Gráficos R

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Graphs with R: Exercises

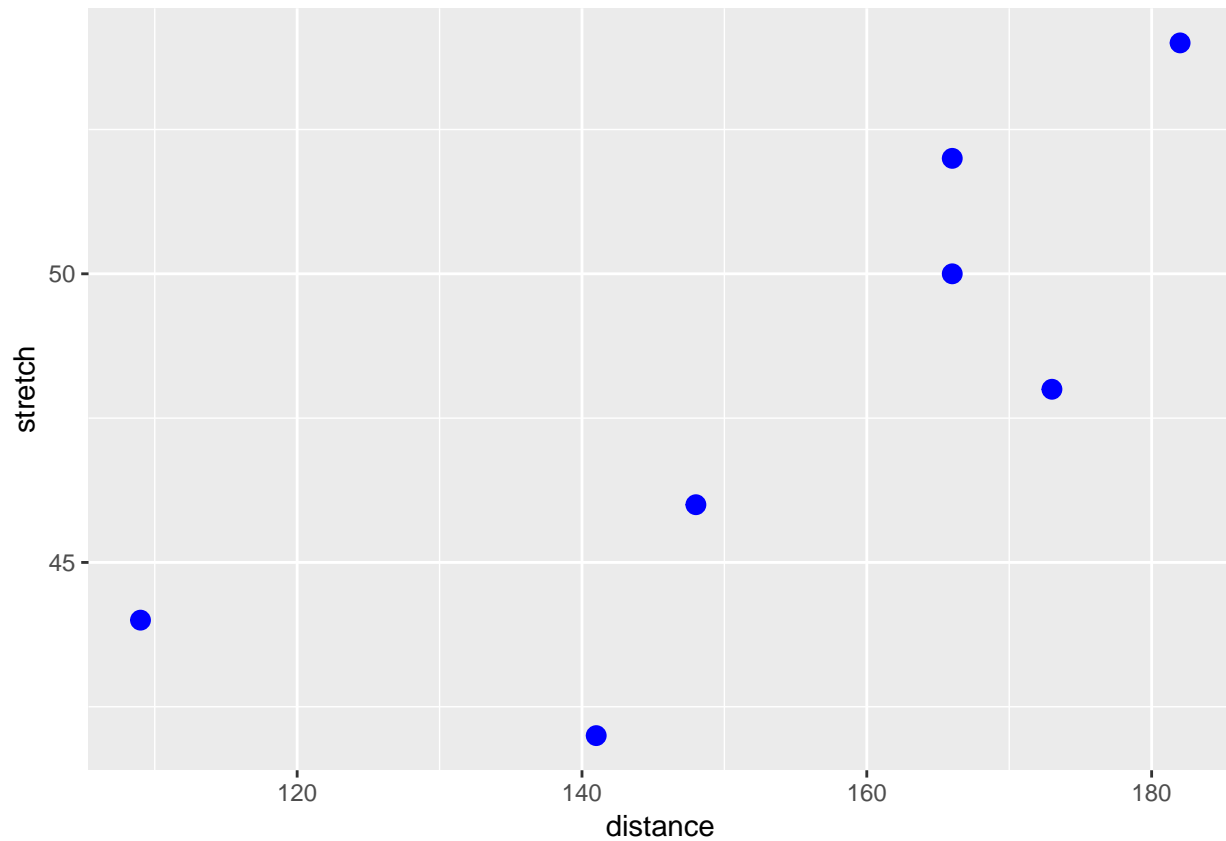First we need to load the ggplot2 library.

```
library(ggplot2)
```

1) Plot distance against stretch.

```
ex1 <- data.frame(stretch=c(46,54,48,50,44,42,52), distance=c(148,182,173,166,109,141,166))
ex1
```

```
##   stretch distance
## 1      46      148
## 2      54      182
## 3      48      173
## 4      50      166
## 5      44      109
## 6      42      141
## 7      52      166
```

```
ggplot(ex1, aes(distance, stretch)) + geom_point(col="blue", size=3)
```

2) The follwing data have ten observations taken during the years 1970-79, on October snow cover for Eurasia (snow cover is in millions of square kilometers).

```
ex2 <- data.frame(year=c(1970:1979), snow.cover=c(6.5,12.0,14.9,10.0,10.7,7.9,21.9,12.5,14.5,9.2))
ex2
```

```
##     year snow.cover
## 1  1970        6.5
## 2  1971       12.0
## 3  1972       14.9
## 4  1973       10.0
## 5  1974       10.7
## 6  1975        7.9
## 7  1976       21.9
## 8  1977       12.5
## 9  1978       14.5
## 10 1979        9.2
```

Plot snow.cover versus year.

```
ggplot(ex2, aes(snow.cover, year)) + geom_point(col="green", size=3)
```
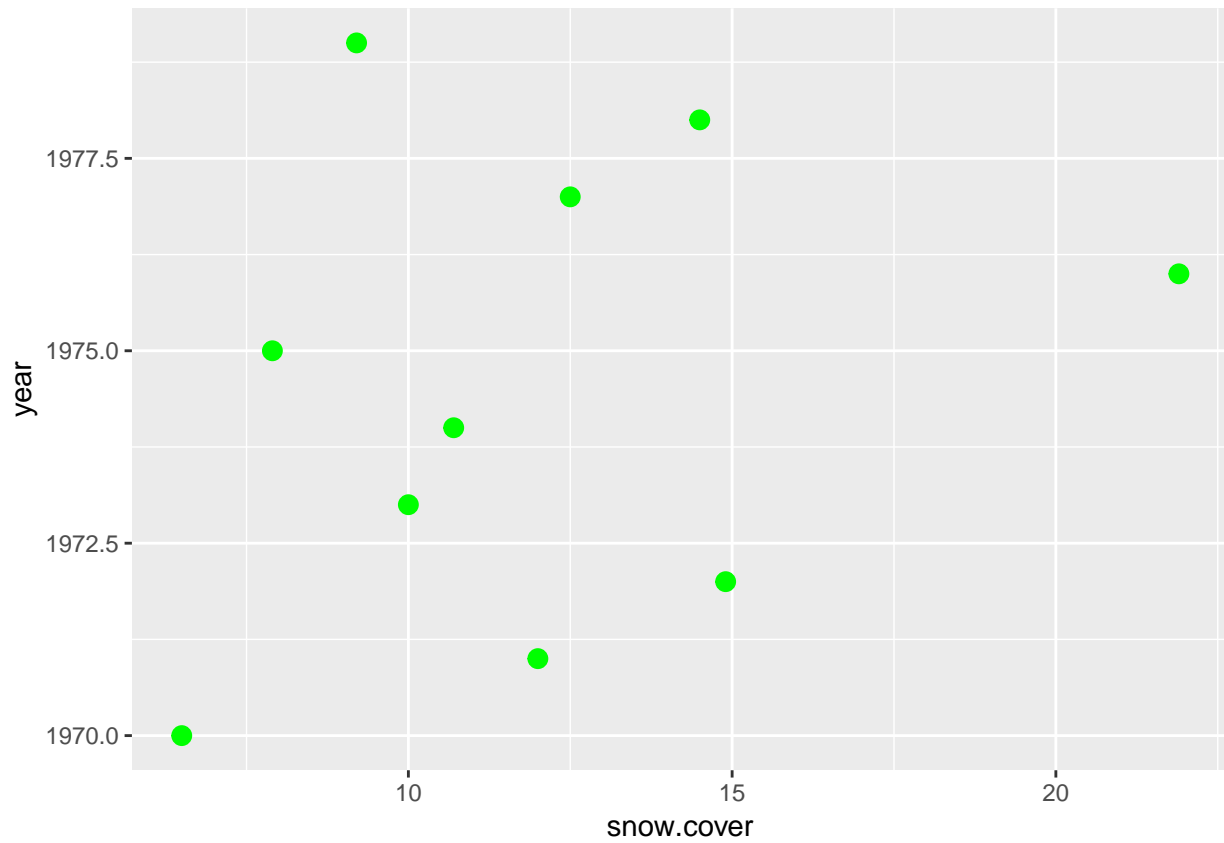
Plot a histogram of the snow.cover values.

```
ggplot(ex2, aes(snow.cover)) + geom_histogram(fill="green", col="darkgreen", bins = 4)
```

