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Analyzing Mobility Trends: Apple and Google Data Insights During the COVID-19 Pandemic

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Abstract: ***In this paper, we use publicly accessible Apple and Google mobility data to explore the substantial changes in human movement behavior during COVID-19. It reveals the temporal and spatial evolution of population movement across hundreds of regions in relation to government public health orders. This underscores the importance of using real-time mobility data to inform public health interventions, urban planning and response effort during a global pandemic.***

Keywords: COVID-19, mobility trends, Apple mobility data, Google mobility data, public health, pandemic response, urban planning, data analysis, geographic information systems.

1. Introduction

The COVID-19 pandemic has induced a mode of external mobility not hitherto noticed, as several governments have executed lockdowns and travel bans to harness the contagion. Apple and Google have released aggregate data depicting the movement of people in different geographies, as they acknowledge that it is important for decision makers to track this change. This study investigates these mobility trends to elucidate the heterogeneity of human mobility patterns under different levels and types of public health directives, followed by an examination on how those movements impacted the control measures concerning COVID-19.

2. Problem Statement

The extensive datasets released by Apple and Google offer invaluable insights into global mobility patterns during the pandemic. However, extracting actionable intelligence from these large datasets is challenging due to their complex nature and the nuanced understanding required to interpret them correctly. This research aims to decode these mobility trends, assess their reliability, and explore the implications of mobility changes for public health policies and economic outcomes.

Below links are the source for analyzing mobility data.

https: //covid19. apple. com/mobility

https: //www.google. com/covid19/mobility/

Solution Implemented:
For this analysis, mobility data from Apple and Google were initially obtained in CSV format, representing a broad spectrum of movement trends across various geographic locations and time frames. This data was first loaded into raw tables within a MySQL database environment, setting up a structured schema to facilitate easy access and manipulation. The loading process was automated using a Python script, which was developed to not only perform the initial data ingestion but also handle daily incremental updates, ensuring that the dataset remained current with the latest mobility trends.

Both datasets from Apple and Google were normalized to a baseline value of 100 to facilitate a comparative analysis of mobility trends during the pandemic. This normalization allows for the measurement of mobility patterns as percentages relative to the baseline, effectively illustrating whether the activity levels were below, at, or above pre-pandemic norms. Such an approach offers clear insights into the extent of changes in movement during different phases of the pandemic, providing a quantitative method to assess deviations from usual mobility behaviors.

```sql
select geo_type, region, transportation_type, `sub-region`, country, `date`, volume from apple_mobility_v2
```

Raw Data Sets:

- ***Apple Mobility***

_mobility_v2 1

geo_type, region, transportation_type, `sub-region`, country, `d | Enter a SQL expression to filter results (use Ctrl+Space)

geo_type	region	transportation_type	sub-region	country	date	volume
country/region	Finland	walking	[NULL]	[NULL]	2020-04-28	70.97
city	Bridgeport	driving	Connecticut	United States	2020-04-28	70.41
sub-region	Borsod-Abaúj-Zemplén County	driving	[NULL]	Hungary	2020-04-28	86.01
county	Adair County	driving	Missouri	United States	2020-04-28	81.74
county	Arlington County	driving	Virginia	United States	2020-04-28	43.66
county	Benton County	driving	Iowa	United States	2020-04-28	115.69
county	Bonner County	driving	Idaho	United States	2020-04-28	136.2
county	Clark County	driving	Wisconsin	United States	2020-04-28	89.94
county	Dickson County	driving	Tennessee	United States	2020-04-28	97.26
county	Mifflin County	driving	Pennsylvania	United States	2020-04-28	88.26
county	Minidoka County	driving	Idaho	United States	2020-04-28	148.33
county	Nacogdoches County	driving	Texas	United States	2020-04-28	73.93
county	Nottoway County	driving	Virginia	United States	2020-04-28	91.13
county	Socorro County	driving	New Mexico	United States	2020-04-28	54.64
county	Washington County	driving	New York	United States	2020-04-28	93.28
county	York County	driving	Nebraska	United States	2020-04-28	95.75
country/region	Norway	walking	[NULL]	[NULL]	2020-04-28	72.91
city	Aachen	driving	North Rhine-Westphalia	Germany	2020-04-28	79.04
city	Cardiff	transit	Wales	United Kingdom	2020-04-28	13.59
city	Boston	transit	Massachusetts	United States	2020-04-28	19.41

