Actuarial Pricing Game(s)

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Paris, Chaire Actinfo, Mars 2017.

http://freakonometrics.hypotheses.org

Seasons 1 & 2 : A Game with Rules... but no Goal

Warning 1

For participants: forget about individuals results, focus on the global picture

Warning 2

Difficult to pool the results together (some mistakes are probably mine...)

Warning 3

The 'pricing game' has rules.
But no goal was ever mentioned.
Every player played according to his/her goals.

Context (and Apologies)

Two datasets : a training one, and a pricing one (without the losses in the later)

Step 1 : provide premiums to all contracts in the pricing dataset

Step 2 : (somme) premiums provided by competitors were given to players

Warning 4

Motor insurance, but on fleats : one 'contract id.', several vehicles

Warning 5

Technical issue : the exposure was still in the pricing dataset

Warning 6

normalization: $\underbrace{\sum_{i=1}^{n} \pi^{(j,1)}(\boldsymbol{x}_i) = \sum_{i=1}^{n} \ell_i = 2.5M}_{\text{loss ratio} = 100\%}$ and $\sum_{i=1}^{n} \pi^{(j,2)}(\boldsymbol{x}_i) = 2.35M, \forall j$

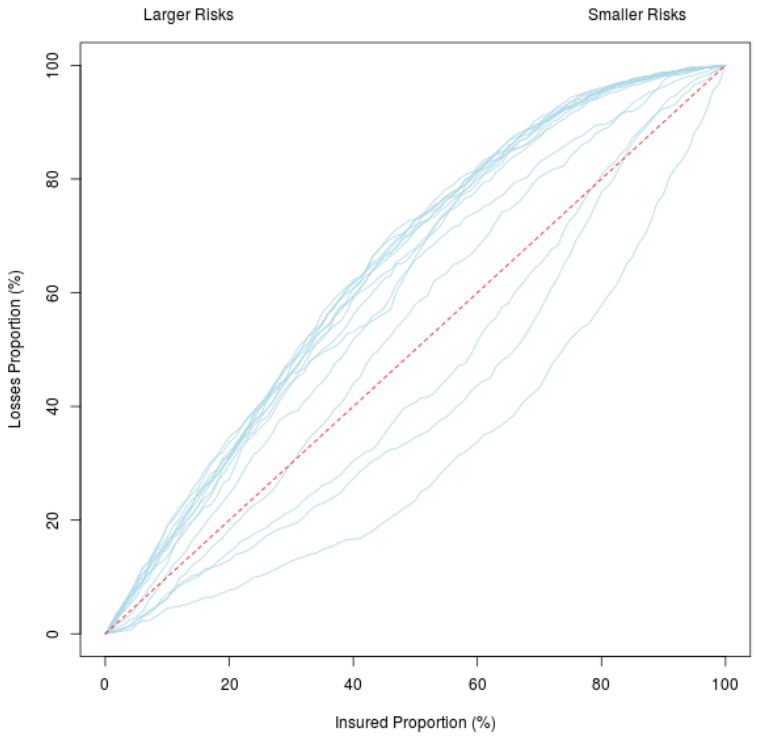
Part 1: Standard Pricing Game, a Global Overview

Consider an ordered sample $\{y_1, \cdots, y_n\}$ of incomes, with $y_1 \leq y_2 \leq \cdots \leq y_n$, then Lorenz curve is

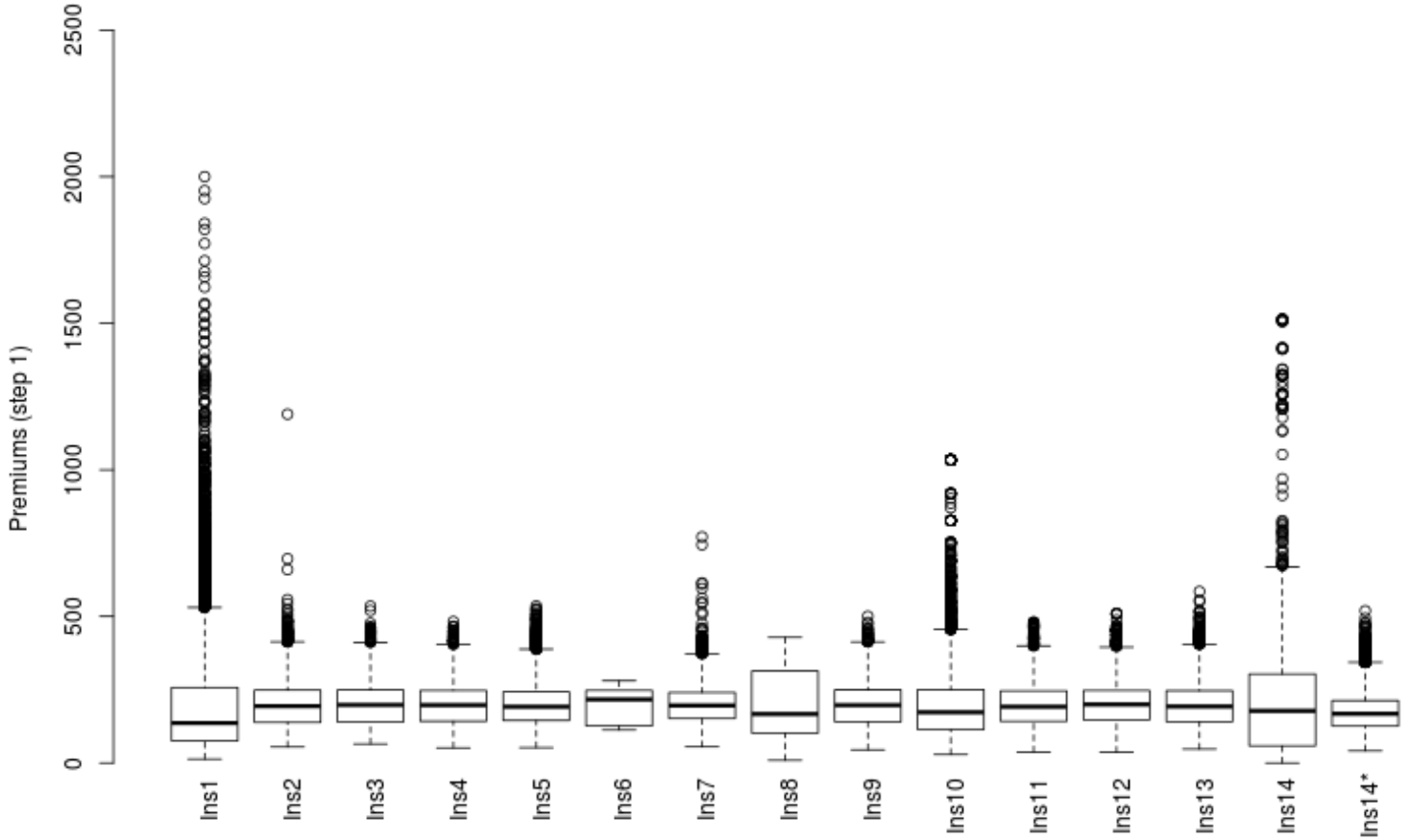
$$\{F_i, L_i\} \text{ with } F_i = \frac{i}{n} \text{ and } L_i = \frac{\sum_{j=1}^{i} y_j}{\sum_{j=1}^{n} y_j}$$

We have observed losses ℓ_i and premiums $\widehat{\pi}(\boldsymbol{x}_i)$. Consider an ordered sample by the model, see Frees, Meyers & Cummins (2014), $\widehat{\pi}(\boldsymbol{x}_1) \geq \widehat{\pi}(\boldsymbol{x}_2) \geq \cdots \geq \widehat{\pi}(\boldsymbol{x}_n)$, then plot

$$\{F_i, L_i\} \text{ with } F_i = \frac{i}{n} \text{ and } L_i = \frac{\sum_{j=1}^{i} \ell_j}{\sum_{j=1}^{n} \ell_j}$$



Part 1: Standard Pricing Game, a Global Overview



Dispersion of the premium, per company, $\pi^{(1,j)}(\boldsymbol{x}_i)$, $j \in \{1, 2, \cdots, 14, 14^*\}$.

