# Define calendars

Demetra+ provides an easy tool for creating calendar regression variables using the Calendar module. The calendar regression variable can include trading or working day variables as well as country or sector specific holidays. These holidays may occur at fixed or moving dates.

If the national calendar doesn't include extraordinarily complex moving holidays, you can use the pre-defined options of Demetra+ for modelling it. If it includes several moving holidays that start or were abolished during the time series, you could set a validity period for the holidays or prepare the national calendar in a format of an external user-defined variable, i.e. as a time series to be imported to Demetra+. In the next section we'll discuss first the pre-defined options.

In Demetra+, TRAMO/SEATS and X-12-ARIMA automatically create appropriate trading day, working day, leap year and Easter regression variables depending on the chosen specifications. However, the user may need to change the automatic options for:

- Modifying the trading day, working day and leap year regression variables to match the national holidays that differ from the pre-specified options of Demetra+.

- Chaining two calendars for two different time periods.

- Combining two or more calendar variables using proper weights.

- Importing user-regression variables including holidays with changing frequency, duration, start and end dates.

Demetra+ offers the following pre-defined regression variables:

- Six variables to test for trading day effects: *(N Mondays) − (N Sundays), (N Tuesdays) − (N Sundays),…, (N Saturdays) − (N Sundays)* where N means the number of.

- One variable to test the effect of weekdays versus weekend days.[9]

- Leap year variable.

- Easter variable.

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[9] The variable may be defined as *(N(M,T,W,Th, F))-(N(Sat,Sun)×5/2* (Gómez and Maravall, 1996)

The leap year variable measures the effect of differences in the number of days in Februaries. This variable equals zero for all months different from February. In February, it takes the value -0.25 if the February comprises 28 days and -0.75 for 29 days.

TRAMO/SEATS assumes that the Easter effect lasts for six days. For X-12-ARIMA, the RSA5(c) specification tests for three different lengths of the Easter effect and selects the optimal length from 1, 8 or 15 days. The user may also define the duration. The variable includes a zero for all months different from March and April since Easter occurs in March or in April (Gómez and Maravall, 1996).

You may define the calendars from the Main menu, **Workspace/Edit/Calendars**. This module creates new calendar regression variables which incorporate both country-specific holidays and default calendar regression variables.

The Calendar module offers a possibility to define National Calendars, Composite Calendars or Chained Calendars (image 38).

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**Image 38**
**Different calendar options available in Demetra+**



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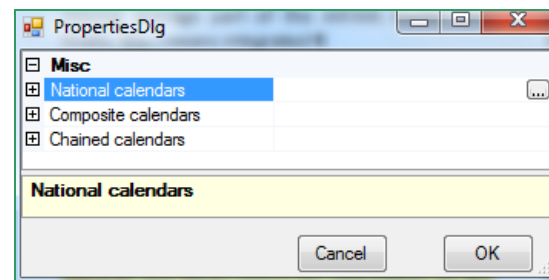
To add a new calendar, activate the row National calendars and c**lick on the** [...] **button** and **Add**. The options for defining the national calendars will appear. These include Pre-specified holidays, Easter holidays and Fixed days (image 39).

## Pre-specified holidays

Demetra+ includes 13 regression variables for modelling pre-specified holidays based on the most common European holidays. To select national holidays, activate the row **Pre-specified holidays** and **click on the** [...] **button** next to it (image 39). Once you add a holiday from the list, you may also add the offset and the validity period. We'll explain these terms in the following example.

**Image 39**
**Options for national calendars**
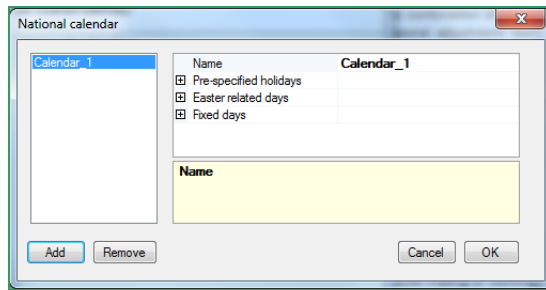


As an example, the following holidays could be defined for Belgium (table 6). They include nine holidays available under the pre-specified holidays. The National day, Assumption of Mary and Armistice Day are not available under the pre-specified holidays.

Demetra+ aggregates all the holidays added by the user into the regression variable. In table 7 you can find the definitions of the pre-specified holidays available in Demetra+.

## Easter-related holidays

The duration and the exact timing of Easter and Easter-related days may vary in different countries. The Easter-related days include Pentecost and Whit Monday. Also, the number of holidays around Easter may vary. Therefore, Demetra+ provides a feature called Easter-related days for the user to design exactly the country-specific **Easter-related holidays**. When you **click on the** ... **button** next to the Easter-related days, you can **Add** the related holidays (image 40). The relationship between Easter and the related days is determined by offset.

