TOE

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```
team_stats <-read.csv('/home/chenjie/Desktop/Math564Project/WinRatio_TOE/toe_results.csv')
team_stats$color = "green"
team_stats$color[team_stats$win_ratio>=0.5]="blue"
team_stats$color[team_stats$win_ratio>=0.7317073]="red" #won more than 60 games
```

2014 win ratio against Team TOE

Season 2014 our new TOE:

```
s14 <- team_stats[team_stats$season == 2014,]
new_mod14 <- lm(win_ratio ~ new_toe, data = s14)
summary(new_mod14)
```

```
##
## Call:
## lm(formula = win_ratio ~ new_toe, data = s14)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.14514 -0.07483 -0.01923  0.04819  0.24369
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -2.7505     0.4995  -5.507 6.95e-06 ***
## new_toe       6.6228     1.0169   6.513 4.66e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1011 on 28 degrees of freedom
## Multiple R-squared:  0.6023, Adjusted R-squared:  0.5881
## F-statistic: 42.41 on 1 and 28 DF,  p-value: 4.661e-07
```

Season 2014 old TOE:

```
mod14 <- lm(win_ratio ~ toe, data = s14)
summary(mod14)
```

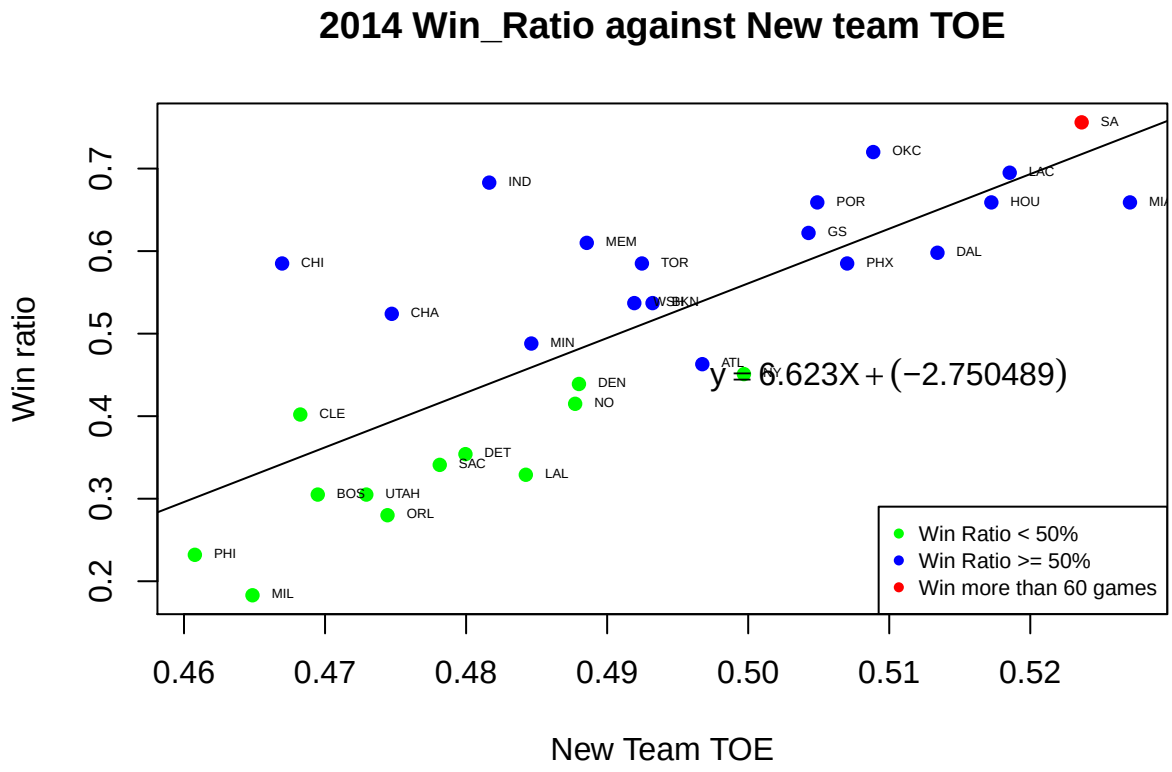
```
##
## Call:
## lm(formula = win_ratio ~ toe, data = s14)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
```

```
## -0.23709 -0.06599 -0.01423  0.08087  0.27310
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -2.7875     0.7047  -3.956 0.000473 ***
## toe           7.5582     1.6193   4.667 6.88e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1203 on 28 degrees of freedom
## Multiple R-squared:  0.4376, Adjusted R-squared:  0.4175
## F-statistic: 21.79 on 1 and 28 DF,  p-value: 6.883e-05
```

```
plot(s14$new_toe,s14$win_ratio,xlab = 'New Team TOE', ylab = 'Win ratio', main = '2014 Win_Ratio agains
```

