z-score

1. z-score的原理

先列举几篇文献里面关于z-score的部分，计算其实就是银行的（资产收益率+资本资产比率）/（资产收益率的标准差）

1.1 bank goverance, regulation, and risk taking(JFE, 2009)

- A as total assets, ROA (=π/A) as return on assets, σ(ROA) as the standard deviation of ROA, and CAR (= E/A) as the capital-asset ratio., then **z = (ROA+CAR)/σ(ROA)**.
- We calculate the average return on assets, its standard deviation and the capital-asset ratio over 1996-2001.（计算ROA的标准差时候，应用是用了整个样本，但文章没有明确注释）

1.2 Regulations, competition and bank risk-taking in transition countries (JFS, 2009)

$$Z = (ROA + EA)/\sigma(ROA)$$

where *ROA* is the rate of return on assets, *EA* is the ratio of equity to assets and *σ*(*ROA*) is an estimate of the standard deviation of the rate of return on assets. To calculate the standard deviation of ROA, **we use data from the two previous years** and we verified that using three of four years produces very similar results.

（但是这篇文章里面没有说明资产负债表的频率，他用的是中欧和东欧银行的数据，1.2的计算方式和1.1一样，除了$\sigma(ROA)$）不清楚外）

1.3 Factors affecting bank risk taking: Evidence from Japan(JBF, 2004)

$$Z = \frac{\sum_{j=1}^{12} \pi_j/A_j + \sum_{j=1}^{12} E_j/A_j}{S_r}$$

where π_j is the estimated market value of total profits; E_j is the market value of total equity (i.e. share price multiplied by the number of outstanding shares); A_j is the market value of total assets (the subscript j denotes the month); S_r is the estimated standard deviation of π_j/A_j .

market values of total equity and total assets are averaged monthly. The estimated market value of total profits is

$$\pi_j = c_j P_j - c_{j-1} P_{j-1}$$

where c_j is the number of outstanding shares adjusted for stock splits, and P_j is the share price of the last business day of month j.

The market value of total assets is

$$A_j = E_j + L$$

where L is the book value of total debt at the end of each fiscal year.

对比1.1和1.3两种计算方式，可以发现略有不同。不同之处在ROA的计算上面，ROA一般定义的是1.1的税后净利润/总资产，但是1.3的计算的ROA是用股票总市值来算的，资产负债表里面用到的信息只有账面总负债L，再结合股票数据，所以每个月都算了一次ROA，不过这篇还是没有说明$\sigma(ROA)$，即S_r是用了多少期的数据去估计的。

2.Volatility of ROAA

2.1 The Impact of Public Guarantees on Bank Risk-Taking: Evidence from a Natural Experiment (RoF, 2014)

这篇文章里面用到了两个指标来衡量risk taking，一个是ROAA(Returen of Average Asset，比之前ROA多了个Average)，另一个是Volatility of ROAA。

由于这篇文章需要的是截面数据，并不是计算面板数据，所以z-score计算中的ROA存在差异。文章是想计算2001年时间银行的risk taking情况，所以用的是前后6年的平均数据，即1995-2006的数据，**文中样本是德国银行，银行资产负债表信息是每年公布1次的。**

$$z-score = (ROAA + CAR)/\sigma(ROAA)$$

where σ(ROAA) is the standard deviation of the return of average assets, E stands for equity, and A for total assets. The latter two are used to calculate the capital assets ratio (E=A 1/4 CAR). ROAA and CAR are both averages for the 6 years before and the 6 years after the removal, respectively. σROAA is calculated using the 6 years before and 6 years after the

removal, respectively.

其中Volatility of ROAA指的就是$\sigma(ROAA)$，所以能计算出z-score就能算出$\sigma(ROAA)$，不需要另外找数据

3. 计算z-score和volatility of ROAA指标具体需要的数据

数据样本：中国所有银行的数据

样本跨度：银行从开始披露信息至今

根据1.1和1.3的计算方式可以将z-score分为两组类型

数据类型一：

1.银行资产负债表中的ROA (return of asset)数据，如果没有直接对应的ROA数据的话，则需要税后净利润数据。

2.银行资产负债表中的账面权益

3.银行资产负债表中的账面总资产

（备注：银行资产负债表频率越高越好，目前披露频率一般是季度，所以应该是季度频率的）

数据类型二：

1.每个月银行平均总市值数据（股票乘股数，然后30天取平均）

2.银行资产负债表中的账面总负债数据（频率越高越好，一般银行是每季度披露一次）

4.所有数据汇总

之前说到基于资产负债表的risk taking衡量有五种

- Z-score
- NPL, non-performing loan ratio(the ratio of non-performing loans to total loans)

- Loan volume (the natural logarithm of the total loan volume)
- Ratio of risk assets to total assets (all bank assets except cash, government securities and balances due from other banks, divided by total assets)
- Volalility of ROA

数据汇总：

银行资产负债表中的

1.ROA数据

2.账面权益数据

3.账面总资产数据

4.不良贷款 (non-performing loans) 的数据

5.总贷款额度 (total loan volume) 的数据

6.现金(cash), 政府证券(government securites)和与其他银行业务有关的数据(balance due from other banks)

（频率越高越好，现在一般是季度披露）