Predicting Average Salary From NBA Stats

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NBA CONTRACTS HISTORY

Data Set

nba_contracts_history

B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
CONTRACT_START	CONTRACT_END	AVG_SALARY	AGE	GP	W	L	MIN	PTS	FGM	FGA	FG%	3PM	3PA	3P%	FTM	FTA	FT%	OREB	DREB	REB	AST	TOV	STL	BLK	PF	+/-
2019	2020	2564753.0	32.0	69.0	27.0	42.0	2091.0	840.0	279.0	698.0	40.0	150.0	403.0	37.2	132.0	163.0	81.0	32.0	138.0	170.0	160.0	91.0	54.0	17.0	160.0	-90.0
2015	2017	21165675.0	27.0	72.0	34.0	38.0	2100.0	1236.0	506.0	987.0	51.3	1.0	10.0	10.0	223.0	274.0	81.4	214.0	321.0	535.0	50.0	104.0	43.0	126.0	206.0	-104.0
2011	2014	10759763.5	22.0	80.0	31.0	49.0	2047.0	566.0	234.0	341.0	68.6	0.0	1.0	0.0	98.0	217.0	45.2	207.0	368.0	575.0	42.0	101.0	41.0	142.0	255.0	-100.0
2015	2018	8143323.5	25.0	82.0	39.0	43.0	2581.0	1258.0	512.0	1100.0	46.5	57.0	179.0	31.8	177.0	232.0	76.3	110.0	396.0	506.0	192.0	170.0	101.0	39.0	245.0	105.0
2018	2019	13410739.0	32.0	81.0	35.0	46.0	2463.0	1347.0	506.0	911.0	55.5	1.0	7.0	14.3	334.0	582.0	57.4	255.0	757.0	1012.0	105.0	208.0	48.0	131.0	249.0	89.0
2015	2016	7055398.0	22.0	76.0	46.0	30.0	1563.0	530.0	203.0	496.0	40.9	39.0	131.0	29.8	85.0	126.0	67.5	27.0	125.0	152.0	155.0	65.0	48.0	14.0	146.0	-128.0
2016	2017	6135000.0	28.0	76.0	18.0	58.0	1615.0	586.0	218.0	561.0	38.9	96.0	268.0	35.8	54.0	63.0	85.7	20.0	154.0	174.0	83.0	45.0	48.0	5.0	82.0	-322.0
2019	2020	4767000.0	29.0	65.0	31.0	34.0	1371.0	611.0	230.0	476.0	48.3	71.0	176.0	40.3	80.0	101.0	79.2	104.0	305.0	409.0	50.0	87.0	45.0	34.0	193.0	-214.0
2015	2018	4051312.5	25.0	51.0	15.0	36.0	824.0	294.0	119.0	242.0	49.2	12.0	43.0	27.9	44.0	57.0	77.2	46.0	153.0	199.0	59.0	55.0	31.0	39.0	110.0	-123.0
2014	2017	8000000.0	28.0	77.0	41.0	36.0	2723.0	1107.0	389.0	853.0	45.6	180.0	442.0	40.7	149.0	193.0	77.2	99.0	376.0	475.0	191.0	132.0	126.0	20.0	179.0	196.0
2013	2016	11000000.0	25.0	78.0	45.0	33.0	2983.0	1786.0	626.0	1388.0	45.1	272.0	600.0	45.3	262.0	291.0	90.0	59.0	255.0	314.0	539.0	240.0	126.0	12.0	198.0	133.0
2017	2019	7000000.0	25.0	74.0	29.0	45.0	1494.0	585.0	207.0	545.0	38.0	120.0	308.0	39.0	51.0	64.0	79.7	27.0	129.0	156.0	93.0	46.0	46.0	6.0	96.0	-60.0
2016	2019	12500000.0	25.0	59.0	31.0	28.0	866.0	246.0	93.0	208.0	44.7	24.0	74.0	32.4	36.0	42.0	85.7	39.0	127.0	166.0	57.0	33.0	37.0	11.0	68.0	46.0
2015	2017	1224935.0	21.0	35.0	2.0	33.0	261.0	73.0	26.0	67.0	38.8	5.0	19.0	26.3	16.0	24.0	66.7	15.0	24.0	39.0	11.0	11.0	6.0	1.0	15.0	27.0
2017	2019	5708251.0	36.0	67.0	33.0	34.0	1753.0	678.0	239.0	515.0	46.4	162.0	359.0	45.1	38.0	42.0	90.5	7.0	179.0	186.0	110.0	69.0	34.0	21.0	107.0	-169.0
2011	2015	4250000.0	25.0	82.0	40.0	42.0	2140.0	867.0	300.0	629.0	47.7	105.0	253.0	41.5	162.0	218.0	74.3	111.0	207.0	318.0	108.0	77.0	87.0	20.0	139.0	-31.0
2018	2019	1682025.0	25.0	82.0	49.0	33.0	1488.0	441.0	165.0	390.0	42.3	74.0	210.0	35.2	37.0	44.0	84.1	36.0	125.0	161.0	91.0	43.0	23.0	22.0	120.0	141.0
2017	2019	31633333.333333300	31.0	60.0	36.0	24.0	2244.0	1344.0	426.0	918.0	46.4	193.0	468.0	41.2	299.0	365.0	81.9	48.0	238.0	286.0	417.0	173.0	88.0	19.0	170.0	356.0
2015	2018	10375000.0	23.0	27.0	9.0	18.0	899.0	374.0	121.0	300.0	40.3	26.0	68.0	38.2	106.0	129.0	82.2	19.0	95.0	114.0	82.0	52.0	17.0	5.0	64.0	-129.0
2017	2018	5250000.0	33.0	62.0	32.0	30.0	1596.0	444.0	174.0	395.0	44.1	41.0	120.0	34.2	55.0	75.0	73.3	54.0	216.0	270.0	107.0	58.0	96.0	31.0	97.0	-65.0
2015	2019	17000450.0	29.0	78.0	41.0	37.0	2640.0	1275.0	502.0	1002.0	50.1	90.0	259.0	34.7	181.0	234.0	77.4	81.0	193.0	274.0	350.0	173.0	78.0	15.0	195.0	20.0
2016	2020	23217391.5	27.0	70.0	41.0	29.0	2448.0	1046.0	372.0	873.0	42.6	139.0	399.0	34.8	163.0	192.0	84.9	55.0	373.0	428.0	403.0	205.0	65.0	43.0	114.0	211.0
2019	2020	2174310.0	26.0	76.0	45.0	31.0	2028.0	618.0	232.0	572.0	40.6	104.0	327.0	31.8	50.0	95.0	52.6	25.0	137.0	162.0	167.0	68.0	47.0	23.0	207.0	104.0

