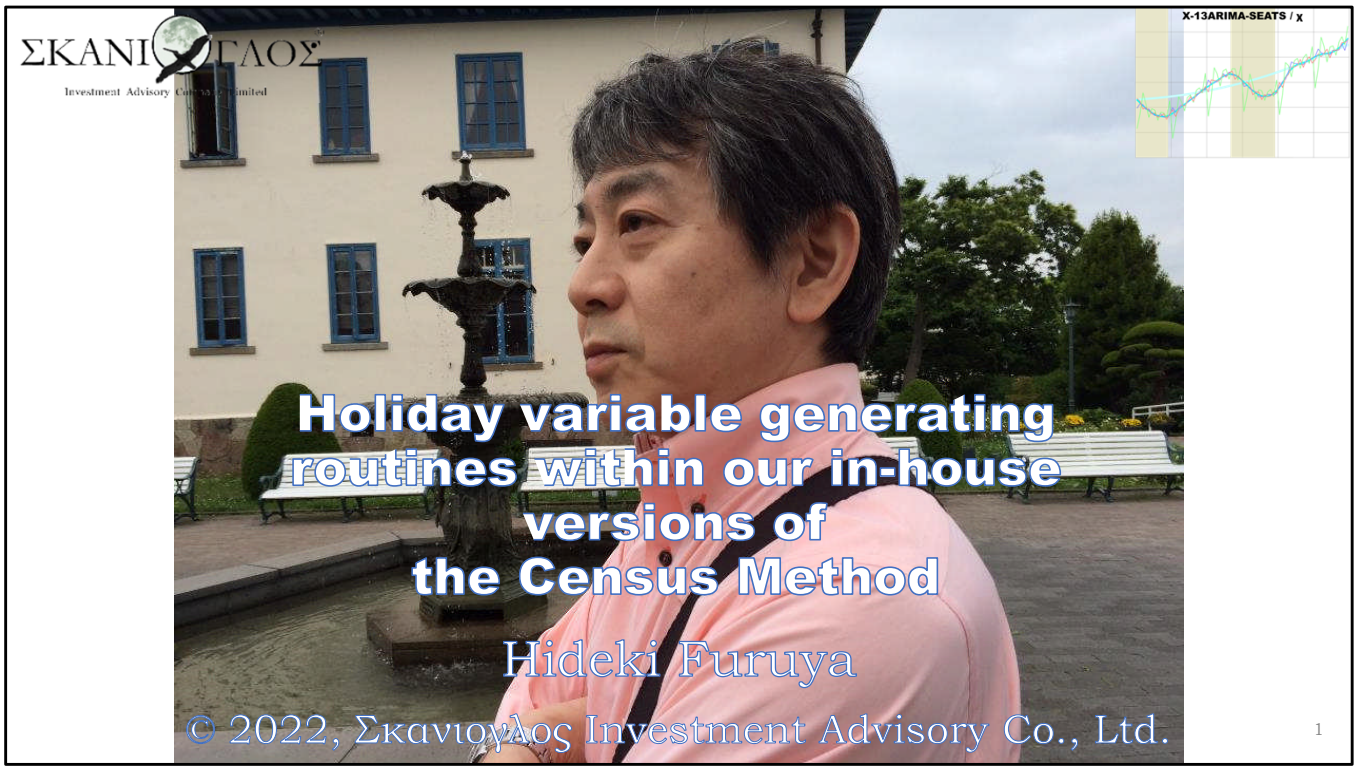

Holiday Variable Generating Routines Within Our In-House Versions of the Census Method.

Holiday adjustment is an important part of seasonal adjustment. But it is often hard to measure. I would like to introduce the way we have been applying. Also, I would like to talk about the current plan for the routines to build in X-13ARIMA-SEATS.

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Member of Japan Investment Advisers Association, No. 012-02829.

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- This presentation adopts software under development. Results of calculations may be different from those of the futures.

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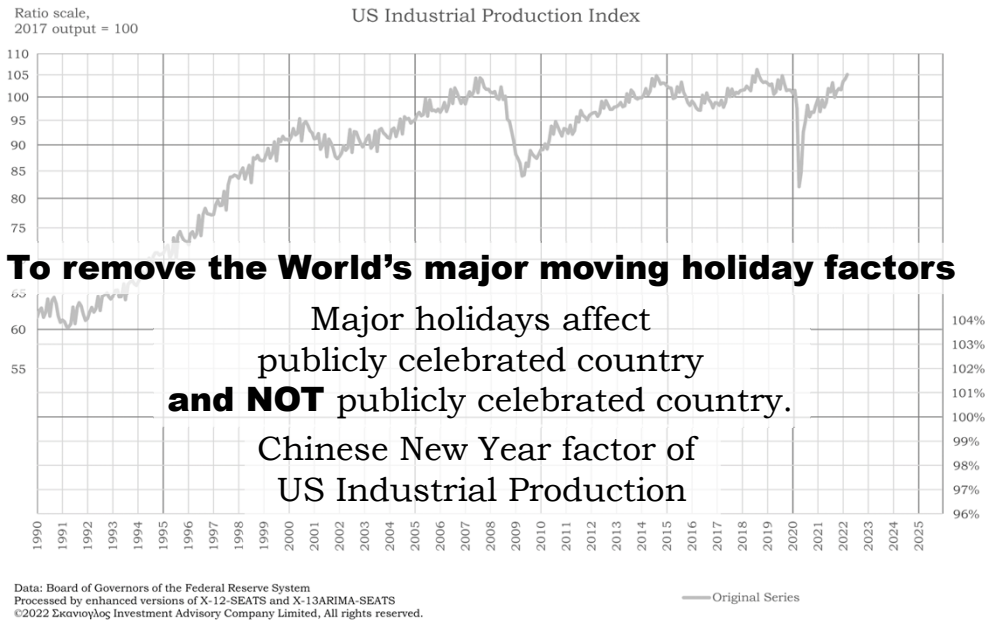
1. Detection of holiday effects (1)



To remove the World's major moving holiday factors

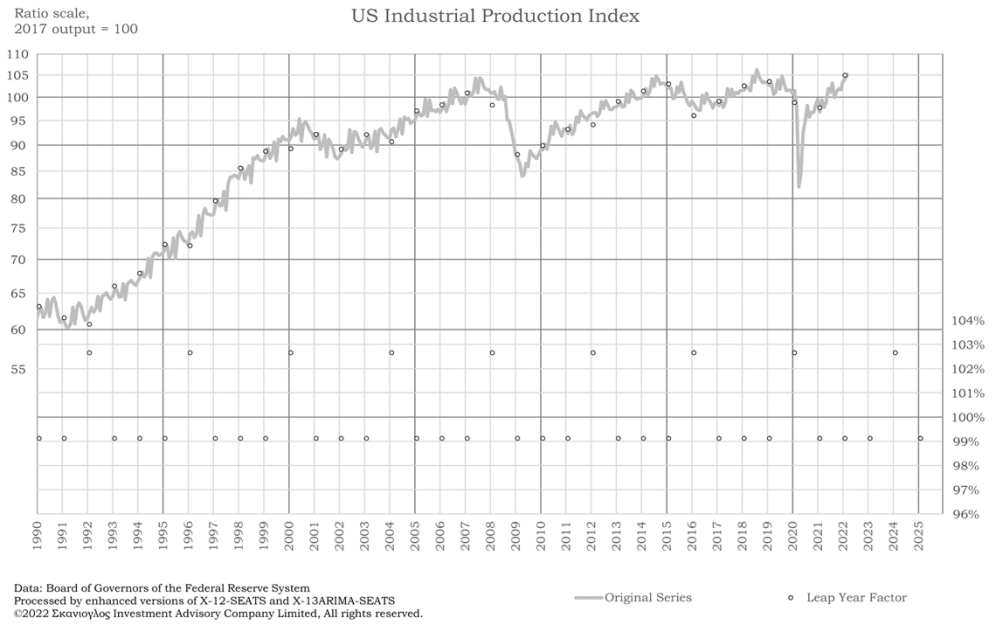
Major holidays affect
publicly celebrated country
and NOT publicly celebrated country.

