Final Project Code/Work

2022-11-17

```
set.seed(400)
library(bootstrap)
library(ggplot2)
```

AUTO

```
carDB <- c(62,62,63,63,64,64,65,65,66,66,67,67,67,68,68,68,69,69,70,70,70,71,71,71,72,72,72,72,73,73,73
carspeed <- c(30:70)
carspeed <- 1.60934*carspeed
carinfo <- data.frame(carspeed) |> cbind(carDB)

B <- 1000

for(b in seq_len(B)) {
  ## Your Turn: Do the bootstrap!
  ## get bs dataset
  idx_star <- sample(1:41, 1000, replace = TRUE)
  x_star <- carinfo[idx_star,]
}

n <- 1000

set.seed(400)

carfunction <- function(n){
  dB <- x_star$carDB
  Mj <- rnorm(n, (46*12/(.26)),1)

  ESDB <- (Mj)/(x_star$carspeed)
  return(ESDB)
}

ESDB_stor <- data.frame(carfunction(n))

# carfunction(n)
mean(carfunction(n))
```

```
## [1] 28.21414
```

```
summary(carfunction(n))
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   18.83   21.99   26.65   28.21   33.80   44.01
```

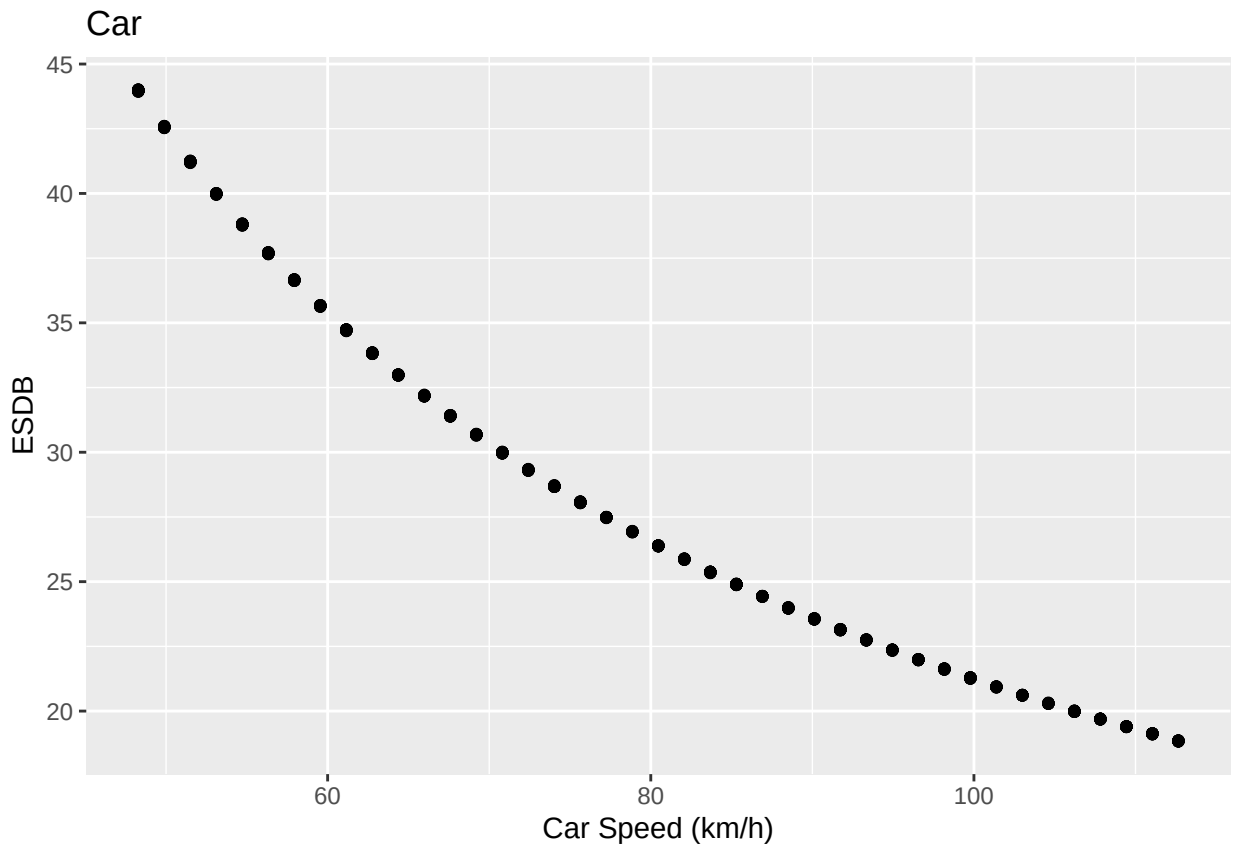
```
ESDB_stor <- data.frame(carfunction(n))

mean(carfunction(n))
```

```
## [1] 28.21461
```

```
summary(carfunction(n))
```

