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# CHC Description

*Context.* Refugees and asylum seekers (TCNs) in Greece need to leave their accommodation (the one that exist via specific programs) when they have the refugee status. Due to the high number of TCNs, it is a challenging task for PRAKSIS to provide help to all TCNs for finding new accommodation facilities. Therefore, they are informed about specific programs that exist, however, due to limitations in the capacity, there is also a high number of them searching for apartments in order to share with other refugees so that to jointly afford related costs.

*Rationale.* This, in turn, requires coordination support of TCNs to find candidates with whom they could share some flat based on most similar preferences.

*MyWELCOME contribution.* In WELCOME, the co-habitation coordination (CHC) scenario is concerned with helping TCNs to form groups of candidates for sharing an apartment according to their given individual and group constraints. The agents, however, neither search for available (rentable space in) rental apartments, nor do they match groups of TCNs with landlords of apartments for rent. These activities may be performed by the proposed groups of TCNs who best match with each other according to their individual preferences and some general hard (group) constraints of sharing some rental apartment in Greece. During self-coordination, TCNs may be assigned to more than one group of candidates for apartment sharing. In the CHC scenario, we consider the following family types: Single man; Single woman; 2-member Nuclear family; 3-member Nuclear family; 4-member Nuclear family; Single-parent (mother) family; Single-parent (father) family; Extended family.

At the end of a CHC process, each participating TCN shall be informed by his/ her agent about the recommended (approximately) optimal cohabitation group for her and the respective contact addresses of the other group members. The WELCOME system should make suggestions to the TCNs for their grouping with respect to co-habitation based on the following constraints:

1. **Individual constraints** specified by the TCNs (preferences)
2. **Age**: A TCN could prefer to belong to a group of certain age group(s), to the extent possible, as they are more likely to share common interests. Recommended age groups for exclusive preference settings by TCNs: *18 – 25, 26 – 33, 34 – 43, 44 – 50, 50 – 65, and 65+.* **Selectable Options**: {“Don’t mind”, 18-25, 26-33, 34-43, 44-50, 51-65, 65-120}
3. **Gender**: A TCN could prefer being member of *Male*, *Female* or *Other* gender group. **Selectable Options**: {“Don’t mind”, “Male”, “Female”, “Other”}
4. **Family:** A TCN could prefer to belong to a cohabitation group certain family type(s). Recommended family types for exclusive preference settings by TCNs: *Single Man, Single Woman, Nuclear Family (a couple and their children) , Single Parent Mother Family, Single Parent Father Family, Extended family (nuclear + grandparents/other relatives).* **Selectable Options**: {“Don’t mind”, “Single Man”, Single Woman”, Nuclear”, “Single Parent Mother”, “Single Parent Father”, “Extended”}
5. **Nationality**: Although many people do not have a problem when working with other nationalities, some of the TCNs might have. To avoid respective conflicts and communication problems in co-habitation groups, the agent should respect the preference of its TCN about being assigned to a group with other nationalities than her own one, or not. A TCN could prefer being member of *same or mixed* gender group. **Selectable Options**: {“Don’t mind”, “Same”, “Mixed”}
6. **Religion**: A TCN could prefer to be in a *mixed or same* religion group. **Selectable Options**: {“Don’t mind”, “Same”, “Mixed”}
7. **Ethnicity**: A TCN could prefer to be in a *mixed or same* ethnic group. **Selectable Options**: {“Don’t mind”, “Same”, “Mixed”}
8. **Apartment preferences:** A TCN could specify rental flat or apartment related preferences
   1. **Location (area) of apartment**: A TCN could specify one or multiple of the following locations listed below, as preference. **Selectable Options**: {“Don’t mind”, “*Ampelokipoi”, “Menemeni”, “Kalamaria”, “Eleftherio-Kordelio”, “Evosmos”, “Agios Pavlos”, “Neapoli”, “Pefka”, “Sykies”, “Nea Efkarpia”, “Polichni”, “Stavroupoli”, “Pylaia”, “Thessaloniki”, “Triandria*”}
   2. **Accessibility (disabled accessible)**: A TCN could select *yes or “Don’t mind”* for availability of accessibility. **Selectable Options**: {“Don’t mind”, “Yes”, “No”}
   3. **Rental period (from-to):** A TCN could specify a *start and end date* as a range, for his/her preferred rental period. **Selectable Options**: {“Don’t mind”, Range (from-to)}. E.g. 2021-03-01 -> 2022-07-01
   4. **Share with**: A TCN could specify a *minimum and maximum number* as a range as the number of people that he/she prefers to share the apartment with. **Selectable Options**: {“Don’t mind”, Range (from-to)}. E.g. 2 -> 4
9. **Cohabitation group constraints**
10. All members of a cohabitation group have most similar individual constraints (preferences) for rental apartment sharing.
11. All members of a cohabitation group should be able to communicate among each other in at least one common language.

