Task 1 – Conditional formatting of Microsoft Excel spreadsheets

A farmer at Trangie is considering investing in the development of part of his property for cotton production. He has learnt from agronomists that based the mathematical modelling of cotton growth and development in his district, the optimal period for sowing cotton (the planting season) at Trangie is from 15 September until 20 October. If the crop has not been sown by 20 October, it risks losing its profitability.

The farmer has also read information about the temperature conditions necessary for sowing cotton. This information, supplied by Cotton Seed Distributors on their website (http://www.csd.net.au/greenlight), is shown below.

Have you got the green light for planting this season?

Planting the cotton crop is one of the most important operations on the farm. It sets the standard for the entire season. There are some key considerations that will help ensure that it is a once only task.

	RED LIGHT	ORANGE LIGHT	GREEN LIGHT
Soil temperature at 10 cm depth above 14°C at 9am (AEST)	❌	✅❌	✅
Forecast average temps for the week following planting on a rising plane	❌	❌✅	✅
		STEADY	GO!

IMPORTANT

- If you cannot give a green tick next to at least one of these statements, then planting conditions are definitely unsuitable - **STOP!**
- If you can give a green tick to only one of these statements - **BE CAUTIOUS**. Adjustments may need to be made.
- If you can give both statements a green tick - **LET'S GO!**

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Determining the Probability of a Good Day for Sowing Cotton

This task requires you to conditionally format climatic data on an Excel spreadsheet so the farmer can easily see and count the number of **red light** days, **amber light** days and **green light** days in a planting season at Trangie.

The farmer has obtained 30 years of temperatures of the soil at a 10 cm depth, measured at Trangie Agricultural Research Station at 9 am AEST (1985 – 2014). He has also found daily maximum and minimum air temperature data for Trangie online at the Bureau of Meteorology website. From these two sets of historical climatic data, he wants to find out how many suitable sowing days for cotton are likely to occur at Trangie during the planting season (15 September and 20 October). The number of days during this period when he can sow cotton will impact on his decision as to whether he will produce cotton, and if he does, how much of his farm he will commit to cotton production.

Average soil temperatures at a depth of 10 cm and average daily temperatures at Trangie during the optimum sowing period of the years 1985 – 2014, are shown in the graph below. Average daily soil temperatures range from 13.7°C (in 1992) up to 19.2 °C (in 2006) and average daily air temperatures range from 14.6°C (in 1992) up to 19.5°C (in 2006). The farmer decides to examine the data for 1992 and 2006 more carefully to find out how many **red light** days, **amber light** days and **green light** days occurred during the planting season in these two extreme years, and also in a more typical season such as that of the year 2000.

Average daily temperatures at Trangie, 15 September – 20 October
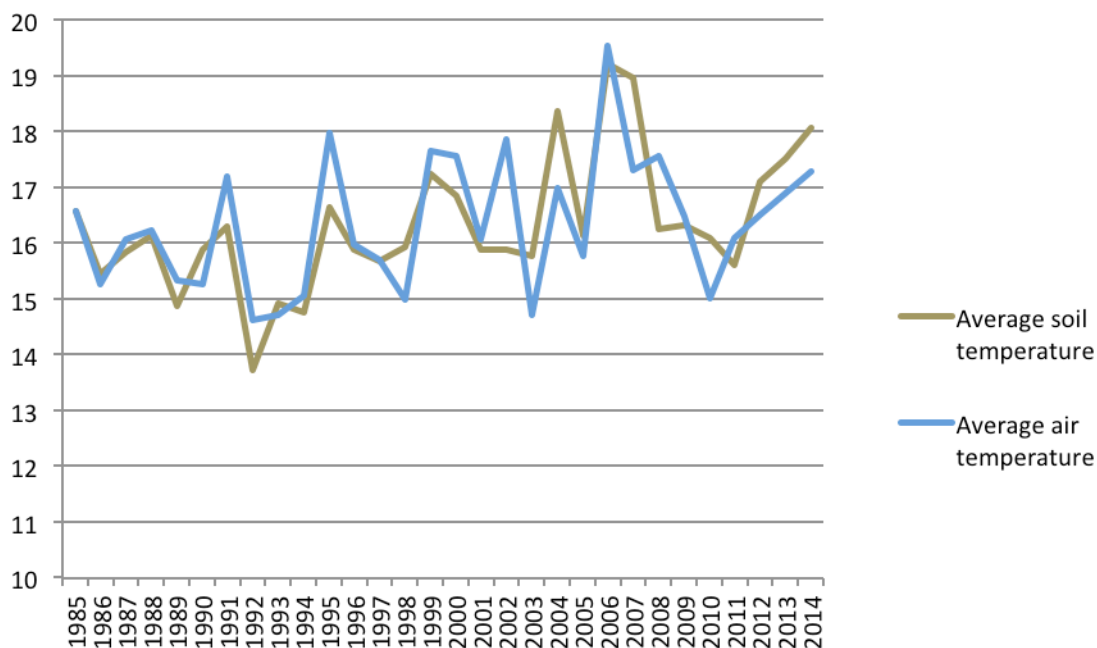
This graph was drawn using data in the Microsoft Excel spreadsheet *Trangie Planting Season Data*.
In this spreadsheet, the data on the worksheets are:
➢ Daily soil temperature at 10 cm depth read at 9am AEST from 15 September – 20 October
➢ Daily maximum air temperature from 15 September – 27 October
➢ Daily maximum air temperature from 15 September – 27 October

