

What is a rolling window?

MANIPULATING TIME SERIES DATA IN R



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Windows

- A window is a limited range of observations

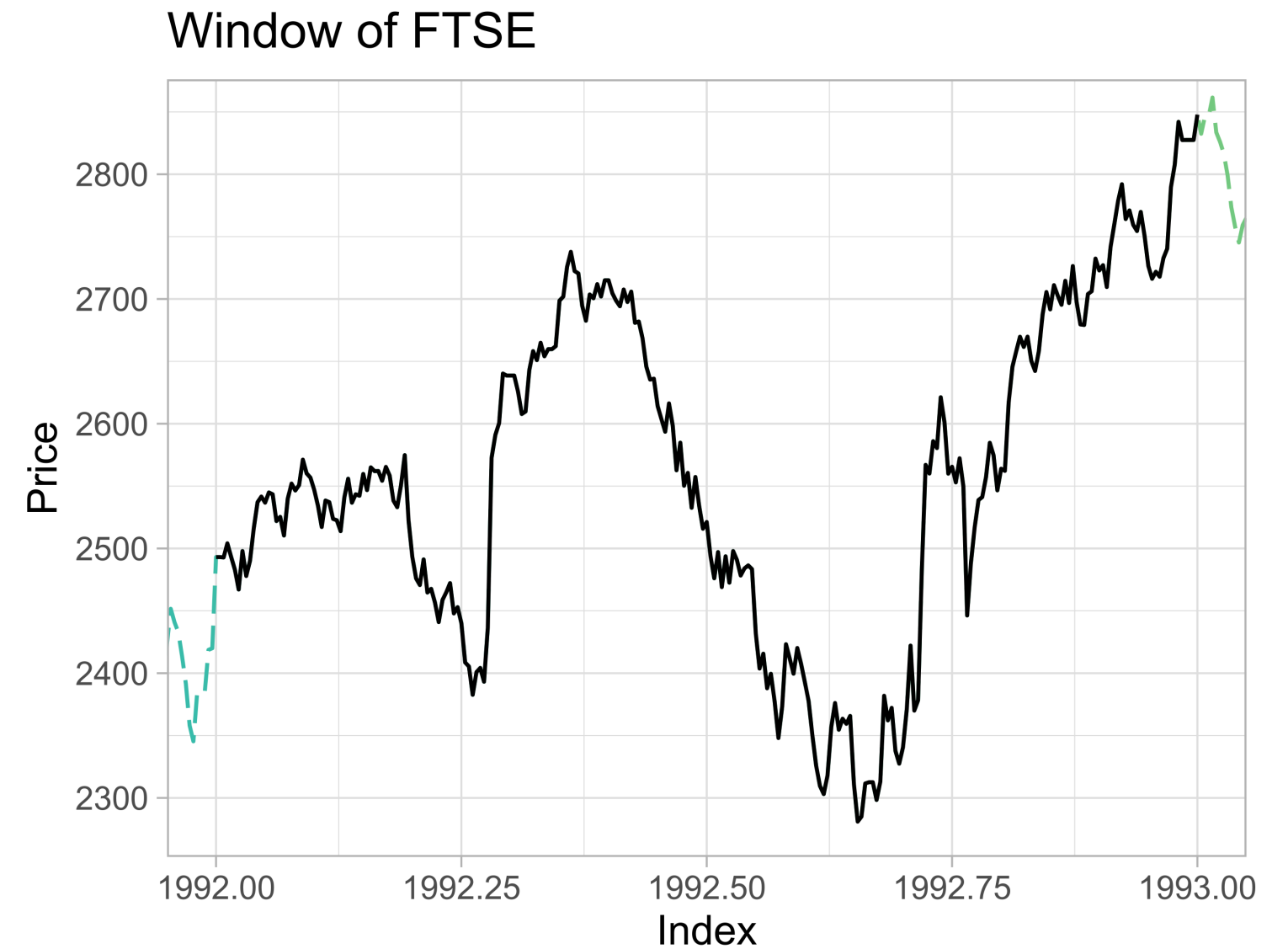


Windows

Original data:



Window:



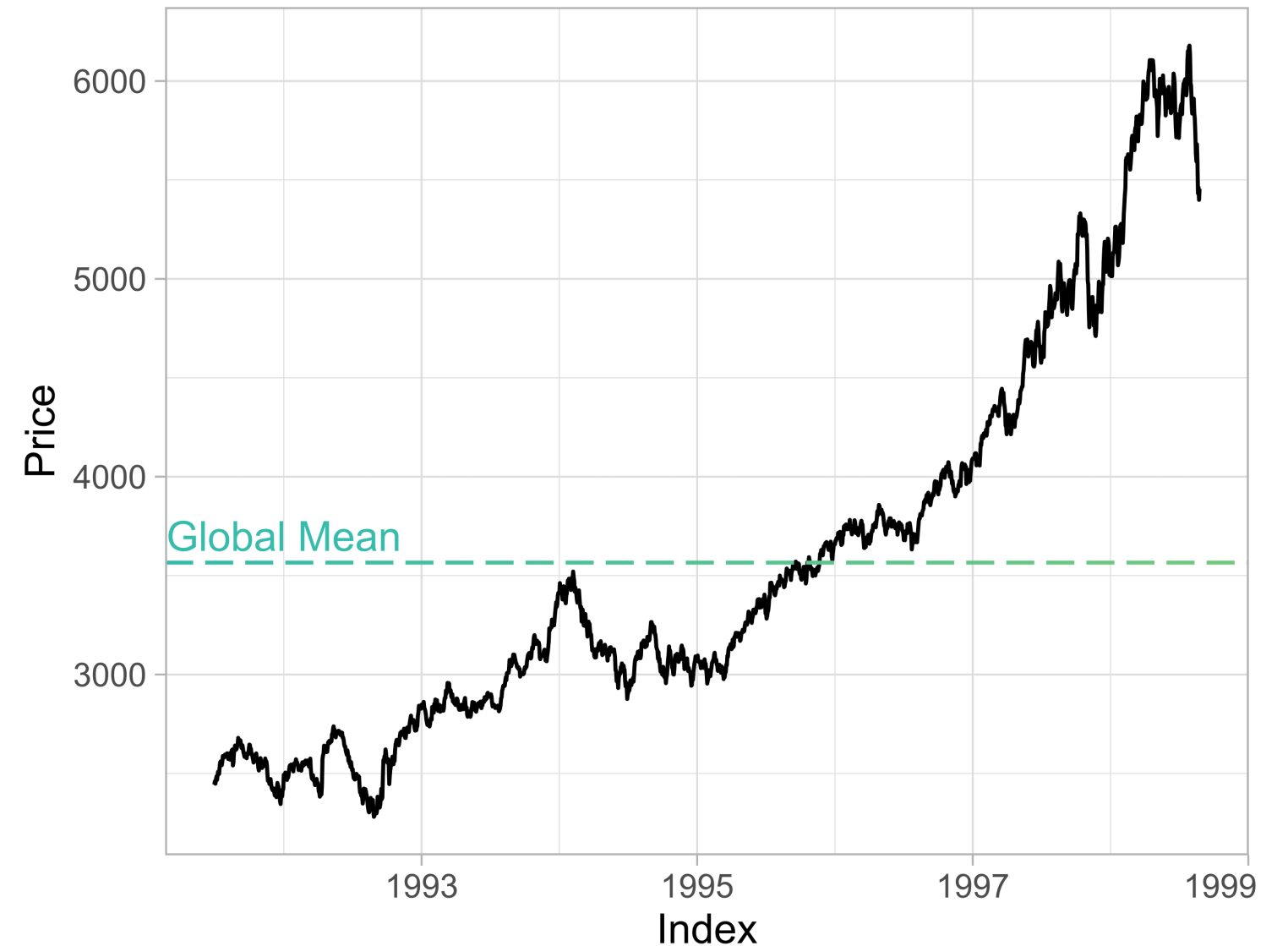
Global summary statistics

```
mean(ftse)
```

```
[1] 3565.643
```

```
autoplot(ftse) +  
  geom_hline(  
    yintercept = mean(ftse)  
  ) +  
  ...
```

Global mean:



Rolling window

- Measure of how statistics change as the data moves in time



- Rolling average plotted in red, on top of original data



Rolling with zoo

- `zoo::rollmean()`
- `zoo::rollsum()`
- `zoo::rollmax()`

```
rollmean(ftse,  
         k = 30,  
         align = 'right',  
         fill = NA)
```

Window arguments

```
ftse_rm_right <-  
  rollmean(ftse,  
           k = 7,  
           align = "right",  
           fill = NA)
```

- `k` : Size of window
- `align` : Alignment of window
- `fill` : Values to fill-in outside of window

```
ftse_rm_right
```

```
[1] NA  
[2] NA  
[3] NA  
[4] NA  
[5] NA  
[6] NA  
[7] 2465.971  
[8] 2475.229  
[9] 2482.414  
...
```

NA values

```
ftse_rm_right
```

```
[1] NA
[2] NA
[3] NA
[4] NA
[5] NA
[6] NA
[7] 2465.971
[8] 2475.229
[9] 2482.414
...
```

```
sum(is.na(ftse_rm_right))
```

