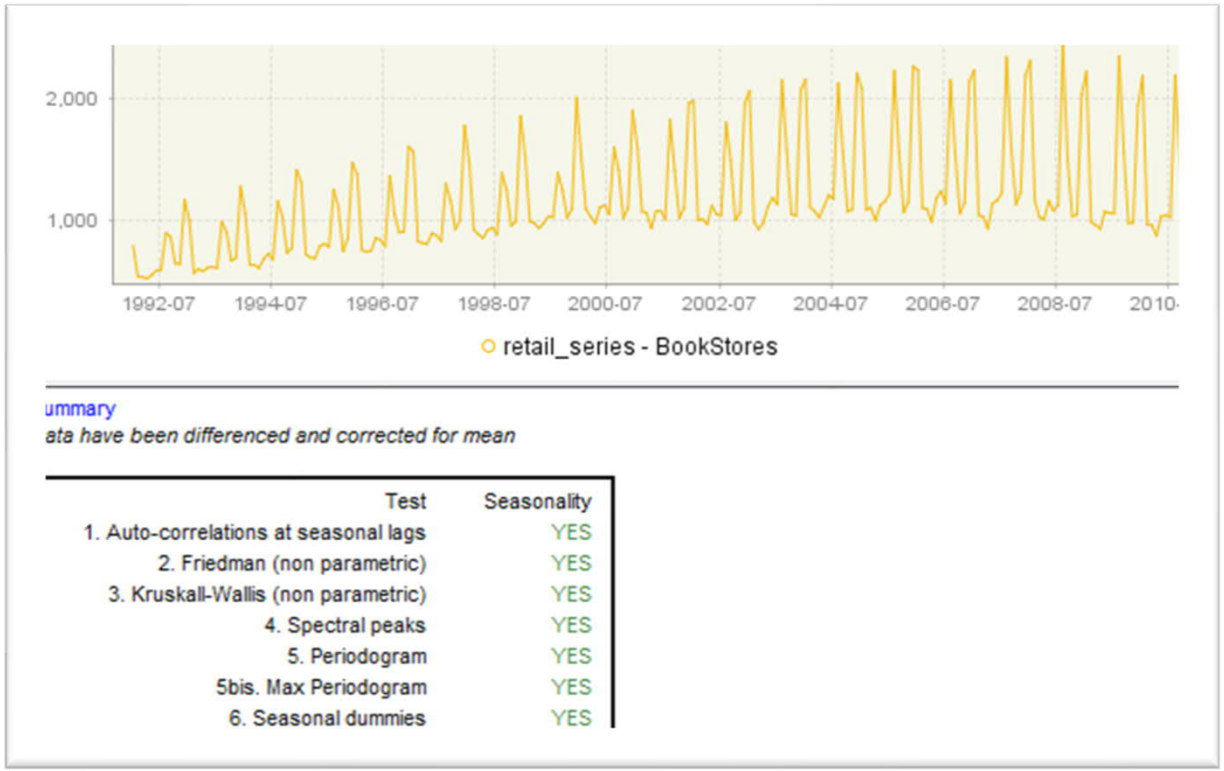
Seasonality and trading days tests in JD+

ESTP training

17-19/10/2023

CONTRACTORS ORGANISING SOME OF THE COURSES ARE ACTING UNDER A FRAMEWORK CONTRACT CONCLUDED WITH THE COMMISSION

Overview



Seasonality tests

- Non parametric tests
  - Friedman
    - ANOVA-type. The test uses the rankings of the observations within each year. It does not require distributional assumptions.
    - H0: all periods can be treated equally (= no seasonality), H1: series is seasonal
    - P-value < 0.01 ⇒ H0 is rejected
    - Applied on series without trend (for instance (log) differenced series)
  - Kruskall-Wallis
    - The test uses the rankings of all the observations. It does not require distributional assumptions.
    - H0: All periods have the same mean(average ranking), H1: series is seasonal
    - Applied on series without trend (could work on any series)

