Lambaga Demografi Seminar on 26th Oct., 2018

Time Series Change of TFR and Average Family Size by Province

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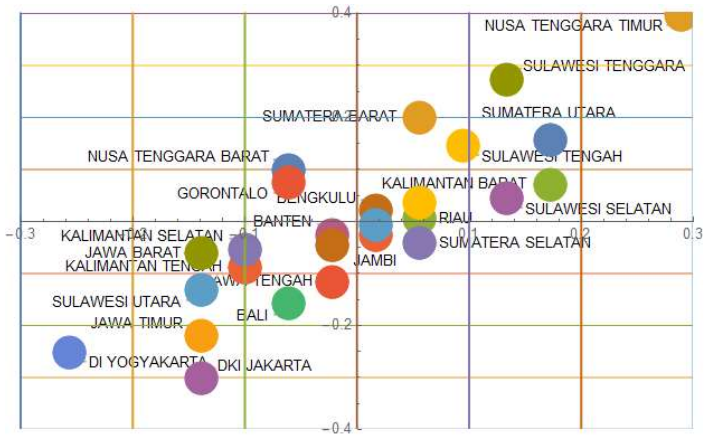
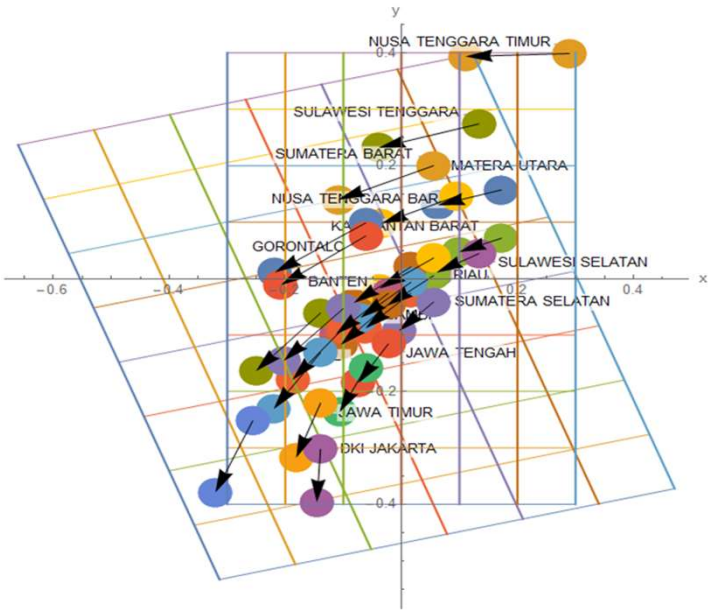
Shape Analysis for demographic data analysis

- A landmark expresses a province
- X-axis: index 1
- Y-axis: index 2
- In the presentation, only 2 dimensional data (x and y) will be handled.

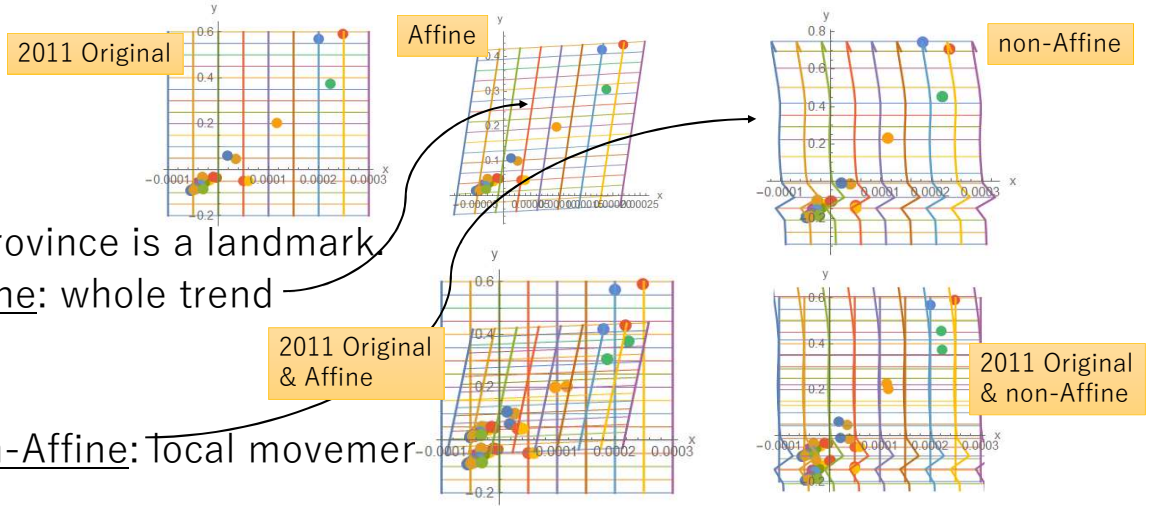


Shape Analysis for demographic data analysis

- **Deformation**
- E.g., 2000 to 2010
- Whole trend ?
- Extra movement ?



