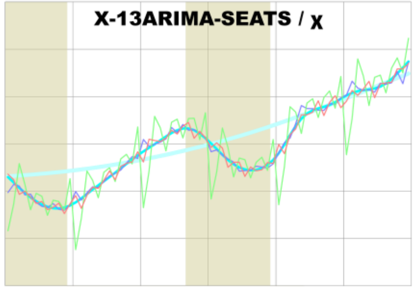
ΣΚΑΝΙΟΓΛΟΣ®

Investment Advisory Company Limited

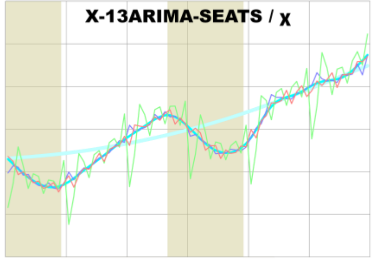


June 2022

Holiday variable generating routines within our in-house versions of the Census Method

Hideki Furuya

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited

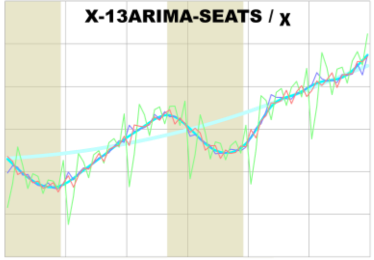


Hideki Furuya

Vice President, SKANIOGLOS Investment Advisory Company Limited†
Certified Member Analyst of the Securities Analysts Association of Japan
Member of Pan Pacific Association of Input-Output Studies

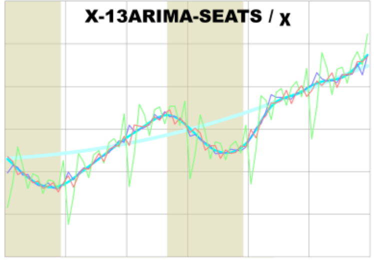
†Registered Financial Instruments Business Operators of Japan
Kanto Local Finance Bureau No. 3059.
Member of Japan Investment Advisers Association
Membership number 012-02829.

https://skanioglos.co.jp

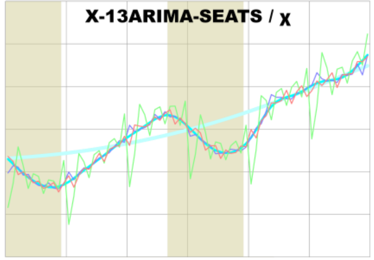


Disclaimer

- This presentation is released to inform interested parties of research and to encourage discussion.
- This presentation is not released to recommend any investment action.
- The views expressed in this presentation are those of the author and not necessarily those of the SKANIOGLOS Investment Advisory Co., Ltd.
- This presentation adopts software under development. Results of calculations may be different from those of futures.



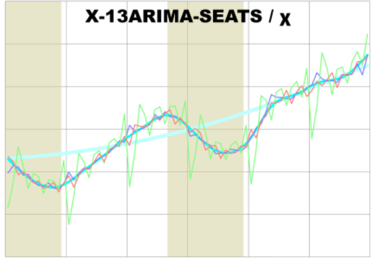
1. Brief history
2. What are tunings
3. Calendar and holiday list
4. Long-term average
5. Detection of holiday effects
6. References and links



1. Brief history (1)

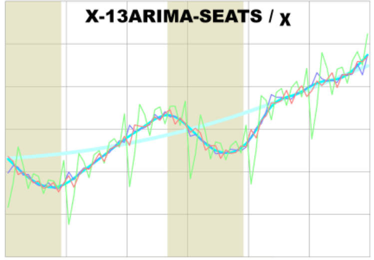
1984: Began to apply X-11 via an economic data service which costed JPY 2 million (USD 10,000 to 20,000) a month.

1. Brief history (1)



1984: Began to apply X-11 via an economic data service which costed JPY 2 million (USD 10,000 to 20,000) a month.

1990: Purchased X11SS (monthly series) and X11Q2 (quarterly series) sources at Washington DC, but could nothing for their profound expressions.

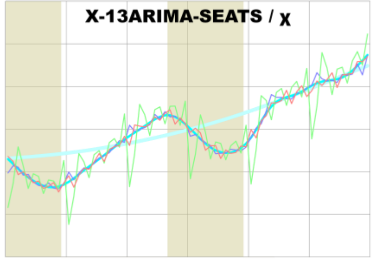


1. Brief history (1)

1984: Began to apply X-11 via an economic data service which costed JPY 2 million (USD 10,000 to 20,000) a month.

1990: Purchased X11SS (monthly series) and X11Q2 (quarterly series) sources at Washington DC, but could nothing for their profound expressions.

1994: Found X-12-ARIMA beta version 0.3 source on the Census Bureau web site. The source was very simple and clear.

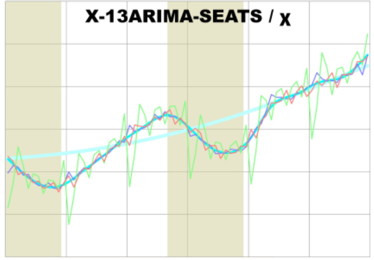


1. Brief history (1)

1984: Began to apply X-11 via an economic data service which costed JPY 2 million (USD 10,000 to 20,000) a month.

1990: Purchased X11SS (monthly series) and X11Q2 (quarterly series) sources at Washington DC, but could nothing for their profound expressions.

1994: 🔍Key 1; Found X-12-ARIMA beta version 0.3 source on the Census Bureau web site. The source was very simple and clear.



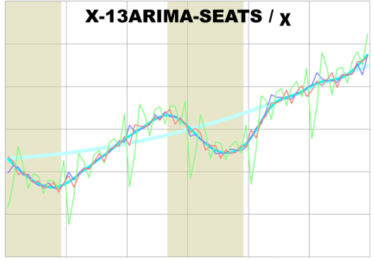
1. Brief history (1)

1984: Began to apply X-11 via an economic data service which costed JPY 2 million (USD 10,000 to 20,000) a month.

1990: Purchased X11SS (monthly series) and X11Q2 (quarterly series) sources at Washington DC, but could nothing for their profound expressions.

1994: Key 1; Found X-12-ARIMA beta version 0.3 source on the Census Bureau web site. The source was very simple and clear.

1997: Key 2; Found When_exe by Takashi SUGA while gathering holiday dates since CA 1996.



1. Brief history (1)

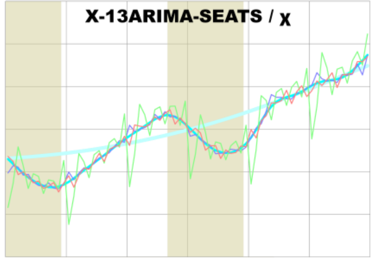
1984: Began to apply X-11 via an economic data service which costed JPY 2 million (USD 10,000 to 20,000) a month.

1990: Purchased X11SS (monthly series) and X11Q2 (quarterly series) sources at Washington DC, but could nothing for their profound expressions.

1994: 🔍Key 1; Found X-12-ARIMA beta version 0.3 source on the Census Bureau web site. The source was very simple and clear.

Two key factors of seasonal and holiday adjustments

1997: 🔍Key 2; Found When_exe by Takashi SUGA while gathering holiday dates since CA 1996.



1. Brief history (1)

1984: Began to apply X-11 via an economic data service which costed JPY 2 million (USD 10,000 to 20,000) a month.

1990: Purchased X11SS (monthly series) and X11Q2 (quarterly series) sources at Washington DC, but could nothing for their profound expressions.

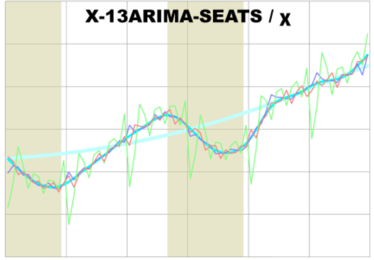
1994: Key 1; Found X-12-ARIMA beta version 0.3 source on the Census Bureau web site. The source was very simple and clear.

Two key factors of seasonal and holiday adjustments

1997: Key 2; Found When_exe by Takashi SUGA while gathering holiday dates since CA 1996.

CA 1998 – CA 2002: Added regressor generating routines. Researched for other holidays. Lists of holiday included; ➢ Chinese type lunisolar calendar, China and Korea variants, New Year (01/01), Duanwu (05/05), and Harvest Moon (08/15), ➢ First dates of Ramadan (09/01, and 09/01 + 30 = 10/01 = beginning of Eid-ul Fitl) of Hijiri lunar calendar.

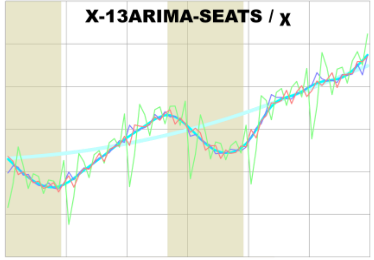
ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited



1. Brief history (2)

CA 1998 – CA 2002: continued.

- All the regressors can have lead and lag up to 50 days from the holiday dates. It can be adopted to measure effects via international trade (but should be up to 100 or 180 days).

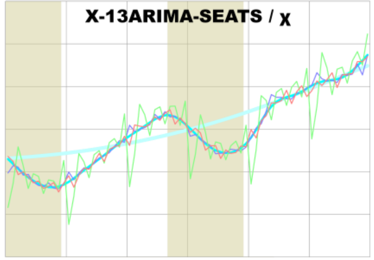


1. Brief history (2)

CA 1998 – CA 2002: continued.

- All the regressors can have lead and lag up to 50 days from the holiday dates. It can be adopted to measure effects via international trade (but should be up to 100 or 180 days).
- Inquired to central banks and statistical offices of five of the ASEAN members, about holiday adjustments of their statistics. It was grateful all the 10 authorities gave replies. As of late 20th century, no quantitative holiday adjustments were answered.

1. Brief history (2)

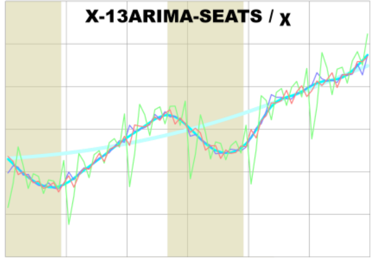


CA 1998 – CA 2002: continued.

- All the regressors can have lead and lag up to 50 days from the holiday dates. It can be adopted to measure effects via international trade (but should be up to 100 or 180 days).
- Inquired to central banks and statistical offices of five of the ASEAN members, about holiday adjustments of their statistics. It was grateful all the 10 authorities gave replies. As of late 20th century, no quantitative holiday adjustments were answered.

What's else? Unknown until next page.

Investment Advisory Company Limited



1. Brief history (2)

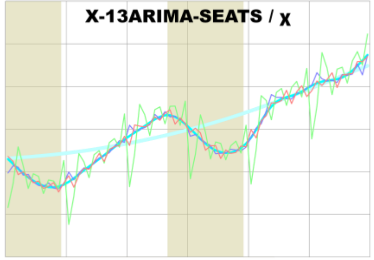
CA 1998 – CA 2002: continued.

- All the regressors can have lead and lag up to 50 days from the holiday dates. It can be adopted to measure effects via international trade (but should be up to 100 or 180 days).
- Inquired to central banks and statistical offices of five of the ASEAN members, about holiday adjustments of their statistics. It was grateful all the 10 authorities gave replies. As of late 20th century, no quantitative holiday adjustments were answered.

What's else? Unknown until next page.

2002: Lin and Liu, measured Chinese calendar holiday effects on series of Taiwan. Furuya, Chinese New Year on series of Taiwan, Korea, and Japan. Although Japan celebrates no Chinese New Year as public holidays, but holiday effects exists.

2005: Australian Bureau of Statistics, holiday effects on short term visitor arrivals: Chinese New Year on visitor from Hong Kong, and Ramadan on visitor from Indonesia.



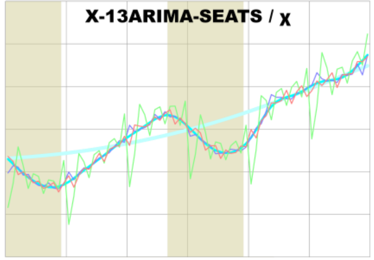
1. Brief history (3)

2007: Yap et al., Chinese New Year, Eid-ul Fitl of Hijili lunar, and Deepavali of Hindu lunisolar calendar on statistics of Malaysia.

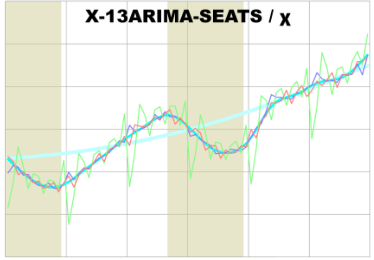
2017: Sanyal et al., Sharada Navaratri and Deepavali of Hindu lunisolar calendar on statistics of India.

2021: Began tuning of X-13ARIMA-SEATS.

List of holidays is mainly based on these papers.



1. Brief history
2. What are tunings
3. Calendar and holiday list
4. Long-term average
5. Detection of holiday effects
6. References and links



2. What are tunings (1)

X-12-A: Already built in X-12-ARIMA during 1994 to 2004, to be used for X-13AS.
Current version is based on build 101, version 0.3 beta dated Oct. 7, 2004.
About 130 files are changed or added.
X-13AS: Planned to built in X-13ARIMA-SEATS. Now coding or unit testing.
As of SAPW 2022, based on build 58, version 1.1 dated Jun. 28, 2021.

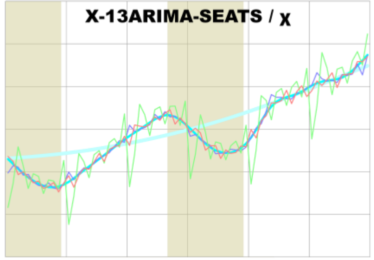
2.1. Metafile run changed to “bundle input/output”.

