Model Ambiguity in Risk Sharing with Monotone Mean-Variance

Emma Kroell[1,a]

Joint work with Sebastian Jaimungal[2] and Silvana Pesenti[2]

[1] Department of Mathematical Sciences, University of Copenhagen
[a] ek@math.ku.dk, www.emmakroell.ca

[2] Department of Statistical Sciences, University of Toronto

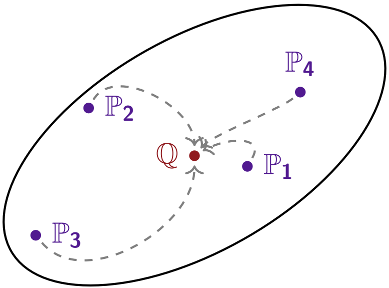
Actuarial and Financial Mathematics Conference

2–3 February 2026

NSERC CRSNG

UNIVERSITY OF COPENHAGEN

Introduction



An agent has multiple models/probability measures $\mathbb{P}_1, \mathbb{P}_2, \mathbb{P}_3, \mathbb{P}_4$.

The agent has to make a decision optimally accounting for ambiguity about these models.

Agent must choose a model $\mathbb{Q}$ to optimize under.

In our setting:

- agent = **insurer**
- decision = **risk sharing**
- penalization = **chi-squared divergence** (monotone mean variance)

Model combination and model ambiguity

Let $D(\cdot,\cdot)$ be a divergence measure, ex., Kullback-Leibler divergence.

Let $\mathbb{P}$ be a probability measure.

Model ambiguity	Model combination (barycenter)
$\inf_{\mathbb{Q}} \mathbb{E}^{\mathbb{Q}}[U(X_T) + \frac{1}{\varepsilon} D(\mathbb{Q}, \mathbb{P})]$	
where $\varepsilon > 0$.	
e.g., [Hansen and Sargent, 2008] [Maccheroni et al., 2006] [Maccheroni et al., 2009]	

The monotone mean-variance criterion [Maccheroni et al., 2009]

$$J_\theta^{MV}[X] = \mathbb{E}^{\mathbb{P}}[X] - \frac{\theta}{2}\mathrm{Var}^{\mathbb{P}}(X)$$

$$J_\theta^{MMV}[X] := \min_{\mathbb{Q}\in\Delta^2(\mathbb{P})}\left(\mathbb{E}^{\mathbb{Q}}[X] + \frac{1}{2\theta}\mathbb{E}^{\mathbb{P}}\left[\left(\frac{d\mathbb{Q}}{d\mathbb{P}}\right)^2 - 1\right]\right)$$

where $\Delta^2(\mathbb{P}) = \{\mathbb{Q} \ll \mathbb{P} : \mathbb{E}^{\mathbb{P}}\left[\left(\frac{d\mathbb{Q}}{d\mathbb{P}}\right)^2\right] < \infty\}$.

Properties of MMV [Maccheroni et al., 2009]

- Agrees with MV criterion where it is monotone
- Best possible monotone approximation of the MV criterion outside of where it is monotone
- Unlike MV, MMV preserves second-order stochastic dominance

Model combination and model ambiguity

Let $D(\cdot,\cdot)$ be a divergence measure, ex., Kullback-Leibler divergence.

Let $\mathbb{P}$, $\mathbb{P}_{\boldsymbol{k}}$, $k = 1, \ldots, n$, be probability measures.

Model ambiguity	Model combination (barycenter)
$\inf_{\mathbb{Q}} \mathbb{E}^{\mathbb{Q}}[U(X_T) + \frac{1}{\varepsilon} D(\mathbb{Q}, \mathbb{P})]$	$\inf_{\mathbb{Q}} \sum_{k=1}^{n} \pi_k \, D(\mathbb{Q}, \mathbb{P}_{\boldsymbol{k}})$
where $\varepsilon > 0$.	where $\pi_k \geq 0$, $\sum_{k=1}^{n} \pi_k = 1$.
e.g., [Hansen and Sargent, 2008] [Maccheroni et al., 2006] [Maccheroni et al., 2009]	[Liu et al., 2025] [Acciaio et al., 2025] [Jaimungal and Pesenti, 2025] [Kroell et al., 2025]