Given the following data (read from csv file):
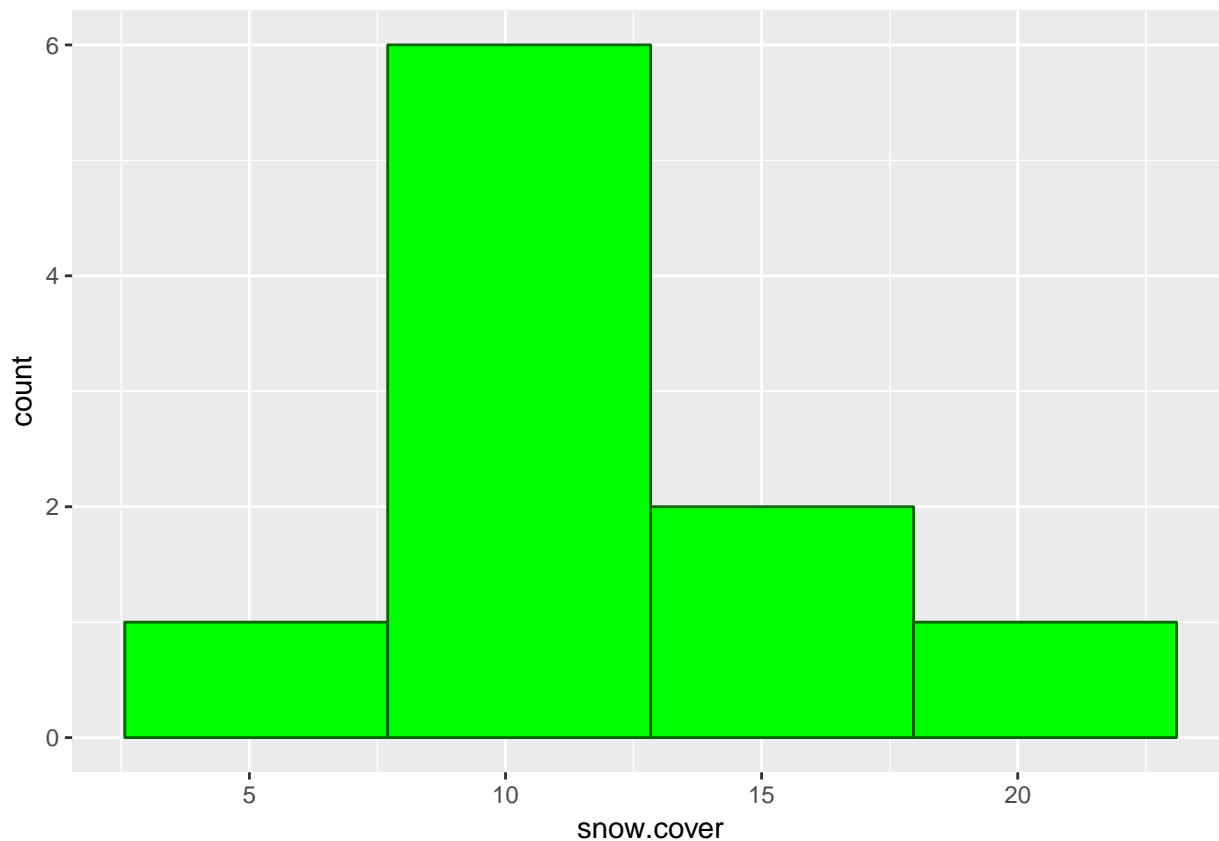
```
ex3 = read.csv("ex3.csv", na = "NR")
ex3
```

```
##    Year Lowest.Temperature..F. Highest.Temperature..F.
## 1  2014                      4                      58
## 2  2013                     11                      61
## 3  2012                     13                      62
## 4  2011                      6                      53
## 5  2010                     13                      57
## 6  2009                      6                      47
## 7  2008                     12                      64
## 8  2007                      9                      72
## 9  2006                     16                      64
## 10 2005                      5                      66
## 11 2004                      1                      58
## 12 2003                      7                      50
## 13 2002                     21                      69
## 14 2001                     18                      54
## 15 2000                      3                      64
## 16 1999                      9                      60
## 17 1998                     14                      65
## 18 1997                      4                      62
## 19 1996                      6                      56
## 20 1995                     15                      64
## 21 1994                     -2                      55
## 22 1993                     21                      64
```

```
## 23   1992                   11                      62
## 24   1991                   10                      55
## 25   1990                   24                      66
## 26   1989                   11                      61
## 27   1988                    5                      53
## 28   1987                    8                      57
## 29   1986                    8                      63
## 30   1985                   -2                      58
## 31   1984                    8                      57
## 32   1983                   12                      58
## 33   1982                    0                      58
## 34   1981                    2                      49
## 35   1980                   17                      60
## 36   1979                    8                      63
## 37   1978                   12                      58
## 38   1977                   -2                      44
## 39   1976                   -1                      56
## 40   1975                   15                      63
## 41   1974                    6                      66
## 42   1973                   10                      66
## 43   1972                    5                      62
## 44   1971                    4                      46
## 45   1970                    3                      51
## 46   1969                   11                      48
## 47   1968                   -1                      50
## 48   1967                   13                      68
## 49   1966                    8                      62
## 50   1965                    9                      55
## 51   1964                    9                      55
## 52   1963                    4                      51
## 53   1962                   11                      56
## 54   1961                    5                      55
## 55   1960                   17                      54
## 56   1959                   14                      61
## 57   1958                   12                      53
## 58   1957                    0                      60
## 59   1956                   14                      48
## 60   1955                   13                      50
## 61   1954                    7                      56
## 62   1953                   21                      57
## 63   1952                    8                      60
## 64   1951                   11                      64
## 65   1950                   16                      72
## 66   1949                   20                      61
## 67   1948                    0                      45
## 68   1947                   12                      63
## 69   1946                    5                      62
## 70   1945                    2                      55
## 71   1944                   12                      62
## 72   1943                   10                      56
## 73   1942                    5                      57
## 74   1941                   10                      47
## 75   1940                    7                      54
## 76   1939                    6                      55
```

```
## 77  1938                        6                       57
## 78  1937                       25                       66
## 79  1936                       -3                       54
## 80  1935                       -1                       58
## 81  1934                        6                       58
## 82  1933                       13                       61
## 83  1932                       24                       70
## 84  1931                       11                       56
## 85  1930                       10                       64
## 86  1929                        8                       62
## 87  1928                       12                       58
## 88  1927                       -1                       52
## 89  1926                        5                       54
## 90  1925                       -2                       45
## 91  1924                        5                       57
## 92  1923                        9                       53
## 93  1922                        7                       50
## 94  1921                        4                       57
## 95  1920                       -1                       51
## 96  1919                       10                       61
## 97  1918                       -4                       53
## 98  1917                        8                       51
## 99  1916                        7                       69
## 100 1915                       12                       58
## 101 1914                       -5                       58
## 102 1913                       18                       63
## 103 1912                       -3                       54
## 104 1911                       18                       56
## 105 1910                        5                       48
## 106 1909                        5                       57
## 107 1908                        8                       50
## 108 1907                        4                       64
## 109 1906                       14                       62
## 110 1905                        4                       53
## 111 1904                       -4                       54
## 112 1903                       10                       51
## 113 1902                       13                       51
## 114 1901                        8                       53
## 115 1900                       10                       57
##      Warmest.Minimum.Temperature..F. Coldest.Minimum.Temperature..F.
## 1                                 44                              18
## 2                                 43                              20
## 3                                 46                              27
## 4                                 40                              24
## 5                                 49                              20
## 6                                 38                              16
## 7                                 53                              20
## 8                                 54                              22
## 9                                 45                              32
## 10                                49                              18
## 11                                44                              15
## 12                                38                              20
## 13                                50                              31
## 14                                40                              27
```

```
## 15             51             19
## 16             41             22
## 17             47             29
## 18             44             17
## 19             40             18
## 20             54             27
## 21             35             10
## 22             41             27
## 23             42             23
## 24             43             20
## 25             46             33
## 26             44             26
## 27             41             17
## 28             46             19
## 29             45             22
## 30             40              9
## 31             39             19
## 32             43             21
## 33             37             15
## 34             40             14
## 35             40             27
## 36             50             20
## 37             36             21
## 38             28             12
## 39             36             15
## 40             48             29
## 41             45             23
## 42             45             18
## 43             45             15
## 44             34             16
## 45             42             14
## 46             42             24
## 47             36             13
## 48             54             25
## 49             52             19
## 50             41             16
## 51             41             22
## 52             39             20
## 53             41             25
## 54             42             19
## 55             38             28
## 56             38             22
## 57             39             23
## 58             43             12
## 59             43             28
## 60             40             24
## 61             41             21
## 62             49             33
## 63             45             23
## 64             47             27
## 65             59             31
## 66             43             30
## 67             33             18
## 68             42             23
```

```
## 69                                               54                                26
## 70                                               33                                15
## 71                                               38                                23
## 72                                               38                                25
## 73                                               43                                14
## 74                                               36                                25
## 75                                               36                                19
## 76                                               44                                18
## 77                                               42                                17
## 78                                               50                                32
## 79                                               37                                16
## 80                                               47                                16
## 81                                               41                                16
## 82                                               48                                28
## 83                                               56                                33
## 84                                               41                                24
## 85                                               52                                22
## 86                                               38                                24
## 87                                               44                                24
## 88                                               40                                22
## 89                                               40                                23
## 90                                               33                                14
## 91                                               40                                18
## 92                                               44                                21
## 93                                               37                                16
## 94                                               42                                16
## 95                                               36                                14
## 96                                               43                                26
## 97                                               29                                10
## 98                                               40                                20
## 99                                               53                                21
## 100                                              47                                24
## 101                                              42                                 9
## 102                                              45                                29
## 103                                              38                                 8
## 104                                              49                                26
## 105                                              40                                27
## 106                                              49                                24
## 107                                              41                                18
## 108                                              49                                20
## 109                                              50                                29
## 110                                              42                                16
## 111                                              39                                13
## 112                                              39                                21
## 113                                              40                                21
## 114                                              38                                27
## 115                                              46                                20
##      Average.Minimum.Temperature..F. Average.Maximum.Temperature..F.
## 1                               21.8                            35.2
## 2                               29.3                            40.8
## 3                               30.2                            44.2
## 4                               24.6                            34.7
## 5                               27.0                            38.1
## 6                               22.4                            33.5
```

```
## 7                       30.6                       42.4
## 8                       31.4                       43.6
## 9                       34.2                       47.5
## 10                      25.2                       37.4
## 11                      18.5                       31.0
## 12                      22.1                       32.9
## 13                      34.5                       45.4
## 14                      28.5                       38.8
## 15                      24.7                       37.9
## 16                      27.0                       40.8
## 17                      34.2                       45.8
## 18                      25.1                       39.2
## 19                      24.0                       37.0
## 20                      31.9                       43.1
## 21                      17.9                       33.2
## 22                      30.1                       42.5
## 23                      28.9                       42.5
## 24                      28.5                       41.2
## 25                      35.2                       47.5
## 26                      30.7                       44.0
## 27                      23.2                       35.8
## 28                      27.1                       37.5
## 29                      27.4                       40.8
## 30                      23.0                       34.6
## 31                      24.6                       35.1
## 32                      29.4                       39.6
## 33                      19.6                       32.5
## 34                      20.2                       32.3
## 35                      28.0                       39.4
## 36                      26.9                       40.2
## 37                      22.0                       33.9
## 38                      16.4                       27.7
## 39                      20.5                       34.2
## 40                      31.3                       43.3
## 41                      29.1                       41.4
## 42                      28.8                       42.1
## 43                      28.0                       42.1
## 44                      20.8                       33.1
## 45                      18.7                       31.5
## 46                      26.3                       37.3
## 47                      20.1                       33.3
## 48                      31.5                       43.2
## 49                      25.7                       38.6
## 50                      23.7                       35.6
## 51                      29.5                       41.8
## 52                      24.0                       36.2
## 53                      25.5                       39.6
## 54                      21.9                       33.5
## 55                      28.8                       38.9
## 56                      24.3                       38.0
## 57                      26.3                       37.5
## 58                      22.2                       34.8
## 59                      26.7                       37.3
## 60                      25.2                       36.7
```

```
## 61                        23.5                    38.1
## 62                        31.8                    43.4
## 63                        28.9                    43.4
## 64                        29.4                    44.5
## 65                        34.2                    48.6
## 66                        32.6                    44.6
## 67                        19.3                    31.2
## 68                        30.2                    44.1
## 69                        27.0                    41.2
## 70                        17.9                    32.5
## 71                        27.8                    40.0
## 72                        24.3                    37.2
## 73                        23.9                    37.5
## 74                        23.2                    35.6
## 75                        18.9                    31.0
## 76                        26.5                    37.8
## 77                        25.9                    38.3
## 78                        33.7                    46.9
## 79                        23.3                    35.3
## 80                        21.6                    36.1
## 81                        28.5                    40.8
## 82                        34.0                    46.6
## 83                        37.7                    48.6
## 84                        26.3                    39.2
## 85                        27.0                    39.5
## 86                        25.0                    38.8
## 87                        26.9                    41.0
## 88                        24.0                    37.8
## 89                        25.7                    38.2
## 90                        22.0                    34.8
## 91                        24.9                    40.4
## 92                        23.6                    36.3
## 93                        21.9                    34.4
## 94                        25.7                    40.8
## 95                        16.1                    30.8
## 96                        29.4                    41.8
## 97                        15.6                    27.7
## 98                        26.1                    39.6
## 99                        28.3                    43.6
## 100                       28.7                    40.2
## 101                       24.8                    38.2
## 102                       33.5                    48.3
## 103                       16.9                    30.5
## 104                       30.6                    41.9
## 105                       25.7                    37.4
## 106                       28.1                    40.8
## 107                       26.2                    39.4
## 108                       28.0                    41.8
## 109                       33.3                    43.5
## 110                       23.6                    34.9
## 111                       19.5                    31.1
## 112                       24.3                    36.7
## 113                       24.7                    36.3
## 114                       26.8                    38.2
```

```
## 115                        25.5                           38.8
##     Mean.Temperature..F. Total.Precipitation..in. Total.Snowfall..in.
## 1                   28.5                     2.34                19.2
## 2                   35.1                     2.76                 1.5
## 3                   37.2                     3.23                 4.3
## 4                   29.7                     4.93                36.0
## 5                   32.5                     2.08                 2.1
## 6                   27.9                     2.98                 9.0
## 7                   36.5                     2.85                 0.0
## 8                   37.5                     3.63                 2.6
## 9                   40.9                     4.99                 2.0
## 10                  31.3                     4.67                15.3
## 11                  24.7                     2.13                17.3
## 12                  27.5                     2.30                 4.7
## 13                  39.9                     1.93                 3.5
## 14                  33.6                     3.16                 8.3
## 15                  31.3                     3.23                 9.5
## 16                  33.9                     7.02                 4.5
## 17                  40.0                     5.20                 0.5
## 18                  32.1                     3.65                 4.4
## 19                  30.5                     5.64                26.1
## 20                  37.5                     3.75                 0.2
## 21                  25.5                     5.62                12.0
## 22                  36.3                     3.44                 1.5
## 23                  35.7                     1.68                 1.5
## 24                  34.9                     3.38                 8.4
## 25                  41.4                     5.34                 0.9
## 26                  37.4                     2.29                 5.0
## 27                  29.5                     3.64                13.9
## 28                  32.3                     5.81                13.6
## 29                  34.1                     4.23                 2.2
## 30                  28.8                     1.00                 8.4
## 31                  29.9                     1.87                11.7
## 32                  34.5                       NA                 1.9
## 33                  26.1                     6.46                11.8
## 34                  26.2                     0.58                 8.0
## 35                  33.7                     1.72                 2.0
## 36                  33.5                    10.52                 6.6
## 37                  28.0                     8.27                34.0
## 38                  22.0                     2.25                13.0
## 39                  27.3                     5.78                 5.6
## 40                  37.3                     4.76                 2.0
## 41                  35.2                     3.80                13.4
## 42                  35.5                     4.53                 1.8
## 43                  35.0                     2.41                 2.8
## 44                  26.9                     2.67                11.4
## 45                  25.1                     0.66                 8.4
## 46                  31.8                     1.10                 1.0
## 47                  26.7                     2.04                 3.6
## 48                  37.3                     1.39                 1.4
## 49                  32.2                     2.63                11.6
## 50                  29.6                     3.09                14.8
## 51                  35.6                     4.62                13.3
## 52                  30.1                     1.93                 5.3
```

