model

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library(tidyverse)  
library(arsenal)  
library(HH)  
library(olsrr)  
library(broom)  
library(formattable)  
library(htmltools)  
library(webshot)

data\_raw = data = read\_csv('./data/Lawsuit.csv') %>%  
 janitor::clean\_names()

## Warning in FUN(X[[i]], ...): strings not representable in native encoding will  
## be translated to UTF-8

data = read\_csv('./data/Lawsuit.csv') %>%  
 janitor::clean\_names() %>%  
 mutate(  
 dept = factor(dept, levels = c(1,2,3,4,5,6), labels = c("Biochemistry/Molecular Biology","Physiology","Genetics","Pediatrics","Medicine","Surgery")),  
 gender = factor(gender, levels = c(0,1), labels = c("Female","Male")),  
 clin = factor(clin, levels = c(0,1), labels = c("Primarily research emphasis","Primarily clinical emphasis")),  
 cert = factor(cert, levels = c(0,1), labels = c("not certified","Board certified")),  
 rank = factor(rank, levels = c(1,2,3), labels = c("Assistant","Associate","Full"))  
 )  
  
data$ln\_sal94 = log(data$sal94)  
data$ln\_sal95 = log(data$sal95)  
data$salavg = (data$sal94 + data$sal95)/2  
data$ln\_salavg = log(data$salavg)

# all covariates  
reg1 = lm(ln\_salavg ~ gender + dept + clin + prate + cert + exper + rank, data = data)  
summary(reg1)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender + dept + clin + prate + cert +   
## exper + rank, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.33729 -0.07685 -0.01218 0.07599 0.89829   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.140871 0.134757 82.674 < 2e-16 \*\*\*  
## genderMale 0.019536 0.020224 0.966 0.33500   
## deptPhysiology -0.175521 0.029090 -6.034 5.80e-09 \*\*\*  
## deptGenetics 0.169395 0.038791 4.367 1.85e-05 \*\*\*  
## deptPediatrics 0.153235 0.053632 2.857 0.00464 \*\*   
## deptMedicine 0.496297 0.045284 10.960 < 2e-16 \*\*\*  
## deptSurgery 0.870767 0.061638 14.127 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.164726 0.041145 4.004 8.25e-05 \*\*\*  
## prate -0.021730 0.017367 -1.251 0.21203   
## certBoard certified 0.190855 0.021238 8.987 < 2e-16 \*\*\*  
## exper 0.018027 0.001826 9.873 < 2e-16 \*\*\*  
## rankAssociate 0.132488 0.023595 5.615 5.25e-08 \*\*\*  
## rankFull 0.219399 0.026316 8.337 5.28e-15 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1335 on 248 degrees of freedom  
## Multiple R-squared: 0.9343, Adjusted R-squared: 0.9311   
## F-statistic: 293.9 on 12 and 248 DF, p-value: < 2.2e-16

vif(reg1) %>%   
 knitr::kable()

|  |  |
| --- | --- |
|  | x |
| genderMale | 1.443762 |
| deptPhysiology | 1.607184 |
| deptGenetics | 1.629419 |
| deptPediatrics | 4.282664 |
| deptMedicine | 6.379551 |
| deptSurgery | 7.215586 |
| clinPrimarily clinical emphasis | 5.877635 |
| prate | 16.626048 |
| certBoard certified | 1.329952 |
| exper | 1.884661 |
| rankAssociate | 1.508016 |
| rankFull | 2.225837 |

pred = data\_raw[,c(2, 4:8)]  
round(cor(pred), 3) %>%   
 broom::tidy() %>%   
 knitr::kable()

## Warning: 'tidy.matrix' is deprecated.  
## See help("Deprecated")

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| .rownames | dept | clin | cert | prate | exper | rank |
| dept | 1.000 | 0.613 | 0.374 | -0.867 | -0.128 | -0.174 |
| clin | 0.613 | 1.000 | 0.329 | -0.843 | -0.064 | -0.095 |
| cert | 0.374 | 0.329 | 1.000 | -0.388 | 0.100 | 0.014 |
| prate | -0.867 | -0.843 | -0.388 | 1.000 | 0.112 | 0.131 |
| exper | -0.128 | -0.064 | 0.100 | 0.112 | 1.000 | 0.648 |
| rank | -0.174 | -0.095 | 0.014 | 0.131 | 0.648 | 1.000 |

# all covariates except clin  
reg2 = lm(ln\_salavg ~ gender + dept + prate + cert + exper + rank, data = data)  
vif(reg2) %>%   
 knitr::kable()

|  |  |
| --- | --- |
|  | x |
| genderMale | 1.380331 |
| deptPhysiology | 1.589997 |
| deptGenetics | 1.593090 |
| deptPediatrics | 3.166892 |
| deptMedicine | 4.954141 |
| deptSurgery | 5.094382 |
| prate | 4.693166 |
| certBoard certified | 1.315310 |
| exper | 1.859083 |
| rankAssociate | 1.497978 |
| rankFull | 2.214993 |

# all covariates except prate  
reg3 = lm(ln\_salavg ~ gender + dept + clin + cert + exper + rank, data = data)  
vif(reg3) %>%   
 knitr::kable()

|  |  |
| --- | --- |
|  | x |
| genderMale | 1.356319 |
| deptPhysiology | 1.607121 |
| deptGenetics | 1.439383 |
| deptPediatrics | 1.894530 |
| deptMedicine | 2.704003 |
| deptSurgery | 2.392543 |
| clinPrimarily clinical emphasis | 1.659126 |
| certBoard certified | 1.327650 |
| exper | 1.852094 |
| rankAssociate | 1.499835 |
| rankFull | 2.209568 |

# dropping prate leads to lower mean vif

# gender only  
reg4 = lm(ln\_salavg ~ gender, data = data)  
summary(reg4)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -1.1255 -0.3659 -0.0078 0.3342 1.0549   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.63319 0.04595 253.162 < 2e-16 \*\*\*  
## genderMale 0.38530 0.05963 6.462 5.1e-10 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.4731 on 259 degrees of freedom  
## Multiple R-squared: 0.1388, Adjusted R-squared: 0.1355   
## F-statistic: 41.75 on 1 and 259 DF, p-value: 5.103e-10

# gender + dept  
reg5 = lm(ln\_salavg ~ gender + dept, data = data)  
summary(reg5)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender + dept, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.70544 -0.19433 -0.02501 0.16341 0.60779   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.34504 0.04110 276.036 < 2e-16 \*\*\*  
## genderMale 0.20521 0.03355 6.116 3.60e-09 \*\*\*  
## deptPhysiology -0.13194 0.05385 -2.450 0.01496 \*   
## deptGenetics 0.20092 0.06602 3.044 0.00258 \*\*   
## deptPediatrics 0.30535 0.05919 5.158 5.02e-07 \*\*\*  
## deptMedicine 0.64943 0.04569 14.215 < 2e-16 \*\*\*  
## deptSurgery 1.07668 0.05453 19.743 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.2534 on 254 degrees of freedom  
## Multiple R-squared: 0.7578, Adjusted R-squared: 0.752   
## F-statistic: 132.4 on 6 and 254 DF, p-value: < 2.2e-16

# gender + clin  
reg6 = lm(ln\_salavg ~ gender + clin, data = data)  
summary(reg6)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender + clin, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -1.00911 -0.25023 -0.01895 0.24564 0.99426   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.28894 0.04470 252.526 < 2e-16 \*\*\*  
## genderMale 0.33718 0.04671 7.218 5.89e-12 \*\*\*  
## clinPrimarily clinical emphasis 0.60819 0.04710 12.912 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.3694 on 258 degrees of freedom  
## Multiple R-squared: 0.4769, Adjusted R-squared: 0.4728   
## F-statistic: 117.6 on 2 and 258 DF, p-value: < 2.2e-16

# gender + cert  
reg7 = lm(ln\_salavg ~ gender + cert, data = data)  
summary(reg7)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender + cert, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -1.11866 -0.27669 -0.01921 0.31081 1.01942   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.28992 0.05510 204.888 < 2e-16 \*\*\*  
## genderMale 0.33285 0.05233 6.360 9.11e-10 \*\*\*  
## certBoard certified 0.51981 0.05726 9.078 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.4127 on 258 degrees of freedom  
## Multiple R-squared: 0.3473, Adjusted R-squared: 0.3423   
## F-statistic: 68.65 on 2 and 258 DF, p-value: < 2.2e-16

# gender + exper  
reg8 = lm(ln\_salavg ~ gender + exper, data = data)  
summary(reg8)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender + exper, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -1.03299 -0.37372 0.04036 0.33276 1.02947   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.50693 0.05839 197.079 < 2e-16 \*\*\*  
## genderMale 0.30755 0.06277 4.900 1.7e-06 \*\*\*  
## exper 0.01686 0.00496 3.399 0.000784 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.4637 on 258 degrees of freedom  
## Multiple R-squared: 0.1757, Adjusted R-squared: 0.1693   
## F-statistic: 27.5 on 2 and 258 DF, p-value: 1.488e-11

# gender + rank  
reg9 = lm(ln\_salavg ~ gender + rank, data = data)  
summary(reg9)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender + rank, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -1.10798 -0.37872 0.01491 0.35397 1.03532   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.615638 0.050964 227.919 < 2e-16 \*\*\*  
## genderMale 0.349481 0.064420 5.425 1.34e-07 \*\*\*  
## rankAssociate -0.005225 0.076187 -0.069 0.9454   
## rankFull 0.123166 0.073223 1.682 0.0938 .   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.4716 on 257 degrees of freedom  
## Multiple R-squared: 0.151, Adjusted R-squared: 0.1411   
## F-statistic: 15.23 on 3 and 257 DF, p-value: 3.747e-09

# all confounders  
summary(reg3)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender + dept + clin + cert + exper +   
## rank, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.34605 -0.07696 -0.01873 0.07596 0.90393   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 10.975773 0.027395 400.656 < 2e-16 \*\*\*  
## genderMale 0.025763 0.019624 1.313 0.19   
## deptPhysiology -0.175749 0.029122 -6.035 5.73e-09 \*\*\*  
## deptGenetics 0.185970 0.036501 5.095 6.90e-07 \*\*\*  
## deptPediatrics 0.203345 0.035712 5.694 3.48e-08 \*\*\*  
## deptMedicine 0.539304 0.029515 18.272 < 2e-16 \*\*\*  
## deptSurgery 0.933820 0.035533 26.280 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.208340 0.021885 9.520 < 2e-16 \*\*\*  
## certBoard certified 0.189749 0.021244 8.932 < 2e-16 \*\*\*  
## exper 0.017726 0.001812 9.783 < 2e-16 \*\*\*  
## rankAssociate 0.134663 0.023557 5.716 3.10e-08 \*\*\*  
## rankFull 0.222214 0.026249 8.466 2.22e-15 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1337 on 249 degrees of freedom  
## Multiple R-squared: 0.9339, Adjusted R-squared: 0.931   
## F-statistic: 319.7 on 11 and 249 DF, p-value: < 2.2e-16

