Process Book

COS30045: Data Visualisation

Ukrainian Refugees During Russian Invasion

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https://mercury.swin.edu.au/cos30045/s104177995/Project/index.html

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1. Introduction

1.1. Background and Motivation

Due to the inception of war between Russia and Ukraine in 2014, this staggering conflict has caused widespread instability and human misery. The war, which began because of geopolitical tensions and Russia's annexation of Crimea, has grown into a long and costly struggle. It has detrimentally influenced the economic growth of several nations around the world. The conflict, marked by armed confrontations, political turmoil, and humanitarian crises, has pushed millions of Ukrainians to evacuate their homes in search of safety and shelter. This massive relocation has been a focal point of world attention, emphasizing the critical need for humanitarian aid and political settlement. Understanding the intricacies and consequences of this war is critical for tackling the serious issue of migration from Ukraine and devising effective methods to serve displaced populations while also promoting regional peace and stability. Thus, this report aims to investigate the issue of migration of Ukrainians influenced by the antipathy with Russia, which could assist in providing valuable insights and develop future strategies illuminating the multifaceted factors driving migration patterns.

Our team has undertaken the task of developing visual representations concerning the migration dynamics observed among Ukrainians. This visualisation, by providing a thorough and analytical picture of migration trends, can help to promote the awareness of individuals and create a greater understanding of the unique experiences and contributions of Ukrainian migrants to Western cultures.

1.2. Project Objectives

This data visualisation enables users to have comprehensive insights and perspectives about the issue of Ukrainians migrating to European countries. Some questions related to this problem could be:

- Where did refugees fleeing Ukraine mostly come?
- What are the overall trends in migration of Ukrainians to European countries from 2022 to 2023?
- Compare migrants after the conflict between Russia and Ukraine, hence we could figure out the migration patterns among Ukrainians.

After delving into this visualisation and investigating a relevant data source, some advantages that users can be offered include:

- Creating a more appealing approach to show complicated migration statistics.

- Understanding Migration Patterns: Users may learn about the movement of Ukrainian refugees throughout European countries, including trends in migration quantities, destinations, and routes. This insight enables stakeholders, such as policymakers, scholars, and humanitarian groups, to better understand the dynamics of Ukrainian migration and its motivations.

- Raise public awareness: Visualisation can gain more understanding of the scope and severity of the refugee situation, promoting empathy and support for Ukrainian refugees. Visualisation may engage a larger audience by presenting facts in a simple and engaging manner, encouraging people to contribute to relief efforts or fight for refugee rights.

- Monitoring Changes Over Time: By observing changes in migration patterns over time, users may follow the conflict's influence on Ukrainian migration. This involves tracking fluctuations in migration volumes, changes in destination nations, and patterns in return migration or resettlement.

- Decision-making: Policymakers and government officials may utilize the graphical data to make evidence-based choices on refugee support programs, budget allocation, and policy development. They can identify regions of need, allocate resources efficiently, and alter policy in response to shifting migratory trends.

- Research and Analysis: Visualized data allows researchers and academics to undertake in-depth analysis of migratory patterns, demographic trends, and the impact of temporary protective measures. Visualisations are useful tools for investigating complicated linkages and gaining fresh insights into the dynamics of forced displacement and protection.

1.3. Project Schedule

- Week 1 – 3: We begin the project work by gathering some topic materials and creating some online meeting channels such as Discord and a GitHub project for our team.

- Week 4: Investigate some research, publications, or articles, then determine which country we will choose to deeply discover about the migration issue.

- Week 5 – 6: Finding data sources related to the chosen field, then deciding what kinds of data our team plans to use and figuring out some ideas for designing charts, referring to efficient designing methods of experts.

- Week 7: Start coding the HTML page and some CSS to decorate the website, and make a sketch of some visualisation designs.

- Week 8 – 10: Focusing mainly on creating charts using D3.js, and aiming to create some useful JavaScript functions for each map.

- Week 11: Rechecking some JavaScript functions to ensure that they will work properly, adding more CSS to make the website more beautiful.

- Week 12: Finalizing the project including checking some bugs or errors in the website, discussing with the tutor what functions we should improve, and finally submitting the assignment to Canvas.

2. Data

2.1. Data Source

The project draws its data from Eurostat, a trusted statistical platform offering detailed information on beneficiaries of temporary protection on a monthly basis in the European Union.

