tsibble and fable

with xaringan

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1) tsibble

2) fable

1) tsibble

```
install.packages("tsibble")
```

> **tsibble** package provides a data infrastructure for tidy temporal data with wrangling tools adapting tidy data principles.

- tsibble is a data- and model-oriented object.
- In tsibble:
  1. **Key** is a set of variables that define observational units over time.
  2. **Index** is a variable with inherent ordering from past to present.
  3. Each observation should be uniquely identified by **key** and **index**.
  4. Each observational unit should be measured at a common **interval**, if regularly spaced.

Coerce to a tsibble - as_tsibble()

> To coerce data frame to tsibble, we need to declare **key** and **index**.

- The **key** can be comprised of empty, one, or more variables.
  - For multiple variables, declare `key = c(x1, x2, x3)`.
  - can be created in conjunction with tidy selectors like `starts_with()`
- The **Index** supports an extensive range of indices
  - native time classes in R (Date, POSIXct and difftime)
  - tsibble's new additions (yearweek, yearmonth, and yearquarter)
- The **Interval** is computed from index based on the representation.

Inverval	Class
Annual	interger/double
Quarterly	yearquarter
Monthly	yearmonth
Weekly	yearweek
Daily (Subdaily)	Date / difftime (POSIXt / difftime / hms)

Ex) nycflights13::weather

- `time_hour` containing the date-times should be declared as **index**
- `origin` should be declared as **key**.
- Other columns can be considered as measured variables.

```
weather <- nycflights13::weather %>%
  select(origin, time_hour, temp, humid, precip)

weather
```

```
## # A tibble: 26,115 x 5
##    origin time_hour             temp humid precip
##    <chr>  <dttm>               <dbl> <dbl>  <dbl>
##  1 EWR    2013-01-01 01:00:00  39.0  59.4       0
##  2 EWR    2013-01-01 02:00:00  39.0  61.6       0
##  3 EWR    2013-01-01 03:00:00  39.0  64.4       0
##  4 EWR    2013-01-01 04:00:00  39.9  62.2       0
##  5 EWR    2013-01-01 05:00:00  39.0  64.4       0
##  6 EWR    2013-01-01 06:00:00  37.9  67.2       0
##  7 EWR    2013-01-01 07:00:00  39.0  64.4       0
##  8 EWR    2013-01-01 08:00:00  39.9  62.2       0
```

Ex) nycflights13::weather

- `time_hour` containing the date-times should be declared as **index**
- `origin` should be declared as **key**.
- Other columns can be considered as measured variables.

```
weather_tsbl <- as_tsibble(weather,
                           key = origin,
                           index = time_hour)
weather_tsbl
```

```
## # A tsibble: 26,115 x 5 [1h] <America/New_York>
## # Key:       origin [3]
##    origin time_hour             temp humid precip
##    <chr>  <dttm>               <dbl> <dbl>  <dbl>
##  1 EWR    2013-01-01 01:00:00  39.0  59.4       0
##  2 EWR    2013-01-01 02:00:00  39.0  61.6       0
##  3 EWR    2013-01-01 03:00:00  39.0  64.4       0
##  4 EWR    2013-01-01 04:00:00  39.9  62.2       0
##  5 EWR    2013-01-01 05:00:00  39.0  64.4       0
##  6 EWR    2013-01-01 06:00:00  37.9  67.2       0
##  7 EWR    2013-01-01 07:00:00  39.0  64.4       0
```

fill_gaps()

> **fill_gaps()** turns implicit missing values into explicit.

- If the observations are made at regular time interval, we could turn these implicit missingness to be explicit simply using `fill_gaps()`.
- `fill_gaps()` also handles filling in time gaps by values or functions, and respects time zones for date-times.

```
full_weather <- weather_tsbl %>%
  fill_gaps(precip = 0) %>%
#filling gaps in precip with 0
  group_by_key() %>%
  tidyr::fill(temp, humid, .direction = "down")
#replaces NAs with its previous observation for each origin (key)

full_weather
```

```
## # A tsibble: 26,190 x 5 [1h] <America/New_York>
## # Key:       origin [3]
## # Groups:    origin [3]
##    origin time_hour             temp humid precip
##    <chr>  <dttm>               <dbl> <dbl>  <dbl>
```

index_by() + summarise()

