

$y = -0.006x + 0.1382$
$R^2 = 0.9549$

Claim Cost vs. Credit Percentile

$y = -80.488x + 3727.8$
$R^2 = 0.4585$

Pure Premium vs. Credit Percentile

$y = -28.878x + 507.72$
$R^2 = 0.8622$

Loss Ratio vs. Credit Percentile

$y = -0.0264x + 0.5537$
$R^2 = 0.8043$

Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Average with Credit Score	846	10.5%	3,325	350	41%
Average without Credit Score	838	9.5%	3,467	328	39%

Company	(All)
Line of Business	Automobile
Province	Atlantic
Accident Year	2007
Credit Score used in Rating	(All)

	Values								
Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	67,663	57,835,158	6,378	23,671,708	855	9.4%	3711	350	41%
P0-P10	4,455	4,092,364	590	2,403,637	919	13.2%	4074	540	59%
P10-P20	4,400	3,983,673	490	1,665,317	905	11.1%	3399	378	42%
P20-P30	4,452	3,958,002	477	1,770,432	889	10.7%	3712	398	45%
P30-P40	4,436	3,899,912	469	1,629,399	879	10.6%	3474	367	42%
P40-P50	4,482	3,898,887	441	1,650,821	870	9.8%	3743	368	42%
P50-P60	4,595	3,895,393	431	1,446,785	848	9.4%	3357	315	37%
P60-P70	4,410	3,677,877	390	1,218,497	834	8.8%	3124	276	33%
P70-P80	4,351	3,527,350	413	1,659,634	811	9.5%	4018	381	47%
P80-P90	4,360	3,483,796	336	1,079,698	799	7.7%	3213	248	31%
P90-P100	4,238	3,281,172	292	899,555	774	6.9%	3081	212	27%
Grand Total	111,840	95,533,584	10,707	39,095,482	854	9.6%	3651	350	41%

Claim Frequency vs. Credit Percentile

$y = -0.0056x + 0.1288$
$R^2 = 0.8993$

Claim Cost vs. Credit Percentile

$y = -61.441x + 3857.5$
$R^2 = 0.2759$

Pure Premium vs. Credit Percentile

$y = -25.873x + 490.69$
$R^2 = 0.7198$

Loss Ratio vs. Credit Percentile

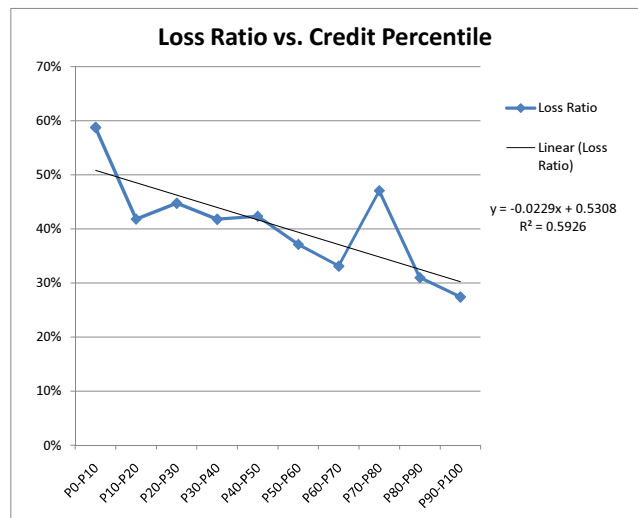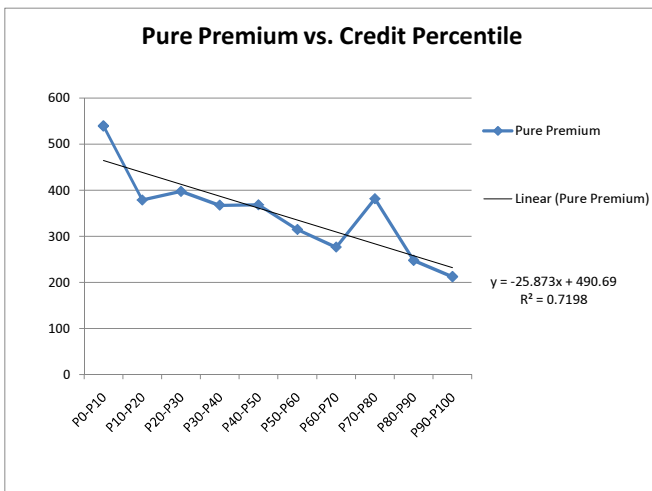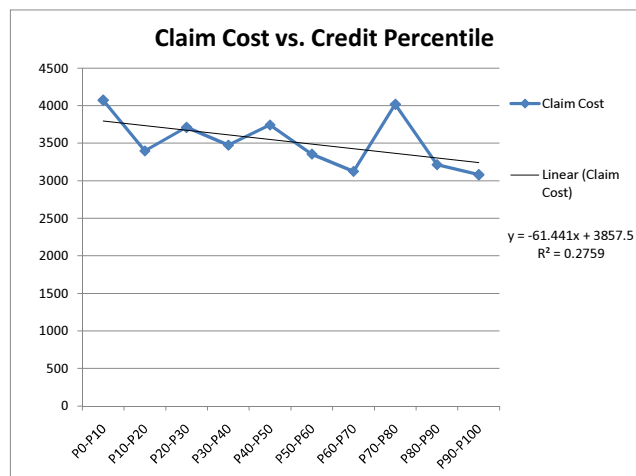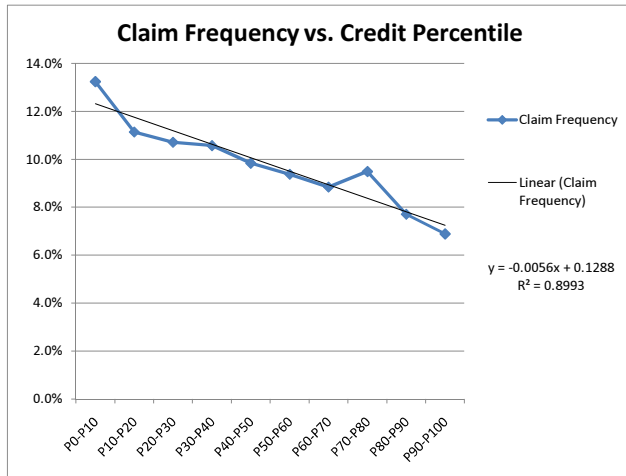$y = -0.0229x + 0.5308$
$R^2 = 0.5926$

Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Average with Credit Score	853	9.8%	3,563	349	41%
Average without Credit Score	855	9.4%	3,711	350	41%

Company	(All)
Line of Business	Automobile
Province	Atlantic
Accident Year	2008
Credit Score used in Rating	(All)

	Values								
Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	55,925	46,546,544	5,268	18,092,333	832	9.4%	3434	324	39%
P0-P10	6,012	5,461,749	829	3,257,440	908	13.8%	3929	542	60%
P10-P20	5,943	5,291,663	695	2,645,452	890	11.7%	3806	445	50%
P20-P30	5,813	5,093,202	642	1,917,380	876	11.0%	2987	330	38%
P30-P40	5,962	5,202,526	661	3,306,680	873	11.1%	5003	555	64%
P40-P50	5,980	5,067,874	619	1,860,144	848	10.4%	3005	311	37%
P50-P60	6,024	5,059,591	618	1,873,236	840	10.3%	3031	311	37%
P60-P70	6,307	5,182,012	628	1,695,573	822	10.0%	2700	269	33%
P70-P80	5,842	4,692,764	516	1,500,744	803	8.8%	2908	257	32%
P80-P90	5,779	4,544,716	518	1,514,962	786	9.0%	2925	262	33%
P90-P100	5,462	4,153,199	410	1,293,688	760	7.5%	3155	237	31%
Grand Total	115,047	96,295,839	11,404	38,957,631	837	9.9%	3416	339	40%
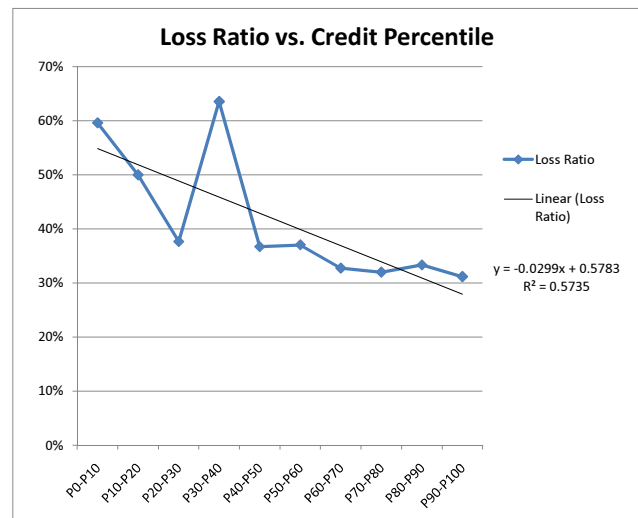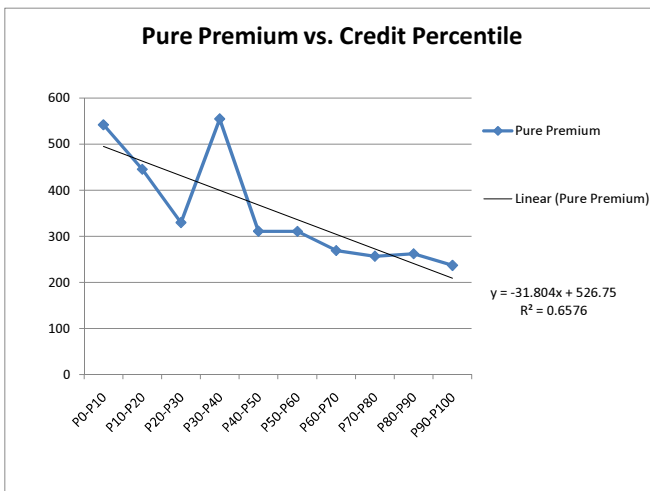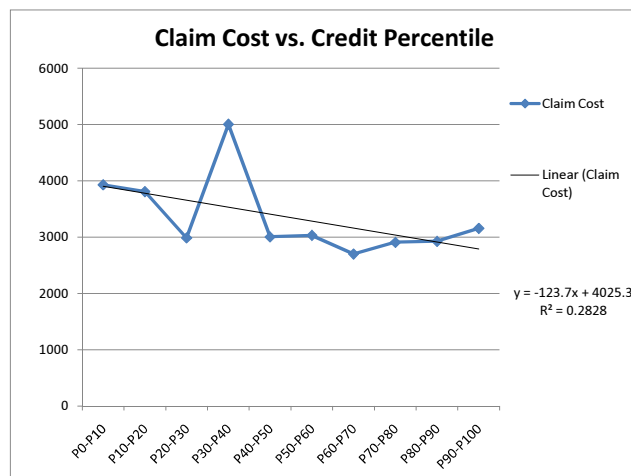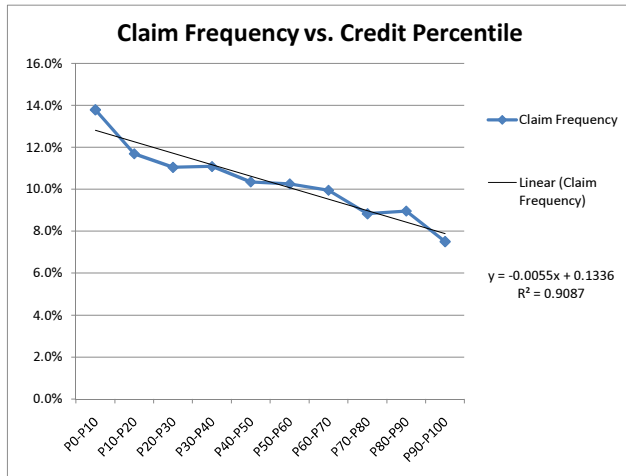
Claim Frequency vs. Credit Percentile