Metafile expanded to maximum 5 columns,
specfile: name of the series, altfile: name of the spec file used, outfile: output file name, and (? and [tab], i.e. tab character are delimiters), all the strings “spec” in the spec altfile.spc are replaced by “altspec”.
Also a spec `bundle{ }` was added for control.

```
specfile1 altfile1 outfile1 ?spec[tab]altspec
specfile2 altfile2 outfile2 ?spec[tab]altspec
  |  |      |  |      |  |
specfileN altfileN outfileN ?spec[tab]altspec
```

ΣΚΑΝΙΟΓΛΟΣ®

Investment Advisory Company Limited



2. What are tunings (2)

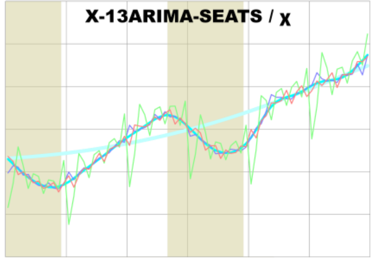
2.2. Added Bry and Boschan turning point detection routine.
A spec `briboschan{ }` was added to control this routine.

2.3. Planning to apply Hodrick-Prescott filter to series from x11.
Not only classical cycle of d12 (TC) or d11 (TCI), growth cycle of cyc (C) is an important factor for forecasts.

Almost all runs are metafile run.

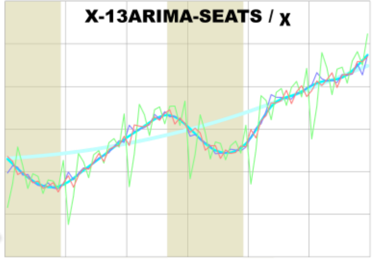
1. *Bundle spec files, input series, save files, and log files.*
2. *Turning point detection*
3. *Growth cycle*

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited



1. Brief history
2. What are tunings
3. Calendar and holiday list
4. Long-term average
5. Detection of holiday effects
6. References and links

Full calendars are based on calculations. They can be different from observation based calendars.



3. Calendar and holiday list (1)

Type 1. List of first date of month, a kind of “shuorun biao (朔閏表)”.

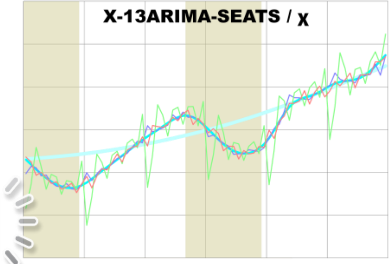
A four digit number stands for mmdd, mm for month, dd for date.

If dd ≧ 30, last day of the month mm. If dd = 00, last day of the preceding month. Below argument adds a holiday regressor as a user-defined variable from the new year’s eve to the third day of new year.

```
regression{ holiday=( china[0100 0103] ) }
```

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited

Full calendars based on calculations, might be different from observation based calendars.



3. Calendar and holiday list (1)

Type 1. List of first date of month, a kind of “shuorun biao (朔閏表)”.

A four digit number stands for mmdd, mm for month, dd for date.

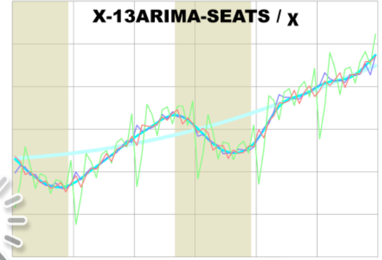
If dd ≧ 30, last day of the month mm. If dd = 00, last day of the preceding month. Below argument adds a holiday regressor as a user-defined variable from the new year’s eve to the third day of new year.

```
regression{ holiday=( china[0100 0103] ) }
```

1. Chinese type lunisolar calendar, intercalary month = (mm+12), anywhere of the year.

1.1.	UTC+09 Korea variant	`korea	Japan`
1.2.	UTC+08 China variant	`china	Taiwan`
1.3.	UTC+07 Vietnam variant	`vietnam`

Full calendars based on calculations, might be different from observation based calendars.



3. Calendar and holiday list (1)

Type 1. List of first date of month, a kind of “shuorun biao (朔閏表)”.

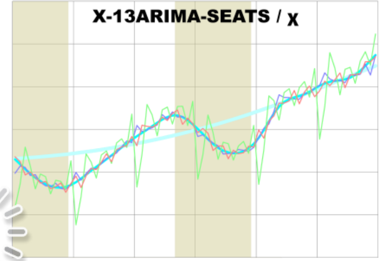
A four digit number stands for mmdd, mm for month, dd for date.

If dd ≧ 30, last day of the month mm. If dd = 00, last day of the preceding month. Below argument adds a holiday regressor as a user-defined variable from the new year’s eve to the third day of new year.

```
regression{ holiday=( china[0100 0103] ) }
```

1.	Chinese type lunisolar calendar, intercalary month = (mm+12), anywhere of the year.	
1.1.	UTC+09 Korea variant	`korea` | `Japan`
1.2.	UTC+08 China variant	`china` | `Taiwan`
1.3.	UTC+07 Vietnam variant	`vietnam`
2.	Buddhist calendar	
2.1.	Thai lunisolar calendar Intercalary month = 20, right before the mm = 08. Add 15 to dates during the waning half (khang raem / ข้างแรม).	`thai`

Full calendars based on calculations, might be different from observation based calendars.



3. Calendar and holiday list (1)

Type 1. List of first date of month, a kind of “shuorun biao (朔閏表)”.

A four digit number stands for mmdd, mm for month, dd for date.

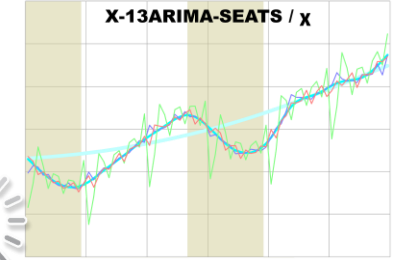
If dd ≧ 30, last day of the month mm. If dd = 00, last day of the preceding month. Below argument adds a holiday regressor as a user-defined variable from the new year’s eve to the third day of new year.

```
regression{ holiday=( china[0100 0103] ) }
```

1.	Chinese type lunisolar calendar, intercalary month = (mm+12), anywhere of the year.	
1.1.	UTC+09 Korea variant	`korea | Japan`
1.2.	UTC+08 China variant	`china | Taiwan`
1.3.	UTC+07 Vietnam variant	`vietnam`
2.	Buddhist calendar	
2.1.	Thai lunisolar calendar Intercalary month = 20, right before the mm = 08. Add 15 to dates during the waning half (khang raem / ข้างแรม).	`thai`
3.	Hijiri lunar calendar	`hijiri`

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited

Full calendars based on calculations, might be different from observation based calendars.



3. Calendar and holiday list (1)

Type 1. List of first date of month, a kind of “shuorun biao (朔閏表)”.

A four digit number stands for mmdd, mm for month, dd for date.

If dd ≧ 30, last day of the month mm. If dd = 00, last day of the preceding month. Below argument adds a holiday regressor as a user-defined variable from the new year’s eve to the third day of new year.

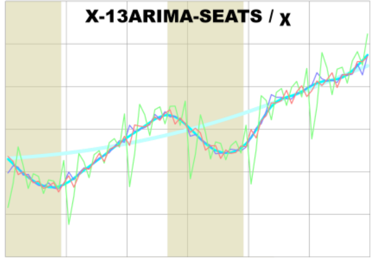
```
regression{ holiday=( china[0100 0103] ) }
```

1. Chinese type lunisolar calendar, intercalary month = (mm+12), anywhere of the year.
1.1. UTC+09 Korea variant — `korea | Japan`
1.2. UTC+08 China variant — `china | Taiwan`
1.3. UTC+07 Vietnam variant — `vietnam`

2. Buddhist calendar
2.1. Thai lunisolar calendar — `thai`
Intercalary month = 20, right before the mm = 08.
Add 15 to dates during the waning half (khang raem / ข้างแรม).

3. Hijiri lunar calendar — `hijiri`

4. Hebrew lunisolar calendar — `Hebrew`
Intercalary month, Adar Aleph = 18, Adar Beit = 30. So far, regressors including ordinary year should include 06dd and 18dd, or 06dd and 30dd.

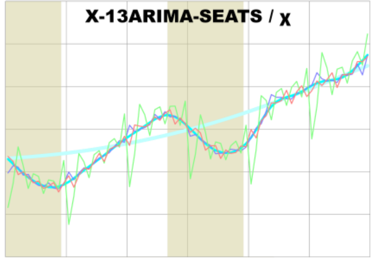


3. Calendar and holiday list (2)

Type 2. Date of holidays.

Hindu holidays are not defined by date of the calendar, but the lunar day named tithi, at certain hour of the solar day. The dates vary according to the place celebrated. Below holidays from 1589 to 2611 (long term values to calculate seasonality) for six cities are copied from https://www.drikpanchang.com/; Allahabad UP, Chennai TN, Delhi NCT, Jaipur RJ, Kolkata WB, and Mumbai MH.

Maori New Year named Matariki Holiday of New Zealand, new in 2022 is included.



3. Calendar and holiday list (2)

Type 2. Date of holidays.

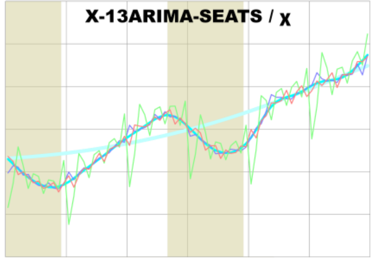
Hindu holidays are not defined by date of the calendar, but the lunar day named tithi, at certain hour of the solar day. The dates vary according to the place celebrated. Below holidays from 1589 to 2611 (long term values to calculate seasonality) for six cities are copied from https://www.drikpanchang.com/; Allahabad UP, Chennai TN, Delhi NCT, Jaipur RJ, Kolkata WB, and Mumbai MH.

Maori New Year named Matariki Holiday of New Zealand, new in 2022 is included.

1. Hindu holidays. Six city averages of below dates. Better ideas would be welcome.

Retrieved from drikpanchang.com

1.1. Holi (Rangwali Holi)	`holi`
1.2. Ganesh Chaturthi	`ganeshchaturthi`
1.3. Sharad Navratri (Dussehra)	`navratri`
1.4. Deepavali (Naraka Chaturdashi, Lakshmi Puja, and Kali Puja)	`deepavali | diwali`



3. Calendar and holiday list (2)

Type 2. Date of holidays.

Hindu holidays are not defined by date of the calendar, but the lunar day named tithi, at certain hour of the solar day. The dates vary according to the place celebrated. Below holidays from 1589 to 2611 (long term values to calculate seasonality) for six cities are copied from https://www.drikpanchang.com/; Allahabad UP, Chennai TN, Delhi NCT, Jaipur RJ, Kolkata WB, and Mumbai MH.

Maori New Year named Matariki Holiday of New Zealand, new in 2022 is included.

1. Hindu holidays. Six city averages of below dates. Better ideas would be welcome.

1.1. Holi (Rangwali Holi) `holi`

1.2. Ganesh Chaturthi `ganeshchaturthi`

1.3. Sharad Navratri (Dussehra) `navratri`

1.4. Deepavali (Naraka Chaturdashi, Lakshmi Puja, and Kali Puja) `deepavali | diwali`

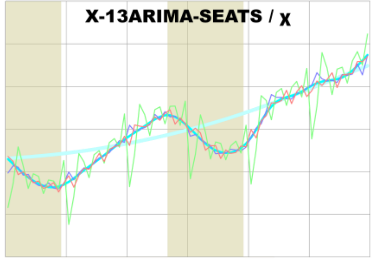
Retrieved from drikpanchang.com

2. Maori calendar

2.1. Matariki Holiday `matariki`

There is a long story before building in, but one reason is a sample that software can be changed anytime anyhow.

Calculated by When_exe



3. Calendar and holiday list (3)

Type 3. Twenty-four Solar terms (二十四節季).

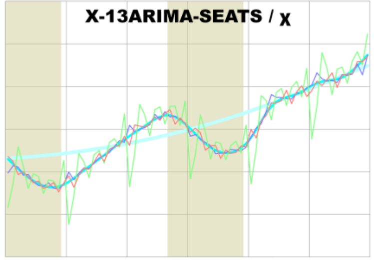
Calculated by When_exe

Twenty-four Solar Terms as well as twelve Astrological Signs may be part of the seasonal factor. Because they fall on the same month of the Gregorian calendar for the recent several millennials (1000-year periods). Dates to be included to calculate ex., day-of-week models.

`solarterm(ddd)`

ddd; 0: March equinox, 15: Qingming, 180: September equinox, etc.

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited



3. Calendar and holiday list (3)

Type 3. Twenty-four Solar terms (二十四節季).

Calculated by When_exe

Twenty-four Solar Terms as well as twelve Astrological Signs may be part of the seasonal factor. Because they fall on the same month of the Gregorian calendar for the recent several millennials (1000-year periods). Dates to be included to calculate ex., day-of-week models. `solarterm(ddd)`

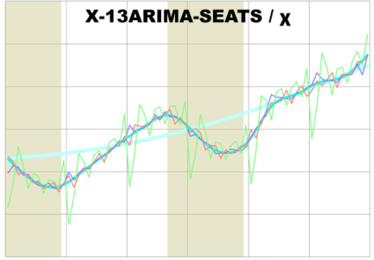
ddd; 0: March equinox, 15: Qingming, 180: September equinox, etc.

Type 4. Formulae.

1. Christian liturgical calendars, d:-48 Shrove Monday, -46 Ash Wednesday, -2 Good Friday, 0 Easter, 1 Easter Monday, 39 Ascension Day, 50 Pentecoste, 60 Corpus Christi.
1.1. Western Christianity (5,700,000 year cycle: See section 4.) `easter[dd]`
1.2. Eastern Christianity `paskha[dd]`
2. Thai traditional astronomy "Suriyayart"
2.1. Maha Songkran `Songkran`

Easter and Pascha: English Wiki
Traditional Songkran: Thai Wiki

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited



3. Calendar and holiday list (4)

Type 5. Public holiday list.