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```
## 53              32.6              2.62              0.6
## 54              27.7              1.88             16.7
## 55              33.9              2.40              2.5
## 56              31.2              2.34              1.5
## 57              31.9              3.79              9.2
## 58              28.5              1.70              8.9
## 59              32.0              1.54              1.2
## 60              30.9              0.77              2.6
## 61              30.8              1.65             12.7
## 62              37.6              4.90              4.1
## 63              36.2              4.58              6.1
## 64              36.9              3.31              0.9
## 65              41.4              2.19              0.4
## 66              38.6              5.98              6.8
## 67              25.2              5.67             15.3
## 68              37.1              2.74              5.5
## 69              34.1              1.86              4.2
## 70              25.2              2.24             12.3
## 71              33.9              3.20              4.8
## 72              30.7              2.46              9.5
## 73              30.7              2.88              6.4
## 74              29.4              3.23              9.2
## 75              25.0              2.61              3.5
## 76              32.1              3.80             10.3
## 77              32.1              3.99              6.5
## 78              40.3              5.67              6.5
## 79              29.3              6.90             12.1
## 80              28.8              3.91             23.6
## 81              34.6              3.42              0.1
## 82              40.4              1.78              0.0
## 83              43.2              4.45              0.8
## 84              32.7              2.56              0.5
## 85              33.3              2.37              3.5
## 86              31.9              3.33              2.3
## 87              34.0              1.87              2.7
## 88              30.9              2.03              5.7
## 89              32.0              2.85              3.1
## 90              28.4              5.42             27.4
## 91              32.6              4.90              2.5
## 92              29.9              6.99             24.5
## 93              28.2              2.73              9.4
## 94              33.2              2.74              3.5
## 95              23.4              2.09              8.2
## 96              35.6              3.51              0.3
## 97              21.7              3.53             13.2
## 98              32.8              2.96              5.8
## 99              36.0              1.28              3.4
## 100             34.5              7.94              3.8
## 101             31.5              5.27              1.3
## 102             40.8              3.43              0.3
## 103             23.7              2.56             13.0
## 104             36.2              2.79              1.3
## 105             31.5              4.64              2.1
## 106             34.5              3.32             11.4
```