Our problem:

$$\inf_{\mathbb{Q}} \mathbb{E}^{\mathbb{Q}} \left[U(X_T) + \frac{1}{\varepsilon} \sum_{k=1}^{n} \pi_k \, D(\mathbb{Q}, \mathbb{P}_{\boldsymbol{k}}) \right]$$

Setting

- **Insurer** in a non-life insurance market faces insurance losses over a finite horizon $[0, T]$.
- **Insurer** can share their risk with another agent, the **counterparty**, by ceding them a portion of their loss in return for a premium payment.
- Insurer has multiple models for the loss distribution: $\mathbb{P}_{\boldsymbol{1}}, \ldots, \mathbb{P}_{\boldsymbol{n}}, \mathbb{P}_{\boldsymbol{C}}$ and chooses a model $\mathbb{Q}$ to optimize the risk sharing under; counterparty sets premium under their model, $\mathbb{P}_{\boldsymbol{C}}$.

Probabilistic set-up

- Assume a complete, filtered measurable space $(\Omega, \mathcal{F}, \mathbb{F} = (\mathcal{F}_t)_{t\in[0,T]})$ and $n+1$ equivalent probability measures $\mathbb{P}_{\boldsymbol{1}}, \dots, \mathbb{P}_{\boldsymbol{n}}, \mathbb{P}_{\boldsymbol{C}}$.
- $N(d\xi, dt)$ is a Poisson random measure driving the insurance losses in the market.
- Under a measure $\mathbb{P}_{\boldsymbol{k}}$ for $k \in \mathcal{I}$, $\mathcal{I} := \{1, \dots, n, C\}$, N has $\mathbb{P}_{\boldsymbol{k}}$-compensator $\nu_k(d\xi, dt) = \nu_k(d\xi)dt$.
- Define the $\mathbb{P}_{\boldsymbol{k}}$-compensated PRM by

$$\tilde{N}^{\mathbb{P}_k}(d\xi, dt) = N(d\xi, dt) - \nu_k(d\xi)dt\,.$$

- Each compensator admits a density $v_k(\xi)$, i.e., $\nu_k(d\xi) = v_k(\xi)d\xi$ for $k \in \mathcal{I}$.

Assumption

$$\int_{\mathbb{R}_+} \frac{v_C^2(\xi)}{v_k(\xi)}\, d\xi < \infty \quad \text{for } k \in \mathcal{I}\,, \qquad \int_{\mathbb{R}_+} \frac{v_C^3(\xi)}{v_j(\xi)v_k(\xi)}\, d\xi < \infty \quad \text{for } j, k \in \mathcal{I}\,.$$

Insurer's surplus

- The insurer's wealth process follows a Cramér-Lundberg model with constant premium rate $c > 0$ and initial wealth $x_0 > 0$:

$$X_t^{CL} = x_0 + c\,t - \int_0^t \int_{\mathbb{R}_+} \xi \, N(d\xi, ds)\,.$$

- Insurer cedes a portion $\boldsymbol{\alpha_t}(\xi)$ of the loss $\xi \in \mathbb{R}_+$ to the counterparty.

Definition (admissible risk sharing strategies)

We define the set of admissible risk sharing strategies, $\mathcal{A}$, as those strategies $\boldsymbol{\alpha_t}$ that are $\mathbb{F}$-predictable random fields satisfying for $t \in [0, T]$,

$$\mathbb{E}^{\mathbb{P}_c}\left[\int_0^t \int_{\mathbb{R}_+} |\boldsymbol{\alpha_s}(\xi)|^2 \, \nu_C(d\xi)\, ds\right] < \infty \quad \text{and}$$

$$\mathbb{E}^{\mathbb{P}_c}\left[\int_0^t \int_{\mathbb{R}_+} [\xi - \boldsymbol{\alpha_s}(\xi)]^2 \, \nu_C(d\xi)\, ds\right] < \infty\,.$$

