Analysis of Genealogies with Pajek

Andrej Mrvar

University of Ljubljana
Slovenia
Sources of genealogies

People collect genealogical data for several different reasons/purposes:

- Research of different cultures in sociology, anthropology and history – kinship as fundamental social relation

- Genealogies of families and/or territorial units, e.g.,
  - genealogy of Ragusan (Dubrovnik) nobel families:
  - Mormons genealogy: http://www.familytreemaker.com/
  - genealogy of Škofja Loka district: http://genealogy.ijp.si

- Special genealogies
  - Students and their PhD thesis advisors:
    * Theoretical Computer Science Genealogy: http://sigact.acm.org/genealogy/
    * Mathematics
GEDCOM Format

GEDCOM is standard for storing genealogical data, which is used to interchange and combine data from different programs. The following lines are extracted from the GEDCOM file of European Royal families.

```
0 HEAD
1 FILE ROYALS.GED
...
0 @I58@ INDI
1 NAME Charles Philip Arthur/Windsor/
1 TITL Prince
1 SEX M
1 BIRT
2 DATE 14 NOV 1948
2 PLAC Buckingham Palace, London
1 CHR
2 DATE 15 DEC 1948
2 PLAC Buckingham Palace, Music Room
1 FAMS @F16@
1 FAMC @F14@
...
0 @I65@ INDI
1 NAME Diana Frances /Spencer/
1 TITL Lady
1 SEX F
1 BIRT
2 DATE 1 JUL 1961
2 PLAC Park House, Sandringham
1 CHR
2 PLAC Sandringham, Church
1 FAMS @F16@
1 FAMC @F78@
...
```

```
0 @I115@ INDI
1 NAME William Arthur Philip/Windsor/
1 TITL Prince
1 SEX M
1 BIRT
2 DATE 21 JUN 1982
2 PLAC St.Mary’s Hospital, Paddington
1 CHR
2 DATE 4 AUG 1982
2 PLAC Music Room, Buckingham Palace
1 FAMC @F16@
...
0 @I116@ INDI
1 NAME Henry Charles Albert/Windsor/
1 TITL Prince
1 SEX M
1 BIRT
2 DATE 15 SEP 1984
2 PLAC St.Mary’s Hosp., Paddington
1 FAMC @F16@
...
0 @F16@ FAM
1 HUSB @I58@
1 WIFE @I65@
1 CHIL @I115@
1 CHIL @I116@
1 DIV N
1 MARR
2 DATE 29 JUL 1981
2 PLAC St.Paul’s Cathedral, London
```
Representation of genealogies using networks

Genealogies can be represented as networks in different ways:

- as Ore-graph,
- as p-graph,
- as bipartite p-graph.
**Ore-graph:** In Ore-graph every person is represented by a vertex, marriages are represented with edges and relation *is a parent of* as arcs pointing from each of the parents to their children.
**p-graph**: In p-graph vertices represent individuals or couples. In the case that person is not married yet (s)he is represented by a vertex, otherwise person is represented with the partner in a common vertex. There are only arcs in p-graphs – they point from children to their parents.
**Bipartite p-graph:** has two types of vertices – vertices representing couples (rectangles) and vertices representing individuals (circles for women and triangles for men). Arcs again point from children to their parents.
Advantages of p-graphs

- there are less vertices and lines in p-graphs;
- p-graphs are directed, acyclic networks;
- every semi-cycle corresponds to a *relinking marriage*. There exist two types of relinking marriages:
  - blood marriage: e.g., marriage among brother and sister.
  - non-blood marriage: e.g., two brothers marry two sisters from another family.
Bipartite p-graphs have additional advantage: we can distinguish between a married uncle and a remarriage of a father or between stepsisters and cousins. This property enables us, for example, to find marriages between half-brothers and half-sisters.
**Relinking index**

Relinking index is a measure of relinking by marriages among persons belonging to the same families. Special case of relinking is a blood-marriage.

