Case Study

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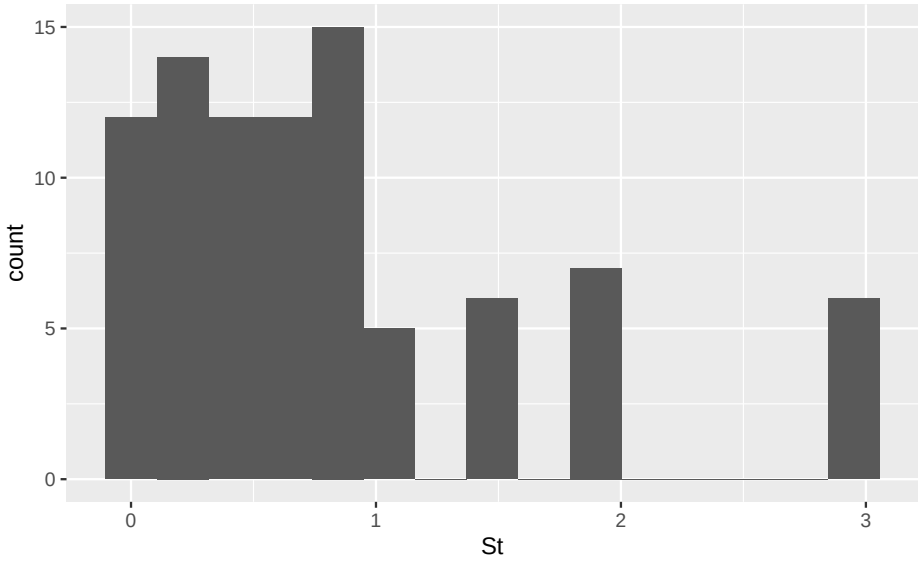
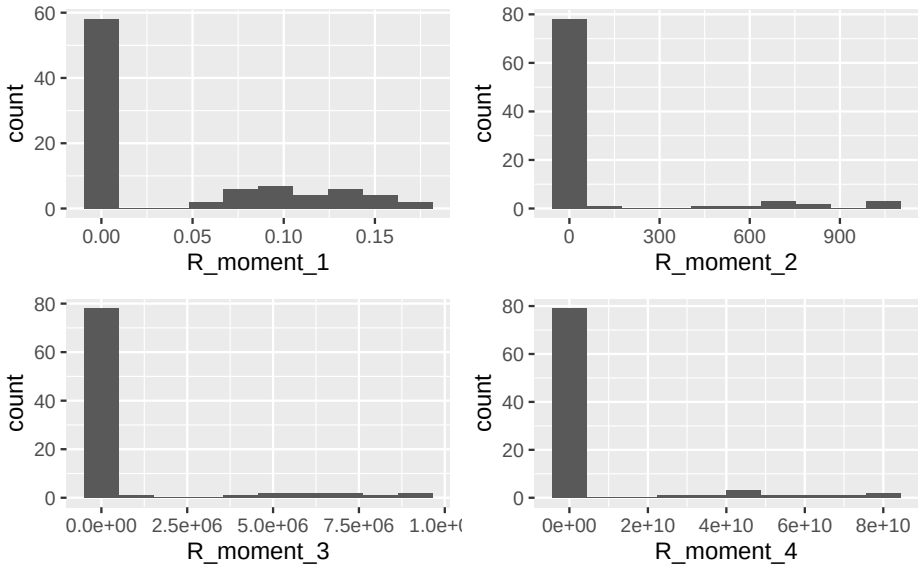
Introduction and Data

Introduction

Data Introduction

Exploratory Data Analysis






```
##
## Call:
## lm(formula = R_moment_4 ~ Re + TFr, data = data_train)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -1.697e+10 -9.357e+09 -7.059e+09  5.489e+08  6.303e+10
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  2.008e+10  3.786e+09   5.303 8.71e-07 ***
## Re          -5.677e+07  1.568e+07  -3.622 0.000494 ***
## TFr         -6.872e+08  2.715e+08  -2.531 0.013206 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.652e+10 on 86 degrees of freedom
## Multiple R-squared:  0.2019, Adjusted R-squared:  0.1833
## F-statistic: 10.88 on 2 and 86 DF,  p-value: 6.152e-05
```