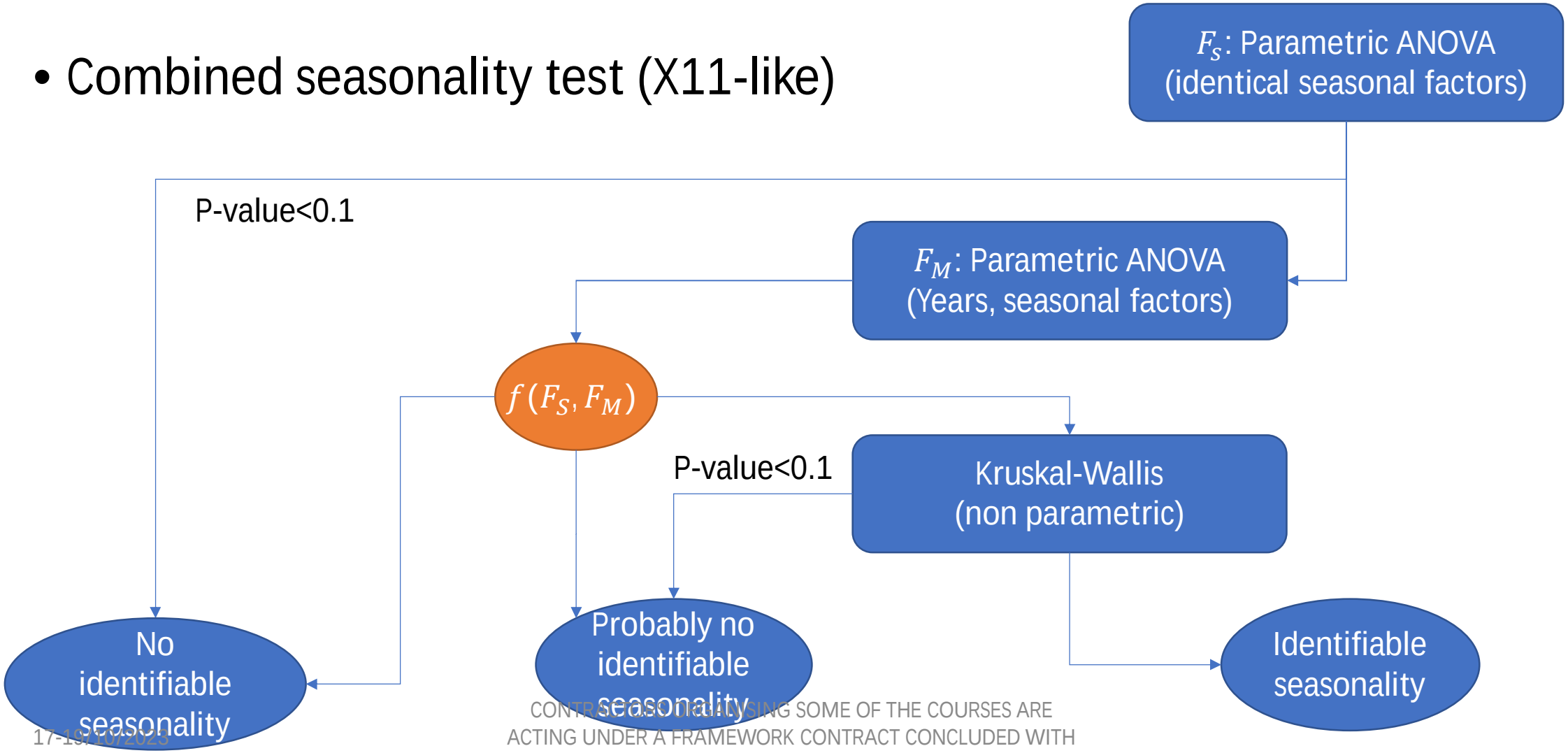
Seasonality tests (cont.)