$y = -0.0055x + 0.1336$
$R^2 = 0.9087$

Claim Cost vs. Credit Percentile

$y = -123.7x + 4025.3$
$R^2 = 0.2828$

Pure Premium vs. Credit Percentile

$y = -31.804x + 526.75$
$R^2 = 0.6576$

Loss Ratio vs. Credit Percentile

$y = -0.0299x + 0.5783$
$R^2 = 0.5735$

Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Average with Credit Score	841	10.4%	3,400	353	42%
Average without Credit Score	832	9.4%	3,434	324	39%

Company	(All)								
Line of Business	Automobile								
Province	Atlantic								
Accident Year	2009								
Credit Score used in Rating	(All)								

	Values								
Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	50,593	41,595,895	4,855	15,445,564	822	9.6%	3181	305	37%
P0-P10	6,930	6,254,287	1,029	3,551,627	903	14.8%	3452	513	57%
P10-P20	6,854	6,139,980	927	3,086,292	896	13.5%	3329	450	50%
P20-P30	6,869	6,109,635	872	3,022,292	889	12.7%	3466	440	49%
P30-P40	6,766	5,927,494	775	2,578,779	876	11.5%	3327	381	44%
P40-P50	7,403	6,367,182	810	2,097,193	860	10.9%	2589	283	33%
P50-P60	6,453	5,488,792	714	2,039,667	851	11.1%	2857	316	37%
P60-P70	7,015	5,759,835	698	1,959,530	821	10.0%	2807	279	34%
P70-P80	7,095	5,728,496	613	1,824,673	807	8.6%	2977	257	32%
P80-P90	7,087	5,592,477	665	2,232,647	789	9.4%	3357	315	40%
P90-P100	5,984	4,553,866	500	1,388,808	761	8.4%	2778	232	30%
Grand Total	119,050	99,517,938	12,458	39,227,071	836	10.5%	3149	330	39%

Claim Frequency vs. Credit Percentile

$y = -0.0068x + 0.1482$
$R^2 = 0.9405$

Claim Cost vs. Credit Percentile

$y = -58.232x + 3414.2$
$R^2 = 0.2937$

Pure Premium vs. Credit Percentile

$y = -28.224x + 501.92$
$R^2 = 0.824$

Loss Ratio vs. Credit Percentile

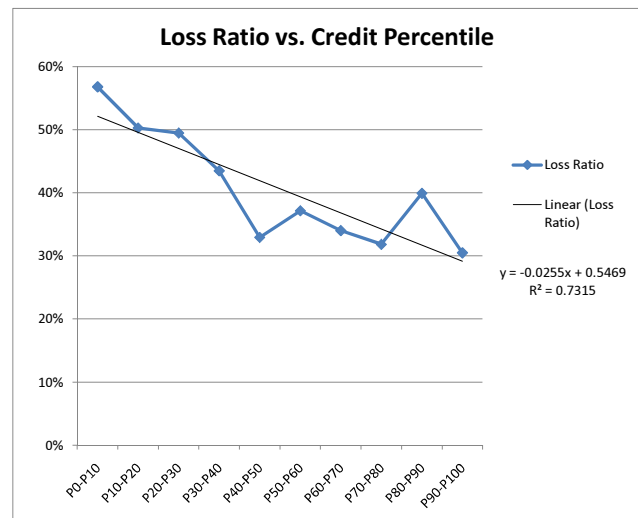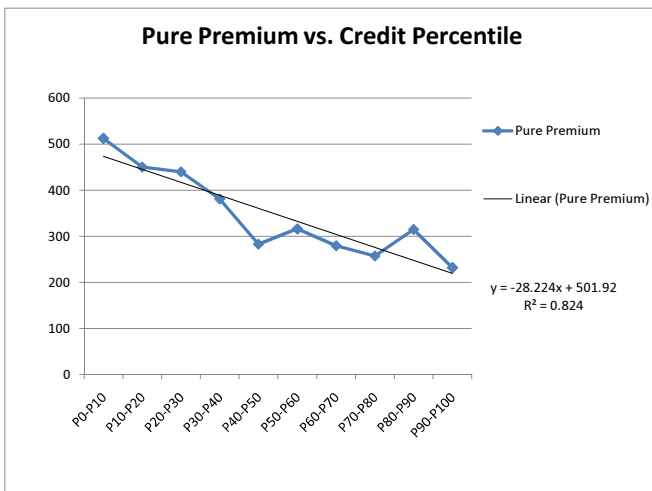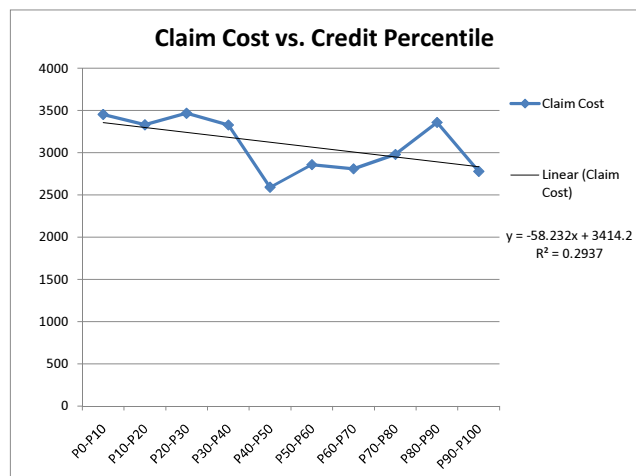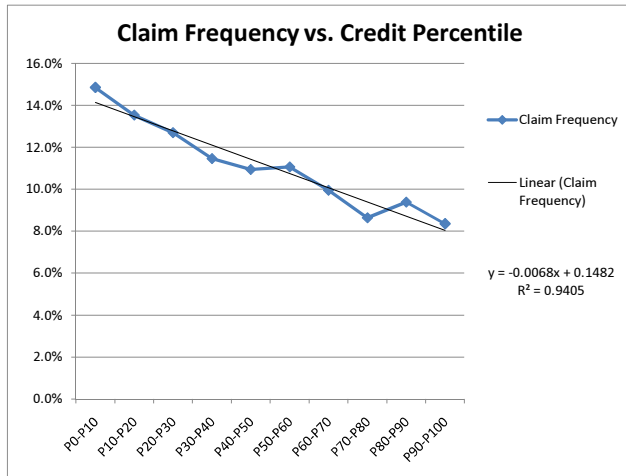$y = -0.0255x + 0.5469$
$R^2 = 0.7315$

Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Average with Credit Score	846	11.1%	3,128	347	41%
Average without Credit Score	822	9.6%	3,181	305	37%

Company	(Multiple Items)
Line of Business	Property
Province	Atlantic
Accident Year	2007-2009
Credit Score used in Rating	(All)

	Values								
Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	58,718	40,273,723	2,384	27,802,697	686	4.1%	11662	473	69%
P0-P10	6,323	4,603,756	424	6,242,544	728	6.7%	14723	987	136%
P10-P20	6,268	4,458,409	324	3,779,931	711	5.2%	11666	603	85%
P20-P30	6,315	4,383,935	316	2,924,875	694	5.0%	9256	463	67%
P30-P40	6,354	4,235,627	303	3,222,548	667	4.8%	10635	507	76%
P40-P50	6,497	4,278,466	315	3,404,122	659	4.8%	10807	524	80%
P50-P60	6,131	3,988,367	278	3,888,602	651	4.5%	13988	634	97%
P60-P70	6,710	4,299,324	271	2,513,033	641	4.0%	9273	375	58%
P70-P80	6,194	3,917,476	217	1,967,807	633	3.5%	9068	318	50%
P80-P90	6,221	3,753,147	217	2,263,841	603	3.5%	10432	364	60%
P90-P100	5,649	3,301,359	195	1,496,056	584	3.5%	7672	265	45%
Grand Total	121,380	81,493,591	5,244	59,506,056	671	4.3%	11347	490	73%