Inflation Index

Purpose

Since the salaries were from a range of years, we decided to adjust for inflation and standardize the values.

Process

From a table of CPI-U values, multiply the base year CPI to the nominal salary, divide by the nominal salary year's CPI, and multiply by 100% to get the adjusted salary.

Inflation Code

```r
# Function to adjust salary for inflation
adjust_for_inflation <- function(year, salary) {
  # Extract CPI values for the year
  yearly_cpi <- cpi_data$CPI[format(cpi_data$Date, "%Y") == as.character(year)]

  # If CPI for that year is not found, return NA
  if (length(yearly_cpi) == 0) {
    return(NA)
  }

  # Use the average CPI for the year
  avg_cpi_year <- mean(yearly_cpi)

  # Calculate the adjusted salary
  adjusted_salary <- (salary * cpi_2023) / avg_cpi_year
  return(adjusted_salary)
}

# Apply the function to adjust each salary
nba$AdjustedSalary <- mapply(adjust_for_inflation, nba$CONTRACT_END, nba$SALARY, SIMPLIFY = FALSE)

# Convert the list to a vector
nba$AdjustedSalary <- unlist(nba$AdjustedSalary)

# Check the output
print(nba$AdjustedSalary)
```

Stepwise Regression

```
> # Summary of the selected model
> summary(stepwise_model)

Call:
lm(formula = target ~ GP + W + MIN + FGM + FGA + ThreePM + ThreePA +
    FTA + DREB + PF, data = data.frame(target, predictors))

Residuals:
      Min        1Q    Median        3Q       Max
-12702205  -3410513    -22293   3096859  10520624

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  8666745    1608968   5.387 3.32e-07 ***
GP           -253372      48355  -5.240 6.43e-07 ***
W             168299      45652   3.687 0.000334 ***
MIN             3373       2040   1.653 0.100691
FGM            62338      21114   2.952 0.003752 **
FGA           -22228      10309  -2.156 0.032941 *
ThreePM       -84708      57142  -1.482 0.140693
ThreePA        48161      23892   2.016 0.045914 *
FTA            13205       4684   2.819 0.005579 **
DREB           16891       5824   2.900 0.004393 **
PF            -35172      13849  -2.540 0.012295 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 4892000 on 128 degrees of freedom
Multiple R-squared:  0.762,	Adjusted R-squared:  0.7434
F-statistic: 40.98 on 10 and 128 DF,  p-value: < 2.2e-16
```

Hypothetical Models

1st Order (Reduced) Model

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 + X_3 + \cdots + \beta_{10} X_{10} + \varepsilon$$

2nd Order (Complete) Model

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_{10} X_{10} + \beta_{11} X_1^2 + \beta_{12} X_2^2 + \ldots + \beta_{20} X_{10}^2 +$ Interaction Terms $+ \epsilon$

