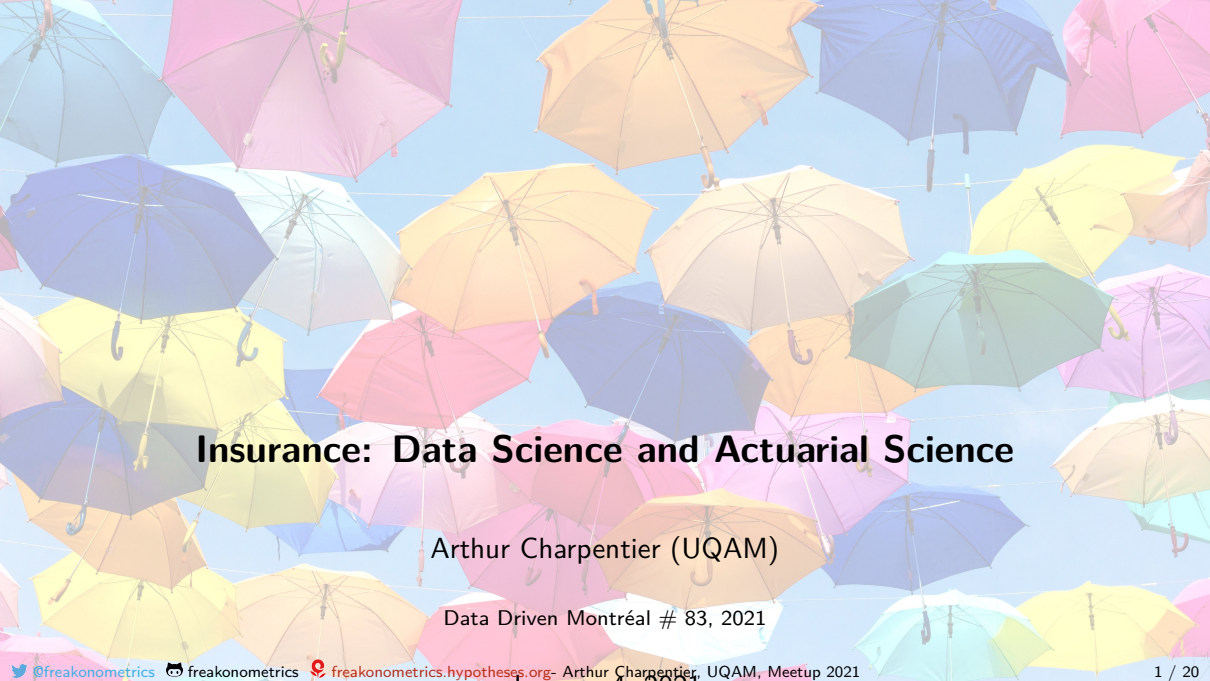


Insurance: Data Science and Actuarial Science

Arthur Charpentier (UQAM)

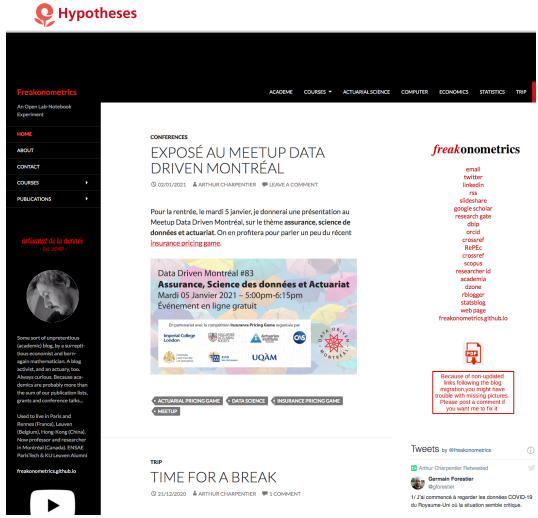
Data Driven Montréal # 83, 2021

Short bio

Arthur Charpentier
@freakonometrics
freakonometrics
freakonometrics.hypotheses.org

