hw1

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2023-02-19

Reshaping practice

1. Reshaping practice The following parts ask you to provide R code that transforms one dataset (I) into another (II).
    a. Regional murder rates: Turn I (https://uwmadison.box.com/shared/static/h4gau9heqy3uue9rmpq9b55s3kw37zd8.csv) into II (https://uwmadison.box.com/shared/static/shy7od3ydtiqu3lmqvy4nbi17qkg2ys4.csv).

```
murder_rate1 <- read.csv("https://uwmadison.box.com/shared/static/h4gau9heqy3uue9rmpq9b55s3kw37zd8.csv")
murder_rate2 <- read.csv("https://uwmadison.box.com/shared/static/shy7od3ydtiqu3lmqvy4nbi17qkg2ys4.csv")
murder_rate1
```

```
##                      state abb        region population total
## 1              Alabama  AL         South    4779736   135
## 2               Alaska  AK          West     710231    19
## 3              Arizona  AZ          West    6392017   232
## 4             Arkansas  AR         South    2915918    93
## 5           California  CA          West   37253956  1257
## 6             Colorado  CO          West    5029196    65
## 7          Connecticut  CT     Northeast    3574097    97
## 8             Delaware  DE         South     897934    38
## 9  District of Columbia DC         South     601723    99
## 10             Florida  FL         South   19687653   669
## 11             Georgia  GA         South    9920000   376
## 12              Hawaii  HI          West    1360301     7
## 13               Idaho  ID          West    1567582    12
## 14            Illinois  IL North Central   12830632   364
## 15             Indiana  IN North Central    6483802   142
## 16                Iowa  IA North Central    3046355    21
## 17              Kansas  KS North Central    2853118    63
## 18            Kentucky  KY         South    4339367   116
## 19           Louisiana  LA         South    4533372   351
## 20               Maine  ME     Northeast    1328361    11
## 21            Maryland  MD         South    5773552   293
## 22       Massachusetts  MA     Northeast    6547629   118
## 23            Michigan  MI North Central    9883640   413
## 24           Minnesota  MN North Central    5303925    53
## 25         Mississippi  MS         South    2967297   120
## 26            Missouri  MO North Central    5988927   321
## 27             Montana  MT          West     989415    12
## 28            Nebraska  NE North Central    1826341    32
## 29              Nevada  NV          West    2700551    84
## 30       New Hampshire  NH     Northeast    1316470     5
## 31          New Jersey  NJ     Northeast    8791894   246
## 32          New Mexico  NM          West    2059179    67
## 33            New York  NY     Northeast   19378102   517
## 34      North Carolina  NC         South    9535483   286
## 35        North Dakota  ND North Central     672591     4
## 36                Ohio  OH North Central   11536504   310
## 37            Oklahoma  OK         South    3751351   111
## 38              Oregon  OR          West    3831074    36
```

```
## 39        Pennsylvania  PA      Northeast   12702379   457
## 40        Rhode Island  RI      Northeast    1052567    16
## 41      South Carolina  SC         South     4625364   207
## 42        South Dakota  SD North Central      814180     8
## 43           Tennessee  TN         South     6346105   219
## 44               Texas  TX         South    25145561   805
## 45                Utah  UT          West     2763885    22
## 46             Vermont  VT      Northeast     625741      2
## 47            Virginia  VA         South     8001024   250
## 48          Washington  WA          West     6724540    93
## 49       West Virginia  WV         South     1852994    27
## 50           Wisconsin  WI North Central     5686986    97
## 51             Wyoming  WY          West      563626      5
```

```
murder_rate1 %>%
  group_by(region) %>%
  summarise(murders = sum(total),population = sum(population)) %>%
  mutate(murder_rate = murders / population) %>%
  arrange(.,murder_rate)
```

```
## # A tibble: 4 × 4
##   region        murders population murder_rate
##   <chr>           <int>      <int>       <dbl>
## 1 Northeast        1469   55317240   0.0000266
## 2 West             1911   71945553   0.0000266
## 3 North Central    1828   66927001   0.0000273
## 4 South            4195  115674434   0.0000363
```

```
murder_rate2
```

```
##          region murders population  murder_rate
## 1      Northeast    1469   55317240 2.655592e-05
## 2           West    1911   71945553 2.656175e-05
## 3  North Central    1828   66927001 2.731334e-05
## 4          South    4195  115674434 3.626558e-05
```

b. Antiobitics and bacteria. Turn I (https://uwmadison.box.com/shared/static/bq4afq9kl2zn9qlb89q2rxhrrv73iuil.csv) into II (https://uwmadison.box.com/shared/static/gmzul7bp78o6kwtutl73hkiyxea4dr21.csv)

```r
data1 <- read.csv("https://uwmadison.box.com/shared/static/bq4afq9kl2zn9qlb89q2rxhrrv73iuil.csv")
data2 <- read.csv("https://uwmadison.box.com/shared/static/gmzul7bp78o6kwtutl73hkiyxea4dr21.csv")
data1
```

```
##      sample      antibiotic Unc05qi6 Unc06af7 Unc06bhm Unc06glh Unc06grq
## 1       D1 Antibiotic-free        0       11       79      108      791
## 2       D2 Antibiotic-free        0       31     1413      192     1616
## 3       D3 Antibiotic-free        0       23      915      165     1323
## 4       D4 Antibiotic-free        0       31     1366      170     1846
## 5       D5 Antibiotic-free        0       26      689      135     2314
## 6       D6 Antibiotic-free        0      175      776      310     2244
## 7       D7 Antibiotic-free        0      181      609      235     1652
## 8       D8 Antibiotic-free        1        3      470       30      347
## 9       D9 Antibiotic-free        0      121      309      159      837
## 10     D10 Antibiotic-free        0       48       74       56      500
## 11     D11 Antibiotic-free        0        0      160       59     1371
## 12     D12       Antibiotic        0        3     1230       38      424
## 13     D13       Antibiotic        0       85     1156      123      576
## 14     D14       Antibiotic        0        4     2744       68      103
## 15     D15       Antibiotic        0     1183       25     1605        5
## 16     D16       Antibiotic        0      104       95     2365       45
## 17     D17  Post-Antibiotic        0       53       65      691       26
## 18     D18  Post-Antibiotic        0      494       43     1672        5
## 19     D19  Post-Antibiotic        0     1216      189     1662       23
## 20     D20  Post-Antibiotic        0      610      369     1077       31
## 21     D21  Post-Antibiotic        0     1209      416     1584      266
## 22     D22  Post-Antibiotic        0     1516      657     2026     1015
## 23     D23  Post-Antibiotic        0      487      946      804      449
## 24     D24 Antibiotic-free        0      100     1337      184      844
## 25     D25 Antibiotic-free        0      159      444      311     1555
## 26     D26 Antibiotic-free        0      292     1062      522      834
## 27     D27 Antibiotic-free        0      254     1236      476      722
## 28     D28 Antibiotic-free        0      367      300      622      902
## 29     D29 Antibiotic-free        0      177      679      268      715
## 30     D30 Antibiotic-free        0       40      628       75      710
## 31     D31 Antibiotic-free        0       90      566      158     1023
## 32     D32 Antibiotic-free        0       44      638       65      605
## 33     D33 Antibiotic-free        1      395      437      577     3398
## 34     D34 Antibiotic-free        0      339      405      480     3045
## 35     D35 Antibiotic-free        0       41      598      284     1810
## 36     D36 Antibiotic-free        0      200      982      322     1769
## 37     D37 Antibiotic-free        0      236     1086      307     2032
## 38     D38 Antibiotic-free        0       36      994      262     1621
```

```
## 39      D39 Antibiotic-free        0      34     826     227    1310
## 40      D40        Antibiotic       0     320     461     439    3033
## 41      D41        Antibiotic       0      40     486     258    1698
## 42      D42        Antibiotic       0     249    1680     266     774
## 43      D43        Antibiotic       0       0      10       0       1
## 44      D44        Antibiotic       0       2       2      31      12
## 45      D45 Post-Antibiotic       0       0       3      52      20
## 46      D46 Post-Antibiotic       0     663       2    1041     605
## 47      D47 Post-Antibiotic       0      76       0     632     396
## 48      D48 Post-Antibiotic       0    1289     139    1865    2164
## 49      D49 Post-Antibiotic       0     565     151     815    1945
## 50      D50 Post-Antibiotic       3      55     112     356    1036
## 51      D51 Post-Antibiotic       0     268     334     751     713
## 52      D52 Antibiotic-free        0      60     276     201    1715
## 53      D53 Antibiotic-free        0     154     364     384    2183
## 54      D54 Antibiotic-free        0      17     400     143    1777
## 55      D55 Antibiotic-free        0      24     307      90    2231
## 56      D56 Antibiotic-free        0     101     339     342    3623
## 57       E1 Antibiotic-free      869     534     270     390    1100
## 58       E2 Antibiotic-free      432     421     141     297    1964
## 59       E3 Antibiotic-free      990     455     194     351     982
## 60       E4 Antibiotic-free      358     502     162     381     822
## 61       E5 Antibiotic-free      987     478     220     375     769
## 62       E6 Antibiotic-free     1188     534     211     477     940
## 63       E7 Antibiotic-free      450     477     228     479    1129
## 64       E8 Antibiotic-free      575     632     247     461    1318
## 65       E9 Antibiotic-free      593     305     152     328     757
## 66      E10 Antibiotic-free      805     560     185     543    2014
## 67      E11 Antibiotic-free      420     930     241     650    2896
## 68      E12        Antibiotic     279     373     120     272    1233
## 69      E13        Antibiotic     571     624     165     596    1210
## 70      E14        Antibiotic     866    3111     297    1795      86
## 71      E15        Antibiotic     100    3280     459    2982       0
## 72      E16        Antibiotic     241    5782     831    3824       1
## 73      E17 Post-Antibiotic     456    6510    1130    3912       3
## 74      E18 Post-Antibiotic      84    2164     278    1214       1
## 75      E19 Post-Antibiotic     142    1496     190     979       1
## 76      E20 Post-Antibiotic      91    1238     110    1217      73
## 77      E21 Antibiotic-free      299     429      97     303     264
```

```
## 78       E22 Antibiotic-free   2626     96     21     42      46
## 79       E23 Antibiotic-free    419    216     95    164     520
## 80       E24 Antibiotic-free     92    356     43    221     939
## 81       E25 Antibiotic-free    582    205    101    141     526
## 82       E26 Antibiotic-free   2550     88     72     61     833
## 83       E27 Antibiotic-free    242    189     66    133     429
## 84       E28 Antibiotic-free    892    167     63    100     614
## 85       E29 Antibiotic-free    724    201     47    107     428
## 86       E30 Antibiotic-free    701    221    951   1837     947
## 87       E31 Antibiotic-free   2552    295    687   2455    1058
## 88       E32 Antibiotic-free    577    268     45    234     547
## 89       E33 Antibiotic-free    197    467     45    450    1269
## 90       E34 Antibiotic-free     85    331     56    247     963
## 91       E35 Antibiotic-free    503    193     46    155     744
## 92       E36 Antibiotic-free    110    257     33    169    1123
## 93       E37     Antibiotic    280    242     57    146    1469
## 94       E38     Antibiotic    329    408     74    406    1189
## 95       E39     Antibiotic    942    905    107    540     248
## 96       E40     Antibiotic    631   1378    129   1365       1
## 97       E41     Antibiotic    286    638    191    445       0
## 98       E42 Post-Antibiotic   157    467     57    308       0
## 99       E43 Post-Antibiotic   124    877     41    519       1
## 100      E44 Post-Antibiotic   756    779     68    758       0
## 101      E45 Post-Antibiotic   194   1041     39    665       0
## 102      E46 Post-Antibiotic   268    902     46    890       0
## 103      E47 Post-Antibiotic   299    447     71    311       4
## 104      E48 Antibiotic-free   3082    204    118    118       6
## 105      E49 Antibiotic-free    756    462     64    384    1293
## 106      E50 Antibiotic-free   1017    354    122    211    1278
## 107      E51 Antibiotic-free    850    526    172    382    1479
## 108      E52 Antibiotic-free   1280    128    109    128     490
## 109       F1 Antibiotic-free     50      0    608      0    1277
## 110       F2 Antibiotic-free     13      0    512      0    1002
## 111       F3 Antibiotic-free    138      0    745      0    2524
## 112       F4 Antibiotic-free     21      0    520      0    2504
## 113       F5 Antibiotic-free    174      0    362      1    1510
## 114       F6 Antibiotic-free    147      0    549      0    1708
## 115       F7 Antibiotic-free    235      1    952      4    2034
## 116       F8 Antibiotic-free    128      0    797      0    1938
```

```
## 117   F9 Antibiotic-free    206    0    674    0   1699
## 118  F10 Antibiotic-free    389    0    895    1   1973
## 119  F11 Antibiotic-free    159    0    863    0   2223
## 120  F12      Antibiotic     16    0    465    0    969
## 121  F13      Antibiotic     31    0   1222    0    985
## 122  F14      Antibiotic     27    0     78    0     90
## 123  F15      Antibiotic      0    0      0    0      2
## 124  F16      Antibiotic      0    0      0    0    105
## 125  F17 Post-Antibiotic      0    0      0    0    125
## 126  F18 Post-Antibiotic      0    0      0    0    344
## 127  F19 Post-Antibiotic      0    0      0    0   1311
## 128  F20 Post-Antibiotic      6    0      0    0   3425
## 129  F21 Post-Antibiotic     63    0      0    0   4064
## 130  F22 Post-Antibiotic     89    0      0    0   2889
## 131  F23 Post-Antibiotic     89    0      0    0   3283
## 132  F24 Antibiotic-free     18    0     30    0    756
## 133  F25 Antibiotic-free    127    0     81    1     72
## 134  F26 Antibiotic-free    105    0      5    0   2262
## 135  F27 Antibiotic-free      5    0    483    0   1344
## 136  F28 Antibiotic-free      6    0   1123    0   1796
## 137  F29 Antibiotic-free     57    0     14    0   1453
## 138  F30 Antibiotic-free     12    0   2070    0   1102
## 139  F31 Antibiotic-free     37    0   2654    0   1081
## 140  F32 Antibiotic-free     34    0   2345    0   1355
## 141  F33 Antibiotic-free    113    0   1180    0   1097
## 142  F34 Antibiotic-free     77    0   2057    0    276
## 143  F35 Antibiotic-free     84    0   1471    1    781
## 144  F36 Antibiotic-free    157    0   1607    0    630
## 145  F37 Antibiotic-free    127    0   2136    0    373
## 146  F38 Antibiotic-free     89    0   2131    0    819
## 147  F39 Antibiotic-free     13    0   1255    0   1060
## 148  F40 Antibiotic-free     13    0   2914    1    259
## 149  F41      Antibiotic     14    0   1910    3    306
## 150  F42      Antibiotic     77    0   1555    1   2201
## 151  F43      Antibiotic     12    0    521    0   2792
## 152  F44      Antibiotic      4    0     18    0   3354
## 153  F45 Post-Antibiotic      6    0      7    0   3827
## 154  F46 Post-Antibiotic      1    0     10    0   2333
## 155  F47 Post-Antibiotic      6    0     46    0   1603
```

```
## 156      F48 Post-Antibiotic     26      0      161      0      2570
## 157      F49 Post-Antibiotic     22      0      777      0      2268
## 158      F50 Post-Antibiotic     48      0      227      0      2709
## 159      F51 Post-Antibiotic     34      0      330      1      2092
## 160      F52 Antibiotic-free     77      0     1476      0      3081
## 161      F53 Antibiotic-free     12      0      500      1      4768
## 162      F54 Antibiotic-free     58      1      852      1      4593
##      Unc09fy6
## 1           0
## 2           0
## 3           0
## 4           0
## 5           0
## 6           0
## 7           0
## 8           0
## 9           1
## 10          0
## 11          0
## 12          0
## 13          0
## 14          0
## 15          1
## 16          0
## 17          0
## 18          0
## 19          1
## 20          0
## 21          0
## 22          1
## 23          0
## 24          0
## 25          0
## 26          0
## 27          0
## 28          0
## 29          0
## 30          0
## 31          0
```

```
## 32        0
## 33        0
## 34        0
## 35        0
## 36        1
## 37        0
## 38        0
## 39        0
## 40        0
## 41        0
## 42        0
## 43        0
## 44        0
## 45        0
## 46        0
## 47        4
## 48        0
## 49        1
## 50        3
## 51        5
## 52        0
## 53        0
## 54        0
## 55        0
## 56        0
## 57     1362
## 58     2146
## 59     1134
## 60     2465
## 61     2536
## 62     2633
## 63     1718
## 64     1043
## 65     2359
## 66     1182
## 67     6136
## 68     3097
## 69     2301
## 70      192
```

```
## 71        12
## 72        19
## 73         3
## 74       207
## 75      4252
## 76      3827
## 77      3309
## 78       535
## 79      2077
## 80      1255
## 81      4258
## 82      1710
## 83      2177
## 84      2802
## 85      2706
## 86      6175
## 87     10970
## 88      2270
## 89       748
## 90      1244
## 91      2654
## 92      3226
## 93      2801
## 94      1441
## 95      1042
## 96       322
## 97      3805
## 98      2436
## 99      2003
## 100     2422
## 101     5215
## 102     3551
## 103     2742
## 104     4184
## 105     3674
## 106     3826
## 107     2201
## 108     2522
## 109      352
```

```
## 110     816
## 111     892
## 112     194
## 113     180
## 114     261
## 115     357
## 116     165
## 117     220
## 118     120
## 119     297
## 120     124
## 121     280
## 122    3339
## 123    5331
## 124    2782
## 125    3163
## 126    1928
## 127     948
## 128     941
## 129    1047
## 130    1131
## 131    2197
## 132    1962
## 133    2503
## 134     800
## 135    1193
## 136     267
## 137    1564
## 138     256
## 139      10
## 140       7
## 141      52
## 142      68
## 143      66
## 144      26
## 145      47
## 146     119
## 147      26
## 148      41
```

```
## 149        19
## 150       269
## 151       806
## 152       736
## 153      1112
## 154       856
## 155       882
## 156       873
## 157       529
## 158       980
## 159       764
## 160       461
## 161       143
## 162       422
```

```
data1 %>%
  pivot_longer(
    cols = Unc05qi6:Unc09fy6,
    names_to = 'species',
    values_to = 'value',
    values_drop_na = TRUE
  ) %>%
  mutate(ind = str_extract(`sample`,"[A-Z]")) %>%
  mutate(time = substring(sample,2,3)) %>%
  select(sample,ind,time,antibiotic,species,value) %>%
  arrange(species)
```

```
## # A tibble: 972 × 6
##     sample ind   time  antibiotic      species  value
##     <chr>  <chr> <chr> <chr>           <chr>    <int>
##  1 D1      D     1     Antibiotic-free Unc05qi6     0
##  2 D2      D     2     Antibiotic-free Unc05qi6     0
##  3 D3      D     3     Antibiotic-free Unc05qi6     0
##  4 D4      D     4     Antibiotic-free Unc05qi6     0
##  5 D5      D     5     Antibiotic-free Unc05qi6     0
##  6 D6      D     6     Antibiotic-free Unc05qi6     0
##  7 D7      D     7     Antibiotic-free Unc05qi6     0
##  8 D8      D     8     Antibiotic-free Unc05qi6     1
##  9 D9      D     9     Antibiotic-free Unc05qi6     0
## 10 D10     D     10    Antibiotic-free Unc05qi6     0
## # … with 962 more rows
```

```
data2
```

```
##    sample ind time       antibiotic  species value
## 1      D1   D    1 Antibiotic-free  Unc05qi6     0
## 2      D2   D    2 Antibiotic-free  Unc05qi6     0
## 3      D3   D    3 Antibiotic-free  Unc05qi6     0
## 4      D4   D    4 Antibiotic-free  Unc05qi6     0
## 5      D5   D    5 Antibiotic-free  Unc05qi6     0
## 6      D6   D    6 Antibiotic-free  Unc05qi6     0
## 7      D7   D    7 Antibiotic-free  Unc05qi6     0
## 8      D8   D    8 Antibiotic-free  Unc05qi6     1
## 9      D9   D    9 Antibiotic-free  Unc05qi6     0
## 10    D10   D   10 Antibiotic-free  Unc05qi6     0
## 11    D11   D   11 Antibiotic-free  Unc05qi6     0
## 12    D12   D   12      Antibiotic  Unc05qi6     0
## 13    D13   D   13      Antibiotic  Unc05qi6     0
## 14    D14   D   14      Antibiotic  Unc05qi6     0
## 15    D15   D   15      Antibiotic  Unc05qi6     0
## 16    D16   D   16      Antibiotic  Unc05qi6     0
## 17    D17   D   17 Post-Antibiotic  Unc05qi6     0
## 18    D18   D   18 Post-Antibiotic  Unc05qi6     0
## 19    D19   D   19 Post-Antibiotic  Unc05qi6     0
## 20    D20   D   20 Post-Antibiotic  Unc05qi6     0
## 21    D21   D   21 Post-Antibiotic  Unc05qi6     0
## 22    D22   D   22 Post-Antibiotic  Unc05qi6     0
## 23    D23   D   23 Post-Antibiotic  Unc05qi6     0
## 24    D24   D   24 Antibiotic-free  Unc05qi6     0
## 25    D25   D   25 Antibiotic-free  Unc05qi6     0
## 26    D26   D   26 Antibiotic-free  Unc05qi6     0
## 27    D27   D   27 Antibiotic-free  Unc05qi6     0
## 28    D28   D   28 Antibiotic-free  Unc05qi6     0
## 29    D29   D   29 Antibiotic-free  Unc05qi6     0
## 30    D30   D   30 Antibiotic-free  Unc05qi6     0
## 31    D31   D   31 Antibiotic-free  Unc05qi6     0
## 32    D32   D   32 Antibiotic-free  Unc05qi6     0
## 33    D33   D   33 Antibiotic-free  Unc05qi6     1
## 34    D34   D   34 Antibiotic-free  Unc05qi6     0
## 35    D35   D   35 Antibiotic-free  Unc05qi6     0
## 36    D36   D   36 Antibiotic-free  Unc05qi6     0
## 37    D37   D   37 Antibiotic-free  Unc05qi6     0
## 38    D38   D   38 Antibiotic-free  Unc05qi6     0
```

```
## 39    D39    D    39 Antibiotic-free Unc05qi6       0
## 40    D40    D    40      Antibiotic Unc05qi6       0
## 41    D41    D    41      Antibiotic Unc05qi6       0
## 42    D42    D    42      Antibiotic Unc05qi6       0
## 43    D43    D    43      Antibiotic Unc05qi6       0
## 44    D44    D    44      Antibiotic Unc05qi6       0
## 45    D45    D    45 Post-Antibiotic Unc05qi6       0
## 46    D46    D    46 Post-Antibiotic Unc05qi6       0
## 47    D47    D    47 Post-Antibiotic Unc05qi6       0
## 48    D48    D    48 Post-Antibiotic Unc05qi6       0
## 49    D49    D    49 Post-Antibiotic Unc05qi6       0
## 50    D50    D    50 Post-Antibiotic Unc05qi6       3
## 51    D51    D    51 Post-Antibiotic Unc05qi6       0
## 52    D52    D    52 Antibiotic-free Unc05qi6       0
## 53    D53    D    53 Antibiotic-free Unc05qi6       0
## 54    D54    D    54 Antibiotic-free Unc05qi6       0
## 55    D55    D    55 Antibiotic-free Unc05qi6       0
## 56    D56    D    56 Antibiotic-free Unc05qi6       0
## 57     D1    D     1 Antibiotic-free Unc06af7      11
## 58     D2    D     2 Antibiotic-free Unc06af7      31
## 59     D3    D     3 Antibiotic-free Unc06af7      23
## 60     D4    D     4 Antibiotic-free Unc06af7      31
## 61     D5    D     5 Antibiotic-free Unc06af7      26
## 62     D6    D     6 Antibiotic-free Unc06af7     175
## 63     D7    D     7 Antibiotic-free Unc06af7     181
## 64     D8    D     8 Antibiotic-free Unc06af7       3
## 65     D9    D     9 Antibiotic-free Unc06af7     121
## 66    D10    D    10 Antibiotic-free Unc06af7      48
## 67    D11    D    11 Antibiotic-free Unc06af7       0
## 68    D12    D    12      Antibiotic Unc06af7       3
## 69    D13    D    13      Antibiotic Unc06af7      85
## 70    D14    D    14      Antibiotic Unc06af7       4
## 71    D15    D    15      Antibiotic Unc06af7    1183
## 72    D16    D    16      Antibiotic Unc06af7     104
## 73    D17    D    17 Post-Antibiotic Unc06af7      53
## 74    D18    D    18 Post-Antibiotic Unc06af7     494
## 75    D19    D    19 Post-Antibiotic Unc06af7    1216
## 76    D20    D    20 Post-Antibiotic Unc06af7     610
## 77    D21    D    21 Post-Antibiotic Unc06af7    1209
```

