System test case - #4

Test case details

Tester: Eetu Luoma

Date: 26.03.2024

Device: Desktop Computer, fast modern processor, Windows 11 Home v.23H2

Environment details:

- Most recent master branch of the project github
- most recent commit is 369416d27d187954a714f2dfe7d13cb406573927
- Anaconda virtual environment used with development
- Python and used imports:
  - Python 3.12.1
  - numpy 1.26.3
  - pandas 2.1.4
  - us 3.1.1

Test details

Test is a system test, running the whole model with specific parameters.

In this test we attempt to recreate the results that Neil Patel achieved with the model in his Master's thesis, "Evaluation of the predictive capabilities of the SuEIR model (https://urn.fi/URN:NBN:fi:tuni-202311139623). Even though the model is not deterministic, we should see similar results as in the thesis IF the model is still functioning as it did for Patel. In any case, with this test we can attempt to see if the model is still working as expected.

IMPORTANT TO NOTE:

Neither the base code nor our project have any *nation level* data from the source of NYtimes. In the code, even if arguments attempt to use NYtimes with the level of 'nation', the program is hardcoded to use JHU global data since no other global data is used by the program. **Therefore**, one can only assume that if Patel did indeed run the base code with the parameters as designated in his master's thesis, the source of data was not NYTimes as Patel writes, but it must have been JHU.

Parameters:

- Dataset: NYtimes
- END_DATE: 2022-03-06
- VAL_END_DATE: 2022-03-08
- level: nation

Test steps and results:

1. Run validation.py with the following arguments:
   validation.py **–END_DATE** *2022-03-06* **–VAL_END_DATE** *2022-03-08* **–dataset** *NYTIMES* **–level** *nation*
   a. Result: After 43 minutes of runtime the program attempted to write some files into a nonexistent directory. Validation went seemingly fine, it just failed due to my mistake in the testing environment.
2. Repeat previous step, but just for nation ‘Argentina’ in order to not waste more time
   validation.py **–END_DATE** *2022-03-06* **–VAL_END_DATE** *2022-03-08* **–dataset** *NYTIMES* **–level** *nation* **–nation** *Argentina*
   a. Result: Success with a runtime of 1 minute 45 seconds. Relevant files in relevant folders.
3. Run generate_predictions.py with the previous arguments
   a. Result: Success with a runtime of 25 seconds. Relevant files in relevant folders.
4. Repeat step 1 in order to get a successful run
   a. Result: Successful validation, runtime of about 43 minutes. Files in relevant folder.
5. Run generate_predictions.py with the previous arguments
   a. Result: Successful run with a time of a little over 9 minutes. Files in relevant folder.

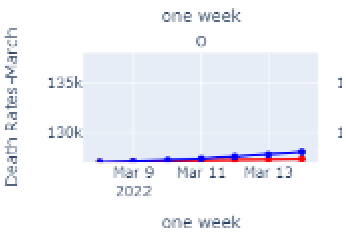
Test results

As I’m not a statistician and it really is outside the scope of this software engineering project, I am not able to make the various plots and graphs that Patel has in his thesis.

Since the thesis has no raw data and I am no statistician, I’ll just look at the raw values generated in the .csv file in Results_5. It has also been saved as a cleaner, .xlsx -file for easier reading.

Comparing generated values to graphs of Argentina, page 35 of Patel’s thesis:

- Assuming that Patel used the same dates in the arguments, the results seem to vary by a small amount. The test file predicts no fatalities in the first week of predicted data, but in Patel’s graph mortality is predicted to increase: pictures of Patel’s graph and of relevant lines from pred_excel_cleaner.xlsx.