Insurer's surplus

- The counterparty charges the expected value premium principle with safety loading $\eta > 0$: $(1+\eta)\int_{\mathbb{R}_+} \boldsymbol{\alpha_t}(\xi)\,\nu_C(d\xi)$.
- Assume that the risk sharing premium is such that $c < (1+\eta)\int_{\mathbb{R}_+} \xi\,\nu_C(d\xi)$.
- The insurer's wealth process $X^{\boldsymbol{\alpha}} := (X_t^{\boldsymbol{\alpha}})_{t\in[0,T]}$ is

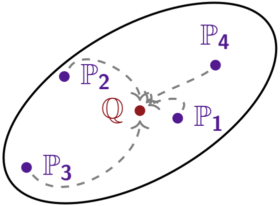
$$X_t^{\boldsymbol{\alpha}} = x_0 + \int_0^t \Bigg[\underbrace{\quad c \quad}_{\text{insurer's premium}} - \underbrace{(1+\eta)\int_{\mathbb{R}_+} \boldsymbol{\alpha_u}(\xi)\,\nu_C(d\xi)}_{\text{counterparty's premium}} \Bigg] du - \underbrace{\int_0^t \int_{\mathbb{R}_+} [\xi - \boldsymbol{\alpha_u}(\xi)]\, N(d\xi, du)}_{\text{losses retained by insurer}} .$$

Insurer's criterion

Recall: the insurer has $n+1$ models/probability measures $\mathbb{P}_1, \ldots, \mathbb{P}_n, \mathbb{P}_C$.

Insurer penalizes model ambiguity using the χ^2-divergence:

$$\chi^2(\mathbb{Q} \,\|\, \mathbb{P}) := \mathbb{E}^{\mathbb{P}}\left[\left(\frac{d\mathbb{Q}}{d\mathbb{P}}\right)^2 - 1\right].$$



Optimization Problem

The insurer seeks the solution to the following problem:

$$\sup_{\boldsymbol{\alpha} \in \mathcal{A}} \inf_{\mathbb{Q} \in \Delta^2} \left(\mathbb{E}^{\mathbb{Q}}[X_T^{\boldsymbol{\alpha}}] + \frac{1}{2\theta} \sum_{k \in \mathcal{I}} \pi_k \, \mathbb{E}^{\mathbb{P}_k}\left[\left(\frac{d\mathbb{Q}}{d\mathbb{P}_k}\right)^2 - 1\right]\right),$$

where $\theta > 0$, $\pi_k \geq 0$, $k \in \mathcal{I} := \{1, \ldots, n, C\}$, are given weights such that $\sum_{k \in \mathcal{I}} \pi_k = 1$, and $\Delta^2 := \left\{\mathbb{Q} : \mathbb{Q} \ll \mathbb{P}_k \text{ and } \mathbb{E}^{\mathbb{P}_k}\left[\left(\frac{d\mathbb{Q}}{d\mathbb{P}_k}\right)^2\right] < \infty \text{ for all } k \in \mathcal{I}\right\}$.

Auxiliary processes

Definition (auxiliary processes)

For an $\mathbb{F}$-predictable random field $\boldsymbol{\beta} = (\boldsymbol{\beta_t})_{t\in[0,T]}$, $\boldsymbol{\beta_t} : \mathbb{R}_+ \to \mathbb{R}_+$, define the stochastic processes $\{Z^{\boldsymbol{\beta}}_{k,t}\}_{t\in[0,T],k\in\mathcal{I}}$, $k \in \mathcal{I}$, which solve the SDEs:

$$dZ^{\boldsymbol{\beta}}_{k,t} = Z^{\boldsymbol{\beta}}_{k,t^-} \int_{\mathbb{R}_+} [\nu_k(\xi) - \boldsymbol{\beta_t}(\xi)]\, d\xi dt - Z^{\boldsymbol{\beta}}_{k,t^-} \int_{\mathbb{R}_+} \left[1 - \frac{\boldsymbol{\beta_t}(\xi)}{\nu_k(\xi)}\right] N(d\xi, dt)\,,$$

$$Z^{\boldsymbol{\beta}}_{k,0} = 1\,.$$

Define $\mathbb{Q}_{\boldsymbol{\beta}}$ such that $d\mathbb{Q}_{\boldsymbol{\beta}}(\omega) = Z^{\boldsymbol{\beta}}_{k,T}\, d\mathbb{P}_{\boldsymbol{k}}(\omega)$ for all $\omega \in \mathcal{F}_T$, $k \in \mathcal{I}$.