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## 78     D22    D   22 Post-Antibiotic Unc06af7   1516
## 79     D23    D   23 Post-Antibiotic Unc06af7    487
## 80     D24    D   24 Antibiotic-free Unc06af7    100
## 81     D25    D   25 Antibiotic-free Unc06af7    159
## 82     D26    D   26 Antibiotic-free Unc06af7    292
## 83     D27    D   27 Antibiotic-free Unc06af7    254
## 84     D28    D   28 Antibiotic-free Unc06af7    367
## 85     D29    D   29 Antibiotic-free Unc06af7    177
## 86     D30    D   30 Antibiotic-free Unc06af7     40
## 87     D31    D   31 Antibiotic-free Unc06af7     90
## 88     D32    D   32 Antibiotic-free Unc06af7     44
## 89     D33    D   33 Antibiotic-free Unc06af7    395
## 90     D34    D   34 Antibiotic-free Unc06af7    339
## 91     D35    D   35 Antibiotic-free Unc06af7     41
## 92     D36    D   36 Antibiotic-free Unc06af7    200
## 93     D37    D   37 Antibiotic-free Unc06af7    236
## 94     D38    D   38 Antibiotic-free Unc06af7     36
## 95     D39    D   39 Antibiotic-free Unc06af7     34
## 96     D40    D   40       Antibiotic Unc06af7    320
## 97     D41    D   41       Antibiotic Unc06af7     40
## 98     D42    D   42       Antibiotic Unc06af7    249
## 99     D43    D   43       Antibiotic Unc06af7      0
## 100    D44    D   44       Antibiotic Unc06af7      2
## 101    D45    D   45 Post-Antibiotic Unc06af7      0
## 102    D46    D   46 Post-Antibiotic Unc06af7    663
## 103    D47    D   47 Post-Antibiotic Unc06af7     76
## 104    D48    D   48 Post-Antibiotic Unc06af7   1289
## 105    D49    D   49 Post-Antibiotic Unc06af7    565
## 106    D50    D   50 Post-Antibiotic Unc06af7     55
## 107    D51    D   51 Post-Antibiotic Unc06af7    268
## 108    D52    D   52 Antibiotic-free Unc06af7     60
## 109    D53    D   53 Antibiotic-free Unc06af7    154
## 110    D54    D   54 Antibiotic-free Unc06af7     17
## 111    D55    D   55 Antibiotic-free Unc06af7     24
## 112    D56    D   56 Antibiotic-free Unc06af7    101
## 113     D1    D    1 Antibiotic-free Unc06bhm     79
## 114     D2    D    2 Antibiotic-free Unc06bhm   1413
## 115     D3    D    3 Antibiotic-free Unc06bhm    915
## 116     D4    D    4 Antibiotic-free Unc06bhm   1366
```

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## 117    D5    D     5 Antibiotic-free Unc06bhm     689
## 118    D6    D     6 Antibiotic-free Unc06bhm     776
## 119    D7    D     7 Antibiotic-free Unc06bhm     609
## 120    D8    D     8 Antibiotic-free Unc06bhm     470
## 121    D9    D     9 Antibiotic-free Unc06bhm     309
## 122   D10    D    10 Antibiotic-free Unc06bhm      74
## 123   D11    D    11 Antibiotic-free Unc06bhm     160
## 124   D12    D    12      Antibiotic Unc06bhm    1230
## 125   D13    D    13      Antibiotic Unc06bhm    1156
## 126   D14    D    14      Antibiotic Unc06bhm    2744
## 127   D15    D    15      Antibiotic Unc06bhm      25
## 128   D16    D    16      Antibiotic Unc06bhm      95
## 129   D17    D    17 Post-Antibiotic Unc06bhm      65
## 130   D18    D    18 Post-Antibiotic Unc06bhm      43
## 131   D19    D    19 Post-Antibiotic Unc06bhm     189
## 132   D20    D    20 Post-Antibiotic Unc06bhm     369
## 133   D21    D    21 Post-Antibiotic Unc06bhm     416
## 134   D22    D    22 Post-Antibiotic Unc06bhm     657
## 135   D23    D    23 Post-Antibiotic Unc06bhm     946
## 136   D24    D    24 Antibiotic-free Unc06bhm    1337
## 137   D25    D    25 Antibiotic-free Unc06bhm     444
## 138   D26    D    26 Antibiotic-free Unc06bhm    1062
## 139   D27    D    27 Antibiotic-free Unc06bhm    1236
## 140   D28    D    28 Antibiotic-free Unc06bhm     300
## 141   D29    D    29 Antibiotic-free Unc06bhm     679
## 142   D30    D    30 Antibiotic-free Unc06bhm     628
## 143   D31    D    31 Antibiotic-free Unc06bhm     566
## 144   D32    D    32 Antibiotic-free Unc06bhm     638
## 145   D33    D    33 Antibiotic-free Unc06bhm     437
## 146   D34    D    34 Antibiotic-free Unc06bhm     405
## 147   D35    D    35 Antibiotic-free Unc06bhm     598
## 148   D36    D    36 Antibiotic-free Unc06bhm     982
## 149   D37    D    37 Antibiotic-free Unc06bhm    1086
## 150   D38    D    38 Antibiotic-free Unc06bhm     994
## 151   D39    D    39 Antibiotic-free Unc06bhm     826
## 152   D40    D    40      Antibiotic Unc06bhm     461
## 153   D41    D    41      Antibiotic Unc06bhm     486
## 154   D42    D    42      Antibiotic Unc06bhm    1680
## 155   D43    D    43      Antibiotic Unc06bhm      10
```

```
## 156   D44   D   44      Antibiotic Unc06bhm      2
## 157   D45   D   45 Post-Antibiotic Unc06bhm      3
## 158   D46   D   46 Post-Antibiotic Unc06bhm      2
## 159   D47   D   47 Post-Antibiotic Unc06bhm      0
## 160   D48   D   48 Post-Antibiotic Unc06bhm    139
## 161   D49   D   49 Post-Antibiotic Unc06bhm    151
## 162   D50   D   50 Post-Antibiotic Unc06bhm    112
## 163   D51   D   51 Post-Antibiotic Unc06bhm    334
## 164   D52   D   52 Antibiotic-free Unc06bhm    276
## 165   D53   D   53 Antibiotic-free Unc06bhm    364
## 166   D54   D   54 Antibiotic-free Unc06bhm    400
## 167   D55   D   55 Antibiotic-free Unc06bhm    307
## 168   D56   D   56 Antibiotic-free Unc06bhm    339
## 169    D1   D    1 Antibiotic-free Unc06glh    108
## 170    D2   D    2 Antibiotic-free Unc06glh    192
## 171    D3   D    3 Antibiotic-free Unc06glh    165
## 172    D4   D    4 Antibiotic-free Unc06glh    170
## 173    D5   D    5 Antibiotic-free Unc06glh    135
## 174    D6   D    6 Antibiotic-free Unc06glh    310
## 175    D7   D    7 Antibiotic-free Unc06glh    235
## 176    D8   D    8 Antibiotic-free Unc06glh     30
## 177    D9   D    9 Antibiotic-free Unc06glh    159
## 178   D10   D   10 Antibiotic-free Unc06glh     56
## 179   D11   D   11 Antibiotic-free Unc06glh     59
## 180   D12   D   12      Antibiotic Unc06glh     38
## 181   D13   D   13      Antibiotic Unc06glh    123
## 182   D14   D   14      Antibiotic Unc06glh     68
## 183   D15   D   15      Antibiotic Unc06glh   1605
## 184   D16   D   16      Antibiotic Unc06glh   2365
## 185   D17   D   17 Post-Antibiotic Unc06glh    691
## 186   D18   D   18 Post-Antibiotic Unc06glh   1672
## 187   D19   D   19 Post-Antibiotic Unc06glh   1662
## 188   D20   D   20 Post-Antibiotic Unc06glh   1077
## 189   D21   D   21 Post-Antibiotic Unc06glh   1584
## 190   D22   D   22 Post-Antibiotic Unc06glh   2026
## 191   D23   D   23 Post-Antibiotic Unc06glh    804
## 192   D24   D   24 Antibiotic-free Unc06glh    184
## 193   D25   D   25 Antibiotic-free Unc06glh    311
## 194   D26   D   26 Antibiotic-free Unc06glh    522
```

```
## 195    D27    D    27 Antibiotic-free Unc06glh    476
## 196    D28    D    28 Antibiotic-free Unc06glh    622
## 197    D29    D    29 Antibiotic-free Unc06glh    268
## 198    D30    D    30 Antibiotic-free Unc06glh     75
## 199    D31    D    31 Antibiotic-free Unc06glh    158
## 200    D32    D    32 Antibiotic-free Unc06glh     65
## 201    D33    D    33 Antibiotic-free Unc06glh    577
## 202    D34    D    34 Antibiotic-free Unc06glh    480
## 203    D35    D    35 Antibiotic-free Unc06glh    284
## 204    D36    D    36 Antibiotic-free Unc06glh    322
## 205    D37    D    37 Antibiotic-free Unc06glh    307
## 206    D38    D    38 Antibiotic-free Unc06glh    262
## 207    D39    D    39 Antibiotic-free Unc06glh    227
## 208    D40    D    40       Antibiotic Unc06glh    439
## 209    D41    D    41       Antibiotic Unc06glh    258
## 210    D42    D    42       Antibiotic Unc06glh    266
## 211    D43    D    43       Antibiotic Unc06glh      0
## 212    D44    D    44       Antibiotic Unc06glh     31
## 213    D45    D    45 Post-Antibiotic Unc06glh     52
## 214    D46    D    46 Post-Antibiotic Unc06glh   1041
## 215    D47    D    47 Post-Antibiotic Unc06glh    632
## 216    D48    D    48 Post-Antibiotic Unc06glh   1865
## 217    D49    D    49 Post-Antibiotic Unc06glh    815
## 218    D50    D    50 Post-Antibiotic Unc06glh    356
## 219    D51    D    51 Post-Antibiotic Unc06glh    751
## 220    D52    D    52 Antibiotic-free Unc06glh    201
## 221    D53    D    53 Antibiotic-free Unc06glh    384
## 222    D54    D    54 Antibiotic-free Unc06glh    143
## 223    D55    D    55 Antibiotic-free Unc06glh     90
## 224    D56    D    56 Antibiotic-free Unc06glh    342
## 225     D1    D     1 Antibiotic-free Unc06grq    791
## 226     D2    D     2 Antibiotic-free Unc06grq   1616
## 227     D3    D     3 Antibiotic-free Unc06grq   1323
## 228     D4    D     4 Antibiotic-free Unc06grq   1846
## 229     D5    D     5 Antibiotic-free Unc06grq   2314
## 230     D6    D     6 Antibiotic-free Unc06grq   2244
## 231     D7    D     7 Antibiotic-free Unc06grq   1652
## 232     D8    D     8 Antibiotic-free Unc06grq    347
## 233     D9    D     9 Antibiotic-free Unc06grq    837
```

```
## 234   D10   D   10 Antibiotic-free Unc06grq   500
## 235   D11   D   11 Antibiotic-free Unc06grq  1371
## 236   D12   D   12      Antibiotic Unc06grq   424
## 237   D13   D   13      Antibiotic Unc06grq   576
## 238   D14   D   14      Antibiotic Unc06grq   103
## 239   D15   D   15      Antibiotic Unc06grq     5
## 240   D16   D   16      Antibiotic Unc06grq    45
## 241   D17   D   17 Post-Antibiotic Unc06grq    26
## 242   D18   D   18 Post-Antibiotic Unc06grq     5
## 243   D19   D   19 Post-Antibiotic Unc06grq    23
## 244   D20   D   20 Post-Antibiotic Unc06grq    31
## 245   D21   D   21 Post-Antibiotic Unc06grq   266
## 246   D22   D   22 Post-Antibiotic Unc06grq  1015
## 247   D23   D   23 Post-Antibiotic Unc06grq   449
## 248   D24   D   24 Antibiotic-free Unc06grq   844
## 249   D25   D   25 Antibiotic-free Unc06grq  1555
## 250   D26   D   26 Antibiotic-free Unc06grq   834
## 251   D27   D   27 Antibiotic-free Unc06grq   722
## 252   D28   D   28 Antibiotic-free Unc06grq   902
## 253   D29   D   29 Antibiotic-free Unc06grq   715
## 254   D30   D   30 Antibiotic-free Unc06grq   710
## 255   D31   D   31 Antibiotic-free Unc06grq  1023
## 256   D32   D   32 Antibiotic-free Unc06grq   605
## 257   D33   D   33 Antibiotic-free Unc06grq  3398
## 258   D34   D   34 Antibiotic-free Unc06grq  3045
## 259   D35   D   35 Antibiotic-free Unc06grq  1810
## 260   D36   D   36 Antibiotic-free Unc06grq  1769
## 261   D37   D   37 Antibiotic-free Unc06grq  2032
## 262   D38   D   38 Antibiotic-free Unc06grq  1621
## 263   D39   D   39 Antibiotic-free Unc06grq  1310
## 264   D40   D   40      Antibiotic Unc06grq  3033
## 265   D41   D   41      Antibiotic Unc06grq  1698
## 266   D42   D   42      Antibiotic Unc06grq   774
## 267   D43   D   43      Antibiotic Unc06grq     1
## 268   D44   D   44      Antibiotic Unc06grq    12
## 269   D45   D   45 Post-Antibiotic Unc06grq    20
## 270   D46   D   46 Post-Antibiotic Unc06grq   605
## 271   D47   D   47 Post-Antibiotic Unc06grq   396
## 272   D48   D   48 Post-Antibiotic Unc06grq  2164
```