NESTED MODELS

Reduced

```
> first_order_model

Call:
lm(formula = target ~ GP + W + MIN + FGM + FGA + ThreePM + ThreePA +
    FTA + DREB + PF, data = data.frame(target, predictors))

Coefficients:
(Intercept)           GP            W          MIN          FGM          FGA      ThreePM
    8666745      -253372       168299         3373        62338       -22229       -84708
    ThreePA          FTA         DREB           PF
      48161        13205        16891       -35172
```

Complete

```
> second_order_model

Call:
lm(formula = target ~ GP + W + MIN + FGM + FGA + ThreePM + ThreePA +
    FTA + DREB + PF + I(GP^2) + I(W^2) + I(MIN^2) + I(FGM^2) +
    I(FGA^2) + I(ThreePM^2) + I(ThreePA^2) + I(FTA^2) + I(DREB^2) +
    I(PF^2) + GP * W + GP * MIN + GP * FGM + GP * FGA + GP *
    ThreePM + GP * ThreePA + GP * FTA + GP * DREB + GP * PF +
    W * MIN + W * FGM + W * FGA + W * ThreePM + W * ThreePA +
    W * FTA + W * DREB + W * PF + MIN * FGM + MIN * FGA + MIN *
    ThreePM + MIN * ThreePA + MIN * FTA + MIN * DREB + MIN *
    PF + FGM * FGA + FGM * ThreePM + FGM * ThreePA + FGM * FTA +
    FGM * DREB + FGM * PF + FGA * ThreePM + FGA * ThreePA + FGA *
    FTA + FGA * DREB + FGA * PF + ThreePM * ThreePA + ThreePM *
    FTA + ThreePM * DREB + ThreePM * PF + ThreePA * FTA + ThreePA *
    DREB + ThreePA * PF + FTA * DREB + FTA * PF + DREB * PF,
    data = data.frame(target, predictors))

Coefficients:
    (Intercept)               GP                W              MIN              FGM              FGA
      5.875e+06       -4.359e+05        2.744e+05        1.174e+04        4.606e+05       -1.300e+05
        ThreePM          ThreePA              FTA             DREB               PF          I(GP^2)
     -3.624e+05        1.176e+05       -1.496e+03       -3.842e+04       -1.102e+05        4.699e+03
         I(W^2)         I(MIN^2)         I(FGM^2)         I(FGA^2)     I(ThreePM^2)     I(ThreePA^2)
      5.718e+03        2.080e+00        1.256e+03        1.370e+02       -1.795e+04       -2.578e+03
       I(FTA^2)        I(DREB^2)          I(PF^2)             GP:W           GP:MIN           GP:FGM
      2.163e+01       -1.218e+02        2.162e+01       -1.282e+04       -2.349e+02       -8.802e+03
         GP:FGA          FGM:FGA       GP:ThreePM       GP:ThreePA           GP:FTA          GP:DREB
      3.076e+03       -8.562e+02        9.686e+03       -3.418e+03        8.380e+02        2.525e+03
          GP:PF            W:MIN            W:FGM            W:FGA        W:ThreePM        W:ThreePA
      1.209e+03        2.456e+02       -3.518e+03        1.418e+03        2.905e+03       -2.055e+03
          W:FTA           W:DREB             W:PF          MIN:FGM          MIN:FGA      MIN:ThreePM
     -9.012e+01       -9.960e+02        3.253e+03        8.052e+01       -4.990e+01        8.116e+01
    MIN:ThreePA          MIN:FTA         MIN:DREB           MIN:PF      FGM:ThreePM      FGM:ThreePA
     -4.703e+01        1.084e+01        2.642e+01       -8.220e+01        4.433e+03       -1.327e+03
        FGM:FTA         FGM:DREB           FGM:PF      FGA:ThreePM      FGA:ThreePA          FGA:FTA
     -8.825e+02        7.842e+00        2.655e+02       -2.124e+03        6.948e+02        2.820e+02
       FGA:DREB           FGA:PF  ThreePM:ThreePA      ThreePM:FTA     ThreePM:DREB       ThreePM:PF
     -8.906e+01       -9.760e+01        1.370e+04       -3.029e+02       -1.441e+03       -1.630e+03
    ThreePA:FTA     ThreePA:DREB       ThreePA:PF         FTA:DREB           FTA:PF          DREB:PF
     -2.948e+01        6.221e+02        9.111e+02        1.795e+02        1.418e+02       -3.686e+02
     GP:FGM:FGA
      1.054e+00
```