# 3 + gender \* dept  
reg10 = lm(ln\_salavg ~ gender\*dept + clin + cert + exper + rank, data = data)  
summary(reg10)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender \* dept + clin + cert + exper +   
## rank, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.34206 -0.07681 -0.01587 0.07247 0.90312   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.002990 0.034998 314.389 < 2e-16 \*\*\*  
## genderMale -0.015893 0.040369 -0.394 0.694151   
## deptPhysiology -0.218213 0.043233 -5.047 8.76e-07 \*\*\*  
## deptGenetics 0.139604 0.051326 2.720 0.006999 \*\*   
## deptPediatrics 0.179095 0.045781 3.912 0.000119 \*\*\*  
## deptMedicine 0.524282 0.042333 12.385 < 2e-16 \*\*\*  
## deptSurgery 0.905280 0.070734 12.798 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.206082 0.022256 9.260 < 2e-16 \*\*\*  
## certBoard certified 0.185790 0.021591 8.605 9.47e-16 \*\*\*  
## exper 0.017540 0.001831 9.582 < 2e-16 \*\*\*  
## rankAssociate 0.137201 0.023824 5.759 2.54e-08 \*\*\*  
## rankFull 0.225945 0.026685 8.467 2.37e-15 \*\*\*  
## genderMale:deptPhysiology 0.077890 0.057948 1.344 0.180155   
## genderMale:deptGenetics 0.087661 0.071822 1.221 0.223442   
## genderMale:deptPediatrics 0.049162 0.065365 0.752 0.452705   
## genderMale:deptMedicine 0.030637 0.049940 0.613 0.540139   
## genderMale:deptSurgery 0.050314 0.075798 0.664 0.507446   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1343 on 244 degrees of freedom  
## Multiple R-squared: 0.9346, Adjusted R-squared: 0.9303   
## F-statistic: 217.9 on 16 and 244 DF, p-value: < 2.2e-16

# 3 + gender \* clin  
reg11 = lm(ln\_salavg ~ gender\*clin + dept + cert + exper + rank, data = data)  
summary(reg11)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender \* clin + dept + cert + exper +   
## rank, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.35356 -0.07897 -0.01664 0.07976 0.89318   
##   
## Coefficients:  
## Estimate Std. Error t value  
## (Intercept) 10.962217 0.030588 358.381  
## genderMale 0.048214 0.029882 1.613  
## clinPrimarily clinical emphasis 0.227322 0.029017 7.834  
## deptPhysiology -0.174042 0.029173 -5.966  
## deptGenetics 0.192013 0.037002 5.189  
## deptPediatrics 0.202340 0.035727 5.664  
## deptMedicine 0.540691 0.029549 18.298  
## deptSurgery 0.938772 0.035880 26.165  
## certBoard certified 0.191900 0.021353 8.987  
## exper 0.017960 0.001827 9.829  
## rankAssociate 0.130965 0.023848 5.492  
## rankFull 0.215522 0.027096 7.954  
## genderMale:clinPrimarily clinical emphasis -0.036750 0.036888 -0.996  
## Pr(>|t|)   
## (Intercept) < 2e-16 \*\*\*  
## genderMale 0.108   
## clinPrimarily clinical emphasis 1.38e-13 \*\*\*  
## deptPhysiology 8.35e-09 \*\*\*  
## deptGenetics 4.39e-07 \*\*\*  
## deptPediatrics 4.09e-08 \*\*\*  
## deptMedicine < 2e-16 \*\*\*  
## deptSurgery < 2e-16 \*\*\*  
## certBoard certified < 2e-16 \*\*\*  
## exper < 2e-16 \*\*\*  
## rankAssociate 9.85e-08 \*\*\*  
## rankFull 6.41e-14 \*\*\*  
## genderMale:clinPrimarily clinical emphasis 0.320   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1337 on 248 degrees of freedom  
## Multiple R-squared: 0.9341, Adjusted R-squared: 0.931   
## F-statistic: 293.2 on 12 and 248 DF, p-value: < 2.2e-16

# 3 + gender \* cert  
reg12 = lm(ln\_salavg ~ gender\*cert + dept + clin + exper + rank, data = data)  
summary(reg12)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender \* cert + dept + clin + exper +   
## rank, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.34790 -0.07963 -0.01940 0.07547 0.90001   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 10.970526 0.031172 351.936 < 2e-16 \*\*\*  
## genderMale 0.035345 0.033399 1.058 0.291   
## certBoard certified 0.197307 0.030107 6.553 3.23e-10 \*\*\*  
## deptPhysiology -0.174932 0.029264 -5.978 7.84e-09 \*\*\*  
## deptGenetics 0.187449 0.036802 5.094 6.96e-07 \*\*\*  
## deptPediatrics 0.202155 0.035932 5.626 4.96e-08 \*\*\*  
## deptMedicine 0.538928 0.029586 18.216 < 2e-16 \*\*\*  
## deptSurgery 0.934320 0.035623 26.228 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.209165 0.022047 9.487 < 2e-16 \*\*\*  
## exper 0.017703 0.001816 9.746 < 2e-16 \*\*\*  
## rankAssociate 0.134115 0.023649 5.671 3.94e-08 \*\*\*  
## rankFull 0.222681 0.026328 8.458 2.37e-15 \*\*\*  
## genderMale:certBoard certified -0.013808 0.038910 -0.355 0.723   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1339 on 248 degrees of freedom  
## Multiple R-squared: 0.9339, Adjusted R-squared: 0.9307   
## F-statistic: 292.1 on 12 and 248 DF, p-value: < 2.2e-16

# 3 + gender \* exper  
reg13 = lm(ln\_salavg ~ gender\*exper + dept + clin + cert + rank, data = data)  
summary(reg13)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender \* exper + dept + clin + cert +   
## rank, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.32130 -0.07860 -0.00987 0.07100 0.86910   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 10.903325 0.034805 313.272 < 2e-16 \*\*\*  
## genderMale 0.128932 0.036912 3.493 0.000566 \*\*\*  
## exper 0.027774 0.003545 7.834 1.38e-13 \*\*\*  
## deptPhysiology -0.165069 0.028755 -5.741 2.75e-08 \*\*\*  
## deptGenetics 0.189770 0.035827 5.297 2.60e-07 \*\*\*  
## deptPediatrics 0.218603 0.035342 6.185 2.54e-09 \*\*\*  
## deptMedicine 0.546771 0.029045 18.825 < 2e-16 \*\*\*  
## deptSurgery 0.939830 0.034907 26.924 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.208175 0.021470 9.696 < 2e-16 \*\*\*  
## certBoard certified 0.182166 0.020969 8.688 5.09e-16 \*\*\*  
## rankAssociate 0.118231 0.023648 5.000 1.09e-06 \*\*\*  
## rankFull 0.208036 0.026112 7.967 5.90e-14 \*\*\*  
## genderMale:exper -0.011728 0.003580 -3.276 0.001204 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1312 on 248 degrees of freedom  
## Multiple R-squared: 0.9366, Adjusted R-squared: 0.9336   
## F-statistic: 305.4 on 12 and 248 DF, p-value: < 2.2e-16

# 3 + gender \* rank  
reg14 = lm(ln\_salavg ~ gender\*rank + dept + clin + cert + exper, data = data)  
summary(reg14)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender \* rank + dept + clin + cert +   
## exper, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.32667 -0.08080 -0.01075 0.07646 0.86686   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 10.959335 0.027936 392.307 < 2e-16 \*\*\*  
## genderMale 0.074479 0.027568 2.702 0.00738 \*\*   
## rankAssociate 0.173142 0.033904 5.107 6.55e-07 \*\*\*  
## rankFull 0.282281 0.039594 7.129 1.11e-11 \*\*\*  
## deptPhysiology -0.175544 0.028871 -6.080 4.53e-09 \*\*\*  
## deptGenetics 0.184572 0.036206 5.098 6.84e-07 \*\*\*  
## deptPediatrics 0.208468 0.035528 5.868 1.41e-08 \*\*\*  
## deptMedicine 0.543204 0.029364 18.499 < 2e-16 \*\*\*  
## deptSurgery 0.931388 0.035267 26.409 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.197031 0.022175 8.885 < 2e-16 \*\*\*  
## certBoard certified 0.191213 0.021363 8.951 < 2e-16 \*\*\*  
## exper 0.018171 0.001806 10.064 < 2e-16 \*\*\*  
## genderMale:rankAssociate -0.082943 0.044750 -1.853 0.06501 .   
## genderMale:rankFull -0.105271 0.046654 -2.256 0.02492 \*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1325 on 247 degrees of freedom  
## Multiple R-squared: 0.9355, Adjusted R-squared: 0.9322   
## F-statistic: 275.8 on 13 and 247 DF, p-value: < 2.2e-16

# both exper and rank are modifiers  
# 3 + gender \* rank + gender \* exper  
reg15 = lm(ln\_salavg ~ gender\*rank + gender\*exper + dept + clin + cert, data = data)  
summary(reg15)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender \* rank + gender \* exper + dept +   
## clin + cert, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.31795 -0.07929 -0.01275 0.07078 0.85987   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 10.906051 0.036673 297.390 < 2e-16 \*\*\*  
## genderMale 0.133412 0.038125 3.499 0.000554 \*\*\*  
## rankAssociate 0.141497 0.036537 3.873 0.000138 \*\*\*  
## rankFull 0.217020 0.049074 4.422 1.47e-05 \*\*\*  
## exper 0.026849 0.004302 6.241 1.89e-09 \*\*\*  
## deptPhysiology -0.166053 0.028962 -5.733 2.87e-08 \*\*\*  
## deptGenetics 0.188370 0.035963 5.238 3.49e-07 \*\*\*  
## deptPediatrics 0.219621 0.035606 6.168 2.82e-09 \*\*\*  
## deptMedicine 0.548131 0.029218 18.760 < 2e-16 \*\*\*  
## deptSurgery 0.939254 0.035170 26.706 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.205465 0.022327 9.203 < 2e-16 \*\*\*  
## certBoard certified 0.181479 0.021644 8.385 3.97e-15 \*\*\*  
## genderMale:rankAssociate -0.040275 0.048384 -0.832 0.405994   
## genderMale:rankFull -0.018879 0.060486 -0.312 0.755215   
## genderMale:exper -0.010471 0.004719 -2.219 0.027410 \*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1315 on 246 degrees of freedom  
## Multiple R-squared: 0.9368, Adjusted R-squared: 0.9332   
## F-statistic: 260.5 on 14 and 246 DF, p-value: < 2.2e-16

# gender \* rank becomes non-significant  
# reg15 is not superior compared to reg13  
reg1315 = anova(reg13, reg15)  
  
# reg15 is superior compared to 14  
reg1415 = anova(reg14, reg15)  
  
# make table for the result for anova  
nested\_anova = data.frame(  
 Fstatistics = c(reg1315$F, reg1415$F),  
 P.value = c(reg1315$`Pr(>F)`, reg1415$`Pr(>F)`)  
) %>%   
 drop\_na()   
  
nested\_anova$model = c("reg13 VS reg15", "reg14 VS reg15")  
nested\_anova = nested\_anova %>%   
 dplyr::select(model, everything())  
nested\_anova %>%   
 knitr::kable()

|  |  |  |  |
| --- | --- | --- | --- |
|  | model | Fstatistics | P.value |
| 2 | reg13 VS reg15 | 0.3543116 | 0.7020138 |
| 4 | reg14 VS reg15 | 4.9232674 | 0.0274105 |