***Please note that the cohabitation group constraints above are key/informal points that the TCNs themselves could adjust (with PRAKSIS) if appropriate.***

# CHC Data Records

CHC feature to be tested and evaluated with the examples in CHC\_Data\_Records (TCN Profiles)\_v1.0.xlsx file. Each example consists of various TCN profiles in terms of their amount and preferences. Additionally, all example data records are realistic. Everyone has a corresponding family type. E.g. a Male doesn’t have a Single Woman family type.

Since there are 10 preferences and each of them can take lots of different values (e.g. age can be any number higher than 18 and lower than 75), the amount (combination) of different TCN profiles is huge. All of them cannot be reflected and tested. People (TCNs) might tend to prefer other people (TCNs) who are similar to them but also people (TCNs) could prefer completely dissimilar attributes. The examples cover both cases.

TCN profiles are not randomly or artificially created. Because of privacy issues, no real world data (real TCN profiles) is (provided) used for evaluation purposes. The profiles below are created one by one and always considering for each profile whether such a TCN (person) could exist. **And it is approved by PRAKSIS that the profiles are realistic**.

Since there are too many preferences and TCNs in CHC, the rows and columns don’t fit in Word Tables. Therefore, example data records are stored in CHC\_Data\_Records (TCN Profiles)\_v1.0.xlsx file.

## Example 1

Check CHC\_Data\_Records (TCN Profiles)\_v1.0.xlsx file for corresponding TCN profiles.

## Example 2

Check CHC\_Data\_Records (TCN Profiles)\_v1.0.xlsx file for corresponding TCN profiles.

## Example 3

Check CHC\_Data\_Records (TCN Profiles)\_v1.0.xlsx file for corresponding TCN profiles.

## Example 4

Check CHC\_Data\_Records (TCN Profiles)\_v1.0.xlsx file for corresponding TCN profiles.

## Example 5

Check CHC\_Data\_Records (TCN Profiles)\_v1.0.xlsx file for corresponding TCN profiles.

# CHC Configurations

## Configuration 1

**Importance weights of preferences:**

**Characteristic:** defaultimportance weights specified by PRAKSIS

Age Preference: 10  
Gender Preference: 9  
Family Preference: 5  
Nationality Preference: 8  
Religion Preference: 6  
Ethnicity Preference: 7  
Location Preference: 2  
Accessibility Preference: 3  
Rent Period Preference: 1  
Share With Preference: 4

**Minimize the number of singleton TCNs**: No

## Configuration 2

**Importance weights of preferences:**

**Characteristic**: Age, Gender and nationality preferences are very important compared to apartment preferences.  
Age Preference: 10  
Gender Preference: 10  
Family Preference: 3  
Nationality Preference: 10  
Religion Preference: 8  
Ethnicity Preference: 9  
Location Preference: 1  
Accessibility Preference: 1  
Rent Period Preference: 1  
Share With Preference: 2

**Minimize the number of singleton TCNs**: Yes

## Configuration 3

**Importance weights of preferences:**

**Characteristic**: Apartment preferences are more important compared to Configuration 1 and 2.   
Age Preference: 4  
Gender Preference: 7  
Family Preference: 5  
Nationality Preference: 7  
Religion Preference: 7  
Ethnicity Preference: 5  
Location Preference: 4  
Accessibility Preference: 7  
Rent Period Preference: 4  
Share With Preference: 5

