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2016 Mathematical Contest in Modeling (MCM) Summary Sheet
(Attach a copy of this page to each copy of your solution paper.)

Abstract

To study the refugee crisis in Europe, we build two models to describe and predict asylum seekers' movement. The first one focuses on the route they take in order to arrive in Europe. We evaluate three different routes with metrics including distance, safety, type of transportation and capacity the country of arrival can provide. With convex optimization, we create a optimal plan for asylum seekers to enter Europe safely and fast. A network connecting 13 countries of different kinds(countries of first arrival, transit countries and destination countries) is built to explain the flow of refugees inside Europe. We assess the countries in four primary factors: accessibility to accommodation, attitude towards refugees and development of a country, and the recognition rate of asylum seekers of different nationalities. We also evaluate the difficulty to enter a country by studying the border laws and the Schengen Area policy. With the network we simulate the flow and find the trend of overcrowding problem: destination countries, then neighbours of destination countries, then countries of first-arrival, and we try to stop this "flu of overcrowding" with policies highlighted the "quota trading system". Then we examine consequences led by breaking events with simulation of different reactions and its outcomes of Germany government towards a bomb attack, and show that a sudden shift in policy may lead a huge crisis to the neighbour countries. In the last, we try to solve the refugee crisis in a long run, with more consideration of integration and development instead of basic needs in life.

Modeling Refugee Immigration Policies

February 2, 2016

Contents

1 Introduction

1.1 Background

Since the first half of 2015,hundreds of thousands of refugees have moved into Europe because of the sustained war in the Middle East and other places.By the end of October 2015, European countries had received over 715,000 asylum applications from refugees.while only a few(about 30%)of these refugees have been accepted.

Thus, many countries are paying more and more attention to refugee integration policies.a quota system has been established where each country has agreed to take a certain capacity of refugees, with the majority of the resettlement burden lying with France and Germany.however, when the number of refugees increases, the local people in those countries will complain.For example, nearly 40 percent of the German are not satisfied with the number of refugees and the policis for refugee in the rencent poll.Countries that have been burdened the most are concerned about their capacity to provide resources for the refugees such as food, water, shelter, and healthcare.

Refugees mainly travel 6 routes:(1) West Mediterranean, (2) Central Mediterranean, (3) Eastern Mediterranean, (4) West Balkans, (5) Eastern Borders, and (6) Albania to Greece. Each route has their own superiorities and inferiorities with Eastern Mediterranean being the most popular route.

In this problem we are required to help develop a better understanding of the factors involved with facilitating the movement of refugees from their countries of origin into safe-haven countries,namely, to create a model of optimal refugee movement.we are also excepted to established a dynamic model in which many factors change rapidly. there are numerous factors that determine how the refugees decide to move through the region,like, transportation availability, safety of routes, the distance, access to basic needs and policy at destination and so on.so we will consider as comprehensive as possible to establish the model with appropriate neglect in calculation.

1.2 Our work

Accoding to the tasks, we divide the problem into two sections: before entering Europe and after entering Europe. Also, we assume that these two sections don't affect eath other, which means that what country refugees want to go won't influence where they enter Europe. We establish two models to solve each section and make a analysis of our model in order to get as close as possible to the real situation. We also get an optimal solution for each situation and discussed them from a lot of factors.

2 Before entering Europe

2.1 Analysis of the Problem

This aspect mainly solve the problem of refugee movement before they enter Europe, and we focus on 6 route mentioned in the problem by which they enter the Europe. There are many factors and we will make a list of them and give the reason.

First,the countries'capacity including number of entry points and resources available to refugee population.the reason why it is considered is that the capacity directly determine how many refugees will go to the country and how fast they can pass through it.Second, the routes they must take including distance,safety and types of transportation.also, most of refugees go to the Europe by water, so types of transportation aren't so important. Distance and safety of the route will undoubtedlly infulence refugees.if a route is convenient and safe, refugees will certainly take this way.(also there are many exceptions but we don't consider in the model becaus they are only a few.) Last but not least,attributes of the individuals themselves including number and the country they are come from.different people think differently.for example many refugees from Africa prefer to take a long journey to Spain instead of going to Italy and refugees from one region are likely to go to the same country.Also, age and gender is a factor, but we don't consider it too much.

In short, the specific factors are the countries'capacity,the routes they must take and attributes of the individuals themselves.and our measures are number of entry points and resources available to refugee population of the destination country, distance and safety of the routes, number of the refugees and the country refugees come form and want to go.other factors have been neglected. In the model, we will decide a function to determine a coefficient of a certain route. if the coefficient is large, more people will go by this route.also, many refugees go by this route will certainly influence other refugees' dicisions.so we must find a model which make satisfaction degree of all the refugees reach a maxium.

We will consider capacity,distance and safety of the route, the number of refugeees and attributes of the refugees.we will give each factor a certain proportion and to see how they will influence the final result.

2.2 Assumption

2.2.1 From the destination countries' point of view

- Each country have a capacity of refugees
- Country treat each refugee equally
- Each entry point has equal reception capacity
- The policy of countries won't change suddenly

2.2.2 From the refugees' point of view

- The destination country of refugees will not influence their first arrival country in Europe
- Refugees get the same information
- Refugees will choose the most convenient and safe route
- Refugees will judge the first arrival country from the resources they can get
- Refugees from different continent prefer to choose the route in thier country

2.3 Calculating and Simplifying the Model

Table 1: the parameters in model 1

symbol	meaning
c	Capacity
d	Straight-line distance
s	Safety of the route
p	The number of refugeees who travel between two certain countries
a	Some unknow factors

In this model, we make an overall consideration of different factors including capacity and the number of the entry points of the country, the distance and safety of the route.In order to simplify the promble, we choose five countries which refugees come from and three first arrival. we use a funtion f (1)to describe the route between every two countries.

$$f = \frac{c \times s^{0.1}}{d^2} \tag{1}$$

Because the safety of the route is not as important as other factors, so we give it a smaller factor and give distance a big fator.

