Homework 05 CSCI 036 Solutions

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Due: Friday, 2022-10-14

Instructions

Please box your answers. For numerical answers, this can be done using something like $\boxed{34}$. For text answers, this can be done using something like $\boxed{\text{My answer}}$. The output of a code chunk is automatically boxed, so no need to do more.

The `PlantGrowth` dataset built into R give the results of the dried weight of plants obtained under a control (where no treatment was given), and two different treatments.

a. Find the overall average weight of the plants for all observations.

b. Find the average weight of the plants for each of the three treatment conditions.

```
PlantGrowth
```

```
##    weight group
## 1    4.17  ctrl
## 2    5.58  ctrl
## 3    5.18  ctrl
## 4    6.11  ctrl
## 5    4.50  ctrl
## 6    4.61  ctrl
## 7    5.17  ctrl
## 8    4.53  ctrl
## 9    5.33  ctrl
## 10   5.14  ctrl
## 11   4.81  trt1
## 12   4.17  trt1
## 13   4.41  trt1
## 14   3.59  trt1
## 15   5.87  trt1
## 16   3.83  trt1
## 17   6.03  trt1
## 18   4.89  trt1
## 19   4.32  trt1
## 20   4.69  trt1
## 21   6.31  trt2
## 22   5.12  trt2
## 23   5.54  trt2
## 24   5.50  trt2
## 25   5.37  trt2
## 26   5.29  trt2
## 27   4.92  trt2
## 28   6.15  trt2
## 29   5.80  trt2
## 30   5.26  trt2
```

a.

```
PlantGrowth |>
  summarize(avg_weight = mean(weight))
```

```
##   avg_weight
## 1      5.073
```

b.

```
PlantGrowth |>
  group_by(group)|>
  summarize(avg_weight = mean(weight))
```

```
## # A tibble: 3 × 2
##   group avg_weight
##   <fct>      <dbl>
## 1 ctrl        5.03
## 2 trt1        4.66
## 3 trt2        5.53
```

The `attenu` dataset built into R gives peak accelerations measured at various observation stations for earthquakes in California.

a. How many observations are there in the whole dataset?

b. The earthquakes are measured by event number. Create a tibble that holds for each earthquake the number of stations that measured that earthquake.

