Data Analysis of Coronavirus CoVID-19: Study of Spread and Vaccination in European Countries

Hela Turki and Kais Khrouf
hnalturki@ju.edu.sa, kmkhrouf@ju.edu.sa
Jouf University, Airport Road, Al Jouf, Saudi Arabia

Summary
Humanity has gone since a long time through several pandemics; we cite H1N1 in 2009 and also Spanish flu in 1917. In December 2019, the health authorities of China detected unexplained cases of pneumonia. The WHO (World Health Organization) has declared the apparition of Covid-19 (novel Coronavirus). In data analysis, multiple approaches and diverse techniques were used to extract useful information from multiple heterogeneous sources and to discover knowledge and new information for decision-making. In this paper, we propose a multidimensional model for analyzing the Coronavirus Covid-19 data (spread and vaccination in European countries).
Keywords:
Multidimensional Model, Constellation Schema, Coronavirus Covid-19, Vaccination, European Countries.

1. Introduction

Since December 2019, the new cases of pneumonia were detected in Wuhan City (Hubei Province of China). This novel virus caused the new infectious respiratory disease, called Covid-19 by the World Health Organization (WHO) [10]. (Pandemic in 2020 with millions of deaths around the world). The fight against this global pandemic is causing cancellations of sporting and cultural events, the implementation of containment measures and the closure of the borders by many countries, etc. It also has effects in terms of social and economic instability.

In order to slow the contagion of this new virus, several studies were proposed in the literature, especially about the spread of the Coronavirus; statistics are announced every day by the countries and databases have been established to store this data. In this paper, we propose to use the Multidimensional Analysis techniques in order to analyze the spread of Coronavirus Covid-19 and the evolution of vaccination in European Countries. This technique allows decision makers to observe data from various sources and analyze them according to several viewpoints. A multidimensional model is composed into two concepts: Dimension and Fact. Dimensions contain a set of unique values in order to categorize a particular theme (Countries, Dates, etc.). Fact is a subject of analysis and it is described by a set of measures.

This paper is organized as follows. Section 2 presents the literature review for spreading of Coronavirus Covid-19. Then, we present the phase of data preparation (Extraction, Cleaning, Transformation and Loading of Data). In section 4, we propose a data warehouse schema for storing the prepared data. The next section describes the multidimensional model we propose for analyzing the spread and the vaccination of Coronavirus Covid-19 data. Finally, we present the phase of implementation for European countries.

2. Literature Review

Since the appearance of the Coronavirus Covid-19, several studies have focused on the spread of the virus (Medical or Data Analysis aspects).

The objective of [1] is to examine the correlation between pollution and climate data and the Covid-19 pandemic. They propose a data warehouse and data cubes built on data from the regions of Lombardy and Puglia (Italia). Their results show that the Covid-19 pandemic is spreading significantly in regions characterized by the absence of rain and wind.

In [2], the authors study the relationship between new cases of Coronavirus Covid-19 and the Multidimensional Poverty Index (MPI) in the city of Manizales (Colombia). The results of the exploration indicate that in the communes of greater poverty the density of cases per Covid-19 is greater; the relation exists between these two parameters.

Internet of Things (IoT) is an interconnection of Internet and physical devices. These devices are record, monitor and respond. The use of IoT with smart sensors to measure and record the body temperature of individuals can help to identify the infected and to maintain social distance. The authors of [3] propose an IoT architecture in order to minimize the spreading of Covid-19.

In [4], the authors study the evolution of cases and deaths

Manuscript received January 5, 2024
Manuscript revised January 20, 2024
https://doi.org/10.22937/IJCSNS.2024.24.1.18

of Covid-19 compared to the population of Brazilian cities. The results show that in the short term small towns are proportionately more affected by Covid-19 during the initial spread of the disease. In the long term, large cities begin to have a higher incidence of cases and deaths.
The authors of [5] propose an interactive visualization using the concept of Tableau [6] for analyzing data of Covid-19. A Tableau is used to show the personalized and the most important data (dashboards and worksheets). They consider that data analysis can be very fast with Tableau and Visualizations (several visualizations in a single view).

The author of [7] presents a data analysis of Covid-19 in cities of China, by using datasets. He uses a correlation matrix for the phase of data preparation (to summarize data). He uses Python libraries Matplotlib and Seaborn for visualizing data.

In this paper, we propose a multidimensional model based on Constellation Model in order to study the spread of Coronavirus Covid-19 in European countries and the evolution of vaccination, according to several dimensions. The first stage concerns the data preparation (presented in next section).

