Robust ALM:

Dealing with Model Ambiguity

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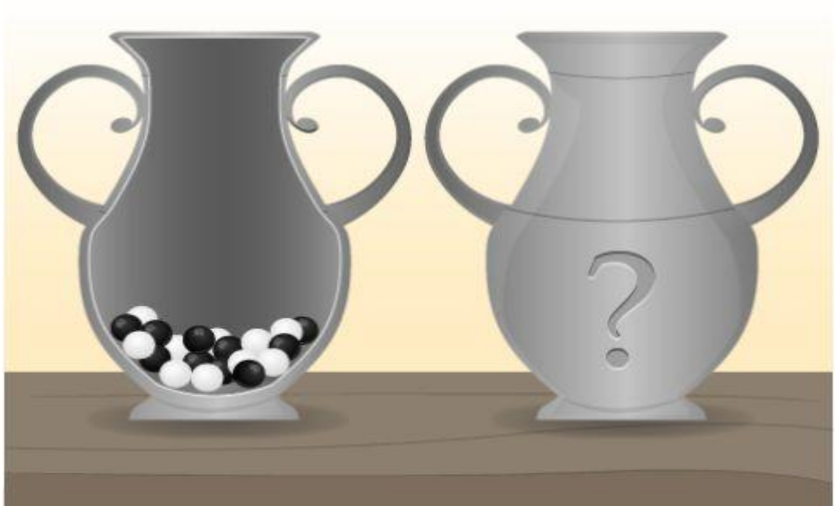
Audience Questions

- Does model uncertainty/ambiguity play a role in determining your ALM strategy?

- Do you discuss model uncertainty with your management?

Risk vs Model Ambiguity

- We don’t know the “true” model in economics
  - Data-generating process may change over time
- We only observe history
- Task: make a decision on optimal investment



Optimality vs Robustness

- Optimal decision sensitive to underlying model
  - Example: mean-variance optimal asset mix

- Optimal in-sample, poor performance out-of-sample
  - Why is the “optimal” portfolio so bad?

ALM Example

- Consider 3 asset classes: A, B, C
  - Volatilities & Correlations:

Vola	Corr Mat	A	B	C
10%	**A**	100%	25%	25%
20%	**B**	25%	100%	90%
20%	**C**	25%	90%	100%

  - Note high correlation between B and C

ALM Example (2)

- Consider different views on returns:

mu-vec	Hist Data	View+A	View+B	View+C
A	2.5%	3.0%	2.0%	2.0%
B	5.0%	5.0%	6.0%	5.0%
C	5.0%	5.0%	5.0%	6.0%

- Find mean/variance optimal asset mix

ALM Example (3)

Optimal Portfolio's

- Extremely sensitive to small changes in return

- Why are the optimal portfolio's so unstable?

mu-vec	View+A	View+B	View+C
A	3.0%	2.0%	2.0%
B	5.0%	6.0%	5.0%
C	5.0%	5.0%	6.0%
	1	1	1
X*	**View+A**	**View+B**	**View+C**
A	61%	41%	41%
B	20%	92%	-33%
C	20%	-33%	92%
mu*	3.8%	4.7%	4.7%
sig*	10.9%	14.3%	14.3%
Objective	2.6%	2.6%	2.6%

ALM: Out-of-Sample test

Sensitivity test

- Evaluate "optimal" portfolio for alternative models
- "Optimal" portfolio has poor out-of-sample performance

X*(+A)	View+A	View+B	View+C
61%	3.8%	3.4%	3.4%
20%	10.9%	10.9%	10.9%
20%	2.6%	2.2%	2.2%

X*(+B)	View+A	View+B	View+C
41%	4.2%	4.7%	3.4%
92%	14.3%	14.3%	14.3%
-33%	2.1%	2.6%	1.4%

Robust ALM

Find “robust” asset mix

- Asset mix that maximises worst-case of all views
  - Filter out “too aggressive” optimisation behaviour
- Good out-of-sample performance

Robust Asset Mix

X*(+A)	View+A	View+B	View+C
61%	3.8%	3.4%	3.4%
20%	10.9%	10.9%	10.9%
20%	2.6%	2.2%	2.2%
X*(+B)	**View+A**	**View+B**	**View+C**
41%	4.2%	4.7%	3.4%
92%	14.3%	14.3%	14.3%
-33%	2.1%	2.6%	1.4%
X*(Rob)	**View+A**	**View+B**	**View+C**
53%	3.9%	3.6%	3.6%
23%	11.7%	11.7%	11.7%
23%	2.6%	2.3%	2.3%

Conclusions

- Optimal ALM portfolios can be very sensitive to model assumptions
  - Optimisation “magnifies” model-assumptions
  - Poor out-of-sample performance
- Use robust optimisation to mitigate sensitivity
  - Good out-of-sample performance