IRL : Professeur, UQAM (maths)
Previously : Université de Rennes
École Polytechnique, ENSAE, KU Leuven

http://cas.uqam.ca/
R package, CASDataset



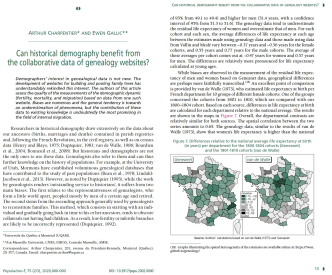
c

Short bio (teaching)

Last summer, INF7100 Artifical Intelligence & Data Science
Last fall, STT5100 Applied Linear Models, ACT6100 Data Science for Insurance

https://freakonometrics.github.io/videos/, $\sim$ 100 hours of video, on YouTube

Short bio (publication)



Arthur Charpentier* and Ewen Gallic**

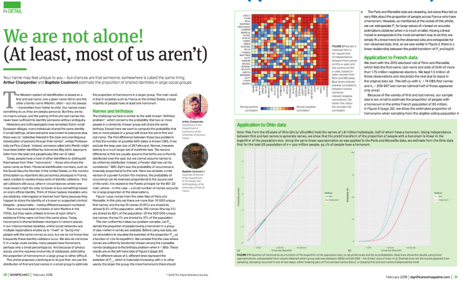
Can historical demography benefit from the collaborative data of genealogy websites?

Population-F, 75 (2/3), 2020,000-000

Original Research Article

Personalization as a promise: Can Big Data change the practice of insurance?

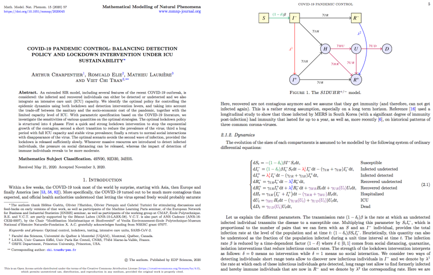
Laurence Barry[1] and Arthur Charpentier[2]



IN DETAIL

We are not alone! (At least, most of us aren't)

Your name may feel unique to you – but chances are that someone, somewhere is called the same thing. Arthur Charpentier and Baptiste Coulmont estimate the proportion of shared identities in large social groups

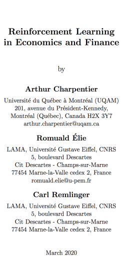


Math. Model. Nat. Phenom. 15 (2020) 57

Mathematical Modelling of Natural Phenomena

COVID-19 PANDEMIC CONTROL: BALANCING DETECTION POLICY AND LOCKDOWN INTERVENTION UNDER ICU SUSTAINABILITY*

Arthur Charpentier[1], Romuald Elie[2], Mathieu Laurière[3] and Viet Chi Tran[2,**]



Reinforcement Learning in Economics and Finance

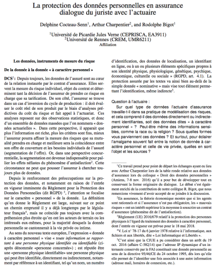
by

Arthur Charpentier

Romuald Élie

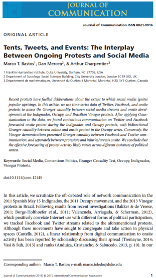
Carl Remlinger

March 2020



La protection des données personnelles en assurance dialogue du juriste avec l'actuaire

Delphine Cocteau-Senn[1], Arthur Charpentier[2], and Rodolphe Bigot[1]



JOURNAL OF COMMUNICATION

ORIGINAL ARTICLE

Tents, Tweets, and Events: The Interplay Between Ongoing Protests and Social Media

Marco T. Bastos[1], Dan Mercea[2], & Arthur Charpentier[3]

Short bio (dissemination)

L'intelligence artificielle dilue-t-elle la responsabilité ?
Arthur Charpentier, Professeur, Université de Rennes

Les modèles prédictifs peuvent-il être loyaux et justes ?
Arthur Charpentier, Professeur, Université de Rennes 1

Repenser la responsabilité et la causalité
Rodolphe Bigot, Maître de conférences, Université de Picardie Jules Verne
Arthur Charpentier, Professeur, Université du Québec à Montréal

Quelle responsabilité pour les algorithmes ?
Rodolphe Bigot, Maître de conférences, Université de Picardie Jules Verne
Arthur Charpentier, Professeur, Université du Québec à Montréal

