# Apply functions

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## Exercise 1

Write a function named mass_from_length_theropoda() that takes length as an argument to get an estimate of mass for Theropoda dinosaurs. Use the equation mass <- 0.73 * length^3.63. Copy and run the code below to generate the object theropoda_lengths in your R environment. Pass the entire vector to your function (by giving it as value for the length argument); this calculates the mass for each length value in the vector theropoda_lengths.

```
get_mass_from_length_theropoda <- function(length){
  mass <- 0.73 * length ^ 3.63
  return(mass)
}
theropoda_lengths <- c(17.8013631070471, 20.3764452071665, 14.0743486294308, 25.65782386974, 26.0952008
```

Calculate the mass for each length values in the vector 'get_mass_from_length_theropoda'

```
get_mass_from_length_theropoda(theropoda_lengths)
```

```
##  [1]  25262.027  41253.332  10767.568  95233.732 101260.017  40775.516
##  [7]  24072.130   4785.145  39129.521  29666.193  26830.297  64700.869
## [13]  42768.180  94697.262  79013.471 103955.226  92798.465  41901.983
## [19]  17439.569  41055.045  37544.201  25198.303  12928.490  36388.290
## [25]  34962.862  80307.929   8854.525  50183.194  28846.165  35735.369
## [31] 115908.187  31765.368  58958.713   5561.862  28349.410  15418.314
## [37]   9218.648   1197.666  94407.873  19552.500
```

Create a new version of the function named mass_from_length() that uses the equation mass <- a * length^b and takes length, a and b as arguments. In the function arguments, set the default values for a to 0.73 and b to 3.63. If you run this function with just the length data from Part 1, you should get the same result as Part 1. Copy the data below into R and call your function using the vector of lengths from Part 1 (above) and these vectors of a and b values to estimate the mass for the dinosaurs using different values of a and b.

```
mass_from_length <- function(length, a = 0.73, b = 3.63) {
  mass <- a * length^b
  return(mass)
}

a_values <- c(0.759, 0.751, 0.74, 0.746, 0.759, 0.751, 0.749, 0.751, 0.738, 0.768, 0.736, 0.749, 0.746,

b_values <- c(3.627, 3.633, 3.626, 3.633, 3.627, 3.629, 3.632, 3.628, 3.633, 3.627, 3.621, 3.63, 3.631,

mass_from_length(length = theropoda_lengths, a = a_values, b = b_values)
```

```
##  [1]  26039.686  42825.603  10800.224  98273.049 104257.481  41822.386
##  [7]  24840.644   4899.022  39915.948  30937.922  26354.908  66384.865
## [13]  43837.944  97141.451  80553.856 105556.405  97374.660  42760.136
## [19]  18749.274  42109.012  40674.182  26003.425  13229.824  37472.789
## [25]  34684.033  80187.272   9460.977  51630.571  29253.772  36399.306
## [31] 117511.962  33384.288  58581.226   5462.316  28637.745  15864.172
## [37]   9284.810   1218.755  98522.609  19534.524
```

```r
mapply(mass_from_length, theropoda_lengths, a_values, b_values )
```

```
##  [1]  26039.686  42825.603  10800.224  98273.049 104257.481  41822.386
##  [7]  24840.644   4899.022  39915.948  30937.922  26354.908  66384.865
## [13]  43837.944  97141.451  80553.856 105556.405  97374.660  42760.136
## [19]  18749.274  42109.012  40674.182  26003.425  13229.824  37472.789
## [25]  34684.033  80187.272   9460.977  51630.571  29253.772  36399.306
## [31] 117511.962  33384.288  58581.226   5462.316  28637.745  15864.172
## [37]   9284.810   1218.755  98522.609  19534.524
```

