COVID-19 IN SPAIN RISK MAP

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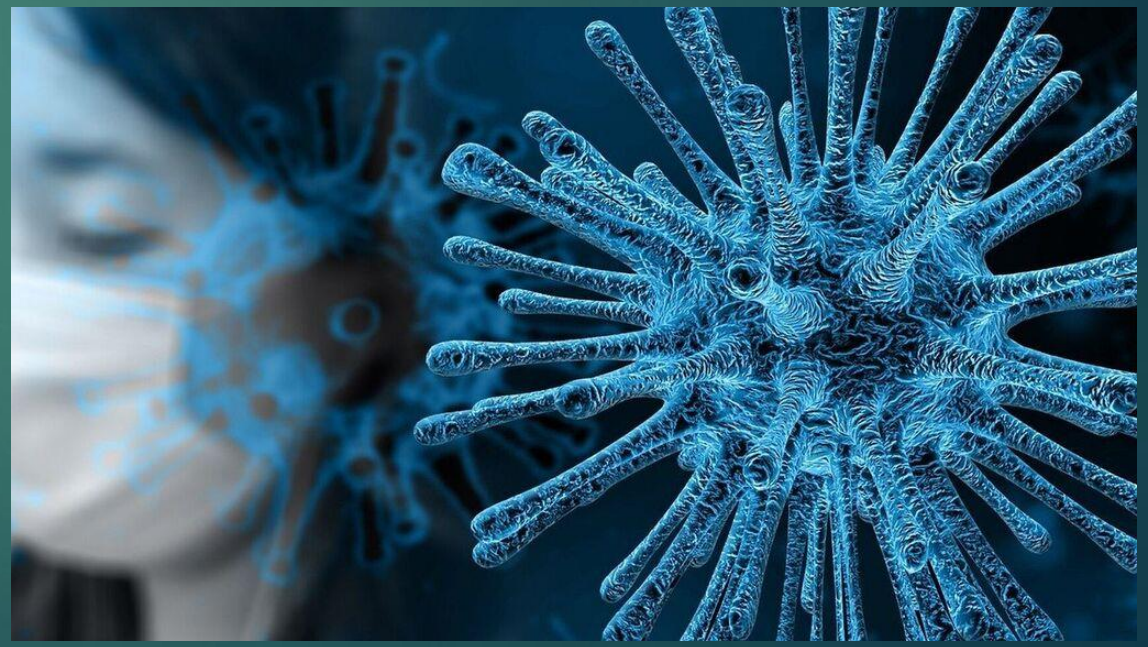

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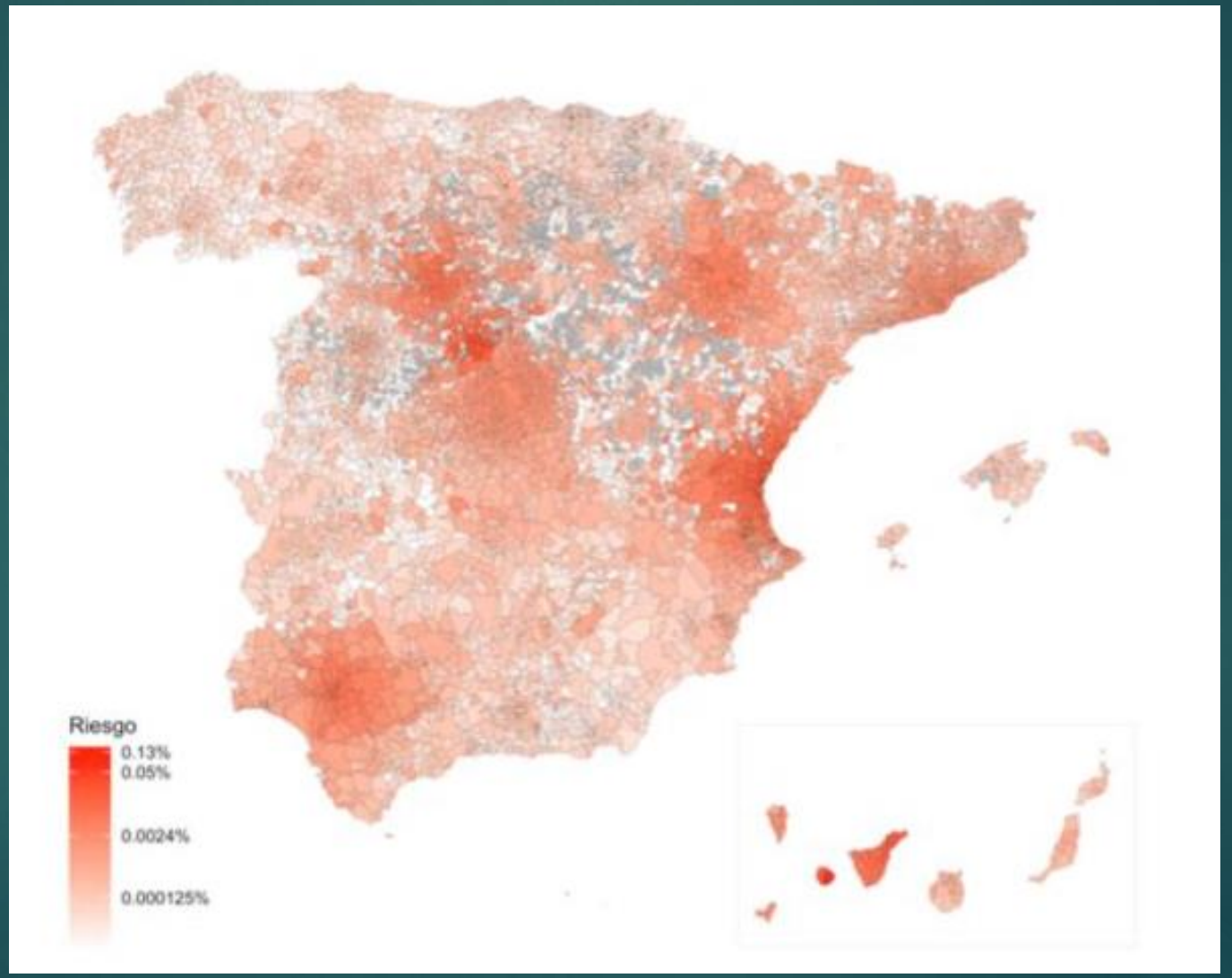
1. INTRODUCTION

