How to Combine Two Relative Rankings of Credit Risk into One Ranking?

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Motivation

- There are two groups of Borrowers: Group 1 (Financial firms) and Group 2 (Oil and Gas); each group has a large number of firms (around 2000 and 9000).
- Each borrower is ranked based on expert opinions. A rank is a number between 1 and 16 (default banks have rank 17). The bank has monthly data on ranks over a period of 10 years for each borrower.
- If two borrowers belong to the same group, it is straightforward to compare the riskiness of these (by comparing the average scores for instance).

- Problem: If there are two borrowers coming from different groups, how can the bank know which borrower is riskier?
- We then need to find a global ranking scale to compare the riskiness amongst borrowers from either groups.
- Data: Group A_i has N_i firms, $i = 1, 2$. The ranks of borrower a at time t is $R_t^a, t = 0, \dots T, R_t^a \in \{1, \dots 17\}$.

First Approach

- For borrower $a \in A_1$, we define a local rank $\overline{R_t^a}$ by

$$\overline{R_t^a} = \sum_{t=1}^{T} w_i R_t^a.$$

- Supose that $(\overline{R_t^a})_{a \in A_1}$ are realizations of the same random variable R^1 whose distribution function is F_1.
- When a varies in A_1, we can plot a histogram for F_1.

- We then approximate the discrete empirical distribution F_1 by a smooth well-known distribution function $\hat{F}_1$ depending on the data.
- We define the conditional probability of default

$$PD^1(x) := PD(R^1 = D | R^1 = x) = \frac{1 - \hat{F}_1(D)}{1 - \hat{F}_1(x)}.$$

- For two arbitrary borrowers a, b: we compare $PD^1(\overline{R_t^a})$ and $PD^2(\overline{R_t^b})$.

Second Approach

- In each group, we suppose that borrowers are realizations of the same markov process (R^1 for group 1 and R^2 for group 2).
- From the data, we get estimates for the transition matrices A_1 and A_2.
- Suppose that a borrower $a \in A_1$ has current rank $R_t^a = x$, we can calculate the probability of default in a time horizon τ by

$$PD^1(x) := PD(R_s^1 = D, s = t, \ldots t + \tau | R_t = x).$$

- Given two borrowers $a \in A_1, b \in A_2$ with current ranks x, y. We compare $PD^1(x)$ and $PD^2(y)$.