Chinese New Year factor of
US Industrial Production

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

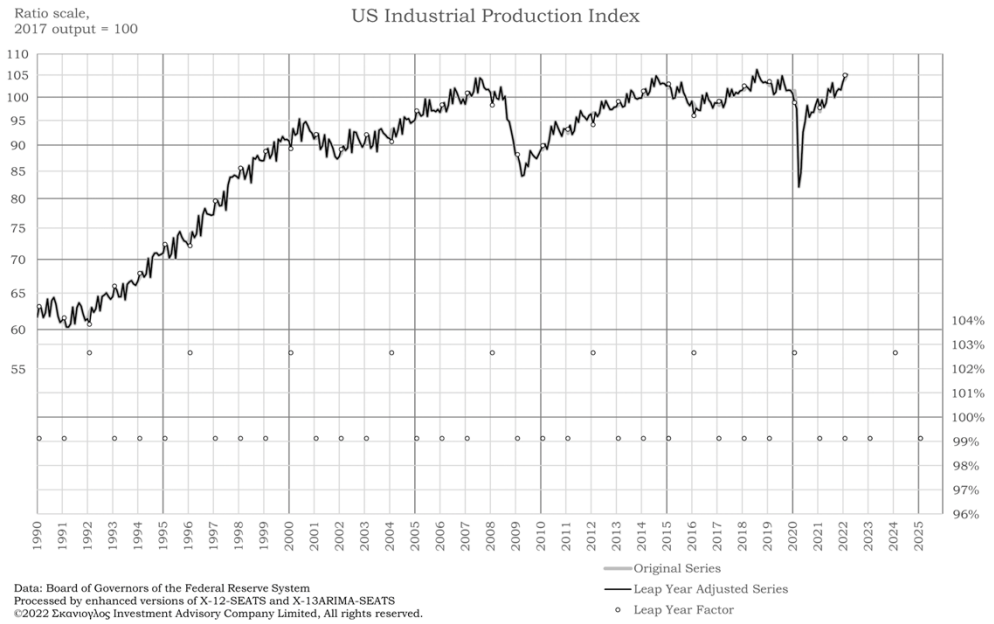
Major holidays often affect to the country where the holidays are not publicly celebrated. This is an example to detect Chinese Year Factor from the industrial production index of the United States. This is the original series, or the series not seasonally adjusted yet.

1. Detection of holiday effects (1)



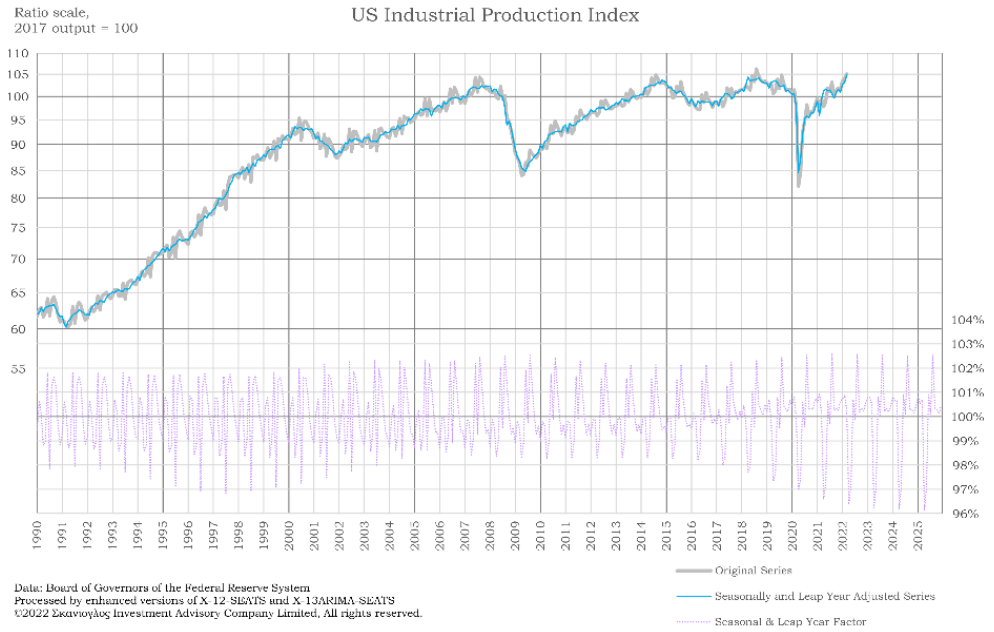
Adjusted for the lengths of Februarys.

1. Detection of holiday effects (1)



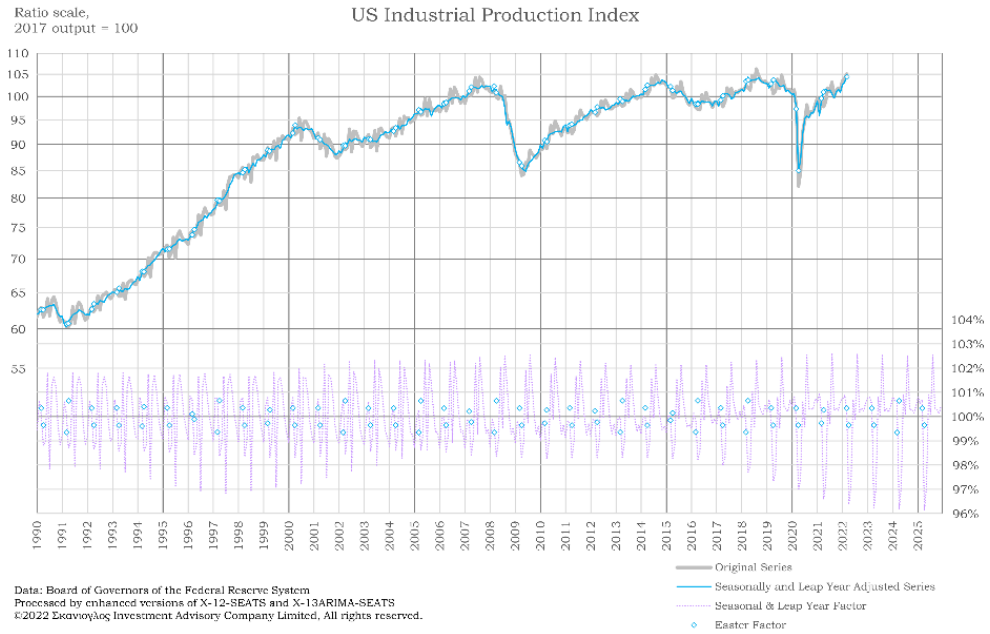
Leap year adjustment.

1. Detection of holiday effects (1)



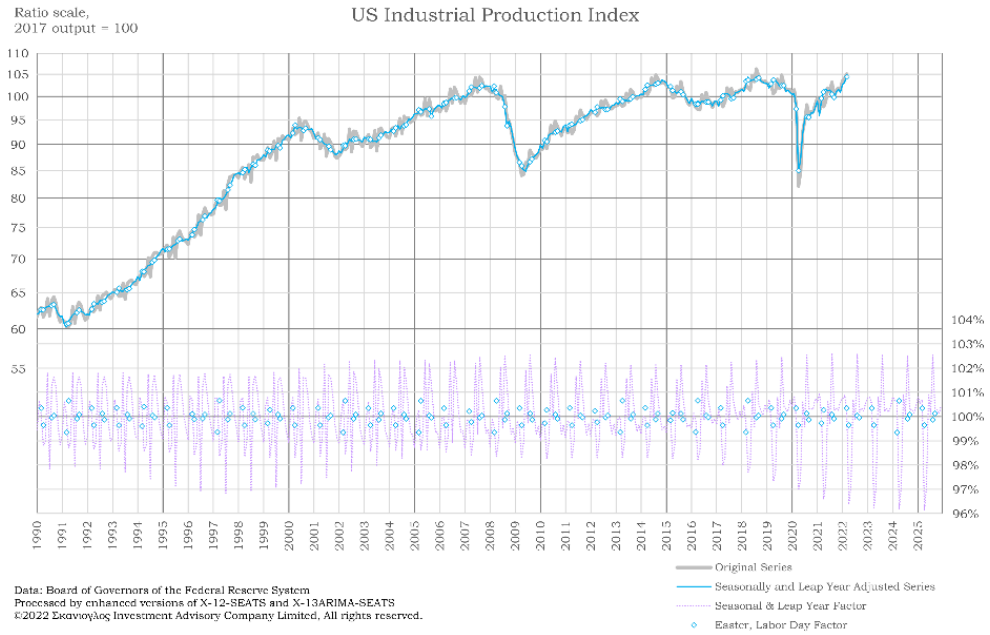
Seasonal factor and leap year factor are plotted as one dotted line. They are removed from the solid line. But holiday factors are not removed yet.

1. Detection of holiday effects (1)



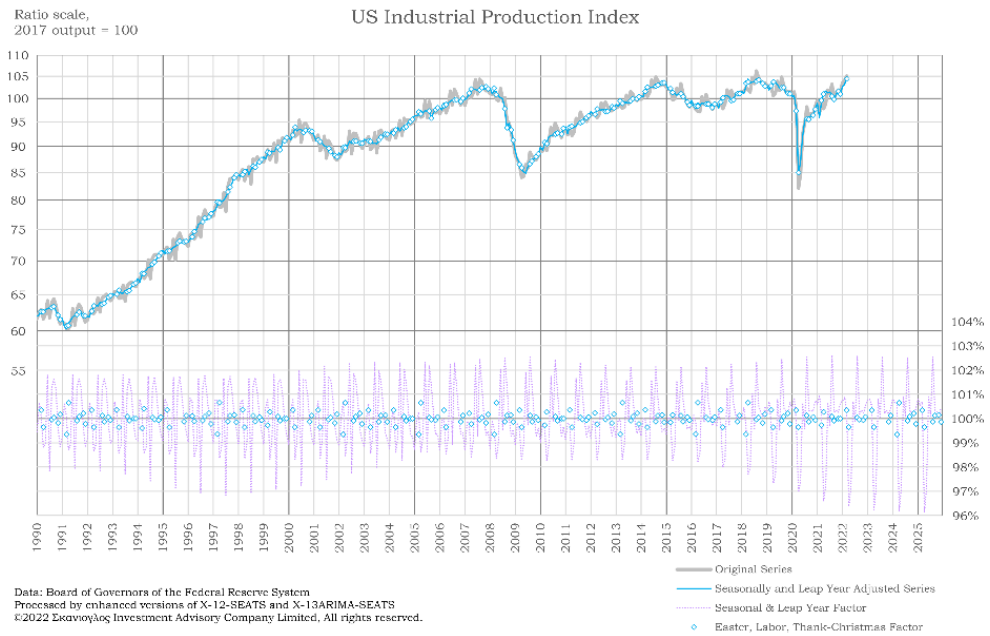
Easter factor.