Create a data frame for this data using the code dino_data <- data.frame(theropoda_lengths, a_values, b_values). Use dplyr to add a new masses column to this data frame (using mutate() and your function) and print the result to the console.

```r
dino_data <- data.frame(length = theropoda_lengths, as = a_values, bs = b_values)
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
```

```r
dino_data %>%
  mutate(masses = mass_from_length(length, as, bs))
```

```
##       length    as    bs     masses
## 1  17.801363 0.759 3.627  26039.686
## 2  20.376445 0.751 3.633  42825.603
## 3  14.074349 0.740 3.626  10800.224
## 4  25.657824 0.746 3.633  98273.049
## 5  26.095201 0.759 3.627 104257.481
## 6  20.311154 0.751 3.629  41822.386
## 7  17.566324 0.749 3.632  24840.644
## 8  11.256343 0.751 3.628   4899.022
## 9  20.081903 0.738 3.633  39915.948
## 10 18.607163 0.768 3.627  30937.922
## 11 18.099189 0.736 3.621  26354.908
## 12 23.065969 0.749 3.630  66384.865
## 13 20.579885 0.746 3.631  43837.944
## 14 25.617925 0.744 3.632  97141.451
## 15 24.371433 0.749 3.628  80553.856
## 16 26.284725 0.751 3.626 105556.405
## 17 25.475378 0.744 3.639  97374.660
## 18 20.464209 0.754 3.626  42760.136
## 19 16.073826 0.774 3.635  18749.274
## 20 20.349417 0.751 3.629  42109.012
## 21 19.854399 0.763 3.642  40674.182
## 22 17.788981 0.749 3.632  26003.425
## 23 14.801642 0.741 3.633  13229.824
## 24 19.684091 0.754 3.629  37472.789
## 25 19.468589 0.746 3.620  34684.033
## 26 24.480778 0.755 3.619  80187.272
## 27 13.335996 0.764 3.638   9460.977
## 28 21.506599 0.758 3.627  51630.571
## 29 18.464030 0.760 3.621  29253.772
## 30 19.586153 0.748 3.628  36399.306
## 31 27.084752 0.745 3.628 117511.962
## 32 18.960937 0.756 3.635  33384.288
## 33 22.482917 0.739 3.624  58581.226
## 34 11.732572 0.733 3.621   5462.316
## 35 18.375885 0.757 3.621  28637.745
## 36 15.537505 0.747 3.632  15864.172
## 37 13.484875 0.741 3.627   9284.810
## 38  7.685612 0.752 3.624   1218.755
## 39 25.596335 0.752 3.634  98522.609
## 40 16.588285 0.748 3.621  19534.524
```

Create a new version of your mass_from_length_theropoda() function from Part 1 of Exercise 1 called mass_from_length_max(). This function should only calculate a mass if the value of length passed to the function is less than 20. If length is greater than 20, return NA instead.

```
mass_from_length_max <- function(length) {
   if(length < 20) {
  mass <- 0.73 * length ^ 3.63
  } else {
  mass <- NA
  }
  return(mass)
}
```

Use sapply() and this new function to estimate the mass for the theropoda_lengths data from Exercise 1.

```
sapply(theropoda_lengths, mass_from_length_max)
```

```
##  [1] 25262.027        NA 10767.568        NA        NA        NA 24072.130
##  [8]  4785.145        NA 29666.193 26830.297        NA        NA        NA
## [15]        NA        NA        NA        NA 17439.569        NA 37544.201
## [22] 25198.303 12928.490 36388.290 34962.862        NA  8854.525        NA
## [29] 28846.165 35735.369        NA 31765.368        NA  5561.862 28349.410
## [36] 15418.314  9218.648  1197.666        NA 19552.500
```

# A Data Set of Dinosaur Lengths

Download the CSV file of data on dinosaur lengths with species names into your data folder and import it using read.csv()

```
dino_lengths <- read.csv("../data-raw/dinosaur_lengths.csv")
```

Write a function get_mass_from_length_by_name() that uses the equation mass <- a * length^b to estimate the size of a dinosaur from its length. This function should take two arguments, the length and the name of the dinosaur group. Inside this function use if/else if/else statements to check to see if the name is one of the following values and if so set a and b to the appropriate values.

