

Data Collection and Data Wrangling

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NOTE:

1. Change author name and date to your exercise submission date in above section
2. Your code MUST execute without errors.
3. You can add more lines in your code as required.

Section 1: Manipulating Data

Question 1

The dataset is loaded for you. Perform the following tasks:

1. use the USPersonalExpenditure dataset and store in a variable.
2. Compute summary statistics: mean, standard deviation (sd) across time for each of the indicators.
3. Create a new column that contains average values for each of the indicators.

```
library(help='datasets')
```

```
### start solution ###
```

```
USPersonalExpenditure
```

```
##           1940    1945    1950    1955    1960
## Food and Tobacco  22.200  44.500  59.60  73.2  86.80
## Household Operation 10.500  15.500  29.00  36.5  46.20
## Medical and Health   3.530   5.760   9.71  14.0  21.10
## Personal Care        1.040   1.980   2.45   3.4   5.40
## Private Education    0.341   0.974   1.80   2.6   3.64
```

```
var_dataset <- as.data.frame(USPersonalExpenditure)
for (i in seq_along(1:ncol(USPersonalExpenditure)))
{
  avg <- mean(var_dataset[,i])
  print(paste('Mean of', colnames(USPersonalExpenditure)[i], ' = ', avg))
  s_deviation <- sd(var_dataset[,i])
  print(paste('Standard Deviation of ', colnames(USPersonalExpenditure)[i], ' = ', s_deviation))
}
```

```
## [1] "Mean of 1940  =  7.5222"
## [1] "Standard Deviation of  1940  =  9.13552566632047"
```

```
## [1] "Mean of 1945 = 13.7428"
## [1] "Standard Deviation of 1945 = 18.126113185126"
## [1] "Mean of 1950 = 20.512"
## [1] "Standard Deviation of 1950 = 24.4590263502045"
## [1] "Mean of 1955 = 25.94"
## [1] "Standard Deviation of 1955 = 29.7505966326728"
## [1] "Mean of 1960 = 32.628"
## [1] "Standard Deviation of 1960 = 34.7612128672174"
```

```
mean_rows <- rowMeans(var_dataset)

var_dataset$'Average' <- mean_rows
var_dataset
```

```
##              1940   1945  1950 1955  1960 Average
## Food and Tobacco 22.200 44.500 59.60 73.2 86.80  57.260
## Household Operation 10.500 15.500 29.00 36.5 46.20  27.540
## Medical and Health  3.530  5.760  9.71 14.0 21.10  10.820
## Personal Care       1.040  1.980  2.45  3.4  5.40   2.854
## Private Education   0.341  0.974  1.80  2.6  3.64   1.871
```

```
### end solution ###
```

Question 2

download the data from the available URL:

1. Create a new column containing the average bodywt (body weight) of each genus and of each order.
2. Create a dataframe containing the average REM sleep time for each order.
3. How many missing values are there (in total) and per column?
4. How would you like to impute missing values? Write Justification. Hint: Overall Mean/median/mode vs. Groupby Mean/median/mode?

```
url <- "https://raw.githubusercontent.com/genomicsclass/dagdata/master/inst/extdata/msleep_ggplot2.csv"

if(!file.exists("msleep_ggplot2.csv"))
{
  download.file(url, destfile = "msleep_ggplot2.csv", method = 'libcurl')
}

r <- read.csv("msleep_ggplot2.csv")
df <- data.frame(r)

avg_bodywt_genus <- aggregate(df$bodywt, list(df$genus), mean)
avg_bodywt_genus
```

```
##      Group.1      x
## 1   Acinonyx 50.000000
## 2     Aotus  0.480000
## 3 Aplodontia 1.350000
## 4   Blarina  0.019000
```

