analysis.rmd

2025-12-02

```
Attaching package: 'dplyr'
The following objects are masked from 'package:stats':

    filter, lag
The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
Loading required package: carData

Attaching package: 'car'
The following object is masked from 'package:dplyr':

    recode

Attaching package: 'olsrr'
The following object is masked from 'package:datasets':

    rivers
```

```
df <- read.csv("main.csv")
head(df)
```

```
##                    Player Team  G   MP FG_pct  FTA  TRB  AST stocks  PTS
## 1 Shai Gilgeous-Alexander  OKC 76 34.2  0.519  8.8  5.0  6.4    2.7 32.7
## 2   Giannis Antetokounmpo  MIL 67 34.2  0.601 10.6 11.9  6.5    2.1 30.4
## 3            Nikola Jokić  DEN 70 36.7  0.576  6.4 12.7 10.2    2.4 29.6
## 4             Luka Dončić  2TM 50 35.4  0.450  7.9  8.2  7.7    2.2 28.2
## 5         Anthony Edwards  MIN 79 36.3  0.447  6.3  5.7  4.5    1.8 27.6
## 6            Jayson Tatum  BOS 72 36.4  0.452  6.1  8.7  6.0    1.6 26.8
##   Value_Billions awards_1 awards_2plus avg_salary_millions Age_22_26 Age_27_31
## 1           4.35        0           1             55.3591         1         0
## 2           4.30        0           1             58.4566         0         1
## 3           4.60        0           1             59.0331         0         1
## 4             NA        0           0             51.8379         1         0
## 5           3.60        0           1             50.6117         1         0
## 6           6.70        0           1             62.7867         1         0
##   Age_32_34 Age_35_plus Pos_PF Pos_PG Pos_SF Pos_SG   Age    Awards
## 1         0           0      0      1      0      0 Age_1 2+ awards
## 2         0           0      1      0      0      0 Age_2 2+ awards
## 3         0           0      0      0      0      0 Age_2 2+ awards
## 4         0           0      0      1      0      0 Age_1  0 awards
## 5         0           0      0      0      0      1 Age_1 2+ awards
```

```
## 6         0           0      1      0      0      0 Age_1 2+ awards
```

Initial Model Creation

```
initial_model <- lm(avg_salary_millions ~ MP + PTS + FG_pct + FTA + TRB + AST + stocks + Value_Billions
summary(initial_model)
```

```
##
## Call:
## lm(formula = avg_salary_millions ~ MP + PTS + FG_pct + FTA +
##     TRB + AST + stocks + Value_Billions + (PTS * FTA), data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -31.3802  -5.0427   0.0288   4.2201  29.8538
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -1.86018    3.52811  -0.527 0.598364
## MP             -0.15249    0.14624  -1.043 0.297808
## PTS             1.25182    0.26460   4.731 3.27e-06 ***
## FG_pct         -6.44657    6.71992  -0.959 0.338074
## FTA            -2.55141    1.04216  -2.448 0.014859 *
## TRB             0.76480    0.29133   2.625 0.009049 **
## AST             1.05710    0.37944   2.786 0.005634 **
## stocks          1.54249    0.96492   1.599 0.110839
## Value_Billions  0.28366    0.23960   1.184 0.237292
## PTS:FTA         0.15463    0.04218   3.666 0.000286 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.28 on 342 degrees of freedom
##   (218 observations deleted due to missingness)
## Multiple R-squared:  0.7187, Adjusted R-squared:  0.7113
## F-statistic: 97.09 on 9 and 342 DF,  p-value: < 2.2e-16
```

VIF Analysis

```
vif_values <- vif(initial_model)
```

```
## there are higher-order terms (interactions) in this model
## consider setting type = 'predictor'; see ?vif
```

```
print(vif_values)
```

```
##             MP            PTS         FG_pct            FTA            TRB
##       8.192566      15.996139       1.471493      17.510374       2.692199
##            AST         stocks Value_Billions        PTS:FTA
##       2.725411       2.119833       1.019061      20.482643
```

```
# high vifs detected, remove
vif_less <- lm(avg_salary_millions ~ MP + PTS + FG_pct + FTA + TRB + AST + stocks + Value_Billions, data
print(vif(vif_less))
```

```
##             MP            PTS         FG_pct            FTA            TRB
##       6.595433      12.115290       1.444336       6.135719       2.684134
##            AST         stocks Value_Billions
##       2.671925       2.116299       1.008714
```