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## 273    D49    D    49 Post-Antibiotic Unc06grq   1945
## 274    D50    D    50 Post-Antibiotic Unc06grq   1036
## 275    D51    D    51 Post-Antibiotic Unc06grq    713
## 276    D52    D    52 Antibiotic-free Unc06grq   1715
## 277    D53    D    53 Antibiotic-free Unc06grq   2183
## 278    D54    D    54 Antibiotic-free Unc06grq   1777
## 279    D55    D    55 Antibiotic-free Unc06grq   2231
## 280    D56    D    56 Antibiotic-free Unc06grq   3623
## 281     D1    D     1 Antibiotic-free Unc09fy6      0
## 282     D2    D     2 Antibiotic-free Unc09fy6      0
## 283     D3    D     3 Antibiotic-free Unc09fy6      0
## 284     D4    D     4 Antibiotic-free Unc09fy6      0
## 285     D5    D     5 Antibiotic-free Unc09fy6      0
## 286     D6    D     6 Antibiotic-free Unc09fy6      0
## 287     D7    D     7 Antibiotic-free Unc09fy6      0
## 288     D8    D     8 Antibiotic-free Unc09fy6      0
## 289     D9    D     9 Antibiotic-free Unc09fy6      1
## 290    D10    D    10 Antibiotic-free Unc09fy6      0
## 291    D11    D    11 Antibiotic-free Unc09fy6      0
## 292    D12    D    12      Antibiotic Unc09fy6      0
## 293    D13    D    13      Antibiotic Unc09fy6      0
## 294    D14    D    14      Antibiotic Unc09fy6      0
## 295    D15    D    15      Antibiotic Unc09fy6      1
## 296    D16    D    16      Antibiotic Unc09fy6      0
## 297    D17    D    17 Post-Antibiotic Unc09fy6      0
## 298    D18    D    18 Post-Antibiotic Unc09fy6      0
## 299    D19    D    19 Post-Antibiotic Unc09fy6      1
## 300    D20    D    20 Post-Antibiotic Unc09fy6      0
## 301    D21    D    21 Post-Antibiotic Unc09fy6      0
## 302    D22    D    22 Post-Antibiotic Unc09fy6      1
## 303    D23    D    23 Post-Antibiotic Unc09fy6      0
## 304    D24    D    24 Antibiotic-free Unc09fy6      0
## 305    D25    D    25 Antibiotic-free Unc09fy6      0
## 306    D26    D    26 Antibiotic-free Unc09fy6      0
## 307    D27    D    27 Antibiotic-free Unc09fy6      0
## 308    D28    D    28 Antibiotic-free Unc09fy6      0
## 309    D29    D    29 Antibiotic-free Unc09fy6      0
## 310    D30    D    30 Antibiotic-free Unc09fy6      0
## 311    D31    D    31 Antibiotic-free Unc09fy6      0
```

```
## 312    D32    D    32 Antibiotic-free Unc09fy6      0
## 313    D33    D    33 Antibiotic-free Unc09fy6      0
## 314    D34    D    34 Antibiotic-free Unc09fy6      0
## 315    D35    D    35 Antibiotic-free Unc09fy6      0
## 316    D36    D    36 Antibiotic-free Unc09fy6      1
## 317    D37    D    37 Antibiotic-free Unc09fy6      0
## 318    D38    D    38 Antibiotic-free Unc09fy6      0
## 319    D39    D    39 Antibiotic-free Unc09fy6      0
## 320    D40    D    40      Antibiotic Unc09fy6      0
## 321    D41    D    41      Antibiotic Unc09fy6      0
## 322    D42    D    42      Antibiotic Unc09fy6      0
## 323    D43    D    43      Antibiotic Unc09fy6      0
## 324    D44    D    44      Antibiotic Unc09fy6      0
## 325    D45    D    45 Post-Antibiotic Unc09fy6      0
## 326    D46    D    46 Post-Antibiotic Unc09fy6      0
## 327    D47    D    47 Post-Antibiotic Unc09fy6      4
## 328    D48    D    48 Post-Antibiotic Unc09fy6      0
## 329    D49    D    49 Post-Antibiotic Unc09fy6      1
## 330    D50    D    50 Post-Antibiotic Unc09fy6      3
## 331    D51    D    51 Post-Antibiotic Unc09fy6      5
## 332    D52    D    52 Antibiotic-free Unc09fy6      0
## 333    D53    D    53 Antibiotic-free Unc09fy6      0
## 334    D54    D    54 Antibiotic-free Unc09fy6      0
## 335    D55    D    55 Antibiotic-free Unc09fy6      0
## 336    D56    D    56 Antibiotic-free Unc09fy6      0
## 337     E1    E     1 Antibiotic-free Unc05qi6    869
## 338     E2    E     2 Antibiotic-free Unc05qi6    432
## 339     E3    E     3 Antibiotic-free Unc05qi6    990
## 340     E4    E     4 Antibiotic-free Unc05qi6    358
## 341     E5    E     5 Antibiotic-free Unc05qi6    987
## 342     E6    E     6 Antibiotic-free Unc05qi6   1188
## 343     E7    E     7 Antibiotic-free Unc05qi6    450
## 344     E8    E     8 Antibiotic-free Unc05qi6    575
## 345     E9    E     9 Antibiotic-free Unc05qi6    593
## 346    E10    E    10 Antibiotic-free Unc05qi6    805
## 347    E11    E    11 Antibiotic-free Unc05qi6    420
## 348    E12    E    12      Antibiotic Unc05qi6    279
## 349    E13    E    13      Antibiotic Unc05qi6    571
## 350    E14    E    14      Antibiotic Unc05qi6    866
```

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## 351    E15    E    15       Antibiotic Unc05qi6    100
## 352    E16    E    16       Antibiotic Unc05qi6    241
## 353    E17    E    17 Post-Antibiotic Unc05qi6    456
## 354    E18    E    18 Post-Antibiotic Unc05qi6     84
## 355    E19    E    19 Post-Antibiotic Unc05qi6    142
## 356    E20    E    20 Post-Antibiotic Unc05qi6     91
## 357    E21    E    21 Antibiotic-free Unc05qi6    299
## 358    E22    E    22 Antibiotic-free Unc05qi6   2626
## 359    E23    E    23 Antibiotic-free Unc05qi6    419
## 360    E24    E    24 Antibiotic-free Unc05qi6     92
## 361    E25    E    25 Antibiotic-free Unc05qi6    582
## 362    E26    E    26 Antibiotic-free Unc05qi6   2550
## 363    E27    E    27 Antibiotic-free Unc05qi6    242
## 364    E28    E    28 Antibiotic-free Unc05qi6    892
## 365    E29    E    29 Antibiotic-free Unc05qi6    724
## 366    E30    E    30 Antibiotic-free Unc05qi6    701
## 367    E31    E    31 Antibiotic-free Unc05qi6   2552
## 368    E32    E    32 Antibiotic-free Unc05qi6    577
## 369    E33    E    33 Antibiotic-free Unc05qi6    197
## 370    E34    E    34 Antibiotic-free Unc05qi6     85
## 371    E35    E    35 Antibiotic-free Unc05qi6    503
## 372    E36    E    36 Antibiotic-free Unc05qi6    110
## 373    E37    E    37       Antibiotic Unc05qi6    280
## 374    E38    E    38       Antibiotic Unc05qi6    329
## 375    E39    E    39       Antibiotic Unc05qi6    942
## 376    E40    E    40       Antibiotic Unc05qi6    631
## 377    E41    E    41       Antibiotic Unc05qi6    286
## 378    E42    E    42 Post-Antibiotic Unc05qi6    157
## 379    E43    E    43 Post-Antibiotic Unc05qi6    124
## 380    E44    E    44 Post-Antibiotic Unc05qi6    756
## 381    E45    E    45 Post-Antibiotic Unc05qi6    194
## 382    E46    E    46 Post-Antibiotic Unc05qi6    268
## 383    E47    E    47 Post-Antibiotic Unc05qi6    299
## 384    E48    E    48 Antibiotic-free Unc05qi6   3082
## 385    E49    E    49 Antibiotic-free Unc05qi6    756
## 386    E50    E    50 Antibiotic-free Unc05qi6   1017
## 387    E51    E    51 Antibiotic-free Unc05qi6    850
## 388    E52    E    52 Antibiotic-free Unc05qi6   1280
## 389     E1    E     1 Antibiotic-free Unc06af7    534
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## 390     E2    E      2 Antibiotic-free Unc06af7     421
## 391     E3    E      3 Antibiotic-free Unc06af7     455
## 392     E4    E      4 Antibiotic-free Unc06af7     502
## 393     E5    E      5 Antibiotic-free Unc06af7     478
## 394     E6    E      6 Antibiotic-free Unc06af7     534
## 395     E7    E      7 Antibiotic-free Unc06af7     477
## 396     E8    E      8 Antibiotic-free Unc06af7     632
## 397     E9    E      9 Antibiotic-free Unc06af7     305
## 398    E10    E     10 Antibiotic-free Unc06af7     560
## 399    E11    E     11 Antibiotic-free Unc06af7     930
## 400    E12    E     12      Antibiotic Unc06af7     373
## 401    E13    E     13      Antibiotic Unc06af7     624
## 402    E14    E     14      Antibiotic Unc06af7    3111
## 403    E15    E     15      Antibiotic Unc06af7    3280
## 404    E16    E     16      Antibiotic Unc06af7    5782
## 405    E17    E     17 Post-Antibiotic Unc06af7    6510
## 406    E18    E     18 Post-Antibiotic Unc06af7    2164
## 407    E19    E     19 Post-Antibiotic Unc06af7    1496
## 408    E20    E     20 Post-Antibiotic Unc06af7    1238
## 409    E21    E     21 Antibiotic-free Unc06af7     429
## 410    E22    E     22 Antibiotic-free Unc06af7      96
## 411    E23    E     23 Antibiotic-free Unc06af7     216
## 412    E24    E     24 Antibiotic-free Unc06af7     356
## 413    E25    E     25 Antibiotic-free Unc06af7     205
## 414    E26    E     26 Antibiotic-free Unc06af7      88
## 415    E27    E     27 Antibiotic-free Unc06af7     189
## 416    E28    E     28 Antibiotic-free Unc06af7     167
## 417    E29    E     29 Antibiotic-free Unc06af7     201
## 418    E30    E     30 Antibiotic-free Unc06af7     221
## 419    E31    E     31 Antibiotic-free Unc06af7     295
## 420    E32    E     32 Antibiotic-free Unc06af7     268
## 421    E33    E     33 Antibiotic-free Unc06af7     467
## 422    E34    E     34 Antibiotic-free Unc06af7     331
## 423    E35    E     35 Antibiotic-free Unc06af7     193
## 424    E36    E     36 Antibiotic-free Unc06af7     257
## 425    E37    E     37      Antibiotic Unc06af7     242
## 426    E38    E     38      Antibiotic Unc06af7     408
## 427    E39    E     39      Antibiotic Unc06af7     905
## 428    E40    E     40      Antibiotic Unc06af7    1378
```