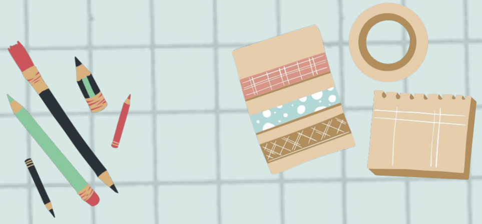
Complete Model Summary Statistics

```
> summary(second_order_model)

Call:
lm(formula = target ~ GP + W + MIN + FGM + FGA + ThreePM + ThreePA +
    FTA + DREB + PF + I(GP^2) + I(W^2) + I(MIN^2) + I(FGM^2) +
    I(FGA^2) + I(ThreePM^2) + I(ThreePA^2) + I(FTA^2) + I(DREB^2) +
    I(PF^2) + GP * W + GP * MIN + GP * FGM * GP * FGA + GP *
    ThreePM + GP * ThreePA + GP * FTA + GP * DREB + GP * PF +
    W * MIN + W * FGM + W * FGA + W * ThreePM + W * ThreePA +
    W * FTA + W * DREB + W * PF + MIN * FGM + MIN * FGA + MIN *
    ThreePM + MIN * ThreePA + MIN * FTA + MIN * DREB + MIN *
    PF + FGM * FGA + FGM * ThreePM + FGM * ThreePA + FGM * FTA +
    FGM * DREB + FGM * PF + FGA * ThreePM + FGA * ThreePA + FGA *
    FTA + FGA * DREB + FGA * PF + ThreePM * ThreePA + ThreePM *
    FTA + ThreePM * DREB + ThreePM * PF + ThreePA * FTA + ThreePA *
    DREB + ThreePA * PF + FTA * DREB + FTA * PF + DREB * PF,
    data = data.frame(target, predictors))

Residuals:
     Min       1Q   Median       3Q      Max
-9149718 -1947195    45188  1993341 11768921
```

```
Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)     5.875e+06  2.823e+06   2.081   0.0410 *
GP             -4.359e+05  2.877e+05  -1.515   0.1341
W               2.744e+05  3.188e+05   0.861   0.3922
MIN             1.174e+04  2.488e+04   0.472   0.6384
FGM             4.606e+05  2.675e+05   1.722   0.0894 .
FGA            -1.300e+05  1.255e+05  -1.036   0.3035
ThreePM        -3.624e+05  6.107e+05  -0.593   0.5548
ThreePA         1.176e+05  2.659e+05   0.442   0.6596
FTA            -1.496e+03  6.473e+04  -0.023   0.9816
DREB           -3.842e+04  6.473e+04  -0.594   0.5547
PF             -1.102e+05  1.369e+05  -0.805   0.4234
I(GP^2)         4.699e+03  5.892e+03   0.798   0.4278
I(W^2)          5.718e+03  5.109e+03   1.119   0.2668
I(MIN^2)        2.080e+00  1.165e+01   0.179   0.8588
I(FGM^2)        1.256e+03  1.021e+03   1.230   0.2226
I(FGA^2)        1.370e+02  2.635e+02   0.520   0.6047
I(ThreePM^2)   -1.795e+04  8.817e+03  -2.036   0.0455 *
I(ThreePA^2)   -2.578e+03  1.536e+03  -1.678   0.0977 .
I(FTA^2)        2.163e+01  4.409e+01   0.491   0.6252
I(DREB^2)      -1.218e+02  6.776e+01  -1.797   0.0765 .
I(PF^2)         2.162e+01  5.201e+02   0.042   0.9670
```

```
GP:W             -1.282e+04  8.561e+03  -1.497   0.1387
GP:MIN           -2.349e+02  4.978e+02  -0.472   0.6385
GP:FGM           -8.802e+03  4.663e+03  -1.887   0.0631 .
GP:FGA            3.076e+03  2.425e+03   1.268   0.2088
FGM:FGA          -8.562e+02  1.018e+03  -0.841   0.4033
GP:ThreePM        9.686e+03  1.241e+04   0.781   0.4375
GP:ThreePA       -3.418e+03  5.036e+03  -0.679   0.4995
GP:FTA            8.380e+02  1.407e+03   0.596   0.5533
GP:DREB           2.525e+03  1.401e+03   1.802   0.0757 .
GP:PF             1.209e+03  2.964e+03   0.408   0.6845
W:MIN             2.456e+02  3.288e+02   0.747   0.4576
W:FGM            -3.518e+03  3.982e+03  -0.883   0.3799
W:FGA             1.418e+03  1.934e+03   0.733   0.4659
W:ThreePM         2.905e+03  9.637e+03   0.301   0.7640
W:ThreePA        -2.055e+03  3.948e+03  -0.520   0.6044
W:FTA            -9.012e+01  9.533e+02  -0.095   0.9249
W:DREB           -9.960e+02  1.047e+03  -0.951   0.3448
W:PF              3.253e+03  2.120e+03   1.535   0.1293
MIN:FGM           8.052e+01  1.769e+02   0.455   0.6504
MIN:FGA          -4.990e+01  9.345e+01  -0.534   0.5950
MIN:ThreePM       8.116e+01  3.839e+02   0.211   0.8332
MIN:ThreePA      -4.703e+01  1.666e+02  -0.282   0.7785
MIN:FTA           1.084e+01  3.796e+01   0.286   0.7760
MIN:DREB          2.642e+01  5.006e+01   0.528   0.5994
MIN:PF           -8.220e+01  1.077e+02  -0.764   0.4477
FGM:ThreePM       4.433e+03  3.951e+03   1.122   0.2656
FGM:ThreePA      -1.327e+03  1.741e+03  -0.762   0.4483
FGM:FTA          -8.825e+02  5.305e+02  -1.664   0.1005
FGM:DREB          7.841e+00  3.314e+02   0.024   0.9812
FGM:PF            2.655e+02  1.296e+03   0.205   0.8383
FGA:ThreePM      -2.124e+03  2.038e+03  -1.042   0.3010
FGA:ThreePA       6.948e+02  9.069e+02   0.766   0.4461
FGA:FTA           2.820e+02  2.457e+02   1.148   0.2549
FGA:DREB         -8.906e+01  1.727e+02  -0.516   0.6077
FGA:PF           -9.760e+01  6.026e+02  -0.162   0.8718
ThreePM:ThreePA   1.370e+04  7.278e+03   1.882   0.0639 .
ThreePM:FTA      -3.029e+02  1.447e+03  -0.209   0.8348
ThreePM:DREB     -1.441e+03  1.299e+03  -1.110   0.2707
ThreePM:PF       -1.630e+03  2.814e+03  -0.579   0.5641
ThreePA:FTA      -2.948e+01  5.599e+02  -0.053   0.9582
ThreePA:DREB      6.221e+02  5.235e+02   1.188   0.2386
ThreePA:PF        9.111e+02  1.160e+03   0.786   0.4346
FTA:DREB          1.795e+02  1.367e+02   1.313   0.1934
FTA:PF            1.418e+02  2.084e+02   0.680   0.4984
DREB:PF          -3.686e+02  3.592e+02  -1.026   0.3082
```

```
GP:FGM:FGA       1.054e+00  7.503e-01   1.404   0.1646
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 4703000 on 72 degrees of freedom
Multiple R-squared:  0.8763,	Adjusted R-squared:  0.7628
F-statistic: 7.725 on 66 and 72 DF,  p-value: 8.996e-16

>
```



