Subfile Example

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1 Introduction

This is the introduction

2 Hot and Cold

This is the hot and cold part

3 The beginning of the seasons

A recent article by SVT Nyheter showed which season is was on the 1st of November for different areas in Sweden, as can be seen in Fig. 1. According to this article it was already winter in the north of Sweden while in the most south part, including Lund, it was still summer. This did not seem to correspond to what one might observe when looking out the window in Lund, the ground was already covered with red leaves even though it was still summer according to SVT Nyheter. So which definitions of the season are there? Using one of these definitions when do the seasons start in Lund and how does the start of each season vary over a number of years?

Figure 1: The season in different areas in Sweden on the 1st of November. Image from [1].

3.1 Definition of the Seasons

There is a definition of the seasons based on the calendar as well as a meteorological definition. According to the definition based on the calendar spring is always from March to May, summer from June to August, fall from September to November and winter from December to February. This is clearly the same for each year and is not dependent on temperature of any other parameter. The meteorological definition of the seasons is based on the average temperature of each day and the seasons can therefore be start on different dates each year. The meteorological winter starts when the average temperature of a day is equal to or below zero for 5 days in a row. The first day of winter is then the first of these 5 days. The definition for the meteorological summer is similar, but the average temperature needs to be 10 degrees or higher. The meteorological spring starts

when the average temperature of a day is between zero and 10 degrees for 7 days in a row. The definition for the meteorological fall is similar, but the temperature only need to be between zero and 10 degrees for 5 days in a row. The season do of course need to occur in the right order, so spring has to start after winter and fall has to start after summer. The meteorological definition of the seasons will be used for the data analyses.

3.2 Method

The temperature data of Lund from Sveriges meteorologiska och hydrologiska institut (SMHI) will be used to determined to beginning of the meteorological season for the years in the dataset.

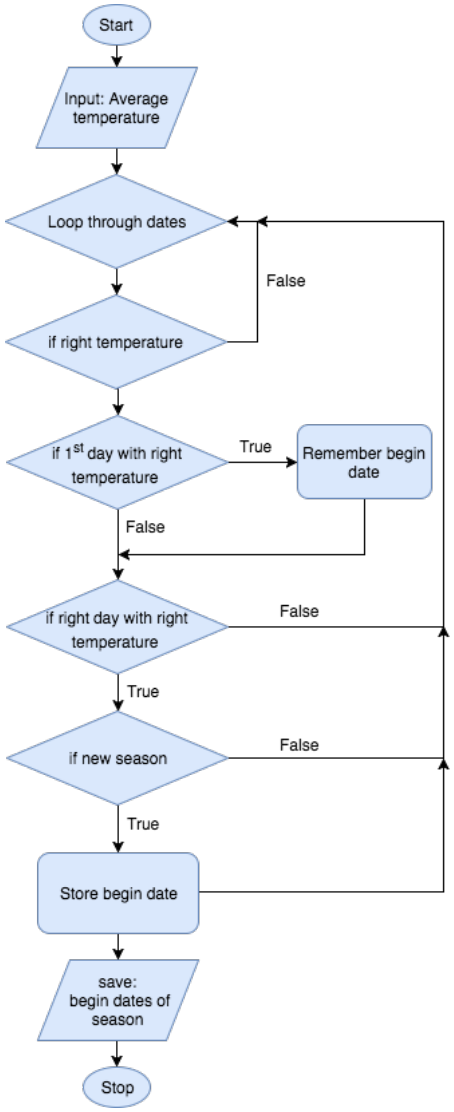
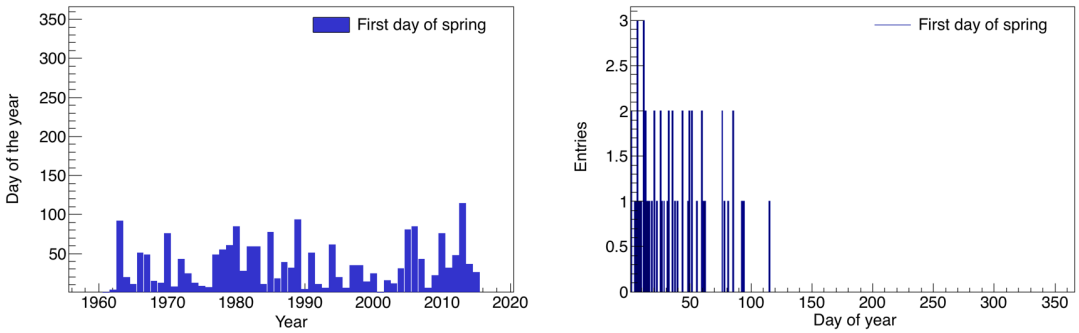


Figure 2: The code used for the calculation of the start of a season represented in a flowchart.