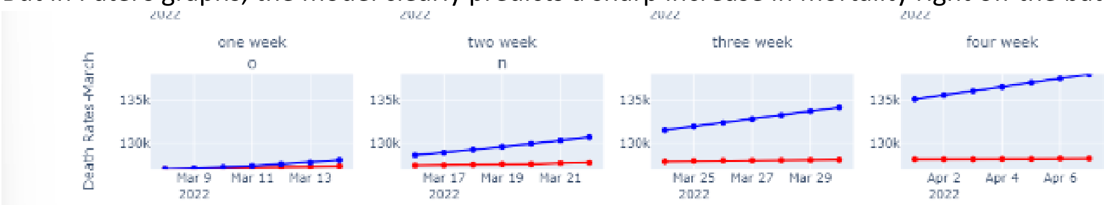


Date	lowe	upp	low	upp	pre_confirm	pre_fata	pre_fata_daily	low	upp	low	uppe	pre_act	pre_confirm_daily	lower_pre_confirm_daily	upper_pre_confirm_daily	Region
2022-06-15	6085	614	147	163	6097132.243497509	157005.88752655894	76.54566297162091	36.	135	64	5461	211804.59820971097	100.21791846025735	31.449476400390267	514.7145629804581	Colombia
2022-03-08	8945	894	126	126	8949362.0	126901.0	0.0	0.0	0.0	61	7603	7358407.438027053	0.0	0.0	0.0	Argentina
2022-03-09	8955	895	126	126	8955817.142857144	126993.0	92.0	92.	92.	56	7259	6893226.279986459	6455.142857143655	6455.142857143655	6455.142857143655	Argentina
2022-03-10	8961	896	126	127	8962225.11850278	127005.92755297695	12.92755297695112	0.0	14	52	6956	6453380.4585935995	6407.97564563714	6074.563137490302	7060.373711436987	Argentina
2022-03-11	8967	897	126	127	8968564.696995506	127005.92755297695	0.0	0.0	18	48	6667	6053257.102630839	6341.092055894434	5717.9267328400165	7518.652534557506	Argentina
2022-03-12	8972	897	126	127	8974829.380312275	127005.92755297695	0.0	0.0	22	45	6391	5695930.386691973	6262.1483745239675	5389.357219289988	7855.070864923298	Argentina
2022-03-13	8978	898	126	127	8981009.117200822	127005.92755297695	0.0	0.0	26	41	6127	5372096.45554629	6178.590197958052	5090.857249984518	8100.550410028547	Argentina
2022-03-14	8982	899	126	128	8987111.472598491	127005.92755297695	0.0	0.0	29	38	5874	5072864.418347394	6094.7064348924905	4820.741022802889	8294.103214297444	Argentina
2022-03-15	8987	900	126	128	8993115.76089908	127005.92755297695	0.0	0.0	32	35	5633	4799194.693911411	6004.288300588727	4579.290049210191	8420.09063395299	Argentina
2022-03-16	8991	901	126	128	8999025.942908512	127005.92755297695	0.0	0.0	35	33	5402	4550058.649221348	5913.8592490088195	4362.385151915252	8481.988503659144	Argentina
2022-03-17	8996	901	126	129	9004838.3077663	127005.92755297695	0.0	0.0	37	30	5182	4304050.705053915	5818.153729407117	4165.350783441216	8487.20527562499	Argentina
2022-03-18	9000	902	126	129	9010573.511161037	127005.92755297695	0.0	0.0	39	28	4971	4076322.4088369077	5724.94755782187	3984.3877686187625	8502.971781924367	Argentina
2022-03-19	9003	903	126	129	9016173.369088093	127005.92755297695	0.0	0.0	41	26	4769	3841397.2933468544	5629.530437845737	3816.708486381918	8557.561551148072	Argentina
2022-03-20	9007	904	126	130	9021700.117810331	127005.92755297695	0.0	0.0	43	24	4575	3620344.020312384	5535.099979056045	3660.397193292156	8584.105950763449	Argentina

In fact, in the test file a mortality increase is only observed at the end of the prediction window. Image of rows here: note small amount of mortality growth