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## 429    E41    E    41       Antibiotic Unc06af7    638
## 430    E42    E    42 Post-Antibiotic Unc06af7    467
## 431    E43    E    43 Post-Antibiotic Unc06af7    877
## 432    E44    E    44 Post-Antibiotic Unc06af7    779
## 433    E45    E    45 Post-Antibiotic Unc06af7   1041
## 434    E46    E    46 Post-Antibiotic Unc06af7    902
## 435    E47    E    47 Post-Antibiotic Unc06af7    447
## 436    E48    E    48 Antibiotic-free Unc06af7    204
## 437    E49    E    49 Antibiotic-free Unc06af7    462
## 438    E50    E    50 Antibiotic-free Unc06af7    354
## 439    E51    E    51 Antibiotic-free Unc06af7    526
## 440    E52    E    52 Antibiotic-free Unc06af7    128
## 441     E1    E     1 Antibiotic-free Unc06bhm    270
## 442     E2    E     2 Antibiotic-free Unc06bhm    141
## 443     E3    E     3 Antibiotic-free Unc06bhm    194
## 444     E4    E     4 Antibiotic-free Unc06bhm    162
## 445     E5    E     5 Antibiotic-free Unc06bhm    220
## 446     E6    E     6 Antibiotic-free Unc06bhm    211
## 447     E7    E     7 Antibiotic-free Unc06bhm    228
## 448     E8    E     8 Antibiotic-free Unc06bhm    247
## 449     E9    E     9 Antibiotic-free Unc06bhm    152
## 450    E10    E    10 Antibiotic-free Unc06bhm    185
## 451    E11    E    11 Antibiotic-free Unc06bhm    241
## 452    E12    E    12       Antibiotic Unc06bhm    120
## 453    E13    E    13       Antibiotic Unc06bhm    165
## 454    E14    E    14       Antibiotic Unc06bhm    297
## 455    E15    E    15       Antibiotic Unc06bhm    459
## 456    E16    E    16       Antibiotic Unc06bhm    831
## 457    E17    E    17 Post-Antibiotic Unc06bhm   1130
## 458    E18    E    18 Post-Antibiotic Unc06bhm    278
## 459    E19    E    19 Post-Antibiotic Unc06bhm    190
## 460    E20    E    20 Post-Antibiotic Unc06bhm    110
## 461    E21    E    21 Antibiotic-free Unc06bhm     97
## 462    E22    E    22 Antibiotic-free Unc06bhm     21
## 463    E23    E    23 Antibiotic-free Unc06bhm     95
## 464    E24    E    24 Antibiotic-free Unc06bhm     43
## 465    E25    E    25 Antibiotic-free Unc06bhm    101
## 466    E26    E    26 Antibiotic-free Unc06bhm     72
## 467    E27    E    27 Antibiotic-free Unc06bhm     66
```

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## 468   E28   E   28 Antibiotic-free Unc06bhm    63
## 469   E29   E   29 Antibiotic-free Unc06bhm    47
## 470   E30   E   30 Antibiotic-free Unc06bhm   951
## 471   E31   E   31 Antibiotic-free Unc06bhm   687
## 472   E32   E   32 Antibiotic-free Unc06bhm    45
## 473   E33   E   33 Antibiotic-free Unc06bhm    45
## 474   E34   E   34 Antibiotic-free Unc06bhm    56
## 475   E35   E   35 Antibiotic-free Unc06bhm    46
## 476   E36   E   36 Antibiotic-free Unc06bhm    33
## 477   E37   E   37      Antibiotic Unc06bhm    57
## 478   E38   E   38      Antibiotic Unc06bhm    74
## 479   E39   E   39      Antibiotic Unc06bhm   107
## 480   E40   E   40      Antibiotic Unc06bhm   129
## 481   E41   E   41      Antibiotic Unc06bhm   191
## 482   E42   E   42 Post-Antibiotic Unc06bhm    57
## 483   E43   E   43 Post-Antibiotic Unc06bhm    41
## 484   E44   E   44 Post-Antibiotic Unc06bhm    68
## 485   E45   E   45 Post-Antibiotic Unc06bhm    39
## 486   E46   E   46 Post-Antibiotic Unc06bhm    46
## 487   E47   E   47 Post-Antibiotic Unc06bhm    71
## 488   E48   E   48 Antibiotic-free Unc06bhm   118
## 489   E49   E   49 Antibiotic-free Unc06bhm    64
## 490   E50   E   50 Antibiotic-free Unc06bhm   122
## 491   E51   E   51 Antibiotic-free Unc06bhm   172
## 492   E52   E   52 Antibiotic-free Unc06bhm   109
## 493    E1   E    1 Antibiotic-free Unc06glh   390
## 494    E2   E    2 Antibiotic-free Unc06glh   297
## 495    E3   E    3 Antibiotic-free Unc06glh   351
## 496    E4   E    4 Antibiotic-free Unc06glh   381
## 497    E5   E    5 Antibiotic-free Unc06glh   375
## 498    E6   E    6 Antibiotic-free Unc06glh   477
## 499    E7   E    7 Antibiotic-free Unc06glh   479
## 500    E8   E    8 Antibiotic-free Unc06glh   461
## 501    E9   E    9 Antibiotic-free Unc06glh   328
## 502   E10   E   10 Antibiotic-free Unc06glh   543
## 503   E11   E   11 Antibiotic-free Unc06glh   650
## 504   E12   E   12      Antibiotic Unc06glh   272
## 505   E13   E   13      Antibiotic Unc06glh   596
## 506   E14   E   14      Antibiotic Unc06glh  1795
```

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## 507    E15   E   15      Antibiotic Unc06glh  2982
## 508    E16   E   16      Antibiotic Unc06glh  3824
## 509    E17   E   17 Post-Antibiotic Unc06glh  3912
## 510    E18   E   18 Post-Antibiotic Unc06glh  1214
## 511    E19   E   19 Post-Antibiotic Unc06glh   979
## 512    E20   E   20 Post-Antibiotic Unc06glh  1217
## 513    E21   E   21 Antibiotic-free Unc06glh   303
## 514    E22   E   22 Antibiotic-free Unc06glh    42
## 515    E23   E   23 Antibiotic-free Unc06glh   164
## 516    E24   E   24 Antibiotic-free Unc06glh   221
## 517    E25   E   25 Antibiotic-free Unc06glh   141
## 518    E26   E   26 Antibiotic-free Unc06glh    61
## 519    E27   E   27 Antibiotic-free Unc06glh   133
## 520    E28   E   28 Antibiotic-free Unc06glh   100
## 521    E29   E   29 Antibiotic-free Unc06glh   107
## 522    E30   E   30 Antibiotic-free Unc06glh  1837
## 523    E31   E   31 Antibiotic-free Unc06glh  2455
## 524    E32   E   32 Antibiotic-free Unc06glh   234
## 525    E33   E   33 Antibiotic-free Unc06glh   450
## 526    E34   E   34 Antibiotic-free Unc06glh   247
## 527    E35   E   35 Antibiotic-free Unc06glh   155
## 528    E36   E   36 Antibiotic-free Unc06glh   169
## 529    E37   E   37      Antibiotic Unc06glh   146
## 530    E38   E   38      Antibiotic Unc06glh   406
## 531    E39   E   39      Antibiotic Unc06glh   540
## 532    E40   E   40      Antibiotic Unc06glh  1365
## 533    E41   E   41      Antibiotic Unc06glh   445
## 534    E42   E   42 Post-Antibiotic Unc06glh   308
## 535    E43   E   43 Post-Antibiotic Unc06glh   519
## 536    E44   E   44 Post-Antibiotic Unc06glh   758
## 537    E45   E   45 Post-Antibiotic Unc06glh   665
## 538    E46   E   46 Post-Antibiotic Unc06glh   890
## 539    E47   E   47 Post-Antibiotic Unc06glh   311
## 540    E48   E   48 Antibiotic-free Unc06glh   118
## 541    E49   E   49 Antibiotic-free Unc06glh   384
## 542    E50   E   50 Antibiotic-free Unc06glh   211
## 543    E51   E   51 Antibiotic-free Unc06glh   382
## 544    E52   E   52 Antibiotic-free Unc06glh   128
## 545     E1   E    1 Antibiotic-free Unc06grq  1100
```

```
## 546    E2   E    2 Antibiotic-free Unc06grq 1964
## 547    E3   E    3 Antibiotic-free Unc06grq  982
## 548    E4   E    4 Antibiotic-free Unc06grq  822
## 549    E5   E    5 Antibiotic-free Unc06grq  769
## 550    E6   E    6 Antibiotic-free Unc06grq  940
## 551    E7   E    7 Antibiotic-free Unc06grq 1129
## 552    E8   E    8 Antibiotic-free Unc06grq 1318
## 553    E9   E    9 Antibiotic-free Unc06grq  757
## 554   E10   E   10 Antibiotic-free Unc06grq 2014
## 555   E11   E   11 Antibiotic-free Unc06grq 2896
## 556   E12   E   12      Antibiotic Unc06grq 1233
## 557   E13   E   13      Antibiotic Unc06grq 1210
## 558   E14   E   14      Antibiotic Unc06grq   86
## 559   E15   E   15      Antibiotic Unc06grq    0
## 560   E16   E   16      Antibiotic Unc06grq    1
## 561   E17   E   17 Post-Antibiotic Unc06grq    3
## 562   E18   E   18 Post-Antibiotic Unc06grq    1
## 563   E19   E   19 Post-Antibiotic Unc06grq    1
## 564   E20   E   20 Post-Antibiotic Unc06grq   73
## 565   E21   E   21 Antibiotic-free Unc06grq  264
## 566   E22   E   22 Antibiotic-free Unc06grq   46
## 567   E23   E   23 Antibiotic-free Unc06grq  520
## 568   E24   E   24 Antibiotic-free Unc06grq  939
## 569   E25   E   25 Antibiotic-free Unc06grq  526
## 570   E26   E   26 Antibiotic-free Unc06grq  833
## 571   E27   E   27 Antibiotic-free Unc06grq  429
## 572   E28   E   28 Antibiotic-free Unc06grq  614
## 573   E29   E   29 Antibiotic-free Unc06grq  428
## 574   E30   E   30 Antibiotic-free Unc06grq  947
## 575   E31   E   31 Antibiotic-free Unc06grq 1058
## 576   E32   E   32 Antibiotic-free Unc06grq  547
## 577   E33   E   33 Antibiotic-free Unc06grq 1269
## 578   E34   E   34 Antibiotic-free Unc06grq  963
## 579   E35   E   35 Antibiotic-free Unc06grq  744
## 580   E36   E   36 Antibiotic-free Unc06grq 1123
## 581   E37   E   37      Antibiotic Unc06grq 1469
## 582   E38   E   38      Antibiotic Unc06grq 1189
## 583   E39   E   39      Antibiotic Unc06grq  248
## 584   E40   E   40      Antibiotic Unc06grq    1
```

```
## 585    E41    E    41        Antibiotic Unc06grq       0
## 586    E42    E    42 Post-Antibiotic Unc06grq         0
## 587    E43    E    43 Post-Antibiotic Unc06grq         1
## 588    E44    E    44 Post-Antibiotic Unc06grq         0
## 589    E45    E    45 Post-Antibiotic Unc06grq         0
## 590    E46    E    46 Post-Antibiotic Unc06grq         0
## 591    E47    E    47 Post-Antibiotic Unc06grq         4
## 592    E48    E    48 Antibiotic-free Unc06grq         6
## 593    E49    E    49 Antibiotic-free Unc06grq      1293
## 594    E50    E    50 Antibiotic-free Unc06grq      1278
## 595    E51    E    51 Antibiotic-free Unc06grq      1479
## 596    E52    E    52 Antibiotic-free Unc06grq       490
## 597     E1    E     1 Antibiotic-free Unc09fy6      1362
## 598     E2    E     2 Antibiotic-free Unc09fy6      2146
## 599     E3    E     3 Antibiotic-free Unc09fy6      1134
## 600     E4    E     4 Antibiotic-free Unc09fy6      2465
## 601     E5    E     5 Antibiotic-free Unc09fy6      2536
## 602     E6    E     6 Antibiotic-free Unc09fy6      2633
## 603     E7    E     7 Antibiotic-free Unc09fy6      1718
## 604     E8    E     8 Antibiotic-free Unc09fy6      1043
## 605     E9    E     9 Antibiotic-free Unc09fy6      2359
## 606    E10    E    10 Antibiotic-free Unc09fy6      1182
## 607    E11    E    11 Antibiotic-free Unc09fy6      6136
## 608    E12    E    12        Antibiotic Unc09fy6     3097
## 609    E13    E    13        Antibiotic Unc09fy6     2301
## 610    E14    E    14        Antibiotic Unc09fy6      192
## 611    E15    E    15        Antibiotic Unc09fy6       12
## 612    E16    E    16        Antibiotic Unc09fy6       19
## 613    E17    E    17 Post-Antibiotic Unc09fy6         3
## 614    E18    E    18 Post-Antibiotic Unc09fy6       207
## 615    E19    E    19 Post-Antibiotic Unc09fy6      4252
## 616    E20    E    20 Post-Antibiotic Unc09fy6      3827
## 617    E21    E    21 Antibiotic-free Unc09fy6      3309
## 618    E22    E    22 Antibiotic-free Unc09fy6       535
## 619    E23    E    23 Antibiotic-free Unc09fy6      2077
## 620    E24    E    24 Antibiotic-free Unc09fy6      1255
## 621    E25    E    25 Antibiotic-free Unc09fy6      4258
## 622    E26    E    26 Antibiotic-free Unc09fy6      1710
## 623    E27    E    27 Antibiotic-free Unc09fy6      2177
```

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## 624    E28    E   28 Antibiotic-free Unc09fy6   2802
## 625    E29    E   29 Antibiotic-free Unc09fy6   2706
## 626    E30    E   30 Antibiotic-free Unc09fy6   6175
## 627    E31    E   31 Antibiotic-free Unc09fy6  10970
## 628    E32    E   32 Antibiotic-free Unc09fy6   2270
## 629    E33    E   33 Antibiotic-free Unc09fy6    748
## 630    E34    E   34 Antibiotic-free Unc09fy6   1244
## 631    E35    E   35 Antibiotic-free Unc09fy6   2654
## 632    E36    E   36 Antibiotic-free Unc09fy6   3226
## 633    E37    E   37      Antibiotic Unc09fy6   2801
## 634    E38    E   38      Antibiotic Unc09fy6   1441
## 635    E39    E   39      Antibiotic Unc09fy6   1042
## 636    E40    E   40      Antibiotic Unc09fy6    322
## 637    E41    E   41      Antibiotic Unc09fy6   3805
## 638    E42    E   42 Post-Antibiotic Unc09fy6   2436
## 639    E43    E   43 Post-Antibiotic Unc09fy6   2003
## 640    E44    E   44 Post-Antibiotic Unc09fy6   2422
## 641    E45    E   45 Post-Antibiotic Unc09fy6   5215
## 642    E46    E   46 Post-Antibiotic Unc09fy6   3551
## 643    E47    E   47 Post-Antibiotic Unc09fy6   2742
## 644    E48    E   48 Antibiotic-free Unc09fy6   4184
## 645    E49    E   49 Antibiotic-free Unc09fy6   3674
## 646    E50    E   50 Antibiotic-free Unc09fy6   3826
## 647    E51    E   51 Antibiotic-free Unc09fy6   2201
## 648    E52    E   52 Antibiotic-free Unc09fy6   2522
## 649     F1    F    1 Antibiotic-free Unc05qi6     50
## 650     F2    F    2 Antibiotic-free Unc05qi6     13
## 651     F3    F    3 Antibiotic-free Unc05qi6    138
## 652     F4    F    4 Antibiotic-free Unc05qi6     21
## 653     F5    F    5 Antibiotic-free Unc05qi6    174
## 654     F6    F    6 Antibiotic-free Unc05qi6    147
## 655     F7    F    7 Antibiotic-free Unc05qi6    235
## 656     F8    F    8 Antibiotic-free Unc05qi6    128
## 657     F9    F    9 Antibiotic-free Unc05qi6    206
## 658    F10    F   10 Antibiotic-free Unc05qi6    389
## 659    F11    F   11 Antibiotic-free Unc05qi6    159
## 660    F12    F   12      Antibiotic Unc05qi6     16
## 661    F13    F   13      Antibiotic Unc05qi6     31
## 662    F14    F   14      Antibiotic Unc05qi6     27
```

