

# Smoothing

## Introduction

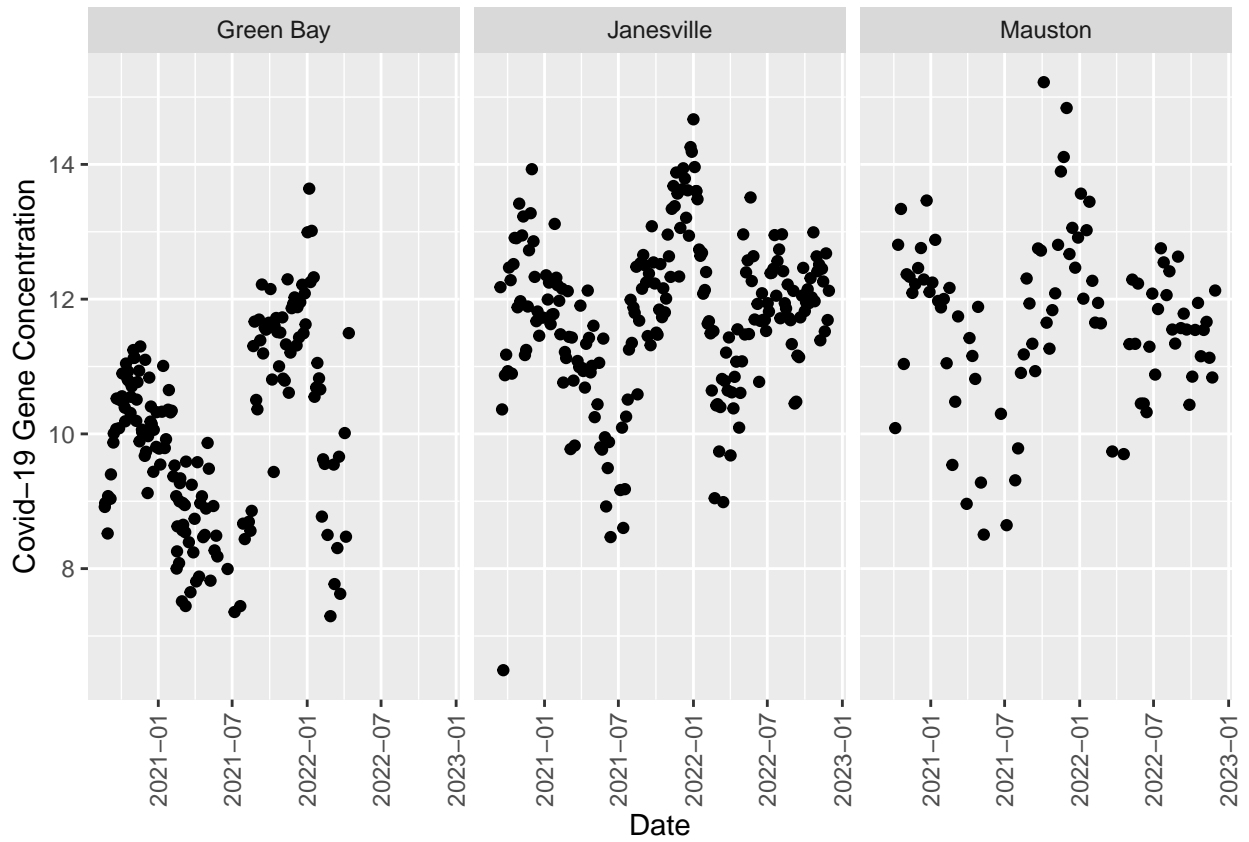
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### Overview of Smoothing

In this vignette, we will explore the smoothing techniques supported in the Covid19Wastewater package. Smoothing is a widely used technique in data analysis and visualization that helps reduce noise, reveal underlying trends, and highlight important patterns in the data. Covid19Wastewater provides several powerful functions to perform smoothing operations, and this vignette will guide you through their usage and showcase their capabilities.

### Data

We will be using the long range Madison Covid data in the vignettes with the occasional use of other data to show a more complete picture of the different smoothing options. This data set has a clear trend but a ton of noise.



