Escuela Superior de Física y Matemáticas

ECONOMETRÍA

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Actividad 2

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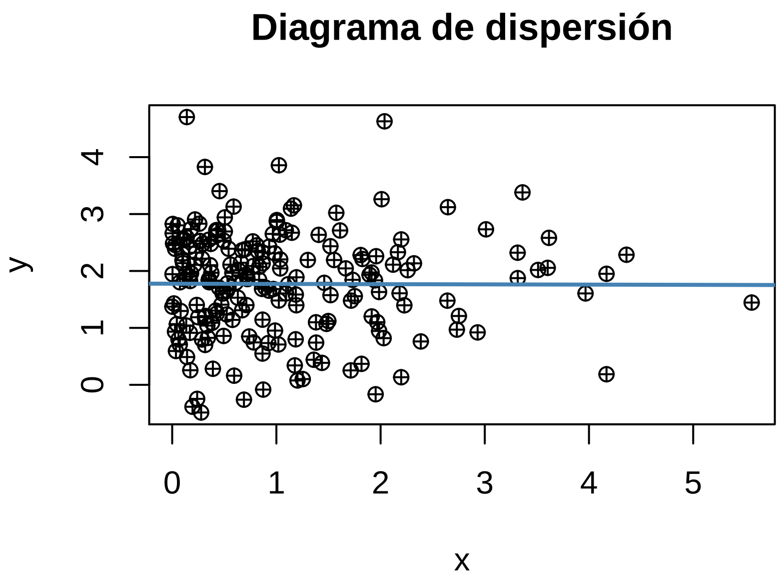
contenido

1. Generar muestra

```
y <- c(rnorm(200,2,1))
x <- c(rexp(200,1))
b <- sum((x-mean(x))*(y-mean(y)))/sum((x-mean(x))^2); b

[1] -0.004027821

a <- mean(y)-b*mean(x);a

[1] 1.776251
```

1.1. Diagrama de dispersión

```
plot(x, y , pch=10, main = "Diagrama de dispersión", xlab = "x", ylab = "y")
abline(a, b, col = "steelblue", lwd = 2 )
```



1.2. Calcular de forma manual

1.2.1. calcular β

$$\hat{\beta} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2} \tag{1}$$

```
b <- sum((x-mean(x))*(y-mean(y)))/sum((x-mean(x))^2); b

## [1] -0.004027821
```

1.2.2. Calcular α

.

$$\hat{\alpha} = \bar{y} - \hat{\beta}\bar{x} \tag{2}$$

```
a <- mean(y)-b*mean(x);a

## [1] 1.776251
```

1.2.3. Coeficiente de ajuste

$$R^2 = 1 - \frac{SRC}{STC} \tag{3}$$

```
y.hat <- a+b*x
e <- y - y.hat
STC <-  sum((y - mean(y))^2)
SEC <-  sum((y.hat - mean(y))^2)
SRC <- sum(e^2)
R.2 <- 1-(SRC/STC); R.2

## [1] 1.97724e-05
```

