Case01-Report

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1 Introduction

2 Methods

2.1 EDA

Before we begin any analysis, let's further split our training data into a smaller train and test set. We also create cross-validation folds with $K = 5$. We do this in an effort to reduce the likelihood of overfitting to the full training data.

While Fr and Re consists of continuous values in real life, a brief examination of our training data reveals that both two variables contain only three levels. As such, we convert both variables to factors.

Below, we plot the relationship between the three predictor variables and each of the four response variables (Figure 1 contains graphs for Moment 1. For plots relating to Moments 2-4, please refer to Figures XX-XX in the Appendix). Note, the curves fit to the points are via local polynomial regression.

In general, these seem to be very strong relationships. We also notice that the interaction between `Fr` and `Re` seems to explain a lot of the variance in the response. That is, the relationship between the third variable `St` and the response depends a lot on the specific interaction between `Fr` and `Re`. We will very likely need to include this interaction in any model we build for these data.

Additionally, we notice that the relationship between `St` and the response may benefit from taking the square root of `St`.

Below, we perform cross validation of a number of candidate models for each moment. Specifically, for each moment, we train a model to predict the moment with the general formula `~ poly(St, degree)*interaction` where `interaction` is the factor interaction between `Fr` and `Re`. We vary the `degree` parameter from 1 to 3. Additionally, we may choose to take the square root of `St` or take the log of the response.