Then, we get a Table 2.Refugees in a certain country will give priority to a distination country if the coefficient between them are large.also, because some hostility country between africa and asia, we suppose that refugees can't move between africa and asia,

Table 2:

Country	Spain	Italy	Greece
Syria	0.00017	0.04128	0.01229
Iraq	*	*	0.00500
Afghanistan	*	*	0.00114
Eritrea	0.00045	0.01469	*
Nigeria	0.00081	0.01573	*

which means the refugees from Eritrea, Nigeria won't go to Greece and Iraq, Afghanistan won't go to italy.

Table 3 is the number of rufugees from different countries we assummed according to the real proportion of the refugees, whcih means the real number of refugees is our number multiplied by a coefficient.

Table 3:

Country	number of refugees
Syria	5000
Iraq	100
Afghanistan	200
Eritrea	450
Nigeria	250

From the Table 3 we can see that most of the refugees are from Syria.so we can consider its different distribution with other countries remainning unchanged.with a overall consideration of Table 2,Table 3 and our assumption,we make the Table 4 to determine the distribution of the refugees from syria.

Table 4:

	Spain	Italy	Greece
Syria	x	y	5000-x-y
Iraq			100
Afghanistan			200
Eritrea		450	
Nigeria	250		

We make a new function g(2)

$$g = \sum_i (\sum_j f_{ij} \times p_{ij}) / (\sum_j p_{ij})^a \tag{2}$$

It compute every country's total value, namely the sum of the coefficent f in the Matrix(2) multipled by the number of refugees go to a certain country, and then divide by *a* power of the number of refugees who go to this country, *a* is a number to be determined.Because if a country has too many refugees , less people will go to it.Then we need to compute the max of the g.We assumed a= 1.0 and x,y has a Minimum intervalof 10 (because the person form same region will prefer to go to one place) to get the following number x=0,y=3390,g(max)=49.72,and we get the optimal method in the Table 5.

Table 5:

	Spain	Italy	Greece
Syria	0	3390	1610
Iraq			100
Afghanistan			200
Eritrea		450	
Nigeria	250		

2.4 Sensitivity

2.4.1 capacity

When capacity of Spain changes 1%,the value of g changes 0.02%,y changes 0%. When capacity of Italy changes 1%,the value of g changes 0.8%,y changes 0.3%. When capacity of Greece changes 1%,the value of g changes 0.2%,y changes -0.3%. In short, the change of capacity don't influence the reslut too much and the Italy influence more because of its largest capacity.

2.4.2 distance

When distance between each two country all change 1%,the value of g changes 2%,y changes 2%.So distance is an important factor, because it has a factor of 2.Also, it's correct in the reality.

2.4.3 safety

We focus on the factor of the safety, in the assumption, we use 0.1 be the power of s,but we don't know how much it affects, so we will change the 0.1 by 10% in order to get that the value of g changes -0.03%,y changes 0.3%.As a result, it's really not a big problem.

2.4.4 a,the importance of number of refugees

When a is small(a<1), we find that most of refugees should go to Italy,which is not the real case; when a is too big(a>1.3),we find that most of refugees should go to Spain,which is also not the real case.We can see the most of the information in Table 6 below.

We also plot some Contour maps to show what the situation is when a changes.In the picture, the paler the colour is , the bigger the value of g is.

So we will focus on the a=1.2, because it is more to the real situation. At the nearby of 1.2, when a changes by 1%,the value of g changes 8.8%,y changes 6.9%.when the a get even bigger x will also change a lot.As a reslut, this factor is very important.

Table 6:

a	x	y
0.3	0	4990
0.4	0	4820
0.5	0	4590
0.6	0	4350
0.7	0	4130
0.8	0	3920
0.9	0	3690
1.0	0	3390
1.1	0	2710
1.2	0	1440
1.3	3440	810
1.4	3890	570
1.5	4160	420
1.6	4340	320
1.7	4470	250
1.8	4560	200
1.9	4630	160

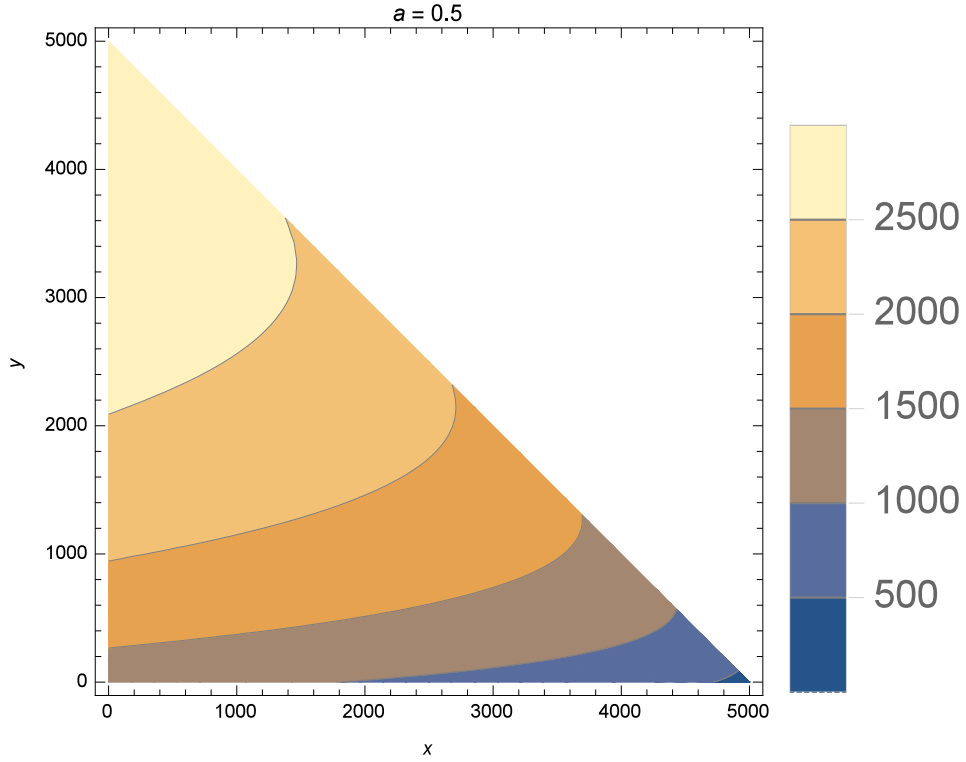


Figure 1:

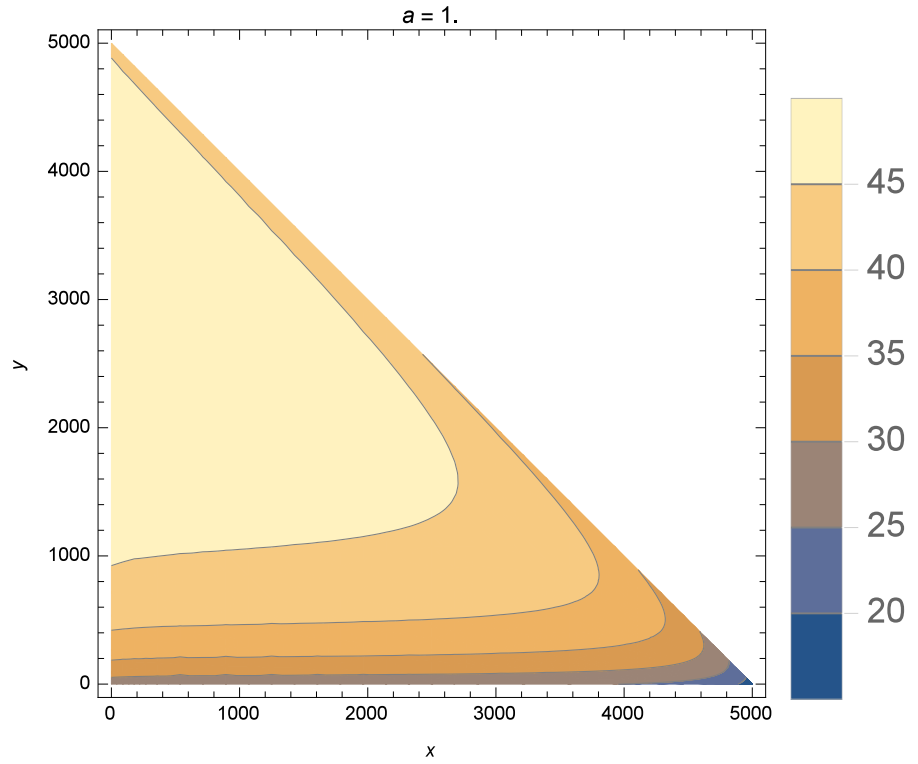


Figure 2:

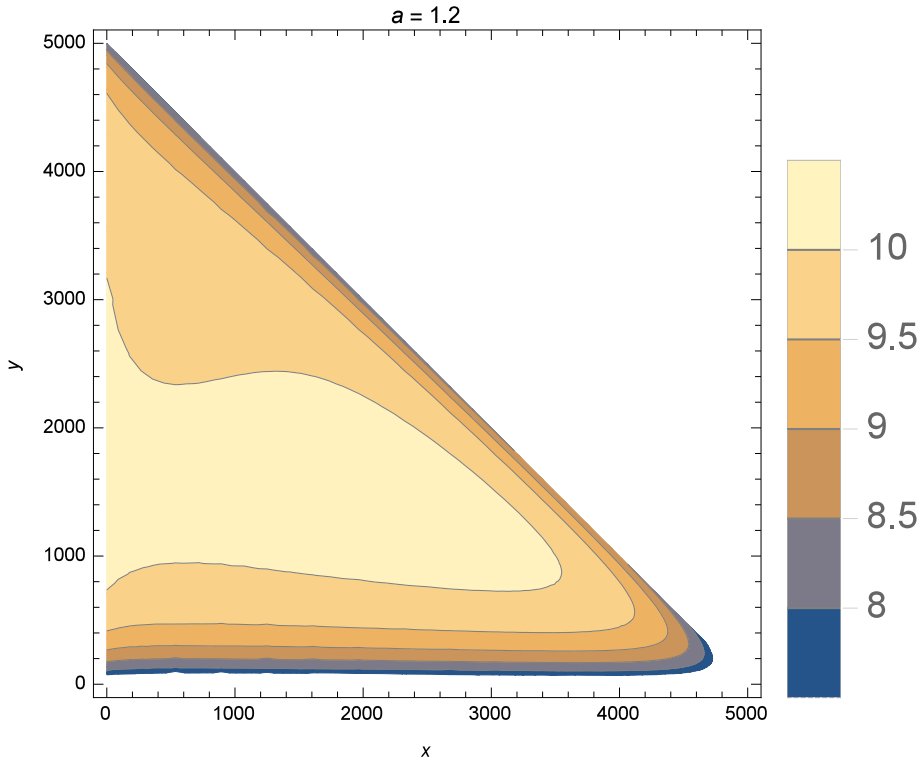


Figure 3:

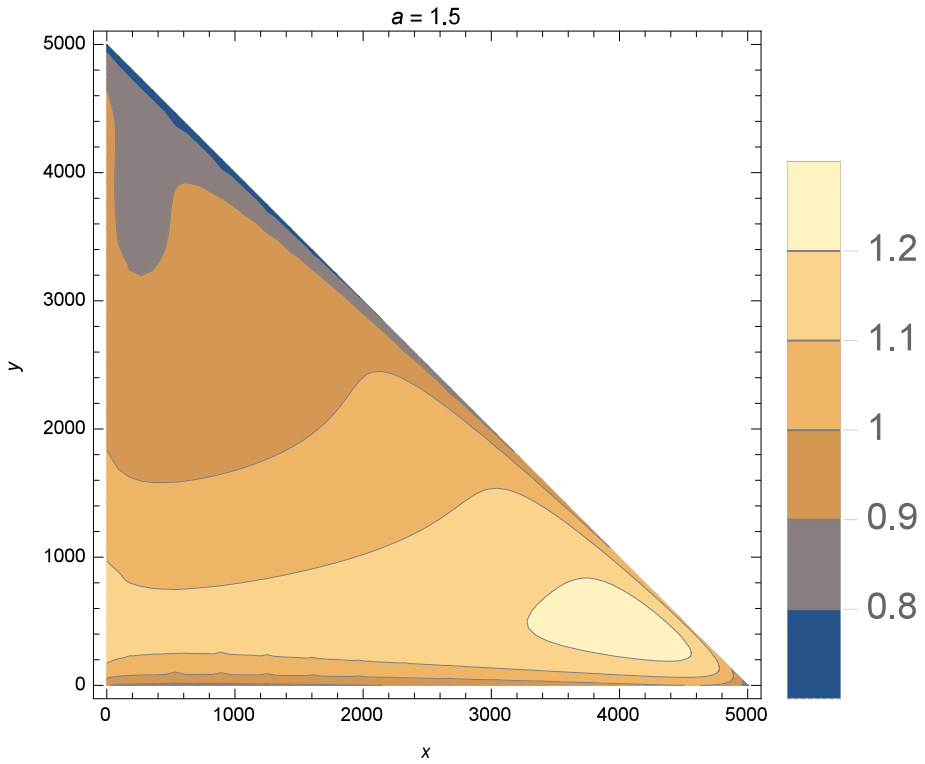


Figure 4:

2.4.5 number of refugees

In this model, the number of refugees won't influence the result of disturbution of refugees, only influence the total time. Even if the crisis expand by a factor of 10, as long as the policy and capacity of first arrival country remains, the disturbution won't change, but it will certainly become a long-time problem.

2.5 Strengths and weaknesses

2.5.1 Strengths

- We consider various factors and make them a different power in the model
- Except the parameter a, our model is very stable
- Our model is very close to the real situation

2.5.2 weaknesses

- Neglect the time it takes to arrange for refugees
- Neglect the influence of countries besides destination country
- Contempt for the impact of security

3 After entering Europe

3.1 Analysis of the Problem

The asylum seekers who have already been in European countries of first arrival like Italy and Greece choose to go to other countries, because these countries attract them much more, thus create a massive flow of people. We put forward a method to measure this attractiveness. To simplify the problem, we look into 13 countries of diversity in Europe, and build a network of 13 nodes representing 13 countries with a edge connected to the adjacent country.

Every country has a attractiveness score concerning policy and resources towards asylum seekers, and the asylum seeker will choose to move to that country if the attractiveness score is high enough to beat factors such as the frastration in movement and so on. But when a country's capacity is nearly full or has been exceeded, this country can be a bad choice for asylum seekers because of the shortage in resources such as food and shelter. Then the attractiveness score will drop, and asylum seekers turn to other countries instead, causing a cascade effect.

We can simulate the asylum seekers' movement and get a pattern of flow, which can be measured by the total satisfactory of the asylum seekers. The pattern can provide the highest total satisfactory is the optimal model we are looking for.

3.2 Metrics

3.2.1 Asylum seekers life quality criteria

We measure the short-term life quality of asylum seekers in the asylum country with three primary components:

- quality of accommodation(mostly material)
- the positive policies that help intergration
- the overall development of a country
- the possibility an asylum seeker can enjoy accommodation

Accommodation. Asylum seekers left their homeland and travelled a long way to find a place to live in. Since getting shelters, food and other materials in a different country is the most urgent issue, we give it the biggest weight among the three factors. Metrics for this component should measure accessibility to material for basic needs for life, allowance and respect they get in the reception centre, among which, allowance is considered the most important one.

Policy. Policy differ even between the neighbour countries, which provide a motivation for movement. It can reflect a country's attitude towards asylum seekers, and this can change their life in that country. This component should be measured by metrics suggest by MIPEX(Migrant Integration Policy Index) for political tolerance.

Development. We measure this component with HDI(Human Development Index)[2014], the standard of life should be measured by metrics used by the UNDP(United Nation Development Programme). **Recognition rate.** Recognition rate is for all types of protection status granted (refugee status, subsidiary protection, or humanitarian status)[AIDA annual report 2014-2015].

3.2.2 Our Metrics

Accommodation. Average financial allowance We use financial allowance given to the asylum seekers to describe the material for living provided by a country, which is the main body of the assessment towards accommodation. reception condition fix The reception centre was asked several questions about the accommodation rules(which is in the appendix). We choose five questions and normalize the grade, which can be a adjustment of the accommodation assessment.

Policy. We use the MIPEX data concerning the labour market mobility, family reunion, education, political participation, permenent residence, access to nationality, anti-discrimination and health. MIPEX provides us with an index, we pick the data of 13 countries we have chosen.

Development. We use the unchanged HDI data , and because it is related to long-term factors, we only give it a little weight.

Recognition rate. We use data from AIDA annual report 2014-2015 includes Syria, Iraq, Eritria and Afghanistan by country of origin. This can determine the possibility an asylum seeker gets shelter, and is the decisive factor towards whether a country is good for asylum seekers to live in.

Movement frustration. We classify the roads into two kind: road between two Schengen countries and road between a non-Schengen country and other countries. The former one has few border restrictions while the latter one is harder to go through. So, the latter one is more dangerous because of the existance of smugglers and human traffickers, as well as the unfriendly action the government may take. We give a larger unwillingness score to the road with at least one end of non-Schengen countries.

