

IntroR.Day3InClassExercise.MV.R

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Introduction to R 3: Working With Data

In-Class Exercise

```
library(ggplot2)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##   filter, lag
```

```
## The following objects are masked from 'package:base':
##
##   intersect, setdiff, setequal, union
```

```
# clear history
rm(list = ls())

# import birdsticks2007 dataset
# assign to tick.dat
tick.dat <- read.csv("C:\\\\Users\\Melanie\\Documents\\School\\Postgrad\\Glasgow\\Academics\\Courses\\Key Research Skills\\Lecture Notes - Intro to R\\Intro to R 3 - Working With Data\\birdsticks2007.csv")

# check dataset
glimpse(tick.dat)
```

```
## Observations: 2,014
## Variables: 17
## $ ringnumber <fctr> T592050, T592873, T592874, T592687, T592875, T5928...
## $ species <fctr> Great tit, Blue tit, Blue tit, Coal tit, Chaffinch...
## $ euring <int> 4, 5, 5, 4, 4, 6, 5, 6, 6, 5, 5, 5, 6, 5, 5, 5, 5, ...
## $ sex <fctr> M, , , , F, F, , F, , F, , , , M, , , F, M, , F,...
## $ day <int> 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, ...
## $ month <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ...
## $ year <int> 2007, 2007, 2007, 2007, 2007, 2007, 2007, 2007, 200...
## $ retrap <int> 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, ...
## $ hour <int> 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 9, 9, 9, 9, 9, 9, 9, 9, ...
## $ minutes. <int> 30, 30, 30, 30, 30, 30, 30, 30, 30, 30, 0, 0, 0, 0, 0, ...
## $ wt.bag <dbl> 18.15, 11.54, 11.44, 9.31, 20.30, 24.56, 10.30, 21....
## $ bagwt <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ wing <int> 73, 64, 61, 61, 78, 83, 62, 79, 60, 78, 61, 66, 67,...
## $ notes <fctr> , , , , , , LARGE GROWTH RIGHT FOOT, , , , , ,...
## $ ticktotal <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ ticklarvae <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ ticknymphs <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
```

```
head(tick.dat)
```

```
##   ringnumber  species euring sex day month year retrap hour minutes.
## 1   T592050 Great tit     4   M  27     1 2007     1    8       30
## 2   T592873 Blue tit     5     27     1 2007     0    8       30
## 3   T592874 Blue tit     5     27     1 2007     0    8       30
## 4   T592687 Coal tit     4     27     1 2007     1    8       30
## 5   T592875 Chaffinch    4   F  27     1 2007     0    8       30
## 6   T592876 Chaffinch    6   F  27     1 2007     0    8       30
##   wt.bag bagwt wing notes ticktotal ticklarvae ticknymphs
## 1  18.15    0   73          0          0          0
## 2  11.54    0   64          0          0          0
## 3  11.44    0   61          0          0          0
## 4   9.31    0   61          0          0          0
## 5  20.30    0   78          0          0          0
## 6  24.56    0   83          0          0          0
```

```
# see number of individuals per species trapped each month
table(tick.dat$species, tick.dat$month)
```

```
##
##           1   2   3   4   5   6   7   8   9  10  11  12
## Blackbird      0   1   1   1   0   5   6   2   2   3   2   1
## Blackcap       0   0   0   0   0   2   0   1   0   0   0   0
## Blue tit      22  72  27  10   0  30  30  12  73  18  14  39
## Bullfinch      0   1   0   0   0   1   1   0   0   0   0   0
## Chaffinch     10  51  21  85  14  10   5  38 112  45  31  98
## Chiffchaff     0   0   0   0   0   0   2   0   0   0   0   0
## Coal tit       3  18  17   5   3   1   5   8  20  12   7  24
## Dunnock       1  10   2   8   1   4   0   0   1   3   2   4
## Garden warbler  0   0   0   0   0   0   1   0   0   0   0   0
## Goldcrest      0   0   0   0   0   0   0   0   0   2   2   0
## Goldfinch      0   0   0   1   0   0   0   0   0   0   0   0
## Great spotted woodpecker 0   0   0   0   0   1   1   0   0   1   0   0
## Great tit      6  15  22   9   2  28  22  16  32  16   6   9
## Greenfinch     1   7   1   8   3   0   1   2  18  29   5   1
## Jay           0   0   0   0   0   0   0   0   0   1   0   0
## Lesser redpoll  0   0   0   0   0   0   0   0   0   0   0   1
## Long-tailed tit 0   4   0   0   0   1   0   0   0   0   0   0
## Robin         1   8   2   7   2   4   3   2   5   7   4   6
## Siskin        1  89  44  74  49 225  86   8  26   2   0   3
## Song thrush    0   0   0   1   0   0   1   0   0   0   0   0
## Sparrowhawk    0   1   0   0   0   0   0   0   0   0   0   0
## Treecreeper    0   0   0   0   0   1   1   0   2   0   0   0
## Willow warbler  0   0   0   1   0   0   7   0   0   0   0   0
## Wren          0   0   0   0   0   0   1   0   1   3   2   1
```

