forecasting ED

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2023-08-28

```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.2     v readr     2.1.4
## v forcats   1.0.0     v stringr   1.5.0
## v ggplot2   3.4.2     v tibble    3.2.1
## v lubridate 1.9.2     v tidyr     1.3.0
## v purrr     1.0.1
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(fpp3)
```

```
## -- Attaching packages --------------------------------------------- fpp3 0.5 --
## v tsibble     1.1.3     v fable       0.3.3
## v tsibbledata 0.4.1     v fabletools  0.3.3
## v feasts      0.3.1
## -- Conflicts ------------------------------------------------ fpp3_conflicts --
## x lubridate::date()    masks base::date()
## x dplyr::filter()      masks stats::filter()
## x tsibble::intersect() masks base::intersect()
## x tsibble::interval()  masks lubridate::interval()
## x dplyr::lag()         masks stats::lag()
## x tsibble::setdiff()   masks base::setdiff()
## x tsibble::union()     masks base::union()
```

```
library(hts)
```

```
## Loading required package: forecast
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
##
## Attaching package: 'forecast'
##
## The following object is masked from 'package:fabletools':
##
##     accuracy
```

```r
data <- read.csv("HLTH0037_ts_cleaned.csv")
```

```r
unique(data$Hospital_Hierarchy)
```

```
## [1] "W11000023" "W11000025" "W11000031" "W11000026" "W11000029" "W11000030"
## [7] "W11000027" "W11000028" "W11000024"
```

```r
data1 <- data %>%
  mutate(YearMonth = yearmonth(YearMonth)) %>%
  as_tsibble(index = YearMonth, key = c(Age_Code, Sex_ItemName_ENG, Hospital_Code, Hospital_ItemName_EN