3.3 Calculating and Simplifying the Model

3.3.1 Formulas

We denote the financial allowance in accommodation centre as FA_i, financial allowance out accommodation centre as FA_o, thus we have:

$$AFA = \frac{FA_i + FA_o}{2} \tag{3}$$

And the average financial allowance is just a approximate number, so we use the function to convert it into a grade number.

1.We normalize AFA and RCF to get AFA_{norm} andRCF_{norm}.

$$AFA_{norm} = \begin{cases} \lfloor \frac{AFA}{50} \rfloor \times \frac{1}{6} & 0 \leq AFA < 300 \\ 1 & 300 \leq AFA \end{cases} \tag{4}$$

Table 7: the parameters in model 2

symbol	meaning
AFA	Average financial allowance in/out an accommodation centre
RCF	Reception condition fix
RCS	Reception condition score
RcgR	Recognition rate, the share of positive decisions in the total number of asylum decisions
MIPEX	Migrant Integration Policy Index, which measures policies to integrate migrants in all EU Member
HDI	Human development index
AS	Attractiveness score
Cpct	The capacity of all accommodation centres in a country
LR	Length of a road
SM	The Schengen multiplier
DS	Danger score of a road
MN	Maximum number of people that can get through a road in a day

$$RCF_{norm} = \frac{RCF}{RCF_{max}} \tag{5}$$

2.RCF is only a fix to AFA, and both stat is normalized, so we use equation below to determine RCS.

$$RCS = (AFA_{norm})^{0.75} \times (RCF_{norm})^{0.25} \tag{6}$$

3.Then we normalize RCS.

$$RCS_{norm} = \frac{RCS}{RCS_{max}} \tag{7}$$

We also normalize MIPEX average overall by the equation:

$$MIPEX_{norm} = \frac{MIPEX_{origin}}{MIPEX_{max} - 25} \tag{8}$$

Then we use equation:

$$AS = (RCS_{norm})^{0.5} \times (MIPEX_{norm})^{0.4} \times (HDI)^{0.1} \tag{9}$$

to determine the attractiveness score of a country.

At last we normalize AS to get AS_{norm}:

$$AS_{norm} = \frac{AS_{origin}}{AS_{max}} \tag{10}$$

Then we have a attractiveness score table of all 13 countries, regardless of the different recognition rate towards asylum seeker of different nationality.

We take different recognition rate into consideration with the equation:

$$AS_{fixed} = AS_{origin} \times RcgR_{nationality} \tag{11}$$

Table 8:

Counrty	Attractiveness score
Greece	0.24
Italy	0.37
Germany	0.94
Croatia	0.23
Austria	0.73
Poland	0.42
Switzerland	0.84
France	0.76
Belgium	0.66
Netherland	0.79
Sweden	0.99
UK	0.79
Hungary	0.17

Table 9:

	Syrian	Eritrean	Iraqi	Afghan
Greece	0.15	0.12	0.04	0.09
Italy	0.24	0.33	0.42	0.46
Germany	0.88	0.81	1	0.8
Croatia	0	0	0	0
Austria*	0.64	0.69	0.87	0.52
Poland	0.43	0.43	0.52	0.39
Switzerland	0.81	0.75	0.85	1
France	0.73	0.2	0.87	0.82
Belgium	0.64	0.54	0.49	0.54
Netherland	0.72	0.72	0.41	0.51
Sweden	1	1	0.61	0.96
UK	0.69	0.68	0.34	0.38
Hungary	0.12	0.18	0.14	0.06

Then we get a table of 13 countries' attractiveness towards asylum seeker from 4 countries.

We use AS_{fixed} as the weight of the node representing a country.

Road frustration

We measure the LR(length of roads) from Google map, and give them a coefficient α regarding whether they connect two Schengen countries or not.

$$\alpha_{Schengen} = 0.00005 \tag{12}$$

$$\alpha_{non-Schengen} = 0.0001 \tag{13}$$

We have

$$US = \alpha \times LR \tag{14}$$

$$US_{min} = min|US_{AtoB}| \tag{15}$$

Thus we have figure 5 with both value of nodes(Attractiveness score of a country) and weight of edges(Unwillingness score of a road):

Base reluctance

People normally tends to stay at a place, so we incorporate a base reluctance into the model and set:

$$BR = 0.01 \tag{16}$$

3.3.2 Asylum seeker flow network

Rule of movement

- If and only if:

$$Nw = AS_{fixed,dest} - US_{min} - BR > 0 \tag{17}$$

an asylum seeker is willing to go to the destination country.

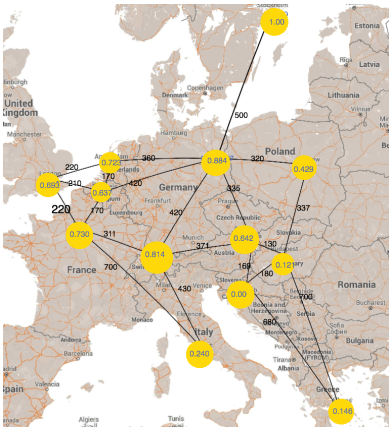


Figure 5: value of nodes

- Everyday there are some asylum seeker of one of 4 nationalities arrive in Greece and Italy, the number is average of the landing number from Jan. to Oct. 2015(Italy) and 1-25 Jan. 2016(Greece).
- Everyday every active asylum seeker check all the 13 countries and tries to find out the country has the largest Nw value and move towards that country.
- If and only if an asylum seeker finds out that no other countries he wants to go, then he decides to stay and apply for the refugee status and become a "resident" of the country.
- Only "resident" occupies capacity of a country.

