Data Programming

Homework 1

Lucas Lorenzo Jakin

2025-04-01

Solutions

Submit a **.html** file created using Quarto via e-classroom. A sample is attached. Display all code (packages,input) and output.

Transform the dataframe **automobile**

```
automobile<-mtcars
```

1. Move rownames to a column **cars.name**, remove rownames.
2. Add a column named **l/100km** whose values are based on column mpg, then delete column mpg.
3. Change the **am** column to a factor with levels **Automatic** and **Manual**.

```
# solve 1-3 here
automobile<-mtcars
automobile
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4

```
Merc 280C           17.8   6 167.6 123 3.92 3.440 18.90  1  0    4    4
Merc 450SE          16.4   8 275.8 180 3.07 4.070 17.40  0  0    3    3
Merc 450SL          17.3   8 275.8 180 3.07 3.730 17.60  0  0    3    3
Merc 450SLC         15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3
Cadillac Fleetwood  10.4   8 472.0 205 2.93 5.250 17.98  0  0    3    4
Lincoln Continental 10.4   8 460.0 215 3.00 5.424 17.82  0  0    3    4
Chrysler Imperial   14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4
Fiat 128            32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1
Honda Civic         30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2
Toyota Corolla      33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1
Toyota Corona       21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1
Dodge Challenger    15.5   8 318.0 150 2.76 3.520 16.87  0  0    3    2
AMC Javelin         15.2   8 304.0 150 3.15 3.435 17.30  0  0    3    2
Camaro Z28          13.3   8 350.0 245 3.73 3.840 15.41  0  0    3    4
Pontiac Firebird    19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
Fiat X1-9           27.3   4  79.0  66 4.08 1.935 18.90  1  1    4    1
Porsche 914-2       26.0   4 120.3  91 4.43 2.140 16.70  0  1    5    2
Lotus Europa        30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
Ford Pantera L      15.8   8 351.0 264 4.22 3.170 14.50  0  1    5    4
Ferrari Dino        19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6
Maserati Bora       15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8
Volvo 142E          21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2
```

```r
#1 add column "cars.name" and delete rownames
rownames(automobile)
```

```
 [1] "Mazda RX4"           "Mazda RX4 Wag"       "Datsun 710"
 [4] "Hornet 4 Drive"      "Hornet Sportabout"   "Valiant"
 [7] "Duster 360"          "Merc 240D"           "Merc 230"
[10] "Merc 280"            "Merc 280C"           "Merc 450SE"
[13] "Merc 450SL"          "Merc 450SLC"         "Cadillac Fleetwood"
[16] "Lincoln Continental" "Chrysler Imperial"   "Fiat 128"
[19] "Honda Civic"         "Toyota Corolla"      "Toyota Corona"
[22] "Dodge Challenger"    "AMC Javelin"         "Camaro Z28"
[25] "Pontiac Firebird"    "Fiat X1-9"           "Porsche 914-2"
[28] "Lotus Europa"        "Ford Pantera L"      "Ferrari Dino"
[31] "Maserati Bora"       "Volvo 142E"
```

```r
automobile$cars.name <- rownames(automobile)
rownames(automobile) <- NULL
automobile
```