Stegosauria: a = 10.95 and b = 2.64 (Seebacher 2001). Theropoda: a = 0.73 and b = 3.63 (Seebacher 2001). Sauropoda: a = 214.44 and b = 1.46 (Seebacher 2001). If the name is not any of these values set a = NA and b = NA.

```
get_mass_from_length_by_name <- function(length, dinosaur_name) {
  if (dinosaur_name == "Stegosauria") {
    a <- 10.95
    b <- 2.64
  } else if (dinosaur_name == "Theropoda") {
    a <- 0.73
    b <- 3.63
  } else if (dinosaur_name == "Sauropoda") {
    a <- 214.44
    b <- 1.46
  } else {
    a = NA
    b = NA
  }
  mass <- a * length^b
  return(mass)
}
```

Use this function and mapply() to calculate the estimated mass for each dinosaur. You'll need to pass the data to mapply() as single vectors or columns, not the whole data frame.

```
mapply(get_mass_from_length_by_name, length = dino_lengths$lengths, dinosaur_name = dino_lengths$species
```

```
##   [1]  24341.681         NA         NA  22114.190         NA         NA
##   [7]  57349.470  14160.494  49677.749  42105.917  10221.747  15339.988
##  [13]  70624.102  23883.825  28552.864  18801.370  19438.673         NA
##  [19]  19607.970  16032.845         NA  50350.112  15969.078  29582.848
##  [25]  15201.456  12980.541   9937.867   9599.415  49245.963  23846.751
##  [31]  53805.661  53326.467         NA  15554.977  18544.119         NA
##  [37]         NA  82492.318  17909.041  38694.503  80303.181  19592.802
##  [43]  10614.785  29560.809  71658.477         NA  83961.661         NA
##  [49]  26284.040  21766.002  63571.873   5480.255  33917.314  22778.032
##  [55]  13819.165  21154.149  17635.099  14577.594         NA  14032.340
##  [61]  30231.694         NA  11293.886  72743.800  23679.901  64258.574
##  [67]  14931.085  16323.818         NA         NA         NA   7599.703
##  [73]         NA         NA         NA         NA  46920.035  70529.031
##  [79]   9484.528         NA  68340.494  44959.626         NA  48249.486
##  [85]  11730.174         NA  52295.177         NA         NA         NA
##  [91]  40358.292  38891.137  30878.439  19125.425         NA         NA
##  [97]   8697.216  19627.357         NA         NA  13411.390  33157.499
## [103]  10874.733  24554.930  16819.494  18421.449         NA  19645.723
## [109]  38206.241  53196.019  22346.109         NA  22685.103         NA
## [115]  13613.983  34685.790         NA  18654.525         NA 101482.428
## [121]  89149.257         NA  20820.837         NA  22232.852  59702.598
## [127]         NA  16321.774  22748.880         NA         NA         NA
## [133]         NA  25987.768  49818.253  13106.766         NA  32112.443
## [139]         NA  16984.463  10859.926  93973.020  52342.265  19151.788
## [145]         NA  13954.186         NA  15021.820  35933.327 140435.607
## [151]  20467.332  23869.639         NA         NA  15211.979  57098.945
## [157]  23588.700  27381.008  85932.513         NA   9331.295         NA
## [163]         NA  32005.502  16613.444   7904.857         NA  26352.263
## [169]  19880.480  15543.679  15493.654  13546.034         NA  36095.081
## [175]  42437.608         NA         NA  51637.913         NA  44120.181
## [181]   9535.583  59840.348         NA         NA         NA  44822.176
## [187]  14232.684  34751.496  11292.437         NA         NA         NA
## [193]  22002.082  19554.166  13223.770         NA         NA  68935.505
## [199]   9172.206  90096.476  25796.762  50594.426  61952.966  20132.528
## [205]         NA  13979.439  15481.074  12104.000  21789.436  54009.090
## [211]  13812.364   8071.939  21144.506  44097.848  16250.303  