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
77	2022-05-22	9105	932	126	155	9197155.73759813	127005.92755297695	0.0	0.0	21	36	3754	109643.43656400187	832.1944174952805	511.8593145981431	1807.8223808649927	Argentina
78	2022-05-23	9110	932	126	155	9197916.496200232	127005.92755297695	0.0	0.0	210	34	3610	104248.89060726532	800.0005935821682	480.1575878225267	1769.71886962652	Argentina
79	2022-05-24	9111	932	126	155	9198645.915672872	127005.92755297695	0.0	0.0	205	33	3472	99147.72663142599	769.3547042440623	449.7249182146042	1732.1213464289904	Argentina
80	2022-05-25	9111	932	126	155	9199344.913802132	127005.92755297695	0.0	0.0	200	31	3339	94322.15026766105	739.5619170665741	420.50458534248173	1695.019068369642	Argentina
81	2022-05-26	9112	933	126	156	9200014.378346883	127005.92755297695	0.0	0.0	195	29	3211	89754.71851382653	710.5978782121092	392.479853739962	1658.4016040805727	Argentina
82	2022-05-27	9112	933	126	156	9200655.167314801	127005.92755297695	0.0	0.0	191	28	3089	85428.33973445754	682.4385118912905	365.6037959624082	1622.2588040400296	Argentina
83	2022-05-28	9113	933	126	156	9201268.109212125	127005.92755297695	0.0	0.0	186	27	2971	81326.27366076807	655.059993898496	339.7757685929537	1586.5807737838477	Argentina
84	2022-05-29	9113	933	126	156	9201854.003269635	127005.92755297695	0.0	0.0	181	25	2857	77432.13139065112	628.4387276712805	314.962268454954	1551.3578496314585	Argentina
85	2022-05-30	9114	933	126	156	9202413.619647145	127005.92755297695	0.0	0.0	17	24	2748	73729.87538868072	602.2284175623208	291.1304331608166	1516.5805766936392	Argentina
86	2022-05-31	9114	933	126	156	9202947.753384953	127005.92755297695	0.0	0.0	17	23	2644	70208.13993865096	576.3984345514327	268.24757553078234	1482.5030479319394	Argentina
87	2022-06-01	9115	933	126	157	9203457.249443948	127005.92755297695	0.0	0.0	169	22	2543	66864.38111401546	554.4612385295331	246.28116693720222	1449.3437382336706	Argentina
88	2022-06-02	9115	933	126	157	9203942.84220135	127005.92755297695	0.0	0.0	165	21	2446	63690.964743725104	534.5497255083174	225.1988222265005	1416.7584533244371	Argentina
89	2022-06-03	9116	933	126	157	9204405.244290806	127005.92755297695	0.0	0.0	161	20	2354	60680.18134908578	513.3213834855705	204.96828602068126	1384.734591640532	Argentina
90	2022-06-04	9116	933	126	157	9204845.149775783	127007.63996651079	1.7124135340709472	0.0	157	19	2264	57824.46189108392	493.6535101272166	185.5574204362929	1353.2635733429343	Argentina
91	2022-06-05	9117	933	126	157	9205263.234261783	127011.37861506433	3.738648553538951	0.0	153	18	2179	55116.377770386476	474.47036257758737	166.9341938495636	1322.336933227256	Argentina
92	2022-06-06	9117	933	126	157	9205660.154997893	127017.03822576629	5.6596107019577175	0.0	150	17	2096	52548.64082734092	456.9395071864128	149.0666707996279	1291.9463097527623	Argentina
93	2022-06-07	9118	933	126	158	9206036.550968656	127024.52324528694	7.485019520652713	0.0	146	16	2017	50114.10334197525	437.50759932026267	131.92300284840167	1262.0834352187812	Argentina
94	2022-06-08	9118	933	126	158	9206393.042977218	127033.74721177094	9.223966484001721	0.0	143	15	1941	47805.758033997976	419.01202563755214	115.4714202769100	1232.7401268221438	Argentina
95	2022-06-09	9118	934	126	158	9206730.233720534	127044.63215740402	10.884945633079042	0.0	140	14	1868	45616.73806279818	402.3326859511435	99.67636000737548	1203.9082785695791	Argentina
96	2022-06-10	9119	934	126	158	9207048.707857447	127057.10804011987	12.475882715851185	0.0	137	14	1797	43540.31702744539	384.44388668239117	84.50144276209176	1175.5798539947718	Argentina
97	2022-06-11	9119	934	126	158	9207349.032070277	127071.11220302765	14.004162907775026	0.0	13	14	1725	41569.908966689734	367.8967516552657	69.92935106344521	1147.746879503131	Argentina
98	2022-06-12	9120	934	126	158	9207631.755120542	127086.58886020581	15.476657178165624	0.0	13	12	1663	39699.068358963	352.74843775853515	55.93870033696294	1120.4014384150505	Argentina
99	2022-06-13	9120	934	126	158	9207897.40789938	127103.48860757699	16.89974737117882	0.0	12	12	1600	37921.4901223809	337.71888223290443	42.50790843553841	1093.5356655567884	Argentina
100	2022-06-14	9120	934	126	158	9208146.503473185	127121.76795764155	18.279350064563914	0.0	12	11	1540	36231.00961472801	323.07724062539637	29.615436416119337	1067.1417423319072	Argentina
101	2022-06-15	9120	934	126	159	9208379.53712488	127141.38889690451	19.620939226295347	0.0	12	10	1481	34621.60263347583	306.820976158604	17.239784438163042	1041.21189231053	Argentina

But in Patel's graphs, the model clearly predicts a sharp increase in mortality right off the bat