1. Detection of holiday effects (1)



Labor day factor.

1. Detection of holiday effects (1)



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

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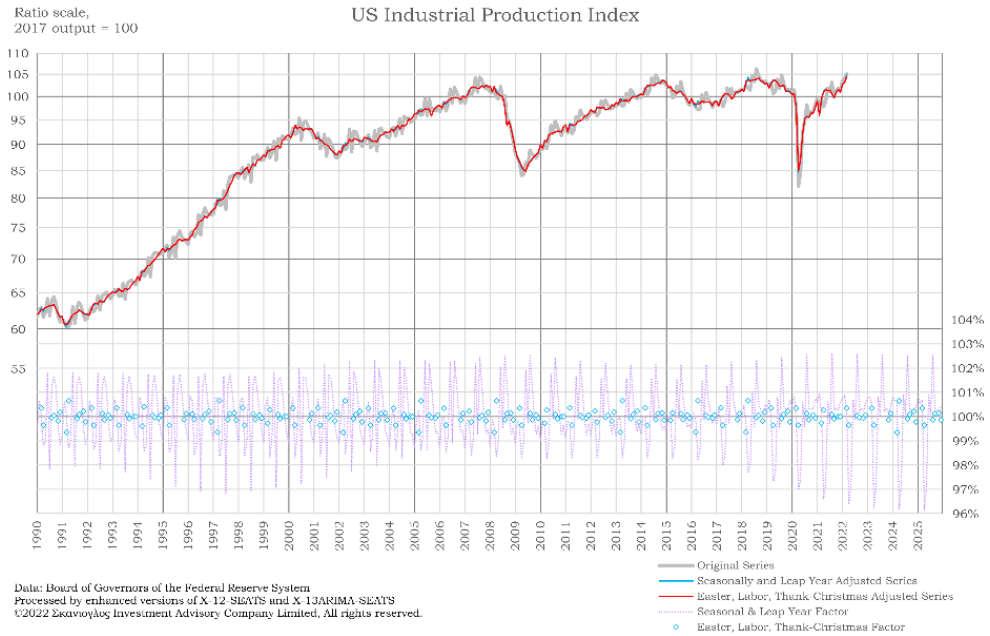
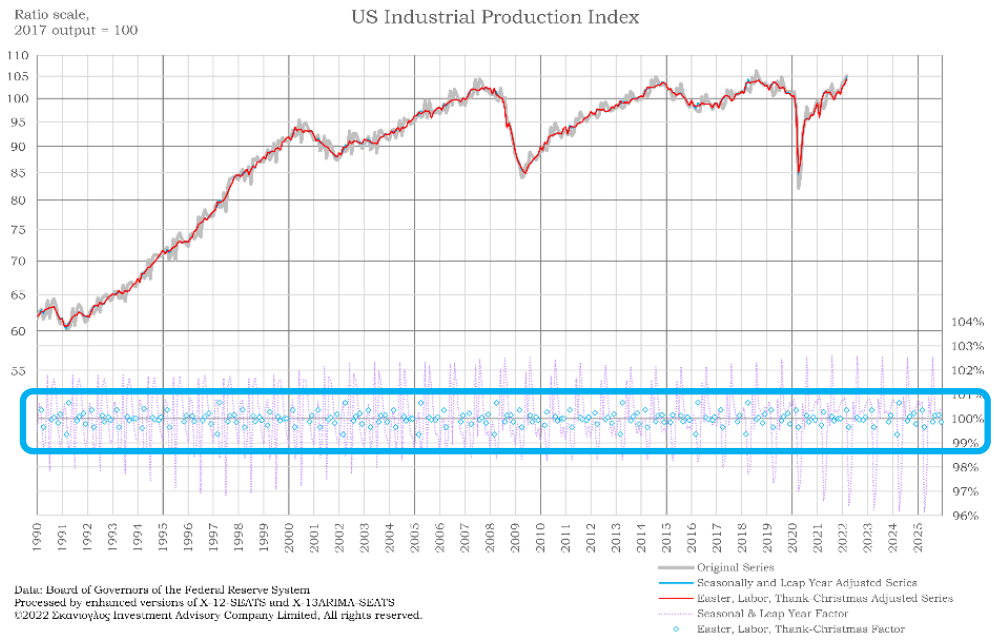
Thanksgiving Christmas factor. These factors were estimated and removed.

1. Detection of holiday effects (1)



Original Census Method can do this.

1. Detection of holiday effects (1)



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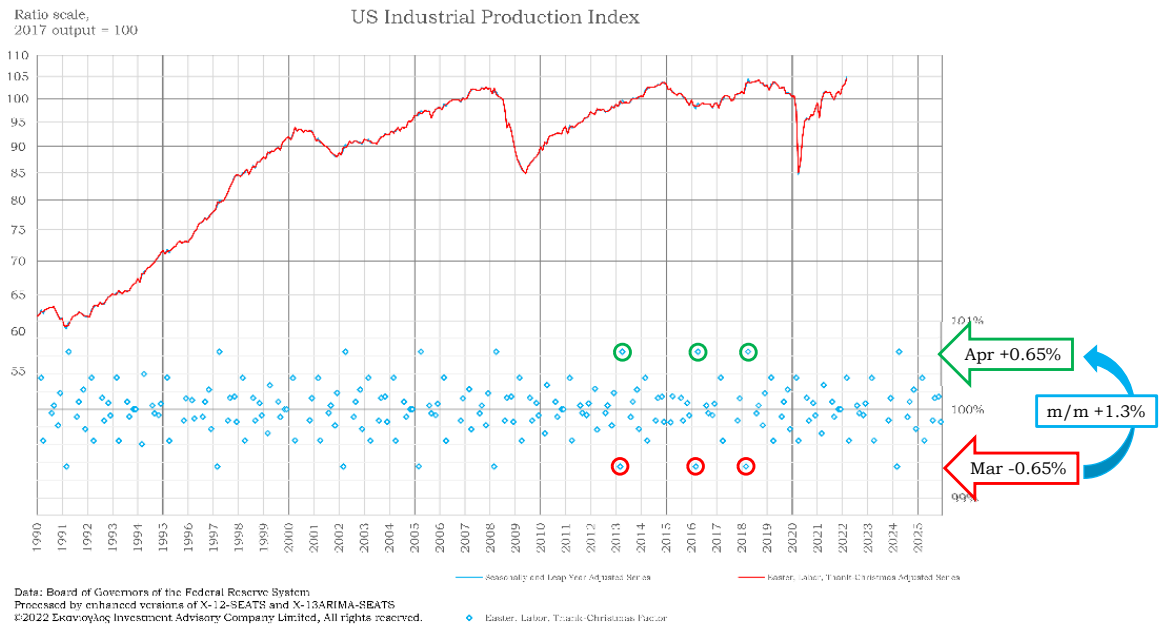
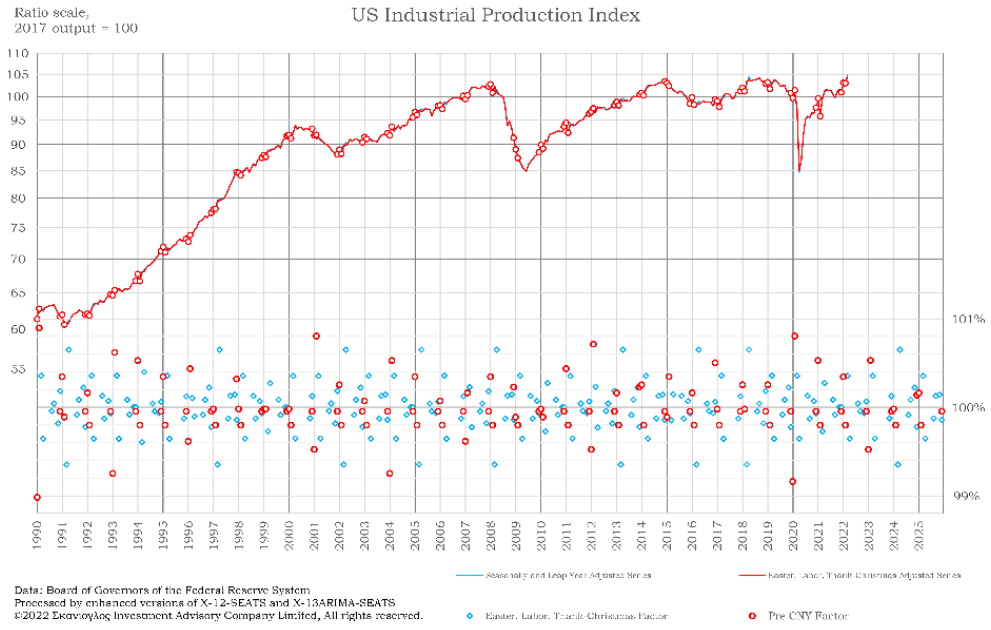
Let the scale be changed for these holiday factors to compare with Chinese New Year factors. Because from earlier this century, industrial productions of many advanced countries often show fluctuations on January and February.