1.2.4. Valores estimados

$$\hat{y}_i = \hat{\alpha} + \hat{\beta} x_i \tag{4}$$

```
y_i <- a + b*x
```

1.2.5. Residuos del modelo

$$e_i = y_i - \hat{y}_i \tag{5}$$

```
e_i <- y-y_i
```

1.2.6. Presentacion de los datos

```
data.frame(x, y, y_i, e_i)

##              x          y      y_i          e_i
## 1   1.185118623  0.79984486 1.771477 -0.971632271
## 2   1.985512054  1.63018976 1.768253 -0.138063533
## 3   3.615863448  2.58182671 1.761687  0.820140190
## 4   2.197981152  2.55370121 1.767398  0.786303707
## 5   0.434323003  2.63048495 1.774501  0.855983750
## 6   1.139757707  3.09483428 1.771660  1.323174440
## 7   0.492669037  2.53387397 1.774266  0.759607774
## 8   3.966891443  1.60558789 1.760273 -0.154684755
## 9   1.817033408  0.36845854 1.768932 -1.400473349
## 10  0.559316525  2.11106399 1.773998  0.337066235
```

```
## 11  0.530442875  1.78354953 1.774114  0.009435479
## 12  1.752548403  1.55686788 1.769192 -0.212323750
## 13  1.406058427  2.63481909 1.770587  0.864231865
## 14  0.169328024  0.91373483 1.775569 -0.861833725
## 15  0.589453124  3.13044085 1.773876  1.356564482
## 16  1.252804692  0.10093031 1.771205 -1.670274198
## 17  1.518476693  2.43438121 1.770134  0.664246785
## 18  1.112490754  1.76665620 1.771770 -0.005113461
## 19  1.090469846  2.71629192 1.771858  0.944433558
## 20  0.711909483  1.40017939 1.773383 -0.373203743
## 21  0.250237063  1.18696003 1.775243 -0.588282634
## 22  0.074307370  1.80172355 1.775951  0.025772272
## 23  0.142813419  0.48780058 1.775675 -1.287874768
## 24  0.106550164  2.56123052 1.775821  0.785409103
## 25  1.023241516  1.48096738 1.772129 -0.291161759
## 26  0.239719477 -0.24690586 1.775285 -2.022190893
## 27  0.036144074  0.59390864 1.776105 -1.182196353
## 28  0.526727420  1.65421070 1.774129 -0.119918310
## 29  0.181129176  1.95973801 1.775521  0.184216988
## 30  0.637475942  2.01162314 1.773683  0.237940206
## 31  1.808828876  2.27930371 1.768965  0.510338774
## 32  2.641141577  1.47846000 1.765613 -0.287152526
## 33  0.578427660  1.14115510 1.773921 -0.632765677
## 34  0.136049909  1.94850333 1.775703  0.172800733
## 35  0.164837028  2.42277762 1.775587  0.647190978
## 36  0.423588575  2.71730368 1.774544  0.942759245
## 37  0.351760359  2.54889368 1.774834  0.774059928
## 38  1.147935644  2.67208448 1.771627  0.900457580
## 39  3.315243818  2.32052276 1.762897  0.557625393
## 40  0.001884350  1.37291343 1.776243 -0.403329559
## 41  0.229559726  2.32086996 1.775326  0.545544011
## 42  0.350733281  1.83758295 1.774838  0.062745065
## 43  0.364096458  2.10134332 1.774784  0.326559258
## 44  0.669867170  2.36246877 1.773552  0.588916301
## 45  2.009884696  3.26060469 1.768155  1.492449566
## 46  0.810369980  2.45034575 1.772987  0.677359201
## 47  0.277891963 -0.48665543 1.775131 -2.261786710
## 48  0.060471829  0.79777527 1.776007 -0.978231738
## 49  0.629738412  1.53053281 1.773714 -0.243181289
## 50  0.313940411  1.18852150 1.774986 -0.586464580
## 51  0.450073819  1.70458262 1.774438 -0.069855141
## 52  0.493407912  0.85878303 1.774263 -0.915480192
## 53  1.914897833  1.20121509 1.768538 -0.567322619
## 54  0.965762402  2.65114575 1.772361  0.878785096
## 55  0.484049492  1.60306017 1.774301 -0.171240739
## 56  0.688593670 -0.26129793 1.773477 -2.034774978
## 57  0.260159082  2.83063980 1.775203  1.055437102
## 58  0.922970436  0.73345081 1.772533 -1.039082211
## 59  0.454817207  3.40303206 1.774419  1.628613409
## 60  1.665363917  2.04541723 1.769543  0.275874443
## 61  2.751276700  1.20898514 1.765169 -0.556183784
## 62  0.081221708  1.29673987 1.775923 -0.479183558
## 63  0.352823296  1.85539725 1.774829  0.080567786
## 64  0.174055371  0.25601096 1.775550 -1.519538556
```