```
## 107                      32.9                        3.76                  10.0
## 108                      34.9                        2.89                  11.0
## 109                      38.4                        2.69                   1.5
## 110                      29.2                        2.77                  18.4
## 111                      25.3                        2.97                  11.1
## 112                      30.5                        4.18                   4.5
## 113                      30.8                        2.27                   6.1
## 114                      32.6                        1.66                   2.0
## 115                      32.4                        4.22                   1.0
##      Max.24hr.Precipitation..in. Max.24hr.Snowfall..in.
## 1                           0.50                   11.0
## 2                           0.90                    1.5
## 3                           1.38                    4.3
## 4                           1.29                   12.3
## 5                           1.25                    1.3
## 6                           1.19                    3.0
## 7                           1.29                    0.0
## 8                           1.52                    1.0
## 9                           1.17                    2.0
## 10                          1.03                    8.5
## 11                          0.56                    6.0
## 12                          1.52                    1.0
## 13                          0.62                    3.0
## 14                          0.83                    6.0
## 15                          0.84                    5.5
## 16                          2.42                    2.5
## 17                          2.55                    0.5
## 18                          1.23                    3.5
## 19                          1.40                   13.6
## 20                          1.41                    0.2
## 21                          1.87                    4.5
## 22                          1.42                    1.1
## 23                          0.50                    1.3
## 24                          0.85                    5.7
## 25                          1.11                    0.8
## 26                          0.60                    5.0
## 27                          0.80                    5.2
## 28                          1.68                    8.1
## 29                          2.19                    1.4
## 30                          0.30                    4.1
## 31                          0.60                    4.2
## 32                            NA                    1.0
## 33                          2.73                    5.8
## 34                          0.41                    4.1
## 35                          0.81                    2.0
## 36                          3.45                    3.1
## 37                          1.80                   13.7
## 38                          1.24                    5.0
## 39                          1.94                    1.9
## 40                          0.80                    1.3
## 41                          1.05                    5.6
## 42                          1.49                    1.8
## 43                          0.64                    1.8
## 44                          0.99                    6.4
```

```
## 45                      0.16                        2.6
## 46                      0.43                        1.0
## 47                      1.30                        1.5
## 48                      0.82                        0.5
## 49                      0.72                        5.8
## 50                      0.64                        6.3
## 51                      1.29                       11.5
## 52                      0.38                        3.0
## 53                      1.57                        0.4
## 54                      0.78                        5.5
## 55                      0.84                        1.8
## 56                      0.83                        0.9
## 57                      0.86                        4.5
## 58                      0.49                        2.9
## 59                      0.52                        0.5
## 60                      0.31                        0.9
## 61                      0.45                        5.4
## 62                      1.30                        2.0
## 63                      0.85                        5.8
## 64                      1.27                        0.9
## 65                      0.46                        0.4
## 66                      1.70                        5.5
## 67                      1.23                        3.5
## 68                      0.93                        4.0
## 69                      0.69                        1.8
## 70                      0.77                        6.7
## 71                      0.99                        3.2
## 72                      1.25                        7.1
## 73                      1.09                        2.8
## 74                      1.18                        5.0
## 75                      2.06                        1.5
## 76                      1.19                        7.8
## 77                      1.35                        2.1
## 78                      0.97                        5.7
## 79                      2.39                        9.0
## 80                      1.09                       12.8
## 81                      1.14                        0.1
## 82                      0.82                        0.0
## 83                      1.33                        0.6
## 84                      0.93                        0.3
## 85                      0.81                        1.8
## 86                      0.78                        0.6
## 87                      0.64                        1.8
## 88                      0.44                        5.1
## 89                      0.95                        2.3
## 90                      1.92                       11.5
## 91                      1.44                        2.4
## 92                      1.68                        7.8
## 93                      1.38                        3.4
## 94                      1.75                        1.8
## 95                      0.64                        2.8
## 96                      1.22                        0.3
## 97                      1.15                        5.9
## 98                      0.57                        1.8
```

```
## 99                     0.30                    3.0
## 100                    2.35                    1.6
## 101                    1.51                    1.1
## 102                    0.54                    0.2
## 103                    0.93                    3.5
## 104                    0.76                    1.0
## 105                    1.18                    1.0
## 106                    1.50                    4.3
## 107                    1.46                   10.0
## 108                    0.96                    6.0
## 109                    0.85                    1.5
## 110                    0.91                   11.0
## 111                    0.72                    7.5
## 112                    1.30                    4.0
## 113                    0.80                    3.0
## 114                    0.90                    1.8
## 115                    1.46                    0.5
```

Create a function to convert ºF to ºC and in (inches) to mm.