3. Data Preparation

Data preparation is the process of several steps (gathering, combining and structuring data) in order to analyze them in business intelligence and data visualization applications. Fig.1 presents the process we propose for data preparation: Data extraction, Data cleaning, Data transformation and Data loading.

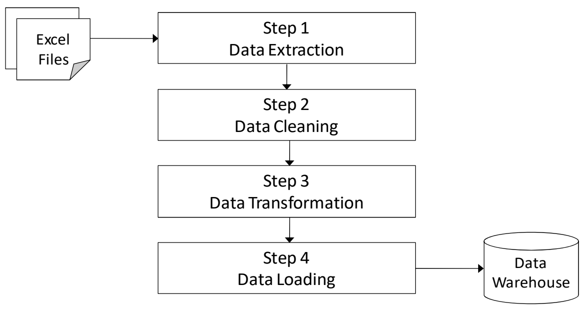


Fig. 1 Data Preparation

First step: Data Collection
Data collection is a systematic process of gathering data from multiple heterogeneous sources. In this paper, the data used was extracted from [11]. The period of analysis is between 01/01/2021 and 30/09/2021. We mainly use the following files:
The first file (cf. Annex 1) concerns data on testing for Covid-19 by week and country and contains the following data: Country name and code, Week of year, Level (national or sub-national), Region code and name, Number of new confirmed cases, Population, Testing rate per 100000 population, Positivity rate and Source.
The second file (cf. Annex 2) concerns data on Covid-19 vaccination and contains the following data: Week of year, Country code, Population denominators for target groups, Number of doses received, Number of first dose vaccine, Number of individuals refusing the first vaccine dose, Number of second dose vaccine, Number of doses where the type of dose was not specified, Region, Target group, Name of vaccine and Population.

Second step: Data Cleaning
Data cleaning is the process of finding errors and removing or modifying data. In this step, we removed unnecessary data:
- Source and Level from the first file.
- Population denominators for target groups and Target group from the second file.
We also add the following data in order to perform analyzes at several levels of granularity:
- Month, Trimester and Year for the week of year.
- Zone for countries: we distinguish four zones: Eastern Europe, Western Europe, Northern Europe and Southern Europe (cf. Table 1).
- Continent: In this study, we focus on Europe.

Table 1: Zones of Europe

Zones	Countries
Eastern Europe	Belarus, Bulgaria, Czech, Hungary Poland, Moldova, Romania, Russia, Slovakia, Ukraine
Western Europe	Austria, Belgium, France, Germany Liechtenstein, Luxembourg, Monaco Netherlands, Switzerland.
Northern Europe	Denmark, Estonia, Finland, Iceland Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom.
Southern Europe	Albania, Andorra, Bosnia & Herzegovina, Croatia, Greece, Italy, Malta, Portugal, Serbia, Slovenia Spain and Macedonia

Third step: Data Transformation
Data transformation is the practice of consolidating data from multiple sources into a data warehouse and converting the extracted data into warehouse format. In this phase, we merged the following data from the two files: Country code, Year of week, Region and Population.

The result after cleaning and merging data is a new file that contains:
- Week of year, Month, Trimester and Year.
- Country Name and Code, Population, Region code and Name.
- Number of new confirmed cases, Testing rate per 100000 population and Positivity rate.
- Number of doses received, Number of first dose vaccine, Number of individuals refusing the first vaccine dose, Number of second dose vaccine, Number of doses where the type of dose was not specified and Name of vaccine.

Four step: Data loading
After data is retrieved, extracted and transformed, it is then loaded into a storage system (a data warehouse); it involves sorting, checking integrity, and building indices and partitions…

After the initial load, the data warehouse needs to be updated by the incremental changes in the data sources.

4. Data Warehousing

Data storage is keeping data in a secure location that the user can easily access. An operational database handles frequent daily changes due to the transactions that take place by the company. However, a data warehouse provides consolidated data in multidimensional form. [8]
A data warehouse is constructed by heterogeneous data from multiple sources in order to support analytical reporting and decision making. Indeed, it focuses on modeling and analysis of data to help decision-makers.
The data in the warehouse must be:
- Subject Oriented: The data warehouse provides information around a subject rather than the company's transactions.
- Integrated: A data warehouse is constructed by integrating heterogeneous data from multiples sources such as databases, files, Internet, etc.
- Non-volatile: New data do not erase the previous data such as operational databases; it does not reflect frequent changes or transactions.
The data warehouse possesses consolidated historical data in order to organize, use and analyze this data to take strategic decisions. The main objective of data warehouses is to transform heterogeneous data into a form suitable for analysis.
In this step, we propose a schema of data warehouse (cf. Fig 2) by using the class diagram of UML (Unified Modeling Language) that contains six classes: Date, Zone, Country, Region, Testing and Vaccine.