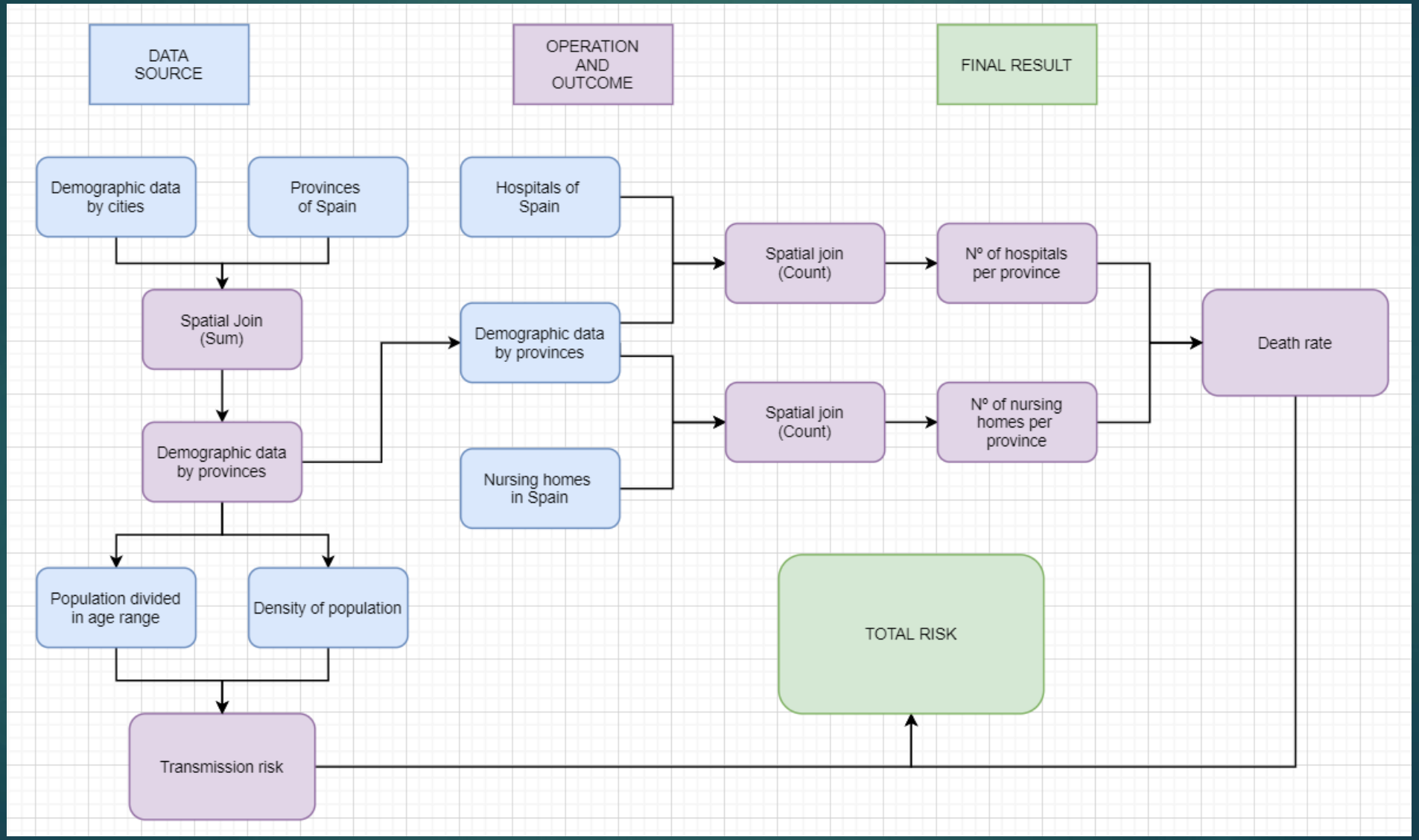
Coronavirus Disease 2019, or COVID-19, poses a threat to global health. While researchers work to develop a vaccine, the rest of the world does their best to prepare for, contain, and help those suffering with the virus.

The objective of the study: To assist these efforts and to controll the spread of the virus, our goal was to create a multivariate risk surface which include risk maps for transmission and death rate of the population of Spain.