1. Adding and Redefining Variables

a. Adding a new variable

```
# wt.bag: weight of bird included in handling bag
# bagwt: weight of bag (if used)
# bird.wt: actual weight of bird
#
# make new bird.wt variable
# by subtracting bagwt from wt.bag
tick.dat <- mutate(tick.dat, bird.wt = wt.bag - bagwt)

# check that dataset has bird.wt variable
glimpse(tick.dat)
```

```
## Observations: 2,014
## Variables: 18
## $ ringnumber <fctr> T592050, T592873, T592874, T592687, T592875, T5928...
## $ species     <fctr> Great tit, Blue tit, Blue tit, Coal tit, Chaffinch...
## $ euring      <int> 4, 5, 5, 4, 4, 6, 5, 6, 6, 5, 5, 5, 6, 5, 5, 5, 5, ...
## $ sex         <fctr> M, , , , F, F, , F, , F, , , , M, , , F, M, , F,...
## $ day         <int> 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27,...
## $ month       <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ...
## $ year        <int> 2007, 2007, 2007, 2007, 2007, 2007, 2007, 2007, 200...
## $ retrap      <int> 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, ...
## $ hour        <int> 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 9, 9, 9, 9, 9, 9, 9, 9, ...
## $ minutes.    <int> 30, 30, 30, 30, 30, 30, 30, 30, 30, 30, 0, 0, 0, 0, 0, 0, ...
## $ wt.bag      <dbl> 18.15, 11.54, 11.44, 9.31, 20.30, 24.56, 10.30, 21....
## $ bagwt       <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ wing        <int> 73, 64, 61, 61, 78, 83, 62, 79, 60, 78, 61, 66, 67,...
## $ notes       <fctr> , , , , , , , LARGE GROWTH RIGHT FOOT, , , , , ,...
## $ ticktotal   <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ ticklarvae  <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ ticknymphs  <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ bird.wt     <dbl> 18.15, 11.54, 11.44, 9.31, 20.30, 24.56, 10.30, 21....
```

b. Recording an existing variable

```
# retrap: shows whether individual has been caught before ('1')
# or caught for first time ('0')
#
# use recode() to redefine retrap as a factor variable
# and show two factor levels as 'yes' (replacing '1')
# and 'no' (replacing '0')
# i.e., replace numerical retrap variable with categorical retrap variable
#
# must do this using mutate()
# first define dataset (tick.dat)
# then transforming retrap via recode()
# before assigning result to tick.dat
tick.dat <- mutate(tick.dat, retrap = recode(retrap, '1' = "yes", '0' = "no"))

# check that dataset has retrap as a factor variable
glimpse(tick.dat)
```

```
## Observations: 2,014
## Variables: 18
## $ ringnumber <fctr> T592050, T592873, T592874, T592687, T592875, T5928...
## $ species    <fctr> Great tit, Blue tit, Blue tit, Coal tit, Chaffinch...
## $ euring     <int> 4, 5, 5, 4, 4, 6, 5, 6, 6, 5, 5, 5, 6, 5, 5, 5, 5, ...
## $ sex        <fctr> M, , , , F, F, , F, , F, , , , M, , , F, M, , F,...
## $ day        <int> 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27,...
## $ month      <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ...
## $ year       <int> 2007, 2007, 2007, 2007, 2007, 2007, 2007, 2007, 200...
## $ retrap     <chr> "yes", "no", "no", "yes", "no", "no", "no", "no", "no", "...
## $ hour       <int> 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 9, 9, 9, 9, 9, 9, 9, 9, ...
## $ minutes.   <int> 30, 30, 30, 30, 30, 30, 30, 30, 30, 30, 0, 0, 0, 0, 0, 0, ...
## $ wt.bag     <dbl> 18.15, 11.54, 11.44, 9.31, 20.30, 24.56, 10.30, 21....
## $ bagwt      <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ wing       <int> 73, 64, 61, 61, 78, 83, 62, 79, 60, 78, 61, 66, 67,...
## $ notes      <fctr> , , , , , , , LARGE GROWTH RIGHT FOOT, , , , , ,...
## $ ticktotal  <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ ticklarvae <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ ticknymphs <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ bird.wt    <dbl> 18.15, 11.54, 11.44, 9.31, 20.30, 24.56, 10.30, 21....
```