```
## integer(0)
```

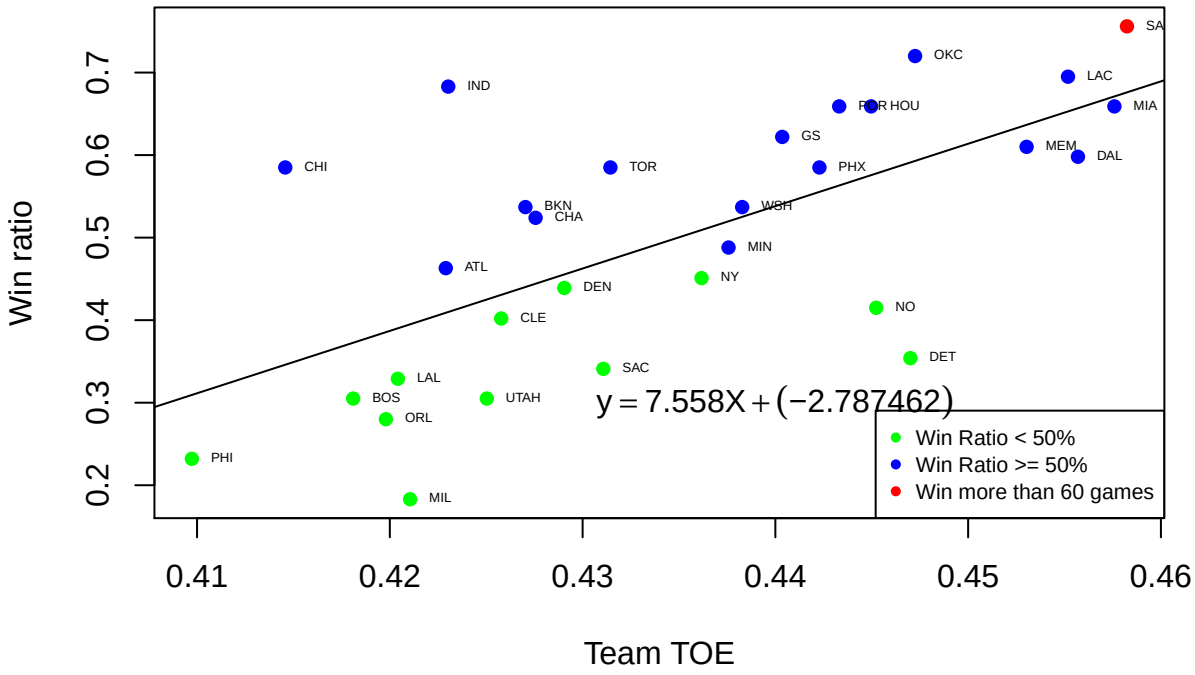
```
legend("bottomright",legend=c("Win Ratio < 50%", "Win Ratio >= 50%","Win more than 60 games"),
       col=c("green", "blue","red"), pch = c(16,16,16), cex = 0.7)
```




```
plot(s14$toe,s14$win_ratio,xlab = 'Team TOE', ylab = 'Win ratio', main = '2014 Win_Ratio against old tea
```

```
## integer(0)
```

```
legend("bottomright",legend=c("Win Ratio < 50%", "Win Ratio >= 50%","Win more than 60 games"),
       col=c("green", "blue","red"), pch = c(16,16,16), cex = 0.7)
```



2015 win ratio against Team TOE

Season 2015 our new TOE:

```
s15 <- team_stats[team_stats$season == 2015,]
new_mod15 <- lm(win_ratio ~ new_toe, data = s15)
summary(new_mod15)
```

```
##
## Call:
## lm(formula = win_ratio ~ new_toe, data = s15)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.145230 -0.038499 -0.005498  0.041102  0.179241
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -2.9699     0.3353  -8.857 1.31e-09 ***
## new_toe       7.1203     0.6875  10.357 4.41e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.076 on 28 degrees of freedom
## Multiple R-squared:  0.793,  Adjusted R-squared:  0.7856
## F-statistic: 107.3 on 1 and 28 DF,  p-value: 4.414e-11
```

Season 2015 old TOE:

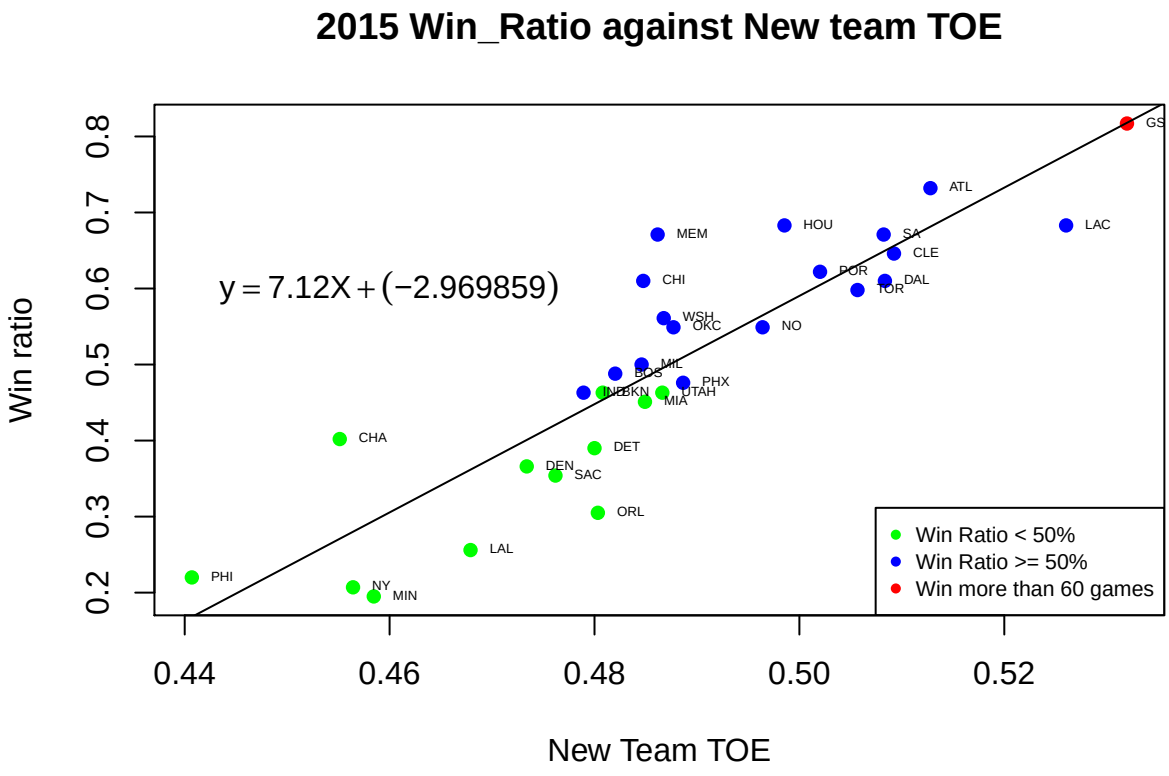
```
mod15 <- lm(win_ratio ~ toe, data = s15)
summary(mod15)
```