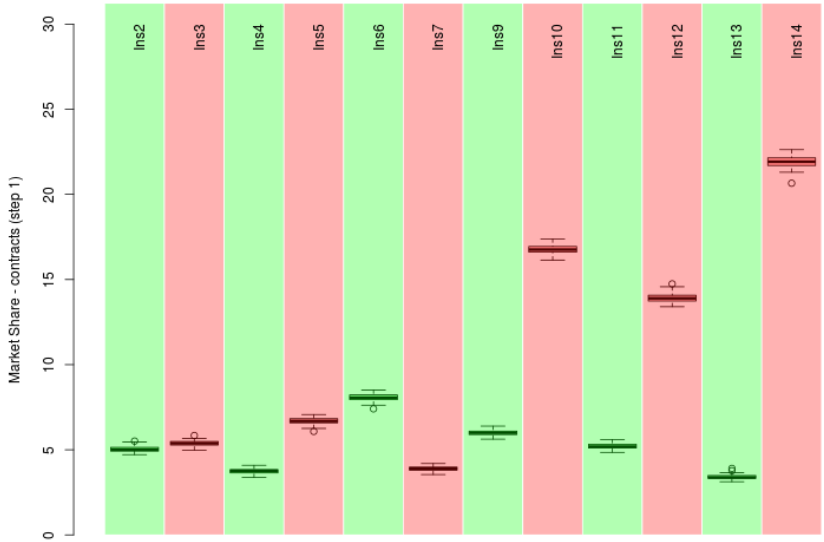
Market Competition

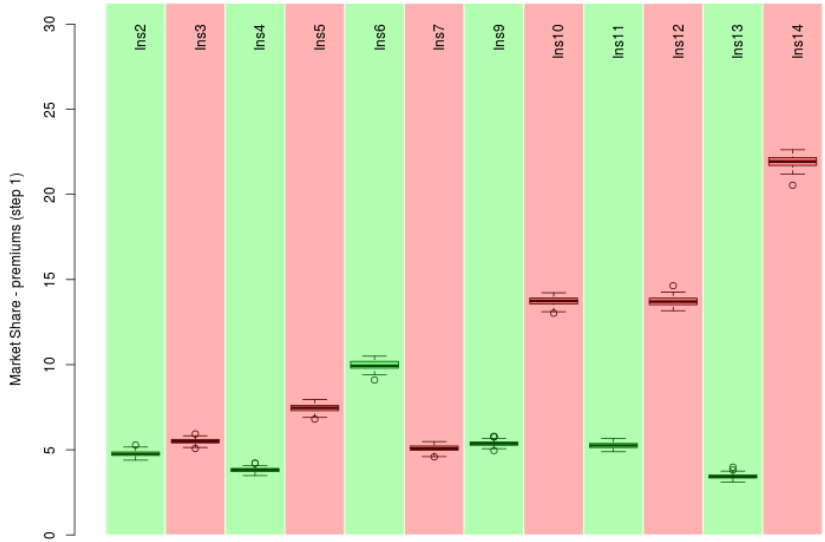
Decision Rule: the insured selects randomly from the three cheapeast premium

	Ins2	Ins3	Ins4	Ins5	Ins6	Ins7
	787.93	706.97	1032.62	907.64	822.58	603.83
	170.04	197.81	285.99	212.71	177.87	265.13
	473.15	447.58	343.64	410.76	414.23	425.23
	337.98	336.20	468.45	339.33	383.55	672.91

Part 1: Standard Pricing Game

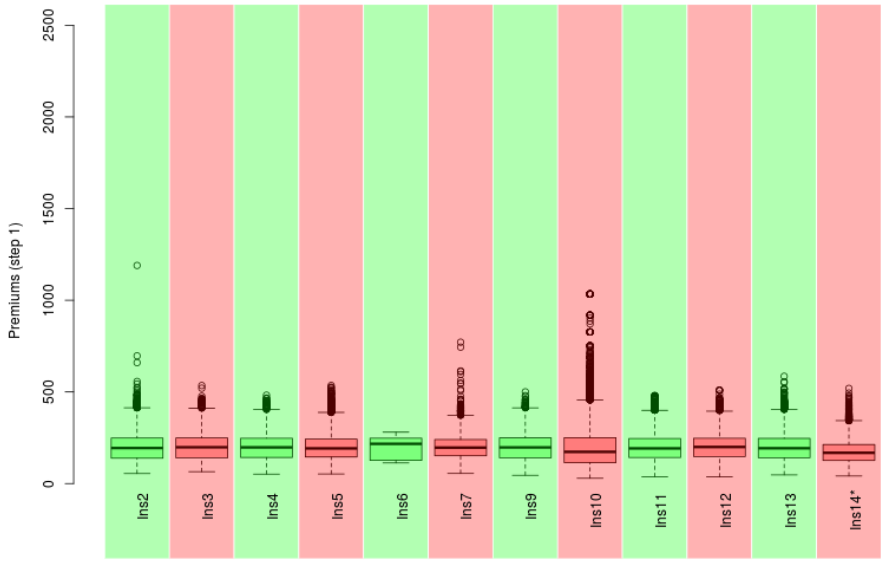
Market shares of the 12 insurance companies