Capacity-adjusted attractiveness score

When the number of "resident" in a country rises, the most attractive country will reach its capacity the quickest. When the number exceeds capacity, shortage of resources occurs and allowance, health services and other materials per capita will drop increasingly. And the happiness of an asylum seeker or refugee will drop even faster than the material condition getting worse. We assume the relationship between the number of residents, capacity and attractiveness score is the equation listed below:

$$AS_{Cap-adjusted} = \begin{cases} As \times (\frac{Cap}{number\ of\ residents})^{1.5} & Cap < number\ of\ residents \\ As & number\ of\ residents \leq Cap \end{cases} \tag{18}$$

Simulation of the flow

"Birth rate" The number of asylum seekers landing in Greece and Italy seperated by nationality is shown by the table below:

Table 10:

	Syrian	Eritrean	Iraqi	Afghan
Greece	28	145	4	1
Italy	653	0	192	393

Simulation result

We simulate 700 days, and the result on the 20th, 100th, 400th, 500th and 700th day is shown by figure 10. And the results on the 700th day is also in the table 11.

Overcrowding "flu"

From the graph we observe that countries with high attractiveness(i.e. Germany and Sweden) attract asylum seekers faster. And when they reach their capacity, the countries surrounding them start to gain asylum seekers. When the population of refugees has grown to exceed the capacity of the whole Europe, Greece and Italy, the main two countries of first arrival become overcrowded. The overcrowding crisis spreads as: destination countries with high AS $\rightarrow$ countries surrounding the overcrowded destination countries $\rightarrow$ countries of first arrival

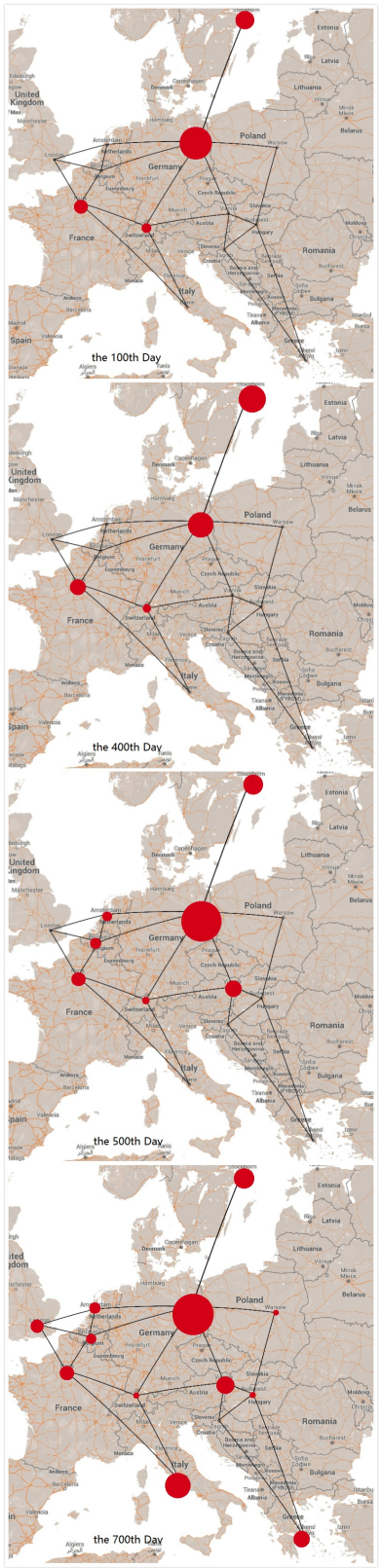


Figure 6: the result on different day

Table 11:

country	resident	capacity
Greece	51438	1271
Italy	274725	100022
Germany	1000521	1000000
Croatia	0	700
Austria	74829	72500
Poland	2364	1980
Switzerland	3582	1900
France	48339	48100
Belgium	18867	18437
Netherland	24873	24850
Sweden	99258	97881
UK	34470	31000
Hungary	1599	1105

3.3.3 Resource allocation

In this aspect, we will mainly focus on the situation in the first one hundred days in order to preposition some resources. Resources are divided in to three catagories according to thier importance:food, clothes and accommodation. Food is the most important because people will die without it. And accommodation is not so important because refugees are accustomed to be homeless. We already know that most of refugees will go to Germany and Sweden in the end, which means that these countries must have enough food, and we just consider the country on the route by which many refugees go through. Table 12 gives us some number of refugees in different contries in the early time. So in the early

Table 12:

days	Austria	Switzerland	France	Hungary
2	0	1815	0	534
50	534	4173	0	534
100	534	2994	45981	534

days, we should first give many food to Switzerland and then preposition some food to France. Suppose that we have 1000 food to preposition every day.Then we can get how we arrange them according to the number of refugees. We should make our best to let every refugee have something to eat. So we can get the Table 13.The number in the table means the number of food.

Table 13:

days	Austria	Switzerland	France	Hungary
2	0	772.6	0	227.31
50	101.8	796.2	0	101.8
100	10.6	59.8	918.8	10.6

The role of NGOs

From the Table 13 we can see a certain country often need a lot of food (more that 50 %) ,so it is inefficient to give only a little food to one country for the government. This time NGOs can give help because they just have a few food and they also can afford for some reqirements of refugees. For example, on the 100th days, NGOs can give food to Austria and Hungary, because it's diffcult for a country to prepare so little food.Then the arrangement of food will change into Table 14.

Table 14:

days	Austria	Switzerland	France	Hungary
2	0	800	0	200
50	100	800	0	100
100	0	0	1000	0

Other refugee destinations

In this section we will consider China as a refugee destinations. We take every province in China as a country in Europe.But our model doesn't work this time. Not only becuase China's provinces is twice the countries in Europe, but also because Chian has more population and more capacity that is far more than those in Europe even compare with Germany. In short, we need a new model to discuss about the situations in China.

3.3.4 Bomb crisis

Assume a bomb attack takes place in Germany in Day 249 in our simulation. The German government has several choices to respond to this crisis.