```
## 65  0.321269964  1.20878255 1.774957 -0.566174008
## 66  0.930911480  2.42694682 1.772501  0.654445791
## 67  1.731667073  1.84466109 1.769276  0.075385362
## 68  2.931283094  0.92076541 1.764444 -0.843678486
## 69  0.722072754  1.85750091 1.773342  0.084158717
## 70  0.781942178  0.74497018 1.773101 -1.028130869
## 71  1.176571930  0.34095827 1.771512 -1.430553282
## 72  1.967507886  1.10088180 1.768326 -0.667444011
## 73  1.036746480  2.20283211 1.772075  0.430757359
## 74  0.383261232  1.08933232 1.774707 -0.685374553
## 75  2.166112089  2.32948837 1.767526  0.561962503
## 76  2.197837068  0.13318823 1.767398 -1.634209853
## 77  0.354826598  1.80197670 1.774821  0.027155305
## 78  5.561196670  1.44484030 1.753851 -0.309010765
## 79  4.168568359  1.95009328 1.759460  0.190632956
## 80  0.235842722  1.40299230 1.775301 -0.372308345
## 81  1.716022259  1.47901871 1.769339 -0.290320037
## 82  0.594549804  0.16036104 1.773856 -1.613494799
## 83  0.003205046  1.94471086 1.776238  0.168473192
## 84  1.190987674  1.39741330 1.771453 -0.374040190
## 85  0.773586571  2.52009100 1.773135  0.746956293
## 86  0.659529446  2.14431063 1.773594  0.370716517
## 87  0.971397449  1.68296231 1.772338 -0.089375651
## 88  0.016092932  1.42929050 1.776186 -0.346895256
## 89  0.429067851  1.25387931 1.774522 -0.520643060
## 90  0.314140054  3.82763405 1.774985  2.052648772
## 91  0.044198761  1.06631444 1.776073 -0.709758117
## 92  0.135039915  1.04122697 1.775707 -0.734479695
## 93  0.140335455  4.70408699 1.775685  2.928401655
## 94  0.194833400 -0.38550769 1.775466 -2.160973513
## 95  0.523679267  1.23545458 1.774141 -0.538686708
## 96  0.390242743  0.28159865 1.774679 -1.493080096
## 97  0.865954794  2.32739230 1.772763  0.554629634
## 98  0.471451542  1.40789505 1.774352 -0.366456609
## 99  3.011535048  2.73176258 1.764121  0.967641931
## 100 1.825370947  2.21054665 1.768898  0.441648339
## 101 1.553889712  2.19241201 1.769992  0.422420224
## 102 0.004750060  2.66161613 1.776231  0.885384683
## 103 0.097637286  2.29650884 1.775857  0.520651533
## 104 1.024036810  3.85716965 1.772126  2.085043713
## 105 0.114759833  2.54488798 1.775788  0.769099631
## 106 0.376229675  1.96874525 1.774735  0.194010056
## 107 0.835105472  2.07247527 1.772887  0.299588351
## 108 0.370835714  2.47587212 1.774757  0.701115202
## 109 2.645955613  3.12111711 1.765593  1.355523965
## 110 0.072901180  0.70894798 1.775957 -1.067008961
## 111 0.541458100  2.39014655 1.774070  0.616076873
## 112 1.519276915  1.57531199 1.770131 -0.194819215
## 113 1.004456599  2.89372450 1.772205  1.121519693
## 114 3.511279693  2.01749542 1.762108  0.255387648
## 115 2.228061067  1.39657743 1.767276 -0.370698918
## 116 0.098438616  2.18845883 1.775854  0.412604745
## 117 1.480911190  1.07056279 1.770286 -0.699722946
## 118 0.866840203  1.14458720 1.772759 -0.628171904
```

```
## 119 0.486286422  1.64505217 1.774292 -0.129239734
## 120 1.168213228  3.15268746 1.771545  1.381142240
## 121 3.603833025  2.05461167 1.761735  0.292876684
## 122 0.005053505  2.82594940 1.776230  1.049719181
## 123 0.286263536  0.79567151 1.775098 -0.979426050
## 124 0.577752403  1.96656812 1.773923  0.192644625
## 125 1.611265849  2.71154491 1.769761  0.941784228
## 126 4.359826096  2.28496538 1.758690  0.526275409
## 127 0.294039531  2.47887664 1.775066  0.703810402
## 128 0.862076912  1.68499187 1.772778 -0.087786413
## 129 1.946029130  1.83511363 1.768412  0.066701308
## 130 0.868088598  2.13307091 1.772754  0.360316843
## 131 1.358695650  0.44038222 1.770778 -1.330395771
## 132 2.119452932  