Statistical Shape Analysis
from deformation from 2011 to 2015
extract local movements as non-Affine transformation

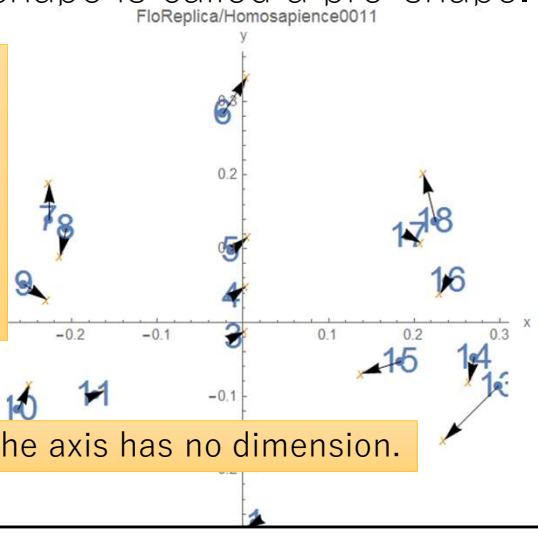


- A province is a landmark.
- Affine: whole trend
- Non-Affine: local movemer

Pre-shape

(1) the given configuration must be moved to the centre (centering) and (2) divided by the centroid size (scaling). The resulting shape is called a pre-shape.

Owing to the pre-shape, we can get to compare the different size configurations.



STANDARDIZATION

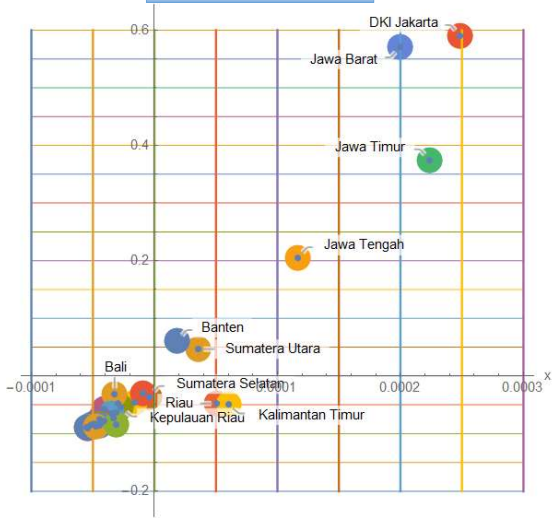
Centroid size

$$S(X) = \sqrt{\sum_{j=1}^{18} \|(X)_j - \bar{X}\|^2}$$

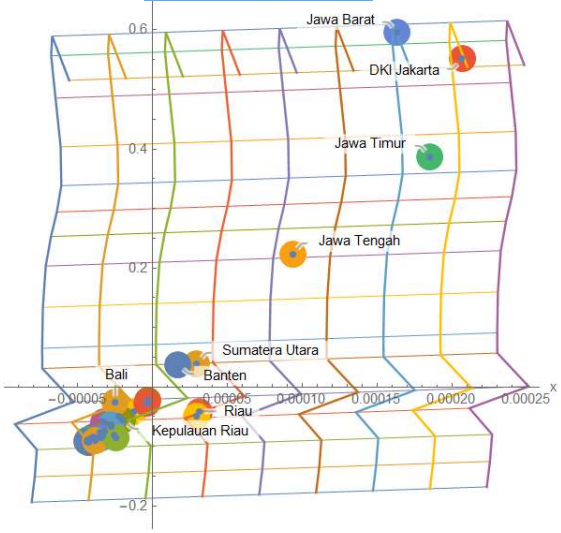
After the scaling the axis has no dimension.

