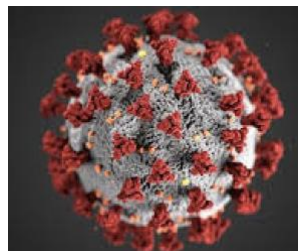
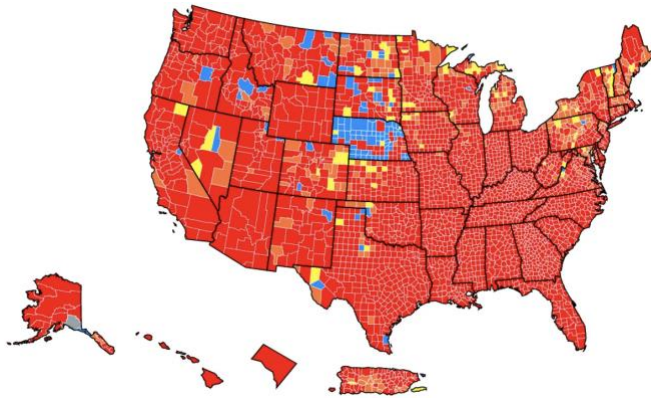


Covid-19 spread overtime in 2020 - USA

Introduction

The world has been staggered by the new virus covid-19 and its impacts. We all have been affected by the pandemic and our life hasn't been same ever since after. It affected each country's health, wealth and what not! It changed our lives in every aspect and that is why it is worth mentioning and its spread is worth analyzing. I am motivated the most to utilize my SAS knowledge on something that has left its big impact on the world, and I feel fortunate enough to be able to represent the spread in graphs and numbers with my SAS knowledge.



Data Source

Kaggle hosts massive open-source public data across various domains, and I found required dataset from the same [www.kaggle.com](https://www.kaggle.com/sudalairajkumar/covid19-in-usa). Data imported for this project is published at <https://www.kaggle.com/sudalairajkumar/covid19-in-usa> a year ago and it was originally obtained from COVID-19 Tracking project and NYTimes. It was collected under federal covid tracking project by government since number of new cases were increasing day by day around the world. I downloaded and modified the dataset from the source and uploaded under 'data' section in EPG194 in SAS. I used PROC IMPORT step to import it into pg1 library to proceed further. This dataset has information from 55 US states and 1925 county at daily level with 8,00,437 observations.

Data Exploration and preparation

I have used SAS steps to explore this dataset. It contains one csv file, “covid-19_usa_cases” that has 8,00,437 observations with number of cases and deaths for a specific state, county and date. It also has FIPS code in this data for that county. Please see figure 1 to sneak pick into raw data.

covid-19_usa_cases

date	county	state	fips	cases	deaths
2020-01-21	Snohomish	Washington	53061.0	1	0.0
2020-01-22	Snohomish	Washington	53061.0	1	0.0
2020-01-23	Snohomish	Washington	53061.0	1	0.0
2020-01-24	Cook	Illinois	17031.0	1	0.0
2020-01-24	Snohomish	Washington	53061.0	1	0.0
2020-01-25	Orange	California	6059.0	1	0.0
2020-01-25	Cook	Illinois	17031.0	1	0.0
2020-01-25	Snohomish	Washington	53061.0	1	0.0
2020-01-26	Maricopa	Arizona	4013.0	1	0.0
2020-01-26	Los Angeles	California	6037.0	1	0.0
2020-01-26	Orange	California	6059.0	1	0.0
2020-01-26	Cook	Illinois	17031.0	1	0.0
2020-01-26	Snohomish	Washington	53061.0	1	0.0
2020-01-27	Maricopa	Arizona	4013.0	1	0.0
2020-01-27	Los Angeles	California	6037.0	1	0.0

Fig.1

The CONTENTS Procedure

Data Set Name	PG1.COVID_USA_CASES	Observations	800437
Member Type	DATA	Variables	6
Engine	V9	Indexes	0
Created	12/06/2021 10:52:42	Observation Length	56
Last Modified	12/06/2021 10:52:42	Deleted Observations	0
Protection		Compressed	NO
Data Set Type		Sorted	NO
Label			
Data Representation	SOLARIS_X86_64 LINUX_X86_64 ALPHA_TRU64 LINUX_I86 LINUX_POWER_64		
Encoding	US-8 Unicode (UTF-8)		