2.11097397 1.767714  0.343260169
## 133 0.441454146  2.71435344 1.774472  0.939880958
## 134 3.316379249  1.87406520 1.762893  0.111172401
## 135 1.713410382  0.25317693 1.769349 -1.516172335
## 136 0.984219737  2.30993193 1.772286  0.537645611
## 137 0.698252522  2.38008200 1.773438  0.606643863
## 138 1.985865578  0.94537168 1.768252 -0.822880189
## 139 0.866799742  0.54927236 1.772759 -1.223486900
## 140 0.267731160  2.52658239 1.775172  0.751410191
## 141 0.873335531 -0.08383649 1.772733 -1.856569424
## 142 0.720510079  1.88867939 1.773348  0.115330901
## 143 0.139141227  2.58785831 1.775690  0.812168170
## 144 0.007918572  2.48388231 1.776219  0.707663629
## 145 2.260106785  2.01388761 1.767147  0.246740340
## 146 0.030570421  2.45439667 1.776127  0.678269220
## 147 2.731861947  0.96926182 1.765247 -0.795985305
## 148 0.219148207  2.90472895 1.775368  1.129361060
## 149 0.179487543  2.73588628 1.775528  0.960358642
## 150 1.019207586  0.70871275 1.772145 -1.063432644
## 151 0.337565952  1.04089420 1.774891 -0.733996720
## 152 1.092760553  1.60597873 1.771849 -0.165870399
## 153 1.380087834  1.09824253 1.770692 -0.672449302
## 154 1.956996022  2.25875678 1.768368  0.490388629
## 155 0.316089543  0.70075440 1.774977 -1.074223027
## 156 1.202429014  0.07671183 1.771407 -1.694695583
## 157 0.051946527  2.80140402 1.776041  1.025362670
## 158 2.320439893  2.13417529 1.766904  0.367271035
## 159 1.498786473  1.12009311 1.770214 -0.650120623
## 160 0.834096014  1.84483135 1.772891  0.071940359
## 161 0.212480741  2.10762217 1.775395  0.332227428
## 162 2.182527823  1.60773071 1.767460 -0.159729036
## 163 0.117100049  1.85583021 1.775779  0.080051289
## 164 0.418047879  1.30348792 1.774567 -0.471078830
## 165 0.167750178  1.90190700 1.775575  0.126332092
## 166 1.004238288  2.86366657 1.772206  1.091460881
## 167 2.038024980  4.62920986 1.768042  2.861168082
## 168 1.381656093  0.74125165 1.770686 -1.029433862
## 169 0.505317018  2.69429025 1.774215  0.920074998
## 170 0.026808808  0.93384513 1.776143 -0.842297463
## 171 0.986753783  0.95268243 1.772276 -0.819593681
## 172 3.361984826  3.38035019 1.762709  1.617641086
```

```
## 173 0.505029801  2.94121177 1.774216  1.166995358
## 174 1.459024424  1.79152350 1.770374  0.021149617
## 175 0.778040925  2.08725219 1.773117  0.314135423
## 176 1.913635923  1.97246745 1.768543  0.203924654
## 177 0.671307162  1.30985562 1.773547 -0.463691050
## 178 0.341895869  0.82503014 1.774873 -0.949843338
## 179 0.027800013  2.38963945 1.776139  0.613500842
## 180 1.033641012  2.63798119 1.772087  0.865893935
## 181 2.386156184  0.76179861 1.766640 -1.004840958
## 182 1.186290581  1.58609350 1.771472 -0.185378915
## 183 1.894025706  1.93300876 1.768622  0.164386976
## 184 1.574890513  3.02217532 1.769907  1.252268120
## 185 0.821464386  2.35293631 1.772942  0.579994443
## 186 4.168340436  0.18586083 1.759461 -1.573600419
## 187 0.893982317  1.70779283 1.772650 -0.064856944
## 188 1.437397713  0.38564101 1.770461 -1.384819987
## 189 1.192609814  1.88869784 1.771447  0.117250886
## 190 1.952581379 -0.16612295 1.768386 -1.934508875
## 191 2.029331064  0.81985922 1.768077 -0.948217578
## 192 1.036680535  2.04456458 1.772075  0.272489565
## 193 0.739474274  0.84950261 1.773272 -0.923769501
## 194 0.609385159  1.79427843 1.773796  0.020482350
## 195 0.103740800  2.13709102 1.775833  0.361258289
## 196 0.707361936  1.93395269 1.773401  0.160551236
## 197 1.301686444  2.19287990 1.771008  0.421872288
## 198 0.929247833  1.65341170 1.772508 -0.119096029
## 199 0.172358404  1.82405412 1.775556  0.048497774
## 200 0.286840000  2.21649561 1.775095  0.441400370
```

