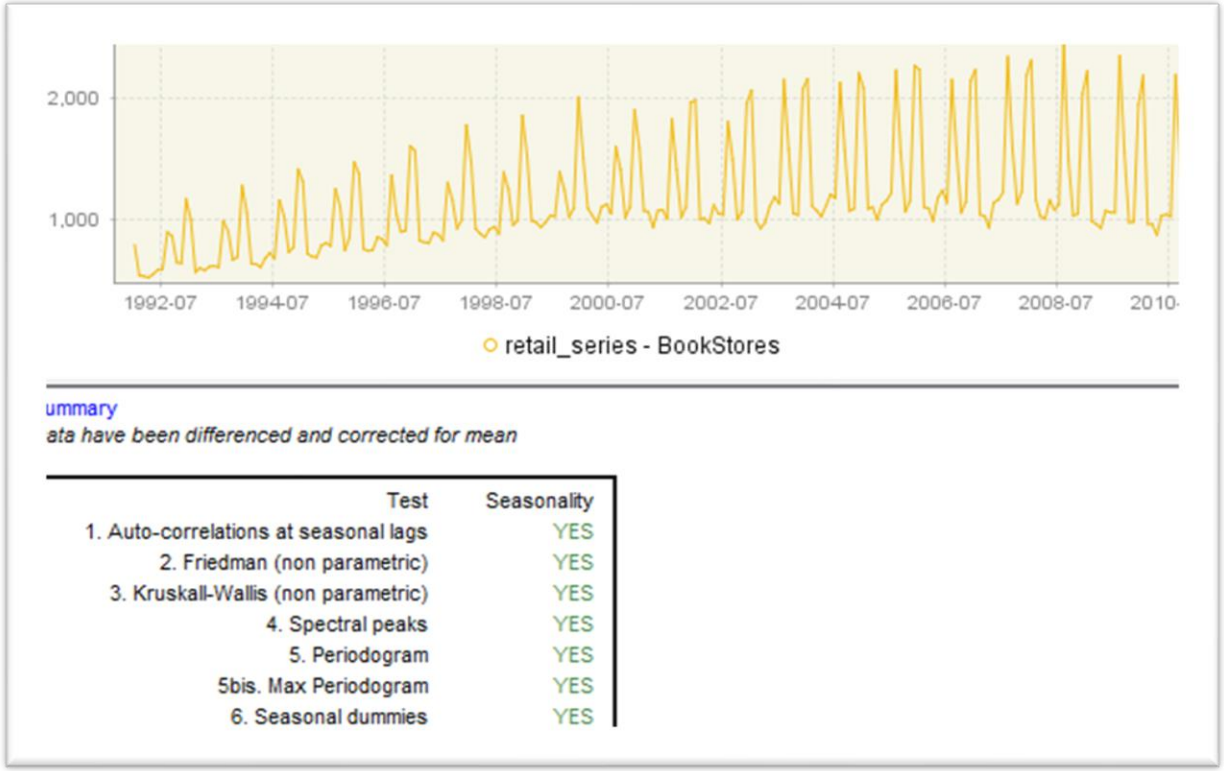
Seasonality and trading days tests in JD+