- QS test
  - Ljung-box on seasonal auto-correlations
  - H0: No correlation (no seasonality), H1: seasonality
  - Applied on (log) differenced series (no trend), corrected for mean effect

- F test on seasonal dummies
  - Regression test with seasonal dummies ($D_{s,t}$) and different models
    - $y_t - y_{t-1} = D_{s,t}\beta + \varepsilon_t + \theta\varepsilon_{t-1}$ (GUI)
    - $y_t = \alpha + \gamma y_{t-1} + D_{s,t}\beta + \varepsilon_t$ (diagnostics)
    - $y_t - y_{t-1} = \alpha + D_{s,t}\beta + \varepsilon_t$ (diagnostics)
  - H0: coefficients (β) are equal to 0, H1: coefficients jointly differ from 0
  - Applied on (log) series. Should be applied on parts of the series

Seasonality tests (cont.)

- Combined seasonality test (X11-like)



Seasonality tests (cont.)

- Spectral diagnostics
  - Spectral peaks (X13-like)
    - Based on the spectrum of a long auto-regressive model that fits the series (see X13 documentation)
  - Periodogram
    - Performed on the periodogram (Fourier transformation) of the series at the Fourier frequencies.
      - maximum of the periodogram on or around the seasonal frequencies
      - sum of the values of the periodogram on or around the seasonal frequencies
    - Strictly speaking, only valid against the hypothesis that the (transformed) series is a white noise. As the spectral peaks, they don't perform well for short series.

Trading days tests

- F test on default trading days variables (contrasts)
  - Regression test with trading days contrasts (TD_t) and different models
    - $y_t = \alpha + \gamma y_{t-1} + TD_t\beta + \varepsilon_t$ (2.2.x)
    - $y_t - y_{t-1} = \alpha + TD_t\beta + \varepsilon_t$ (2.2.x)
    - $\Delta(y_t - TD_t\beta) = \alpha + \varepsilon_t$ (3.0)
    - $\Delta(y_t - TD_t\beta) = \varepsilon_t + \theta\varepsilon_{t-1}$ (3.0)
    - More generally: $y_t = \alpha + TD_t\beta + arima_t$
  - H0: coefficients (β) are equal to 0, H1: coefficients jointly differ from 0
  - Applied on (log) series. Should be applied on parts of the series

Seasonality tests in R

```
s<-rjd3toolkit::retail$RetailSalesTotal
ls<-log(s)
st<-rjd3toolkit::do_stationary(ls, 12)
dls<-st$ddata

spec.pgram(dls)

spec.ar(dls)

print(rjd3toolkit::seasonality_qs(dls, 12))

# H0: the series has no seasonality
# pvalue = prob[x>T]
# pvalue nearly 0 -> w reject H0

print(rjd3toolkit::seasonality_kruskalwallis(dls, 12))

print(rjd3toolkit::seasonality_friedman(dls, 12))

print(rjd3toolkit::seasonality_f(ls, 12, "D1"))
```

Trading days tests in R

```r
#s<-rjd3toolkit::ABS$X0.2.20.10.M
s<-rjd3toolkit::retail$RetailSalesTotal

td_all<-function(s, title, len=length(s)/12){
  a<-sapply(6:len, function(j){rjd3toolkit::td_f(s, model = "D1", nyears = j)$pvalue})
  b<-sapply(6:len, function(j){rjd3toolkit::td_f(s, model = "R011", nyears = j)$pvalue})
  c<-sapply(6:len, function(j){rjd3toolkit::td_f(s, model = "R100", nyears = j)$pvalue})

  matplot(main=title, x=6:len, y=cbind(a,b,c), pch=19, col=c('black', 'blue', 'red'),
          xlab="number of years", ylab="p-value")
}

# seasonal adjustment with calendar effects correction
sa<-rjd3tramoseats::tramoseats_fast(s, "rsafull")
# seasonal adjustment without calendar effects correction
sa2<-rjd3tramoseats::tramoseats_fast(log(s), "rsa0")

ssa<-sa$decomposition$stochastics$sa$data
ssa2<-sa2$decomposition$stochastics$sa$data

td_all(ssa, "sa - rasafull")
td_all(ssa2, "sa - rsa0")

sirr<-sa$decomposition$stochastics$i$data
sirr2<-sa2$decomposition$stochastics$i$data

td_all(sirr, "irregular - rsafull")
td_all(sirr2, "irregular - rsa0")
```