

# Train and Test



### OLS Regression Results

<b>Dep. Variable:</b>	DomesticTotalGross	<b>R-squared:</b>	0.286
<b>Model:</b>	OLS	<b>Adj. R-squared:</b>	0.278
<b>Method:</b>	Least Squares	<b>F-statistic:</b>	34.82
<b>Date:</b>	Sun, 14 Sep 2014	<b>Prob (F-statistic):</b>	6.80e-08
<b>Time:</b>	21:59:46	<b>Log-Likelihood:</b>	-1738.1
<b>No. Observations:</b>	89	<b>AIC:</b>	3480.
<b>Df Residuals:</b>	87	<b>BIC:</b>	3485.
<b>Df Model:</b>	1		

	<b>coef</b>	<b>std err</b>	<b>t</b>	<b>P&gt; t </b>	<b>[95.0% Conf. Int.]</b>
<b>Budget</b>	0.7846	0.133	5.901	0.000	0.520 1.049
<b>Ones</b>	4.44e+07	1.27e+07	3.504	0.001	1.92e+07 6.96e+07

<b>Omnibus:</b>	39.749	<b>Durbin-Watson:</b>	0.674
<b>Prob(Omnibus):</b>	0.000	<b>Jarque-Bera (JB):</b>	99.441
<b>Skew:</b>	1.587	<b>Prob(JB):</b>	2.55e-22
<b>Kurtosis:</b>	7.091	<b>Cond. No.</b>	1.54e+08

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# Training and test sets

	Date	Title	Budget	DomesticTotalGross	Director	Rating	Runtime
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4	2013-06-14	Man of Steel	225000000	291045518	Zack Snyder	PG-13	143
5	2013-10-04	Gravity	100000000	274092705	Alfonso Cuaron	PG-13	91
6	2013-06-21	Monsters University	NaN	268492764	Dan Scanlon	G	107
7	2013-12-13	The Hobbit: The Desolation of Smaug	NaN	258366855	Peter Jackson	PG-13	161
8	2013-05-24	Fast & Furious 6	160000000	238679850	Justin Lin	PG-13	130
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11	2013-11-08	Thor: The Dark World	170000000	206362140	Alan Taylor	PG-13	120
12	2013-06-21	World War Z	190000000	202359711	Marc Forster	PG-13	116
13	2013-03-22	The Croods	135000000	187168425	Kirk De MiccoChris Sanders	PG	98
14	2013-06-28	The Heat	43000000	159582188	Paul Feig	R	117
15	2013-08-07	We're the Millers	37000000	150394119	Rawson Marshall Thurber	R	110
16	2013-12-13	American Hustle	40000000	150117807	David O. Russell	R	138
17	2013-05-10	The Great Gatsby	105000000	144840419	Baz Luhrmann	PG-13	143

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6	2013-06-21	Monsters University	NaN	268492764	Dan Scanlon	G	107
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8	2013-05-24	Fast & Furious 6	160000000	238679850	Justin Lin	PG-13	130
9	2013-03-08	Oz The Great and Powerful	215000000	234911825	Sam Raimi	PG	127
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11	2013-11-08	Thor: The Dark World	170000000	206362140	Alan Taylor	PG-13	120
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17	2013-05-10	The Great Gatsby	105000000	144840419	Baz Luhrmann	PG-13	143