ANOVA TEST

TAKEAWAYS

The p-value = 0.2447. Therefore, we decided to go with the more parsimonious model and chose the REDUCED MODEL.

```
> anova(first_order_model, second_order_model)
Analysis of Variance Table

Model 1: target ~ GP + W + MIN + FGM + FGA + ThreePM + ThreePA + FTA +
    DREB + PF
Model 2: target ~ GP + W + MIN + FGM + FGA + ThreePM + ThreePA + FTA +
    DREB + PF + I(GP^2) + I(W^2) + I(MIN^2) + I(FGM^2) + I(FGA^2) +
    I(ThreePM^2) + I(ThreePA^2) + I(FTA^2) + I(DREB^2) + I(PF^2) +
    GP * W + GP * MIN + GP * FGM * GP * FGA + GP * ThreePM +
    GP * ThreePA + GP * FTA + GP * DREB + GP * PF + W * MIN +
    W * FGM + W * FGA + W * ThreePM + W * ThreePA + W * FTA +
    W * DREB + W * PF + MIN * FGM + MIN * FGA + MIN * ThreePM +
    MIN * ThreePA + MIN * FTA + MIN * DREB + MIN * PF + FGM *
    FGA + FGM * ThreePM + FGM * ThreePA + FGM * FTA + FGM * DREB +
    FGM * PF + FGA * ThreePM + FGA * ThreePA + FGA * FTA + FGA *
    DREB + FGA * PF + ThreePM * ThreePA + ThreePM * FTA + ThreePM *
    DREB + ThreePM * PF + ThreePA * FTA + ThreePA * DREB + ThreePA *
    PF + FTA * DREB + FTA * PF + DREB * PF
  Res.Df        RSS Df  Sum of Sq      F Pr(>F)
1    128 3.0626e+15
2     72 1.5923e+15 56 1.4704e+15 1.1873 0.2447
```

Reduced Model Summary Statistics

```
> first_order_model <- lm(target ~ GP + W + MIN + FGM + FGA + ThreePM + ThreePA + FTA +DREB + PF , data = data.frame(target, predictors))
> summary(first_order_model)

Call:
lm(formula = target ~ GP + W + MIN + FGM + FGA + ThreePM + ThreePA +
    FTA + DREB + PF, data = data.frame(target, predictors))

Residuals:
      Min        1Q    Median        3Q       Max
-12702205  -3410513    -22293   3096859  10520624

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  8666745    1608968   5.387 3.32e-07 ***
GP           -253372      48355  -5.240 6.43e-07 ***
W             168299      45652   3.687 0.000334 ***
MIN             3373       2040   1.653 0.100691
FGM            62338      21114   2.952 0.003752 **
FGA           -22228      10309  -2.156 0.032941 *
ThreePM       -84708      57142  -1.482 0.140693
ThreePA        48161      23892   2.016 0.045914 *
FTA            13205       4684   2.819 0.005579 **
DREB           16891       5824   2.900 0.004393 **
PF            -35172      13849  -2.540 0.012295 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 4892000 on 128 degrees of freedom
Multiple R-squared:  0.762,	Adjusted R-squared:  0.7434
F-statistic: 40.98 on 10 and 128 DF,  p-value: < 2.2e-16
```

$$y = -253372x_1 + 168299x_2 + 3373x_3 + 62338x_4 - 22228x_5 - 84708x_6 + 48161x_7 + 13205x_8 + 16891x_9 - 35172x_{10}.$$