Claim Frequency vs. Credit Percentile

y = -0.0031x + 0.0625
R² = 0.8716

Claim Cost vs. Credit Percentile

y = -448.12x + 13217
R² = 0.377

Pure Premium vs. Credit Percentile

y = -55.703x + 810.35
R² = 0.6552

Loss Ratio vs. Credit Percentile

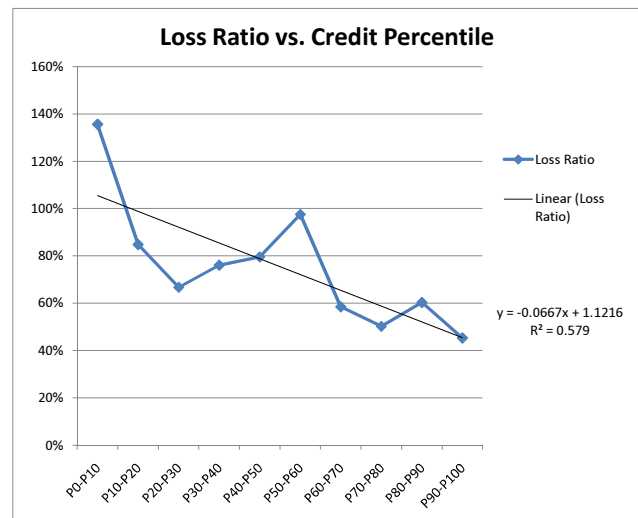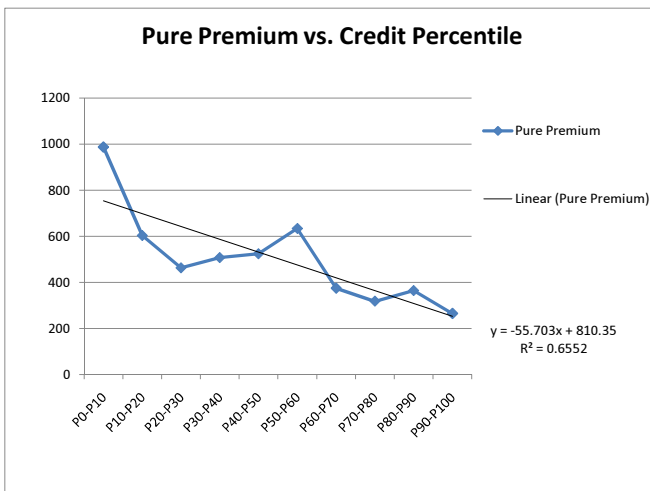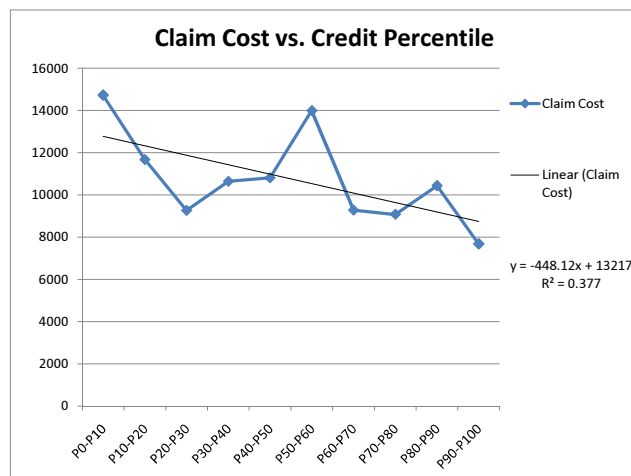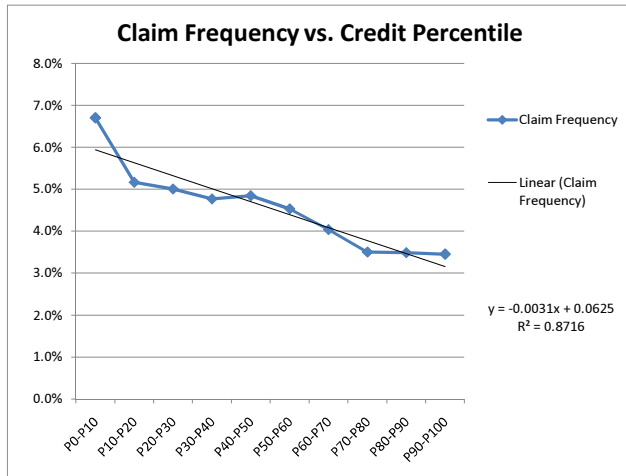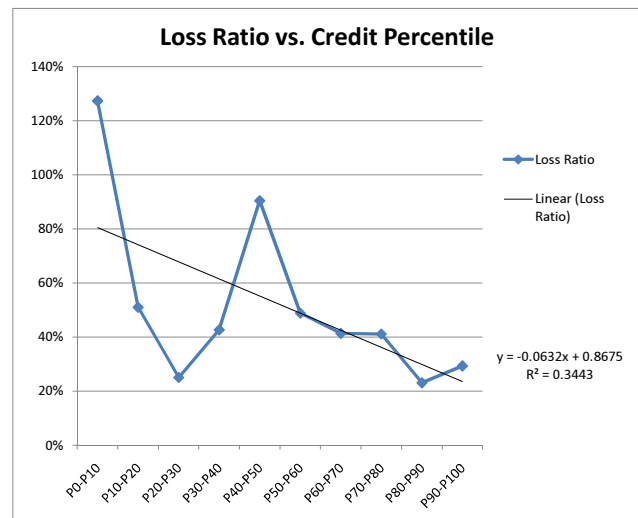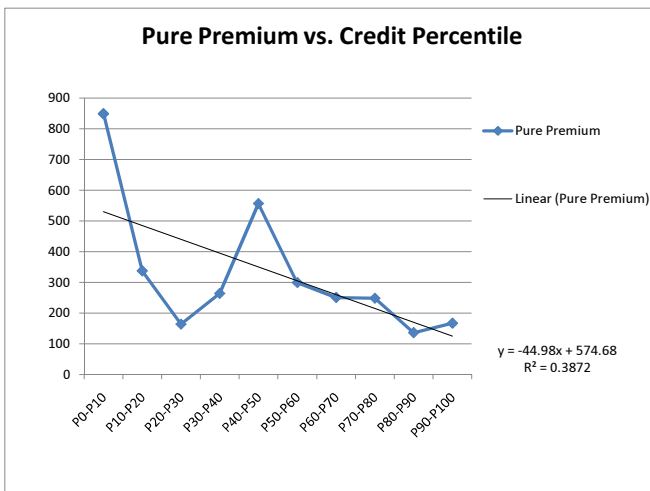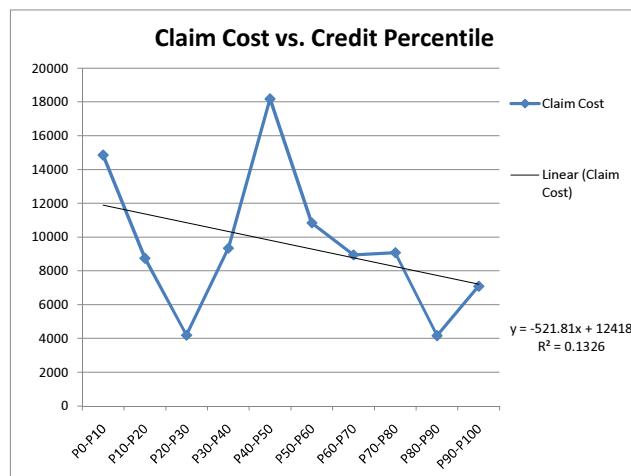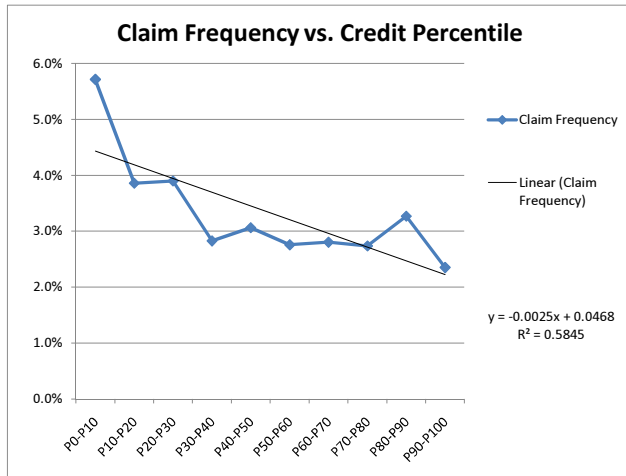y = -0.0667x + 1.1216
R² = 0.579

Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Average with Credit Score	658	4.6%	11,085	506	77%
Average without Credit Score	686	4.1%	11,662	473	69%

Company	(Multiple Items)							
Line of Business	Property							
Province	Atlantic							
Accident Year	2007							
Credit Score used in Rating	(All)							