List of Japan and EU to be built in.

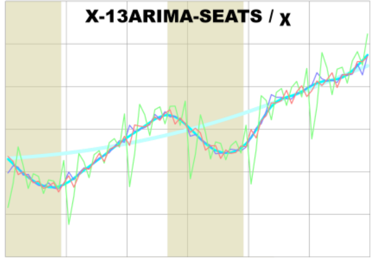
This list should have
- (1) name for confirmation,
- (2) start year or 0 for unknown,
- (3) end year or 9999 for not decided,
- (4) definition, and
- (5) substitute holiday.

Definition is whether
- (4.1) month and date,
- (4.2) possibly latest month, date, and day-of-week, ex., “Nov 28 Thu”, or
- (4.3) other date defined in type 1 to 4 above.
- (4.4) And also, frequency (n-annual), although almost all are annual.

Substitute holiday could be so complexed. Currently, the list is designed that each holiday has its substitute holiday candidate dates. It should have
- (5.1) start year or 0 for unknown,
- (5.2) end year, the last year before changed, or 9999 for not decided, and
- (5.3) conditions.

Variation of substitute holiday has a long story, but exiguitas non caperet.

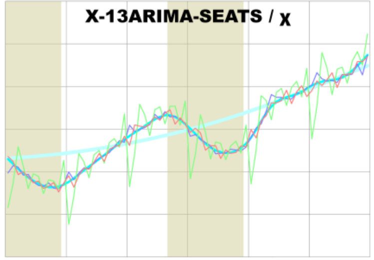
ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited

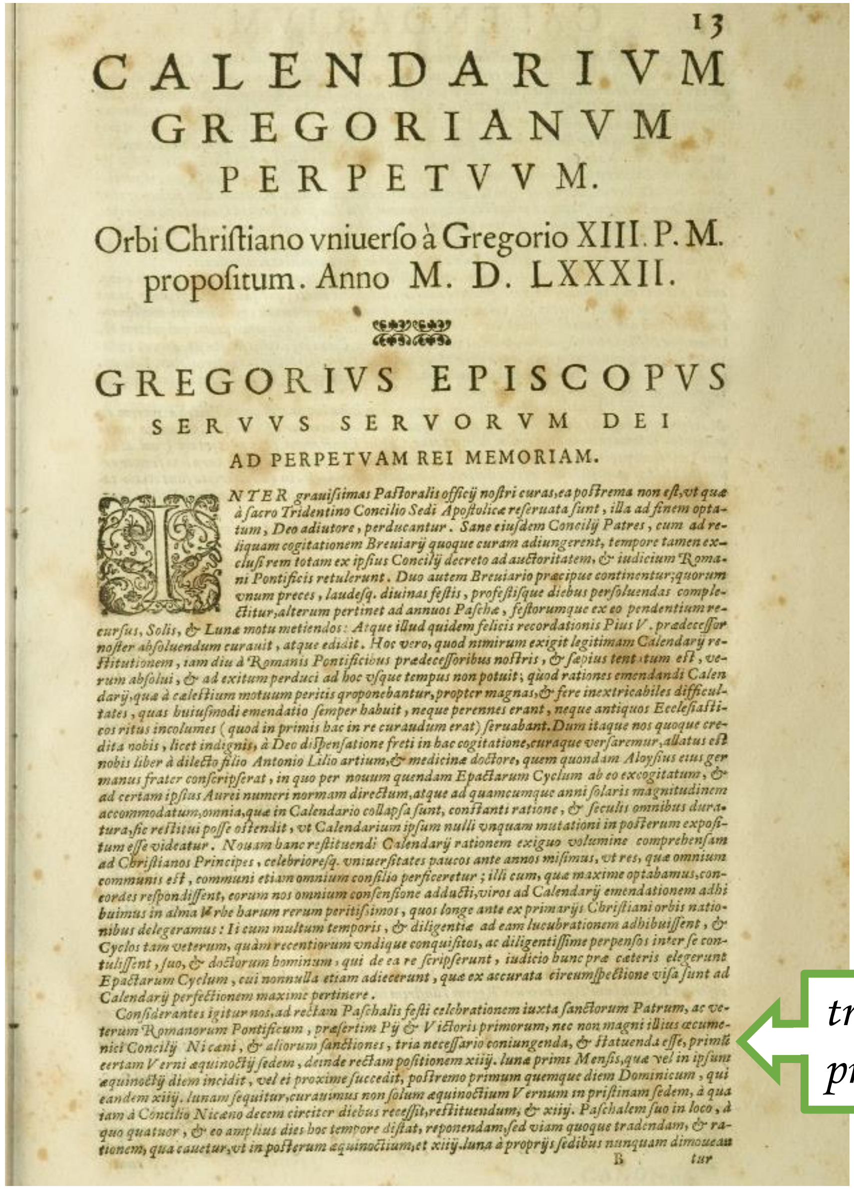


1. Brief history
2. What are tunings
3. Calendar and holiday list
4. Long-term average
5. Detection of holiday effects
6. References and links

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited

4. Long-term average (1)





The Gregorian Calendar was introduced to fix date of Easter, or in short, March equinox to around March 21st.

The first date of Gregorian Calendar was October 15th, 1582, the next day of Julian October 4th, 1582, a 10-day adjustment.

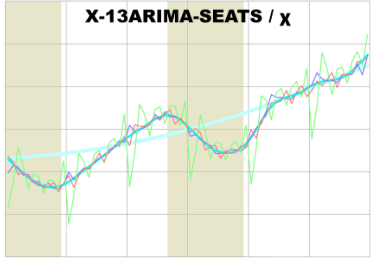
Left photo:

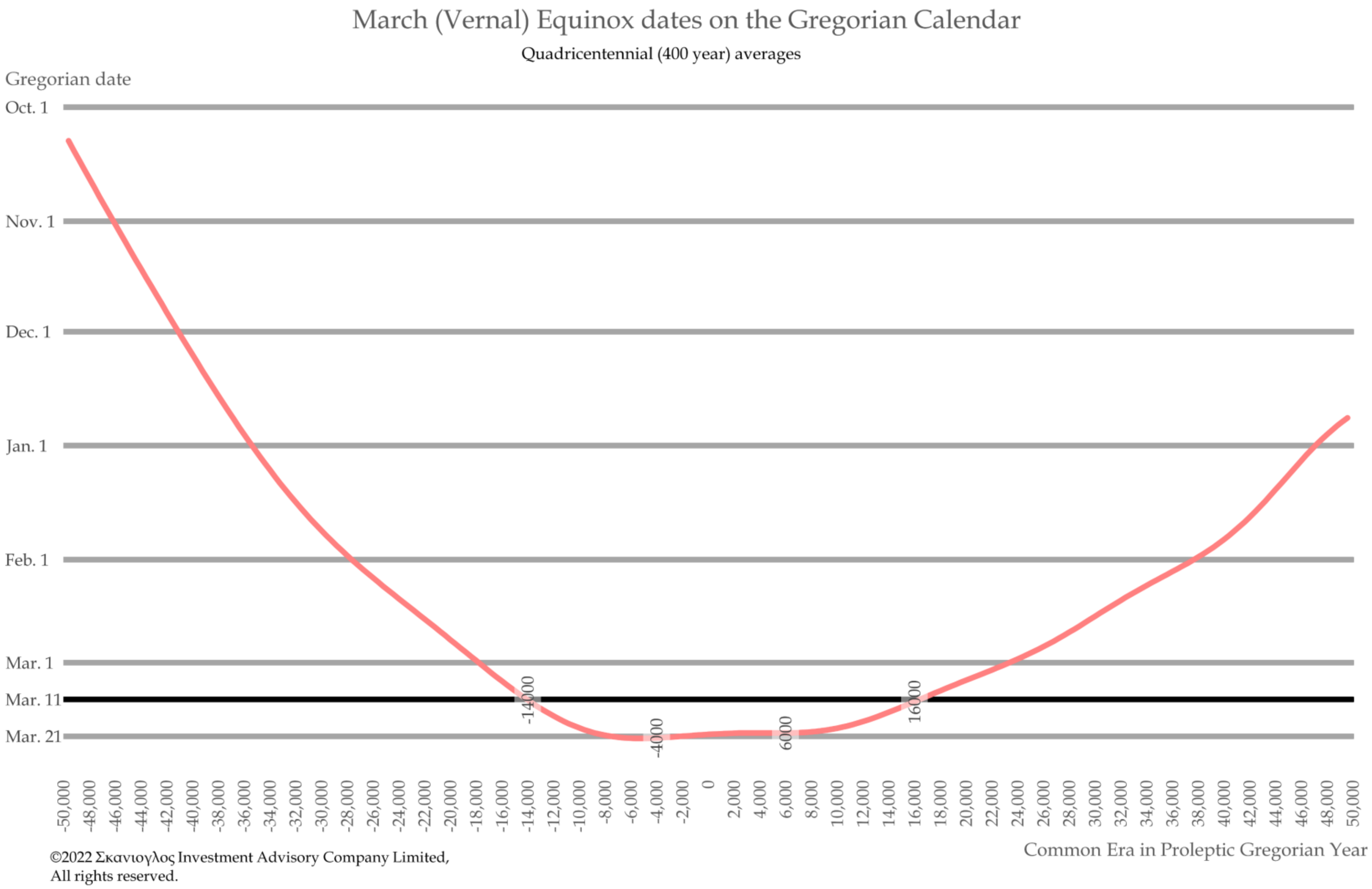
Pope Gregory XIII wrote in his "*Inter gravissimas*" (1582) that, the aim of Gregorian calendar was to fix Easter dates as decided at the Council Ncæa held May to August AD 325. The first (*primii*) of three necessary conditions of proper dates was to fix Vernal (March) equinox date (*certam Verni æquinoctii sedem*).

tria necessario coniungenda et statuenda esse, primii, certam Verni æquinoctii sedem,

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited

4. Long-term average (2)





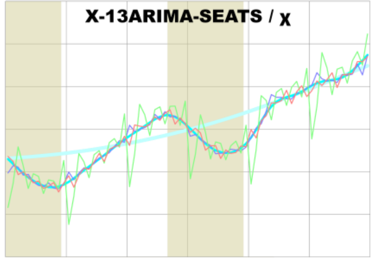
The Gregorian calendar without adjustments is not eternal. March equinox dates would shift from March 21st in the long run.

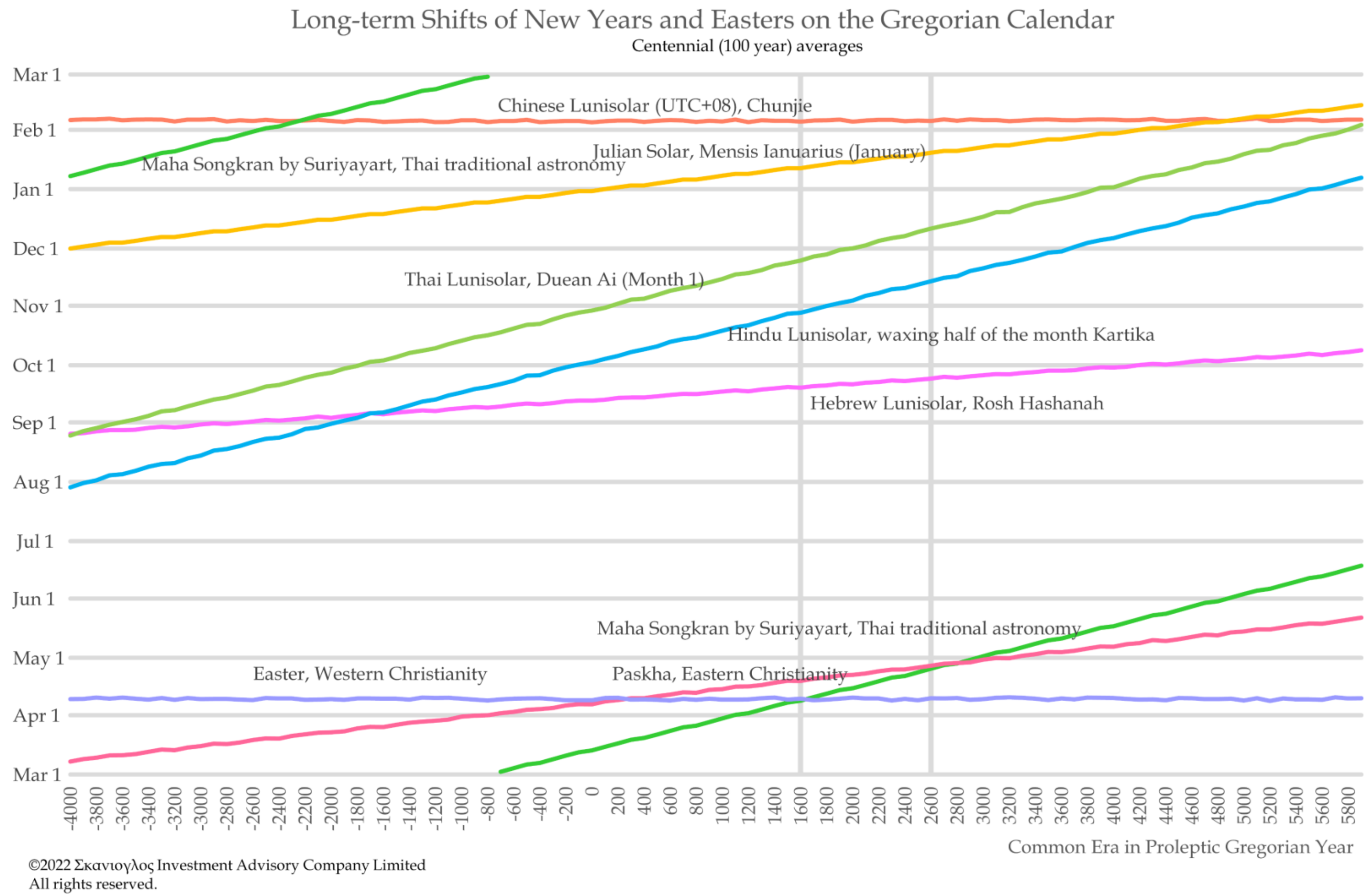
Gregorian calendar would be adjusted in the long run. Therefore, averages of tens of thousand years, or longer span, are unrealistic.