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## 663    F15    F   15        Antibiotic Unc05qi6      0
## 664    F16    F   16        Antibiotic Unc05qi6      0
## 665    F17    F   17 Post-Antibiotic Unc05qi6      0
## 666    F18    F   18 Post-Antibiotic Unc05qi6      0
## 667    F19    F   19 Post-Antibiotic Unc05qi6      0
## 668    F20    F   20 Post-Antibiotic Unc05qi6      6
## 669    F21    F   21 Post-Antibiotic Unc05qi6     63
## 670    F22    F   22 Post-Antibiotic Unc05qi6     89
## 671    F23    F   23 Post-Antibiotic Unc05qi6     89
## 672    F24    F   24 Antibiotic-free Unc05qi6     18
## 673    F25    F   25 Antibiotic-free Unc05qi6    127
## 674    F26    F   26 Antibiotic-free Unc05qi6    105
## 675    F27    F   27 Antibiotic-free Unc05qi6      5
## 676    F28    F   28 Antibiotic-free Unc05qi6      6
## 677    F29    F   29 Antibiotic-free Unc05qi6     57
## 678    F30    F   30 Antibiotic-free Unc05qi6     12
## 679    F31    F   31 Antibiotic-free Unc05qi6     37
## 680    F32    F   32 Antibiotic-free Unc05qi6     34
## 681    F33    F   33 Antibiotic-free Unc05qi6    113
## 682    F34    F   34 Antibiotic-free Unc05qi6     77
## 683    F35    F   35 Antibiotic-free Unc05qi6     84
## 684    F36    F   36 Antibiotic-free Unc05qi6    157
## 685    F37    F   37 Antibiotic-free Unc05qi6    127
## 686    F38    F   38 Antibiotic-free Unc05qi6     89
## 687    F39    F   39 Antibiotic-free Unc05qi6     13
## 688    F40    F   40 Antibiotic-free Unc05qi6     13
## 689    F41    F   41        Antibiotic Unc05qi6     14
## 690    F42    F   42        Antibiotic Unc05qi6     77
## 691    F43    F   43        Antibiotic Unc05qi6     12
## 692    F44    F   44        Antibiotic Unc05qi6      4
## 693    F45    F   45 Post-Antibiotic Unc05qi6      6
## 694    F46    F   46 Post-Antibiotic Unc05qi6      1
## 695    F47    F   47 Post-Antibiotic Unc05qi6      6
## 696    F48    F   48 Post-Antibiotic Unc05qi6     26
## 697    F49    F   49 Post-Antibiotic Unc05qi6     22
## 698    F50    F   50 Post-Antibiotic Unc05qi6     48
## 699    F51    F   51 Post-Antibiotic Unc05qi6     34
## 700    F52    F   52 Antibiotic-free Unc05qi6     77
## 701    F53    F   53 Antibiotic-free Unc05qi6     12
```

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## 702    F54    F    54 Antibiotic-free Unc05qi6    58
## 703     F1    F     1 Antibiotic-free Unc06af7     0
## 704     F2    F     2 Antibiotic-free Unc06af7     0
## 705     F3    F     3 Antibiotic-free Unc06af7     0
## 706     F4    F     4 Antibiotic-free Unc06af7     0
## 707     F5    F     5 Antibiotic-free Unc06af7     0
## 708     F6    F     6 Antibiotic-free Unc06af7     0
## 709     F7    F     7 Antibiotic-free Unc06af7     1
## 710     F8    F     8 Antibiotic-free Unc06af7     0
## 711     F9    F     9 Antibiotic-free Unc06af7     0
## 712    F10    F    10 Antibiotic-free Unc06af7     0
## 713    F11    F    11 Antibiotic-free Unc06af7     0
## 714    F12    F    12       Antibiotic Unc06af7    0
## 715    F13    F    13       Antibiotic Unc06af7    0
## 716    F14    F    14       Antibiotic Unc06af7    0
## 717    F15    F    15       Antibiotic Unc06af7    0
## 718    F16    F    16       Antibiotic Unc06af7    0
## 719    F17    F    17 Post-Antibiotic Unc06af7     0
## 720    F18    F    18 Post-Antibiotic Unc06af7     0
## 721    F19    F    19 Post-Antibiotic Unc06af7     0
## 722    F20    F    20 Post-Antibiotic Unc06af7     0
## 723    F21    F    21 Post-Antibiotic Unc06af7     0
## 724    F22    F    22 Post-Antibiotic Unc06af7     0
## 725    F23    F    23 Post-Antibiotic Unc06af7     0
## 726    F24    F    24 Antibiotic-free Unc06af7     0
## 727    F25    F    25 Antibiotic-free Unc06af7     0
## 728    F26    F    26 Antibiotic-free Unc06af7     0
## 729    F27    F    27 Antibiotic-free Unc06af7     0
## 730    F28    F    28 Antibiotic-free Unc06af7     0
## 731    F29    F    29 Antibiotic-free Unc06af7     0
## 732    F30    F    30 Antibiotic-free Unc06af7     0
## 733    F31    F    31 Antibiotic-free Unc06af7     0
## 734    F32    F    32 Antibiotic-free Unc06af7     0
## 735    F33    F    33 Antibiotic-free Unc06af7     0
## 736    F34    F    34 Antibiotic-free Unc06af7     0
## 737    F35    F    35 Antibiotic-free Unc06af7     0
## 738    F36    F    36 Antibiotic-free Unc06af7     0
## 739    F37    F    37 Antibiotic-free Unc06af7     0
## 740    F38    F    38 Antibiotic-free Unc06af7     0
```

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## 741   F39   F   39 Antibiotic-free Unc06af7      0
## 742   F40   F   40 Antibiotic-free Unc06af7      0
## 743   F41   F   41      Antibiotic Unc06af7      0
## 744   F42   F   42      Antibiotic Unc06af7      0
## 745   F43   F   43      Antibiotic Unc06af7      0
## 746   F44   F   44      Antibiotic Unc06af7      0
## 747   F45   F   45 Post-Antibiotic Unc06af7      0
## 748   F46   F   46 Post-Antibiotic Unc06af7      0
## 749   F47   F   47 Post-Antibiotic Unc06af7      0
## 750   F48   F   48 Post-Antibiotic Unc06af7      0
## 751   F49   F   49 Post-Antibiotic Unc06af7      0
## 752   F50   F   50 Post-Antibiotic Unc06af7      0
## 753   F51   F   51 Post-Antibiotic Unc06af7      0
## 754   F52   F   52 Antibiotic-free Unc06af7      0
## 755   F53   F   53 Antibiotic-free Unc06af7      0
## 756   F54   F   54 Antibiotic-free Unc06af7      1
## 757    F1   F    1 Antibiotic-free Unc06bhm    608
## 758    F2   F    2 Antibiotic-free Unc06bhm    512
## 759    F3   F    3 Antibiotic-free Unc06bhm    745
## 760    F4   F    4 Antibiotic-free Unc06bhm    520
## 761    F5   F    5 Antibiotic-free Unc06bhm    362
## 762    F6   F    6 Antibiotic-free Unc06bhm    549
## 763    F7   F    7 Antibiotic-free Unc06bhm    952
## 764    F8   F    8 Antibiotic-free Unc06bhm    797
## 765    F9   F    9 Antibiotic-free Unc06bhm    674
## 766   F10   F   10 Antibiotic-free Unc06bhm    895
## 767   F11   F   11 Antibiotic-free Unc06bhm    863
## 768   F12   F   12      Antibiotic Unc06bhm    465
## 769   F13   F   13      Antibiotic Unc06bhm   1222
## 770   F14   F   14      Antibiotic Unc06bhm     78
## 771   F15   F   15      Antibiotic Unc06bhm      0
## 772   F16   F   16      Antibiotic Unc06bhm      0
## 773   F17   F   17 Post-Antibiotic Unc06bhm      0
## 774   F18   F   18 Post-Antibiotic Unc06bhm      0
## 775   F19   F   19 Post-Antibiotic Unc06bhm      0
## 776   F20   F   20 Post-Antibiotic Unc06bhm      0
## 777   F21   F   21 Post-Antibiotic Unc06bhm      0
## 778   F22   F   22 Post-Antibiotic Unc06bhm      0
## 779   F23   F   23 Post-Antibiotic Unc06bhm      0
```

```
## 780     F24    F    24 Antibiotic-free Unc06bhm      30
## 781     F25    F    25 Antibiotic-free Unc06bhm      81
## 782     F26    F    26 Antibiotic-free Unc06bhm       5
## 783     F27    F    27 Antibiotic-free Unc06bhm     483
## 784     F28    F    28 Antibiotic-free Unc06bhm    1123
## 785     F29    F    29 Antibiotic-free Unc06bhm      14
## 786     F30    F    30 Antibiotic-free Unc06bhm    2070
## 787     F31    F    31 Antibiotic-free Unc06bhm    2654
## 788     F32    F    32 Antibiotic-free Unc06bhm    2345
## 789     F33    F    33 Antibiotic-free Unc06bhm    1180
## 790     F34    F    34 Antibiotic-free Unc06bhm    2057
## 791     F35    F    35 Antibiotic-free Unc06bhm    1471
## 792     F36    F    36 Antibiotic-free Unc06bhm    1607
## 793     F37    F    37 Antibiotic-free Unc06bhm    2136
## 794     F38    F    38 Antibiotic-free Unc06bhm    2131
## 795     F39    F    39 Antibiotic-free Unc06bhm    1255
## 796     F40    F    40 Antibiotic-free Unc06bhm    2914
## 797     F41    F    41      Antibiotic Unc06bhm    1910
## 798     F42    F    42      Antibiotic Unc06bhm    1555
## 799     F43    F    43      Antibiotic Unc06bhm     521
## 800     F44    F    44      Antibiotic Unc06bhm      18
## 801     F45    F    45 Post-Antibiotic Unc06bhm       7
## 802     F46    F    46 Post-Antibiotic Unc06bhm      10
## 803     F47    F    47 Post-Antibiotic Unc06bhm      46
## 804     F48    F    48 Post-Antibiotic Unc06bhm     161
## 805     F49    F    49 Post-Antibiotic Unc06bhm     777
## 806     F50    F    50 Post-Antibiotic Unc06bhm     227
## 807     F51    F    51 Post-Antibiotic Unc06bhm     330
## 808     F52    F    52 Antibiotic-free Unc06bhm    1476
## 809     F53    F    53 Antibiotic-free Unc06bhm     500
## 810     F54    F    54 Antibiotic-free Unc06bhm     852
## 811      F1    F     1 Antibiotic-free Unc06g1h       0
## 812      F2    F     2 Antibiotic-free Unc06g1h       0
## 813      F3    F     3 Antibiotic-free Unc06g1h       0
## 814      F4    F     4 Antibiotic-free Unc06g1h       0
## 815      F5    F     5 Antibiotic-free Unc06g1h       1
## 816      F6    F     6 Antibiotic-free Unc06g1h       0
## 817      F7    F     7 Antibiotic-free Unc06g1h       4
## 818      F8    F     8 Antibiotic-free Unc06g1h       0
```

```
## 819    F9    F    9 Antibiotic-free Unc06g1h    0
## 820   F10    F   10 Antibiotic-free Unc06g1h    1
## 821   F11    F   11 Antibiotic-free Unc06g1h    0
## 822   F12    F   12      Antibiotic Unc06g1h    0
## 823   F13    F   13      Antibiotic Unc06g1h    0
## 824   F14    F   14      Antibiotic Unc06g1h    0
## 825   F15    F   15      Antibiotic Unc06g1h    0
## 826   F16    F   16      Antibiotic Unc06g1h    0
## 827   F17    F   17 Post-Antibiotic Unc06g1h    0
## 828   F18    F   18 Post-Antibiotic Unc06g1h    0
## 829   F19    F   19 Post-Antibiotic Unc06g1h    0
## 830   F20    F   20 Post-Antibiotic Unc06g1h    0
## 831   F21    F   21 Post-Antibiotic Unc06g1h    0
## 832   F22    F   22 Post-Antibiotic Unc06g1h    0
## 833   F23    F   23 Post-Antibiotic Unc06g1h    0
## 834   F24    F   24 Antibiotic-free Unc06g1h    0
## 835   F25    F   25 Antibiotic-free Unc06g1h    1
## 836   F26    F   26 Antibiotic-free Unc06g1h    0
## 837   F27    F   27 Antibiotic-free Unc06g1h    0
## 838   F28    F   28 Antibiotic-free Unc06g1h    0
## 839   F29    F   29 Antibiotic-free Unc06g1h    0
## 840   F30    F   30 Antibiotic-free Unc06g1h    0
## 841   F31    F   31 Antibiotic-free Unc06g1h    0
## 842   F32    F   32 Antibiotic-free Unc06g1h    0
## 843   F33    F   33 Antibiotic-free Unc06g1h    0
## 844   F34    F   34 Antibiotic-free Unc06g1h    0
## 845   F35    F   35 Antibiotic-free Unc06g1h    1
## 846   F36    F   36 Antibiotic-free Unc06g1h    0
## 847   F37    F   37 Antibiotic-free Unc06g1h    0
## 848   F38    F   38 Antibiotic-free Unc06g1h    0
## 849   F39    F   39 Antibiotic-free Unc06g1h    0
## 850   F40    F   40 Antibiotic-free Unc06g1h    1
## 851   F41    F   41      Antibiotic Unc06g1h    3
## 852   F42    F   42      Antibiotic Unc06g1h    1
## 853   F43    F   43      Antibiotic Unc06g1h    0
## 854   F44    F   44      Antibiotic Unc06g1h    0
## 855   F45    F   45 Post-Antibiotic Unc06g1h    0
## 856   F46    F   46 Post-Antibiotic Unc06g1h    0
## 857   F47    F   47 Post-Antibiotic Unc06g1h    0
```

```
## 858    F48    F    48 Post-Antibiotic Unc06g1h       0
## 859    F49    F    49 Post-Antibiotic Unc06g1h       0
## 860    F50    F    50 Post-Antibiotic Unc06g1h       0
## 861    F51    F    51 Post-Antibiotic Unc06g1h       1
## 862    F52    F    52 Antibiotic-free Unc06g1h       0
## 863    F53    F    53 Antibiotic-free Unc06g1h       1
## 864    F54    F    54 Antibiotic-free Unc06g1h       1
## 865     F1    F     1 Antibiotic-free Unc06grq    1277
## 866     F2    F     2 Antibiotic-free Unc06grq    1002
## 867     F3    F     3 Antibiotic-free Unc06grq    2524
## 868     F4    F     4 Antibiotic-free Unc06grq    2504
## 869     F5    F     5 Antibiotic-free Unc06grq    1510
## 870     F6    F     6 Antibiotic-free Unc06grq    1708
## 871     F7    F     7 Antibiotic-free Unc06grq    2034
## 872     F8    F     8 Antibiotic-free Unc06grq    1938
## 873     F9    F     9 Antibiotic-free Unc06grq    1699
## 874    F10    F    10 Antibiotic-free Unc06grq    1973
## 875    F11    F    11 Antibiotic-free Unc06grq    2223
## 876    F12    F    12      Antibiotic Unc06grq     969
## 877    F13    F    13      Antibiotic Unc06grq     985
## 878    F14    F    14      Antibiotic Unc06grq      90
## 879    F15    F    15      Antibiotic Unc06grq       2
## 880    F16    F    16      Antibiotic Unc06grq     105
## 881    F17    F    17 Post-Antibiotic Unc06grq     125
## 882    F18    F    18 Post-Antibiotic Unc06grq     344
## 883    F19    F    19 Post-Antibiotic Unc06grq    1311
## 884    F20    F    20 Post-Antibiotic Unc06grq    3425
## 885    F21    F    21 Post-Antibiotic Unc06grq    4064
## 886    F22    F    22 Post-Antibiotic Unc06grq    2889
## 887    F23    F    23 Post-Antibiotic Unc06grq    3283
## 888    F24    F    24 Antibiotic-free Unc06grq     756
## 889    F25    F    25 Antibiotic-free Unc06grq      72
## 890    F26    F    26 Antibiotic-free Unc06grq    2262
## 891    F27    F    27 Antibiotic-free Unc06grq    1344
## 892    F28    F    28 Antibiotic-free Unc06grq    1796
## 893    F29    F    29 Antibiotic-free Unc06grq    1453
## 894    F30    F    30 Antibiotic-free Unc06grq    1102
## 895    F31    F    31 Antibiotic-free Unc06grq    1081
## 896    F32    F    32 Antibiotic-free Unc06grq    1355
```

```
## 897     F33    F    33 Antibiotic-free Unc06grq  1097
## 898     F34    F    34 Antibiotic-free Unc06grq   276
## 899     F35    F    35 Antibiotic-free Unc06grq   781
## 900     F36    F    36 Antibiotic-free Unc06grq   630
## 901     F37    F    37 Antibiotic-free Unc06grq   373
## 902     F38    F    38 Antibiotic-free Unc06grq   819
## 903     F39    F    39 Antibiotic-free Unc06grq  1060
## 904     F40    F    40 Antibiotic-free Unc06grq   259
## 905     F41    F    41      Antibiotic Unc06grq   306
## 906     F42    F    42      Antibiotic Unc06grq  2201
## 907     F43    F    43      Antibiotic Unc06grq  2792
## 908     F44    F    44      Antibiotic Unc06grq  3354
## 909     F45    F    45 Post-Antibiotic Unc06grq  3827
## 910     F46    F    46 Post-Antibiotic Unc06grq  2333
## 911     F47    F    47 Post-Antibiotic Unc06grq  1603
## 912     F48    F    48 Post-Antibiotic Unc06grq  2570
## 913     F49    F    49 Post-Antibiotic Unc06grq  2268
## 914     F50    F    50 Post-Antibiotic Unc06grq  2709
## 915     F51    F    51 Post-Antibiotic Unc06grq  2092
## 916     F52    F    52 Antibiotic-free Unc06grq  3081
## 917     F53    F    53 Antibiotic-free Unc06grq  4768
## 918     F54    F    54 Antibiotic-free Unc06grq  4593
## 919      F1    F     1 Antibiotic-free Unc09fy6   352
## 920      F2    F     2 Antibiotic-free Unc09fy6   816
## 921      F3    F     3 Antibiotic-free Unc09fy6   892
## 922      F4    F     4 Antibiotic-free Unc09fy6   194
## 923      F5    F     5 Antibiotic-free Unc09fy6   180
## 924      F6    F     6 Antibiotic-free Unc09fy6   261
## 925      F7    F     7 Antibiotic-free Unc09fy6   357
## 926      F8    F     8 Antibiotic-free Unc09fy6   165
## 927      F9    F     9 Antibiotic-free Unc09fy6   220
## 928     F10    F    10 Antibiotic-free Unc09fy6   120
## 929     F11    F    11 Antibiotic-free Unc09fy6   297
## 930     F12    F    12      Antibiotic Unc09fy6   124
## 931     F13    F    13      Antibiotic Unc09fy6   280
## 932     F14    F    14      Antibiotic Unc09fy6  3339
## 933     F15    F    15      Antibiotic Unc09fy6  5331
## 934     F16    F    16      Antibiotic Unc09fy6  2782
## 935     F17    F    17 Post-Antibiotic Unc09fy6  3163
```