1. Detection of holiday effects (2)



Easter factor is the largest among these three holiday factors. Years like 2013, 16, 18, March productions were down by -0.65% and April productions were up by +0.65% as holiday effect. Therefore, month on month basis, holiday factor pushed up April monthly growth by 1.3%.

1. Detection of holiday effects (2)



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

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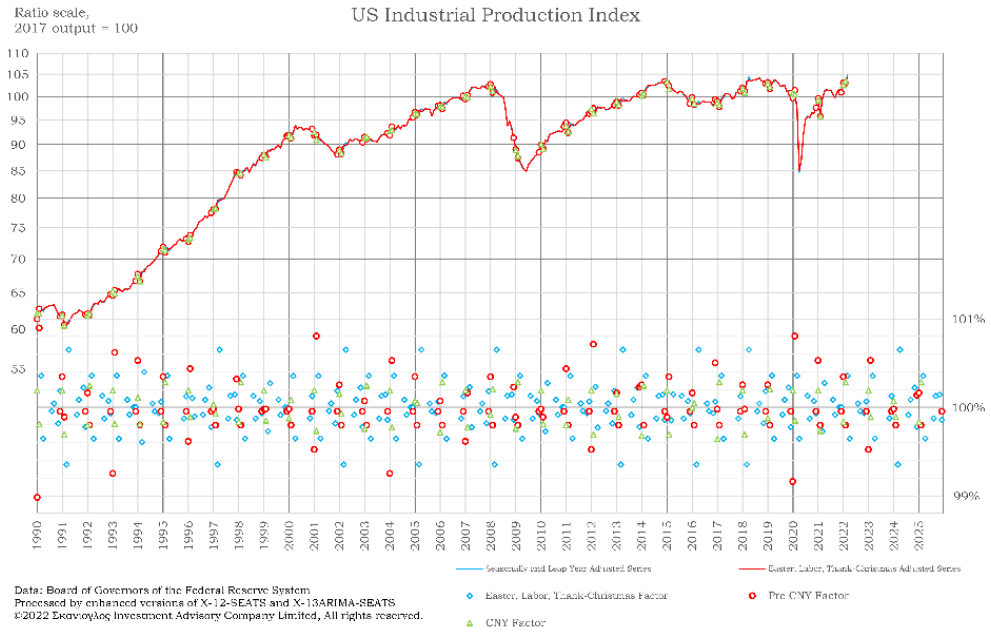
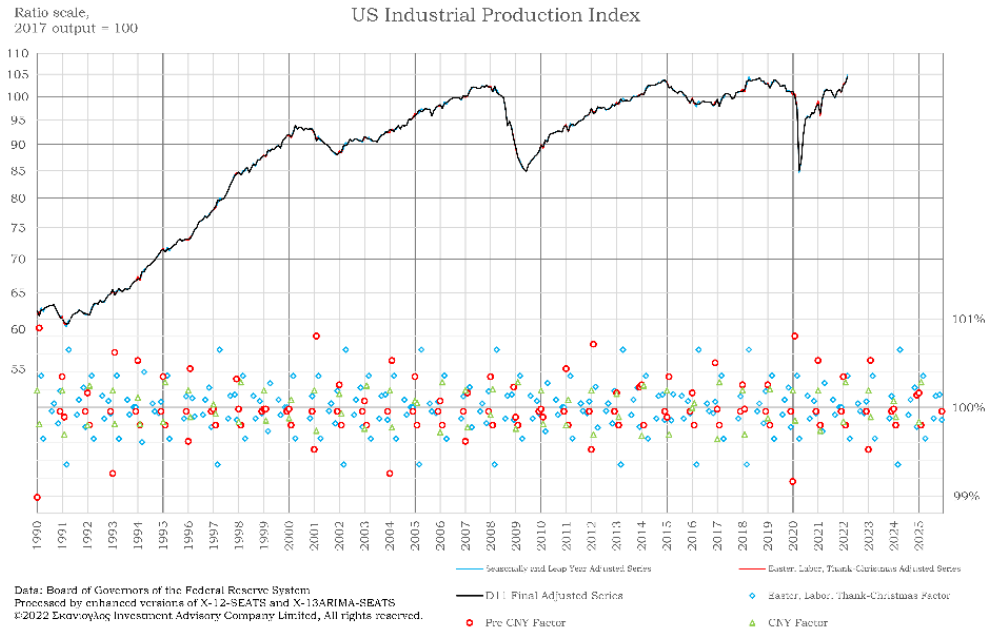
Chinese New Year effect is divided into two factors. One is Pre Chinese New Year factor, to trace surge of production prior to the holiday.

1. Detection of holiday effects (2)



Two is Chinese New Year factor, to trace low production period amid and after the holiday.

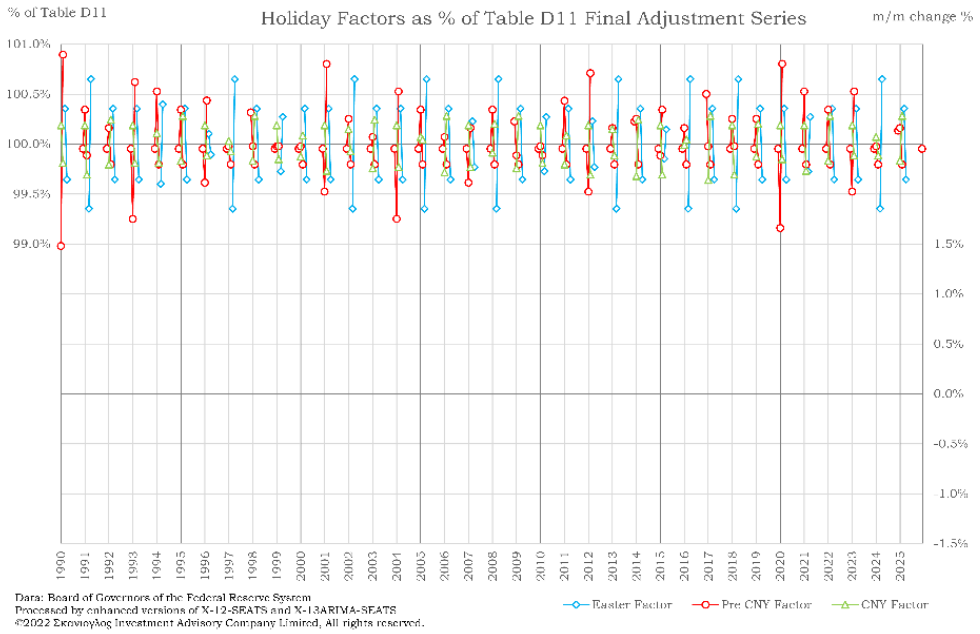
1. Detection of holiday effects (2)



 16

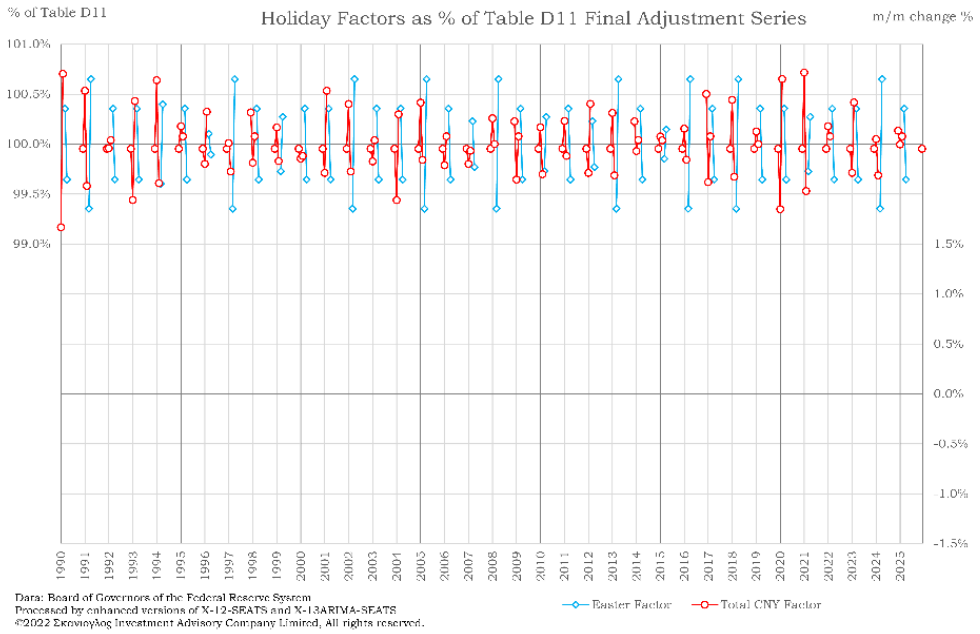
Chinese New Year factors were accepted by the AIC test of the Census Method. Magnitudes of them are not so different from the Easter, as charted in the lower part of this figure. Let us look at the lower part of this chart, holiday factors for a while.

