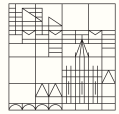
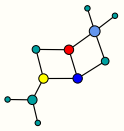


Social shifts in the Late Pre–hispanic US Southwest

Habiba, Jan C. Athenstädt & Ulrik Brandes

Department of Computer & Information Science
University of Konstanz

April 26th, 2014



Agenda

Introduction

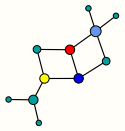
- Overview
- Mills et al. (2013):Transformation of social networks in the late pre–Hispanic US Southwest
- Follow–up questions

Beyond Brainerd–Robinson

- Alternative measures of similarity
- Index of Significance of Wares
- Across–Time Comparison

ViSim - A tool to explore similarities among sites

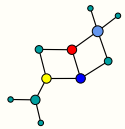
Conclusions and future work



Introduction

Summary

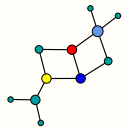
- US Southwest (A.D. 1200–1450): large-scale demographic changes
  - long-distance migration
  - population aggregation



Introduction

Summary

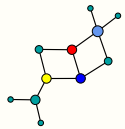
- US Southwest (A.D. 1200–1450): large-scale demographic changes
  - long-distance migration
  - population aggregation



Introduction

Summary

- US Southwest (A.D. 1200–1450): large-scale demographic changes
  - long-distance migration
  - population aggregation



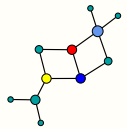
Introduction

Mills et al. (2013): Transformation of social networks in the late pre–Hispanic US Southwest

- Reconstruct population dynamics using network approach
- Database: 42 distinct artifacts, 700+ sites/settlements, over 250 years
  - 515 settlements with ≥ 30 artifacts
  - discretized 250 years into 50-years periods
- Similarity: Brainerd-Robinson index

$$BR(x, y) = 2 - \sum_{z=1}^{p} |P_{xz} - P_{yz}|$$

- Assumption: Social exchanges, movement, migrations = Similarity in proportions of wares



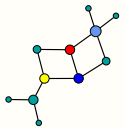
Introduction

Mills et al. (2013): Transformation of social networks in the late pre–Hispanic US Southwest

- Reconstruct population dynamics using network approach
- Database: 42 distinct artifacts, 700+ sites/settlements, over 250 years
  - 515 settlements with ≥ 30 artifacts
  - discretized 250 years into 50-years periods
- Similarity: Brainerd-Robinson index

$$BR(x, y) = 2 - \sum_{z=1}^{p} |P_{xz} - P_{yz}|$$

- Assumption: Social exchanges, movement, migrations = Similarity in proportions of wares



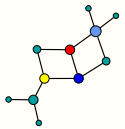
Introduction

Mills et al. (2013): Transformation of social networks in the late pre–Hispanic US Southwest

- Reconstruct population dynamics using network approach
- Database: 42 distinct artifacts, 700+ sites/settlements, over 250 years
  - 515 settlements with ≥ 30 artifacts
  - discretized 250 years into 50-years periods
- Similarity: Brainerd-Robinson index

$$BR(x, y) = 2 - \sum_{z=1}^{p} |P_{xz} - P_{yz}|$$

- Assumption: Social exchanges, movement, migrations = Similarity in proportions of wares



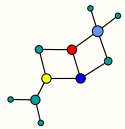
Introduction

Mills et al. (2013): Transformation of social networks in the late pre–Hispanic US Southwest

- Reconstruct population dynamics using network approach
- Database: 42 distinct artifacts, 700+ sites/settlements, over 250 years
  - 515 settlements with ≥ 30 artifacts
  - discretized 250 years into 50-years periods
- Similarity: Brainerd-Robinson index

$$BR(x, y) = 2 - \sum_{z=1}^{p} |P_{xz} - P_{yz}|$$

- Assumption: Social exchanges, movement, migrations = Similarity in proportions of wares



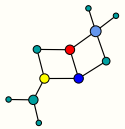
Introduction

Mills et al. (2013): Transformation of social networks in the late pre–Hispanic US Southwest

- Reconstruct population dynamics using network approach
- Database: 42 distinct artifacts, 700+ sites/settlements, over 250 years
  - 515 settlements with ≥ 30 artifacts
  - discretized 250 years into 50-years periods
- Similarity: Brainerd-Robinson index

$$BR(x, y) = 2 - \sum_{z=1}^{p} |P_{xz} - P_{yz}|$$

- Assumption: Social exchanges, movement, migrations = Similarity in proportions of wares



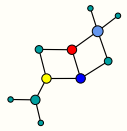
Introduction

Mills et al. (2013): Transformation of social networks in the late pre–Hispanic US Southwest