3.3 Results

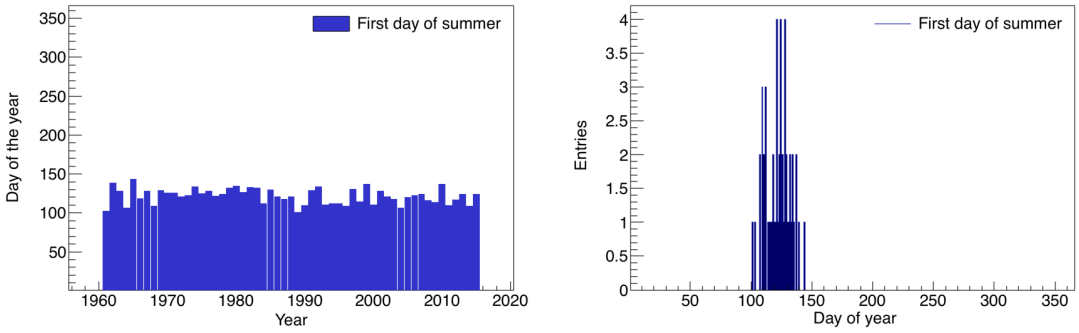
4 The temperature of a given day

Two functions were created, both giving the temperature of a certain day. The difference is that one takes the date (month, day) as input and the other one takes the day number as input. To make it as simple as possible, the function that takes day number as input first coverts it into month and day, so that the functions after that is identical.



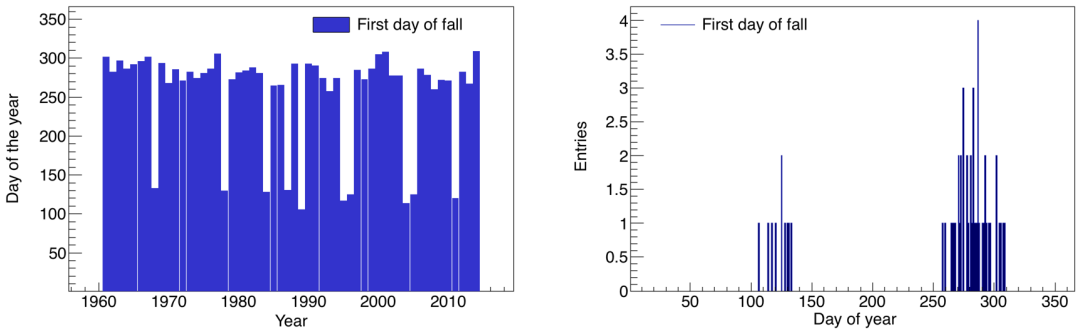
(a) Bar graph **(b)** Histogram

Figure 3: The first day on which spring starts for each year in Lund is shown in (a). While (b) shows the number of times spring starts on a certain day in the year.



(a) Bar graph **(b)** Histogram

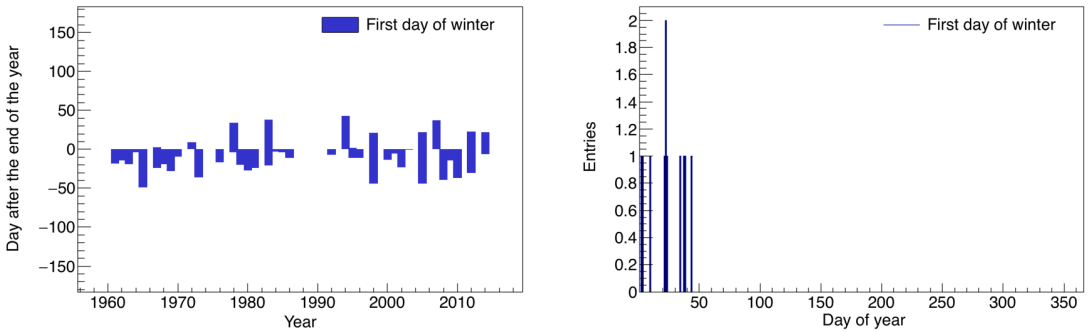
Figure 4: The first day on which summer starts for each year in Lund is shown in (a). While (b) shows the number of times summer starts on a certain day in the year.



(a) Bar graph **(b)** Histogram

Figure 5: The first day on which fall starts for each year in Lund is shown in (a). While (b) shows the number of times summer starts on a certain day in the year.