Transformation Grids to Express the Bending

Pre-shape 2011



Pre-shape 2015



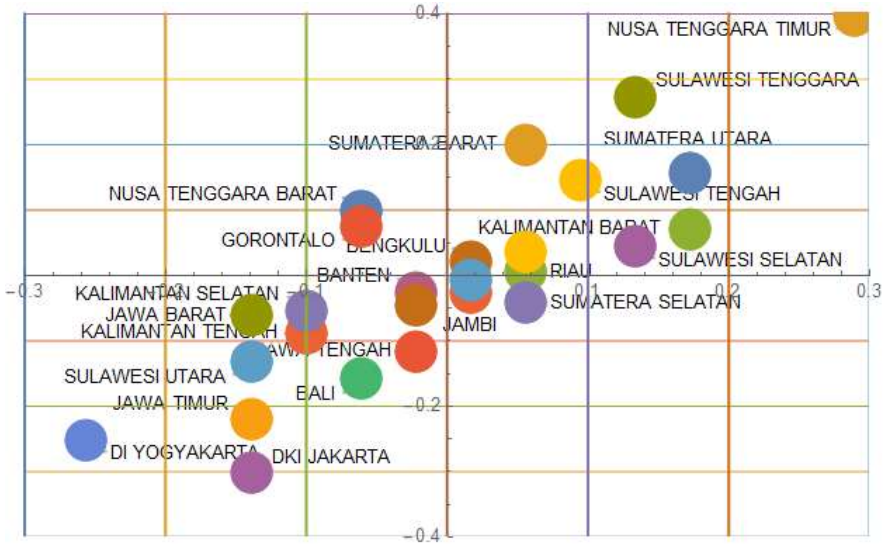
Data I used

- Data cited from “Statistics Indonesia” web site
  - Total Fertility Rate (TFR) by Province, { 1971, 1980, 1985, 1990, 1991, 1994, 1997, 1998, 1999, 2000, 2002, 2007, 2010, and 2012}, updated on 20 Aug 2014
  - Average Household Size by Province, {2000-2015}, updated on 02 Mar 2017

Shape Analysis on the data

- Affine transformation: Total change trend
- Non-Affine transformation: Local movement
- Among the whole change trend, for example, Jakarta movement is larger than others or not ?

Original pre-shape in 2000

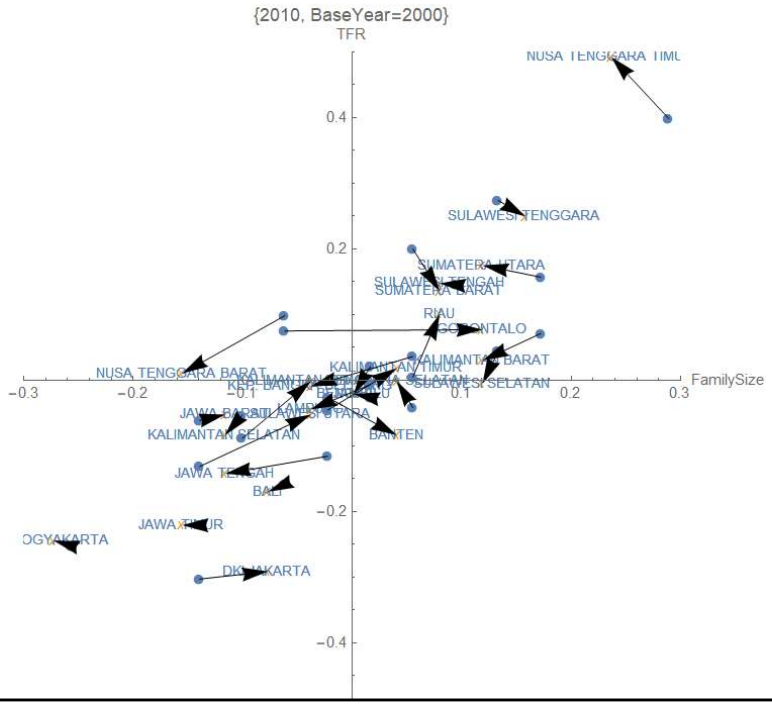


Pre-shape
deformation 2000 to 2010
26 provinces

- Relative position movement

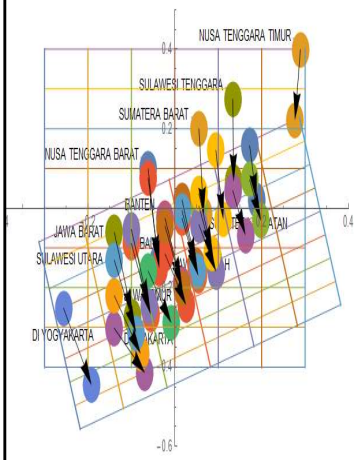
◆FamilySize
- GOLONTALO
- SULAWESI UTARA
- DKI JAKARTA
- JAWA TENGAH
- NUSA TENGGARA BARAT