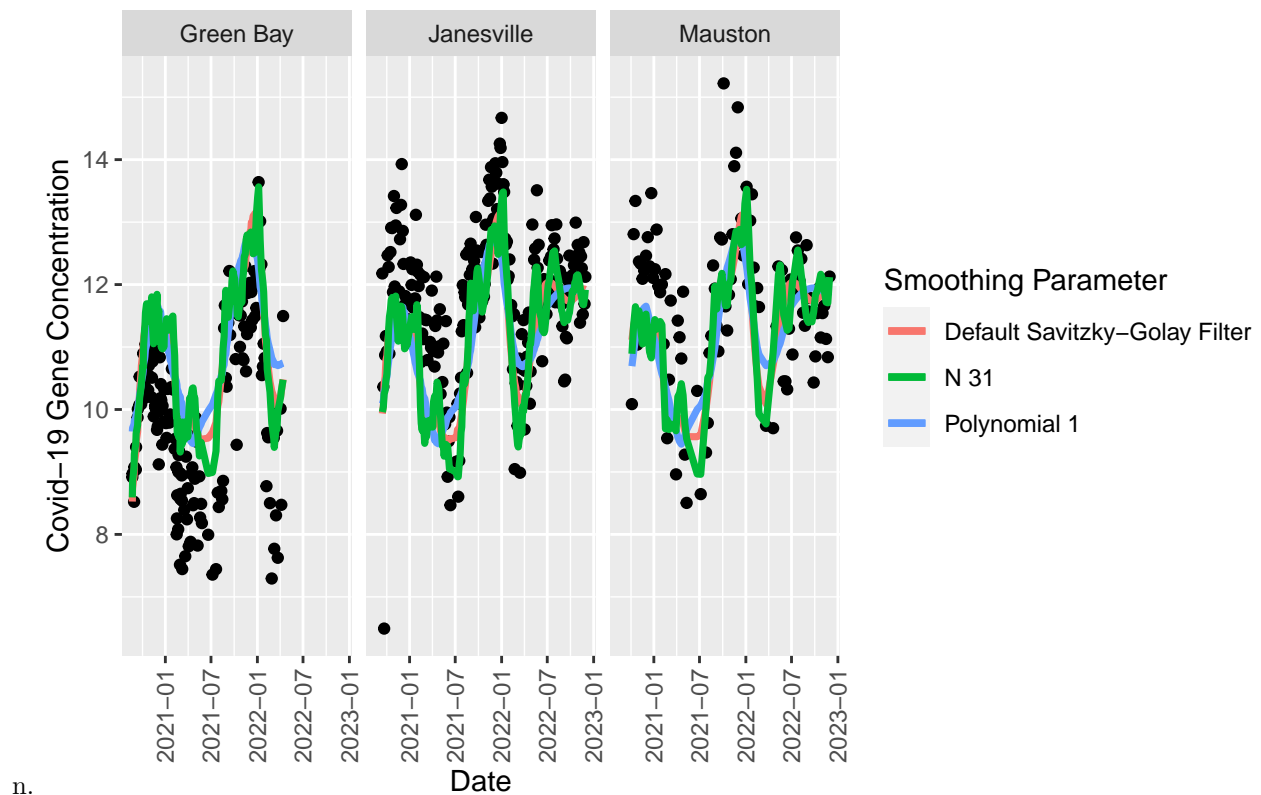
## Smoothing Techniques

Each smoothing function shares the same framework. The first three arguments are the dataframe, the name of the column to be smoothed, and the name of the column the smoothing is placed. The last argument “Filter” control if some data points should be removed before the filtering happening. Other arguments are parameters for how the smoothing should be done.

### Savitzky-Golay Filter

The Savitzky-Golay filter is a widely used smoothing technique that performs local polynomial regression on the data. It provides excellent noise reduction while preserving important features such as peaks and valleys. The Covid19Wastewater package includes the `sgolaySmoothMod()` function, which allows you to apply this filter to your data. `sgolaySmoothMod()` has 2 parameters. “poly” controls the degree of the polynomial fit on the local data whereas “n” control the number of points considered “local”. by default its set to “guess” which uses the density of the data to make guesses about the ideal

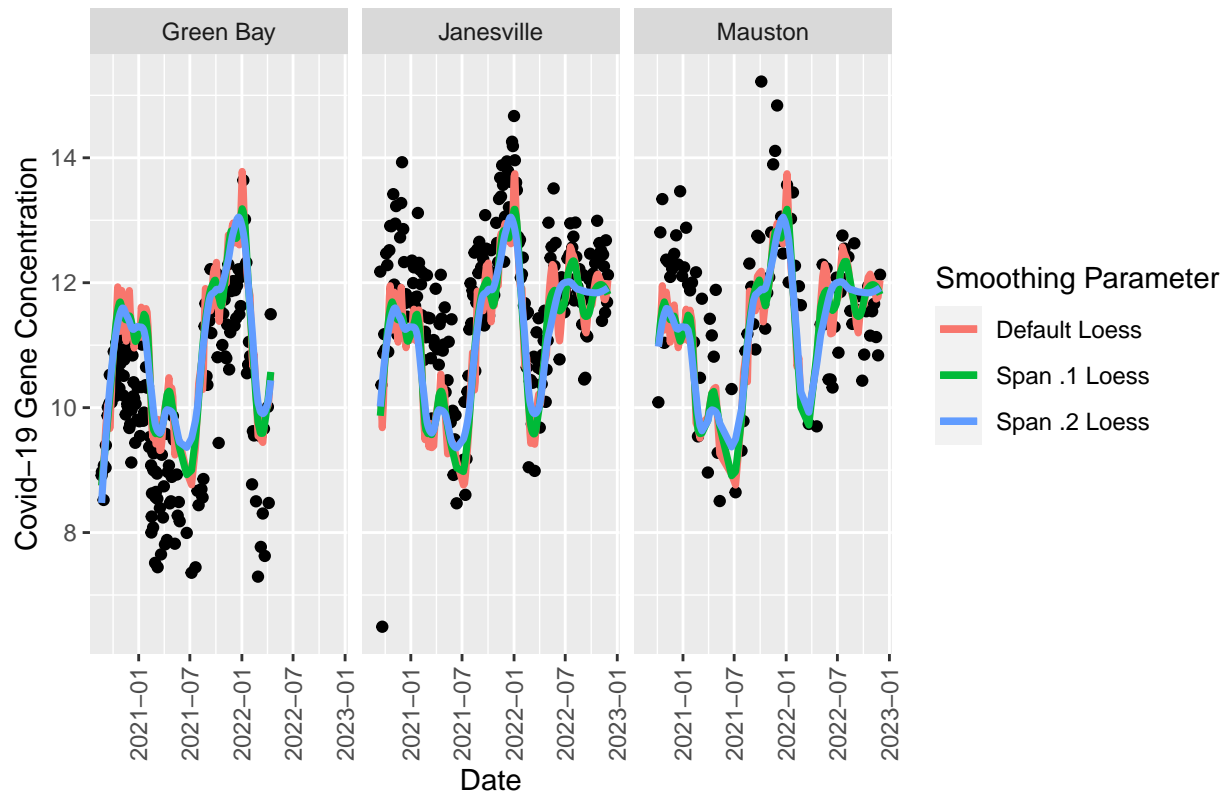
#### Savitzky-Golay Smoothing With Different Parameters



### Loess Smoothing

Loess (locally estimated scatterplot smoothing) is a non-parametric regression technique that fits a smooth curve to the data by locally weighted polynomial regression. It is particularly useful when dealing with complex or nonlinear relationships. The Covid19Wastewater package provides the `loessSmoothMod()` function to perform loess smoothing on your data. The only parameter is “span” which controls what portion of the data is looked at. This is set to “guess” by default where the package picks what it thinks is optimal based on data density.