1. INTRODUCCTION II



2. FLOWCHART

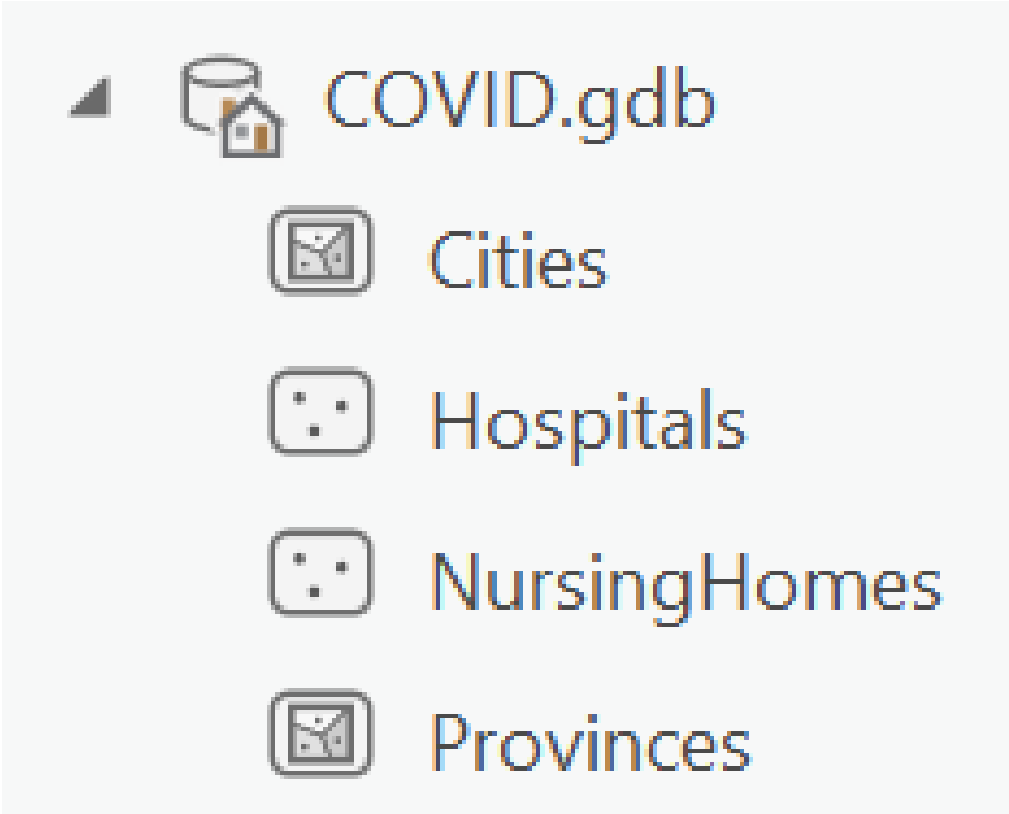

DATA SOURCE
OPERATION AND OUTCOME
FINAL RESULT
Demographic data by cities
Provinces of Spain
Hospitals of Spain
Spatial join (Count)
Nº of hospitals per province
Spatial Join (Sum)
Demographic data by provinces
Death rate
Demographic data by provinces
Spatial join (Count)
Nº of nursing homes per province
Nursing homes in Spain
Population divided in age range
Density of population
TOTAL RISK
Transmission risk

3. SOURCE OF DATA

- Source: Esri Spain
- 4 layers:
  - Hospitals of Spain:
    - https://comunidadsig.maps.arcgis.com/home/item.html?id=68745a7fb7a348b6b0d722c8517790af
  - Nursing homes:
    - https://comunidadcovid.maps.arcgis.com/home/item.html?id=e295d0fe5def4102b42bdab776fe67d0
  - Demographic info by municipalities:
    - https://comunidadsig.maps.arcgis.com/home/item.html?id=9ca8469ce8db4cd79e3fc4c31cca026e
  - Provinces of Spain:
    - https://www.arcgis.com/home/item.html?id=83d81d9336c745fd839465beab885ab7

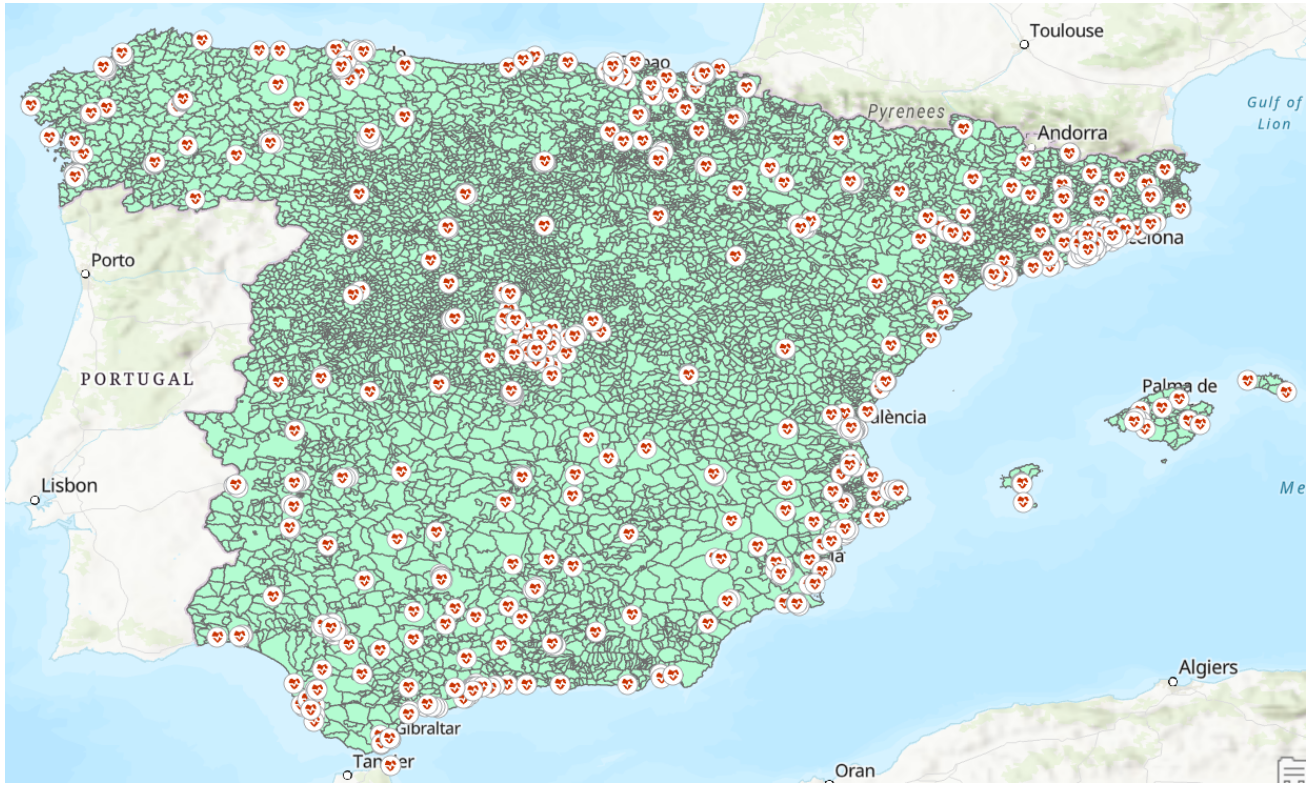
4. DATA

- For our project, we used 4 different layers of data:
  - Demographic info by municipalities (polygons)
    - Population by age ranges
    - Density of population
  - Hospitals of Spain (points)
  - Nursing homes in Spain
  - Provinces (polygons)
    - Shape of each region