Then by Girsanov's theorem:

$$\tilde{N}^{\mathbb{Q}_{\boldsymbol{\beta}}}(d\xi, dt) = \tilde{N}^{\mathbb{P}_{\boldsymbol{k}}}(d\xi, dt) + \left[1 - \frac{\boldsymbol{\beta_t}(\xi)}{\nu_k(\xi)}\right] \nu_k(d\xi)dt = N(d\xi, dt) - \boldsymbol{\beta_t}(\xi)d\xi dt\,,$$

i.e. N has $\mathbb{Q}_{\boldsymbol{\beta}}$-compensator $\boldsymbol{\beta_t}(\xi)\, d\xi\, dt$.

Re-writing the criterion

Definition (admissible compensators)

Let $\mathfrak{B}$ denote the $\mathbb{F}$-predictable random fields $\boldsymbol{\beta}$ such that, for all $k \in \mathcal{I}$,

$$\mathbb{E}^{\mathbb{P}_{\boldsymbol{k}}}\left[\left(Z_{k,T}^{\boldsymbol{\beta}}\right)^2\right] < \infty\,.$$

Lemma

The processes $\boldsymbol{\beta} \in \mathfrak{B}$ induce the same probability measures as $\Delta^2 = \left\{\mathbb{Q} : \mathbb{Q} \ll \mathbb{P}_{\boldsymbol{k}} \text{ and } \mathbb{E}^{\mathbb{P}_{\boldsymbol{k}}}\left[\left(\frac{d\mathbb{Q}}{d\mathbb{P}_{\boldsymbol{k}}}\right)^2\right] < \infty \text{ for all } k \in \mathcal{I}\right\}$, i.e.,

$$\Delta^2 = \{\mathbb{Q}_{\boldsymbol{\beta}} : \boldsymbol{\beta} \in \mathfrak{B}\}\,.$$

Insurer's optimization problem

Optimization Problem

The insurer seeks the solution to the following problem:

$$\sup_{\boldsymbol{\alpha}\in\mathcal{A}} \inf_{\boldsymbol{\beta}\in\mathfrak{B}} \mathbb{E}^{\mathbb{Q}_{\boldsymbol{\beta}}}\left[X_T^{\boldsymbol{\alpha}} + \frac{1}{2\theta}\sum_{k\in\mathcal{I}}\pi_k\left(Z_{k,T}^{\boldsymbol{\beta}} - 1\right)\right],$$

where $\theta > 0$ and $\pi_k \geq 0$, $k \in \mathcal{I} := \{1, \ldots, n, C\}$, are given weights such that $\sum_{k\in\mathcal{I}}\pi_k = 1$.

Theorem (Optimal Controls)

The optimal controls in feedback form are

$$\alpha^*(t,\xi,\boldsymbol{z}) = \xi - \frac{1}{\theta}\sum_{k\in\mathcal{I}} \pi_k\, z_k\, \ell_k(T-t)\left[(1+\eta)\frac{v_C(\xi)}{v_k(\xi)} - 1\right],$$

$$\beta^*(\xi) = (1+\eta)\, v_C(\xi)\,,$$

where

$$\ell_k(t) = \exp\left(t\int_{\mathbb{R}_+}\left[1-(1+\eta)\frac{v_C(\xi)}{v_k(\xi)}\right]^2 \nu_k(d\xi)\right),$$

and the insurer's value function is

$$J(t,x,\boldsymbol{z}) = x + \sum_{k\in\mathcal{I}} \frac{\pi_k}{2\theta}\, z_k\, \ell_k(T-t) - \frac{1}{2\theta} - \left[(1+\eta)\int_{\mathbb{R}_+}\xi\,\nu_C(d\xi) - c\right](T-t)\,.$$

