COVID-19 in Five States

David Himrich

9 May 2020

Contents

Introduction

The site https://covidtracking.com provides numerous visualizations and summaries of COVID-19 data in the Unitied States. They also provide an API to enable users to download their data sets. In this document I will download and summarize their "States Historical Data" file.

Another site with helpful visualizations is https://ourworldindata.org/coronavirus. However, many of the graphics at these sites display cumulative counts and I found it hard to identify trends. In this document I will examine daily death counts in the five States of the Upper Midwest.

For each State I will provide a simple running record of the daily death count. I will also place those same counts on a Shewhart chart for individual values. A Shewhart chart is also known as a control chart or process behavior chart, and provides a simple way to identify trends. I am an industrial engineer by training and

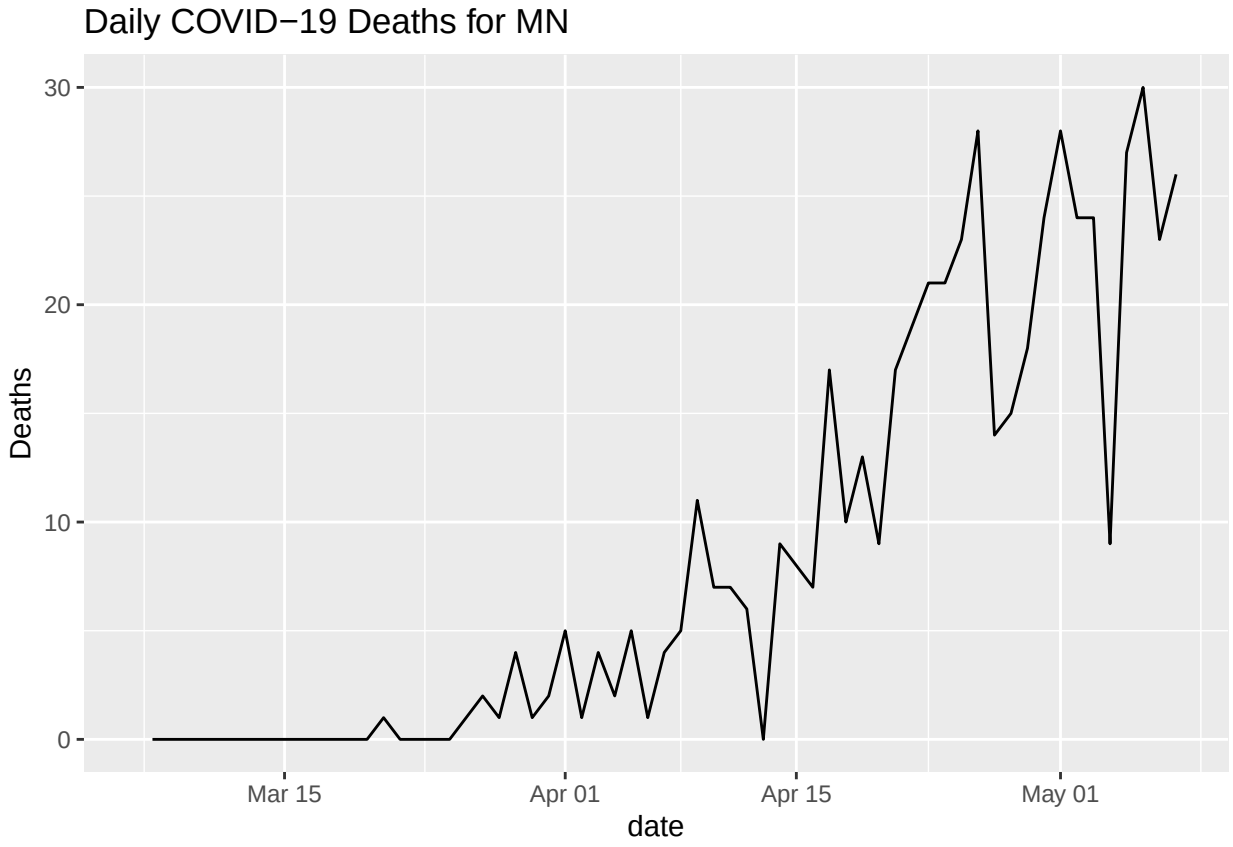
have applied them to many different data sets over the years. They identify departures from random patterns such as a run of points on one side of the center line (orange on these charts) or single points beyond the process limits (red on these charts.) I have started the Shewhart charts on the day of the tenth cumulative death in a State. For some States, that method produces a run below the center during the early phase of the pandemic. Those runs are signals of conditions we would expect to see.

I have published a web application at https://dhimrich.shinyapps.io/states_covid_dashboard that enables user display similar charts for daily counts of deaths, hospitalized patients, and patients in ICU for any of the States.