Let \( n \) denotes number of vertices in p-graph, \( m \) number of arcs, and \( M \) number of maximal vertices (vertices having output degree 0, \( M \geq 1 \)).

If we take a connected genealogy we get

\[
RI = \frac{m - n + 1}{n - 2M + 1}
\]

For a trivial graph (having only one vertex) we define \( RI = 0 \).

* \( 0 \leq RI \leq 1 \)
* If network is a forest/tree, then \( RI = 0 \) (no relinking).
* There exist genealogies having \( RI = 1 \) (the highest relinking).
* Relinking is usually computed for the largest biconnected component.
Patterns with Relinking Index = 1
Comparing genealogies

For comparison, we took five genealogies:

- **Loka.ged** – genealogy of Škofja Loka district, Slovenia (P. Hawlina).
- **Silba.ged** – genealogy of the island Silba, Croatia (P. Hawlina).
  *Special geographical position.*
  *Very restricted marriage rules.*
- **Tur.ged** – genealogy of Turkish nomads, Yörük. Data collected by Ulla C. Johansen and D.R. White (2001)
  *A relinking marriage is a signal of commitment to stay within the nomad group.*
- **Royal.ged** – genealogy of European royal families.
Škofja Loka
Silba, Dubrovnik; Croatia
Aydin Southwest-Anatolia, Turkey
Ragusan nobility - some history

1023: As a result of the segregation of the town’s community into patricians and commoners, a new class, the nobles (*nobiles*) is mentioned for the first time.

1332: The Ragusan nobility was finally recognized by statute. After 1332 no new family was accepted until the large earthquake in 1667.

In Ragusa all political power was in the hands of male nobles older than 18 years. They were members of the Great Council (*Consilium majus*) which had the legislative function. Every year, 11 members of the Small Council (*Consilium minus*) were elected. Together with a duke it had both executive and representative functions. The main power was in the hands of the Senat (*Consilium rogatorum*) which had 45 members elected for one year.

This organization prevented any single family unlike the Medici in Florence, from prevailing. Nevertheless the historians agree that the Sorgo family was all the time among the most influential.

A major problem facing the Ragusan noble families was also that by decreases of their numbers and the lack of noble families in the neighbouring areas (which were under Turkish control), they became more and more closely related – the marriages between relatives of only 3rd and 4th removes were frequent.
1189: Kulin Ban allowed the people of Dubrovnik the liberty of trading in Bosnia without the payment of taxes. In return they gave him whatever they thought appropriate. In the agreement the Croatian name, Dubrovnik, appeared for the first time.

1348: The black death struck down 110 members of the Great Council and 7,000 townsfolk. The Plague re-occurred in 1357, 1366, 1371, 1374 and 1391. To protect themselves, the people of Dubrovnik brought into effect quarantine for all ships.

1667: A terrible earthquake and fire demolished Dubrovnik. Over 4,000 citizens were left under the ruins. Between 2,000 and 3,000 people survived. Dubrovnik recovered thanks to the trade. Due to the fact that a number of aristocrats were killed and their family names died with them, the Great Council accepted amongst its aristocracy 10 of the town’s families. In the year 1673 another five families were accepted amongst the aristocracy.

1763: The conflict between the old and new nobility (the latter were those co-opted into the ranks after the earthquake) resulted in reforms of election rights for the state administration in favour of the newcomers.
Collecting data on Ragusan genealogy

Data collected from private documents and notes of Great Council (Consilium Maius).
She presented data as trees (more than 100 hand written pages).
Genealogy was entered to electronic form using GIM by P. Dremelj (1999).
Available data: names, surnames, date of birth, date of marriage, date of death.
In some occasions additional data were given: profession, children born out of wedlock (filius), persons entering the monastery...
Several missing data: dates corresponding to women, data about first generations...
Other problems

Surnames are written sometimes in Latin, sometimes in Croatian language, sometimes in combination:

Menčetić – Mence,
Sorkočević – Sorgo,
Djurdjević – Georgio,
Gundulić – Gondola,
Gučetić – Gozze (Goce),
Bunić – Bona,
Crijević – Crieva (Zrieva),
Lukarević – Luccari (Lucaro),
Bobaljević – Babalio,
Budačić – Bodazza (Bodaca),
Pucić – Poca…

some individuals changed their surnames or took another…
Some numbers

- 5999 persons from 254 families. Largest families:
  - Goce (8.64%)
  - Mence (6.21%)
  - Sorgo (5.41%)
  - Bona (5.28%)
  - Georgio (4.65%)
  - Gondola (4.13%)
  - Zrieva (3.15%)

- only one person (unknown) isolated,
  all others in single weakly connected component

- Ore-graph
  - 5999 vertices
  - 2002 undirected (marriages) and 9315 directed (a child of) lines
Ore graph – The highest number of children

Nicolaus Caboga (1396-1453)
Ursula Zamagna (M:1413 D:1427)

- Phiocha Caboga (+1444)
- Giovanni Caboga (+1480)
- Jelussa Caboga
- Martolo Caboga (1423-1482)
- Thomas Caboga (+1494)
- Anucla Caboga (+1497)
- Bielava Poca (M:1431)

- Matchus Caboga (filius)
- Fioca Caboga
- Nicoleta Caboga (+1473)
- Ziuana Caboga (+1480)
- Marussa Caboga (+1473)
- Petrus Caboga (1453)
- Junius Caboga (1440-53)
- Michael Caboga (+1464)
- Franciscus Caboga (1445-1487)
- Christophorus Caboga (1445-87)
- Nicolaus Caboga (1453-1512)
- Bartholus Caboga (1468->Mon)
- Catharina Caboga (+1475)
Ore graph – The longest patrilineage

Macro/Play/LongestPatrilineage.mcr
Layers/Optimize layers in x direction/Complete
Relinking marriages (p-graphs with 2 to 6 vertices)
p-graph – Relinking marriages

Read genealogy as p-graph
Options/ReadWrite/GEDCOM-Pgraph [checked]
File/Network/Read/Ragusa.ged (Second)

Read project file with 16 fragments defined:
File/Pajek Project File/Read/frag16.paj (First)

Select first fragment as first network and genealogy as second, then
Nets/Fragment(First in Second)/Find

Repeat the command on another 15 fragments and on the same network:
Macro/Repeat Last Command/Fix Second Network
Macro/Repeat Last Command [15]

Select one of the results (fragments found) and then:
Macro/Play Layers1.mcr
Layout/Tile Components
## Frequencies of fragments

<table>
<thead>
<tr>
<th>pattern</th>
<th>Loka</th>
<th>Silba</th>
<th>Ragusa</th>
<th>Tur</th>
<th>Royal</th>
<th>∑</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>A3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>A4.1</td>
<td>12</td>
<td>5</td>
<td>3</td>
<td>65</td>
<td>21</td>
<td>106</td>
</tr>
<tr>
<td>B4</td>
<td>54</td>
<td>25</td>
<td>21</td>
<td>40</td>
<td>7</td>
<td>147</td>
</tr>
<tr>
<td>A4.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A5.1</td>
<td>9</td>
<td>7</td>
<td>4</td>
<td>15</td>
<td>13</td>
<td>48</td>
</tr>
<tr>
<td>A5.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B5</td>
<td>19</td>
<td>11</td>
<td>47</td>
<td>19</td>
<td>8</td>
<td>104</td>
</tr>
<tr>
<td>A6.1</td>
<td>28</td>
<td>28</td>
<td>2</td>
<td>65</td>
<td>13</td>
<td>140</td>
</tr>
<tr>
<td>A6.2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>A6.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C6</td>
<td>10</td>
<td>12</td>
<td>19</td>
<td>15</td>
<td>5</td>
<td>61</td>
</tr>
<tr>
<td>B6.1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>B6.2</td>
<td>27</td>
<td>39</td>
<td>63</td>
<td>54</td>
<td>12</td>
<td>194</td>
</tr>
<tr>
<td>B6.3</td>
<td>47</td>
<td>30</td>
<td>82</td>
<td>46</td>
<td>13</td>
<td>218</td>
</tr>
<tr>
<td>B6.4</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>No. indi.</td>
<td>47956</td>
<td>6427</td>
<td>5999</td>
<td>1269</td>
<td>3010</td>
<td></td>
</tr>
<tr>
<td>Largest bic.</td>
<td>4095</td>
<td>1340</td>
<td>1446</td>
<td>250</td>
<td>435</td>
<td></td>
</tr>
<tr>
<td>RI</td>
<td>0.55</td>
<td>0.78</td>
<td>0.74</td>
<td>0.75</td>
<td>0.37</td>
<td></td>
</tr>
</tbody>
</table>
Observations