data1 <- data1 %>%
  mutate(Number = 1)
```

```r
#Produce a table or plot to show the hierarchy between the organisation and hospital hierararchy

# Assuming data is your hierarchical time series data
data2 <- data1 %>%
  select(YearMonth, Hospital_ItemName_ENG, Hospital_Hierarchy, Organisation, Number)
```

```r
# Convert to data.table
library(data.table)
```

```
##
## Attaching package: 'data.table'
```

```
## The following object is masked from 'package:tsibble':
##
##     key
```

```
## The following objects are masked from 'package:lubridate':
##
##     hour, isoweek, mday, minute, month, quarter, second, wday, week,
##     yday, year
```

```
## The following objects are masked from 'package:dplyr':
##
##     between, first, last
```

```
## The following object is masked from 'package:purrr':
##
##     transpose
```

```r
setDT(data2)

# Create a hierarchical table using data.table operations
hierarchical_table <- data2[, .(Total = sum(Number)), by = .(Hospital_Hierarchy, Organisation, Hospital

knitr::kable(hierarchical_table)
```

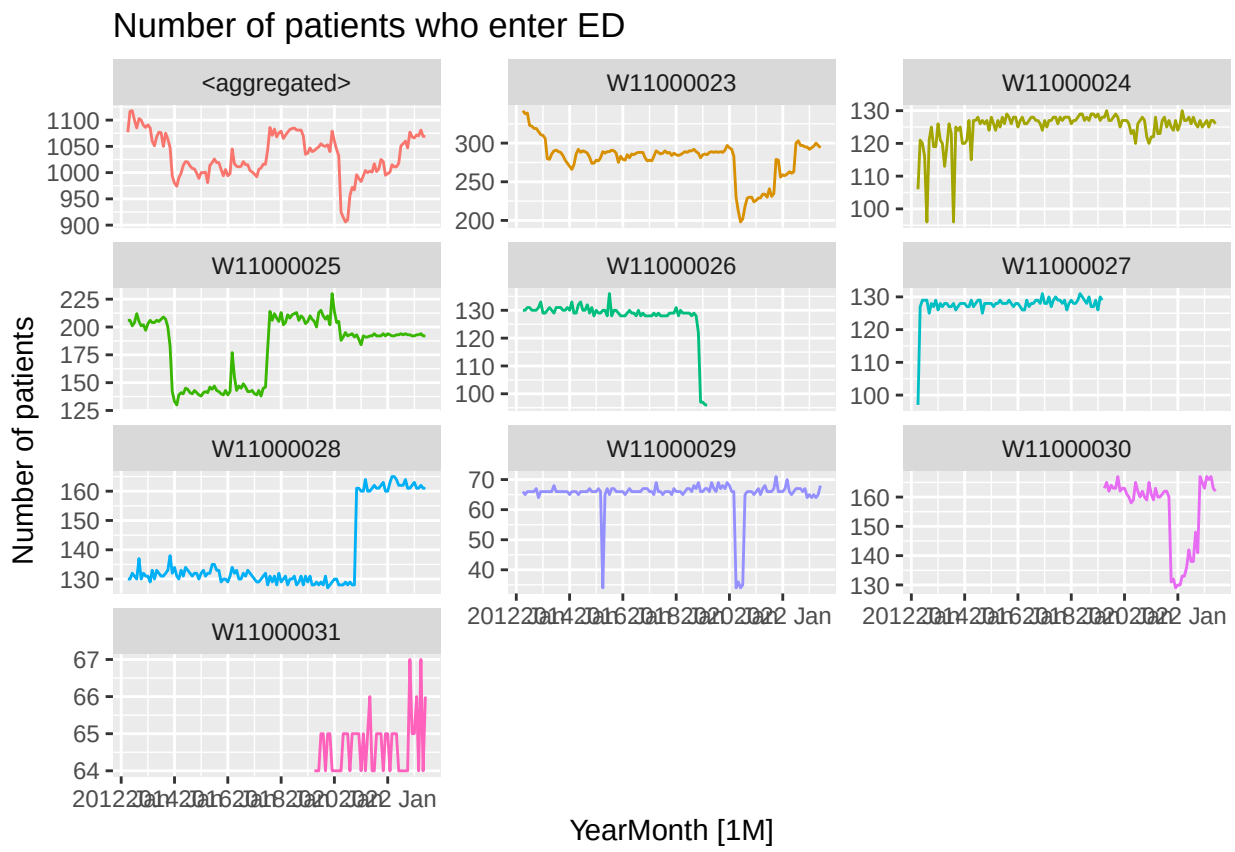
Hospital_Hierarchy	Organisation	Hospital_ItemName_ENG	Total
W11000023	Betsi Cadwaladr	Ysbyty Glan Clwyd	4437
W11000023	Betsi Cadwaladr	Wrexham Maelor Hospital	4478
W11000023	Betsi Cadwaladr	Colwyn Bay Community Hospital	340
W11000023	Betsi Cadwaladr	Holywell Community Hospital	394
W11000023	Betsi Cadwaladr	Mold Community Hospital	682
W11000023	Betsi Cadwaladr	Ysbyty Gwynedd	4381
W11000023	Betsi Cadwaladr	Llandudno General Hospital	4342
W11000023	Betsi Cadwaladr	Bryn Beryl Hospital	4058
W11000023	Betsi Cadwaladr	Dolgellau And Barmouth District Hospital	3066