```r
fahrenheit_to_celsius = function(fahrenheit_value) {
  (fahrenheit_value-32) * 5/9
}


inches_to_mm = function(inches) {
  inches * 25.4
}


fahrenheit_columns_to_celsius = function(dataframe) {
  fahrenheit_columns = names(dataframe)[grepl("\\.F\\.", names(dataframe))]
  fahrenheit_indices = which(names(dataframe) %in% fahrenheit_columns)
  dataframe[,fahrenheit_indices] = apply(dataframe[,fahrenheit_indices], 2, fahrenheit_to_celsius)
  names(dataframe) = gsub("\\.F\\.", ".C.", names(dataframe))
  dataframe
}


inches_columns_to_mm = function(dataframe) {
  inches_columns = names(dataframe)[grepl("\\.in\\.", names(dataframe))]
  inches_indices = which(names(dataframe) %in% inches_columns)
  dataframe[,inches_indices] = apply(dataframe[,inches_indices], 2, inches_to_mm)
  names(dataframe) = gsub("\\.in\\.", ".mm.", names(dataframe))
  dataframe
}


ex3 = fahrenheit_columns_to_celsius(ex3)
ex3 = inches_columns_to_mm(ex3)
ex3
```

```
##      Year Lowest.Temperature..C. Highest.Temperature..C.
## 1    2014            -15.555556                14.444444
## 2    2013            -11.666667                16.111111
## 3    2012            -10.555556                16.666667
## 4    2011            -14.444444                11.666667
```

15

```
## 5  2010           -10.555556                13.888889
## 6  2009           -14.444444                 8.333333
## 7  2008           -11.111111                17.777778
## 8  2007           -12.777778                22.222222
## 9  2006            -8.888889                17.777778
## 10 2005           -15.000000                18.888889
## 11 2004           -17.222222                14.444444
## 12 2003           -13.888889                10.000000
## 13 2002            -6.111111                20.555556
## 14 2001            -7.777778                12.222222
## 15 2000           -16.111111                17.777778
## 16 1999           -12.777778                15.555556
## 17 1998           -10.000000                18.333333
## 18 1997           -15.555556                16.666667
## 19 1996           -14.444444                13.333333
## 20 1995            -9.444444                17.777778
## 21 1994           -18.888889                12.777778
## 22 1993            -6.111111                17.777778
## 23 1992           -11.666667                16.666667
## 24 1991           -12.222222                12.777778
## 25 1990            -4.444444                18.888889
## 26 1989           -11.666667                16.111111
## 27 1988           -15.000000                11.666667
## 28 1987           -13.333333                13.888889
## 29 1986           -13.333333                17.222222
## 30 1985           -18.888889                14.444444
## 31 1984           -13.333333                13.888889
## 32 1983           -11.111111                14.444444
## 33 1982           -17.777778                14.444444
## 34 1981           -16.666667                 9.444444
## 35 1980            -8.333333                15.555556
## 36 1979           -13.333333                17.222222
## 37 1978           -11.111111                14.444444
## 38 1977           -18.888889                 6.666667
## 39 1976           -18.333333                13.333333
## 40 1975            -9.444444                17.222222
## 41 1974           -14.444444                18.888889
## 42 1973           -12.222222                18.888889
## 43 1972           -15.000000                16.666667
## 44 1971           -15.555556                 7.777778
## 45 1970           -16.111111                10.555556
## 46 1969           -11.666667                 8.888889
## 47 1968           -18.333333                10.000000
## 48 1967           -10.555556                20.000000
## 49 1966           -13.333333                16.666667
## 50 1965           -12.777778                12.777778
## 51 1964           -12.777778                12.777778
## 52 1963           -15.555556                10.555556
## 53 1962           -11.666667                13.333333
## 54 1961           -15.000000                12.777778
## 55 1960            -8.333333                12.222222
## 56 1959           -10.000000                16.111111
## 57 1958           -11.111111                11.666667
## 58 1957           -17.777778                15.555556
```

```
## 59  1956            -10.000000                8.888889
## 60  1955            -10.555556               10.000000
## 61  1954            -13.888889               13.333333
## 62  1953             -6.111111               13.888889
## 63  1952            -13.333333               15.555556
## 64  1951            -11.666667               17.777778
## 65  1950             -8.888889               22.222222
## 66  1949             -6.666667               16.111111
## 67  1948            -17.777778                7.222222
## 68  1947            -11.111111               17.222222
## 69  1946            -15.000000               16.666667
## 70  1945            -16.666667               12.777778
## 71  1944            -11.111111               16.666667
## 72  1943            -12.222222               13.333333
## 73  1942            -15.000000               13.888889
## 74  1941            -12.222222                8.333333
## 75  1940            -13.888889               12.222222
## 76  1939            -14.444444               12.777778
## 77  1938            -14.444444               13.888889
## 78  1937             -3.888889               18.888889
## 79  1936            -19.444444               12.222222
## 80  1935            -18.333333               14.444444
## 81  1934            -14.444444               14.444444
## 82  1933            -10.555556               16.111111
## 83  1932             -4.444444               21.111111
## 84  1931            -11.666667               13.333333
## 85  1930            -12.222222               17.777778
## 86  1929            -13.333333               16.666667
## 87  1928            -11.111111               14.444444
## 88  1927            -18.333333               11.111111
## 89  1926            -15.000000               12.222222
## 90  1925            -18.888889                7.222222
## 91  1924            -15.000000               13.888889
## 92  1923            -12.777778               11.666667
## 93  1922            -13.888889               10.000000
## 94  1921            -15.555556               13.888889
## 95  1920            -18.333333               10.555556
## 96  1919            -12.222222               16.111111
## 97  1918            -20.000000               11.666667
## 98  1917            -13.333333               10.555556
## 99  1916            -13.888889               20.555556
## 100 1915            -11.111111               14.444444
## 101 1914            -20.555556               14.444444
## 102 1913             -7.777778               17.222222
## 103 1912            -19.444444               12.222222
## 104 1911             -7.777778               13.333333
## 105 1910            -15.000000                8.888889
## 106 1909            -15.000000               13.888889
## 107 1908            -13.333333               10.000000
## 108 1907            -15.555556               17.777778
## 109 1906            -10.000000               16.666667
## 110 1905            -15.555556               11.666667
## 111 1904            -20.000000               12.222222
## 112 1903            -12.222222               10.555556
```