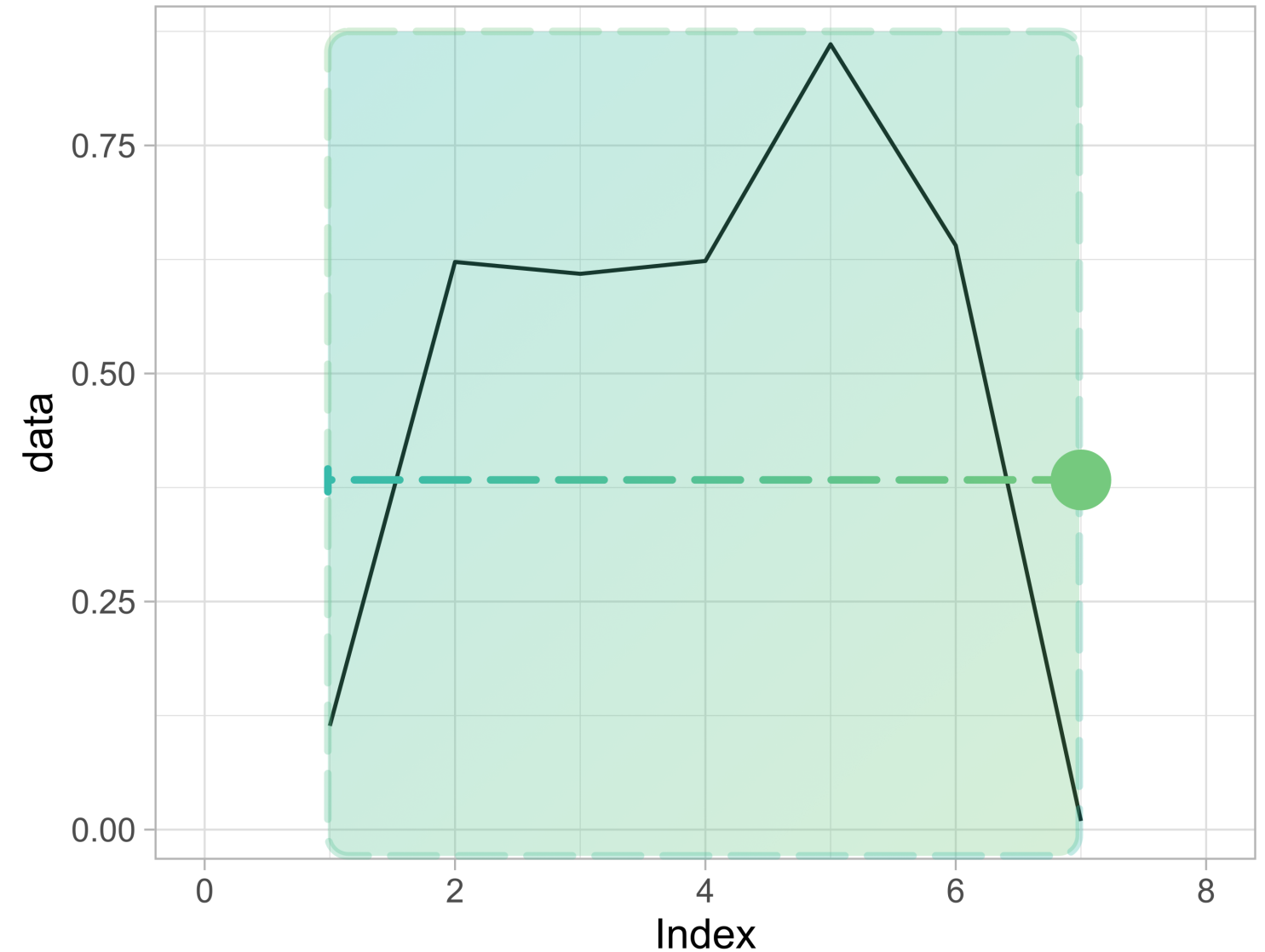
```
[1] 6
```

Window alignment

Alignments:

- Right-aligned

```
data_rm <- rollmean(  
  data,  
  k = 7,  
  fill = NA,  
  align = "right"  
)
```

