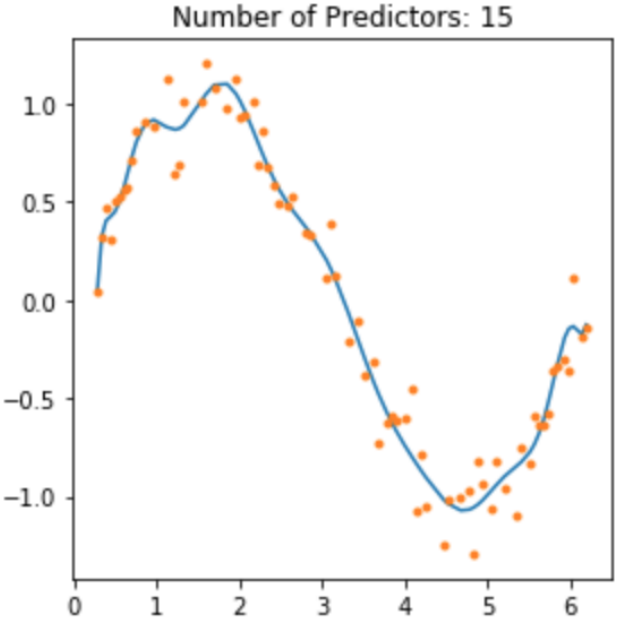
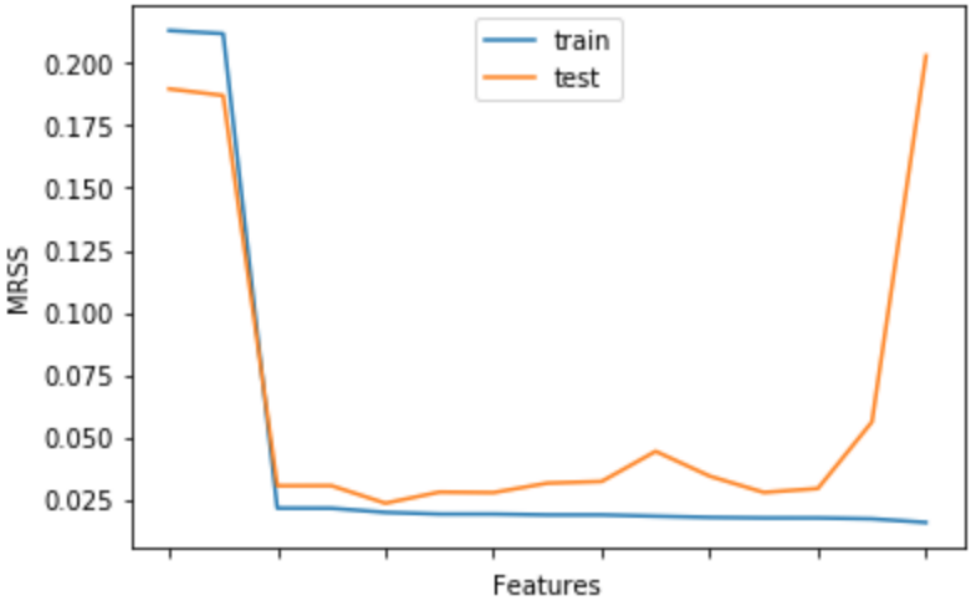
Regularisation

Issues with Linear Regression





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Issues with Linear Regression

	mrss_train	mrss_test	intercept	coef_Var_1	coef_Var_2	coef_Var_3	coef_Var_4	coef_Var_5	coef_Var_6	coef_Var_7	coef_Var_8
Number_of_variable_1	0.21	0.19	1	-0.31	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Number_of_variable_2	0.21	0.19	1.1	-0.39	0.012	NaN	NaN	NaN	NaN	NaN	NaN
Number_of_variable_3	0.021	0.03	-0.4	2.2	-0.99	0.1	NaN	NaN	NaN	NaN	NaN
Number_of_variable_4	0.021	0.03	-0.43	2.3	-1	0.12	-0.001	NaN	NaN	NaN	NaN
Number_of_variable_5	0.02	0.023	-0.096	1.2	0.0084	-0.29	0.069	-0.0043	NaN	NaN	NaN
Number_of_variable_6	0.019	0.028	-0.4	2.5	-1.6	0.66	-0.2	0.031	-0.0018	NaN	NaN
Number_of_variable_7	0.019	0.028	-0.38	2.4	-1.5	0.53	-0.15	0.021	-0.00067	-5.1e-05	NaN
Number_of_variable_8	0.019	0.032	-0.85	5.1	-7	6	-3.1	0.92	-0.16	0.015	-0.00058
Number_of_variable_9	0.019	0.032	-0.94	5.7	-8.5	7.7	-4.3	1.4	-0.28	0.033	-0.002
Number_of_variable_10	0.018	0.044	-2.4	16	-38	50	-39	19	-6	1.2	-0.15
Number_of_variable_11	0.018	0.034	-0.34	-0.37	15	-38	47	-34	16	-4.7	0.9
Number_of_variable_12	0.018	0.028	1.6	-18	78	-1.6e+02	1.8e+02	-1.4e+02	67	-22	4.9
Number_of_variable_13	0.018	0.029	0.84	-10	47	-92	98	-62	23	-3.9	-0.31
Number_of_variable_14	0.017	0.056	-5.5	57	-2.4e+02	6e+02	-9.3e+02	9.5e+02	-6.7e+02	3.3e+02	-1.2e+02
Number_of_variable_15	0.016	0.2	-25	2.7e+02	-1.3e+03	3.3e+03	-5.4e+03	5.9e+03	-4.5e+03	2.5e+03	-1e+03