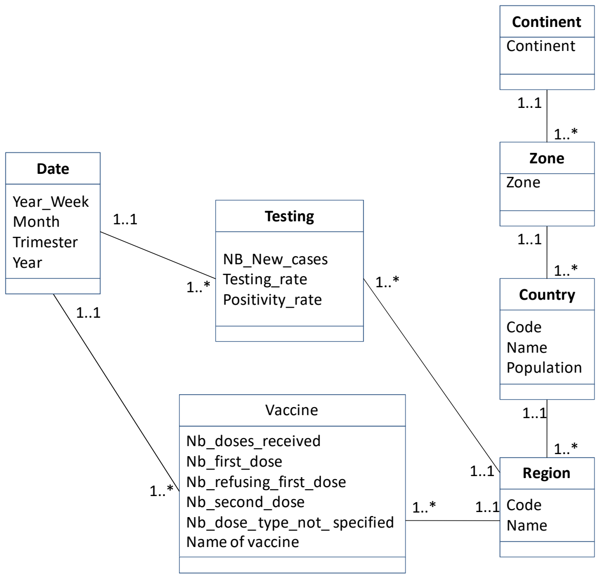


Fig. 2 Data Warehouse for testing and vaccination

5. Data Analysis: Multidimensional Schema

A data warehouses provides Online Analytical Processing (OLAP) tools that presents an interactive analysis of data in a multidimensional view. The results of these OLAP tools are generally Data Cubes, defined by dimensions (described by attributes and hierarchies) and facts (described by measures) [9].
- A *dimension* is a structure that describes a subject in order to help decision-makers answer business questions (Example: product, store, and date).
- An attribute describes a summary level or characteristic of a dimension (Example: Year)
- A *hierarchy* classifies a dimension into several levels of granularity (Example: Date can be decomposed into Date→Month→Year).
- A *fact* presents a subject that models a set of events (Examples: sales, purchases); it has dynamic properties (numeric attributes).
- A *measure* is a numerical property of quantitative aspect that is relevant to analysis (Example: quantity, number_of_customers)
Schema represents a logical description of a database, data warehouse, XML document, etc. If a database generally uses relational model, a data warehouse can use Star, Snowflake or Constellation schemas.

- Star Schema: Each dimension is represented by only one-dimension table and the fact table at the center that contains the keys of all dimensions.
- Snowflake Schema: Some dimension tables are normalized.
- Fact Constellation Schema: It contains multiple fact tables connected by common dimensions.

Table 2: Components of Multidimensional Schema

Concept	Description
Constellation C *C = (F ; D_i)*	*F* is a set of facts. *D_i* is a set of dimensions.
Fact F *F=(NameFct; M_i)*	*NameFct* is the fact name of *F*. *M_i* is a list of measures.
Dimension D_i *Di*=(*$NameDim_i$*; *Att_j*; *$Hierar_k$*)	*$NameDim_i$* is the dimension name. *Att_j* is the list of attributes. *$Hierar_k$* is the list of hierarchies.

The Figure 3 presents the proposed multidimensional model that contains two facts (Testing and Vaccine) surrounded by two dimensions (D_Date, D_Region). D_Date is decomposed into the hierarchy H_1 (Week→ Month → Trimester → Year). D_Region is decomposed into the hierarchy H2 (Region → Country → Zone → Continent).

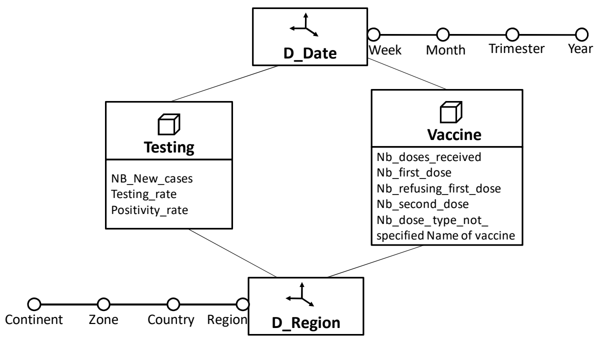


Fig. 3 Multidimensional Schema

6. Implementation and Discussions

The data used for analysis in this paper was extracted from [11]. The analysis period is between 01/01/2021 and 30/09/2021. In this section, we present several examples of multidimensional queries for analyzing data about spreading of Coronavirus Covid-19 and vaccination.