Determining Homoscedasticity

```r
t1 <- target[1:70]   # First 70 elements
p1<-predictors[1:70,]
t2 <- target[71:length(target)] # Elements from 71 to the end
p2<-predictors[71:nrow(predictors),]


first_order_model_1 <- lm(t1 ~ GP + W + MIN + FGM + FGA + ThreePM + ThreePA + FTA +DREB + PF , data = data.frame(t1, p1))

first_order_model_2 <- lm(t2 ~ GP + W + MIN + FGM + FGA + ThreePM + ThreePA + FTA +DREB + PF , data = data.frame(t2, p2))


summary(first_order_model_1)
summary(first_order_model_2)

var.test(first_order_model_1, first_order_model_2)
```

```
> summary(first_order_model_1)

Call:
lm(formula = t1 ~ GP + W + MIN + FGM + FGA + ThreePM + ThreePA + 
    FTA + DREB + PF, data = data.frame(t1, p1))

Residuals:
     Min       1Q   Median       3Q      Max 
-7667234 -3360339  -364052  2425137 11516259 

Coefficients:
              Estimate Std. Error t value Pr(>|t|)    
(Intercept) 10300497.4  2096925.1   4.912 7.49e-06 ***
GP           -255960.8    63963.3  -4.002 0.000178 ***
W             155530.5    59085.9   2.632 0.010808 *  
MIN              173.3     2791.7   0.062 0.950721    
FGM            40403.6    26292.7   1.537 0.129716    
FGA            -8598.0    14073.9  -0.611 0.543602    
ThreePM       -46227.5    71811.4  -0.644 0.522242    
ThreePA        28895.0    30299.5   0.954 0.344153    
FTA            17064.7     5608.7   3.043 0.003499 ** 
DREB           25017.9     7831.9   3.194 0.002250 ** 
PF            -26955.5    16834.8  -1.601 0.114679    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 4609000 on 59 degrees of freedom
Multiple R-squared:  0.8144,	Adjusted R-squared:  0.7829 
F-statistic: 25.89 on 10 and 59 DF,  p-value: < 2.2e-16
```

```
> summary(first_order_model_2)

Call:
lm(formula = t2 ~ GP + W + MIN + FGM + FGA + ThreePM + ThreePA + 
    FTA + DREB + PF, data = data.frame(t2, p2))

Residuals:
      Min        1Q    Median        3Q       Max 
-12025836  -3146869     -1205   2415391  10918239 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)   
(Intercept)  6824008    2532444   2.695  0.00920 **
GP           -233498      79220  -2.947  0.00461 **
W             157004      81783   1.920  0.05981 . 
MIN             5696       3266   1.744  0.08644 . 
FGM            84465      39746   2.125  0.03785 * 
FGA           -34274      17691  -1.937  0.05757 . 
ThreePM       -86007     101350  -0.849  0.39958   
ThreePA        53591      42207   1.270  0.20926   
FTA            11519       8955   1.286  0.20345   
DREB            9442       9310   1.014  0.31470   
PF            -44220      26792  -1.651  0.10424   
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 5234000 on 58 degrees of freedom
Multiple R-squared:  0.7401,	Adjusted R-squared:  0.6953 
F-statistic: 16.51 on 10 and 58 DF,  p-value: 1.381e-13
```

Variance Test

```
> var.test(first_order_model_1, first_order_model_2)

	F test to compare two variances

data:  first_order_model_1 and first_order_model_2
F = 0.77553, num df = 59, denom df = 58, p-value = 0.3332
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.4619306 1.3005260
sample estimates:
ratio of variances
          0.775531
```