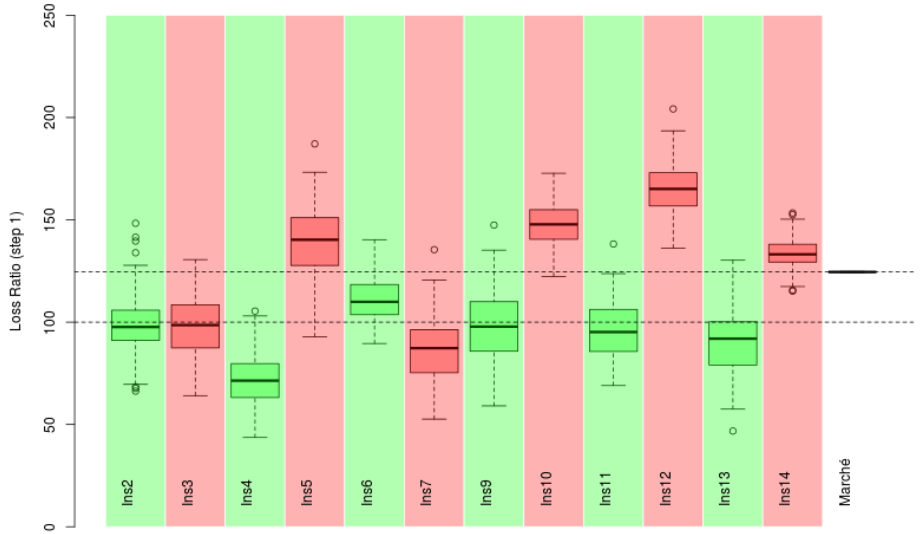




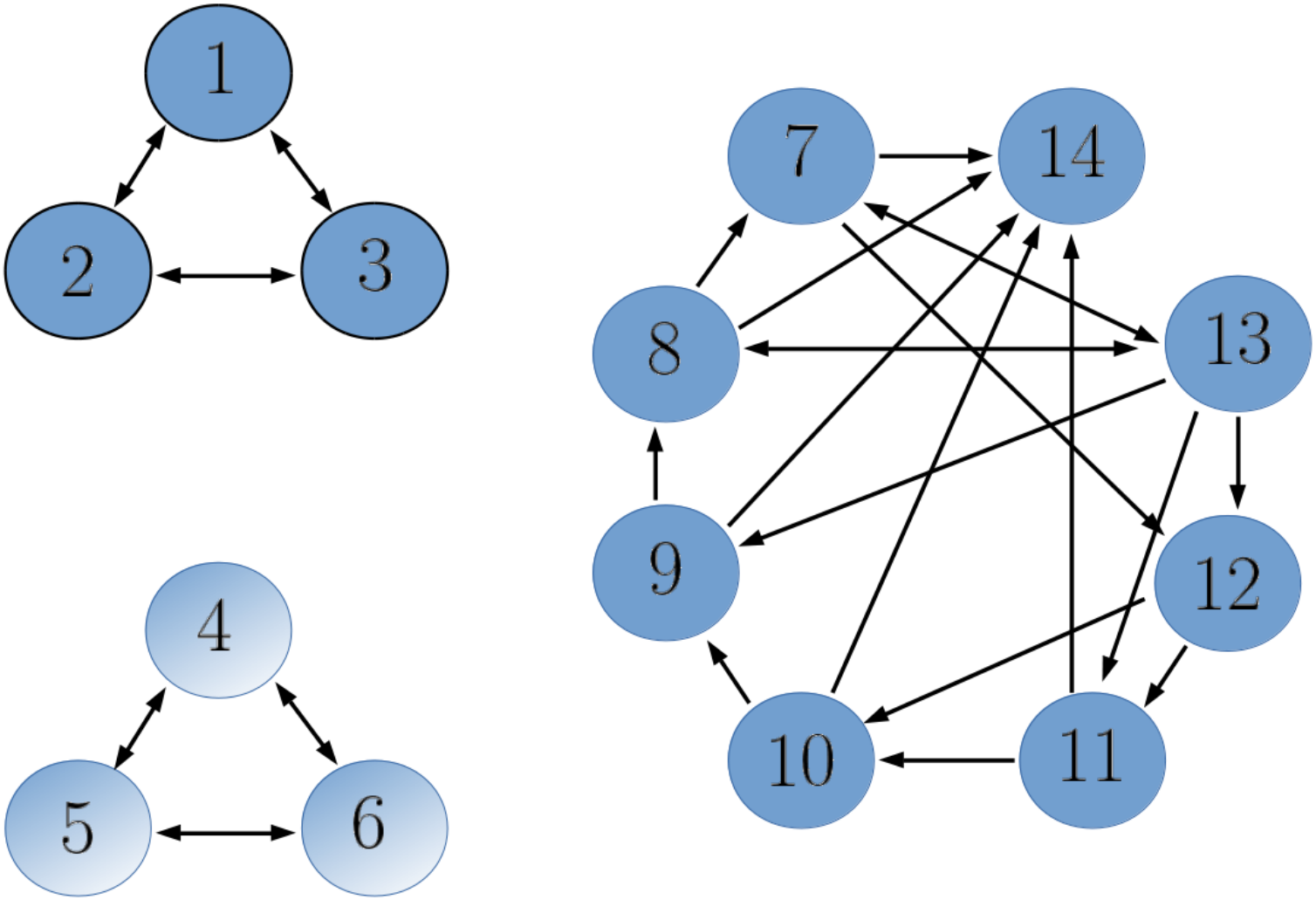
Part 1: Standard Pricing Game

Premium variability (overall) and loss ratios of the 12 companies





Part 2: Pricing Game with Additional Information



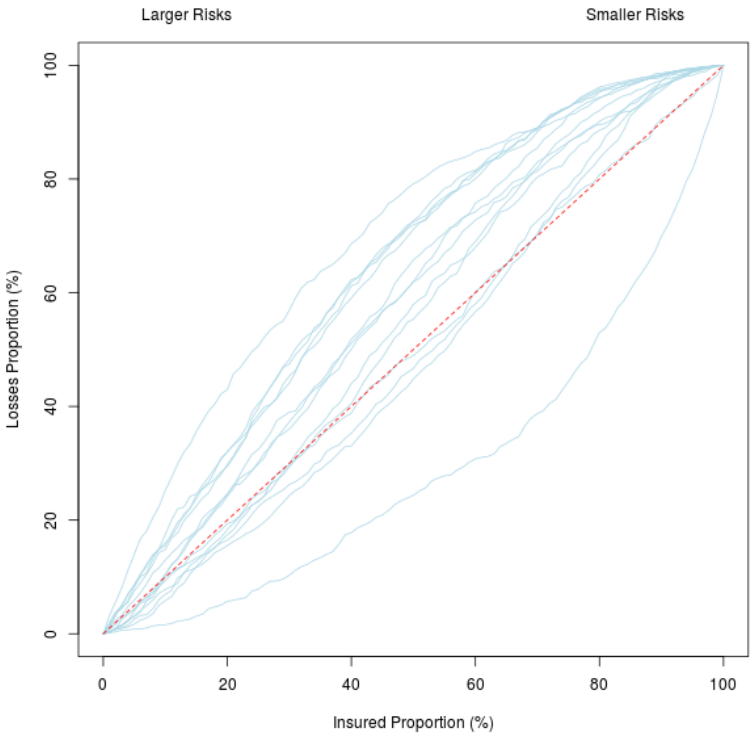
Part 2: Pricing Game with Additional Information

New Lorentz curves:
order policies according to the premium

$$\pi^{(2,j)}(\boldsymbol{x}_1) \geq \pi^{(2,j)}(\boldsymbol{x}_2) \geq \cdots \geq \pi^{(2,j)}(\boldsymbol{x}_n)$$

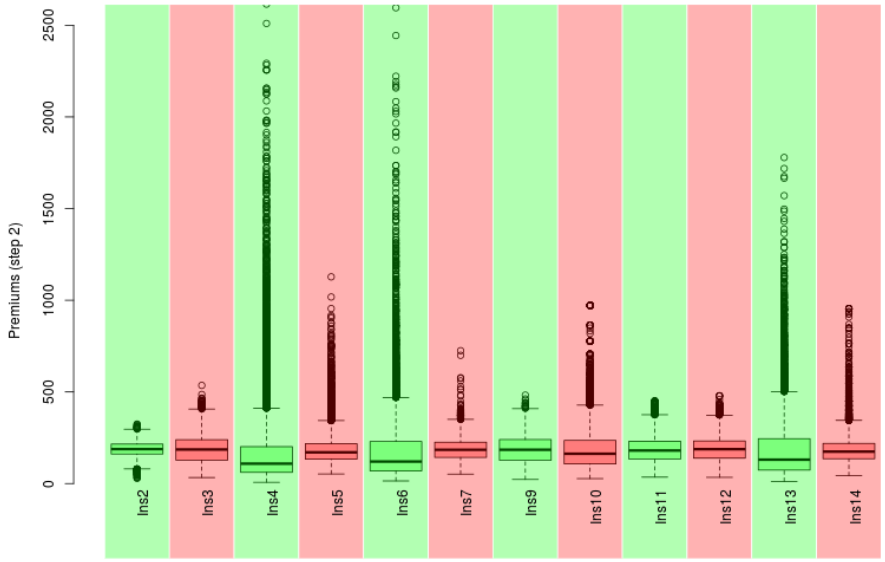
then plot

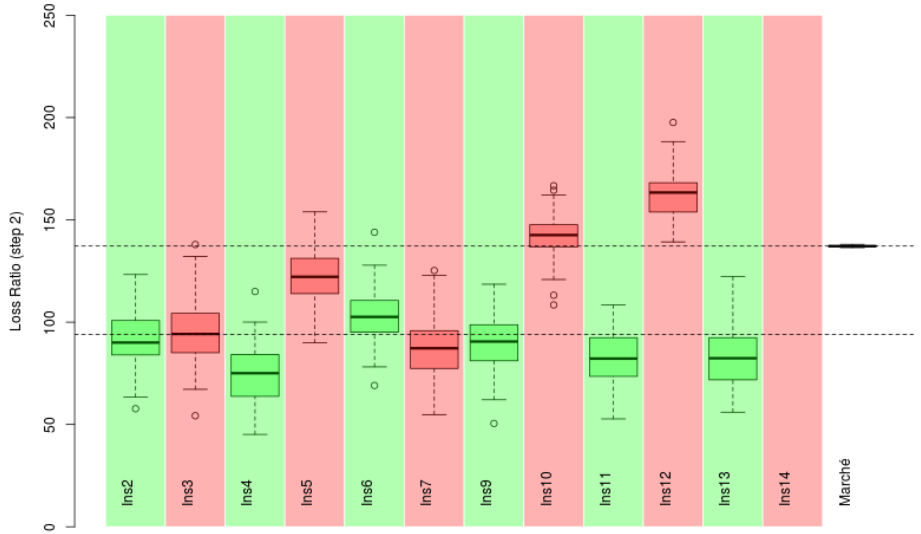
$$\{F_i, L_i\} \text{ with } F_i = \frac{i}{n} \text{ and } L_i = \frac{\sum_{j=1}^{i} \ell_j}{\sum_{j=1}^{n} \ell_j}$$