Stepwise

```
ols_step_both_p(vif_less,p_ent=0.15,p_rem=0.15,details=T)
```

```
## Stepwise Selection Method
## -------------------------
##
## Candidate Terms:
##
## 1. MP
## 2. PTS
## 3. FG_pct
## 4. FTA
## 5. TRB
## 6. AST
## 7. stocks
## 8. Value_Billions
##
##
## Step   => 0
## Model  => avg_salary_millions ~ 1
## R2     => 0
##
## Initiating stepwise selection...
##
## Step      => 1
## Selected  => PTS
## Model     => avg_salary_millions ~ PTS
## R2        => 0.682
##
## Step      => 2
## Selected  => AST
## Model     => avg_salary_millions ~ PTS + AST
## R2        => 0.689
##
## Step      => 3
## Selected  => TRB
## Model     => avg_salary_millions ~ PTS + AST + TRB
## R2        => 0.694
##
## Step      => 4
## Selected  => MP
## Model     => avg_salary_millions ~ PTS + AST + TRB + MP
## R2        => 0.702
##
## Step      => 5
## Selected  => stocks
## Model     => avg_salary_millions ~ PTS + AST + TRB + MP + stocks
```

```
## R2        => 0.703
##
## Step      => 6
## Selected  => Value_Billions
## Model     => avg_salary_millions ~ PTS + AST + TRB + MP + stocks + Value_Billions
## R2        => 0.705
##
##
## No more variables to be added or removed.
```

```
##
##
##                                    Stepwise Summary
## ----------------------------------------------------------------------------------------
## Step    Variable                AIC         SBC         SBIC        R2       Adj. R2
## ----------------------------------------------------------------------------------------
##  0      Base Model            2927.395    2935.123    1926.083    0.00000    0.00000
##  1      PTS (+)               2526.552    2538.143    1527.381    0.68160    0.68069
##  2      AST (+)               2520.300    2535.755    1521.153    0.68898    0.68719
##  3      TRB (+)               2516.367    2535.685    1517.282    0.69417    0.69154
##  4      MP (+)                2509.800    2532.982    1510.919    0.70153    0.69809
##  5      stocks (+)            2509.509    2536.554    1510.717    0.70346    0.69918
##  6      Value_Billions (+)    2509.349    2540.258    1510.667    0.70528    0.70015
## ----------------------------------------------------------------------------------------
##
## Final Model Output
## ------------------
##
##                           Model Summary
## ------------------------------------------------------------------
## R                       0.840       RMSE                  8.354
## R-Squared               0.705       MSE                  69.791
## Adj. R-Squared          0.700       Coef. Var            57.484
## Pred R-Squared          0.688       AIC                2509.349
## MAE                     6.410       SBC                2540.258
## ------------------------------------------------------------------
##  RMSE: Root Mean Square Error
##  MSE: Mean Square Error
##  MAE: Mean Absolute Error
##  AIC: Akaike Information Criteria
##  SBC: Schwarz Bayesian Criteria
##
##                                  ANOVA
## --------------------------------------------------------------------------
##                  Sum of
##                 Squares         DF    Mean Square       F         Sig.
## --------------------------------------------------------------------------
## Regression    58787.907          6       9797.984    137.599    0.0000
## Residual      24566.324        345         71.207
## Total         83354.230        351
## --------------------------------------------------------------------------
##
##                                    Parameter Estimates
## ----------------------------------------------------------------------------------------------------
```

```
##          model      Beta    Std. Error    Std. Beta      t        Sig       lower     upper
## ------------------------------------------------------------------------------------------
##    (Intercept)    -6.546         1.927                -3.398    0.001    -10.336    -2.757
##            PTS     1.853         0.153        0.803   12.144    0.000      1.553     2.153
##            AST     1.362         0.375        0.170    3.637    0.000      0.626     2.099
##            TRB     0.585         0.258        0.094    2.266    0.024      0.077     1.092
##             MP    -0.392         0.118       -0.220   -3.311    0.001     -0.625    -0.159
##         stocks     1.551         0.975        0.067    1.592    0.112     -0.365     3.468
## Value_Billions     0.353         0.243        0.043    1.457    0.146     -0.124     0.831
## ------------------------------------------------------------------------------------------
```