c. Creating a new data variable

```
# make new date variable with day.month.year format
# to show full date for each observation
# rather than having just three separate columns
# for day, month, and year per observation
#
# must do this using mutate()
# first define dataset (tick.dat)
# then with paste(), copy values from day, month, and year variables
# and paste them into a single new date variable
# with a '.' separating each value per slot
# then assign result to tick.dat
tick.dat <- mutate(tick.dat, date = paste(day, month, year, sep = "."))

# check dataset for date variable
glimpse(tick.dat)
```

```
## Observations: 2,014
## Variables: 19
## $ ringnumber <fctr> T592050, T592873, T592874, T592687, T592875, T5928...
## $ species    <fctr> Great tit, Blue tit, Blue tit, Coal tit, Chaffinch...
## $ euring     <int> 4, 5, 5, 4, 4, 6, 5, 6, 6, 5, 5, 5, 6, 5, 5, 5, 5, ...
## $ sex        <fctr> M, , , , F, F, , F, , F, , , , M, , , F, M, , F,...
## $ day        <int> 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27,...
## $ month      <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ...
## $ year       <int> 2007, 2007, 2007, 2007, 2007, 2007, 2007, 2007, 200...
## $ retrap     <chr> "yes", "no", "no", "yes", "no", "no", "no", "no", "no", "...
## $ hour       <int> 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 9, 9, 9, 9, 9, 9, 9, 9, ...
## $ minutes.   <int> 30, 30, 30, 30, 30, 30, 30, 30, 30, 30, 0, 0, 0, 0, 0, 0, ...
## $ wt.bag     <dbl> 18.15, 11.54, 11.44, 9.31, 20.30, 24.56, 10.30, 21....
## $ bagwt      <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ wing       <int> 73, 64, 61, 61, 78, 83, 62, 79, 60, 78, 61, 66, 67,...
## $ notes      <fctr> , , , , , , , LARGE GROWTH RIGHT FOOT, , , , , ,...
## $ ticktotal  <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ ticklarvae <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ ticknymphs <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ bird.wt    <dbl> 18.15, 11.54, 11.44, 9.31, 20.30, 24.56, 10.30, 21....
## $ date       <chr> "27.1.2007", "27.1.2007", "27.1.2007", "27.1.2007",...
```

```
# convert date variable into dates recognized by R
# by using dmy() from lubridate package
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
```

```
## The following object is masked from 'package:base':
##
##     date
```

```
# dmy(): converts values to dates that R recognizes
# (in year-month-day format, e.g., 2007-01-27)
tick.dat <- mutate(tick.dat, date = dmy(date))

# check that date variable is now R-friendly
glimpse(tick.dat)
```

```
## Observations: 2,014
## Variables: 19
## $ ringnumber <fctr> T592050, T592873, T592874, T592687, T592875, T5928...
## $ species    <fctr> Great tit, Blue tit, Blue tit, Coal tit, Chaffinch...
## $ euring     <int> 4, 5, 5, 4, 4, 6, 5, 6, 6, 5, 5, 5, 6, 5, 5, 5, 5, ...
## $ sex        <fctr> M, , , , F, F, , F, , F, , , , M, , , F, M, , F,...
## $ day        <int> 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27, 27,...
## $ month      <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ...
## $ year       <int> 2007, 2007, 2007, 2007, 2007, 2007, 2007, 2007, 200...
## $ retrap     <chr> "yes", "no", "no", "yes", "no", "no", "no", "no", "no", "...
## $ hour       <int> 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 9, 9, 9, 9, 9, 9, 9, 9, ...
## $ minutes.   <int> 30, 30, 30, 30, 30, 30, 30, 30, 30, 30, 0, 0, 0, 0, 0, 0, ...
## $ wt.bag     <dbl> 18.15, 11.54, 11.44, 9.31, 20.30, 24.56, 10.30, 21....
## $ bagwt      <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ wing       <int> 73, 64, 61, 61, 78, 83, 62, 79, 60, 78, 61, 66, 67,...
## $ notes      <fctr> , , , , , , , LARGE GROWTH RIGHT FOOT, , , , , ,...
## $ ticktotal  <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ ticklarvae <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ ticknymphs <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
## $ bird.wt    <dbl> 18.15, 11.54, 11.44, 9.31, 20.30, 24.56, 10.30, 21....
## $ date       <date> 2007-01-27, 2007-01-27, 2007-01-27, 2007-01-27, 20...
```

2. Sorting

```
# using arrange(), sort data by species then by sex in ascending order
tick.dat <- arrange(tick.dat, species, sex)

# check dataset for new order
select(tick.dat, species, sex)
```

##	species	sex
## 1	Blackbird	
## 2	Blackbird	
## 3	Blackbird	
## 4	Blackbird	
## 5	Blackbird	
## 6	Blackbird	
## 7	Blackbird	
## 8	Blackbird	
## 9	Blackbird	
## 10	Blackbird	
## 11	Blackbird	
## 12	Blackbird	F
## 13	Blackbird	F
## 14	Blackbird	F
## 15	Blackbird	F
## 16	Blackbird	F
## 17	Blackbird	M
## 18	Blackbird	M
## 19	Blackbird	M
## 20	Blackbird	M
## 21	Blackbird	M
## 22	Blackbird	M
## 23	Blackbird	M
## 24	Blackbird	M
## 25	Blackcap	F
## 26	Blackcap	M
## 27	Blackcap	M
## 28	Blue tit	
## 29	Blue tit	
## 30	Blue tit	
## 31	Blue tit	
## 32	Blue tit	
## 33	Blue tit	
## 34	Blue tit	
## 35	Blue tit	
## 36	Blue tit	
## 37	Blue tit	
## 38	Blue tit	
## 39	Blue tit	
## 40	Blue tit	
## 41	Blue tit	
## 42	Blue tit	
## 43	Blue tit	
## 44	Blue tit	
## 45	Blue tit	
## 46	Blue tit	
## 47	Blue tit	
## 48	Blue tit	
## 49	Blue tit	
## 50	Blue tit	
## 51	Blue tit	