- Generation jumps for more than one generation are very unlikely.
- There are many marriages B6.3 (two grandchildren married into the same family) and B6.2 (two families were relinked by a marriage between children and again in the next generation by a marriage between grandchildren).
- In Tur there are many marriages of types A4.1 and A6.1.
- For all genealogies number of relinking ’non-blood’ marriages is much higher than number of blood marriages (this is especially true for Ragusa, exception is Royal). There were economic reasons for non-blood relinking marriages: to keep the wealth and power within selected families.

<table>
<thead>
<tr>
<th>type of marriage</th>
<th>Loka</th>
<th>Silba</th>
<th>Ragusa</th>
<th>Tur</th>
<th>Royal</th>
</tr>
</thead>
<tbody>
<tr>
<td>blood-marriages</td>
<td>51</td>
<td>42</td>
<td>9</td>
<td>149</td>
<td>51</td>
</tr>
<tr>
<td>relinking-marriages</td>
<td>157</td>
<td>118</td>
<td>239</td>
<td>176</td>
<td>45</td>
</tr>
</tbody>
</table>

Number of individuals in genealogy Tur is much lower than in others, Silba and Ragusa are approximately of the same size, while Loka is much larger genealogy, what we must also take into account.
<table>
<thead>
<tr>
<th>pattern</th>
<th>Loka</th>
<th>Silba</th>
<th>Ragusa</th>
<th>Tur</th>
<th>Royal</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>0.07</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>A3</td>
<td>0.07</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>2.64</td>
</tr>
<tr>
<td>A4.1</td>
<td>0.85</td>
<td>2.26</td>
<td>1.50</td>
<td>159.71</td>
<td>18.45</td>
</tr>
<tr>
<td>B4</td>
<td>3.82</td>
<td><strong>11.28</strong></td>
<td><strong>10.49</strong></td>
<td>98.28</td>
<td>6.15</td>
</tr>
<tr>
<td>A4.2</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>A5.1</td>
<td>0.64</td>
<td>3.16</td>
<td>2.00</td>
<td>36.86</td>
<td>11.42</td>
</tr>
<tr>
<td>A5.2</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>B5</td>
<td>1.34</td>
<td>4.96</td>
<td><strong>23.48</strong></td>
<td>46.68</td>
<td>7.03</td>
</tr>
<tr>
<td>A6.1</td>
<td>1.98</td>
<td><strong>12.63</strong></td>
<td>1.00</td>
<td>169.53</td>
<td>11.42</td>
</tr>
<tr>
<td>A6.2</td>
<td>0.00</td>
<td>0.90</td>
<td>0.00</td>
<td>0.00</td>
<td>0.88</td>
</tr>
<tr>
<td>A6.3</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>C6</td>
<td>0.71</td>
<td>5.41</td>
<td><strong>9.49</strong></td>
<td>36.86</td>
<td>4.39</td>
</tr>
<tr>
<td>B6.1</td>
<td>0.00</td>
<td>0.45</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>B6.2</td>
<td>1.91</td>
<td><strong>17.59</strong></td>
<td><strong>31.47</strong></td>
<td>130.22</td>
<td>10.54</td>
</tr>
<tr>
<td>B6.3</td>
<td>3.32</td>
<td><strong>13.53</strong></td>
<td><strong>40.96</strong></td>
<td>113.02</td>
<td>11.42</td>
</tr>
<tr>
<td>B6.4</td>
<td>0.00</td>
<td>0.00</td>
<td>2.50</td>
<td>7.37</td>
<td>0.00</td>
</tr>
<tr>
<td>∑</td>
<td>14.70</td>
<td>72.17</td>
<td>123.88</td>
<td>798.53</td>
<td>84.36</td>
</tr>
</tbody>
</table>
Bipartite p-graphs: Marriage between half-brother and half-sister