```
## 936   F18   F   18 Post-Antibiotic Unc09fy6 1928
## 937   F19   F   19 Post-Antibiotic Unc09fy6  948
## 938   F20   F   20 Post-Antibiotic Unc09fy6  941
## 939   F21   F   21 Post-Antibiotic Unc09fy6 1047
## 940   F22   F   22 Post-Antibiotic Unc09fy6 1131
## 941   F23   F   23 Post-Antibiotic Unc09fy6 2197
## 942   F24   F   24 Antibiotic-free Unc09fy6 1962
## 943   F25   F   25 Antibiotic-free Unc09fy6 2503
## 944   F26   F   26 Antibiotic-free Unc09fy6  800
## 945   F27   F   27 Antibiotic-free Unc09fy6 1193
## 946   F28   F   28 Antibiotic-free Unc09fy6  267
## 947   F29   F   29 Antibiotic-free Unc09fy6 1564
## 948   F30   F   30 Antibiotic-free Unc09fy6  256
## 949   F31   F   31 Antibiotic-free Unc09fy6   10
## 950   F32   F   32 Antibiotic-free Unc09fy6    7
## 951   F33   F   33 Antibiotic-free Unc09fy6   52
## 952   F34   F   34 Antibiotic-free Unc09fy6   68
## 953   F35   F   35 Antibiotic-free Unc09fy6   66
## 954   F36   F   36 Antibiotic-free Unc09fy6   26
## 955   F37   F   37 Antibiotic-free Unc09fy6   47
## 956   F38   F   38 Antibiotic-free Unc09fy6  119
## 957   F39   F   39 Antibiotic-free Unc09fy6   26
## 958   F40   F   40 Antibiotic-free Unc09fy6   41
## 959   F41   F   41      Antibiotic Unc09fy6   19
## 960   F42   F   42      Antibiotic Unc09fy6  269
## 961   F43   F   43      Antibiotic Unc09fy6  806
## 962   F44   F   44      Antibiotic Unc09fy6  736
## 963   F45   F   45 Post-Antibiotic Unc09fy6 1112
## 964   F46   F   46 Post-Antibiotic Unc09fy6  856
## 965   F47   F   47 Post-Antibiotic Unc09fy6  882
## 966   F48   F   48 Post-Antibiotic Unc09fy6  873
## 967   F49   F   49 Post-Antibiotic Unc09fy6  529
## 968   F50   F   50 Post-Antibiotic Unc09fy6  980
## 969   F51   F   51 Post-Antibiotic Unc09fy6  764
## 970   F52   F   52 Antibiotic-free Unc09fy6  461
## 971   F53   F   53 Antibiotic-free Unc09fy6  143
## 972   F54   F   54 Antibiotic-free Unc09fy6  422
```

City Temperatures

1. City Temperatures Let's create versions of Figure 2.3 and 2.4 from the reading (https://clauswilke.com/dataviz/aesthetic-mapping.html) this week. The command below reads in the data. We've filtered to a slightly different set of cities (Barrow is in Alaska, Honolulu is in Hawaii), but we should still be able to study changes in temperature over time.

```
temp <- read_csv("https://raw.githubusercontent.com/krisrs1128/stat479_s22/main/data/temperatures.csv")
```

```
## Rows: 1464 Columns: 7
## —— Column specification ——————————————————————————————————————————————————————
————————————
## Delimiter: ","
## chr  (4): station_id, month, flag, city
## dbl  (2): day, temperature
## date (1): date
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
temp
```

```
## # A tibble: 1,464 × 7
##    station_id  month   day temperature flag  date       city
##    <chr>       <chr> <dbl>       <dbl> <chr> <date>      <chr>
##  1 USC00042319 01        1        51   S     0000-01-01 Death Valley
##  2 USC00042319 01        2        51.2 S     0000-01-02 Death Valley
##  3 USC00042319 01        3        51.3 S     0000-01-03 Death Valley
##  4 USC00042319 01        4        51.4 S     0000-01-04 Death Valley
##  5 USC00042319 01        5        51.6 S     0000-01-05 Death Valley
##  6 USC00042319 01        6        51.7 S     0000-01-06 Death Valley
##  7 USC00042319 01        7        51.9 S     0000-01-07 Death Valley
##  8 USC00042319 01        8        52   S     0000-01-08 Death Valley
##  9 USC00042319 01        9        52.2 S     0000-01-09 Death Valley
## 10 USC00042319 01       10        52.3 S     0000-01-10 Death Valley
## # … with 1,454 more rows
```

a. Make a version of Figure 2.3 using a line mark (`geom_line`). Make at least one customization of the theme to make the plot more similar to the version in Figure 2.3. *Hint: To group the lines by city, use the* `group =` *aesthetic mapping.*

```
ggplot(temp) +
  geom_line(aes(x = date, y = temperature, group = city, col = city),size = 1) +
  labs(x = "month", y= "temperature(° F)") +
  scale_x_continuous(label = c("Jan","Apr","Jul","Oct","Jan")) +
  scale_y_continuous(
    limits = c(-20,110),
    breaks = c(0,20,40,60,80,100)
    )
```

```
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## ℹ Please use `linewidth` instead.
```
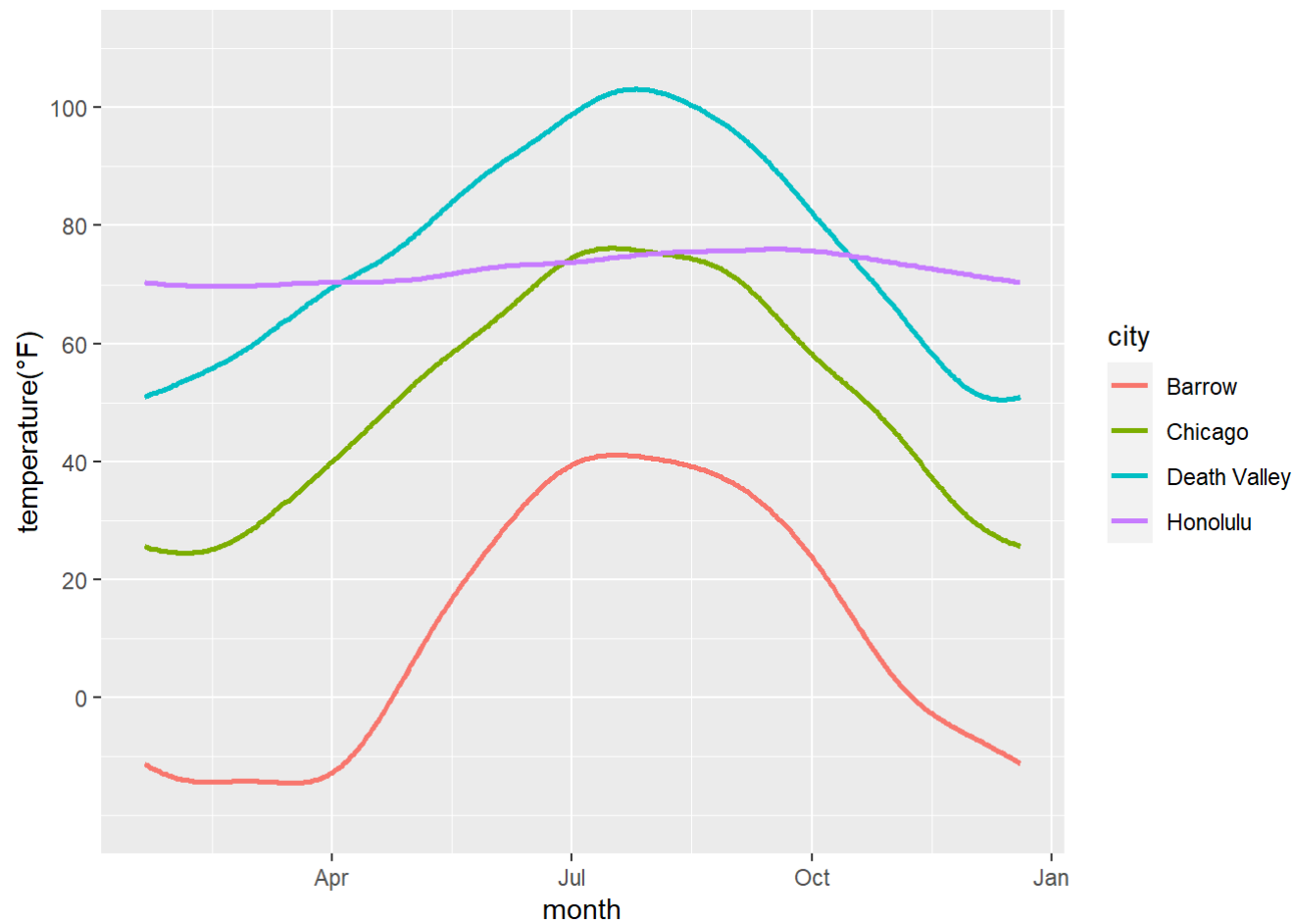
b. Using the `group_by` + `summarise` pattern, compute the mean temperature for each month in each city.

```
temp %>%
  group_by(city,month) %>%
  summarise(mean_temperature = mean(temperature))
```

```
## `summarise()` has grouped output by 'city'. You can override using the
## `.groups` argument.
```

```
## # A tibble: 48 × 3
## # Groups:   city [4]
##    city   month mean_temperature
##    <chr>  <chr>            <dbl>
##  1 Barrow 01              -13.4
##  2 Barrow 02              -14.2
##  3 Barrow 03              -12.6
##  4 Barrow 04                1.78
##  5 Barrow 05               21.1
##  6 Barrow 06               35.6
##  7 Barrow 07               40.8
##  8 Barrow 08               39
##  9 Barrow 09               32.1
## 10 Barrow 10               17.2
## # … with 38 more rows
```

c. Using the data generated in (b), Make a version of Figure 2.4 using a tile mark (`geom_tile`). Try either (i) adding the
`scale_fill_viridis_c(option = "magma")` scale to match the color scheme from the reading or (ii) adding coord_fixed()` to make sure the
marks are squares, not rectangles.

```
average_temp <- temp %>%
  group_by(city,month) %>%
  summarise(mean_temperature = mean(temperature))
```

```
## `summarise()` has grouped output by 'city'. You can override using the
## `.groups` argument.
```

```
average_temp
```

```
## # A tibble: 48 × 3
## # Groups:   city [4]
##    city   month mean_temperature
##    <chr>  <chr>            <dbl>
##  1 Barrow 01              -13.4
##  2 Barrow 02              -14.2
##  3 Barrow 03              -12.6
##  4 Barrow 04                1.78
##  5 Barrow 05               21.1
##  6 Barrow 06               35.6
##  7 Barrow 07               40.8
##  8 Barrow 08               39
##  9 Barrow 09               32.1
## 10 Barrow 10               17.2
## # … with 38 more rows
```

```
ggplot(average_temp,aes(month,city,fill=mean_temperature)) +
  geom_tile() +
  scale_fill_viridis_c(option ="magma") +
  scale_x_discrete(
    #breaks = c(1,2,3,4,5,6,7,8,9,10,11,12),
    labels = c("01"="Jan","02"="Feb","03"="Mar","04"="Apr","05"="May","06"="Jun","07"="Jul","08"="Aug","09"="Sep","10"="Oct","11"="Nov","12"="Dec")
    )
```
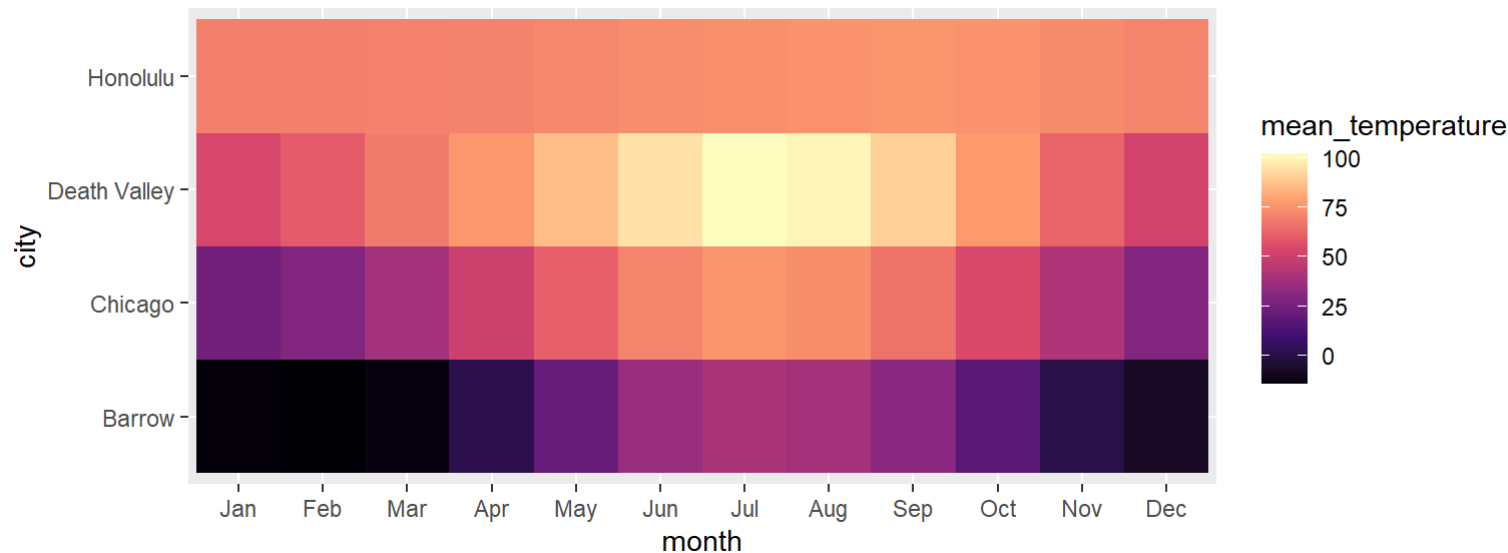
d. Compare and contrast the two displays. What types of comparisons are easier to make / what patterns are most readily visible using Figure 2.3 vs. Figure 2.4, and vice versa?

For Figure 2.3, we can easily get precise information about how the temperature change over time for each city.Therefore, with the help of it, we know the variation through the year for each city. At the same time, as a line chart, we can obtain more accurate temperature at any point in any city.

Figure 2.4 shows the mean temperature of each month in each city. In this heat map, mean temperature is presented in intuitive colors. People can know which month's average temperature is higher. Also, because of the intuition of colors, we can tell in which city the average temperature through the whole year is higher.

To sum up, Figure 2.3 is more precise, clearly showing the trend through the year. Figure 2.4 is more intuitive, focusing on the average temperature. Our choice depends on the data we want to visualize and the way we want people to understand these data.

Soccer code review

1. Soccer Code Review This exercise asks you to conduct an imaginary code review. These are often used in data science teams to,

   - Catch potential bugs
   - Make sure code is transparent to others
   - Create a shared knowledge base

   It is important to be perceptive but friendly.

- Can the code be made more compact?
- Are there visual design choices / encodings that could be refined?
- If your colleague did something well, say so!

They can also be a great way to learn new functions and programming patterns. Unlike standard code-reviews, I ask you to give an example implementing your recommendations.

Specifically, in this review, suppose you are working on a sports blog, and your colleague is soccer interested in which teams won the most games in a few European leagues over the last few years. They have written the code below. Provide your code review as a set of bullet points, and include code giving an example implementation of your ideas. The original data are from this link (https://www.kaggle.com/slehkyi/extended-football-stats-for-european-leagues-xg).

```
win_props <- read_csv("https://raw.githubusercontent.com/krisrs1128/stat479_s22/main/exercises/data/understat_per_game.csv") %>%
  group_by(team, year) %>%
  summarise(n_games = n(), wins = sum(wins) / n_games)
```

```
## Rows: 24580 Columns: 29
## ── Column specification ──────────────────────────────────────────────────────────────────────
## Delimiter: ","
## chr   (4): league, h_a, result, team
## dbl  (24): year, xG, xGA, npxG, npxGA, deep, deep_allowed, scored, missed, x...
## dttm  (1): date
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
## `summarise()` has grouped output by 'team'. You can override using the `.groups` argument.
```

```
best_teams <- win_props %>%
  ungroup() %>%
  slice_max(wins, prop = 0.2) %>%
  pull(team)

win_props %>%
  filter(team %in% best_teams) %>%
  ggplot(aes(x=year,y=team,fill=)) +
  geom_point(aes(year, team, size = n_games, alpha = wins))
```
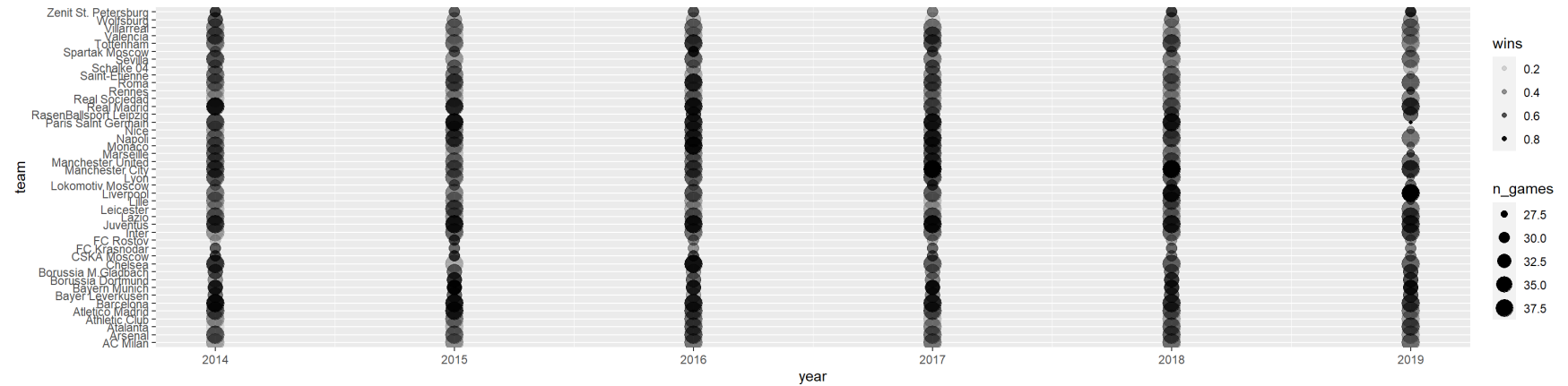
An example figure for code review.