**Minimize the number of singleton TCNs**: Yes

# CHC Results and Evaluation

Each solution for a **data record (example) and configuration pair** will be evaluated with Customer Satisfaction Score (**CSAT**) metric on a Likert scale shown below:

* 5: very satisfied
* 4: satisfied
* 3: neither satisfied nor dissatisfied
* 2: dissatisfied
* 1: very dissatisfied

## Results-Example 1

* **Configuration 1**
  + **Total computation time**: *63 seconds*
  + **Solution**:
    - **Singleton**: [8, 1, 4, 11]

**Group1**: [7, 14]

**Group2**: [9, 10, 12, 15]

**Group3**: [2, 13]

**Group4**: [3, 5, 6]

* + **Customer Satisfaction Score on Likert scale**: 4
* **Configuration 2**
  + **Total computation time**: 71 *seconds*
  + **Solution**:
    - **Group1**: [tcn4, tcn8, tcn11]

**Group2**: [tcn3, tcn5, tcn6]

**Group3**: [tcn9]

**Group4**: [tcn1, tcn10, tcn12, tcn15]

**Group5**: [tcn2, tcn13]

**Group6**: [tcn7, tcn14]

* + **Customer Satisfaction Score on Likert scale**: 4.17 (as the Group 3 evaluated with 5, while the rest of the groups with 4).

**Explanation:** Taking into account the weights of preferences (Configuration 2), and following your explanations that it is a difficult task to satisfy all the preferences, as agents try to satisfy maximum amount of preferences and the sum of them is higher than the weight of a specific preference that is very important, it seems to be an appropriate grouping. Even in most of cases/groups some preferences (1-5) of a TCN are violated [e.g. Group 1: TCN’s 11 the age and gender preferences (very important) don’t match, also, the location preference (less important) doesn’t match. The nationality preference (very important) doesn’t match for all of them and the ethnicity preference for one of them], but the rest of them are satisfied, the total satisfaction score is 4.17.

Finally, Configuration 2 minimizes the number of singleton TCNs, as we have Group 3 with only 1 TCN that doesn’t match with anyone else in this example.

* **Configuration 3**
  + **Total computation time**:  *62 seconds*
  + **Solution**:
    - **Group1**: [tcn1, tcn4, tcn9, tcn11, tcn15]

**Group2**: [tcn13]

**Group3**: [tcn10, tcn12]

**Group4**: [tcn3, tcn5, tcn6 ]

**Group5**: [tcn2, tcn7, tcn8, tcn14]

* + **Customer Satisfaction Score on Likert scale**: 4.20 (as the Group 3 evaluated with 5, while the rest of the groups with 4).

**Explanation:** Taking into account the weights of preferences (Configuration 3), and following your explanations that it is a difficult task to satisfy all the preferences, as agents try to satisfy maximum amount of preferences and the sum of them is higher than the weight of a specific preference that is very important, it seems to be an appropriate grouping. Even in most of cases/groups some preferences (1-3) of a TCN are violated [e.g. Group 1: TCN’s 9 the religion preference (very important) doesn’t match, also, the ethnicity preference (medium important) doesn’t match. The family preference (medium important) doesn’t match for TCNs 1,11,15 and the ethnicity preference for two more (TCNs 4,15) of them. Finally, the suggested grouping violates TCN’s 11 age preference (less important)], but the rest of them are satisfied, the total satisfaction score is 4.20.

Finally, Configuration 3 minimizes the number of singleton TCNs, as we have Group 2 with only 1 TCN that doesn’t match with anyone else in this example. But, if we want to minimize the number of singleton TCNs to zero, a suggestion would be to group TCN 13 with TCN 8 (by removing TCN 8 from Group 5, where three of his preferences (nationality, family and age) are violated). As we cannot satisfy all the preferences, TCN’s 8 violated preferences remains violated if we group him with TCN 13, but the sum of the preferences is the same by giving options for co-habitation to all TCNs in Example 1.