Using p-graphs we cannot distinguish persons married several times. In this case we must use bipartite p-graphs. Using bipartite p-graphs we can find marriages between half-brothers and half-sisters. In our five genealogies we found only one such example in Royal.ged.
Bipartite p-graphs: Marriage among half-cousins

There also do not exist many marriages between half-cousins. We found one such marriage in Loka genealogy and four in Turkish genealogy.
Other analyses

People collecting data about their families are interested in several other ‘standard’ analyses:

- changes in relinking patterns over time;
- special situations: persons married several times, persons having the highest number of children;
- checking whether the two persons are relatives and searching for the shortest genealogical path between them;
- searching for all predecessors/successors of selected person and searching for person with the largest number of known predecessors or successors;
- the largest difference in age between husband and wife, the oldest/youngest person at the time of marriage, the oldest/youngest person at the time of child’s birth;
- searching for the longest patrilineage and matrilineage;
- special situations → errors made in data entry (network consistency check).
The largest number of marriages...

[Diagram showing genealogical relationships involving Henry VIII and his wives and other family members.]

- Arthur Tudor (brother of Henry VIII)
- Henry VIII Tudor King of England 1491-1547
- Catherine of Aragon
- Anne Boleyn
- Jane Seymour
- Anne of Cleves
- Catherine Howard
- Catherine Parr
- Edward Borough
- John Nevill
- Thomas Seymour

[Note: The diagram illustrates the marriage connections among these individuals.]
The largest number of children…

Marguerite of France

Edward I (Longshanks)

Eleanor of Castile

Eleanor

Edmund of Woodstock

Thomas of Brotherton

Blanche

Beatrice

Elizabeth

Alice

Mary

Berengaria

Margaret

Alfonso

Joan of Acre

Julian (Katherine)

Henry

John

Joan

Eleanor

Edward II
The largest connected component in the genealogy of American presidents
The shortest genealogical path between *Charles Philip Arthur Windsor* (Prince of UK) and *Juan Carlos* (King of Spain) in Royal.ged

Charles Philip Arthur Windsor & Diana Frances Spencer

Philip Mountbatten & Elizabeth II Alexandra Mary Windsor

Andrew of Greece & Alice of Battenberg

William George I of the Hellenes Oldenburg & Olga Constantinovna

Juan Carlos & Sophia of Greece Oldenburg

Paul I Oldenburg & Frederica of Hanover Hanover

Constantine I Oldenburg & Sophie of Prussia
Basic Kin Types

Anthropologists typically use a basic vocabulary of kin types to represent genealogical relationships. One common version of the vocabulary for basic relationships:

<table>
<thead>
<tr>
<th>KinType</th>
<th>EnglishType</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Parent</td>
</tr>
<tr>
<td>F</td>
<td>Father</td>
</tr>
<tr>
<td>M</td>
<td>Mother</td>
</tr>
<tr>
<td>C</td>
<td>Child</td>
</tr>
<tr>
<td>D</td>
<td>Daughter</td>
</tr>
<tr>
<td>S</td>
<td>Son</td>
</tr>
<tr>
<td>G</td>
<td>Sibling</td>
</tr>
<tr>
<td>Z</td>
<td>Sister</td>
</tr>
<tr>
<td>B</td>
<td>Brother</td>
</tr>
<tr>
<td>E</td>
<td>Spouse</td>
</tr>
<tr>
<td>H</td>
<td>Husband</td>
</tr>
<tr>
<td>W</td>
<td>Wife</td>
</tr>
</tbody>
</table>
Calculating kinship relations