T-Test Quant Only

```
summary(vif_less)
```

```
##
## Call:
## lm(formula = avg_salary_millions ~ MP + PTS + FG_pct + FTA +
##     TRB + AST + stocks + Value_Billions, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -31.5085  -5.4221  -0.0979   4.6283  28.9494
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -2.2846     3.5896  -0.636  0.52491
## MP              -0.3892     0.1336  -2.914  0.00381 **
## PTS              1.7296     0.2344   7.378 1.22e-12 ***
## FG_pct          -9.7931     6.7773  -1.445  0.14937
## FTA              0.5277     0.6280   0.840  0.40132
## TRB              0.7063     0.2961   2.385  0.01761 *
## AST              1.2520     0.3824   3.274  0.00117 **
## stocks           1.6869     0.9814   1.719  0.08655 .
## Value_Billions   0.3722     0.2427   1.534  0.12604
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.429 on 343 degrees of freedom
##   (218 observations deleted due to missingness)
## Multiple R-squared:  0.7076, Adjusted R-squared:  0.7008
## F-statistic: 103.8 on 8 and 343 DF,  p-value: < 2.2e-16
```

New Model as a Result of Test

```
quant <- lm(avg_salary_millions ~ MP + PTS + TRB + AST, data = df)
summary(quant)
```

```
##
## Call:
## lm(formula = avg_salary_millions ~ MP + PTS + TRB + AST, data = df)
##
```

```
## Residuals:
##      Min       1Q   Median       3Q      Max
## -31.1269  -4.9182  -0.0684   4.5662  29.5636
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -4.8411     1.3315  -3.636 0.000314 ***
## MP           -0.3215     0.1051  -3.059 0.002373 **
## PTS           1.8412     0.1419  12.971  < 2e-16 ***
## TRB           0.7630     0.2182   3.497 0.000524 ***
## AST           1.3912     0.3527   3.944 9.48e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.362 on 393 degrees of freedom
##   (172 observations deleted due to missingness)
## Multiple R-squared:  0.7087, Adjusted R-squared:  0.7058
## F-statistic: 239.1 on 4 and 393 DF,  p-value: < 2.2e-16
```

Adding Qualitative Predictors

```
quant_and_qual <- lm(avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus + Age_22_26 +
summary(quant_and_qual)
```

```
##
## Call:
## lm(formula = avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 +
##     awards_2plus + Age_22_26 + Age_27_31 + Age_32_34 + Age_35_plus +
##     Pos_PF + Pos_PG + Pos_SF + Pos_SG, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -25.9536  -4.6282  -0.5886   4.5199  26.8865
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -5.16538    1.93231  -2.673  0.00784 **
## MP           -0.18030    0.10929  -1.650  0.09981 .
## PTS           1.57116    0.14250  11.026  < 2e-16 ***
## TRB           0.05635    0.31127   0.181  0.85644
## AST           1.62076    0.41008   3.952 9.22e-05 ***
## awards_1      2.98982    1.97163   1.516  0.13024
## awards_2plus 11.49110    2.35847   4.872 1.62e-06 ***
## Age_22_26     2.17957    1.16495   1.871  0.06211 .
## Age_27_31     6.36656    1.27120   5.008 8.40e-07 ***
## Age_32_34     5.69093    1.74793   3.256  0.00123 **
## Age_35_plus   3.86745    2.15448   1.795  0.07343 .
## Pos_PF        1.18073    1.40622   0.840  0.40163
## Pos_PG       -3.63427    2.04020  -1.781  0.07565 .
## Pos_SF       -0.94499    1.62190  -0.583  0.56048
## Pos_SG       -3.49451    1.71234  -2.041  0.04196 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Residual standard error: 7.742 on 383 degrees of freedom
##   (172 observations deleted due to missingness)
## Multiple R-squared:  0.7566, Adjusted R-squared:  0.7477
## F-statistic: 85.06 on 14 and 383 DF,  p-value: < 2.2e-16
```