```
win_props <- read_csv("https://raw.githubusercontent.com/krisrs1128/stat479_s22/main/exercises/data/understat_per_game.csv") %
>%
  group_by(team, year) %>%
  summarise(n_games = n(), wins = sum(wins) / n_games)
```

```
## Rows: 24580 Columns: 29
## ── Column specification ──────────────────────────────────────────────────
───────────
## Delimiter: ","
## chr   (4): league, h_a, result, team
## dbl  (24): year, xG, xGA, npxG, npxGA, deep, deep_allowed, scored, missed, x...
## dttm  (1): date
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
## `summarise()` has grouped output by 'team'. You can override using the `.groups` argument.
```

```
win_props
```

```
## # A tibble: 684 × 4
## # Groups:   team [168]
##    team       year n_games  wins
##    <chr>     <dbl>   <int> <dbl>
##  1 AC Milan   2014      38 0.342
##  2 AC Milan   2015      38 0.395
##  3 AC Milan   2016      38 0.474
##  4 AC Milan   2017      38 0.474
##  5 AC Milan   2018      38 0.5
##  6 AC Milan   2019      38 0.5
##  7 Alaves     2016      38 0.368
##  8 Alaves     2017      38 0.395
##  9 Alaves     2018      38 0.342
## 10 Alaves     2019      38 0.263
## # … with 674 more rows
```

```
best_teams <- win_props %>%
    ungroup() %>%
    slice_max(wins, prop = 0.2) %>%
    pull(team)
best_teams
```

```
##   [1] "Liverpool"              "Manchester City"        "Manchester City"
##   [4] "Bayern Munich"          "Paris Saint Germain"    "Bayern Munich"
##   [7] "Barcelona"              "Chelsea"                "Juventus"
##  [10] "Liverpool"              "Monaco"                 "Paris Saint Germain"
##  [13] "Real Madrid"            "Bayern Munich"          "Barcelona"
##  [16] "Juventus"               "Juventus"               "Paris Saint Germain"
##  [19] "Paris Saint Germain"    "Real Madrid"            "Atletico Madrid"
##  [22] "Barcelona"              "Barcelona"              "Juventus"
##  [25] "Napoli"                 "Real Madrid"            "Roma"
##  [28] "Bayern Munich"          "Bayern Munich"          "Spartak Moscow"
##  [31] "Zenit St. Petersburg"   "Paris Saint Germain"    "Bayern Munich"
##  [34] "Borussia Dortmund"      "Barcelona"              "Chelsea"
##  [37] "Juventus"               "Juventus"               "Manchester City"
##  [40] "Napoli"                 "Real Madrid"            "Tottenham"
##  [43] "Borussia Dortmund"      "CSKA Moscow"            "Zenit St. Petersburg"
##  [46] "Zenit St. Petersburg"   "Barcelona"              "Manchester United"
##  [49] "Napoli"                 "CSKA Moscow"            "FC Rostov"
##  [52] "Inter"                  "Lazio"                  "Manchester City"
##  [55] "Monaco"                 "Napoli"                 "Paris Saint Germain"
##  [58] "Borussia Dortmund"      "Arsenal"                "Atalanta"
##  [61] "Atletico Madrid"        "Atletico Madrid"        "Atletico Madrid"
##  [64] "Leicester"              "Lyon"                   "Manchester City"
##  [67] "Roma"                   "Roma"                   "Sevilla"
##  [70] "Tottenham"              "Tottenham"              "CSKA Moscow"
##  [73] "Lokomotiv Moscow"       "Zenit St. Petersburg"   "Borussia M.Gladbach"
##  [76] "RasenBallsport Leipzig" "Wolfsburg"              "Arsenal"
##  [79] "Atletico Madrid"        "Lille"                  "Liverpool"
##  [82] "Lyon"                   "Marseille"              "Nice"
##  [85] "Real Madrid"            "Valencia"               "Valencia"
##  [88] "Marseille"              "CSKA Moscow"            "FC Krasnodar"
##  [91] "Zenit St. Petersburg"   "Bayer Leverkusen"       "Borussia M.Gladbach"
##  [94] "RasenBallsport Leipzig" "Arsenal"                "Atalanta"
##  [97] "Chelsea"                "Chelsea"                "Lazio"
## [100] "Lazio"                  "Lazio"                  "Liverpool"
## [103] "Lyon"                   "Lyon"                   "Marseille"
## [106] "Real Madrid"            "Roma"                   "Sevilla"
## [109] "Lille"                  "Rennes"                 "FC Krasnodar"
## [112] "FC Krasnodar"           "FC Krasnodar"           "Lokomotiv Moscow"
## [115] "Lokomotiv Moscow"       "Spartak Moscow"         "Bayer Leverkusen"
```

```
## [118] "Bayer Leverkusen"      "Borussia Dortmund"      "RasenBallsport Leipzig"
## [121] "Schalke 04"            "Arsenal"                "Atalanta"
## [124] "Chelsea"               "Inter"                  "Inter"
## [127] "Inter"                 "Manchester United"      "Monaco"
## [130] "AC Milan"              "AC Milan"               "Arsenal"
## [133] "Athletic Club"         "Bayer Leverkusen"       "Borussia M.Gladbach"
## [136] "Inter"                 "Lyon"                   "Manchester City"
## [139] "Manchester United"     "Manchester United"      "Real Sociedad"
## [142] "Roma"                  "Saint-Etienne"          "Saint-Etienne"
## [145] "Sevilla"               "Spartak Moscow"         "Tottenham"
## [148] "Tottenham"             "Villarreal"
```

The code above calculate the rate of winning for each team, choose the top 20% and plot a scatter plot for them. I think we can redesign the size of this plot and labels to make it more intuitive.

```
win_props <- read_csv("https://raw.githubusercontent.com/krisrs1128/stat479_s22/main/exercises/data/understat_per_game.csv") %>%
  group_by(team, year) %>%
  summarise(total_games = n(), wins_rate = sum(wins) / total_games)
```

```
## Rows: 24580 Columns: 29
## —— Column specification ———————————————————————————————————————————————————————
## ————————
## Delimiter: ","
## chr   (4): league, h_a, result, team
## dbl  (24): year, xG, xGA, npxG, npxGA, deep, deep_allowed, scored, missed, x...
## dttm  (1): date
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
## `summarise()` has grouped output by 'team'. You can override using the `.groups` argument.
```

```
best_teams <- win_props %>%
  ungroup() %>%
  slice_max(wins_rate, prop = 0.2) %>%
  pull(team)

win_props %>%
  filter(team %in% best_teams) %>%

  ggplot(aes(year, team, size = total_games, alpha = wins_rate)) +
  geom_point() +
  theme(text = element_text(size=10),element_line(size=1)) +
  labs(title = "Winning Rate of Top 20% Teams")
```

```
## Warning: The `size` argument of `element_line()` is deprecated as of ggplot2 3.4.0.
## ℹ Please use the `linewidth` argument instead.
```

Winning Rate of Top 20% Teams
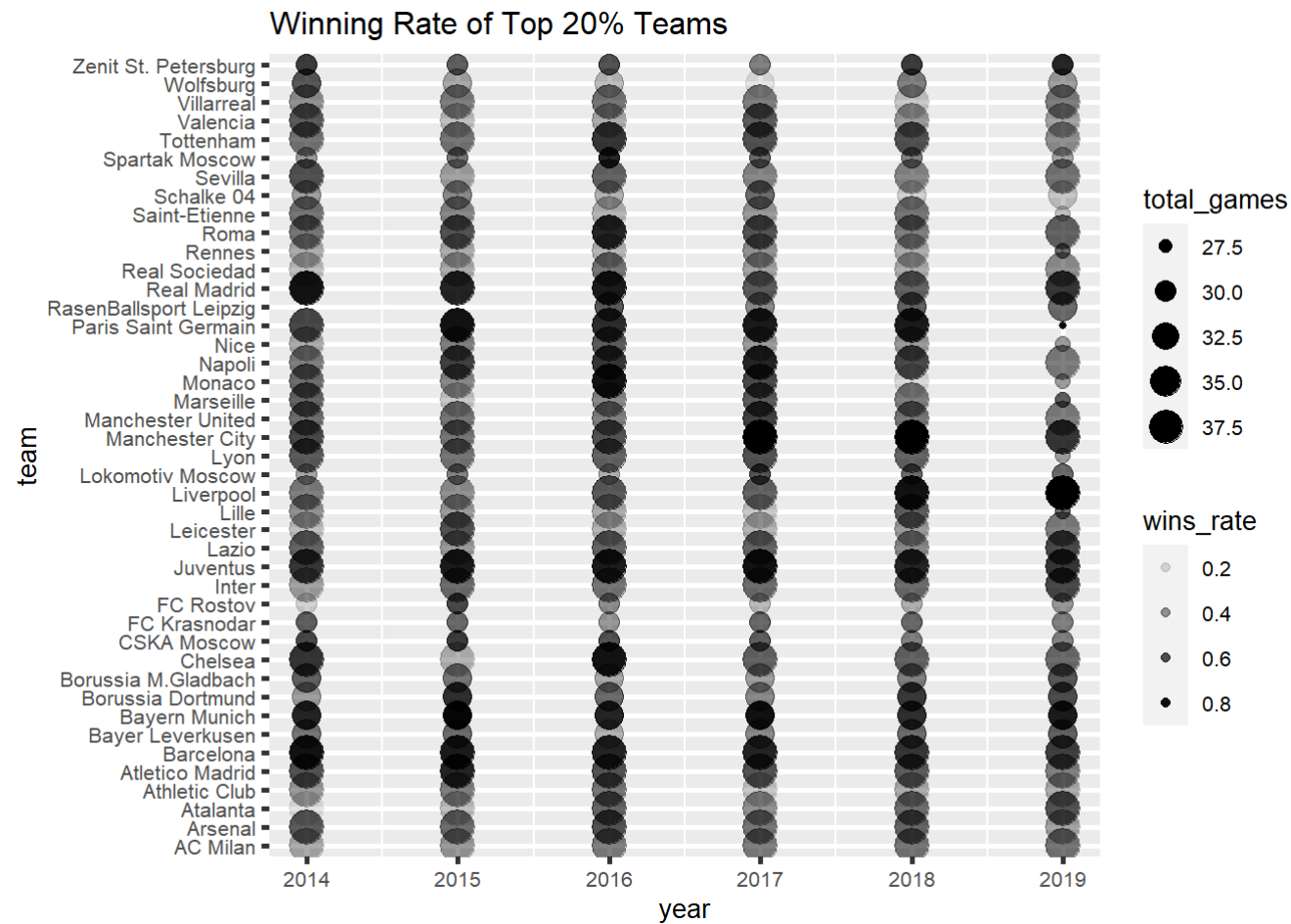
Visual Redesign

Visual Redesign In this exercise, you will find a visualization you have made in the past and redesign it using the skills you have learned in this course.

```
a. Identify one of your past visualizations for which you still have data.
Include a screenshot of this past visualization.
```

Diamond
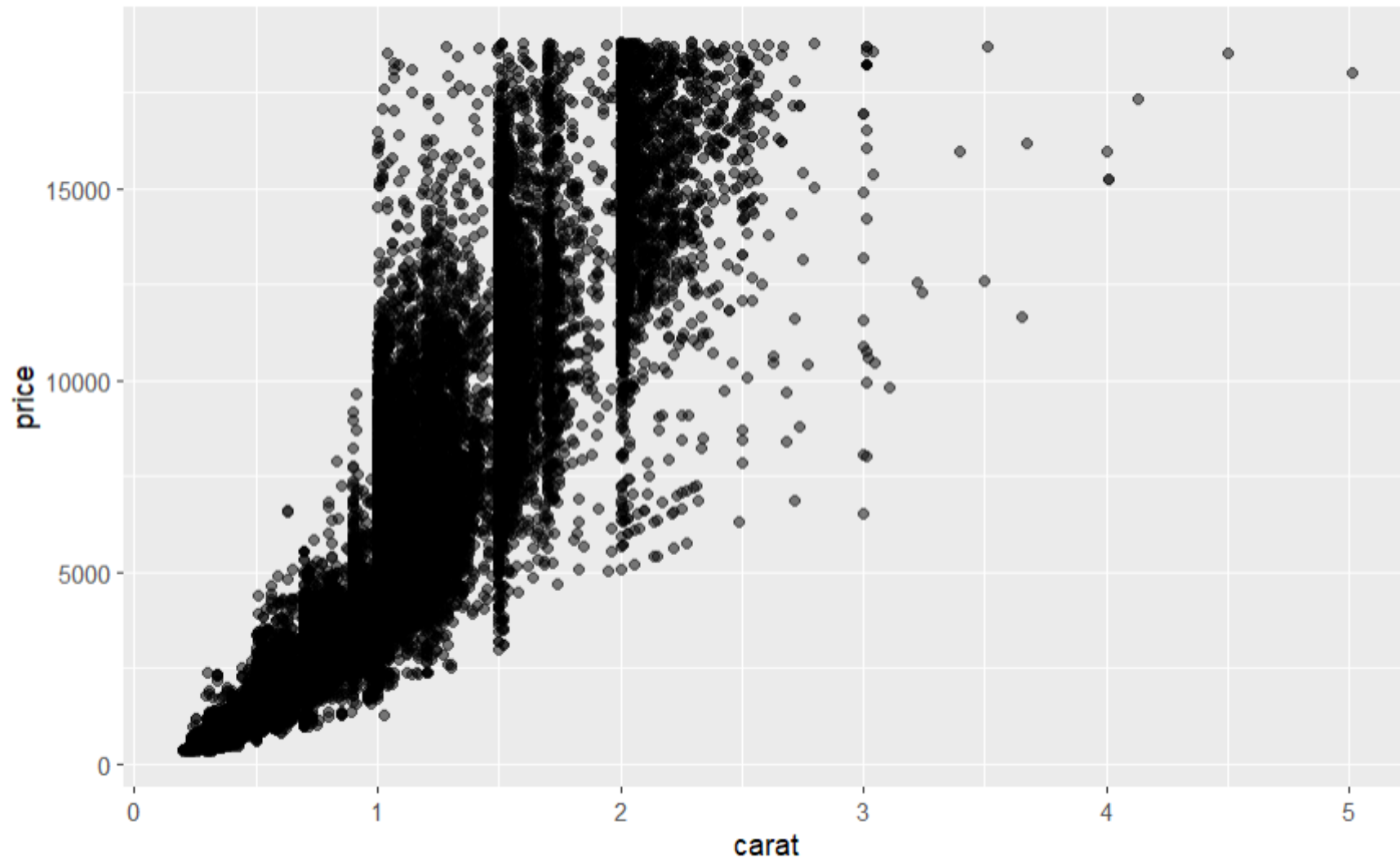
  b. Comment on the main takeaways from the visualization and the graphical
  relationships that lead to that conclusion. Is this takeaway consistent with
  the intended message? Are there important comparisons that you would like to
  highlight, but which are harder to make in the current design?

  According to the screenshot, the main takeaway is the relationship between
  price of diamonds and the carat of diamonds. And there is a clear positive
  relation between those two values. However, the picture does not fully show
  the impact of other factors on the price, which may be the reason of those
  obvious unusual data in certain range of carat.

c. Comment on the legibility of the original visualization. Are there aspects
of the visualization that are cluttered or difficult to read?

Yes. We can see that at certain points, like carat=1, carat=1.5, data points are
clustered together.And even for diamonds at same mass, the variance of price
is huge. So we can try to find the relation between price and other factors
to find out the reasons for this phenomenon.

d. Propose and implement an alternative design. What visual tasks do you
prioritize in the new design? Did you have to make any trade-offs? Did you
make any changes specifically to improve legibility.

For this implement, I want to find out the influence of cut, color and clarity
on the relationship between price and carat.

diamonds