ESTP training

15-17/10/2024

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

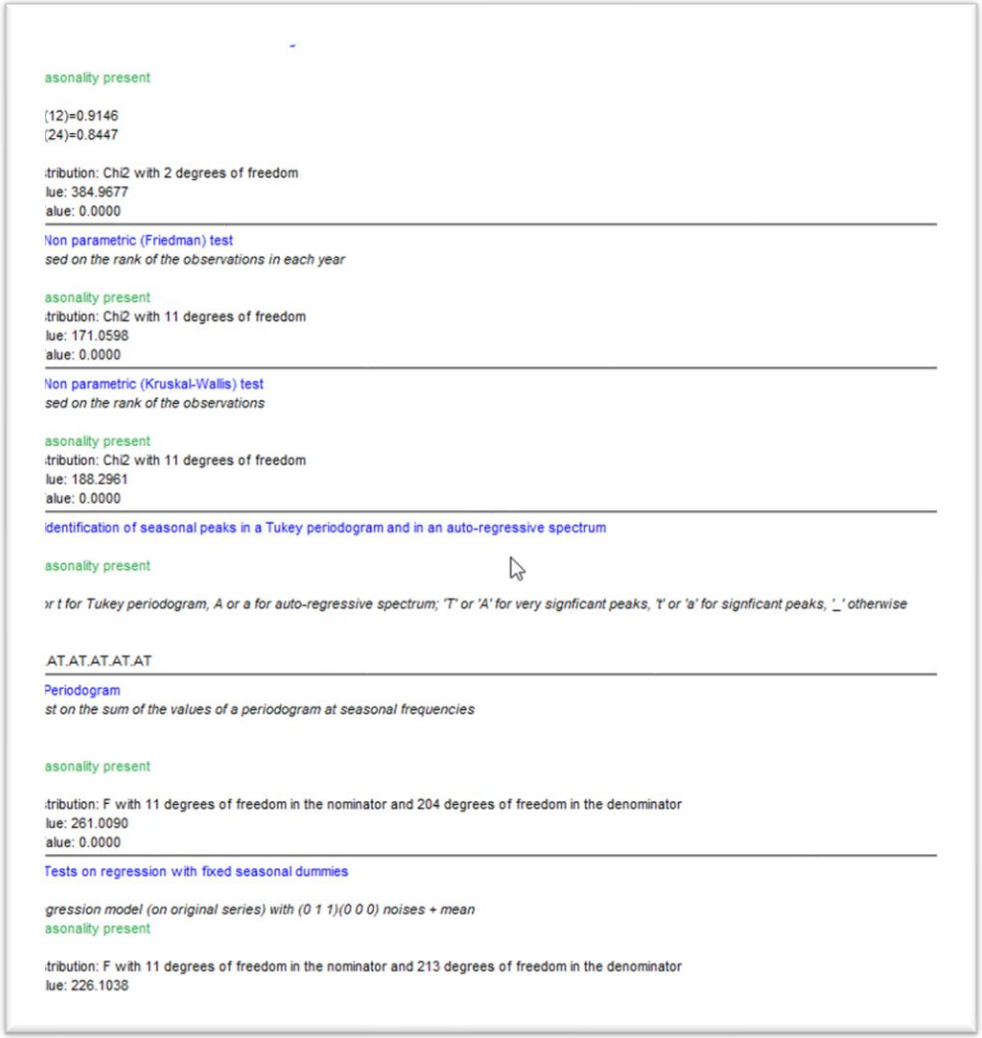
Overview



ummary

ata have been differenced and corrected for mean

Test	Seasonality
1. Auto-correlations at seasonal lags	YES
2. Friedman (non parametric)	YES
3. Kruskall-Wallis (non parametric)	YES
4. Spectral peaks	YES
5. Periodogram	YES
5bis. Max Periodogram	YES
6. Seasonal dummies	YES



asonality present

(12)=0.9146
(24)=0.8447

tribution: Chi2 with 2 degrees of freedom
lue: 384.9677
alue: 0.0000

Non parametric (Friedman) test
sed on the rank of the observations in each year

asonality present
tribution: Chi2 with 11 degrees of freedom
lue: 171.0598
alue: 0.0000

Non parametric (Kruskal-Wallis) test
sed on the rank of the observations

asonality present
tribution: Chi2 with 11 degrees of freedom
lue: 188.2961
alue: 0.0000

dentification of seasonal peaks in a Tukey periodogram and in an auto-regressive spectrum

asonality present

r t for Tukey periodogram, A or a for auto-regressive spectrum; 'T' or 'A' for very signficant peaks, 't' or 'a' for signficant peaks, '_' otherwise

AT.AT.AT.AT.AT

Periodogram
st on the sum of the values of a periodogram at seasonal frequencies

asonality present

tribution: F with 11 degrees of freedom in the nominator and 204 degrees of freedom in the denominator
lue: 261.0090
alue: 0.0000

Tests on regression with fixed seasonal dummies

gression model (on original series) with (0 1 1)(0 0 0) noises + mean
asonality present

tribution: F with 11 degrees of freedom in the nominator and 213 degrees of freedom in the denominator
lue: 226.1038

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 (for instance (log) differenced series)