Part 2: Pricing Game with Additional Information

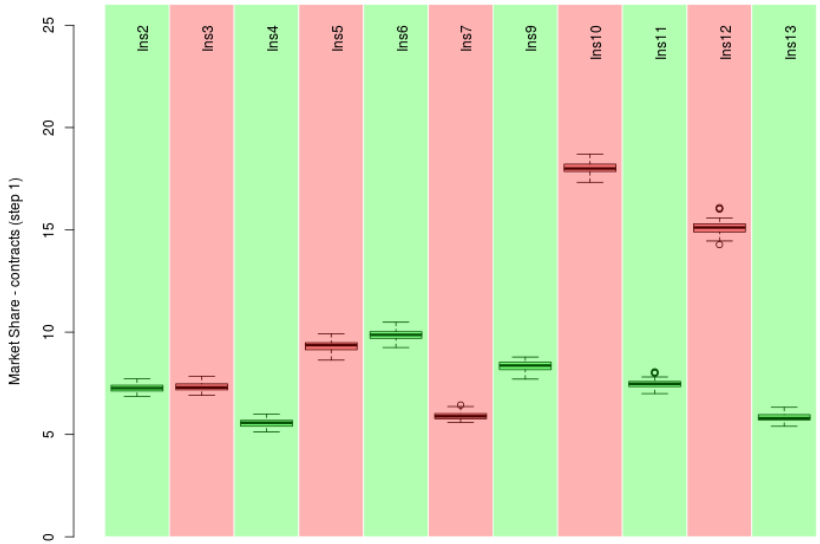
Premium variability (overall) and loss ratios of the 12 companies

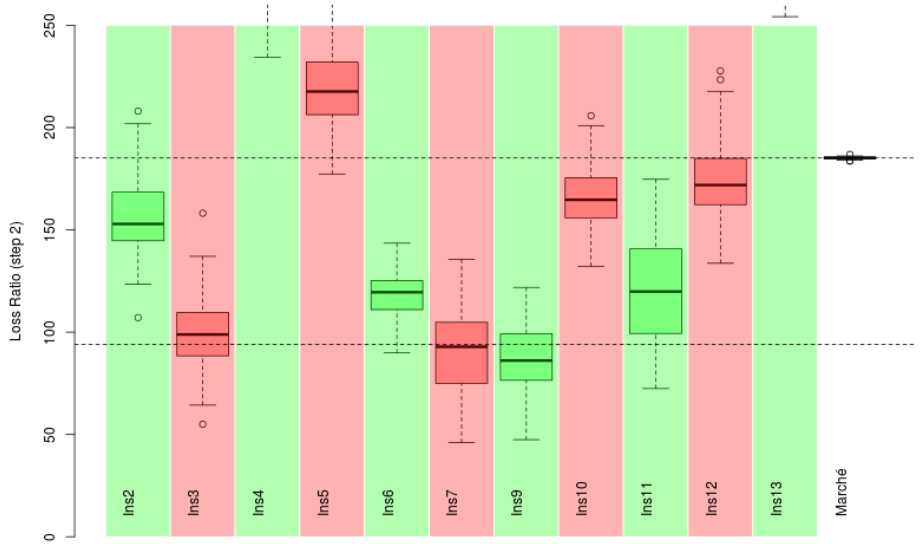




Part 2: Pricing Game with Additional Information

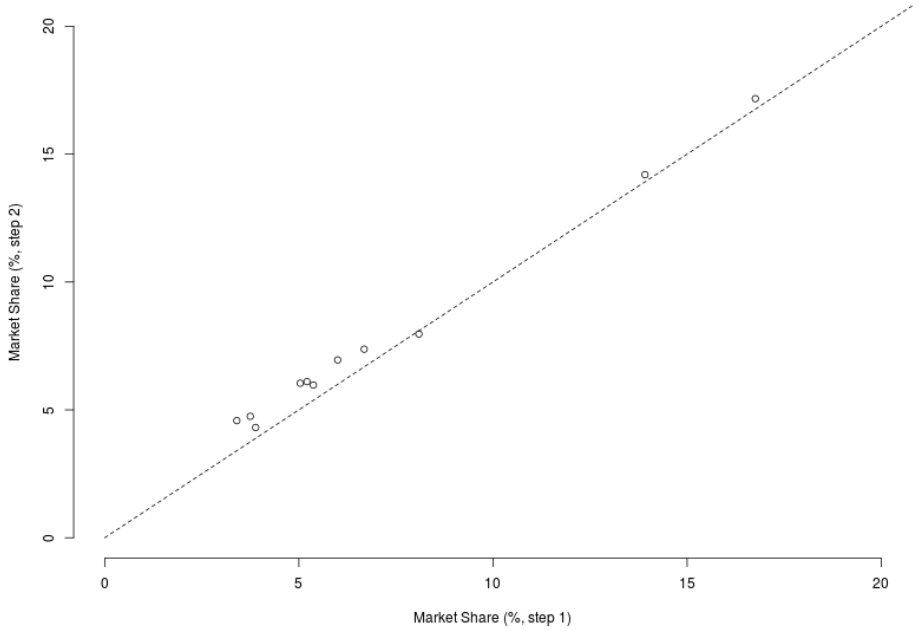
Premium variability (overall) and loss ratios of the 11 companies

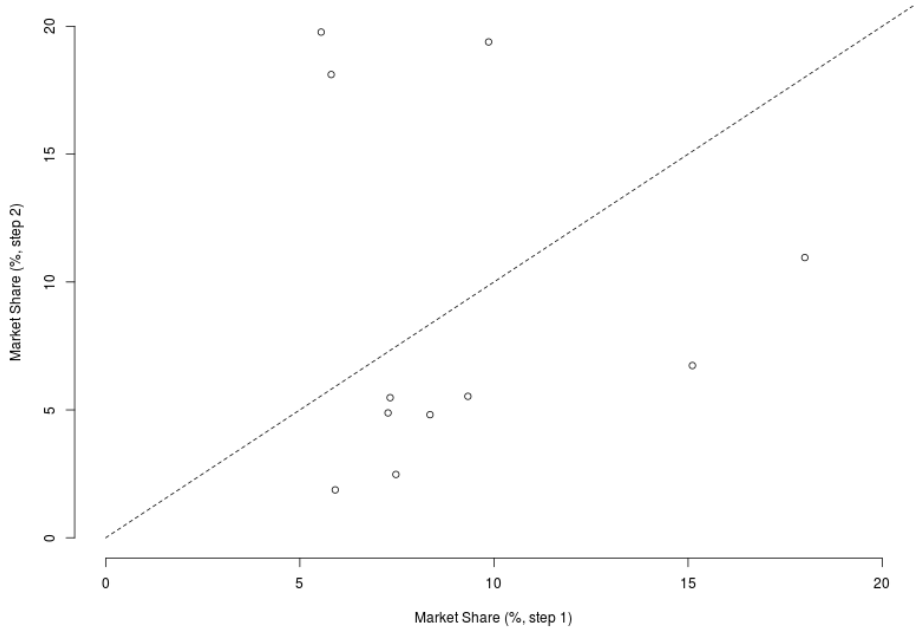




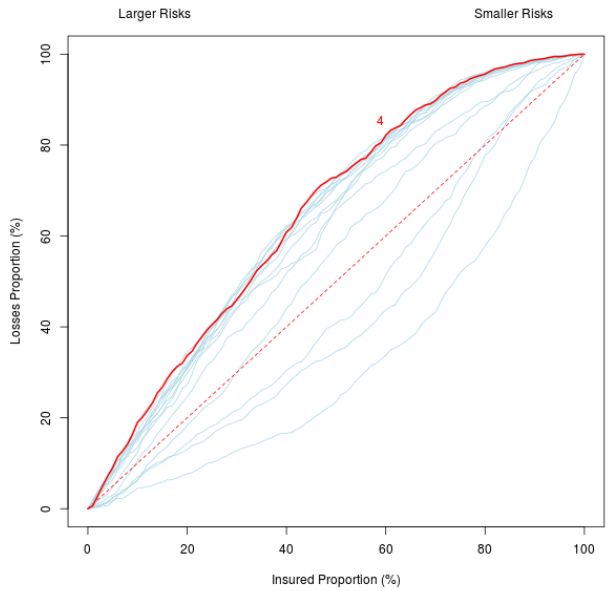
Part 2: Pricing Game with Additional Information