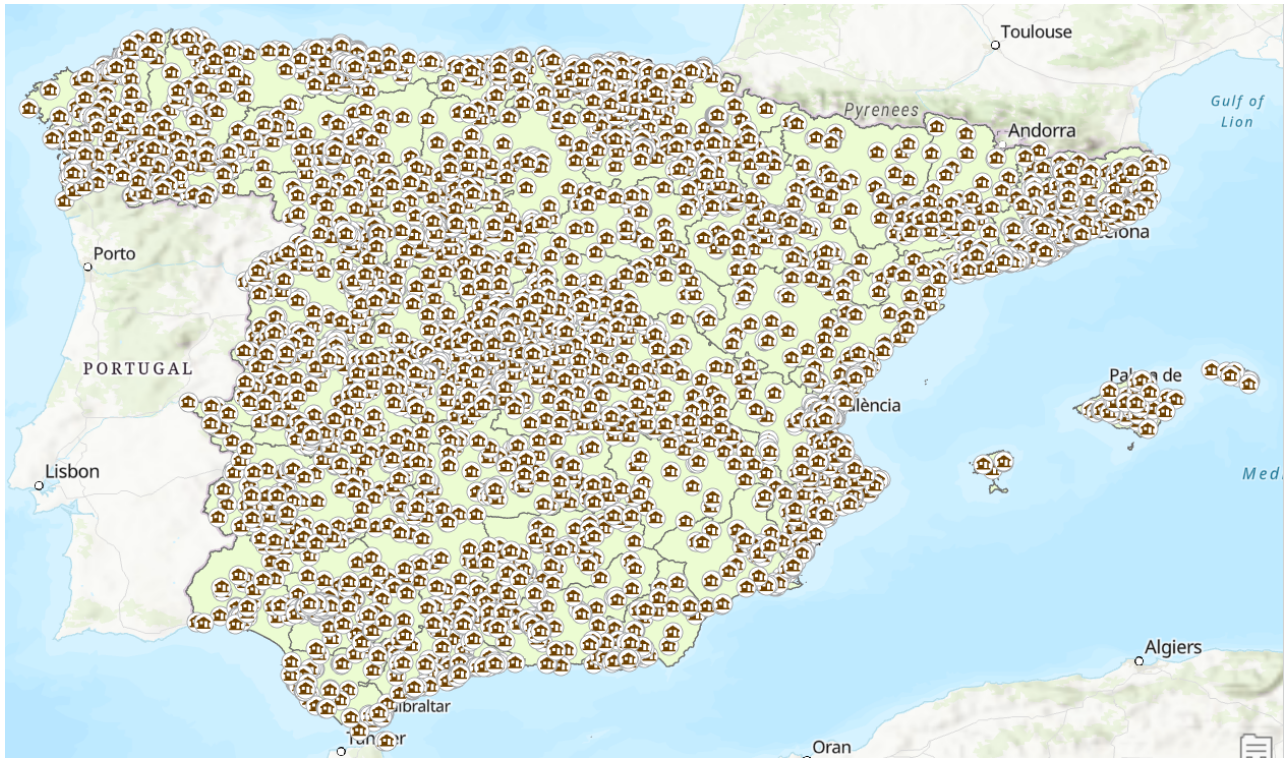
4. DATA II

- Cities (population data)
- Hospitals (location of hospitals)