◆TFR
- NUSA TENGGARA TIMUR
- NUSA TENGGARA BARAT

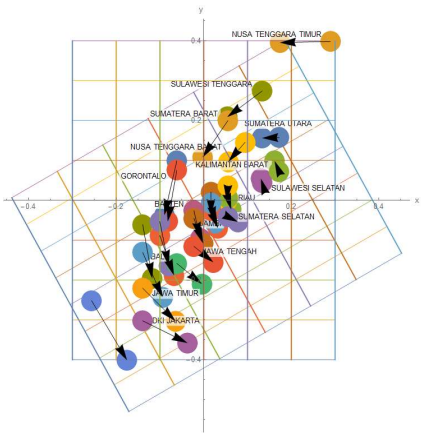


Affine transformation change from 2000

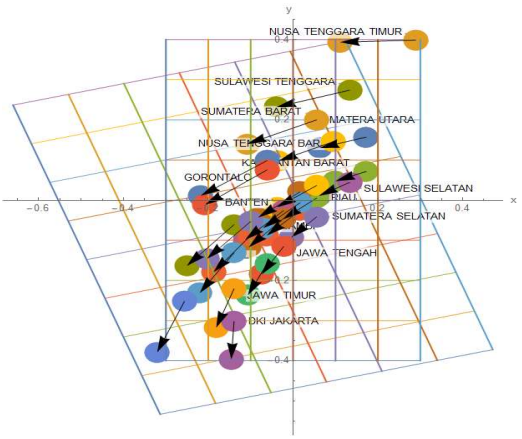
2002



2007



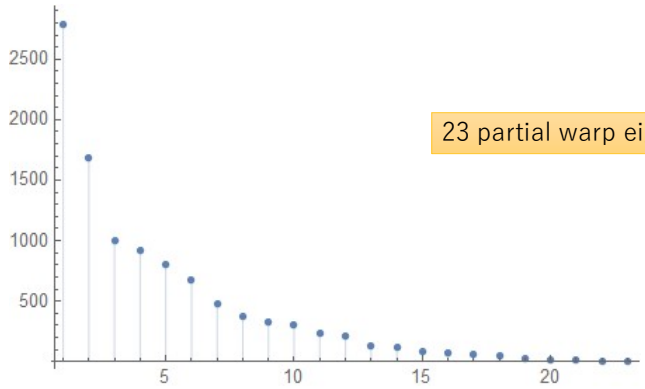
2010



We can divide
the non-Affine transportation to
a set of partial warp eigenvectors

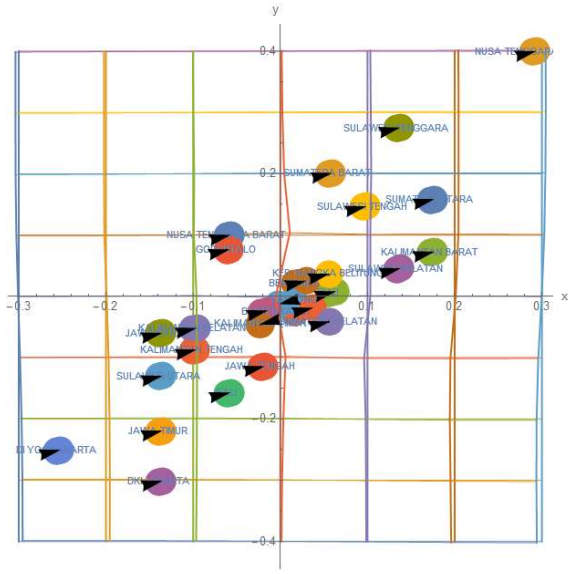
Non-Affine transformation
of eigenvectors : 26 provinces – 3= 23