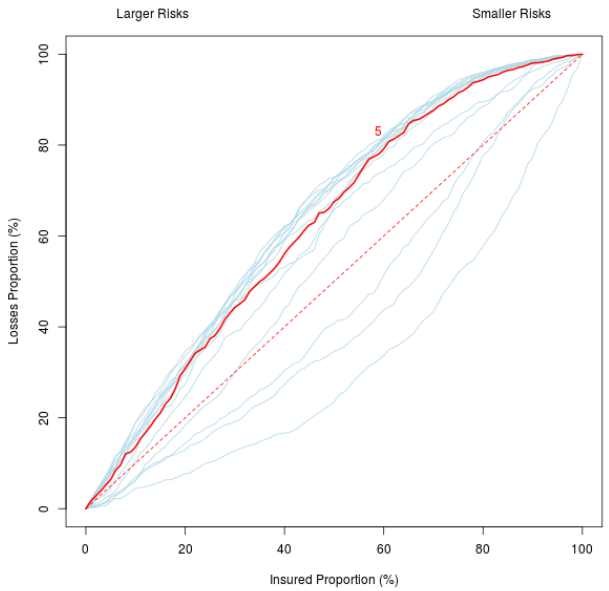
Premium variability (overall) and loss ratios of the 12 and the 11 companies

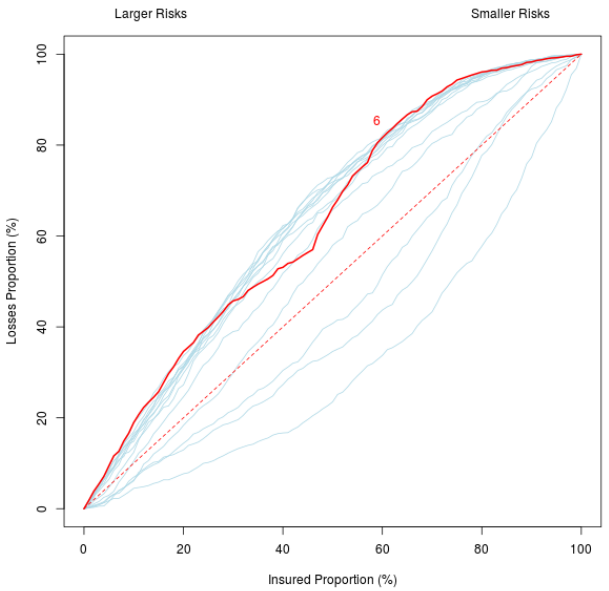




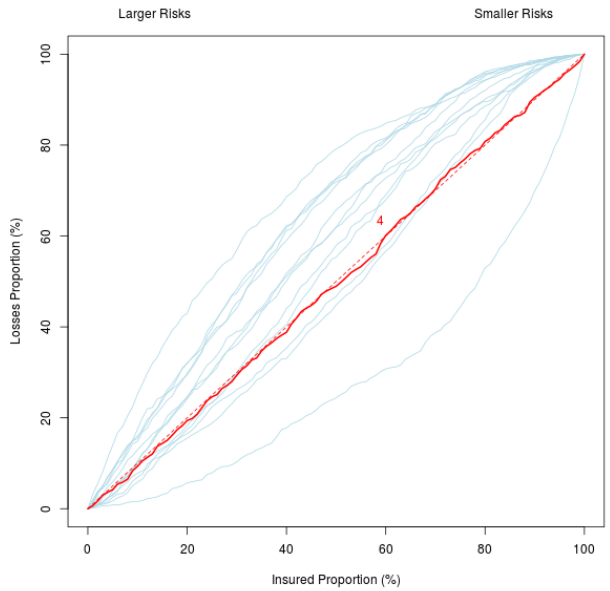
Smaller Market Competition (3 companies) : Step 1

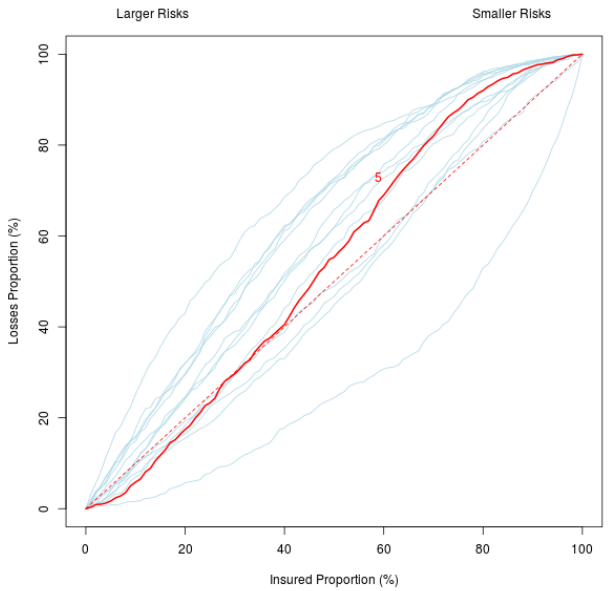


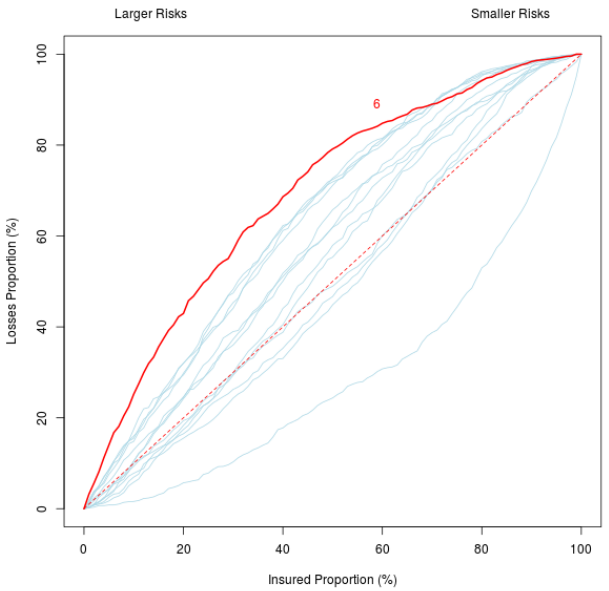




Smaller Market Competition (3 companies) : Step 2







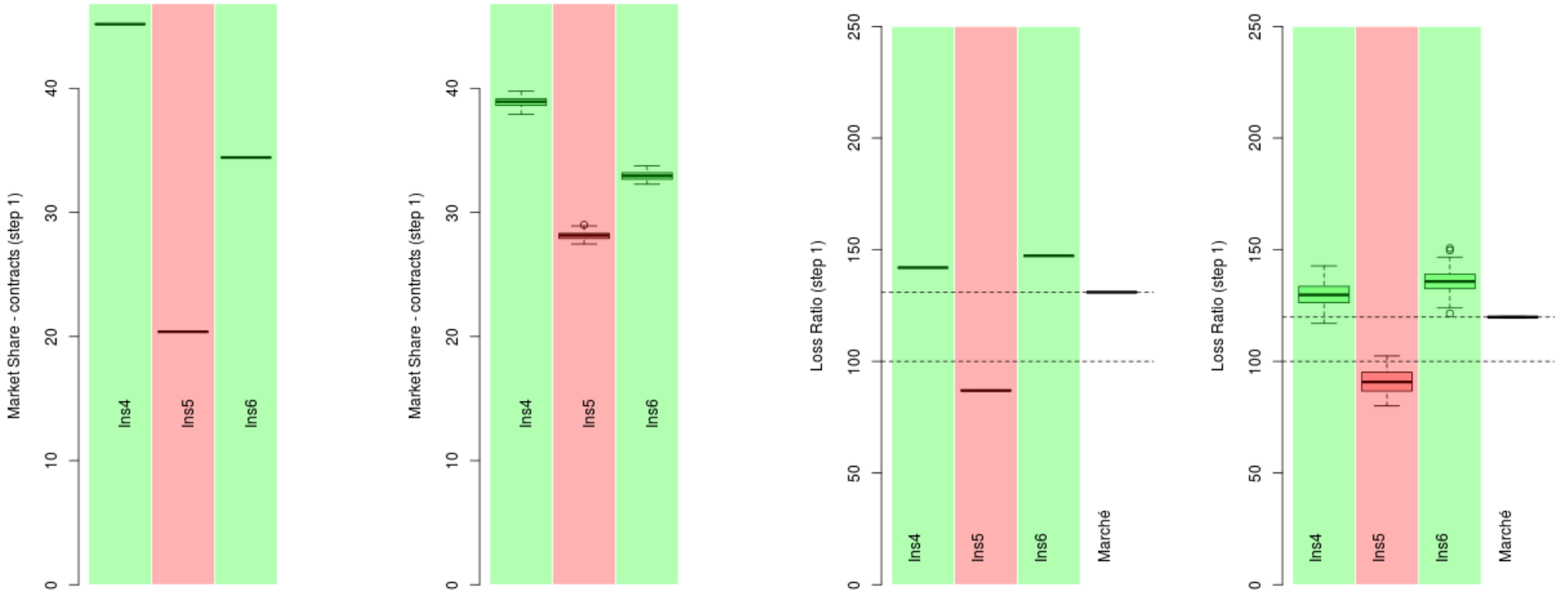
Smaller Market Competition (3 companies)