```
##
## Call:
## lm(formula = win_ratio ~ toe, data = s15)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.219372 -0.068909 -0.000372  0.063043  0.279014
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -2.9506     0.5896  -5.005 2.74e-05 ***
## toe           8.0058     1.3671   5.856 2.70e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.112 on 28 degrees of freedom
## Multiple R-squared:  0.5505, Adjusted R-squared:  0.5345
## F-statistic: 34.29 on 1 and 28 DF,  p-value: 2.697e-06
```

```
plot(s15$new_toe,s15$win_ratio,xlab = 'New Team TOE', ylab = 'Win ratio', main = '2015 Win_Ratio agains
```

```
## integer(0)
```

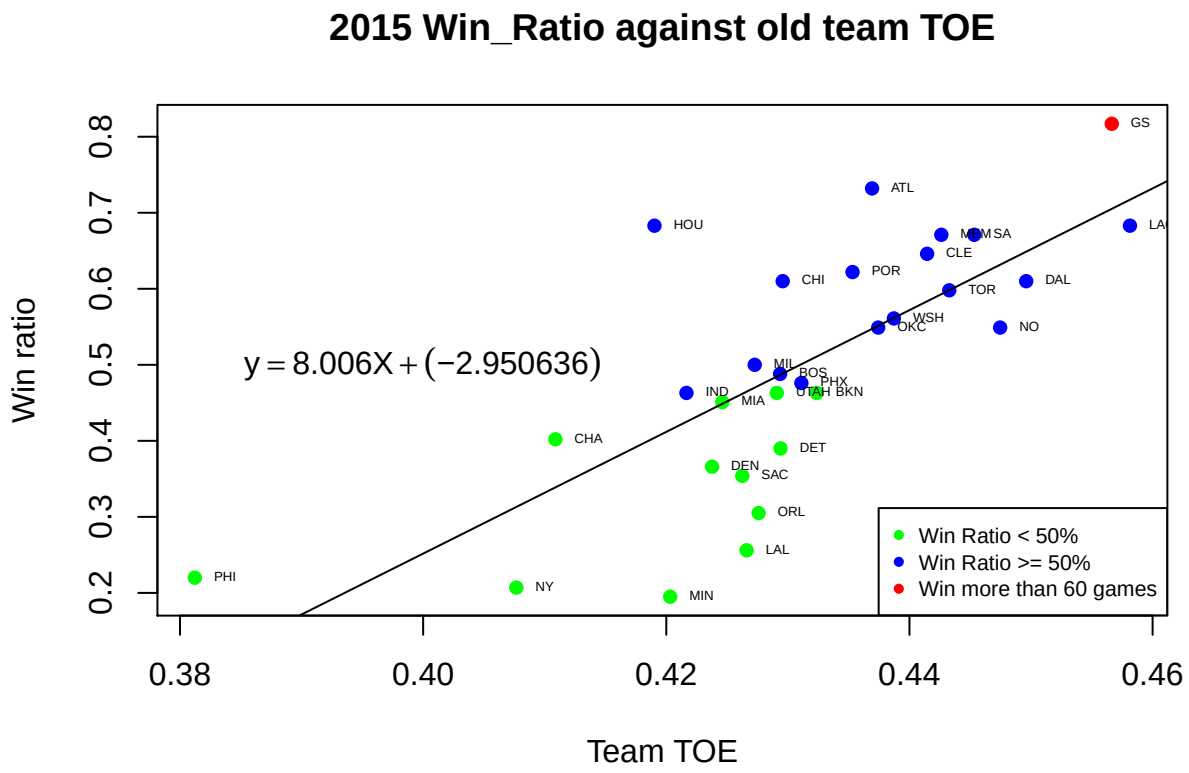
```
legend("bottomright",legend=c("Win Ratio < 50%", "Win Ratio >= 50%","Win more than 60 games"),
       col=c("green", "blue","red"), pch = c(16,16,16), cex = 0.7)
```



