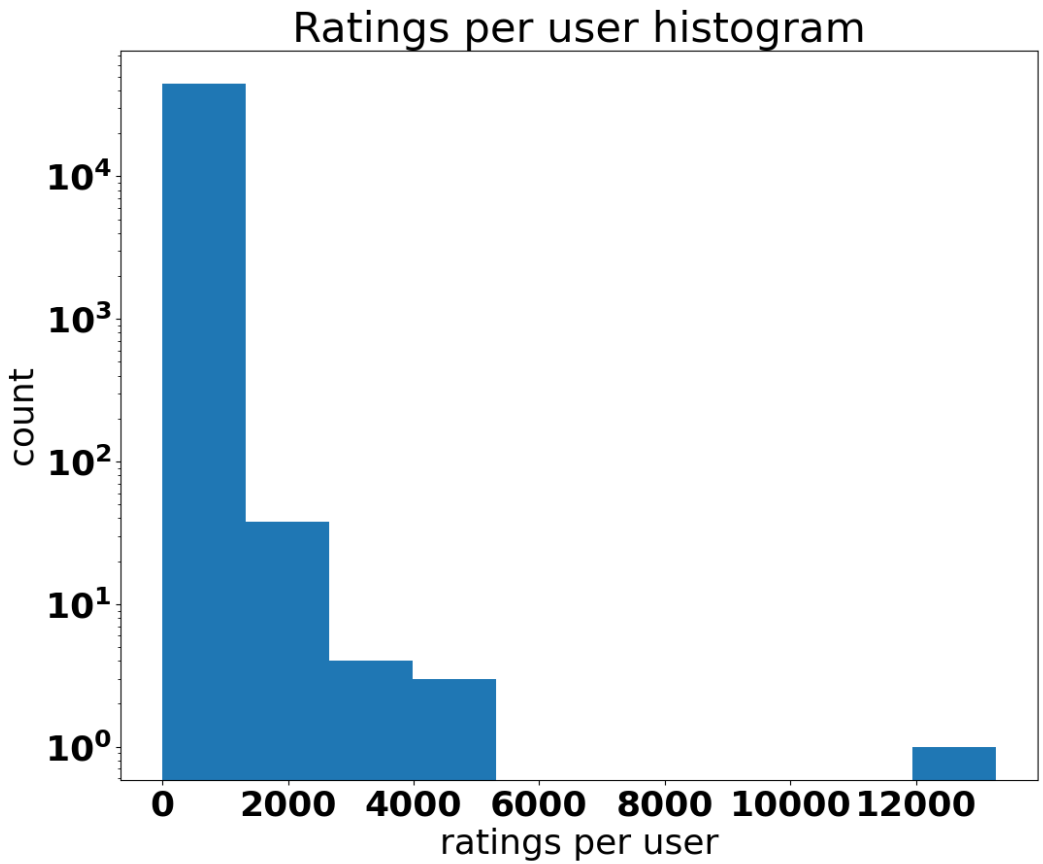
Crawling in the books

Daniel Šmít

Initial insights

Filter the data, gain initial insights

- clean bad data, remove lone ratings: user with 1 book, book with 1 rating
- filter LOTR books (keep other Tolkien books for validation), compute rating count and mean rating
- plot ratings by age (bell), geolocation (USA), ratings count per user



Rating group processing

Process user-based groups

- select user-based rating groups $\{\gamma_i\}$ which contain at least one LOTR book
- *count LOTR books* $\{\lambda_i\}$ and *count all books* $\{\beta_i\}$ in each user group i

Prepare metrics for each relevant book

1. book belongs to $J > 5$ rating groups $\{\gamma_1, \ldots, \gamma_J\}$
2. mean number of LOTR books co-ocurring in rating groups $\Lambda = \frac{1}{J} \sum_{j=1}^{J} \lambda_j$
3. mean size of rating groups $B = \frac{1}{J} \sum_{j=1}^{J} \beta_j$
4. book weight as $W = \frac{\Lambda}{B}$

Weight add importance to groups where a book is accompanied by a large proportion of LOTR/Tolkien books.
Note that we could have chosen another metric for weight, possibly involving mean rating, or rating std.