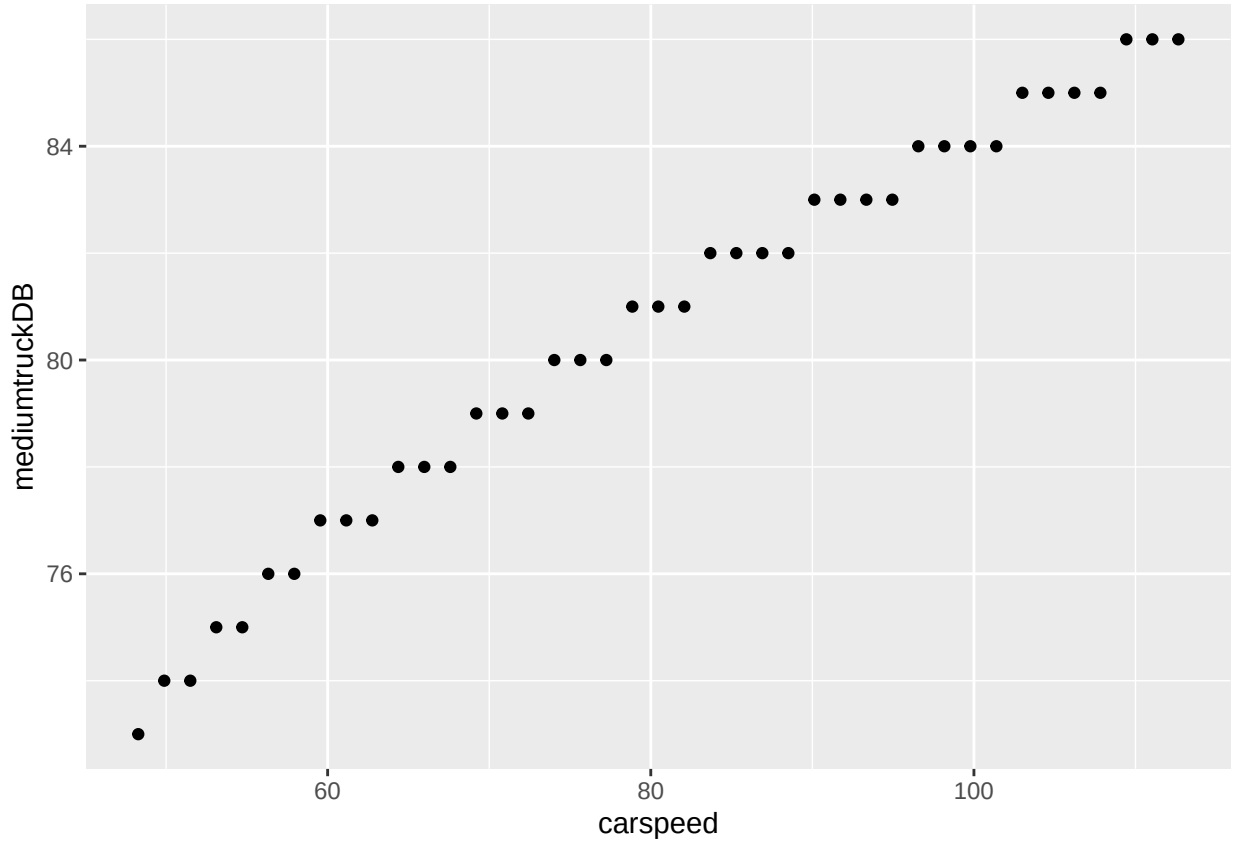
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   18.83   21.98   26.66   28.21   33.81   44.00
```