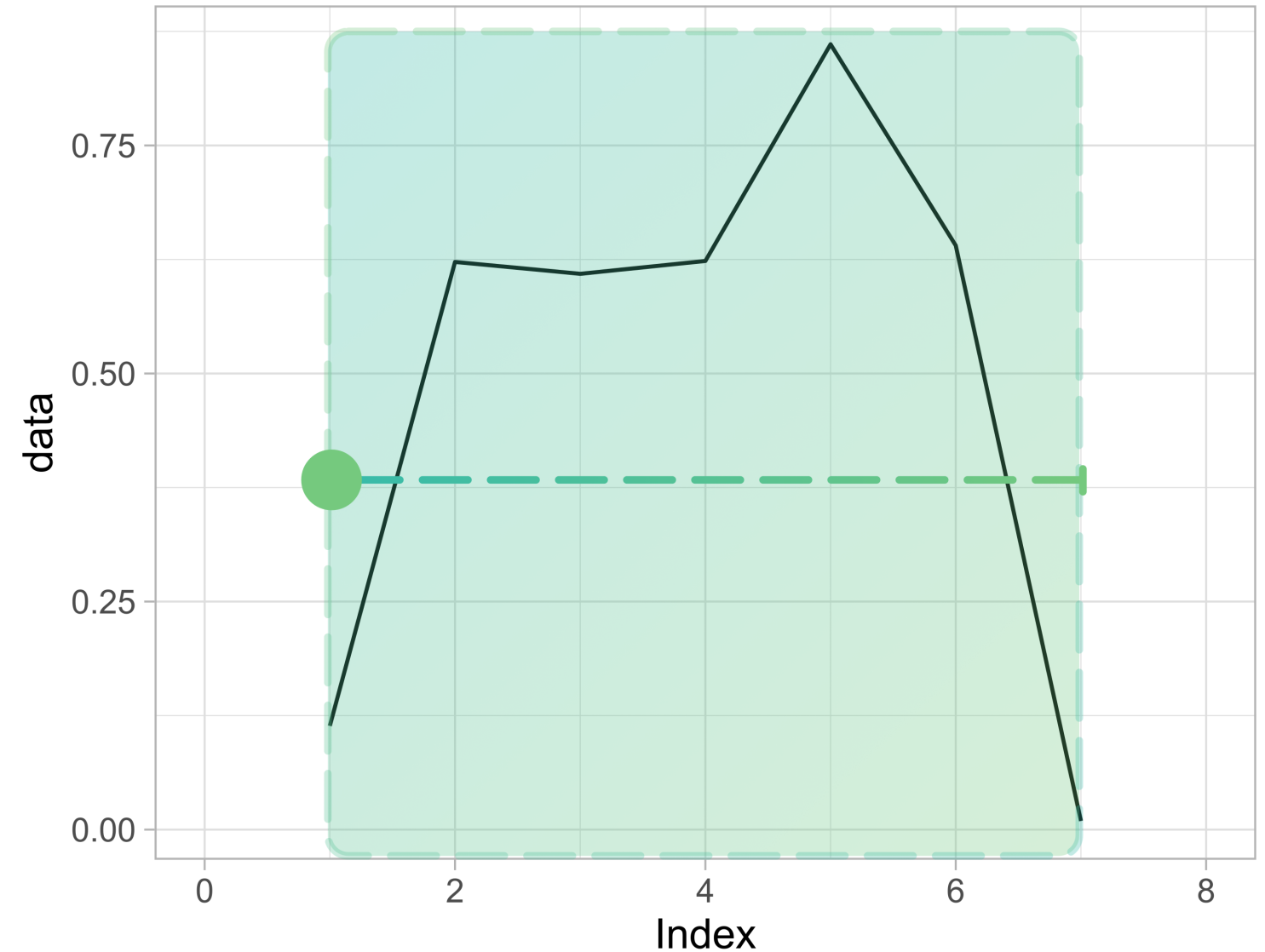


Window alignment

Alignments:

- Left-aligned

```
data_rm <- rollmean(  
  data,  
  k = 7,  
  fill = NA,  
  align = "left"  
)
```