# reg13 reg14 is similar  
summary\_reg13 = summary(reg13)  
summary\_reg14 = summary(reg14)  
# make table for the result  
anova\_table =   
data.frame(adj.R2 = c(summary\_reg13$adj.r.squared,summary\_reg14$adj.r.squared),  
Fstatistics = c(summary\_reg13$fstatistic,summary\_reg14$fstatistic)  
)  
anova\_table1 = data.frame(anova\_table[c(1,4),])  
anova\_table1$F.test = c(1.79, 1.76)  
anova\_table1$model = c("model1","model2")  
anova\_table1 = anova\_table1 %>%   
 dplyr::select(model, adj.R2, Fstatistics, F.test) %>% knitr::kable()  
anova\_table1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | model | adj.R2 | Fstatistics | F.test |
| 1 | model1 | 0.9335614 | 305.4488 | 1.79 |
| 4 | model2 | 0.9321528 | 275.7799 | 1.76 |

# piecewise regression  
data$experstar = ifelse(data$exper<16, 0, data$exper-16)  
reg\_spline = lm(ln\_salavg ~ gender\*exper + dept + clin + cert + experstar + rank, data = data)  
summary(reg\_spline)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender \* exper + dept + clin + cert +   
## experstar + rank, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.32096 -0.07645 -0.00968 0.07007 0.87885   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 10.899237 0.035283 308.905 < 2e-16 \*\*\*  
## genderMale 0.117105 0.040334 2.903 0.00403 \*\*   
## exper 0.028553 0.003705 7.706 3.15e-13 \*\*\*  
## deptPhysiology -0.162634 0.028974 -5.613 5.33e-08 \*\*\*  
## deptGenetics 0.190000 0.035862 5.298 2.59e-07 \*\*\*  
## deptPediatrics 0.220203 0.035443 6.213 2.19e-09 \*\*\*  
## deptMedicine 0.548676 0.029188 18.798 < 2e-16 \*\*\*  
## deptSurgery 0.940754 0.034962 26.908 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.208271 0.021490 9.691 < 2e-16 \*\*\*  
## certBoard certified 0.181101 0.021039 8.608 8.84e-16 \*\*\*  
## experstar -0.004059 0.005553 -0.731 0.46549   
## rankAssociate 0.113039 0.024713 4.574 7.57e-06 \*\*\*  
## rankFull 0.200268 0.028215 7.098 1.34e-11 \*\*\*  
## genderMale:exper -0.010380 0.004031 -2.575 0.01060 \*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1313 on 247 degrees of freedom  
## Multiple R-squared: 0.9368, Adjusted R-squared: 0.9334   
## F-statistic: 281.5 on 13 and 247 DF, p-value: < 2.2e-16

# compare with and without interaction term  
anova(reg3, reg13)

## Analysis of Variance Table  
##   
## Model 1: ln\_salavg ~ gender + dept + clin + cert + exper + rank  
## Model 2: ln\_salavg ~ gender \* exper + dept + clin + cert + rank  
## Res.Df RSS Df Sum of Sq F Pr(>F)   
## 1 249 4.4506   
## 2 248 4.2660 1 0.18458 10.731 0.001204 \*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

# compare linear and piecewise  
anova(reg13, reg\_spline)

## Analysis of Variance Table  
##   
## Model 1: ln\_salavg ~ gender \* exper + dept + clin + cert + rank  
## Model 2: ln\_salavg ~ gender \* exper + dept + clin + cert + experstar +   
## rank  
## Res.Df RSS Df Sum of Sq F Pr(>F)  
## 1 248 4.2660   
## 2 247 4.2568 1 0.0092083 0.5343 0.4655

# AIC  
AIC(reg13)

## [1] -305.0287

AIC(reg14)

## [1] -298.6076

AIC(reg\_spline)

## [1] -303.5927

# BIC   
AIC(reg13, k = log(length(data$ln\_salavg)))

## [1] -255.1254

AIC(reg14, k = log(length(data$ln\_salavg)))

## [1] -245.1398

AIC(reg\_spline, k = log(length(data$ln\_salavg)))

## [1] -250.1249

png('reg13%03d.png', width = 6, height = 6, units='in', res = 300)  
plot(reg13, ask = FALSE)  
ols\_plot\_resid\_stud\_fit(reg13)  
ols\_plot\_resid\_lev(reg13)  
dev.off()

## png   
## 2

png("reg13all.png", width= 6, height = 6, units = 'in', res = 300)  
layout(matrix(1:4, ncol = 2))  
plot(reg13, ask = FALSE)  
dev.off()

## png   
## 2

# stratification by exper  
data\_low = filter(data, exper < 10)  
data\_medium = filter(data, exper >= 10 & exper < 20)  
data\_high = filter(data, exper >= 20)  
reg\_low = lm(ln\_salavg ~ gender + dept + clin + cert + rank, data = data\_low)  
summary(reg\_low)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender + dept + clin + cert + rank,   
## data = data\_low)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.33887 -0.08354 -0.00479 0.08268 0.74977   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.07409 0.03858 287.021 < 2e-16 \*\*\*  
## genderMale 0.07255 0.02679 2.709 0.007683 \*\*   
## deptPhysiology -0.22757 0.04664 -4.879 3.11e-06 \*\*\*  
## deptGenetics 0.19782 0.05757 3.436 0.000796 \*\*\*  
## deptPediatrics 0.23605 0.05733 4.118 6.82e-05 \*\*\*  
## deptMedicine 0.58380 0.05086 11.479 < 2e-16 \*\*\*  
## deptSurgery 0.95601 0.06027 15.862 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.16923 0.03561 4.752 5.31e-06 \*\*\*  
## certBoard certified 0.14907 0.03083 4.836 3.74e-06 \*\*\*  
## rankAssociate 0.14613 0.03223 4.534 1.31e-05 \*\*\*  
## rankFull 0.28070 0.04321 6.497 1.66e-09 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1431 on 128 degrees of freedom  
## Multiple R-squared: 0.9203, Adjusted R-squared: 0.9141   
## F-statistic: 147.8 on 10 and 128 DF, p-value: < 2.2e-16

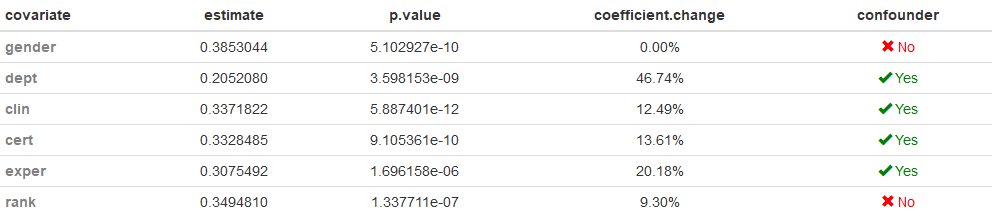
reg\_medium = lm(ln\_salavg ~ gender + dept + clin + cert + rank, data = data\_medium)  
summary(reg\_medium)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender + dept + clin + cert + rank,   
## data = data\_medium)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.32538 -0.09266 -0.00250 0.09039 0.24601   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.24358 0.04416 254.626 < 2e-16 \*\*\*  
## genderMale -0.02091 0.03006 -0.696 0.48841   
## deptPhysiology -0.13374 0.03997 -3.346 0.00119 \*\*   
## deptGenetics 0.17225 0.05037 3.420 0.00094 \*\*\*  
## deptPediatrics 0.16019 0.04729 3.387 0.00104 \*\*   
## deptMedicine 0.48815 0.03931 12.418 < 2e-16 \*\*\*  
## deptSurgery 0.92571 0.04814 19.231 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.24927 0.03009 8.283 9.90e-13 \*\*\*  
## certBoard certified 0.21901 0.03165 6.921 6.14e-10 \*\*\*  
## rankAssociate 0.11412 0.04078 2.799 0.00627 \*\*   
## rankFull 0.21777 0.03933 5.537 2.95e-07 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.12 on 91 degrees of freedom  
## Multiple R-squared: 0.9419, Adjusted R-squared: 0.9355   
## F-statistic: 147.4 on 10 and 91 DF, p-value: < 2.2e-16

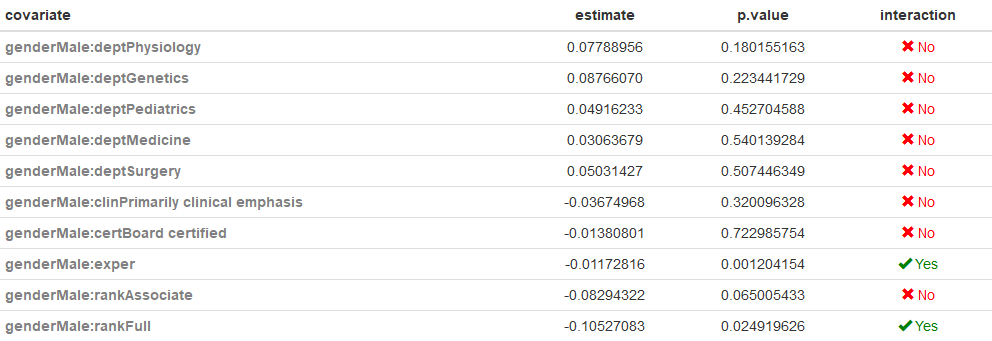
reg\_high = lm(ln\_salavg ~ gender + dept + clin + cert + rank, data = data\_high)  
summary(reg\_high)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender + dept + clin + cert + rank,   
## data = data\_high)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.17144 -0.08454 0.03411 0.06116 0.12144   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.41268 0.18527 61.600 2.55e-15 \*\*\*  
## genderMale 0.23344 0.14897 1.567 0.14541   
## deptPhysiology -0.19732 0.08750 -2.255 0.04549 \*   
## deptGenetics 0.03156 0.14016 0.225 0.82598   
## deptMedicine 0.56460 0.09137 6.179 6.91e-05 \*\*\*  
## deptSurgery 0.84820 0.10010 8.473 3.77e-06 \*\*\*  
## clinPrimarily clinical emphasis 0.08608 0.08052 1.069 0.30791   
## certBoard certified 0.35944 0.08259 4.352 0.00115 \*\*   
## rankFull -0.05353 0.08459 -0.633 0.53975   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1204 on 11 degrees of freedom  
## Multiple R-squared: 0.9652, Adjusted R-squared: 0.9399   
## F-statistic: 38.17 on 8 and 11 DF, p-value: 5.988e-07

# function to export formattable  
export\_formattable = function(f, file, width = "100%", height = NULL, background = "white", delay = 0.2)  
 {w = as.htmlwidget(f, width = width, height = height)  
 path = html\_print(w, background = background, viewer = NULL)  
 url = paste0("file:///", gsub("\\\\", "/", normalizePath(path)))  
 webshot(url,  
 file = file,  
 selector = ".formattable\_widget",  
 delay = delay)  
 }  
# confounding  
tidy4 = tidy(reg4)  
tidy5 = tidy(reg5)  
tidy6 = tidy(reg6)  
tidy7 = tidy(reg7)  
tidy8 = tidy(reg8)  
tidy9 = tidy(reg9)  
con\_df = rbind(tidy4[2, c(2:5)], tidy5[2, c(2:5)], tidy6[2, c(2:5)], tidy7[2, c(2:5)], tidy8[2, c(2:5)], tidy9[2, c(2:5)])  
con\_df$coefficient.change = abs((con\_df$estimate-tidy4$estimate[2])/tidy4$estimate[2])  
con\_df$confounder = con\_df$coefficient.change  
con\_df$covariate = c("gender", "dept", "clin", "cert", "exper", "rank")  
con\_ft = formattable(con\_df[, c(7,1,4,5,6)],   
 align = c("l", rep("c", 4)),  
 list(`covariate` = formatter("span", style = ~ style(color = "grey", font.weight = "bold")), `coefficient.change` = percent, `confounder` = formatter("span", x ~ icontext(ifelse(x > 0.1, "ok", "remove"), ifelse(x > 0.1, "Yes", "No")), style = x ~ style(color = ifelse(x > 0.1, "green", "red"))))  
 )  
# export formattable con\_ft  
export\_formattable(con\_ft,"con\_ft.png")