## Loess Smoothing With Different Parameters



##	site	date	N1	N2	N1_sgolay
## 1	Green Bay	2020-08-23	8.915916	8.403801	8.526126
## 2	Green Bay	2020-08-24	8.973503	8.462272	8.739188
## 3	Green Bay	2020-08-30	8.521822	8.430851	8.940858
## 4	Green Bay	2020-08-31	9.076032	8.417152	9.131558
## 5	Green Bay	2020-09-06	9.037129	7.914252	9.311701
## 6	Green Bay	2020-09-07	9.398644	8.723622	9.481689
## 7	Green Bay	2020-09-13	9.871873	9.051860	9.641916
## 8	Green Bay	2020-09-14	10.006333	9.332062	9.792766
## 9	Janesville	2020-09-15	12.177874	11.757040	9.934614
## 10	Janesville	2020-09-19	10.362999	9.626679	10.067825
## 11	Green Bay	2020-09-20	10.072926	9.464424	10.192757
## 12	Green Bay	2020-09-21	10.525225	9.874718	10.309757
## 13	Janesville	2020-09-22	6.492240	4.553877	10.419163
## 14	Janesville	2020-09-26	10.870642	10.601846	10.521307
## 15	Green Bay	2020-09-27	10.084108	9.568630	10.616510
## 16	Green Bay	2020-09-28	10.506688	9.902487	10.705084
## 17	Janesville	2020-09-29	11.175773	11.498096	10.787334
## 18	Janesville	2020-10-03	10.930801	10.684669	10.863557
## 19	Green Bay	2020-10-04	10.558310	9.888333	10.934040
## 20	Green Bay	2020-10-05	10.896206	10.342310	10.999063
## 21	Janesville	2020-10-06	12.468437	12.736701	11.058898
## 22	Mauston	2020-10-06	10.085809	10.518673	11.113808
## 23	Green Bay	2020-10-07	10.467801	9.938237	11.164049
## 24	Janesville	2020-10-10	12.281380	10.919099	11.209869
## 25	Green Bay	2020-10-11	10.388872	10.109916	11.251509
## 26	Green Bay	2020-10-12	10.186921	9.675733	11.289201

## 27	Janesville	2020-10-13	10.894162	11.071983	11.323170
## 28	Mauston	2020-10-13	12.806929	13.134254	11.353634
## 29	Green Bay	2020-10-14	11.044239	10.498713	11.380804
## 30	Janesville	2020-10-17	12.520076	12.286897	11.404883
## 31	Green Bay	2020-10-18	10.804517	10.286747	11.426067
## 32	Green Bay	2020-10-19	10.927973	10.175802	11.444545
## 33	Janesville	2020-10-20	12.909482	12.686951	11.460500
## 34	Mauston	2020-10-20	13.338648	13.087325	11.474106
## 35	Green Bay	2020-10-21	10.784988	10.309867	11.485532
## 36	Janesville	2020-10-24	12.904051	12.740617	11.494941
## 37	Green Bay	2020-10-25	10.309867	10.007147	11.502488
## 38	Green Bay	2020-10-26	10.550029	10.227762	11.508322
## 39	Janesville	2020-10-27	11.878561	11.261858	11.512585
## 40	Mauston	2020-10-27	11.037306	10.523365	11.515414
## 41	Green Bay	2020-10-28	10.704389	10.174735	11.516940
## 42	Janesville	2020-10-31	13.417522	13.309749	11.517285
## 43	Green Bay	2020-11-01	11.244642	10.519486	11.516569
## 44	Green Bay	2020-11-02	11.127203	10.209881	11.514904
## 45	Janesville	2020-11-03	11.969381	11.841229	11.512396
## 46	Mauston	2020-11-03	12.369326	12.186982	11.509146
## 47	Green Bay	2020-11-04	11.131314	10.003985	11.505250
## 48	Janesville	2020-11-07	12.945781	12.668230	11.500797
## 49	Green Bay	2020-11-08	10.193249	10.611214	11.495871
## 50	Green Bay	2020-11-09	10.508840	10.133868	11.490552
## 51	Janesville	2020-11-10	13.226668	13.040739	11.484914
## 52	Mauston	2020-11-10	12.332027	12.229765	11.479024
## 53	Green Bay	2020-11-11	10.768613	10.415134	11.472948
## 54	Janesville	2020-11-14	11.169998	11.143556	11.466743
## 55	Green Bay	2020-11-15	10.936982	10.569105	11.460465
## 56	Green Bay	2020-11-16	9.889364	9.706758	11.454161
## 57	Janesville	2020-11-17	11.245882	10.882152	11.447877
## 58	Mauston	2020-11-17	12.092546	12.283992	11.441652
## 59	Green Bay	2020-11-18	11.297784	10.706587	11.435523
## 60	Janesville	2020-11-21	11.890546	10.410155	11.429521
## 61	Green Bay	2020-11-22	10.062409	9.080385	11.423673
## 62	Green Bay	2020-11-23	10.020317	8.921705	11.418001
## 63	Janesville	2020-11-24	12.725289	12.246346	11.412525
## 64	Mauston	2020-11-24	12.222556	11.899704	11.407259
## 65	Janesville	2020-11-28	13.275587	13.203873	11.402214
## 66	Green Bay	2020-11-29	9.673826	9.616720	11.397398
## 67	Green Bay	2020-11-30	11.099426	11.070202	11.392815
## 68	Janesville	2020-12-01	13.928950	13.834961	11.388463
## 69	Mauston	2020-12-01	12.462101	12.253533	11.353541
## 70	Green Bay	2020-12-02	9.734088	9.525970	11.339657
## 71	Janesville	2020-12-05	12.858645	12.661942	11.343284
## 72	Green Bay	2020-12-06	9.121781	9.061060	11.375043
## 73	Green Bay	2020-12-07	9.966562	8.967375	11.393122
## 74	Janesville	2020-12-08	12.330059	12.688026	11.383897
## 75	Mauston	2020-12-08	12.758693	12.640702	11.386787
## 76	Green Bay	2020-12-10	10.835599	10.141625	11.378112
## 77	Janesville	2020-12-12	11.672780	12.186803	11.333813
## 78	Green Bay	2020-12-13	10.182182	8.958406	11.300887
## 79	Green Bay	2020-12-14	10.406279	9.340169	11.327402
## 80	Janesville	2020-12-15	11.816365	11.772455	11.345907