	Values							
	Sum of Total	Sum of Total	Sum of Number	Sum of Incurred	Average		Average Cost per	
Row Labels	Exposure	Premium	of claims	claims	Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	23,500	14,920,721	742	8,076,830	635	3.2%	10885	344	54%
P0-P10	1,436	957,299	82	1,219,105	667	5.7%	14867	849	127%
P10-P20	1,452	961,421	56	490,140	662	3.9%	8752	337	51%
P20-P30	1,436	941,512	56	234,989	656	3.9%	4196	164	25%
P30-P40	1,415	875,911	40	373,681	619	2.8%	9342	264	43%
P40-P50	1,567	965,478	48	872,857	616	3.1%	18185	557	90%
P50-P60	1,306	799,604	36	390,404	612	2.8%	10845	299	49%
P60-P70	1,534	930,281	43	384,808	607	2.8%	8949	251	41%
P70-P80	1,425	860,666	39	354,079	604	2.7%	9079	248	41%
P80-P90	1,346	795,949	44	183,409	591	3.3%	4168	136	23%
P90-P100	1,361	775,379	32	227,200	570	2.4%	7100	167	29%
Grand Total	37,778	23,784,221	1,218	12,807,503	630	3.2%	10515	339	54%

Claim Frequency vs. Credit Percentile

Claim Frequency; Linear (Claim Frequency)

y = -0.0025x + 0.0468
R² = 0.5845

Claim Cost vs. Credit Percentile

Claim Cost; Linear (Claim Cost)

y = -521.81x + 12418
R² = 0.1326

Pure Premium vs. Credit Percentile

Pure Premium; Linear (Pure Premium)

y = -44.98x + 574.68
R² = 0.3872

Loss Ratio vs. Credit Percentile

Loss Ratio; Linear (Loss Ratio)

y = -0.0632x + 0.8675
R² = 0.3443

	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Comparison of exposures with credit score to those without					
Average with Credit Score	621	3.3%	9,938	331	53%
Average without Credit Score	635	3.2%	10,885	344	54%

Company	(Multiple Items)							
Line of Business	Property							
Province	Atlantic							
Accident Year	2008							
Credit Score used in Rating	(All)							

Row Labels	Values Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	18,710	13,206,591	862	10,183,196	706	4.6%	11813	544	77%
P0-P10	2,147	1,555,303	146	1,996,974	724	6.8%	13678	930	128%
P10-P20	2,134	1,513,212	121	1,879,779	709	5.7%	15535	881	124%
P20-P30	2,130	1,455,557	110	1,467,176	683	5.2%	13338	689	101%
P30-P40	2,189	1,442,034	123	1,031,904	659	5.6%	8389	471	72%
P40-P50	2,093	1,357,183	119	1,227,595	648	5.7%	10316	586	90%
P50-P60	2,255	1,450,137	103	1,097,590	643	4.6%	10656	487	76%
P60-P70	2,275	1,430,602	109	936,437	629	4.8%	8591	412	65%
P70-P80	1,985	1,243,753	77	627,769	627	3.9%	8153	316	50%
P80-P90	2,300	1,360,005	84	832,532	591	3.7%	9911	362	61%
P90-P100	1,789	1,036,504	81	617,843	579	4.5%	7628	345	60%
Grand Total	40,007	27,050,880	1,935	21,898,795	676	4.8%	11317	547	81%

Claim Frequency vs. Credit Percentile

y = -0.0027x + 0.0652
R² = 0.7463

Claim Cost vs. Credit Percentile

y = -720.01x + 14580
R² = 0.6517

Pure Premium vs. Credit Percentile

y = -66.903x + 915.95
R² = 0.8472

Loss Ratio vs. Credit Percentile
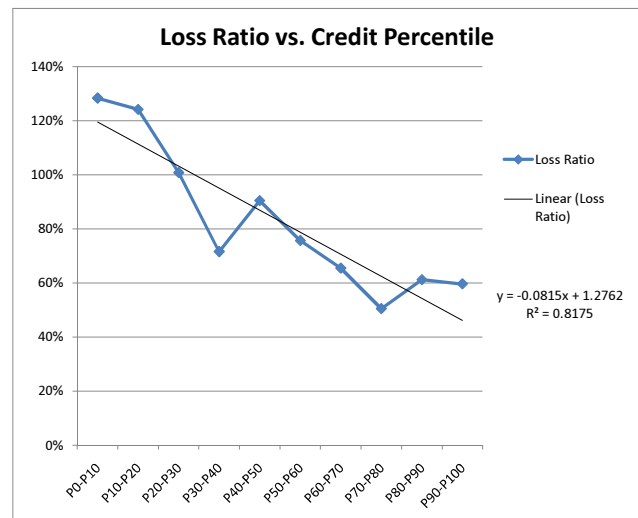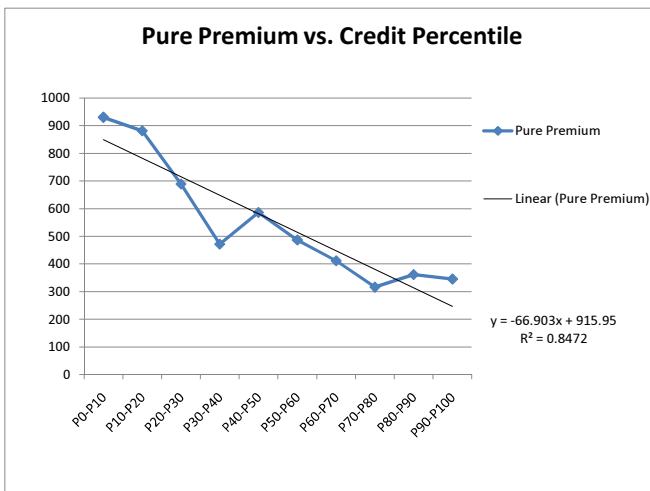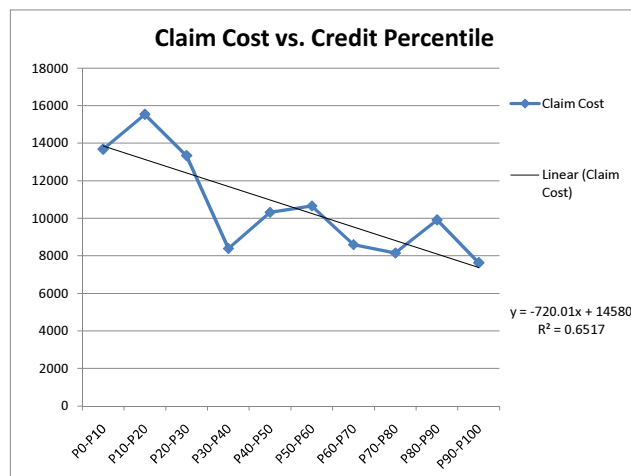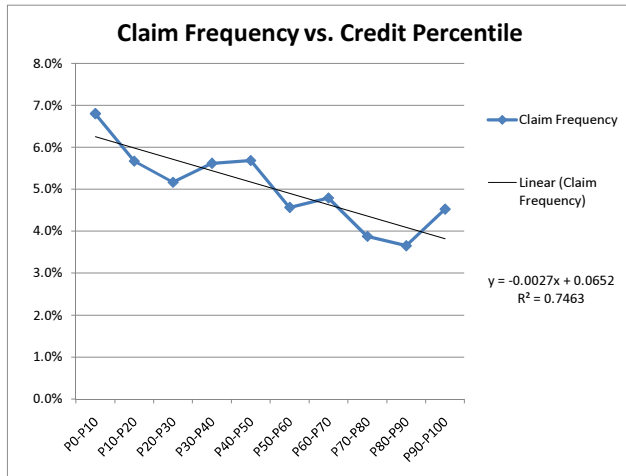
y = -0.0815x + 1.2762
R² = 0.8175

Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Average with Credit Score	650	5.0%	10,919	550	85%
Average without Credit Score	706	4.6%	11,813	544	77%

Company	(Multiple Items)
Line of Business	Property
Province	Atlantic
Accident Year	2009
Credit Score used in Rating	(All)

	Values						Average Cost per		
Row Labels	Sum of Total Exposure	Sum of Total Premium	Sum of Number of claims	Sum of Incurred claims	Average Premium	Claim Frequency	Claim	Pure Premium	Loss Ratio
No Hit, No Score, No Consent	16,508	12,146,411	780	9,542,671	736	4.7%	12234	578	79%
P0-P10	2,741	2,091,155	196	3,026,466	763	7.2%	15441	1104	145%
P10-P20	2,681	1,983,776	147	1,410,012	740	5.5%	9592	526	71%
P20-P30	2,750	1,986,867	150	1,222,710	723	5.5%	8151	445	62%
P30-P40	2,749	1,917,683	140	1,816,963	698	5.1%	12978	661	95%
P40-P50	2,837	1,955,805	148	1,303,670	689	5.2%	8809	460	67%
P50-P60	2,570	1,738,625	139	2,400,608	676	5.4%	17271	934	138%
P60-P70	2,901	1,938,441	119	1,191,788	668	4.1%	10015	411	61%
P70-P80	2,784	1,813,057	101	985,959	651	3.6%	9762	354	54%
P80-P90	2,576	1,597,193	89	1,247,900	620	3.5%	14021	484	78%
P90-P100	2,499	1,489,476	82	651,013	596	3.3%	7939	261	44%
Grand Total	43,595	30,658,490	2,091	24,799,758	703	4.8%	11860	569	81%

