Covid Excess Death

By Amirsalar Safaei Ghaderi 99100177 * **Covid Excess Death** * How to run * Question 1 * Question 2 * Question 3 * Thanks for your time :D

How to run

- Open **`solution.R`** and replace `$` in

  ```
  base_folder <- "$" # change this:)
  ```

  with absolute path of project folder in format of your operating system and run the whole code.

  Doing this will automatically install packages, create and save the heatmaps and the tables to the **`base_folder`** that was defined.

- comment the first line for multiple runs so it doesn't install packages every time
- You must include **`iranprovs_mortality_monthly.csv`** in root of the project.
- My outputs can be find in **`./output`** folder.

Question 1

my answer was `256731` I used bit-masking to check every possible aggregation and feature selection.

I modified age feature by eda-ing which you can see in **`eda.R`**, encoded sex feature as a categorical feature and added season and month in season for more aggregation possibilities.

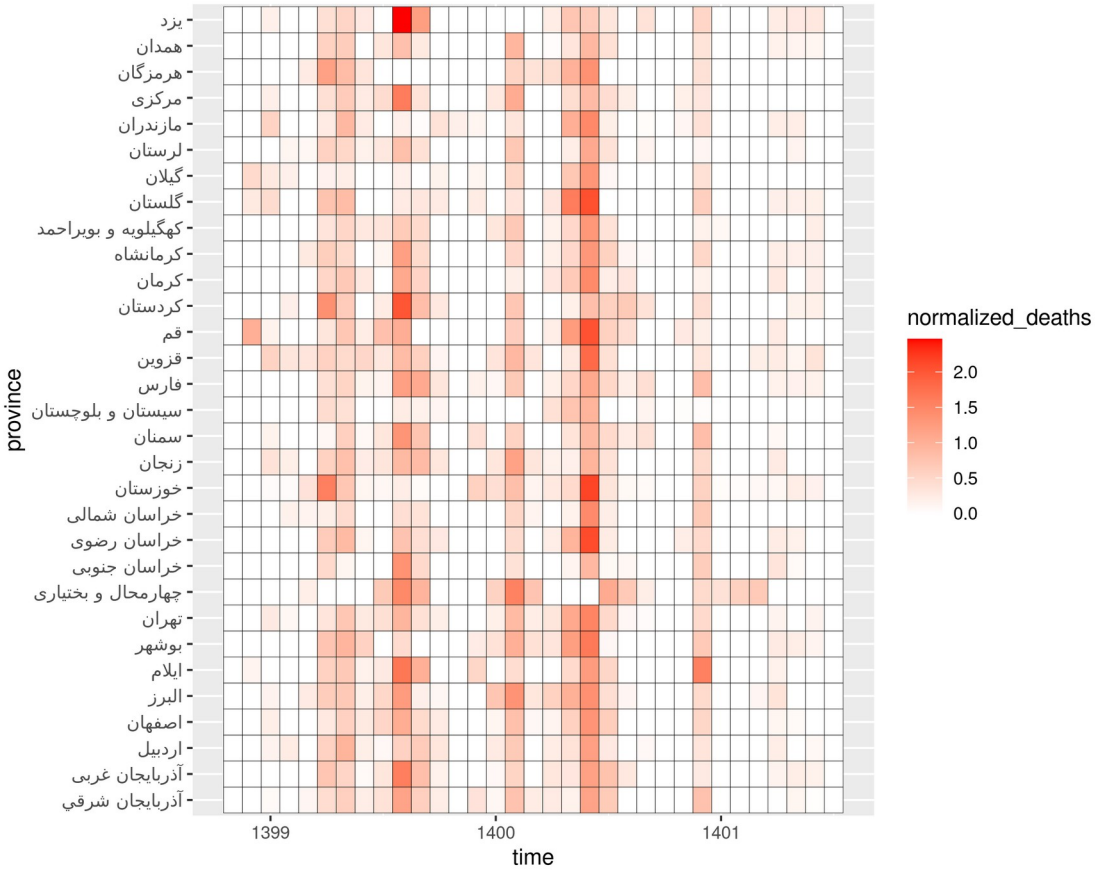
Question 2

you can see the answer in **`provinces-death.csv`** file. I used Question 1s answer and aggregated it by province.