## 5	Bos	600.0000000
## 6	Bradypus	3.8500000
## 7	Callorhinus	20.4900000
## 8	Calomys	0.0450000
## 9	Canis	14.0000000
## 10	Capreolus	14.8000000
## 11	Capri	33.5000000
## 12	Cavis	0.7280000
## 13	Cercopithecus	4.7500000
## 14	Chinchilla	0.4200000
## 15	Condylura	0.0600000
## 16	Cricetomys	1.0000000
## 17	Cryptotis	0.0050000
## 18	Dasypus	3.5000000
## 19	Dendrohyrax	2.9500000
## 20	Didelphis	1.7000000
## 21	Elephas	2547.0000000
## 22	Eptesicus	0.0230000
## 23	Equus	354.0000000
## 24	Erinaceus	0.7700000
## 25	Erythrocebus	10.0000000
## 26	Eutamias	0.0710000
## 27	Felis	3.3000000
## 28	Galago	0.2000000
## 29	Genetta	2.0000000
## 30	Giraffa	899.9950000
## 31	Globicephalus	800.0000000
## 32	Haliochoerus	85.0000000
## 33	Heterohyrax	2.6250000
## 34	Homo	62.0000000
## 35	Lemur	1.6700000
## 36	Loxodonta	6654.0000000
## 37	Lutreolina	0.3700000
## 38	Macaca	6.8000000
## 39	Meriones	0.0530000
## 40	Mesocricetus	0.1200000
## 41	Microtus	0.0350000
## 42	Mus	0.0220000
## 43	Myotis	0.0100000
## 44	Neofiber	0.2660000
## 45	Nyctibeus	1.4000000
## 46	Octodon	0.2100000
## 47	Onychomys	0.0280000
## 48	Oryctolagus	2.5000000
## 49	Ovis	55.5000000
## 50	Pan	52.2000000
## 51	Panthera	141.3543333
## 52	Papio	25.2350000
## 53	Paraechinus	0.5500000
## 54	Perodicticus	1.1000000
## 55	Peromyscus	0.0210000
## 56	Phalanger	1.6200000
## 57	Phoca	86.0000000
## 58	Phocoena	53.1800000

```
## 59      Potorous      1.1000000
## 60    Priodontes    60.0000000
## 61      Procavia     3.6000000
## 62       Rattus     0.3200000
## 63    Rhabdomys     0.0440000
## 64      Saimiri     0.7430000
## 65     Scalopus     0.0750000
## 66     Sigmodon     0.1480000
## 67      Spalax     0.1220000
## 68  Sperophilus     0.4086667
## 69      Suncus     0.0480000
## 70        Sus    86.2500000
## 71  Tachyglossus     4.5000000
## 72      Tamias     0.1120000
## 73      Tapirus   207.5010000
## 74      Tenrec     0.9000000
## 75      Tupaia     0.1040000
## 76    Tursiops   173.3300000
## 77      Vulpes     3.8050000
```

```
avg_bodywt_order <- aggregate(df$bodywt, list(df$order), mean)
avg_bodywt_order
```

```
##      Group.1      x
## 1  Afrosoricida  0.9000000
## 2  Artiodactyla 281.6741667
## 3    Carnivora   57.7052500
## 4    Cetacea   342.1700000
## 5  Chiroptera   0.0165000
## 6    Cingulata  31.7500000
## 7  Didelphimorphia 1.0350000
## 8  Diprotodontia 1.3600000
## 9  Erinaceomorpha 0.6600000
## 10 Hyracoidea   3.0583333
## 11  Lagomorpha   2.5000000
## 12  Monotremata  4.5000000
## 13 Perissodactyla 305.1670000
## 14      Pilosa   3.8500000
## 15    Primates  13.8815000
## 16  Proboscidea 4600.5000000
## 17    Rodentia   0.2882273
## 18  Scandentia   0.1040000
## 19  Soricomorpha 0.0414000
```

```
avg_sleepREM_order <- aggregate(df$sleep_rem, list(df$order), mean)
avg_sleepREM_order <- as.data.frame(avg_sleepREM_order)
avg_sleepREM_order
```

```
##      Group.1      x
## 1  Afrosoricida 2.3000000
## 2  Artiodactyla    NA
## 3    Carnivora    NA
## 4    Cetacea    NA
```

```
## 5      Chiroptera 2.9500000
## 6      Cingulata 4.6000000
## 7 Didelphimorphia 5.7500000
## 8      Diprotodontia 1.6500000
## 9      Erinaceomorpha 3.1000000
## 10     Hyracoidea 0.5333333
## 11     Lagomorpha 0.9000000
## 12     Monotremata      NA
## 13 Perissodactyla 0.6666667
## 14     Pilosa 2.2000000
## 15     Primates      NA
## 16     Proboscidea      NA
## 17     Rodentia      NA
## 18     Scandentia 2.6000000
## 19     Soricomorpha 2.0000000
```

```
print(paste("Total NA(s) in whole file = ", sum(is.na(df))))
```

```
## [1] "Total NA(s) in whole file = 136"
```

```
for (j in seq_along(1:ncol(df)))
{
  print(paste("NA(s) in column ", j, " = ", sum(is.na(df[, j]))))
}
```

```
## [1] "NA(s) in column 1 = 0"
## [1] "NA(s) in column 2 = 0"
## [1] "NA(s) in column 3 = 7"
## [1] "NA(s) in column 4 = 0"
## [1] "NA(s) in column 5 = 29"
## [1] "NA(s) in column 6 = 0"
## [1] "NA(s) in column 7 = 22"
## [1] "NA(s) in column 8 = 51"
## [1] "NA(s) in column 9 = 0"
## [1] "NA(s) in column 10 = 27"
## [1] "NA(s) in column 11 = 0"
```

```
df
```

	name	genus	vore	order
## 1	Cheetah	Acinonyx	carni	Carnivora
## 2	Owl monkey	Aotus	omni	Primates
## 3	Mountain beaver	Aplodontia	herbi	Rodentia
## 4	Greater short-tailed shrew	Blarina	omni	Soricomorpha
## 5	Cow	Bos	herbi	Artiodactyla
## 6	Three-toed sloth	Bradypus	herbi	Pilosa
## 7	Northern fur seal	Callorhinus	carni	Carnivora
## 8	Vesper mouse	Calomys	<NA>	Rodentia
## 9	Dog	Canis	carni	Carnivora
## 10	Roe deer	Capreolus	herbi	Artiodactyla
## 11	Goat	Capri	herbi	Artiodactyla