Issues with Linear Regression

- More features are participating, leads to more coefficients

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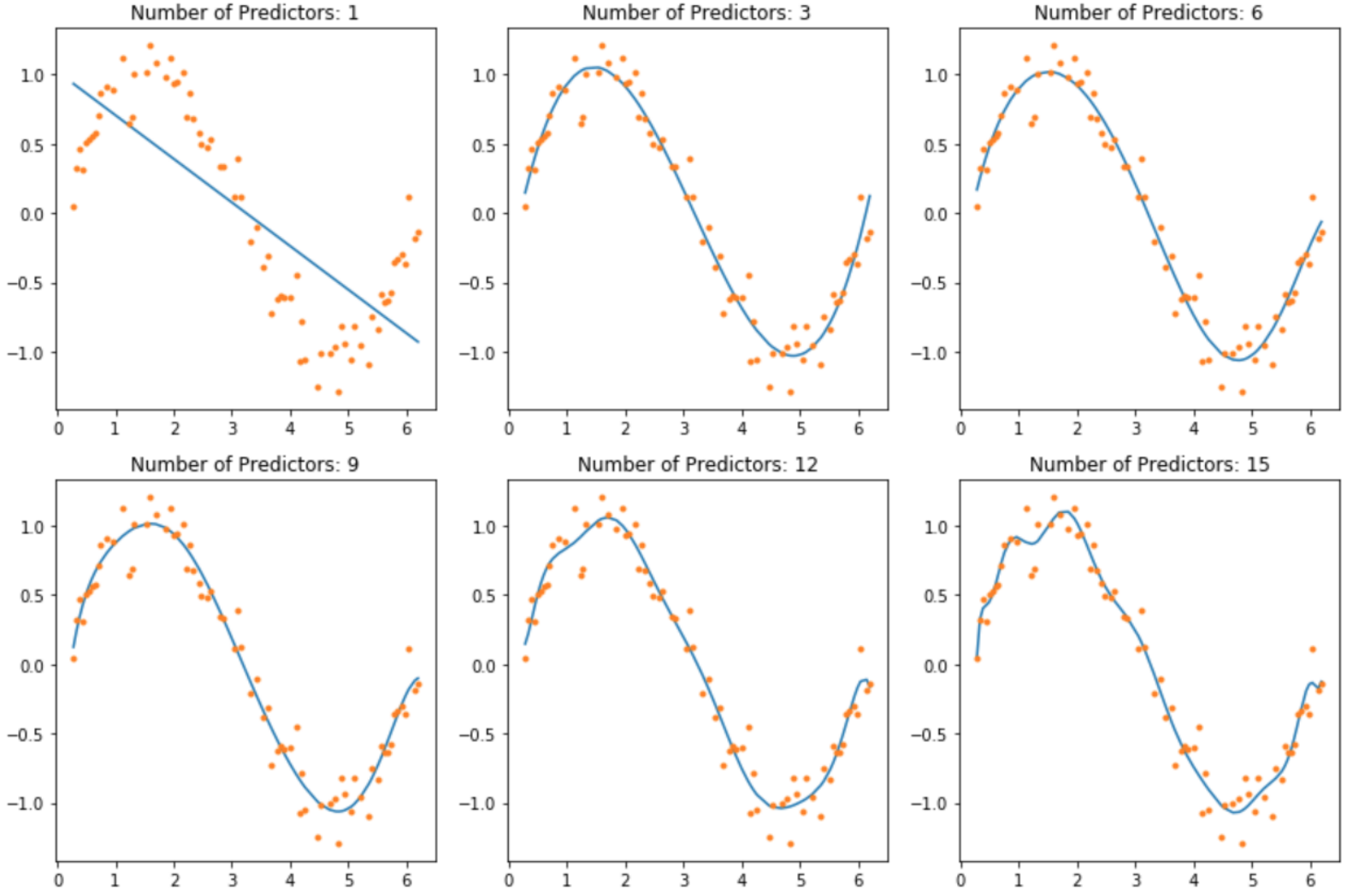
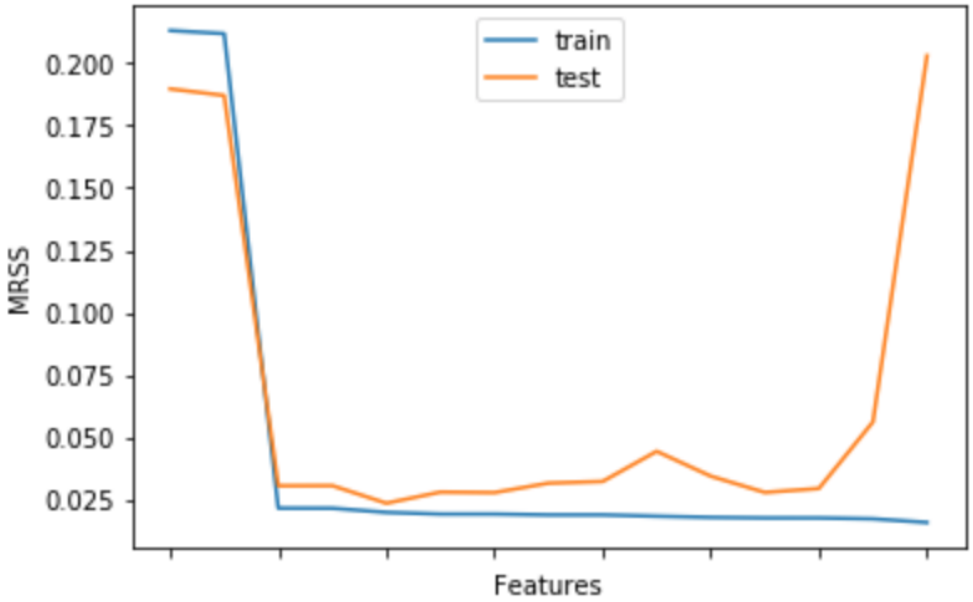
- Values of coefficients are large