1.Reinforce border control

Only b% asylum seekers can enter Germany since Day 250. We observe the two neighbour countries of Germany: Austria and Switzerland. The figure 7 and figure 8 shows vividly how border control of Germany can cause a cascade effect to destroy its neighbour countries. The blue line shows the circumstance of b = 100, the yellow one shows b = 80, the green one shows b = 50, while the red shows b = 0. If Germany blockes asylum seekers out of the border, Austria and Switzerland have to take tens of times of the normal number of the refugees. So this respond is not appropriate.

2.Shift policies into unfriendly, even Xenophobic.

Attractiveness score will decrease immediately but those who have already been granted the status of refugee will stay. The figure 9 and figure 10 below shows a% loss of attractiveness score of Germany will results in unexpected reaction of the number of refugee in Switzerland. The blue line shows the circumstance of a = 80, while the yellow line shows a = 10. the latter one, which symbolizes a more gentle policy, is better than the tougher one.

3.Exile all the refugees

Germany is totally mad at the bomb attack, so they decide to banish all the asylum

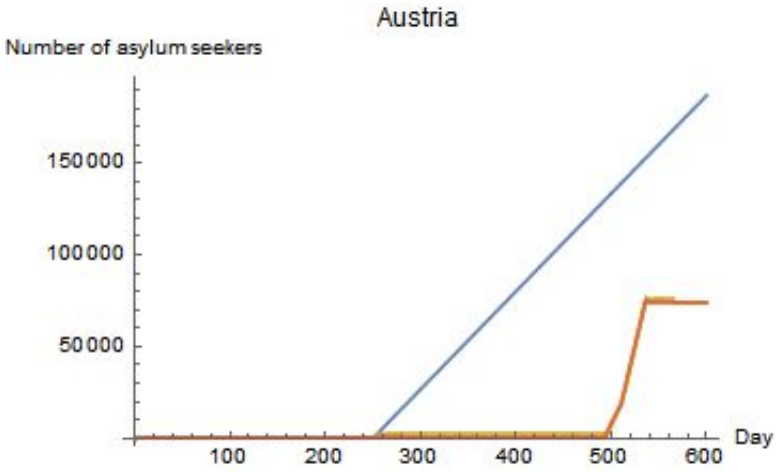
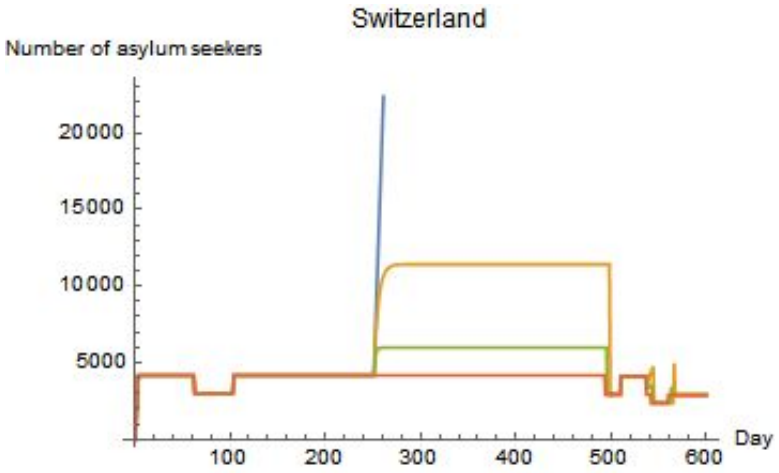


Figure 7:



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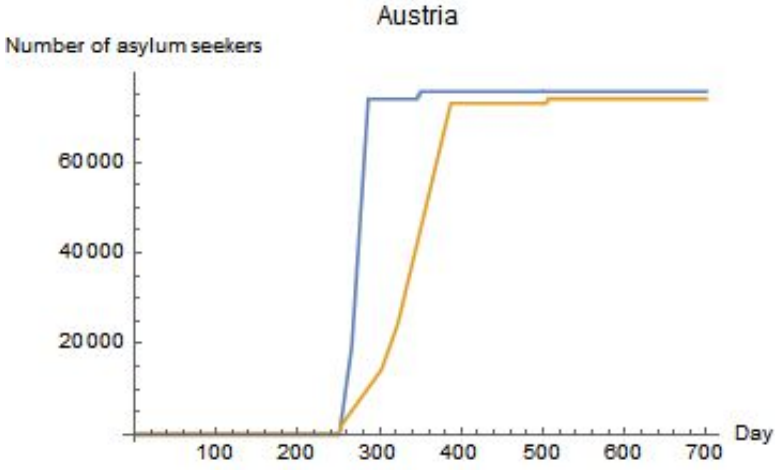

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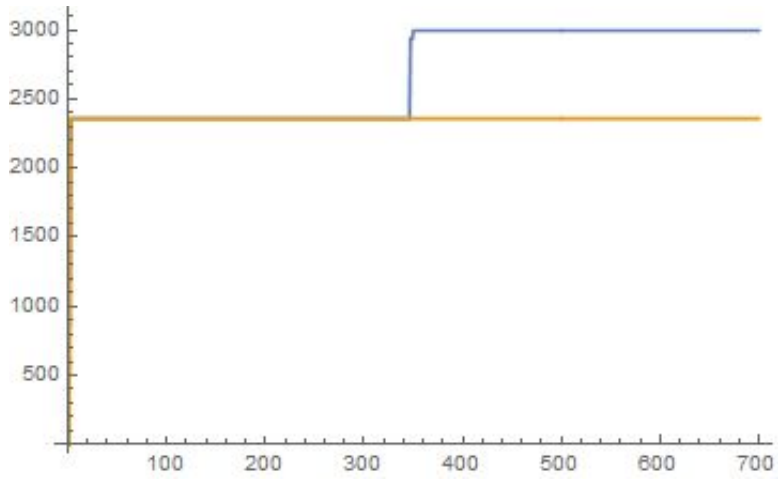