```
## 113 1902                 -10.555556                    10.555556
## 114 1901                 -13.333333                    11.666667
## 115 1900                 -12.222222                    13.888889
##      Warmest.Minimum.Temperature..C. Coldest.Minimum.Temperature..C.
## 1                          6.6666667                      -7.7777778
## 2                          6.1111111                      -6.6666667
## 3                          7.7777778                      -2.7777778
## 4                          4.4444444                      -4.4444444
## 5                          9.4444444                      -6.6666667
## 6                          3.3333333                      -8.8888889
## 7                         11.6666667                      -6.6666667
## 8                         12.2222222                      -5.5555556
## 9                          7.2222222                       0.0000000
## 10                         9.4444444                      -7.7777778
## 11                         6.6666667                      -9.4444444
## 12                         3.3333333                      -6.6666667
## 13                        10.0000000                      -0.5555556
## 14                         4.4444444                      -2.7777778
## 15                        10.5555556                      -7.2222222
## 16                         5.0000000                      -5.5555556
## 17                         8.3333333                      -1.6666667
## 18                         6.6666667                      -8.3333333
## 19                         4.4444444                      -7.7777778
## 20                        12.2222222                      -2.7777778
## 21                         1.6666667                     -12.2222222
## 22                         5.0000000                      -2.7777778
## 23                         5.5555556                      -5.0000000
## 24                         6.1111111                      -6.6666667
## 25                         7.7777778                       0.5555556
## 26                         6.6666667                      -3.3333333
## 27                         5.0000000                      -8.3333333
## 28                         7.7777778                      -7.2222222
## 29                         7.2222222                      -5.5555556
## 30                         4.4444444                     -12.7777778
## 31                         3.8888889                      -7.2222222
## 32                         6.1111111                      -6.1111111
## 33                         2.7777778                      -9.4444444
## 34                         4.4444444                     -10.0000000
## 35                         4.4444444                      -2.7777778
## 36                        10.0000000                      -6.6666667
## 37                         2.2222222                      -6.1111111
## 38                        -2.2222222                     -11.1111111
## 39                         2.2222222                      -9.4444444
## 40                         8.8888889                      -1.6666667
## 41                         7.2222222                      -5.0000000
## 42                         7.2222222                      -7.7777778
## 43                         7.2222222                      -9.4444444
## 44                         1.1111111                      -8.8888889
## 45                         5.5555556                     -10.0000000
## 46                         5.5555556                      -4.4444444
## 47                         2.2222222                     -10.5555556
## 48                        12.2222222                      -3.8888889
## 49                        11.1111111                      -7.2222222
## 50                         5.0000000                      -8.8888889
```

```
## 51                    5.0000000                        -5.5555556
## 52                    3.8888889                        -6.6666667
## 53                    5.0000000                        -3.8888889
## 54                    5.5555556                        -7.2222222
## 55                    3.3333333                        -2.2222222
## 56                    3.3333333                        -5.5555556
## 57                    3.8888889                        -5.0000000
## 58                    6.1111111                       -11.1111111
## 59                    6.1111111                        -2.2222222
## 60                    4.4444444                        -4.4444444
## 61                    5.0000000                        -6.1111111
## 62                    9.4444444                         0.5555556
## 63                    7.2222222                        -5.0000000
## 64                    8.3333333                        -2.7777778
## 65                   15.0000000                        -0.5555556
## 66                    6.1111111                        -1.1111111
## 67                    0.5555556                        -7.7777778
## 68                    5.5555556                        -5.0000000
## 69                   12.2222222                        -3.3333333
## 70                    0.5555556                        -9.4444444
## 71                    3.3333333                        -5.0000000
## 72                    3.3333333                        -3.8888889
## 73                    6.1111111                       -10.0000000
## 74                    2.2222222                        -3.8888889
## 75                    2.2222222                        -7.2222222
## 76                    6.6666667                        -7.7777778
## 77                    5.5555556                        -8.3333333
## 78                   10.0000000                         0.0000000
## 79                    2.7777778                        -8.8888889
## 80                    8.3333333                        -8.8888889
## 81                    5.0000000                        -8.8888889
## 82                    8.8888889                        -2.2222222
## 83                   13.3333333                         0.5555556
## 84                    5.0000000                        -4.4444444
## 85                   11.1111111                        -5.5555556
## 86                    3.3333333                        -4.4444444
## 87                    6.6666667                        -4.4444444
## 88                    4.4444444                        -5.5555556
## 89                    4.4444444                        -5.0000000
## 90                    0.5555556                       -10.0000000
## 91                    4.4444444                        -7.7777778
## 92                    6.6666667                        -6.1111111
## 93                    2.7777778                        -8.8888889
## 94                    5.5555556                        -8.8888889
## 95                    2.2222222                       -10.0000000
## 96                    6.1111111                        -3.3333333
## 97                   -1.6666667                       -12.2222222
## 98                    4.4444444                        -6.6666667
## 99                   11.6666667                        -6.1111111
## 100                   8.3333333                        -4.4444444
## 101                   5.5555556                       -12.7777778
## 102                   7.2222222                        -1.6666667
## 103                   3.3333333                       -13.3333333
## 104                   9.4444444                        -3.3333333
```

```
## 105                               4.4444444                            -2.7777778
## 106                               9.4444444                            -4.4444444
## 107                               5.0000000                            -7.7777778
## 108                               9.4444444                            -6.6666667
## 109                              10.0000000                            -1.6666667
## 110                               5.5555556                            -8.8888889
## 111                               3.8888889                           -10.5555556
## 112                               3.8888889                            -6.1111111
## 113                               4.4444444                            -6.1111111
## 114                               3.3333333                            -2.7777778
## 115                               7.7777778                            -6.6666667
##      Average.Minimum.Temperature..C. Average.Maximum.Temperature..C.
## 1                        -5.66666667                       1.7777778
## 2                        -1.50000000                       4.8888889
## 3                        -1.00000000                       6.7777778
## 4                        -4.11111111                       1.5000000
## 5                        -2.77777778                       3.3888889
## 6                        -5.33333333                       0.8333333
## 7                        -0.77777778                       5.7777778
## 8                        -0.33333333                       6.4444444
## 9                         1.22222222                       8.6111111
## 10                       -3.77777778                       3.0000000
## 11                       -7.50000000                      -0.5555556
## 12                       -5.50000000                       0.5000000
## 13                        1.38888889                       7.4444444
## 14                       -1.94444444                       3.7777778
## 15                       -4.05555556                       3.2777778
## 16                       -2.77777778                       4.8888889
## 17                        1.22222222                       7.6666667
## 18                       -3.83333333                       4.0000000
## 19                       -4.44444444                       2.7777778
## 20                       -0.05555556                       6.1666667
## 21                       -7.83333333                       0.6666667
## 22                       -1.05555556                       5.8333333
## 23                       -1.72222222                       5.8333333
## 24                       -1.94444444                       5.1111111
## 25                        1.77777778                       8.6111111
## 26                       -0.72222222                       6.6666667
## 27                       -4.88888889                       2.1111111
## 28                       -2.72222222                       3.0555556
## 29                       -2.55555556                       4.8888889
## 30                       -5.00000000                       1.4444444
## 31                       -4.11111111                       1.7222222
## 32                       -1.44444444                       4.2222222
## 33                       -6.88888889                       0.2777778
## 34                       -6.55555556                       0.1666667
## 35                       -2.22222222                       4.1111111
## 36                       -2.83333333                       4.5555556
## 37                       -5.55555556                       1.0555556
## 38                       -8.66666667                      -2.3888889
## 39                       -6.38888889                       1.2222222
## 40                       -0.38888889                       6.2777778
## 41                       -1.61111111                       5.2222222
## 42                       -1.77777778                       5.6111111
```

```
## 43                   -2.22222222                        5.6111111
## 44                   -6.22222222                        0.6111111
## 45                   -7.38888889                       -0.2777778
## 46                   -3.16666667                        2.9444444
## 47                   -6.61111111                        0.7222222
## 48                   -0.27777778                        6.2222222
## 49                   -3.50000000                        3.6666667
## 50                   -4.61111111                        2.0000000
## 51                   -1.38888889                        5.4444444
## 52                   -4.44444444                        2.3333333
## 53                   -3.61111111                        4.2222222
## 54                   -5.61111111                        0.8333333
## 55                   -1.77777778                        3.8333333
## 56                   -4.27777778                        3.3333333
## 57                   -3.16666667                        3.0555556
## 58                   -5.44444444                        1.5555556
## 59                   -2.94444444                        2.9444444
## 60                   -3.77777778                        2.6111111
## 61                   -4.72222222                        3.3888889
## 62                   -0.11111111                        6.3333333
## 63                   -1.72222222                        6.3333333
## 64                   -1.44444444                        6.9444444
## 65                    1.22222222                        9.2222222
## 66                    0.33333333                        7.0000000
## 67                   -7.05555556                       -0.4444444
## 68                   -1.00000000                        6.7222222
## 69                   -2.77777778                        5.1111111
## 70                   -7.83333333                        0.2777778
## 71                   -2.33333333                        4.4444444
## 72                   -4.27777778                        2.8888889
## 73                   -4.50000000                        3.0555556
## 74                   -4.88888889                        2.0000000
## 75                   -7.27777778                       -0.5555556
## 76                   -3.05555556                        3.2222222
## 77                   -3.38888889                        3.5000000
## 78                    0.94444444                        8.2777778
## 79                   -4.83333333                        1.8333333
## 80                   -5.77777778                        2.2777778
## 81                   -1.94444444                        4.8888889
## 82                    1.11111111                        8.1111111
## 83                    3.16666667                        9.2222222
## 84                   -3.16666667                        4.0000000
## 85                   -2.77777778                        4.1666667
## 86                   -3.88888889                        3.7777778
## 87                   -2.83333333                        5.0000000
## 88                   -4.44444444                        3.2222222
## 89                   -3.50000000                        3.4444444
## 90                   -5.55555556                        1.5555556
## 91                   -3.94444444                        4.6666667
## 92                   -4.66666667                        2.3888889
## 93                   -5.61111111                        1.3333333
## 94                   -3.50000000                        4.8888889
## 95                   -8.83333333                       -0.6666667
## 96                   -1.44444444                        5.4444444
```