Example 1:

Dimension 1: Zone
Dimension 2: Trimester
Fact: Average (Positivity_rate)

Table 3: Average of Positivity Rate by Zone and Trimester

	T1-2021	T2-2021	T3-2021
Eastern Europe	18,29	9,43	0,71
Northern Europe	3,34	2,00	1,81
Southern Europe	7,73	3,87	4,19
Western Europe	5,29	3,78	2,79

We note that the positivity rate is very high for the zone of Eastern Europe during the first two trimesters of 2021. In order to analyze more this multidimensional table, we propose to apply the Drill-down Operator that fragments data into smaller parts. It can be done by descending from a level to another in the hierarchy. Example: For Dimension 1, we can visualize data by passing from *Zone* to *Country*.

Example 2:

Dimension 1: Country
Dimension 2: Trimester
Fact: Average (Test_Positivity)

Table 4: Average of Positivity Rate by Country and Trimester

	T1-2021	T2-2021	T3-2021
Austria	2,22	0,40	0,18
Belgium	5,74	5,65	3,27
Bulgaria	13,01	8,41	3,04
Croatia	10,34	11,83	1,98
Cyprus	1,13	0,72	0,99
Czechia	11,93	0,94	0,22
Demmark	0,52	0,15	0,41
Estonia	14,93	6,98	4,44
Finland	2,66	1,28	2,46
France	6,68	4,91	3,98
Germany	6,96	6,38	3,88
Greece	3,63	0,87	1,54
Hungary	14,78	8,50	1,10
Iceland	0,38	0,26	1,56
Ireland	7,70	2,45	5,88
Italy	6,90	3,54	2,16
Latvia	6,61	3,54	2,16
Lithuania	8,83	4,35	0,93
Luxembourg	1,92	1,43	1,42
Malta	6,06	1,19	2,94
Netherlands	9,46	8,13	4,07
Norway	1,38	1,44	1,40
Poland	18,82	10,86	0,52
Portugal	6,79	1,11	2,68
Romania	13,53	5,61	1,47
Slovakia	46,43	8,03	0,70
Slovenia	6,06	1,93	0,95
Spain	8,81	4,96	9,34
Sweden	11,76	8,25	3,60

For analyzing the number of cases compared to population by Country and Month for Western Europe, we propose the following query. In this example, We add constraints on the measure of the multidimensional table based on colors ({<=2‰ : Green; <=3‰: Orange; >=4‰: Red) in order to highlight the most important values.

Example 3:

Dimension 1: Month
Dimension 2: Country
Dimension 3: Zone {Western Europe}
Fact: (Number_Cases/Population)*1000
{<=2‰ : Green; <=3‰: Orange; >=4‰: Red}

The result of this query is the following multidimensional table.

Table 4: Number of cases by Month and Country

Western	**Europe**					
	Austria	**Belgium**	**France**	**Germany**	**Luxembourg**	**Netherlands**
Janv-21	1,38	1,30	1,74	1,34	1,50	2,30
Fevr-21	1,24	1,34	1,98	0,68	1,90	1,54
Mars-21	2,10	2,28	2,17	1,01	2,13	2,35
Avr-21	1,93	2,37	2,77	1,55	2,17	3,00
Mai-21	0,92	1,65	1,01	1,06	1,36	2,37
Juin-21	0,23	0,71	0,67	0,21	0,36	0,76
Juil-21	0,12	0,52	0,60	0,07	0,90	1,71
Aout-21	0,43	1,16	3,19	0,23	0,73	1,49
Sept-21	1,13	1,52	2,32	0,78	0,81	0,99

In the next example, we apply the same query for the zone of Eastern Europe.