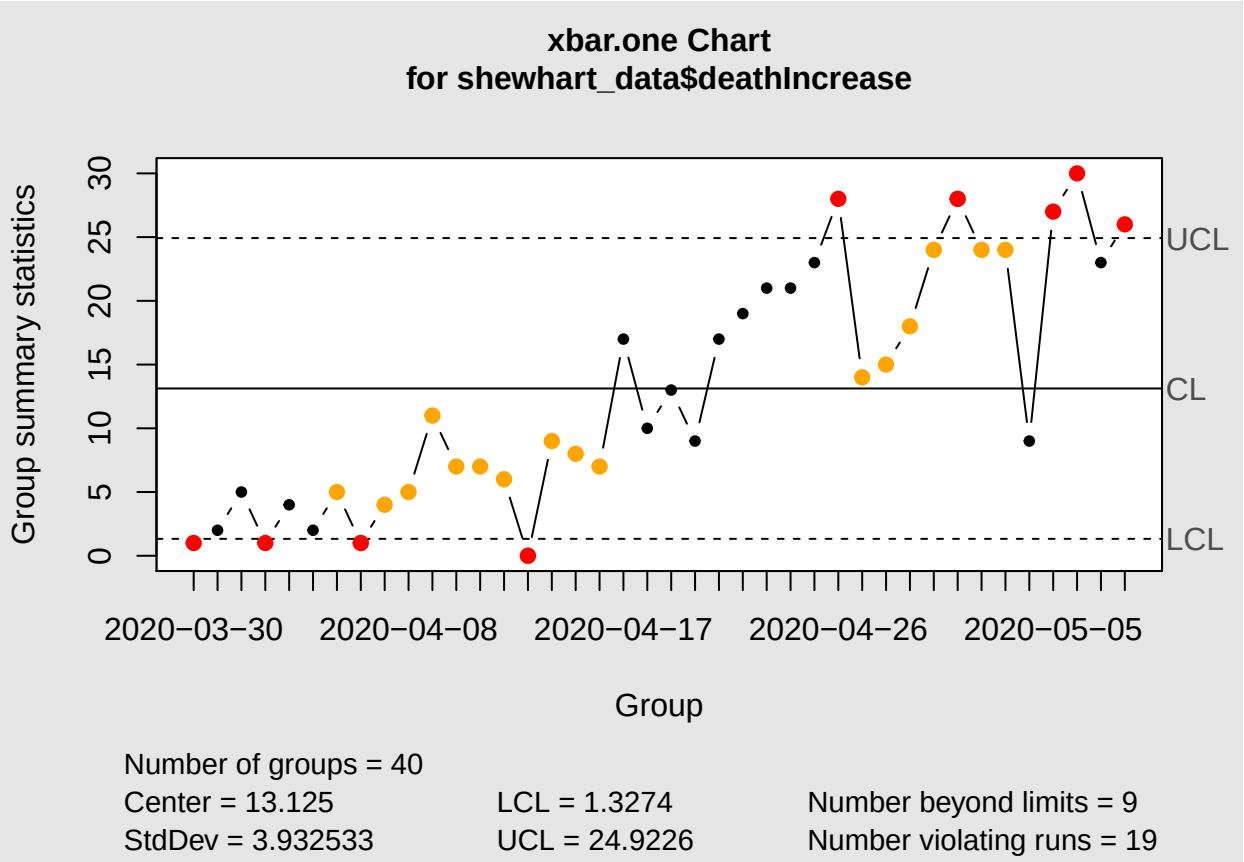
Minnesota

Running Record

```
Warning: Removed 1 row(s) containing missing values (geom_path).
```



Shewhart Chart



For Minnesota, this Shewhart chart is unhelpful. If we started the chart in late April, it might suggest that deaths have been steady at about 20 per day since then.

Data Table

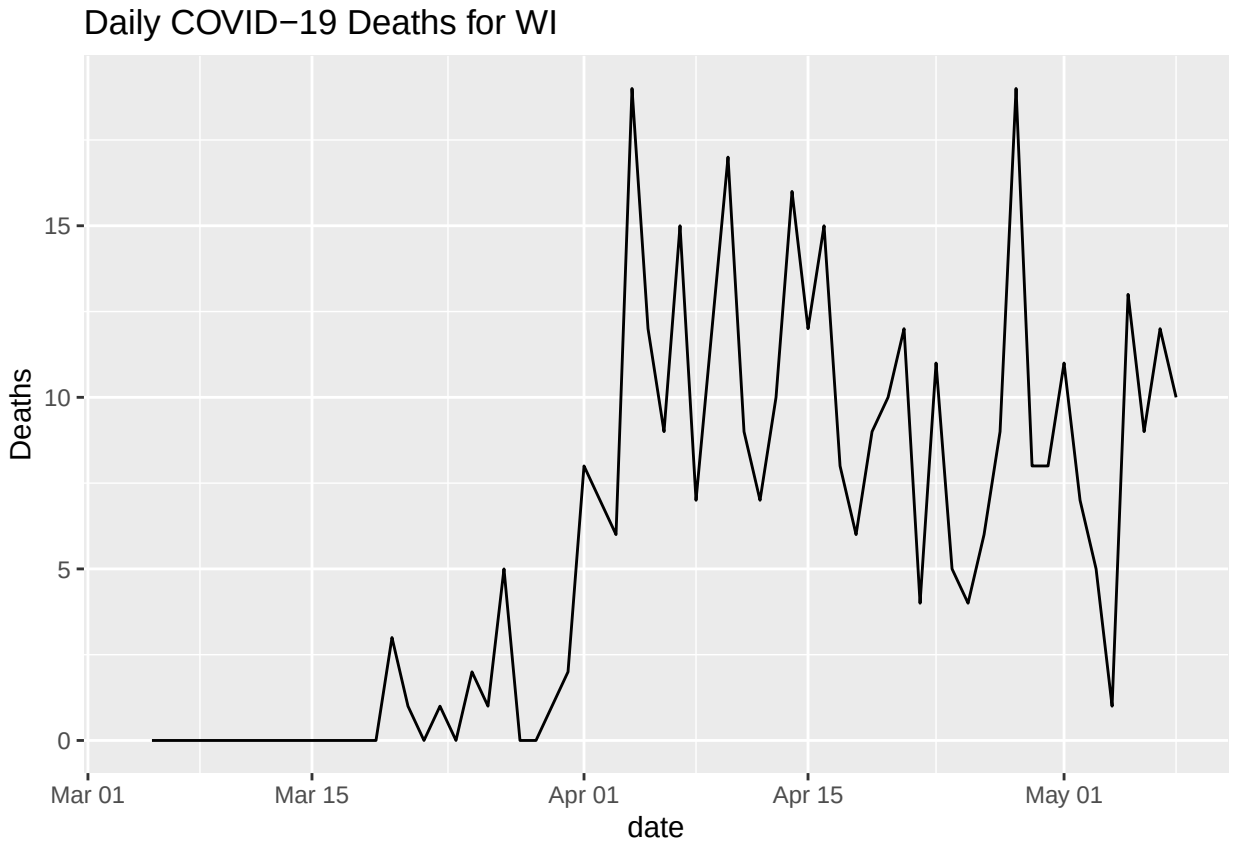
date	deathIncrease
2020-03-06	NA
2020-03-07	0
2020-03-08	0
2020-03-09	0
2020-03-10	0
2020-03-11	0
2020-03-12	0
2020-03-13	0
2020-03-14	0
2020-03-15	0
2020-03-16	0
2020-03-17	0
2020-03-18	0
2020-03-19	0
2020-03-20	0
2020-03-21	1
2020-03-22	0