## Results-Example 2

* **Configuration 1**
  + **Total computation time**: 60 *seconds*
  + **Solution**:
    - **Singleton**: [2, 5, 6, 9, 10, 20]

**Group1**: [1, 16]

**Group2**: [15, 17]

**Group3**: [3, 7, 8, 12, 13, 19, 4, 11, 14, 18]

* + **Customer Satisfaction Score on Likert scale**: 4
* **Configuration 2**
  + **Total computation time**: 61 *seconds*
  + **Solution**:
    - **Group1**: [tcn2, tcn6, tcn9, tcn10, tcn20]

**Group2**: [tcn1, tcn16]

**Group3**: [tcn5]

**Group4**: [tcn4, tcn7, tcn8, tcn11, tcn12, tcn13, tcn14, tcn19]

**Group5**: [tcn3, tcn15, tcn17, tcn18]

* + **Customer Satisfaction Score on Likert scale**: 4.20 (as the Group 3 evaluated with 5, while the rest of the groups with 4).

**Explanation:** Taking into account the weights of preferences (Configuration 2), and the explanations on Example 1, it seems to be an appropriate grouping. Even in most of cases/groups some preferences (1-5) of a TCN are violated [e.g. in one group two of them are very important (10) and two important (9)], but the rest of them are satisfied, the total satisfaction score is 4.20.

Finally, Configuration 2 minimizes the number of singleton TCNs, as we have Group 3 with only 1 TCN that doesn’t match with anyone else in this example.

* **Configuration 3**
  + **Total computation time**:  *64 seconds*
  + **Solution**:
    - **Group1**: [tcn2, tcn5, tcn6, tcn8, tcn9, tcn15, tcn17, tcn20]

**Group2**: [tcn1, tcn16]

**Group3**: [tcn14]

**Group4**: [tcn4, tcn10]

**Group5**: [tcn13]

**Group6**: [tcn7, tcn11, tcn12, tcn19]

**Group7**: [tcn3, tcn18]

* + **Customer Satisfaction Score on Likert scale**: 4.28 (as the Group 6,7 evaluated with 5 as only medium and low important preferences are violated, while the rest of the groups with 4).

**Explanation:** Taking into account the weights of preferences (Configuration 3), and following your explanations that it is a difficult task to satisfy all the preferences, as agents try to satisfy maximum amount of preferences and the sum of them is higher than the weight of a specific preference that is very important, it seems to be an appropriate grouping. Even in most of cases/groups some preferences (1-3) of a TCN are violated, the total satisfaction score is 4.28.

Finally, Configuration 3 minimizes the number of singleton TCNs, as we have Group 3,5 with only 1 TCN that doesn’t match with anyone else in this example. But, if we want to minimize the number of singleton TCNs to zero, please find below two suggestions for matching TCN 13 and TCN 14 with others:

* TCN 13 can be grouped with TCN 7 (by offering TCN 7 the option of Group 6 and an additional option) from Group 5, where three of his preferences (nationality, family and age) are violated). As we cannot satisfy all the preferences, there are violated preferences, but we offer options for co-habitation to all TCNs in Example 2.
* TCN 14 can be grouped with TCNs 1,16 from Group 2, where three preferences (gender, religion, family) are violated. As we cannot satisfy all the preferences, there are violated preferences (religion and family), but are less, and we offer options for co-habitation to all TCNs in Example 2.

## Results-Example 3

* **Configuration 1**
  + **Total computation time**: 67 *seconds*
  + **Solution**:
    - **Singleton**: [3, 5, 6, 7, 9, 10, 13, 19, 1, 11, 14, 18, 20, 21, 23]

**Group1**: [15, 24]

**Group2**: [2, 8, 17, 16, 25]

**Group3**: [12, 22, 4]

* + **Customer Satisfaction Score on Likert scale**: 4.25
* **Configuration 2**
  + **Total computation time**: 72 *seconds*
  + **Solution**:
    - **Group1**: [tcn1, tcn3, tcn6, tcn7, tcn11, tcn13, tcn18, tcn20, tcn21, tcn24]

**Group2**: [tcn14, tcn23]

**Group3**: [tcn5, tcn9, tcn10, tcn12, tcn15, tcn17, tcn19]

**Group4**: [tcn2, tcn8, tcn16, tcn25]

**Group5**: [tcn4, tcn22]

* + **Customer Satisfaction Score on Likert scale**: 4 (all groups evaluated with 4).