```
plot(s15$toe,s15$win_ratio,xlab = 'Team TOE', ylab = 'Win ratio', main = '2015 Win_Ratio against old tea
```

```
## integer(0)
```

```
legend("bottomright",legend=c("Win Ratio < 50%", "Win Ratio >= 50%","Win more than 60 games"),
       col=c("green", "blue","red"), pch = c(16,16,16), cex = 0.7)
```



2016 win ratio against Team TOE

Season 2016 our new TOE:

```
s16 <- team_stats[team_stats$season == 2016,]
new_mod16 <- lm(win_ratio ~ new_toe, data = s16)
summary(new_mod16)
```

```
##
## Call:
## lm(formula = win_ratio ~ new_toe, data = s16)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.154603 -0.052252 -0.004685  0.038798  0.180176
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -3.3433     0.3913  -8.544 2.75e-09 ***
## new_toe       7.8113     0.7948   9.828 1.41e-10 ***
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.08169 on 28 degrees of freedom
## Multiple R-squared:  0.7753, Adjusted R-squared:  0.7672
## F-statistic:  96.6 on 1 and 28 DF,  p-value: 1.409e-10
```

Season 2016 old TOE:

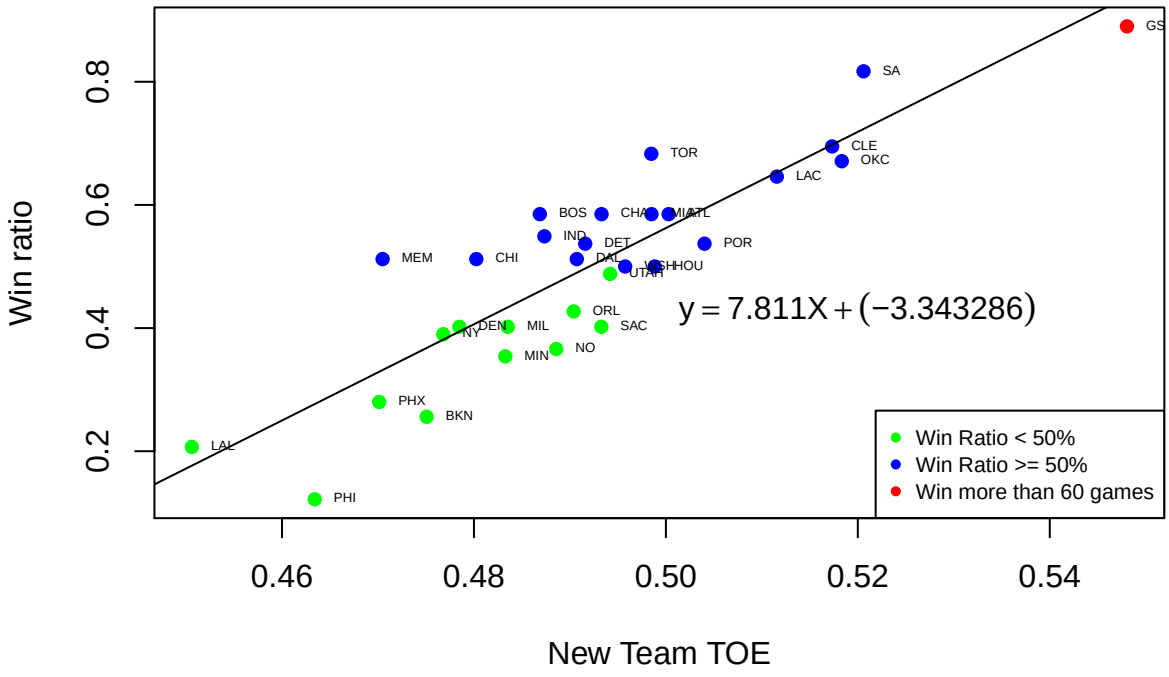
```
mod16 <- lm(win_ratio ~ toe, data = s16)
summary(mod16)
```

```
##
## Call:
## lm(formula = win_ratio ~ toe, data = s16)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.23305 -0.07065  0.01909  0.05874  0.18231
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -3.333      0.582  -5.727 3.83e-06 ***
## toe            8.874      1.347   6.589 3.81e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1079 on 28 degrees of freedom
## Multiple R-squared:  0.6079, Adjusted R-squared:  0.5939
## F-statistic: 43.42 on 1 and 28 DF,  p-value: 3.806e-07
```

```
plot(s16$new_toe,s16$win_ratio,xlab = 'New Team TOE', ylab = 'Win ratio', main = '2016 Win_Ratio agains
```