## 52	Blue tit
## 53	Blue tit
## 54	Blue tit
## 55	Blue tit
## 56	Blue tit
## 57	Blue tit
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## 59	Blue tit
## 60	Blue tit
## 61	Blue tit
## 62	Blue tit
## 63	Blue tit
## 64	Blue tit
## 65	Blue tit
## 66	Blue tit
## 67	Blue tit
## 68	Blue tit
## 69	Blue tit
## 70	Blue tit
## 71	Blue tit
## 72	Blue tit
## 73	Blue tit
## 74	Blue tit
## 75	Blue tit
## 76	Blue tit
## 77	Blue tit
## 78	Blue tit
## 79	Blue tit
## 80	Blue tit
## 81	Blue tit
## 82	Blue tit
## 83	Blue tit
## 84	Blue tit
## 85	Blue tit
## 86	Blue tit
## 87	Blue tit
## 88	Blue tit
## 89	Blue tit
## 90	Blue tit
## 91	Blue tit
## 92	Blue tit
## 93	Blue tit
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## 115	Blue tit
## 116	Blue tit
## 117	Blue tit
## 118	Blue tit
## 119	Blue tit
## 120	Blue tit
## 121	Blue tit
## 122	Blue tit
## 123	Blue tit
## 124	Blue tit
## 125	Blue tit
## 126	Blue tit
## 127	Blue tit
## 128	Blue tit
## 129	Blue tit
## 130	Blue tit
## 131	Blue tit
## 132	Blue tit
## 133	Blue tit
## 134	Blue tit
## 135	Blue tit
## 136	Blue tit
## 137	Blue tit
## 138	Blue tit
## 139	Blue tit
## 140	Blue tit
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## 167	Blue tit
## 168	Blue tit
## 169	Blue tit
## 170	Blue tit
## 171	Blue tit
## 172	Blue tit
## 173	Blue tit
## 174	Blue tit
## 175	Blue tit
## 176	Blue tit
## 177	Blue tit
## 178	Blue tit
## 179	Blue tit
## 180	Blue tit
## 181	Blue tit
## 182	Blue tit
## 183	Blue tit
## 184	Blue tit
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## 186	Blue tit
## 187	Blue tit
## 188	Blue tit
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## 220	Blue tit
## 221	Blue tit
## 222	Blue tit
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## 224	Blue tit
## 225	Blue tit
## 226	Blue tit
## 227	Blue tit
## 228	Blue tit
## 229	Blue tit
## 230	Blue tit
## 231	Blue tit
## 232	Blue tit
## 233	Blue tit
## 234	Blue tit
## 235	Blue tit
## 236	Blue tit
## 237	Blue tit
## 238	Blue tit
## 239	Blue tit
## 240	Blue tit
## 241	Blue tit
## 242	Blue tit
## 243	Blue tit
## 244	Blue tit
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## 247	Blue tit
## 248	Blue tit
## 249	Blue tit
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## 270	Blue tit
## 271	Blue tit
## 272	Blue tit
## 273	Blue tit
## 274	Blue tit
## 275	Blue tit
## 276	Blue tit
## 277	Blue tit
## 278	Blue tit
## 279	Blue tit
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## 283	Blue tit
## 284	Blue tit
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## 291	Blue tit
## 292	Blue tit
## 293	Blue tit
## 294	Blue tit
## 295	Blue tit
## 296	Blue tit
## 297	Blue tit
## 298	Blue tit
## 299	Blue tit
## 300	Blue tit
## 301	Blue tit
## 302	Blue tit
## 303	Blue tit
## 304	Blue tit
## 305	Blue tit
## 306	Blue tit
## 307	Blue tit
## 308	Blue tit
## 309	Blue tit
## 310	Blue tit
## 311	Blue tit

## 312	Blue tit
## 313	Blue tit
## 314	Blue tit
## 315	Blue tit
## 316	Blue tit
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## 1061	Goldcrest	M
## 1062	Goldcrest	M
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## 1064	Goldfinch	
## 1065	Great spotted woodpecker	
## 1066	Great spotted woodpecker	
## 1067	Great spotted woodpecker	F
## 1068	Great tit	
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## 1168	Great tit	
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## 1198	Great tit	M
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## 1320	Greenfinch	M
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## 1325	Greenfinch	M
## 1326	Greenfinch	M
## 1327	Jay	
## 1328	Lesser redpoll	F
## 1329	Long-tailed tit	
## 1330	Long-tailed tit	
## 1331	Long-tailed tit	
## 1332	Long-tailed tit	
## 1333	Long-tailed tit	
## 1334	Robin	
## 1335	Robin	
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## 1339	Robin	
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## 1376	Robin
## 1377	Robin
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## 1379	Robin
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## 1961	Siskin	M
## 1962	Siskin	M
## 1963	Siskin	M
## 1964	Siskin	M
## 1965	Siskin	M
## 1966	Siskin	M
## 1967	Siskin	M
## 1968	Siskin	M
## 1969	Siskin	M
## 1970	Siskin	M
## 1971	Siskin	M
## 1972	Siskin	M
## 1973	Siskin	M
## 1974	Siskin	M
## 1975	Siskin	M

## 1976	Siskin	M
## 1977	Siskin	M
## 1978	Siskin	M
## 1979	Siskin	M
## 1980	Siskin	M
## 1981	Siskin	M
## 1982	Siskin	M
## 1983	Siskin	M
## 1984	Siskin	M
## 1985	Siskin	M
## 1986	Siskin	M
## 1987	Siskin	M
## 1988	Siskin	M
## 1989	Siskin	M
## 1990	Siskin	M
## 1991	Siskin	M
## 1992	Song thrush	
## 1993	Song thrush	
## 1994	Sparrowhawk	M
## 1995	Treecreeper	
## 1996	Treecreeper	
## 1997	Treecreeper	
## 1998	Treecreeper	
## 1999	Willow warbler	
## 2000	Willow warbler	
## 2001	Willow warbler	
## 2002	Willow warbler	
## 2003	Willow warbler	
## 2004	Willow warbler	
## 2005	Willow warbler	
## 2006	Willow warbler	
## 2007	Wren	
## 2008	Wren	
## 2009	Wren	
## 2010	Wren	
## 2011	Wren	
## 2012	Wren	
## 2013	Wren	
## 2014	Wren	

```
# same, but now in descending order
tick.dat <- arrange(tick.dat, desc(species, sex))

# check dataset for new order
select(tick.dat, species, sex)
```