**Explanation:** Taking into account the weights of preferences (Configuration 2), and the explanations on Example 1, it seems to be an appropriate grouping. Even in most of cases/groups some preferences (1-4) of a TCN are violated [e.g. in one group two of them are very important (10) and one important (9)], but the rest of them are satisfied, the total satisfaction score is 4.

Finally, Configuration 2 minimizes the number of singleton TCNs to zero.

* **Configuration 3**
  + **Total computation time**: 65 *seconds*
  + **Solution**:
    - **Group1**: [tcn1, tcn7, tcn18, ]

**Group2**: [tcn11, tcn20, ]

**Group3**: [tcn2, tcn3, tcn4, tcn5, tcn6, tcn8, tcn9, tcn10, tcn12, tcn13, tcn14, tcn15, tcn16, tcn17, tcn19, tcn21, tcn22, tcn23, tcn24, tcn25, ]

* + **Customer Satisfaction Score on Likert scale**: 4.5 (Group 1 evaluated with 4.3, Group 2 with 4.7 and Group 3 with 4.6)

**Explanation:** Taking into account the weights of preferences (Configuration 3), and following your explanations, that it is a difficult task to satisfy all the preferences, as agents try to satisfy maximum amount of preferences and the sum of them is higher than the weight of a specific preference that is very important, it seems to be an appropriate grouping. More specifically Group 1 is evaluated with 4.3, as the location preference of TCN 18 is violated. Also, the other preferences are evaluated with 4 because there is a match between one female and two males and we have to take into account the difficulties that this situation could create from the perspective of how do we ensure the matching among TCNs on a safe way. The second group is evaluated with 4.4. One preference is not satisfied, e.g.: nationality preference of both TCN 11 & TCN 20 and again even if this is the preference of TCNs to stay with another gender of theirs we have to consider this matching and the difficulties that this cohabitation could create. The last 3rd group is evaluated with 4.5. Again in this group we have to take into account the cohabitation of males and females. Moreover, some preferences are not satisfied, e.g. TCN 24 preferences for the same nationality and the same religion.

## Results-Example 4

* **Configuration 1**
  + **Total computation time**: 225 *seconds*
  + **Solution**:
    - **Singleton**: [2, 3, 5, 7, 8, 10, 12, 13, 17, 19, 29, 35, 42, 44, 47, 1, 4, 14, 18, 20, 21, 23, 36, 40, 41, 43, 45, 50]

**Group1**: [6, 11, 25, 46]

**Group2**: [9, 24, 38]

**Group3**: [28, 39]

**Group4**: [15, 49]

**Group5**: [27, 37, 16]

**Group6**: [30, 32, 31]

**Group7**: [26, 34]

**Group8**: [22, 33, 48]

* + **Customer Satisfaction Score on Likert scale**: 4.2
* **Configuration 2**
  + **Total computation time**: 214 *seconds*
  + **Solution**:
    - **Group1**: [tcn2, tcn3, tcn4, tcn7, tcn8, tcn13, tcn14, tcn35, tcn36, tcn40, tcn41, tcn45]

**Group2**: [tcn6, tcn19, tcn25, tcn43]

**Group3**: [tcn18, tcn47]

**Group4**: [tcn1, tcn12]

**Group5**: [tcn5, tcn42]

**Group6**: [tcn11, tcn46]

**Group7**: [tcn10, tcn20, tcn24, tcn44]

**Group8**: [tcn21]

**Group9**: [tcn9, tcn17, tcn22, tcn23, tcn38, tcn50]

**Group10**: [tcn15, tcn28, tcn29, tcn39, tcn49]

**Group11**: [tcn16, tcn27, tcn37]

**Group12**: [tcn30, tcn31, tcn32]

**Group13**: [tcn26, tcn34]

**Group14**: [tcn33, tcn48]

* + **Customer Satisfaction Score on Likert scale**: 4.64 [as the Groups 1,3,8,9,10,11,12,13,14 evaluated with 5 (most of the preferences matches for all TCNs, there are also cases where 1-2 low-important preferences don’t match, while the rest of the groups with 4].