W11000023	Betsi Cadwaladr	Ffestiniog Memorial Hospital	65
W11000023	Betsi Cadwaladr	Tywyn & District War Memorial Hospital	2897
W11000023	Betsi Cadwaladr	Ysbyty Alltwen	4315
W11000023	Betsi Cadwaladr	Ysbyty Penrhos Stanley	4320
W11000025	Hywel Dda	Glangwili General Hospital	4353
W11000025	Hywel Dda	Llandovery Hospital	1320
W11000025	Hywel Dda	Bronglais General Hospital	4339
W11000025	Hywel Dda	Cardigan And District Memorial Hospital	921
W11000025	Hywel Dda	Prince Philip Hospital	4339
W11000025	Hywel Dda	Withybush General Hospital	4349
W11000025	Hywel Dda	S. Pembs Hosp. Health & Social Care Res Centre	607
W11000025	Hywel Dda	New Tenby Cottage Hospital Outpatients	2977
W11000025	Hywel Dda	Cardigan Integrated Care Centre	1368
W11000031	Swansea Bay	Morriston Hospital	1653
W11000031	Swansea Bay	Neath Port Talbot Hospital	1646
W11000026	Abertawe Bro Morgannwg	Princess Of Wales Hospital	2764
W11000026	Abertawe Bro Morgannwg	Singleton Hospital	2558
W11000026	Abertawe Bro Morgannwg	Morriston Hospital	2716
W11000026	Abertawe Bro Morgannwg	Neath Port Talbot Hospital	2706
W11000029	Cardiff & Vale	University Hospital Of Wales	4633
W11000029	Cardiff & Vale	The Barry Hospital	4158
W11000030	Cwm Taf Morgannwg	Princess Of Wales Hospital	1686
W11000030	Cwm Taf Morgannwg	The Royal Glamorgan Hospital	1717
W11000030	Cwm Taf Morgannwg	Prince Charles Hospital	1680
W11000030	Cwm Taf Morgannwg	Ysbyty Cwm Rhondda	1602
W11000030	Cwm Taf Morgannwg	Ysbyty Cwm Cynon	1250
W11000027	Cwm Taf	The Royal Glamorgan Hospital	2712
W11000027	Cwm Taf	Prince Charles Hospital	2718
W11000027	Cwm Taf	Aberdare General Hospital	32
W11000027	Cwm Taf	Ysbyty Cwm Rhondda	2610