70065.996
## [217]  11170.349  22826.560  40885.088  17292.043  18394.391  50267.629
## [223]  70791.032  28464.276  41431.346         NA  14242.918         NA
## [229]         NA  52014.366  32865.058         NA  11906.150  17964.362
## [235]  14844.497  13079.836  76048.107  18843.875         NA  30737.511
## [241]  37983.026  18711.957  22636.970  29868.755  42799.606         NA
## [247]  43632.463 103600.943         NA         NA  10330.761  23659.805
## [253]  19126.024  17175.845  28017.230  54437.041         NA  20657.057
## [259]  13275.051         NA   8222.362         NA 108964.075         NA
## [265]   5845.741  26356.588         NA  59636.239  14857.582  45043.701
## [271]  47427.024         NA         NA  11807.182  27575.709  18177.367
## [277]         NA  22108.648  33908.940         NA         NA         NA
## [283]         NA  45862.941  23366.240  16165.694  10263.470         NA
## [289]  24026.928  33497.651         NA  15770.110  48190.121  33107.401
## [295]  20523.437  21387.730  15771.706  12632.938  28352.199  10401.651
## [301]  41162.369  16740.472  29576.590  28831.907  21622.906         NA
## [307]  26736.709  18663.882  10872.689  13072.222  35308.681  17145.703
## [313]  19620.530   1550.370         NA  11509.202  16574.358  94984.150
## [319]   9448.048  56370.430         NA  47899.078  27521.456  24907.229
## [325]  12800.024  34456.895         NA  19137.794   9084.302         NA
## [331]  20396.019   7636.822  15452.482         NA  11482.576         NA
## [337]  21323.042  17062.973  24482.018  19394.529  61929.256         NA
## [343]  29113.203  53044.431  17891.216  21665.733  21611.857  13917.623
## [349]  21715.000         NA  10525.601  31777.548  45932.499  16396.801
## [355]         NA  21020.829   9499.589         NA  11886.269  13597.168
## [361]         NA  32610.060  50496.496  23180.857  20838.975  27426.143
## [367]  51655.501  52241.022  27527.983  40947.425  26691.614  23152.573
## [373]  43419.737  44236.593  60396.602  15878.961  70561.697  17374.235
## [379]  10332.362  34844.884         NA  43839.492         NA  10259.928
## [385]  24344.124         NA  23490.643  15151.289  40052.674  31011.453
## [391]         NA  36300.595  28716.671  21434.730         NA  27977.292
## [397]  13912.492         NA         NA  45387.391  21638.866  12782.316
## [403]         NA         NA         NA  74279.377  19250.194  19647.872
## [409]  39022.265         NA         NA   9446.876  33097.292         NA
## [415]  23694.389  15501.027  13490.363   7311.070  63156.403  40543.550
## [421]  19942.976         NA         NA  26888.995         NA  18102.809
## [427] 125939.133         NA         NA  14393.863         NA  62045.506
## [433]  60194.052  36753.957         NA         NA  32061.537         NA
## [439]  67466.670  17627.746  24171.682  25917.752  67098.902         NA
## [445]  17699.295  18903.752  13127.745  17295.450  42209.926  23426.667
## [451] 118937.988         NA  18165.832         NA  46816.660         NA
## [457]  53237.908  23121.375  25937.746         NA  47637.068         NA
## [463] 127540.554         NA  12313.099  24276.516  15500.675  16109.794
## [469]  15965.471  54296.492         NA         NA  14365.977 153749.934
## [475]  59143.016  18524.301   6227.675  13606.978         NA         NA
## [481]  49146.996 103896.484  38059.728  41076.716         NA  30013.153
## [487]  41805.513  20113.277  24071.440         NA         NA   8489.727
## [493]  24349.181         NA         NA  44921.367  26262.993  16883.382
## [499]  14444.693         NA
```