```
## integer(0)
```

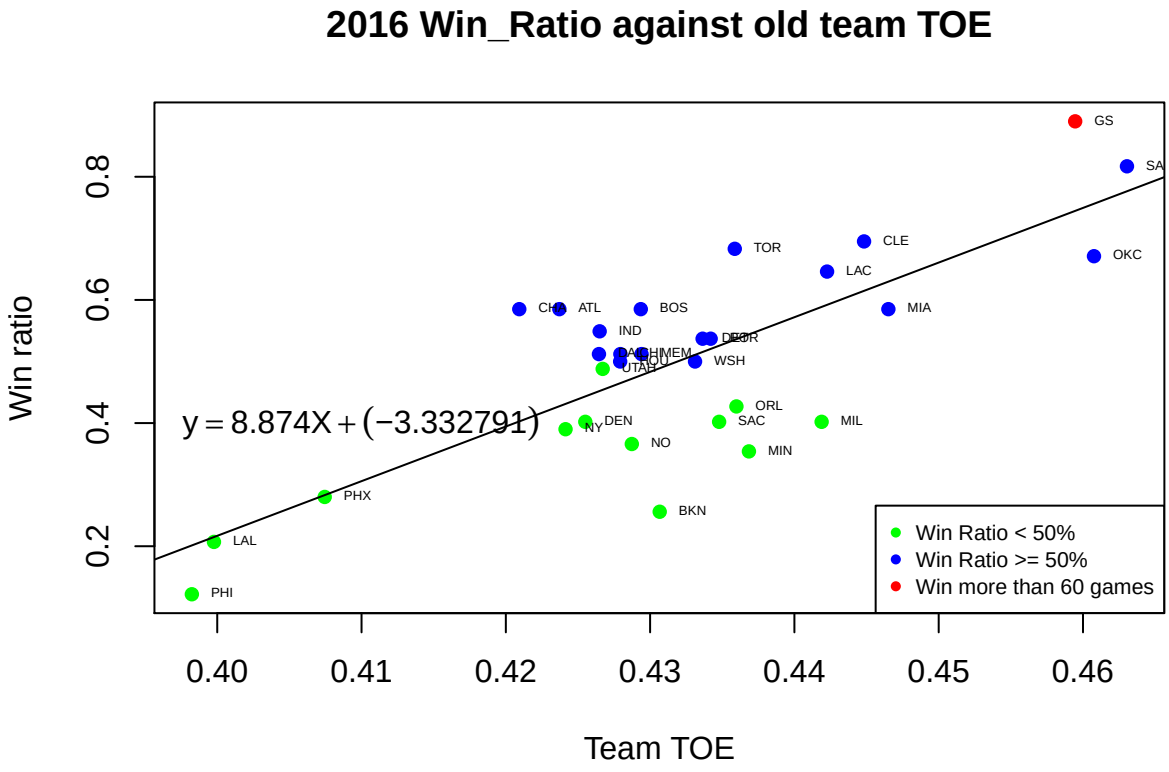
```
legend("bottomright",legend=c("Win Ratio < 50%", "Win Ratio >= 50%","Win more than 60 games"),
       col=c("green", "blue","red"), pch = c(16,16,16), cex = 0.7)
```




```
plot(s16$toe,s16$win_ratio,xlab = 'Team TOE', ylab = 'Win ratio', main = '2016 Win_Ratio against old tea
```

```
## integer(0)
```

```
legend("bottomright",legend=c("Win Ratio < 50%", "Win Ratio >= 50%","Win more than 60 games"),
       col=c("green", "blue","red"), pch = c(16,16,16), cex = 0.7)
```



2017 win ratio against Team TOE

Season 2017 our new TOE:

```
s17 <- team_stats[team_stats$season == 2017,]
new_mod17 <- lm(win_ratio ~ new_toe, data = s17)
summary(new_mod17)
```