W11000027	Cwm Taf	Ysbyty Cwm Cynon	2652
W11000028	Aneurin Bevan	Nevill Hall Hospital	4402
W11000028	Aneurin Bevan	Royal Gwent Hospital	4465
W11000028	Aneurin Bevan	Ysbyty Aneurin Bevan	4328
W11000028	Aneurin Bevan	Ysbyty Ystrad Fawr	4387
W11000028	Aneurin Bevan	The Grange Hospital	1055
W11000024	Powys Teaching	Llandrindod Wells Hospital	4319
W11000024	Powys Teaching	Victoria Memorial Hospital	4294
W11000024	Powys Teaching	Breconshire War Memorial Hospital	4323

Hospital_Hierarchy	Organisation	Hospital_ItemName_ENG	Total
W11000024	Powys Teaching	Ystradgynlais Community Hospital	3951

```
#Number of patients entering ED under different hospital hierarchy

data1_hts <- data1 %>%
  aggregate_key(Hospital_Hierarchy/Hospital_ItemName_ENG, Number = sum(Number))

data1_hts |>
  filter(is_aggregated(Hospital_ItemName_ENG)) |>
  autoplot(Number) +
  labs(y = "Number of patients",
       title = "Number of patients who enter ED") +
  facet_wrap(vars(Hospital_Hierarchy), scales = "free_y", ncol = 3) +
  theme(legend.position = "none")
```




```
#Choose only two age groups in case of too many categories
unique(data$Age_Code)
```

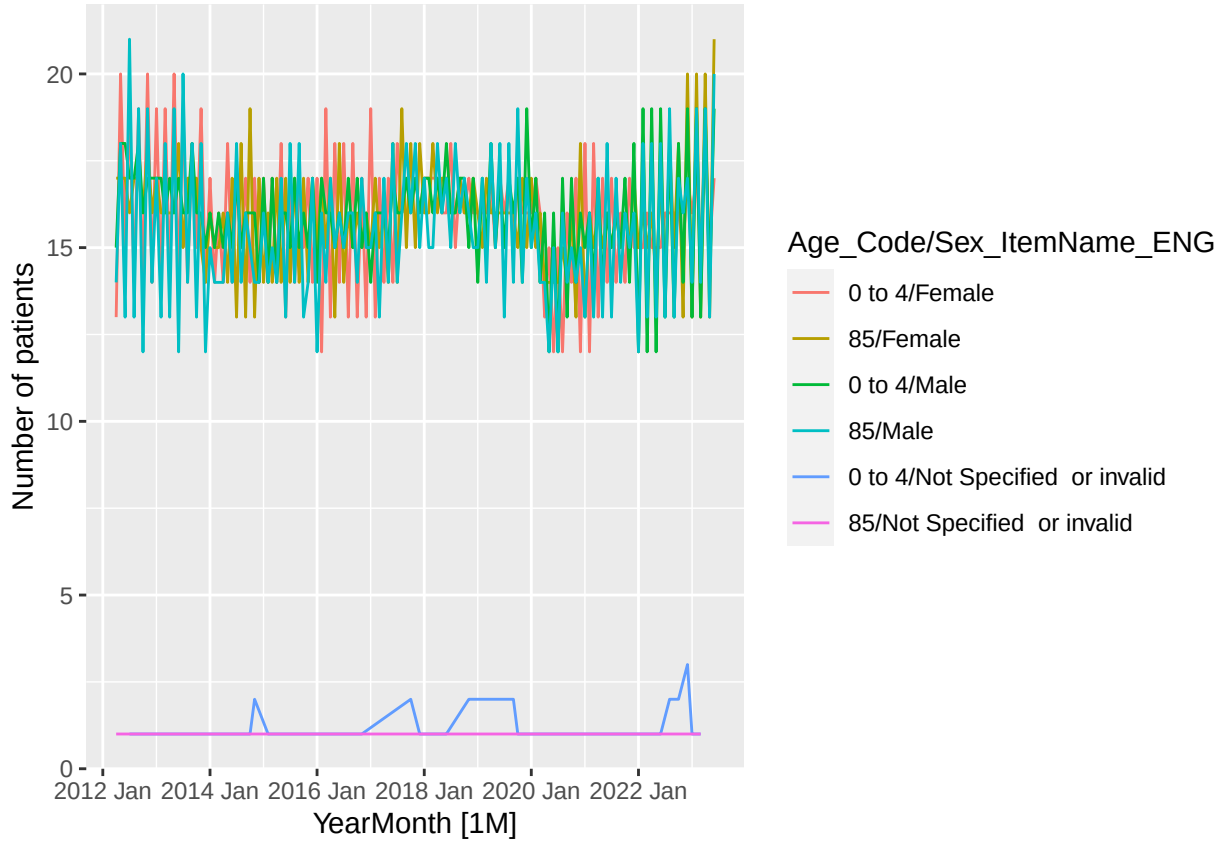
```
##  [1] "0 to 4"   "18 to 24" "25 to 29" "30 to 34" "35 to 39" "40 to 44"
##  [7] "45 to 49" "5 to 17"  "50 to 54" "55 to 59" "60 to 64" "65 to 69"
## [13] "70 to 74" "75 to 79" "80 to 84" "85"       "Unknown"
```

```
#There are 17 different age groups, if also grouping with sex,
#then there will be 17*3 groups

data1_gts <- data1 %>%
  filter(Age_Code == c("0 to 4", "85")) %>%
  aggregate_key(Age_Code* Sex_ItemName_ENG , Number = sum(Number))
```