1.3. Cálculo con linea de comando

1.3.1. Estimar con MCO

```
reg <- lm(x ~ y, data = data.frame(x, y))
summary(reg)

##
## Call:
## lm(formula = x ~ y, data = data.frame(x, y))
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.0577 -0.7348 -0.2792  0.4615  4.5019
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.066341   0.155985   6.836 9.84e-11 ***
## y           -0.004909   0.078455  -0.063     0.95
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1 on 198 degrees of freedom
## Multiple R-squared:  1.977e-05,Adjusted R-squared:  -0.005031
## F-statistic: 0.003915 on 1 and 198 DF,  p-value: 0.9502
```

1.3.2. Calcular residuales

```
res <- residuals(reg)
est <- fitted.values(reg)
```

1.3.3. ESR y el R^2

```
summary(reg)$sigma

## [1] 1.000417

summary(reg)$r.squared

## [1] 1.97724e-05
```

2. Utilizando la base de datos cps08.Rdata

```
load("C:/Users/81799/Downloads/cps08.RData")
```

Replicando la tabla

```
media_age <- mean(cps08$age)
media_ahe <- mean(cps08$ahe)
es_age <- sd(cps08$age)
es_ahe <- sd(cps08$ahe)
quantiles <- c(0.1, 0.25, 0.40, 0.50, 0.60, 0.75, 0.90)
quantil_age <- quantile(cps08$age, quantiles)
quantil_ahe <- quantile(cps08$ahe, quantiles)
data.frame(media = c(media_age, media_ahe), error_standar=c(es_age, es_ahe),
           percentil=rbind(quantil_age, quantil_ahe))

##                media error_standar percentil.10. percentil.25. percentil.40.
## quantil_age 29.57723      2.855258     26.000000      27.00000      29.00000
## quantil_ahe 18.97609     10.139439      8.653846      12.01923      14.66346
##             percentil.50. percentil.60. percentil.75. percentil.90.
## quantil_age      30.00000      31.00000      32.00000      34.00000
## quantil_ahe      16.82692      19.23077      23.55769      32.45192
```

2.1. Graficar la dispersión de las variables age y ahe

2.1.1. Estimar $\hat{\alpha}$ y $\hat{\beta}$

$$\hat{\beta} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2} \tag{6}$$

```
b <- sum((cps08$age-mean(cps08$age))*(cps08$ahe-mean(cps08$ahe)))/sum((cps08$age-mean(cps08$age)
```

```
## [1] 0.6049863
```