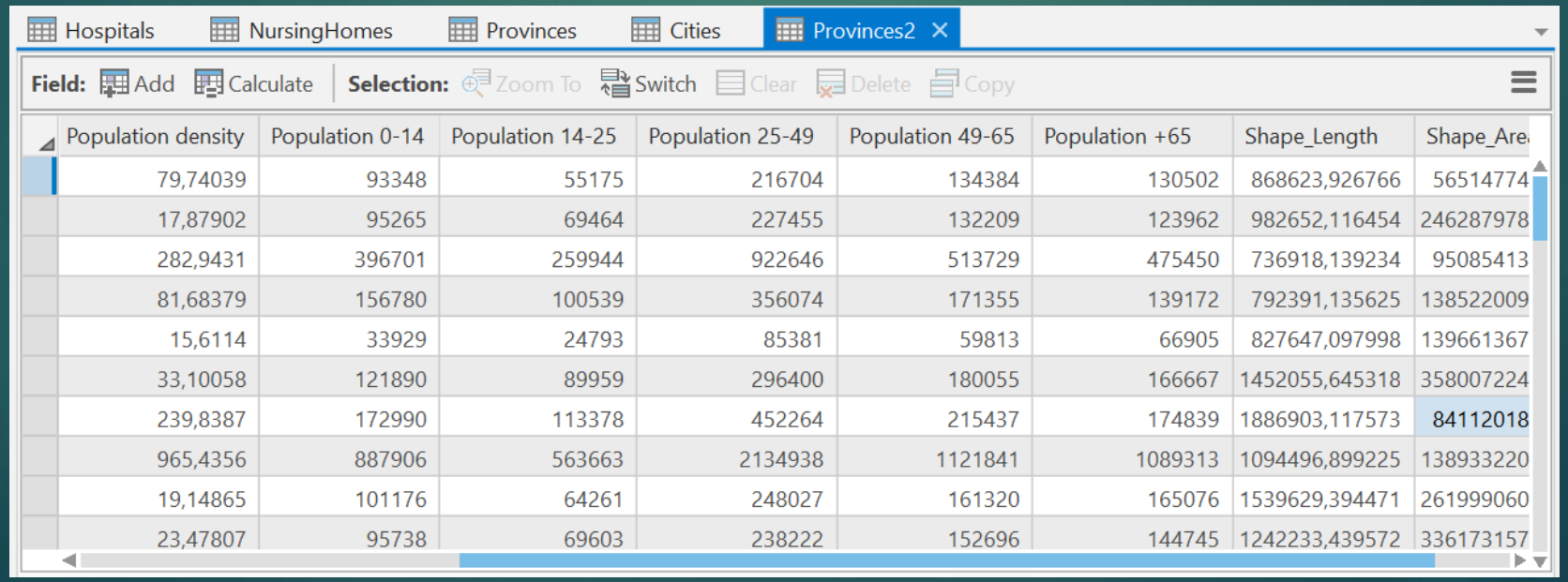
4. DATA III

- Province (region shape)
- Nursing homes (location of nursing homes)



5. DATA PROCESSING

- To add these data layers to our project file we did 2 steps in ArcGIS Pro interface:
  1. We export our data to our project using the tool "Feature class to geodatabase" 4 times (once per layer).
  2. We combined "Cities" and "Province" layers into one using the tool "Spatial Join", creating the new layer "Provinces2".



Population density	Population 0-14	Population 14-25	Population 25-49	Population 49-65	Population +65	Shape_Length	Shape_Are
79,74039	93348	55175	216704	134384	130502	868623,926766	56514774
17,87902	95265	69464	227455	132209	123962	982652,116454	246287978
282,9431	396701	259944	922646	513729	475450	736918,139234	95085413
81,68379	156780	100539	356074	171355	139172	792391,135625	138522009
15,6114	33929	24793	85381	59813	66905	827647,097998	139661367
33,10058	121890	89959	296400	180055	166667	1452055,645318	358007224
239,8387	172990	113378	452264	215437	174839	1886903,117573	84112018
965,4356	887906	563663	2134938	1121841	1089313	1094496,899225	138933220
19,14865	101176	64261	248027	161320	165076	1539629,394471	261999060
23,47807	95738	69603	238222	152696	144745	1242233,439572	336173157

6. WHY USE CODING?

- To create our risk maps we have used Arcpy instead of the ArcGIS Pro interface.
- Why coding is useful in these kind of projects?
  - It allow you to understand how ArcGIS Pro works.
  - Having the base file with all the data you can run all the project just typing one word (everyone with the code could do it).
  - We can implement all the steps in just one function.
  - You can change how the results will be obtain just changing a few lines. (This allow us to explore different methods of calculation and different results as well).

7. OPERATION I

- Having our base file with all the data we need to run some tools to obtain our final results:
  - Count the number of hospitals ands nursing homes in each province
  - Calculate total population in each region
  - Calculate transmission risk, death rate and total risk
  - Normalize the final results in order to have more scaled results
- The first step is to import Arcpy and set the workspace:

```
#Import arcpy, os and create workspace:
import arcpy
import os
location = "C:\\Users\\Angel Naranjo\\Desktop\\COVID\\COVID.gdb"
arcpy.env.workspace = location
arcpy.Exists(arcpy.env.workspace)
arcpy.env.overwriteOutput = True
```

7. OPERATION II

- The second step is to calculate the number of hospitals in each province.
- Tool: “Spatial Join”
- It creates “Provinces3” with the data of “Province2” and the number of hospitals.

```
# Count the number of hospitals in each province:
# Create provinces3 with the data of Provinces2 and the number of hospitals in each one
target_features = "Provinces2"
join_features = "Hospitals"
out_feature_class = "Provinces3"
join_operation = "JOIN_ONE_TO_ONE"
join_type =  "KEEP_ALL"
field_mapping = ""
match_option = "INTERSECT"
search_radius = ""
distance_field_name = ""
arcpy.SpatialJoin_analysis (target_features, join_features, out_feature_class,join_operation,join_type,
                  field_mapping, match_option, search_radius , distance_field_name)
```

7. OPERATION III

- After that, we need to rename the field "Join_Count" as "Hospitals" to avoid errors.
- Tool: "AlterField"

```
#Rename Join_Count as Hospitals:
fc = location + "\\Provinces3"
field = "Join_Count"
new_name = "Hospitals"
new_alias = "Hospitals"
new_type = ""
new_length = "60"
new_is_nullable = "NULLABLE"
clear_alias = "FALSE"
arcpy.AlterField_management(fc, field, new_name, new_alias, new_type, new_length, new_is_nullable,clear_alias)
```

- Now we can use again the same process to count nursing homes creating "Provinces4".

7. OPERATION IV

- The next step is to add all the fields that we want to calculate into the layer "Provinces4:
  - Total population
  - Transmission risk
  - Death rate
  - Total risk
- Tool: "Add field"

```
# Add field: Total population:
inFeatures = "Provinces4"
field_name = "Total_population"
field_type = "FLOAT"
arcpy.AddField_management(inFeatures, field_name, field_type)
```

7. OPERATION V

- Once we have all the fields in “Provinces4” we can calculate them.
- Tool: “Calculate field”

```
#Calculate Total population:
in_table = "Provinces4"
field = "Total_population"
expression = "!Total14! + !Total25! + !Total49! + !Total65! + !Total100!"
expression_type = "PYTHON3"
code_block = ""
field_type = "TEXT"
arcpy.CalculateField_management(in_table, field, expression, expression_type, code_block,
                                field_type)
```