## 81	Mauston	2020-12-15	12.291429	12.048237	11.392920
## 82	Green Bay	2020-12-16	10.146030	9.934495	11.399803
## 83	Janesville	2020-12-19	11.456546	12.191401	11.403175
## 84	Green Bay	2020-12-20	9.437379	9.604519	11.383849
## 85	Green Bay	2020-12-21	10.060017	10.060017	11.349472
## 86	Janesville	2020-12-22	11.727036	12.118465	11.366118
## 87	Mauston	2020-12-22	13.463827	13.996653	11.361034
## 88	Green Bay	2020-12-27	9.807247	10.095315	11.374596
## 89	Green Bay	2020-12-28	10.322381	9.977026	11.325934
## 90	Janesville	2020-12-29	11.725323	11.997251	11.359016
## 91	Mauston	2020-12-29	12.106904	11.868325	11.345760
## 92	Green Bay	2021-01-03	9.781475	9.716936	11.305627
## 93	Janesville	2021-01-05	12.354092	12.535384	11.321493
## 94	Mauston	2021-01-05	12.246029	12.126445	11.299233
## 95	Green Bay	2021-01-06	9.545191	9.545191	11.313216
## 96	Janesville	2021-01-09	11.994376	12.412481	11.301335
## 97	Green Bay	2021-01-10	10.328809	9.491681	11.284213
## 98	Janesville	2021-01-12	12.245572	12.430463	11.259418
## 99	Mauston	2021-01-12	12.880569	12.655019	11.219691
## 100	Green Bay	2021-01-13	11.009059	10.525144	11.227901
## 101	Janesville	2021-01-16	11.628920	11.950800	11.200158
## 102	Green Bay	2021-01-17	9.789355	9.258177	11.130097
## 103	Janesville	2021-01-19	11.770571	12.185074	11.135047
## 104	Mauston	2021-01-19	11.973384	11.945649	11.064316
## 105	Green Bay	2021-01-20	9.921168	9.655599	11.060353
## 106	Janesville	2021-01-23	11.777718	12.207157	11.043833
## 107	Green Bay	2021-01-25	10.359012	9.763916	10.977774
## 108	Janesville	2021-01-26	13.116687	12.726683	10.958165
## 109	Mauston	2021-01-26	11.877270	11.709873	10.912157
## 110	Green Bay	2021-01-27	10.650462	9.929049	10.862279
## 111	Janesville	2021-01-30	12.318240	12.287422	10.848116
## 112	Green Bay	2021-01-31	10.319152	9.363271	10.793896
## 113	Janesville	2021-02-02	12.206917	11.868177	10.765138
## 114	Mauston	2021-02-02	12.002462	11.687450	10.702982
## 115	Green Bay	2021-02-03	10.343348	9.575781	10.662882
## 116	Janesville	2021-02-06	11.975048	11.709881	10.583537
## 117	Green Bay	2021-02-07	9.369262	8.764122	10.547104
## 118	Janesville	2021-02-09	11.478489	10.874797	10.490522
## 119	Mauston	2021-02-09	11.048490	10.963965	10.434017
## 120	Green Bay	2021-02-10	9.531064	9.531064	10.360608
## 121	Janesville	2021-02-13	12.155390	12.326984	10.344381
## 122	Green Bay	2021-02-14	9.075589	7.976976	10.294185
## 123	Green Bay	2021-02-15	8.000730	8.000730	10.262129
## 124	Green Bay	2021-02-16	8.256209	8.256209	10.229023
## 125	Janesville	2021-02-16	10.761853	10.415293	10.203170
## 126	Mauston	2021-02-16	12.166807	11.625280	10.149562
## 127	Green Bay	2021-02-17	8.627146	7.034504	10.146915
## 128	Janesville	2021-02-20	11.215597	10.768822	10.091076
## 129	Green Bay	2021-02-21	8.081856	8.369538	10.089115
## 130	Green Bay	2021-02-22	8.999012	8.746461	10.079095
## 131	Green Bay	2021-02-23	9.268801	9.067543	10.041964
## 132	Janesville	2021-02-23	11.126130	10.484977	10.015061
## 133	Mauston	2021-02-23	9.539428	9.672123	9.952162
## 134	Green Bay	2021-02-24	9.340169	8.385641	9.937000

##	135	Janesville	2021-02-27	12.118290	11.948506	9.938699
##	136	Green Bay	2021-02-28	7.514636	7.514636	9.882147
##	137	Green Bay	2021-03-01	8.569027	7.650074	9.835551
##	138	Green Bay	2021-03-02	8.974492	9.091487	9.813991
##	139	Janesville	2021-03-02	11.440161	10.925687	9.789161
##	140	Mauston	2021-03-02	10.477570	9.502786	9.796728
##	141	Green Bay	2021-03-03	8.650705	9.342626	9.807353
##	142	Janesville	2021-03-06	9.774233	9.368625	9.800080
##	143	Green Bay	2021-03-07	8.943887	8.099024	9.746070
##	144	Green Bay	2021-03-08	8.540704	7.344454	9.761178
##	145	Green Bay	2021-03-09	7.444893	7.814457	9.770883
##	146	Janesville	2021-03-09	11.429794	10.605743	9.773212
##	147	Mauston	2021-03-09	11.743688	11.797292	9.768106
##	148	Green Bay	2021-03-10	9.588335	9.405630	9.788161
##	149	Janesville	2021-03-13	10.791029	10.333645	9.748523
##	150	Janesville	2021-03-16	9.826607	10.338026	9.778821
##	151	Green Bay	2021-03-17	8.392011	7.007619	9.768247
##	152	Green Bay	2021-03-21	7.650074	7.625325	9.814582
##	153	Janesville	2021-03-23	11.081927	11.068964	9.850686
##	154	Green Bay	2021-03-24	9.244736	8.144770	9.849525
##	155	Janesville	2021-03-27	10.991359	10.572393	9.791440
##	156	Green Bay	2021-03-28	8.241557	8.531082	9.835089
##	157	Janesville	2021-03-30	11.903412	12.066241	9.820355
##	158	Mauston	2021-03-30	8.961238	9.066816	9.817667
##	159	Green Bay	2021-03-31	8.739757	7.643385	9.814988
##	160	Janesville	2021-04-03	10.978285	11.390916	9.814755
##	161	Green Bay	2021-04-04	7.809922	8.215387	9.819406
##	162	Janesville	2021-04-06	10.933535	11.124347	9.814698
##	163	Mauston	2021-04-06	11.422672	11.007021	9.862095
##	164	Green Bay	2021-04-07	9.579661	8.550235	9.869195
##	165	Janesville	2021-04-10	10.687161	10.424036	9.888050
##	166	Green Bay	2021-04-11	7.881185	7.881185	9.884732
##	167	Janesville	2021-04-13	11.337119	11.373445	9.845380
##	168	Mauston	2021-04-13	11.156679	10.848327	9.858657
##	169	Green Bay	2021-04-14	8.969159	8.682071	9.849911
##	170	Janesville	2021-04-17	12.126986	12.361417	9.846773
##	171	Green Bay	2021-04-18	9.073985	8.382441	9.846823
##	172	Janesville	2021-04-20	11.425481	11.793825	9.828901
##	173	Mauston	2021-04-20	10.815911	10.715373	9.846377
##	174	Green Bay	2021-04-21	8.466912	8.265259	9.825606
##	175	Janesville	2021-04-24	10.912266	11.463199	9.826162
##	176	Green Bay	2021-04-25	8.500224	9.310205	9.787976
##	177	Janesville	2021-04-27	11.010167	11.072714	9.772764
##	178	Mauston	2021-04-27	11.885378	11.778178	9.774092
##	179	Green Bay	2021-04-28	8.891342	8.379231	9.730543
##	180	Janesville	2021-05-01	11.605031	11.760496	9.718836
##	181	Green Bay	2021-05-02	9.865647	8.949356	9.682365
##	182	Janesville	2021-05-04	10.248141	10.667676	9.648816
##	183	Mauston	2021-05-04	9.277158	9.703572	9.655715
##	184	Green Bay	2021-05-05	9.483188	8.277793	9.630181
##	185	Green Bay	2021-05-09	7.821222	7.126950	9.622624
##	186	Janesville	2021-05-11	10.438986	10.409130	9.599170
##	187	Mauston	2021-05-11	8.504513	9.466377	9.565215
##	188	Janesville	2021-05-15	11.054329	10.804624	9.561672