Example 4:

Dimension 1: Month
Dimension 2: Country
Dimension 3: Zone {Eastern Europe}
Fact: (Number_Cases/Population)*1000
{<=2‰ : Green; <=3‰: Orange; >=4‰: Red}

Eastern	**Europe**						
	Bulgaria	**Cyprus**	**Czechia**	**Hungary**	**Poland**	**Romania**	**Slovakia**
janv-21	0,56	1,80	5,63	1,02	1,33	1,16	6,60
fevr-21	1,02	1,00	5,91	1,64	1,32	0,96	6,88
mars-21	2,94	2,65	6,47	5,33	3,02	1,76	4,92
aver-21	2,47	4,93	2,42	3,34	3,49	1,38	2,11
mai-21	0,69	2,69	0,88	0,79	0,66	0,37	0,85
juin-21	0,16	0,52	0,18	0,14	0,09	0,06	0,24
juil-21	0,07	5,65	0,11	0,03	0,02	0,02	0,06
acut-21	0,37	5,15	0,12	0,04	0,03	0,08	0,09
sept-21	1,37	1,94	0,16	0,13	0,08	0,45	0,38

We note that the number of cases is higher in zone Eastern Europe than Western Europe; mainly in Cyprus, Czechia Hungary and Slovakia.

We now analyze vaccines (Second doses) by Country and Trimester.

Example 5:

Dimension 1: Country
Dimension 2: Trimester
Fact: Sum (SecondDoses)

	T1-2021	T2-2021	T3-2021
Austria	1304688	6051042	7707459
Belgium	1452645	5784945	8654586
Bulgaria	211609	1340262	648475
Croatia	233581	1640893	1322132
Cyprus	88440	536712	460645
Denmark	1571130	6238333	7342890
Estonia	900590	2678019	5398098
Finland	147075	627317	443309
France	364736	3070298	9160820
Germany	10687536	54558541	98587748
Greece	3953903	20467926	24342182
Hungery	1784184	7348828	7387333
Iceland	1583766	7260894	1932295
Italy	52869	215571	179425
Latvia	651935	2441616	3749838
Liechtenstein	9027705	34698931	64225845
Lithuania	57248	851813	457016
Luxembourg	1735	7932	9515
Maita	452004	2069468	1643559
Netherland	43508	336621	319917
Norway	116516	468899	167250
Poland	675565	4084539	5326585
Portigal	617754	2538436	4019710
Romania	1519613	6765390	11437756
Slovakia	2239536	10406398	1291069
Slovenis	520086	2204046	1678675
Spain	6950539	21686332	36015214
Sweden	1567226	6911820	1084471

We note that the number of vaccines is very low for the first trimester. To improve the visibility of this observation, we propose the following multidimensional query.

Example 6:

Dimension 1: Country
Dimension 2: Trimester
Fact: Average(SecondDoses)
{<=20% : Red; <=40%: Orange; >=60%: Green}

	T1-2021	T2-2021	T3-2021
Austria	8,66	40,17	51,17
Belgium	9,14	36,40	54,46
Bulgaria	9,62	60,91	29,47
Croatia	7,31	51,33	41,36
Cyprus	8,15	49,43	42,42
Czechia	10,37	41,17	48,46
Denmark	10,03	29,83	60,13
Estonia	12,08	51,52	36,41
Finland	2,90	24,38	72,73
France	6,52	33,30	60,13
Germany	8,11	41,97	49,92
Greece	10,80	44,48	44,72
Hungary	14,70	67,37	17,93
Iceland	11,80	48,13	40,06
Ireland	9,53	35,68	54,80
Italy	8,36	32,14	59,49
Latvia	4,19	62,35	33,45
Liechtenstein	9,04	41,35	49,60
Lithuania	10,85	49,69	39,46
Luxembourg	6,22	48,09	45,70
Maita	15,48	62,30	22,22
Netherlands	6,70	40,49	52,81
Norway	8,61	35,37	56,02
Poland	12,99	48,85	38,15
Portugal	7,70	34,30	57,99
Romania	16,07	74,67	9,26
Slovakia	11,81	50,06	38,13
Slovenia	12,99	54,00	33,01
Spain	10,75	33,54	55,71
Sweden	8,40	37,03	54,57

7. Conclusion

In this paper, we propose a data warehouse for storing data about spreading of Coronavirus Covid-19 and vaccination in European countries. We present a multidimensional model based on constellation schema in order to deduce new knowledge. The user can add constraints or criteria on multidimensional tables based on colors in order to highlight the most important values.

For future work, we plan to study the impact of vaccination on the spread of the Coronavirus Covid-19 by integrating statistical tools into multidimensional tables.

References

[1] G. Agapito, C. Zucco, M. Cannataro, "COVID-WAREHOUSE: A Data Warehouse of Italian COVID-19, Pollution, and Climate Data", International Journal of Environmental Research and Public Health, Vol. 17, No 15, 2020.