From
-4000 CE
to 6000 CE
next page

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited

4. Long-term average (2)



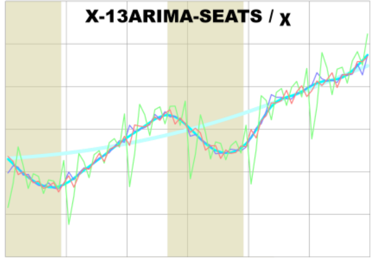


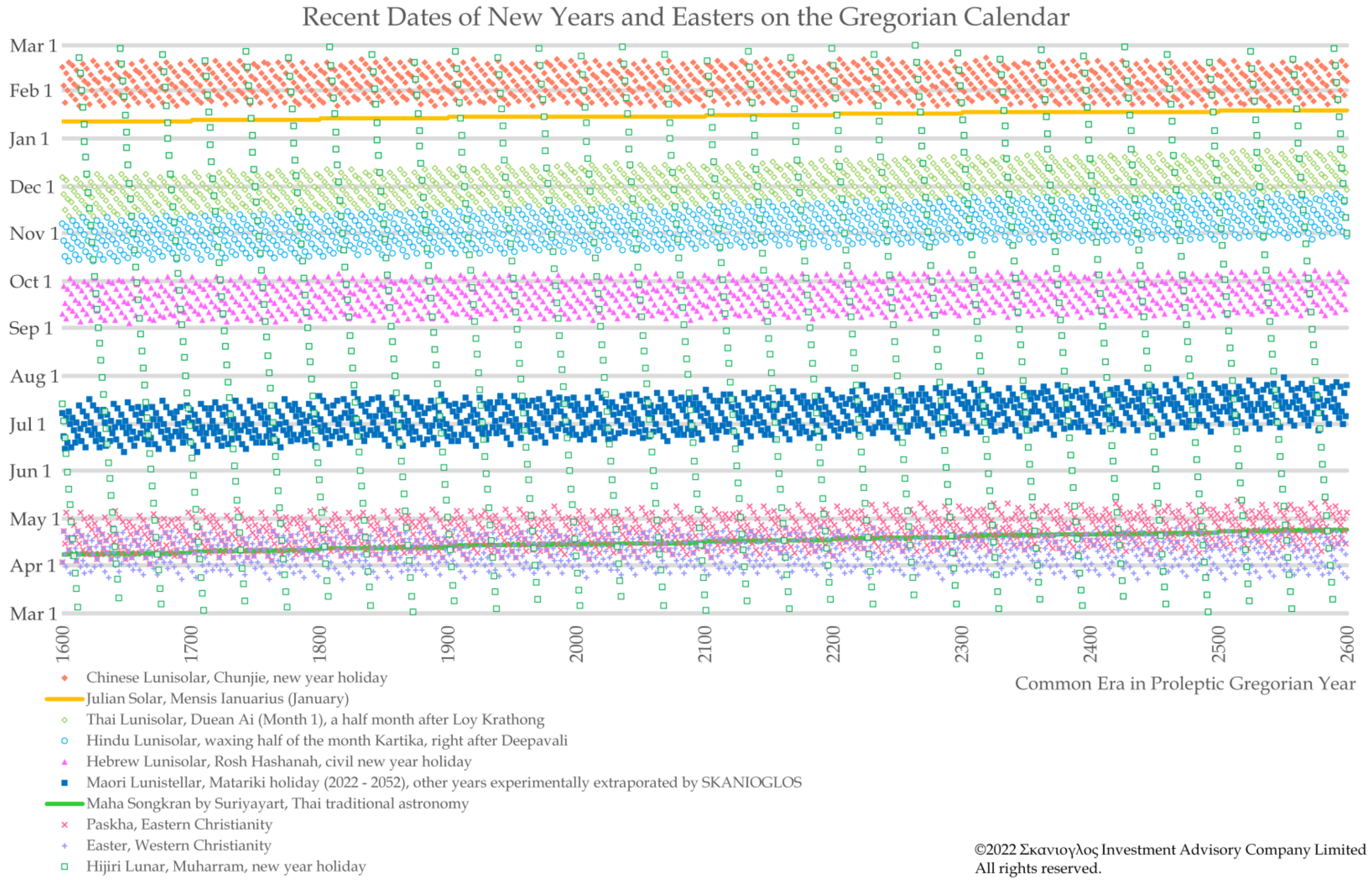
Many of major calendars shift against the Gregorian calendar. The author chose the span to calculate long-term average within 1600 CE (< Common Era) and 2599 CE to fix around not so much different from recent dates.

From 1600 CE to 2599 CE next page

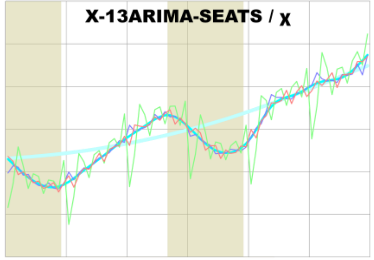
ΣΚΑΝΙΓΛΟΣ®
Investment Advisory Company Limited

4. Long-term average (3)



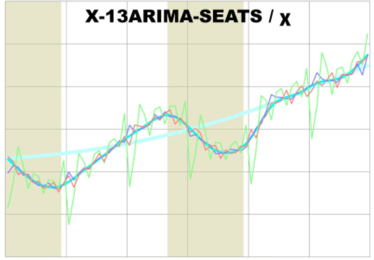


Key dates to be included into our in-house version of X-13ARIMA-SEATS to generate regressors and long-term averages.



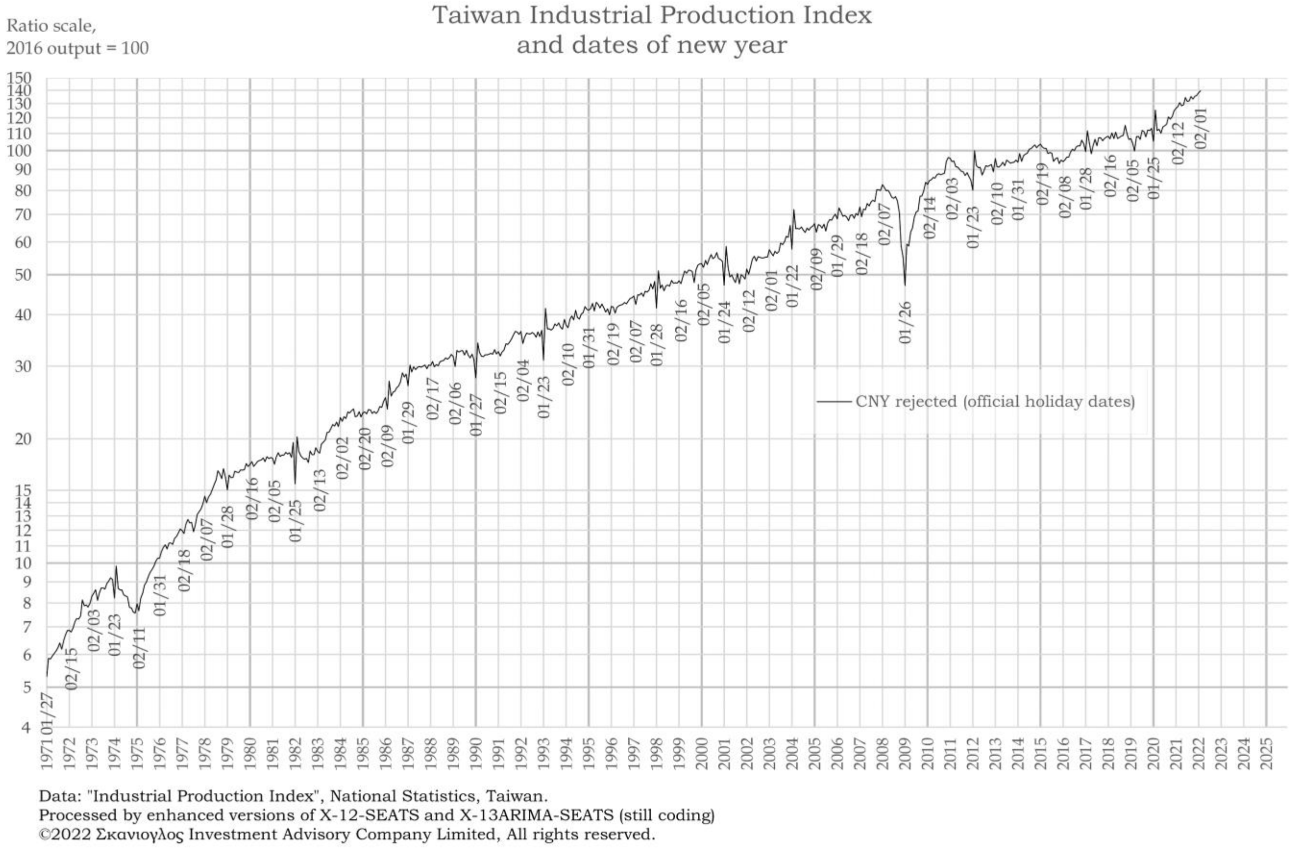
1. Brief history
2. What are tunings
3. Calendar and holiday list
4. Long-term average
5. Detection of holiday effects
6. References and links

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited



5. Detection of holiday effects (1)

Problem of 1990's: Spikes of holiday were there but rejected by AIC tests.

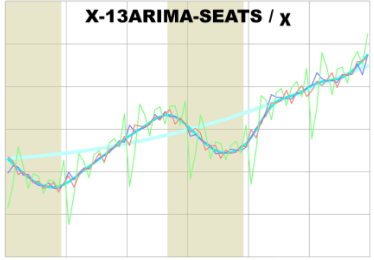


The author's research house began to apply holiday adjustments of X-12-ARIMA during late 1990's. Problems of those days were rejections of Chinese New Year factors from east Asian series, when regressed by the numbers of public holiday dates.

Mr. Brian Monsell taught the author that holiday effects included both increase and decrease of production, and that beginning and end of holiday effects were often related to day-of-the-week.

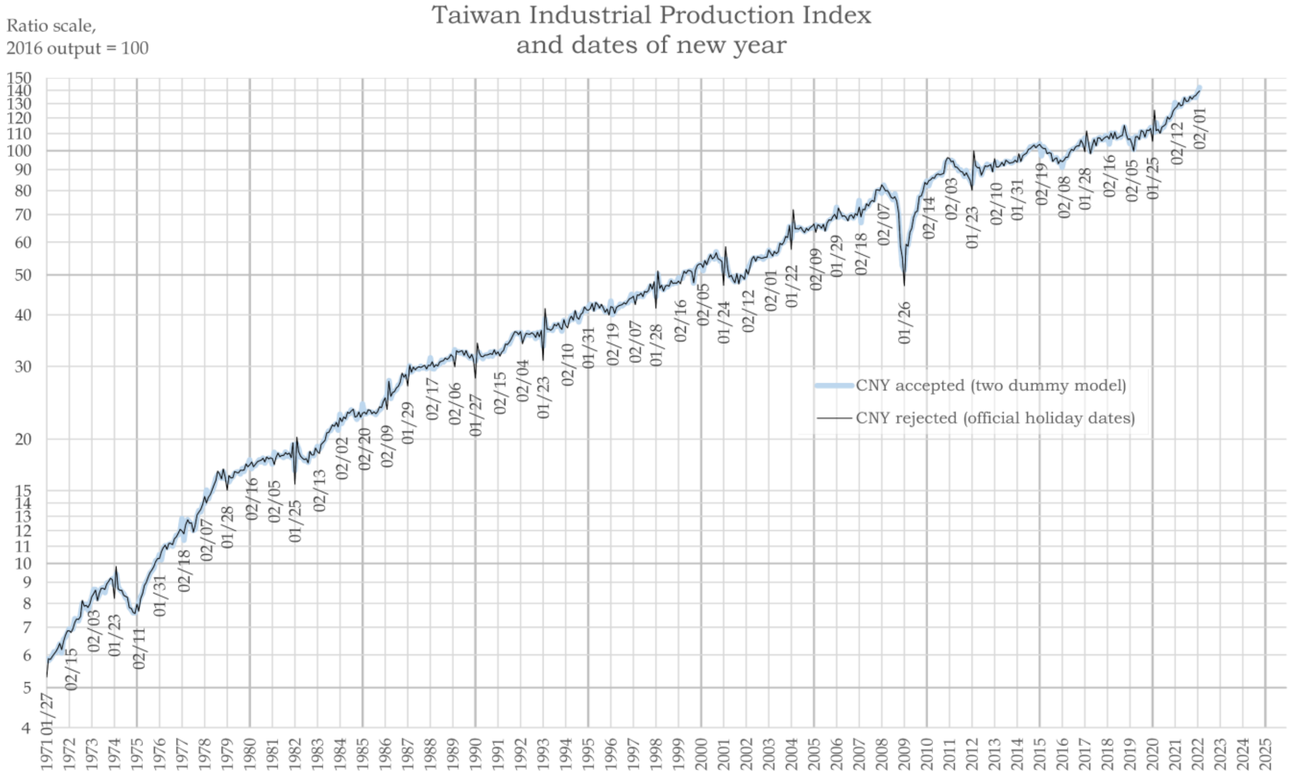
Two or three (described in Lin and Liu 2002) variable models significantly detected holiday factors. But this meant thousands sets of regressors to be compared.

Our in-house Census Method have been equipped with generator of these unknown regressors. This capability can be used to detect, ex., Chinese New Year factors of the US industrial production.