c. What was the event number of the earthquake that was measured by the most stations?

```
attenu
```

```
##     event mag station  dist accel
## 1       1 7.0     117  12.0 0.359
## 2       2 7.4    1083 148.0 0.014
## 3       2 7.4    1095  42.0 0.196
## 4       2 7.4     283  85.0 0.135
## 5       2 7.4     135 107.0 0.062
## 6       2 7.4     475 109.0 0.054
## 7       2 7.4     113 156.0 0.014
## 8       2 7.4    1008 224.0 0.018
## 9       2 7.4    1028 293.0 0.010
## 10      2 7.4    2001 359.0 0.004
## 11      2 7.4     117 370.0 0.004
## 12      3 5.3    1117   8.0 0.127
## 13      4 6.1    1438  16.1 0.411
## 14      4 6.1    1083  63.6 0.018
## 15      4 6.1    1013   6.6 0.509
## 16      4 6.1    1014   9.3 0.467
## 17      4 6.1    1015  13.0 0.279
## 18      4 6.1    1016  17.3 0.072
## 19      4 6.1    1095 105.0 0.012
## 20      4 6.1    1011 112.0 0.006
## 21      4 6.1    1028 123.0 0.003
## 22      5 6.6     270 105.0 0.018
## 23      5 6.6     280 122.0 0.048
## 24      5 6.6     116 141.0 0.011
## 25      5 6.6     266 200.0 0.007
## 26      5 6.6     117  45.0 0.142
## 27      5 6.6     113 130.0 0.031
## 28      5 6.6     112 147.0 0.006
## 29      5 6.6     130 187.0 0.010
## 30      5 6.6     475 197.0 0.010
## 31      5 6.6     269 203.0 0.006
## 32      5 6.6     135 211.0 0.013
## 33      6 5.6    1093  62.0 0.005
## 34      7 5.7    1093  62.0 0.003
## 35      8 5.3     111  19.0 0.086
## 36      8 5.3     116  21.0 0.179
## 37      8 5.3     290  13.0 0.205
## 38      8 5.3     112  22.0 0.073
## 39      8 5.3     113  29.0 0.045
## 40      9 6.6     128  17.0 0.374
## 41      9 6.6     126  19.6 0.200
## 42      9 6.6     127  20.2 0.147
## 43      9 6.6     141  21.1 0.188
## 44      9 6.6     266  21.9 0.204
## 45      9 6.6     110  24.2 0.335
## 46      9 6.6    1027  66.0 0.057
## 47      9 6.6     111  87.0 0.021
## 48      9 6.6     125  23.4 0.152
## 49      9 6.6     135  24.6 0.217
## 50      9 6.6     475  25.7 0.114
## 51      9 6.6     262  28.6 0.150
## 52      9 6.6     269  37.4 0.148
## 53      9 6.6    1052  46.7 0.112
## 54      9 6.6     411  56.9 0.043
## 55      9 6.6     290  60.7 0.057
## 56      9 6.6     130  61.4 0.030
## 57      9 6.6     272  62.0 0.027
## 58      9 6.6    1096  64.0 0.028
## 59      9 6.6    1102  82.0 0.034
## 60      9 6.6     112  88.0 0.030
## 61      9 6.6     113  91.0 0.039
```

```
## 62      10 5.3    1028  31.0 0.030
## 63      11 7.7    2714  45.0 0.110
## 64      11 7.7    2708 145.0 0.010
## 65      11 7.7    2715 300.0 0.010
## 66      12 6.2    3501   5.0 0.390
## 67      13 5.6     655  50.0 0.031
## 68      13 5.6     272  16.0 0.130
## 69      14 5.2    1032  17.0 0.011
## 70      14 5.2    1377   8.0 0.120
## 71      14 5.2    1028  10.0 0.170
## 72      14 5.2    1250  10.0 0.140
## 73      15 6.0    1051   8.0 0.110
## 74      15 6.0    1293  32.0 0.040
## 75      15 6.0    1291  30.0 0.070
## 76      15 6.0    1292  31.0 0.080
## 77      16 5.1     283   2.9 0.210
## 78      16 5.1     885   3.2 0.390
## 79      16 5.1    <NA>   7.6 0.280
## 80      17 7.6    2734  25.4 0.160
## 81      17 7.6    <NA>  32.9 0.064
## 82      17 7.6    2728  92.2 0.090
## 83      18 5.8    1413   1.2 0.420
## 84      18 5.8    1445   1.6 0.230
## 85      18 5.8    1408   9.1 0.130
## 86      18 5.8    1411   3.7 0.260
## 87      18 5.8    1410   5.3 0.270
## 88      18 5.8    1409   7.4 0.260
## 89      18 5.8    1377  17.9 0.110
## 90      18 5.8    1492  19.2 0.120
## 91      18 5.8    1251  23.4 0.038
## 92      18 5.8    1422  30.0 0.044
## 93      18 5.8    1376  38.9 0.046
## 94      19 6.5    <NA>  23.5 0.170
## 95      19 6.5     286  26.0 0.210
## 96      19 6.5    <NA>   0.5 0.320
## 97      19 6.5    5028   0.6 0.520
## 98      19 6.5     942   1.3 0.720
## 99      19 6.5    <NA>   1.4 0.320
## 100     19 6.5    5054   2.6 0.810
## 101     19 6.5     958   3.8 0.640
## 102     19 6.5     952   4.0 0.560
## 103     19 6.5    5165   5.1 0.510
## 104     19 6.5     117   6.2 0.400
## 105     19 6.5     955   6.8 0.610
## 106     19 6.5    5055   7.5 0.260
## 107     19 6.5    <NA>   7.6 0.240
## 108     19 6.5    <NA>   8.4 0.460
## 109     19 6.5    5060   8.5 0.220
## 110     19 6.5     412   8.5 0.230
## 111     19 6.5    5053  10.6 0.280
## 112     19 6.5    5058  12.6 0.380
## 113     19 6.5    5057  12.7 0.270
## 114     19 6.5    <NA>  12.9 0.310
## 115     19 6.5    5051  14.0 0.200
## 116     19 6.5    <NA>  15.0 0.110
## 117     19 6.5    5115  16.0 0.430
## 118     19 6.5    <NA>  17.7 0.270
## 119     19 6.5     931  18.0 0.150
## 120     19 6.5    5056  22.0 0.150
## 121     19 6.5    5059  22.0 0.150
## 122     19 6.5    5061  23.0 0.130
## 123     19 6.5    <NA>  23.2 0.190
```

```
## 124     19 6.5    5062  29.0 0.130
## 125     19 6.5    5052  32.0 0.066
## 126     19 6.5    <NA>  32.7 0.350
## 127     19 6.5     724  36.0 0.100
## 128     19 6.5    <NA>  43.5 0.160
## 129     19 6.5    5066  49.0 0.140
## 130     19 6.5    5050  60.0 0.049
## 131     19 6.5    2316  64.0 0.034
## 132     20 5.0    5055   7.5 0.264
## 133     20 5.0     942   8.8 0.263
## 134     20 5.0    5028   8.9 0.230
## 135     20 5.0    5165   9.4 0.147
## 136     20 5.0     952   9.7 0.286
## 137     20 5.0     958   9.7 0.157
## 138     20 5.0     955  10.5 0.237
## 139     20 5.0     117  10.5 0.133
## 140     20 5.0     412  12.0 0.055
## 141     20 5.0    5053  12.2 0.097
## 142     20 5.0    5054  12.8 0.129
## 143     20 5.0    5058  14.6 0.192
## 144     20 5.0    5057  14.9 0.147
## 145     20 5.0    5115  17.6 0.154
## 146     20 5.0    5056  23.9 0.060
## 147     20 5.0    5060  25.0 0.057
## 148     21 5.8    1030  10.8 0.120
## 149     21 5.8    1418  15.7 0.154
## 150     21 5.8    1383  16.7 0.052
## 151     21 5.8    1308  20.8 0.045
## 152     21 5.8    1298  28.5 0.086
## 153     21 5.8    1299  33.1 0.056
## 154     21 5.8    1219  40.3 0.065
## 155     22 5.5    <NA>   4.0 0.259
## 156     22 5.5    <NA>  10.1 0.267
## 157     22 5.5    1030  11.1 0.071
## 158     22 5.5    1418  17.7 0.275
## 159     22 5.5    1383  22.5 0.058
## 160     22 5.5    <NA>  26.5 0.026
## 161     22 5.5    1299  29.0 0.039
## 162     22 5.5    1308  30.9 0.112
## 163     22 5.5    1219  37.8 0.065
## 164     22 5.5    1456  48.3 0.026
## 165     23 5.3    5045   5.8 0.123
## 166     23 5.3    5044  12.0 0.133
## 167     23 5.3    5160  12.1 0.073
## 168     23 5.3    5043  20.5 0.097
## 169     23 5.3    5047  20.5 0.096
## 170     23 5.3    c168  25.3 0.230
## 171     23 5.3    5068  35.9 0.082
## 172     23 5.3    c118  36.1 0.110
## 173     23 5.3    5042  36.3 0.110
## 174     23 5.3    5067  38.5 0.094
## 175     23 5.3    5049  41.4 0.040
## 176     23 5.3    c204  43.6 0.050
## 177     23 5.3    5070  44.4 0.022
## 178     23 5.3    c266  46.1 0.070
## 179     23 5.3    c203  47.1 0.080
## 180     23 5.3    5069  47.7 0.033
## 181     23 5.3    5073  49.2 0.017
## 182     23 5.3    5072  53.1 0.022
```

```
attenu
```

```
##      event mag station  dist accel
## 1        1 7.0     117  12.0 0.359
## 2        2 7.4    1083 148.0 0.014
## 3        2 7.4    1095  42.0 0.196
## 4        2 7.4     283  85.0 0.135
## 5        2 7.4     135 107.0 0.062
## 6        2 7.4     475 109.0 0.054
## 7        2 7.4     113 156.0 0.014
## 8        2 7.4    1008 224.0 0.018
## 9        2 7.4    1028 293.0 0.010
## 10       2 7.4    2001 359.0 0.004
## 11       2 7.4     117 370.0 0.004
## 12       3 5.3    1117   8.0 0.127
## 13       4 6.1    1438  16.1 0.411
## 14       4 6.1    1083  63.6 0.018
## 15       4 6.1    1013   6.6 0.509
## 16       4 6.1    1014   9.3 0.467
## 17       4 6.1    1015  13.0 0.279
## 18       4 6.1    1016  17.3 0.072
## 19       4 6.1    1095 105.0 0.012
## 20       4 6.1    1011 112.0 0.006
## 21       4 6.1    1028 123.0 0.003
## 22       5 6.6     270 105.0 0.018
## 23       5 6.6     280 122.0 0.048
## 24       5 6.6     116 141.0 0.011
## 25       5 6.6     266 200.0 0.007
## 26       5 6.6     117  45.0 0.142
## 27       5 6.6     113 130.0 0.031
## 28       5 6.6     112 147.0 0.006
## 29       5 6.6     130 187.0 0.010
## 30       5 6.6     475 197.0 0.010
## 31       5 6.6     269 203.0 0.006
## 32       5 6.6     135 211.0 0.013
## 33       6 5.6    1093  62.0 0.005
## 34       7 5.7    1093  62.0 0.003
## 35       8 5.3     111  19.0 0.086
## 36       8 5.3     116  21.0 0.179
## 37       8 5.3     290  13.0 0.205
## 38       8 5.3     112  22.0 0.073
## 39       8 5.3     113  29.0 0.045
## 40       9 6.6     128  17.0 0.374
## 41       9 6.6     126  19.6 0.200
## 42       9 6.6     127  20.2 0.147
## 43       9 6.6     141  21.1 0.188
## 44       9 6.6     266  21.9 0.204
## 45       9 6.6     110  24.2 0.335
## 46       9 6.6    1027  66.0 0.057
## 47       9 6.6     111  87.0 0.021
## 48       9 6.6     125  23.4 0.152
## 49       9 6.6     135  24.6 0.217
## 50       9 6.6     475  25.7 0.114
## 51       9 6.6     262  28.6 0.150
## 52       9 6.6     269  37.4 0.148
## 53       9 6.6    1052  46.7 0.112
## 54       9 6.6     411  56.9 0.043
## 55       9 6.6     290  60.7 0.057
## 56       9 6.6     130  61.4 0.030
## 57       9 6.6     272  62.0 0.027
## 58       9 6.6    1096  64.0 0.028
## 59       9 6.6    1102  82.0 0.034
## 60       9 6.6     112  88.0 0.030
## 61       9 6.6     113  91.0 0.039
```

```
## 62      10 5.3    1028  31.0 0.030
## 63      11 7.7    2714  45.0 0.110
## 64      11 7.7    2708 145.0 0.010
## 65      11 7.7    2715 300.0 0.010
## 66      12 6.2    3501   5.0 0.390
## 67      13 5.6     655  50.0 0.031
## 68      13 5.6     272  16.0 0.130
## 69      14 5.2    1032  17.0 0.011
## 70      14 5.2    1377   8.0 0.120
## 71      14 5.2    1028  10.0 0.170
## 72      14 5.2    1250  10.0 0.140
## 73      15 6.0    1051   8.0 0.110
## 74      15 6.0    1293  32.0 0.040
## 75      15 6.0    1291  30.0 0.070
## 76      15 6.0    1292  31.0 0.080
## 77      16 5.1     283   2.9 0.210
## 78      16 5.1     885   3.2 0.390
## 79      16 5.1    <NA>   7.6 0.280
## 80      17 7.6    2734  25.4 0.160
## 81      17 7.6    <NA>  32.9 0.064
## 82      17 7.6    2728  92.2 0.090
## 83      18 5.8    1413   1.2 0.420
## 84      18 5.8    1445   1.6 0.230
## 85      18 5.8    1408   9.1 0.130
## 86      18 5.8    1411   3.7 0.260
## 87      18 5.8    1410   5.3 0.270
## 88      18 5.8    1409   7.4 0.260
## 89      18 5.8    1377  17.9 0.110
## 90      18 5.8    1492  19.2 0.120
## 91      18 5.8    1251  23.4 0.038
## 92      18 5.8    1422  30.0 0.044
## 93      18 5.8    1376  38.9 0.046
## 94      19 6.5    <NA>  23.5 0.170
## 95      19 6.5     286  26.0 0.210
## 96      19 6.5    <NA>   0.5 0.320
## 97      19 6.5    5028   0.6 0.520
## 98      19 6.5     942   1.3 0.720
## 99      19 6.5    <NA>   1.4 0.320
## 100     19 6.5    5054   2.6 0.810
## 101     19 6.5     958   3.8 0.640
## 102     19 6.5     952   4.0 0.560
## 103     19 6.5    5165   5.1 0.510
## 104     19 6.5     117   6.2 0.400
## 105     19 6.5     955   6.8 0.610
## 106     19 6.5    5055   7.5 0.260
## 107     19 6.5    <NA>   7.6 0.240
## 108     19 6.5    <NA>   8.4 0.460
## 109     19 6.5    5060   8.5 0.220
## 110     19 6.5     412   8.5 0.230
## 111     19 6.5    5053  10.6 0.280
## 112     19 6.5    5058  12.6 0.380
## 113     19 6.5    5057  12.7 0.270
## 114     19 6.5    <NA>  12.9 0.310
## 115     19 6.5    5051  14.0 0.200
## 116     19 6.5    <NA>  15.0 0.110
## 117     19 6.5    5115  16.0 0.430
## 118     19 6.5    <NA>  17.7 0.270
## 119     19 6.5     931  18.0 0.150
## 120     19 6.5    5056  22.0 0.150
## 121     19 6.5    5059  22.0 0.150
## 122     19 6.5    5061  23.0 0.130
## 123     19 6.5    <NA>  23.2 0.190
```

```
## 124     19 6.5    5062  29.0 0.130
## 125     19 6.5    5052  32.0 0.066
## 126     19 6.5    <NA>  32.7 0.350
## 127     19 6.5     724  36.0 0.100
## 128     19 6.5    <NA>  43.5 0.160
## 129     19 6.5    5066  49.0 0.140
## 130     19 6.5    5050  60.0 0.049
## 131     19 6.5    2316  64.0 0.034
## 132     20 5.0    5055   7.5 0.264
## 133     20 5.0     942   8.8 0.263
## 134     20 5.0    5028   8.9 0.230
## 135     20 5.0    5165   9.4 0.147
## 136     20 5.0     952   9.7 0.286
## 137     20 5.0     958   9.7 0.157
## 138     20 5.0     955  10.5 0.237
## 139     20 5.0     117  10.5 0.133
## 140     20 5.0     412  12.0 0.055
## 141     20 5.0    5053  12.2 0.097
## 142     20 5.0    5054  12.8 0.129
## 143     20 5.0    5058  14.6 0.192
## 144     20 5.0    5057  14.9 0.147
## 145     20 5.0    5115  17.6 0.154
## 146     20 5.0    5056  23.9 0.060
## 147     20 5.0    5060  25.0 0.057
## 148     21 5.8    1030  10.8 0.120
## 149     21 5.8    1418  15.7 0.154
## 150     21 5.8    1383  16.7 0.052
## 151     21 5.8    1308  20.8 0.045
## 152     21 5.8    1298  28.5 0.086
## 153     21 5.8    1299  33.1 0.056
## 154     21 5.8    1219  40.3 0.065
## 155     22 5.5    <NA>   4.0 0.259
## 156     22 5.5    <NA>  10.1 0.267
## 157     22 5.5    1030  11.1 0.071
## 158     22 5.5    1418  17.7 0.275
## 159     22 5.5    1383  22.5 0.058
## 160     22 5.5    <NA>  26.5 0.026
## 161     22 5.5    1299  29.0 0.039
## 162     22 5.5    1308  30.9 0.112
## 163     22 5.5    1219  37.8 0.065
## 164     22 5.5    1456  48.3 0.026
## 165     23 5.3    5045   5.8 0.123
## 166     23 5.3    5044  12.0 0.133
## 167     23 5.3    5160  12.1 0.073
## 168     23 5.3    5043  20.5 0.097
## 169     23 5.3    5047  20.5 0.096
## 170     23 5.3    c168  25.3 0.230
## 171     23 5.3    5068  35.9 0.082
## 172     23 5.3    c118  36.1 0.110
## 173     23 5.3    5042  36.3 0.110
## 174     23 5.3    5067  38.5 0.094
## 175     23 5.3    5049  41.4 0.040
## 176     23 5.3    c204  43.6 0.050
## 177     23 5.3    5070  44.4 0.022
## 178     23 5.3    c266  46.1 0.070
## 179     23 5.3    c203  47.1 0.080
## 180     23 5.3    5069  47.7 0.033
## 181     23 5.3    5073  49.2 0.017
## 182     23 5.3    5072  53.1 0.022
```