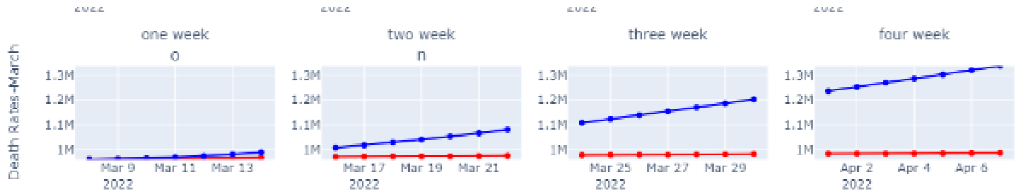


This difference is something I am unable to explain at this time.

If Patel used the same base code as our project does, that being the publicly available repository of UCLA people, then Patel's run of the program on these arguments must also have used JHU data instead of NYtimes data, which means the test case here and Patel's run used the same dataset for the prediction. Maybe it can be explained by the machine learning not being deterministic, but this test case predicts 0 increase in mortality between 2022-03-08 and 2022-03-15, but Patel's graph above would indicate that his run of the model predicted atleast a few thousand mortalities in that time period.

Looking at mortality for US, Patel's graphs on page 38, a difference can also be found.

702	2022-03-08	7945	7946	961	961	79499165.0	961251.0	0.0	0.0	0.0	58	7102	69839506.94310157	0.0	0.0	0.0	US
703	2022-03-09	7953	7959	962	962	79537838.57142857	962560.2857142857	1309.285714285681	13	13	58	7103	69857355.20005526	38673.57142856717	38673.57142856717	38673.57142856717	US
704	2022-03-10	7958	7969	963	963	79622808.66121751	963812.452932554	1252.1672182682669	12	12	58	7110	69919597.59866172	84970.08978894353	42217.74496630012	95944.11552512646	US
705	2022-03-11	7962	7979	964	965	79727044.7832775	965010.9769870394	1198.5240544854896	11	12	58	7115	69999335.15608998	104608.72673843801	43466.117799177766	117408.91509707272	US
706	2022-03-12	7966	7989	966	966	79840793.86881472	966164.4074003675	1153.2240540781058	10	11	58	7128	70073984.23310606	113535.90778669715	43660.317349776626	127345.56570188701	US
707	2022-03-13	7971	8009	967	967	79957955.88145225	967284.0251923066	1119.280943607213	10	11	58	7137	70151193.93678345	117769.20434598625	43394.59621326625	132035.9671150893	US
708	2022-03-14	7975	8019	967	968	80080026.17694756	968380.9484887675	1097.5637553664856	97	11	58	7146	70222596.51474085	120156.6741875261	42957.49368163943	134275.00845995545	US
709	2022-03-15	7979	8029	968	969	80200610.76348841	969466.7261480081	1086.1748197762063	93	11	58	7154	70314601.59314866	121460.07906535268	42427.57594434917	135797.03094390035	US
710	2022-03-16	7983	8049	969	970	80322373.60123235	970549.1308237696	1082.4046757614706	91	11	58	7163	70376682.45304784	122597.75906823575	41962.11424331367	136531.29377029836	US
711	2022-03-17	7987	8059	970	972	80447265.06393439	971632.6264041481	1083.4955803784542	89	11	58	7171	70469132.11997244	123332.62174090743	41460.428413674235	137357.13475953043	US
712	2022-03-18	7992	8069	971	973	80569512.02899824	972719.8966572339	1087.077893251204	87	11	58	7180	70565827.99993782	123789.86646981537	40980.36788481474	138965.25812488794	US
713	2022-03-19	7996	8089	972	974	80692967.69172141	973812.1900526469	1091.643055984634	86	12	58	7188	70623930.12645178	124183.60160237551	40554.61296804249	140400.91239215434	US
714	2022-03-20	8000	8059	973	975	80818716.40726271	974909.9309659399	1096.5901971640997	85	12	58	7196	70707577.81050014	124596.88122339547	40133.10720744729	141787.72056286037	US
715	2022-03-21	8004	8119	974	976	80941943.99205227	976013.1450684278	1101.6192645416595	84	12	58	7203	70766746.02230442	124889.98385067284	39684.96587604284	143031.21928100288	US
716	2022-03-22	8008	8129	975	978	81064936.3666669	977121.6936613009	1106.8930860732216	83	12	58	7211	70847394.3273017	124543.41573929787	39271.38071003556	143956.5310147017	US
717	2022-03-23	8011	8139	975	979	81187145.12829873	978233.6996321667	1111.9884713181527	82	12	57	7218	70940153.87024586	123988.01375435293	38901.80135446787	144537.54627208412	US