L'éthique de la modélisation dans un monde où la normalité n'existe plus
Arthur Charpentier, Professeur, Université de Rennes 1

Les autorités publiques face aux risques de la confiance au doute
Arthur Charpentier, Professeur, Université du Québec à Montréal

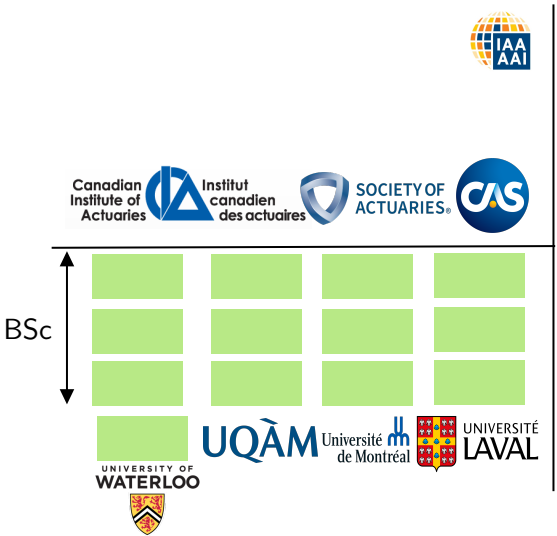
Segmentation et mutualisation les deux faces d'une même pièce ?
Arthur Charpentier, Professeur à l'Université du Québec, Montréal
Michel Denuit, Professeur à l'Université catholique de Louvain
Romuald Elie, Professeur à l'Université de Marne-la-Vallée

Les marchés prédictifs comme technique de prévision
Arthur Charpentier, Maître de conférences, Université de Rennes 1

Concilier risques collectifs et décisions individuelles
Arthur Charpentier, Professeur, Université du Québec à Montréal
Laurence Barry, Cotitulaire, Chaire Pari

***Fake news, post-truth*, Wikipedia et *blockchain* : vérité et consensus**
Arthur Charpentier, Professeur, Université de Rennes

Actuarial Systems: Canada vs. Europe



Actuarial Systems: Canada vs. Europe

Les six cours de mathématiques/statistique suivants (18 crédits):

- MAT1115 - Calcul I — A20 H21 E21
- MAT1191 - Compléments de mathématiques — A20 H21 E21
- MAT1700 - Probabilités I — A20 H21 E21
- MAT2720 - Processus stochastiques (P) — A20 H21 E21
- STT1000 - Statistique I (P) — A20 H21 E21
- STT5100 - Modèles linéaires appliqués (P) — A20 H21 E21

Profil régulier

Six cours optionnels choisis parmi les suivants, dont 5 siglés ACT (18 crédits)

- ACT6011 - Modélisation des risques actuariels et financiers (P) — A20 H21 E21
- ACT6021 - Mathématiques de la solvabilité (P) — A20 H21 E21
- ACT6031 - Modèles actuariels en régimes de retraite — A20 H21 E21
- ACT6041 - Modèles actuariels en assurance collective (P) — A20 H21 E21
- ACT6051 - Modèles actuariels en assurance de personne (P) — A20 H21 E21
- ACT6061 - Modèles actuariels en assurance non-vie (P) — A20 H21 E21
- ACT6071 - Initiation à la recherche (P) — A20 H21 E21
- ACT6100 - Analyse de données en actuariat (P) — A20 H21 E21