# interaction  
tidy10 = tidy(reg10)  
tidy11 = tidy(reg11)  
tidy12 = tidy(reg12)  
tidy13 = tidy(reg13)  
tidy14 = tidy(reg14)  
int\_df = rbind(tidy10[c(13:17), c(1:5)], tidy11[13, c(1:5)], tidy12[13, c(1:5)], tidy13[13, c(1:5)], tidy14[c(13:14), c(1:5)])  
int\_df$interaction = int\_df$p.value  
names(int\_df)[1] = "covariate"  
int\_ft = formattable(int\_df[, c(1,2,5,6)],   
 align = c("l", rep("c", 3)),  
 list(`covariate` = formatter("span", style = ~ style(color = "grey", font.weight = "bold")), `interaction` = formatter("span", x ~ icontext(ifelse(x < 0.05, "ok", "remove"), ifelse(x < 0.05, "Yes", "No")), style = x ~ style(color = ifelse(x < 0.05, "green", "red"))))  
 )  
# export formattable int\_ft  
export\_formattable(int\_ft,"int\_ft.png")



influence.measures(reg13)

## Influence measures of  
## lm(formula = ln\_salavg ~ gender \* exper + dept + clin + cert + rank, data = data) :  
##   
## dfb.1\_ dfb.gndM dfb.expr dfb.dptPh dfb.dptG dfb.dptPd dfb.dptM  
## 1 -6.64e-02 -1.88e-02 2.64e-02 5.74e-02 4.88e-02 2.83e-02 4.45e-02  
## 2 -6.46e-02 -2.00e-02 1.37e-02 6.49e-02 5.71e-02 4.55e-02 5.96e-02  
## 3 -2.86e-02 -3.17e-02 -1.09e-02 2.60e-02 2.59e-02 1.71e-02 2.81e-02  
## 4 -2.20e-02 2.96e-02 3.79e-03 5.07e-02 4.29e-02 5.13e-02 7.06e-02  
## 5 2.96e-02 7.28e-03 -1.10e-02 -2.57e-02 -2.19e-02 -1.24e-02 -1.98e-02  
## 6 -1.60e-01 -1.54e-02 1.30e-01 1.97e-01 1.25e-01 1.68e-01 1.97e-01  
## 7 -8.53e-03 -1.74e-03 6.47e-03 1.28e-02 8.38e-03 1.38e-02 1.47e-02  
## 8 1.01e-01 4.50e-03 -8.64e-02 -1.75e-01 -1.48e-01 -1.91e-01 -2.44e-01  
## 9 -1.43e-01 1.44e-02 1.73e-02 1.29e-01 1.10e-01 4.78e-02 9.14e-02  
## 10 5.56e-02 1.97e-02 -1.38e-02 -5.55e-02 -4.88e-02 -3.95e-02 -5.12e-02  
## 11 5.35e-04 1.16e-04 -7.30e-05 -5.45e-04 -4.80e-04 -3.70e-04 -4.94e-04  
## 12 9.37e-02 2.49e-02 -7.42e-02 -1.38e-01 -9.10e-02 -1.50e-01 -1.59e-01  
## 13 -2.40e-02 1.03e-02 1.50e-02 4.63e-02 3.91e-02 4.90e-02 6.45e-02  
## 14 -5.24e-02 -3.26e-03 6.43e-04 5.47e-02 4.82e-02 3.52e-02 4.86e-02  
## 15 9.41e-02 2.92e-02 -1.99e-02 -9.46e-02 -8.32e-02 -6.62e-02 -8.67e-02  
## 16 -1.40e-02 -3.97e-03 5.57e-03 1.21e-02 1.03e-02 5.97e-03 9.38e-03  
## 17 -1.84e-02 9.95e-05 3.49e-03 1.64e-02 1.40e-02 6.59e-03 1.19e-02  
## 18 3.67e-02 5.40e-03 -3.08e-02 -4.47e-02 -2.85e-02 -3.86e-02 -4.50e-02  
## 19 -1.49e-02 3.07e-02 -2.53e-02 2.03e-02 1.83e-02 5.80e-03 1.44e-02  
## 20 2.23e-02 -2.85e-03 -1.55e-02 -2.84e-02 -1.79e-02 -2.35e-02 -2.81e-02  
## 21 6.42e-02 -7.76e-02 -8.60e-03 -9.75e-02 -5.83e-02 -6.82e-02 -9.02e-02  
## 22 4.13e-02 3.46e-03 -1.05e-02 -3.65e-02 -3.11e-02 -1.56e-02 -2.70e-02  
## 23 8.01e-02 -2.58e-02 -4.76e-02 -1.06e-01 -6.59e-02 -8.46e-02 -1.03e-01  
## 24 3.79e-02 -3.03e-02 -1.31e-02 -5.42e-02 -3.30e-02 -4.02e-02 -5.12e-02  
## 25 -5.83e-02 -1.14e-02 5.04e-02 7.03e-02 4.50e-02 6.13e-02 7.10e-02  
## 26 -8.81e-02 4.11e-02 4.58e-02 1.19e-01 7.37e-02 9.31e-02 1.15e-01  
## 27 -1.72e-02 -1.07e-03 2.10e-04 1.79e-02 1.58e-02 1.15e-02 1.59e-02  
## 28 -1.86e-02 4.74e-03 1.17e-02 2.43e-02 1.52e-02 1.96e-02 2.38e-02  
## 29 -6.03e-03 1.15e-03 4.00e-03 7.79e-03 4.88e-03 6.36e-03 7.65e-03  
## 30 -4.22e-03 -4.53e-03 -1.80e-03 3.85e-03 3.85e-03 2.48e-03 4.15e-03  
## 31 9.04e-02 -4.86e-02 -5.22e-02 -4.35e-02 -3.59e-02 -3.65e-02 -3.70e-02  
## 32 -1.30e-02 1.13e-03 -2.94e-02 5.52e-02 3.74e-02 5.96e-02 5.41e-02  
## 33 -1.94e-01 7.89e-02 4.07e-02 1.73e-01 1.20e-01 1.89e-01 1.86e-01  
## 34 5.64e-04 5.05e-03 1.21e-02 -6.76e-03 -6.62e-03 -4.18e-03 -4.74e-03  
## 35 -4.61e-02 2.32e-02 1.30e-02 3.72e-02 3.11e-02 2.92e-02 2.75e-02  
## 36 -2.74e-03 5.63e-04 -7.86e-05 1.84e-03 1.68e-03 1.36e-03 1.56e-03  
## 37 -7.66e-03 5.06e-02 9.06e-02 -3.78e-02 -3.79e-02 -9.65e-03 -1.88e-02  
## 38 -6.78e-02 4.41e-02 4.79e-02 4.18e-02 2.75e-02 4.68e-02 4.37e-02  
## 39 1.33e-02 -2.32e-02 -4.26e-02 3.40e-02 3.19e-02 3.65e-02 4.58e-02  
## 40 1.80e-02 4.30e-03 1.58e-02 -2.45e-02 -2.17e-02 -1.11e-02 -1.39e-02  
## 41 1.05e-01 -5.30e-02 -2.96e-02 -8.49e-02 -7.10e-02 -6.67e-02 -6.29e-02  
## 42 2.99e-02 2.65e-02 7.28e-02 -7.05e-02 -5.31e-02 -7.44e-02 -7.88e-02  
## 43 9.30e-02 2.07e-02 1.00e-01 -1.49e-01 -1.10e-01 -1.59e-01 -1.65e-01  
## 44 2.24e-02 -5.21e-02 -9.37e-02 4.69e-02 4.93e-02 5.96e-02 7.73e-02  
## 45 -1.52e-02 -1.69e-03 -9.20e-03 1.29e-02 1.25e-02 8.85e-03 1.09e-02  
## 46 2.42e-01 -7.38e-02 -3.70e-02 -1.49e-01 -1.33e-01 -1.13e-01 -1.26e-01  
## 47 -3.28e-04 1.73e-03 7.49e-03 -1.18e-02 -1.07e-02 -1.50e-02 -1.68e-02  
## 48 5.67e-03 2.46e-02 4.73e-02 -1.85e-02 -2.04e-02 -9.94e-03 -1.56e-02  
## 49 -9.86e-02 4.87e-02 3.83e-02 7.82e-02 5.36e-02 8.59e-02 8.34e-02  
## 50 -4.93e-02 4.76e-03 -2.10e-02 6.14e-02 4.43e-02 6.59e-02 6.72e-02  
## 51 -3.36e-02 6.42e-02 3.80e-02 7.83e-02 -1.54e-02 -3.21e-02 -5.40e-02  
## 52 -3.00e-03 5.51e-03 -5.34e-03 1.30e-02 -3.28e-03 -6.18e-03 -9.18e-03  
## 53 4.21e-03 -1.30e-02 1.19e-02 -3.62e-02 -6.83e-03 -3.61e-03 -4.77e-03  
## 54 -7.84e-03 -5.34e-03 3.06e-03 1.82e-02 -1.72e-03 -3.00e-03 -7.26e-03  
## 55 5.96e-03 -9.58e-03 9.37e-03 -3.93e-02 -8.02e-03 -5.37e-03 -6.36e-03  
## 56 7.80e-02 -9.18e-02 3.63e-02 -2.89e-01 -5.63e-02 7.94e-03 -1.71e-02  
## 57 1.30e-02 1.06e-02 -6.60e-03 -2.88e-02 2.24e-03 3.82e-03 1.06e-02  
## 58 -1.37e-01 -1.20e-01 1.26e-01 2.91e-01 8.48e-02 6.62e-02 7.63e-02  
## 59 2.54e-02 8.04e-03 -7.02e-02 -2.56e-01 -3.80e-02 -1.39e-01 -1.19e-01  
## 60 -1.05e-02 2.03e-02 1.64e-02 7.92e-02 8.52e-03 2.65e-02 2.55e-02  
## 61 -2.83e-02 4.56e-02 -4.46e-02 1.87e-01 3.82e-02 2.56e-02 3.03e-02  
## 62 1.25e-02 9.44e-02 -1.48e-02 2.18e-01 1.68e-02 9.28e-02 7.97e-02  
## 63 4.95e-03 -8.20e-02 2.41e-03 -1.43e-01 -8.41e-03 -3.51e-02 -3.56e-02  
## 64 -3.32e-02 4.21e-02 -4.25e-02 2.04e-01 4.26e-02 3.03e-02 3.49e-02  
## 65 -4.16e-02 -8.20e-04 -7.48e-03 1.18e-01 -1.87e-02 -3.43e-02 -6.19e-02  
## 66 1.81e-03 2.50e-04 1.40e-04 -4.96e-03 7.36e-04 1.34e-03 2.50e-03  
## 67 -2.45e-03 -2.16e-02 2.24e-03 -5.44e-02 -4.50e-03 -2.37e-02 -2.03e-02  
## 68 3.90e-04 -2.63e-03 -3.46e-04 -5.66e-03 -4.30e-04 -1.57e-03 -1.55e-03  
## 69 2.83e-02 -8.83e-02 -2.41e-02 -7.83e-02 2.00e-02 4.14e-02 6.34e-02  
## 70 -1.81e-02 1.31e-02 -1.47e-02 9.79e-02 2.14e-02 1.68e-02 1.86e-02  
## 71 1.79e-03 5.61e-04 -1.03e-03 -3.75e-03 9.42e-04 2.59e-03 2.36e-03  
## 72 -1.07e-02 1.16e-02 1.10e-02 -1.67e-02 -2.01e-03 3.61e-03 -1.37e-04  
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## 74 -9.04e-03 9.19e-03 -2.85e-03 -5.31e-02 2.21e-02 5.82e-03 1.21e-02  
## 75 -1.12e-02 1.72e-02 3.34e-04 -6.25e-02 -3.18e-03 -1.22e-02 -2.34e-02  
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## 78 -4.07e-03 5.77e-03 -2.98e-03 -3.71e-02 -5.58e-03 2.45e-03 -3.49e-03  
## 79 -4.98e-02 1.59e-02 5.26e-02 8.49e-02 1.71e-02 2.08e-03 1.94e-02  
## 80 -6.12e-02 6.63e-02 6.25e-02 -9.51e-02 -1.15e-02 2.06e-02 -7.82e-04  
## 81 6.79e-02 -3.60e-02 -1.60e-02 1.12e-01 1.40e-03 2.13e-02 3.18e-02  
## 82 -3.03e-01 2.23e-01 2.29e-01 -2.55e-01 8.19e-03 -1.77e-02 -5.61e-02  
## 83 -1.68e-02 2.58e-02 5.00e-04 -9.35e-02 -4.75e-03 -1.82e-02 -3.50e-02  
## 84 -1.07e-01 8.23e-02 8.52e-02 -6.81e-02 4.23e-02 4.15e-02 4.81e-02  
## 85 -1.04e-03 1.16e-03 9.06e-04 -2.30e-03 -3.02e-04 3.74e-04 -8.94e-05  
## 86 -3.96e-03 3.95e-03 1.07e-02 1.83e-02 -6.40e-03 2.93e-05 -2.59e-03  
## 87 -2.67e-02 2.85e-02 2.96e-02 -3.15e-02 -3.43e-03 8.64e-03 7.80e-04  
## 88 -1.67e-01 1.06e-01 1.99e-01 1.23e-01 -1.37e-02 -3.42e-02 -3.90e-02  
## 89 1.70e-02 -9.74e-03 -4.59e-03 2.28e-02 -1.10e-02 -8.19e-03 -1.14e-02  
## 90 -7.03e-02 3.73e-02 1.65e-02 -1.16e-01 -1.45e-03 -2.21e-02 -3.30e-02  
## 91 4.33e-03 4.84e-03 5.65e-05 -2.63e-03 -2.55e-02 -4.73e-03 -5.57e-03  
## 92 9.96e-03 -2.51e-02 -1.86e-03 -1.82e-02 -1.53e-01 -3.48e-02 -3.97e-02  
## 93 -1.83e-02 4.58e-02 9.03e-03 -5.18e-03 8.02e-02 -2.35e-02 -3.37e-02  
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## 97 -2.85e-02 -7.21e-03 -2.69e-02 -1.38e-02 1.57e-01 -2.59e-02 -3.97e-02  
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## 105 6.62e-03 1.33e-02 4.84e-03 6.43e-03 -4.44e-02 1.78e-02 1.37e-02  
## 106 -1.26e-02 9.28e-03 5.63e-03 -1.82e-03 -3.18e-02 -4.57e-03 -7.77e-03  
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## 110 -1.69e-02 -1.33e-02 4.26e-02 2.27e-02 2.23e-01 4.34e-02 7.30e-02  
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## 114 -9.06e-03 9.30e-03 1.07e-03 -4.75e-04 -1.13e-03 2.16e-02 -4.79e-03  
## 115 -2.25e-02 1.10e-02 9.29e-03 9.60e-04 -7.58e-04 4.93e-02 -7.45e-03  
## 116 2.08e-02 -4.18e-02 1.20e-02 -2.09e-02 -3.46e-02 -1.63e-01 -5.76e-02  
## 117 -5.61e-03 1.54e-02 6.71e-03 4.80e-04 -1.21e-03 1.51e-02 -4.12e-03  
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## 120 -7.30e-03 2.21e-02 1.33e-02 1.36e-02 9.88e-03 7.56e-02 3.12e-02  
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## 123 4.40e-02 -4.22e-02 2.57e-03 3.42e-02 5.48e-02 2.71e-01 9.48e-02  
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## 127 1.58e-01 -1.22e-01 -2.02e-01 -1.66e-02 -1.53e-03 -1.68e-01 -2.15e-02  
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## 130 1.46e-02 -4.46e-02 -3.74e-02 -1.25e-02 -8.51e-03 5.01e-02 -1.44e-02  
## 131 -6.23e-02 -4.14e-04 5.44e-02 -6.35e-03 -9.67e-03 1.32e-01 -1.33e-02  
## 132 -8.13e-02 9.07e-02 5.57e-02 3.00e-02 3.32e-02 -1.99e-01 6.07e-02  
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## 135 2.02e-01 -2.05e-01 -3.60e-01 -9.10e-02 -8.20e-02 -3.65e-01 -1.50e-01  
## 136 4.54e-02 -4.44e-02 -2.62e-02 1.61e-02 3.07e-02 1.55e-01 5.26e-02  
## 137 -7.68e-02 8.67e-02 8.18e-02 1.81e-02 2.80e-02 -1.05e-01 1.31e-03  
## 138 -3.39e-04 1.59e-03 -7.88e-03 1.80e-03 3.61e-03 -3.04e-02 6.37e-03  
## 139 -2.21e-02 2.19e-02 2.15e-02 -2.05e-03 -7.18e-03 -3.81e-02 -1.20e-02  
## 140 -1.60e-02 1.48e-02 3.13e-02 1.70e-03 -2.16e-03 3.50e-02 -3.37e-03  
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## 143 3.68e-03 -8.29e-03 -8.54e-03 -2.50e-03 6.27e-03 -1.03e-02 -2.90e-02  
## 144 -9.59e-03 7.15e-03 -8.04e-03 -2.82e-03 -1.67e-03 -9.26e-03 1.19e-02  
## 145 3.04e-02 -1.25e-01 -3.58e-02 1.50e-03 1.09e-02 2.36e-02 -3.19e-02  
## 146 8.25e-03 -1.60e-02 5.80e-02 -3.61e-02 -7.36e-02 -9.05e-02 -2.16e-01  
## 147 1.55e-04 -7.23e-06 3.66e-05 1.75e-05 5.86e-06 8.88e-05 -1.81e-04  
## 148 2.09e-03 2.11e-03 1.06e-03 2.64e-04 -1.96e-04 -6.92e-04 -5.29e-03  
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## 152 1.74e-02 -6.23e-03 8.78e-03 3.37e-03 1.72e-03 1.30e-02 -2.09e-02  
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## 156 -1.33e-02 3.90e-02 1.81e-02 8.74e-04 -2.79e-03 -6.22e-03 1.36e-02  
## 157 -3.55e-02 6.90e-03 -1.29e-02 -5.36e-03 -2.37e-03 -2.33e-02 4.20e-02  
## 158 6.24e-03 5.04e-03 3.87e-03 1.78e-02 1.69e-02 5.25e-02 8.39e-02  
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## 165 -8.15e-03 -8.24e-03 -4.12e-03 -1.03e-03 7.63e-04 2.70e-03 2.06e-02  
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## 174 7.06e-02 6.16e-03 8.54e-03 5.53e-03 8.18e-04 3.51e-02 -8.16e-02  
## 175 1.81e-02 -5.32e-02 -2.46e-02 -1.19e-03 3.80e-03 8.47e-03 -1.85e-02  
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## 177 -3.78e-03 -3.29e-04 -4.56e-04 -2.95e-04 -4.37e-05 -1.88e-03 4.36e-03  
## 178 -4.24e-04 2.19e-02 1.39e-03 5.20e-04 -9.95e-03 8.49e-03 3.24e-02  
## 179 2.48e-02 4.02e-02 -1.05e-02 -3.20e-03 -5.92e-03 -1.42e-02 -4.88e-02  
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## 189 2.49e-02 1.75e-02 2.44e-02 6.39e-03 -5.00e-04 -5.24e-03 -7.03e-02  
## 190 -3.09e-02 8.11e-02 4.34e-02 2.96e-03 -5.26e-03 -1.20e-02 3.13e-02  
## 191 8.52e-03 4.29e-03 1.09e-02 2.89e-03 2.32e-04 -1.13e-03 -2.56e-02  
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## 211 -2.96e-03 2.79e-02 1.28e-02 6.66e-03 3.46e-03 1.49e-02 -1.53e-02  
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## 215 -1.08e-01 9.12e-02 8.13e-02 1.66e-02 2.50e-02 1.03e-02 -3.75e-02  
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## 226 -1.47e-03 1.07e-02 1.74e-02 2.81e-03 -6.92e-04 -3.94e-03 -3.26e-03  
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## 246 -5.58e-03 2.97e-02 1.61e-02 2.01e-03 -1.18e-03 -2.16e-03 -6.36e-03  
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## 3 2.55e-02 3.22e-03 2.59e-02 3.21e-02 2.85e-02 1.59e-02 -0.072099  
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## 7 1.36e-02 3.26e-03 -1.37e-02 -1.27e-02 -1.85e-04 -2.62e-03 -0.029009  
## 8 -2.29e-01 1.81e-01 8.20e-02 3.51e-02 1.14e-01 3.10e-02 0.325267  
## 9 7.28e-02 1.90e-02 1.41e-01 4.72e-02 -4.69e-02 -5.03e-02 -0.306308  
## 10 -4.42e-02 -2.31e-03 -3.68e-02 4.63e-02 -2.74e-03 1.26e-03 0.128280  
## 11 -4.29e-04 -2.59e-05 -4.04e-04 3.95e-04 -1.64e-04 8.94e-05 0.001281  
## 12 -1.47e-01 -3.48e-02 1.49e-01 1.41e-01 1.20e-02 2.25e-02 0.316740  
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## 15 -7.50e-02 -4.12e-03 -6.50e-02 7.55e-02 -1.24e-02 6.49e-03 0.218544  
## 16 7.37e-03 1.47e-03 1.01e-02 -6.45e-04 -1.24e-02 4.41e-04 -0.027931  
## 17 9.46e-03 2.32e-03 1.70e-02 4.37e-03 -8.59e-03 -4.73e-03 -0.037436  
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## 19 1.40e-02 2.40e-03 3.43e-02 1.23e-02 6.80e-02 -3.80e-02 -0.139133  
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## 22 -2.14e-02 -4.94e-03 -3.56e-02 -6.18e-03 2.46e-02 6.93e-03 0.081293  
## 23 -9.25e-02 -3.77e-02 8.27e-02 -4.00e-03 4.88e-02 5.26e-02 0.213084  
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## 28 2.13e-02 8.54e-03 -1.92e-02 -1.03e-04 -1.29e-02 -1.09e-02 -0.048347  
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## 30 3.77e-03 4.89e-04 3.96e-03 5.00e-03 4.62e-03 2.20e-03 -0.010738  
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## 32 4.11e-02 1.56e-02 -5.74e-02 -5.84e-02 -4.92e-04 3.47e-02 -0.142177  
## 33 1.47e-01 5.41e-02 -1.58e-01 6.60e-02 7.74e-02 -3.96e-02 -0.347970  
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## 39 3.92e-02 -4.14e-02 -1.11e-02 1.77e-03 -1.61e-02 4.91e-02 -0.092018  
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## 41 -3.79e-02 -3.30e-03 -4.30e-02 9.74e-02 3.62e-02 1.74e-02 0.185604  
## 42 -6.33e-02 -2.71e-02 6.16e-02 -6.53e-02 -7.72e-02 -6.08e-02 0.183773  
## 43 -1.32e-01 -5.42e-02 1.32e-01 -1.15e-01 -1.36e-01 -8.22e-02 0.354716  
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## 54 -9.25e-03 1.55e-02 4.38e-03 -7.26e-03 -5.29e-03 9.08e-03 0.043338  
## 55 -4.26e-03 2.34e-02 -2.21e-02 -2.03e-03 -2.19e-02 8.66e-04 -0.068699  
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## 63 -2.95e-02 4.80e-02 7.05e-02 -8.20e-02 -7.88e-03 4.27e-02 -0.261215  
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## 87 -1.84e-03 2.12e-02 -2.88e-02 3.74e-03 4.41e-03 -2.75e-02 -0.069843  
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## 115 -1.29e-02 1.89e-02 8.56e-04 2.27e-02 -1.58e-02 3.27e-03 0.096897  