a.

$\boxed{182}$

```
attenu |>
  summarize(n())
```

```
##   n()
## 1 182
```

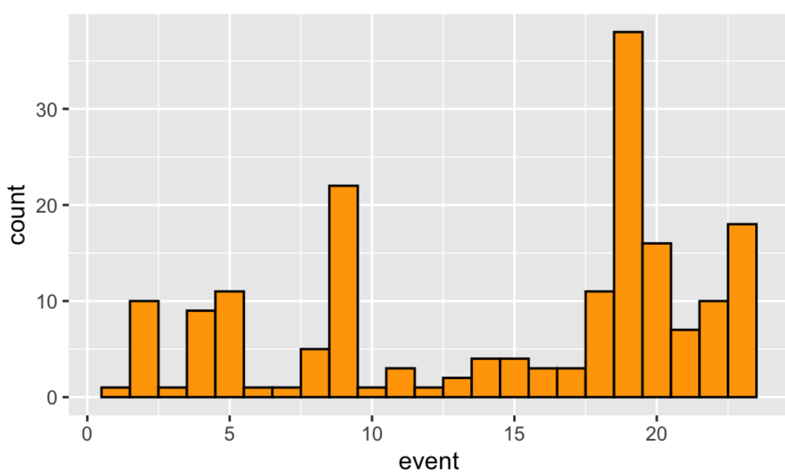
b.

```
attenu |>
  group_by(station) |>
  summarize(n())
```

```
## # A tibble: 118 × 2
##    station `n()`
##    <fct>   <int>
##  1 1008        1
##  2 1011        1
##  3 1013        1
##  4 1014        1
##  5 1015        1
##  6 1016        1
##  7 1027        1
##  8 1028        4
##  9 1030        2
## 10 1032        1
## # … with 108 more rows
```

c.

```
ggplot(attenu, aes(x = event)) + geom_histogram(binwidth = 1, fill = "orange", color = "black")
```



$\boxed{19}$

The `attenu` dataset built into R gives peak accelerations measured at various observation stations for earthquakes in California.

a. Find the observation with the largest magnitude measurement.

b. Write code to find the largest magnitude earthquake for each station.