The algorithm itself is straightforward. First, the dates in the data that matches the input date are found. Temperatures for every year is then stored in a vector, which is plotted in a histogram. A histogram for the 19^{th} of July in Uppsala, for the years from 1722 to 2013, is shown in Fig. 6. From the histogram it is possible to get both the mean and the standard deviation. For Fig. 6, the mean is 16.88 and the standard deviation is 2.96. If we want to know the probability for a certain temperature on the given day, we can use the mean and the standard deviation and



(a) Bar graph

(b) Histogram

Figure 6: The first day on which winter starts for each year in Lund is shown in (a). The day is given relative to the start of a new year, all negative numbers are before the 1$^{\text{st}}$ of January and all the positive numbers are on or after the 1$^{\text{st}}$ of January. The number of times spring starts on a certain day in the year in given in (b).

assume a Gaussian distribution. The black line in Fig. 6 is a Gaussian fitted to the histogram, to see if it is a reasonable assumption. For Uppsala the data contains enough years to give 274 counts, so the Gaussian fit is sensible. Some of the other data sets would give a lot less data points, as in Fig. 7. The histogram contains only 35 entries for the 19^{th} of July in Lund, and the Gaussian fit is not good.

5 tempExtrap

This is the tempExtrap

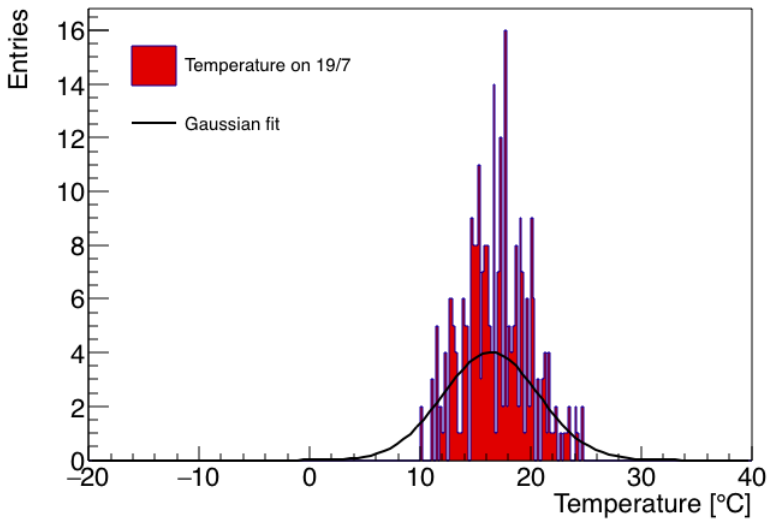


Figure 7: The temperatures on July 19^{th} in Uppsala for the years between 1722 and 2013. The black line is a Gaussian fitted to the histogram.

References

[1] SVT Nyheter. Vintern 2017-2018. `https://www.svt.se/vader/vintern20172018`. Accessed: 2017-11-09.

[2] Sveriges meteorologiska och hydrologiska institut (SMHI). Årstider. `https://www.smhi.se/kunskapsbanken/meteorologi/arstider-1.1082`. Accessed: 2017-11-09.

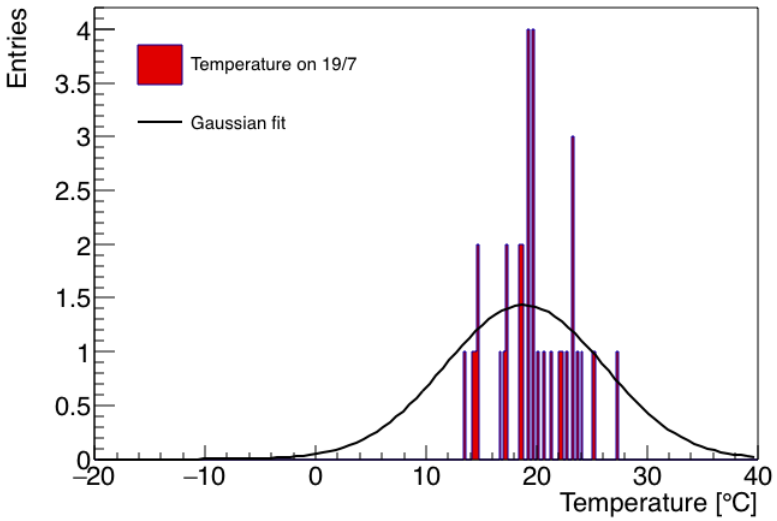


Figure 8: The temperatures on July 19^{th} in Lund between 1961 and 2014. The black line is a Gaussian fitted to the data.