Decision Rule: out of 3 companies the insured selects (i) the cheapest premium (ii) randomly from the two cheapeast premiums, with probabilities 2/3 (cheapest) and 1/3 (second cheapest)

	Ins4	Ins5	Ins6	Ins4	Ins5	Ins6
	787.93	**706.97**	1032.62	787.93	**706.97**	1032.62
	**170.04**	197.81	285.99	**170.04**	197.81	285.99
	473.15	447.58	**343.64**	473.15	447.58	**343.64**
	337.98	**336.20**	468.45	337.98	**336.20**	468.45

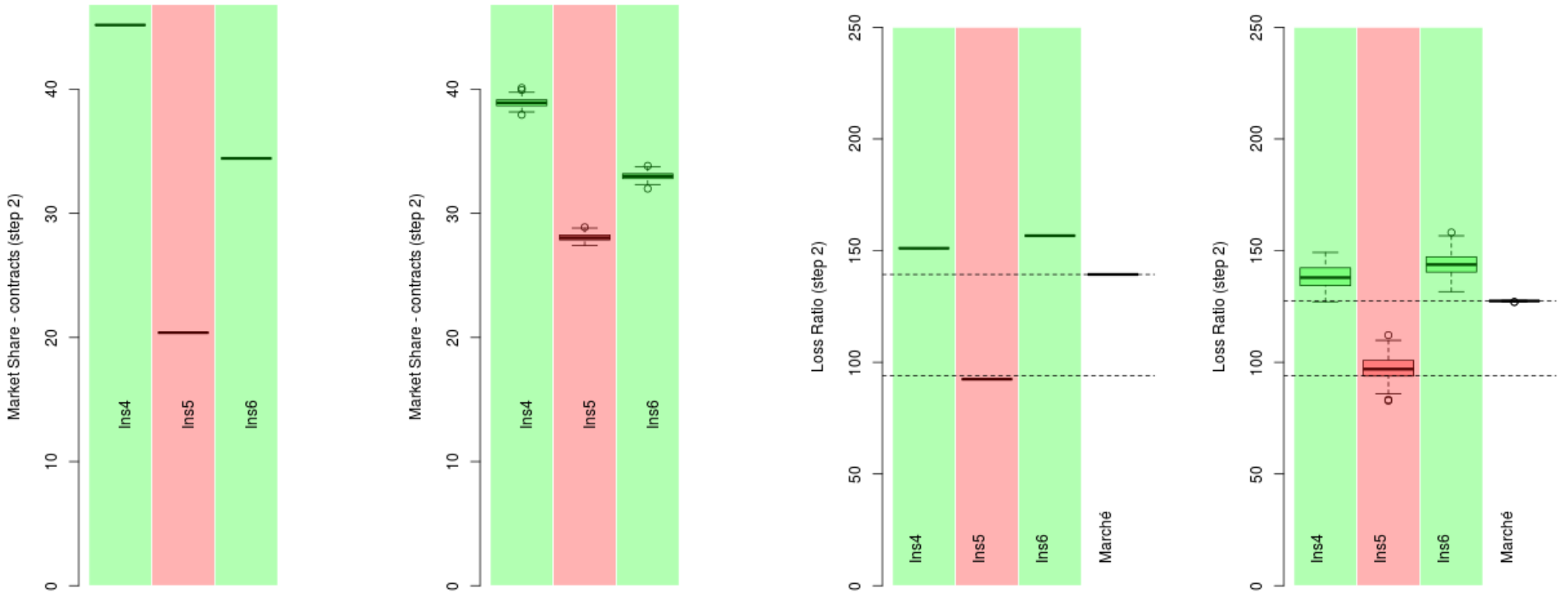
Smaller Market Competition (3 companies)

Step 1: market shares and loss ratios



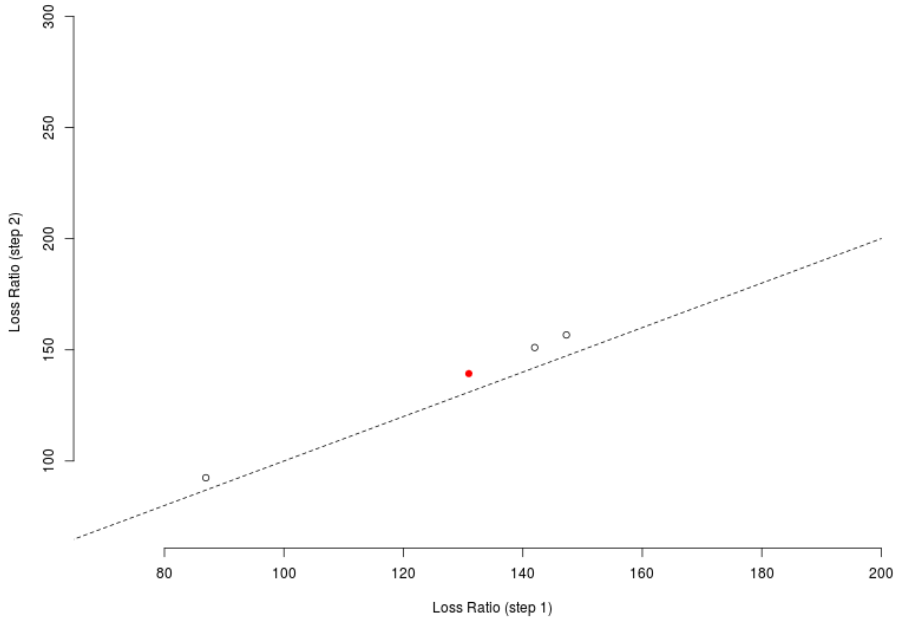
Smaller Market Competition (3 companies)

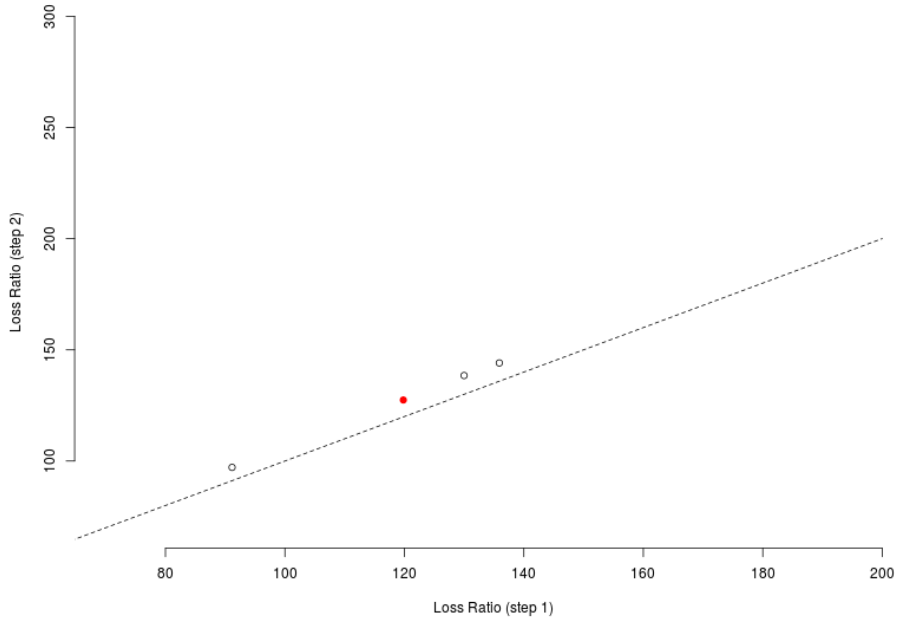
Step 2: market shares and loss ratios ((i) and (ii))



