A User-Centric Approach to the Design and Consequences of Recommender Systems

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Summary & Goals

Recommender systems have increasingly come under focus for negative social consequences:

- **Filter Bubbles:** Individuals consume increasingly similar goods and are isolated from diversity of content
- **User Homogenization**: Individuals consume increasingly similar goods as each other

We look at the extent to which these effects can be attributed to recommender systems as opposed to natural consequences of individual decision-making in markets where recommender systems are deployed.
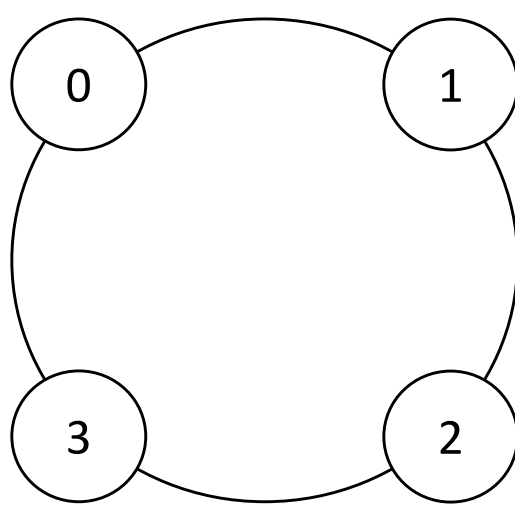
Model

User Decision-Making:

- **N** items, users sequentially consume **T** items
- Realized utility vectors for consumer **i**:

  $X_i = V_i + \beta V$, $V \sim N(0, \Sigma)$, $V_i \sim N(V, \Sigma_i)$
- Users have *beliefs* over the realized utilities and are *risk-averse*
- Assume myopic users: no purposeful exploration

Product Space: Products are evenly spaced on a circle

$d(n, m) = \min\{|m-n|, N-|m-n|\}$, m, n indices

Learning:

- Users employ **similarity-based generalization**
- Observe realized utilities directly after consumption
- Spillovers: Bayesian update beliefs about other items, but more strongly about value of similar items than about dissimilar items
- Strength of updating controlled by ρ

Recommendation Regimes:

- No Recommendation: users get no information
- Recommendation: information on V and combine with user beliefs
- Oracle: Ex-post (full information) optimal consumption path

Evaluation: Characterization via simulation over populations of users and a grid of relevant parameter values. Results here reported for N = 200, T = 20

Filter Bubble Effect

- Track average consumption distance across t
- Empirical work (Nguyen, et. al 2014 WWW) has found that filter bubble effects arise **without recommendation**
- Spillovers lead to a natural "narrowing" effect
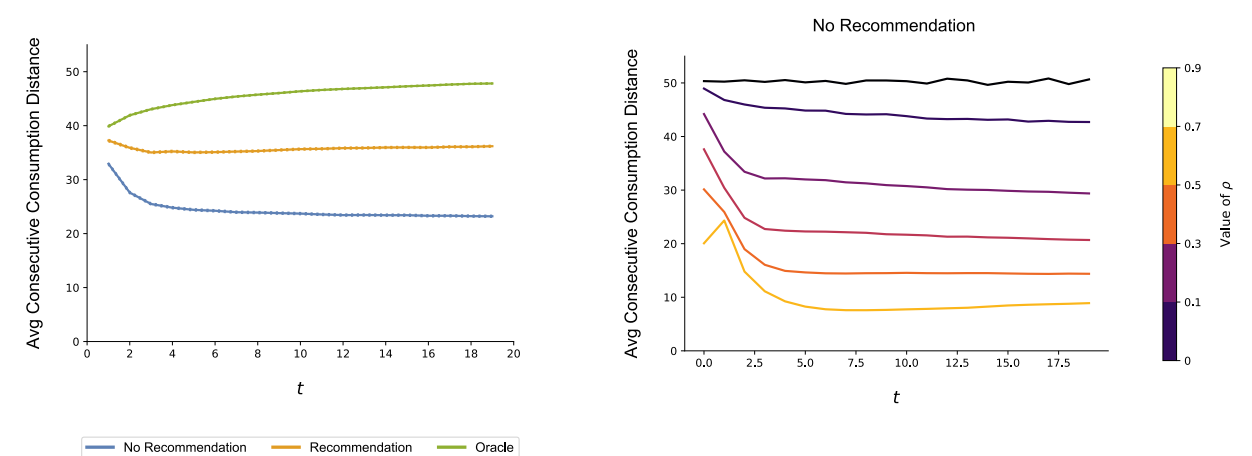
Welfare and Content Diversity