Figure 1: Beneficiaries of temporary protection at the end of the month

Data extracted on 01/03/2024 11:43:27 from [ESTAT]
Dataset: **Beneficiaries of temporary protection at the end of the month by citizenship, age and sex - monthly data [migr_asytpsm__custom_10172157]**
Last updated: 28/02/2024 23:00

Time frequency	Monthly
Unit of measure	Person
Country of citizenship	Extra-EU27 (from 2020)
Sex	Total
Age class	Total

TIME	2022-03	2022-04	2022-05	2022-06	2022-07	2022-08	2022-09	2022-10	2022-11	2022-12	2023-01	2023-02	2023-03	2023-04	2023-05	2023-06	2023-07	2023-08	2023-09	2023-10	2023-11	2023-12	2024-01
GEO (Labels)																							
European Union	:	:	:	:	:	3,668,615	3,895,725	3,670,420	3,719,525	3,825,500	3,918,510	4,004,165	3,910,400	3,961,375	4,018,725	4,067,250	4,113,050	4,154,245	4,186,165	4,238,010	4,278,485	4,312,150	:
Belgium	26,495	37,520	44,795	49,120	52,300	55,405	57,580	56,545	61,475	63,210	62,520	63,610	64,550	65,420	66,450	67,655	68,680	70,065	71,350	72,670	73,705	74,600	75,760
Bulgaria	30,695	92,405	112,355	119,305	125,795	130,290	134,790	142,050	144,890	147,385	149,790	151,590	153,545	155,000	157,645	160,690	162,980	164,880	166,535	168,300	169,845	170,970	172,275
Czechia	250,225	314,935	352,870	373,150	388,035	398,440	408,550	419,760	424,955	432,415	440,870	447,830	325,245	331,850	340,090	349,140	357,540	365,085	357,960	364,450	369,330	373,035	381,190
Denmark	1,220	10,430	20,710	25,245	26,425	27,930	29,770	29,835	30,680	32,155	32,915	33,865	34,830	34,920	35,340	35,640	35,945	36,880	37,440	35,740	36,065	36,265	:
Germany	:	:	:	:	:	699,870	813,725	873,860	931,545	967,715	1,004,965	1,034,630	1,067,755	1,090,235	1,111,590	1,133,420	1,153,865	1,175,695	1,194,900	1,215,365	1,235,960	1,251,245	1,270,150
Estonia	13,810	22,295	25,865	28,015	29,730	32,045	34,025	36,000	37,455	38,385	39,085	39,815	37,020	35,135	35,105	35,215	35,425	35,780	35,820	35,855	35,885	35,945	35,720
Ireland	13,115	25,210	33,185	40,100	45,830	49,815	54,660	60,700	64,800	69,370	72,010	75,065	78,230	80,080	82,755	85,790	89,090	91,210	94,085	97,315	99,415	101,490	102,800
Greece	0	8,880	14,765	16,750	18,050	19,080	19,780	20,415	21,025	21,530	21,985	22,280	22,705	23,310	23,645	24,580	25,335	25,735	26,095	26,435	26,675	26,850	27,100
Spain	32,980	83,060	115,775	127,235	133,690	139,970	145,825	150,980	156,300	160,995	165,415	168,970	172,660	175,185	178,035	180,235	182,615	184,830	187,205	189,945	192,665	194,920	197,750
France	27,525	51,255	59,690	64,815	68,570	72,180	67,515	65,910	67,035	68,430	69,645	69,890	67,745	66,760	66,590	67,280	67,350	66,930	64,775	65,300	65,175	64,930	:
Croatia	4,650	10,355	13,000	14,755	16,045	16,810	17,475	17,900	18,410	18,970	19,390	19,925	19,915	20,400	21,025	21,635	22,005	22,325	22,485	22,700	22,900	23,040	:
Italy	0	17,270	54,145	80,265	99,485	116,065	127,970	136,095	143,195	145,800	146,520	148,060	155,490	156,065	158,330	160,110	160,435	159,885	161,220	161,660	161,500	161,375	:
Cyprus	670	3,435	6,640	8,805	9,620	10,290	11,070	11,630	12,250	12,610	13,560	14,610	15,275	15,980	16,710	17,055	17,275	17,915	18,360	18,635	19,080	19,270	:
Latvia	11,165	19,805	24,510	27,290	28,910	30,270	31,830	33,080	35,005	35,865	36,235	36,745	35,985	39,685	42,245	44,260	42,500	42,840	43,035	43,330	43,565	43,815	44,135
Lithuania	3,160	28,185	45,430	49,210	52,880	56,910	59,800	62,385	64,280	65,425	66,455	66,960	67,775	68,735	69,875	70,650	71,395	72,225	72,810	73,715	74,450	74,955	75,350
Luxembourg	950	2,650	3,725	4,040	4,205	4,260	4,380	4,470	4,535	4,655	4,685	4,665	4,065	4,065	4,075	4,085	4,105	4,190	4,180	4,190	4,175	4,230	4,220
Hungary	:	:	14,085	20,985	23,730	25,470	26,440	27,605	28,585	28,905	29,555	29,975	30,585	30,960	31,480	31,855	32,260	32,750	33,060	33,325	33,720	33,880	34,250
Malta	190	585	995	1,175	1,240	1,300	1,370	1,435	1,465	1,515	1,570	1,625	1,665	1,715	1,755	1,770	1,825	1,850	1,885	1,935	1,955	1,965	1,985
Netherlands	25,430	53,785	66,735	76,265	83,985	91,295	96,215	101,690	106,355	109,640	113,205	116,125	118,695	120,690	122,950	125,790	129,305	131,940	135,625	139,630	143,615	145,620	147,920
Austria	:	:	:	:	74,770	77,910	80,755	83,355	85,445	87,570	88,690	85,655	71,515	72,900	74,220	75,775	77,065	78,345	79,790	81,295	82,610	83,405	83,560
Poland	677,110	1,049,510	1,145,665	1,205,785	1,262,080	1,330,075	1,370,625	1,016,685	944,360	961,340	974,060	993,755	999,735	995,035	991,375	977,740	971,080	960,550	958,655	960,620	955,110	954,795	951,560
Portugal	25,040	34,080	39,320	45,485	48,215	50,605	52,180	53,720	55,020	55,920	56,925	57,865	57,895	55,375	54,905	55,425	56,035	56,710	57,230	57,975	58,360	58,820	:
Romania	2,030	13,040	33,670	44,135	51,425	61,095	70,700	78,965	89,710	100,955	109,845	117,395	124,035	127,355	131,180	133,545	135,485	137,850	140,585	142,340	144,295	145,850	:
Slovenia	860	3,850	5,235	5,715	6,230	6,655	6,985	7,170	7,420	7,675	7,885	8,030	8,210	8,365	8,505	8,620	8,750	8,870	8,465	8,625	8,710	8,765	:
Slovakia	:	72,035	77,005	80,470	83,520	86,965	89,930	92,275	93,905	95,550	96,610	97,980	99,525	100,660	102,050	103,960	105,690	107,630	109,530	111,615	113,110	114,225	116,005
Finland	2,805	15,110	22,715	28,360	32,660	36,060	38,745	41,415	43,395	45,215	46,810	48,905	51,030	52,145	53,875	56,145	58,765	60,100	61,165	62,515	63,485	64,185	64,950
Sweden	18,160	30,025	34,635	36,785	39,305	41,555	43,035	44,485	46,045	46,295	47,310	48,355	24,720	33,360	36,930	39,190	40,250	41,175	41,915	42,530	43,125	43,705	44,390
Iceland	260	825	1,050	1,240	1,375	1,515	1,710	1,935	2,110	2,315	2,485	2,635	2,775	2,870	2,995	3,085	3,230	3,325	3,470	3,615	3,760	3,875	3,975
Liechtenstein	55	175	195	235	250	270	295	330	340	385	410	435	445	450	455	480	515	520	530	540	565	570	:
Norway	2,245	9,020	14,625	17,585	18,860	23,055	26,390	29,080	31,200	33,540	35,705	38,620	41,530	43,385	45,235	47,200	49,785	52,605	56,455	60,980	65,160	66,940	68,145
Switzerland	15,095	38,130	51,620	55,945	57,265	58,790	59,970	60,585	61,535	62,800	63,945	65,110	65,730	65,615	65,475	65,170	64,895	65,385	65,725	66,125	66,110	:	:

Special value
: not available

This dataset encompasses the statistics of non-EU citizens, who had fled Ukraine as a consequence of the Russian invasion in 2022, and were under temporary protection in the EU in the time period from 2022 to 2023. The provided table provides a peek into the table layout, yet it merely displays

a segment of the entire dataset. Upon the acquisition of this data, a pivotal phase involves an exhaustive data cleaning process, designed to ensure the accuracy and reliability of the dataset. Rigorous measures are taken to address inconsistencies, rectify missing values, and eliminate redundant labels such as GEO (Labels), age class, sex, and so on. This meticulous cleaning process is vital in preparing the dataset for in-depth analysis, with particular attention given to handling ambiguous or missing entries. These efforts are undertaken with the overarching goal of preserving the integrity of the information and creating a solid foundation for subsequent visualisation.

2.2. Data Processing

To eliminate unnecessary data and align the details with the project's specifications, the tables must be properly cleaned. This guarantees that tables are optimized for optimal coding and data processing. According to Bhandari (2022), standardizing nation names across all tables is an important step in the cleaning process, as it allows for easier and more uniform coding. The records are simplified to retrieve the original values while ensuring data correctness. The appropriate time, country, and refugee numbers are kept to provide context and ease of analysis while maintaining the dataset's original structure.

Figure 2 depicts the necessary processes for cleaning up the initial table in order to assure data consistency and correctness. First, we needed to eliminate the GEO (Labels) and European Union rows, which included useless information and did not contribute to the total dataset. Furthermore, we noticed the significance of matching the nation names to the world_polygons JSON document that we were utilizing. Consistency in nation names allowed us to precisely match and integrate data from both files, making it easier to code. Not to mention, we also replaced the ":" which stands for not available value in the dataset to "0", therefore making it easier to calculate the value to display on the webpage.