##	species	sex
## 1	Wren	
## 2	Wren	
## 3	Wren	
## 4	Wren	
## 5	Wren	
## 6	Wren	
## 7	Wren	
## 8	Wren	
## 9	Willow warbler	
## 10	Willow warbler	
## 11	Willow warbler	
## 12	Willow warbler	
## 13	Willow warbler	
## 14	Willow warbler	
## 15	Willow warbler	
## 16	Willow warbler	
## 17	Treecreeper	
## 18	Treecreeper	
## 19	Treecreeper	
## 20	Treecreeper	
## 21	Sparrowhawk	M
## 22	Song thrush	
## 23	Song thrush	
## 24	Siskin	
## 25	Siskin	
## 26	Siskin	
## 27	Siskin	
## 28	Siskin	
## 29	Siskin	
## 30	Siskin	
## 31	Siskin	
## 32	Siskin	
## 33	Siskin	
## 34	Siskin	
## 35	Siskin	
## 36	Siskin	
## 37	Siskin	
## 38	Siskin	
## 39	Siskin	
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## 52	Siskin
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## 60	Siskin
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## 67	Siskin
## 68	Siskin
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## 72	Siskin
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## 74	Siskin
## 75	Siskin
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## 118	Siskin
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## 120	Siskin
## 121	Siskin
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## 123	Siskin
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## 126	Siskin
## 127	Siskin
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## 221	Siskin	F
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## 628	Siskin	M
## 629	Siskin	M
## 630	Siskin	M
## 631	Robin	
## 632	Robin	
## 633	Robin	
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## 636	Robin	
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## 674	Robin	
## 675	Robin	

## 676	Robin	
## 677	Robin	
## 678	Robin	
## 679	Robin	
## 680	Robin	
## 681	Robin	
## 682	Long-tailed tit	
## 683	Long-tailed tit	
## 684	Long-tailed tit	
## 685	Long-tailed tit	
## 686	Long-tailed tit	
## 687	Lesser redpoll	F
## 688	Jay	
## 689	Greenfinch	
## 690	Greenfinch	
## 691	Greenfinch	
## 692	Greenfinch	F
## 693	Greenfinch	F
## 694	Greenfinch	F
## 695	Greenfinch	F
## 696	Greenfinch	F
## 697	Greenfinch	F
## 698	Greenfinch	F
## 699	Greenfinch	F
## 700	Greenfinch	F
## 701	Greenfinch	F
## 702	Greenfinch	F
## 703	Greenfinch	F
## 704	Greenfinch	F
## 705	Greenfinch	F
## 706	Greenfinch	F
## 707	Greenfinch	F
## 708	Greenfinch	F
## 709	Greenfinch	F
## 710	Greenfinch	F
## 711	Greenfinch	F
## 712	Greenfinch	F
## 713	Greenfinch	F
## 714	Greenfinch	F
## 715	Greenfinch	F
## 716	Greenfinch	F
## 717	Greenfinch	F
## 718	Greenfinch	F
## 719	Greenfinch	F
## 720	Greenfinch	F
## 721	Greenfinch	F
## 722	Greenfinch	F
## 723	Greenfinch	F
## 724	Greenfinch	F
## 725	Greenfinch	F
## 726	Greenfinch	F
## 727	Greenfinch	F

## 728	Greenfinch	F
## 729	Greenfinch	M
## 730	Greenfinch	M
## 731	Greenfinch	M
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## 748	Greenfinch	M
## 749	Greenfinch	M
## 750	Greenfinch	M
## 751	Greenfinch	M
## 752	Greenfinch	M
## 753	Greenfinch	M
## 754	Greenfinch	M
## 755	Greenfinch	M
## 756	Greenfinch	M
## 757	Greenfinch	M
## 758	Greenfinch	M
## 759	Greenfinch	M
## 760	Greenfinch	M
## 761	Greenfinch	M
## 762	Greenfinch	M
## 763	Greenfinch	M
## 764	Greenfinch	M
## 765	Great tit	
## 766	Great tit	
## 767	Great tit	
## 768	Great tit	
## 769	Great tit	
## 770	Great tit	
## 771	Great tit	
## 772	Great tit	
## 773	Great tit	
## 774	Great tit	
## 775	Great tit	
## 776	Great tit	
## 777	Great tit	
## 778	Great tit	
## 779	Great tit	

## 780	Great tit
## 781	Great tit
## 782	Great tit
## 783	Great tit
## 784	Great tit
## 785	Great tit
## 786	Great tit
## 787	Great tit
## 788	Great tit
## 789	Great tit
## 790	Great tit
## 791	Great tit
## 792	Great tit
## 793	Great tit
## 794	Great tit
## 795	Great tit
## 796	Great tit
## 797	Great tit
## 798	Great tit
## 799	Great tit
## 800	Great tit
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## 946	Great tit	M
## 947	Great tit	M
## 948	Great spotted woodpecker	
## 949	Great spotted woodpecker	
## 950	Great spotted woodpecker	F
## 951	Goldfinch	
## 952	Goldcrest	M
## 953	Goldcrest	M
## 954	Goldcrest	M
## 955	Goldcrest	M
## 956	Garden warbler	
## 957	Dunnock	
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## 1311	Chaffinch	M
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## 1635	Chaffinch	M
## 1636	Chaffinch	M
## 1637	Chaffinch	M
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## 1639	Bullfinch	M
## 1640	Bullfinch	M
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## 1982	Blue tit	
## 1983	Blue tit	
## 1984	Blue tit	
## 1985	Blue tit	
## 1986	Blue tit	
## 1987	Blue tit	
## 1988	Blackcap	F
## 1989	Blackcap	M
## 1990	Blackcap	M
## 1991	Blackbird	
## 1992	Blackbird	
## 1993	Blackbird	
## 1994	Blackbird	
## 1995	Blackbird	
## 1996	Blackbird	
## 1997	Blackbird	
## 1998	Blackbird	
## 1999	Blackbird	
## 2000	Blackbird	
## 2001	Blackbird	
## 2002	Blackbird	F
## 2003	Blackbird	F
## 2004	Blackbird	F
## 2005	Blackbird	F
## 2006	Blackbird	F
## 2007	Blackbird	M
## 2008	Blackbird	M
## 2009	Blackbird	M
## 2010	Blackbird	M
## 2011	Blackbird	M
## 2012	Blackbird	M
## 2013	Blackbird	M
## 2014	Blackbird	M

```
# sort data by chronological order (i.e., by date)
tick.dat <- arrange(tick.dat, date)

# check dataset for new order
select(tick.dat, date)
```