```
## # A tibble: 53,940 × 10
##     carat cut       color clarity depth table price     x     y     z
##     <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl> <dbl> <dbl>
##  1  0.23 Ideal     E     SI2      61.5    55   326  3.95  3.98  2.43
##  2  0.21 Premium   E     SI1      59.8    61   326  3.89  3.84  2.31
##  3  0.23 Good      E     VS1      56.9    65   327  4.05  4.07  2.31
##  4  0.29 Premium   I     VS2      62.4    58   334  4.2   4.23  2.63
##  5  0.31 Good      J     SI2      63.3    58   335  4.34  4.35  2.75
##  6  0.24 Very Good J     VVS2     62.8    57   336  3.94  3.96  2.48
##  7  0.24 Very Good I     VVS1     62.3    57   336  3.95  3.98  2.47
##  8  0.26 Very Good H     SI1      61.9    55   337  4.07  4.11  2.53
##  9  0.22 Fair      E     VS2      65.1    61   337  3.87  3.78  2.49
## 10  0.23 Very Good H     VS1      59.4    61   338  4     4.05  2.39
## # … with 53,930 more rows
```

```
library(patchwork)
```

```
## Warning: package 'patchwork' was built under R version 4.2.2
```

```
p1 <- ggplot(diamonds,aes(x=carat,y=price,color = clarity)) +
  facet_wrap(~ cut) +
  geom_point(alpha = 0.5)

p2 <- ggplot(diamonds,aes(x=carat,y=color,fill = price)) +
  geom_tile() +
  scale_fill_viridis_c(option = 'magma') +
  labs(x="Carat",y="Color",fill="Price")

p1/p2
```

Antibiotcs Comparison
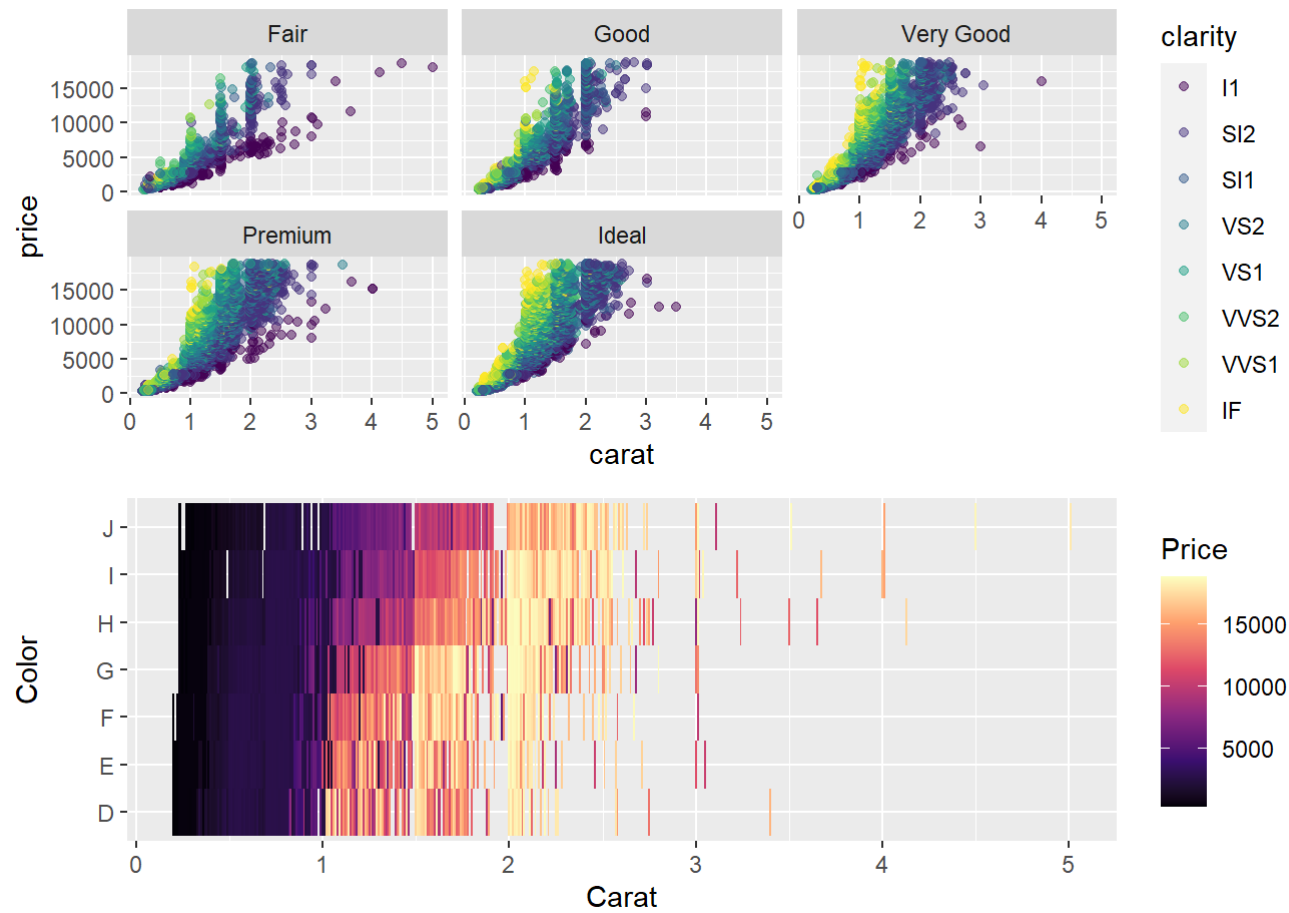
[Antibiotics Comparison] Below, we provide three approaches to visualizing species abundance over time in an antibiotics dataset.

```r
antibiotic <- read_csv("https://uwmadison.box.com/shared/static/5jmd9pku62291ek20lioevsw1c588ahx.csv")
```

```
## Rows: 972 Columns: 7
## ── Column specification ─────────────────────────────────────────────────
──────────
## Delimiter: ","
## chr (4): species, sample, ind, antibiotic
## dbl (3): value, time, svalue
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```r
antibiotic
```

```
## # A tibble: 972 × 7
##    species  sample value ind    time svalue antibiotic
##    <chr>    <chr>  <dbl> <chr> <dbl>  <dbl> <chr>
##  1 Unc05qi6 D1         0 D         1     NA  Antibiotic-free
##  2 Unc05qi6 D2         0 D         2     NA  Antibiotic-free
##  3 Unc05qi6 D3         0 D         3      0  Antibiotic-free
##  4 Unc05qi6 D4         0 D         4      0  Antibiotic-free
##  5 Unc05qi6 D5         0 D         5      0  Antibiotic-free
##  6 Unc05qi6 D6         0 D         6    0.2 Antibiotic-free
##  7 Unc05qi6 D7         0 D         7    0.2 Antibiotic-free
##  8 Unc05qi6 D8         1 D         8    0.2 Antibiotic-free
##  9 Unc05qi6 D9         0 D         9    0.2 Antibiotic-free
## 10 Unc05qi6 D10        0 D        10    0.2 Antibiotic-free
## # … with 962 more rows
```

For each approach, describe,

```
   * One type of visual comparison for which the visualization is well-suited.

   * One type of visual comparison for which the visualization is poorly-suited.

Make sure to explain your reasoning.

a. Approach 1
```

It's easy for people to compare the trend of different species and different antibiotics under different conditions. As a line chart, this approach focus on the value change in different samples, which make comparison between samples very intuitive.

However, because of the fixed y-axis range, when the absolute value is very small in certain samples, we can hardly get detailed information about them. That's the cost of the convenient comparison.

```
b. Approach 2
```

Approach 2 is a group of heat map. Our attention will be attracted to those darker areas, which represent higher values than other times and samples. So this approach emphasizes outstanding values, and we can easily know under which conditions the values will be higher.

As the cost of that, we are unable to learn the exact value of each data point. Different colors represent different range of value, so the detailed values are hidden.

```
c. Approach 3
```

For this approach, data are divided into three line chart according to their sample. So we can easily know how the value of different species change over time in each sample. And comparison between different species in the same sample are explicit.

However, because the data are divided into three groups. Comparison between different samples from the same species at the same time are difficult.

```
   d. Sketch code that could be used to make one of the three visualizations above.
```

ggplot(temp) + geom_line(aes(x = date, y = temperature, group = city, col = city),size = 1) + labs(x = "month", y= "temperature(°F)") + scale_x_continuous(label = c("Jan","Apr","Jul","Oct","Jan")) + scale_y_continuous(limits = c(-20,110), breaks = c(0,20,40,60,80,100))
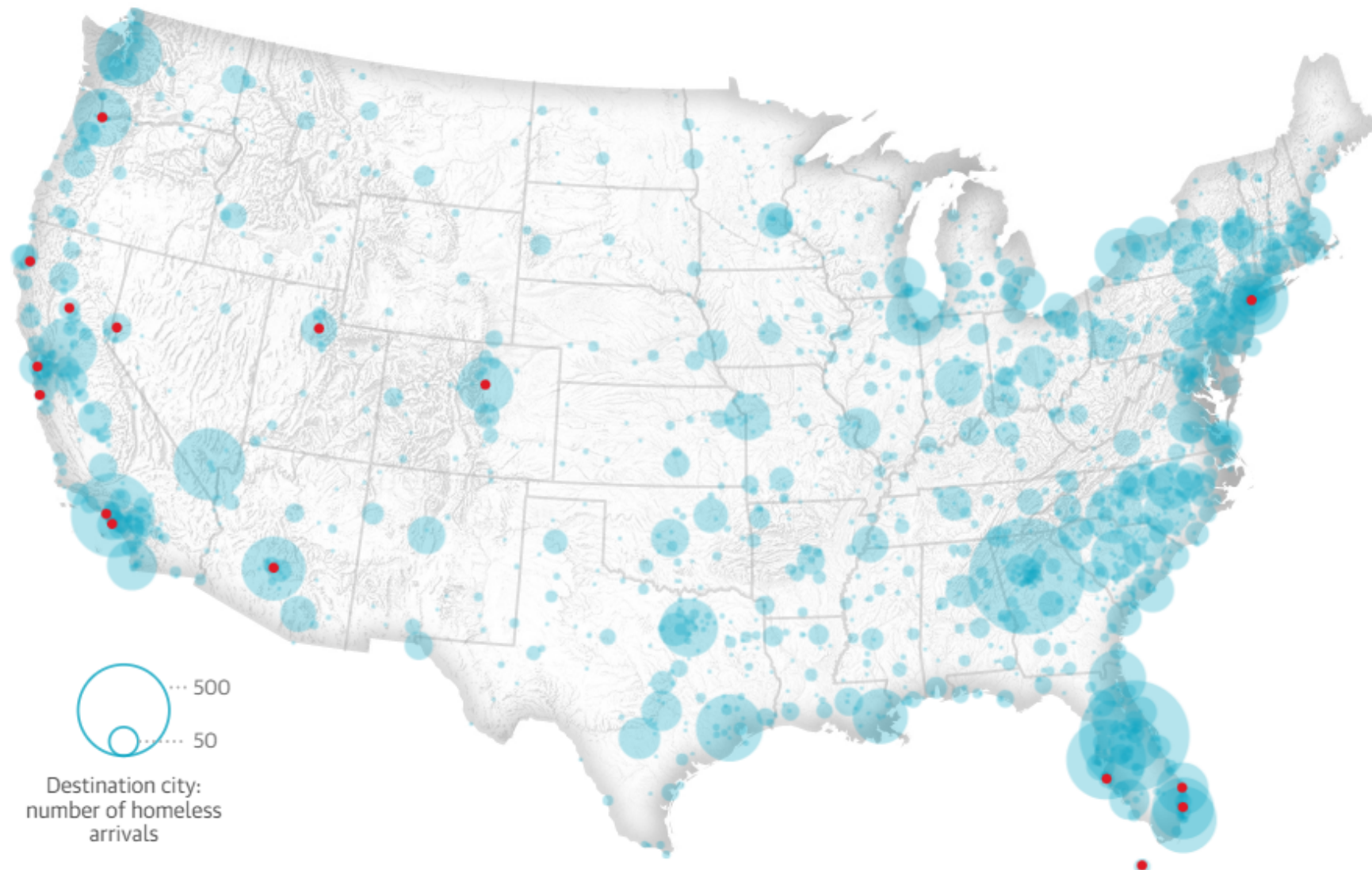
```
ggplot(antibiotic) +
  geom_line(aes(x=time,y=svalue,group=species,col = species),size = 0.7) +
  labs(x = "time",y="svalue")+
  facet_wrap(~ind,nrow = 3)
```

```
## Warning: Removed 4 rows containing missing values (`geom_line()`).
```
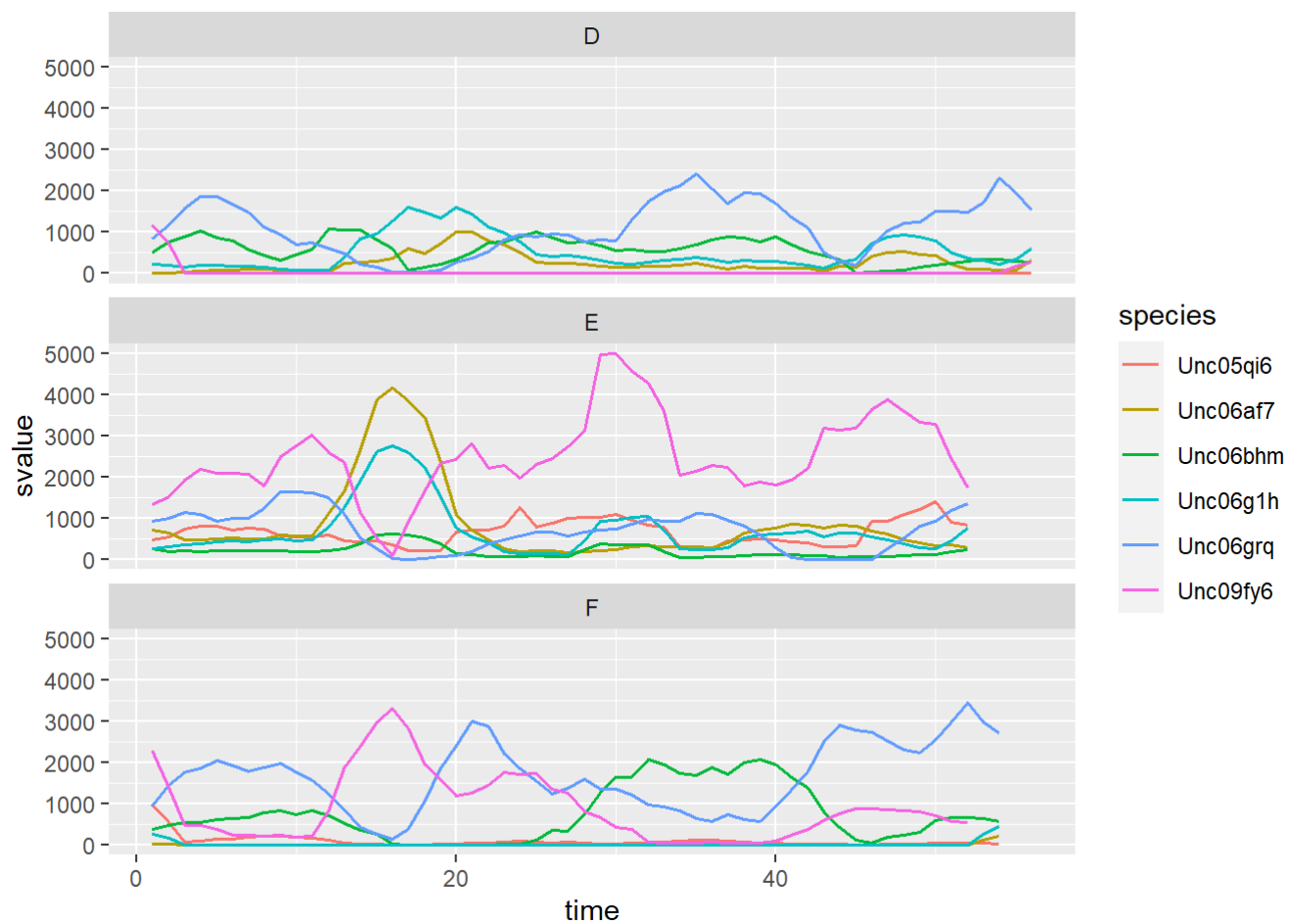

Homelessness

Homelessness Take a static screenshot from any of the visualizations in this article (https://www.theguardian.com/us-news/ng-interactive/2017/dec/20/bussed-out-america-moves-homeless-people-country-study), and deconstruct its associated visual encodings.

500

50

Destination city:
number of homeless
arrivals

Homeless bus relocation journeys to destinations in the mainland US

21,400

homelessness

   a. What do you think was the underlying data behind the current view? What where the rows, and what were the columns?

   b. What were the data types of each of the columns?

   c. What encodings were used? How are properties of marks on the page derived from the underlying abstract data?

   d. Is multi-view composition being used? If so, how?

   e. The data behind the plot should contain information about the the departure and destination of homeless bus journeys. For each row, there are detailed departure and destination, which contains the exact state and city.The column names should have ID, time, departure and destination. IDs are used to count the total number of journeys.

   f. For columns, the data type of ID, departure and destination should be characters. And the data type of time can be date or numeric.

   g. The main encoding in these figures is detailed locations in the map and color and size of points. The red points represent the starting points of journeys. the blue points represent the destinations. And the size of blue points indicates the total number of people arriving in these cities.

   h. Yes. There two main plots. The first one is a map, where shows the number of homeless people arriving in the cities by the size of the dots. And the second views show the total number of homelessness bus journeys for each year using a bar chart.