## 12	Guinea pig	Cavis	herbi	Rodentia
## 13	Grivet	Cercopithecus	omni	Primates
## 14	Chinchilla	Chinchilla	herbi	Rodentia
## 15	Star-nosed mole	Condylura	omni	Soricomorpha
## 16	African giant pouched rat	Cricetomys	omni	Rodentia
## 17	Lesser short-tailed shrew	Cryptotis	omni	Soricomorpha
## 18	Long-nosed armadillo	Dasypus	carni	Cingulata
## 19	Tree hyrax	Dendrohyrax	herbi	Hyracoidea
## 20	North American Opossum	Didelphis	omni	Didelphimorphia
## 21	Asian elephant	Elephas	herbi	Proboscidea
## 22	Big brown bat	Eptesicus	insecti	Chiroptera
## 23	Horse	Equus	herbi	Perissodactyla
## 24	Donkey	Equus	herbi	Perissodactyla
## 25	European hedgehog	Erinaceus	omni	Erinaceomorpha
## 26	Patas monkey	Erythrocebus	omni	Primates
## 27	Western american chipmunk	Eutamias	herbi	Rodentia
## 28	Domestic cat	Felis	carni	Carnivora
## 29	Galago	Galago	omni	Primates
## 30	Giraffe	Giraffa	herbi	Artiodactyla
## 31	Pilot whale	Globicephalus	carni	Cetacea
## 32	Gray seal	Haliobroderus	carni	Carnivora
## 33	Gray hyrax	Heterohyrax	herbi	Hyracoidea
## 34	Human	Homo	omni	Primates
## 35	Mongoose lemur	Lemur	herbi	Primates
## 36	African elephant	Loxodonta	herbi	Proboscidea
## 37	Thick-tailed opossum	Lutreolina	carni	Didelphimorphia
## 38	Macaque	Macaca	omni	Primates
## 39	Mongolian gerbil	Meriones	herbi	Rodentia
## 40	Golden hamster	Mesocricetus	herbi	Rodentia
## 41	Vole	Microtus	herbi	Rodentia
## 42	House mouse	Mus	herbi	Rodentia
## 43	Little brown bat	Myotis	insecti	Chiroptera
## 44	Round-tailed muskrat	Neofiber	herbi	Rodentia
## 45	Slow loris	Nyctibeus	carni	Primates
## 46	Degu	Octodon	herbi	Rodentia
## 47	Northern grasshopper mouse	Onychomys	carni	Rodentia
## 48	Rabbit	Oryctolagus	herbi	Lagomorpha
## 49	Sheep	Ovis	herbi	Artiodactyla
## 50	Chimpanzee	Pan	omni	Primates
## 51	Tiger	Panthera	carni	Carnivora
## 52	Jaguar	Panthera	carni	Carnivora
## 53	Lion	Panthera	carni	Carnivora
## 54	Baboon	Papio	omni	Primates
## 55	Desert hedgehog	Paraechinus	<NA>	Erinaceomorpha
## 56	Potto	Perodicticus	omni	Primates
## 57	Deer mouse	Peromyscus	<NA>	Rodentia
## 58	Phalanger	Phalanger	<NA>	Diprotodontia
## 59	Caspian seal	Phoca	carni	Carnivora
## 60	Common porpoise	Phocoena	carni	Cetacea
## 61	Potoroo	Potorous	herbi	Diprotodontia
## 62	Giant armadillo	Priodontes	insecti	Cingulata
## 63	Rock hyrax	Procavia	<NA>	Hyracoidea
## 64	Laboratory rat	Rattus	herbi	Rodentia
## 65	African striped mouse	Rhabdomys	omni	Rodentia