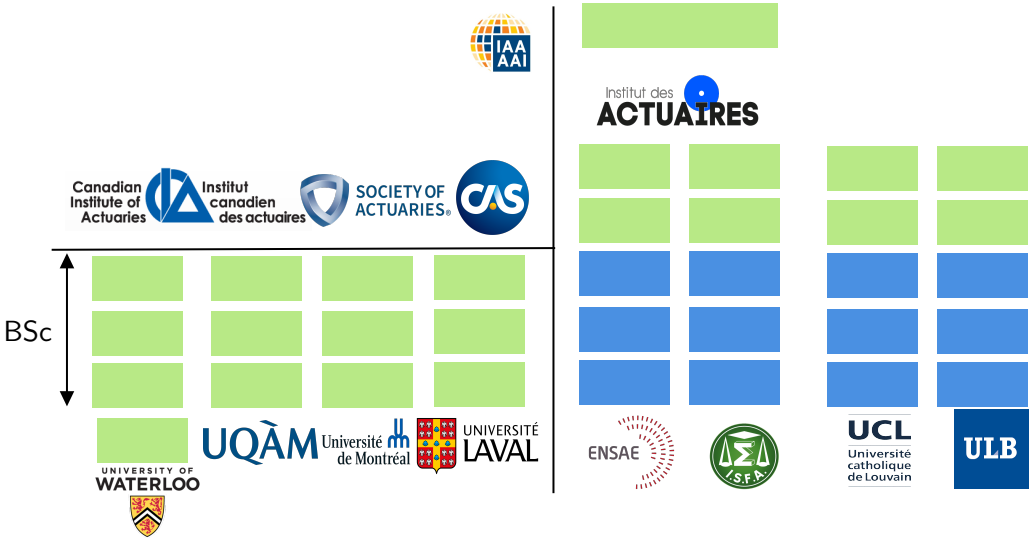
Les treize cours d'actuariat suivants (39 crédits):

- ACT1050 - Introduction à l'actuariat I — A20 H21 E21
- ACT1200 - Mathématiques financières I — A20 H21 E21
- ACT2035 - Actuariat et informatique (P) — A20 H21 E21
- ACT2060 - Applications probabilistes des risques actuariels (P) — A20 H21 E21
- ACT2100 - Compléments de probabilités (P) — A20 H21 E21
- ACT3035 - Laboratoire d'actuariat (P) — A20 H21 E21
- ACT3300 - Mathématiques de l'assurance de personne I (P) — A20 H21 E21
- ACT3400 - Distribution de sinistres (P) — A20 H21 E21
- ACT4300 - Mathématiques de l'assurance de personne II (P) — A20 H21 E21
- ACT4310 - Mathématiques de la finance actuarielle I (P) — A20 H21 E21
- ACT4400 - Modèles de survie (P) — A20 H21 E21
- ACT5310 - Mathématiques de la finance actuarielle II (P) — A20 H21 E21
- ACT5400 - Crédibilité (P) — A20 H21 E21

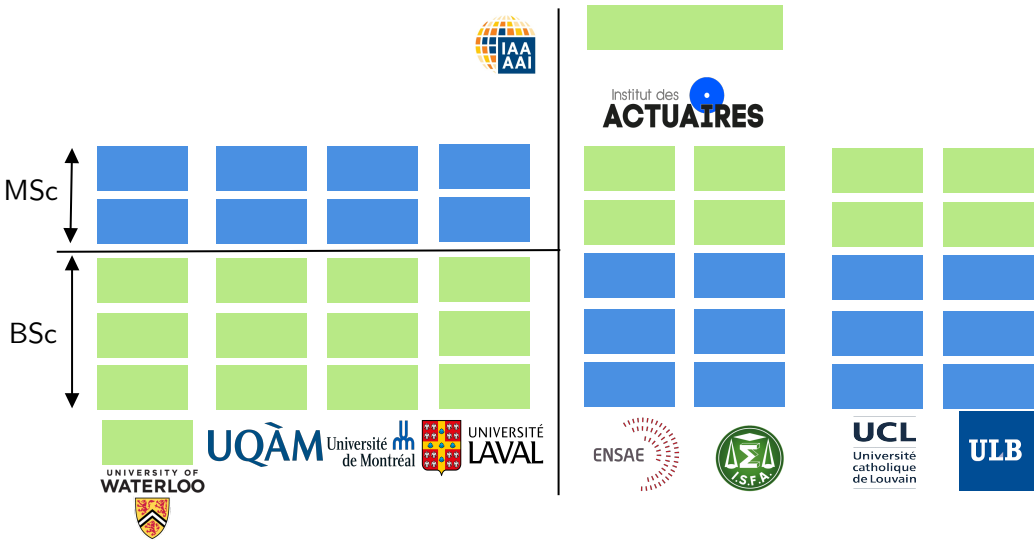
Les deux cours d'économie suivants (6 crédits):