5. Detection of holiday effects (1)

Problem of 1990's: Spikes of holiday were there but rejected by AIC tests.



Data: "Industrial Production Index", National Statistics, Taiwan.
Processed by enhanced versions of X-12-SEATS and X-13ARIMA-SEATS (still coding)

The author's research house began to apply holiday adjustments of X-12-ARIMA during late 1990's. Problems of those days were rejections of Chinese New Year factors from east Asian series, when regressed by the numbers of public holiday dates.

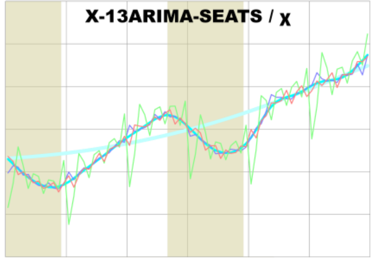
Mr. Brian Monsell taught the author that holiday effects included both increase and decrease of production, and that beginning and end of holiday effects were often related to day-of-the-week.

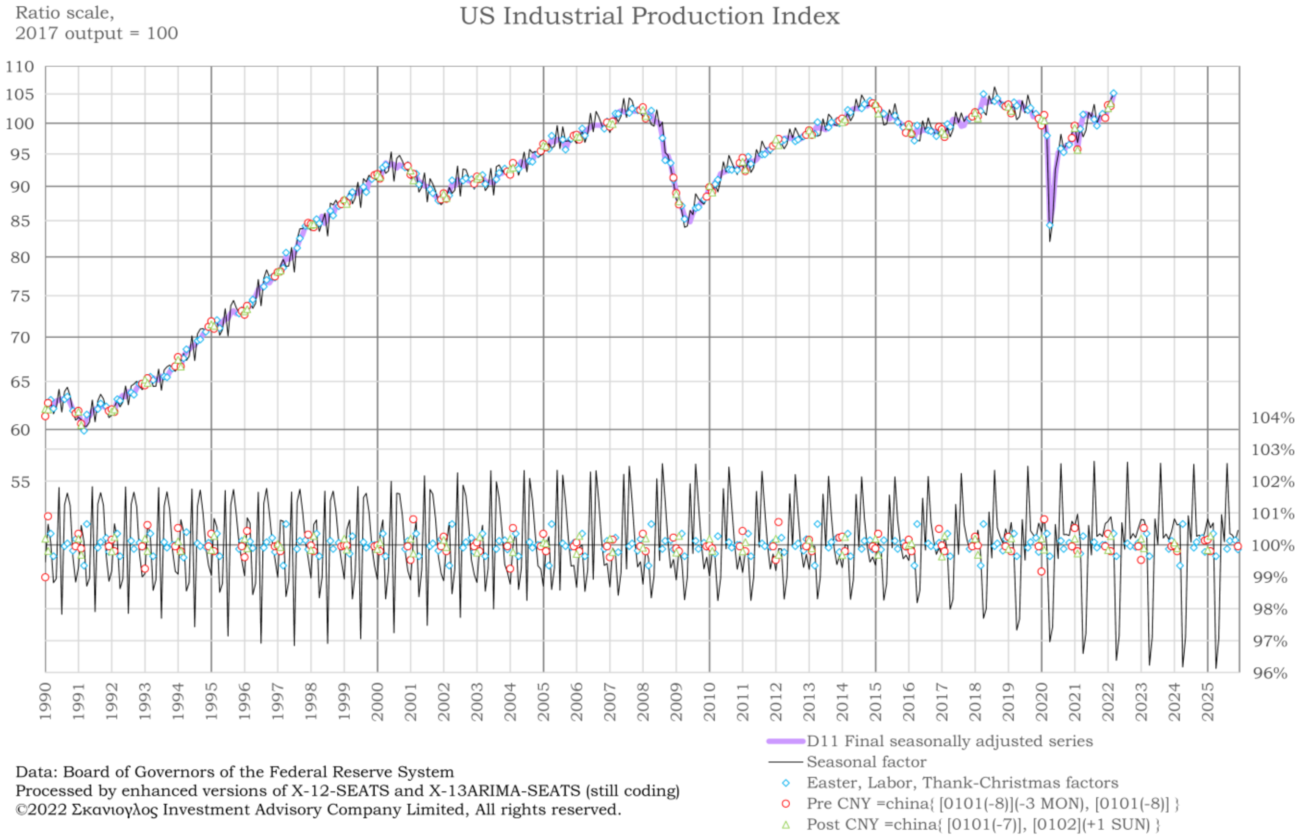
Two or three (described in Lin and Liu 2002) variable models significantly detected holiday factors. But this meant thousands sets of regressors to be compared.

Our in-house Census Method have been equipped with generator of these unknown regressors. This capability can be used to detect, ex., Chinese New Year factors of the US industrial production.

5. Detection of holiday effects (2)

Holiday effects transfer through international linkage.





Data: Board of Governors of the Federal Reserve System
Processed by enhanced versions of X-12-SEATS and X-13ARIMA-SEATS (still coding)

Fluctuations of production during January and February among major industrial countries are often found since earlier this century. Therefore, industrial production index (IP) for USA, Germany, and Japan were tested for Chinese New Year (CNY) factors. The three has no public holidays based on Chinese type lunisolar calendars.

Two kinds of factors were detected. (Sorry only US chart today.)

(1) Surge and decline prior to CNY. They would be effects from export. USA: about 1 week earlier. Japan: 1 or 2 months earlier.

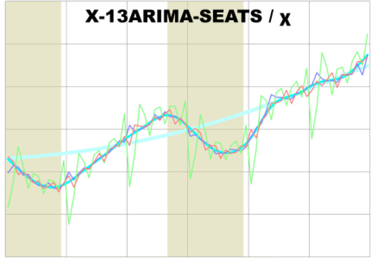
(2) Surge after CNY. They would be effects from import. Germany: about 3 weeks later. Japan: about 2 weeks later.

Below is for US IPI: Modelspan = (2000.01, 2022.03). Aictest = (user). # Note that additional holiday regressors are generated as user holiday variables.

Easter[8] × Labor[8] × Thanksgiving[1] factors ◇

Pre Chinese New Year factor ◯ higher production; end: 8 days earlier than the New Year Day [0101(-8)], start: the 3rd Monday earlier from [0101(-8)].

Post Chinese New Year factor △ lower production; start: 7 days earlier than the New Year Day [0101(-7)], end: the 1st Sunday from the second day of New Year [0102].

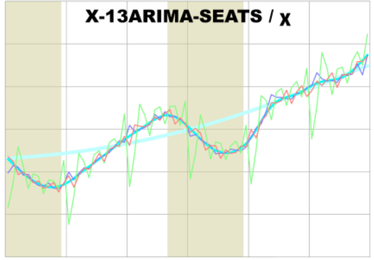


5. Detection of holiday effects (3)

(1) Holiday "window"

Holiday windows are periods, or number of dates which the holiday affects.

- ✓ There may be several windows for each holiday season;

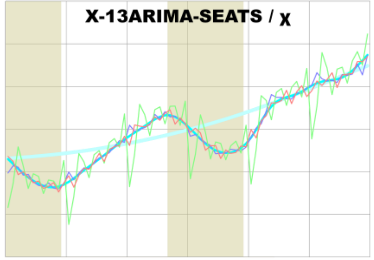


5. Detection of holiday effects (3)

(1) Holiday "window"

Holiday windows are periods, or number of dates which the holiday affects.

- ✓ There may be several windows for each holiday season; **3** (three-window model) pre (before)-holiday, peri (mid)-holiday, and post (after)-holiday.

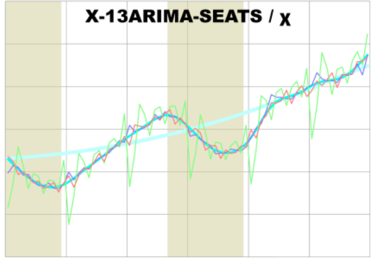


5. Detection of holiday effects (3)

(1) Holiday “window”

Holiday windows are periods, or number of dates which the holiday affects.

✓ There may be several windows for each holiday season; **3** (three-window model) pre (before)-holiday, peri (mid)-holiday, and post (after)-holiday. **2** (two-window model) Peri- and post-holiday windows may hardly be separated.

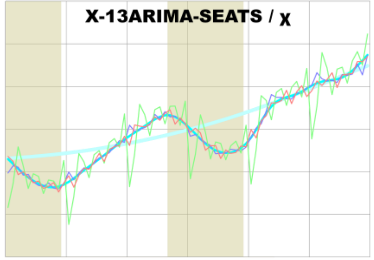


5. Detection of holiday effects (3)

(1) Holiday “window”

Holiday windows are periods, or number of dates which the holiday affects.

✓ There may be several windows for each holiday season; **3** (three-window model) pre (before)-holiday, peri (mid)-holiday, and post (after)-holiday. **2** (two-window model) Peri- and post-holiday windows may hardly be separated. **1** (one-window model) If the signs of all the parameters are equal, one-window model would be enough.

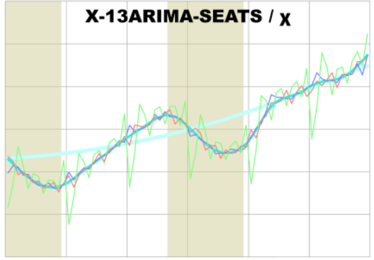


5. Detection of holiday effects (3)

(1) Holiday “window”

Holiday windows are periods, or number of dates which the holiday affects.

- ✓ There may be several windows for each holiday season; **3** (three-window model) pre (before)-holiday, peri (mid)-holiday, and post (after)-holiday. **2** (two-window model) Peri- and post-holiday windows may hardly be separated. **1** (one-window model) If the signs of all the parameters are equal, one-window model would be enough.
- ✓ Windows often start or end at weekends.
- ✓ Windows could be different from national holidays.



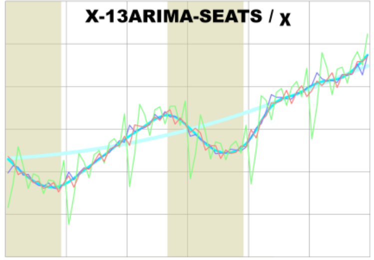
5. Detection of holiday effects (3)

(1) Holiday “window”

Holiday windows are periods, or number of dates which the holiday affects.

An example of two-window model, which statistically detected for industrial production index of Taiwan, from January 1971 to June 2001;

Pre-holiday window, when the production surges: from the Saturday 4 weeks before to the preceding day of new year’s eve.



5. Detection of holiday effects (3)

(1) Holiday “window”

Holiday windows are periods, or number of dates which the holiday affects.

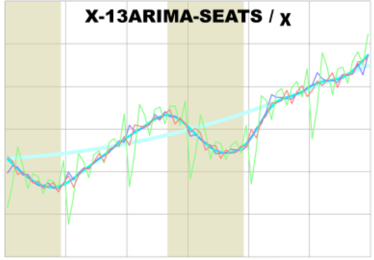
An example of two-window model, which statistically detected for industrial production index of Taiwan, from January 1971 to June 2001;

Pre-holiday window, when the production surges: from the Saturday 4 weeks before to the preceding day of new year’s eve.

Post-holiday window, when the production stops and slowly accelerates: from the new year’s eve to the Thursday 2 weeks after the second day of new year.

Furuya, Hideki, “Experimental Report on Moving Holiday Adjustment” (October 2001), an internal memo.

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited



5. Detection of holiday effects (4)

(2) RegARIMA model. See further details for chapter 4 of the Reference Manual.

https://www2.census.gov/software/x-13arima-seats/x13as/unix-linux/documentation/docx13ashtml.pdf

2.1. $\phi_p(B)\Phi_P(B^S)(1-B)^d(1-B^S)^D\left(y_t-\beta' X_t-\sum_{i=1}^{3}\alpha_i H_i(\tau,t)\right)=\theta_q(B)\Theta_Q(B^S)\varepsilon_t.$

Or,

2.2. $y_t=\beta' X_t+\sum_{i=1}^{3}\alpha_i H_i(\tau,t)+z_t,$

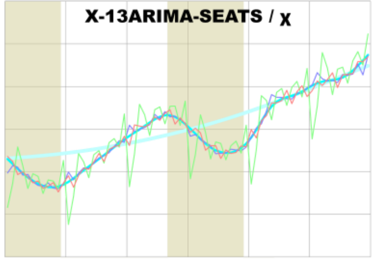
where, $y_t=\ln Y_t$, logarithm of the original series,

$\beta' X_t$, other regressors, say, trading day regressors,

$\sum_{i=1}^{3}\alpha_i H_i(\tau,t)$, holiday regressors, that is,

pre-holiday $H_1(\tau,t)$, peri-holiday $H_2(\tau,t)$, post-holiday $H_3(\tau,t)$ regressors of the period t, which month is τ,

and, z_t, residual to follow ARIMA process.



5. Detection of holiday effects (5)

(3) Generation of holiday regressors.

For example, pre-holiday regressor for flow series would be generated as

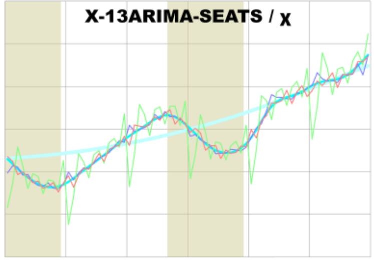
3.1. $H_1(\tau, t) = N_1(\tau, t)/N_1(\tau)$,

where $N_1(\tau, t)$ for days of pre-holiday window falls on the period t, which month is τ,

$N_1(\tau)$ for long-term average days of pre-holiday window falls on the month τ.

Peri- and post-holiday regressors can be write in the same manner.

Division by long-term average means seasonal adjustment of regressor to avoid multicollinearity. So don’t miss it.



5. Detection of holiday effects (6)

What is the measure to choose?:

Holiday windows are chosen by AICC (Akaike Information Criterion).

Procedure:

Below are the procedure for full test the author applies since 1990's.