country	2022-03	2022-04	2022-05	2022-06	2022-07	2022-08	2022-09	2022-10	2022-11	2022-12	2023-01	2023-02	2023-03	2023-04	2023-05	2023-06	2023-07	2023-08	2023-09	2023-10	2023-11	2023-12	2024-01
Belgium	26495	37520	44795	49120	52300	55405	57580	56545	61475	63210	62520	63610	64550	65420	66450	67655	68680	70065	71350	72670	73705	74600	75760
Bulgaria	30695	92405	112355	119305	125795	130290	134790	142050	144890	147385	149790	151590	153545	155000	157645	160690	162980	164880	166535	168300	169845	170970	172275
Czechia	250225	314935	352870	373150	388035	398440	408550	419760	424955	432415	440870	447830	325245	331850	340090	349140	357540	365085	357960	364450	369330	373035	381190
Denmark	1220	10430	20710	25245	26425	27930	29770	29835	30680	32155	32915	33865	34830	34920	35340	35640	35945	36880	37440	35740	36065	36265	0
Germany	0	0	0	0	0	699870	813725	873860	931545	967715	1004965	1034630	1067755	1090235	1111590	1133420	1153865	1175695	1194900	1215365	1235960	1251245	1270150
Estonia	13810	22295	25865	28015	29730	32045	34025	36000	37455	38385	39085	39815	37020	35135	35105	35215	35425	35780	35820	35855	35885	35945	35720
Ireland	13115	25210	33185	40100	45830	49815	54660	60700	64800	69370	72010	75065	78230	80080	82755	85790	89090	91210	94085	97315	99415	101490	102800
Greece	0	8880	14765	16750	18050	19080	19780	20415	21025	21530	21985	22280	22705	23310	23645	24580	25335	25735	26095	26435	26675	26850	27100
Spain	32980	83060	115775	127235	133690	139970	145825	150980	156300	160995	165415	168970	172660	175185	178035	180235	182615	184830	187205	189945	192665	194920	197750
France	27525	51255	59690	64815	68570	72180	67515	65910	67035	68430	69645	69890	67745	66760	66590	67280	67350	66930	64775	65300	65175	64930	0
Croatia	4650	10355	13000	14755	16045	16810	17475	17900	18410	18970	19390	19925	19915	20400	21025	21635	22005	22325	22485	22700	22900	23040	0
Italy	0	17270	54145	80265	99485	116065	127970	136095	143195	145800	146520	148060	155490	156065	158330	160110	160435	159885	161220	161660	161500	161375	0
Cyprus	670	3435	6640	8805	9620	10290	11070	11630	12250	12610	13560	14610	15275	15980	16710	17055	17275	17915	18360	18635	19080	19270	0
Latvia	11165	19805	24510	27290	28910	30270	31830	33080	35005	35865	36235	36745	35985	39685	42245	44260	42500	42840	43035	43330	43565	43815	44135
Lithuania	3160	28185	45430	49210	52880	56910	59800	62385	64280	65425	66455	66960	67775	68735	69875	70650	71395	72225	72810	73715	74450	74955	75350
Luxembou	950	2650	3725	4040	4205	4260	4380	4470	4535	4655	4685	4665	4065	4065	4075	4085	4105	4190	4180	4190	4175	4230	4220
Hungary	0	0	14085	20985	23730	25470	26440	27605	28585	28905	29555	29975	30585	30960	31480	31855	32260	32750	33060	33325	33720	33880	34250
Malta	190	585	995	1175	1240	1300	1370	1435	1465	1515	1570	1625	1665	1715	1755	1770	1825	1850	1885	1935	1955	1965	1985
Netherlan	25430	53785	66735	76265	83985	91295	96215	101690	106355	109640	113205	116125	118695	120690	122950	125790	129305	131940	135625	139630	143615	145620	147920
Austria	0	0	0	0	74770	77910	80755	83355	85445	87570	88690	85655	71515	72900	74220	75775	77065	78345	79790	81295	82610	83405	83560
Poland	677110	1049510	1145665	1205785	1262080	1330075	1370625	1016685	944360	961340	974060	993755	999735	995035	991375	977740	971080	960550	958655	960620	955110	954795	951560
Portugal	25040	34080	39320	45485	48215	50605	52180	53720	55020	55920	56925	57865	57895	55375	54905	55425	56035	56710	57230	57975	58360	58820	0
Romania	2030	13040	33670	44135	51425	61095	70700	78965	89710	100955	109845	117395	124035	127355	131180	133545	135485	137850	140585	142340	144295	145850	0
Slovenia	860	3850	5235	5715	6230	6655	6985	7170	7420	7675	7885	8030	8210	8365	8505	8620	8750	8870	8465	8625	8710	8765	0
Slovakia	0	72035	77005	80470	83520	86965	89930	92275	93905	95550	96610	97980	99525	100660	102050	103960	105690	107630	109530	111615	113110	114225	116005
Finland	2805	15110	22715	28360	32660	36060	38745	41415	43395	45215	46810	48905	51030	52145	53875	56145	58765	60100	61165	62515	63485	64185	64950
Sweden	18160	30025	34635	36785	39305	41555	43035	44485	46045	46295	47310	48355	24720	33360	36930	39190	40250	41175	41915	42530	43125	43705	44390
Iceland	260	825	1050	1240	1375	1515	1710	1935	2110	2315	2485	2635	2775	2870	2995	3085	3230	3325	3470	3615	3760	3875	3975
Liechtenst	55	175	195	235	250	270	295	330	340	385	410	435	445	450	455	480	515	520	530	540	565	570	0
Norway	2245	9020	14625	17585	18860	23055	26390	29080	31200	33540	35705	38620	41530	43385	45235	47200	49785	52605	56455	60980	65160	66940	68145
Switzerlan	15095	38130	51620	55945	57265	58790	59970	60585	61535	62800	63945	65110	65730	65615	65475	65170	64895	65385	65725	66125	66110	0	0