```
ggplot() +
  geom_point(aes(x = x_star$carspeed, y = ESDB_stor$carfunction.n.)) + xlab("Car Speed (km/h)") + ylab(
```



MEDIUM TRUCK

```
## Method with DB from sample data
# Referring to pickup trucks
# medium truck data
mediumtruckDB <- c(73,74,74,75,75,76,76,77,77,77,78,78,78,79,79,79,80,80,80,81,81,81,82,82,82,82,83,83,

mediumtruckinfo <- data.frame(carspeed) |> cbind(mediumtruckDB)

ggplot() +
  geom_point(aes(carspeed, mediumtruckDB), data = mediumtruckinfo)
```



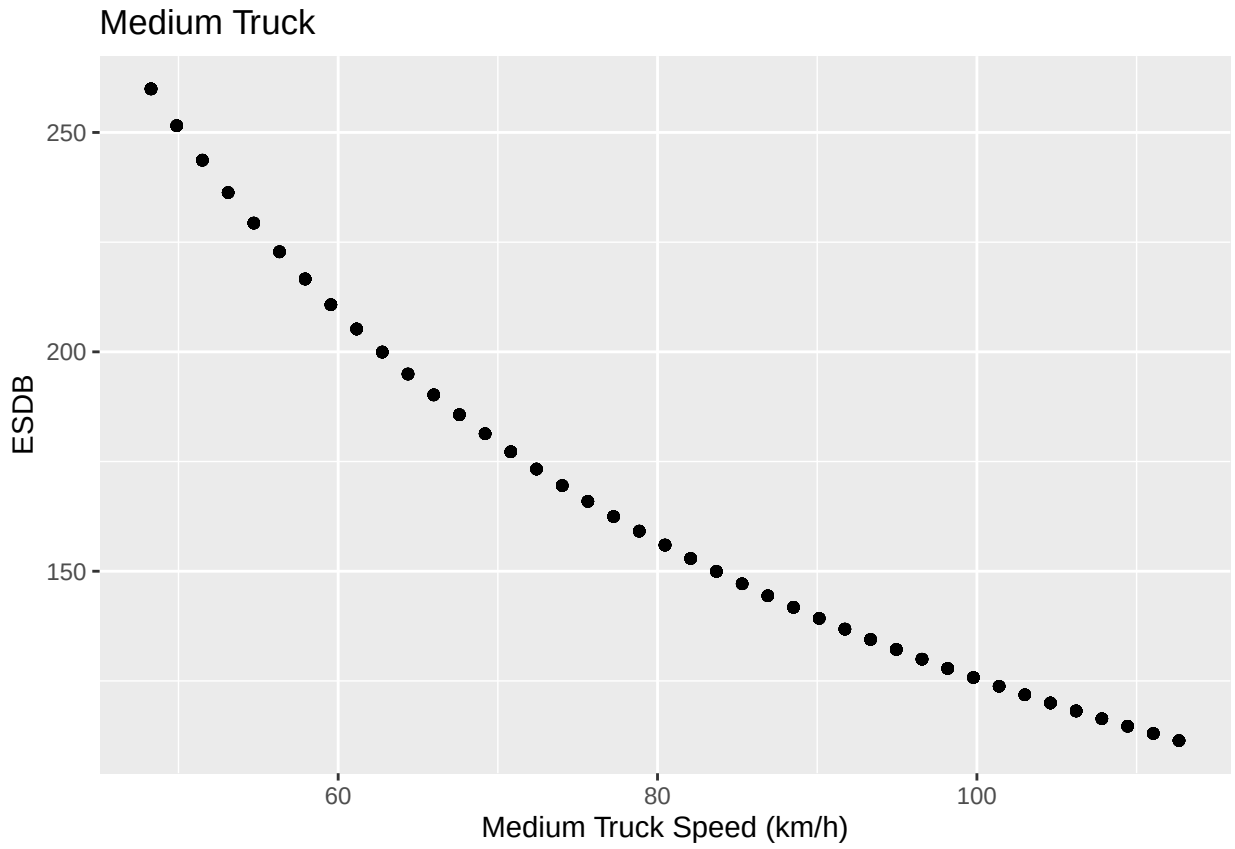