## 116 -5.10e-02 1.10e-01 -1.12e-02 -1.31e-03 -8.29e-02 1.52e-02 -0.232260  
## 117 -5.86e-03 5.18e-03 -1.00e-03 -1.09e-02 -9.01e-03 -8.80e-03 0.030411  
## 118 -1.90e-02 2.34e-02 6.44e-03 4.10e-02 5.16e-03 -9.67e-03 0.115335  
## 119 3.25e-02 -3.90e-02 -1.20e-02 -7.14e-02 -1.44e-02 1.93e-02 -0.194297  
## 120 2.80e-02 -3.45e-02 -4.66e-02 1.51e-02 -5.52e-03 -9.21e-03 0.101134  
## 121 1.76e-02 -1.61e-02 4.37e-03 3.73e-02 3.37e-02 2.44e-02 -0.094317  
## 122 6.78e-02 -1.06e-01 -3.26e-02 6.43e-02 1.97e-02 -1.49e-01 -0.533628  
## 123 1.02e-01 -2.13e-01 4.29e-02 -8.66e-02 -5.17e-02 1.81e-02 0.399282  
## 124 7.92e-03 -1.24e-02 -3.81e-03 7.52e-03 2.30e-03 -1.74e-02 -0.062352  
## 125 -5.83e-03 1.07e-02 1.06e-02 3.92e-02 2.64e-02 3.20e-02 0.064106  
## 126 -3.45e-02 5.90e-02 1.16e-02 -5.00e-02 -2.77e-02 4.96e-02 0.291090  
## 127 -2.34e-02 -4.10e-02 3.81e-02 3.00e-02 -5.81e-02 2.06e-01 -0.333784  
## 128 -1.56e-02 2.08e-02 1.09e-02 -2.80e-03 7.73e-03 5.25e-02 0.114013  
## 129 3.10e-02 -7.03e-02 1.94e-02 -1.76e-02 -3.94e-03 3.28e-02 0.135461  
## 130 -9.55e-03 2.75e-02 1.69e-02 7.96e-02 4.19e-02 2.87e-02 0.138608  
## 131 -8.21e-03 5.72e-02 1.32e-02 1.20e-01 3.19e-02 -5.49e-02 0.287300  
## 132 4.96e-02 -8.51e-02 -1.68e-02 7.20e-02 3.99e-02 -7.14e-02 -0.419350  
## 133 -2.26e-03 -5.15e-03 3.51e-03 1.13e-03 -1.03e-02 1.93e-02 -0.037551  
## 134 -2.71e-02 4.64e-02 9.15e-03 -3.93e-02 -2.18e-02 3.90e-02 0.228915  
## 135 -1.44e-01 2.35e-01 1.36e-02 2.22e-01 2.08e-01 2.90e-01 -0.565400  
## 136 5.80e-02 -1.26e-01 3.01e-02 -4.14e-02 -1.88e-02 3.47e-02 0.237830  
## 137 -1.07e-02 -6.13e-02 1.09e-01 -1.19e-01 -8.00e-02 -7.02e-02 -0.253095  
## 138 5.45e-03 -1.16e-02 3.15e-04 1.55e-02 1.21e-02 3.61e-03 -0.057838  
## 139 -1.40e-02 3.31e-02 -1.04e-02 5.69e-03 -1.24e-03 -2.17e-02 -0.065832  
## 140 -3.37e-03 1.15e-02 -4.26e-03 -2.39e-02 -2.21e-02 -2.38e-02 0.065376  
## 141 -3.85e-02 4.78e-02 3.03e-02 4.71e-03 3.09e-02 1.47e-01 0.276925  
## 142 -3.61e-03 2.50e-03 1.15e-03 -9.05e-03 -1.09e-02 -2.92e-03 0.017581  
## 143 -2.48e-03 -2.21e-02 5.50e-02 -2.77e-02 9.17e-03 -2.65e-04 -0.092060  
## 144 -1.20e-02 1.17e-02 1.51e-02 3.89e-02 4.76e-03 9.99e-04 0.067039  
## 145 5.61e-02 -3.35e-02 -2.96e-02 8.05e-02 7.48e-02 7.50e-02 -0.233204  
## 146 -1.13e-01 2.45e-01 -6.84e-02 -3.63e-02 -1.67e-01 -8.37e-03 -0.372425  
## 147 1.36e-04 -1.49e-04 -1.66e-04 -4.29e-04 7.67e-05 -9.08e-05 -0.000860  
## 148 8.82e-04 -2.21e-03 -7.10e-04 3.13e-05 -4.65e-03 -3.26e-03 -0.015860  
## 149 -4.73e-02 1.02e-01 -2.72e-02 -1.22e-02 -6.41e-02 -6.28e-03 -0.151688  
## 150 1.12e-02 -1.98e-02 -1.17e-02 -1.33e-02 -6.52e-02 -1.48e-02 -0.134256  
## 151 -1.24e-02 1.24e-02 1.55e-02 4.00e-02 2.24e-03 2.67e-03 0.070670  
## 152 1.82e-02 -1.87e-02 -2.25e-02 -5.82e-02 9.27e-04 -6.46e-03 -0.106293  
## 153 5.23e-03 -7.20e-03 -6.10e-03 -9.57e-03 -3.20e-02 -3.99e-04 -0.052506  
## 154 2.08e-03 -3.97e-03 -2.08e-03 -2.00e-03 -1.19e-02 -3.69e-03 -0.026992  
## 155 6.58e-03 -6.23e-03 -8.36e-03 -2.15e-02 -3.95e-03 2.65e-04 -0.036313  
## 156 -1.89e-02 1.20e-02 8.46e-03 -3.50e-02 -3.75e-02 -2.15e-02 0.080383  
## 157 -3.40e-02 3.61e-02 4.17e-02 1.08e-01 -1.01e-02 1.72e-02 0.205573  
## 158 5.35e-02 -6.34e-02 -6.67e-02 -9.05e-03 3.29e-02 1.47e-03 0.126379  
## 159 -2.11e-02 3.48e-02 2.28e-02 2.92e-02 1.25e-01 2.00e-02 0.238293  
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## 162 1.56e-02 -9.47e-03 -7.81e-03 2.44e-02 2.40e-02 1.98e-02 -0.064693  
## 163 8.14e-04 -3.61e-03 -1.48e-04 2.64e-03 -3.12e-03 -8.08e-03 -0.030470  
## 164 3.86e-02 -2.22e-02 -2.22e-02 4.59e-02 3.67e-02 5.61e-02 -0.162859  
## 165 -3.44e-03 8.61e-03 2.77e-03 -1.22e-04 1.82e-02 1.27e-02 0.061877  
## 166 -4.42e-02 2.64e-02 2.33e-02 -6.34e-02 -5.89e-02 -5.90e-02 0.183541  
## 167 7.41e-02 -4.50e-02 -3.71e-02 1.16e-01 1.14e-01 9.41e-02 -0.307658  
## 168 1.08e-02 -6.67e-03 -5.11e-03 1.83e-02 1.89e-02 1.30e-02 -0.045016  
## 169 3.37e-02 -1.14e-01 3.28e-02 -5.98e-02 -5.60e-02 -3.92e-02 0.175765  
## 170 3.57e-02 -3.38e-02 -4.54e-02 -1.17e-01 -2.14e-02 1.44e-03 -0.197159  
## 171 1.88e-02 -1.15e-02 -9.45e-03 2.95e-02 2.90e-02 2.40e-02 -0.078300  
## 172 -9.11e-03 -1.81e-02 2.05e-02 6.76e-02 7.87e-02 -9.80e-02 -0.317341  
## 173 5.62e-03 -2.79e-02 8.35e-02 4.77e-02 3.29e-02 4.69e-02 -0.135848  
## 174 5.70e-02 -6.45e-02 -6.85e-02 -1.78e-01 4.83e-02 -4.78e-02 -0.377932  
## 175 2.58e-02 -1.63e-02 -1.15e-02 4.76e-02 5.11e-02 2.92e-02 -0.109476  
## 176 -7.57e-02 9.55e-02 9.26e-02 -7.84e-03 -8.88e-02 1.96e-02 -0.201309  
## 177 -3.05e-03 3.45e-03 3.66e-03 9.50e-03 -2.58e-03 2.56e-03 0.020203  
## 178 4.18e-04 2.78e-02 -6.42e-02 4.48e-02 7.43e-03 -1.02e-02 0.113709  
## 179 1.49e-03 -1.66e-02 2.96e-03 2.15e-02 1.80e-03 -4.71e-02 -0.163358  
## 180 -2.08e-02 1.26e-02 1.04e-02 -3.25e-02 -3.20e-02 -2.64e-02 0.086304  
## 181 -3.05e-02 8.44e-02 -3.96e-02 -6.33e-02 -1.28e-02 1.07e-03 -0.139931  
## 182 1.53e-01 -2.91e-01 4.86e-02 -3.64e-02 5.39e-02 8.99e-02 0.458811  
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## 184 5.50e-01 -9.25e-01 -8.91e-01 -6.27e-01 -3.61e-01 -6.35e-01 1.965224  
## 185 -3.46e-03 9.22e-03 -4.10e-03 -6.36e-03 -4.29e-04 -4.25e-04 -0.014952  
## 186 -1.55e-02 -2.01e-02 7.94e-02 2.59e-02 7.17e-03 -2.22e-02 -0.131398  
## 187 -2.66e-03 1.67e-02 -5.15e-02 -3.16e-02 -2.50e-02 -2.54e-02 0.080040  
## 188 2.10e-06 3.92e-05 -9.34e-05 5.76e-05 -1.37e-07 -8.52e-06 0.000159  
## 189 1.51e-02 -3.12e-02 -1.43e-02 -1.04e-02 -8.47e-02 -3.47e-02 -0.214743  
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## 194 2.16e-02 -2.14e-02 -4.27e-02 -1.51e-02 -2.09e-02 -1.05e-01 -0.170662  
## 195 4.69e-03 4.54e-03 4.39e-04 3.09e-03 1.78e-02 -2.60e-02 0.048455  
## 196 2.52e-02 -3.43e-02 -5.08e-02 1.58e-02 1.42e-02 -7.35e-02 -0.222072  
## 197 3.12e-02 3.42e-02 1.03e-02 3.80e-02 1.50e-01 -1.58e-01 0.343896  
## 198 -2.52e-03 3.05e-03 5.04e-03 -2.03e-04 1.73e-04 9.38e-03 0.020890  
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## 202 1.06e-04 8.86e-04 -2.03e-03 9.06e-05 5.82e-04 2.47e-03 0.004539  
## 203 2.96e-02 8.83e-02 -2.41e-01 -6.61e-02 -3.07e-02 6.77e-02 0.385262  
## 204 -2.82e-02 5.20e-02 5.83e-02 -6.60e-02 -7.14e-02 1.20e-02 0.324121  
## 205 2.68e-02 -5.76e-02 2.19e-02 -1.11e-02 -8.61e-03 1.18e-02 0.084593  
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## 211 2.18e-03 -1.18e-02 -1.86e-02 -5.43e-02 -2.24e-02 -7.92e-03 -0.078933  
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## 213 -1.04e-02 1.63e-02 2.12e-02 -1.41e-02 -1.45e-02 1.95e-02 0.102048  
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## 219 2.12e-02 -2.89e-02 -4.27e-02 1.33e-02 1.19e-02 -6.19e-02 -0.186974  
## 220 -1.66e-01 2.77e-01 -3.22e-02 2.05e-01 2.22e-01 3.12e-01 -0.553686  
## 221 -4.18e-02 1.01e-01 -4.83e-02 -1.55e-03 -9.88e-03 -7.16e-02 -0.165255  
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## 226 -5.47e-02 -3.77e-04 -8.27e-04 -1.36e-02 -5.10e-02 -8.84e-03 -0.102035  
## 227 -1.08e-01 2.81e-04 1.08e-02 5.55e-03 -3.83e-02 -4.71e-02 -0.201917  
## 228 -5.70e-02 -6.45e-03 -2.31e-02 -8.80e-02 -3.82e-02 6.88e-03 -0.154909  
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## 232 3.81e-03 -3.38e-05 -6.67e-04 -9.51e-04 -9.92e-05 2.35e-03 0.008290  
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## 248 8.74e-02 7.82e-03 1.82e-02 8.73e-02 -9.02e-03 2.52e-02 0.195414  
## 249 8.76e-02 2.02e-02 -1.02e-01 4.12e-02 -2.03e-02 1.11e-02 0.177003  
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## 253 7.01e-03 -4.80e-05 -1.06e-03 -1.30e-03 6.76e-04 3.92e-03 0.014411  
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## 260 1.67e-02 5.69e-04 6.78e-03 4.45e-03 6.98e-03 2.34e-02 0.044694  
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## cov.r cook.d hat inf  
## 1 1.0798 1.35e-03 0.0436   
## 2 1.0652 1.73e-03 0.0390   
## 3 1.1000 4.01e-04 0.0472   
## 4 1.1249 1.14e-03 0.0724   
## 5 1.0948 2.64e-04 0.0413   
## 6 0.9022 1.27e-02 0.0422   
## 7 1.1051 6.50e-05 0.0471   
## 8 1.0173 8.11e-03 0.0562   
## 9 0.9665 7.18e-03 0.0378   
## 10 1.0751 1.27e-03 0.0399   
## 11 1.0961 1.27e-07 0.0385   
## 12 1.0003 7.69e-03 0.0489   
## 13 1.1022 5.73e-04 0.0507   
## 14 1.0735 1.44e-03 0.0407   
## 15 1.0311 3.67e-03 0.0390   
## 16 1.1009 6.02e-05 0.0436   
## 17 1.0915 1.08e-04 0.0363   
## 18 1.0924 6.98e-04 0.0449   
## 19 1.2580 1.49e-03 0.1665 \*  
## 20 1.0875 2.45e-04 0.0353   
## 21 1.0424 6.11e-03 0.0567   
## 22 1.0837 5.10e-04 0.0364   
## 23 1.0204 3.49e-03 0.0342   
## 24 1.0795 1.31e-03 0.0429   
## 25 1.0804 1.81e-03 0.0481   
## 26 0.9999 4.79e-03 0.0356   
## 27 1.0960 1.55e-04 0.0407   
## 28 1.0874 1.80e-04 0.0342   
## 29 1.0912 1.84e-05 0.0345   
## 30 1.1052 8.91e-06 0.0465   
## 31 1.1045 6.49e-04 0.0533   
## 32 1.0918 1.56e-03 0.0529   
## 33 0.9399 9.24e-03 0.0393   
## 34 1.1204 4.07e-05 0.0597   
## 35 1.0946 5.10e-04 0.0443   
## 36 1.0933 1.18e-06 0.0361   
## 37 1.1232 1.82e-03 0.0757   
## 38 1.1092 5.75e-04 0.0560   
## 39 1.1450 6.54e-04 0.0840   
## 40 1.1074 3.43e-04 0.0523   
## 41 1.0606 2.65e-03 0.0443   
## 42 1.0649 2.60e-03 0.0460   
## 43 0.9474 9.61e-03 0.0422   
## 44 1.1480 1.70e-03 0.0923   
## 45 1.0958 7.69e-05 0.0394   
## 46 0.9624 7.10e-03 0.0366   
## 47 1.1384 5.98e-05 0.0746   
## 48 1.1210 3.98e-04 0.0636   
## 49 1.0677 1.85e-03 0.0413   
## 50 1.0723 1.41e-03 0.0398   
## 51 1.0915 2.56e-03 0.0604   
## 52 1.1112 8.49e-05 0.0525   
## 53 1.1066 3.73e-04 0.0520   
## 54 1.1228 1.45e-04 0.0627   
## 55 1.0979 3.64e-04 0.0451   
## 56 0.8499 2.20e-02 0.0532   
## 57 1.1306 3.99e-04 0.0711   
## 58 1.0137 4.04e-02 0.1326 \*  
## 59 0.9593 1.56e-02 0.0629   
## 60 1.0934 1.33e-03 0.0519   
## 61 0.9803 8.18e-03 0.0451   
## 62 0.9649 1.13e-02 0.0520   
## 63 1.0504 5.25e-03 0.0557   
## 64 0.9592 9.23e-03 0.0436   
## 65 1.0269 5.10e-03 0.0457   
## 66 1.1057 9.08e-06 0.0469   
## 67 1.1000 6.79e-04 0.0502   
## 68 1.1103 7.24e-06 0.0509   
## 69 1.0921 3.03e-03 0.0638   
## 70 1.0661 1.99e-03 0.0417   
## 71 1.1228 7.94e-06 0.0614   
## 72 1.1072 8.95e-05 0.0492   
## 73 0.9603 1.71e-02 0.0671   
## 74 1.1104 1.65e-03 0.0659   
## 75 1.0954 1.00e-03 0.0502   
## 76 1.0548 5.57e-03 0.0593   
## 77 1.0524 8.97e-03 0.0733   
## 78 1.0974 3.23e-04 0.0442   
## 79 1.0999 2.04e-03 0.0618   
## 80 1.0668 2.91e-03 0.0492   
## 81 1.0564 2.87e-03 0.0439   
## 82 0.8530 2.18e-02 0.0533   
## 83 1.0780 2.24e-03 0.0502   
## 84 1.0862 3.60e-03 0.0640   
## 85 1.1048 1.48e-06 0.0461   
## 86 1.1307 1.75e-04 0.0694   
## 87 1.1088 3.77e-04 0.0538   
## 88 1.1051 8.31e-03 0.0959   
## 89 1.1111 2.59e-04 0.0544   
## 90 1.0531 3.08e-03 0.0439   
## 91 1.1602 9.43e-05 0.0922 \*  
## 92 1.1039 3.32e-03 0.0725   
## 93 1.1318 1.52e-03 0.0799   
## 94 1.0376 9.67e-03 0.0698   
## 95 1.0784 5.86e-03 0.0719   
## 96 1.0317 9.83e-03 0.0682   
## 97 1.0841 4.53e-03 0.0682   
## 98 1.1234 1.46e-03 0.0735   
## 99 1.0984 5.01e-03 0.0783   
## 100 1.1436 4.04e-05 0.0787   
## 101 1.0733 8.09e-03 0.0792   
## 102 1.0156 1.24e-02 0.0711   
## 103 1.1056 2.05e-03 0.0655   
## 104 1.1315 1.46e-03 0.0793   
## 105 1.1466 4.89e-04 0.0841   
## 106 1.1276 1.47e-04 0.0666   
## 107 1.1242 6.04e-04 0.0678   
## 108 1.1189 8.65e-04 0.0659   
## 109 1.1598 5.35e-05 0.0916 \*  
## 110 1.0714 7.55e-03 0.0761   
## 111 1.1183 1.01e-03 0.0666   
## 112 1.0953 1.76e-03 0.0568   
## 113 1.1068 2.19e-03 0.0673   
## 114 1.1100 1.50e-04 0.0523   
## 115 1.1066 7.25e-04 0.0556   
## 116 1.0900 4.15e-03 0.0692   
## 117 1.1174 7.14e-05 0.0575   
## 118 1.1001 1.03e-03 0.0537   
## 119 1.0780 2.91e-03 0.0551   
## 120 1.1382 7.90e-04 0.0798   
## 121 1.1083 6.87e-04 0.0565   
## 122 0.7892 2.14e-02 0.0426 \*  
## 123 0.9595 1.22e-02 0.0532   
## 124 1.0957 3.00e-04 0.0426   
## 125 1.1450 3.17e-04 0.0818   
## 126 0.9883 6.49e-03 0.0404   
## 127 1.1007 8.57e-03 0.0946   
## 128 1.0970 1.00e-03 0.0513   
## 129 1.0984 1.42e-03 0.0560   
## 130 1.0980 1.48e-03 0.0563   
## 131 1.0330 6.34e-03 0.0541   
## 132 0.8831 1.34e-02 0.0404   
## 133 1.1414 1.09e-04 0.0774   
## 134 1.0288 4.03e-03 0.0404   
## 135 0.9767 2.44e-02 0.0896   
## 136 1.0572 4.35e-03 0.0538   
## 137 1.1012 4.93e-03 0.0795   
## 138 1.0938 2.58e-04 0.0404   
## 139 1.1166 3.35e-04 0.0595   
## 140 1.1065 3.30e-04 0.0514   
## 141 1.0477 5.89e-03 0.0579   
## 142 1.0838 2.39e-05 0.0281   
## 143 1.0929 6.54e-04 0.0448   
## 144 1.0792 3.47e-04 0.0307   
## 145 0.9887 4.17e-03 0.0295   
## 146 0.9490 1.06e-02 0.0457   
## 147 1.0864 5.71e-08 0.0299   
## 148 1.0805 1.94e-05 0.0251   
## 149 1.0745 1.77e-03 0.0443   
## 150 1.0375 1.39e-03 0.0234   
## 151 1.0772 3.85e-04 0.0299   
## 152 1.0649 8.71e-04 0.0295   
## 153 1.0791 2.13e-04 0.0282   
## 154 1.0773 5.63e-05 0.0233   
## 155 1.0863 1.02e-04 0.0319   
## 156 1.0692 4.99e-04 0.0265   
## 157 1.0095 3.25e-03 0.0295   
## 158 1.1032 1.23e-03 0.0577   
## 159 0.9569 4.35e-03 0.0240   
## 160 1.0810 4.03e-04 0.0329   
## 161 1.0614 8.33e-04 0.0271   
## 162 1.0762 3.23e-04 0.0281   
## 163 1.0885 7.17e-05 0.0331   
## 164 1.0474 2.04e-03 0.0335   
## 165 1.0726 2.96e-04 0.0251   
## 166 1.0245 2.59e-03 0.0295   
## 167 0.9138 7.21e-03 0.0281   
## 168 1.0791 1.56e-04 0.0271   
## 169 1.0680 2.38e-03 0.0459   
## 170 1.0232 2.99e-03 0.0319   
## 171 1.0724 4.73e-04 0.0281   
## 172 1.1518 7.75e-03 0.1199   
## 173 1.0881 1.42e-03 0.0494   
## 174 0.8593 1.08e-02 0.0307   
## 175 1.0579 9.24e-04 0.0265   
## 176 1.0908 3.12e-03 0.0636   
## 177 1.0866 3.15e-05 0.0307   
## 178 1.0867 9.97e-04 0.0443   
## 179 1.0680 2.06e-03 0.0433   
## 180 1.0698 5.75e-04 0.0281   
## 181 1.0857 1.51e-03 0.0486   
## 182 0.9013 1.60e-02 0.0502   
## 183 1.0683 4.49e-04 0.0251   
## 184 0.0739 2.42e-01 0.0629 \*  
## 185 1.1053 1.73e-05 0.0467   
## 186 1.1263 1.33e-03 0.0747   
## 187 1.0986 4.95e-04 0.0472   
## 188 1.1016 1.96e-09 0.0433   
## 189 0.9760 3.53e-03 0.0235   
## 190 1.0192 2.38e-03 0.0263   
## 191 1.0639 4.93e-04 0.0233   
## 192 1.0391 4.06e-03 0.0444   
## 193 1.0115 2.50e-03 0.0250   
## 194 1.0576 2.24e-03 0.0397   
## 195 1.1122 1.81e-04 0.0544   
## 196 0.9774 3.78e-03 0.0250   
## 197 0.9836 9.05e-03 0.0493   
## 198 1.0839 3.37e-05 0.0285   
## 199 1.0781 2.66e-04 0.0285   
## 200 1.0675 3.39e-04 0.0226   
## 201 1.0764 5.76e-05 0.0226   
## 202 1.1160 1.59e-06 0.0556   
## 203 0.9061 1.13e-02 0.0390   
## 204 0.8504 7.97e-03 0.0226   
## 205 1.0906 5.52e-04 0.0419   
## 206 1.0380 1.53e-03 0.0250   
## 207 1.0679 3.53e-04 0.0231   
## 208 0.8671 1.52e-02 0.0420   
## 209 1.0650 4.46e-04 0.0231   
## 210 0.9589 4.06e-03 0.0231   
## 211 1.0913 4.81e-04 0.0415   
## 212 1.0299 4.66e-03 0.0444   
## 213 1.0541 8.03e-04 0.0231   
## 214 1.0941 2.71e-04 0.0409   
## 215 1.0752 2.32e-03 0.0493   
## 216 1.1214 4.84e-02 0.1867 \*  
## 217 1.0803 1.52e-03 0.0454   
## 218 1.1099 6.55e-04 0.0574   
## 219 1.0064 2.69e-03 0.0250   
## 220 0.9504 2.33e-02 0.0793   
## 221 1.0830 2.10e-03 0.0520   
## 222 1.0312 2.92e-03 0.0341   
## 223 0.8970 1.05e-02 0.0352   
## 224 1.1110 3.94e-04 0.0557   
## 225 1.0405 2.58e-03 0.0351   
## 226 1.0771 8.03e-04 0.0358   
## 227 1.0471 3.14e-03 0.0418   
## 228 1.0783 1.85e-03 0.0472   
## 229 1.0850 5.86e-04 0.0383   
## 230 1.1023 2.79e-05 0.0443   
## 231 0.9954 4.96e-03 0.0352   
## 232 1.1246 5.31e-06 0.0629   
## 233 1.0897 1.31e-04 0.0352   
## 234 1.0299 2.99e-03 0.0341   
## 235 1.0790 5.32e-04 0.0335   
## 236 1.1239 2.47e-05 0.0625   
## 237 1.0776 1.02e-03 0.0387   
## 238 1.0324 2.77e-03 0.0335   
## 239 0.9049 1.06e-02 0.0369   
## 240 1.0545 2.32e-03 0.0389   
## 241 1.0347 3.64e-03 0.0402   
## 242 1.1016 1.27e-04 0.0451   
## 243 1.0954 7.08e-04 0.0472   
## 244 1.0071 4.50e-03 0.0361   
## 245 1.0346 2.66e-03 0.0335   
## 246 1.0764 6.59e-04 0.0335   
## 247 0.9673 7.69e-03 0.0399   
## 248 1.0448 2.94e-03 0.0394   
## 249 1.0971 2.42e-03 0.0627   
## 250 1.0909 1.18e-05 0.0341   
## 251 1.0492 3.11e-03 0.0425   
## 252 0.9721 1.42e-02 0.0626   
## 253 1.1142 1.60e-05 0.0543   
## 254 1.0912 5.61e-04 0.0425   
## 255 1.0748 8.66e-04 0.0352   
## 256 1.0979 5.44e-06 0.0402   
## 257 1.1032 1.58e-03 0.0606   
## 258 1.1272 3.82e-06 0.0650   
## 259 1.0445 3.08e-03 0.0403   
## 260 1.1169 1.54e-04 0.0580   
## 261 1.0803 1.22e-03 0.0426