Engine/Host Dependent Information				
Data Set Page Size	65536			
Number of Data Set Pages	687			
First Data Page	1			
Max Obs per Page	1166			
Obs in First Data Page	1121			
Number of Data Set Repairs	0			
Filename	home\m001\EPG194\data\covid_usa_cases.sas7bdat			
Release Created	V.03030AD			
Host Created	Linux			
Index Number	57234			
Access Permission	rwr--r--			
Owner Name	m001			
File Size	43MB			
File Size (bytes)	45088768			

Variables in Creation Order				
#	Variable	Type	Len	Format
1	date	Num	8	YYMMDD10.
2	county	Char	11	\$11.
3	state	Char	10	\$10.
4	fips	Num	8	BE5T12.
5	cases	Num	8	BE5T12.
6	deaths	Num	8	BE5T12.

Fig. 2

We can tell from the figure 2 where I performed CONTENTS procedure, that covid_usa_cases has number of observations with 6 variables named ‘date’, ‘county’, ‘state’, ‘fips’, ‘cases’, ‘deaths’.

Each variable has significance as shown below:

date - date of observation

county – USA state’s county name

state - USA state name

fips - federal information processing system code which uniquely identifies geographic areas.

cases – number of cases

death - number of deaths

Cases and death comes with ‘Num’ datatype whereas county and state as ‘Char’. ‘Variable in Creation Order table’ helped me explore on length and format information as well.

Creating frequency tables for the variables ‘state’ where ‘frequency’ column gave me an idea about how many observations fell into the given category. I kept ‘order=freq’ to sort it down from the higher to lower frequency. We can interpret from below table by saying that there are 60398 observations for Texas state with 7.55% of observations for Texas out of all nonmissing observations. The Cumulative Frequency column is the number of observations in the sample that have been accounted for up to and including the current row. It can be computed by adding all of the numbers in the Frequency column above and including the current row. The Cumulative Percent column is the proportion of the sample that has been accounted for up to and including that row. It can be computed by adding all of the numbers in the Percent column up to the current row. If there would be any missing data , it would have been printed right below the output of PROC FREQ results. That can also be printed by ‘/MISSING’ option right after tables statement. Here, we do not have any missing data except for deaths. So from the table below we can say

that Texas has the highest number of observations recorded that is 60398 and Guam has the lowest, being 266, among all the states. I used 'NLEVELS' option in frequency procedure that gave the number of variable levels output. Hence we can see that there are total 55 states data recorded.