## 66	Squirrel monkey	Saimiri	omni	Primates			
## 67	Eastern american mole	Scalopus	insecti	Soricomorpha			
## 68	Cotton rat	Sigmodon	herbi	Rodentia			
## 69	Mole rat	Spalax	<NA>	Rodentia			
## 70	Arctic ground squirrel	Spermophilus	herbi	Rodentia			
## 71	Thirteen-lined ground squirrel	Spermophilus	herbi	Rodentia			
## 72	Golden-mantled ground squirrel	Spermophilus	herbi	Rodentia			
## 73	Musk shrew	Suncus	<NA>	Soricomorpha			
## 74	Pig	Sus	omni	Artiodactyla			
## 75	Short-nosed echidna	Tachyglossus	insecti	Monotremata			
## 76	Eastern american chipmunk	Tamias	herbi	Rodentia			
## 77	Brazilian tapir	Tapirus	herbi	Perissodactyla			
## 78	Tenrec	Tenrec	omni	Afrosoricida			
## 79	Tree shrew	Tupaia	omni	Scandentia			
## 80	Bottle-nosed dolphin	Tursiops	carni	Cetacea			
## 81	Genet	Genetta	carni	Carnivora			
## 82	Arctic fox	Vulpes	carni	Carnivora			
## 83	Red fox	Vulpes	carni	Carnivora			
##	conservation	sleep_total	sleep_rem	sleep_cycle	awake	brainwt	bodywt
## 1	lc	12.1	NA	NA	11.90	NA	50.000
## 2	<NA>	17.0	1.8	NA	7.00	0.01550	0.480
## 3	nt	14.4	2.4	NA	9.60	NA	1.350
## 4	lc	14.9	2.3	0.1333333	9.10	0.00029	0.019
## 5	domesticated	4.0	0.7	0.6666667	20.00	0.42300	600.000
## 6	<NA>	14.4	2.2	0.7666667	9.60	NA	3.850
## 7	vu	8.7	1.4	0.3833333	15.30	NA	20.490
## 8	<NA>	7.0	NA	NA	17.00	NA	0.045
## 9	domesticated	10.1	2.9	0.3333333	13.90	0.07000	14.000
## 10	lc	3.0	NA	NA	21.00	0.09820	14.800
## 11	lc	5.3	0.6	NA	18.70	0.11500	33.500
## 12	domesticated	9.4	0.8	0.2166667	14.60	0.00550	0.728
## 13	lc	10.0	0.7	NA	14.00	NA	4.750
## 14	domesticated	12.5	1.5	0.1166667	11.50	0.00640	0.420
## 15	lc	10.3	2.2	NA	13.70	0.00100	0.060
## 16	<NA>	8.3	2.0	NA	15.70	0.00660	1.000
## 17	lc	9.1	1.4	0.1500000	14.90	0.00014	0.005
## 18	lc	17.4	3.1	0.3833333	6.60	0.01080	3.500
## 19	lc	5.3	0.5	NA	18.70	0.01230	2.950
## 20	lc	18.0	4.9	0.3333333	6.00	0.00630	1.700
## 21	en	3.9	NA	NA	20.10	4.60300	2547.000
## 22	lc	19.7	3.9	0.1166667	4.30	0.00030	0.023
## 23	domesticated	2.9	0.6	1.0000000	21.10	0.65500	521.000
## 24	domesticated	3.1	0.4	NA	20.90	0.41900	187.000
## 25	lc	10.1	3.5	0.2833333	13.90	0.00350	0.770
## 26	lc	10.9	1.1	NA	13.10	0.11500	10.000
## 27	<NA>	14.9	NA	NA	9.10	NA	0.071
## 28	domesticated	12.5	3.2	0.4166667	11.50	0.02560	3.300
## 29	<NA>	9.8	1.1	0.5500000	14.20	0.00500	0.200
## 30	cd	1.9	0.4	NA	22.10	NA	899.995
## 31	cd	2.7	0.1	NA	21.35	NA	800.000
## 32	lc	6.2	1.5	NA	17.80	0.32500	85.000
## 33	lc	6.3	0.6	NA	17.70	0.01227	2.625
## 34	<NA>	8.0	1.9	1.5000000	16.00	1.32000	62.000
## 35	vu	9.5	0.9	NA	14.50	NA	1.670

## 36	vu	3.3	NA	NA	20.70	5.71200	6654.000
## 37	lc	19.4	6.6	NA	4.60	NA	0.370
## 38	<NA>	10.1	1.2	0.7500000	13.90	0.17900	6.800
## 39	lc	14.2	1.9	NA	9.80	NA	0.053
## 40	en	14.3	3.1	0.2000000	9.70	0.00100	0.120
## 41	<NA>	12.8	NA	NA	11.20	NA	0.035
## 42	nt	12.5	1.4	0.1833333	11.50	0.00040	0.022
## 43	<NA>	19.9	2.0	0.2000000	4.10	0.00025	0.010
## 44	nt	14.6	NA	NA	9.40	NA	0.266
## 45	<NA>	11.0	NA	NA	13.00	0.01250	1.400
## 46	lc	7.7	0.9	NA	16.30	NA	0.210
## 47	lc	14.5	NA	NA	9.50	NA	0.028
## 48	domesticated	8.4	0.9	0.4166667	15.60	0.01210	2.500
## 49	domesticated	3.8	0.6	NA	20.20	0.17500	55.500
## 50	<NA>	9.7	1.4	1.4166667	14.30	0.44000	52.200
## 51	en	15.8	NA	NA	8.20	NA	162.564
## 52	nt	10.4	NA	NA	13.60	0.15700	100.000
## 53	vu	13.5	NA	NA	10.50	NA	161.499
## 54	<NA>	9.4	1.0	0.6666667	14.60	0.18000	25.235
## 55	lc	10.3	2.7	NA	13.70	0.00240	0.550
## 56	lc	11.0	NA	NA	13.00	NA	1.100
## 57	<NA>	11.5	NA	NA	12.50	NA	0.021
## 58	<NA>	13.7	1.8	NA	10.30	0.01140	1.620
## 59	vu	3.5	0.4	NA	20.50	NA	86.000
## 60	vu	5.6	NA	NA	18.45	NA	53.180
## 61	<NA>	11.1	1.5	NA	12.90	NA	1.100
## 62	en	18.1	6.1	NA	5.90	0.08100	60.000
## 63	lc	5.4	0.5	NA	18.60	0.02100	3.600
## 64	lc	13.0	2.4	0.1833333	11.00	0.00190	0.320
## 65	<NA>	8.7	NA	NA	15.30	NA	0.044
## 66	<NA>	9.6	1.4	NA	14.40	0.02000	0.743
## 67	lc	8.4	2.1	0.1666667	15.60	0.00120	0.075
## 68	<NA>	11.3	1.1	0.1500000	12.70	0.00118	0.148
## 69	<NA>	10.6	2.4	NA	13.40	0.00300	0.122
## 70	lc	16.6	NA	NA	7.40	0.00570	0.920
## 71	lc	13.8	3.4	0.2166667	10.20	0.00400	0.101
## 72	lc	15.9	3.0	NA	8.10	NA	0.205
## 73	<NA>	12.8	2.0	0.1833333	11.20	0.00033	0.048
## 74	domesticated	9.1	2.4	0.5000000	14.90	0.18000	86.250
## 75	<NA>	8.6	NA	NA	15.40	0.02500	4.500
## 76	<NA>	15.8	NA	NA	8.20	NA	0.112
## 77	vu	4.4	1.0	0.9000000	19.60	0.16900	207.501
## 78	<NA>	15.6	2.3	NA	8.40	0.00260	0.900
## 79	<NA>	8.9	2.6	0.2333333	15.10	0.00250	0.104
## 80	<NA>	5.2	NA	NA	18.80	NA	173.330
## 81	<NA>	6.3	1.3	NA	17.70	0.01750	2.000
## 82	<NA>	12.5	NA	NA	11.50	0.04450	3.380
## 83	<NA>	9.8	2.4	0.3500000	14.20	0.05040	4.230