- ECO1013 - Microéconomie I — A20 H21 E21
- ECO1023 - Macroéconomie I — A20 H21 E21

Actuarial Systems: Canada vs. Europe



Actuarial Systems: Canada vs. Europe



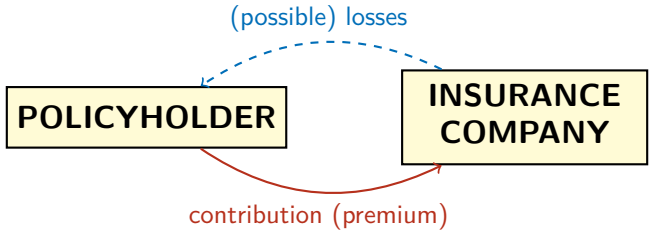
Actuarial Systems: Canada vs. Europe

- Théorie de la décision bayésienne
- Modèles de régression
- Risk Theory
- Time Series and Forecasting
- Stochastic Processes
- Statistical Learning
- Topics in Statistics & Probability: Large Sample Statistics
- Méthodes d'analyse des données
- Statistique computationnelle
- Generalized Linear Models
- Sampling Theory and Applications

- Topics in Statistics & Probability: Reinforcement Learning
- Analysis of Extreme Values with Application to Financial Engineering
- Statistique mathématique avancée
- Théorie et applications des méthodes de régression
- Nonparametric Statistics
- Honours Regression and Analysis of Variance
- Mathematical Statistics I
- Topics in Applied Mathematics. Statistical Learning Theory: Mathematical Foundations of Machine Learning
- Topics in Statistics: Bayesian Inference, Computational Methods and Monte Carlo
- Computation Intensive Statistics

Insurance & Actuarial Science

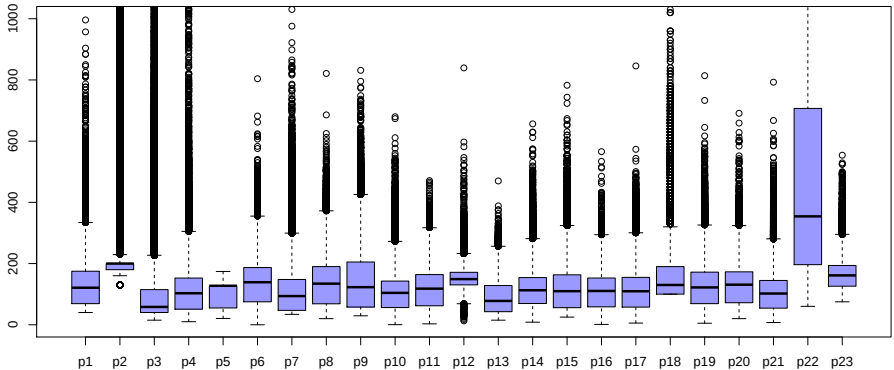
"*Insurance is the contribution of the many to the misfortune of the few* "



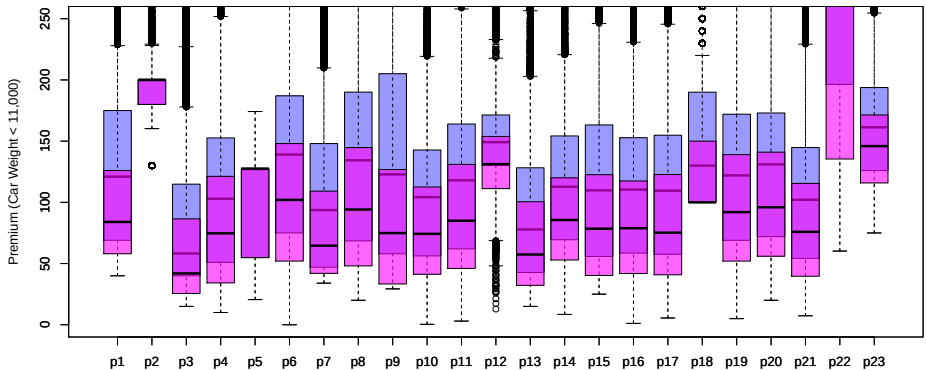
What would be a "*fair contribution* " ? see O'Neill (1997)