c. Write code to find the station that measured the largest magnitude for each of the earthquakes recorded.

```
attenu
```

```
##    event mag station  dist accel
## 1      1 7.0     117  12.0 0.359
## 2      2 7.4    1083 148.0 0.014
## 3      2 7.4    1095  42.0 0.196
## 4      2 7.4     283  85.0 0.135
## 5      2 7.4     135 107.0 0.062
## 6      2 7.4     475 109.0 0.054
## 7      2 7.4     113 156.0 0.014
## 8      2 7.4    1008 224.0 0.018
## 9      2 7.4    1028 293.0 0.010
## 10     2 7.4    2001 359.0 0.004
## 11     2 7.4     117 370.0 0.004
## 12     3 5.3    1117   8.0 0.127
## 13     4 6.1    1438  16.1 0.411
## 14     4 6.1    1083  63.6 0.018
## 15     4 6.1    1013   6.6 0.509
## 16     4 6.1    1014   9.3 0.467
## 17     4 6.1    1015  13.0 0.279
## 18     4 6.1    1016  17.3 0.072
## 19     4 6.1    1095 105.0 0.012
## 20     4 6.1    1011 112.0 0.006
## 21     4 6.1    1028 123.0 0.003
## 22     5 6.6     270 105.0 0.018
## 23     5 6.6     280 122.0 0.048
## 24     5 6.6     116 141.0 0.011
## 25     5 6.6     266 200.0 0.007
## 26     5 6.6     117  45.0 0.142
## 27     5 6.6     113 130.0 0.031
## 28     5 6.6     112 147.0 0.006
## 29     5 6.6     130 187.0 0.010
## 30     5 6.6     475 197.0 0.010
## 31     5 6.6     269 203.0 0.006
## 32     5 6.6     135 211.0 0.013
## 33     6 5.6    1093  62.0 0.005
## 34     7 5.7    1093  62.0 0.003
## 35     8 5.3     111  19.0 0.086
## 36     8 5.3     116  21.0 0.179
## 37     8 5.3     290  13.0 0.205
## 38     8 5.3     112  22.0 0.073
## 39     8 5.3     113  29.0 0.045
## 40     9 6.6     128  17.0 0.374
## 41     9 6.6     126  19.6 0.200
## 42     9 6.6     127  20.2 0.147
## 43     9 6.6     141  21.1 0.188
## 44     9 6.6     266  21.9 0.204
## 45     9 6.6     110  24.2 0.335
## 46     9 6.6    1027  66.0 0.057
## 47     9 6.6     111  87.0 0.021
## 48     9 6.6     125  23.4 0.152
## 49     9 6.6     135  24.6 0.217
## 50     9 6.6     475  25.7 0.114
## 51     9 6.6     262  28.6 0.150
## 52     9 6.6     269  37.4 0.148
## 53     9 6.6    1052  46.7 0.112
## 54     9 6.6     411  56.9 0.043
## 55     9 6.6     290  60.7 0.057
## 56     9 6.6     130  61.4 0.030
## 57     9 6.6     272  62.0 0.027
## 58     9 6.6    1096  64.0 0.028
## 59     9 6.6    1102  82.0 0.034
## 60     9 6.6     112  88.0 0.030
## 61     9 6.6     113  91.0 0.039
```

```
## 62      10 5.3    1028  31.0 0.030
## 63      11 7.7    2714  45.0 0.110
## 64      11 7.7    2708 145.0 0.010
## 65      11 7.7    2715 300.0 0.010
## 66      12 6.2    3501   5.0 0.390
## 67      13 5.6     655  50.0 0.031
## 68      13 5.6     272  16.0 0.130
## 69      14 5.2    1032  17.0 0.011
## 70      14 5.2    1377   8.0 0.120
## 71      14 5.2    1028  10.0 0.170
## 72      14 5.2    1250  10.0 0.140
## 73      15 6.0    1051   8.0 0.110
## 74      15 6.0    1293  32.0 0.040
## 75      15 6.0    1291  30.0 0.070
## 76      15 6.0    1292  31.0 0.080
## 77      16 5.1     283   2.9 0.210
## 78      16 5.1     885   3.2 0.390
## 79      16 5.1    <NA>   7.6 0.280
## 80      17 7.6    2734  25.4 0.160
## 81      17 7.6    <NA>  32.9 0.064
## 82      17 7.6    2728  92.2 0.090
## 83      18 5.8    1413   1.2 0.420
## 84      18 5.8    1445   1.6 0.230
## 85      18 5.8    1408   9.1 0.130
## 86      18 5.8    1411   3.7 0.260
## 87      18 5.8    1410   5.3 0.270
## 88      18 5.8    1409   7.4 0.260
## 89      18 5.8    1377  17.9 0.110
## 90      18 5.8    1492  19.2 0.120
## 91      18 5.8    1251  23.4 0.038
## 92      18 5.8    1422  30.0 0.044
## 93      18 5.8    1376  38.9 0.046
## 94      19 6.5    <NA>  23.5 0.170
## 95      19 6.5     286  26.0 0.210
## 96      19 6.5    <NA>   0.5 0.320
## 97      19 6.5    5028   0.6 0.520
## 98      19 6.5     942   1.3 0.720
## 99      19 6.5    <NA>   1.4 0.320
## 100     19 6.5    5054   2.6 0.810
## 101     19 6.5     958   3.8 0.640
## 102     19 6.5     952   4.0 0.560
## 103     19 6.5    5165   5.1 0.510
## 104     19 6.5     117   6.2 0.400
## 105     19 6.5     955   6.8 0.610
## 106     19 6.5    5055   7.5 0.260
## 107     19 6.5    <NA>   7.6 0.240
## 108     19 6.5    <NA>   8.4 0.460
## 109     19 6.5    5060   8.5 0.220
## 110     19 6.5     412   8.5 0.230
## 111     19 6.5    5053  10.6 0.280
## 112     19 6.5    5058  12.6 0.380
## 113     19 6.5    5057  12.7 0.270
## 114     19 6.5    <NA>  12.9 0.310
## 115     19 6.5    5051  14.0 0.200
## 116     19 6.5    <NA>  15.0 0.110
## 117     19 6.5    5115  16.0 0.430
## 118     19 6.5    <NA>  17.7 0.270
## 119     19 6.5     931  18.0 0.150
## 120     19 6.5    5056  22.0 0.150
## 121     19 6.5    5059  22.0 0.150
## 122     19 6.5    5061  23.0 0.130
## 123     19 6.5    <NA>  23.2 0.190
```

```
## 124    19 6.5    5062  29.0 0.130
## 125    19 6.5    5052  32.0 0.066
## 126    19 6.5    <NA>  32.7 0.350
## 127    19 6.5     724  36.0 0.100
## 128    19 6.5    <NA>  43.5 0.160
## 129    19 6.5    5066  49.0 0.140
## 130    19 6.5    5050  60.0 0.049
## 131    19 6.5    2316  64.0 0.034
## 132    20 5.0    5055   7.5 0.264
## 133    20 5.0     942   8.8 0.263
## 134    20 5.0    5028   8.9 0.230
## 135    20 5.0    5165   9.4 0.147
## 136    20 5.0     952   9.7 0.286
## 137    20 5.0     958   9.7 0.157
## 138    20 5.0     955  10.5 0.237
## 139    20 5.0     117  10.5 0.133
## 140    20 5.0     412  12.0 0.055
## 141    20 5.0    5053  12.2 0.097
## 142    20 5.0    5054  12.8 0.129
## 143    20 5.0    5058  14.6 0.192
## 144    20 5.0    5057  14.9 0.147
## 145    20 5.0    5115  17.6 0.154
## 146    20 5.0    5056  23.9 0.060
## 147    20 5.0    5060  25.0 0.057
## 148    21 5.8    1030  10.8 0.120
## 149    21 5.8    1418  15.7 0.154
## 150    21 5.8    1383  16.7 0.052
## 151    21 5.8    1308  20.8 0.045
## 152    21 5.8    1298  28.5 0.086
## 153    21 5.8    1299  33.1 0.056
## 154    21 5.8    1219  40.3 0.065
## 155    22 5.5    <NA>   4.0 0.259
## 156    22 5.5    <NA>  10.1 0.267
## 157    22 5.5    1030  11.1 0.071
## 158    22 5.5    1418  17.7 0.275
## 159    22 5.5    1383  22.5 0.058
## 160    22 5.5    <NA>  26.5 0.026
## 161    22 5.5    1299  29.0 0.039
## 162    22 5.5    1308  30.9 0.112
## 163    22 5.5    1219  37.8 0.065
## 164    22 5.5    1456  48.3 0.026
## 165    23 5.3    5045   5.8 0.123
## 166    23 5.3    5044  12.0 0.133
## 167    23 5.3    5160  12.1 0.073
## 168    23 5.3    5043  20.5 0.097
## 169    23 5.3    5047  20.5 0.096
## 170    23 5.3    c168  25.3 0.230
## 171    23 5.3    5068  35.9 0.082
## 172    23 5.3    c118  36.1 0.110
## 173    23 5.3    5042  36.3 0.110
## 174    23 5.3    5067  38.5 0.094
## 175    23 5.3    5049  41.4 0.040
## 176    23 5.3    c204  43.6 0.050
## 177    23 5.3    5070  44.4 0.022
## 178    23 5.3    c266  46.1 0.070
## 179    23 5.3    c203  47.1 0.080
## 180    23 5.3    5069  47.7 0.033
## 181    23 5.3    5073  49.2 0.017
## 182    23 5.3    5072  53.1 0.022
```