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➢ Daily mean air temperature (calculated by averaging the maximum and minimum temperatures for each day) from 15 September – 27 October.

Note: Averages calculated at the bottom of each worksheet are over the period from 15 September – 20 October. Air temperature data continues for another week to make it possible to detect whether the forecast temperatures were on a "rising plane" for the week following 20 October.

Open the spreadsheet *Trangie Planting Season Data*.
The first worksheet shows soil temperature at 10 cm depth during the planting season each year from 1985-2014. These data are measurements made at Trangie Agricultural Research Station before this job was taken over by the Bureau of Meteorology in 2015.
Some of the data in this worksheet are missing. This missing data forms a pattern.
• Why do you think this pattern happens?

Open the spreadsheet *Testing for Good Sowing Days*.
This spreadsheet contains three worksheets, each with a year of daily data selected from the spreadsheet *Trangie Planting Season Data*. These years are 1992 (the year with the coldest planting season) , 2006 (the year with the warmest planting season) and 2000 (a year with a fairly average planting season.

You will be using these data to determine which days in the planting season satisfy one, both or neither of two criteria given by Cotton Seed Distributors as being important when deciding whether to plant cotton on a particular day, namely:

a) Soil temperature at 10 cm depth above 14°C at 9am (AEST)
b) Forecast average temps for the week following planting on a rising plane.

In Microsoft Excel spreadsheets you can specify rules for formatting cells according to what is written in the cell.
In the worksheet for 1992, select the soil temperature data in Column B (Cells B3:B38), then select *Conditional Formatting >Highlight Cells Rules >Greater Than…*

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In the resulting box, type **14** and select *Red Border* from the dropdown menu (shown below).

To count the number of days in the planting season for which there is soil temperature data, go to Cell E47. In the formula box, type **=COUNT(B3:B38)**.

- On how many days in the 1992 planting season, was soil temperature measured?