date	deathIncrease
2020-03-23	0
2020-03-24	0
2020-03-25	0
2020-03-26	1
2020-03-27	2
2020-03-28	1
2020-03-29	4
2020-03-30	1
2020-03-31	2
2020-04-01	5
2020-04-02	1
2020-04-03	4
2020-04-04	2
2020-04-05	5
2020-04-06	1
2020-04-07	4
2020-04-08	5
2020-04-09	11
2020-04-10	7
2020-04-11	7
2020-04-12	6
2020-04-13	0
2020-04-14	9
2020-04-15	8
2020-04-16	7
2020-04-17	17
2020-04-18	10
2020-04-19	13
2020-04-20	9
2020-04-21	17
2020-04-22	19
2020-04-23	21
2020-04-24	21
2020-04-25	23
2020-04-26	28
2020-04-27	14
2020-04-28	15
2020-04-29	18
2020-04-30	24
2020-05-01	28
2020-05-02	24
2020-05-03	24
2020-05-04	9
2020-05-05	27
2020-05-06	30
2020-05-07	23
2020-05-08	26

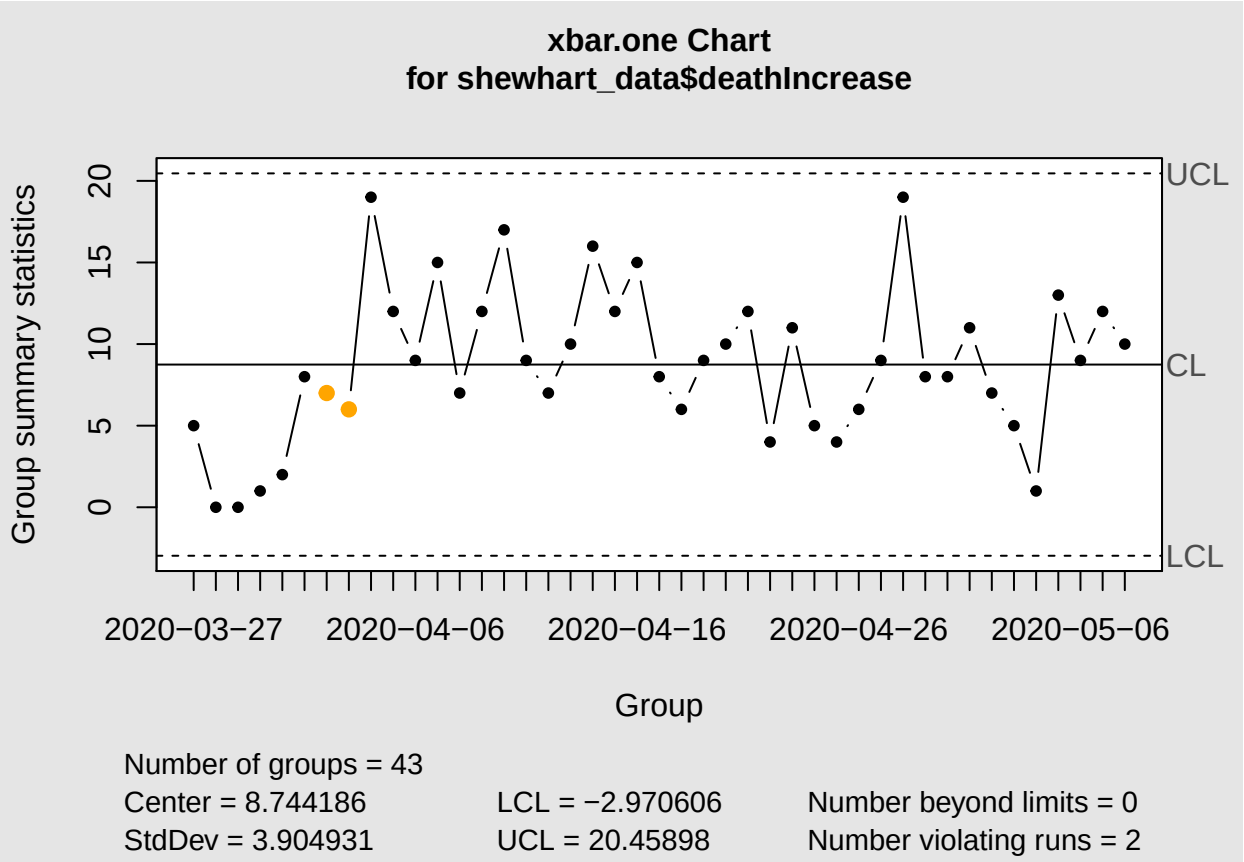
Wisconsin

Running Record

```
Warning: Removed 1 row(s) containing missing values (geom_path).
```



Shewhart Chart



The Shewhart chart for Wisconsin signals a run below the centerline in the early phase of the pandemic. Deaths in Wisconsin appear to have varied randomly at around 10 per day since early April.