Issues with Linear Regression

- More features are participating, leads to more coefficients
- Values of coefficients are large
- Overfitting, performing well on train but not on test dataset


Number of Predictors: 1
Number of Predictors: 3
Number of Predictors: 6
Number of Predictors: 9
Number of Predictors: 12
Number of Predictors: 15

Issues with Linear Regression



Regularisation: Ridge

J = Mean of Squared Errors

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n}$$

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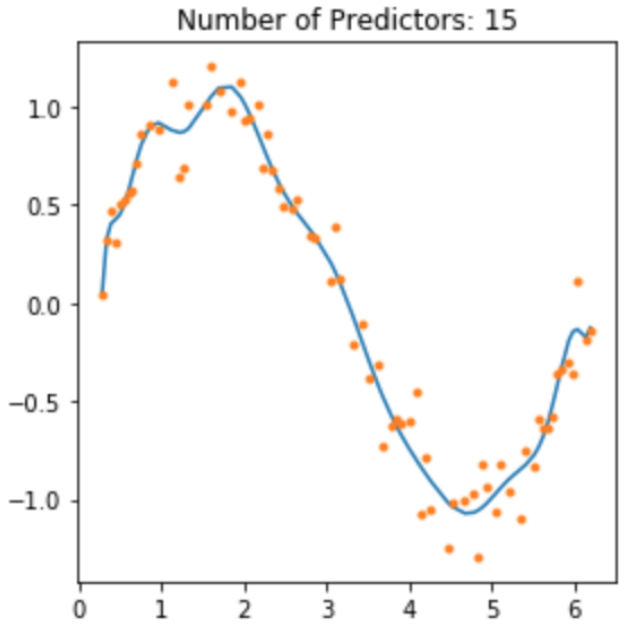

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Regularisation: Ridge

J = Mean of Squared Errors

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n} + \text{Sum of Squared of all coefficients}$$

Regularisation: Ridge

$J =$ Mean of Squared Errors

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n}$$ + Sum of Squared of all coefficients

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n} + \frac{\lambda}{n} \sum_{j=1}^{m} ß_j^2$$

Regularisation: Ridge

$J =$ Mean of Squared Errors

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n} + \text{Sum of Squared of all coefficients}$$

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Regularisation: Ridge

J = Mean of Squared Errors

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n}$$ + Sum of Squared of all coefficients

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n} + \frac{0}{n} \sum_{j=1}^{m} ß_j^2$$

Linear Regression Cost Function

Regularisation: Ridge

J = Mean of Squared Errors

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n}$$ + Sum of Squared of all coefficients

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n} + \frac{\lambda}{n} \sum_{j=1}^{m} ß_j^2$$

λ -> ∞
ß -> 0

Regularisation: Ridge

J = Mean of Squared Errors

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n}$$ + Sum of Squared of all coefficients

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n} + \frac{\lambda}{n} \sum_{j=1}^{m} ß_j^2$$

Regularisation: Lasso

J = Mean of Squared Errors

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n} + \text{Sum of Absolute value of all coefficients}$$

$$J = \frac{\sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2}{n} + \frac{\lambda}{n} \sum_{j=1}^{m} |ß_j|$$

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Regularisation: Ridge

- Nullified coefficients still participate

Regularisation: Ridge

- Nullified coefficients still participate

- Difficult interpretation