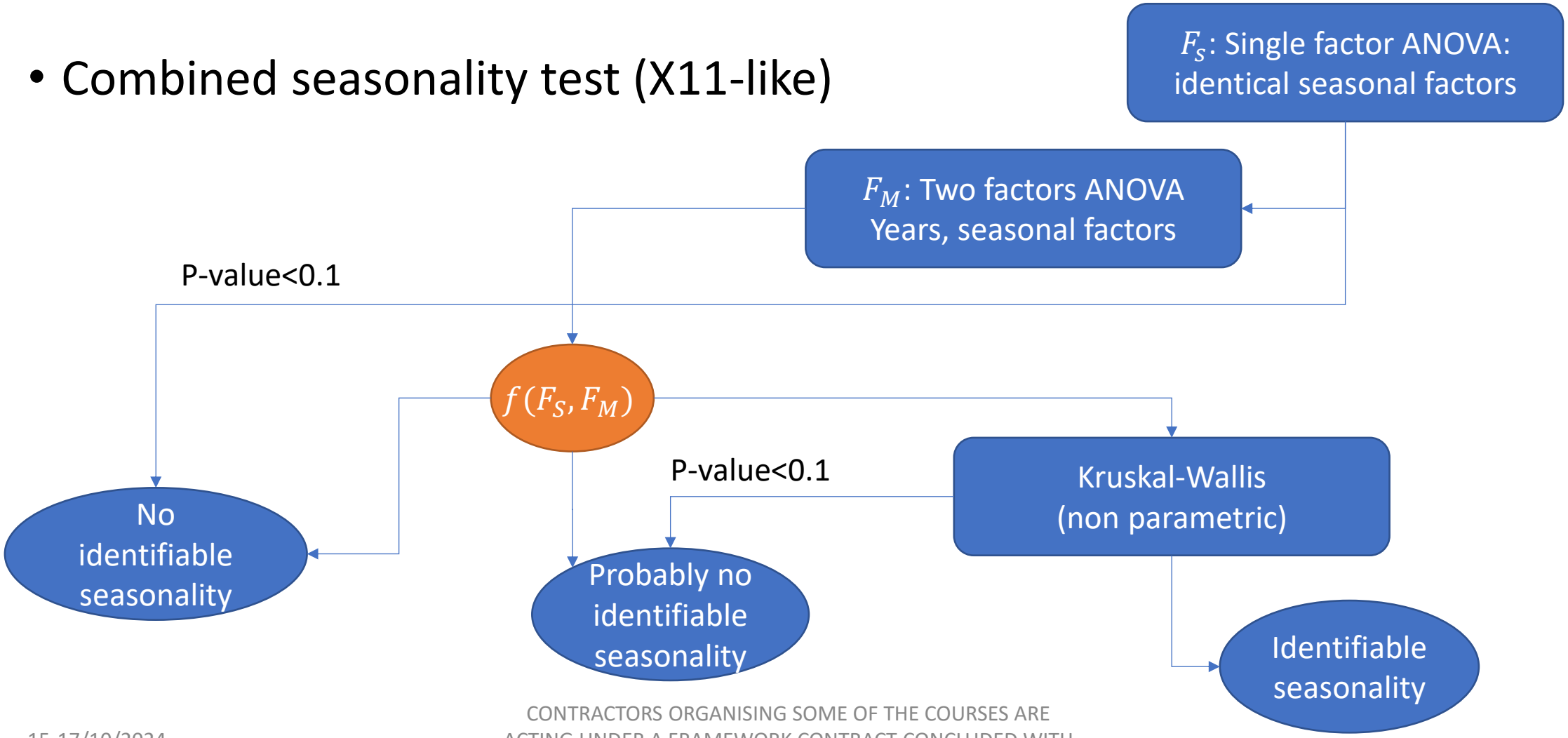
Seasonality tests (cont.)

- **QS test**
  - Modified 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.

Seasonality tests (cont.)

- **Canova-Hansen test (R only)**
  - test the stability of the coefficients of seasonal regressors (model quite similar to the F-test), using a Lagrange multiplier test.
  - H0: stable seasonal pattern (no seasonality ≡ stable 0 coefficients).
  - H1: seasonal unit roots.
  - P-values computed numerically for small samples.

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

Trading days tests(cont.)

- **Canova-Hansen test** on trading days variables **(R only)**
  - test the stability of the coefficients of trading days, using a Lagrange multiplier test.

- Likelihood test on time varying trading days coefficients **(R only)**
  - rjd3toolkit >= 3.2.5

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")
```