- Reconstruct population dynamics using network approach
- Database: 42 distinct artifacts, 700+ sites/settlements, over 250 years
  - 515 settlements with ≥ 30 artifacts
  - discretized 250 years into 50-years periods
- Similarity: Brainerd-Robinson index

$$BR(x, y) = 2 - \sum_{z=1}^{p} |P_{xz} - P_{yz}|$$

- Assumption: Social exchanges, movement, migrations = Similarity in proportions of wares



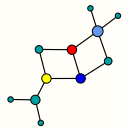
Introduction

Mills et al. (2013): Transformation of social networks in the late pre–Hispanic US Southwest

- Reconstruct population dynamics using network approach
- Database: 42 distinct artifacts, 700+ sites/settlements, over 250 years
  - 515 settlements with ≥ 30 artifacts
  - discretized 250 years into 50-years periods
- Similarity: Brainerd-Robinson index

$$BR(x, y) = 2 - \sum_{z=1}^{p} |P_{xz} - P_{yz}|$$

- Assumption: Social exchanges, movement, migrations = Similarity in proportions of wares



Introduction

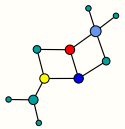
Follow-up questions

1. How do larger and more diverse settlements relate to the smaller and more homogeneous ones?
2. How does population shifts happened within shorter or longer time periods?
3. How much is the evolving “identity” of settlements indicative of movement trends?

Introduction

Follow-up questions

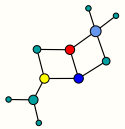
1. How do larger and more diverse settlements relate to the smaller and more homogeneous ones?
2. How does population shifts happened within shorter or longer time periods?
3. How much is the evolving “identity” of settlements indicative of movement trends?



Introduction

Follow-up questions

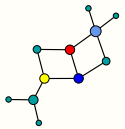
1. How do larger and more diverse settlements relate to the smaller and more homogeneous ones?
2. How does population shifts happened within shorter or longer time periods?
3. How much is the evolving “identity” of settlements indicative of movement trends?



Introduction

Follow-up questions

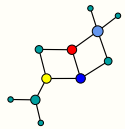
1. How do larger and more diverse settlements relate to the smaller and more homogeneous ones?
2. How does population shifts happened within shorter or longer time periods?
3. How much is the evolving “identity” of settlements indicative of movement trends?



Beyond Brainerd–Robinson

Proposed Extensions

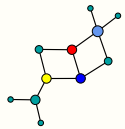
1. Alternative measures of similarity
2. Index of significance of wares
3. Across–time comparison of settlements



Beyond Brainerd–Robinson

Proposed Extensions

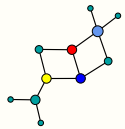
1. Alternative measures of similarity
2. Index of significance of wares
3. Across–time comparison of settlements



Beyond Brainerd–Robinson

Proposed Extensions

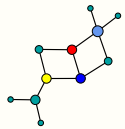
1. Alternative measures of similarity
2. Index of significance of wares
3. Across–time comparison of settlements



Beyond Brainerd–Robinson

Proposed Extensions

1. Alternative measures of similarity
2. Index of significance of wares
3. Across–time comparison of settlements



Beyond Brainerd–Robinson

Alternative measures of similarity

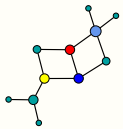
Asymmetric similarity based on dominance relationship

- Integral:

$$W_x \subseteq W_y \Rightarrow x <_D y$$

- Fractional:

$$\forall w_x^z \in W_x : P_{xz} < P_{yz} \Rightarrow x <_D y$$



Beyond Brainerd–Robinson

Alternative measures of similarity

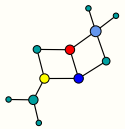
Asymmetric similarity based on dominance relationship

- Integral:

$$W_x \subseteq W_y \Rightarrow x <_D y$$

- Fractional:

$$\forall w_x^z \in W_x : P_{xz} < P_{yz} \Rightarrow x <_D y$$



Beyond Brainerd–Robinson

Alternative measures of similarity

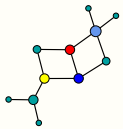
Asymmetric similarity based on dominance relationship

- Integral:

$$W_x \subseteq W_y \Rightarrow x <_D y$$

- Fractional:

$$\forall w_x^z \in W_x : P_{xz} < P_{yz} \Rightarrow x <_D y$$



Beyond Brainerd–Robinson

Alternative measures of similarity

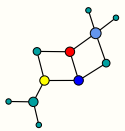
Similarity based on relative ranking of wares

- Parametrized:

$$S_R(x,y) = \begin{cases} 1 & \text{if } |V_R^x[1:k] \cap V_R^y[1:k]| \geq l \\ 0 & \text{otherwise} \end{cases}$$

- Non–parametrized:

$$S_R^1(x,y) = \max_{1 \leq k \leq p} \frac{|V_R^x \cap V_R^y|}{k}.$$



Beyond Brainerd–Robinson

Alternative measures of similarity

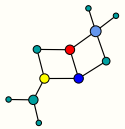
Similarity based on relative ranking of wares