##	189	Green Bay	2021-05-16	8.929154	8.525542	9.525353
##	190	Janesville	2021-05-18	9.799737	9.774119	9.515319
##	191	Green Bay	2021-05-19	8.270650	7.986546	9.524388
##	192	Janesville	2021-05-22	9.766464	10.518105	9.545922
##	193	Green Bay	2021-05-23	8.488763	8.488763	9.526566
##	194	Janesville	2021-05-25	11.414397	11.876054	9.533110
##	195	Green Bay	2021-05-26	8.180702	7.491468	9.524925
##	196	Janesville	2021-05-29	9.950085	10.607500	9.498825
##	197	Janesville	2021-06-01	8.922792	9.695233	9.488956
##	198	Janesville	2021-06-05	9.492356	10.334165	9.517521
##	199	Janesville	2021-06-08	9.878426	10.135353	9.533770
##	200	Janesville	2021-06-12	8.468213	7.273093	9.525305
##	201	Green Bay	2021-06-20	7.994451	7.298149	9.541846
##	202	Mauston	2021-06-22	10.297588	10.511676	9.564406
##	203	Janesville	2021-07-06	9.166388	8.915298	9.553445
##	204	Mauston	2021-07-06	8.644883	8.479076	9.596116
##	205	Green Bay	2021-07-07	7.356448	7.356448	9.635777
##	206	Janesville	2021-07-10	10.092702	8.623893	9.679421
##	207	Janesville	2021-07-13	8.604105	9.873853	9.679750
##	208	Janesville	2021-07-17	9.179675	8.873748	9.706734
##	209	Janesville	2021-07-20	10.256044	10.811081	9.758643
##	210	Green Bay	2021-07-21	7.443459	8.133870	9.793993
##	211	Janesville	2021-07-24	10.508950	10.387178	9.862823
##	212	Janesville	2021-07-27	11.251717	10.466441	9.923559
##	213	Mauston	2021-07-27	9.310909	9.602518	10.018510
##	214	Green Bay	2021-07-28	8.667717	8.381372	10.052423
##	215	Janesville	2021-07-31	11.990773	11.652983	10.062572
##	216	Green Bay	2021-08-01	8.438531	7.747402	10.123693
##	217	Janesville	2021-08-03	11.350418	11.191949	10.147836
##	218	Mauston	2021-08-03	9.784535	10.296205	10.219973
##	219	Janesville	2021-08-07	11.876346	11.611793	10.304399
##	220	Janesville	2021-08-10	11.796012	11.532267	10.384780
##	221	Mauston	2021-08-10	10.904763	11.060683	10.451426
##	222	Green Bay	2021-08-11	8.695441	7.598780	10.522089
##	223	Janesville	2021-08-14	12.481106	12.344368	10.581910
##	224	Green Bay	2021-08-15	8.561910	8.561910	10.684777
##	225	Janesville	2021-08-17	10.586483	10.335400	10.691555
##	226	Mauston	2021-08-17	11.180093	11.411933	10.783938
##	227	Green Bay	2021-08-18	8.857374	9.550521	10.845246
##	228	Janesville	2021-08-21	11.680768	11.638615	10.908874
##	229	Green Bay	2021-08-22	11.303132	11.352118	11.022063
##	230	Janesville	2021-08-24	12.533389	12.008615	11.061427
##	231	Mauston	2021-08-24	12.306131	12.004391	11.098538
##	232	Green Bay	2021-08-25	11.666354	11.527853	11.155201
##	233	Janesville	2021-08-28	12.154669	12.232457	11.211383
##	234	Green Bay	2021-08-29	10.503817	10.726961	11.329045
##	235	Janesville	2021-08-31	12.655201	12.881707	11.358186
##	236	Mauston	2021-08-31	11.935510	11.932090	11.407677
##	237	Green Bay	2021-09-01	10.364652	9.989004	11.455116
##	238	Janesville	2021-09-04	12.502723	11.682187	11.492920
##	239	Green Bay	2021-09-05	11.696633	11.763977	11.550909
##	240	Janesville	2021-09-07	12.247584	12.182144	11.564495
##	241	Mauston	2021-09-07	11.337726	11.450167	11.607902
##	242	Green Bay	2021-09-08	11.389012	11.467560	11.650703