1. Detection of holiday effects (3)



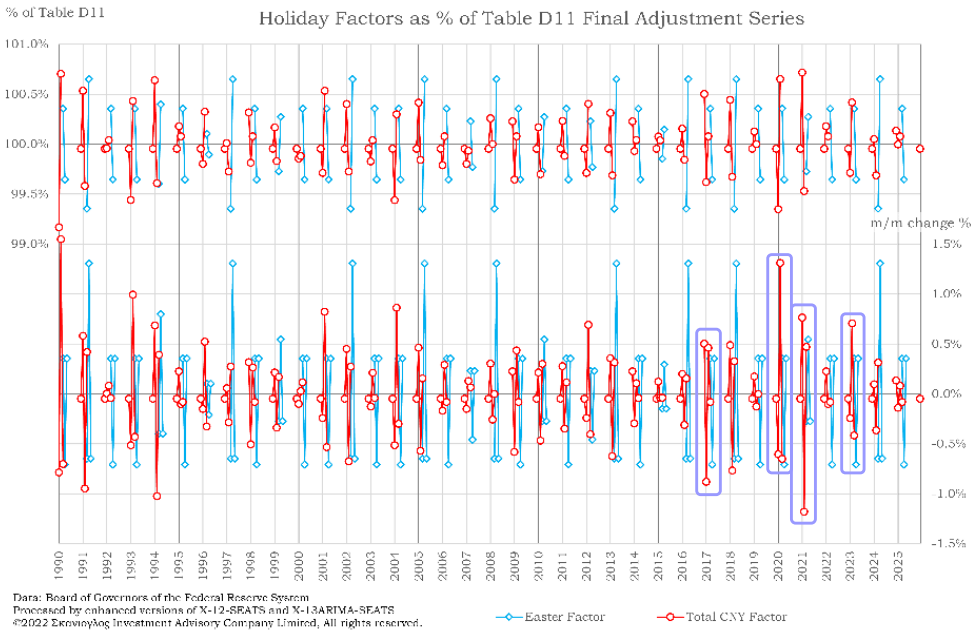
Pre Chinese New Year factor and Chinese New Year factor cross out each other. Let the product of both factors to name Total Chinese New Year factor.

1. Detection of holiday effects (3)



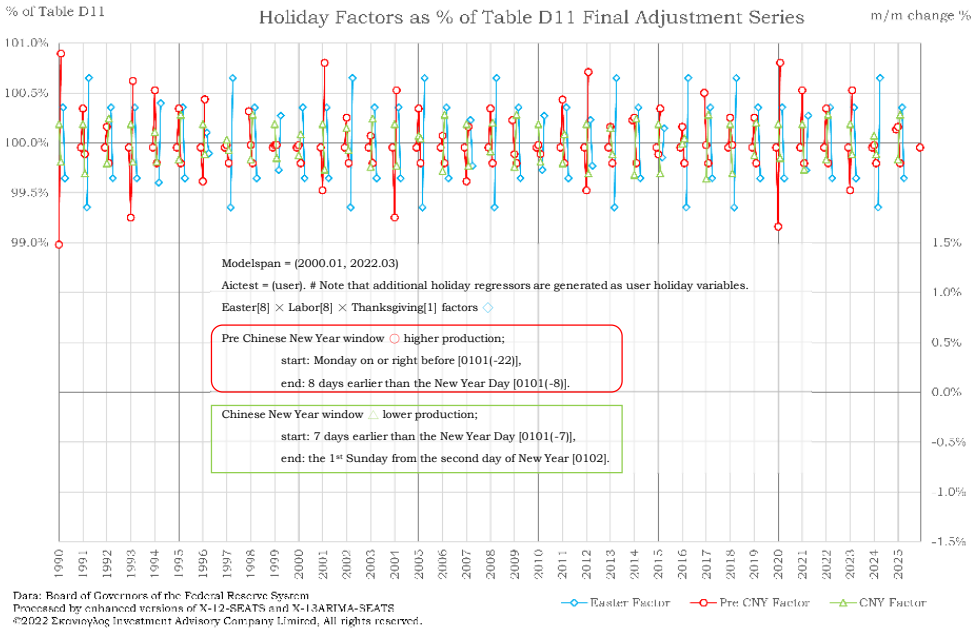
Easter factor occurs on March and April in this model. For other months, value of Easter factor is 100% which means neutral. Chinese New Year factor occurs from December to February, and other months are 100% in this model.

1. Detection of holiday effects (3)



Upper part is level of holiday factors. Lower part is month on month change of holiday factors. For the years 2017, 20, 21, and year 2023, Total Chinese New Year factor is estimated to be larger than Easter factor. For the purpose of, say, international comparison of equally adjusted series, Chinese New Year would be a candidate.

1. Detection of holiday effects (3)



Then, how the Chinese New Year factors were estimated while there are no such official holidays in the USA?

1. Detection of holiday effects (4)

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 window ○ higher production;

start: Monday on or right before [0101(-22)],

Pre holiday window, written in the rounded rectangle, starts at Monday, on or right before, the 22 days earlier than Chinese New Year.

1. Detection of holiday effects (4)

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 window ○ higher production;

start: Monday on or right before [0101(-22)],

end: 8 days earlier than the New Year Day [0101(-8)].

Pre holiday window ends at eight days earlier than the Chinese New Year.

1. Detection of holiday effects (4)

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 window ○ higher production;

start: Monday on or right before [0101(-22)],

end: 8 days earlier than the New Year Day [0101(-8)].

Chinese New Year window △ lower production;

start: 7 days earlier than the New Year Day [0101(-7)],

Holiday window, in the rectangle, starts at seven days earlier than the Chinese New Year.

1. Detection of holiday effects (4)

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 window ○ higher production;

start: Monday on or right before [0101(-22)],

end: 8 days earlier than the New Year Day [0101(-8)].

Chinese New Year window △ 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].

Holiday window ends at the first Sunday on or right after new year the second.

1. Detection of holiday effects (4)

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 window ○ higher production;
start: Monday on or right before [0101(-22)],
end: 8 days earlier than the New Year Day [0101(-8)].

Chinese New Year window △ 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].

Lower AICC than else.

These windows were selected from various windows because they had lower AICCs than other windows. How these windows were chosen?

2. Procedure

RegARIMA model. See further details for chapters 4 and 5 of the Reference Manual, especially, chapter 5, section 5.5 “Use of model selection criteria”.
https://www2.census.gov/software/x-13arima-seats/x13as/unix-linux/documentation/docx13ashtml.pdf

Use of model selection criteria is explained in the section 5.5 of the reference manual.

That is the former half of the story, holiday effects which dates are not public holiday. And the story continues to the latter half.

PDF version of this slide, with references, will be uploaded to our corporate website. Also, reports on development of enhanced X-13ARIMA-SEATS will be uploaded.

2. Procedure

RegARIMA model. See further details for chapters 4 and 5 of the Reference Manual, especially, chapter 5, section 5.5 “Use of model selection criteria”.
https://www2.census.gov/software/x-13arima-seats/x13as/unix-linux/documentation/docx13ashtml.pdf

1. Fix other things being equal.
   1.1. to AICC comparable
   1.1.1. Fix outlier regressors. Do not use `outlier{ }`.
   1.1.2. Fix differencing operators like `arima{ model=(011)(011)12 }`.
   1.2. Fix other regressors (td, Easter, etc.) which usually applied.

The story continues. Procedure of detection can be divided into three steps. One. Outliers, differencing operators, and other regressors which usually applied should be fixed.

2. Procedure

RegARIMA model. See further details for chapters 4 and 5 of the Reference Manual, especially, chapter 5, section 5.5 “Use of model selection criteria”.
https://www2.census.gov/software/x-13arima-seats/x13as/unix-linux/documentation/docx13ashtml.pdf

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   1.1.1. Fix outlier regressors. Do not use `outlier{ }`.
   1.1.2. Fix differencing operators like `arima{ model=(011)(011)12 }`.
   1.2. Fix other regressors (td, Easter, etc.) which usually applied.
2. Compare AICCs of holiday regressors and choose one.

Two. Compare various holiday regressors and choose one.