```
## 97                        -9.11111111                           -2.3888889
## 98                        -3.27777778                            4.2222222
## 99                        -2.05555556                            6.4444444
## 100                       -1.83333333                            4.5555556
## 101                       -4.00000000                            3.4444444
## 102                        0.83333333                            9.0555556
## 103                       -8.38888889                           -0.8333333
## 104                       -0.77777778                            5.5000000
## 105                       -3.50000000                            3.0000000
## 106                       -2.16666667                            4.8888889
## 107                       -3.22222222                            4.1111111
## 108                       -2.22222222                            5.4444444
## 109                        0.72222222                            6.3888889
## 110                       -4.66666667                            1.6111111
## 111                       -6.94444444                           -0.5000000
## 112                       -4.27777778                            2.6111111
## 113                       -4.05555556                            2.3888889
## 114                       -2.88888889                            3.4444444
## 115                       -3.61111111                            3.7777778
##      Mean.Temperature..C. Total.Precipitation..mm. Total.Snowfall..mm.
## 1            -1.94444444                   59.436             487.68
## 2             1.72222222                   70.104              38.10
## 3             2.88888889                   82.042             109.22
## 4            -1.27777778                  125.222             914.40
## 5             0.27777778                   52.832              53.34
## 6            -2.27777778                   75.692             228.60
## 7             2.50000000                   72.390               0.00
## 8             3.05555556                   92.202              66.04
## 9             4.94444444                  126.746              50.80
## 10           -0.38888889                  118.618             388.62
## 11           -4.05555556                   54.102             439.42
## 12           -2.50000000                   58.420             119.38
## 13            4.38888889                   49.022              88.90
## 14            0.88888889                   80.264             210.82
## 15           -0.38888889                   82.042             241.30
## 16            1.05555556                  178.308             114.30
## 17            4.44444444                  132.080              12.70
## 18            0.05555556                   92.710             111.76
## 19           -0.83333333                  143.256             662.94
## 20            3.05555556                   95.250               5.08
## 21           -3.61111111                  142.748             304.80
## 22            2.38888889                   87.376              38.10
## 23            2.05555556                   42.672              38.10
## 24            1.61111111                   85.852             213.36
## 25            5.22222222                  135.636              22.86
## 26            3.00000000                   58.166             127.00
## 27           -1.38888889                   92.456             353.06
## 28            0.16666667                  147.574             345.44
## 29            1.16666667                  107.442              55.88
## 30           -1.77777778                   25.400             213.36
## 31           -1.16666667                   47.498             297.18
## 32            1.38888889                       NA              48.26
## 33           -3.27777778                  164.084             299.72
## 34           -3.22222222                   14.732             203.20
```

```
## 35        0.94444444            43.688              50.80
## 36        0.83333333           267.208             167.64
## 37       -2.22222222           210.058             863.60
## 38       -5.55555556            57.150             330.20
## 39       -2.61111111           146.812             142.24
## 40        2.94444444           120.904              50.80
## 41        1.77777778            96.520             340.36
## 42        1.94444444           115.062              45.72
## 43        1.66666667            61.214              71.12
## 44       -2.83333333            67.818             289.56
## 45       -3.83333333            16.764             213.36
## 46       -0.11111111            27.940              25.40
## 47       -2.94444444            51.816              91.44
## 48        2.94444444            35.306              35.56
## 49        0.11111111            66.802             294.64
## 50       -1.33333333            78.486             375.92
## 51        2.00000000           117.348             337.82
## 52       -1.05555556            49.022             134.62
## 53        0.33333333            66.548              15.24
## 54       -2.38888889            47.752             424.18
## 55        1.05555556            60.960              63.50
## 56       -0.44444444            59.436              38.10
## 57       -0.05555556            96.266             233.68
## 58       -1.94444444            43.180             226.06
## 59        0.00000000            39.116              30.48
## 60       -0.61111111            19.558              66.04
## 61       -0.66666667            41.910             322.58
## 62        3.11111111           124.460             104.14
## 63        2.33333333           116.332             154.94
## 64        2.72222222            84.074              22.86
## 65        5.22222222            55.626              10.16
## 66        3.66666667           151.892             172.72
## 67       -3.77777778           144.018             388.62
## 68        2.83333333            69.596             139.70
## 69        1.16666667            47.244             106.68
## 70       -3.77777778            56.896             312.42
## 71        1.05555556            81.280             121.92
## 72       -0.72222222            62.484             241.30
## 73       -0.72222222            73.152             162.56
## 74       -1.44444444            82.042             233.68
## 75       -3.88888889            66.294              88.90
## 76        0.05555556            96.520             261.62
## 77        0.05555556           101.346             165.10
## 78        4.61111111           144.018             165.10
## 79       -1.50000000           175.260             307.34
## 80       -1.77777778            99.314             599.44
## 81        1.44444444            86.868               2.54
## 82        4.66666667            45.212               0.00
## 83        6.22222222           113.030              20.32
## 84        0.38888889            65.024              12.70
## 85        0.72222222            60.198              88.90
## 86       -0.05555556            84.582              58.42
## 87        1.11111111            47.498              68.58
## 88       -0.61111111            51.562             144.78
```

```
## 89           0.00000000             72.390            78.74
## 90          -2.00000000            137.668           695.96
## 91           0.33333333            124.460            63.50
## 92          -1.16666667            177.546           622.30
## 93          -2.11111111             69.342           238.76
## 94           0.66666667             69.596            88.90
## 95          -4.77777778             53.086           208.28
## 96           2.00000000             89.154             7.62
## 97          -5.72222222             89.662           335.28
## 98           0.44444444             75.184           147.32
## 99           2.22222222             32.512            86.36
## 100          1.38888889            201.676            96.52
## 101         -0.27777778            133.858            33.02
## 102          4.88888889             87.122             7.62
## 103         -4.61111111             65.024           330.20
## 104          2.33333333             70.866            33.02
## 105         -0.27777778            117.856            53.34
## 106          1.38888889             84.328           289.56
## 107          0.50000000             95.504           254.00
## 108          1.61111111             73.406           279.40
## 109          3.55555556             68.326            38.10
## 110         -1.55555556             70.358           467.36
## 111         -3.72222222             75.438           281.94
## 112         -0.83333333            106.172           114.30
## 113         -0.66666667             57.658           154.94
## 114          0.33333333             42.164            50.80
## 115          0.22222222            107.188            25.40
##      Max.24hr.Precipitation..mm. Max.24hr.Snowfall..mm.
## 1                         12.700                 279.40
## 2                         22.860                  38.10
## 3                         35.052                 109.22
## 4                         32.766                 312.42
## 5                         31.750                  33.02
## 6                         30.226                  76.20
## 7                         32.766                   0.00
## 8                         38.608                  25.40
## 9                         29.718                  50.80
## 10                        26.162                 215.90
## 11                        14.224                 152.40
## 12                        38.608                  25.40
## 13                        15.748                  76.20
## 14                        21.082                 152.40
## 15                        21.336                 139.70
## 16                        61.468                  63.50
## 17                        64.770                  12.70
## 18                        31.242                  88.90
## 19                        35.560                 345.44
## 20                        35.814                   5.08
## 21                        47.498                 114.30
## 22                        36.068                  27.94
## 23                        12.700                  33.02
## 24                        21.590                 144.78
## 25                        28.194                  20.32
## 26                        15.240                 127.00
```