7. OPERATION VI

- With all the fields calculated, we need to define a function to normalize all of them in order to have a more scaled map of results.
- The function:

```
#Function to normalize:

def NormalizedNumbersToField(table, field, scratchGDB):
    import arcpy
    import os
    field_NORMALIZED = field + "_NORMALIZED"
    arcpy.AddField_management(table,field_NORMALIZED , "DOUBLE")
    scratchTable = os.path.join(scratchGDB, "Temp_Feat")
    arcpy.Statistics_analysis(table,scratchTable, [[str(field),"MIN"],[str(field),"MAX"]])
    with arcpy.da.SearchCursor(scratchTable, ("MAX_" + str(field) , "MIN_" + str(field))) as cursor:
        for row in cursor:
            maxNum = row[0]
            minNum = row[1]
    del cursor, row
    arcpy.Delete_management(scratchTable)
    with arcpy.da.UpdateCursor(table, ( field , field_NORMALIZED )) as cursor:
        for row in cursor:
            number = row[0]
            row[1] = (( number - minNum ) / ( maxNum - minNum ))
            cursor.updateRow(row)
    del cursor, row
```

7. OPERATION VII

- The last step is to call the function mentioned before to normalize all the results.

```
#Normalize Transmission risk:
NormalizedNumbersToField("Provinces4", "Transsmission_risk",location)

#Normalize Death rate:
NormalizedNumbersToField("Provinces4", "Death_rate",location)

#Normalize Total risk:
NormalizedNumbersToField("Provinces4", "Total_risk",location)
```

7. OPERATION VII

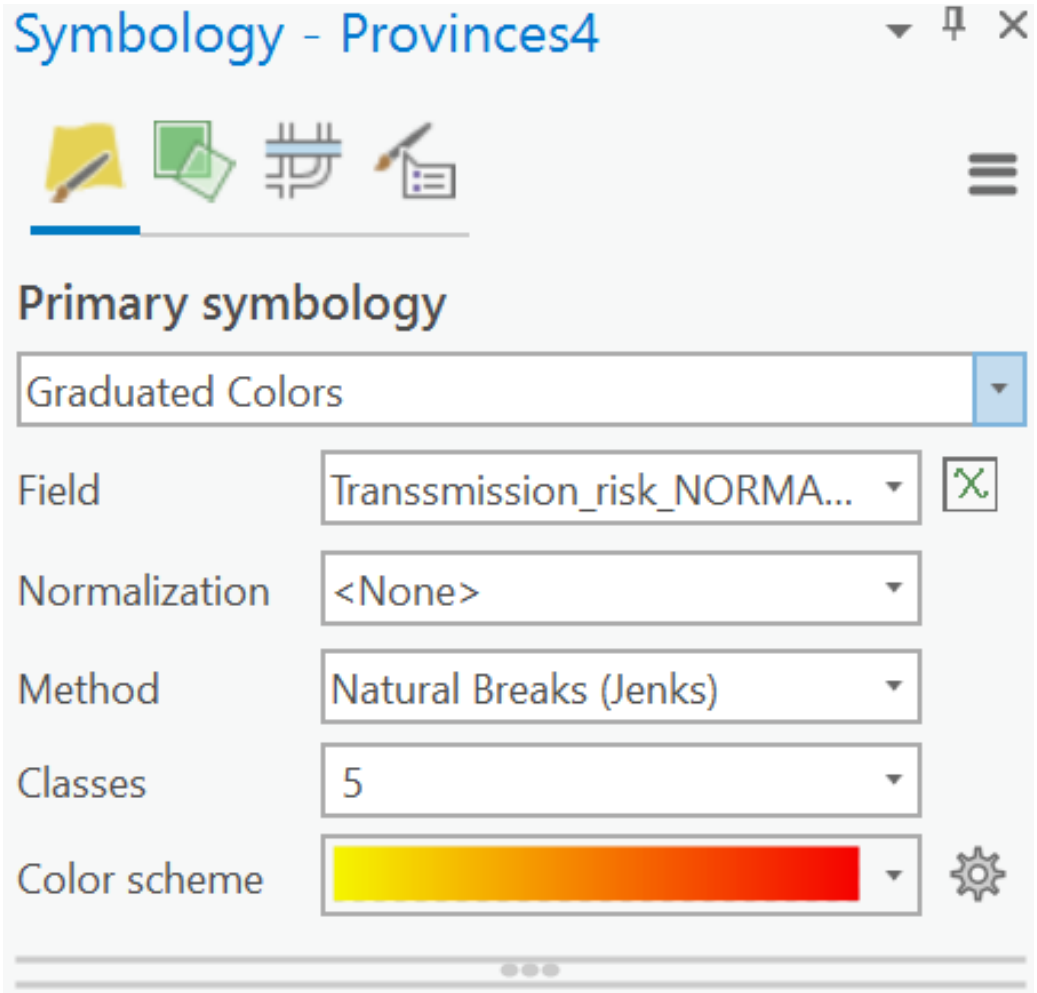
- All the steps before has been implemented in a function called "Covid( )" allowing us to run everything just typing it *.
- *We also need to change the location line and type where is our project saved:

```
location = "C:\\Users\\Angel Naranjo\\Desktop\\COVID\\COVID.gdb"
```