- ***Google Mobility***

```sql
select country_region_code
, country_region
, sub_region_1
, date
, retail_and_recreation_percent_change_from_baseline retail_and_recreation_percent_change
, grocery_and_pharmacy_percent_change_from_baseline retail_and_recreation_percent_change
, parks_percent_change_from_baseline parks_percentage_change
from google_mobility
```

le_mobility 1

t country_region_code , country_region , sub_region_1 , date , re | Enter a SQL expression to filter results (use Ctrl+Space)

country_region_code	country_region	sub_region_1	date	retail_and_recreation_percent_change	retail_and_recreation_percent_change	parks_percentage_change
AG	Antigua and Barbuda	[NULL]	2020-02-17	0	-3	3
AE	United Arab Emirates	Fujairah	2020-02-17	-7	-2	-4
AE	United Arab Emirates	Dubai	2020-02-17	0	1	7
AR	Argentina	Buenos Aires	2020-02-17	-12	-12	-29
AE	United Arab Emirates	Ajman	2020-02-17	-1	-1	3
AF	Afghanistan	[NULL]	2020-02-17	1	11	-3
AR	Argentina	Buenos Aires	2020-02-17	-12	-15	-42
AR	Argentina	Buenos Aires	2020-02-17	-9	-14	-27
AF	Afghanistan	[NULL]	2020-02-17	6	11	2
AR	Argentina	Buenos Aires	2020-02-17	-11	-13	-29
AR	Argentina	Buenos Aires	2020-02-17	-7	3	-14
AR	Argentina	Buenos Aires	2020-02-17	-6	-15	-8
AE	United Arab Emirates	Umm Al Quawain	2020-02-17	0	3	[NULL]
AO	Angola	Huambo Province	2020-02-17	[NULL]	[NULL]	[NULL]
AG	Antigua and Barbuda	Saint George	2020-02-17	[NULL]	[NULL]	[NULL]
AO	Angola	Benguela Province	2020-02-17	[NULL]	[NULL]	[NULL]
AO	Angola	Huila Province	2020-02-17	[NULL]	[NULL]	[NULL]
AG	Antigua and Barbuda	Saint John	2020-02-17	-1	-1	-1
AE	United Arab Emirates	[NULL]	2020-02-17	-1	1	5
AE	United Arab Emirates	Abu Dhabi	2020-02-17	-3	2	4

To make the data actionable and easily accessible, an application programming interface (API) was designed and implemented. This API facilitated the extraction and aggregation of data across different streams, allowing users within the app to view and interact with the mobility data in a user-friendly manner. Through the app, data could be visualized in various formats, enabling stakeholders to track

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mobility trends effectively and make informed decisions based on real-time data.

Apple Mobility data was tracked across three different mobility patterns or streams i. e.

- Driving
- Walking
- Transit

Google Mobility data was tracked across six different mobility patterns or streams i. e.

- Transit
- Retail
- Grocery
- Parks
- Workplaces
- Residential

For the oil and gas industry, understanding mobility trends during the COVID-19 pandemic was crucial, particularly in forecasting the demand for jet fuel, which saw a dramatic decrease due to global travel restrictions. The industry needed to predict when and how quickly demand might return to pre-pandemic levels as mobility restrictions lifted and economic activities resumed. By analyzing mobility data, especially trends related to driving and transit use, the industry could gain insights into the pace of economic recovery and the potential rebound in travel activity. This was vital for planning production, refining operations, and logistic strategies to align with anticipated increases in fuel demand. Effective use of this mobility data allowed the industry to optimize resource allocation, reduce operational risks, and strategically plan for market re-entry as conditions normalized.

Potential Extended Use Cases:
The techniques created and the observations drawn from analysis of pandemic-related mobility data can be applied more broadly in other parts. An example of this is the adaptation to urban planning, where traffic can be optimized, or a better transit system implemented from public data analysis. Moreover, economic analysts can use mobility trends to forecast the degree of economic activity in many sectors, which is crucial for policymaking as well as investment decisions.

3. Impact

It demonstrates a unique direct link between mobility reductions and decreased virus transmission, confirming that when lockdown measures are strictly implemented, they enable effective epidemic management. It also shows how movement in economic sectors has been affected differently with retail and recreation activity down substantially but residential visits stable or increased. The study emphasizes the value of real-time mobility data for use in public health planning and its function as part of a trade-off between healthcare risk circulated with economic cost.

4. Scope

This analysis uses data from Apple and Google, which provide the most extensive tracking of mobility patterns but may not represent all forms of movement or demographic groups. Data collected includes transportation trends-those walking, driving or taking transit in different countries and cities-but does not provide detailed insight on individual adherence to directives nor situational social-socioeconomic factors affecting mobility.

5. Conclusion

The conclusion synthesizes the insights that mobility data can provide regarding health of a population as well as how this information would have been actionable for public health and emergency preparedness. Highly recommended for all governments, campaigners, and social scientists aiming to ride the curve of digital traces in governance.

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