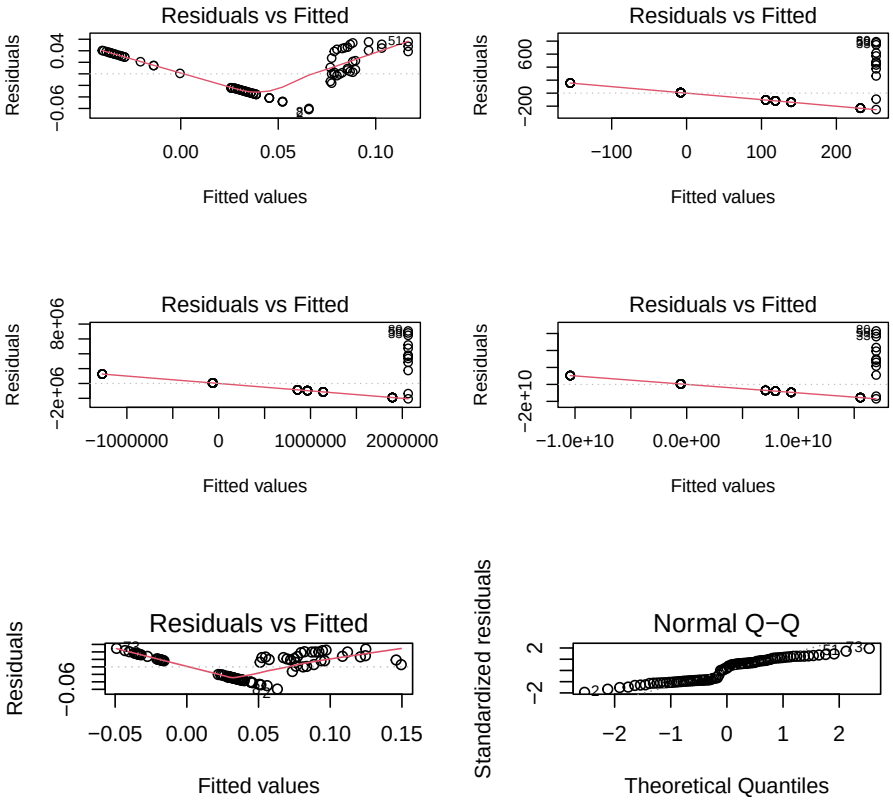
Here are the linear models we obtained for the moments (without interactions):

$$\hat{R_1} = 0.0102 + 0.01353 * St - 0.0003798 * Re$$

$$\hat{R_2} = 299.6593 - 0.8473 * Re - 10.2317 TFr$$

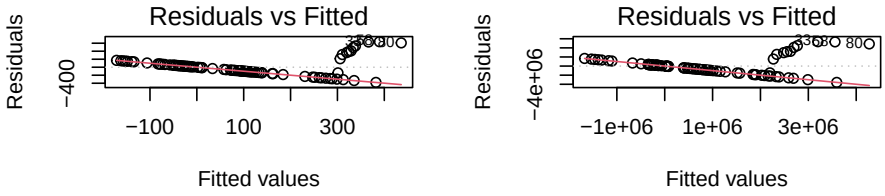
$$\hat{R_3} = 2442265 - 6905 * Re - -83580 TFr$$

$$\hat{R_4} = 2.008 * 10^{10} - 5.677 * 10^7 * Re - 6.872 * 10^8 TFr$$




```
##
## Call:
## lm(formula = R_moment_4 ~ St + TFr + Re + St:TFr + St:Re + TFr:Re,
##     data = data_train)
##
## Residuals:
##       Min         1Q     Median         3Q        Max
## -3.694e+10 -7.457e+09 -1.392e+09  4.131e+09  4.499e+10
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)  1.528e+10  5.349e+09   2.857 0.005419 **
## St           1.050e+10  4.256e+09   2.467 0.015706 *
## TFr         -1.915e+09  6.114e+08  -3.133 0.002401 **
## Re          -5.598e+07  2.293e+07  -2.442 0.016773 *
## St:TFr      -5.176e+08  3.144e+08  -1.646 0.103497
## St:Re       -2.662e+07  1.816e+07  -1.466 0.146595
## TFr:Re       7.304e+06  2.125e+06   3.438 0.000924 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.499e+10 on 82 degrees of freedom
## Multiple R-squared:  0.3735, Adjusted R-squared:  0.3277
## F-statistic: 8.147 on 6 and 82 DF,  p-value: 6.439e-07
```



$$\hat{R_1} = 9.822 * 10^{-2} + 3.398 * 10^{-2} * St - 2.534 * 10^{-3} * TFr - 3.176 * 10^{-4} * Re$$
$$-1.002 * 10^{-4} * St * Re + 9.098 * 10^{-6} * TFr * Re$$

$$\hat{R_2} = 327.50288 + 46.54518 * St - 36.88062 * TFr - 1.19146 * Re$$
$$-0.11802 * TFr * Re$$

$$\hat{R_3} = 2525699.0 + 556624.1 * St - 252310.1 * TFr - 9805.7 * Re$$

$$-54692.6 * St * TFr + 953.2 * TFr * Re$$

$$\hat{R}_4 = 1.528 * 10^{10} + 1.050 * 10^{10} * St - 1.915 * 10^{10} * TFr - 5.598 * 10^7 * Re$$

$$-5.176 * 10^8 * St * TFr - 2.662 * 10^7 * St * Re + 7.7304 * 10^6 * TFr * Re$$

Model Evalutation

Linear RMSE	No Interactions	Interactions
R_1	0.0349	0.0340
R_2	237.411	222.3977
R_3	1991432	1870992
R_4	16757102688	15946689806

Linear R-Squared	No Interactions	Interactions
R_1	0.6054832	0.6282726
R_2	0.1716913	0.2754936
R_3	0.161867	0.2650636
R_4	0.1539926	0.2466392