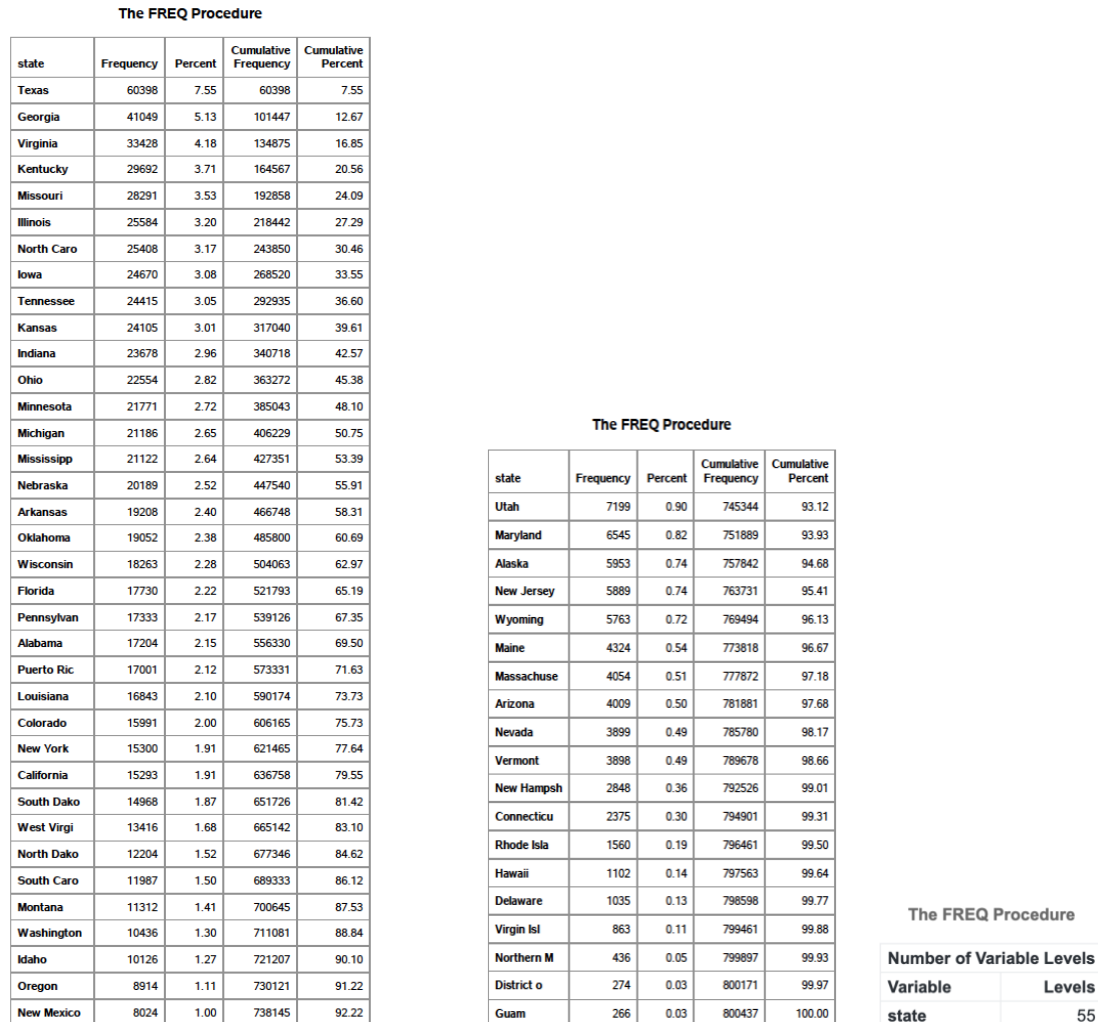


Fig. 3

FREQ procedure also helped me explore the distribution of state with number of observations with PLOTS=FREQPLOT option where order=data is set so distrubution is presented alphabatically.