**Explanation:** Taking into account the weights of preferences (Configuration 2), and the explanations on Example 1, it seems to be an appropriate grouping. Even in most of cases/groups some preferences (1-5) of a TCN are violated, but the rest of them are satisfied, the total satisfaction score is 4.64.

Finally, Configuration 2 minimizes the number of singleton TCNs, as we have Group 8 with only 1 TCN that doesn’t match with anyone else in this example.

* **Configuration 3**
  + **Total computation time**: 231 *seconds*
  + **Solution**:
    - **Group1**: [tcn2, tcn3, tcn4, tcn5, tcn7, tcn8, tcn11, tcn13, tcn14, tcn18, tcn20, tcn35, tcn36, tcn40, tcn41, tcn42, tcn43, tcn44, tcn45, tcn47]

**Group2**: [tcn19, tcn23]

**Group3**: [tcn9, tcn12, tcn25]

**Group4**: [tcn16, tcn21]

**Group5**: [tcn1, tcn17, tcn46]

**Group6**: [tcn6, tcn24, tcn38]

**Group7**: [tcn15]

**Group8**: [tcn10, tcn22, tcn33, tcn48]

**Group9**: [tcn26, tcn34, tcn50]

**Group10**: [tcn27, tcn37]

**Group11**: [tcn30, tcn31, tcn32]

**Group12**: [tcn28, tcn39]

**Group13**: [tcn29, tcn49]

* + **Customer Satisfaction Score on Likert scale**: 4.48

Taking into account the weights of preferences (Configuration 3), and following your explanations, that it is a difficult task to satisfy all the preferences, as agents try to satisfy maximum number of preferences and the sum of them is higher than the weight of a specific preference that is very important, it seems to be an appropriate grouping.

Groups 4, 9, 10, 11 and 13 are evaluated with 5 (most of the preferences matches for all TCNs).

Group 1 and 6 are evaluated with 4.9. Generally, all the preferences are satisfied except of the preference of TCN 44 for the same ethnicity (Group 1) and the gender preference of TCN 6 (Group 6).

Groups 8 and 12 are evaluated with 4.7. Generally, all the preferences are satisfied except of some preferences, e.g.: Group 8: age preference of TCN 1 and religion preference of TCN 33. Moreover, in this group there are 3 men and 1 woman. It would be better to have another matching with the same genders. Continuing with the violated preferences of Group 12: nationality preference of TCN 39 is not satisfied and again there will be families with female and male head of the family.

Group 3 is evaluated with 4.5. There is a gap between the ages of TCNs and the location preference of TCNs 9, 12 are not satisfied.

Group 2 is evaluated with 4. There is not a match at the age of TCNs. In addition, this is not an appropriate cohabitation as there will live a male and female together and maybe there will be problems. Group 5 is evaluated with 3.6, because there are many preferences which are not satisfied. For example: TCN 1 age preference, gender preferences of TCNs, different location preferences, different share with preferences. Moreover, a problem emerges from the family preference as there will be a cohabitation of different genders.

Group 7 is evaluated with 2, because there is only TCN 15 in that group and it seems that it could match better in the Group 9.

## Results-Example 5

* **Configuration 1**
  + **Total computation time**: 514 *seconds*
  + **Solution**:
    - **Singleton**: [tcn1, tcn3, tcn4, tcn5, tcn6, tcn7, tcn8, tcn11, tcn13, tcn14, tcn15, tcn17, tcn19, tcn20, tcn21, tcn22, tcn23, tcn25, tcn27, tcn28, tcn30, tcn33, tcn34, tcn35, tcn38, tcn41, tcn42, tcn43, tcn44, tcn45, tcn47, tcn48, tcn49, tcn50, tcn52, tcn53, tcn54, tcn55, tcn56, tcn59, tcn60, tcn61, tcn62, tcn63, tcn64, tcn65, tcn66, tcn67, tcn68, tcn69, tcn70, tcn72, tcn73, tcn74, tcn75, tcn77, tcn78, tcn79, tcn80, tcn81, tcn82, tcn83, tcn84, tcn85, tcn89, tcn95, tcn96, tcn100]