# remove outliers in x  
data\_outlierx = data[c(-56,-122,-184),]  
reg\_outlierx = lm(ln\_salavg ~ gender\*exper + dept + clin + cert + rank, data = data\_outlierx)  
summary(reg\_outlierx)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender \* exper + dept + clin + cert +   
## rank, data = data\_outlierx)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.28224 -0.06967 -0.01314 0.07766 0.28377   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 10.903753 0.030692 355.260 < 2e-16 \*\*\*  
## genderMale 0.095239 0.032811 2.903 0.00404 \*\*   
## exper 0.025954 0.003128 8.298 7.13e-15 \*\*\*  
## deptPhysiology -0.165764 0.025523 -6.495 4.60e-10 \*\*\*  
## deptGenetics 0.184248 0.031542 5.841 1.64e-08 \*\*\*  
## deptPediatrics 0.207317 0.031320 6.619 2.26e-10 \*\*\*  
## deptMedicine 0.517730 0.025802 20.065 < 2e-16 \*\*\*  
## deptSurgery 0.919866 0.030801 29.864 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.225264 0.019087 11.802 < 2e-16 \*\*\*  
## certBoard certified 0.204054 0.018653 10.940 < 2e-16 \*\*\*  
## rankAssociate 0.134496 0.020954 6.419 7.06e-10 \*\*\*  
## rankFull 0.215152 0.023001 9.354 < 2e-16 \*\*\*  
## genderMale:exper -0.009175 0.003166 -2.898 0.00410 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1154 on 245 degrees of freedom  
## Multiple R-squared: 0.9505, Adjusted R-squared: 0.9481   
## F-statistic: 392.2 on 12 and 245 DF, p-value: < 2.2e-16