```
    mpg cyl  disp  hp drat    wt  qsec vs am gear carb           cars.name
1  21.0   6 160.0 110 3.90 2.620 16.46  0  1    4    4           Mazda RX4
2  21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4       Mazda RX4 Wag
3  22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1          Datsun 710
4  21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1      Hornet 4 Drive
5  18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2   Hornet Sportabout
6  18.1   6 225.0 105 2.76 3.460 20.22  1  0    3    1             Valiant
7  14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4          Duster 360
8  24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2           Merc 240D
9  22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2            Merc 230
10 19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4            Merc 280
11 17.8   6 167.6 123 3.92 3.440 18.90  1  0    4    4           Merc 280C
12 16.4   8 275.8 180 3.07 4.070 17.40  0  0    3    3          Merc 450SE
13 17.3   8 275.8 180 3.07 3.730 17.60  0  0    3    3          Merc 450SL
14 15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3         Merc 450SLC
15 10.4   8 472.0 205 2.93 5.250 17.98  0  0    3    4  Cadillac Fleetwood
16 10.4   8 460.0 215 3.00 5.424 17.82  0  0    3    4 Lincoln Continental
17 14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4   Chrysler Imperial
18 32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1            Fiat 128
19 30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2         Honda Civic
20 33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1      Toyota Corolla
21 21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1       Toyota Corona
22 15.5   8 318.0 150 2.76 3.520 16.87  0  0    3    2    Dodge Challenger
23 15.2   8 304.0 150 3.15 3.435 17.30  0  0    3    2         AMC Javelin
24 13.3   8 350.0 245 3.73 3.840 15.41  0  0    3    4          Camaro Z28
25 19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2    Pontiac Firebird
26 27.3   4  79.0  66 4.08 1.935 18.90  1  1    4    1           Fiat X1-9
27 26.0   4 120.3  91 4.43 2.140 16.70  0  1    5    2       Porsche 914-2
28 30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2        Lotus Europa
29 15.8   8 351.0 264 4.22 3.170 14.50  0  1    5    4      Ford Pantera L
30 19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6        Ferrari Dino
31 15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8       Maserati Bora
32 21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2          Volvo 142E
```

```
#2 add column "l/100km" and delete "mpg"
automobile$L100km <- (1 / automobile$mpg * 235.214)
automobile$mpg <- NULL
automobile
```

```
   cyl  disp  hp drat    wt  qsec vs am gear carb           cars.name    L100km
1    6 160.0 110 3.90 2.620 16.46  0  1    4    4           Mazda RX4 11.200667
2    6 160.0 110 3.90 2.875 17.02  0  1    4    4       Mazda RX4 Wag 11.200667
```

```
3    4 108.0  93 3.85 2.320 18.61  1  1    4    1          Datsun 710 10.316404
4    6 258.0 110 3.08 3.215 19.44  1  0    3    1      Hornet 4 Drive 10.991308
5    8 360.0 175 3.15 3.440 17.02  0  0    3    2   Hornet Sportabout 12.578289
6    6 225.0 105 2.76 3.460 20.22  1  0    3    1             Valiant 12.995249
7    8 360.0 245 3.21 3.570 15.84  0  0    3    4          Duster 360 16.448531
8    4 146.7  62 3.69 3.190 20.00  1  0    4    2           Merc 240D  9.639918
9    4 140.8  95 3.92 3.150 22.90  1  0    4    2            Merc 230 10.316404
10   6 167.6 123 3.92 3.440 18.30  1  0    4    4            Merc 280 12.250729
11   6 167.6 123 3.92 3.440 18.90  1  0    4    4           Merc 280C 13.214270
12   8 275.8 180 3.07 4.070 17.40  0  0    3    3          Merc 450SE 14.342317
13   8 275.8 180 3.07 3.730 17.60  0  0    3    3          Merc 450SL 13.596185
14   8 275.8 180 3.07 3.780 18.00  0  0    3    3         Merc 450SLC 15.474605
15   8 472.0 205 2.93 5.250 17.98  0  0    3    4  Cadillac Fleetwood 22.616731
16   8 460.0 215 3.00 5.424 17.82  0  0    3    4 Lincoln Continental 22.616731
17   8 440.0 230 3.23 5.345 17.42  0  0    3    4   Chrysler Imperial 16.000952
18   4  78.7  66 4.08 2.200 19.47  1  1    4    1            Fiat 128  7.259691
19   4  75.7  52 4.93 1.615 18.52  1  1    4    2         Honda Civic  7.737303
20   4  71.1  65 4.22 1.835 19.90  1  1    4    1      Toyota Corolla  6.938466
21   4 120.1  97 3.70 2.465 20.01  1  0    3    1       Toyota Corona 10.940186
22   8 318.0 150 2.76 3.520 16.87  0  0    3    2    Dodge Challenger 15.175097
23   8 304.0 150 3.15 3.435 17.30  0  0    3    2         AMC Javelin 15.474605
24   8 350.0 245 3.73 3.840 15.41  0  0    3    4          Camaro Z28 17.685263
25   8 400.0 175 3.08 3.845 17.05  0  0    3    2    Pontiac Firebird 12.250729
26   4  79.0  66 4.08 1.935 18.90  1  1    4    1            Fiat X1-9  8.615897
27   4 120.3  91 4.43 2.140 16.70  0  1    5    2       Porsche 914-2  9.046692
28   4  95.1 113 3.77 1.513 16.90  1  1    5    2         Lotus Europa  7.737303
29   8 351.0 264 4.22 3.170 14.50  0  1    5    4      Ford Pantera L 14.886962
30   6 145.0 175 3.62 2.770 15.50  0  1    5    6        Ferrari Dino 11.939797
31   8 301.0 335 3.54 3.570 14.60  0  1    5    8       Maserati Bora 15.680933
32   4 121.0 109 4.11 2.780 18.60  1  1    4    2          Volvo 142E 10.991308
```