[2] V. Henao-Cespedes, Y. A. Garcés-Gómez, S. Ruggeri, T. M. Henao-Cespedes, "Relationship analysis between the spread of COVID-19 and the multidimensional poverty index in the city of Manizales, Colombia", The Egyptian Journal of Remote Sensing and Space Science, 2021.

[3] K. Krishna; K. Narendra; S. Rachna, "Role of IoT to avoid spreading of COVID-19, International Journal of Intelligent Networks: 32-35, 2020.

[4] H. V. Ribeiro, A. S. Sunahara, J. Sutton, M. Perc, Q. S. Hanley, "City size and the spreading of COVID-19 in Brazil", PLos One, Vol. 15, No 9, 2020.

[5] N. Akhtar, N. Tabassum, A Perwej, Y. Perwej, "Data analytics and visualization using Tableau utilitarian for COVID-19", Global Journal of Engineering and Technology Advances, Vol. 3, No. 2, p. 28–50.

[6] V. Manohar, G. Arpan, B. Björn, "Tableau: A High-Throughput and Predictable VM Scheduler for High-Density Workloads", EuroSys Conference, ACM, New York, USA, 2018.

[7] S. Shashank Raj, "Exploratory Data Analysis on outbreak of Coronavirus", International Research Journal of Engineering and Technology, Vol. 7, No. 2, 2020.

[8] R. Kimball, M. Ross, W. Thornthwaite, J. Mundy, B. Becker, J. Caserta, "Kimball's Data Warehouse Toolkit Classics", 2nd Edition, Wiley, 2014.

[9] T. B. Sardinha, M. V. Pinto, "Multi-Dimensional Analysis: Research Methods and Current Issues", Bloomsbury Academic, 2019.

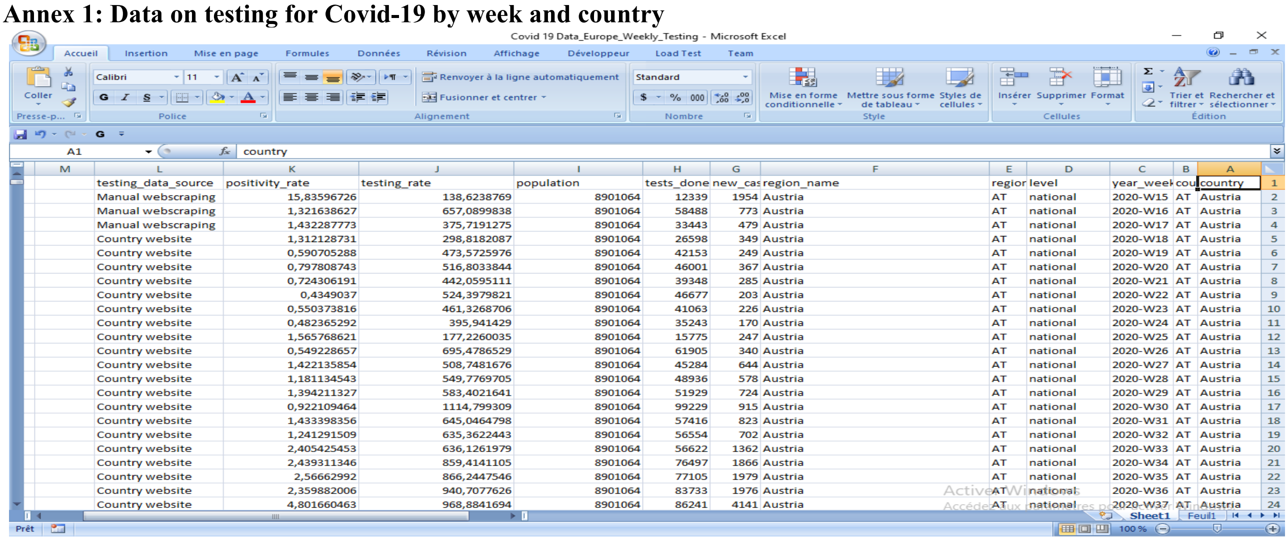
[10] https://www.who.int/health-topics/coronavirus

[11] https://www.ecdc.europa.eu/en

Dr. Hela Turki received the B.S. and the M.S. degree from University of Sfax, Tunisia in 2012. She received the Ph.D. degree from University of Sfax, Tunisia in 2017. From 2015 to 2017, she was a contractual professor at University of Sfax, Tunisia. Since 2017, she is an assistant professor at Jouf University, Saudi Arabia. She is the author of many papers in international journals and conferences. Her research interest includes Decision Making and Data Analysis.