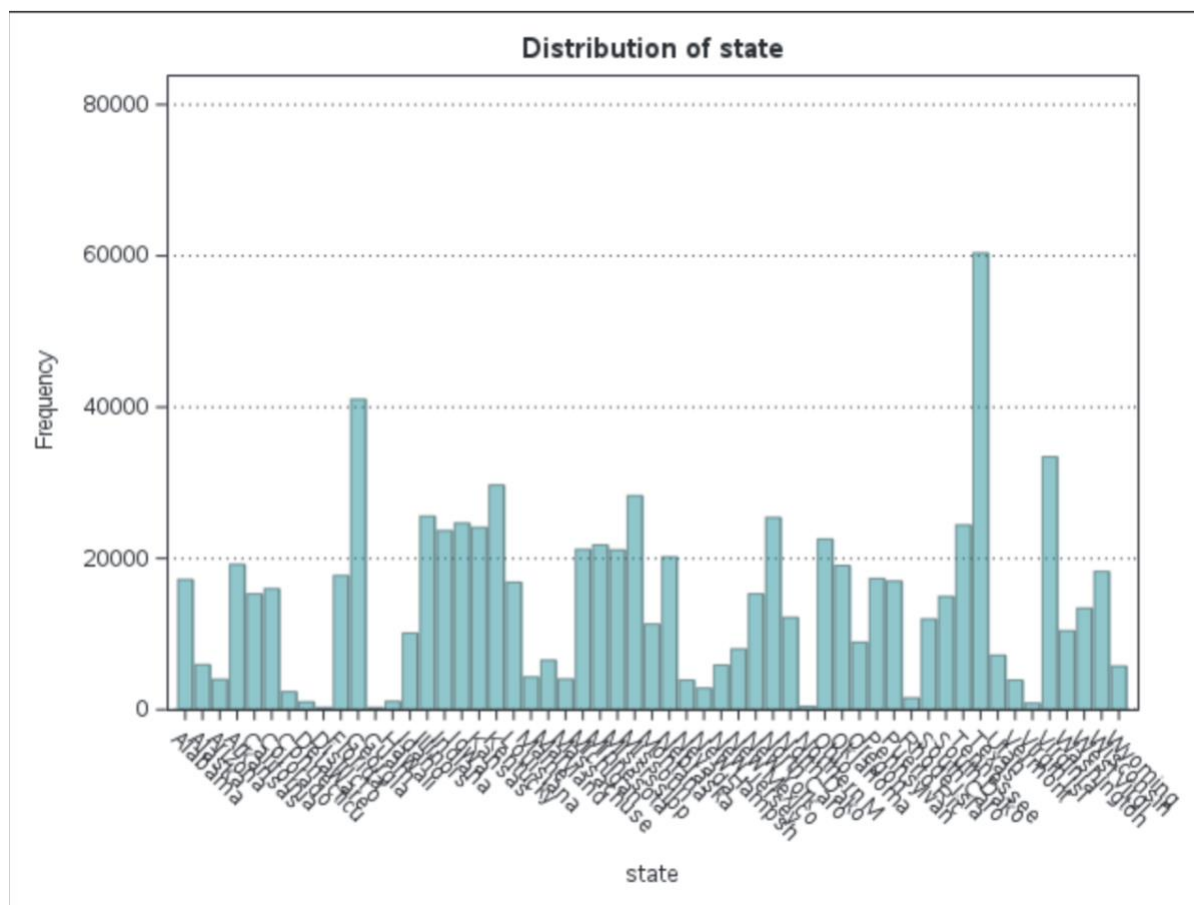


Fig. 4

After exploring county data, I found there are cases reported for 1925 counties under 55 states, which is huge and detailed data I would say! Below is the sneak pick into that.

The FREQ Procedure

Number of Variable Levels				
Variable	Levels			
county	1925			

county	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Washington	7971	1.00	7971	1.00
Unknown	6886	0.86	14857	1.86
Jefferson	6667	0.83	21524	2.69
Franklin	6357	0.79	27881	3.48
Jackson	5991	0.75	33872	4.23
Lincoln	5953	0.74	39825	4.98
Madison	5090	0.64	44915	5.61
Montgomery	4649	0.58	49564	6.19
Union	4540	0.57	54104	6.76
Clay	4476	0.56	58580	7.32
Marion	4304	0.54	62884	7.86
Monroe	4269	0.53	67153	8.39

Fig. 5

I also found that there are 16733 missing values of deaths in 'Puerto Rico' state which we are keeping as it is since those data is significant while checking number of cases every month. As we can see below, there are no deaths in 30% of our observations. Below is the frequency table for deaths column.

The FREQ Procedure					
deaths	Frequency	Percent	24,287	1	0.00
0	235150	30.00	24,297	1	0.00
1	87523	11.17	24,305	1	0.00
2	52427	6.69	24,323	1	0.00
			24,346	1	0.00
			Frequency Missing = 16733		

Data Preparation

After exploring data and the quality of data, figured out that there are no missing values of a state or county so no need to remove nulls, as a first step, to clean data.

Also, there were no missing/Null values other than mentioned 16733 death counts for Puerto Rico hence no observation deletion requires. I, then realized that there is a column named 'date' and this whole dataset belongs to year 2020 so my further analysis requires date to be divided into month and day columns so that I can make detailed analysis and graph to see if there any trend exist in number of cases/deaths month wise. Hence, I created two new columns 'month' and 'day' and formatted 'cases' and 'deaths' to see numbers in readable format during data preparation step. I dropped 'fips' column since it does not require in further analysis that I want to perform. Now, my clean data is ready, and it looks like below.