Smaller Market Competition (3 companies)

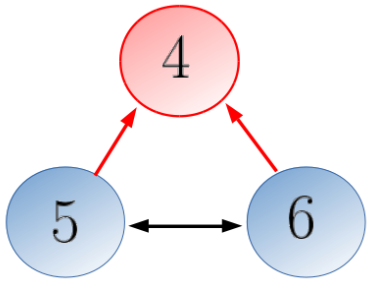
Loss ratios, Step 2 vs. Step 1 ((i) and (ii))

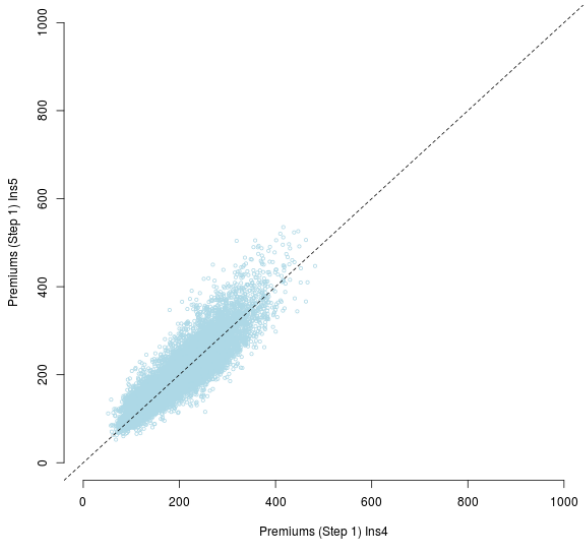




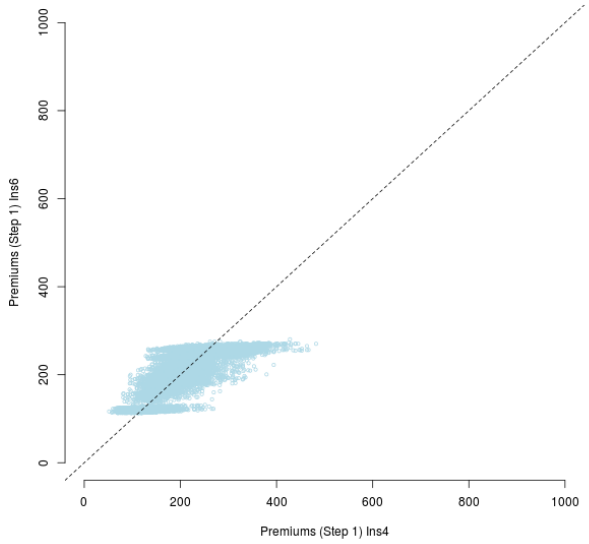
Behaviors of Insurance, Local Perspective: Ins4

Insurer 4 has informations about premiums provided by Insurer 5 and Insurer 6 (after Step 1).
Only 50% of the premiums were observed.

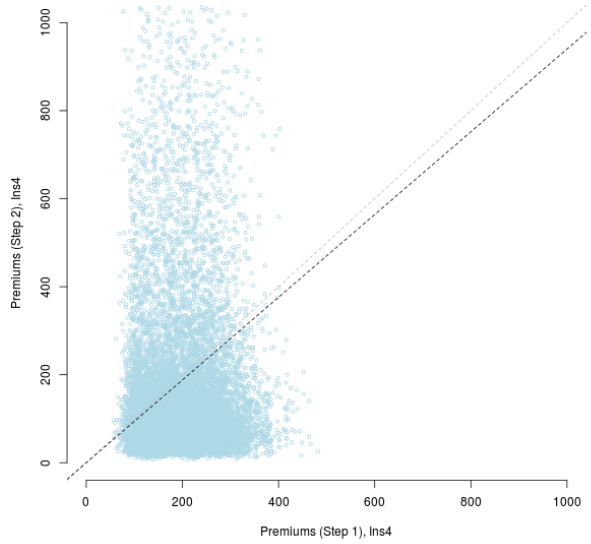




Ins 5. vs. Ins 4.



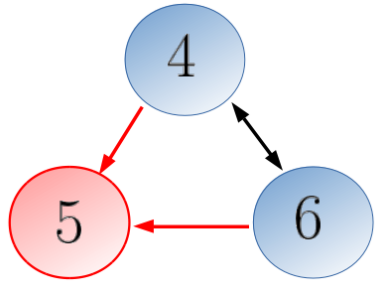
Ins 6. vs. Ins 4.

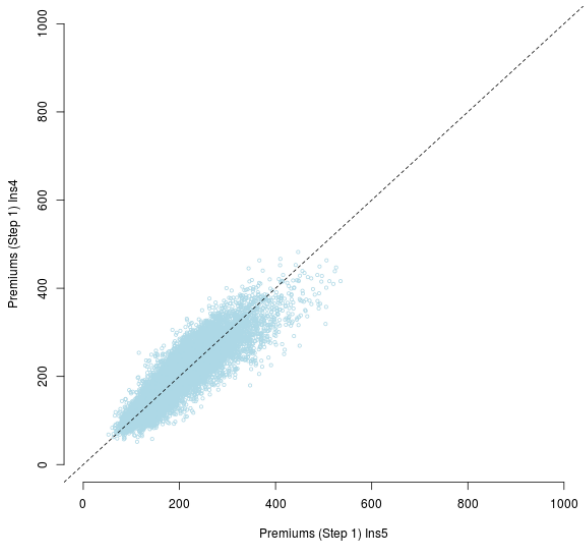


Step 2 vs. Step 1.

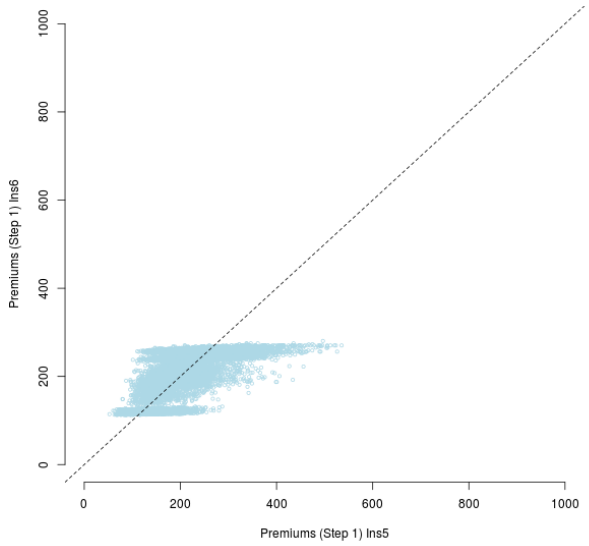
Behaviors of Insurance, Local Perspective: Ins5

Insurer 5 has informations about premiums provided by Insurer 4 and Insurer 6 (after Step 1).
Only 50% of the premiums were observed.