start solution

For a missing value of a certain group, we will use mean of that group.
 ### Otherwise if there is a group of only one specie then we will use the overall mean


```
### end solution ###
```

Good job! You've completed this section!

Section 2: Tidyverse

Question 1

Use the above dataset and perform the following tasks using any library from tidyverse:

1. Filter results to print average REM sleep and average total sleep for those animals who are carnivores and then for those who are primates.
2. Use the order column and “spread” it across the rest of the observations.

```
### start solution ###
```

```
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
```

```
library('tidyr')
```

```
df
```

	name	genus	vore	order
## 1	Cheetah	Acinonyx	carni	Carnivora
## 2	Owl monkey	Aotus	omni	Primates
## 3	Mountain beaver	Aplodontia	herbi	Rodentia
## 4	Greater short-tailed shrew	Blarina	omni	Soricomorpha
## 5	Cow	Bos	herbi	Artiodactyla
## 6	Three-toed sloth	Bradypus	herbi	Pilosa
## 7	Northern fur seal	Callorhinus	carni	Carnivora
## 8	Vesper mouse	Calomys	<NA>	Rodentia
## 9	Dog	Canis	carni	Carnivora
## 10	Roe deer	Capreolus	herbi	Artiodactyla
## 11	Goat	Capri	herbi	Artiodactyla
## 12	Guinea pig	Cavis	herbi	Rodentia
## 13	Grivet	Cercopithecus	omni	Primates
## 14	Chinchilla	Chinchilla	herbi	Rodentia
## 15	Star-nosed mole	Condylura	omni	Soricomorpha
## 16	African giant pouched rat	Cricetomys	omni	Rodentia
## 17	Lesser short-tailed shrew	Cryptotis	omni	Soricomorpha
## 18	Long-nosed armadillo	Dasypus	carni	Cingulata
## 19	Tree hyrax	Dendrohyrax	herbi	Hyracoidea

## 20	North American Opossum	Didelphis	omni	Didelphimorphia
## 21	Asian elephant	Elephas	herbi	Proboscidea
## 22	Big brown bat	Eptesicus	insecti	Chiroptera
## 23	Horse	Equus	herbi	Perissodactyla
## 24	Donkey	Equus	herbi	Perissodactyla
## 25	European hedgehog	Erinaceus	omni	Erinaceomorpha
## 26	Patas monkey	Erythrocebus	omni	Primates
## 27	Western american chipmunk	Eutamias	herbi	Rodentia
## 28	Domestic cat	Felis	carni	Carnivora
## 29	Galago	Galago	omni	Primates
## 30	Giraffe	Giraffa	herbi	Artiodactyla
## 31	Pilot whale	Globicephalus	carni	Cetacea
## 32	Gray seal	Haliochoerus	carni	Carnivora
## 33	Gray hyrax	Heterohyrax	herbi	Hyracoidea
## 34	Human	Homo	omni	Primates
## 35	Mongoose lemur	Lemur	herbi	Primates
## 36	African elephant	Loxodonta	herbi	Proboscidea
## 37	Thick-tailed opossum	Lutreolina	carni	Didelphimorphia
## 38	Macaque	Macaca	omni	Primates
## 39	Mongolian gerbil	Meriones	herbi	Rodentia
## 40	Golden hamster	Mesocricetus	herbi	Rodentia
## 41	Vole	Microtus	herbi	Rodentia
## 42	House mouse	Mus	herbi	Rodentia
## 43	Little brown bat	Myotis	insecti	Chiroptera
## 44	Round-tailed muskrat	Neofiber	herbi	Rodentia
## 45	Slow loris	Nyctibeus	carni	Primates
## 46	Degu	Octodon	herbi	Rodentia
## 47	Northern grasshopper mouse	Onychomys	carni	Rodentia
## 48	Rabbit	Oryctolagus	herbi	Lagomorpha
## 49	Sheep	Ovis	herbi	Artiodactyla
## 50	Chimpanzee	Pan	omni	Primates
## 51	Tiger	Panthera	carni	Carnivora
## 52	Jaguar	Panthera	carni	Carnivora
## 53	Lion	Panthera	carni	Carnivora
## 54	Baboon	Papio	omni	Primates
## 55	Desert hedgehog	Paraechinus	<NA>	Erinaceomorpha
## 56	Potto	Perodicticus	omni	Primates
## 57	Deer mouse	Peromyscus	<NA>	Rodentia
## 58	Phalanger	Phalanger	<NA>	Diprotodontia
## 59	Caspian seal	Phoca	carni	Carnivora
## 60	Common porpoise	Phocoena	carni	Cetacea
## 61	Potoroo	Potorous	herbi	Diprotodontia
## 62	Giant armadillo	Priodontes	insecti	Cingulata
## 63	Rock hyrax	Procavia	<NA>	Hyracoidea
## 64	Laboratory rat	Rattus	herbi	Rodentia
## 65	African striped mouse	Rhabdomys	omni	Rodentia
## 66	Squirrel monkey	Saimiri	omni	Primates
## 67	Eastern american mole	Scalopus	insecti	Soricomorpha
## 68	Cotton rat	Sigmodon	herbi	Rodentia
## 69	Mole rat	Spalax	<NA>	Rodentia
## 70	Arctic ground squirrel	Spermophilus	herbi	Rodentia
## 71	Thirteen-lined ground squirrel	Spermophilus	herbi	Rodentia
## 72	Golden-mantled ground squirrel	Spermophilus	herbi	Rodentia
## 73	Musk shrew	Suncus	<NA>	Soricomorpha