Predicted Values

	Names	Contract_Start	Contract_End	TargetTest	PredictedValues	APE
1	DeAndre Jordan	2011	2014	13983783	7686193	45.034950
2	Mike Conley	2011	2015	10418932	14923507	43.234510
3	Thaddeus Young	2011	2014	10812412	13330709	23.290798
4	Marc Gasol	2011	2014	18683500	13592977	27.246091
5	Ian Mahinmi	2012	2015	5192387	4781268	7.917733
6	Danilo Gallinari	2012	2015	14422107	14950364	3.662829
7	Stephen Curry	2013	2016	14101166	21750738	54.247791
8	Zaza Pachulia	2013	2015	6750103	6394612	5.266455
9	Chris Paul	2013	2017	26947234	21378245	20.666273
10	James Johnson	2013	2014	1954269	1676129	14.232429
11	Kyle Korver	2013	2016	7691545	11885260	54.523700
12	Trevor Ariza	2014	2017	10041499	19173745	90.945049
13	Paul George	2014	2018	24667093	28854086	16.974004
14	Quincy Pondexter	2014	2017	4393156	7817527	77.947869
15	Garrett Temple	2014	2015	1351115	-1689618	225.053615
16	Patrick Patterson	2014	2016	7755642	8507149	9.689811
17	Thabo Sefolosha	2014	2016	5127697	11062352	115.737248
18	Udonis Haslem	2014	2015	3626194	5679599	56.626982
19	DeMarcus Cousins	2014	2017	19533973	22559785	15.489998
20	Derrick Favors	2014	2017	15062248	12404715	17.643669
21	Brook Lopez	2015	2017	26566887	15024077	43.448108
22	Alec Burks	2015	2018	12712066	9376533	26.239107
23	Kawhi Leonard	2015	2019	26179919	22087094	15.633453
24	Tobias Harris	2015	2018	19604150	17945336	8.461542
25	Robin Lopez	2015	2018	16545749	11390974	31.154682
26	Jae Crowder	2015	2019	8424152	9142763	8.530365
27	Tyson Chandler	2015	2018	15928372	20846036	30.873614
28	Ed Davis	2015	2017	8367916	7017060	16.143277
29	Tristan Thompson	2015	2019	19736376	13103284	33.608458
30	Khris Middleton	2015	2019	21085280	13743450	34.819691
31	Ricky Rubio	2015	2018	16847316	8606826	48.912775
32	LeBron James	2015	2016	34569618	33027018	4.462301
33	Draymond Green	2015	2019	19736585	21135401	7.087424
34	Kent Bazemore	2016	2019	21060381	15115484	28.227870
35	Austin Rivers	2016	2018	14695076	8511023	42.082487
36	Spencer Dinwiddie	2016	2017	1412699	7336946	419.356636
37	Jeremy Lamb	2016	2018	8576816	10771612	25.589874
38	Spencer Dinwiddie	2016	2018	1595724	7336946	359.787798
39	Kevin Durant	2016	2017	32346241	39041068	20.697388
40	Bismack Biyombo	2016	2019	20458655	9844122	51.882852
41	Hassan Whiteside	2016	2019	29309893	22857551	22.014210
42	Seth Curry	2016	2017	3719377	5335696	43.456684
43	Jared Dudley	2016	2018	12252594	7172904	41.458074
44	Eric Gordon	2016	2019	15911656	11040776	30.612027
45	Kyle Korver	2017	2019	6869596	9990250	45.427027
46	Kyle Lowry	2017	2019	38069145	22293527	41.439380
47	Thabo Sefolosha	2017	2018	6432612	9326248	44.983848
48	JaMychal Green	2017	2018	10169653	9620485	5.400065
49	Quinn Cook	2017	2018	1062780	7885551	641.974312
50	Paul Millsap	2017	2019	36243912	22205538	38.733053
51	Jeff Teague	2017	2019	22865556	17980755	21.363142
52	Bojan Bogdanovic	2017	2018	12865223	12504884	2.800882
53	Quinn Cook	2017	2018	1062780	7885551	641.974312
54	Patrick McCaw	2018	2019	2987026	6550429	119.295995
55	Jahlil Okafor	2018	2019	1967336	5451630	177.107165
56	Nerlens Noel	2018	2019	2190458	5131594	134.270421
57	Edmond Sumner	2018	2019	1474103	8441947	472.683751
58	Joe Harris	2018	2019	9627603	9376069	2.612631
59	Rajon Rondo	2019	2020	3048942	9140298	199.785939
60	Robin Lopez	2019	2020	5666941	6387387	12.713132

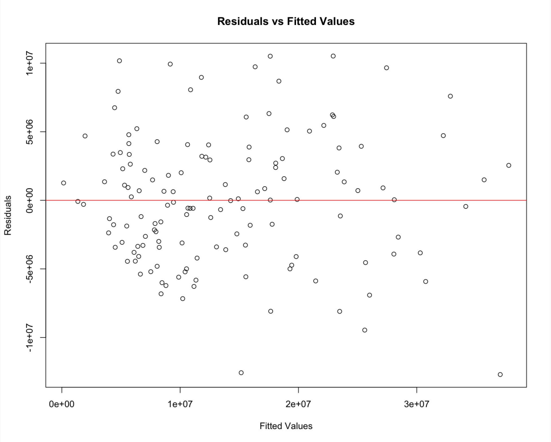
Paired Difference Test

```
> t.test(target_test, predicted_values, paired = TRUE, alternative="two.side")

        Paired t-test

data:  target_test and predicted_values
t = 1.297, df = 59, p-value = 0.1997
alternative hypothesis: true mean difference is not equal to 0
95 percent confidence interval:
 -641209.1 3004080.0
sample estimates:
mean difference
        1181435
```