```r
#3 change "am" column with AUTOMATIC & MANUAL
automobile$am <- ifelse(automobile$am == 1, "Automatic", "Manual")
automobile
```

```
   cyl  disp  hp drat    wt  qsec vs        am gear carb           cars.name
1    6 160.0 110 3.90 2.620 16.46  0 Automatic    4    4           Mazda RX4
2    6 160.0 110 3.90 2.875 17.02  0 Automatic    4    4       Mazda RX4 Wag
3    4 108.0  93 3.85 2.320 18.61  1 Automatic    4    1          Datsun 710
4    6 258.0 110 3.08 3.215 19.44  1    Manual    3    1      Hornet 4 Drive
5    8 360.0 175 3.15 3.440 17.02  0    Manual    3    2   Hornet Sportabout
6    6 225.0 105 2.76 3.460 20.22  1    Manual    3    1             Valiant
```

```
7    8 360.0 245 3.21 3.570 15.84  0    Manual    3    4          Duster 360
8    4 146.7  62 3.69 3.190 20.00  1    Manual    4    2           Merc 240D
9    4 140.8  95 3.92 3.150 22.90  1    Manual    4    2            Merc 230
10   6 167.6 123 3.92 3.440 18.30  1    Manual    4    4            Merc 280
11   6 167.6 123 3.92 3.440 18.90  1    Manual    4    4           Merc 280C
12   8 275.8 180 3.07 4.070 17.40  0    Manual    3    3          Merc 450SE
13   8 275.8 180 3.07 3.730 17.60  0    Manual    3    3          Merc 450SL
14   8 275.8 180 3.07 3.780 18.00  0    Manual    3    3         Merc 450SLC
15   8 472.0 205 2.93 5.250 17.98  0    Manual    3    4  Cadillac Fleetwood
16   8 460.0 215 3.00 5.424 17.82  0    Manual    3    4 Lincoln Continental
17   8 440.0 230 3.23 5.345 17.42  0    Manual    3    4   Chrysler Imperial
18   4  78.7  66 4.08 2.200 19.47  1 Automatic    4    1            Fiat 128
19   4  75.7  52 4.93 1.615 18.52  1 Automatic    4    2         Honda Civic
20   4  71.1  65 4.22 1.835 19.90  1 Automatic    4    1      Toyota Corolla
21   4 120.1  97 3.70 2.465 20.01  1    Manual    3    1       Toyota Corona
22   8 318.0 150 2.76 3.520 16.87  0    Manual    3    2    Dodge Challenger
23   8 304.0 150 3.15 3.435 17.30  0    Manual    3    2         AMC Javelin
24   8 350.0 245 3.73 3.840 15.41  0    Manual    3    4          Camaro Z28
25   8 400.0 175 3.08 3.845 17.05  0    Manual    3    2    Pontiac Firebird
26   4  79.0  66 4.08 1.935 18.90  1 Automatic    4    1           Fiat X1-9
27   4 120.3  91 4.43 2.140 16.70  0 Automatic    5    2       Porsche 914-2
28   4  95.1 113 3.77 1.513 16.90  1 Automatic    5    2        Lotus Europa
29   8 351.0 264 4.22 3.170 14.50  0 Automatic    5    4      Ford Pantera L
30   6 145.0 175 3.62 2.770 15.50  0 Automatic    5    6        Ferrari Dino
31   8 301.0 335 3.54 3.570 14.60  0 Automatic    5    8       Maserati Bora
32   4 121.0 109 4.11 2.780 18.60  1 Automatic    4    2          Volvo 142E
      L100km
1  11.200667
2  11.200667
3  10.316404
4  10.991308
5  12.578289
6  12.995249
7  16.448531
8   9.639918
9  10.316404
10 12.250729
11 13.214270
12 14.342317
13 13.596185
14 15.474605
15 22.616731
16 22.616731
```