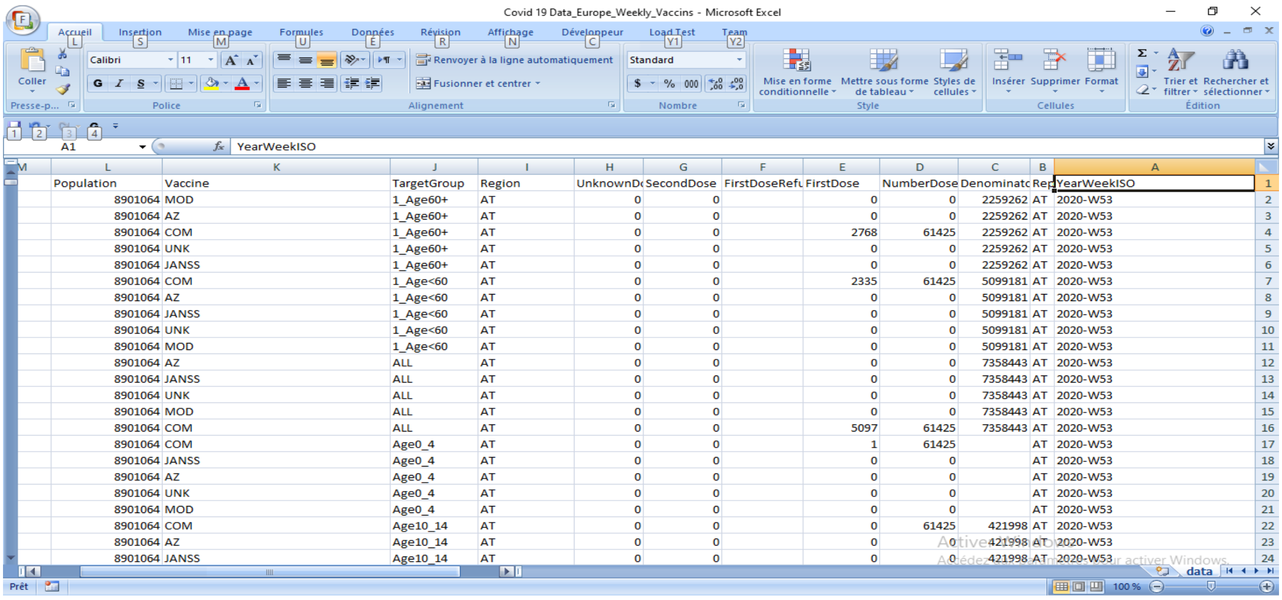
Dr. Kais Khrouf received the B.S. degree in Computer Sciences from University of Sfax, Tunisia in 1999. He received the M.S. (2000) and Ph.D. (2004) degrees in Computer Sciences from University of Paul Sabatier, Toulouse, France. From 2005 to 2017, he was an assistant professor at University of Sfax, Tunisia. Since 2017, he is an assistant professor at Jouf University, Saudi Arabia. He is the author of more than 40 articles in international journals and conferences and he is a permanent reviewer in International Journal of Information and Decision Sciences (Inderscience Publishers). His research interests include Decision Support Systems, Data Analysis, Data Warehouses, Social Networks and Semi-Structured Data.