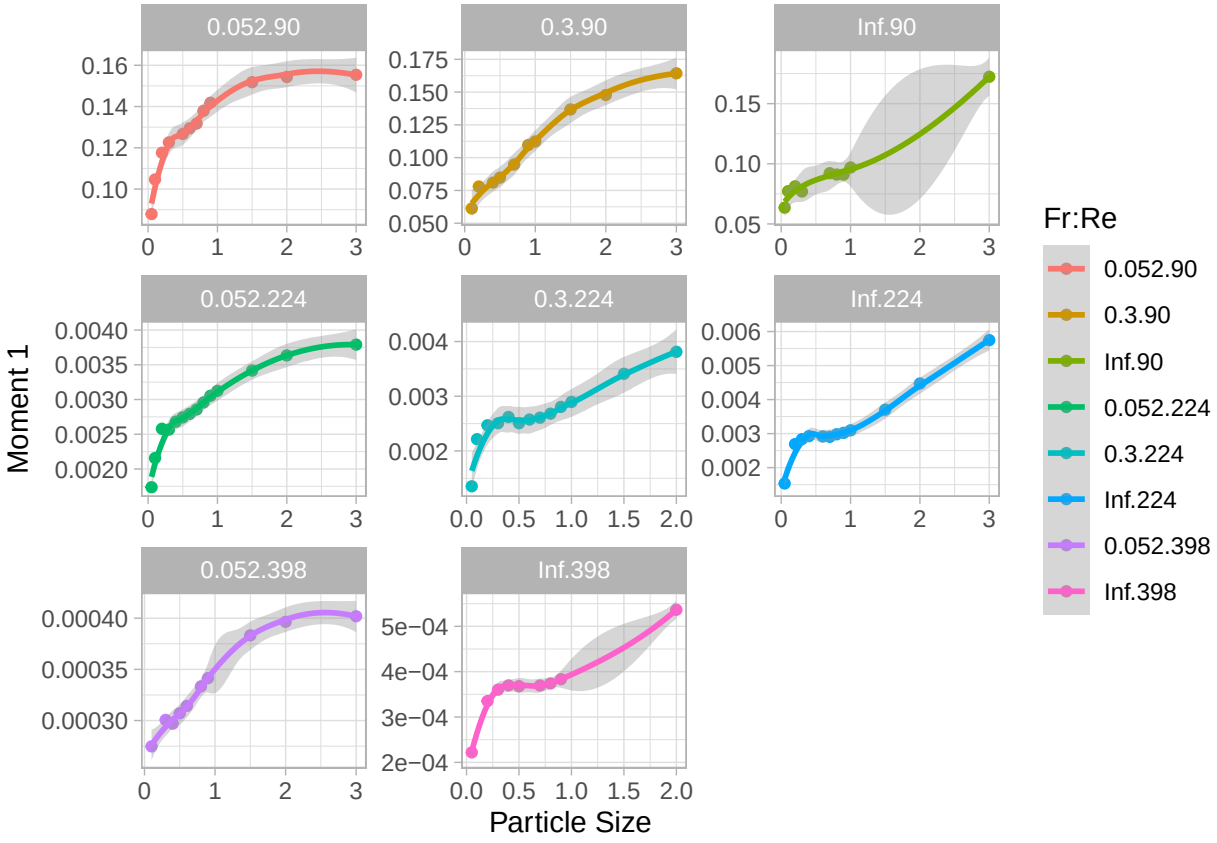
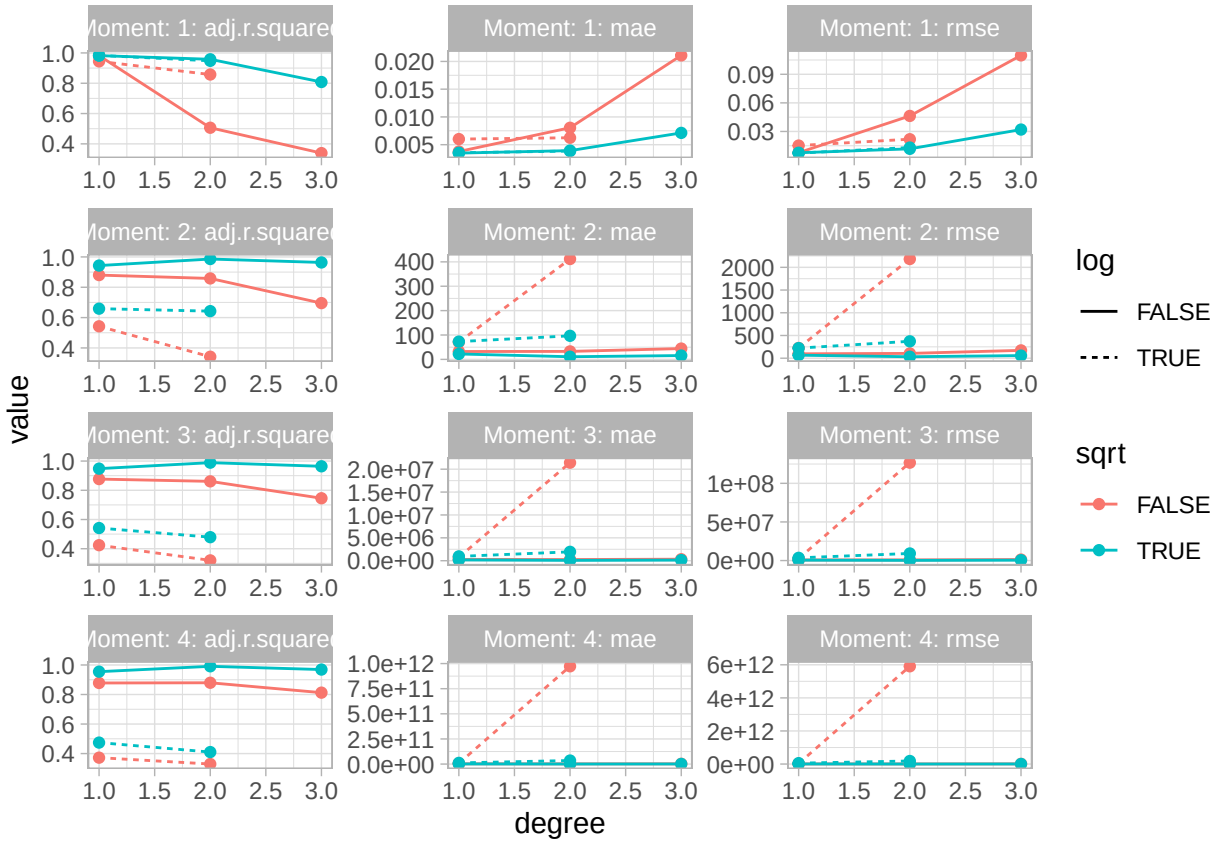


Figure 1: Moment 1 values as a function of particle size at different levels of interaction between Fr and Re.