Ranking

Ranking of Tolkien co-rated books:

- compute weighted count $\kappa = W \cdot J$ of each book belonging to $\{\gamma_1, \ldots, \gamma_J\}$
- rank book within Tolkien co-rated set $\{\gamma_i\}$ by κ
- rank all general books by their count κ' in all ratings
- compute rank-gain for each book in Tolkien co-rated set $\kappa - \kappa'$

The rank gain represents how much more frequently a book co-occurs with Tolkien books relatively to other book as compared with its general Tolkien—non-weighted occurence frequency.

Relevance

Filter books with positive ranking gain $\kappa - \kappa' > 0$

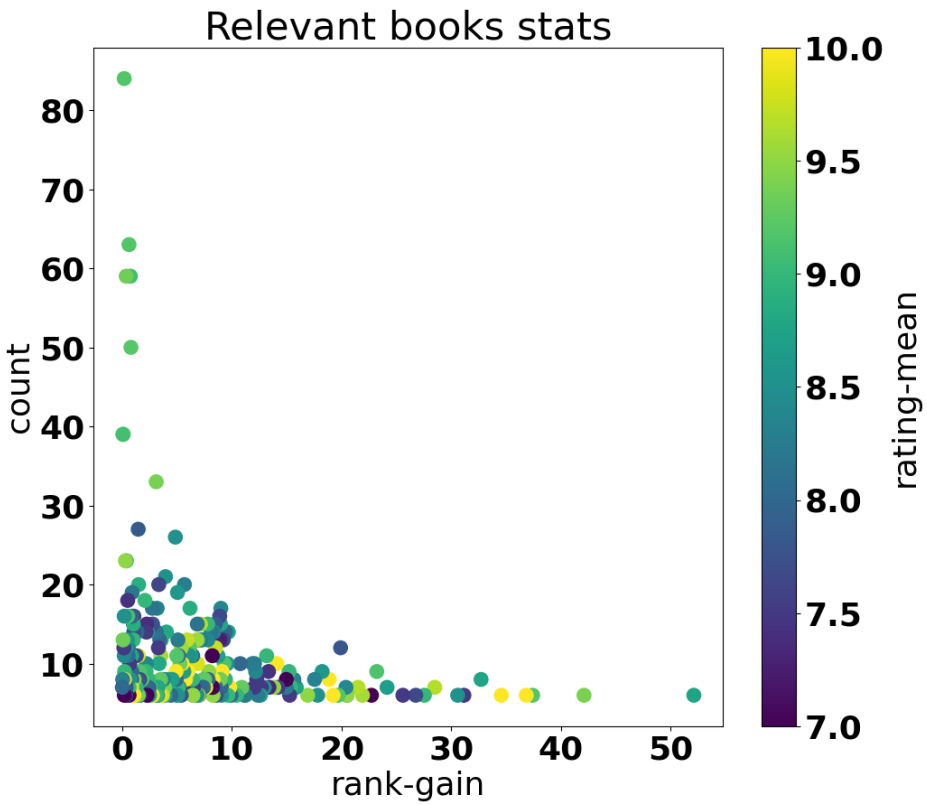


Figure: Scatter plot of Tolkien co-rated book metrics

Note that we could select books for further analysis in different ways. Prefering those with highest rank gain, those with high count, or some sort of combined multi-objective (Pareto) selection.

Linking

Build a graph of links between books with positive ranking gain

- create set of most common Tolkien books $\{\tau_k\}$ and positive rank gain books $\{\rho_l\}$, $\{\mu_m\} = \{\tau_k\} \cup \{\rho_l\}$
- count pair-wise co-ocurrence in the same rating group γ_i for each pair (μ_m, μ_n)
- get symmetric matrix of co-ocurrence, naming $\rho{-}\rho$ co-occurences R, $\tau{-}\tau$ co-occurences T, and $\rho{-}\tau$ co-occurences Q

Getting linked group

Estimate a group of books linked to LOTR books and to one another

- create a normalized vector of weights $\tau^{(1)}$ as relative LOTR books count
- compute a vector of non-LOTR books linked ($\rho{-}\tau$ co-ocurrence) to this vector, $\rho^{(1)}$
- redistribute weights $\rho^{(n-1)} \to \rho^{(n)}$ by links between the books while weight std grows, until vector converges
- select the top books from $\rho^{(n)}$

$$\begin{bmatrix} \rho^{(1)} \\ 0 \end{bmatrix} = \begin{bmatrix} R & Q \\ Q^T & T \end{bmatrix} \begin{bmatrix} 0 \\ \tau^{(1)} \end{bmatrix}$$

$$\left[\rho^{(n)}\right] = R\left[\rho^{(n-1)}\right]$$