# remove outliers in y  
data\_outliery = data[c(-19,-58,-172,-216),]  
reg\_outliery = lm(ln\_salavg ~ gender\*exper + dept + clin + cert + rank, data = data\_outliery)  
summary(reg\_outliery)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender \* exper + dept + clin + cert +   
## rank, data = data\_outliery)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.31670 -0.07865 -0.00703 0.07199 0.85833   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 10.890519 0.036123 301.481 < 2e-16 \*\*\*  
## genderMale 0.143918 0.038284 3.759 0.000213 \*\*\*  
## exper 0.029861 0.003818 7.820 1.59e-13 \*\*\*  
## deptPhysiology -0.169192 0.029069 -5.820 1.84e-08 \*\*\*  
## deptGenetics 0.191114 0.035804 5.338 2.15e-07 \*\*\*  
## deptPediatrics 0.224661 0.035479 6.332 1.15e-09 \*\*\*  
## deptMedicine 0.556018 0.029623 18.770 < 2e-16 \*\*\*  
## deptSurgery 0.946561 0.035087 26.977 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.205531 0.021679 9.481 < 2e-16 \*\*\*  
## certBoard certified 0.178603 0.021014 8.499 1.92e-15 \*\*\*  
## rankAssociate 0.113641 0.023715 4.792 2.87e-06 \*\*\*  
## rankFull 0.213152 0.027448 7.766 2.24e-13 \*\*\*  
## genderMale:exper -0.014145 0.003875 -3.650 0.000320 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1304 on 244 degrees of freedom  
## Multiple R-squared: 0.9375, Adjusted R-squared: 0.9345   
## F-statistic: 305.2 on 12 and 244 DF, p-value: < 2.2e-16