Log Output Data

PG1.CLEAN_DATA_COVID_USA_CASES ▾ Total rows: 800437 Columns: 7 of 7 Rows 800401 to 800437

Enter expression

	date	county	state	@ cases	@ deaths	@ month	@ day
800401	2020-12-04	Johnson	Wyoming	368	5	12	
800402	2020-12-04	Laramie	Wyoming	5,682	28	12	
800403	2020-12-04	Lincoln	Wyoming	689	6	12	
800404	2020-12-04	Natrona	Wyoming	5,394	55	12	
800405	2020-12-04	Niobrara	Wyoming	125	0	12	

Fig. 6

PROC CONTENT helped me to give summary on variables and descriptive statistics on base level which says that now there are 7 variables with given Type and length and number of observation remains same 8,00,437 as before.

#	Variable	Type	Len
1	date	Num	8
2	county	Char	11
3	state	Char	10
4	cases	Num	8
5	deaths	Num	8
6	month	Num	8
7	day	Num	8

Data Analysis

From the figure below, we can say that number of cases starts with zero which means some of the states/counties had no cases and maximum cases were 4,39,538. This dataset has data from 1st month of 2020 which is January to 12th which is December and day 1 to day 31 in a month.

The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
date	800437	22129.51	73.42	21935.00	22254.00
cases	800437	1589.67	8385.20	0.00	439538.00
deaths	783704	48.82	440.48	0.00	24346.00
month	800437	7.56	2.42	1.00	12.00
day	800437	15.83	8.94	1.00	31.00

Talking about observation count, distribution of state with State and its percent value is shown below. It says that maximum observation covers nearly 7.5% of the total observations in data and it seems to be Texas which is 60398 out of 800437 observations. Graph looks like below.

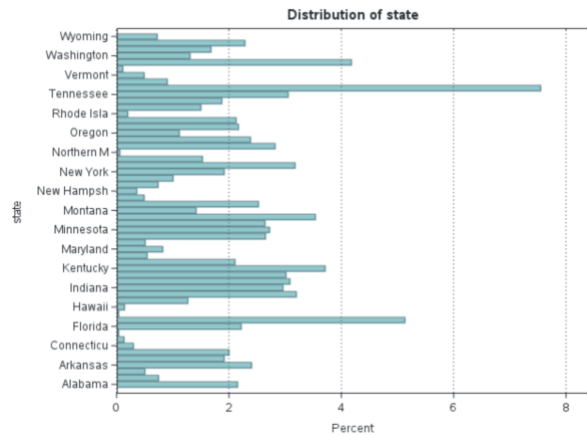


Fig. 7

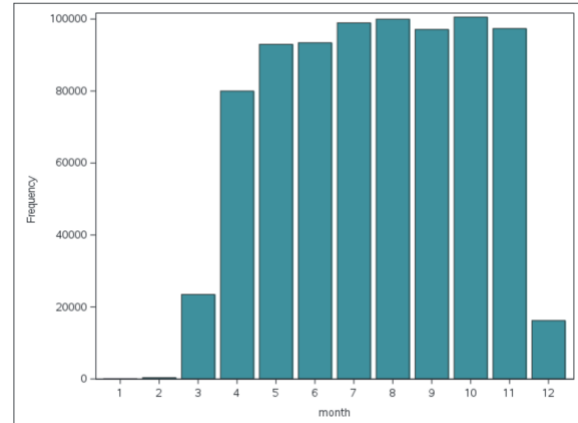


Fig. 8

Figure 8 shows how the observations are distributed among months. There were very few observations recorded in first 2 months and it spiked like a rocket and highest observations seem to be recorded in August and October while December gave us little relief.

Analyzing through scatterplot makes it easy to visualize data and conclude facts that can mirror reality that happened. I was curious to know about what the scenario in January 2020 was and how gradually/non-gradually it went till December 2020. I was also curious to know graph of cases vs death, state wise cases , state wise deaths too. My all questions were simply answered by applying gplot on the dataset and getting scatterplot as result.