**Table 6**
**List of holidays in the example of Belgium**

| Holiday |
| --- |
| New Year's Day |
| Easter |
| Easter Monday |
| Labour Day |
| Ascension |
| Pentecost |
| Pentecost Monday (WhitMonday) |
| National day |
| Assumption of Mary |
| All Saints |
| Armistice Day |
| Christmas |

**Image 40**
**Selecting Easter-related days**
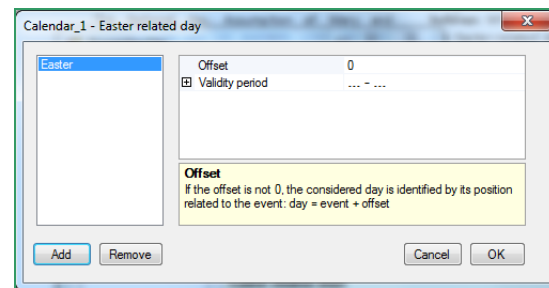


As the Easter-related holidays vary between countries, let's assume that Pentecost and Whit Monday wouldn't be available in the pre-specified

**Table 7**
**Definitions of the pre-specified holidays in Demetra+**

| Holidays | General Definitions |
| --- | --- |
| New Year | falls on 1 January |
| AshWednesday | a moving holiday, occurring 46 days before Easter |
| Easter | a moving holiday; it varies between 22 March and 25 April depending on offset time |
| MaundyThursday | falls on the Thursday before Easter. It is the fifth day of Holy Week, and is preceded by Holy Wednesday and followed by Good Friday |
| GoodFriday | refers to the Friday in Easter week |
| EasterMonday | the day after Easter Sunday |
| Ascension Day | traditionally celebrated on a Thursday, the 40th day from Easter day |
| Pentecost | celebrated seven weeks (50 days) after Easter Sunday, Pentecost falls on the tenth day after Ascension Thursday |
| WhitMonday | the holiday celebrated the day after Pentecost, a movable feast in the Christian calendar. It is movable because it is determined by the date of Easter |
| MayDay | on 1 May is a spring festival and usually a public holiday |
| Halloween | an annual holiday observed on 31 October |
| AllSaintsDay | a solemnity celebrated on 1 November by parts of Western Christianity, and on the first Sunday after Pentecost in Eastern Christianity |
| ThanksGiving | currently, in Canada, Thanksgiving is celebrated on the second Monday of October and in the United States, it is celebrated on the fourth Thursday of November |
| Christmas Day | a holiday observed on 25 December in most countries |

holidays. These holidays occur as defined in table 7.

The calendar regression variable for Belgium was created in the previous example of pre-specified holidays. For exercise, Pentecost and Whit Monday will be entered as Easter-related days. Therefore, you need to remove them from the selected pre-specified holidays. The number of pre-specified holidays for Belgium is now seven.

**Click on the** [...] **button** next to the **Easter-related days**. Since the Pentecost holiday occurs 50 days after Easter the offset is set to 50. If it were to occur 50 days before Easter the user would enter 50 with a minus (-) sign. For Whit Monday, the offset value will be 51 since the holiday is celebrated one day after Pentecost.

## Fixed holidays

Countries usually also have fixed holidays in their national holiday calendar. These holidays always occur on the same date. You may add these exact dates by **clicking on the** [...] **button** next to the **Fixed days** and **enter the dates**. Sometimes the fixed holidays may occur during the weekend and sometimes during the week. This information can't be given to Demetra+ by using the currently available tools for setting fixed holidays.

The National day, Assumption of Mary and Armistice Day are not available for the pre-specified holidays, but they occur on fixed dates every year (table 8) and can be added as fixed holidays.

**Table 8**
**Fixed holidays in the Belgian example**

| Holiday | Date |
|---|---|
| National holiday | July 21 |
| Assumption of Mary | August 15 |
| Armistice Day | November 11 |

The resulting full holiday calendar for Belgium, used in this example, is illustrated in image 41. It includes seven pre-specified holidays, two Easter-related holidays and three fixed dates that repeat each year.