Processes under optimal controls

Proposition

For $t \in [0, T]$,

$$X_t^* = x_0 + \left[c - (1+\eta)\int_{\mathbb{R}_+} \xi \, \nu_C(d\xi)\right] t + \frac{1}{\theta}\sum_{k\in\mathcal{I}} \pi_k \, \ell_k(T) \, \left[1 - \ell_k(-t) Z_{k,t}^*\right] .$$

where

$$Z_{k,t}^* = \exp\left(t\int_{\mathbb{R}_+} [v_k(\xi) - (1+\eta) v_C(\xi)] \, d\xi + \int_0^t \int_{\mathbb{R}_+} \ln\left((1+\eta)\frac{v_C(\xi)}{v_k(\xi)}\right) N(d\xi, ds)\right), \; k \in \mathcal{I} .$$

Sketch of proof: optimal controls

$\boldsymbol{\alpha}^*$, $\boldsymbol{\beta}^*$, J derived using the Hamilton-Jacobi-Bellman-Isaacs equation.

Are $\boldsymbol{\alpha}^*$ and $\boldsymbol{\beta}^*$ admissible?

Lemma

For $k \in \mathcal{I}$: $\quad \mathbb{E}^{\mathbb{P}_k}[Z^*_{k,T}] = 1\,, \quad \mathbb{E}^{\mathbb{P}_k}[(Z^*_{k,T})^2] = \ell_k(T) < \infty\,, \quad \mathbb{E}^{\mathbb{P}_C}[(Z^*_{k,T})^2] < \infty\,.$

Then $\boldsymbol{\beta}^* \in \mathfrak{B}$ and we can show that:

$$\left.\begin{aligned} &\mathbb{E}^{\mathbb{P}_C}\left[\int_0^t \int_{\mathbb{R}_+} |\boldsymbol{\alpha}^*(s,\xi,\boldsymbol{Z}^*_s)|^2\,\nu_C(d\xi)\,ds\right] < \infty \\ &\mathbb{E}^{\mathbb{P}_C}\left[\int_0^t \int_{\mathbb{R}_+} [\xi - \boldsymbol{\alpha}^*(s,\xi,\boldsymbol{Z}^*_s)]^2\,\nu_C(d\xi)\,ds\right] < \infty \end{aligned}\right\} \boldsymbol{\alpha}^* \in \mathcal{A}$$

Mean and variance of insurer's wealth

Proposition

For $t \in [0, T]$:

$$\mathbb{E}^{\mathbb{Q}^*}[X_t^*] = x_0 + \left[c - (1+\eta)\int_{\mathbb{R}_+} \xi\, \nu_C(d\xi)\right] t = \mathbb{E}^{\mathbb{Q}^*}[X_t^{CL}]\,,$$

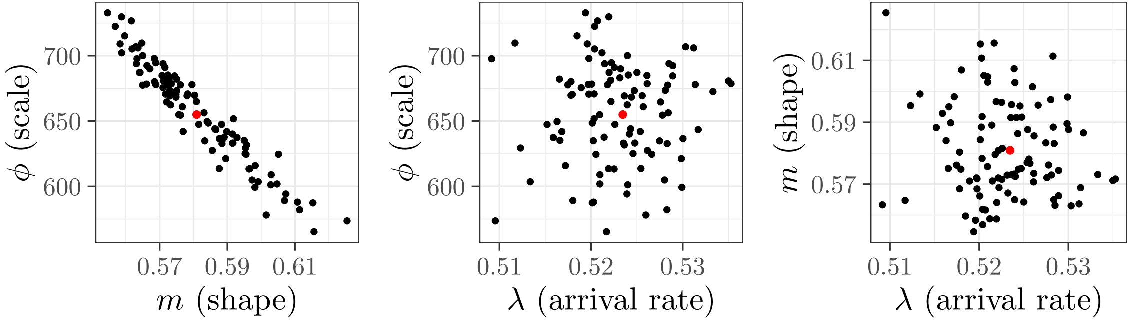
$$\mathrm{Var}^{\mathbb{Q}^*}(X_t^*) = \frac{1}{\theta^2}\, \boldsymbol{p}_t^\intercal\, \Sigma_{\boldsymbol{Z}^*}^{\mathbb{Q}^*}\, \boldsymbol{p}_t\,.$$