```
## Warning: There was 1 warning in `filter()`.
## i In argument: `Age_Code == c("0 to 4", "85")`.
## Caused by warning in `Age_Code == c("0 to 4", "85")`:
## ! longer object length is not a multiple of shorter object length
```

```
data1_gts |>
  filter(!is_aggregated(Sex_ItemName_ENG), !is_aggregated(Age_Code)) |>
  autoplot(Number) +
  labs(y = "Number of patients")
```

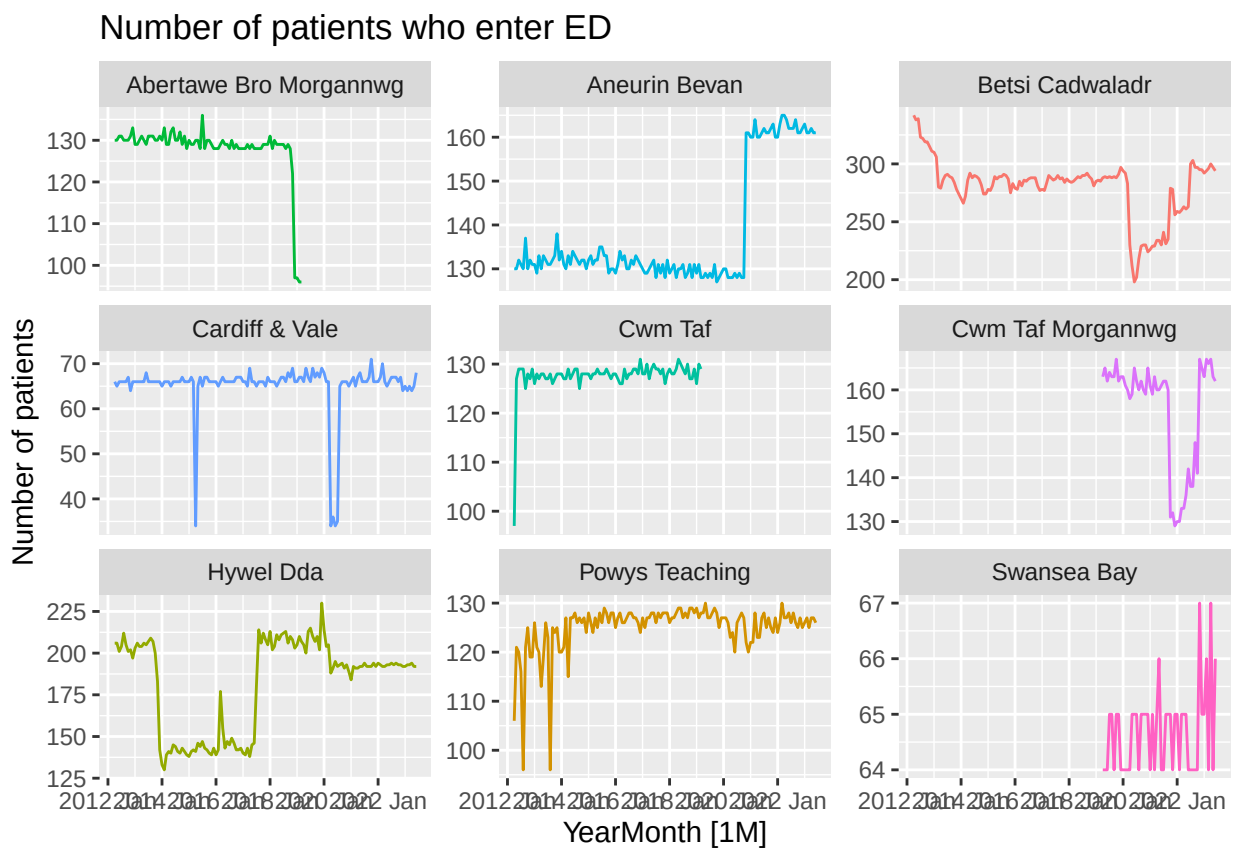



```
# Number of patients entering ED within different organisation

data2_hts <- data1 %>%
  aggregate_key(Organisation/Hospital_Hierarchy, Number = sum(Number))

data2_hts |>
  filter(!is_aggregated(Hospital_Hierarchy)) |>
```

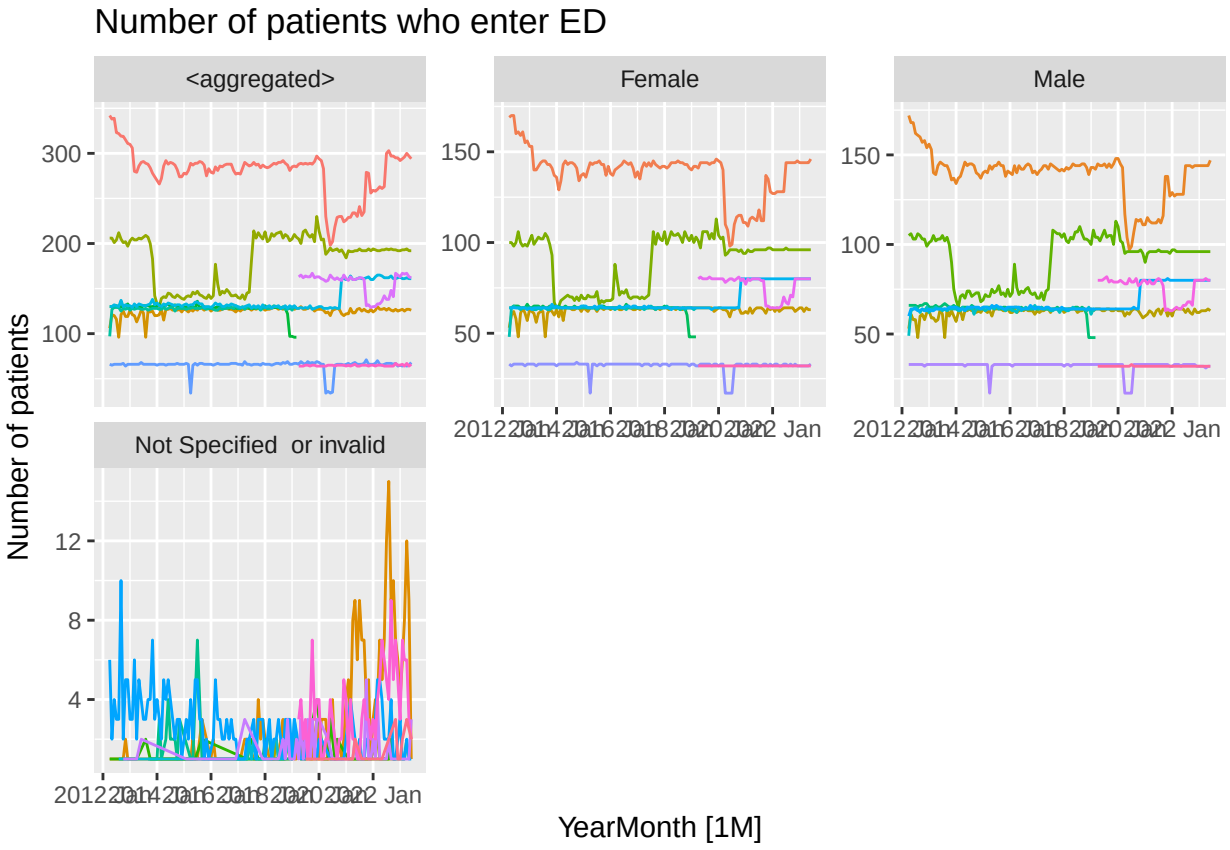
```
  autoplot(Number) +
  labs(y = "Number of patients",
       title = "Number of patients who enter ED") +
  facet_wrap(vars(Organisation), scales = "free_y", ncol = 3) +
  theme(legend.position = "none")
```




```
# Number of patients entering ED, facet by sex

data3_ghts <- data1 %>%
  aggregate_key((Organisation/Hospital_Hierarchy)* Sex_ItemName_ENG , Number = sum(Number))

data3_ghts |>
  filter(!is_aggregated(Hospital_Hierarchy), !is_aggregated(Hospital_Hierarchy)) |>
  autoplot(Number) +
  labs(y = "Number of patients",
       title = "Number of patients who enter ED") +
  facet_wrap(vars(Sex_ItemName_ENG), scales = "free_y", ncol = 3) +
  theme(legend.position = "none")
```


Number of patients who enter ED
<aggregated>
Female
Male
Not Specified or invalid
Number of patients
YearMonth [1M]