Figure 2: Ukrainian Refugees to EU nations from 2022 to 2024

3. Requirements

3.1. Must have features

- **A choropleth map of the EU with selected countries**

The site efficiently integrated a choropleth map of the European Union, that enabled smooth user interaction via nation selection. When users choose a country, they are effortlessly directed to a relevant line chart presenting relevant data. Additionally, when hovering over a specific nation, users can observe the number of Ukrainian emigrants to that country, represented by a corresponding color. This functionality was carried out precisely as envisioned.

- **A line graph for Ukrainian refugees by nation**

Moreover, the web page featured a separate line chart tracking the transit of Ukrainian migrants to the destination country. This graph provided valuable information on the flow of Ukrainian emigrants to various nations across different time periods. Users were able to communicate with the graph, thoroughly examine particular data points, and gain a thorough understanding of

migration trends. The effective integration of these several visual representations enabled users to go into and thoroughly study migration data.

3.2 Optional features

- **Line chart transition effect**

The line chart now features an effortless transition effect. When users pick a value, a data point dot appears initially, followed by a connecting line that elegantly connects it to the other data points. This transition effect improves the graphical display of the data, providing viewers with a smooth and appealing experience.

- **Choropleth map transition and animation effect**

When filtering or updating the data, the choropleth map that depicts Ukrainian refugees in EU countries uses minimal animations and transitions. When viewers modify the time slider, the map's values and colors refresh seamlessly. These movements not merely bring about a visually beautiful impact, but also improve the user behavior during their visits to the visualisation.

4. Visualisation design

4.1 Design Ideas

In this final assignment, our team has chosen two separate visualisation methods: a choropleth map to illustrate the distribution of Ukrainian refugees throughout European states, and a line chart to demonstrate how the total number of Ukrainian migrants in each European nation has changed over time from Quarter 2, 2022 to Quarter 4, 2023.

- **Choropleth map**

Creating a choropleth map to reveal Ukrainian migrants' migratory patterns across European nations requires a comprehensive methodology. Initially, data gathering would be critical, with information sourced from reputable international organizations, and governmental agencies to get accurate and comprehensive statistics on refugee intake.

Delineating geographical borders, such as administrative areas or nations, would thus make it easier to describe refugee movements spatially. To ensure that the map successfully communicates relevant information without overwhelming the viewer, acceptable variables to display on the map, such as the number of refugees, their destinations, and demographic features, must be carefully selected.

Our preference is to create animations in which, when hovered over, a certain nation is emphasized with pronounced geographical demarcations and textual information indicating the number of Ukrainian refugees residing within that nation.

Furthermore, our team created a slider bar function to help display the number of Ukrainian refugees that have changed in each quarter from 2022 to 2023 and also the average amount of migrants in a specific period of time, improving the accessibility and navigability of the information displayed.

A sketch design:

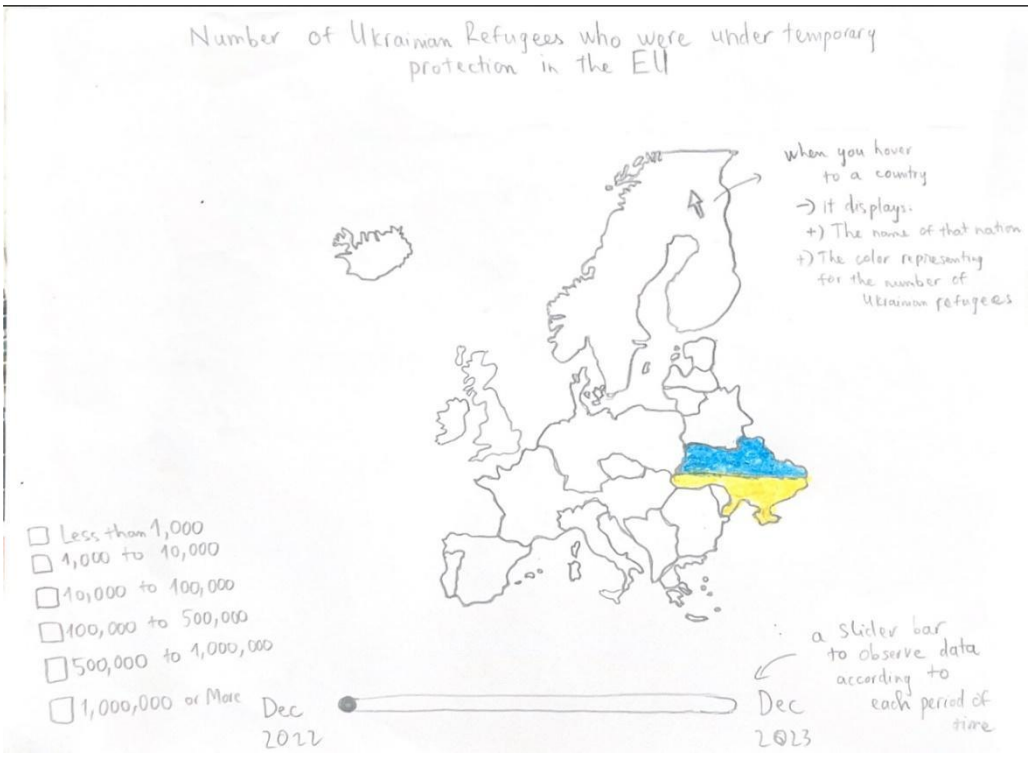


Figure 3: Sketch design of choropleth map

- **Line chart**

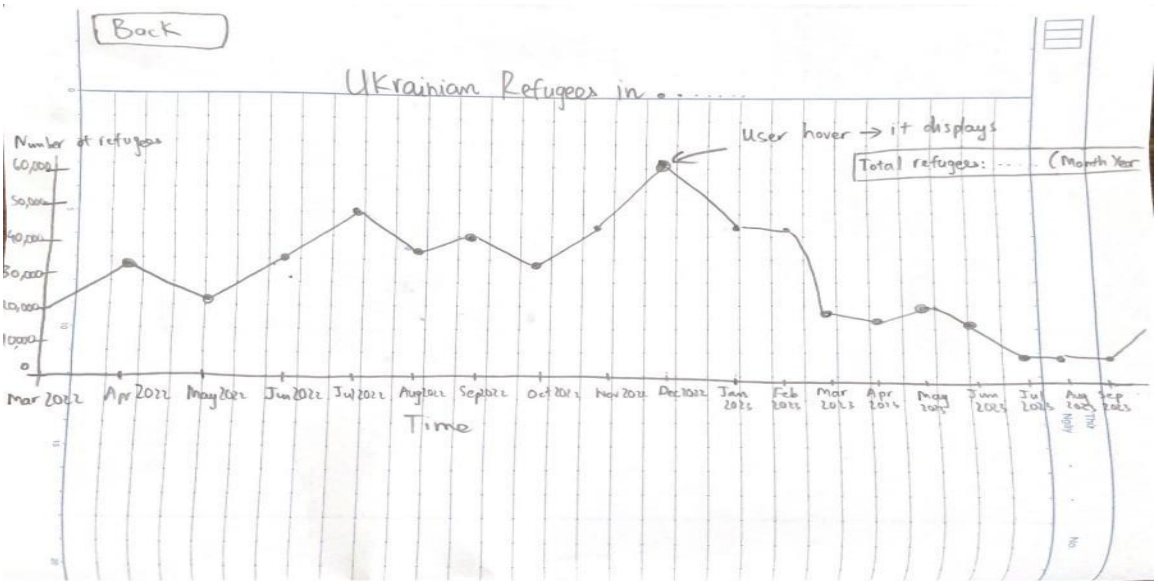
Several factors must be considered while developing the idea of using a line chart to show the chronological history of the overall number of Ukrainian migrants in all European countries.

Initially, a complete dataset covering various time periods would be required, obtained from credible international organizations, governmental bodies, or humanitarian groups. Subsequently, dividing the temporal axis into meaningful periods, such as months or years, would make it easier to display trends and variations throughout time. Choosing relevant variables, such as the overall

number of refugees or the rate of movement, is critical for successfully communicating the dynamics of the refugee crisis.

A sketch design:

Figure 4: Sketch design of line chart



4.2 Initial progress

During the iterative rounds of the design process, our team focused on refining different features and enhancing functions in both representations. While great progress has been achieved in increasing overall efficacy and user experience, several aspects of the visualisations remain work in progress, requiring more development and fine-tuning to attain maximum performance and clarity in delivering the desired information.

- **Choropleth map**

Within our visualisation framework, we successfully added tooltips to represent the names of nations as well as the relative numbers of Ukrainian refugees.

Furthermore, a draggable bar feature has been smoothly integrated to allow for the depiction of migrant numbers over many time periods. Moreover, the drag bar functionality not only enhances user control and interactivity but also serves as a conduit for analytical insights. By utilizing the drag bar, users can effectively discern the average number of refugees within a specific period, thereby fostering a more nuanced understanding of migration patterns and temporal fluctuations.

This multifaceted capability not only enriches the user experience but also elevates the utility of our visualisation as a tool for in-depth analysis and informed decision-making regarding refugee dynamics in Europe.

In addition, a distinct color pattern has been devised to properly reflect the varied magnitudes of refugee numbers, improving the visual clarity and interpretability of the displayed data.