## 74		Pig	Sus	omni	Artiodactyla		
## 75		Short-nosed echidna	Tachyglossus	insecti	Monotremata		
## 76		Eastern american chipmunk	Tamias	herbi	Rodentia		
## 77		Brazilian tapir	Tapirus	herbi	Perissodactyla		
## 78		Tenrec	Tenrec	omni	Afrosoricida		
## 79		Tree shrew	Tupaia	omni	Scandentia		
## 80		Bottle-nosed dolphin	Tursiops	carni	Cetacea		
## 81		Genet	Genetta	carni	Carnivora		
## 82		Arctic fox	Vulpes	carni	Carnivora		
## 83		Red fox	Vulpes	carni	Carnivora		
##	conservation	sleep_total	sleep_rem	sleep_cycle	awake	brainwt	bodywt
## 1	lc	12.1	NA	NA	11.90	NA	50.000
## 2	<NA>	17.0	1.8	NA	7.00	0.01550	0.480
## 3	nt	14.4	2.4	NA	9.60	NA	1.350
## 4	lc	14.9	2.3	0.1333333	9.10	0.00029	0.019
## 5	domesticated	4.0	0.7	0.6666667	20.00	0.42300	600.000
## 6	<NA>	14.4	2.2	0.7666667	9.60	NA	3.850
## 7	vu	8.7	1.4	0.3833333	15.30	NA	20.490
## 8	<NA>	7.0	NA	NA	17.00	NA	0.045
## 9	domesticated	10.1	2.9	0.3333333	13.90	0.07000	14.000
## 10	lc	3.0	NA	NA	21.00	0.09820	14.800
## 11	lc	5.3	0.6	NA	18.70	0.11500	33.500
## 12	domesticated	9.4	0.8	0.2166667	14.60	0.00550	0.728
## 13	lc	10.0	0.7	NA	14.00	NA	4.750
## 14	domesticated	12.5	1.5	0.1166667	11.50	0.00640	0.420
## 15	lc	10.3	2.2	NA	13.70	0.00100	0.060
## 16	<NA>	8.3	2.0	NA	15.70	0.00660	1.000
## 17	lc	9.1	1.4	0.1500000	14.90	0.00014	0.005
## 18	lc	17.4	3.1	0.3833333	6.60	0.01080	3.500
## 19	lc	5.3	0.5	NA	18.70	0.01230	2.950
## 20	lc	18.0	4.9	0.3333333	6.00	0.00630	1.700
## 21	en	3.9	NA	NA	20.10	4.60300	2547.000
## 22	lc	19.7	3.9	0.1166667	4.30	0.00030	0.023
## 23	domesticated	2.9	0.6	1.0000000	21.10	0.65500	521.000
## 24	domesticated	3.1	0.4	NA	20.90	0.41900	187.000
## 25	lc	10.1	3.5	0.2833333	13.90	0.00350	0.770
## 26	lc	10.9	1.1	NA	13.10	0.11500	10.000
## 27	<NA>	14.9	NA	NA	9.10	NA	0.071
## 28	domesticated	12.5	3.2	0.4166667	11.50	0.02560	3.300
## 29	<NA>	9.8	1.1	0.5500000	14.20	0.00500	0.200
## 30	cd	1.9	0.4	NA	22.10	NA	899.995
## 31	cd	2.7	0.1	NA	21.35	NA	800.000
## 32	lc	6.2	1.5	NA	17.80	0.32500	85.000
## 33	lc	6.3	0.6	NA	17.70	0.01227	2.625
## 34	<NA>	8.0	1.9	1.5000000	16.00	1.32000	62.000
## 35	vu	9.5	0.9	NA	14.50	NA	1.670
## 36	vu	3.3	NA	NA	20.70	5.71200	6654.000
## 37	lc	19.4	6.6	NA	4.60	NA	0.370
## 38	<NA>	10.1	1.2	0.7500000	13.90	0.17900	6.800
## 39	lc	14.2	1.9	NA	9.80	NA	0.053
## 40	en	14.3	3.1	0.2000000	9.70	0.00100	0.120
## 41	<NA>	12.8	NA	NA	11.20	NA	0.035
## 42	nt	12.5	1.4	0.1833333	11.50	0.00040	0.022
## 43	<NA>	19.9	2.0	0.2000000	4.10	0.00025	0.010