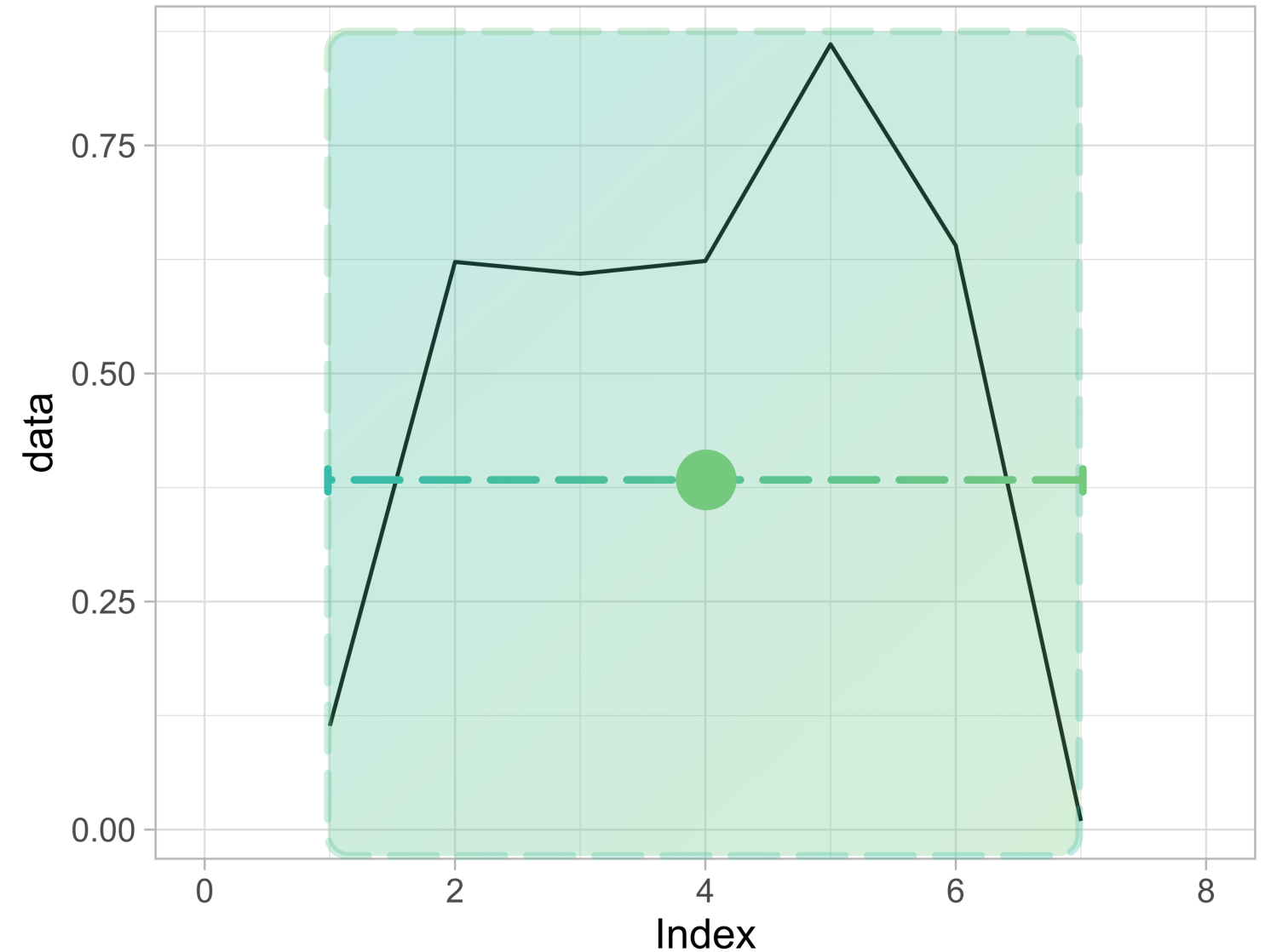


Window alignment

Alignments:

- Center-aligned

```
data_rm <- rollmean(  
  data,  
  k = 7,  
  fill = NA,  
  align = "center"  
)
```



Let's practice!

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Applying functions to rolling windows

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Rolling functions from zoo

`zoo::roll*` :

- `rollmean()`
- `rollmax()`
- `rollsum()`
- ...

Limitations:

- No `rollmin()` !
- Only certain functions exist

rollapply

```
rollapply(data = ftse,  
          width = 7,  
          FUN = min,  
          align = 'right',  
          fill = NA)
```

Arguments:

- `data` : Time series object
- `width` : Width of window (`k`)
- `FUN` : Summary function (`mean` , `max` , ...)
- `align` : Window alignment (`'left'` , `'right'` , or `'center'`)
- `fill` : Values to fill in outside of window

Roll-applying functions

Goal:

- Find range of values within 30-day window
- Approximate 'variation' in data

```
daily_temp
```

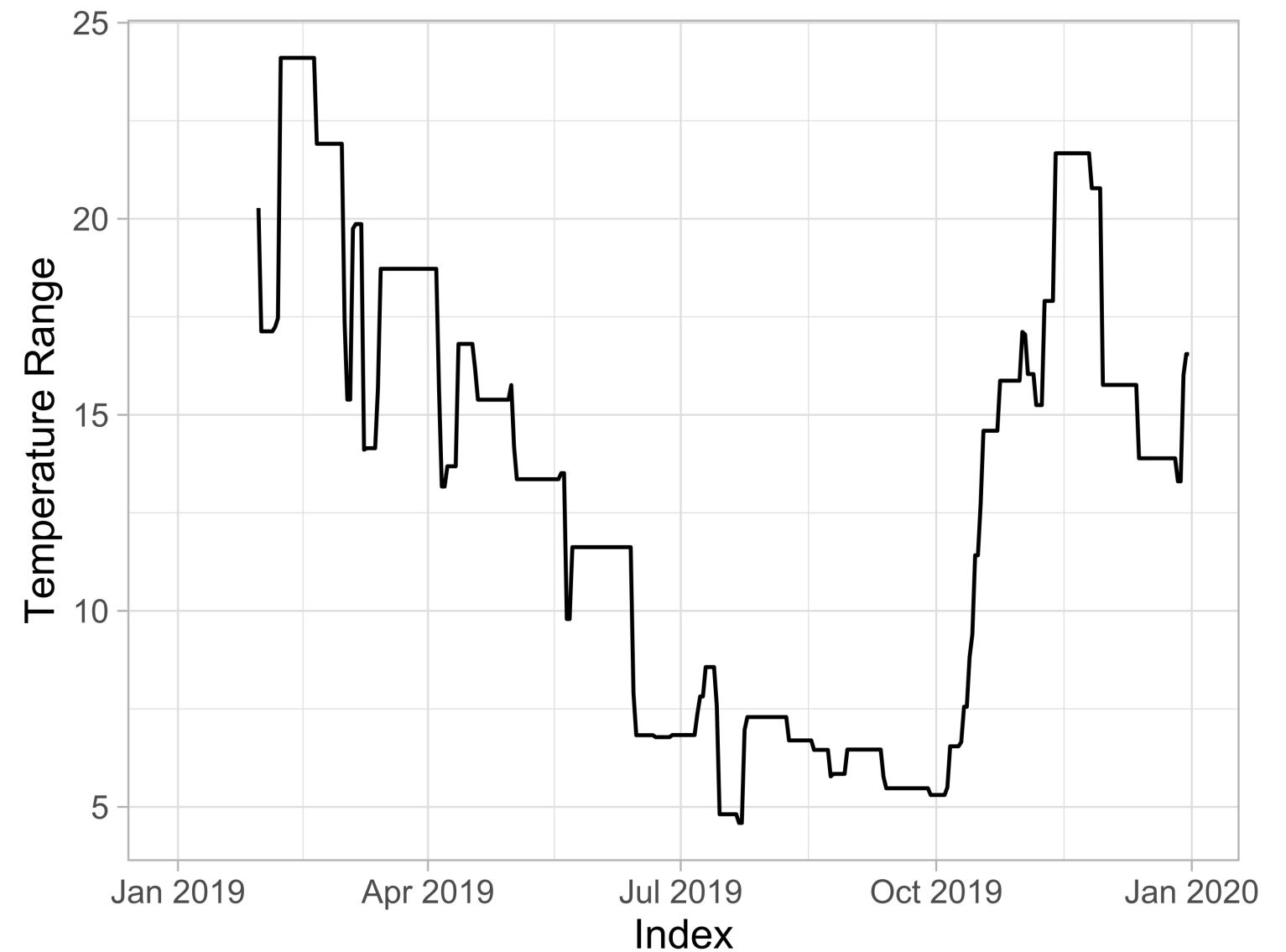
```
2019-01-01 13.191304
2019-01-02  6.945833
2019-01-03  8.495833
2019-01-04  8.683333
2019-01-05  7.400000
...
```

```
find_range <- function(x){
  max(x) - min(x)
}
```

```
daily_temp_range <-
  rollapply(
    daily_temp,
    FUN = find_range,
    width = 30,
    align = 'right',
    fill = NA
  )
```