a.

```
attenu |>
  arrange(desc(mag))
```

```
##      event mag station  dist accel
## 1       11 7.7    2714  45.0 0.110
## 2       11 7.7    2708 145.0 0.010
## 3       11 7.7    2715 300.0 0.010
## 4       17 7.6    2734  25.4 0.160
## 5       17 7.6    <NA>  32.9 0.064
## 6       17 7.6    2728  92.2 0.090
## 7        2 7.4    1083 148.0 0.014
## 8        2 7.4    1095  42.0 0.196
## 9        2 7.4     283  85.0 0.135
## 10       2 7.4     135 107.0 0.062
## 11       2 7.4     475 109.0 0.054
## 12       2 7.4     113 156.0 0.014
## 13       2 7.4    1008 224.0 0.018
## 14       2 7.4    1028 293.0 0.010
## 15       2 7.4    2001 359.0 0.004
## 16       2 7.4     117 370.0 0.004
## 17       1 7.0     117  12.0 0.359
## 18       5 6.6     270 105.0 0.018
## 19       5 6.6     280 122.0 0.048
## 20       5 6.6     116 141.0 0.011
## 21       5 6.6     266 200.0 0.007
## 22       5 6.6     117  45.0 0.142
## 23       5 6.6     113 130.0 0.031
## 24       5 6.6     112 147.0 0.006
## 25       5 6.6     130 187.0 0.010
## 26       5 6.6     475 197.0 0.010
## 27       5 6.6     269 203.0 0.006
## 28       5 6.6     135 211.0 0.013
## 29       9 6.6     128  17.0 0.374
## 30       9 6.6     126  19.6 0.200
## 31       9 6.6     127  20.2 0.147
## 32       9 6.6     141  21.1 0.188
## 33       9 6.6     266  21.9 0.204
## 34       9 6.6     110  24.2 0.335
## 35       9 6.6    1027  66.0 0.057
## 36       9 6.6     111  87.0 0.021
## 37       9 6.6     125  23.4 0.152
## 38       9 6.6     135  24.6 0.217
## 39       9 6.6     475  25.7 0.114
## 40       9 6.6     262  28.6 0.150
## 41       9 6.6     269  37.4 0.148
## 42       9 6.6    1052  46.7 0.112
## 43       9 6.6     411  56.9 0.043
## 44       9 6.6     290  60.7 0.057
## 45       9 6.6     130  61.4 0.030
## 46       9 6.6     272  62.0 0.027
## 47       9 6.6    1096  64.0 0.028
## 48       9 6.6    1102  82.0 0.034
## 49       9 6.6     112  88.0 0.030
## 50       9 6.6     113  91.0 0.039
## 51      19 6.5    <NA>  23.5 0.170
## 52      19 6.5     286  26.0 0.210
## 53      19 6.5    <NA>   0.5 0.320
## 54      19 6.5    5028   0.6 0.520
## 55      19 6.5     942   1.3 0.720
## 56      19 6.5    <NA>   1.4 0.320
## 57      19 6.5    5054   2.6 0.810
## 58      19 6.5     958   3.8 0.640
## 59      19 6.5     952   4.0 0.560
## 60      19 6.5    5165   5.1 0.510
## 61      19 6.5     117   6.2 0.400
```

```
## 62      19 6.5     955   6.8 0.610
## 63      19 6.5    5055   7.5 0.260
## 64      19 6.5    <NA>   7.6 0.240
## 65      19 6.5    <NA>   8.4 0.460
## 66      19 6.5    5060   8.5 0.220
## 67      19 6.5     412   8.5 0.230
## 68      19 6.5    5053  10.6 0.280
## 69      19 6.5    5058  12.6 0.380
## 70      19 6.5    5057  12.7 0.270
## 71      19 6.5    <NA>  12.9 0.310
## 72      19 6.5    5051  14.0 0.200
## 73      19 6.5    <NA>  15.0 0.110
## 74      19 6.5    5115  16.0 0.430
## 75      19 6.5    <NA>  17.7 0.270
## 76      19 6.5     931  18.0 0.150
## 77      19 6.5    5056  22.0 0.150
## 78      19 6.5    5059  22.0 0.150
## 79      19 6.5    5061  23.0 0.130
## 80      19 6.5    <NA>  23.2 0.190
## 81      19 6.5    5062  29.0 0.130
## 82      19 6.5    5052  32.0 0.066
## 83      19 6.5    <NA>  32.7 0.350
## 84      19 6.5     724  36.0 0.100
## 85      19 6.5    <NA>  43.5 0.160
## 86      19 6.5    5066  49.0 0.140
## 87      19 6.5    5050  60.0 0.049
## 88      19 6.5    2316  64.0 0.034
## 89      12 6.2    3501   5.0 0.390
## 90       4 6.1    1438  16.1 0.411
## 91       4 6.1    1083  63.6 0.018
## 92       4 6.1    1013   6.6 0.509
## 93       4 6.1    1014   9.3 0.467
## 94       4 6.1    1015  13.0 0.279
## 95       4 6.1    1016  17.3 0.072
## 96       4 6.1    1095 105.0 0.012
## 97       4 6.1    1011 112.0 0.006
## 98       4 6.1    1028 123.0 0.003
## 99      15 6.0    1051   8.0 0.110
## 100     15 6.0    1293  32.0 0.040
## 101     15 6.0    1291  30.0 0.070
## 102     15 6.0    1292  31.0 0.080
## 103     18 5.8    1413   1.2 0.420
## 104     18 5.8    1445   1.6 0.230
## 105     18 5.8    1408   9.1 0.130
## 106     18 5.8    1411   3.7 0.260
## 107     18 5.8    1410   5.3 0.270
## 108     18 5.8    1409   7.4 0.260
## 109     18 5.8    1377  17.9 0.110
## 110     18 5.8    1492  19.2 0.120
## 111     18 5.8    1251  23.4 0.038
## 112     18 5.8    1422  30.0 0.044
## 113     18 5.8    1376  38.9 0.046
## 114     21 5.8    1030  10.8 0.120
## 115     21 5.8    1418  15.7 0.154
## 116     21 5.8    1383  16.7 0.052
## 117     21 5.8    1308  20.8 0.045
## 118     21 5.8    1298  28.5 0.086
## 119     21 5.8    1299  33.1 0.056
## 120     21 5.8    1219  40.3 0.065
## 121      7 5.7    1093  62.0 0.003
## 122      6 5.6    1093  62.0 0.005
## 123     13 5.6     655  50.0 0.031
```

```
## 124    13 5.6     272  16.0 0.130
## 125    22 5.5    <NA>   4.0 0.259
## 126    22 5.5    <NA>  10.1 0.267
## 127    22 5.5    1030  11.1 0.071
## 128    22 5.5    1418  17.7 0.275
## 129    22 5.5    1383  22.5 0.058
## 130    22 5.5    <NA>  26.5 0.026
## 131    22 5.5    1299  29.0 0.039
## 132    22 5.5    1308  30.9 0.112
## 133    22 5.5    1219  37.8 0.065
## 134    22 5.5    1456  48.3 0.026
## 135     3 5.3    1117   8.0 0.127
## 136     8 5.3     111  19.0 0.086
## 137     8 5.3     116  21.0 0.179
## 138     8 5.3     290  13.0 0.205
## 139     8 5.3     112  22.0 0.073
## 140     8 5.3     113  29.0 0.045
## 141    10 5.3    1028  31.0 0.030
## 142    23 5.3    5045   5.8 0.123
## 143    23 5.3    5044  12.0 0.133
## 144    23 5.3    5160  12.1 0.073
## 145    23 5.3    5043  20.5 0.097
## 146    23 5.3    5047  20.5 0.096
## 147    23 5.3    c168  25.3 0.230
## 148    23 5.3    5068  35.9 0.082
## 149    23 5.3    c118  36.1 0.110
## 150    23 5.3    5042  36.3 0.110
## 151    23 5.3    5067  38.5 0.094
## 152    23 5.3    5049  41.4 0.040
## 153    23 5.3    c204  43.6 0.050
## 154    23 5.3    5070  44.4 0.022
## 155    23 5.3    c266  46.1 0.070
## 156    23 5.3    c203  47.1 0.080
## 157    23 5.3    5069  47.7 0.033
## 158    23 5.3    5073  49.2 0.017
## 159    23 5.3    5072  53.1 0.022
## 160    14 5.2    1032  17.0 0.011
## 161    14 5.2    1377   8.0 0.120
## 162    14 5.2    1028  10.0 0.170
## 163    14 5.2    1250  10.0 0.140
## 164    16 5.1     283   2.9 0.210
## 165    16 5.1     885   3.2 0.390
## 166    16 5.1    <NA>   7.6 0.280
## 167    20 5.0    5055   7.5 0.264
## 168    20 5.0     942   8.8 0.263
## 169    20 5.0    5028   8.9 0.230
## 170    20 5.0    5165   9.4 0.147
## 171    20 5.0     952   9.7 0.286
## 172    20 5.0     958   9.7 0.157
## 173    20 5.0     955  10.5 0.237
## 174    20 5.0     117  10.5 0.133
## 175    20 5.0     412  12.0 0.055
## 176    20 5.0    5053  12.2 0.097
## 177    20 5.0    5054  12.8 0.129
## 178    20 5.0    5058  14.6 0.192
## 179    20 5.0    5057  14.9 0.147
## 180    20 5.0    5115  17.6 0.154
## 181    20 5.0    5056  23.9 0.060
## 182    20 5.0    5060  25.0 0.057
```

b.

```
attenu |>
  group_by(station) |>
  arrange(desc(mag))
```

```
## # A tibble: 182 × 5
## # Groups:   station [118]
##    event   mag station  dist accel
##    <dbl> <dbl> <fct>   <dbl> <dbl>
##  1    11   7.7 2714     45   0.11
##  2    11   7.7 2708    145   0.01
##  3    11   7.7 2715    300   0.01
##  4    17   7.6 2734     25.4 0.16
##  5    17   7.6 <NA>     32.9 0.064
##  6    17   7.6 2728     92.2 0.09
##  7     2   7.4 1083    148   0.014
##  8     2   7.4 1095     42   0.196
##  9     2   7.4 283      85   0.135
## 10     2   7.4 135     107   0.062
## # … with 172 more rows
```

c.

COME BACK

The `msleep` dataset is in the ggplot2 library.

```
library(ggplot2)
msleep |> head()
```

```
## # A tibble: 6 × 11
##   name  genus vore  order conse…¹ sleep…² sleep…³ sleep…⁴ awake  brainwt  bodywt
##   <chr> <chr> <chr> <chr> <chr>     <dbl>   <dbl>   <dbl> <dbl>    <dbl>   <dbl>
## 1 Chee… Acin… carni Carn… lc         12.1    NA    NA      11.9 NA        50
## 2 Owl … Aotus omni  Prim… <NA>       17       1.8  NA       7    0.0155    0.48
## 3 Moun… Aplo… herbi Rode… nt         14.4     2.4  NA       9.6 NA         1.35
## 4 Grea… Blar… omni  Sori… lc         14.9     2.3   0.133   9.1  0.00029   0.019
## 5 Cow   Bos   herbi Arti… domest…     4       0.7   0.667  20    0.423   600
## 6 Thre… Brad… herbi Pilo… <NA>       14.4     2.2   0.767   9.6 NA         3.85
## # … with abbreviated variable names ¹conservation, ²sleep_total, ³sleep_rem,
## #   ⁴sleep_cycle
```

There are three types of mammals whose sleep is being studied, carnivores, omnivores, insectavores, and herbivores. For each of these four types, find the animal with the largest `sleep_total`.

Carni = Thick-tailed opposum, Herbi = Artctic ground squirrel, Insecti = Little Brown Bat, Omni = North American Opposum

```
msleep |>
  group_by(vore)|>
  summarize(max_sleep =  max(sleep_total))
```

```
## # A tibble: 5 × 2
##   vore    max_sleep
##   <chr>       <dbl>
## 1 carni        19.4
## 2 herbi        16.6
## 3 insecti      19.9
## 4 omni         18
## 5 <NA>         13.7
```

```
msleep |>
  select(name, vore, sleep_total) |>
  group_by("carni")
```

```
## # A tibble: 83 × 4
## # Groups:   "carni" [1]
##    name                       vore  sleep_total `"carni"`
##    <chr>                      <chr>       <dbl> <chr>
##  1 Cheetah                    carni        12.1 carni
##  2 Owl monkey                 omni         17   carni
##  3 Mountain beaver            herbi        14.4 carni
##  4 Greater short-tailed shrew omni         14.9 carni
##  5 Cow                        herbi         4   carni
##  6 Three-toed sloth           herbi        14.4 carni
##  7 Northern fur seal          carni         8.7 carni
##  8 Vesper mouse               <NA>          7   carni
##  9 Dog                        carni        10.1 carni
## 10 Roe deer                   herbi         3   carni
## # … with 73 more rows
```

Consider the `airquality` dataset built into R, which gives daily air quality measurements in New York from May to September of 1973.