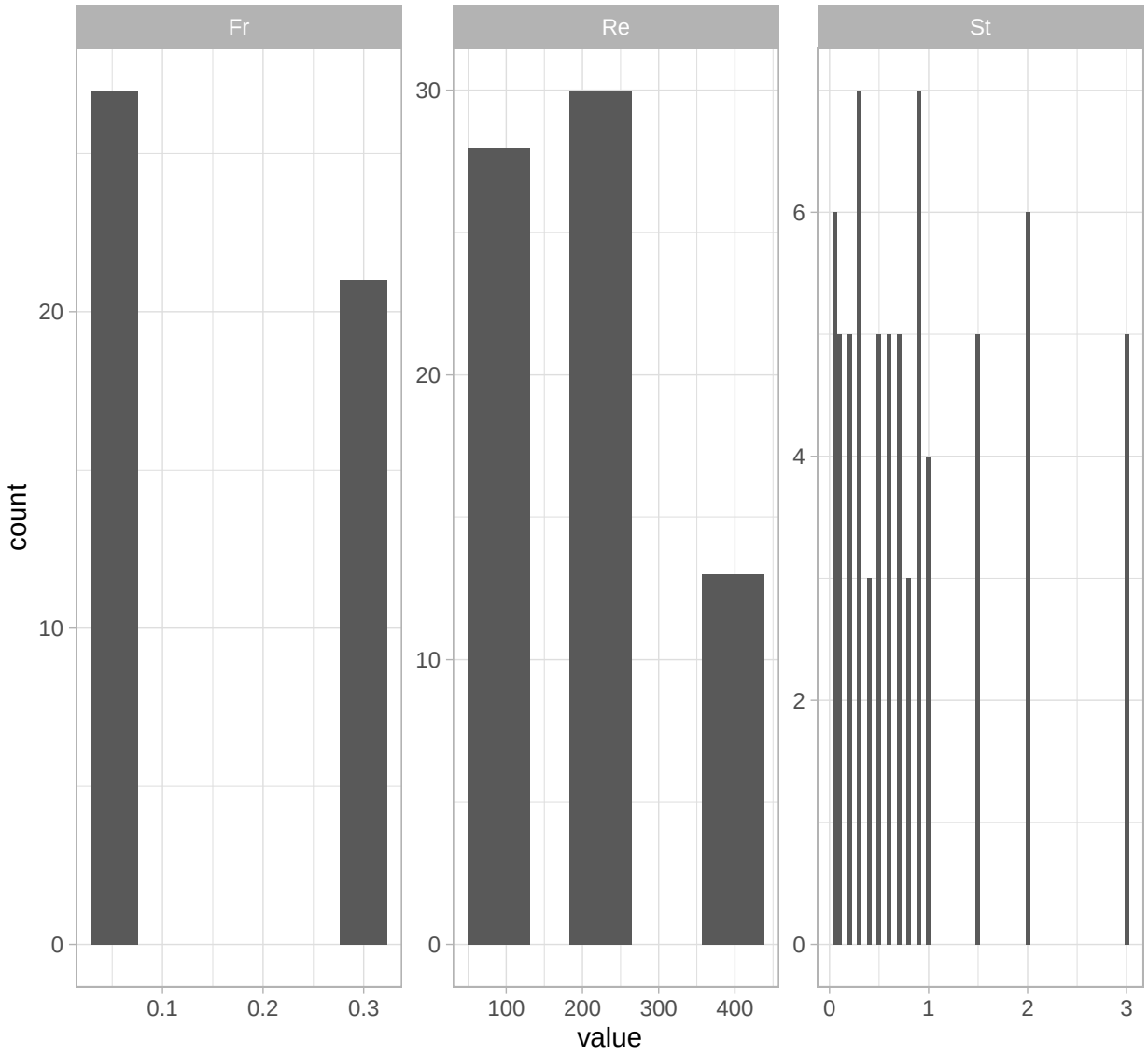
moment	degree	sqrt	log	name	value
1	1	TRUE	FALSE	mae	0.00348
1	1	TRUE	TRUE	rmse	0.00730
1	1	TRUE	TRUE	adj.r.squared	0.98384
2	2	TRUE	FALSE	rmse	32.42433
2	2	TRUE	FALSE	mae	10.84030
2	2	TRUE	FALSE	adj.r.squared	0.98613
3	2	TRUE	FALSE	rmse	240,845.80324
3	2	TRUE	FALSE	mae	76,364.57174
3	2	TRUE	FALSE	adj.r.squared	0.98910
4	2	TRUE	FALSE	rmse	1,837,866,060.54046
4	2	TRUE	FALSE	mae	558,091,625.13870
4	2	TRUE	FALSE	adj.r.squared	0.99101