##	date
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## 2	2007-01-27
## 3	2007-01-27
## 4	2007-01-27
## 5	2007-01-27
## 6	2007-01-27
## 7	2007-01-27
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## 45	2007-01-27
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## 2010 2007-12-19
## 2011 2007-12-19
## 2012 2007-12-19
## 2013 2007-12-19
## 2014 2007-12-19
```

3. Subsetting Your Data

```
# make subset of tick.dat
# including observations only from April though October
# by using filter()
# and setting filter to be 4 <= month <= 10 from tick.dat
# then assign result to new data frame tick.season
tick.season <- filter(tick.dat, month >= 4 & month <= 10)

# check tick.season dataset
glimpse(tick.season)
```

```
## Observations: 1,293
## Variables: 19
## $ ringnumber <fctr> RW48928, T593174, R450869, T593189, T592222, T5922...
## $ species <fctr> Song thrush, Siskin, Siskin, Siskin, Siskin, Siski...
## $ euring <int> 5, 5, 6, 5, 6, 6, 5, 5, 5, 6, 5, 5, 5, 5, 5, 6, ...
## $ sex <fctr> , F, F, F, M, M, M, M, M, M, M, M, M, M, M, M, M, ...
## $ day <int> 11, 11, 11, 11, 11, 11, 11, 11, 11, 11, 11, 11, 11, 11,...
## $ month <int> 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, ...
## $ year <int> 2007, 2007, 2007, 2007, 2007, 2007, 2007, 2007, 200...
## $ retrap <chr> "no", "no", "yes", "no", "yes", "yes", "no", "no", ...
## $ hour <int> 8, 7, 8, 9, 7, 7, 7, 8, 8, 8, 8, 8, 8, 8, 8, 9, ...
## $ minutes. <int> 30, 30, 0, 0, 30, 30, 30, 0, 0, 0, 0, 0, 0, 30, 30,...
## $ wt.bag <dbl> 106.00, 11.30, 13.87, 13.16, 11.84, 12.20, 12.08, 1...
## $ bagwt <int> 36, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, NA, 0, 0...
## $ wing <int> 120, 70, 70, 71, 73, 75, 71, 73, 74, 75, 73, 71, 70...
## $ notes <fctr> , NO BP, BP, BP, , , , , , , , , , , , , , , ...
## $ ticktotal <int> 4, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, NA, 0, 0,...
## $ ticklarvae <int> 3, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, NA, 0, 0,...
## $ ticknymphs <int> 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, NA, 0, 0,...
## $ bird.wt <dbl> 70.00, 11.30, 13.87, 13.16, 11.84, 12.20, 12.08, 12...
## $ date <date> 2007-04-11, 2007-04-11, 2007-04-11, 2007-04-11, 20...
```

4. Dealing With NAs

```
# calculate median number of ticks (ticktotal) for each species
#
# via piping method, use group_by() to group by species within tick.season
# then use summarise() to determine median of ticktotal
# and assign those medians per species to median.tick variable
#
# notice in the results how some of the species have missing medians
# due to missing ticktotal values (NAs) from those species groups

tick.season %>%
  group_by(species) %>%
    summarise(median.tick = median(ticktotal))
```

```
## # A tibble: 22 x 2
##       species median.tick
##       <fctr>      <dbl>
## 1   Blackbird         7
## 2   Blackcap          0
## 3   Blue tit         NA
## 4   Bullfinch         4
## 5   Chaffinch        NA
## 6   Chiffchaff        0
## 7   Coal tit          0
## 8   Dunnock          NA
## 9 Garden warbler      0
## 10  Goldcrest         0
## # ... with 12 more rows
```

```
# exclude rows where there are missing values (NAs)
# in ticktotal variable from tick.season data frame
#
# use is.na() to select all NAs in ticktotal from tick.season
# and use '!' action before that to exclude all results
# (that are to right-hand side of '!')
# from tick.season
# then assign result to tick.season
tick.season <- tick.season[!is.na(tick.season$ticktotal),]

# overwrite default where printing data frame results
# shows only first ten rows
options(tibble.print_max = Inf)

# check that there are no NAs in ticktotal
filter(tick.season, is.na(tick.season$ticktotal))
```

```
## [1] ringnumber species euring sex day month
## [7] year retrap hour minutes. wt.bag bagwt
## [13] wing notes ticktotal ticklarvae ticknymphs bird.wt
## [19] date
## <0 rows> (or 0-length row.names)
```