Using dplyr, add a new masses column to the data frame (using rowwise(), mutate() and your function) and print the result to the console.

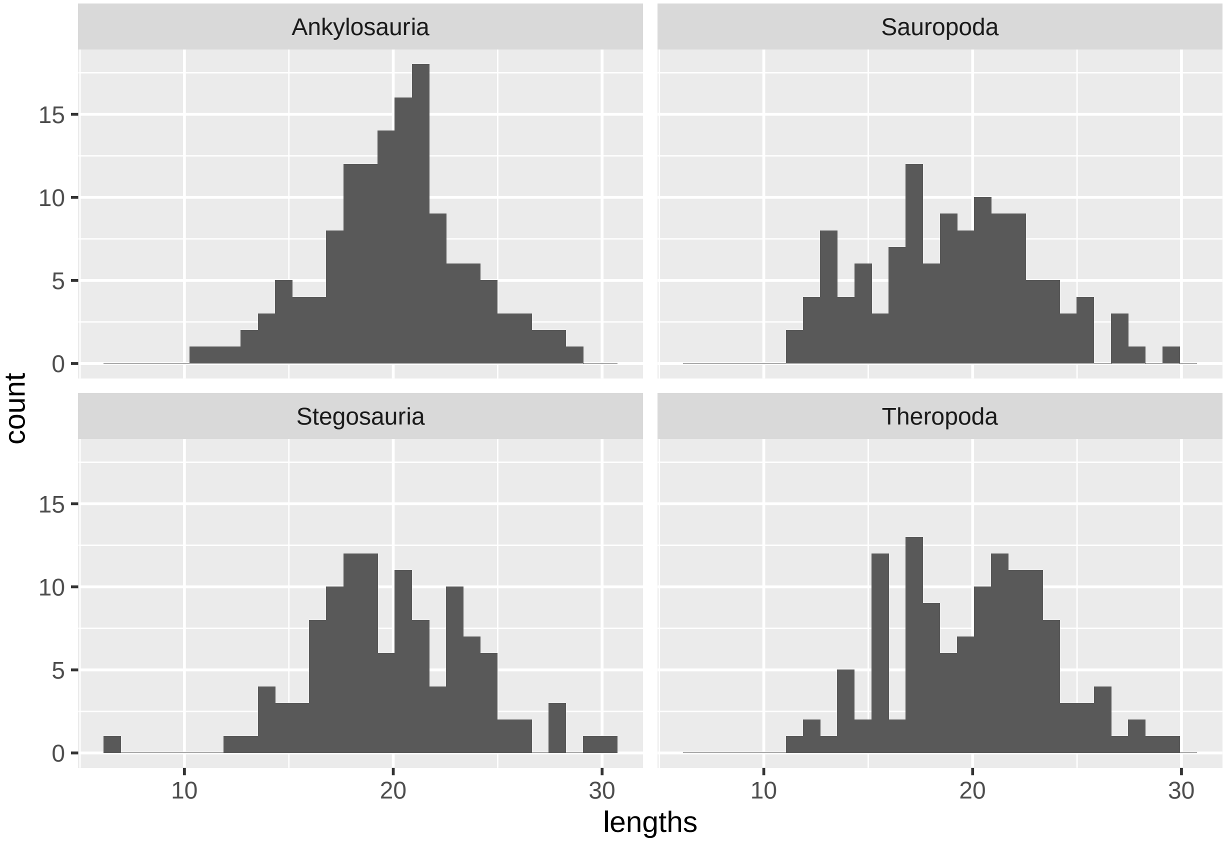
```
library(dplyr)
dino_lengths %>%
  rowwise %>%
  mutate(masses = get_mass_from_length_by_name(lengths, species))
```

```
## # A tibble: 500 x 3
## # Rowwise:
##    species      lengths masses
##    <chr>          <dbl>  <dbl>
##  1 Stegosauria     18.5 24342.
##  2 Ankylosauria    16.4    NA
##  3 Ankylosauria    23.7    NA
##  4 Sauropoda       23.9 22114.
##  5 Ankylosauria    21.7    NA
##  6 Ankylosauria    21.4    NA
##  7 Theropoda       22.3 57349.
##  8 Theropoda       15.2 14160.
##  9 Theropoda       21.4 49678.
## 10 Stegosauria     22.8 42106.
## # ... with 490 more rows
```

Using ggplot2, make a histogram of dinosaur masses with one subplot for each species (remember facet_wrap()).

```
library("ggplot2")
ggplot(data = dino_lengths, mapping = aes(x = lengths)) +
  geom_histogram() +
  facet_wrap(~species)
```

```
## ‘stat_bin()‘ using ‘bins = 30‘. Pick better value with ‘binwidth‘.
```


Ankylosauria
Sauropoda
Stegosauria
Theropoda
count
0
5
10
15
lengths
10
20
30