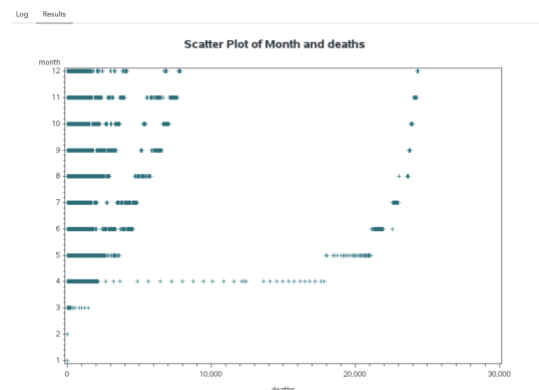
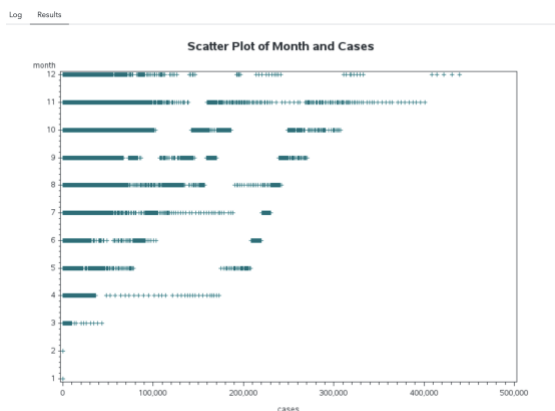


Fig. 9

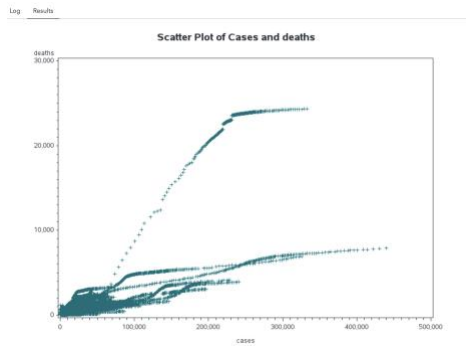


Fig. 10

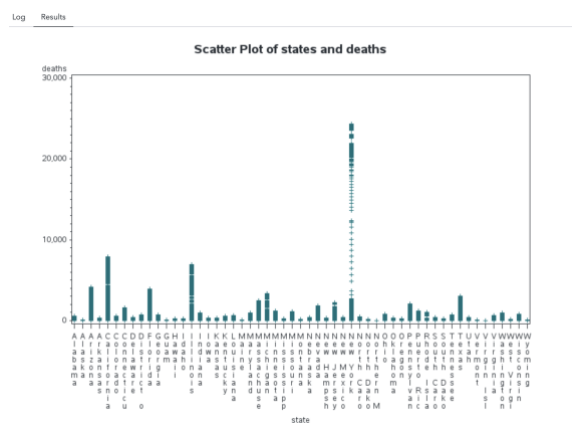
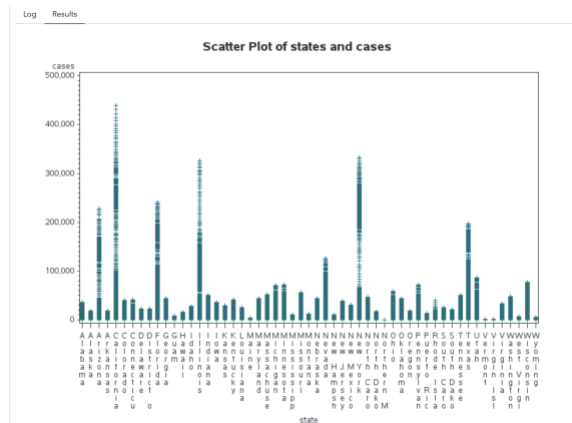