```
##
## Call:
## lm(formula = win_ratio ~ new_toe, data = s17)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.133492 -0.046916 -0.009949  0.057958  0.146446
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -2.7251     0.4314  -6.318 7.82e-07 ***
## new_toe       6.3994     0.8554   7.481 3.79e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.08019 on 28 degrees of freedom
## Multiple R-squared:  0.6665, Adjusted R-squared:  0.6546
## F-statistic: 55.96 on 1 and 28 DF,  p-value: 3.788e-08
```

Season 2017 old TOE:

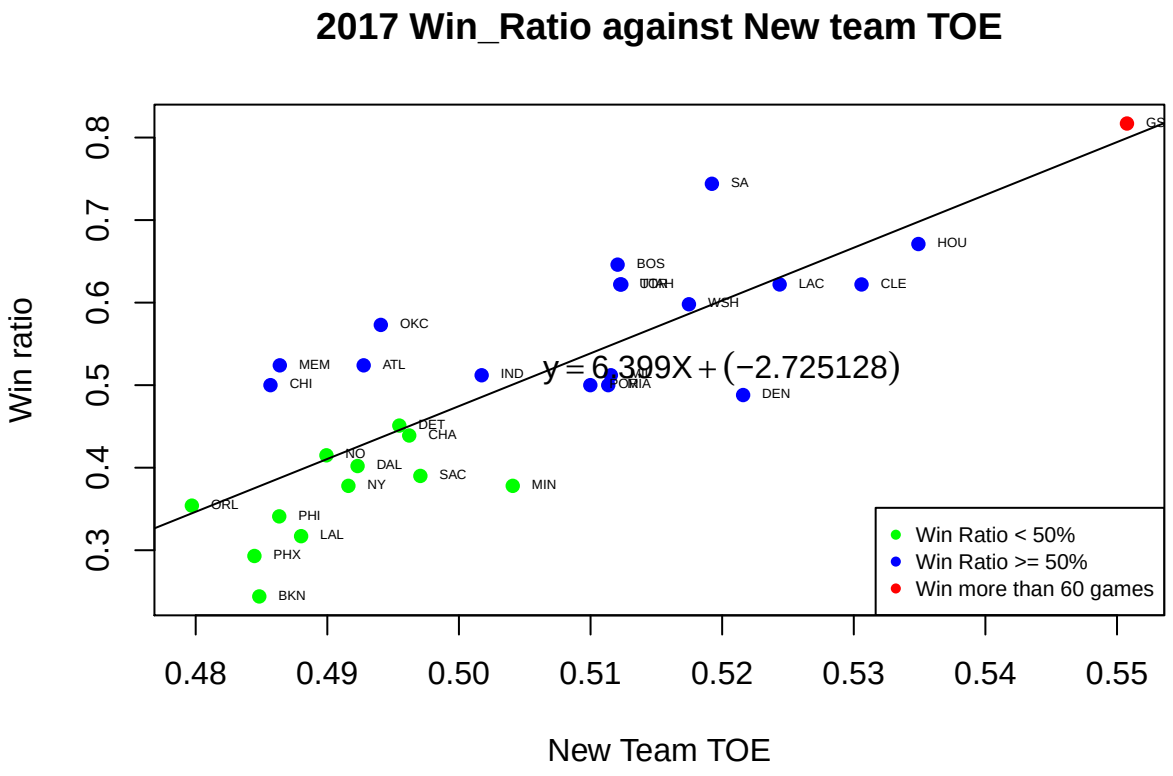
```
mod17 <- lm(win_ratio ~ toe, data = s17)
summary(mod17)
```

```
##
## Call:
## lm(formula = win_ratio ~ toe, data = s17)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.230886 -0.051278 -0.000371  0.068626  0.181794
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -2.4082     0.6082  -3.959 0.000468 ***
## toe           6.6452     1.3891   4.784 5.01e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.103 on 28 degrees of freedom
## Multiple R-squared:  0.4497, Adjusted R-squared:  0.4301
## F-statistic: 22.88 on 1 and 28 DF,  p-value: 5.009e-05
```

```
plot(s17$new_toe,s17$win_ratio,xlab = 'New Team TOE', ylab = 'Win ratio', main = '2017 Win_Ratio agains
```

```
## integer(0)
```

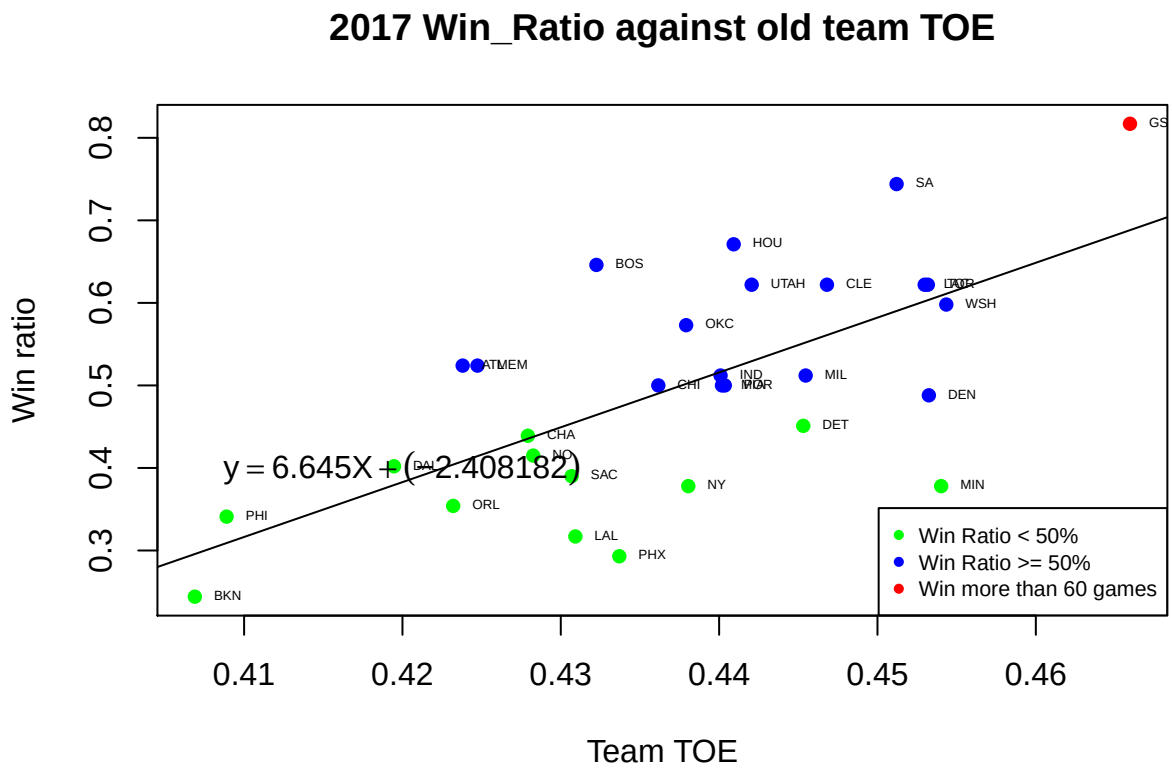
```
legend("bottomright",legend=c("Win Ratio < 50%", "Win Ratio >= 50%","Win more than 60 games"),
       col=c("green", "blue","red"), pch = c(16,16,16), cex = 0.7)
```