```
#-----------------------------------------------------------------

for(b in seq_len(B)) {
  ## Your Turn: Do the bootstrap!
  ## get bs dataset
  mediumidx_star <- sample(1:41, 1000, replace = TRUE)
  mediumx_star <- mediumtruckinfo[mediumidx_star,]
}

n <- 1000

set.seed(400)

mediumtruckfunction <- function(n){
  dB <- mediumx_star$carspeed*1.609
    Mj <- rnorm(n, (35*150/(.26*1.609)),1)
  ESDB <- (Mj)/(mediumx_star$carspeed)
  return(ESDB)
}

medium_ESDB_stor <- mediumtruckfunction(n)

# mediumtruckfunction(n)
mean(mediumtruckfunction(n))
```

```
## [1] 165.898
```

```
summary(mediumtruckfunction(n))
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   111.4   130.0   156.0   165.9   199.9   260.0
```

```
ggplot() +
  geom_point(aes(x = mediumx_star$carspeed, y = medium_ESDB_stor)) + geom_smooth() + xlab("Medium Truck
```



HEAVY TRUCK

```
# WHAT WE ARE USING
## Method with dB as an rnorm
set.seed(400)

heavytruckDB <- c(80,80,81,81,81,82,82,82,82,83,83,83,84,84,84,84,85,85,85,85,85,86,86,86,86,86,87,87,8

heavytruckinfo <- data.frame(carspeed) |> cbind(heavytruckDB)

for(b in seq_len(B)) {
  ## Your Turn: Do the bootstrap!
  ## get bs dataset
  heavyidx_star <- sample(1:41, 1000, replace = TRUE)
  heavyx_star <- heavytruckinfo[heavyidx_star,]
}
n <- 1000

heavy_rnormfunction <- function(n){
```

```
  dB <- heavyx_star$carspeed*1.609
    Mj <- rnorm(n, (43*300/(.26*1.609)),1)


  ESDB <- ((Mj)/heavyx_star$carspeed)
  return(ESDB)
}

heavy_ESDB_stor <- heavy_rnormfunction(n)