```
# again, calculate median ticktotal for each species
tick.season %>%
  group_by(species) %>%
  summarise(median.tick = median(ticktotal))
```

```
## # A tibble: 22 x 2
##           species median.tick
##           <fctr>      <dbl>
##  1      Blackbird      7.0
##  2      Blackcap      0.0
##  3      Blue tit      0.0
##  4      Bullfinch      4.0
##  5      Chaffinch      0.0
##  6      Chiffchaff      0.0
##  7      Coal tit      0.0
##  8      Dunnock      3.0
##  9      Garden warbler  0.0
## 10      Goldcrest      0.0
## 11      Goldfinch      0.0
## 12 Great spotted woodpecker 0.0
## 13      Great tit      1.0
## 14      Greenfinch      0.0
## 15      Jay      2.0
## 16      Long-tailed tit  0.0
## 17      Robin      0.0
## 18      Siskin      0.0
## 19      Song thrush     10.0
## 20      Treecreeper      0.5
## 21      Willow warbler  0.5
## 22      Wren      1.0
```

```
# assign median ticktotal result to new object tick.summary
tick.summary <- tick.season %>%
  group_by(species) %>%
  summarise(median.tick = median(ticktotal))

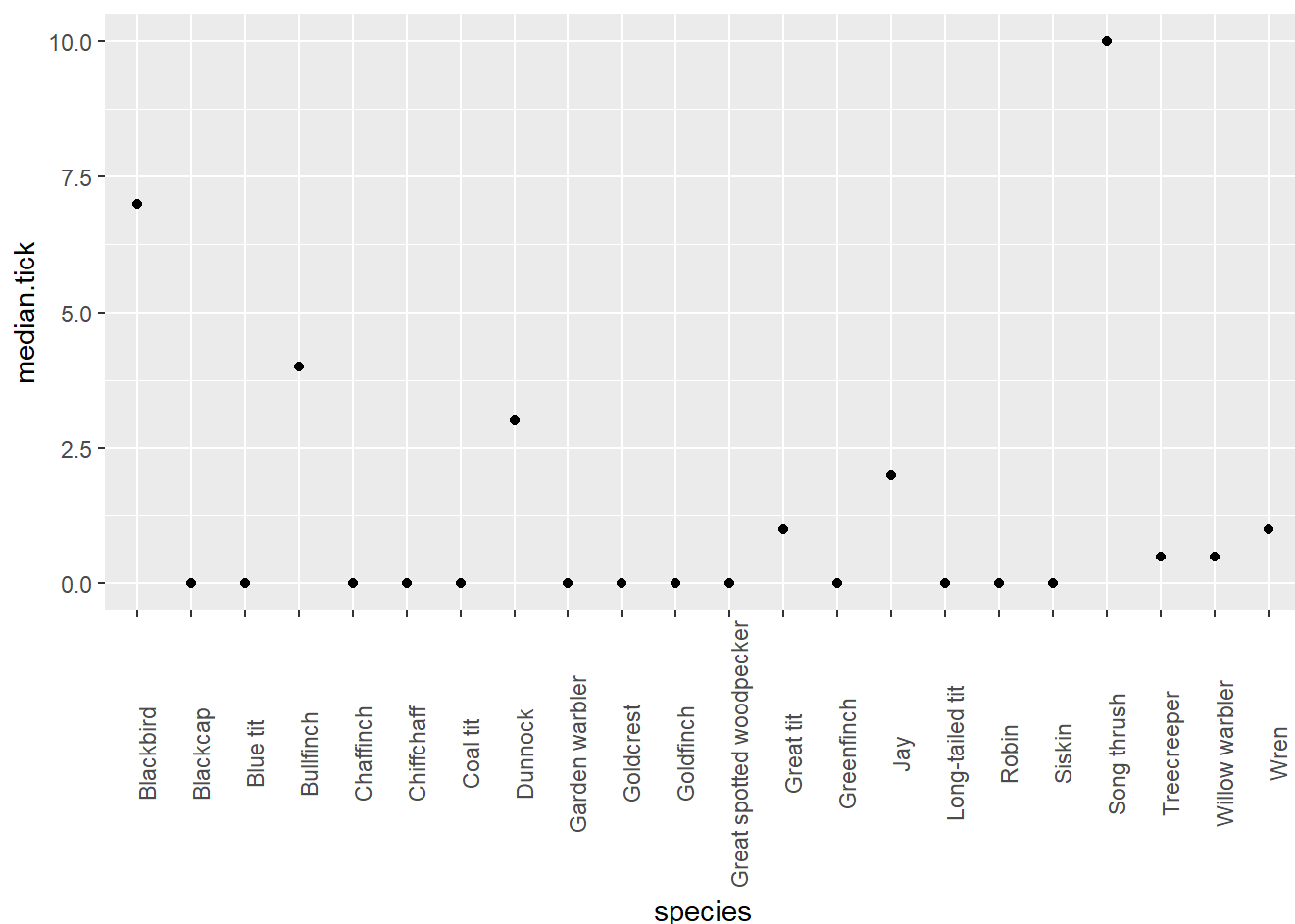
# sort tick.summary data frame by median.tick in descending order
# (so that species with the most ticks come first)
tick.summary <- arrange(tick.summary, desc(median.tick))