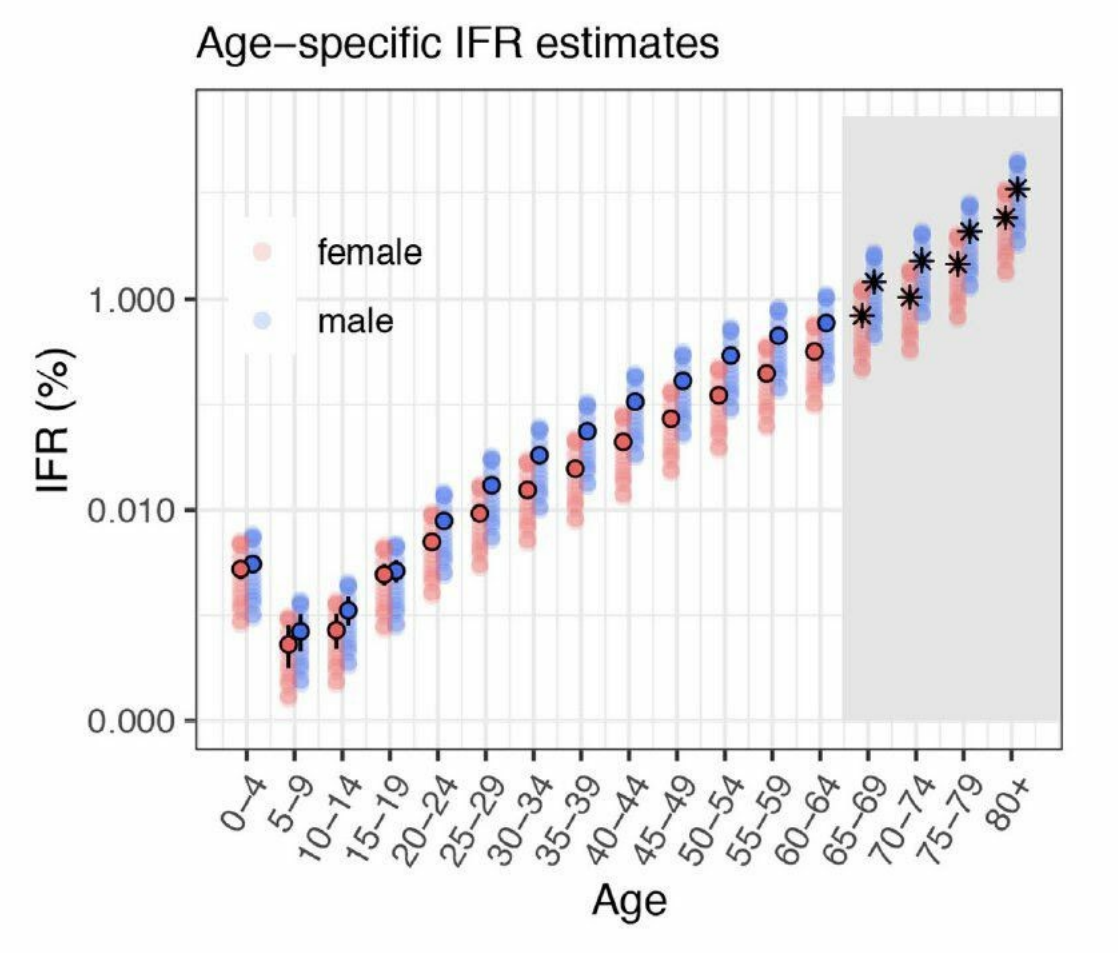
excess_death	normalized_death	predicted_deaths	استان
16164.372548887	0.251759958684038	64205.4941277357	آذربایجان شرقي
11127.0935430602	0.249102955576034	44668.6532374917	آذربایجان غربی
4424.63063766886	0.222402700884244	19894.6803257205	اردبیل
17019.0446711328	0.244156412233239	69705.4995011755	اصفهان
10337.8686947532	0.315128918814224	32805.2047195568	البرز
1756.17976190477	0.270646855802617	6488.82380952379	ایلام
3122.92857142857	0.262600575161389	11892.3142857143	بوشهر
46157.8173409	0.272229830379433	169554.590239304	تهران
2740.33295826339	0.252797692307322	10840.0236301683	چهارمحال و بختیاری
1624.6419282932	0.146071898338662	11122.2072607458	خراسان جنوبی