ANOVA Test for reduced model (Awards)

```
reduced_awards <- lm(avg_salary_millions ~ MP + PTS + TRB + AST + Age_22_26 + Age_27_31 + Age_32_34 + Ag
anova(reduced_awards, quant_and_qual)
```

```
## Analysis of Variance Table
##
## Model 1: avg_salary_millions ~ MP + PTS + TRB + AST + Age_22_26 + Age_27_31 +
##     Age_32_34 + Age_35_plus + Pos_PF + Pos_PG + Pos_SF + Pos_SG
## Model 2: avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus +
##     Age_22_26 + Age_27_31 + Age_32_34 + Age_35_plus + Pos_PF +
##     Pos_PG + Pos_SF + Pos_SG
##   Res.Df   RSS Df Sum of Sq      F    Pr(>F)
## 1    385 24397
## 2    383 22958  2      1439 12.003 8.792e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

ANOVA Test for reduced model (Age)

```
reduced_age <- lm(avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus + Pos_PF + Pos_PG
anova(reduced_age, quant_and_qual)
```

```
## Analysis of Variance Table
##
## Model 1: avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus +
##     Pos_PF + Pos_PG + Pos_SF + Pos_SG
## Model 2: avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus +
##     Age_22_26 + Age_27_31 + Age_32_34 + Age_35_plus + Pos_PF +
##     Pos_PG + Pos_SF + Pos_SG
##   Res.Df   RSS Df Sum of Sq      F    Pr(>F)
## 1    387 24947
## 2    383 22958  4    1989.3 8.2965 1.997e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

ANOVA Test for reduced model (Pos)

```
reduced_pos <- lm(avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus + Age_22_26 + Age
anova(reduced_pos, quant_and_qual)
```

```
## Analysis of Variance Table
##
## Model 1: avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus +
##     Age_22_26 + Age_27_31 + Age_32_34 + Age_35_plus
```

```
## Model 2: avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus +
##     Age_22_26 + Age_27_31 + Age_32_34 + Age_35_plus + Pos_PF +
##     Pos_PG + Pos_SF + Pos_SG
##   Res.Df   RSS Df Sum of Sq      F   Pr(>F)
## 1    387 23808
## 2    383 22958  4    849.47 3.5428 0.007451 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Confidence/Prediction Intervals

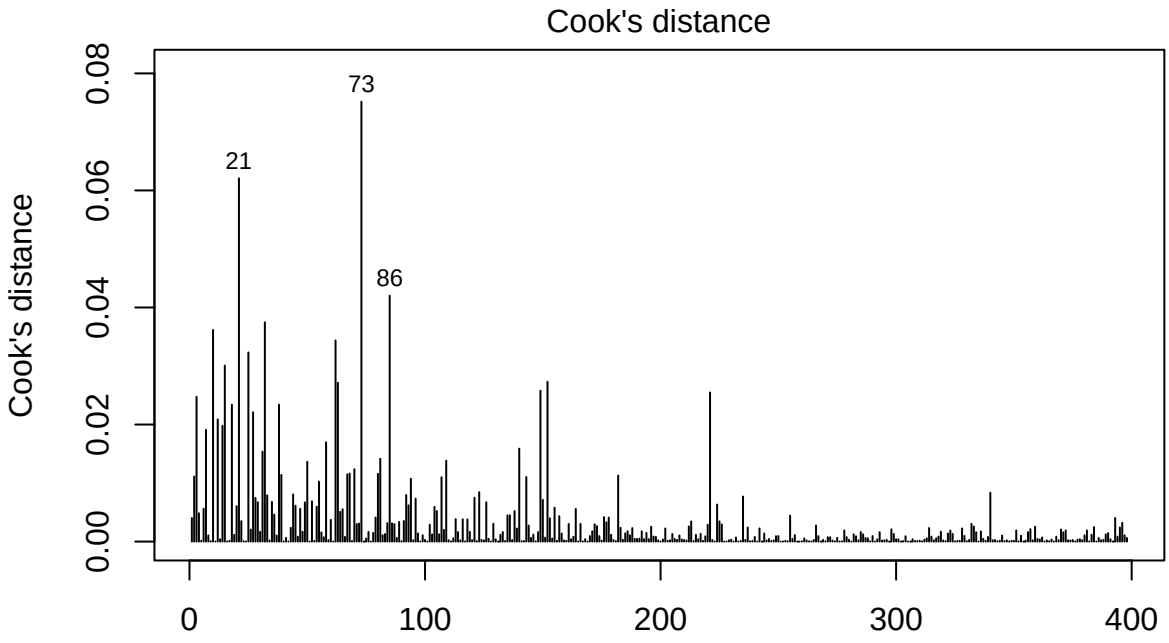
```
conf <- confint(quant_and_qual, level = 0.95)
conf
```