where $\Sigma_{\boldsymbol{Z}^*}^{\mathbb{Q}^*}$ denotes the covariance matrix of $\boldsymbol{Z}^*$, i.e., $(\Sigma_{\boldsymbol{Z}^*}^{\mathbb{Q}^*})_{jk} = \mathrm{Cov}^{\mathbb{Q}^*}(Z_{j,t}^*, Z_{k,t}^*)$ and $\boldsymbol{p}_t := (\pi_1\ell_1(T-t), \ldots, \pi_n\ell_n(T-t), \pi_C\ell_C(T-t))$.

Motivating data example

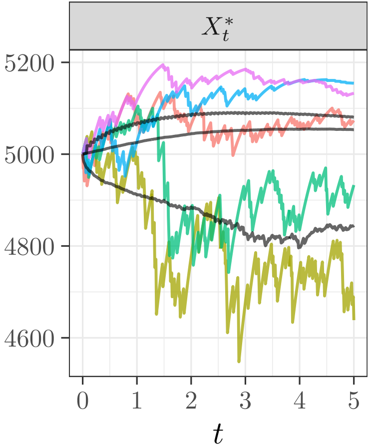
- Recent open-access insurance data set [Segura-Gisbert et al., 2024], 105,555 observations, giving policy-level data on annual **motor insurance policies** of a Spanish non-life insurer for policies started in the years 2015–2018
- Using cross-validation, estimate 100 models $\mathbb{P}_{\boldsymbol{k}}$, $k = 1, \ldots, 100$ from the data set. For each estimate, we sample 50% of the data and then estimate the parameters.
- Estimate arrival rate and severity distribution by maximum likelihood.
- Assume that under all models $k \in \mathcal{I}$:
  - the claim arrival rate is Poisson distributed with rate $\lambda_k > 0$,
  - the severity distribution is Gamma distributed with shape parameter $m_k > 0$ and scale parameter $\phi_k > 0$.
- Estimate the counterparty's model, $\mathbb{P}_{\boldsymbol{C}}$, using the full dataset.

Estimated parameters

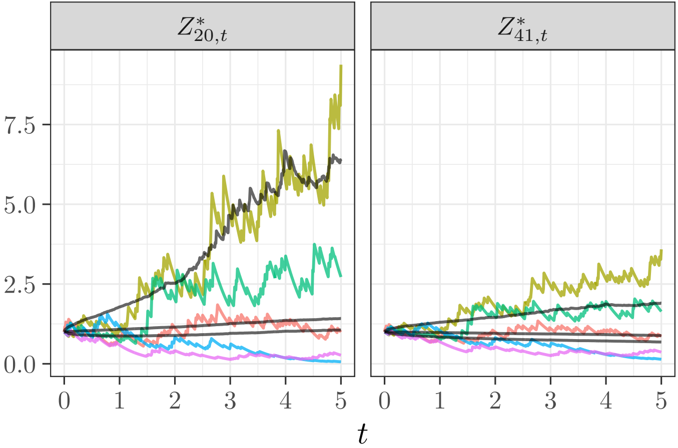


(a) Shape versus scale (b) Arrival rate versus scale (c) Arrival rate versus shape

