SLR

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library(tidyverse)

## ── Attaching packages ─────────────────────────────────────── tidyverse 1.3.1 ──

## ✓ ggplot2 3.3.5 ✓ purrr 0.3.4  
## ✓ tibble 3.1.6 ✓ dplyr 1.0.7  
## ✓ tidyr 1.1.4 ✓ stringr 1.4.0  
## ✓ readr 2.1.1 ✓ forcats 0.5.1

## ── Conflicts ────────────────────────────────────────── tidyverse\_conflicts() ──  
## x dplyr::filter() masks stats::filter()  
## x dplyr::lag() masks stats::lag()

getwd()

## [1] "/Users/brookewheeler/Desktop/Regression/Labs"

House <- read.csv("../Data/HOME\_SAlES.csv")  
attach(House)

# 1. Find correlation and covariance between house prices and house sizes. What do these values indicate?

cor(SALES\_PRICE, FINISHED\_AREA)

## [1] 0.8194701

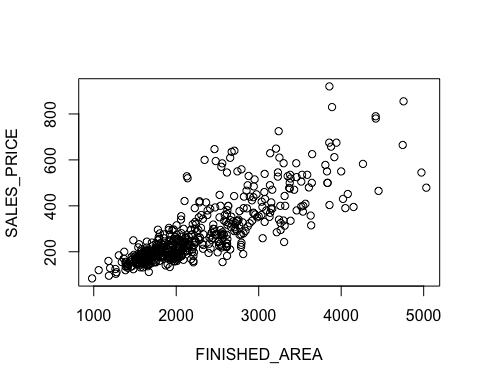
cov(SALES\_PRICE, FINISHED\_AREA)

## [1] 80367.58

# The correlation value is closer to 1 than 0 meaning that linear relationship between sales price and house size is strong. The covariance value is positive, showing that as sales price increases so does house size and as house size increases so does sales price.

# 2. Scatterplot

plot(FINISHED\_AREA, SALES\_PRICE)



# 3. Find equation of least-squares regression line. Find regression coefficients.

#y first  
reg <- lm(SALES\_PRICE ~ FINISHED\_AREA, data = House)  
reg

##   
## Call:  
## lm(formula = SALES\_PRICE ~ FINISHED\_AREA, data = House)  
##   
## Coefficients:  
## (Intercept) FINISHED\_AREA   
## -81.433 0.159

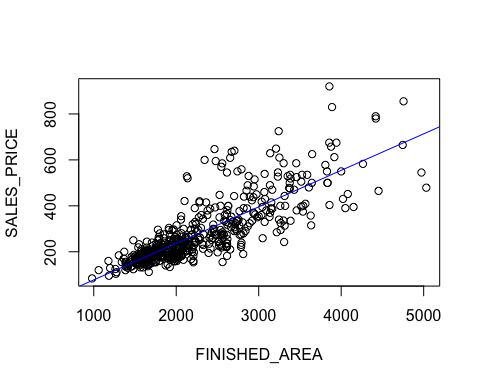
# y (hat)= -81.433 + .159

# 4. Plot regression line

reg

##   
## Call:  
## lm(formula = SALES\_PRICE ~ FINISHED\_AREA, data = House)  
##   
## Coefficients:  
## (Intercept) FINISHED\_AREA   
## -81.433 0.159

plot(FINISHED\_AREA, SALES\_PRICE)  
abline(reg, col = "blue")

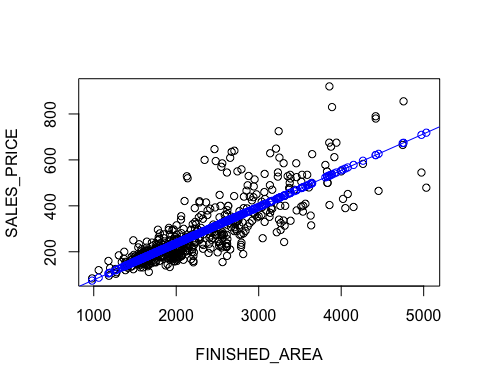


## 5. Create a new plot that shows all predicted house prices, using new color for points

reg

##   
## Call:  
## lm(formula = SALES\_PRICE ~ FINISHED\_AREA, data = House)  
##   
## Coefficients:  
## (Intercept) FINISHED\_AREA   
## -81.433 0.159

plot(FINISHED\_AREA, SALES\_PRICE)  
abline(reg, col = "blue")  
  