Fig. 11

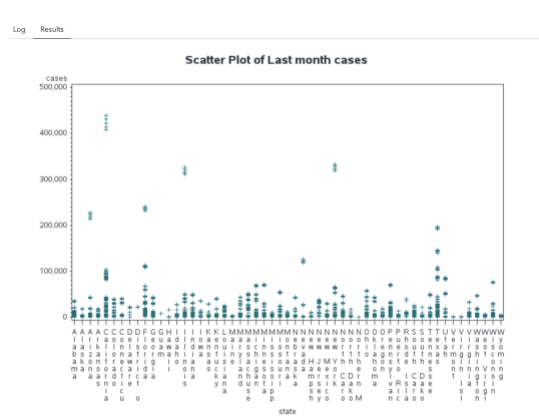
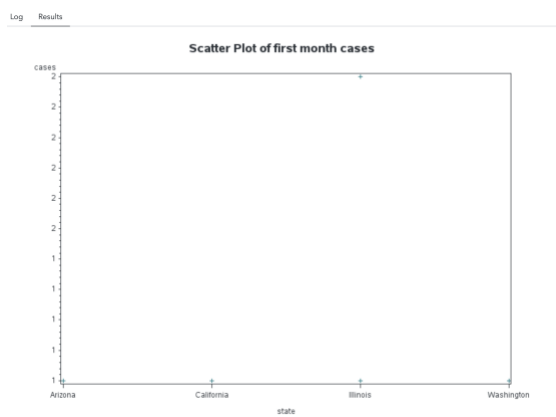


Fig. 12

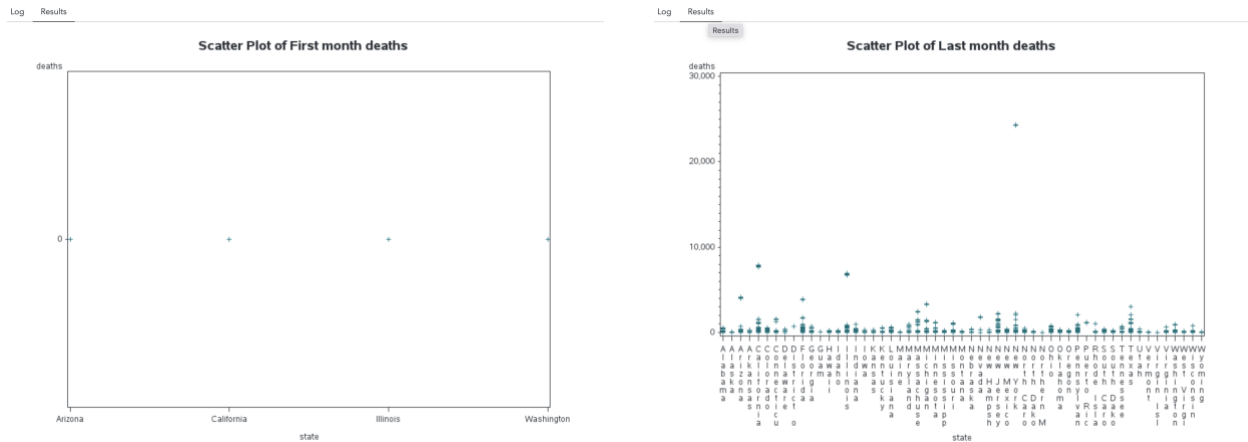


Fig. 13

From all the figured above, I could analyze those cases increased gradually every month and so the death but luckily deaths were not as high as cases produced even when it was deadly virus. I can tell from figure 10 that as cases and deaths were linearly increased. Figure 11 shows that California had the highest number of cases 4,39,538 in Los Angeles County and New York had highest number of deaths 24,346 all over the USA. There are many states that had zero cases and Maryland was one of them which has zero cases even in the last month of 2020! Texas, Illinois, Florida, Arizona joined California in massive number of cases, I found. Washington, Arizona, Illinois, and California started with 2 cases in January,2020 and no other state seen covid-19 virus even then. However, December showed all the states on the graph with huge number of cases. There were zero deaths in first month of covid-19 virus but throughout the year, ending in December, many states witnessed deaths. There are 2,35,150 observations out of all that showed zero deaths and only 665 observations showed zero cases. I exported my results and data using PROC EXPORT on EPG194 itself.