heavy_rnormfunction(n)
```

```
##    [1] 299.3940 314.1034 294.7885 532.2116 504.2543 290.3139 517.8453 504.2551
##    [9] 309.0366 383.2070 294.7661 407.6741 547.4534 368.4642 304.1229 294.7825
##   [17] 309.0487 375.7049 416.5517 598.7815 416.5323 319.3549 273.7464 383.2165
##   [25] 638.7038 391.0379 285.9803 456.1917 324.7597 547.4422 563.5216 336.1602
##   [33] 456.2531 425.8012 277.7040 383.2235 445.5833 456.2172 425.7907 532.2643
##   [41] 342.1624 456.2272 361.5111 290.3199 375.7156 354.8366 435.4733 580.6193
##   [49] 547.4242 467.3379 294.7942 273.7253 319.3483 368.4697 618.0736 467.3549
##   [57] 532.2338 479.0225 532.2523 638.6977 504.2222 309.0501 456.2132 563.5761
##   [65] 342.1560 342.1359 407.6786 383.1996 598.7314 618.0907 445.5699 375.7046
##   [73] 361.5186 479.0427 285.9810 399.1674 638.6988 342.1641 383.2277 425.7725
##   [81] 407.6676 330.3615 324.7571 407.6916 348.3664 598.7706 273.7264 309.0447
##   [89] 285.9853 416.5319 563.5434 416.5422 517.8490 580.6069 383.2270 598.7569
##   [97] 375.6911 479.0053 383.2290 517.8546 277.6937 277.6855 330.3749 285.9839
##  [105] 467.3425 547.4854 504.2362 368.4771 563.5325 547.4467 309.0493 361.5060
##  [113] 299.3857 416.5558 399.1983 479.0537 416.5403 348.3872 342.1617 324.7567
##  [121] 273.7120 425.7949 638.6546 299.3861 407.6864 547.4657 580.6302 517.8594
##  [129] 309.0333 348.3443 273.7310 383.2245 290.3207 618.1094 580.6317 304.1425
##  [137] 273.7398 547.4619 435.4579 491.3061 547.4575 504.2390 290.3381 445.5776
##  [145] 504.2391 342.1555 598.7331 391.0089 309.0472 290.3101 294.7811 504.2366
##  [153] 294.7721 491.3036 563.5553 491.3041 299.3923 532.2521 479.0452 375.7108
##  [161] 319.3333 354.8141 391.0511 348.3995 368.4897 324.7446 517.8207 399.1842
##  [169] 309.0500 281.7765 383.1836 407.6545 285.9789 491.2981 273.7240 290.3080
##  [177] 479.0163 319.3503 445.6018 416.5489 638.6987 407.6671 277.6902 304.1355
##  [185] 375.7144 563.5109 467.3250 342.1552 290.3123 361.4971 309.0458 456.1831
##  [193] 435.4655 435.4538 580.6146 456.2057 456.2052 290.3130 491.3006 399.1961
##  [201] 273.7058 314.1143 336.1525 391.0411 336.1525 319.3370 290.3101 618.0604
##  [209] 281.7872 580.6495 354.8243 504.2279 456.2299 368.4572 368.4831 416.5305
##  [217] 281.7678 580.6021 618.0968 314.1158 304.1536 299.3625 354.8584 277.6896
##  [225] 638.6875 324.7552 479.0221 277.6924 342.1536 491.2975 456.1809 532.2226
##  [233] 354.8249 368.4800 425.7899 416.5186 517.8619 504.2138 309.0282 467.3302
##  [241] 445.6147 467.3166 368.4628 281.7819 399.1724 407.6536 456.2048 532.2095
##  [249] 368.4704 638.6942 290.3048 314.1143 491.3084 479.0181 281.7666 361.5266
##  [257] 319.3526 314.1001 314.1186 563.5564 532.2712 638.6803 277.7031 517.8857
##  [265] 319.3472 416.5531 504.2541 324.7394 598.7832 491.3022 319.3266 342.1550
##  [273] 383.2243 618.0750 324.7646 416.5425 336.1505 375.6858 361.5309 456.2085
##  [281] 361.5173 342.1704 547.4699 517.8644 416.5354 456.2060 435.4470 491.2960
##  [289] 467.3428 598.7955 407.6771 304.1432 319.3320 285.9850 479.0304 547.4465
##  [297] 517.8481 435.4728 504.2090 491.2995 618.0564 399.1761 456.2229 277.6895
##  [305] 532.2454 348.3857 354.8243 491.2974 383.2217 304.1415 445.6009 479.0502
##  [313] 383.1937 285.9762 456.2036 425.8006 618.0987 299.3925 330.3571 290.3239
##  [321] 304.1305 361.5089 342.1458 277.6994 563.5332 532.2301 314.1393 425.7776
##  [329] 281.7705 547.4697 479.0189 342.1530 547.4502 563.5550 309.0381 324.7532
```