# check tick.summary dataset
glimpse(tick.summary)
```

```
## Observations: 22
## Variables: 2
## $ species      <fctr> Song thrush, Blackbird, Bullfinch, Dunnock, Jay, ...
## $ median.tick  <dbl> 10.0, 7.0, 4.0, 3.0, 2.0, 1.0, 1.0, 0.5, 0.5, 0.0,...
```

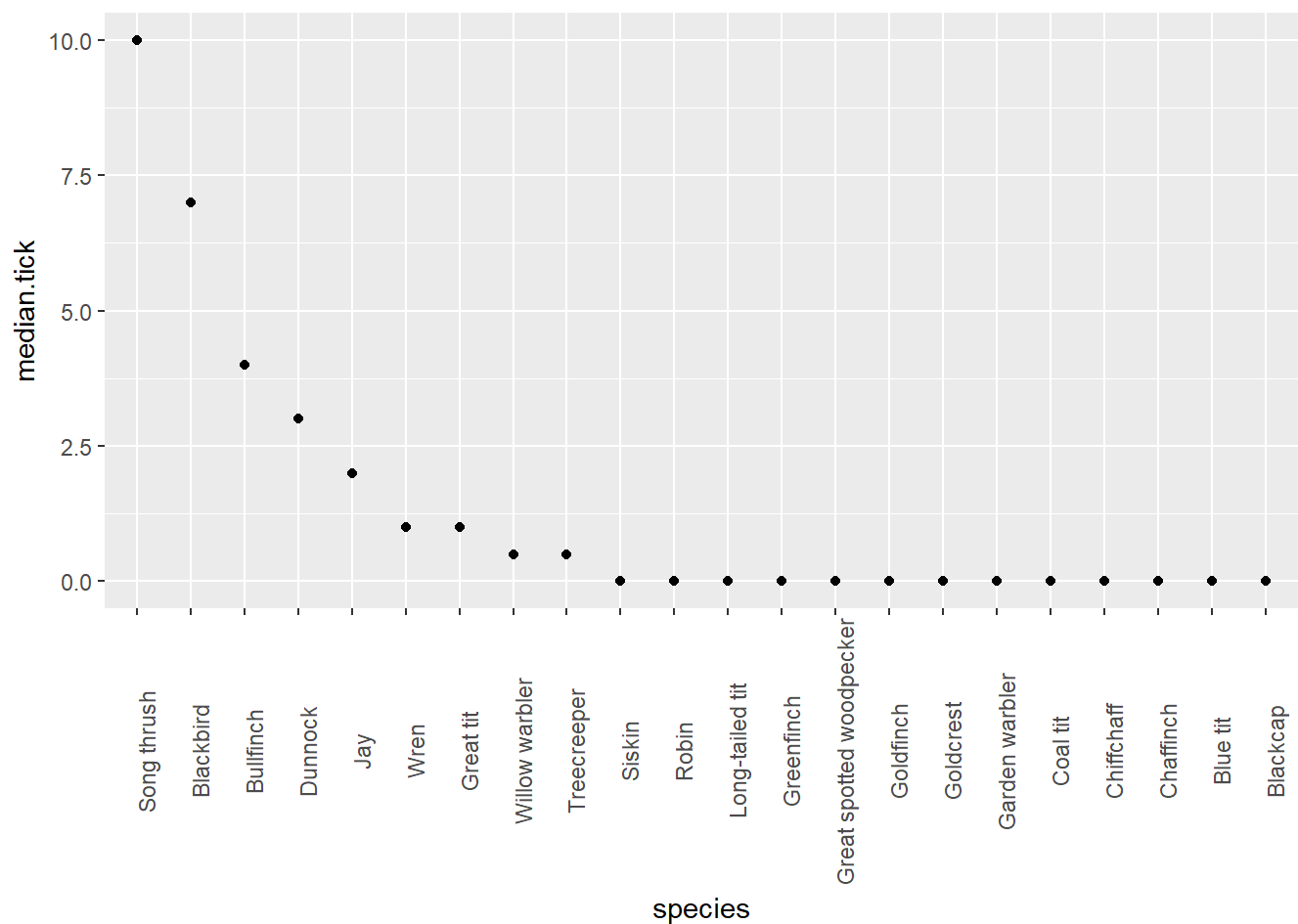
5. Plotting the Data

```
# make point plot with species (x-axis) vs. median.tick (y-axis)
# and change x-axis labels (species names) so that they're readable
#
# theme() line changes the x-axis text from being parallel to the x-axis
# (which makes the labels unreadable
# since the species names side-by-side run into each other)
# to being perpendicular (more legible)
ggplot(tick.summary, aes(x = species, y = median.tick)) +
  geom_point() +
  theme(axis.text.x = element_text(angle = 90))
```



```
# the plot ends up not being sorted by median.tick
# since ggplot by default wants the factor levels
# in a categorical variable (i.e., species) in alphabetical order
#
# to fix this, change species variable so that it is ordered by median.tick
# rather than by the default alphabetical order
tick.summary$species <- factor(tick.summary$species, levels =
  tick.summary$species[rev(order(tick.summary$median.tick))])

# plot the same graph and check that species are sorted by median.tick
ggplot(tick.summary, aes(x = species, y = median.tick)) +
  geom_point() +
  theme(axis.text.x = element_text(angle = 90))
```

```
# plot species (x-axis) vs. ticktotal (y-axis) from tick.season
# use boxplot to see not just the median tick numbers
# but also how the data are distributed
ggplot(tick.season, aes(x = species, y = ticktotal)) +
  geom_boxplot() +
  geom_point() +
  xlab("Bird species") +
  ylab("Number of ticks") +
  theme_bw() +
  theme(axis.text.x = element_text(angle = 90))
```