- Diversity = average normalized pairwise distance between consumed products
- Does higher "content diversity" imply higher welfare?
  - Low diversity can come from consumption of many similar high utility goods
  - High diversity can come from consumption of many different low utility goods
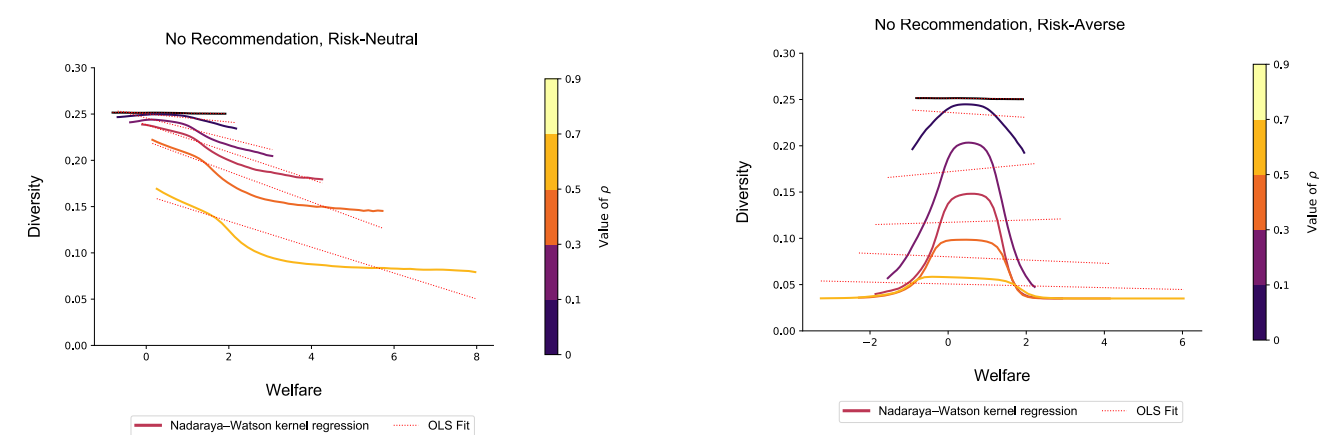
User Homogeneity

- Homogeneity = Jaccard index across consumption sets
- Recommendation "coordinates" individuals in similar portions of the product space
- Without recommendation, no coordination leads to low homogeneity
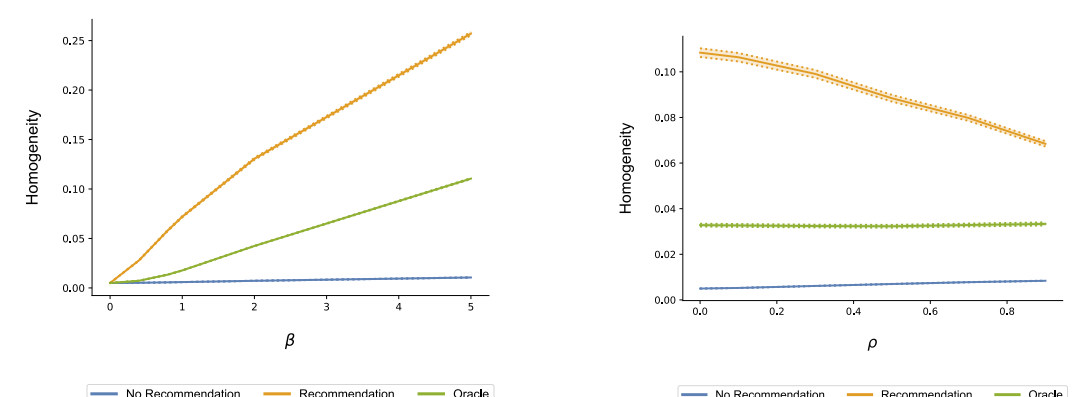
Conclusions

- Filter bubble effects can be generated by a natural model of user decision-making
- Homogeneity naturally arises in recommender systems by coordinating consumers in the product space
- Understanding user beliefs and user decision-making are