```
plot(s17$toe,s17$win_ratio,xlab = 'Team TOE', ylab = 'Win ratio', main = '2017 Win_Ratio against old tea
```

```
## integer(0)
```

```
legend("bottomright",legend=c("Win Ratio < 50%", "Win Ratio >= 50%","Win more than 60 games"),
       col=c("green", "blue","red"), pch = c(16,16,16), cex = 0.7)
```



2018 win ratio against Team TOE

Season 2018 our new TOE:

```
s18 <- team_stats[team_stats$season == 2018,]
new_mod18 <- lm(win_ratio ~ new_toe, data = s18)
summary(new_mod18)
```

```
##
## Call:
## lm(formula = win_ratio ~ new_toe, data = s18)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.146570 -0.050708 -0.001863  0.038705  0.188224
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -3.7317     0.4399  -8.482 3.19e-09 ***
## new_toe       8.3093     0.8634   9.623 2.23e-10 ***
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.0731 on 28 degrees of freedom
## Multiple R-squared:  0.7678, Adjusted R-squared:  0.7596
## F-statistic: 92.61 on 1 and 28 DF,  p-value: 2.23e-10
```

Season 2018 old TOE:

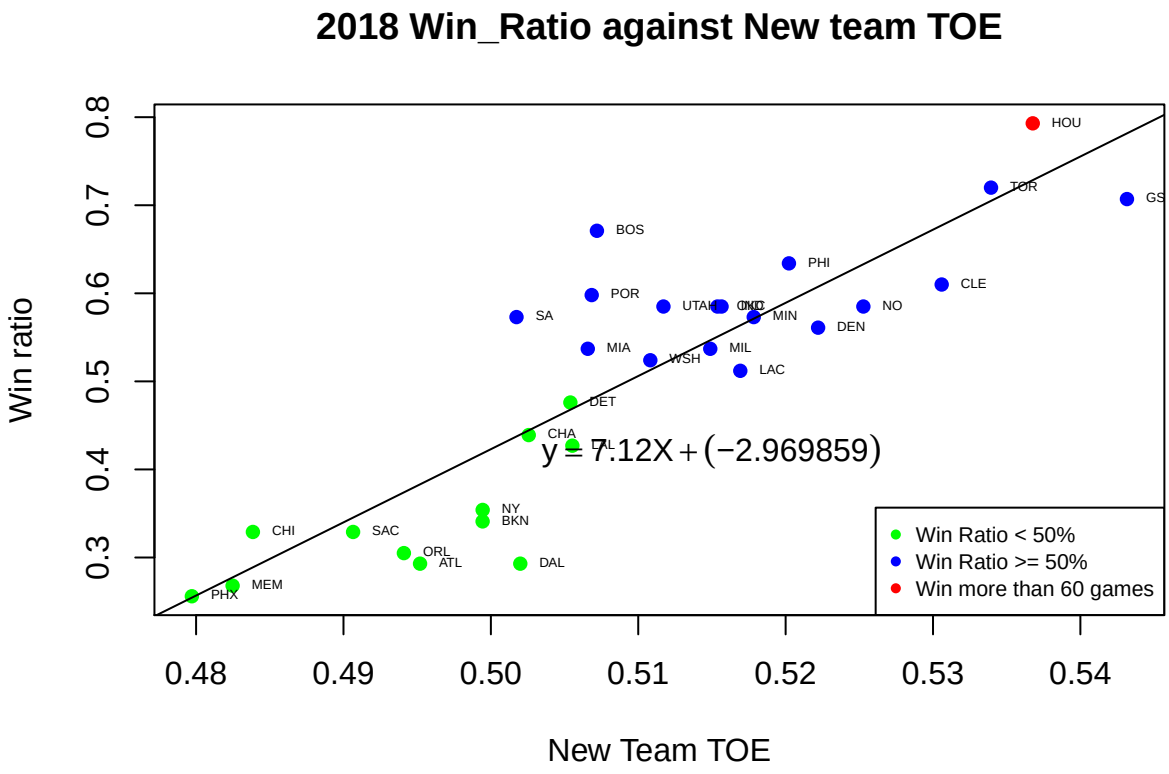
```
mod18 <- lm(win_ratio ~ toe, data = s18)
summary(mod18)
```

```
##
## Call:
## lm(formula = win_ratio ~ toe, data = s18)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.18725 -0.06340 -0.01733  0.03139  0.30990
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -2.6613     0.6128  -4.343 0.000166 ***
## toe           7.2314     1.4009   5.162 1.78e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1086 on 28 degrees of freedom
## Multiple R-squared:  0.4876, Adjusted R-squared:  0.4693
## F-statistic: 26.64 on 1 and 28 DF,  p-value: 1.782e-05
```