Pajek generates three relations when reading genealogy as Ore graph:

- **F**: _is a father of_
- **M**: _is a mother of_
- **E**: _is a spouse of_

Additionally we must generate two binary diagonal matrices, to distinguish between male and female:

- **L**: _male_ / 1-male, 0-female
- **J**: _female_ / 1-female, 0-male
Other *basic* relations can be obtained by running given macros:

- _is a parent of _  \( P = F \cup M \)
- _is a child of _  \( C = P^{-1} \)
- _is a son of _  \( S = L \ast C \)
- _is a daughter of _  \( D = J \ast C \)
- _is a husband of _  \( H = L \ast E \)
- _is a wife of _  \( W = J \ast E \)
- _is a sibling of _  \( G = ((F^{-1} \ast F) \cap (M^{-1} \ast M)) \setminus I \)
- _is a brother of _  \( B = L \ast G \)
- _is a sister of _  \( Z = J \ast G \)

Several *derived* relations can be computed, e.g.:

- _is an uncle of _  \( U = B \ast P \)
- _is an aunt of _  \( A = Z \ast P \)
- _is a semi-sibling of _  \( G_e = (P^{-1} \ast P) \setminus I \)
- _is a grandparent of _  \( GP = P^2 \)
- _is a grandfather of _  \( GF = F \ast P = L \ast GP \)
- _is a niece of _  \( N_i = D \ast G \)
### Sizes of kinship relations in genealogies

<table>
<thead>
<tr>
<th>Kin Type</th>
<th>Turks</th>
<th>Ragusa</th>
<th>Loka</th>
<th>Silba</th>
<th>Royal</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-Parent</td>
<td>1987</td>
<td>9315</td>
<td>68052</td>
<td>9627</td>
<td>3724</td>
</tr>
<tr>
<td>F-Father</td>
<td>1022</td>
<td>4956</td>
<td>34330</td>
<td>4998</td>
<td>2010</td>
</tr>
<tr>
<td>M-Mother</td>
<td>965</td>
<td>4359</td>
<td>33722</td>
<td>4629</td>
<td>1714</td>
</tr>
<tr>
<td>C-Child</td>
<td>1987</td>
<td>9315</td>
<td>68052</td>
<td>9627</td>
<td>3724</td>
</tr>
<tr>
<td>D-Daughter</td>
<td>857</td>
<td>3577</td>
<td>32647</td>
<td>4518</td>
<td>1589</td>
</tr>
<tr>
<td>S-Son</td>
<td>1130</td>
<td>5738</td>
<td>35405</td>
<td>5109</td>
<td>2135</td>
</tr>
<tr>
<td>G-Sibling</td>
<td>2485</td>
<td>8782</td>
<td>69347</td>
<td>7803</td>
<td>2858</td>
</tr>
<tr>
<td>Z-Sister</td>
<td>2256</td>
<td>6949</td>
<td>66874</td>
<td>7314</td>
<td>2634</td>
</tr>
<tr>
<td>B-Brother</td>
<td>2714</td>
<td>10615</td>
<td>71820</td>
<td>8292</td>
<td>3082</td>
</tr>
<tr>
<td>E-Spouse</td>
<td>407</td>
<td>2002</td>
<td>14154</td>
<td>2217</td>
<td>1138</td>
</tr>
<tr>
<td>H-Husband</td>
<td>407</td>
<td>2002</td>
<td>14154</td>
<td>2217</td>
<td>1138</td>
</tr>
<tr>
<td>W-Wife</td>
<td>407</td>
<td>2002</td>
<td>14154</td>
<td>2217</td>
<td>1138</td>
</tr>
<tr>
<td>U-Uncle</td>
<td>3816</td>
<td>16665</td>
<td>81695</td>
<td>11372</td>
<td>3453</td>
</tr>
<tr>
<td>A-Aunt</td>
<td>3477</td>
<td>10644</td>
<td>80995</td>
<td>10564</td>
<td>2973</td>
</tr>
<tr>
<td>Ge-Semi-sibling</td>
<td>2926</td>
<td>10763</td>
<td>76746</td>
<td>8972</td>
<td>3372</td>
</tr>
</tbody>
</table>