Roll-applying functions

```
autoplot(daily_temp_range) +  
  theme_light() +  
  labs(y = 'Temperature Range')
```



Let's practice!

MANIPULATING TIME SERIES DATA IN R

Expanding windows

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Rolling versus expanding windows

Rolling window:

- Moving start point
- Window has a fixed width

Expanding window:

- Fixed start point
- Window has an increasing width

Expanding window process

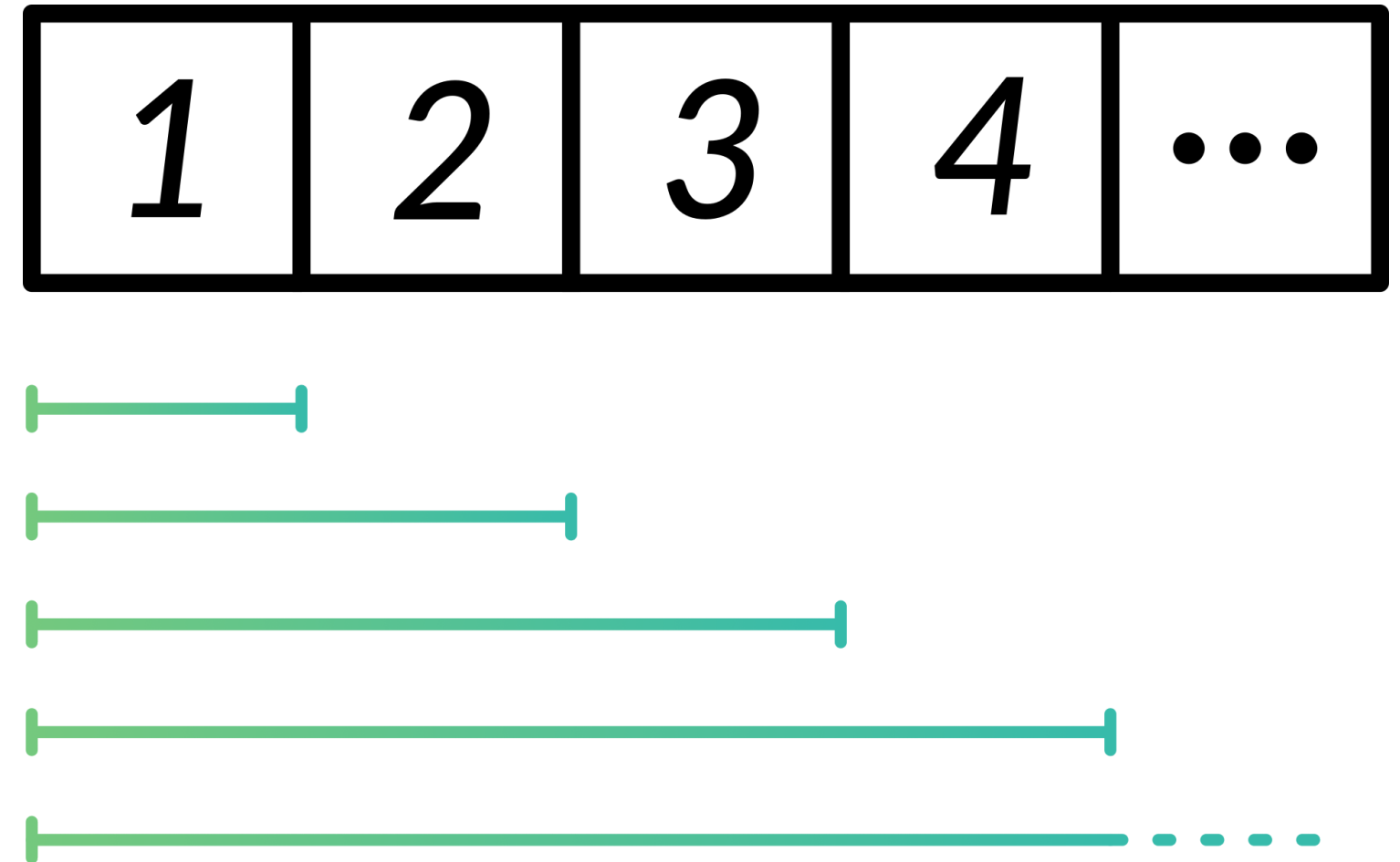
Increasing window width:

- Width 1 at observation 1,
- Width 2 at observation 2,
- Width 3 at observation 3,
- ...