Remove any observations where the `Ozone` measurement is missing. Create a new variable `Ozone_high` that is true if the ozone level is at least 30, and false otherwise. Finally, find the average temperature for the observations where the ozone level is high, and for the observations here the ozone level is not high.

```
airquality |>
  mutate(Ozone_high = Ozone >= 30)
```

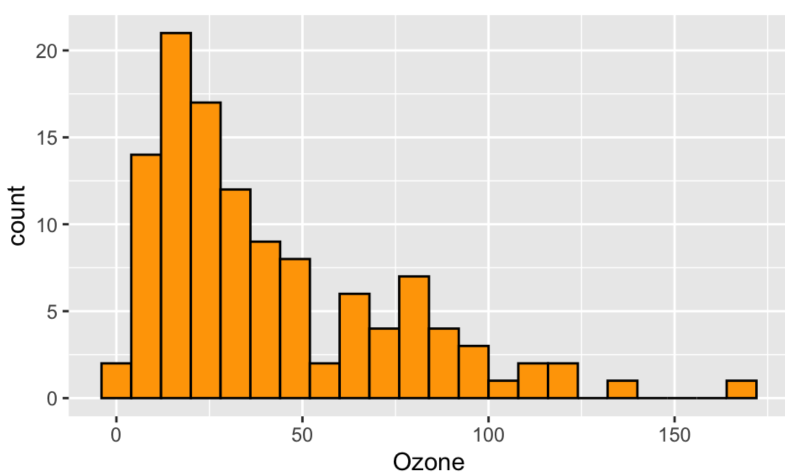
```
##     Ozone Solar.R Wind Temp Month Day Ozone_high
## 1     41     190  7.4   67     5   1       TRUE
## 2     36     118  8.0   72     5   2       TRUE
## 3     12     149 12.6   74     5   3      FALSE
## 4     18     313 11.5   62     5   4      FALSE
## 5     NA      NA 14.3   56     5   5         NA
## 6     28      NA 14.9   66     5   6      FALSE
## 7     23     299  8.6   65     5   7      FALSE
## 8     19      99 13.8   59     5   8      FALSE
## 9      8      19 20.1   61     5   9      FALSE
## 10    NA     194  8.6   69     5  10         NA
## 11     7      NA  6.9   74     5  11      FALSE
## 12    16     256  9.7   69     5  12      FALSE
## 13    11     290  9.2   66     5  13      FALSE
## 14    14     274 10.9   68     5  14      FALSE
## 15    18      65 13.2   58     5  15      FALSE
## 16    14     334 11.5   64     5  16      FALSE
## 17    34     307 12.0   66     5  17       TRUE
## 18     6      78 18.4   57     5  18      FALSE
## 19    30     322 11.5   68     5  19       TRUE
## 20    11      44  9.7   62     5  20      FALSE
## 21     1       8  9.7   59     5  21      FALSE
## 22    11     320 16.6   73     5  22      FALSE
## 23     4      25  9.7   61     5  23      FALSE
## 24    32      92 12.0   61     5  24       TRUE
## 25    NA      66 16.6   57     5  25         NA
## 26    NA     266 14.9   58     5  26         NA
## 27    NA      NA  8.0   57     5  27         NA
## 28    23      13 12.0   67     5  28      FALSE
## 29    45     252 14.9   81     5  29       TRUE
## 30   115     223  5.7   79     5  30       TRUE
## 31    37     279  7.4   76     5  31       TRUE
## 32    NA     286  8.6   78     6   1         NA
## 33    NA     287  9.7   74     6   2         NA
## 34    NA     242 16.1   67     6   3         NA
## 35    NA     186  9.2   84     6   4         NA
## 36    NA     220  8.6   85     6   5         NA
## 37    NA     264 14.3   79     6   6         NA
## 38    29     127  9.7   82     6   7      FALSE
## 39    NA     273  6.9   87     6   8         NA
## 40    71     291 13.8   90     6   9       TRUE
## 41    39     323 11.5   87     6  10       TRUE
## 42    NA     259 10.9   93     6  11         NA
## 43    NA     250  9.2   92     6  12         NA
## 44    23     148  8.0   82     6  13      FALSE
## 45    NA     332 13.8   80     6  14         NA
## 46    NA     322 11.5   79     6  15         NA
## 47    21     191 14.9   77     6  16      FALSE
## 48    37     284 20.7   72     6  17       TRUE
## 49    20      37  9.2   65     6  18      FALSE
## 50    12     120 11.5   73     6  19      FALSE
## 51    13     137 10.3   76     6  20      FALSE
## 52    NA     150  6.3   77     6  21         NA
## 53    NA      59  1.7   76     6  22         NA
## 54    NA      91  4.6   76     6  23         NA
## 55    NA     250  6.3   76     6  24         NA
## 56    NA     135  8.0   75     6  25         NA
## 57    NA     127  8.0   78     6  26         NA
## 58    NA      47 10.3   73     6  27         NA
## 59    NA      98 11.5   80     6  28         NA
## 60    NA      31 14.9   77     6  29         NA
## 61    NA     138  8.0   83     6  30         NA
```

```
## 62    135     269  4.1   84      7   1        TRUE
## 63     49     248  9.2   85      7   2        TRUE
## 64     32     236  9.2   81      7   3        TRUE
## 65     NA     101 10.9   84      7   4          NA
## 66     64     175  4.6   83      7   5        TRUE
## 67     40     314 10.9   83      7   6        TRUE
## 68     77     276  5.1   88      7   7        TRUE
## 69     97     267  6.3   92      7   8        TRUE
## 70     97     272  5.7   92      7   9        TRUE
## 71     85     175  7.4   89      7  10        TRUE
## 72     NA     139  8.6   82      7  11          NA
## 73     10     264 14.3   73      7  12       FALSE
## 74     27     175 14.9   81      7  13       FALSE
## 75     NA     291 14.9   91      7  14          NA
## 76      7      48 14.3   80      7  15       FALSE
## 77     48     260  6.9   81      7  16        TRUE
## 78     35     274 10.3   82      7  17        TRUE
## 79     61     285  6.3   84      7  18        TRUE
## 80     79     187  5.1   87      7  19        TRUE
## 81     63     220 11.5   85      7  20        TRUE
## 82     16       7  6.9   74      7  21       FALSE
## 83     NA     258  9.7   81      7  22          NA
## 84     NA     295 11.5   82      7  23          NA
## 85     80     294  8.6   86      7  24        TRUE
## 86    108     223  8.0   85      7  25        TRUE
## 87     20      81  8.6   82      7  26       FALSE
## 88     52      82 12.0   86      7  27        TRUE
## 89     82     213  7.4   88      7  28        TRUE
## 90     50     275  7.4   86      7  29        TRUE
## 91     64     253  7.4   83      7  30        TRUE
## 92     59     254  9.2   81      7  31        TRUE
## 93     39      83  6.9   81      8   1        TRUE
## 94      9      24 13.8   81      8   2       FALSE
## 95     16      77  7.4   82      8   3       FALSE
## 96     78      NA  6.9   86      8   4        TRUE
## 97     35      NA  7.4   85      8   5        TRUE
## 98     66      NA  4.6   87      8   6        TRUE
## 99    122     255  4.0   89      8   7        TRUE
## 100    89     229 10.3   90      8   8        TRUE
## 101   110     207  8.0   90      8   9        TRUE
## 102    NA     222  8.6   92      8  10          NA
## 103    NA     137 11.5   86      8  11          NA
## 104    44     192 11.5   86      8  12        TRUE
## 105    28     273 11.5   82      8  13       FALSE
## 106    65     157  9.7   80      8  14        TRUE
## 107    NA      64 11.5   79      8  15          NA
## 108    22      71 10.3   77      8  16       FALSE
## 109    59      51  6.3   79      8  17        TRUE
## 110    23     115  7.4   76      8  18       FALSE
## 111    31     244 10.9   78      8  19        TRUE
## 112    44     190 10.3   78      8  20        TRUE
## 113    21     259 15.5   77      8  21       FALSE
## 114     9      36 14.3   72      8  22       FALSE
## 115    NA     255 12.6   75      8  23          NA
## 116    45     212  9.7   79      8  24        TRUE
## 117   168     238  3.4   81      8  25        TRUE
## 118    73     215  8.0   86      8  26        TRUE
## 119    NA     153  5.7   88      8  27          NA
## 120    76     203  9.7   97      8  28        TRUE
## 121   118     225  2.3   94      8  29        TRUE
## 122    84     237  6.3   96      8  30        TRUE
## 123    85     188  6.3   94      8  31        TRUE
```

```
## 124    96      167  6.9   91      9   1        TRUE
## 125    78      197  5.1   92      9   2        TRUE
## 126    73      183  2.8   93      9   3        TRUE
## 127    91      189  4.6   93      9   4        TRUE
## 128    47       95  7.4   87      9   5        TRUE
## 129    32       92 15.5   84      9   6        TRUE
## 130    20      252 10.9   80      9   7       FALSE
## 131    23      220 10.3   78      9   8       FALSE
## 132    21      230 10.9   75      9   9       FALSE
## 133    24      259  9.7   73      9  10       FALSE
## 134    44      236 14.9   81      9  11        TRUE
## 135    21      259 15.5   76      9  12       FALSE
## 136    28      238  6.3   77      9  13       FALSE
## 137     9       24 10.9   71      9  14       FALSE
## 138    13      112 11.5   71      9  15       FALSE
## 139    46      237  6.9   78      9  16        TRUE
## 140    18      224 13.8   67      9  17       FALSE
## 141    13       27 10.3   76      9  18       FALSE
## 142    24      238 10.3   68      9  19       FALSE
## 143    16      201  8.0   82      9  20       FALSE
## 144    13      238 12.6   64      9  21       FALSE
## 145    23       14  9.2   71      9  22       FALSE
## 146    36      139 10.3   81      9  23        TRUE
## 147     7       49 10.3   69      9  24       FALSE
## 148    14       20 16.6   63      9  25       FALSE
## 149    30      193  6.9   70      9  26        TRUE
## 150    NA      145 13.2   77      9  27          NA
## 151    14      191 14.3   75      9  28       FALSE
## 152    18      131  8.0   76      9  29       FALSE
## 153    20      223 11.5   68      9  30       FALSE
```

```
ggplot(airquality, aes(x = Ozone)) + geom_histogram(binwidth = 8, fill = "orange", color = "black")
```

```
## Warning: Removed 37 rows containing non-finite values (stat_bin).
```