To count the number of days in the planting season for which the soil temperature is greater than 14°C, go to Cell E48.
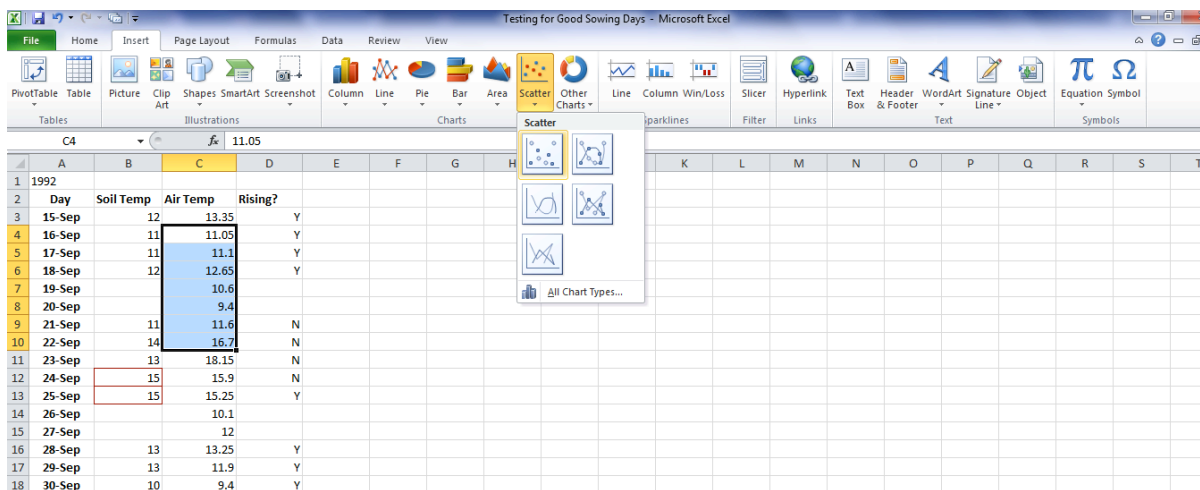In the formula box, type **=COUNTIF(B3:B38,">14")**.
This formula consists of an array of cells to search (B3:B38) followed by a condition for a cell to be included in the count ("">14").

- How many of these days have a soil temperature greater than 14°C?
- What fraction of the days when soil temperature was measured, have a soil temperature greater than 14°C? Write your answer as a decimal correct to 2 decimal places.

The second condition for a good sowing date is a forecast of rising air temperatures for the following week. To determine this, a scatter plot can be drawn using the mean air temperature data for the 7 days after the date of the soil temperature measurement.

- By using data in this spreadsheet as "a forecast of average temperatures", what assumption has been made?

To make a scatterplot of air temperature data for the week following 15 September (i.e. the week of 16 – 22 September), select the cells C4:C10. Then select the tab *Insert*, the icon *Scatter*, and the first of the types of scatter plot (as shown below).

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You should now have a scatterplot with 7 data points on it.

The numbers on the horizontal axis represent the order of the 7 dates.

The numbers on the vertical axis represent the mean air temperature for each date (in °C).

Draw a trend line through these 7 data points by selecting *Chart Layouts* (Under the *Design* tab) then *Layout 3* (as shown below).

You can quickly see by the direction of the slope of the line, whether the week's temperatures are rising or falling.
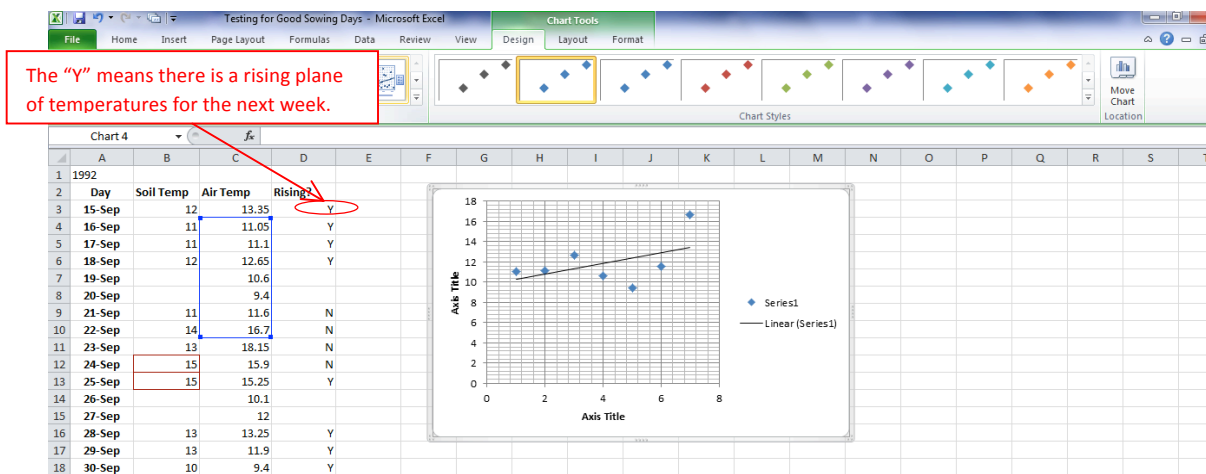
The scatterplot for the week following (and not including) 15 September shows that temperatures are "on a rising plane" (i.e. the trend line is going up). To record this trend in your table for 15 September, the letter "Y" (for Yes) has been placed in Cell D3.