excess_death	normalized_death	predicted_deaths	استان
20975.6937081055	0.238164087732869	88072.4457989332	خراسان رضوی
2103.81205625009	0.151552465144739	13881.7409155362	خراسان شمالی
16219.7239212282	0.278054581777288	58332.8777305299	خوزستان
3809.13184529097	0.265656368049152	14338.567801944	زنجان
2157.51562174279	0.217290793817095	9929.16259286568	سمنان
3889.37066488741	0.108054619191804	35994.4877320193	سیستان و بلوچستان
16384.1177683715	0.266701016441287	61432.528405749	فارس
4977.90802499206	0.28393044750523	17532.13883446	قزوین
5070.37809126025	0.295614420857032	17151.9984598871	قم
5881.87692307693	0.282926832878159	20789.3923076923	کردستان
7625.59829660447	0.189845874929512	40167.3109802137	کرمان
7014.44695968735	0.223758928987322	31348.2326333659	کرمانشاه
1489.17199396997	0.183727173169129	8105.3442900312	کهگیلویه و بویراحمد
6476.77599270467	0.251088017964619	25794.8429606757	گلستان
6817.71340827685	0.141305884285138	48247.9087319502	گیلان
4427.76716543038	0.168021702458145	26352.352705945	لرستان
9691.38585424311	0.196378775282849	49350.4750718826	مازندران
4951.16088786975	0.229395410465708	21583.5219973151	مرکزی
3374.15934065934	0.184747513606435	18263.625175748	هرمزگان
5475.09321253241	0.176503080603505	31019.8167296105	همدان
3443.49221081875	0.249828116342599	13783.4454393298	یزد

I drew a heatmap by normalizing, excess death (dividing it by predicted deaths); It's named **`heatmap-provinces-by-time.png`** and red means more excess death.