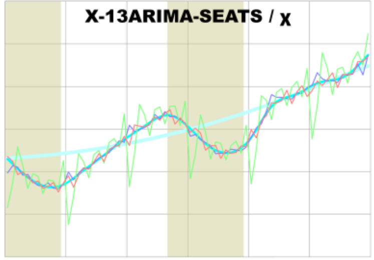
1. Fix other things equal to keep AICC comparable.

1.1. No other dummies except for re-unification dummy of Germany (ls1991.01).

1.2. Fix ARIMA = (pdq) $(PDQ)_s$. Difference times d and seasonal difference times D should not be changed. So use airline model=(011)$(011)_s$.

1.3. Do not apply aictest to other dummies (td, easter, and else, which usually applied). Ex., US IP, if easter[w] is rejected, CNY seems easier to be accepted.

ΣΚΑΝΙΓΛΟΣ®
Investment Advisory Company Limited



5. Detection of holiday effects (7)

2. Find border between pre-holiday and post-holiday windows.

2.1. Three windows or two windows? Public holiday exists, compare $AICC_3$ and $AICC_2$.

$AICC_3$; pre-holiday: [$d3_{y,11}$ $d3_{y,12}$], peri: [$d3_{y,21}$ $d3_{y,22}$], post: [$d3_{y,31}$ $d3_{y,33}$]
peri window = public holiday.

$AICC_2$; pre-holiday: [$d2_{y,11}$ $d2_{y,12}$], peri & post (holiday): [$d2_{y,21}$ $d2_{y,22}$]

$d2_{y,21}$ = start of public holiday, or the weekend right before.

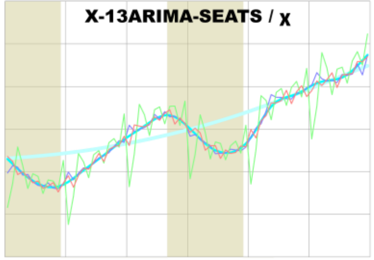
2.2. No public holidays.

Ex., set as initial values: pre-holiday = [$d_{y,21}$-8 $d_{y,21}$-1], holiday = [$d_{y,21}$ $d_{y,21}$+7].

Then compare AICC's of various $d_{y,21}$.

If the series is merchandise import or export, the span can be as long as several months.

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited



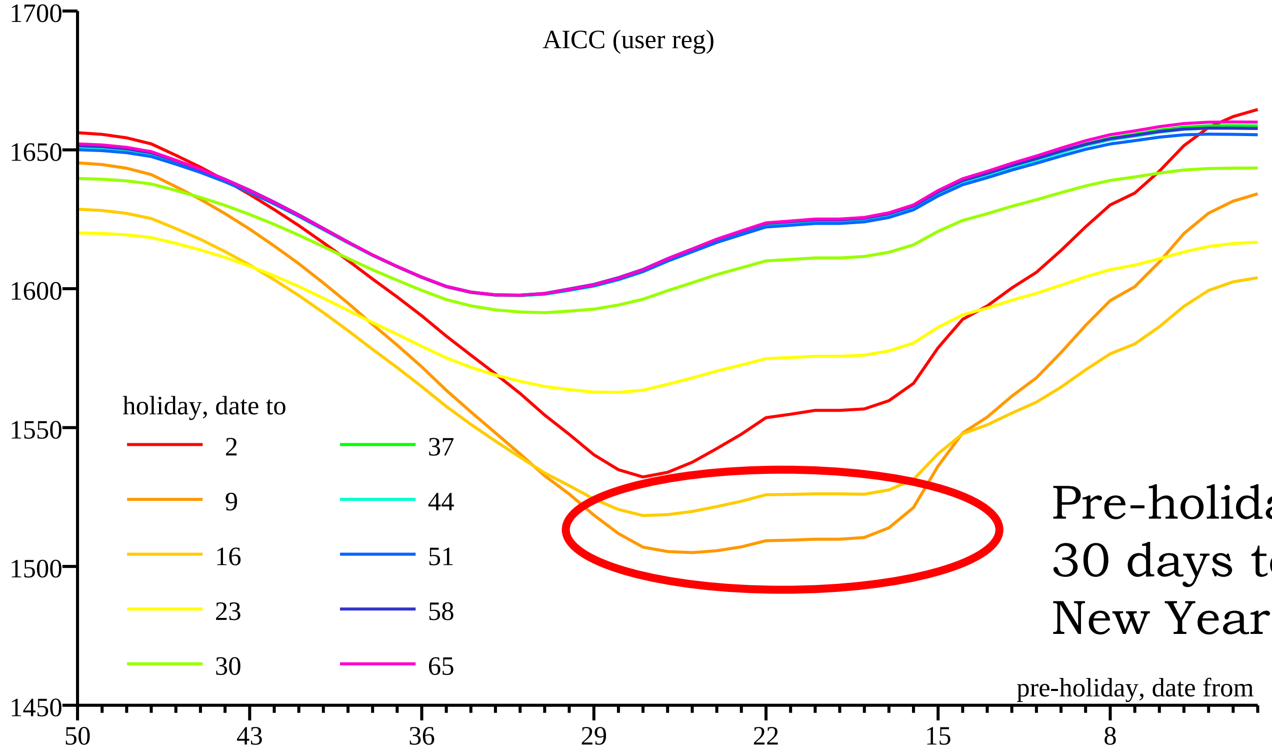
5. Detection of holiday effects (8)

3. Find start of pre-holiday window and end of holiday window.

pre-holiday = [$d_{y,11}$ $d_{y,21}$-1], holiday = [$d_{y,21}$ $d_{y,22}$].

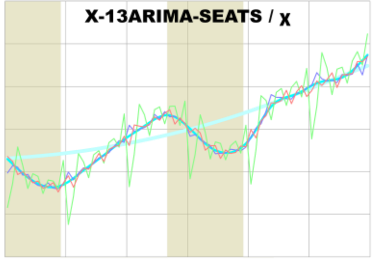
Example is industrial production of Taiwan (1971 – 2001).

From New Year's Eve to 3rd day New Year are assumed to be holidays.



Pre-holiday:
30 days to 15 days preceding to New Year's Eve.

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited



5. Detection of holiday effects (8)

3. Find start of pre-holiday window and end of holiday window.

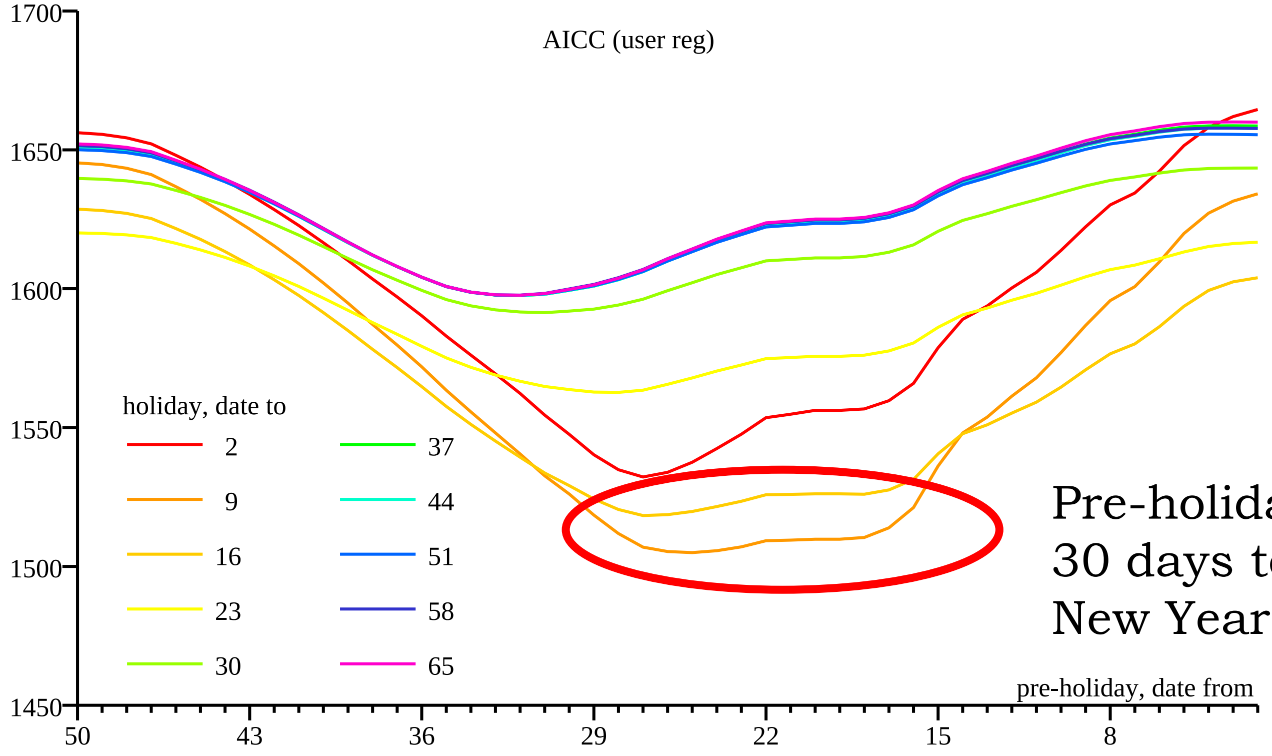
The Day before New Year's Eve

New Year's Eve

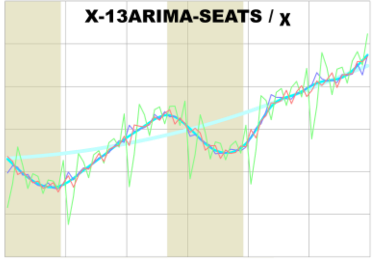
pre-holiday = [$d_{y,11}$ $d_{y,21}$-1], holiday = [$d_{y,21}$ $d_{y,22}$].

Example is industrial production of Taiwan (1971 – 2001).

From New Year's Eve to 3rd day New Year are assumed to be holidays.



Pre-holiday:
30 days to 15 days preceding to New Year's Eve.



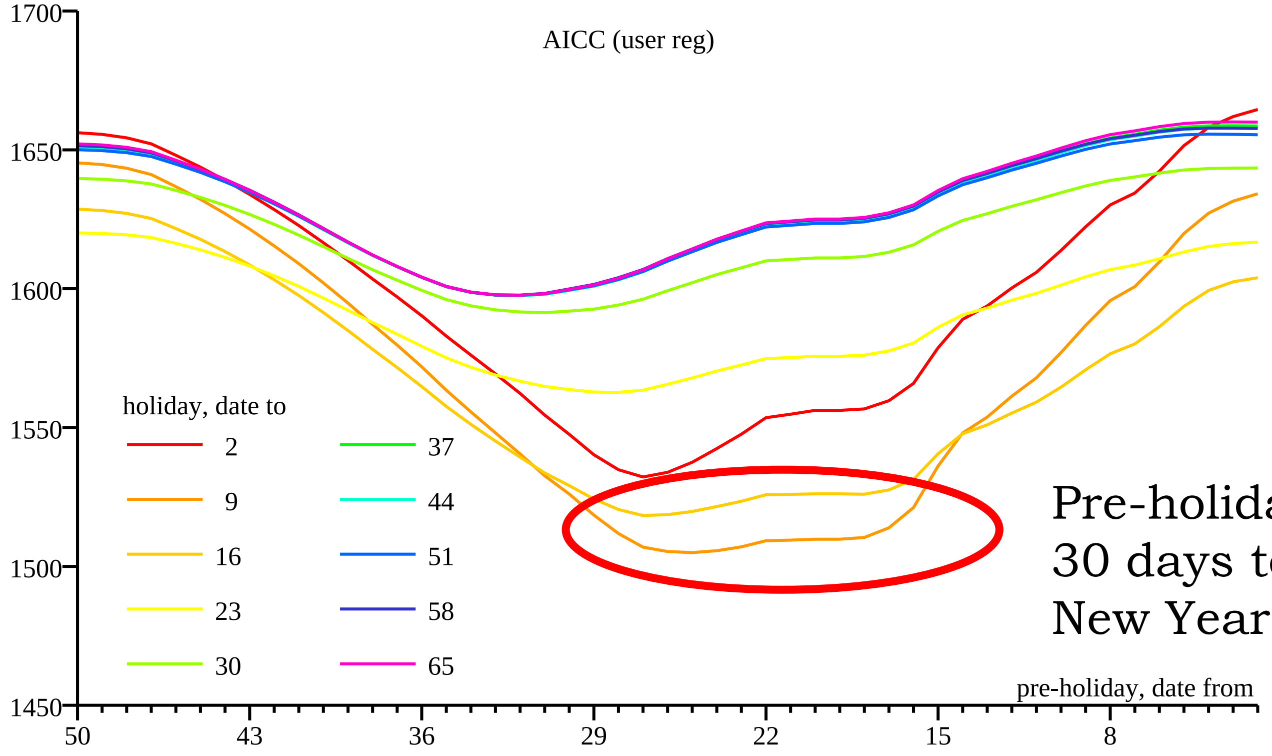
5. Detection of holiday effects (8)

3. Find start of pre-holiday window and end of holiday window.

pre-holiday = [$d_{y,11}$ $d_{y,21}$-1], holiday = [$d_{y,21}$ $d_{y,22}$].

Example is industrial production of Taiwan (1971 – 2001).

From New Year's Eve to 3rd day New Year are assumed to be holidays.