##	243	Janesville	2021-09-11	11.451763	11.749388	11.684325
##	244	Green Bay	2021-09-12	12.216957	12.092680	11.747080
##	245	Janesville	2021-09-14	12.379257	12.037382	11.758933
##	246	Mauston	2021-09-14	10.931534	10.435556	11.775078
##	247	Green Bay	2021-09-15	11.193800	11.169556	11.809100
##	248	Janesville	2021-09-18	11.316010	11.823479	11.812404
##	249	Green Bay	2021-09-19	11.574419	11.132052	11.828149
##	250	Janesville	2021-09-21	13.082066	12.895869	11.823615
##	251	Mauston	2021-09-21	12.752563	12.653428	11.867655
##	252	Green Bay	2021-09-22	11.547335	11.413627	11.875575
##	253	Janesville	2021-09-25	12.545120	12.401286	11.903081
##	254	Green Bay	2021-09-26	11.574419	11.431281	11.928318
##	255	Janesville	2021-09-28	12.232164	12.229027	11.958584
##	256	Mauston	2021-09-28	12.720760	12.423182	11.972262
##	257	Green Bay	2021-09-29	11.649971	11.718338	11.986063
##	258	Janesville	2021-10-02	11.502683	11.586650	11.998100
##	259	Green Bay	2021-10-03	12.149663	12.170305	12.023184
##	260	Janesville	2021-10-05	11.472270	10.915688	12.026616
##	261	Mauston	2021-10-05	15.220546	15.247318	12.045353
##	262	Green Bay	2021-10-07	10.806831	10.843495	12.019352
##	263	Janesville	2021-10-09	11.845024	11.860804	12.017887
##	264	Green Bay	2021-10-11	9.434955	9.552511	11.991147
##	265	Janesville	2021-10-12	12.520314	12.501500	11.999121
##	266	Mauston	2021-10-12	11.650407	11.619248	11.991918
##	267	Green Bay	2021-10-13	11.600086	11.528610	11.974584
##	268	Janesville	2021-10-16	11.732551	11.220124	11.972754
##	269	Green Bay	2021-10-17	11.720213	11.262205	11.986620
##	270	Janesville	2021-10-19	12.160526	12.103702	11.975058
##	271	Mauston	2021-10-19	11.264785	10.963255	11.947500
##	272	Green Bay	2021-10-20	11.510811	11.256266	11.962342
##	273	Janesville	2021-10-23	11.803900	11.745623	11.975307
##	274	Green Bay	2021-10-24	11.003059	10.623471	11.976570
##	275	Janesville	2021-10-26	12.008353	12.338836	12.018856
##	276	Mauston	2021-10-26	11.836616	12.020785	12.024327
##	277	Green Bay	2021-10-27	11.503861	11.633315	12.033949
##	278	Janesville	2021-10-30	12.958363	13.181225	12.071390
##	279	Green Bay	2021-11-01	11.729120	11.885537	12.094534
##	280	Janesville	2021-11-02	12.635827	12.673545	12.104403
##	281	Mauston	2021-11-02	12.086050	12.508611	12.121863
##	282	Green Bay	2021-11-03	10.820226	11.086833	12.169464
##	283	Janesville	2021-11-06	12.330037	12.750514	12.137493
##	284	Green Bay	2021-11-07	10.790094	11.227736	12.201560
##	285	Janesville	2021-11-09	13.340528	13.256426	12.227905
##	286	Mauston	2021-11-09	12.805958	13.042315	12.251819
##	287	Green Bay	2021-11-10	11.328695	11.328695	12.275850
##	288	Janesville	2021-11-13	13.678843	13.686880	12.274071
##	289	Green Bay	2021-11-14	12.294171	12.248856	12.301949
##	290	Janesville	2021-11-16	13.379809	13.226727	12.381618
##	291	Mauston	2021-11-16	13.894802	14.158535	12.402467
##	292	Green Bay	2021-11-17	10.610932	10.941075	12.440453
##	293	Janesville	2021-11-20	13.879471	13.722238	12.468650
##	294	Green Bay	2021-11-21	11.206748	11.386110	12.526915
##	295	Janesville	2021-11-23	13.566626	13.177272	12.603317
##	296	Mauston	2021-11-23	14.109952	13.543345	12.605279



##	297	Green Bay	2021-11-24	11.865766	12.296513	12.660522
##	298	Janesville	2021-11-27	12.335692	12.594978	12.687984
##	299	Green Bay	2021-11-28	11.935250	12.089808	12.714385
##	300	Janesville	2021-11-30	13.057072	12.911645	12.759871
##	301	Mauston	2021-11-30	14.837395	14.327446	12.762702
##	302	Green Bay	2021-12-01	12.025989	12.147765	12.832112
##	303	Janesville	2021-12-04	13.630012	13.761741	12.844792
##	304	Green Bay	2021-12-06	11.312873	11.125285	12.857705
##	305	Janesville	2021-12-07	13.942294	13.959545	12.926956
##	306	Mauston	2021-12-07	12.669596	12.940973	12.948032
##	307	Green Bay	2021-12-08	11.881118	11.797081	12.996372
##	308	Janesville	2021-12-11	13.790336	14.179912	13.011398
##	309	Green Bay	2021-12-12	11.432114	11.411079	13.009885
##	310	Janesville	2021-12-14	13.208139	13.206258	13.049413
##	311	Mauston	2021-12-14	13.058134	13.306185	13.093215
##	312	Green Bay	2021-12-15	11.954365	12.242952	13.096600
##	313	Janesville	2021-12-18	13.615627	13.810602	13.097540
##	314	Green Bay	2021-12-20	12.214802	12.197137	13.122642
##	315	Janesville	2021-12-21	12.941355	12.777349	13.113949
##	316	Mauston	2021-12-21	12.466870	12.313118	13.129484
##	317	Green Bay	2021-12-23	11.492690	12.008831	13.143551
##	318	Janesville	2021-12-25	14.257074	13.807410	13.137368
##	319	Green Bay	2021-12-26	12.085197	12.270091	13.119661
##	320	Green Bay	2021-12-28	11.625797	11.822948	13.117477
##	321	Janesville	2021-12-28	14.186950	14.356268	13.070243
##	322	Mauston	2021-12-28	12.913497	13.272222	13.038624
##	323	Janesville	2022-01-01	14.669004	14.786531	13.000888
##	324	Green Bay	2022-01-02	12.992579	13.269801	12.955755
##	325	Janesville	2022-01-04	13.960559	14.337216	12.942313
##	326	Mauston	2022-01-04	13.566083	13.762039	12.900811
##	327	Green Bay	2022-01-06	13.639892	13.440464	12.846743
##	328	Janesville	2022-01-08	13.603505	13.663757	12.808307
##	329	Janesville	2022-01-08	13.603505	13.663757	12.704445
##	330	Green Bay	2022-01-09	12.253262	12.657994	12.655030
##	331	Mauston	2022-01-10	12.006646	12.444775	12.571619
##	332	Janesville	2022-01-11	13.482998	13.506809	12.519696
##	333	Green Bay	2022-01-12	13.013748	13.306965	12.451908
##	334	Janesville	2022-01-15	12.736230	12.524672	12.371954
##	335	Green Bay	2022-01-17	12.324417	11.996122	12.288962
##	336	Janesville	2022-01-18	12.643036	12.616326	12.206493
##	337	Mauston	2022-01-18	13.023206	13.311065	12.109025
##	338	Green Bay	2022-01-19	10.550465	10.145335	11.988899
##	339	Janesville	2022-01-22	12.687511	12.661470	11.903171
##	340	Green Bay	2022-01-23	10.688010	11.158670	11.796142
##	341	Janesville	2022-01-25	12.080963	12.171895	11.693375
##	342	Mauston	2022-01-25	13.445490	13.721991	11.617440
##	343	Green Bay	2022-01-26	11.052945	10.716229	11.512575
##	344	Janesville	2022-01-29	12.135650	11.564379	11.437024
##	345	Green Bay	2022-01-30	10.824312	11.420951	11.362163
##	346	Janesville	2022-02-01	12.402297	12.469052	11.263028
##	347	Mauston	2022-02-01	12.271860	12.456053	11.187959
##	348	Green Bay	2022-02-02	10.660773	11.163765	11.099848
##	349	Janesville	2022-02-05	11.634789	11.297750	11.028194
##	350	Green Bay	2022-02-06	8.772021	9.282847	10.975744