Claim Frequency vs. Credit Percentile

$y = -0.0037x + 0.0686$
$R^2 = 0.8641$

Claim Cost vs. Credit Percentile

$y = -175.07x + 12361$
$R^2 = 0.026$

Pure Premium vs. Credit Percentile

$y = -52.192x + 850.99$
$R^2 = 0.3563$

Loss Ratio vs. Credit Percentile
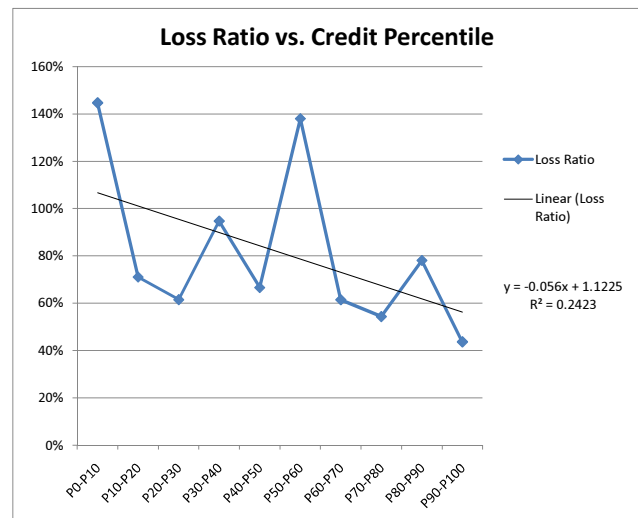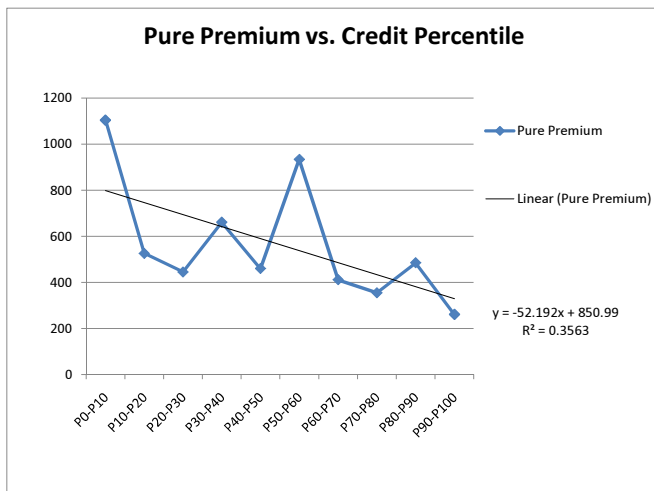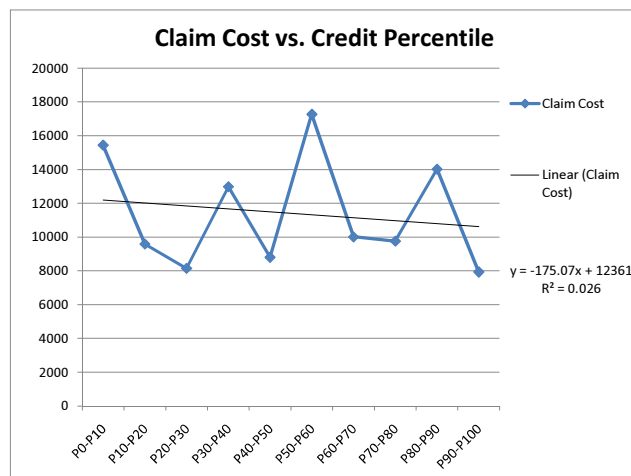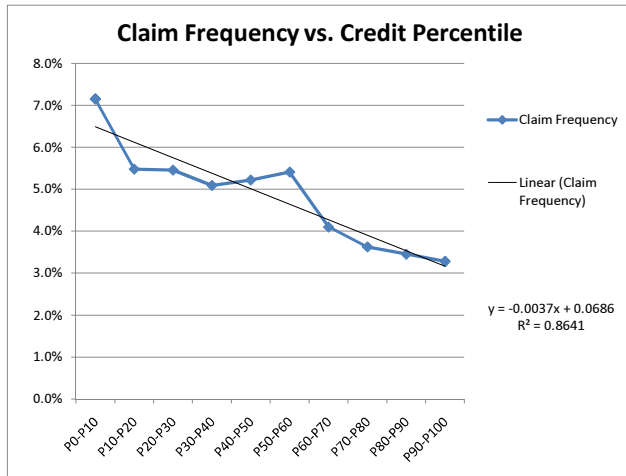
$y = -0.056x + 1.1225$
$R^2 = 0.2423$

Comparison of exposures with credit score to those without	Average Premium	Claim Frequency	Average Cost per Claim	Pure Premium	Loss Ratio
Average with Credit Score	683	4.8%	11,638	563	82%
Average without Credit Score	736	4.7%	12,234	578	79%

CADRI Credit Score Quantitative Analysis

Appendix F

Data Template

(Title)

CADRI - Call for Data - Research project
Step 1 : Univariate Analysis
Aggregated Data by Company, CBIS, Line of Business & Province
Using Accident Year 2007, 2008 & 2009   Input Required   Calculated Field

(1) Company	(2) Line of Business	(3) Province	(4) Accident Year	(5) Credit Score	(6) Credit Score used in Rating	(7) Earned Exposure	(8) Earned Premium	(9) Number of claims	(10) Incurred claims	(11) Distribution	(12) Average Premium	(13) Claim frequency	(14) Average cost per claim	(15) Pure Premium	(16) Loss Ratios
			2007	No Hit, No Score, No Consent											
0	0	0	2007	Bankruptcy											
0	0	0	2007	P0-P10											
0	0	0	2007	P10-P20											
0	0	0	2007	P20-P30											
0	0	0	2007	P30-P40											
0	0	0	2007	P40-P50											
0	0	0	2007	P50-P60											
0	0	0	2007	P60-P70											
0	0	0	2007	P70-P80											
0	0	0	2007	P80-P90											
0	0	0	2007	P90-P100											
0	**0**	**0**	**2007**	**Total**		**0**	**0**	**0**	**0**						

(1) Company	(2) Line of Business	(3) Province	(4) Accident Year	(5) Credit Score	(6) Credit Score used in Rating	(7) Earned Exposure	(8) Earned Premium	(9) Number of claims	(10) Incurred claims	(11) Distribution	(12) Average Premium	(13) Claim frequency	(14) Average cost per claim	(15) Pure Premium	(16) Loss Ratios
		0	2008	No Hit, No Score, No Consent											
0	0	0	2008	Bankruptcy											
0	0	0	2008	P0-P10											
0	0	0	2008	P10-P20											
0	0	0	2008	P20-P30											
0	0	0	2008	P30-P40											
0	0	0	2008	P40-P50											
0	0	0	2008	P50-P60											
0	0	0	2008	P60-P70											
0	0	0	2008	P70-P80											
0	0	0	2008	P80-P90											
0	0	0	2008	P90-P100											
0	**0**	**0**	**2008**	**Total**		**0**	**0**	**0**	**0**						

(1) Company	(2) Line of Business	(3) Province	(4) Accident Year	(5) Credit Score	(6) Credit Score used in Rating	(7) Earned Exposure	(8) Earned Premium	(9) Number of claims	(10) Incurred claims	(11) Distribution	(12) Average Premium	(13) Claim frequency	(14) Average cost per claim	(15) Pure Premium	(16) Loss Ratios
		0	2009	No Hit, No Score, No Consent											
0	0	0	2009	Bankruptcy											
0	0	0	2009	P0-P10											
0	0	0	2009	P10-P20											
0	0	0	2009	P20-P30											
0	0	0	2009	P30-P40											
0	0	0	2009	P40-P50											
0	0	0	2009	P50-P60											
0	0	0	2009	P60-P70											
0	0	0	2009	P70-P80											
0	0	0	2009	P80-P90											
0	0	0	2009	P90-P100											
0	**0**	**0**	**2009**	**Total**		**0**	**0**	**0**	**0**						