**Image 41**
**The example holiday calendar for Belgium**
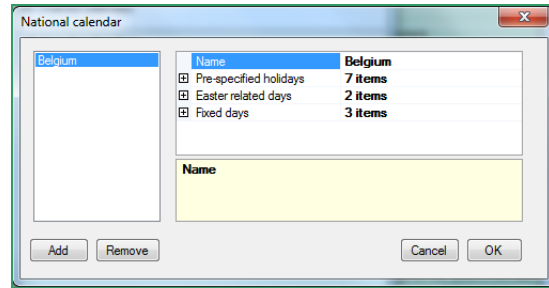


## Composite calendars and chained calendars

Demetra+ offers an option to define a composite calendar. Sometimes it could be useful, e.g. for preparing a calendar for the aggregate industrial production index of the EU-countries. With this application, the users can combine the calendar regression variables previously created by defining appropriate weights for each calendar.

On a rare occasion, the user of Demetra+ may need to chain two different calendar regression variables. This request may arise for a holiday being removed which existed before a certain date. You can chain calendar regression variables by selecting the calendars and a break date.

After selecting **Chained calendar** instead of a National calendar (as seen earlier in image 38), **click on the** [...] **button** next to the **Chained calendars**, and you can **Add** the required calendars and the break date. You should first add the calendar to be used in the first part of the chained regression variable.

## Viewing the calendar regression variables

Demetra+ presents the calendar regression variable created for Belgium by **a double click on the calendar** called "Belgium" on the *Workspace* panel. Image 42 displays the regression variable. The upper-left panel, Misc, displays the properties of the calendar regression variable. The upper-right panel presents the selected regression variable graphically.

The Misc panel allows the user to access the frequency of the regression variable, length in years, start date and variable type. The user can transform the regression variable: the option None of the variable type leads to Demetra+ applying only the leap year variable. The option Trading days refers to the six trading day variables and the leap year variable.

**Image 42**
**Viewing the calendar regression variables in Demetra+**
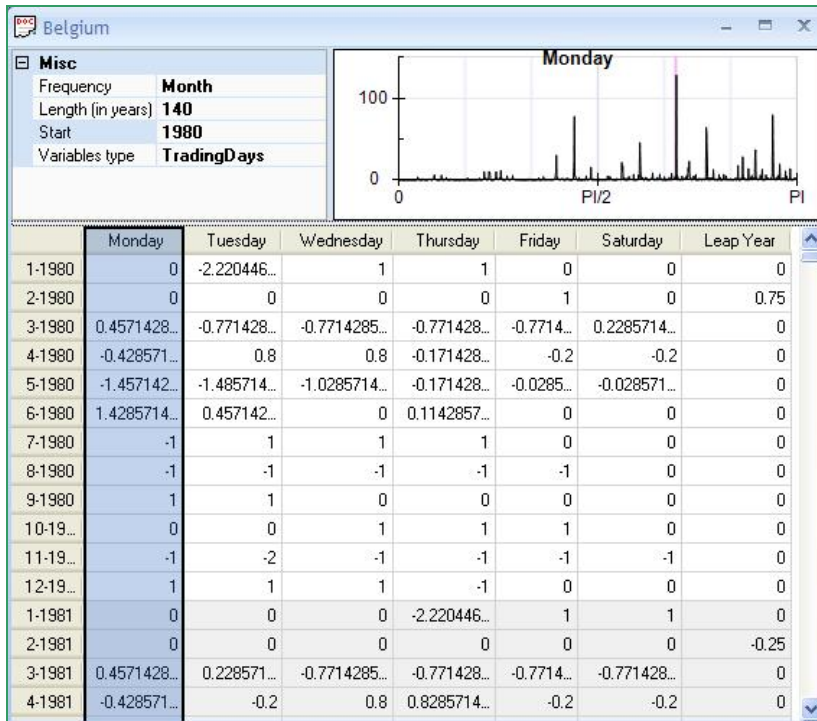


The last option Working days represents the calendar regression variable which models the difference of activity between the weekend and the weekdays and the leap year variable (image 42). The regression variables generated can be copied by drag and drop into Excel.

## External user-defined variables

The user may want to add specific calendar regression variables by defining them outside of Demetra+. Some moving holidays such as Ramadan or the Feast of Sacrifice may require using an external user-defined variable.

To do this, you could prepare the regression variables in Excel and import them to Demetra+ as a user-defined variable. This section shows how to create such an external variable.

First, the dates of Ramadan and the Feast of Sacrifice should be determined day-by-day for a specific length. In this example, the required length is from 1 January 1974 to 31 December 2015.

Table 9 displays the design of the required Excel file. The columns from A to F represent the official holidays in Turkey. Saturdays and Sundays are also listed in the file to see when they coincide with the dates of Ramadan or the Feast of Sacrifice.

For each moving holiday value 1 is given when it occurs on the specific date. This is measured in two ways: first for each time the holiday occurs excluding Saturdays, Sundays and official holidays, and second for each time the holiday occurs excluding Sundays and official holidays.