Results

Discussion

References

Appendix



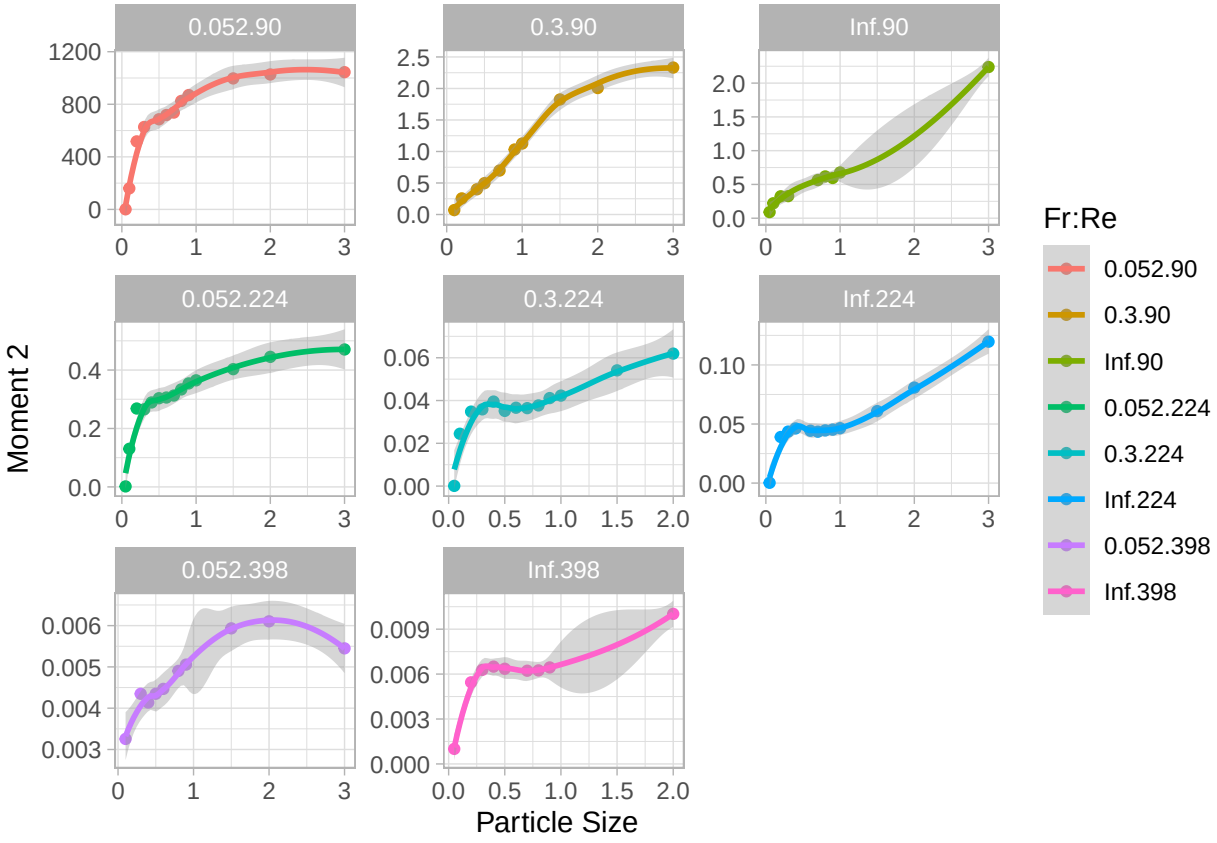


Figure 2: Moment 2 values as a function of particle size at different levels of interaction between Fr and Re.