2. Procedure

RegARIMA model. See further details for chapters 4 and 5 of the Reference Manual, especially, chapter 5, section 5.5 “Use of model selection criteria”.
https://www2.census.gov/software/x-13arima-seats/x13as/unix-linux/documentation/docx13ashtml.pdf

1. Fix other things being equal.
   1.1. to AICC comparable
   1.1.1. Fix outlier regressors. Do not use `outlier{ }`.
   1.1.2. Fix differencing operators like `arima{ model=(011)(011)12 }`.
   1.2. Fix other regressors (td, Easter, etc.) which usually applied.
2. Compare AICCs of holiday regressors and choose one.
3. Apply chosen holiday regressors and estimate with automodel or other automatic selections if needed.

Three. Apply chosen holiday regressors and estimate with automatic selections if needed.

3. Holiday windows

Holiday windows are the dates which are assumed to be affected by the holiday.

Ex. 1, begins at the New Year's Eve, ends at the 3rd of the New Year.
Ex. 2, begins at the 3rd Monday prior to the day before New Year's Eve, ends at the day before New Year's Eve.

Holiday windows are the dates which are assumed to be affected by the holiday. For example one. A window begins at the New Year's Eve, and ends at the third of the New Year. Example two. A window begins at the third Monday prior to the day before New Year's Eve, and ends at the day before New Year's Eve.

3. Holiday windows

Holiday windows are the dates which are assumed to be affected by the holiday.
Holiday windows are not necessarily equal to public holiday.

- Public holiday dates are often rejected by the AIC tests.
- Chinese New Year effects can be observed for the countries without public holidays.

For such cases;

Holiday windows are not necessarily equal to public holiday. Public holiday dates are often rejected by the AIC tests. Chinese New Year effects can be observed for the countries without public holidays.

3. Holiday windows

Holiday windows are the dates which are assumed to be affected by the holiday.

Detection of unknown holiday windows;
three regressor model: $y_t = \beta' X_t + \sum_{i=1}^{3} \alpha_i H_i(\tau, t) + z_t$,

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

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

$\alpha_i H_i(\tau, t)$, holiday regressors of the period t, which month in Gregorian calendar is τ,

pre-holiday $H_1(\tau, t) = N_1(\tau, t)/N_1(\tau)$, phase of higher production prior to the holiday,

For the detection of unknown holiday windows, three-regressor model may be applicable. The first of three regressors is for pre-holiday, the phase of higher production prior to the holiday.

3. Holiday windows

Holiday windows are the dates which are assumed to be affected by the holiday.

Detection of unknown holiday windows;
three regressor model: $y_t = \beta' X_t + \sum_{i=1}^{3} \alpha_i H_i(\tau, t) + z_t$,

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

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

$\alpha_i H_i(\tau, t)$, holiday regressors of the period t, which month in Gregorian calendar is τ,

pre-holiday $H_1(\tau, t) = N_1(\tau, t)/N_1(\tau)$, phase of higher production prior to the holiday,

peri-holiday $H_2(\tau, t) = N_2(\tau, t)/N_2(\tau)$, phase of low production during the holiday,

The second of three regressors is for peri-holiday, the phase of low production during the holiday.

3. Holiday windows

Holiday windows are the dates which are assumed to be affected by the holiday.

Detection of unknown holiday windows;
three regressor model: $y_t = \beta' X_t + \sum_{i=1}^{3} \alpha_i H_i(\tau, t) + z_t$,

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

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

$\alpha_i H_i(\tau, t)$, holiday regressors of the period t, which month in Gregorian calendar is τ,

pre-holiday $H_1(\tau, t) = N_1(\tau, t)/N_1(\tau)$, phase of higher production prior to the holiday,

peri-holiday $H_2(\tau, t) = N_2(\tau, t)/N_2(\tau)$, phase of low production during the holiday,

post-holiday $H_3(\tau, t) = N_3(\tau, t)/N_3(\tau)$, phase of recovery of production after the holiday,

$N_i(\tau, t)$, number of dates within above phase in the period t, which month is τ,

$N_i(\tau)$, long-term average of $N_i(\tau, t)$ which month is τ,

and, z_t, residual to follow ARIMA process.

The third of three regressors is for post-holiday, the phase of recovery of production after the holiday.

3. Holiday windows

Or;
two regressor model: $y_t = \beta' X_t + \sum_{i=1}^{2} \alpha_i H_i(\tau, t) + z_t$,

$\alpha_i H_i(\tau, t)$, holiday regressors of the period t, which month in Gregorian calendar is τ,

pre-holiday $H_1(\tau, t) = N_1(\tau, t)/N_1(\tau)$, phase of higher production prior to the holiday,

Also, two regressor model can be applicable. The first of two regressors is for pre-holiday, the phase of higher production prior to the holiday.

3. Holiday windows

Or;
two regressor model: $y_t = \beta' X_t + \sum_{i=1}^{2} \alpha_i H_i(\tau, t) + z_t$,

$\alpha_i H_i(\tau, t)$, holiday regressors of the period t, which month in Gregorian calendar is τ,

pre-holiday $H_1(\tau, t) = N_1(\tau, t)/N_1(\tau)$, phase of higher production prior to the holiday,

holiday $H_2(\tau, t) = N_2(\tau, t)/N_2(\tau)$, phase of low production and recovery after the holiday.

The second of two regressors is for holiday, the phase of low production and recovery after the holiday.

3. Holiday windows

Or;
two regressor model: $y_t = \beta' X_t + \sum_{i=1}^{2} \alpha_i H_i(\tau, t) + z_t$,

$\alpha_i H_i(\tau, t)$, holiday regressors of the period t, which month in Gregorian calendar is τ,

pre-holiday $H_1(\tau, t) = N_1(\tau, t)/N_1(\tau)$, phase of high production prior to the holiday,

holiday $H_2(\tau, t) = N_2(\tau, t)/N_2(\tau)$, phase of low production and recovery after the holiday.

Or;
one regressor model: $y_t = \beta' X_t + \alpha H(\tau, t) + z_t$,

$\alpha H(\tau, t)$, holiday regressor of the period t, which month in Gregorian calendar is τ,

holiday $H(\tau, t) = N(\tau, t)/N(\tau)$.

Of course, one regressor model may be applicable.

3. Holiday windows

Or;
two regressor model: $y_t = \beta' X_t + \sum_{i=1}^{2} \alpha_i H_i(\tau, t) + z_t$,

$\alpha_i H_i(\tau, t)$, holiday regressors of the period t, which month in Gregorian calendar is τ,

pre-holiday $H_1(\tau, t) = N_1(\tau, t)/N_1(\tau)$, phase of high production prior to the holiday,

holiday $H_2(\tau, t) = N_2(\tau, t)/N_2(\tau)$, phase of low production and recovery after the holiday.

Or;
one regressor model: $y_t = \beta' X_t + \alpha H(\tau, t) + z_t$,

$\alpha H(\tau, t)$, holiday regressor of the period t, which month in Gregorian calendar is τ,

holiday $H(\tau, t) = N(\tau, t)/N(\tau)$.

Holiday window to monthly regressor (or regressor of any given seasonal period longer than daily)
⇨ to be built into the enhanced X-13ARIMA-SEATS.

Then, holiday window would be changed to holiday regressor by the program.

4. Border of holiday windows

- Compare AICCs of holiday regressors and choose one

Let me explain about the procedure which has been applied. The first to fix is, border of holiday windows with a 7-day pre-holiday window and a 7-day holiday window.

4. Border of holiday windows

- Compare AICCs of holiday regressors and choose one
  - Find border between pre-holiday and holiday window.

Compare AICCs of various borders and, find the lowest. Of course the windows can be overlapped. But I prefer to separate the holiday periods.

4. Border of holiday windows

- Compare AICCs of holiday regressors and choose one
  - Find border between pre-holiday and post-holiday windows.
  - Find start of pre-holiday window and end of holiday window.

Next, find start of pre-holiday window and end of holiday window.

4. Border of holiday windows

- Compare AICCs of holiday regressors and choose one
  - Find border between pre-holiday and post-holiday windows.
  - Find start of pre-holiday window and end of holiday window.

1. Public holiday

$AICC_3$; 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.

Border of windows. If there exists public holiday, test three window models. Let the peri-holiday to be the public holiday dates.

4. Border of holiday windows

- Compare AICCs of holiday regressors and choose one
  - Find border between pre-holiday and post-holiday windows.
  - Find start of pre-holiday window and end of holiday window.

1. Public holiday

$AICC_3$; 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: [$d2_{y,21}$ $d2_{y,22}$]

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

And two window models. Let the beginning of holiday window as beginning of public holiday, or the weekend right before.

4. Border of holiday windows

- Compare AICCs of holiday regressors and choose one
  - Find border between pre-holiday and post-holiday windows.
  - Find start of pre-holiday window and end of holiday window.

1. Public holiday

$AICC_3$; 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: [$d2_{y,21}$ $d2_{y,22}$]

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

Three windows or two windows? After all, compare $AICC_3$ and $AICC_2$ of best models.

After fixing the beginning of pre-holiday window and the end of holiday window, compare the AICCs of best models and choose one.