Yhat <- predict(reg, x= FINISHED\_AREA)  
  
points(FINISHED\_AREA, Yhat, col="blue")



## 6. If the size of a house is 2000 square feet, what is the predicted house price? Also, show predictions for houses that are 1500 and 3500 square feet.

predict(reg, data.frame(FINISHED\_AREA = 2000))

## 1   
## 236.4675

# predicted house price for 2000 square feet is 236.4675 thousand $  
  
predict(reg, data.frame(FINISHED\_AREA = 1500))

## 1   
## 156.9924

predict(reg, data.frame(FINISHED\_AREA = 3500))

## 1   
## 474.8929

## 7. Find values of all residuals

resid(reg)

## 1 2 3 4 5   
## -40.50415343 94.31337139 48.50153555 26.57246833 7.87823953   
## 6 7 8 9 10   
## 16.93679262 -40.90076508 -22.41057221 18.61567202 -72.65270969   
## 11 12 13 14 15   
## -175.53510265 196.80285220 79.02221602 56.62409802 49.12696400   
## 16 17 18 19 20   
## 94.70580041 12.58969972 -19.95333764 -54.03322065 -8.65122484   
## 21 22 23 24 25   
## 41.60948217 13.20368947 -73.64478456 -75.72188568 -142.69850743   
## 26 27 28 29 30   
## -68.74651984 -33.53535308 -30.68353369 -109.52916324 -144.04735712   
## 31 32 33 34 35   
## 13.86560941 -42.30063987 -115.52916324 -53.47964448 -66.16347931   
## 36 37 38 39 40   
## -75.78851061 -201.87441713 -152.38085741 27.36560941 2.19158171   
## 41 42 43 44 45   
## 14.86560941 20.14959095 -4.18997397 -1.70222844 -20.20841829   
## 46 47 48 49 50   
## -30.35647368 -39.02780360 -74.93669122 -64.50762400 9.18041495   
## 51 52 53 54 55   
## -28.19294368 3.64340110 -71.69603860 9.66172020 -170.79754494   
## 56 57 58 59 60   
## 75.21161461 -16.11594627 138.54956945 108.99547092 -85.29618531   
## 61 62 63 64 65   
## -5.34248392 -8.24664506 -18.75446647 -53.95204062 -0.54476306   
## 66 67 68 69 70   
## -23.91582106 -7.71205706 -57.08326177 259.83825598 -4.46797685   
## 71 72 73 74 75   
## 129.85113654 293.27549877 388.36190616 180.46564866 142.07928426   
## 76 77 78 79 80   
## 62.55278959 169.19082667 -7.94484904 291.11629810 336.77957768   
## 81 82 83 84 85   
## 159.03187644 122.68290154 54.15046747 44.81696718 98.64926781   
## 86 87 88 89 90   
## 268.57903382 291.71792967 62.22746487 126.68250440 117.70389894   
## 91 92 93 94 95   
## -46.54077013 23.57014620 220.20270549 46.11951824 291.47257205   
## 96 97 98 99 100   
## 308.85360537 -13.83083778 210.77809282 -12.05948637 282.39532421   
## 101 102 103 104 105   
## 174.68574603 246.58670852 -239.40461505 -164.02655143 6.02345044   
## 106 107 108 109 110   
## 211.48817188 28.06393486 271.77790500 -15.24493127 77.79072295   
## 111 112 113 114 115   
## 72.96502257 56.13338278 70.82489231 94.44942274 2.21830532   
## 116 117 118 119 120   
## 132.13783734 113.04685018 41.61617289 -112.69850743 -18.88073219   
## 121 122 123 124 125   
## 6.23365471 81.50797583 153.97418212 78.17621083 -128.29704408   
## 126 127 128 129 130   
## 195.59141351 -88.53485221 -28.30013900 -161.37243141 -115.58399532   
## 131 132 133 134 135   
## -107.26176551 22.97146285 58.87391019 73.03434528 127.52976550   
## 136 137 138 139 140   
## 120.99250122 -30.04116727 115.38158489 23.92961879 53.77363827   
## 141 142 143 144 145   
## 83.03139706 117.76868284 -2.57991641 143.67980662 61.74887889   
## 146 147 148 149 150   
## -27.66433807 48.51441611 -17.51665833 22.50203642 -127.86488193   
## 151 152 153 154 155   
## 19.65801694 16.15318674 -81.25087068 -7.57050643 -183.21051147   
## 156 157 158 159 160   
## 