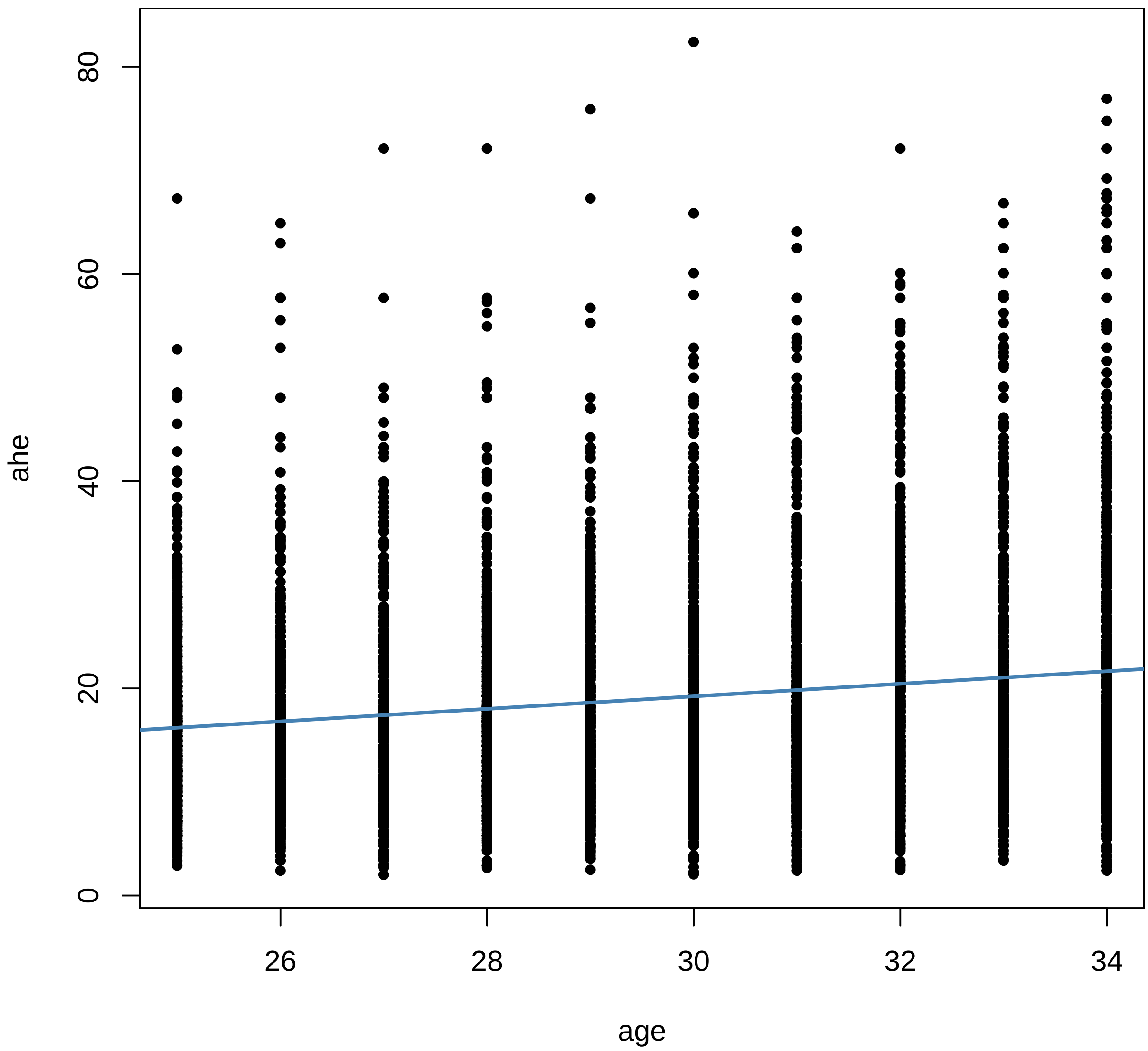
$$\hat{\alpha} = \bar{y} - \hat{\beta}\bar{x} \tag{7}$$

```
a <- mean(cps08$ahe)-b*mean(cps08$age); a
```

```
## [1] 1.082275
```