Data Table

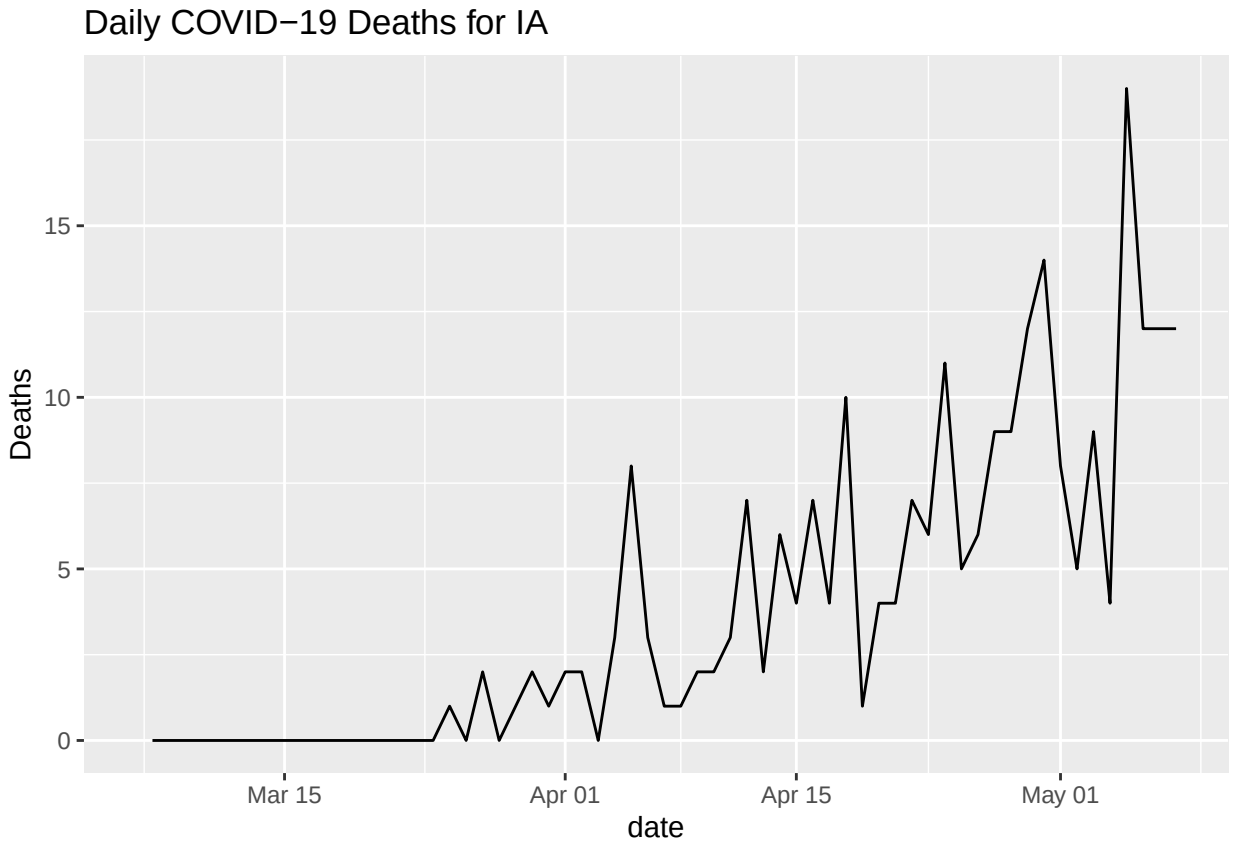
date	deathIncrease
2020-03-04	NA
2020-03-05	0
2020-03-06	0
2020-03-07	0
2020-03-08	0
2020-03-09	0
2020-03-10	0
2020-03-11	0
2020-03-12	0
2020-03-13	0
2020-03-14	0
2020-03-15	0
2020-03-16	0
2020-03-17	0
2020-03-18	0
2020-03-19	0
2020-03-20	3

date	deathIncrease
2020-03-21	1
2020-03-22	0
2020-03-23	1
2020-03-24	0
2020-03-25	2
2020-03-26	1
2020-03-27	5
2020-03-28	0
2020-03-29	0
2020-03-30	1
2020-03-31	2
2020-04-01	8
2020-04-02	7
2020-04-03	6
2020-04-04	19
2020-04-05	12
2020-04-06	9
2020-04-07	15
2020-04-08	7
2020-04-09	12
2020-04-10	17
2020-04-11	9
2020-04-12	7
2020-04-13	10
2020-04-14	16
2020-04-15	12
2020-04-16	15
2020-04-17	8
2020-04-18	6
2020-04-19	9
2020-04-20	10
2020-04-21	12
2020-04-22	4
2020-04-23	11
2020-04-24	5
2020-04-25	4
2020-04-26	6
2020-04-27	9
2020-04-28	19
2020-04-29	8
2020-04-30	8
2020-05-01	11
2020-05-02	7
2020-05-03	5
2020-05-04	1
2020-05-05	13
2020-05-06	9
2020-05-07	12
2020-05-08	10