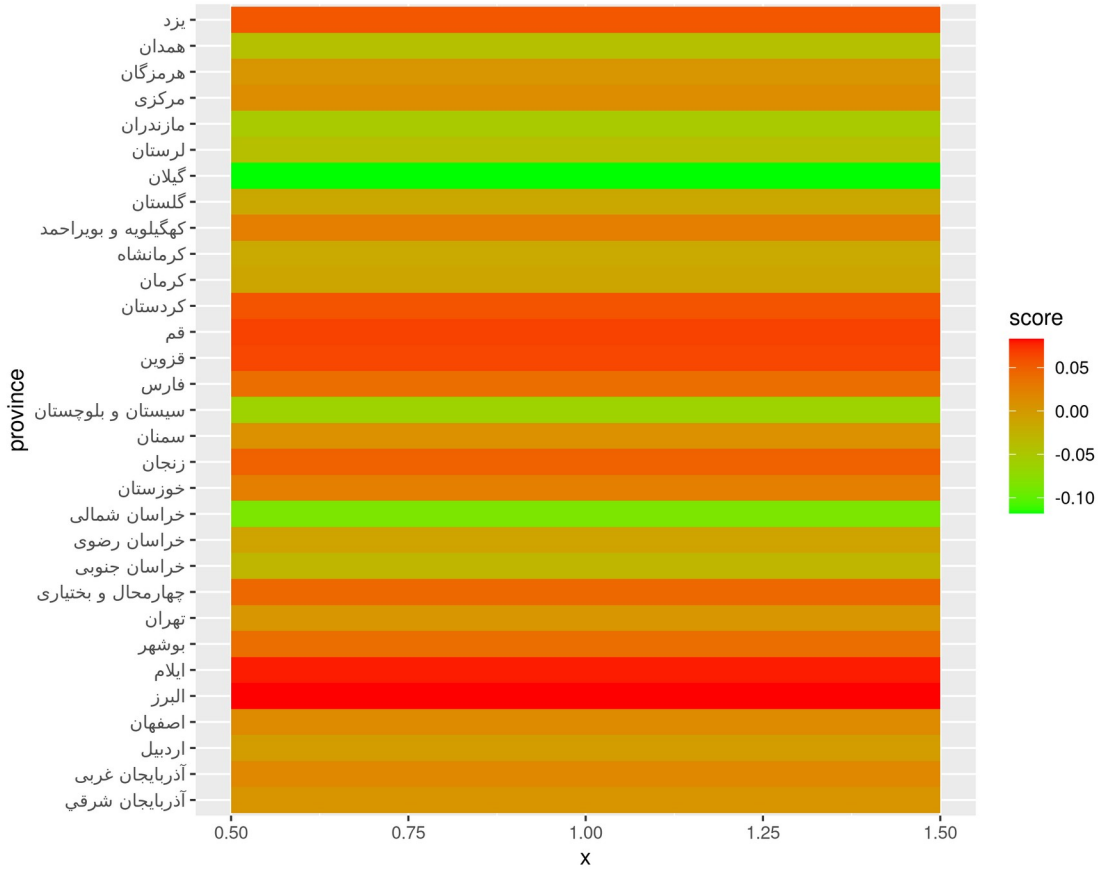

province
یزد
همدان
هرمزگان
مرکزی
مازندران
لرستان
گیلان
گلستان
کهگیلویه و بویراحمد
کرمانشاه
کرمان
کردستان
قم
قزوین
فارس
سیستان و بلوچستان
سمنان
زنجان
خوزستان
خراسان شمالی
خراسان رضوی
خراسان جنوبی
چهارمحال و بختیاری
تهران
بوشهر
ایلام
البرز
اصفهان
اردبیل
آذربایجان غربی
آذربایجان شرقي
1399
1400
1401
time
normalized_deaths
2.0
1.5
1.0
0.5
0.0

Question 3



By the image above we can conclude that age 45 till 80 is more prune to death by covid (higher than that can be noisy). I made linear model predicting each province excess death by pre covid death of said age group. The fited model had an Adjusted R-squared of `0.9623`.

Then I scored each province by their residual to the said line and normalized it like Question 2. I drew a heatmap named **`provinces-performances.png`** green means better performance.



We can see that some provinces like گیلان and خراسان شمالی were better than others and some provinces like ایلام and البرز were worse. And yes there is substantial difference between them.

score	استان
-0.117921511656693	گیلان
-0.0861715218356684	خراسان شمالی
-0.062607369978038	سیستان و بلوچستان
-0.0521672770563369	مازندران
-0.0411922713706035	همدان
-0.0394093939940929	لرستان
-0.029085963474852	خراسان جنوبی
-0.0155930558550585	کرمانشاه
-0.0143619540070557	گلستان
-0.0110346655274466	کرمان
-0.00873157665234498	خراسان رضوی
-0.00324988248981538	اردبیل
0.00402348716598945	هرمزگان
0.00420365358106597	تهران

score	استان
0.0052984070404647	آذربایجان شرقي
0.00881984700179208	سمنان
0.0120798389666201	مرکزی
0.0150756293671394	اصفهان
0.0179440346300615	آذربایجان غربی
0.0252781739122741	کهگیلویه و بویراحمد
0.0257463717014915	خوزستان
0.0383499155693316	بوشهر
0.0384133205192176	فارس
0.0430770127217586	چهارمحال و بختیاری
0.0492159947805244	زنجان
0.0553977045676227	یزد
0.0575456755173814	کردستان
0.0642266488379919	قزوین
0.06670063487863	قم
0.079467806875571	ایلام
0.0829631683496146	البرز

There is also a table called **`provinces-scores.csv`** containing the scores and sorted from best performance to least performance.

lower score means better performance. For example negative score is better than expected.

Thanks for your time :D