```
## 27                   20.320                 132.08
## 28                   42.672                 205.74
## 29                   55.626                  35.56
## 30                    7.620                 104.14
## 31                   15.240                 106.68
## 32                       NA                  25.40
## 33                   69.342                 147.32
## 34                   10.414                 104.14
## 35                   20.574                  50.80
## 36                   87.630                  78.74
## 37                   45.720                 347.98
## 38                   31.496                 127.00
## 39                   49.276                  48.26
## 40                   20.320                  33.02
## 41                   26.670                 142.24
## 42                   37.846                  45.72
## 43                   16.256                  45.72
## 44                   25.146                 162.56
## 45                    4.064                  66.04
## 46                   10.922                  25.40
## 47                   33.020                  38.10
## 48                   20.828                  12.70
## 49                   18.288                 147.32
## 50                   16.256                 160.02
## 51                   32.766                 292.10
## 52                    9.652                  76.20
## 53                   39.878                  10.16
## 54                   19.812                 139.70
## 55                   21.336                  45.72
## 56                   21.082                  22.86
## 57                   21.844                 114.30
## 58                   12.446                  73.66
## 59                   13.208                  12.70
## 60                    7.874                  22.86
## 61                   11.430                 137.16
## 62                   33.020                  50.80
## 63                   21.590                 147.32
## 64                   32.258                  22.86
## 65                   11.684                  10.16
## 66                   43.180                 139.70
## 67                   31.242                  88.90
## 68                   23.622                 101.60
## 69                   17.526                  45.72
## 70                   19.558                 170.18
## 71                   25.146                  81.28
## 72                   31.750                 180.34
## 73                   27.686                  71.12
## 74                   29.972                 127.00
## 75                   52.324                  38.10
## 76                   30.226                 198.12
## 77                   34.290                  53.34
## 78                   24.638                 144.78
## 79                   60.706                 228.60
## 80                   27.686                 325.12
```

```
## 81                    28.956                 2.54
## 82                    20.828                 0.00
## 83                    33.782                15.24
## 84                    23.622                 7.62
## 85                    20.574                45.72
## 86                    19.812                15.24
## 87                    16.256                45.72
## 88                    11.176               129.54
## 89                    24.130                58.42
## 90                    48.768               292.10
## 91                    36.576                60.96
## 92                    42.672               198.12
## 93                    35.052                86.36
## 94                    44.450                45.72
## 95                    16.256                71.12
## 96                    30.988                 7.62
## 97                    29.210               149.86
## 98                    14.478                45.72
## 99                     7.620                76.20
## 100                   59.690                40.64
## 101                   38.354                27.94
## 102                   13.716                 5.08
## 103                   23.622                88.90
## 104                   19.304                25.40
## 105                   29.972                25.40
## 106                   38.100               109.22
## 107                   37.084               254.00
## 108                   24.384               152.40
## 109                   21.590                38.10
## 110                   23.114               279.40
## 111                   18.288               190.50
## 112                   33.020               101.60
## 113                   20.320                76.20
## 114                   22.860                45.72
## 115                   37.084                12.70
```

Plot Year vs. Warmest Minimum Temperature.

```
ggplot(ex3, aes(Year, Warmest.Minimum.Temperature..C.)) + geom_line(col="red")
```
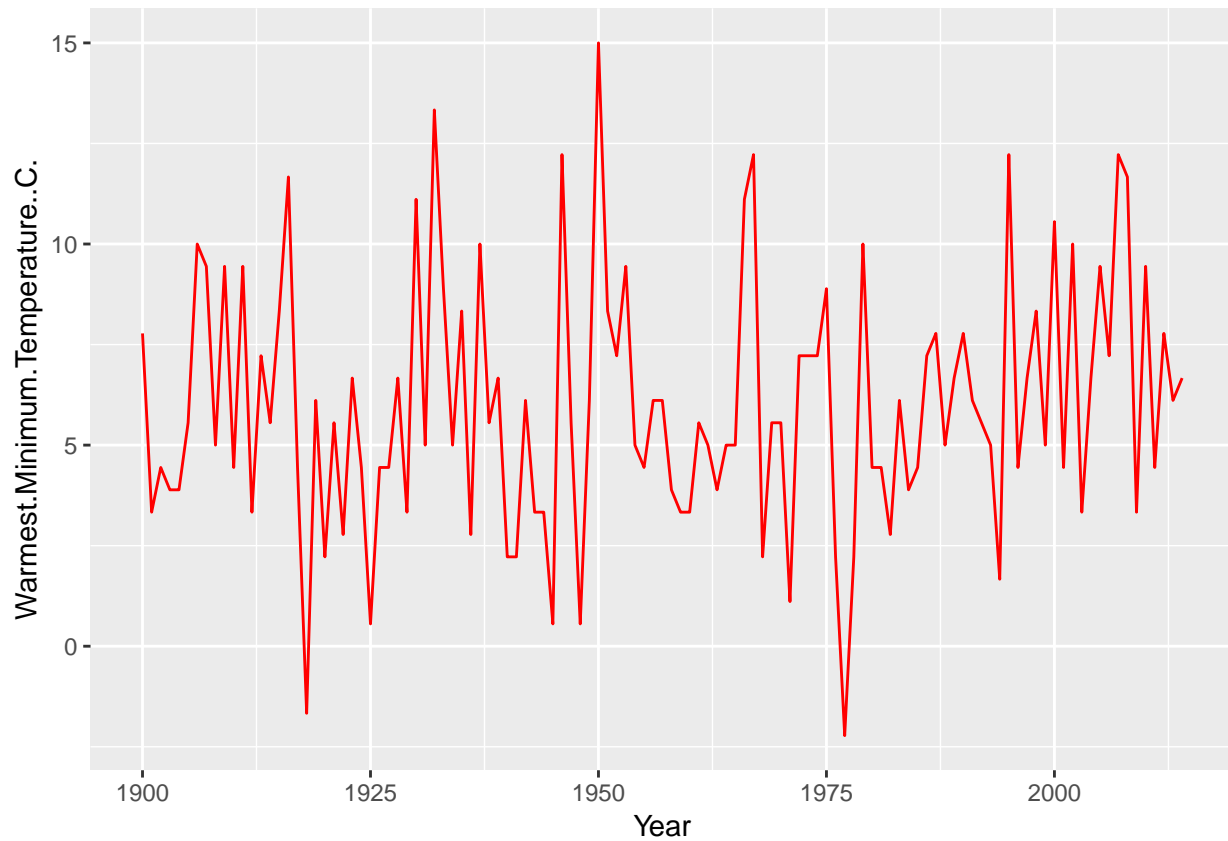
Plot Year vs. Warmest Minimum Temperature and Coldest Minimum Temperature. Don't forget to add a legend!

```
ggplot(ex3, aes(x = Year)) +
  geom_line(aes(y = Coldest.Minimum.Temperature..C., colour = "Coldest")) +
  geom_line(aes(y = Warmest.Minimum.Temperature..C., colour = "Warmest")) +
  scale_color_manual(name = "Temperature", values = c("blue", "red")) +
  labs(x = "Year", y = "Temperature (C)")
```