Check that Column D is correct for other days ("Y" for a rising trend and "N" if it is not rising) by using the same method. You can change the data used in an existing scatter plot by right clicking on the plot, selecting *Select Data*, highlighting a different string of 7 temperatures and clicking *OK*.

Note: Temperature trends do not need to be found for the weeks when the prior day has no soil temperature data. This is because if a day has no soil temperature measurement it cannot be used to decide whether it is good for sowing cotton or not.

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The column indicating whether the temperatures are rising (Column D) can now be conditionally formatted to highlight only those cells that have a "Y" in them.
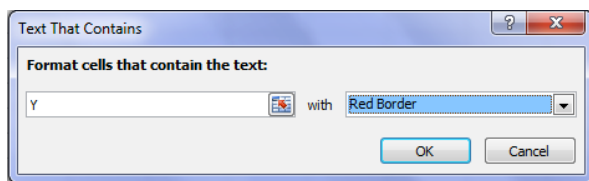
Select the data in Column D (Cells D3:D38), then select *Conditional Formatting >Highlight Cells Rules >Text that Contains…*
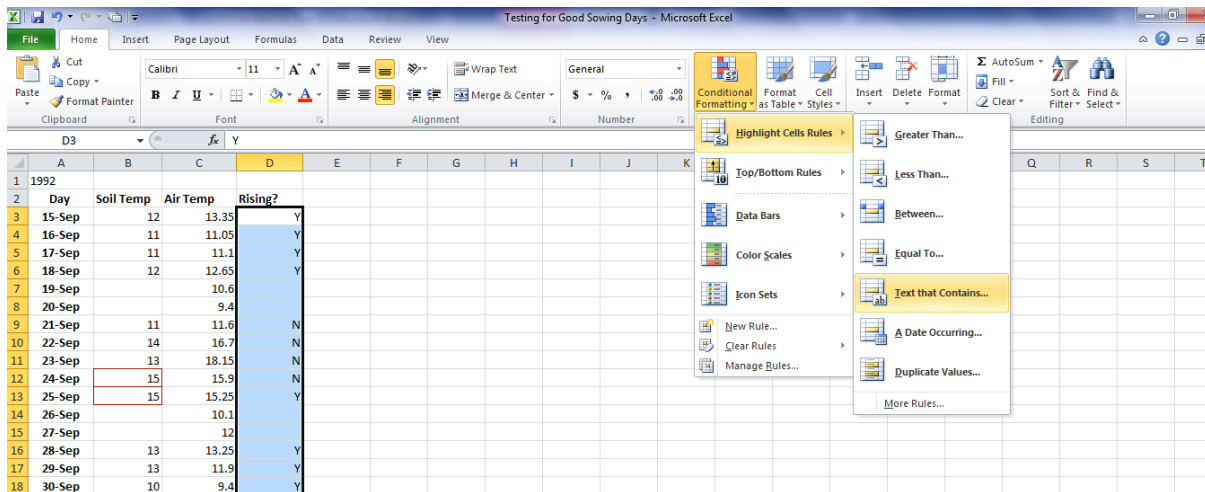
In the resulting box, type **Y** and select *Red Border* from the dropdown menu (shown below).

In Cell E49, make a count of the number of days with a forecast of rising temperatures, by typing the formula **=COUNTIF(D3:D38, "Y")** into the formula bar.

- How many of the days with soil temperature data, have mean temperatures for the following week on a rising plane?
- What fraction of the days with soil temperature data, have average temperatures for the following week on a rising plane? Write your answer as a decimal correct to 2 decimal places.

Look again at the decision-making criteria supplied by Cotton Seed Distributors.
- From conditionally formatting your spreadsheet:
 -how could you tell which days are **green light** days?
 -how could you tell which days are **red light** days?
 -how could you tell which days are **amber light** days?

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In Excel, it is possible to format a cell based on the value or text in one or more other cells.
Highlight the data in Column A from 15-Sep to 20-Oct (Cells A3:A38).