```
##  [337] 638.7210 407.6570 277.6874 563.5387 290.3173 361.5098 491.3068 435.4653
##  [345] 435.4701 445.5918 399.1900 281.7645 273.7268 407.6967 342.1628 273.7130
##  [353] 445.5801 383.1978 286.0049 273.7478 285.9660 273.7229 336.1429 391.0295
##  [361] 425.8052 342.1579 517.8945 309.0343 456.2073 407.6922 299.4003 479.0132
##  [369] 277.7063 517.8308 309.0391 348.3935 309.0387 342.1651 445.5927 348.3639
##  [377] 294.7701 638.6727 618.0726 368.4713 416.5358 547.4438 532.2594 314.1172
##  [385] 456.2049 342.1424 314.1251 319.3529 354.8252 467.3521 435.4589 383.2129
##  [393] 285.9955 425.7906 435.4805 299.3973 290.3168 309.0479 330.3600 456.1901
##  [401] 456.2199 598.7730 416.5403 425.8003 435.4975 435.4584 309.0366 391.0392
##  [409] 416.5167 348.3756 319.3344 383.1865 467.3491 445.5977 399.1785 416.5376
##  [417] 375.6898 491.2929 517.8273 456.2104 425.8151 375.6923 368.4498 361.5063
##  [425] 281.7898 319.3165 309.0402 277.7023 375.7128 416.5425 618.0703 299.3769
##  [433] 425.7924 547.4732 399.1782 532.2535 467.3319 290.3207 299.3917 361.5319
##  [441] 504.2189 504.2263 285.9771 445.5889 314.1095 445.6072 348.3675 290.3072
##  [449] 479.0140 324.7538 435.4908 479.0269 290.3113 273.7182 532.2463 580.6579
##  [457] 361.5380 361.5305 445.6082 618.0892 383.2274 638.6888 491.3158 563.5313
##  [465] 336.1541 435.4446 324.7638 425.7853 399.1757 375.6937 407.6866 399.1873
##  [473] 342.1628 290.3189 504.2297 309.0460 375.6975 580.6139 445.6093 348.3917
##  [481] 277.6894 563.5451 563.5510 336.1759 304.1588 281.7756 491.3062 517.8485
##  [489] 399.1938 361.5189 547.4533 330.3658 638.7181 618.1019 383.2149 638.6945
##  [497] 435.4823 504.2456 467.3472 383.1950 281.7920 517.8473 361.5369 391.0284
##  [505] 281.7786 342.1674 342.1591 425.8075 309.0573 547.4478 491.2945 354.8359
##  [513] 407.6750 435.4723 491.2984 479.0131 281.7819 517.8703 532.2526 504.2465
##  [521] 407.6849 547.4401 563.5486 314.1114 598.7898 309.0362 299.3744 361.5250
##  [529] 407.6783 309.0367 407.6623 330.3583 618.0650 281.7804 281.7904 336.1522
##  [537] 425.8118 478.9950 491.3359 563.5719 580.6212 285.9889 273.7392 517.8786
##  [545] 336.1706 324.7655 330.3611 336.1390 290.3092 336.1645 407.6780 294.7972
##  [553] 618.1177 407.6723 425.7868 361.5366 618.0554 354.8306 425.7806 467.3408
##  [561] 532.2420 324.7553 281.7735 277.6955 304.1392 618.0725 304.1337 407.6708
##  [569] 580.6175 425.8063 416.5393 383.2117 277.6995 375.6956 368.4741 407.6956
##  [577] 383.2003 361.5059 330.3503 391.0117 285.9776 348.3970 281.7698 304.1361
##  [585] 348.3628 285.9792 416.5165 330.3509 361.5290 336.1426 491.3172 547.4570
##  [593] 479.0005 277.7041 368.4850 598.7797 563.5577 638.6743 277.7051 598.7767
##  [601] 314.1172 517.9022 479.0322 330.3588 383.1998 290.3159 407.6704 638.7179
##  [609] 598.7966 342.1481 563.5612 290.3228 273.7127 285.9835 361.5075 563.5988
##  [617] 375.7176 309.0340 445.6314 383.2329 368.4789 314.0996 517.8572 435.4667
##  [625] 342.1586 407.6745 407.6946 479.0085 435.4497 456.2038 336.1809 330.3614
##  [633] 290.3065 354.8395 445.6139 445.6111 330.3747 309.0505 375.6874 407.6741
##  [641] 532.2118 467.3325 294.7877 532.2268 456.1770 299.3753 273.7158 391.0504
##  [649] 479.0218 504.2235 416.5460 383.2072 467.3424 277.6859 324.7567 547.4582
##  [657] 479.0239 479.0214 368.4621 375.7129 285.9698 456.2073 563.5645 330.3675
##  [665] 361.5491 336.1671 299.3788 491.3013 416.5525 504.2247 324.7623 425.7832
##  [673] 580.6489 314.1164 314.1039 435.4725 638.6890 383.2223 416.5251 618.0771
##  [681] 399.1676 348.4098 290.3148 479.0146 580.6090 618.0757 361.5114 290.3239
##  [689] 319.3540 504.2517 425.7852 299.3711 416.5378 299.3894 491.2830 435.4659
##  [697] 467.3346 354.8064 563.5450 491.3210 368.4652 361.5228 281.7710 277.6847
##  [705] 290.3120 336.1611 547.4330 416.5230 598.7664 445.6036 319.3414 330.3484
##  [713] 336.1537 314.0968 330.3694 467.3204 368.4865 407.6868 285.9805 598.7938
##  [721] 319.3428 324.7479 273.7288 563.5467 277.6822 324.7503 281.7856 598.7610
##  [729] 294.7851 273.7352 375.6893 504.2516 547.4966 304.1339 361.5318 309.0595
##  [737] 638.6874 348.3719 290.3115 532.2201 285.9790 309.0458 290.3184 330.3634
##  [745] 290.2998 277.6933 273.7417 348.3691 342.1450 532.2305 638.7094 517.8862
##  [753] 319.3322 314.1159 456.2164 342.1504 618.0604 478.9930 407.6853 361.5252
##  [761] 491.2899 504.2441 467.3363 517.8375 425.7975 435.4797 416.5264 336.1749
```