## 44	nt	14.6	NA	NA	9.40	NA	0.266
## 45	<NA>	11.0	NA	NA	13.00	0.01250	1.400
## 46	lc	7.7	0.9	NA	16.30	NA	0.210
## 47	lc	14.5	NA	NA	9.50	NA	0.028
## 48	domesticated	8.4	0.9	0.4166667	15.60	0.01210	2.500
## 49	domesticated	3.8	0.6	NA	20.20	0.17500	55.500
## 50	<NA>	9.7	1.4	1.4166667	14.30	0.44000	52.200
## 51	en	15.8	NA	NA	8.20	NA	162.564
## 52	nt	10.4	NA	NA	13.60	0.15700	100.000
## 53	vu	13.5	NA	NA	10.50	NA	161.499
## 54	<NA>	9.4	1.0	0.6666667	14.60	0.18000	25.235
## 55	lc	10.3	2.7	NA	13.70	0.00240	0.550
## 56	lc	11.0	NA	NA	13.00	NA	1.100
## 57	<NA>	11.5	NA	NA	12.50	NA	0.021
## 58	<NA>	13.7	1.8	NA	10.30	0.01140	1.620
## 59	vu	3.5	0.4	NA	20.50	NA	86.000
## 60	vu	5.6	NA	NA	18.45	NA	53.180
## 61	<NA>	11.1	1.5	NA	12.90	NA	1.100
## 62	en	18.1	6.1	NA	5.90	0.08100	60.000
## 63	lc	5.4	0.5	NA	18.60	0.02100	3.600
## 64	lc	13.0	2.4	0.1833333	11.00	0.00190	0.320
## 65	<NA>	8.7	NA	NA	15.30	NA	0.044
## 66	<NA>	9.6	1.4	NA	14.40	0.02000	0.743
## 67	lc	8.4	2.1	0.1666667	15.60	0.00120	0.075
## 68	<NA>	11.3	1.1	0.1500000	12.70	0.00118	0.148
## 69	<NA>	10.6	2.4	NA	13.40	0.00300	0.122
## 70	lc	16.6	NA	NA	7.40	0.00570	0.920
## 71	lc	13.8	3.4	0.2166667	10.20	0.00400	0.101
## 72	lc	15.9	3.0	NA	8.10	NA	0.205
## 73	<NA>	12.8	2.0	0.1833333	11.20	0.00033	0.048
## 74	domesticated	9.1	2.4	0.5000000	14.90	0.18000	86.250
## 75	<NA>	8.6	NA	NA	15.40	0.02500	4.500
## 76	<NA>	15.8	NA	NA	8.20	NA	0.112
## 77	vu	4.4	1.0	0.9000000	19.60	0.16900	207.501
## 78	<NA>	15.6	2.3	NA	8.40	0.00260	0.900
## 79	<NA>	8.9	2.6	0.2333333	15.10	0.00250	0.104
## 80	<NA>	5.2	NA	NA	18.80	NA	173.330
## 81	<NA>	6.3	1.3	NA	17.70	0.01750	2.000
## 82	<NA>	12.5	NA	NA	11.50	0.04450	3.380
## 83	<NA>	9.8	2.4	0.3500000	14.20	0.05040	4.230

```
df %>%
  filter(order=="Primates") %>%
  select(order, sleep_total, sleep_rem)
```