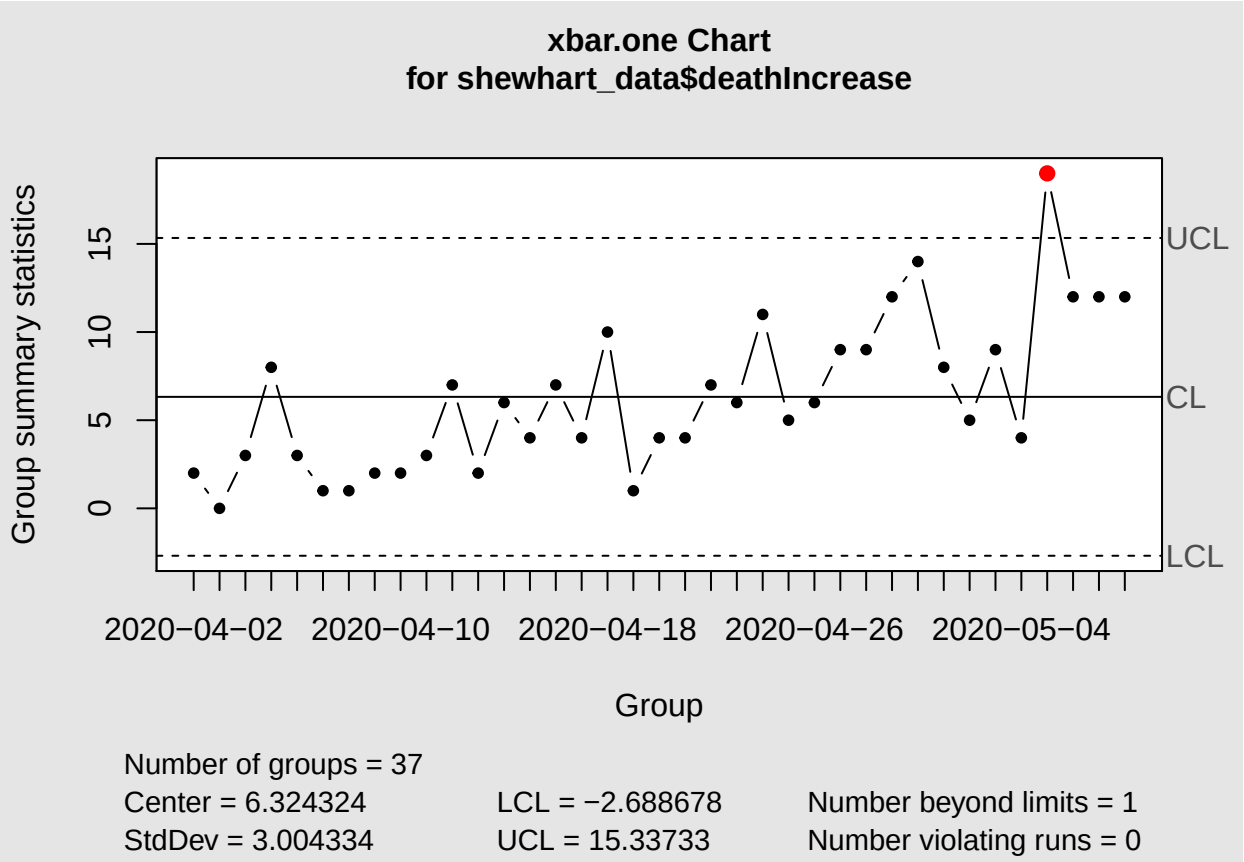
Iowa

Running Record

```
Warning: Removed 1 row(s) containing missing values (geom_path).
```



Shewhart Chart



For Iowa, the Shewhart chart suggests a recent increase in daily deaths. The red point above the upper process limit represents the 19 deaths on 2020-05-05 (see the data table below.) That point, and three consecutive subsequent counts of 12 deaths, all suggest a recent increase.

Data Table

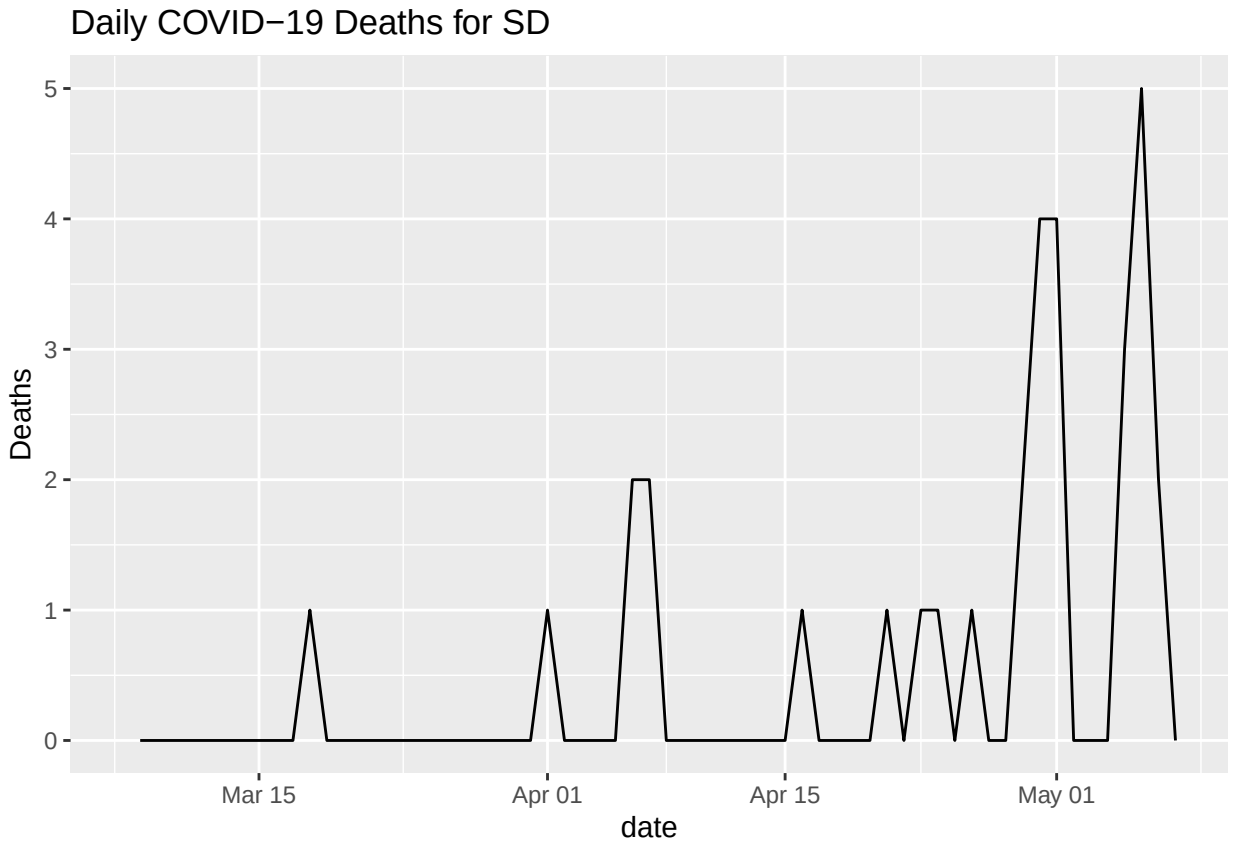
date	deathIncrease
2020-03-06	NA
2020-03-07	0
2020-03-08	0
2020-03-09	0
2020-03-10	0
2020-03-11	0
2020-03-12	0
2020-03-13	0
2020-03-14	0
2020-03-15	0
2020-03-16	0
2020-03-17	0
2020-03-18	0
2020-03-19	0
2020-03-20	0
2020-03-21	0