Then select *Conditional Formatting >Highlight Cell Rules >More Rules…*as shown below.
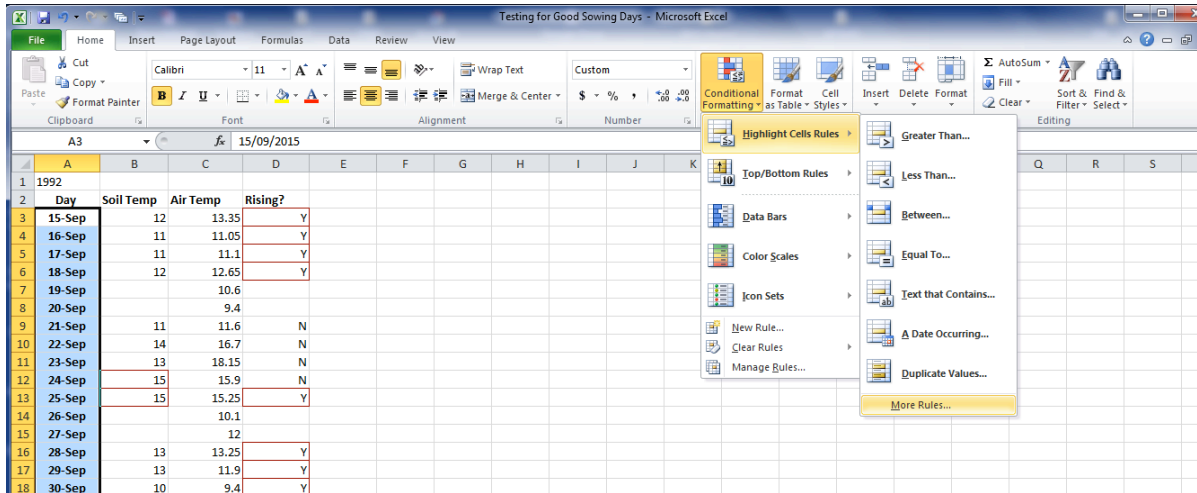
Select the Rule Type **>Use a formula to determine which cells to forma**t

Type the Rule Description as: **=AND($B3>14,$D3="Y")**

Click on *Format*. Format so the selected cells are filled with green if the rule is obeyed.

Click *OK* for the formatting, then *OK* to have the new formatting rule applied.

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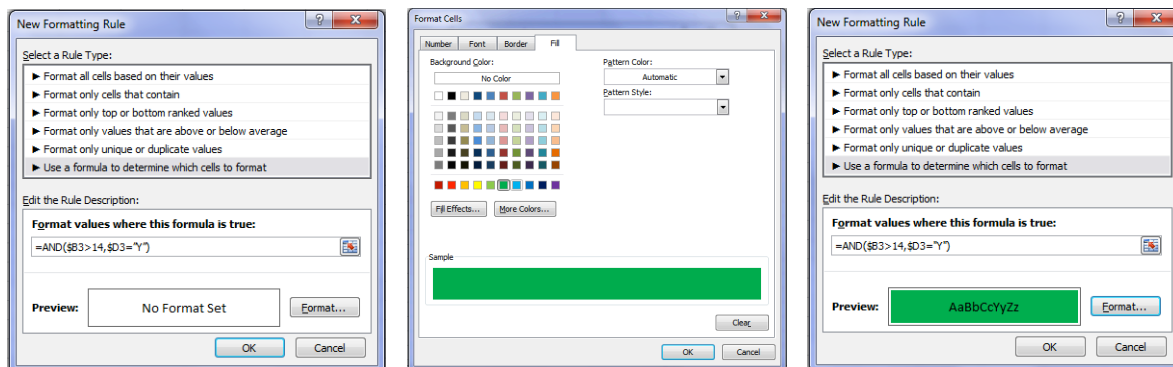
You can see all the formatting rules you have used for your worksheet so far, by selecting *Conditional Formatting >Manage Rules…*