Paths of X^* and selected Z^* under $\mathbb{P}_C$

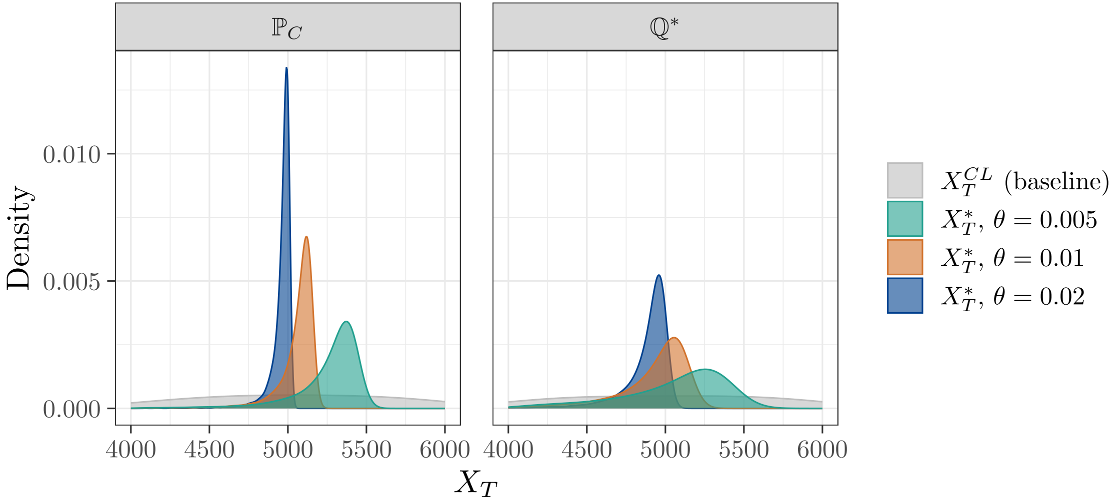


(a) Paths of X_t^* under $\mathbb{P}_C$



(b) Paths of $Z_{20,t}^*$, $Z_{41,t}^*$ under $\mathbb{P}_C$

KDE of X_T under different scenarios



Comparison with a risk-sharing mean-variance strategy

- If there is only one model, $\mathbb{P}$, then the MMV criterion with model ambiguity reduces to the original MMV criterion [Maccheroni et al., 2009]
- In continuous-time, the optimal strategies for MMV and MV generally coincide [Du and Strub, 2024; Y. Li et al., 2025; Trybuła and Zawisza, 2019]
- How does the optimal strategy for the risk sharing problem with model combination relate to the mean-variance strategy?

Criterion with one reference measure $\mathbb{P}$:

$$\sup_{\boldsymbol{\alpha}\in\mathcal{A}} \inf_{\boldsymbol{\beta}\in\mathfrak{B}} \mathbb{E}^{\mathbb{Q}_{\boldsymbol{\beta}}}\left[X_T^{\boldsymbol{\alpha}} + \frac{1}{2\theta}\left(Z_T^{\boldsymbol{\beta}} - 1\right)\right]$$

Monotone mean-variance problem

Proposition

The optimal controls for the problem with a single reference measure $\mathbb{P}$ are

$$\boldsymbol{\alpha}^*(t,\xi,Z_t) = \xi - \frac{\eta}{\theta} e^{\lambda\eta^2(T-t)} Z_t \,,$$

$$\boldsymbol{\beta}^*(\xi) = (1+\eta)\, v(\xi)\,.$$

Furthermore, the insurer's wealth under the optimal strategy is for $t \in [0, T]$,

$$X_t^* = x_0 - [(1+\eta)\lambda\mu - c]\, t + \frac{1}{\theta} e^{\lambda\eta^2 T} - \frac{1}{\theta} e^{\lambda\eta^2(T-t)} Z_t^* \,.$$

where $Z_t^* = (1+\eta)^{M_t} e^{-\eta\lambda t}$ and $M_t = \int_0^t \int_{\mathbb{R}_+} N(d\xi, dt)$.

Mean-variance problem

Optimization Problem 2 (Mean-Variance)

The insurer seeks the solution to the following problem for $\theta > 0$:

$$\sup_{\boldsymbol{\alpha}\in\mathcal{A}} \left\{ \mathbb{E}^{\mathbb{P}}\left[X_T^{\boldsymbol{\alpha}}\right] - \frac{\theta}{2}\mathrm{Var}^{\mathbb{P}}(X_T^{\boldsymbol{\alpha}}) \right\},$$

where

$$dX_t^{\boldsymbol{\alpha}} = \left(c - \int_{\mathbb{R}_+} [\xi + \eta\, \boldsymbol{\alpha_t}(\xi)]\, \nu(d\xi) \right) dt - \int_{\mathbb{R}_+} [\xi - \boldsymbol{\alpha_t}(\xi)]\, \tilde{N}^{\mathbb{P}}(d\xi, dt), \quad X_0^{\boldsymbol{\alpha}} = x_0 .$$