```
##  [769] 391.0382 491.3087 368.4485 348.3926 354.8284 435.4604 375.7044 348.3830
##  [777] 504.2288 638.7136 286.0011 435.4613 336.1619 547.4485 294.7837 456.2314
##  [785] 290.3326 336.1465 273.7222 467.3447 285.9861 383.2180 416.5214 277.6994
##  [793] 368.4673 399.2120 435.4796 330.3503 375.7245 273.7135 330.3780 383.2089
##  [801] 368.4753 425.7675 281.7721 425.8080 563.5656 285.9810 354.8206 273.7153
##  [809] 281.7757 479.0235 336.1385 290.3188 425.7971 309.0402 638.7231 598.7705
##  [817] 467.3361 456.2257 309.0249 285.9674 324.7506 336.1556 285.9901 517.8547
##  [825] 319.3627 504.2147 638.7206 532.2585 304.1444 375.7174 416.5269 618.0793
##  [833] 348.3857 314.1021 467.3159 504.2485 399.1754 467.3469 348.3898 314.1049
##  [841] 354.8129 504.2326 383.2194 598.7521 361.5330 445.6134 304.1416 299.3849
##  [849] 277.6823 598.7724 309.0542 467.3126 309.0460 285.9938 479.0245 598.7523
##  [857] 504.2193 580.6070 563.5299 361.5210 277.6995 319.3433 391.0364 532.2218
##  [865] 336.1414 563.5400 281.7787 330.3549 517.8737 491.2777 399.1826 598.7353
##  [873] 314.1041 314.1047 478.9977 435.4754 304.1289 330.3408 563.5696 547.4602
##  [881] 361.5379 330.3537 504.2284 563.5624 445.6144 479.0015 348.3724 348.3755
##  [889] 285.9855 290.3206 324.7302 563.5323 504.2351 309.0412 375.6950 314.0993
##  [897] 375.6909 342.1699 281.7846 290.3207 532.2136 491.3035 277.7091 638.6712
##  [905] 285.9836 