Annex 1: Data on testing for Covid-19 by week and country



testing_data_source	positivity_rate	testing_rate	population	tests_done	new_cas	region_name	regior	level	year_week	cou	country	
Manual webscraping	15,83596726	138,6238769	8901064	12339	1954	Austria	AT	national	2020-W15	AT	Austria	2
Manual webscraping	1,321638627	657,0899838	8901064	58488	773	Austria	AT	national	2020-W16	AT	Austria	3
Manual webscraping	1,432287773	375,7191275	8901064	33443	479	Austria	AT	national	2020-W17	AT	Austria	4
Country website	1,312128731	298,8182087	8901064	26598	349	Austria	AT	national	2020-W18	AT	Austria	5
Country website	0,590705288	473,5725976	8901064	42153	249	Austria	AT	national	2020-W19	AT	Austria	6
Country website	0,797808743	516,8033844	8901064	46001	367	Austria	AT	national	2020-W20	AT	Austria	7
Country website	0,724306191	442,0595111	8901064	39348	285	Austria	AT	national	2020-W21	AT	Austria	8
Country website	0,4349037	524,3979821	8901064	46677	203	Austria	AT	national	2020-W22	AT	Austria	9
Country website	0,550373816	461,3268706	8901064	41063	226	Austria	AT	national	2020-W23	AT	Austria	10
Country website	0,482365292	395,941429	8901064	35243	170	Austria	AT	national	2020-W24	AT	Austria	11
Country website	1,565768621	177,2260035	8901064	15775	247	Austria	AT	national	2020-W25	AT	Austria	12
Country website	0,549228657	695,4786529	8901064	61905	340	Austria	AT	national	2020-W26	AT	Austria	13
Country website	1,422135854	508,7481676	8901064	45284	644	Austria	AT	national	2020-W27	AT	Austria	14
Country website	1,181134543	549,7769705	8901064	48936	578	Austria	AT	national	2020-W28	AT	Austria	15
Country website	1,394211327	583,4021641	8901064	51929	724	Austria	AT	national	2020-W29	AT	Austria	16
Country website	0,922109464	1114,799309	8901064	99229	915	Austria	AT	national	2020-W30	AT	Austria	17
Country website	1,433398356	645,0464798	8901064	57416	823	Austria	AT	national	2020-W31	AT	Austria	18
Country website	1,241291509	635,3622443	8901064	56554	702	Austria	AT	national	2020-W32	AT	Austria	19
Country website	2,405425453	636,1261979	8901064	56622	1362	Austria	AT	national	2020-W33	AT	Austria	20
Country website	2,439311346	859,4141105	8901064	76497	1866	Austria	AT	national	2020-W34	AT	Austria	21
Country website	2,56662992	866,2447546	8901064	77105	1979	Austria	AT	national	2020-W35	AT	Austria	22
Country website	2,359882006	940,7077626	8901064	83733	1976	Austria	AT	national	2020-W36	AT	Austria	23
Country website	4,801660463	968,8841694	8901064	86241	4141	Austria	AT	national	2020-W37	AT	Austria	24

Annex 2: Data on Covid-19 vaccination



Population	Vaccine	TargetGroup	Region	UnknownD	SecondDose	FirstDoseRefu	FirstDose	NumberDose	Denominato	Rep	YearWeekISO	
8901064	MOD	1_Age60+	AT	0	0		0	0	2259262	AT	2020-W53	2
8901064	AZ	1_Age60+	AT	0	0		0	0	2259262	AT	2020-W53	3
8901064	COM	1_Age60+	AT	0	0		2768	61425	2259262	AT	2020-W53	4
8901064	UNK	1_Age60+	AT	0	0		0	0	2259262	AT	2020-W53	5
8901064	JANSS	1_Age60+	AT	0	0		0	0	2259262	AT	2020-W53	6
8901064	COM	1_Age<60	AT	0	0		2335	61425	5099181	AT	2020-W53	7
8901064	AZ	1_Age<60	AT	0	0		0	0	5099181	AT	2020-W53	8
8901064	JANSS	1_Age<60	AT	0	0		0	0	5099181	AT	2020-W53	9
8901064	UNK	1_Age<60	AT	0	0		0	0	5099181	AT	2020-W53	10
8901064	MOD	1_Age<60	AT	0	0		0	0	5099181	AT	2020-W53	11
8901064	AZ	ALL	AT	0	0		0	0	7358443	AT	2020-W53	12
8901064	JANSS	ALL	AT	0	0		0	0	7358443	AT	2020-W53	13
8901064	UNK	ALL	AT	0	0		0	0	7358443	AT	2020-W53	14
8901064	MOD	ALL	AT	0	0		0	0	7358443	AT	2020-W53	15
8901064	COM	ALL	AT	0	0		5097	61425	7358443	AT	2020-W53	16
8901064	COM	Age0_4	AT	0	0		1	61425		AT	2020-W53	17
8901064	JANSS	Age0_4	AT	0	0		0	0		AT	2020-W53	18
8901064	AZ	Age0_4	AT	0	0		0	0		AT	2020-W53	19
8901064	UNK	Age0_4	AT	0	0		0	0		AT	2020-W53	20
8901064	MOD	Age0_4	AT	0	0		0	0		AT	2020-W53	21
8901064	COM	Age10_14	AT	0	0		0	61425	421998	AT	2020-W53	22
8901064	AZ	Age10_14	AT	0	0		0	0	421998	AT	2020-W53	23
8901064	JANSS	Age10_14	AT	0	0		0	0	421998	AT	2020-W53	24