- pure actuarial fairness contributions for individual policyholders should perfectly reflect their predicted risk levels $\rightarrow$ predictive modeling
- choice-sensitive fairness contributions should take into account only risks that result from choices - luck-egalitarianism (Cohen (1989) or Arneson (2011))

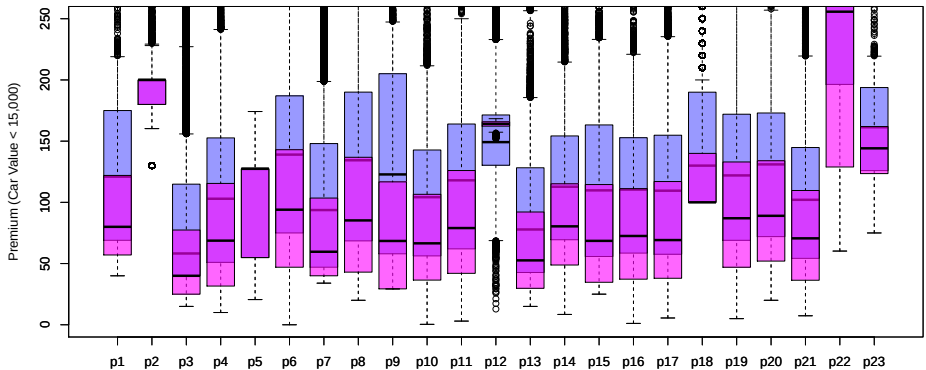
Insurance Ratemaking Before Competition



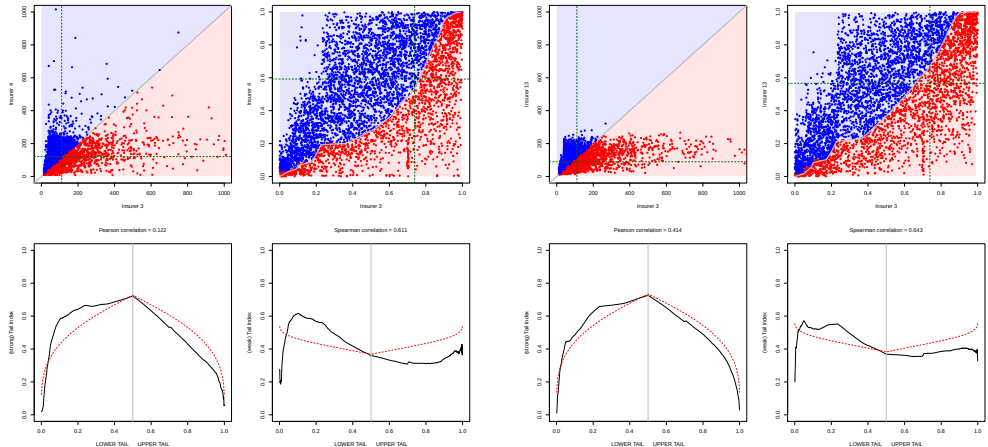
Insurance Ratemaking Before Competition



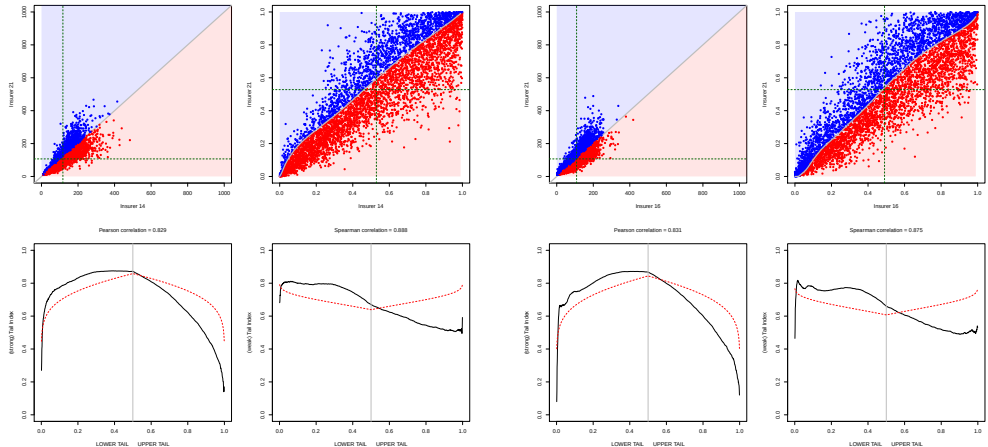
Insurance Ratemaking Before Competition



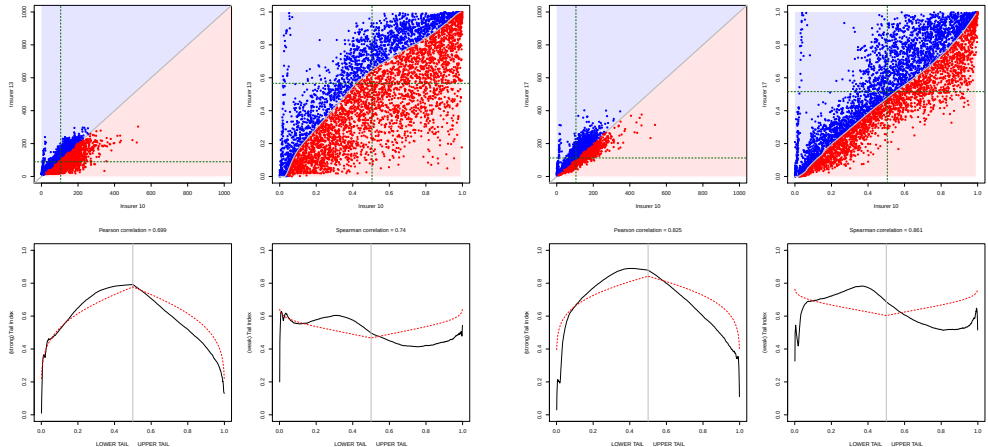
Premiums Correlations



Premiums Correlations



Premiums Correlations



Insurance Ratemaking Competition

We need a **Decision Rule** to select premium chosen by insured i

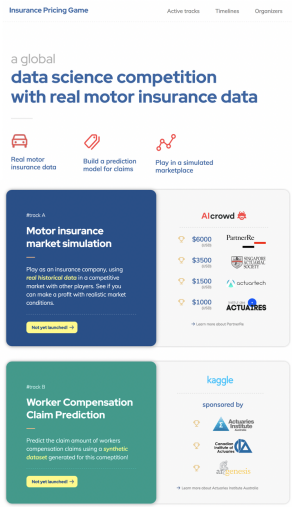
	Ins1	Ins2	Ins3	Ins4	Ins5	Ins6
	787.93	706.97	1032.62	907.64	822.58	603.83
	170.04	197.81	285.99	212.71	177.87	265.13
	473.15	447.58	343.64	410.76	414.23	425.23
	337.98	336.20	468.45	339.33	383.55	672.91

Insurance Ratemaking Competition

Basic '**rational rule**' $\pi_i = \min\{\widehat{\pi}_1(\boldsymbol{x}_i), \cdots, \widehat{\pi}_d(\boldsymbol{x}_i)\} = \widehat{\pi}_{1:d}(\boldsymbol{x}_i)$

	Ins1	Ins2	Ins3	Ins4	Ins5	Ins6
	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

https://pricing-game.com/



Overview | Leaderboard | Discussion | Insights | Resources | Submissions

- Overview
- Cheapest-wins Market
- Leaderboards
- Evaluation Metric
- Market Rules
- Dataset
- How To Submit
- Prizes
- Timeline
- Research Sponsors
- Contact

🏆 Second weekly profit leaderboard: comments and FAQs
Python Starter Notebook
R Starter Notebook
</> Code based starter kit

CHAT 51 ONLINE

Overview

In this challenge, you will act as an insurance company, where you build a pricing model and compete against other players (other insurance companies) for profit. In other words, the player that maximises competitive profit is the winner.

The market in this challenge will be a `cheapest-wins market`. That means every insurance company offers every customer an annual premium price, and the customer will always pick the company that offers the cheapest price to them (e.g., using a price comparison website).