94.81943601 85.54498968 10.35373059 69.98012153 52.38706873   
## 161 162 163 164 165   
## 127.42466337 10.66383114 -64.24022628 -26.66483894 -131.82811851   
## 166 167 168 169 170   
## 56.97393169 63.23488913 -12.87776249 -16.63388972 -37.16270651   
## 171 172 173 174 175   
## 23.60529954 -29.94238020 30.11914259 -138.05639145 65.84419539   
## 176 177 178 179 180   
## 49.79480185 -65.84384356 133.70851968 -2.32811851 12.37353454   
## 181 182 183 184 185   
## -2.95030533 -78.98570911 16.86004565 45.38442938 61.22993370   
## 186 187 188 189 190   
## 45.98334167 96.18660479 30.06974906 -47.85287789 -24.18462140   
## 191 192 193 194 195   
## -76.38357668 -13.46107495 -26.74183635 -33.98558389 -6.68662861   
## 196 197 198 199 200   
## -50.53483072 -47.70172757 -49.52594310 -36.42245103 -20.45488510   
## 201 202 203 204 205   
## -80.43606514 -105.81506975 261.59735292 -25.59378095 30.23934369   
## 206 207 208 209 210   
## -4.57818112 -108.68610625 18.99547092 -7.77721863 -172.31548839   
## 211 212 213 214 215   
## -31.27291078 -76.86216266 30.08361360 -64.11841511 -94.51950282   
## 216 217 218 219 220   
## -41.84532841 19.84741553 61.68551709 -181.51009284 72.83800555   
## 221 222 223 224 225   
## -29.96357985 -121.77253513 55.53260999 65.30099170 34.67757046   
## 226 227 228 229 230   
## -99.53980764 -96.74505648 -36.59202417 5.83060278 46.05711893   
## 231 232 233 234 235   
## -29.45662039 -39.27613092 168.47851146 51.74243861 23.98309124   
## 236 237 238 239 240   
## 37.41983316 -111.74505648 -6.27734385 -60.24505648 -105.07224171   
## 241 242 243 244 245   
## 18.61765774 -20.44127100 -36.57370507 -10.83462140 -42.90549157   
## 246 247 248 249 250   
## 77.89668385 94.00688812 -12.22673739 -12.92109140 -93.12163525   
## 251 252 253 254 255   
## -85.39323710 5.76397785 -87.52916324 23.00760018 0.13436677   
## 256 257 258 259 260   
## -46.72351725 -113.84505648 15.93382291 -63.13698464 27.29183215   
## 261 262 263 264 265   
## -40.51774604 -39.68340848 -36.53547830 -8.57518992 -86.82029711   
## 266 267 268 269 270   
## -88.59081125 -21.81611448 7.55578079 21.21916409 22.26876694   
## 271 272 273 274 275   
## -65.04760755 -34.40883692 -40.63859471 20.45214201 15.17744525   
## 276 277 278 279 280   
## -63.93613092 -52.49821401 -13.77303600 -2.85647368 -145.22784659   
## 281 282 283 284 285   
## -130.42096618 75.00463047 7.88578901 -140.40239665 53.27623232   
## 286 287 288 289 290   
## -84.54129249 -20.24518170 -36.51812169 -80.11665833 64.11876694   
## 291 292 293 294 295   
## -5.66508938 -14.90574200 -51.21893747 -2.49227460 9.75159816   
## 296 297 298 299 300   
## 8.28564230 -53.34074864 -23.78972354 17.44582695 11.18982493   
## 301 302 303 304 305   
## -14.26239160 -12.91515199 -18.16199445 -35.01046849 10.09425800   
## 306 307 308 309 310   
## -31.33602215 -53.93050138 4.03235956 -33.04154292 4.37204969   
## 311 312 313 314 315   
## 30.74568847 31.83633287 23.54043140 15.83033085 -12.70829307   
## 316 317 318 319 320   
## 35.25644986 14.13733647 -110.31820579 -32.49026739 10.10638725   
## 321 322 323 324 325   
## 29.04473924 27.87987110 19.62508200 -8.92303600 -68.48595954   
## 326 327 328 329 330   
## -29.70816785 -21.65122484 -24.44894569 -56.89955216 -27.33480923   
## 331 332 333 334 335   
## 0.85335494 -52.54894569 32.09722770 -11.04166814 -19.06617709   
## 336 337 338 339 340   
## -3.80250037 1.08175309 -29.03844800 50.42280286 