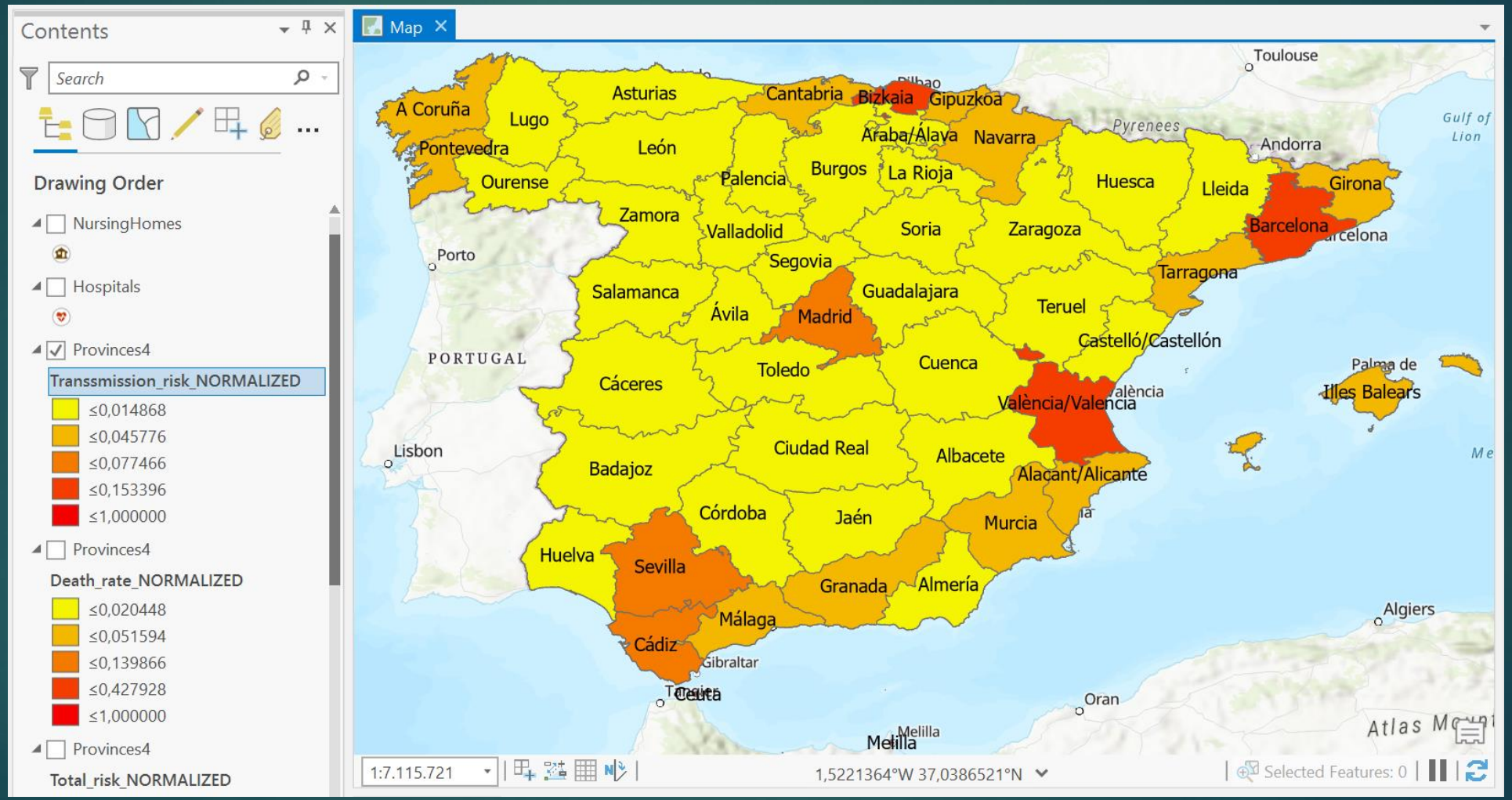
- After running the program, all the results will be on the attribute table of "Provinces4".
- To see them we just need to open our project in ArcGIS Pro and use the tool "Add to current map" to add "Provinces4" to our map (3 times, one per result).

8. RESULTS I

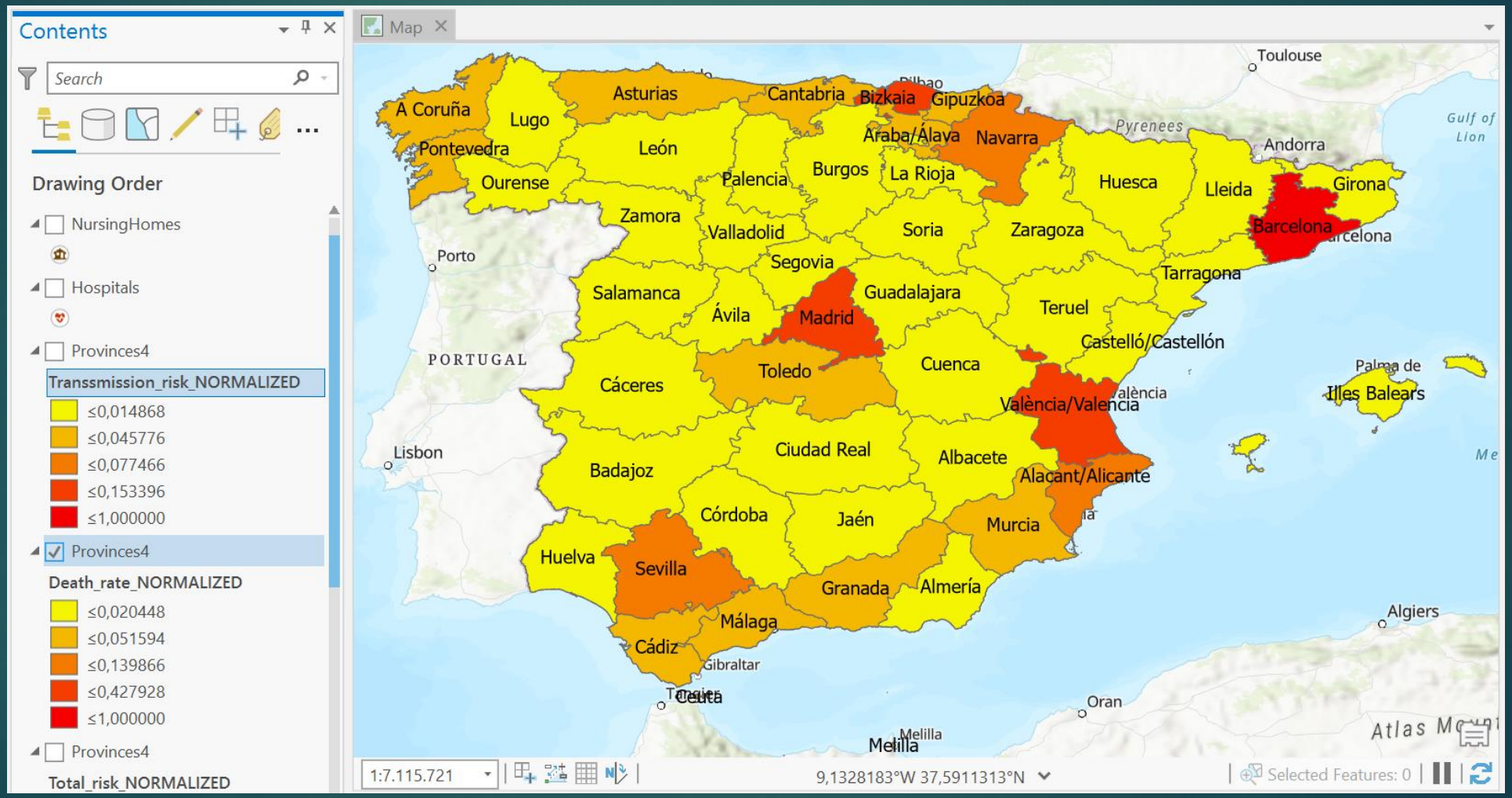
- To see property of the results we will need to do right click on “Provinces4”, go to symbology, then graduate colors and finally choose the result we want to see in each case.