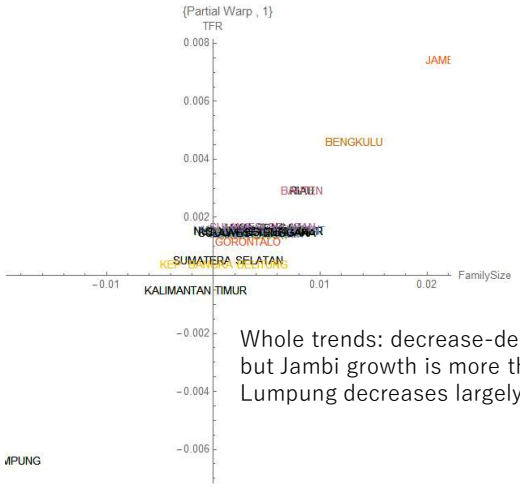
- Eigenvalue (Bending Energy) of each partial warp eigenvector



23 partial warp eigenvectors

2000-> 2010 Partial Warp #1

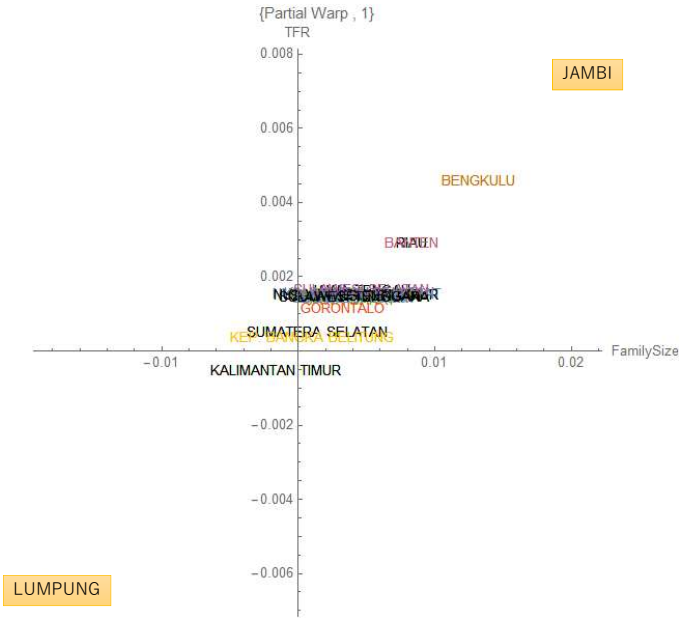




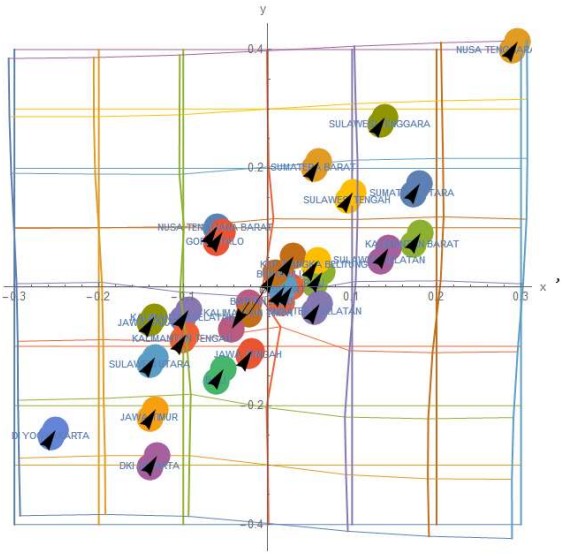
Whole trends: decrease-decrease but Jambi growth is more than others Lumpung decreases largely.

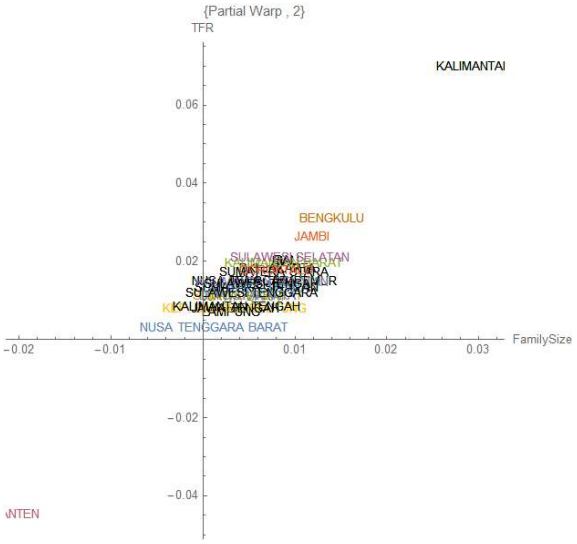
Partial Warp #1

- JAMBI ++
- LUMPUNG --



2000-> 2010 Partial Warp #2





Partial Warp #2

- Kalimantan Timur ++
- BUNTEN --