Proposition

The optimal risk sharing strategy $\hat{\alpha}^*$ for Optimization Problem 2 is

$$\hat{\alpha}^*(t, \xi, \hat{X}_t^*) = \xi + \eta \left(\hat{X}_t^* - x_0 + t \left[(1+\eta)\lambda\mu - c \right] - \frac{1}{\theta} e^{\lambda \eta^2 T} \right) ,$$

where $\hat{X}_t^*$ is the insurer's wealth under the strategy $\hat{\alpha}^*$ with $\hat{X}_0^* = x_0$.

Proof follows by the pre-commitment approach of [Zhou and D. Li, 2000].

Proposition

The optimal risk sharing strategy for Optimization Problem 2, $\hat{\alpha}^*$, coincides with the optimal risk sharing strategy for Optimization Problem 1 with one reference measure $\mathbb{P}$, α^*.

Contributions

- We introduce a **novel model combination criterion** that generalizes the monotone mean-variance preferences to multiple reference models
- We derive **explicit solutions** for the insurer's **optimal risk-sharing strategy**, **optimal decision measure**, and their **wealth process**
- We prove that the strategy we obtain is admissible and that the value function satisfies the appropriate verification conditions
- We show how the optimal strategy relates to the pre-commitment mean variance strategy
- We determine the **mean** and **variance** of the insurer's wealth process X, and show that the model penalization parameter θ penalizes the variance of X
- We illustrate the strategy with recent open-access non-life insurance data

Thank you for your attention!

Download the pre-print:

References

Acciaio, B., D. Kršek, and G. Pammer (2025). "Multicausal transport: barycenters and dynamic matching". *SIAM Journal on Financial Mathematics* 16.3, pp. 1104–1138.

Du, J. and M. S. Strub (2024). "Optimal strategies and values for monotone and classical mean-variance preferences coincide when asset prices are continuous". *Operations Research Letters* 57, p. 107204.

Hansen, L. P. and T. J. Sargent (2008). *Robustness*. Princeton University Press.

Jaimungal, S. and S. M. Pesenti (2025). *Kullback-Leibler Barycentre of Stochastic Processes*. Forthcoming in SIAM J. Fin. Math. arXiv: 2407.04860v3 [q-fin.MF].

Kroell, E., S. Jaimungal, and S. M. Pesenti (2025). "Optimal robust reinsurance with multiple insurers". *Scandinavian Actuarial Journal* 2025.5, pp. 1–31.

Li, Y., Z. Liang, and S. Pang (2025). "Comparison Between Mean-Variance and Monotone Mean-Variance Preferences Under Jump Diffusion and Stochastic Factor Model". *Mathematics of Operations Research* 50.3, pp. 2405–2432.

Liu, H., J. T. Ye, J. Blanchet, and N. Si (2025). *ScoreFusion: Fusing Score-based Generative Models via Kullback-Leibler Barycenters*. arXiv: 2406.19619v3 [stat.ML].

Maccheroni, F., M. Marinacci, and A. Rustichini (2006). "Ambiguity Aversion, Robustness, and the Variational Representation of Preferences". *Econometrica* 74.6, pp. 1447–1498. ISSN: 00129682, 14680262.

Maccheroni, F., M. Marinacci, A. Rustichini, and M. Taboga (2009). "Portfolio Selection with Monotone Mean-Variance Preferences". *Mathematical Finance* 19.3, pp. 487–521.

Segura-Gisbert, J., J. Lledó, and J. M. Pavía (2024). "Dataset of an actual motor vehicle insurance portfolio". *European Actuarial Journal*.

Trybuła, J. and D. Zawisza (2019). "Continuous-Time Portfolio Choice Under Monotone Mean-Variance Preferences—Stochastic Factor Case". *Mathematics of Operations Research* 44.3, pp. 966–987.

Zhou, X. Y. and D. Li (2000). "Continuous-Time Mean-Variance Portfolio Selection: A Stochastic LQ Framework". *Applied Mathematics & Optimization* 42.1, pp. 19–33.