2.1.2. Gráfico 4.2

```
plot( cps08$age,cps08$ahe, pch=20, ylim = c(min(cps08$ahe), max(cps08$ahe)), xlim = c(min(cps08$
     ylab = "ahe")
abline(a,b, col = "steelblue", lwd = 2 )
```



2.2. Estimar regresión entre los ingresos medios por hora (ahe) contra la edad (age), cuanto aumentará el ingreso si los trabajadores tienen un año más de vida

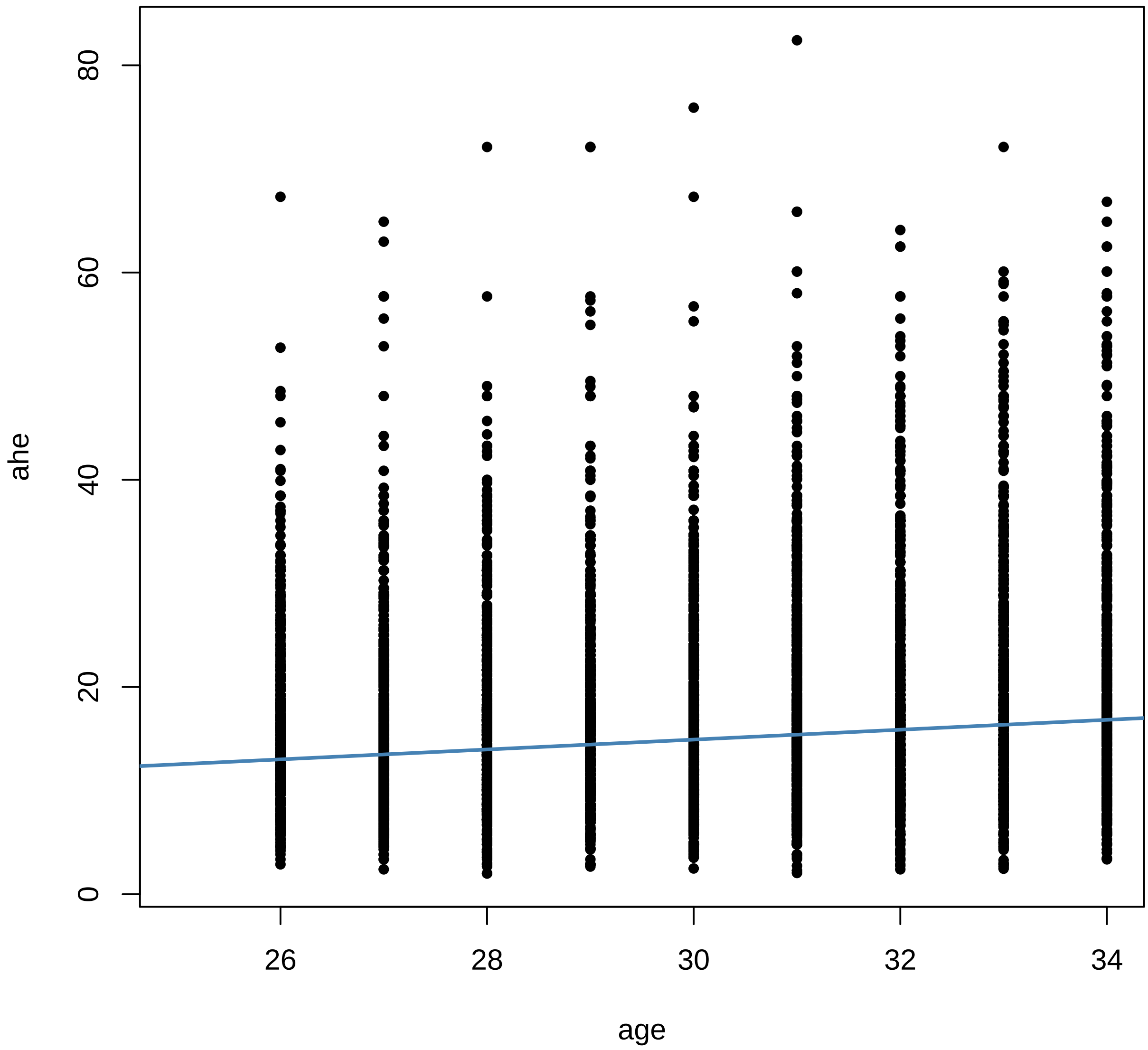
```
be <- sum(((cps08$age+1)-mean(cps08$age+1))*(cps08$ahe-mean(cps08$ahe)))/sum((cps08$age+1-mean(c
```

```
## [1] 0.6049863
```

```
al <- mean(cps08$ahe)-b*mean(cps08$age+1); al
```

```
## [1] 0.4772889
```

```
plot( cps08$age+1,cps08$ahe, pch=20, ylim = c(min(cps08$ahe), max(cps08$ahe)), xlim = c(min(cps0
     ylab = "ahe")
abline(be,al, col = "steelblue", lwd = 2 )
```