- Parametrized:

$$S_R(x,y) = \begin{cases} 1 & \text{if } |V_R^x[1:k] \cap V_R^y[1:k]| \geq l \\ 0 & \text{otherwise} \end{cases}$$

- Non–parametrized:

$$S_R^1(x,y) = \max_{1 \leq k \leq p} \frac{|V_R^x \cap V_R^y|}{k}.$$



Beyond Brainerd–Robinson

Alternative measures of similarity

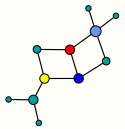
Similarity based on relative ranking of wares

- Parametrized:

$$S_R(x,y) = \begin{cases} 1 & \text{if } |V_R^x[1:k] \cap V_R^y[1:k]| \geq l \\ 0 & \text{otherwise} \end{cases}$$

- Non–parametrized:

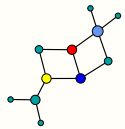
$$S_R^1(x,y) = \max_{1 \leq k \leq p} \frac{|V_R^x \cap V_R^y|}{k}.$$



Beyond Brainerd–Robinson

Index of Significance of Wares

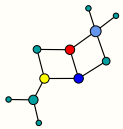
- $I(w_i, x) = f(w_i, x) \times \frac{N}{1+|x \in S : w_i \in s_i|}$
  - Similarity among sites based on $I(w_i, s_x)$
  - Co–occurrence of wares
- Evolving “identity” of settlements over periods of time.



Beyond Brainerd–Robinson

Index of Significance of Wares

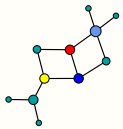
- $I(w_i, x) = f(w_i, x) \times \frac{N}{1+|x \in S : w_i \in s_i|}$
  - Similarity among sites based on $I(w_i, s_x)$
  - Co–occurrence of wares
- Evolving “identity” of settlements over periods of time.



Beyond Brainerd–Robinson

Index of Significance of Wares

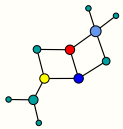
- $I(w_i, x) = f(w_i, x) \times \frac{N}{1+|x \in S : w_i \in s_i|}$
  - Similarity among sites based on $I(w_i, s_x)$
  - Co–occurrence of wares
- Evolving “identity” of settlements over periods of time.



Beyond Brainerd–Robinson

Index of Significance of Wares

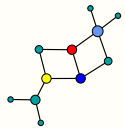
- $I(w_i, x) = f(w_i, x) \times \frac{N}{1+|x \in S : w_i \in s_i|}$
  - Similarity among sites based on $I(w_i, s_x)$
  - Co–occurrence of wares
- Evolving “identity” of settlements over periods of time.



Beyond Brainerd–Robinson

Index of Significance of Wares

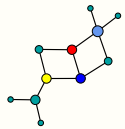
- $I(w_i, x) = f(w_i, x) \times \frac{N}{1+|x \in S : w_i \in s_i|}$
  - Similarity among sites based on $I(w_i, s_x)$
  - Co–occurrence of wares
- Evolving “identity” of settlements over periods of time.



Beyond Brainerd–Robinson

Across–Time Comparison

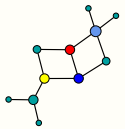
- Long distance movement/migration/resettlement
- Shorter/longer distance movements



Beyond Brainerd–Robinson

Across–Time Comparison

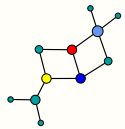
- Long distance movement/migration/resettlement
- Shorter/longer distance movements

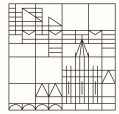


Beyond Brainerd–Robinson

Across–Time Comparison

- Long distance movement/migration/resettlement
- Shorter/longer distance movements



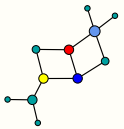


Introduction

The Value of Data Visualization

The greatest value of a picture is when it forces us to notice what we never expected to see.

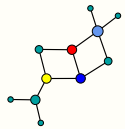
John Tukey, American Mathematician



Introduction

Types of Data Visualization

- Exploratory Analysis
  - no prior idea on possible outcomes
  - look for interesting patterns in the data
  - $\Rightarrow$ hypothesis
- Confirmatory Analysis
  - validate a hypothesis
  - goal-oriented examination of the data
  - $\Rightarrow$ facts that are confirmed by the visualization
- Presentation
  - show the facts to an audience
  - emphasis on the relevant parts
  - $\Rightarrow$ high-quality visualization that is easy to understand



Introduction

Types of Data Visualization

- Exploratory Analysis
  - no prior idea on possible outcomes
  - look for interesting patterns in the data
  - $\Rightarrow$ hypothesis
- Confirmatory Analysis
  - validate a hypothesis
  - goal-oriented examination of the data
  - $\Rightarrow$ facts that are confirmed by the visualization
- Presentation
  - show the facts to an audience
  - emphasis on the relevant parts
  - $\Rightarrow$ high-quality visualization that is easy to understand