# remove influential points  
data\_influential = data[c(-19,-58,-91,-122,-184,-216),]  
reg\_influential = lm(ln\_salavg ~ gender\*exper + dept + clin + cert + rank, data = data\_influential)  
summary(reg\_influential)

##   
## Call:  
## lm(formula = ln\_salavg ~ gender \* exper + dept + clin + cert +   
## rank, data = data\_influential)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.28001 -0.07117 -0.01186 0.07585 0.27247   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 10.898096 0.032210 338.341 < 2e-16 \*\*\*  
## genderMale 0.106949 0.034239 3.124 0.00200 \*\*   
## exper 0.027567 0.003402 8.103 2.65e-14 \*\*\*  
## deptPhysiology -0.178715 0.025913 -6.897 4.61e-11 \*\*\*  
## deptGenetics 0.183210 0.032748 5.595 5.97e-08 \*\*\*  
## deptPediatrics 0.211465 0.031824 6.645 1.99e-10 \*\*\*  
## deptMedicine 0.523157 0.026598 19.669 < 2e-16 \*\*\*  
## deptSurgery 0.925194 0.031377 29.487 < 2e-16 \*\*\*  
## clinPrimarily clinical emphasis 0.226098 0.019613 11.528 < 2e-16 \*\*\*  
## certBoard certified 0.196725 0.018901 10.408 < 2e-16 \*\*\*  
## rankAssociate 0.127377 0.021132 6.028 6.16e-09 \*\*\*  
## rankFull 0.222617 0.024236 9.185 < 2e-16 \*\*\*  
## genderMale:exper -0.011366 0.003454 -3.291 0.00115 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.1161 on 242 degrees of freedom  
## Multiple R-squared: 0.9508, Adjusted R-squared: 0.9484   
## F-statistic: 390 on 12 and 242 DF, p-value: < 2.2e-16