date	deathIncrease
2020-03-22	0
2020-03-23	0
2020-03-24	0
2020-03-25	1
2020-03-26	0
2020-03-27	2
2020-03-28	0
2020-03-29	1
2020-03-30	2
2020-03-31	1
2020-04-01	2
2020-04-02	2
2020-04-03	0
2020-04-04	3
2020-04-05	8
2020-04-06	3
2020-04-07	1
2020-04-08	1
2020-04-09	2
2020-04-10	2
2020-04-11	3
2020-04-12	7
2020-04-13	2
2020-04-14	6
2020-04-15	4
2020-04-16	7
2020-04-17	4
2020-04-18	10
2020-04-19	1
2020-04-20	4
2020-04-21	4
2020-04-22	7
2020-04-23	6
2020-04-24	11
2020-04-25	5
2020-04-26	6
2020-04-27	9
2020-04-28	9
2020-04-29	12
2020-04-30	14
2020-05-01	8
2020-05-02	5
2020-05-03	9
2020-05-04	4
2020-05-05	19
2020-05-06	12
2020-05-07	12
2020-05-08	12

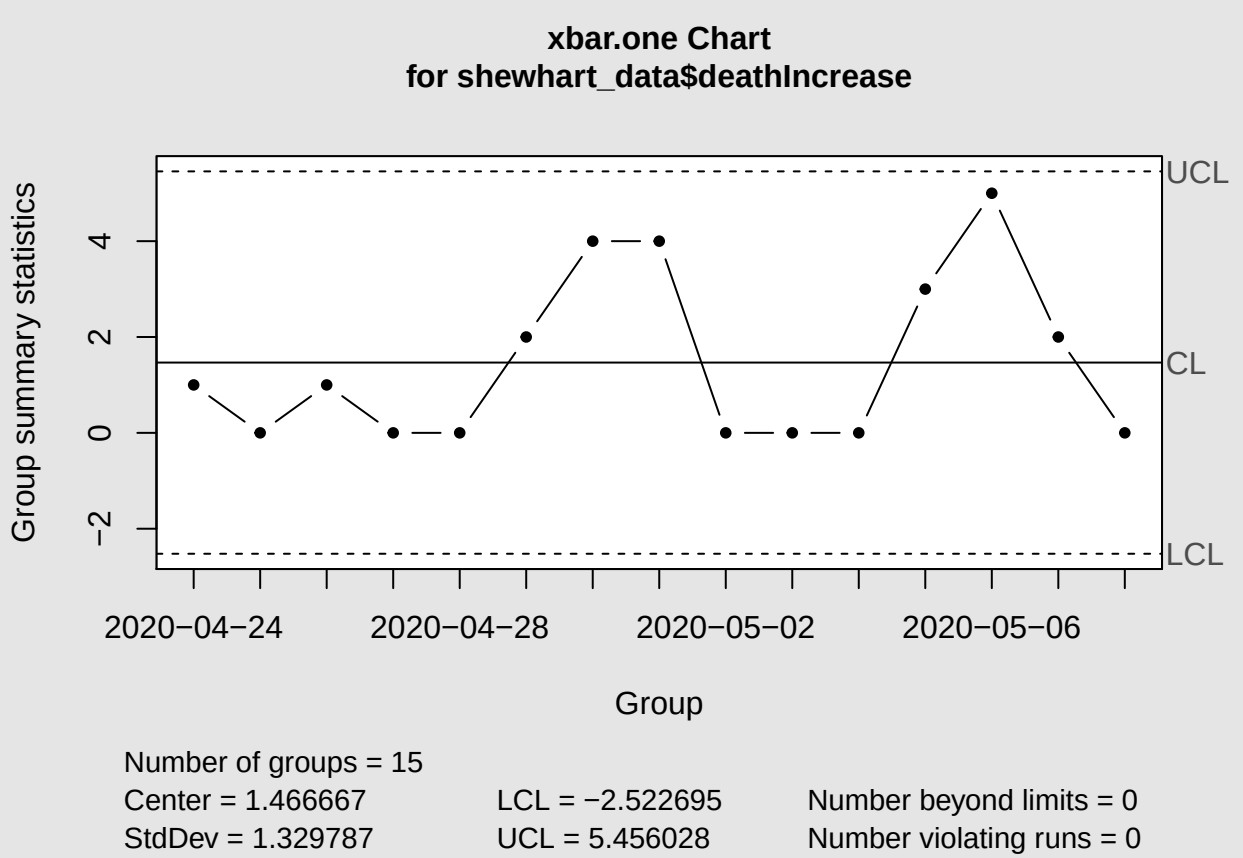
South Dakota

Running Record

```
Warning: Removed 1 row(s) containing missing values (geom_path).
```