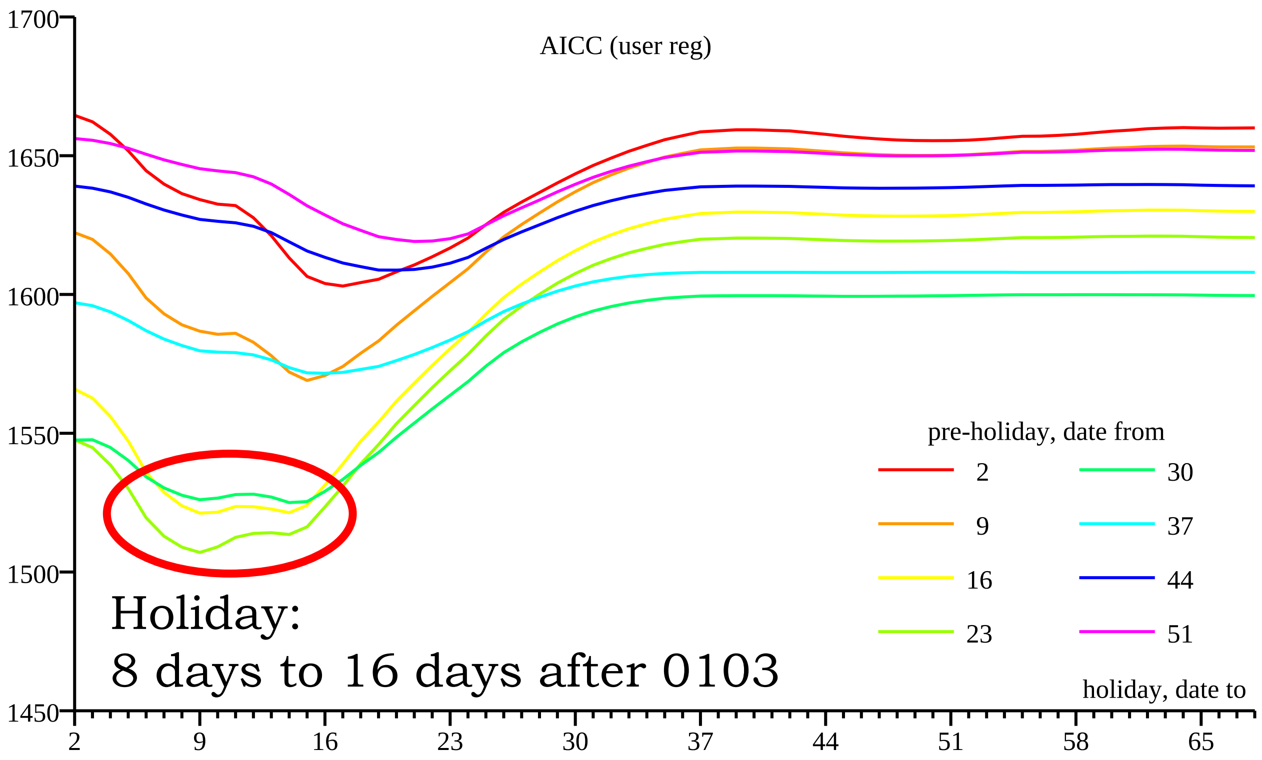


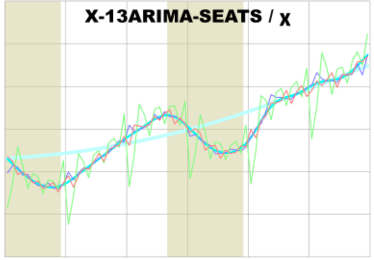
Pre-holiday:
30 days to 15 days preceding to New Year's Eve.

5. Detection of holiday effects (9)

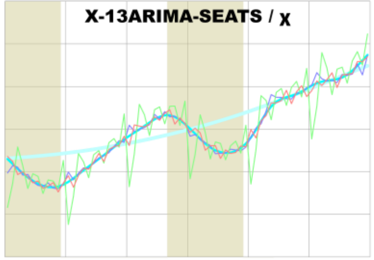
3. Find start of pre-holiday window and end of holiday window.

pre-holiday = [$d_{y,11}$ $d_{y,21}$-1], holiday = [$d_{y,21}$ $d_{y,22}$].





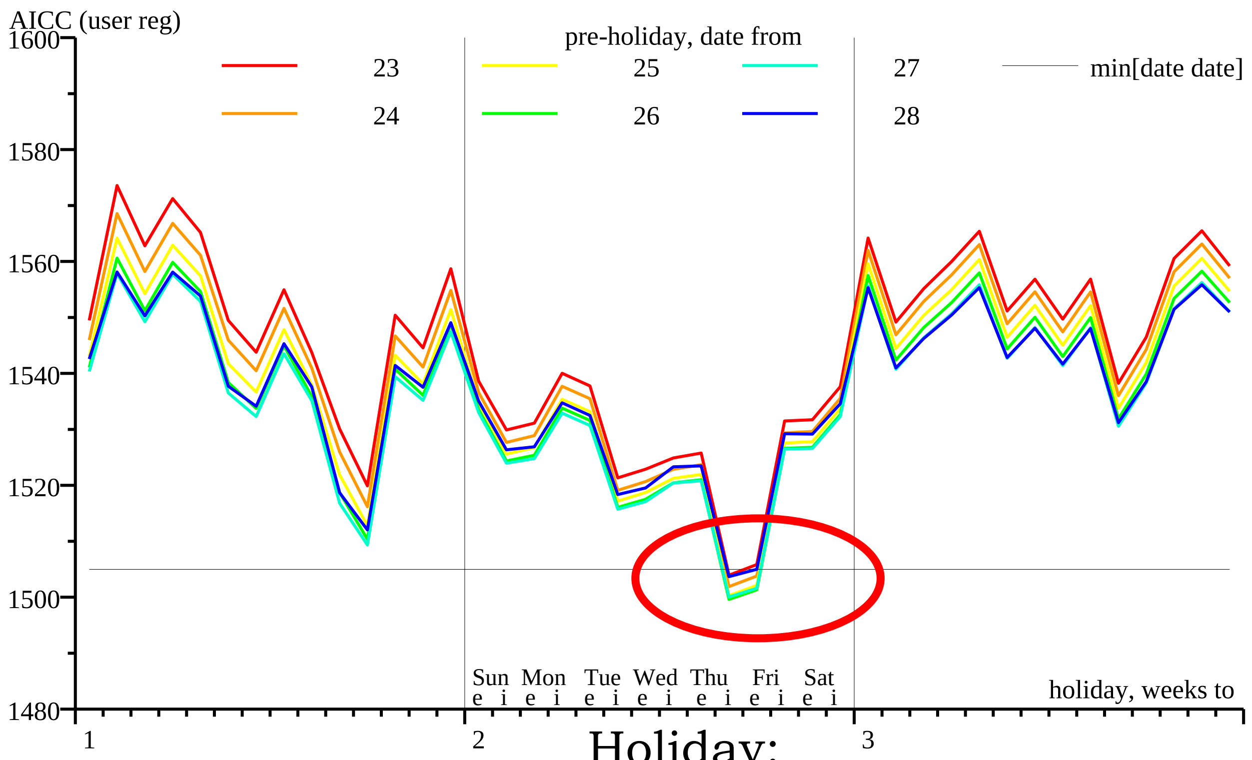
ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited



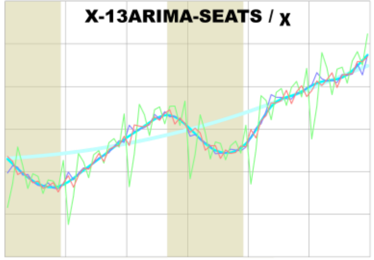
5. Detection of holiday effects (10)

3. Find start of pre-holiday window and end of holiday window.

pre-holiday = [$d_{y,11}$ $d_{y,21}$-1], holiday = [$d_{y,21}$ $d_{y,22}$].



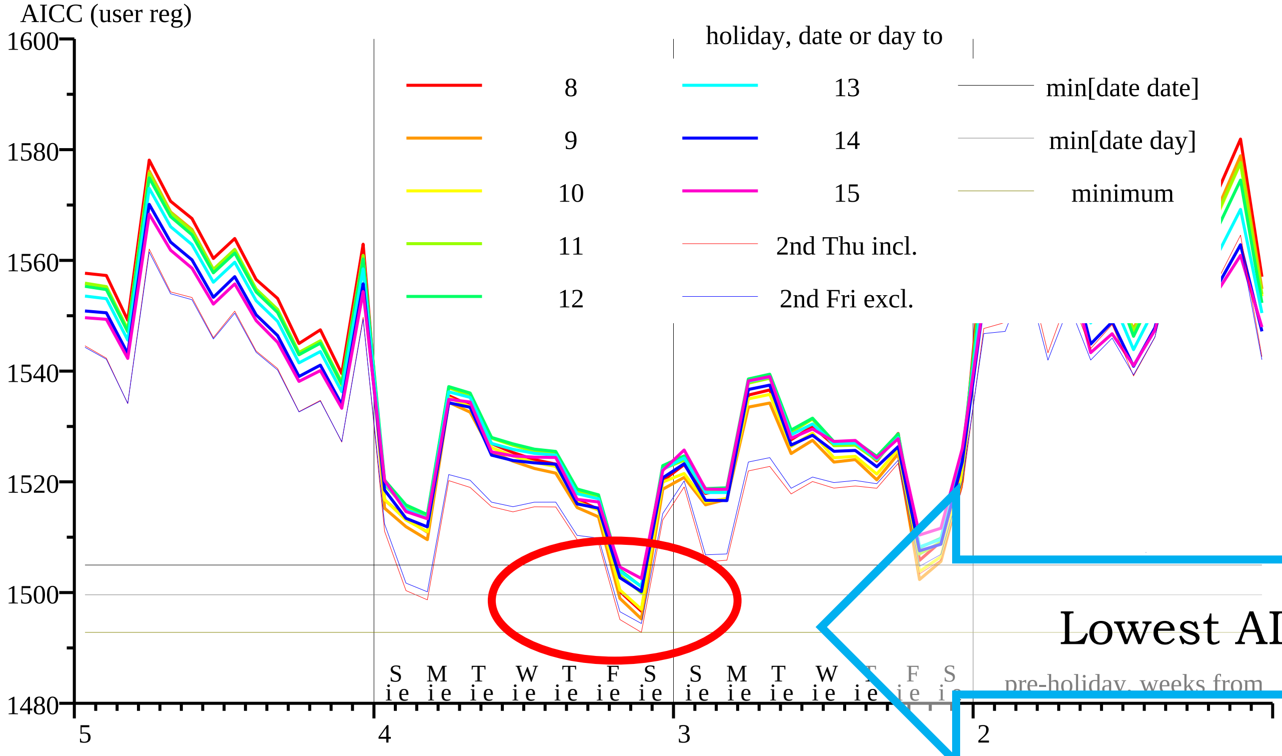
Holiday:
To the 2nd Thursday after 0103



5. Detection of holiday effects (11)

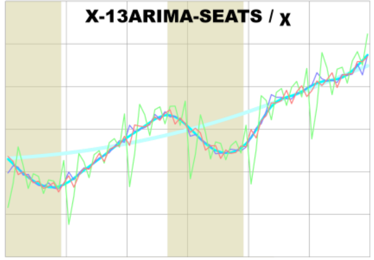
3. Find start of pre-holiday window and end of holiday window.

pre-holiday = $d_{y,11}$ $d_{y,21}$-1], holiday = [$d_{y,21}$ $d_{y,22}$].



Lowest AICC among tested.

Pre-holiday:
From the 4th Saturday preceding to New Year's Eve.



5. Detection of holiday effects (12 end)

4. ARIMA model and other fixed things to be re-estimate if needed.

Holiday regressor with the lowest AICC among airline models would derive low AICC with automatically selected ARIMA model.

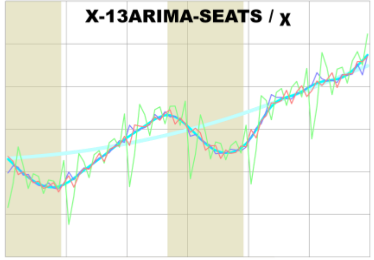
2-regressor model

Pre-holiday window	start:	4th Saturday preceding to New Year's Eve.	Day-of-week
	end:	The day before New Year's Eve.	date
Holiday window	start:	New Year's Eve.	date
	end:	2nd Thursday after New Year the 3rd exclusive.	Day-of-week

3-regressor model

Pre-holiday window	start:	4th Saturday preceding to New Year's Eve.	Day-of-week
	end:	The day before New Year's Eve.	date
Peri-holiday window	start:	New Year's Eve.	date
	end:	New Year the 3rd.	date
Post-holiday window	start:	New Year the 4th.	date
	end:	2nd Thursday after New Year the 4th inclusive.	Day-of-week

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited



5. Detection of holiday effects (12 end)

4. ARIMA model and other fixed things to be re-estimate if needed.

Holiday regressor with the lowest AICC among airline models would derive low AICC with automatically selected ARIMA model.

2-regressor model

Pre-holiday window start: 4^{th} Saturday preceding to New Year's Eve. Day-of-week
end: The day before New Year's Eve. date

Holiday window start: New Year's Eve. date
end: 2^{nd} Thursday after New Year the 3^{rd} exclusive. Day-of-week

3-regressor model

Pre-holiday window start: 4^{th} Saturday preceding to New Year's Eve. Day-of-week
end: The day before New Year's Eve. date

Peri-holiday window start: New Year's Eve. date
end: New Year the 3^{rd}. date

Post-holiday window start: New Year the 4^{th}. date
end: 2^{nd} Thursday after New Year the 4^{th} inclusive. Day-of-week

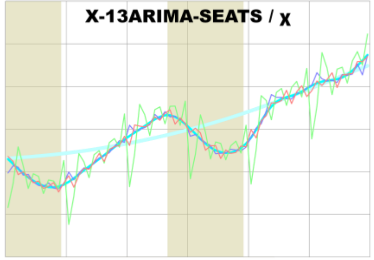
Above procedure needs thousands of regressors to be tests. (actually about 6000)

☞ Conclusion is clear. **Automatic detection.**

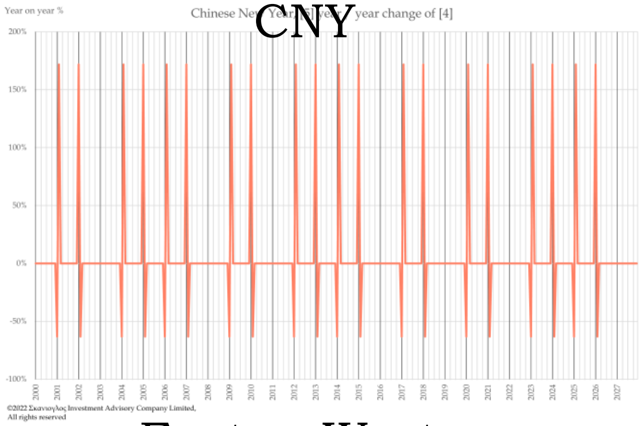
ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited

Holiday occurrences are different each other.