Select *This Worksheet* from the dropdown menu at the drop and you should see the rules below.
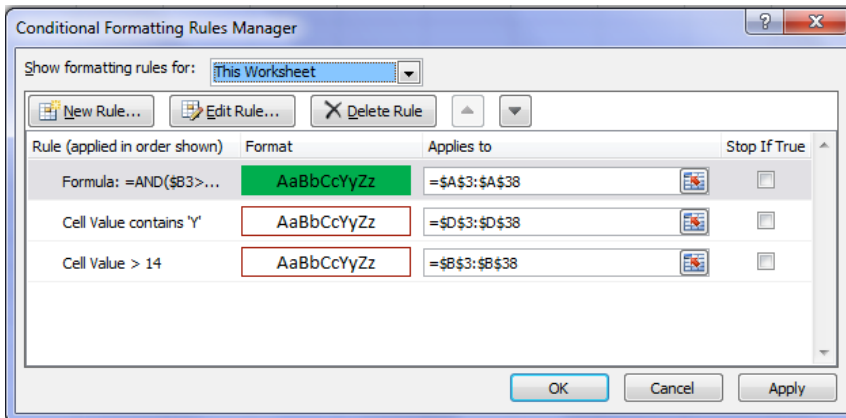
The rule **=AND($B3>14,$D3="Y")** selects cells where:
- the soil temperature is greater than 14°C **AND**
- temperatures are rising for the following week.
These are **green light** days.

- What are the two conditions for **red light** days?
- Write this rule as an Excel formula to conditionally format these days.
  (Note that the symbols <= written together mean "less than or equal to".)
  Use your new formatting rule to colour these days in Column A, red.

  The conditions for **amber light** days are:
  - the soil temperature is greater than 14°C **OR**
  - temperatures are rising for the following week.
  but **NOT BOTH** of these conditions.

  So there are two types of **amber light** days.
  To separate them, we will call them **brown light** days when <u>only the soil condition</u> is met, and **orange light** days when <u>only the rising temperature condition</u> is met.

- What are the two conditions for **brown light** days?
- Write this rule as an Excel formula to conditonally format these days.
  Use your new formatting rule to colour these days in Column A, brown.

- What are the two conditions for **orange light** days?
- Write this rule as an Excel formula to conditonally format these days.
- Use your new formatting rule to colour these days in Column A, orange.

  To count the number of **green light** days, go to Cell E51 and type the formula

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=COUNTIFS(B3:B38,">14",D3:D38,"=Y").

- Explain the meaning of the symbols in this formula.
- What formula would you type to get a count of the **red light** days into Cell E52?
- What formula would you type to get a count of the **brown light** days into Cell E53?
- What formula would you type to get a count of the **orange light** days into Cell E54?

    Type in these formulae and check that the counts made are correct by counting the coloured cells.

    In the first column of the table below, write your results for 1992 planting season.

    Repeat the conditional formatting exercise for 2000 and 2006 using the other worksheets in the spreadsheet *Testing for Good Sowing Days*. Write these results into the table below.

	1992 Planting Season	2000 Planting Season	2006 Planting Season
Number of **green light** days			
Number of **red light** days			
Number of **brown light** days			
Number of **orange light** days			
TOTAL number of days with data	**25**	**24**	**23**

- Why is it better to compare the proportion of days in each category rather than compare the number of days in each category?

    For each year, calculate the proportion of days in each category.
    Write your answers as decimal fractions (to 2 decimal places) in the table below.
    For each season, the proportions should add to 1.

	1992 Planting Season	2000 Planting Season	2006 Planting Season
Proportion of **green light** days			
Proportion of **red light** days			
Proportion of **brown light** days			
Proportion of **orange light** days			

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From this data, the minimum proportion of **green light** days in a planting season at Trangie is expected to be the proportion of **green light** days in 1992 (the coolest planting season).

- How many days are there in a planting season (15 September – 20 October)?
- What is the proportion of **green light** days in the 1992 season?
- In the coolest planting seasons, how many **green light** days are expected?

The number of **amber light** days is the sum of the **brown light** days and the **orange light** days.

- What is the proportion of **amber light** days in the 1992 season?
- In the coolest planting seasons, how many **amber light** are expected?

If a farmer has a smaller property, he is usually not prepared to take the risk and sow on an amber light day. He would rather wait for a green light day.
Farmers with larger properties are likely to sow on all days *except* red light days.

- In the coolest planting seasons, on how many days during the coolest planting seasons are farmers with larger properties likely to sow cotton?

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