Shewhart Chart



The running record and Shewhart chart for South Dakota are both interesting because that State has experienced relatively few COVID-19 deaths. South Dakota has recorded zero deaths on many days, and did not record the tenth death until 2020-04-24. They have recorded about 1.5 deaths per day since then, with no apparent increase. It will be difficult for this chart to detect a decrease from a level that low. It will require 7 or 8 consecutive days with 0 or 1 death recorded.

Data Table

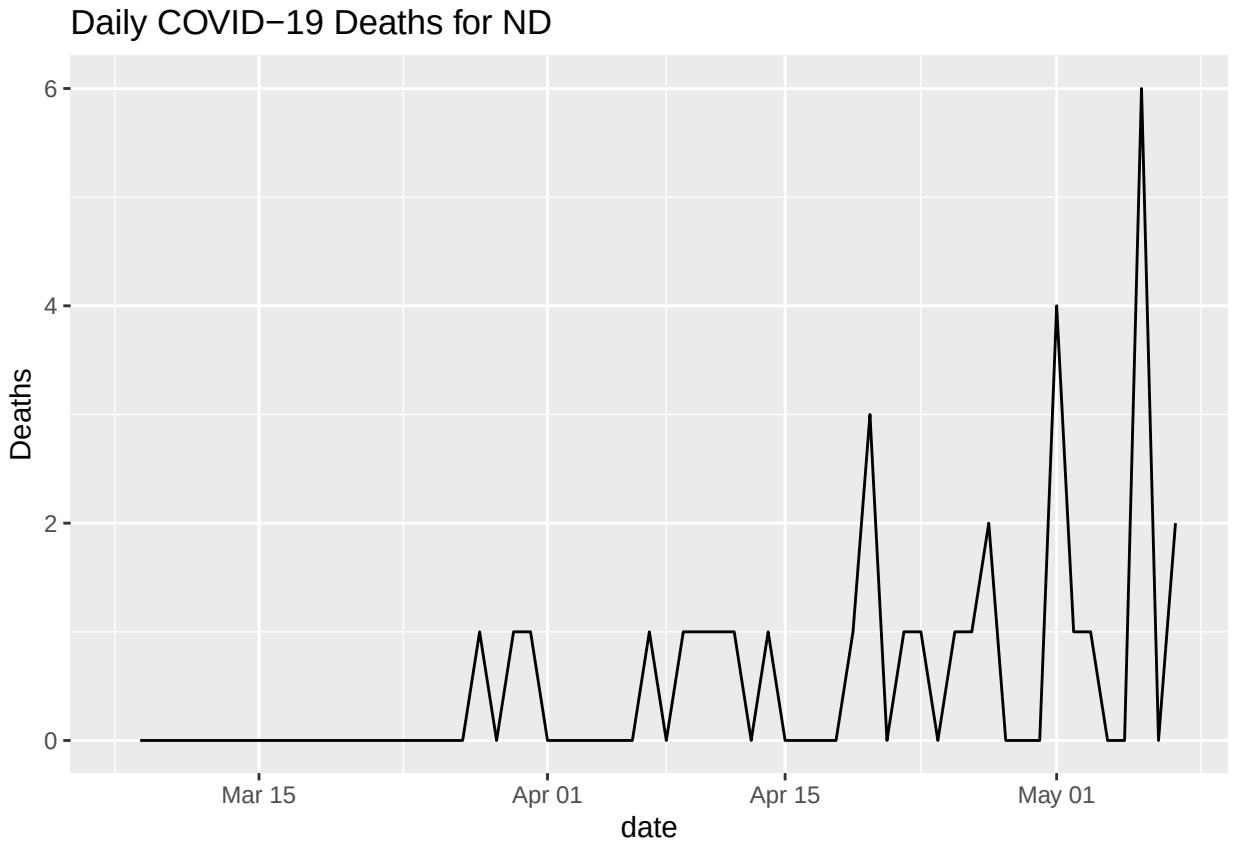
date	deathIncrease
2020-03-07	NA
2020-03-08	0
2020-03-09	0
2020-03-10	0
2020-03-11	0
2020-03-12	0
2020-03-13	0
2020-03-14	0
2020-03-15	0
2020-03-16	0
2020-03-17	0
2020-03-18	1
2020-03-19	0
2020-03-20	0

date	deathIncrease
2020-03-21	0
2020-03-22	0
2020-03-23	0
2020-03-24	0
2020-03-25	0
2020-03-26	0
2020-03-27	0
2020-03-28	0
2020-03-29	0
2020-03-30	0
2020-03-31	0
2020-04-01	1
2020-04-02	0
2020-04-03	0
2020-04-04	0
2020-04-05	0
2020-04-06	2
2020-04-07	2
2020-04-08	0
2020-04-09	0
2020-04-10	0
2020-04-11	0
2020-04-12	0
2020-04-13	0
2020-04-14	0
2020-04-15	0
2020-04-16	1
2020-04-17	0
2020-04-18	0
2020-04-19	0
2020-04-20	0
2020-04-21	1
2020-04-22	0
2020-04-23	1
2020-04-24	1
2020-04-25	0
2020-04-26	1
2020-04-27	0
2020-04-28	0
2020-04-29	2
2020-04-30	4
2020-05-01	4
2020-05-02	0
2020-05-03	0
2020-05-04	0
2020-05-05	3
2020-05-06	5
2020-05-07	2
2020-05-08	0