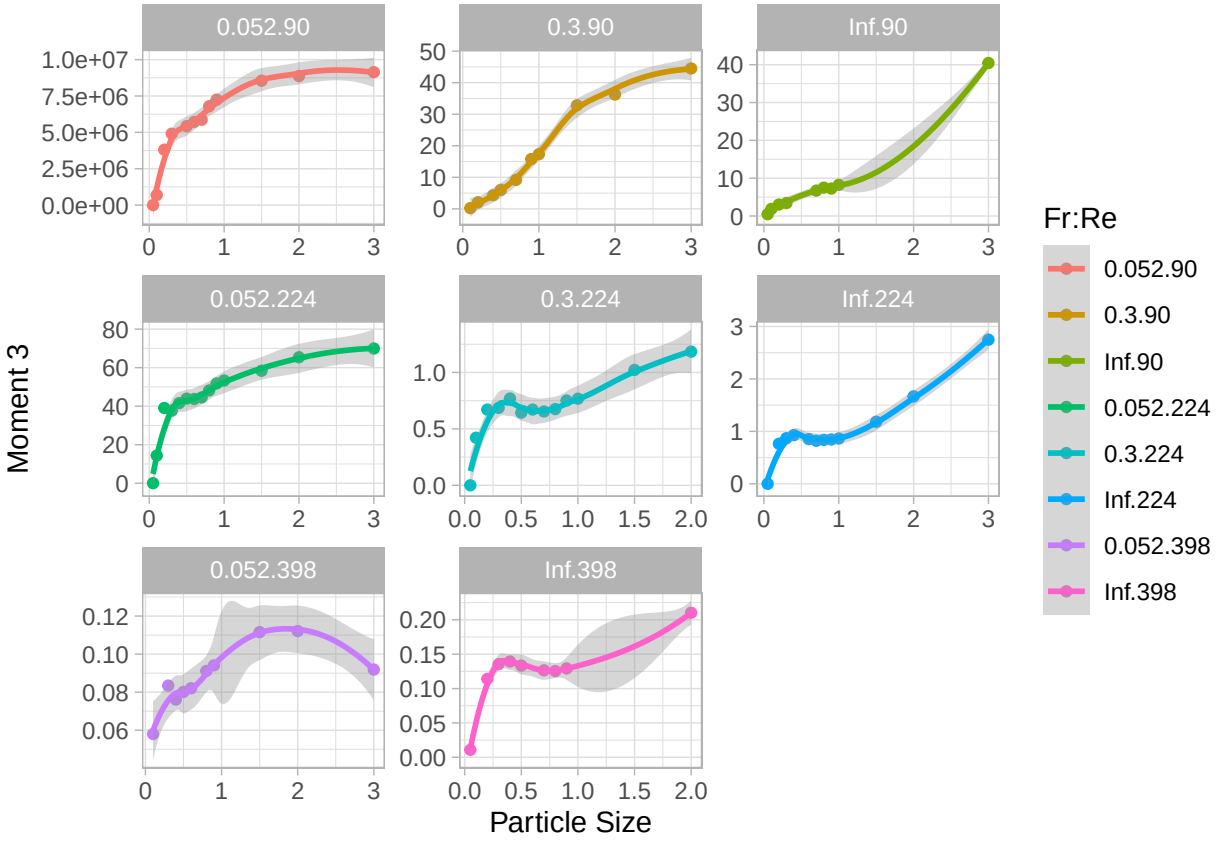


Figure 3: Moment 3 values as a function of particle size at different levels of interaction between Fr and Re.