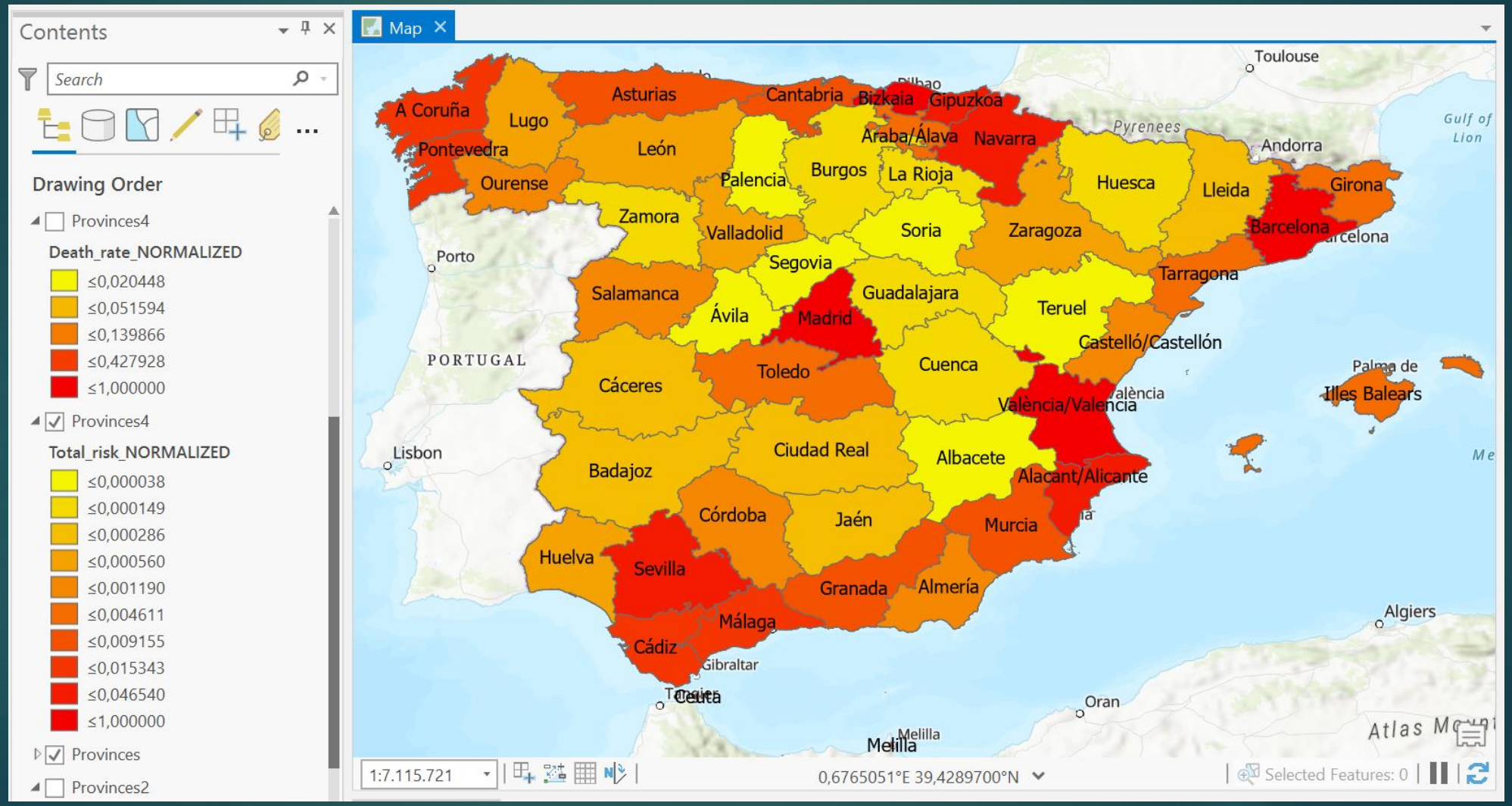
8. RESULTS II (Transmission risk)



8. RESULTS III (Death rate)



8. RESULTS IV (Total risk)



9. CONCLUSION

- With the research done we have found out Spain provinces which pose a great risk of infection and death of the population of this country.
- There are: Bizkaia, Valencia, Barcelona, Madrid, Sevilla, Cadiz, Navarra, Alicante and Malaga.
- In these provinces the density of population is higher than in the other regions (> 130 per 1 sq km). There are more young and senior population. And that is why it causes to high rate of transmission and death risk.
- We would like to offer these provinces to launch additional hospitals to ensure timely treatment of infected people, to strengthen measures to provide social support for elderly people and to limit movement around the province as much as possible.

Thank for your attention

Merci beaucoup