37.95214201   
## 341 342 343 344 345   
## -49.52594310 24.16506556 -86.17090357 -33.59254653 -16.68353369   
## 346 347 348 349 350   
## 5.86585984 -37.76362602 -12.19415660 -58.20952749 38.70456786   
## 351 352 353 354 355   
## -47.62176047 -3.94139621 11.79492707 -118.76053109 -18.66236029   
## 356 357 358 359 360   
## -44.01071892 7.19170693 13.59716509 -48.14342492 -29.48756961   
## 361 362 363 364 365   
## -122.64714780 -76.16793386 -11.09415660 -50.34099907 -0.25781182   
## 366 367 368 369 370   
## 17.51688494 -10.66098883 -1.75277230 10.47623232 -4.85189391   
## 371 372 373 374 375   
## -5.08177691 -25.92431153 -6.06320738 -13.85498883 -41.44894569   
## 376 377 378 379 380   
## -57.58016684 -61.54530692 -75.12634024 -57.62176047 -61.16347931   
## 381 382 383 384 385   
## -29.22807553 -33.47370507 6.95711893 -43.98271791 0.29158171   
## 386 387 388 389 390   
## -20.15404783 0.71755402 -0.45835568 -3.98298984 12.10019741   
## 391 392 393 394 395   
## -31.13547830 32.94570174 11.64959095 67.96008864 -131.66134688   
## 396 397 398 399 400   
## 13.45699372 -56.12309861 -59.26214116 9.06949862 -49.08784154   
## 401 402 403 404 405   
## 7.48148117 -9.85028384 23.13263148 -1.15283491 12.38417894   
## 406 407 408 409 410   
## -15.27140444 51.59413278 -14.27019151 -11.10034645 30.92144323   
## 411 412 413 414 415   
## 31.73290341 34.62483157 55.64959095 13.84097525 11.55396140   
## 416 417 418 419 420   
## -52.56630230 -2.87033822 -73.14181485 26.78430416 21.73599833   
## 421 422 423 424 425   
## -31.20802114 -39.89160553 -17.61582106 -28.60963121 -14.77746907   
## 426 427 428 429 430   
## -15.88742290 17.06008864 18.25948217 -4.88123306 24.00638725   
## 431 432 433 434 435   
## -9.33183952 -20.93493444 -0.06764044 -55.20950600 -37.67598421   
## 436 437 438 439 440   
## -28.33305245 2.83788033 -9.81582106 -11.21770305 -51.83790415   
## 441 442 443 444 445   
## -15.03991136 6.01379002 -25.48311506 6.06506556 13.07422511   
## 446 447 448 449 450   
## -42.39769165 -13.00477951 -97.17855677 -4.51824691 5.11257710   
## 451 452 453 454 455   
## -10.38754812 23.62186186 -8.31945983 19.60032263 -13.60963121   
## 456 457 458 459 460   
## 13.58794294 -98.84384356 -8.84085236 -5.80720536 11.88457609   
## 461 462 463 464 465   
## -40.25162198 -103.77600571 -40.51205706 -18.65417305 -2.33802937   
## 466 467 468 469 470   
## 81.67905531 13.29777156 -0.37370507 -50.87491800 1.70207941   
## 471 472 473 474 475   
## -16.71609298 -28.22067276 -13.88432798 -1.52322383 -18.41582106   
## 476 477 478 479 480   
## -4.06939722 -45.30089030 22.66197063 -18.88123306 -14.04488828   
## 481 482 483 484 485   
## 18.38417894 -27.67073537 5.71002603 -19.01393906 -42.99685438   
## 486 487 488 489 490   
## -70.73911707 8.76506556 0.60948217 13.75147294 -26.06333260   
## 491 492 493 494 495   
## -77.83911707 -15.52322383 -67.03077331 -15.39670767 -21.70222844   
## 496 497 498 499 500   
## -38.78244598 -12.65592983 -14.12510582 -38.08183952 6.51997987   
## 501 502 503 504 505   
## -43.39785799 14.85026002 -47.28851061 -0.56157582 54.18957450   
## 506 507 508 509 510   
## 5.67880488 63.50824776 58.66184542 23.43963711 -16.37046344   
## 511 512 513 514 515   
## 2.99522049 20.01056988 0.08781772 63.67113018 -20.44421921   
## 516 517 518 519 520   
## -35.64206529 -5.62792882 -44.62968560 -42.56630230 -90.56939722   
## 521 522   
## -29.81339521 -11.26412689