##	351	Janesville	2022-02-08	11.672320	11.113045	10.904742
##	352	Mauston	2022-02-08	11.651643	11.427803	10.848339
##	353	Green Bay	2022-02-09	9.622715	9.467151	10.781701
##	354	Janesville	2022-02-12	11.491906	11.404895	10.722089
##	355	Green Bay	2022-02-13	9.554327	9.842463	10.679081
##	356	Janesville	2022-02-15	10.643518	10.422281	10.614308
##	357	Mauston	2022-02-15	11.944188	11.944188	10.575693
##	358	Janesville	2022-02-19	11.525644	11.641846	10.519579
##	359	Green Bay	2022-02-20	8.500088	8.094623	10.446050
##	360	Janesville	2022-02-22	9.045466	10.436466	10.429330
##	361	Mauston	2022-02-22	11.640439	11.640439	10.370616
##	362	Janesville	2022-02-26	10.422281	10.131420	10.354693
##	363	Green Bay	2022-02-27	7.294377	7.294377	10.296691
##	364	Janesville	2022-03-01	10.441150	10.849725	10.237680
##	365	Janesville	2022-03-05	9.738613	9.738613	10.224829
##	366	Green Bay	2022-03-07	9.544295	9.716483	10.202571
##	367	Janesville	2022-03-08	10.398184	9.006999	10.191646
##	368	Green Bay	2022-03-09	7.770341	9.157446	10.164212
##	369	Janesville	2022-03-12	10.814967	9.026418	10.113167
##	370	Janesville	2022-03-15	8.987197	8.987197	10.100886
##	371	Green Bay	2022-03-16	8.305187	8.998335	10.080737
##	372	Janesville	2022-03-19	10.785601	8.987197	10.091800
##	373	Green Bay	2022-03-20	9.660957	9.543378	10.067778
##	374	Janesville	2022-03-22	11.206400	11.311543	10.070896
##	375	Mauston	2022-03-22	9.738613	9.738613	10.087508
##	376	Green Bay	2022-03-23	7.625868	8.723231	10.100059
##	377	Janesville	2022-03-26	10.643518	9.026418	10.142259
##	378	Janesville	2022-03-29	11.431281	11.836747	10.144414
##	379	Janesville	2022-04-02	9.680344	8.987197	10.170292
##	380	Green Bay	2022-04-03	10.012234	7.709649	10.203839
##	381	Janesville	2022-04-05	10.616437	9.006999	10.230793
##	382	Green Bay	2022-04-06	8.473701	7.779484	10.290288
##	383	Janesville	2022-04-09	10.378479	8.987197	10.335911
##	384	Janesville	2022-04-12	10.846615	11.136631	10.401041
##	385	Green Bay	2022-04-13	11.495820	11.692791	10.483280
##	386	Janesville	2022-04-16	11.071626	10.604603	10.536984
##	387	Janesville	2022-04-19	11.552146	10.933107	10.627172
##	388	Mauston	2022-04-19	9.700147	9.700147	10.702041
##	389	Janesville	2022-04-23	10.092454	10.092454	10.764843
##	390	Janesville	2022-04-26	10.608563	10.383442	10.846924
##	391	Janesville	2022-04-30	11.076589	10.792202	10.889212
##	392	Janesville	2022-05-03	12.961255	12.747466	10.971814
##	393	Mauston	2022-05-03	11.332841	11.110655	11.036025
##	394	Janesville	2022-05-07	11.475431	11.764773	11.097697
##	395	Janesville	2022-05-10	12.397684	12.024071	11.165906
##	396	Mauston	2022-05-10	12.290414	11.670954	11.226310
##	397	Janesville	2022-05-14	12.575150	12.518252	11.281296
##	398	Janesville	2022-05-17	11.482054	11.637618	11.365462
##	399	Mauston	2022-05-17	11.336665	11.336665	11.436753
##	400	Janesville	2022-05-21	13.509420	13.363457	11.474662
##	401	Janesville	2022-05-24	12.268108	12.342001	11.535239
##	402	Mauston	2022-05-24	12.231350	12.145048	11.590959
##	403	Janesville	2022-05-28	12.637335	12.637335	11.636828
##	404	Janesville	2022-05-31	11.697910	11.832106	11.687907