What is the summary of the data available to us?

Fixed start point:

- Windows all start at beginning of time series.



Calculating an expanding window

Expanding windows in R:

- `zoo::rollapply()` !
- `width` can be single number or vector

Expanding window width:

- `1` , `2` , `3` , `4` , ...

Function for sequence of numbers:

- `base::seq_along()`

```
seq_along(daily_temp)
```

```
[1] 1 2 3 4 5 6 7 8 9 ...  
    ... 363 364 365
```

Calculating an expanding window

```
exp_widths <- seq_along(daily_temp)
```

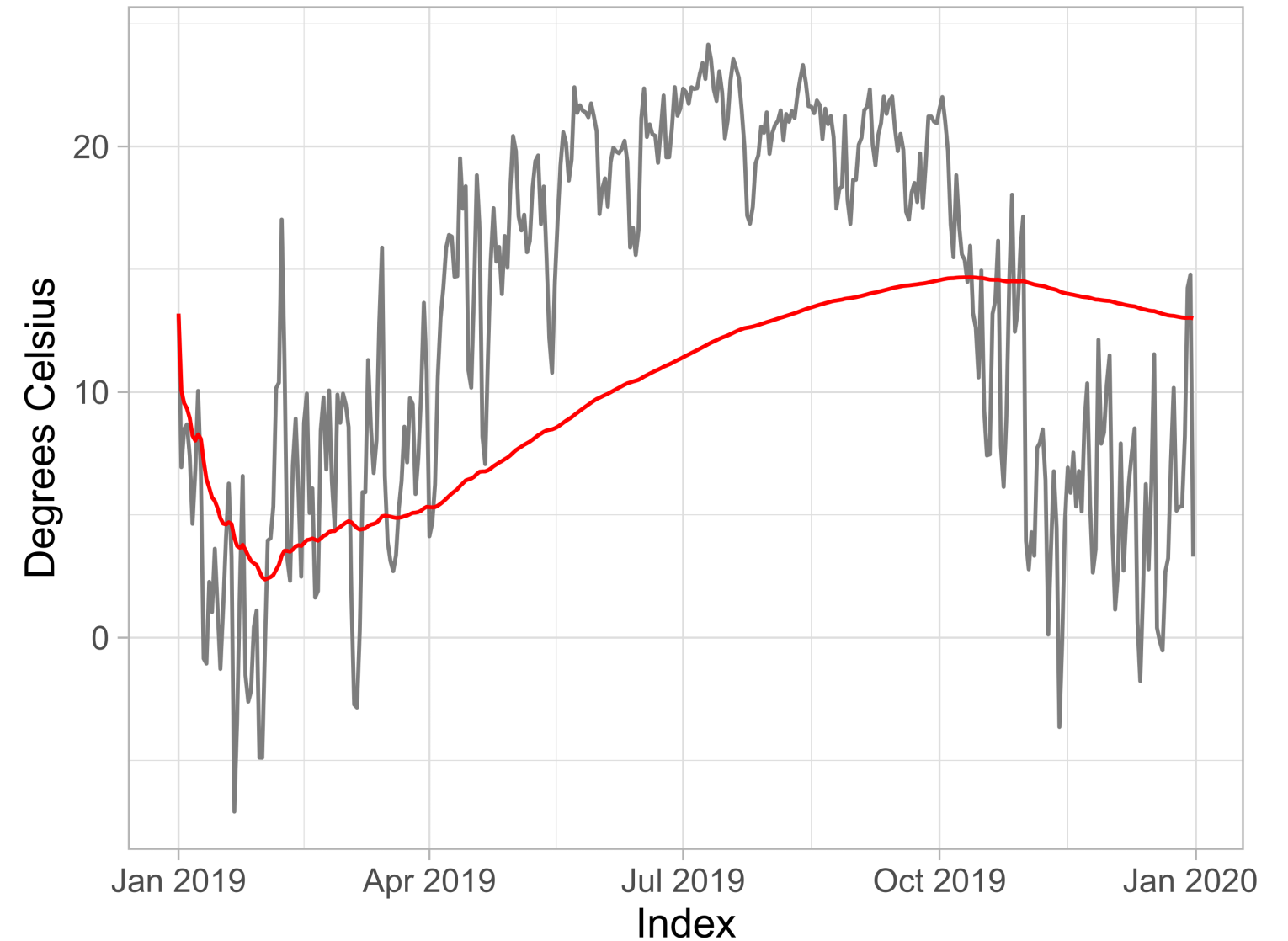
```
exp_widths
```

```
[1] 1 2 3 4 5 ... 363 364 365
```

```
temp_expand <-  
  rollapply(  
    data = daily_temp,  
    FUN = mean,  
    width = exp_widths,  
    # Alignment must be 'right'  
    align = 'right'  
  )
```