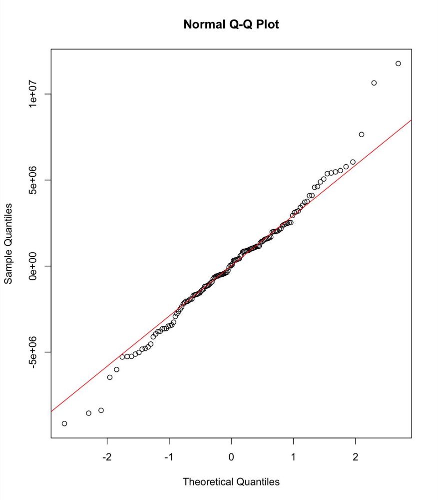
Null Hypothesis: Mean Difference = 0

p-value = 0.1997 > 0.05, therefore we cannot reject the null and we can conclude that there is no significant mean difference between the values

Residuals vs. Fitted Values Plot



Q-Q Plot



Cook's Distance

```
> cooks.distance(first_order_model)
         159          179           14          195          170           50          118           43          197          193 
1.868320e-03 3.669328e-04 2.561298e-05 4.249411e-02 7.589519e-03 2.675489e-04 5.608942e-03 1.099776e-03 1.200256e-04 7.808866e-05 
         153           90           91          187          185           92          137           99           72           26 
8.575132e-03 5.883973e-04 1.045973e-03 2.350675e-03 5.515502e-04 3.262444e-03 9.631915e-04 2.060704e-03 1.657917e-02 1.359437e-02 
           7          196          183          164           78           81          192          103          117           76 
4.277578e-03 1.967439e-02 5.642879e-05 5.852480e-03 7.845100e-03 1.068339e-03 1.366539e-04 2.035266e-05 2.431557e-02 1.443466e-02 
         143           32          109          198          177           74           23          155           53          135 
5.325977e-03 1.842739e-02 1.694131e-03 4.478592e-02 3.004701e-02 8.527088e-04 2.157899e-02 1.332008e-04 6.002085e-03 9.716409e-03 
         161          162           34           69          181          178           63          141           97          186 
6.235383e-03 2.808030e-03 2.824190e-03 2.948240e-07 6.892402e-04 1.523627e-04 3.386747e-05 8.685631e-04 6.834917e-03 2.497188e-07 
          38           21           41          188           60           16          116           94            6           86 
3.312861e-04 3.437004e-03 9.027465e-04 4.860320e-03 2.250259e-03 9.046606e-03 1.105943e-03 1.877718e-06 2.166347e-03 1.456605e-04 
         140           39          190          194          157            4           13          156          127           52 
2.562961e-02 1.016807e-02 5.578498e-03 4.083219e-03 3.956273e-02 8.615835e-03 1.264084e-02 9.147899e-03 1.921873e-03 5.873497e-02 
          22           89          168          110           25           87           35           40          112           30 
1.435179e-02 3.674920e-03 4.016948e-05 2.560506e-02 3.691003e-03 2.516495e-06 3.023460e-03 8.577337e-05 3.627973e-03 4.524658e-05 
          12           31          126          120           64          182          191           93           96           71 
2.654897e-03 1.861877e-03 3.611353e-02 1.579717e-04 8.217710e-06 1.009803e-02 2.097235e-03 1.516433e-03 2.678629e-03 5.696928e-04 
          67          163           79           85           37            8           51          176          136           98 
1.172575e-03 1.710566e-02 8.651326e-03 7.058579e-05 1.210946e-06 1.706134e-03 9.733462e-03 7.404100e-02 3.044846e-03 3.305972e-02 
         102          139          154           84           46           17           62           95           54          123 
1.195307e-02 3.389185e-02 2.322475e-03 1.695987e-03 2.844726e-04 1.687517e-03 1.947909e-02 7.430167e-03 8.032072e-04 3.201655e-04 
         107           24          124          166          128          108          180          131          100           27 
4.744336e-03 1.791954e-03 4.451680e-05 1.050819e-03 3.738842e-03 1.393323e-04 1.261507e-02 9.566555e-04 4.365091e-02 4.281317e-03 
          42            5           70          144           88           82          148           55           36          138 
6.569628e-04 6.226283e-02 1.494948e-03 1.478967e-02 2.858400e-03 6.264795e-04 4.957033e-03 5.372092e-03 2.365261e-02 4.111030e-03 
         150            9           48           56           77          134            1          122          169 
2.208728e-02 2.620138e-04 1.989401e-02 1.987042e-02 4.961994e-06 1.873799e-06 1.219195e-02 1.875847e-03 9.651578e-03 
```