Summary

I started this project, and it took no longer than 2 minutes for me to know what kind of data I want to work on. As I got to know that we are going to choose our own goal, dataset, tasks and so on; I, right away got a thought about how exciting it would be to apply my SAS knowledge on a deadly coronavirus! I have been curious about COVID-19 data but never thought to work on it just like this. From results, I got to know more about how covid-19 affected the country, and I am glad I could do it using my SAS experience. I always had such questions like did the cases increased/decreased or what was the death graph all over the year and exactly which county/state got affected the most. Of course, news channels did show us lot of count and it is still available to see online but having the real dataset gathered by authorized organization and getting to work on it by coding on it is really a pleasure. That is why this project is even more special for me that I could convert my interest into a project work which I will cherish forever.

SAS Code

Starting the process by downloading dataset from the data source. I uploaded it into data folder of EPG194 into SAS. I used below steps in SAS code.

- PROC IMPORT- to import and then access data from local system into SAS.

- PROC CONTENTS - to see summary of dataset such as total number of observations, variable level information such as type, names, length, format.
- PROC PRINT - to print out the observations and look at raw dataset.
- PROC FREQ - to see descriptive statistics with keeping one variable as a center point and to see if that variable contains missing values or not.
- PROC MEAN - to answer question like what is minimum, maximum, or total number of cases/deaths, average number of cases/deaths.
- PROC SORT - to sort data and see highest or lowest value with WHERE statement.
- PROC GPLOT - to draw scatter plot with 'PLOT' to define x and y axis.
- DATA step - declare additional variable with specific format, change the format of existing variable and save clean data into pg1 library.
- Title – to give description of a graph or table or any result.
- ODS – to turn on graphics.
- PROC EXPORT – to export data once analysis is done.

The full SAS code is as below.

```

1  *Import data;
2
3  proc import datafile = '/home/vmodi/EPGI94/data/covid-19_usa_cases.csv'
4    out = pg1.covid_usa_cases
5    dbms = CSV;
6  run;
7
8  *Data exploration;
9
10 proc contents data=pg1.covid_usa_cases order=varnum;
11 run;
12
13
14 *sorted data;
15 proc sort data=pg1.covid_usa_cases;
16   by state date;
17 run;
18
19
20 *view raw data;
21 proc print data=pg1.covid_usa_cases noobs;
22   by state;
23 run;
24
25
26 *data preparation;
27 data pg1.clean_data_covid_usa_cases;
28   set pg1.covid_usa_cases;
29   drop file;
30   month=MONTHS(date);
31   day=DAY(date);
32   format cases comma9.;
33   format deaths comma9.;
34 run;
35
36 *Means;
37 proc means data=pg1.clean_data_covid_usa_cases maxdec=2;
38 run;
39
40
41 *bar chart for cases;
42 proc sgplot data=pg1.clean_data_covid_usa_cases;
43   vbar month/group=cases;
44   title 'Cases count each month';
45 run;
46
47 *scatterplot;
48 proc gplot data=pg1.clean_data_covid_usa_cases;
49   title Scatter Plot of Month and Cases;
50   plot month* cases;
51 run;
52 quit;
53
54 proc gplot data=pg1.clean_data_covid_usa_cases;
55   title Scatter Plot of Month and deaths;
56   plot month* deaths;
57 run;
58 quit;
59
60 proc gplot data=pg1.clean_data_covid_usa_cases;
61   title Scatter Plot of Cases and deaths;
62   plot deaths* cases;
63 run;
64 quit;
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66 proc gplot data=pg1.clean_data_covid_usa_cases;
67   title Scatter Plot of states and cases;
68   plot cases* state;
69 run;
70 quit;
71
72 proc gplot data=pg1.clean_data_covid_usa_cases;
73   title Scatter Plot of states and deaths;
74   plot deaths* state;
75 run;
76 quit;
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