This list is then constructed for the required period of time for which the regression variable is needed.

**Table 9**
**Design of an Excel file for compiling an external calendar regression variable**

| Date | Sacrifice | Ramadan | New Year | 23 April | 1May | 19 May | 30 Agu | 29 Oct | Saturday | Sunday | Sacrifice=1 ; otherwise=0 (Excl. Sat, Sun and official holidays) | Sacrifice=1 ; otherwise=0 (Excl. Sun and official holidays) | Ramadan=1 ; otherwise=0 (Excl. Sat, Sun and official holidays) | Ramadan=1 ; otherwise=0 (Excl. Sun and official holidays) |
| | | | A | B | C | D | E | F | | | G | H | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Jan 1974 Tue | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 Jan 1974 Wed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 Jan 1974 Thu | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 Jan 1974 Fri | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 5 Jan 1974 Sat | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| 6 Jan 1974 Sun | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 7 Jan 1974 Mon | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 8 Jan 1974 Tue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| 26 Dec 2015 Sat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 27 Dec 2015 Sun | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 28 Dec 2015 Mon | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 29 Dec 2015 Tue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 Dec 2015 Wed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 Dec 2015 Thu | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

As shown in table 10, the second step is to aggregate the results for each month.

**Table 10**
**Aggregated monthly values**

| Date | Sacrifice Holidays (Excl. Sat, Sun and official holidays) | Ramadan Holidays (Excl. Sat, Sun and official holidays) | Sacrifice Holidays (Excl. Sun and official holidays) | Ramadan Holidays (Excl. Sun and official holidays) |
|---|---|---|---|---|
| Jan.74 | 2 | 0 | 3 | 0 |
| Feb.74 | 0 | 0 | 0 | 0 |
| Mar.74 | 0 | 0 | 0 | 0 |
| Apr.74 | 0 | 0 | 0 | 0 |
| May.74 | 0 | 0 | 0 | 0 |
| Jun.74 | 0 | 0 | 0 | 0 |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| Jul.15 | 0 | 1 | 0 | 2 |
| Agu.15 | 0 | 0 | 0 | 0 |
| Sep.15 | 3 | 0 | 4 | 0 |
| Oct.15 | 0 | 0 | 0 | 0 |
| Nov.15 | 0 | 0 | 0 | 0 |
| Dec.15 | 0 | 0 | 0 | 0 |

The third step is to extract the variables from the averages of each month (table 11). Demetra+ assumes that a user-defined regression variable is appropriately centered, i.e. the mean of each user-defined regression variable is subtracted from the means for each calendar period. One has to be careful with the centered regression variable, as changes in the number of public holidays will influence the monthly average for the whole time span.

The calendar variable should be centered, first, not to cause any level effect on the series. Second, the monthly average should be extracted from the calendar variable since the calendar variable may contain seasonality. The calendar variable should measure only calendar effects, not seasonality.

The average value for the regression variable is calculated for each month. The user can directly deduct the sum of the Ramadan and Sacrifice holiday regression variables from the monthly average to obtain a total holiday regression variable.

**Table 11**
**Feast of Sacrifice holiday regression variable**

| Date | Sacrifice Holidays (Excl. Sat, Sun and official holidays) | Average values for 1974-2015 | Sacrifice Regressor (Excl. Sat, Sun and official holidays) |
|---|---|---|---|
| Jan.74 | 2 | 0.2381 | **1.7619** |
| Feb.74 | 0 | 0.2143 | **-0.2143** |
| Mar.74 | 0 | 0.2143 | **-0.2143** |
| Apr.74 | 0 | 0.1905 | **-0.1905** |
| May.74 | 0 | 0.1429 | **-0.1429** |
| Jun.74 | 0 | 0.2143 | **-0.2143** |
| ⋮ | ⋮ | ⋮ | ⋮ |
| Agu.15 | 0 | 0.2143 | **-0.2143** |
| Sep.15 | 3 | 0.2619 | **2.7381** |
| Oct.15 | 0 | 0.3333 | **-0.3333** |
| Nov.15 | 0 | 0.4048 | **-0.4048** |
| Dec.15 | 0 | 0.2857 | **-0.2857** |

To import the user-defined calendar regression variables, you may drag and drop them into Demetra+ to make a static variable or directly read them from an Excel file to make dynamic variables. For the second option, select the Main menu and **Workspace/User variables**, or **double click on the User-defined variables** in the *Workspace* panel and drag and drop the time series from Excel with the key combination **ctrl-c** and **ctrl-v**. To apply this imported regression variable, you need to change the type of specifications for calendar effects to **UserDefined**.