##	405	Mauston	2022-05-31	10.450452	10.855917	11.712935
##	406	Janesville	2022-06-07	11.929528	12.025989	11.774819
##	407	Mauston	2022-06-07	10.450452	10.855917	11.815290
##	408	Janesville	2022-06-11	10.772267	11.468765	11.876973
##	409	Janesville	2022-06-14	11.676404	11.810954	11.902161
##	410	Mauston	2022-06-14	10.322198	10.322198	11.909037
##	411	Janesville	2022-06-18	12.087289	11.886418	11.959181
##	412	Janesville	2022-06-21	11.692577	12.231350	11.965091
##	413	Mauston	2022-06-21	11.293774	11.071626	11.998863
##	414	Janesville	2022-06-25	11.692577	11.539762	12.011910
##	415	Janesville	2022-06-28	11.527223	12.039309	12.018883
##	416	Mauston	2022-06-28	12.081869	12.613136	12.026779
##	417	Janesville	2022-07-02	11.940022	11.689899	12.032633
##	418	Janesville	2022-07-05	11.815693	12.221946	12.036527
##	419	Mauston	2022-07-05	10.880309	11.392339	12.038550
##	420	Janesville	2022-07-09	12.385724	12.145048	12.038795
##	421	Janesville	2022-07-12	12.391057	11.832106	12.037358
##	422	Mauston	2022-07-12	11.852820	10.874266	12.034338
##	423	Janesville	2022-07-16	12.450430	12.380362	12.029840
##	424	Janesville	2022-07-19	12.950673	12.565145	12.023967
##	425	Mauston	2022-07-19	12.754887	12.592695	12.016829
##	426	Janesville	2022-07-23	12.050588	12.146747	12.008535
##	427	Janesville	2022-07-26	12.565145	12.727720	11.999196
##	428	Mauston	2022-07-26	12.545968	12.864214	11.988924
##	429	Janesville	2022-07-30	12.738112	12.921373	11.977834
##	430	Janesville	2022-08-02	11.716356	11.850540	11.966038
##	431	Mauston	2022-08-02	12.059890	12.155200	11.953651
##	432	Janesville	2022-08-06	12.962758	12.962758	11.940785
##	433	Janesville	2022-08-09	12.414712	12.751184	11.927555
##	434	Mauston	2022-08-09	12.413412	12.259045	11.914070
##	435	Janesville	2022-08-13	11.940022	11.822760	11.900442
##	436	Janesville	2022-08-16	11.861891	12.347572	11.886779
##	437	Mauston	2022-08-16	11.549065	11.143599	11.873187
##	438	Janesville	2022-08-20	12.217210	11.929528	11.859769
##	439	Janesville	2022-08-23	11.718964	11.381449	11.846626
##	440	Mauston	2022-08-23	11.340475	11.524063	11.833857
##	441	Janesville	2022-08-27	11.687215	11.129613	11.821553
##	442	Janesville	2022-08-30	11.332841	11.110655	11.809805
##	443	Mauston	2022-08-30	12.631079	12.305013	11.798698
##	444	Janesville	2022-09-03	12.122691	12.027902	11.788311
##	445	Janesville	2022-09-06	10.450452	11.545973	11.778721
##	446	Mauston	2022-09-06	11.570439	11.724158	11.769997
##	447	Janesville	2022-09-10	10.477851	10.880309	11.762201
##	448	Janesville	2022-09-13	11.161949	10.874266	11.755392
##	449	Mauston	2022-09-13	11.784478	11.901719	11.749619
##	450	Janesville	2022-09-17	11.138959	11.138959	11.744927
##	451	Janesville	2022-09-20	11.729326	11.392339	11.741350
##	452	Mauston	2022-09-20	11.549065	11.143599	11.738918
##	453	Janesville	2022-09-24	12.050588	12.520591	11.737650
##	454	Janesville	2022-09-27	12.464120	12.058037	11.737557
##	455	Mauston	2022-09-27	10.431760	11.533512	11.738643
##	456	Janesville	2022-10-01	11.822760	11.689899	11.740899
##	457	Janesville	2022-10-04	11.954530	11.836747	11.744310
##	458	Mauston	2022-10-04	10.849725	11.138959	11.748848

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## 459 Janesville 2022-10-08 12.146747 12.146747 11.754476
## 460 Janesville 2022-10-11 11.940022 12.141641 11.761148
## 461 Mauston 2022-10-11 11.542873 10.849725 11.768802
## 462 Janesville 2022-10-15 12.310793 11.692577 11.777368
## 463 Janesville 2022-10-18 12.025989 12.362734 11.786765
## 464 Mauston 2022-10-18 11.944188 12.638374 11.796896
## 465 Janesville 2022-10-22 12.991617 12.863385 11.807654
## 466 Janesville 2022-10-25 11.968830 12.412111 11.818917
## 467 Mauston 2022-10-25 11.152816 11.152816 11.830553
## 468 Janesville 2022-10-30 12.635254 12.688993 11.842412
## 469 Janesville 2022-11-01 12.414712 11.855096 11.854332
## 470 Mauston 2022-11-01 11.542873 11.138959 11.866137
## 471 Janesville 2022-11-05 12.514733 12.449176 11.877634
## 472 Janesville 2022-11-08 11.388722 11.388722 11.888617
## 473 Mauston 2022-11-08 11.662724 11.662724 11.898861
## 474 Janesville 2022-11-12 12.451682 11.689899 11.908130
## 475 Janesville 2022-11-15 12.262075 11.857366 11.916166
## 476 Mauston 2022-11-15 11.129613 10.431760 11.922697
## 477 Janesville 2022-11-19 11.520894 11.520894 11.927435
## 478 Janesville 2022-11-22 12.679072 12.186686 11.930073
## 479 Mauston 2022-11-22 10.837225 9.738613 11.930284
## 480 Janesville 2022-11-26 11.689899 12.046842 11.927726
## 481 Janesville 2022-11-29 12.124429 12.291883 11.922037
## 482 Mauston 2022-11-29 12.127895 12.294816 11.912836

```

## Exponential Smoothing

Exponential smoothing is a technique used to smooth time series data by assigning exponentially decreasing weights to observations. It is particularly useful for capturing trends and seasonality in time series data. It has two parameters alpha and beta which control the change of the weights.

## Everything

Finally this shows each of the methods with the default parameters on the same dataset. This shows that exponential smoothing has a systemic lag and loess by default is a little less stable.