The `flights` dataset is part of the `nycflights13` library.

```
library(nycflights13)
```

In the `flights` data set, the variable `tailnum` tells us the exact plane that took a flight.

a. Find the plane that flew the most number of the flights.

b. How many planes flew at least 100 flights?

a.

```
flights |>
  filter(!is.na(tailnum)) |>
  group_by(tailnum) |>
  count() |>
  filter(n >= 100)
```

```
## # A tibble: 1,217 × 2
## # Groups:   tailnum [1,217]
##    tailnum     n
##    <chr>   <int>
##  1 N0EGMQ    371
##  2 N10156    153
##  3 N10575    289
##  4 N11106    129
##  5 N11107    148
##  6 N11109    148
##  7 N11113    138
##  8 N11119    148
##  9 N11121    154
## 10 N11127    124
## # … with 1,207 more rows
```

$\boxed{\text{N0EGMQ}}$

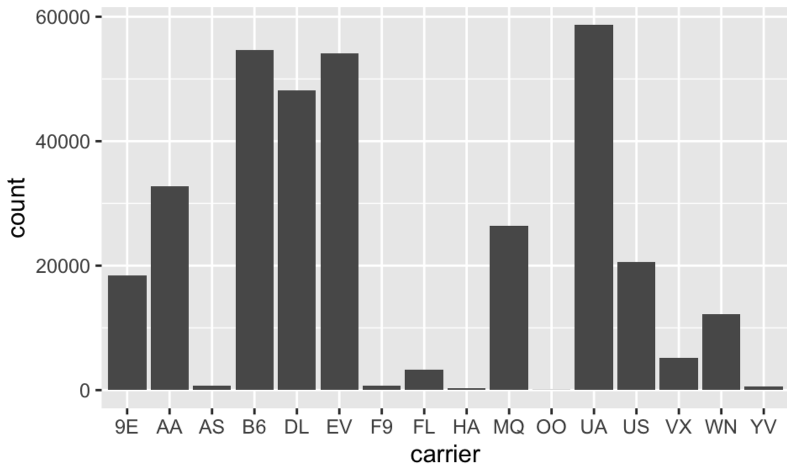
b.

$\boxed{1217}$

Which carrier had the highest percentage of on time flights?

a.

```
ggplot(data = flights, aes(x = carrier, fill = dep_delay))+
  geom_bar()
```



$\boxed{\text{HA}}$

Consider the following two tibbles:

```
df1 <- tibble(
  name = c("Sophia", "Olivia", "Emma", "Ava", "Isabella"),
  gender = c("F", "F", "F", "F", "F")
  )
df2 <- tibble(
  name = c("Jackson", "Liam", "Noah", "Aiden", "Caden"),
  gender = c("M", "M", "M", "M", "M")
  )
```

Give a command that combines the observations from `df1` and `df2` .

```
df1 |> full_join(df2, by = "name")
```

```
## # A tibble: 10 × 3
##    name     gender.x gender.y
##    <chr>    <chr>    <chr>
##  1 Sophia   F        <NA>
##  2 Olivia   F        <NA>
##  3 Emma     F        <NA>
##  4 Ava      F        <NA>
##  5 Isabella F        <NA>
##  6 Jackson  <NA>     M
##  7 Liam     <NA>     M
##  8 Noah     <NA>     M
##  9 Aiden    <NA>     M
## 10 Caden    <NA>     M
```

Suppose the following datasets contain restricted observations from the `iris` dataset built in to R.

```
iris_sepal <-
  iris |>
  filter(Sepal.Length > 5)

iris_petal <-
  iris |>
  filter(Petal.Length < 3)
```

a. Find the observations that are in both `iris_sepal` and `iris_petal`.