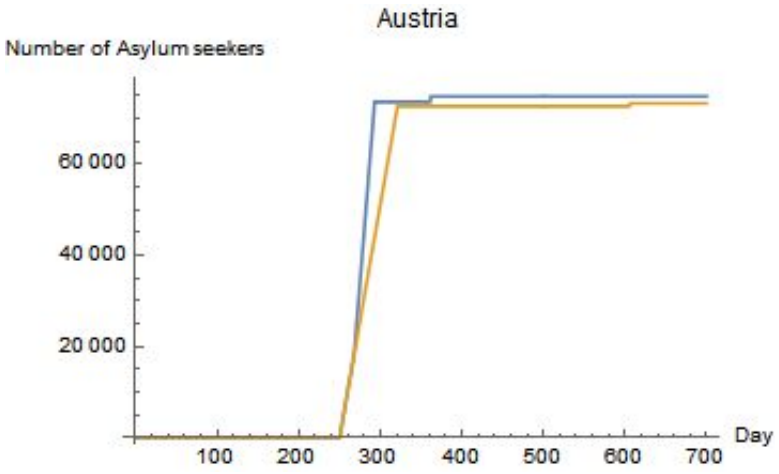
Figure 10:

seekers. The asylum seekers have to go to other countries for protection. Assume 2000 people a day leave Germany, what will the neighbour react? Figure 11 and Figure 12 mean that The blue line shows Germany choose to exile refugees, while the yellow line shows circumstance without an exile.

3.3.5 Policy strategy

Our model gives us some information of the movement of refugees, and we must make some policy strategys to improve the situation. We will prioritize the health and safety of refugees. Also, we will consider the benifits of local people.So we list some policies below.

- Greece should give more capacity and open more entry points
- Because Spain is too far for a lot of African, so it's important to let them go through Asia



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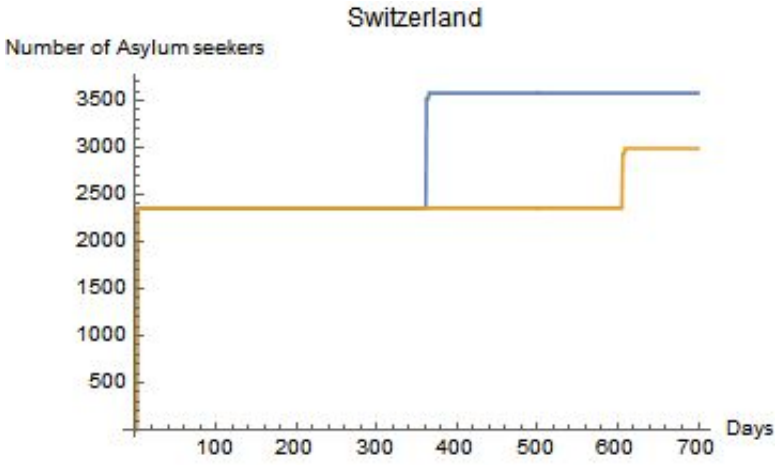

Figure 12:

- Country should give more resources for the first arrival country
- Government shouldn't change thier policy suddenly even if refugees have done something wrong
- Country should preposition some resources for some countries that accept refugee in the early time
- Country can make resources trade espically food trade with each other, this one is very important and effective because it will be more fair for all the countries to solve the refugee problem but not to throw all refugees on Germany
- Government should cooperate with NGOs

3.3.6 Integration of migrants in the long run

We use migrant integration indicators from eurostat to assess a country, which concerns social inclusion, education, employment. compared to the original short-term metrics we think about(mainly focuse on accommodation), social tolerance, development of a country and environment issues gain their importance.

4 Conclusion

We build two models to describe and predict asylum seekers' movement. The first one focuses on the route they take in order to arrive in Europe. We evaluate three different routes with metrics including distance, safety, type of transportation and capacity the country of arrival can provide. With convex optimization, we create a optimal plan for asylum seekers to enter Europe safely and fast.

A network connecting 13 countries of different kinds(countries of first arrival, transit countries and destination countries) is built to explain the flow of refugees inside Europe. We assess the countries in four primary factors: accessibility to accommodation,

attitude towards refugees and development of a country, and the recognition rate of asylum seekers of different nationalities. We also evaluate the difficulty to enter a country by studying the border laws and the Schengen Area policy.

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To whom it may be concerned:

Hello! I am a member of ICM-RUN(RefUgee aNalytics), you have asked us to help develop a better understanding of the factors involved with facilitating the movement of refugees from their countries of origin into safe-haven countries. We make two different models to simulate reality and get some achievements.First, l will show you what we havedone.In the next two tables you will see the optimal number of refugees who go to the entry point of Europe and the disturbtion of them after entering Europe for 700days.

Table 15:

	Spain	Italy	Greece
Syria	0	3390	1610
Iraq			100
Afghanistan			200
Eritrea		450	
Nigeria	250		

Table 16:

country	resident	capacity
Greece	51438	1271
Italy	274725	100022
Germany	1000521	1000000
Croatia	0	700
Austria	74829	72500
Poland	2364	1980
Switzerland	3582	1900
France	48339	48100
Belgium	18867	18437
Netherland	24873	24850
Sweden	99258	97881
UK	34470	31000
Hungary	1599	1105

Next, l will give you some suggestion and reason for it. First, you should let Greece give more capacity and open more entry points inoder to enable more refugees to enter Europe. Second, you should preposition some resources for some countries that accept refugee in the early time inorder to prevent refugees from hunger.Last bu not least, Country should make resources trade espically food trade with each other, this one is very important and effective because it will be more fair for all the countries to solve the refugee problem but not to throw all refugees on Germany.

Best wishes!