**Group1**: [tcn16, tcn31]

**Group2**: [tcn24, tcn46]

**Group3**: [tcn10, tcn12]

**Group4**: [tcn9, tcn18]

**Group5**: [tcn36, tcn71]

**Group6**: [tcn29, tcn40]

**Group7**: [tcn58, tcn93]

**Group8**: [tcn26, tcn98]

**Group9**: [tcn2, tcn88, tcn99]

**Group10**: [tcn39, tcn57]

**Group11**: [tcn32, tcn37, tcn51, tcn76, tcn86, tcn87, tcn94, tcn97]

**Group12**: [tcn90, tcn91, tcn92]

* + **Customer Satisfaction Score on Likert scale**: 4.2
* **Configuration 2**
  + **Total computation time**: 498 *seconds*
  + **Solution**:
    - **Group1**: [tcn4, tcn6, tcn8, tcn11, tcn16, tcn25, tcn30, tcn31, tcn35, tcn38, tcn41, tcn42, tcn48, tcn53, tcn54, tcn55, tcn56, tcn59, tcn63, tcn64, tcn67, tcn68, tcn74, tcn78, tcn89, tcn95, tcn96, tcn100]

**Group2**: [tcn24, tcn46]

**Group3**: [tcn7, tcn23, tcn28, tcn61, tcn75, tcn79, tcn85]

**Group4**: [tcn14]

**Group5**: [tcn49, tcn73]

**Group6**: [tcn9, tcn18, tcn72]

**Group7**: [tcn10, tcn12]

**Group8**: [tcn22, tcn34, tcn52, tcn65, tcn80, tcn82]

**Group9**: [tcn29, tcn40]

**Group10**: [tcn1, tcn44]

**Group11**: [tcn36, tcn71]

**Group12**: [tcn62]

**Group13**: [tcn58, tcn93]

**Group14**: [tcn26, tcn98]

**Group15**: [tcn13, tcn15, tcn17, tcn21, tcn33, tcn43, tcn47, tcn50, tcn66, tcn77, tcn81, tcn83, tcn84]

**Group16**: [tcn39, tcn57]

**Group17**: [tcn19, tcn69]

**Group18**: [tcn5, tcn20]

**Group19**: [tcn2, tcn99]

**Group20**: [tcn3, tcn27, tcn32, tcn45, tcn60, tcn70, tcn76, tcn87, tcn88]

**Group21**: [tcn37, tcn51, tcn86, tcn94, tcn97]

**Group22**: [tcn90, tcn91, tcn92]

* + **Customer Satisfaction Score on Likert scale**: 4.77 [as the Groups 1,2,4,6,7,9,10,11,12,13,14,15,16,18,20,21,22 evaluated with 5 (where most of the preferences matches for all TCNs, there are also cases where 1-2 low-important preferences don’t match, or don’t match 1 to 4 preferences for the minority of TCNs) while the rest of the groups with 4].

**Explanation:** Taking into account the weights of preferences (Configuration 2), and the explanations on Example 1, it seems to be an appropriate grouping. Even in most of cases/groups some preferences (1-4) of a TCN are violated, but the rest of them are satisfied, the total satisfaction score is 4.77.

Finally, Configuration 2 minimizes the number of singleton TCNs, as we have Groups 4, 12 with only 1 TCN each of them that don’t match with anyone else in this example.