b. Find the observations that are in `iris_petal` but not in `iris_sepal`. Find it.

```
iris_petal
```

```
##    Sepal.Length Sepal.Width Petal.Length Petal.Width Species
## 1           5.1         3.5          1.4         0.2  setosa
## 2           4.9         3.0          1.4         0.2  setosa
## 3           4.7         3.2          1.3         0.2  setosa
## 4           4.6         3.1          1.5         0.2  setosa
## 5           5.0         3.6          1.4         0.2  setosa
## 6           5.4         3.9          1.7         0.4  setosa
## 7           4.6         3.4          1.4         0.3  setosa
## 8           5.0         3.4          1.5         0.2  setosa
## 9           4.4         2.9          1.4         0.2  setosa
## 10          4.9         3.1          1.5         0.1  setosa
## 11          5.4         3.7          1.5         0.2  setosa
## 12          4.8         3.4          1.6         0.2  setosa
## 13          4.8         3.0          1.4         0.1  setosa
## 14          4.3         3.0          1.1         0.1  setosa
## 15          5.8         4.0          1.2         0.2  setosa
## 16          5.7         4.4          1.5         0.4  setosa
## 17          5.4         3.9          1.3         0.4  setosa
## 18          5.1         3.5          1.4         0.3  setosa
## 19          5.7         3.8          1.7         0.3  setosa
## 20          5.1         3.8          1.5         0.3  setosa
## 21          5.4         3.4          1.7         0.2  setosa
## 22          5.1         3.7          1.5         0.4  setosa
## 23          4.6         3.6          1.0         0.2  setosa
## 24          5.1         3.3          1.7         0.5  setosa
## 25          4.8         3.4          1.9         0.2  setosa
## 26          5.0         3.0          1.6         0.2  setosa
## 27          5.0         3.4          1.6         0.4  setosa
## 28          5.2         3.5          1.5         0.2  setosa
## 29          5.2         3.4          1.4         0.2  setosa
## 30          4.7         3.2          1.6         0.2  setosa
## 31          4.8         3.1          1.6         0.2  setosa
## 32          5.4         3.4          1.5         0.4  setosa
## 33          5.2         4.1          1.5         0.1  setosa
## 34          5.5         4.2          1.4         0.2  setosa
## 35          4.9         3.1          1.5         0.2  setosa
## 36          5.0         3.2          1.2         0.2  setosa
## 37          5.5         3.5          1.3         0.2  setosa
## 38          4.9         3.6          1.4         0.1  setosa
## 39          4.4         3.0          1.3         0.2  setosa
## 40          5.1         3.4          1.5         0.2  setosa
## 41          5.0         3.5          1.3         0.3  setosa
## 42          4.5         2.3          1.3         0.3  setosa
## 43          4.4         3.2          1.3         0.2  setosa
## 44          5.0         3.5          1.6         0.6  setosa
## 45          5.1         3.8          1.9         0.4  setosa
## 46          4.8         3.0          1.4         0.3  setosa
## 47          5.1         3.8          1.6         0.2  setosa
## 48          4.6         3.2          1.4         0.2  setosa
## 49          5.3         3.7          1.5         0.2  setosa
## 50          5.0         3.3          1.4         0.2  setosa
```

```
iris_sepal
```

```
##      Sepal.Length Sepal.Width Petal.Length Petal.Width    Species
## 1             5.1         3.5          1.4         0.2     setosa
## 2             5.4         3.9          1.7         0.4     setosa
## 3             5.4         3.7          1.5         0.2     setosa
## 4             5.8         4.0          1.2         0.2     setosa
## 5             5.7         4.4          1.5         0.4     setosa
## 6             5.4         3.9          1.3         0.4     setosa
## 7             5.1         3.5          1.4         0.3     setosa
## 8             5.7         3.8          1.7         0.3     setosa
## 9             5.1         3.8          1.5         0.3     setosa
## 10            5.4         3.4          1.7         0.2     setosa
## 11            5.1         3.7          1.5         0.4     setosa
## 12            5.1         3.3          1.7         0.5     setosa
## 13            5.2         3.5          1.5         0.2     setosa
## 14            5.2         3.4          1.4         0.2     setosa
## 15            5.4         3.4          1.5         0.4     setosa
## 16            5.2         4.1          1.5         0.1     setosa
## 17            5.5         4.2          1.4         0.2     setosa
## 18            5.5         3.5          1.3         0.2     setosa
## 19            5.1         3.4          1.5         0.2     setosa
## 20            5.1         3.8          1.9         0.4     setosa
## 21            5.1         3.8          1.6         0.2     setosa
## 22            5.3         3.7          1.5         0.2     setosa
## 23            7.0         3.2          4.7         1.4 versicolor
## 24            6.4         3.2          4.5         1.5 versicolor
## 25            6.9         3.1          4.9         1.5 versicolor
## 26            5.5         2.3          4.0         1.3 versicolor
## 27            6.5         2.8          4.6         1.5 versicolor
## 28            5.7         2.8          4.5         1.3 versicolor
## 29            6.3         3.3          4.7         1.6 versicolor
## 30            6.6         2.9          4.6         1.3 versicolor
## 31            5.2         2.7          3.9         1.4 versicolor
## 32            5.9         3.0          4.2         1.5 versicolor
## 33            6.0         2.2          4.0         1.0 versicolor
## 34            6.1         2.9          4.7         1.4 versicolor
## 35            5.6         2.9          3.6         1.3 versicolor
## 36            6.7         3.1          4.4         1.4 versicolor
## 37            5.6         3.0          4.5         1.5 versicolor
## 38            5.8         2.7          4.1         1.0 versicolor
## 39            6.2         2.2          4.5         1.5 versicolor
## 40            5.6         2.5          3.9         1.1 versicolor
## 41            5.9         3.2          4.8         1.8 versicolor
## 42            6.1         2.8          4.0         1.3 versicolor
## 43            6.3         2.5          4.9         1.5 versicolor
## 44            6.1         2.8          4.7         1.2 versicolor
## 45            6.4         2.9          4.3         1.3 versicolor
## 46            6.6         3.0          4.4         1.4 versicolor
## 47            6.8         2.8          4.8         1.4 versicolor
## 48            6.7         3.0          5.0         1.7 versicolor
## 49            6.0         2.9          4.5         1.5 versicolor
## 50            5.7         2.6          3.5         1.0 versicolor
## 51            5.5         2.4          3.8         1.1 versicolor
## 52            5.5         2.4          3.7         1.0 versicolor
## 53            5.8         2.7          3.9         1.2 versicolor
## 54            6.0         2.7          5.1         1.6 versicolor
## 55            5.4         3.0          4.5         1.5 versicolor
## 56            6.0         3.4          4.5         1.6 versicolor
## 57            6.7         3.1          4.7         1.5 versicolor
## 58            6.3         2.3          4.4         1.3 versicolor
## 59            5.6         3.0          4.1         1.3 versicolor
## 60            5.5         2.5          4.0         1.3 versicolor
## 61            5.5         2.6          4.4         1.2 versicolor
```

```
## 62          6.1         3.0          4.6         1.4 versicolor
## 63          5.8         2.6          4.0         1.2 versicolor
## 64          5.6         2.7          4.2         1.3 versicolor
## 65          5.7         3.0          4.2         1.2 versicolor
## 66          5.7         2.9          4.2         1.3 versicolor
## 67          6.2         2.9          4.3         1.3 versicolor
## 68          5.1         2.5          3.0         1.1 versicolor
## 69          5.7         2.8          4.1         1.3 versicolor
## 70          6.3         3.3          6.0         2.5  virginica
## 71          5.8         2.7          5.1         1.9  virginica
## 72          7.1         3.0          5.9         2.1  virginica
## 73          6.3         2.9          5.6         1.8  virginica
## 74          6.5         3.0          5.8         2.2  virginica
## 75          7.6         3.0          6.6         2.1  virginica
## 76          7.3         2.9          6.3         1.8  virginica
## 77          6.7         2.5          5.8         1.8  virginica
## 78          7.2         3.6          6.1         2.5  virginica
## 79          6.5         3.2          5.1         2.0  virginica
## 80          6.4         2.7          5.3         1.9  virginica
## 81          6.8         3.0          5.5         2.1  virginica
## 82          5.7         2.5          5.0         2.0  virginica
## 83          5.8         2.8          5.1         2.4  virginica
## 84          6.4         3.2          5.3         2.3  virginica
## 85          6.5         3.0          5.5         1.8  virginica
## 86          7.7         3.8          6.7         2.2  virginica
## 87          7.7         2.6          6.9         2.3  virginica
## 88          6.0         2.2          5.0         1.5  virginica
## 89          6.9         3.2          5.7         2.3  virginica
## 90          5.6         2.8          4.9         2.0  virginica
## 91          7.7         2.8          6.7         2.0  virginica
## 92          6.3         2.7          4.9         1.8  virginica
## 93          6.7         3.3          5.7         2.1  virginica
## 94          7.2         3.2          6.0         1.8  virginica
## 95          6.2         2.8          4.8         1.8  virginica
## 96          6.1         3.0          4.9         1.8  virginica
## 97          6.4         2.8          5.6         2.1  virginica
## 98          7.2         3.0          5.8         1.6  virginica
## 99          7.4         2.8          6.1         1.9  virginica
## 100         7.9         3.8          6.4         2.0  virginica
## 101         6.4         2.8          5.6         2.2  virginica
## 102         6.3         2.8          5.1         1.5  virginica
## 103         6.1         2.6          5.6         1.4  virginica
## 104         7.7         3.0          6.1         2.3  virginica
## 105         6.3         3.4          5.6         2.4  virginica
## 106         6.4         3.1          5.5         1.8  virginica
## 107         6.0         3.0          4.8         1.8  virginica
## 108         6.9         3.1          5.4         2.1  virginica
## 109         6.7         3.1          5.6         2.4  virginica
## 110         6.9         3.1          5.1         2.3  virginica
## 111         5.8         2.7          5.1         1.9  virginica
## 112         6.8         3.2          5.9         2.3  virginica
## 113         6.7         3.3          5.7         2.5  virginica
## 114         6.7         3.0          5.2         2.3  virginica
## 115         6.3         2.5          5.0         1.9  virginica
## 116         6.5         3.0          5.2         2.0  virginica
## 117         6.2         3.4          5.4         2.3  virginica
## 118         5.9         3.0          5.1         1.8  virginica
```

a.

Additional species: versicolor and virginica

b. $\boxed{\text{Sepal.Length values are < 5, which means there are iris\_petals includes observaitons where Sepal.Length are below 5}}$

Consider two datasets derived from the `mtcars` dataset built in to R

```
cyl4 <-
  mtcars |>
  select(mpg:hp) |>
  filter(cyl == 4) |>
  select(-cyl)
cyl4
```

```
##                 mpg  disp  hp
## Datsun 710     22.8 108.0  93
## Merc 240D      24.4 146.7  62
## Merc 230       22.8 140.8  95
## Fiat 128       32.4  78.7  66
## Honda Civic    30.4  75.7  52
## Toyota Corolla 33.9  71.1  65
## Toyota Corona  21.5 120.1  97
## Fiat X1-9      27.3  79.0  66
## Porsche 914-2  26.0 120.3  91
## Lotus Europa   30.4  95.1 113
## Volvo 142E     21.4 121.0 109
```

```
cyl6 <-
  mtcars |>
  select(mpg:hp) |>
  filter(cyl == 6) |>
  select(-cyl)
cyl6
```

```
##                 mpg  disp  hp
## Mazda RX4      21.0 160.0 110
## Mazda RX4 Wag  21.0 160.0 110
## Hornet 4 Drive 21.4 258.0 110
## Valiant        18.1 225.0 105
## Merc 280       19.2 167.6 123
## Merc 280C      17.8 167.6 123
## Ferrari Dino   19.7 145.0 175
```

For each tibble `cyl4` and `cyl6` , add a variable `cyl` that holds the number of cylinders for each variable in the dataset, then combine into one dataset called `cyl_new` .

```
cyl4 <-
  mtcars |>
  select(mpg:hp) |>
  filter(cyl == 4) |>
  select(-cyl) |>
  mutate(cyl = 4)
cyl4
```

```
##                 mpg  disp  hp cyl
## Datsun 710     22.8 108.0  93   4
## Merc 240D      24.4 146.7  62   4
## Merc 230       22.8 140.8  95   4
## Fiat 128       32.4  78.7  66   4
## Honda Civic    30.4  75.7  52   4
## Toyota Corolla 33.9  71.1  65   4
## Toyota Corona  21.5 120.1  97   4
## Fiat X1-9      27.3  79.0  66   4
## Porsche 914-2  26.0 120.3  91   4
## Lotus Europa   30.4  95.1 113   4
## Volvo 142E     21.4 121.0 109   4
```

```
cyl6 <-
  mtcars |>
  select(mpg:hp) |>
  filter(cyl == 6) |>
  select(-cyl) |>
  mutate(cyl = 6)
cyl6
```

```
##                 mpg  disp  hp cyl
## Mazda RX4      21.0 160.0 110   6
## Mazda RX4 Wag  21.0 160.0 110   6
## Hornet 4 Drive 21.4 258.0 110   6
## Valiant        18.1 225.0 105   6
## Merc 280       19.2 167.6 123   6
## Merc 280C      17.8 167.6 123   6
## Ferrari Dino   19.7 145.0 175   6
```

```
cyl_new <- cyl4 |> full_join(cyl6)
```

```
## Joining, by = c("mpg", "disp", "hp", "cyl")
```

```
cyl_new
```

```
##     mpg  disp  hp cyl
## 1  22.8 108.0  93   4
## 2  24.4 146.7  62   4
## 3  22.8 140.8  95   4
## 4  32.4  78.7  66   4
## 5  30.4  75.7  52   4
## 6  33.9  71.1  65   4
## 7  21.5 120.1  97   4
## 8  27.3  79.0  66   4
## 9  26.0 120.3  91   4
## 10 30.4  95.1 113   4
## 11 21.4 121.0 109   4
## 12 21.0 160.0 110   6
## 13 21.0 160.0 110   6
## 14 21.4 258.0 110   6
## 15 18.1 225.0 105   6
## 16 19.2 167.6 123   6
## 17 17.8 167.6 123   6
## 18 19.7 145.0 175   6
```