4. Border of holiday windows

- Compare AICCs of holiday regressors and choose one
  - Find border between pre-holiday and post-holiday windows.
  - Find start of pre-holiday window and end of holiday window.

1. Public holiday

$AICC_3$; 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: [$d2_{y,21}$ $d2_{y,22}$]

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

Three windows or two windows? After all, compare $AICC_3$ and $AICC_2$ of best models.

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.

If there are no public holidays and the series is affected via merchandise trade, border of holiday windows is unknown. Experimentally fix pre-holiday window and holiday window to 7 days. Move the border from several months earlier to several months later. Then, choose the lowest AICC as the border.

4. Border of holiday windows

- Compare AICCs of holiday regressors and choose one
  - Find border between pre-holiday and post-holiday windows.
  - Find start of pre-holiday window and end of holiday window.

1. Public holiday

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

Hence, the border of holiday window is fixed.

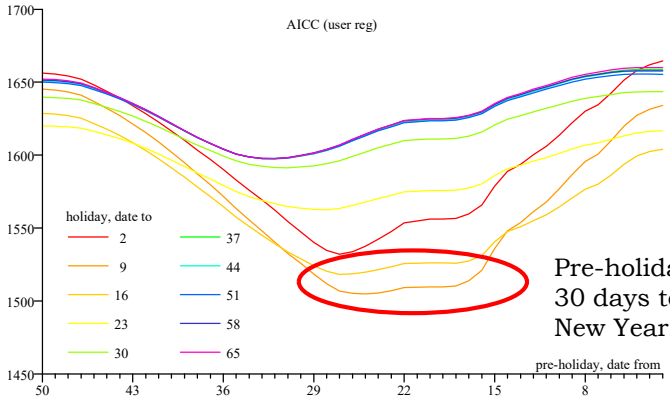
5. Start and end of holiday windows

- 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.

Then, fix the start of pre-holiday window and end of holiday window, you can get regressors. This chart and coming charts trace the procedure to find holiday windows of the lowest AICC for industrial production of Taiwan.

6. Border of holiday windows again

- Find sta[illegible] holiday window.

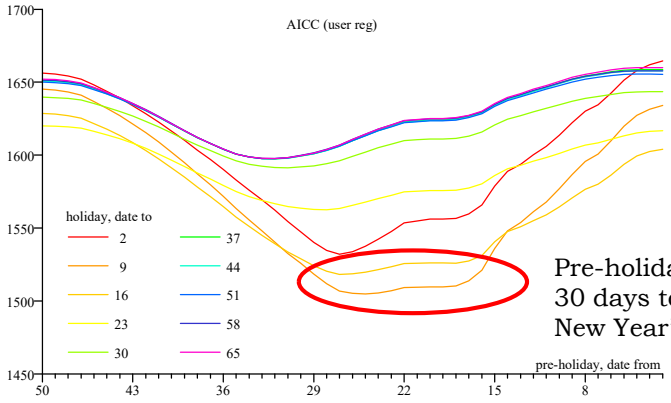
The Day before New Year's Eve

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.

This case, end of pre-holiday window was fixed as the day before New Year's Eve. Start of holiday window was also fixed as New Year's Eve.

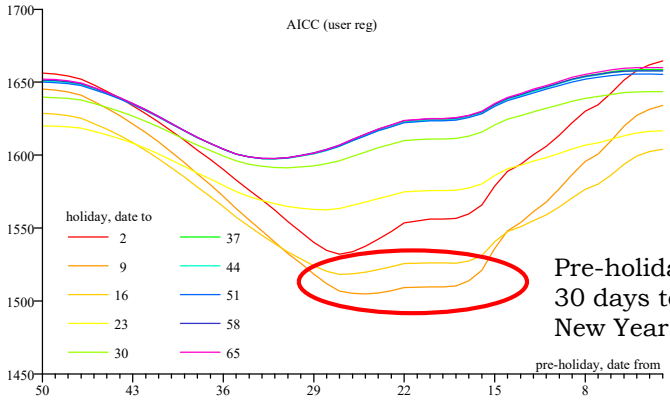
7. Start of pre-holiday window

- 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.



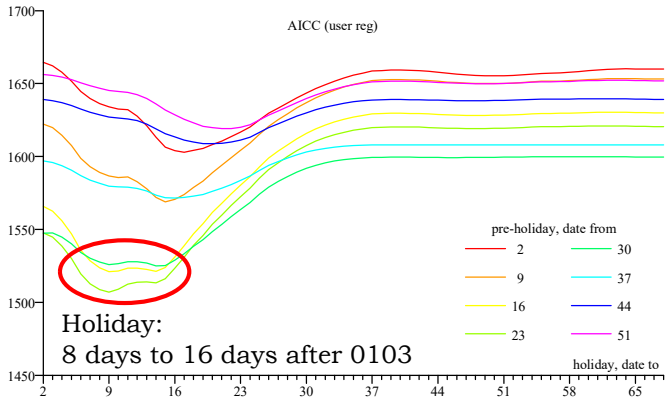
Pre-holiday:
30 days to 15 days preceding to New Year's Eve.

Comparing various start of pre-holiday window, lower AICC's were seen among pre-holiday window, which start from, 30 days to 15 days preceding to the New Year's Eve.

8. End of holiday window

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

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

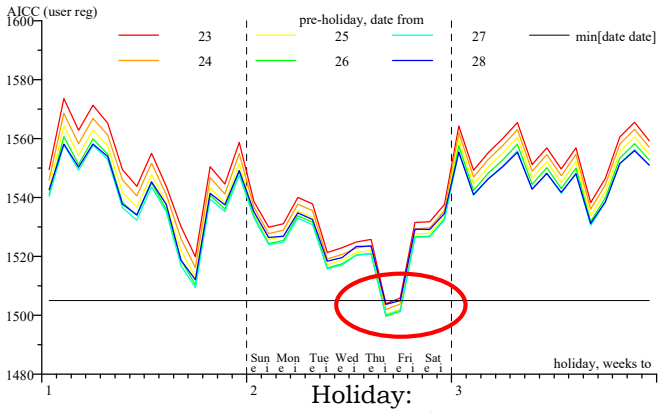


End of holiday window. Lower AICC's were found among, 8 days to 16 days after the third day of the New Year.

9. End of holiday window in day-of-week

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

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



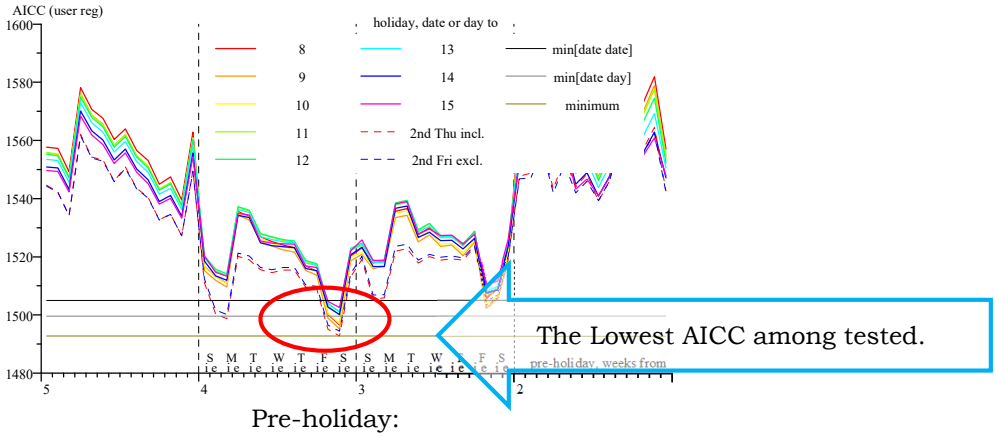
Holiday:
To the 2nd Thursday after 0103

End of holiday window continues. End of windows defined by day-of-week had lower AICC's. Among them, end at the second Thursday after New Year the third was selected.

10.Start of pre-holiday window in day-of-week

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

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



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

Start of pre-holiday windows were as well. From the fourth Saturday preceding to the New Year's Eve had the lowest AICC.

2. Procedure

RegARIMA model. See further details for chapters 4 and 5 of the Reference Manual, especially, chapter 5, section 5.5 “Use of model selection criteria”.
https://www2.census.gov/software/x-13arima-seats/x13as/unix-linux/documentation/docx13ashtml.pdf

1. Fix other things being equal.
   1.1. to AICC comparable
   1.1.1. Fix outlier regressors. Do not use `outlier{ }`.
   1.1.2. Fix differencing operators like `arima{ model=(011)(011)12 }`.
   1.2. Fix other regressors (td, Easter, etc.) which usually applied.
2. Compare AICCs of holiday regressors and choose one. Stored in the file METAFILE.SLG.
3. Apply chosen holiday regressors and estimate with automodel or other automatic selections if needed.

Let’s back to the procedure section. Assume all the holiday regressors are tested. Also assume key statistics including AICC’s, regressed parameters, and chosen models are stored into one file named meta file dot SLG. Choose one model from the low AICC group within this file.