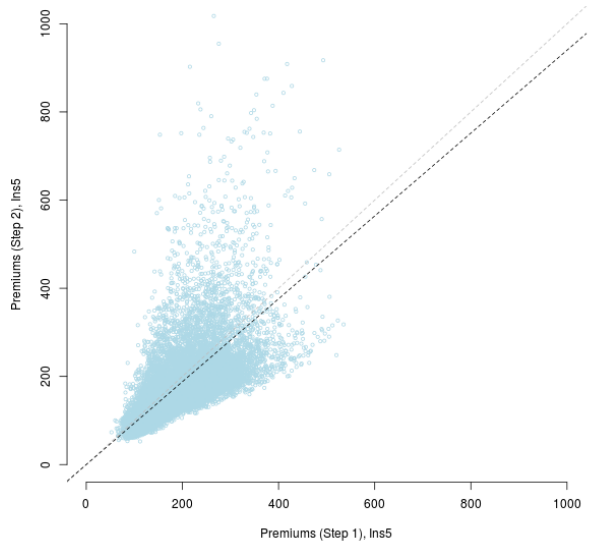




Ins 4. vs. Ins 5.



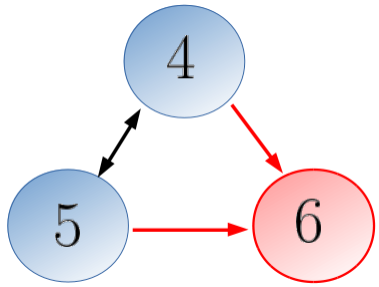
Ins 6. vs. Ins 5.

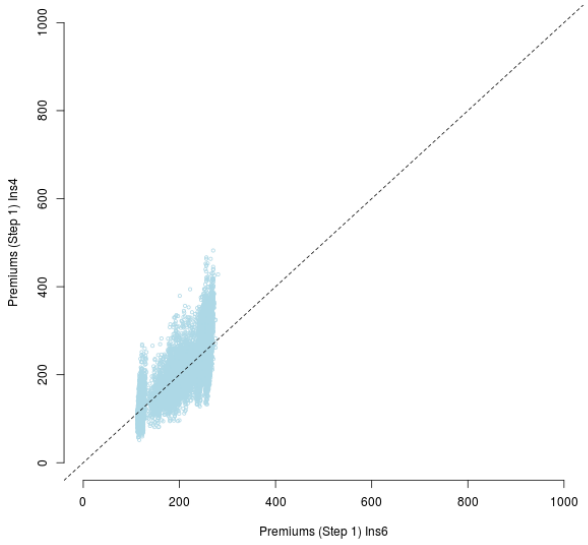


Step 2 vs. Step 1.

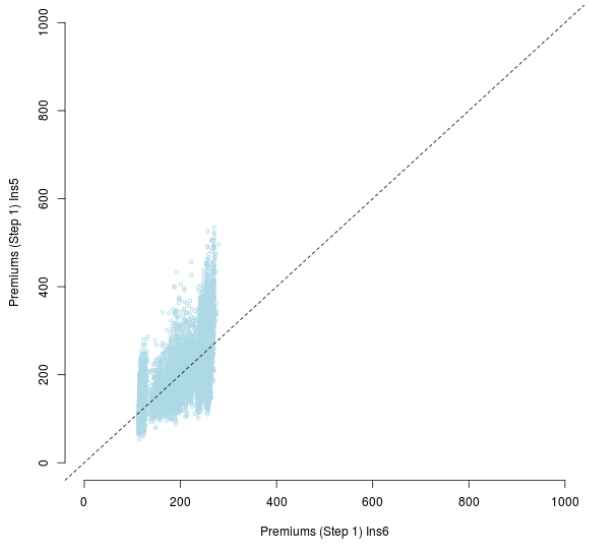
Behaviors of Insurance, Local Perspective: Ins6

Insurer 6 has informations about premiums provided by Insurer 4 and Insurer 5 (after Step 1).
Only 50% of the premiums were observed.

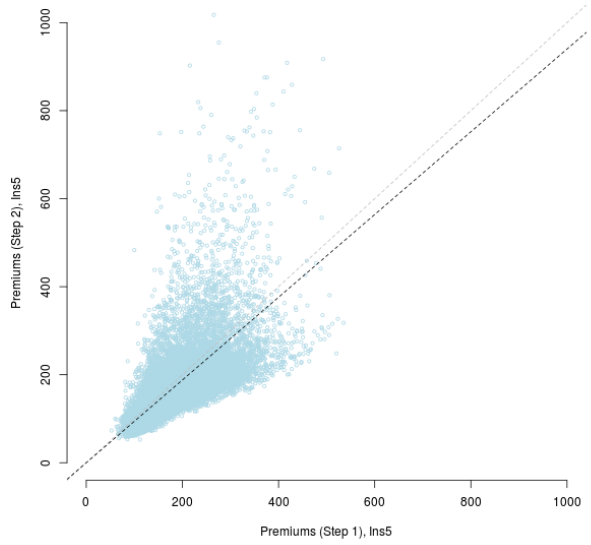




Ins 4. vs. Ins 6.



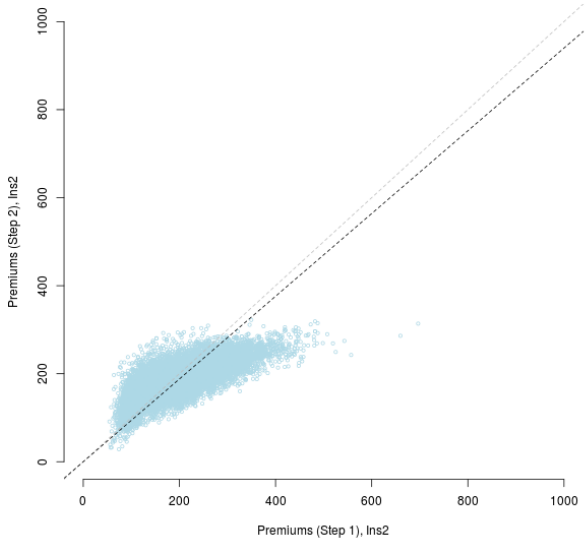
Ins 5. vs. Ins 6.



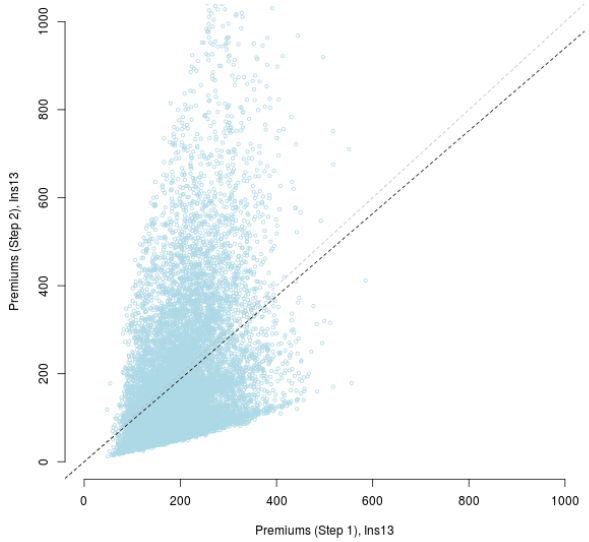
Step 2 vs. Step 1.

Behaviors of Insurance, Local Perspective

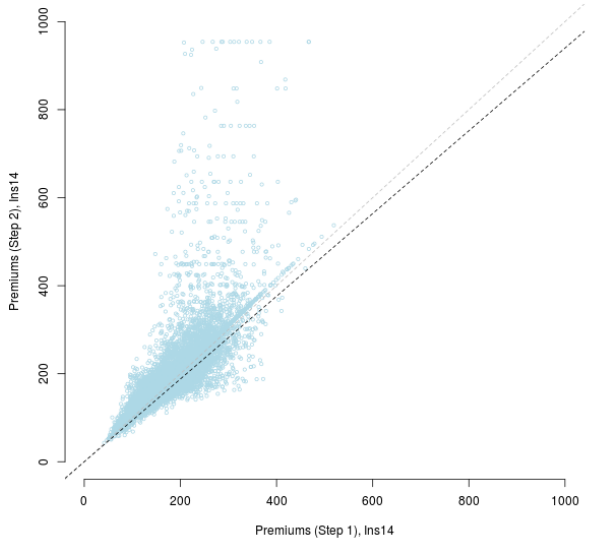
Very different behaviors, for various insurance companies



Ins. 2



Ins. 13



Ins. 14

Season 3: A Dynamic Game