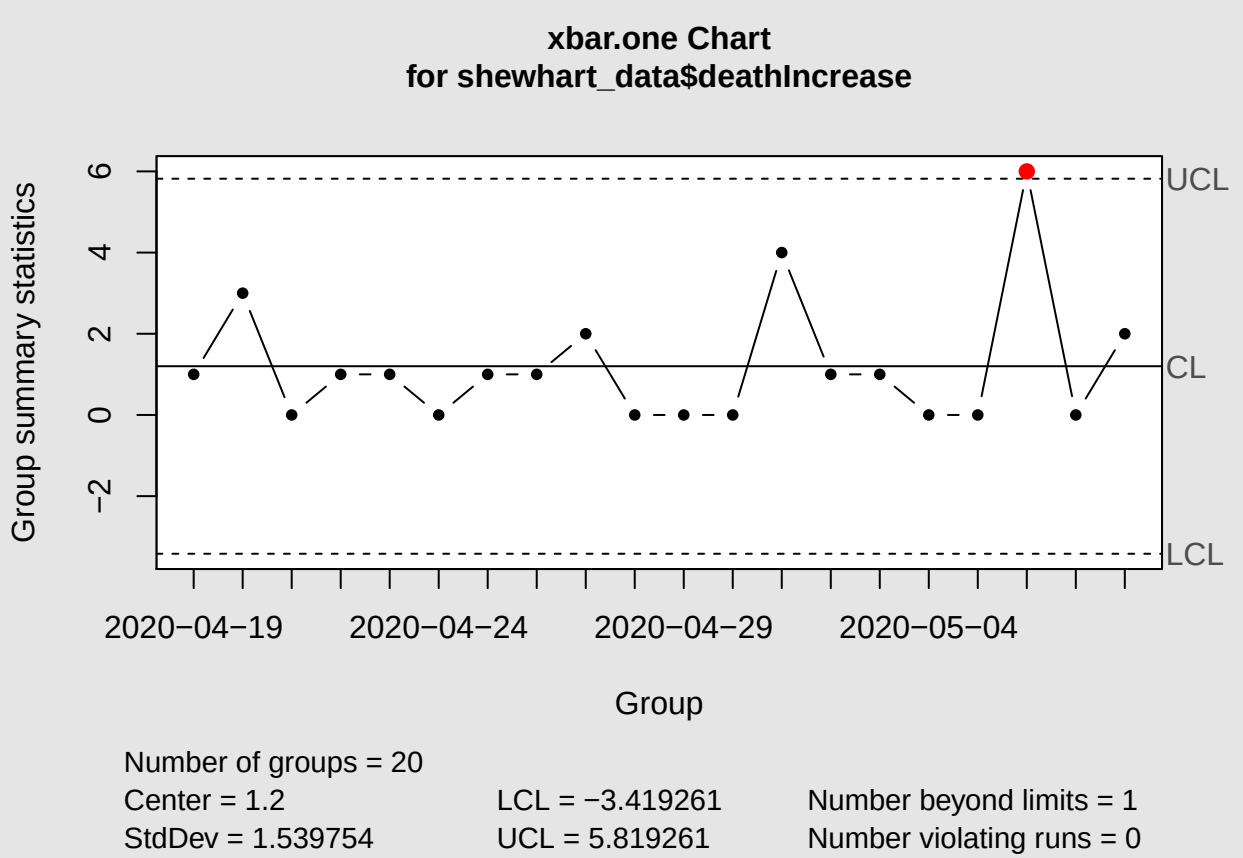
North Dakota

Running Record

```
Warning: Removed 1 row(s) containing missing values (geom_path).
```



Shewhart Chart



THe 6 deaths recorded in North Dakota on 2020-05-06 produced a signal on this Shewhart chart. Those deaths might be work closer examination for some special cause, but this signal may be spurious. THe natural lower limit of zero deaths in a day produces skewed data at levels this low. We could arguably place the upper process limit higher than it is under such circumstances. I interpret the death counts for North Dakota as varying randomly around 1.2 per day since mid-April.

Data Table

date	deathIncrease
2020-03-07	NA
2020-03-08	0
2020-03-09	0
2020-03-10	0
2020-03-11	0
2020-03-12	0
2020-03-13	0
2020-03-14	0
2020-03-15	0
2020-03-16	0
2020-03-17	0
2020-03-18	0
2020-03-19	0
2020-03-20	0

date	deathIncrease
2020-03-21	0
2020-03-22	0
2020-03-23	0
2020-03-24	0
2020-03-25	0
2020-03-26	0
2020-03-27	0
2020-03-28	1
2020-03-29	0
2020-03-30	1
2020-03-31	1
2020-04-01	0
2020-04-02	0
2020-04-03	0
2020-04-04	0
2020-04-05	0
2020-04-06	0
2020-04-07	1
2020-04-08	0
2020-04-09	1
2020-04-10	1
2020-04-11	1
2020-04-12	1
2020-04-13	0
2020-04-14	1
2020-04-15	0
2020-04-16	0
2020-04-17	0
2020-04-18	0
2020-04-19	1
2020-04-20	3
2020-04-21	0
2020-04-22	1
2020-04-23	1
2020-04-24	0
2020-04-25	1
2020-04-26	1
2020-04-27	2
2020-04-28	0
2020-04-29	0
2020-04-30	0
2020-05-01	4
2020-05-02	1
2020-05-03	1
2020-05-04	0
2020-05-05	0
2020-05-06	6
2020-05-07	0
2020-05-08	2