2.3. ¿ Cuál es la diferencia salarial entrre un inidividuo de 26 años y uno de 30?

```
y=(a+(b*26))-(a+(b*30));y

## [1] -2.419945
```

2.4. Calcular R^2

$$R^2 = 1 - \frac{SRC}{STC} \tag{8}$$

```
ahe.hat <- a+b*cps08$ahe
e <- cps08$ahe - ahe.hat
STC <-  sum((cps08$ahe - mean(cps08$ahe))^2)
SEC <-  sum((ahe.hat - mean(cps08$ahe))^2)
SRC <- sum(e^2)
R.2 <- 1-(SRC/STC); R.2

## [1] 0.4438129
```

2.5. Realizar nuevamente la regresión del inciso 2.2 utilizar solo los datos de los gradudados de escuela secundaria

```
x <- cps08[cps08$bachelor == 0, 5 ]+1
y <- cps08[cps08$bachelor == 0, 1 ]
graddo <- data.frame(x,y)


reg <- lm(x ~ y,graddo )
summary(reg)

##
## Call:
## lm(formula = x ~ y, data = graddo)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -6.0834 -2.4015  0.0291  2.4534  4.9439
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 29.959313   0.099143 302.182  < 2e-16 ***
## y            0.040269   0.005779   6.969 3.73e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.815 on 4000 degrees of freedom
## Multiple R-squared:  0.01199,Adjusted R-squared:  0.01175
## F-statistic: 48.56 on 1 and 4000 DF,  p-value: 3.727e-12
```

```
res <- residuals(reg)
est <- fitted.values(reg)
summary(reg)$sigma

## [1] 2.814879

summary(reg)$r.squared

## [1] 0.01199473
```

2.6. Repetir la regresión entre ingresos medios por hora (ahe) contra la edad (age) considerar solo los datos de los graduados universitarios

```
x <- cps08[cps08$bachelor == 1, 5 ]+1
y <- cps08[cps08$bachelor == 1, 1 ]
graddo <- data.frame(x,y)


reg <- lm(x ~ y,graddo )
summary(reg)

##
## Call:
## lm(formula = x ~ y, data = graddo)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.4178 -2.3425  0.0424  2.3220  5.6825
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 29.11245    0.10640  273.62   <2e-16 ***
## y            0.06396    0.00419   15.27   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.795 on 3707 degrees of freedom
## Multiple R-squared:  0.05914,Adjusted R-squared:  0.05889
## F-statistic:   233 on 1 and 3707 DF,  p-value: < 2.2e-16

res <- residuals(reg)
est <- fitted.values(reg)
summary(reg)$sigma

## [1] 2.794876

summary(reg)$r.squared

## [1] 0.05914197
```

2.7. Es distinto el efecto de la variable age sobre los ingresos salariales para los graduados de secundaria quer para los ingresos universitarios. Explicar

Si, porque en el inciso 2.5 sòlo consideramos a las personas graduadas y en el inciso 2.6 consideramos a las personas que sòlo tienen secundaria. Son personas totalmente diferentes, por eso el efecto es diferente.