Final design:

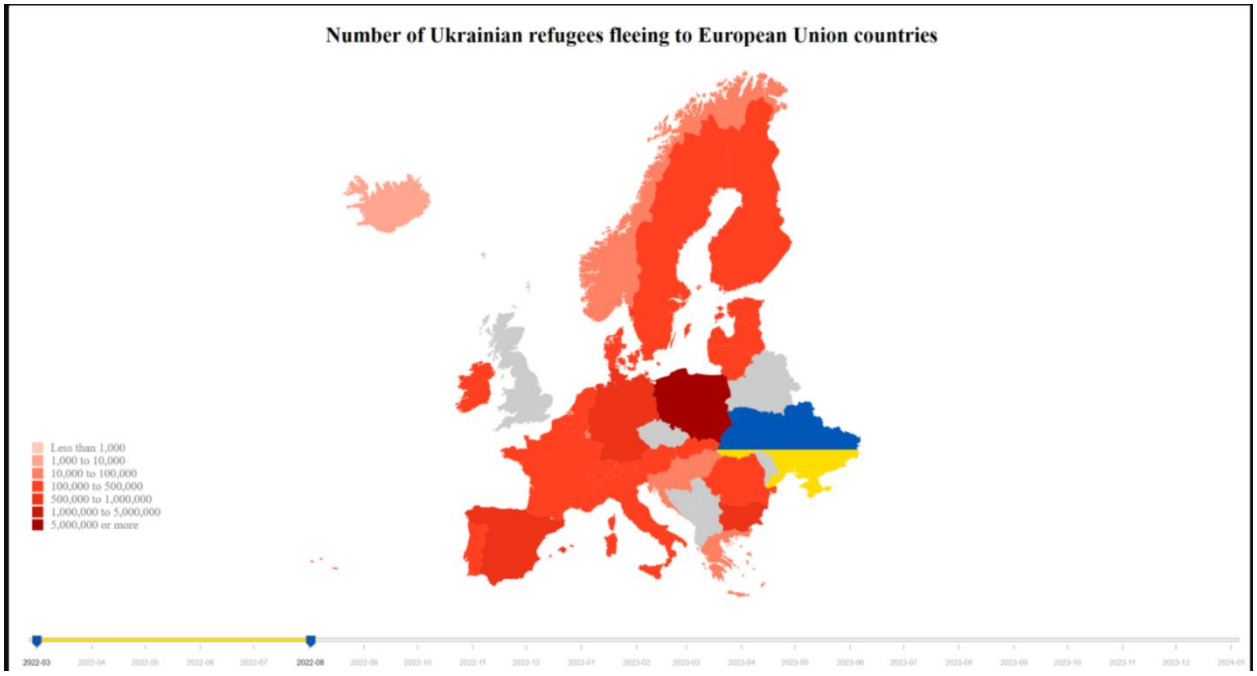


Figure 5: Complete design of choropleth map

- **Line chart**

Early in the study project, our group made great progress in creating a line graph that would show the variations in the number of Ukrainian refugees in different European countries.

We have made some progress in the design phase, sketching the basic framework of the chart. Furthermore, we have completely included dynamic elements, such as interactive animations along the line route to improve user engagement and comprehension. These animations use discrete data points represented by dots, each of which represents the number of refugees in a certain nation over a specified time.

In addition, we have included a tooltip capability to give consumers full information. When a user hovers over a data point, a tooltip emerges, providing extensive information on the matching refugee count, month, and year. Our visualisation modifications seek to provide an intuitive and informative user experience, allowing for a better comprehension of the growing migration dynamics in Europe.

Final design:

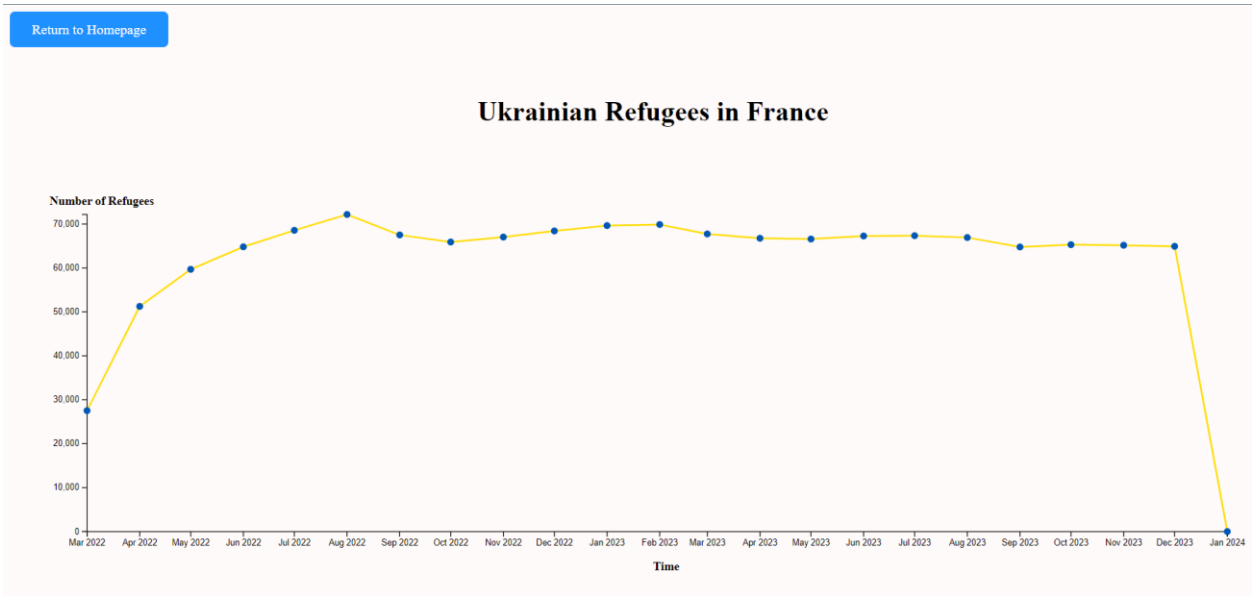


Figure 6: Complete design of line chart

4.3 Intention of Choosing Visualisation Types

- **Choropleth map**

According to a blog by Laura Short published on September 22, 2021, it was demonstrated that choropleth maps utilize color to depict how data varies from one location to another. These maps enable us to display geographic information while also comparing and analyzing data from several areas. Choropleths let readers perceive tales in statistics, such as using data to tell a story about a student competition or analyzing voting trends to gain insights into the political environment.

- Geographical context: Choropleth maps give geographic context, helping users to rapidly grasp the spatial distribution of Ukrainian migrants across Europe. This spatial viewpoint is critical for understanding migration patterns and trends within and between nations.
- Data aggregation: Choropleth maps allow users to aggregate data at the regional or country level, making it easier to view enormous datasets and discover broad movement trends. Choropleth maps, which use color gradients or shades to display data, may efficiently show changes in migrant populations across areas.
- Comparative analysis: Choropleth maps provide a comparative study by graphically contrasting the intensity of migration between European nations. The map's different hues or colors can emphasize locations with high or low numbers of Ukrainian migrants, allowing users to see trends and inequalities across regions.
- Decision-making assistance: Choropleth maps may help policymakers and stakeholders make decisions by offering useful insights about the spatial distribution of Ukrainian migrants throughout Europe, as well as the total number of refugees in some countries using

the tooltip function. This data can help influence policy creation, resource allocation, and intervention initiatives focused on meeting the needs of migratory populations in various locations.

- **Line chart**

As mentioned in a blog from Tableau which instructs how to use line charts effectively, it depicts that line charts may be quite useful for tracking the behavior of data over a specific length of time. The audience will observe changes in the data, which are shown with a line linking each data point as it changes over time. Besides, the line chart makes it easier to track behavior in a group of data. These charts are valuable for more than just monitoring changes over time. They can also assist users in identifying discrepancies and connections between data points in the dataset.

- Time-series data: Using a line chart is appropriate for displaying time-series data, with the x-axis typically representing time (e.g., months, years) and the y-axis representing the number of Ukrainian refugees.
- Identifying patterns: One of our team's objectives is to create a line chart to observe how the number of Ukrainian refugees in European countries has changed over time. Thus, this type of visualisation provides a clear and concise visualisation of data, making it easy for audiences to understand and interpret trends in Ukrainian refugee numbers over time.
- Highlighting outliers: The usage of drawing line charts can showcase outliers or extraordinary occurrences, such as abrupt surges or drops in refugee numbers, which may reflect crises or policy changes influencing migration patterns.

5. Conclusion

In summary, the process of creating our website to showcase the movement of Ukrainian refugees during the Russian invasion was a remarkable experience. Our objective was to establish an interactive platform that effectively presents the trends and patterns of Ukrainian emigration, with a specific focus on EU nations.

One of the pivotal features we implemented was a map of European Union nations. Users have the ability to explore the preferred locations of the refugees and select different time periods to observe the migratory movement. By hovering over each nation, users can access information about the number of refugees, providing them with a deeper understanding of the devastating impact of the war on local communities.

In addition, we incorporated a line graph to illustrate the influx of Ukrainian emigration to European Union nations, categorized by country. This graph enabled users to identify trends and changes over time, facilitating the analysis and comparison of migration patterns across different regions. Our aim was to present the data in a straightforward and comprehensible manner, offering valuable insights into the migration trends of the country.

Throughout the project, we encountered problems and made innovative choices to enhance user engagement and effectively convey the information. To foster engagement, we integrated features such as animations, dynamic elements, and tooltips. Furthermore, the implementation of various visual approaches, such as connecting lines and color gradient, effectively conveyed details and aided in data comprehension.

In conclusion, this project provided us with practical experience in designing and implementing data visualisation. We gained a deeper understanding of data preparation, design processes, visual

techniques, user interaction, and the importance of striking a balance between elegance and utility. These lessons will prove invaluable for future endeavors that involve data visualisation, enabling us to effectively present our findings and create engaging data-driven narratives.

6. References

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