718	2022-03-24	8015	8169	976	980	81314237.53650187	979348.7143140469	1116.9082643374568	81	12	57	7226	71003468.86287679	123685.4844044894	38546.63363318456	145104.05166947287	US
719	2022-03-25	8019	8169	977	981	81435835.540023	980467.7339426412	1121.6299715444911	80	12	57	7233	71067741.54470338	123033.05768802762	38176.87981556356	145652.21695062518	US
720	2022-03-26	8023	8179	978	983	81563257.22865544	981590.5188038546	1126.1652076501632	79	12	57	7235	71119947.48027405	121983.0526728332	37769.11559487879	146050.58821997046	US
721	2022-03-27	8027	8159	979	984	81683579.98772682	982716.8385618863	1130.5011909109307	78	13	57	7246	71174507.71903314	121398.38338012993	37393.05906006694	146166.31163327396	US
722	2022-03-28	8030	8209	979	985	81803246.43560573	983848.5777402329	1134.320652010967	78	13	57	7253	71219273.58936042	120801.23270986974	37091.61084267497	145921.31667603552	US
723	2022-03-29	8034	8229	980	987	81921909.0059892	984986.8067612449	1138.2290210119681	77	13	57	7259	71267211.6033874	119616.44594404101	36814.39873512089	145767.20317308605	US
724	2022-03-30	8038	8239	981	988	82041688.24373247	986128.7701200618	1141.9633588169236	76	13	57	7265	71313581.58820352	118659.54241725802	36507.89005802572	145805.29923194647	US
725	2022-03-31	8041	8259	982	989	82165243.20633976	987274.5752723953	1145.5453617864987	75	13	57	7271	71358083.21823367	117966.07606428862	36122.07425934076	145775.74494856596	US
726	2022-04-01	8045	8269	982	991	82284700.45949104	988424.1995200096	1148.9689860935323	75	13	57	7277	71401450.45869134	116801.47731648386	35756.934371337295	145417.88488015532	US
727	2022-04-02	8048	8279	983	992	82400362.4892489	989577.1915693401	1152.235425437335	74	13	57	7283	71453998.83643846	115570.95351231098	35501.32921560109	144629.22784043849	US
728	2022-04-03	8052	8299	984	993	82518267.70686331	990733.3992195252	1155.3664133623242	74	13	57	7288	71501081.63433702	114768.77258653939	35274.37108412385	144136.22893472016	US
729	2022-04-04	8055	8309	985	995	82634771.38901722	991892.6871319859	1158.3647328326479	73	13	57	7294	71541590.77179047	113527.91117058694	34996.59622773528	143919.85902108252	US
730	2022-04-05	8059	8329	985	996	82754202.99957111	993054.9378828278	1161.0660737842554	73	13	57	7299	71580608.816416	112323.51006030417	34621.639354005456	143630.41798901558	US
731	2022-04-06	8062	8339	986	998	82868431.66760984	994220.0219201805	1163.7998767968966	72	13	57	7304	71617876.37478358	111294.6820653528	34329.49266976118	142924.23434825242	US
732	2022-04-07	8066	8359	987	999	82977949.5516897	995387.8104396136	1166.4044649525313	72	13	57	7305	71653974.9604936	110099.6904989779	34118.862128287554	141789.22641019523	US
733	2022-04-08	8069	8389	987	100	83086421.8928138	996550.5314223222	1168.9009941265685	71	13	57	7314	71688913.41858123	109039.73532792926	33908.49179176986	141162.55721713603	US



In the test case, mortality is predicted to have about 1200 cases per day throughout the whole prediction period, starting at 962 560 total in 2022-03-09, and finishing at 1 077 837 in 2022-06-15. This means that the test case predicts mortality to get about a 110 000 new cases in three months, but Patel's run presumably predicted much sharper mortality rates, reaching 1 100 000 cases in just two weeks of prediction. This difference in daily predicted mortality is surely significant.

To sum up, I have no idea why the results of this test case vary so from the results seen in Patel's thesis. This is really not my field and I do not understand the mathematical model behind the code, or even the program in that much depth. More testing should be done in regards to Patel's results, and the other members of the team should also take a look at this in case I am missing something crucial.