383.2200 299.4014 277.6909 314.1214 532.2282 399.1801 309.0414
##  [913] 314.1098 314.1209 517.8523 517.8463 456.1889 348.3616 383.2056 399.1752
##  [921] 547.4414 348.3806 532.2564 361.5249 309.0324 383.2038 445.5852 456.2102
##  [929] 491.3094 504.2325 299.3855 478.9994 547.4493 309.0412 354.8478 273.7157
##  [937] 304.1328 375.7001 435.4590 309.0419 491.3208 273.7192 273.7168 435.4810
##  [945] 304.1400 445.6099 354.8176 598.7677 309.0399 425.7848 281.7728 309.0425
##  [953] 638.7038 467.3325 319.3388 383.2198 618.0839 391.0316 563.5291 290.3258
##  [961] 491.3100 638.7022 467.3122 348.3687 425.8160 435.4827 638.7122 504.2428
##  [969] 368.4681 456.2317 368.4731 532.2584 342.1450 504.2241 618.0929 547.4383
##  [977] 563.5504 580.6100 504.2454 399.1867 491.2910 348.4008 445.5891 281.7798
##  [985] 563.5319 368.4876 618.0590 618.1301 324.7528 324.7512 361.5102 309.0490
##  [993] 304.1431 547.4584 479.0312 383.2062 336.1665 504.2289 416.5448 285.9835
```

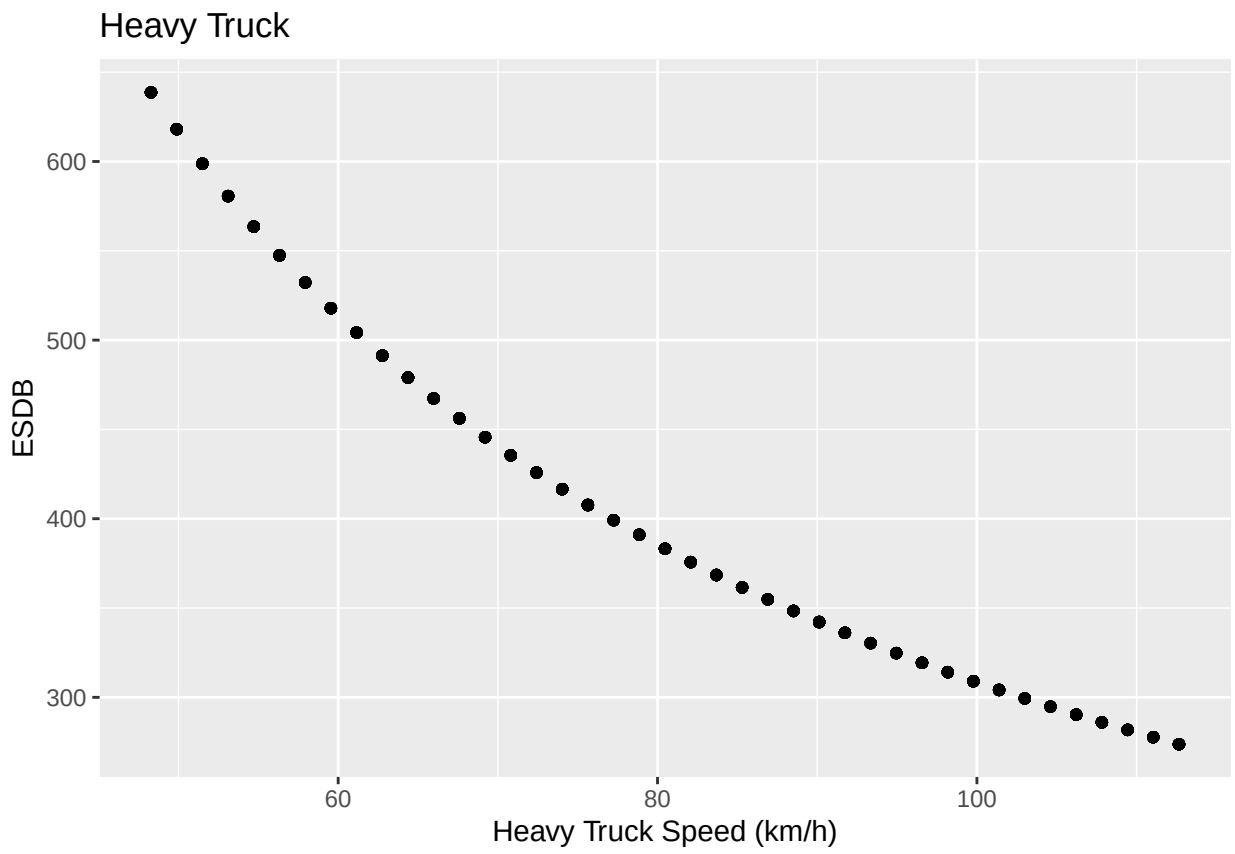
```
mean(heavy_rnormfunction(n))
```

```
## [1] 409.7901
```

```
summary(heavy_rnormfunction(n))
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   273.7   319.3   387.1   409.8   491.3   638.7
```

```
ggplot() +
  geom_point(aes(x = heavyx_star$carspeed, y = heavy_ESDB_stor)) + geom_smooth() + xlab("Heavy Truck Sp
```


Heavy Truck
ESDB
600
500
400
300
60
80
100
Heavy Truck Speed (km/h)