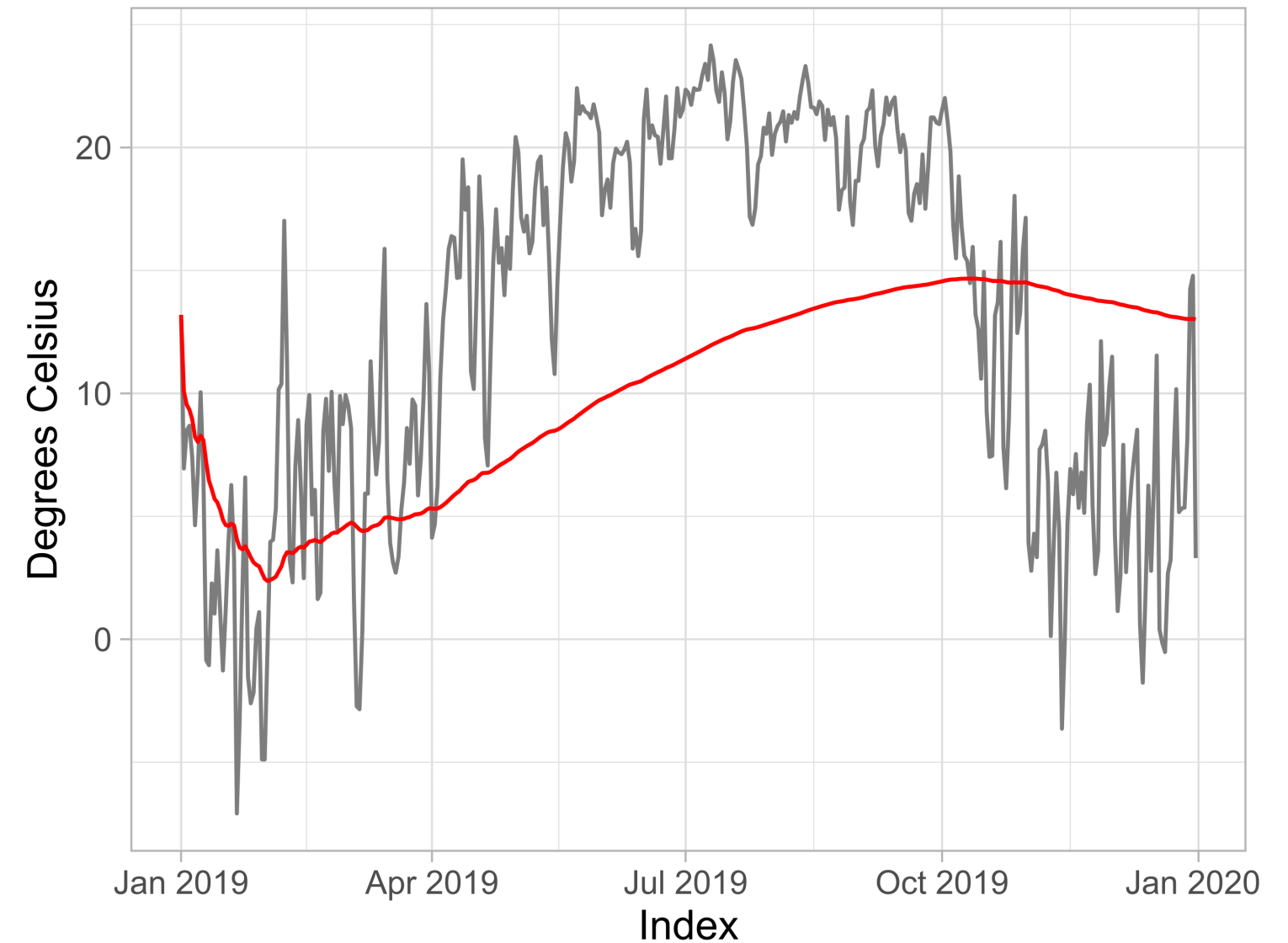
Plotting expanding windows

```
ggplot() +  
# Original data  
  geom_line(data = daily_temp,  
            aes(x = Index,  
                y = daily_temp),  
            color = 'grey50') +  
# Expanding window plot  
  geom_line(data = temp_expand,  
            aes(x = Index,  
                y = temp_expand),  
            color = 'red') +  
  theme_light() +  
  labs(y = 'Degrees Celsius')
```



Expanding window inferences

- Statistics approach global summaries
- Expanding mean becomes less sensitive to change
- Earlier observations are more sensitive to change



Let's practice!

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Congratulations!

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Chapter 1:

- Time series data
- `Date` , `POSIXct` , etc.
- ISO 8601
- Temporal information

Chapter 2:

- `zoo` package and class
- Converting between `zoo` and `data.frame`
- Plotting with `ggplot2`

Chapter 3:

- Subsetting a time series
- `zoo::yearmon` and `zoo::yearqtr`
- Resampling and Aggregating
- Imputing missing values

Chapter 4:

- Rolling windows
- `rollapply()`
- Expanding windows

What's next?

Courses:

- [Time Series Analysis in R](#)
- [Visualizing Time Series Data in R](#)

Skill Track:

- [Time Series with R](#)

Thank you!

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