## 8. Look at the first house. Calc. the residual value

predict(reg, data.frame(FINISHED\_AREA = 3032))

## 1   
## 400.5042

## 9. One property we discussed is that the sum of the residuals is zero. Find the sum of the residuals here and comment on the value that you obtain.

sum(resid(reg))

## [1] -2.375877e-13

#The value I obtained is very very close to one which would make sense if the expected value is zero.

## 10. Show the regression line passes through (X ̅,Y ̅). Hint: First find the means and then predict the appropriate value.

summary(House)

## ID SALES\_PRICE FINISHED\_AREA BEDROOMS BATHROOMS   
## Min. : 1.0 Min. : 84.0 Min. : 980 Min. :0.000 Min. :0.000   
## 1st Qu.:131.2 1st Qu.:180.0 1st Qu.:1701 1st Qu.:3.000 1st Qu.:2.000   
## Median :261.5 Median :229.9 Median :2061 Median :3.000 Median :3.000   
## Mean :261.5 Mean :277.9 Mean :2261 Mean :3.471 Mean :2.642   
## 3rd Qu.:391.8 3rd Qu.:335.0 3rd Qu.:2636 3rd Qu.:4.000 3rd Qu.:3.000   
## Max. :522.0 Max. :920.0 Max. :5032 Max. :7.000 Max. :7.000   
## GARAGE\_SIZE YEAR\_BUILT STYLE LOT\_SIZE   
## Min. :0.0 Min. :1885 Min. :1.000 Min. : 4560   
## 1st Qu.:2.0 1st Qu.:1956 1st Qu.:1.000 1st Qu.:17205   
## Median :2.0 Median :1966 Median :2.000 Median :22200   
## Mean :2.1 Mean :1967 Mean :1.925 Mean :24370   
## 3rd Qu.:2.0 3rd Qu.:1981 3rd Qu.:3.000 3rd Qu.:26787   
## Max. :7.0 Max. :1998 Max. :3.000 Max. :86830   
## AIR\_CONDITIONER POOL QUALITY HIGHWAY   
## Length:522 Length:522 Length:522 Length:522   
## Class :character Class :character Class :character Class :character   
## Mode :character Mode :character Mode :character Mode :character   
##   
##   
##

# mean sales price = 277.9  
# mean finished area = 2261  
  
predict(reg, data.frame(FINISHED\_AREA = 2261))

## 1   
## 277.9535

# at x= 2261 y = 277.9535