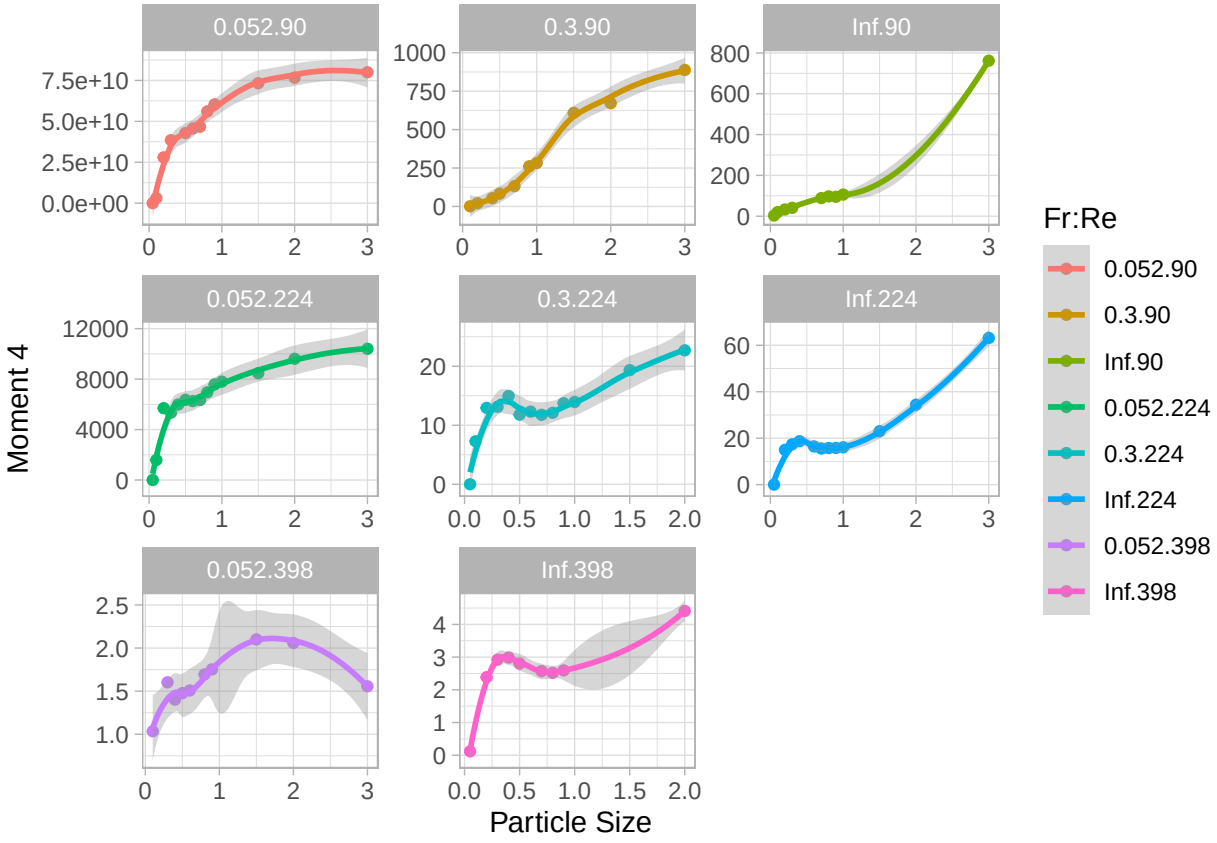


Figure 4: Moment 4 values as a function of particle size at different levels of interaction between Fr and Re.