##	order	sleep_total	sleep_rem
## 1	Primates	17.0	1.8
## 2	Primates	10.0	0.7
## 3	Primates	10.9	1.1
## 4	Primates	9.8	1.1
## 5	Primates	8.0	1.9
## 6	Primates	9.5	0.9
## 7	Primates	10.1	1.2
## 8	Primates	11.0	NA

```
## 9 Primates      9.7      1.4
## 10 Primates     9.4      1.0
## 11 Primates    11.0      NA
## 12 Primates     9.6      1.4
```

```
df %>%
  filter(order=="Carnivora") %>%
  select(order, sleep_total, sleep_rem)
```

```
##      order sleep_total sleep_rem
## 1 Carnivora      12.1      NA
## 2 Carnivora       8.7      1.4
## 3 Carnivora     10.1      2.9
## 4 Carnivora     12.5      3.2
## 5 Carnivora       6.2      1.5
## 6 Carnivora     15.8      NA
## 7 Carnivora     10.4      NA
## 8 Carnivora     13.5      NA
## 9 Carnivora       3.5      0.4
## 10 Carnivora      6.3      1.3
## 11 Carnivora     12.5      NA
## 12 Carnivora      9.8      2.4
```

```
wide_DF <- df %>% spread(order, sleep_total) %>% select(-name, -genus, -vore, -conservation,
  -sleep_rem, -awake, -sleep_cycle,
  -brainwt, -bodywt)
head(wide_DF, 24)
```

```
##      Afrosoricida Artiodactyla Carnivora Cetacea Chiroptera Cingulata
## 1      NA      NA      12.1      NA      NA      NA
## 2      NA      NA      NA      NA      NA      NA
## 3      NA      NA      NA      NA      NA      NA
## 4      NA      NA      NA      NA      NA      NA
## 5      NA      4.0      NA      NA      NA      NA
## 6      NA      NA      NA      NA      NA      NA
## 7      NA      NA      8.7      NA      NA      NA
## 8      NA      NA      NA      NA      NA      NA
## 9      NA      NA     10.1      NA      NA      NA
## 10     NA      3.0      NA      NA      NA      NA
## 11     NA      5.3      NA      NA      NA      NA
## 12     NA      NA      NA      NA      NA      NA
## 13     NA      NA      NA      NA      NA      NA
## 14     NA      NA      NA      NA      NA      NA
## 15     NA      NA      NA      NA      NA      NA
## 16     NA      NA      NA      NA      NA      NA
## 17     NA      NA      NA      NA      NA      NA
## 18     NA      NA      NA      NA      NA     17.4
## 19     NA      NA      NA      NA      NA      NA
## 20     NA      NA      NA      NA      NA      NA
## 21     NA      NA      NA      NA      NA      NA
## 22     NA      NA      NA      NA     19.7      NA
## 23     NA      NA      NA      NA      NA      NA
## 24     NA      NA      NA      NA      NA      NA
```

##	Didelphimorphia	Diprotodontia	Erinaceomorpha	Hyracoidea	Lagomorpha		
## 1	NA	NA	NA	NA	NA		
## 2	NA	NA	NA	NA	NA		
## 3	NA	NA	NA	NA	NA		
## 4	NA	NA	NA	NA	NA		
## 5	NA	NA	NA	NA	NA		
## 6	NA	NA	NA	NA	NA		
## 7	NA	NA	NA	NA	NA		
## 8	NA	NA	NA	NA	NA		
## 9	NA	NA	NA	NA	NA		
## 10	NA	NA	NA	NA	NA		
## 11	NA	NA	NA	NA	NA		
## 12	NA	NA	NA	NA	NA		
## 13	NA	NA	NA	NA	NA		
## 14	NA	NA	NA	NA	NA		
## 15	NA	NA	NA	NA	NA		
## 16	NA	NA	NA	NA	NA		
## 17	NA	NA	NA	NA	NA		
## 18	NA	NA	NA	NA	NA		
## 19	NA	NA	NA	5.3	NA		
## 20	18	NA	NA	NA	NA		
## 21	NA	NA	NA	NA	NA		
## 22	NA	NA	NA	NA	NA		
## 23	NA	NA	NA	NA	NA		
## 24	NA	NA	NA	NA	NA		
##	Monotremata	Perissodactyla	Pilosa	Primates	Proboscidea	Rodentia	Scandentia
## 1	NA	NA	NA	NA	NA	NA	NA
## 2	NA	NA	NA	17	NA	NA	NA
## 3	NA	NA	NA	NA	NA	14.4	NA
## 4	NA	NA	NA	NA	NA	NA	NA
## 5	NA	NA	NA	NA	NA	NA	NA
## 6	NA	NA	14.4	NA	NA	NA	NA
## 7	NA	NA	NA	NA	NA	NA	NA
## 8	NA	NA	NA	NA	NA	7.0	NA
## 9	NA	NA	NA	NA	NA	NA	NA
## 10	NA	NA	NA	NA	NA	NA	NA
## 11	NA	NA	NA	NA	NA	NA	NA
## 12	NA	NA	NA	NA	NA	9.4	NA
## 13	NA	NA	NA	10	NA	NA	NA
## 14	NA	NA	NA	NA	NA	12.5	NA
## 15	NA	NA	NA	NA	NA	NA	NA
## 16	NA	NA	NA	NA	NA	8.3	NA
## 17	NA	NA	NA	NA	NA	NA	NA
## 18	NA	NA	NA	NA	NA	NA	NA
## 19	NA	NA	NA	NA	NA	NA	NA
## 20	NA	NA	NA	NA	NA	NA	NA
## 21	NA	NA	NA	NA	3.9	NA	NA
## 22	NA	NA	NA	NA	NA	NA	NA
## 23	NA	2.9	NA	NA	NA	NA	NA
## 24	NA	3.1	NA	NA	NA	NA	NA
##	Soricomorpha						
## 1	NA						
## 2	NA						
## 3	NA						

```
## 4      14.9
## 5      NA
## 6      NA
## 7      NA
## 8      NA
## 9      NA
## 10     NA
## 11     NA
## 12     NA
## 13     NA
## 14     NA
## 15     10.3
## 16     NA
## 17     9.1
## 18     NA
## 19     NA
## 20     NA
## 21     NA
## 22     NA
## 23     NA
## 24     NA
```

```
### end solution ###
```

Good job! You've completed this entire exercise!