| # Individuals     | 1269    | 5999    | 47956  | 6427   | 3010   |
### Relative sizes of kinship relations in genealogies

<table>
<thead>
<tr>
<th>Kin Type</th>
<th>Turks</th>
<th>Ragusa</th>
<th>Loka</th>
<th>Silba</th>
<th>Royal</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-Parent</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>F-Father</td>
<td>0.514</td>
<td>0.532</td>
<td>0.504</td>
<td>0.519</td>
<td>0.540</td>
</tr>
<tr>
<td>M-Mother</td>
<td>0.486</td>
<td>0.468</td>
<td>0.496</td>
<td>0.481</td>
<td>0.460</td>
</tr>
<tr>
<td>C-Child</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>D-Daughter</td>
<td>0.431</td>
<td>0.384</td>
<td>0.480</td>
<td>0.469</td>
<td>0.427</td>
</tr>
<tr>
<td>S-Son</td>
<td>0.569</td>
<td>0.616</td>
<td>0.520</td>
<td>0.531</td>
<td>0.573</td>
</tr>
<tr>
<td>G-Sibling</td>
<td>1.250</td>
<td>0.943</td>
<td>1.019</td>
<td>0.811</td>
<td>0.767</td>
</tr>
<tr>
<td>Z-Sister</td>
<td>1.135</td>
<td>0.746</td>
<td>0.983</td>
<td>0.760</td>
<td>0.707</td>
</tr>
<tr>
<td>B-Brother</td>
<td>1.366</td>
<td>1.140</td>
<td>1.055</td>
<td>0.861</td>
<td>0.828</td>
</tr>
<tr>
<td>E-Spouse</td>
<td>0.205</td>
<td>0.215</td>
<td>0.208</td>
<td>0.230</td>
<td>0.306</td>
</tr>
<tr>
<td>H-Husband</td>
<td>0.205</td>
<td>0.215</td>
<td>0.208</td>
<td>0.230</td>
<td>0.306</td>
</tr>
<tr>
<td>W-Wife</td>
<td>0.205</td>
<td>0.215</td>
<td>0.208</td>
<td>0.230</td>
<td>0.306</td>
</tr>
<tr>
<td>U-Uncle</td>
<td>1.920</td>
<td>1.789</td>
<td>1.200</td>
<td>1.181</td>
<td>0.927</td>
</tr>
<tr>
<td>A-Aunt</td>
<td>1.750</td>
<td>1.143</td>
<td>1.190</td>
<td>1.097</td>
<td>0.798</td>
</tr>
<tr>
<td>Ge-Semi-sibling</td>
<td>1.473</td>
<td>1.155</td>
<td>1.128</td>
<td>0.932</td>
<td>0.905</td>
</tr>
</tbody>
</table>
Ore graph – Relation Uncle

Options/ReadWrite/Ore: Different relations for male and female links [checked]
Options/ReadWrite/GEDCOM-Pgraph [unchecked]
File/Network/Read/Ragusa.ged
Select Gender partition in the First Partition box
Macro/Play/AddAllRelations.mcr
Info/Network/Multiple Relations
Net/Transform/Multiple Relations/Extract Relations [13]

Find person who is in position of an uncle the highest number of times:
Net/Partitions/Degree/Output
Info/Partition --> Federicus/Goce/

Visualize the person and his neighbourhood:
Net/k-Neighbours/Output --> Federicus/Goce/
Operations/Extract from Network/Partition [0 1]
Layout/Circular/Using Partition