* **Configuration 3**
  + **Total computation time**: 517 *seconds*
  + **Solution**:
    - **Group1**: [tcn11, tcn16, tcn20, tcn24, tcn25, tcn41, tcn42, tcn48, tcn59, tcn63, tcn64, tcn74]

**Group2**: [tcn46, tcn55]

**Group3**: [tcn6, tcn8, tcn28, tcn38, tcn54, tcn68, tcn96]

**Group4**: [tcn36, tcn71]

**Group5**: [tcn4, tcn5, tcn10, tcn17, tcn18, tcn21, tcn23, tcn31, tcn35, tcn44, tcn45, tcn49, tcn50, tcn53, tcn56, tcn65, tcn67, tcn73, tcn75, tcn78, tcn89, tcn95, tcn100]

**Group6**: [tcn1, tcn7, tcn34, tcn80]

**Group7**: [tcn2, tcn82]

**Group8**: [tcn79, tcn83]

**Group9**: [tcn3, tcn14, tcn22, tcn29, tcn30, tcn40, tcn47, tcn61, tcn69, tcn72, tcn77, tcn85]

**Group10**: [tcn13, tcn19, tcn27, tcn60, tcn70, tcn76, tcn81]

**Group11**: [tcn52, tcn66]

**Group12**: [tcn39, tcn57]

**Group13**: [tcn9, tcn33, tcn84]

**Group14**: [tcn58, tcn93]

**Group15**: [tcn26, tcn98]

**Group16**: [tcn12, tcn43]

**Group17**: [tcn90, tcn91, tcn92]

**Group18**: [tcn88, tcn99]

**Group19**: [tcn15, tcn37, tcn62]

**Group20**: [tcn32, tcn51, tcn86, tcn94]

**Group21**: [tcn87, tcn97]

* + **Customer Satisfaction Score on Likert scale**: 4.7

Taking into account the weights of preferences (Configuration 3), it seems to be an appropriate grouping.

More specifically:

Groups, 5, 9, 15, 17, 21 are evaluated with 5. All of the TCNs preferences are satisfied and there is an appropriate match for each case.

Groups 7, 12 are evaluated with 4.9. In the Group 7, TCN 2 family preference is not satisfied. In the Group 12 the only issue is that there is a gap between the ages of TCNs.

Groups 10, 13, 14, 19, 20 are evaluated with 4.8 as there are some violated preferences. For example: Group 10, TCN 13 gender preference and TCN 27 religion preference are not satisfied. Group 13, TCN 84 age preference and TCN 9 ethnicity preference are not satisfied. Group 14, TCN 93 age preference is not satisfied. Group 19, TCN 62 age preference and TCN 15 ethnicity preference are not satisfied. Group 20 the location preference of TCN 31 and 51 are not satisfied and, this is not an appropriate cohabitation as there will live males and a female together and maybe there will be problems.

Groups 1, 6 & 18 are evaluated with 4.7, as there are some violated preferences. For the Group 1 TCN 16 nationality preference, TCN 63 religion preference and TCN 20 location preference are not satisfied. In the Group 6 TCN 34 age preference and nationality preference are not satisfied. About Group 18, TCN 88 nationality preference is not satisfied and in this group there is the matching of different genders and maybe this is not the appropriate solution.

Group 8 is evaluated with 4.6. Many preferences are satisfied but there are some TCN preferences without satisfaction, for example TCN 79 age and religion preferences are not satisfied. Also we evaluated with 4 the gender preference as there have been a matching between male and female.

Group 2 is evaluated with 4.5. There is not any satisfaction for nationality preference and there is not an appropriate gender matching.

Groups 3 and 4 are evaluated with 4.3. The reason of this evaluation is some violated preferences. Analytically, in the 3rd Group TCN 96 gender, nationality and ethnicity preferences are not satisfied and TCN 8 and 28 family preference are not satisfied. In the 4th Group, TCN 36 ethnicity preference is not satisfied, location and rent period preferences do not have the appropriate matching.

The minimum evaluation is for the groups 11 and 16 with 4.1. About Group 11 TCN 66 gender and religion preferences are not satisfied and there is a gap between the age preferences. Moreover, there is not an appropriate matching in the location preference and for that reason there is not any TCN satisfaction. Regarding Group 16, TCN 43 ethnicity preference is not satisfied and there is not any matching at the age and the location preferences. Although TCN 12 gender preference is not satisfied but we have an appropriate cohabitation, as there will live 2 men together (two people of the same gender).