> **`index_by()`** + **`summarise()`** to aggregate over calendar periods

- `index_by()` is the counterpart of `group_by()` in temporal context, but it groups the index only.
- In conjunction with `index_by()`, **`summarise()`** and its scoped variants aggregate variables over calendar periods.
- `index_by()` goes hand in hand with the index functions including `as.Date()`, `yearweek()`, `yearmonth()` and `yearquarter()`, as well as other friends from `lubridate`.

index_by() + summarise()

Example) To compute average temperature and total precipitation *per month*, we can apply `yearmonth()` to the index variable (referred to as .).

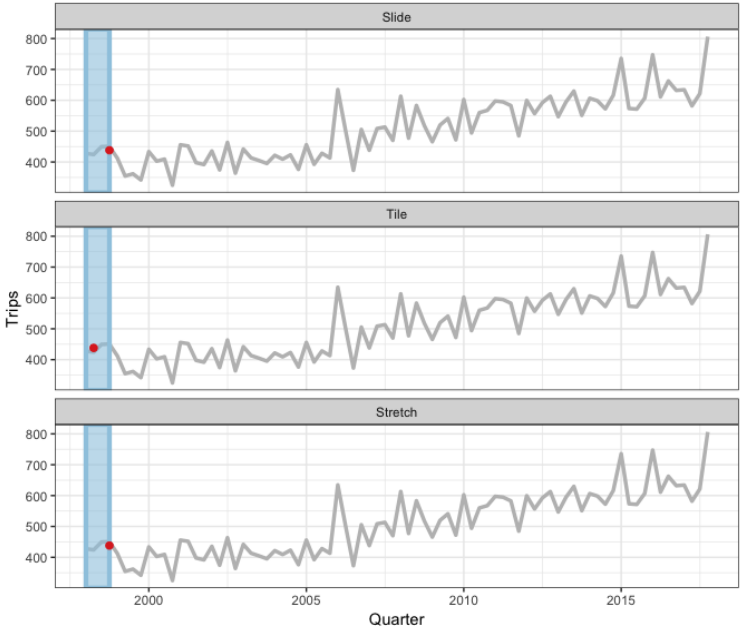
- While collapsing rows (by `summarise()`), `group_by()` and `index_by()` take care of updating the key and index respectively.

```
full_weather %>%
  group_by_key() %>%
  index_by(year_month = ~ yearmonth(.)) %>% # monthly aggregates
  summarise(
    avg_temp = mean(temp, na.rm = TRUE),
    ttl_precip = sum(precip, na.rm = TRUE)
  )
```

```
## # A tsibble: 36 x 4 [1M]
## # Key:       origin [3]
##    origin year_month avg_temp ttl_precip
##    <chr>       <mth>    <dbl>      <dbl>
##  1 EWR      2013 Jan     35.6       3.53
##  2 EWR      2013 Feb     34.2       3.83
##  3 EWR      2013 Mar     40.1       3
##  4 EWR      2013 Apr     53.0       1.47
```

Rolling with slide(), tile(), stretch()

- Several functions in tsibble allow for different variations of moving windows using purrr-like syntax:
  - `slide()`: sliding window with overlapping observations.
  - `tile()`: tiling window without overlapping observations.
  - `stretch()`: fixing an initial window and expanding to include more observations.



2) fable

```
install.packages("fable")
```

> **fable** package provides a collection of commonly used univariate and multivariate time series forecasting models

- Forecasing models include exponential smoothing via state space models and automatic ARIMA modelling.
- These models work within the fable framework, which provides the tools to evaluate, visualise, and combine models in a workflow consistent with the tidyverse.

Example

```
p_load(fable, tsibble, tsibbledata, lubridate, dplyr, feast)

aus_retail %>%
  filter(
    State %in% c("New South Wales", "Victoria"),
    Industry == "Department stores"
  ) %>%
  model(
    ets = ETS(box_cox(Turnover, 0.3)),
    arima = ARIMA(log(Turnover)),
    snaive = SNAIVE(Turnover)
  ) %>%
  forecast(h = "2 years") %>%
  autoplot(filter(aus_retail, year(Month) > 2010), level = NULL)
```

Example