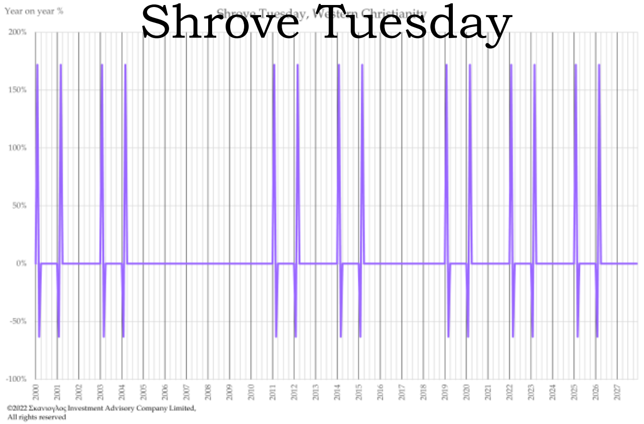
Year / year change of regressors have different spikes.



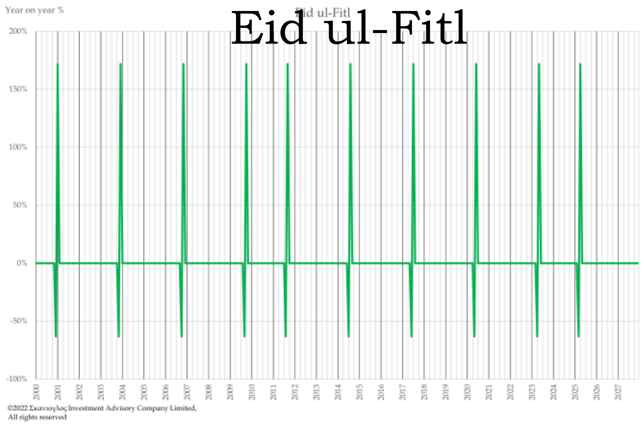
CNY



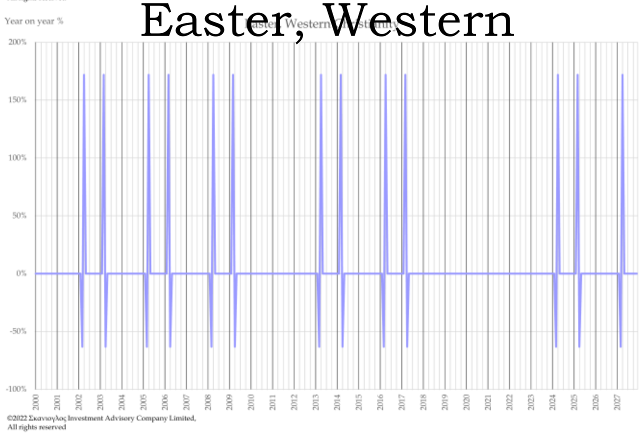
Shrove Tuesday



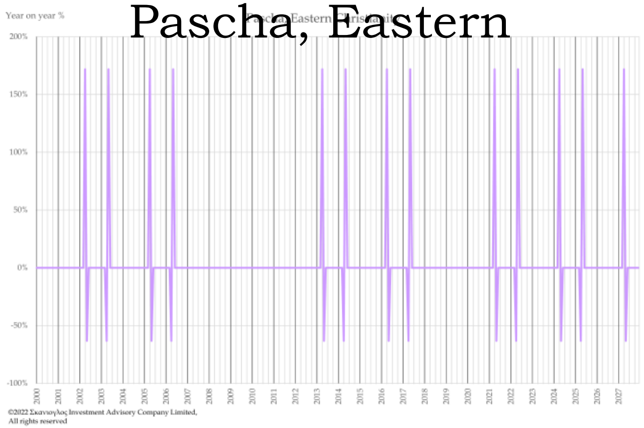
Eid ul-Fitl



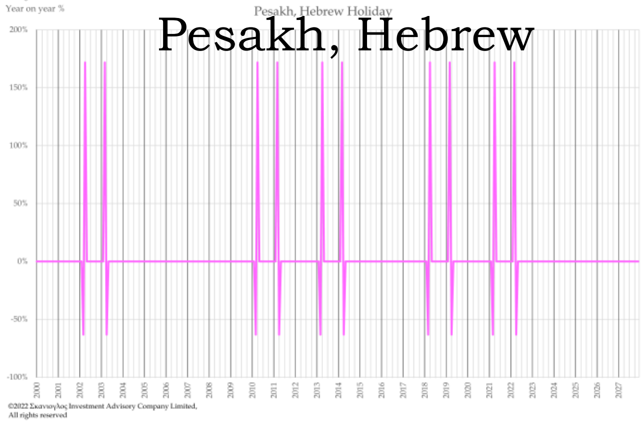
Easter, Western



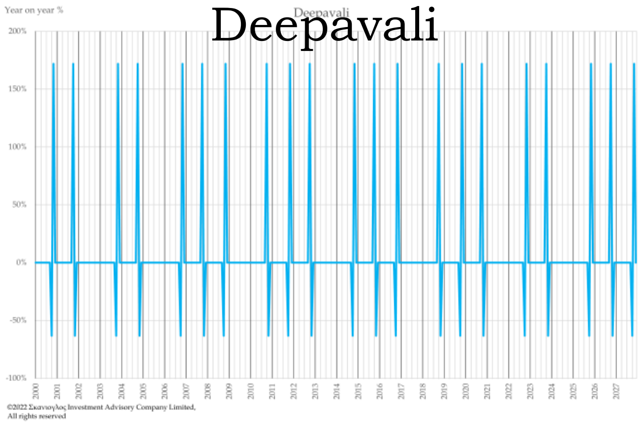
Pascha, Eastern



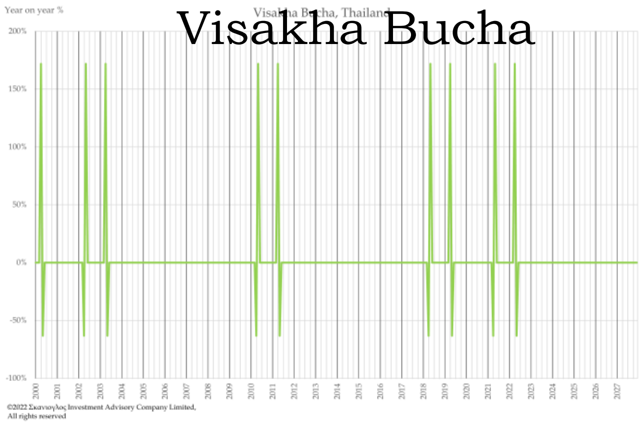
Pesakh, Hebrew



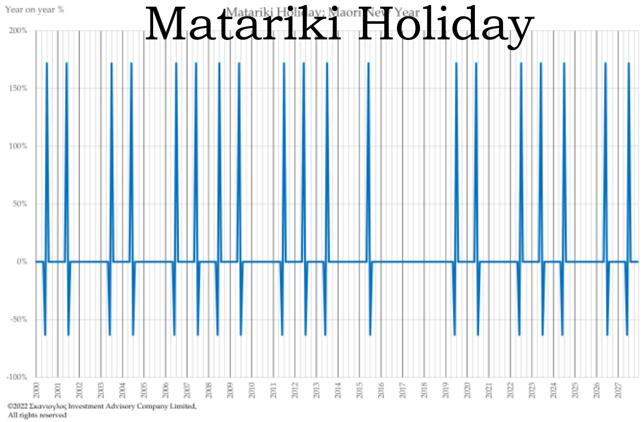
Deepavali

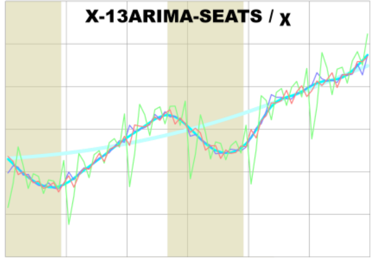


Visakha Bucha



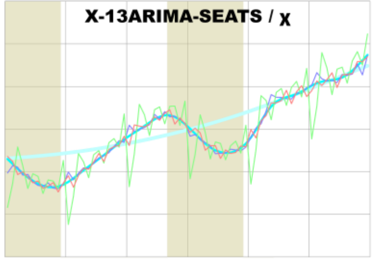
Matariki Holiday





1. Brief history
2. What are tunings
3. Calendar and holiday list
4. Long-term average
5. Detection of holiday effects
6. References and links

ΣΚΑΝΙΟΓΛΟΣ®
Investment Advisory Company Limited



6. References and links (1)

Software:

Census Bureau, USA, X-13ARIMA-SEATS Seasonal Adjustment Program https://www.census.gov/data/software/x13as.X-13ARIMA-SEATS.html.

SUGA, Takashi "When_exe - A multicultural and multilingualized calendar library" Gems for Ruby are here https://github.com/suchowan/when_exe. Usages can be seen on http://hosi.org/. When_exe aims to express and convert the calendar used in all cultures and languages of all ages. This aim kicked off my plan to include almost all the world's statistically significant calendars.

Articles:

Anirban Sanyal, Pratik Mitra, Tucker S. McElroy, and Anindya Roy, August 2017, "Holiday Effects in Indian Manufacturing Series", https://www.census.gov/library/working-papers/2017/adrm/rrs2017-04.html.

Australian Bureau of Statistics, November 2005, "Estimating and Removing the Effects of Chinese New Year and Ramadan to Improve the Seasonal Adjustment Process" https://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/1350.0Technical%20Note1Nov%202005?OpenDocument.

Furuya, Hideki, August 2002, "Chinese New Year Effects Estimated by X-12-ARIMA" https://www.jcer.or.jp/report/research_paper/detail3606.html, sorry written in Japanese and no translations, and pdf here is members only. Draft in Japanese is available.

Lin, Jin-Lung and Liu, Tian-Syh July 2002, "Modeling Lunar Calendar Holiday Effects in Taiwan" https://www.census.gov/library/working-papers/2002/adrm/lin-01.html.

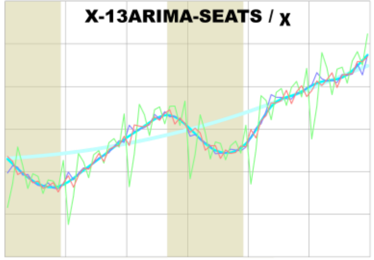
Matariki Advisory Committee, New Zealand, May 2021, "Matariki Dates 2022 – 2052" https://www.mbie.govt.nz/assets/matariki-dates-2022-to-2052-matariki-advisory-group.pdf

Yap, Bee Wah, Norhayati Shuja', and Mohd Alias Lazim, 2007, "Moving Holiday Effects Adjustment for Malaysian Economic Time Series", https://www.academia.edu/20549481/Moving_Holiday_Effects_Adjustment_for_Malaysian_Economic_Time_Series.

Formulae:

Christian liturgical calendars:
Western https://en.wikipedia.org/wiki/Date_of_Easter#Anonymous_Gregorian_algorithm
Eastern https://en.wikipedia.org/wiki/Date_of_Easter#Meeus's_Julian_algorithm

Thai traditional Songkran: https://th.wikipedia.org/wiki/สงกรานต์ในประเทศไทย. English wiki seems strange.



6. References and links (2)

Sites:

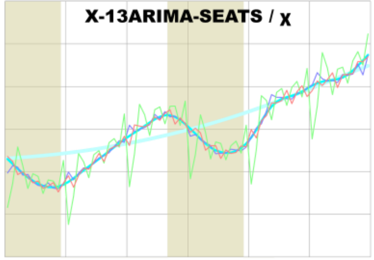
Hindu festivals: https://www.drikpanchang.com/. Among the panchang sites, span of this site is extremely long.
The author retrieved drikpanchang very many times as a free user.
{1001 years from 1600 to 2600 + (10 year backcast span + 10 year forecast span) + (maximum 1 year lead + maximum 1 year lag)} × 6 cities × 4 holidays = 28,872 times.

The Gregorian Calendar was introduced to set proper dates of Easter (*ad rectam Paschalis festi*). In the today's title "Inter Gravissimas", Pope Gregory XIII stated as three appropriate that

- first, correct placement of the vernal equinox; **The first condition is, March equinox to fall around March 21st .**
- next, correct placement of the fourteenth day of the moon in the first month, which [fourteenth day] either occurs on the day of the equinox itself or is the next to follow after;
- and lastly, the first Sunday which follows that same fourteenth day of the moon.

Photocopy of *Clavius, Christoph*, **Romani Calendarii A Gregorio XIII. P. M. restitvti explicatio S. D. N. Clementis VIII. P. M. Ivssv edita : accesit confutatio eorum, qui Calendarium aliter instaurandum esse contenderunt**, *1603*
was taken from
https://echo.mpiwg-berlin.mpg.de/ECHOdocuView?pn=53&ws=3&url=/mpiwg/online/permanent/library/YXK9FE9W/pageimg&start=51&viewMode=images&mode=imagepath,
and English translation taken from https://en.wikipedia.org/wiki/Inter_gravissimas.

Euro area and EU working days to build Calendar Adjustment Regressor
https://ec.europa.eu/eurostat/cros/content/euro-area-and-eu-working-days-build-calendar-adjustment-regressor_en



Thank you for viewing.

hidekifuruya@skanioglos.co.jp