2. Procedure

RegARIMA model. See further details for chapters 4 and 5 of the Reference Manual, especially, chapter 5, section 5.5 “Use of model selection criteria”.
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Then, apply chosen holiday regressors and estimate with automatic selections if needed.

2. Procedure

RegARIMA model. See further details for chapters 4 and 5 of the Reference Manual, especially, chapter 5, section 5.5 “Use of model selection criteria”.
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Usually several 1000s of regressors.

Note that above process needs to compare several thousands of regressors for each holiday.

2. Procedure

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Usually several 1000s of regressors.

Detection of "the World's major moving holiday factors": several hours for each series.

Detection of the World's major moving holiday factors would need several hour calculation for each series.

2. Procedure

RegARIMA model. See further details for chapters 4 and 5 of the Reference Manual, especially, chapter 5, section 5.5 “Use of model selection criteria”.
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Usually several 1000s of regressors.

Detection of “the World’s major moving holiday factors”: several hours for each series.
✓ **Efficient processes are welcome.**

Therefore, efficient processes are welcome.

2. Procedure

RegARIMA model. See further details for chapters 4 and 5 of the Reference Manual, especially, chapter 5, section 5.5 "Use of model selection criteria".
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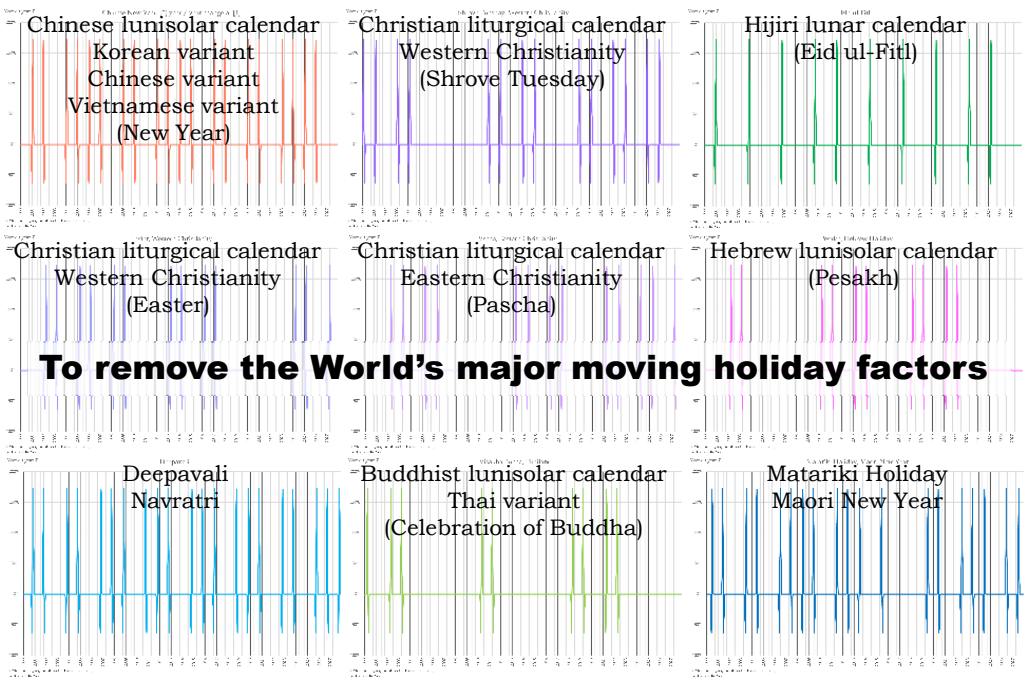
Usually several 1000s of regressors.

Detection of "the World's major moving holiday factors": several hours for each series.

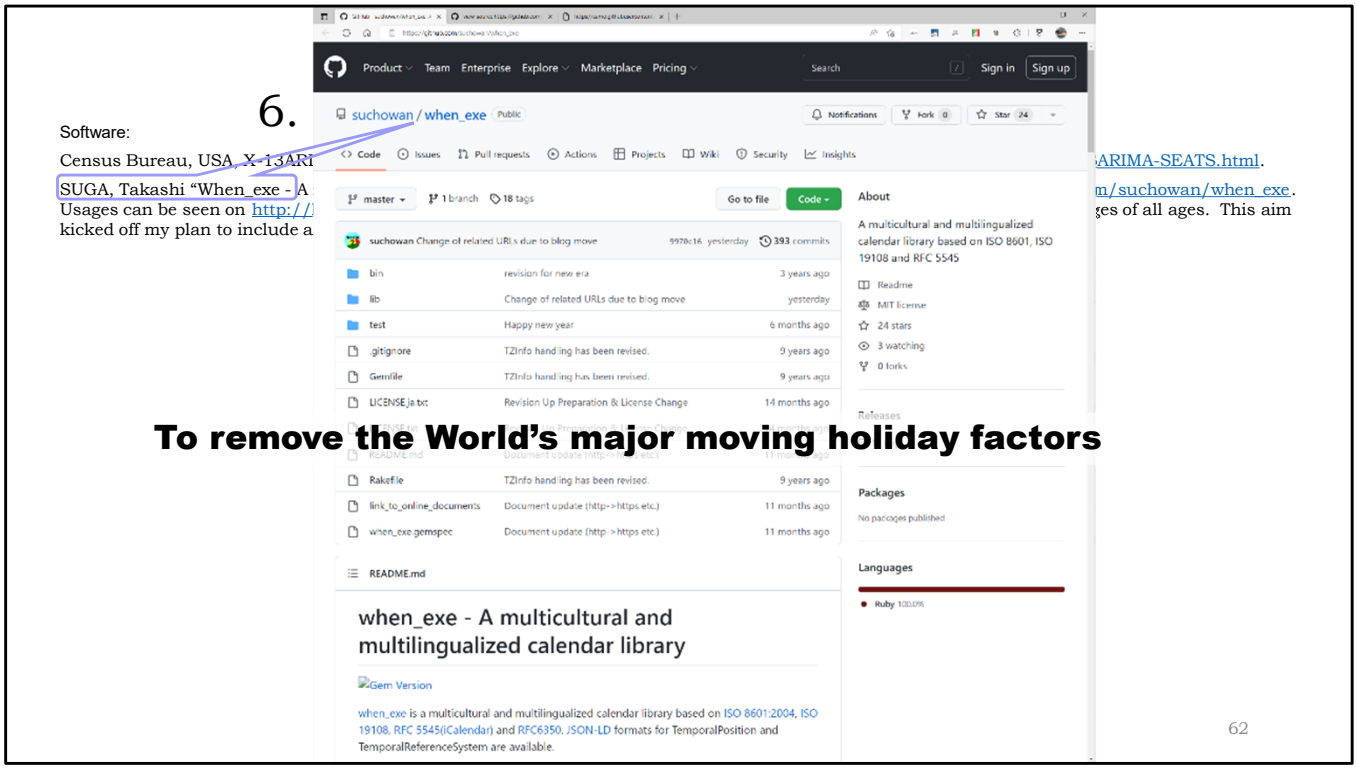
✓ **Efficient processes are welcome.**

✓ **Automated selection is needed.**

I will automate above process for easier detections.



Data of the following calendars and holidays have been prepared to build in X-13ARIMA-SEATS. Very roughly from east to west; Matariki holiday of Maori New Year: Korean, Chinese, and Vietnamese variants of Chinese type lunisolar calendar: Thai variant of Buddhist calendar: Deepavali and other holidays of Hindu calendar: Hijiri lunar calendar: Hebrew lunisolar calendar: Liturgical calendars of Eastern and Western Christianity.



There remains lots of stories about enhancement of the Census Method. Mr. Takashi Suga began to develop When_exe in the mid 1990s. When_exe is a library of all the calendars which have ever appeared, planned, or imagined in the history. This is the source of my idea for a module to remove the World's major moving holiday factors.

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.

Links to articles, formulae,

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 is thankful that this site allowed to retrieve 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. At least, 28,872 times.

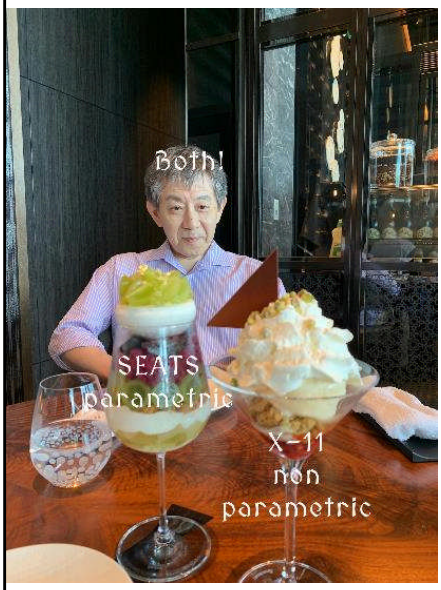
The Gregorian Calendar was introduced to set proper dates of Easter (*ad rectam Paschalis festi*). In the today's title "Inter Gravissimas", Pope Gregory XIII stated as three appropriate that

- 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

And important sites will be stored in the pdf version of this slide.



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and development reports
will be stored here.

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Inquiries, suggestions, or questions are welcome (^_^)!