```
17 16.000952
18  7.259691
19  7.737303
20  6.938466
21 10.940186
22 15.175097
23 15.474605
24 17.685263
25 12.250729
26  8.615897
27  9.046692
28  7.737303
29 14.886962
30 11.939797
31 15.680933
32 10.991308
```

After the transformation display the data frame as a tibble then answer these questions independently.

```
library(tidyverse)
as.tibble(automobile)
```

```
# A tibble: 32 x 12
     cyl  disp    hp  drat    wt  qsec    vs am      gear  carb cars.name L100km
   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <chr>  <dbl> <dbl> <chr>      <dbl>
 1     6  160    110  3.9   2.62  16.5     0 Autom~     4     4 Mazda RX4  11.2
 2     6  160    110  3.9   2.88  17.0     0 Autom~     4     4 Mazda RX~  11.2
 3     4  108     93  3.85  2.32  18.6     1 Autom~     4     1 Datsun 7~  10.3
 4     6  258    110  3.08  3.22  19.4     1 Manual     3     1 Hornet 4~  11.0
 5     8  360    175  3.15  3.44  17.0     0 Manual     3     2 Hornet S~  12.6
 6     6  225    105  2.76  3.46  20.2     1 Manual     3     1 Valiant    13.0
 7     8  360    245  3.21  3.57  15.8     0 Manual     3     4 Duster 3~  16.4
 8     4  147.    62  3.69  3.19  20       1 Manual     4     2 Merc 240D   9.64
 9     4  141.    95  3.92  3.15  22.9     1 Manual     4     2 Merc 230   10.3
10     6  168.   123  3.92  3.44  18.3     1 Manual     4     4 Merc 280   12.3
# i 22 more rows
```

4. What is the average number of gears?
5. Return the rows with cars with horsepower between 200 and 400.
6. Which car is most fuel efficient car among 6 cylinder cars?

```r
# solve 4-6 here
#4 Average number of gears
average_gears <- mean(automobile$gear)
average_gears
```

```
[1] 3.6875
```

```r
#5 Return rows with cars between 200 & 400 hp
#automobile[automobile$hp>=200 & automobile$hp>=400,] -> It returns dataframe with length
#automobile
filter_auto <- subset(automobile,hp>=200 & hp<=400)
filter_auto
```

```
   cyl disp  hp drat    wt  qsec vs        am gear carb           cars.name
7    8  360 245 3.21 3.570 15.84  0    Manual    3    4          Duster 360
15   8  472 205 2.93 5.250 17.98  0    Manual    3    4  Cadillac Fleetwood
16   8  460 215 3.00 5.424 17.82  0    Manual    3    4 Lincoln Continental
17   8  440 230 3.23 5.345 17.42  0    Manual    3    4   Chrysler Imperial
24   8  350 245 3.73 3.840 15.41  0    Manual    3    4          Camaro Z28
29   8  351 264 4.22 3.170 14.50  0 Automatic    5    4      Ford Pantera L
31   8  301 335 3.54 3.570 14.60  0 Automatic    5    8       Maserati Bora
     L100km
7  16.44853
15 22.61673
16 22.61673
17 16.00095
24 17.68526
29 14.88696
31 15.68093
```

```r
#6 Return most fuel efficient car among 6 cylinders
six_cyl<- subset(automobile,automobile$cyl == 6)
final<- six_cyl[which.min(six_cyl$L100km),]
final
```

```
  cyl disp  hp drat    wt  qsec vs     am gear carb      cars.name   L100km
4   6  258 110 3.08 3.215 19.44  1 Manual    3    1 Hornet 4 Drive 10.99131
```