```
##                   2.5 %     97.5 %
## (Intercept)  -8.9646519 -1.3661091
## MP           -0.3951891  0.0345813
## PTS           1.2909795  1.8513318
## TRB          -0.5556541  0.6683504
## AST           0.8144629  2.4270608
## awards_1     -0.8867470  6.8663866
## awards_2plus  6.8539179 16.1282741
## Age_22_26    -0.1109316  4.4700691
## Age_27_31     3.8671633  8.8659545
## Age_32_34     2.2541889  9.1276762
## Age_35_plus  -0.3686395  8.1035371
## Pos_PF       -1.5841382  3.9456016
## Pos_PG       -7.6456599  0.3771299
## Pos_SF       -4.1339343  2.2439509
## Pos_SG       -6.8612683 -0.1277516
```

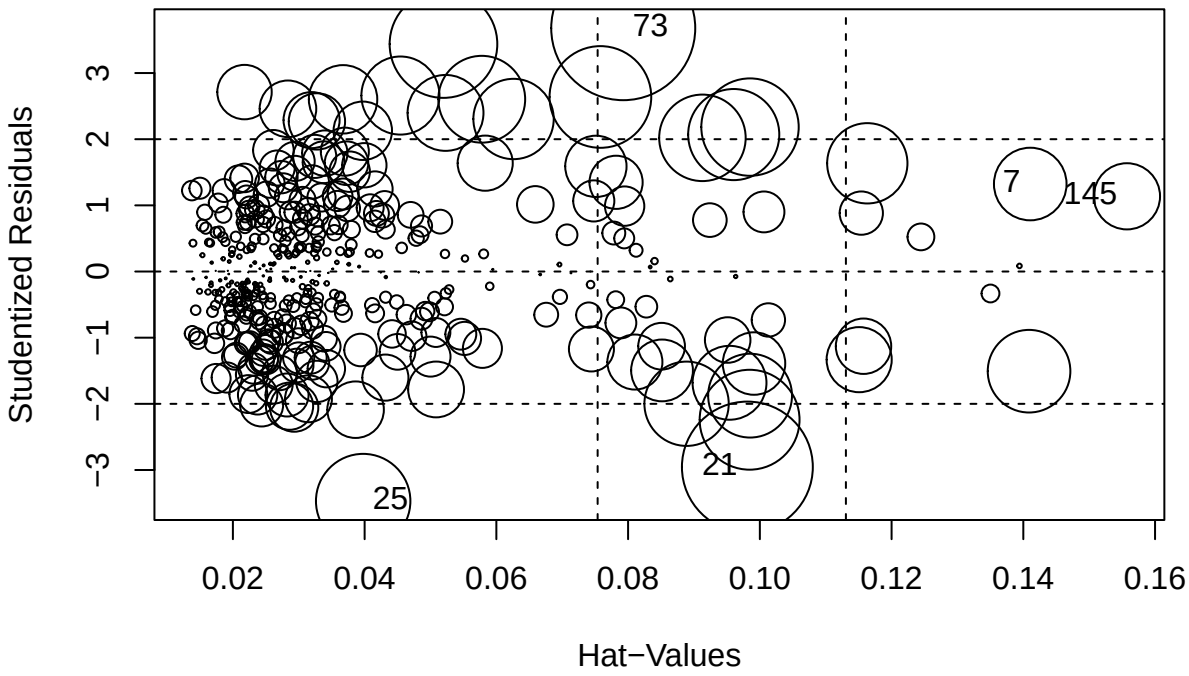
```
# add prediction
```

Residual Analysis

```
# Cooks Distance Thresholds
plot(quant_and_qual,which=4)
```




```
# Leverage vs Studentized Residuals
influencePlot(quant_and_qual,fill=F)
```




```
##       StudRes        Hat      CookD
## 7    1.322322 0.14105368 0.01910530
## 21  -2.955050 0.09810717 0.06207313
## 25  -3.469876 0.03977828 0.03231987
## 73   3.677788 0.07926145 0.07516773
## 145  1.136801 0.15573349 0.01587993
```

```
# Deleted Studentized Residuals vs Predicted values
ols_plot_resid_stud_fit(quant_and_qual)
```