Ad-hoc meeting

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Overview

- The core algorithm chosen to set the probabilities is simple:

1. Calculate the portfolio "risk" in each deal by applying RBC to each loan
2. Randomly generate probability distributions
3. Select distribution which minimizes the mean squared error for all CLOs in our database:

$$\sum (RBC_{Liab} - RBC_{Port})$$

- Due to computational costs in step 2, a hybrid approach was taken as described below.
- The resulting PRELIMINARY probability distribution is

1	2	3	4	5	6	7	8	9	10
0.0890	0.0900	0.2000	0.2460	0.1350	0.1300	0.0565	0.0500	0.0025	0.0010

CLO Project Thesis

- The underlying thesis for this project is that matching the RBC on the CLO tranches with the RBC of the underlying portfolio ensures that risk is conserved.
  - This is consistent with options pricing theory which uses risk neutral probabilities.
  - However, the current approaches effectively matches only the first moment of the distribution.
- Please note that if the work undertaken by the Academy and approved by the appropriate regulatory channels takes a different view, we will follow that approach.

Calculating the Risk of the Portfolio

- We calculated the risk for 1,851 CLOs in our database.
- We applied the appropriate RBC factor to each line item in the portfolio. Since the typical portfolio size in CLOs is in the 300-400 range, we assume that a portfolio adjustment was unnecessary.
- The results were retained in $.
- The detailed results are available in the *risk_adhoc.csv* file.
  - The fist column is the unique Deal ID
  - The second column is the deal risk in $

Probabilities - Initial Approach

- The initial approach to setting the probabilities was to simply generate a large number of probabilities, subject to the full constraints. This proved to be very computationally costly–
  - 2 hours of cloud computing could not generate a single valid distribution.
- As a result, the constraints were relaxed. This was still computationally expensive, but a number of scenarios were generated.
  - For example, in a cloud environment, 100 billion passes generated approx.. 500 valid relaxed distributions.

Full Constraints	Relaxed Constraints
P10<= 10bps P9 <= 25bps Smoothness P7 >= P8 >= P9 >= P10 P4 >= P3 >= P2 >= P1	P10<= 10bps P9 <= 25bps Smoothness P8 >= P9 >= P10 P3 >= P2 >= P1

Probabilities - Hybrid Approach

- As a result of the computational expense, it was decided to take a hybrid approach to the optimization.

Phase I – Constrained Randomness

- Generate a limited set of distributions using the relaxed constraints above
- Select distribution which minimizes Mean Square Error (MSE)

Phase II – Human curation

- Try to minimize MSE "by hand" and select the winning distribution

Phase III – Local Randomness

- Create new distributions by multiplying by small perturbations ($P_{new} = P_{old} * \varepsilon_{norm}(0,\sigma)$)
- Select distribution which minimizes Mean Square Error (MSE)

Probabilities - Local Randomness

- In phase III, we sought to optimize the local solution found in Phase II above.
- Starting with the selected probability distribution ("winner"):
  1. Generate 10 normal error terms with a mean of 0 and a σ starting with 0.125.
  2. Multiply the winner by the error terms and normalize it to one.
  3. Calculate the MSE for the new distribution. If $MSE_{new} < MSE_{winner}$ then the set the new distribution as the new winner.
- This approach maintains the shape of the distribution

Matching Overview

- We calculated the RBC of the tranche for each probability distribution. The percentage loss was mapped to a Designation Category via Part 4 Section 28 of the P&P. The percentage was multiplied by the face value of the tranche to determine the $ value of tranche risk.
- These values were then aggregated by deal.
  - For the purposes of matching only, the Equity tranche was assumed to be 100% multiplied by the implied value (all Assets + Cash – all Liabilities).
- The "error" for each deal was the difference between the Liabilities and the Portfolio

$$(RBC_{Liab} - RBC_{Port})$$

- The probability scenario which minimized the mean squared error was selected.
- This process was repeated for each new probability distribution.
- The selected probability explains 97% of the RBC risk in the portfolio (with Equity @100%).

Alternative Matching Assumptions

- A number of decisions were taken at this step which deserve attention
  1. We used 100% for Equity instead of 45% in the interim solution. This was done to avoid penalizing the senior debt tranches.
  2. We could also have used the probability weighted total loss on the tranches, however this would be inconsistent with the idea of a RBC match.
  3. The RBC of the tranches was set using the mid-point RBC as described in P&P. Alternatively, we could have used the RBC threshold, but that would not have been consistent with the treatment of R/CMBS.
  4. In calculating the error for each deal we used $ instead of percentages. This had the effect of weighting the minimization term by deal size. The match could have been done by percentage.
- We are requesting Feedback on all of these items.

Feedback Requested

1. Feedback on the overall approach
2. Better Probability Distribution?
3. Addition of scenarios on the right? The current approach has difficulty in differentiating between AAA-A. Should more scenarios be added – without adding more probability.
4. Matching Assumptions as described above:
   - Matching $ vs %
   - Match RBC vs total loss
   - Use of Mid-point
   - Equity "RBC"

Next Steps

- Seeking formal or informal feedback
- Starting early next year we will endeavor to rerun all the deals with the new probabilities on a monthly basis.
  - We will also add the previously discussed methodology adjustments.
  - Add FE designations and updated Implied Equity Balance (added Cash Principal).

Appendix

- *lossperc final.csv* layout

Columns	Name	Description
1	DEAL ID	Unique Deal Id
2	DEAL NAME	Deal Name
3	Equity	0/1 flag for Equity
4-13	SCEN_1 to SCEN_10	Percentage loss in each scenario
14	IMPLIED_EQUITY	Assets (incl Prin Cash) – other Liabilities
15	CLASS_FACE_VALUE	Current face value of the tranche