```
plot(s18$new_toe,s18$win_ratio,xlab = 'New Team TOE', ylab = 'Win ratio', main = '2018 Win_Ratio agains
```

```
## integer(0)
```

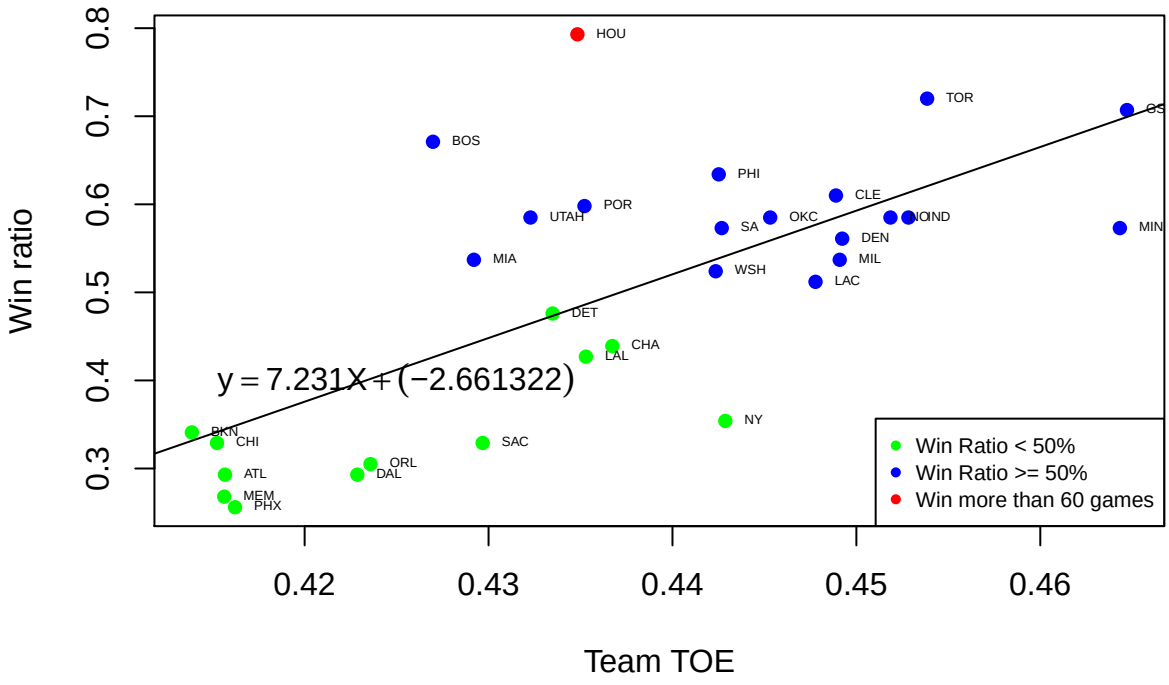
```
legend("bottomright",legend=c("Win Ratio < 50%", "Win Ratio >= 50%","Win more than 60 games"),
       col=c("green", "blue","red"), pch = c(16,16,16), cex = 0.7)
```




```
plot(s18$toe,s18$win_ratio,xlab = 'Team TOE', ylab = 'Win ratio', main = '2018 Win_Ratio against old tea
```

```
## integer(0)
```

```
legend("bottomright",legend=c("Win Ratio < 50%", "Win Ratio >= 50%","Win more than 60 games"),
       col=c("green", "blue","red"), pch = c(16,16,16), cex = 0.7)
```




```
summary(mod14)$r.squared
```

```
## [1] 0.4375821
```

```
summary(mod15)$r.squared
```

```
## [1] 0.5505217
```

```
summary(mod16)$r.squared
```

```
## [1] 0.6079441
```

```
summary(mod17)$r.squared
```

```
## [1] 0.4497334
```

```
summary(new_mod17)$r.squared
```

```
## [1] 0.6665262
```

```
summary(new_mod16)$r.squared
```

```
## [1] 0.7752725
```

```
summary(new_mod15)$r.squared
```

```
## [1] 0.7929965
```

```
summary(new_mod14)$r.squared
```

```
## [1] 0.6023495
```

```
mod14$coef
```

```
## (Intercept)         toe
##   -2.787462    7.558199
```

```
mod15$coef
```

```
## (Intercept)         toe
##   -2.950636    8.005761
```

```
mod16$coef
```

```
## (Intercept)         toe
##   -3.332791    8.874283
```

```
mod17$coef
```

```
## (Intercept)         toe
##   -2.408182    6.645190
```

```
new_mod14$coef
```

```
## (Intercept)     new_toe
##   -2.750489    6.622779
```

```
new_mod15$coef
```

```
## (Intercept)     new_toe
##   -2.969859    7.120309
```

```
new_mod16$coef
```

```
## (Intercept)     new_toe
##   -3.343286    7.811340
```

```
new_mod17$coef
```

```
## (Intercept)     new_toe
##   -2.725128    6.399379
```