Training  
set

Test set

# Training and test sets

Training set

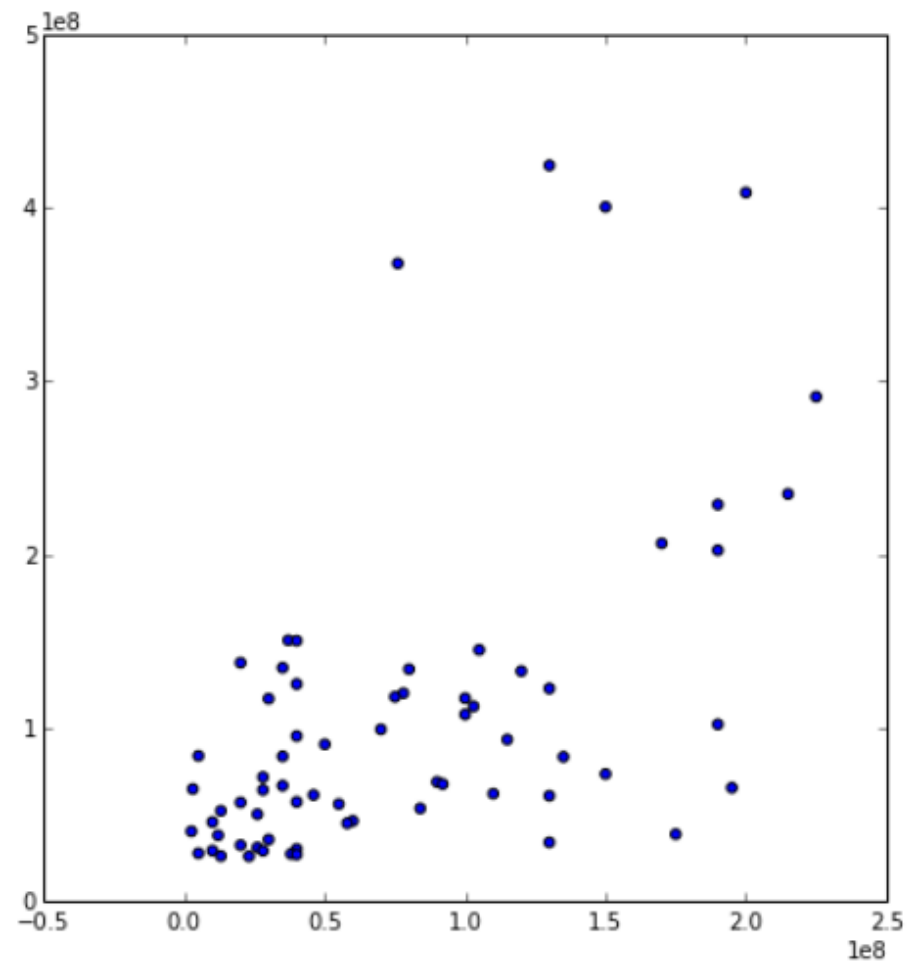
fit the model

Test set

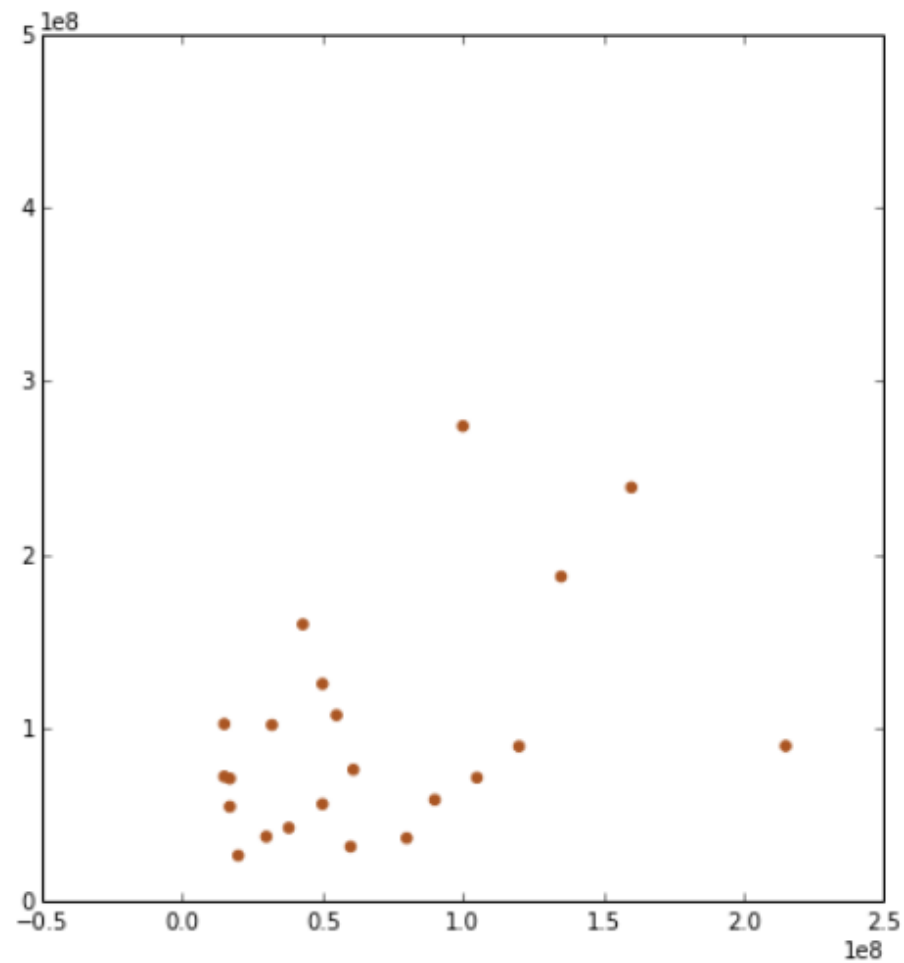
measure performance

- predict  $y$  with model
- compare with actual  $y$
- measure error

# Training set

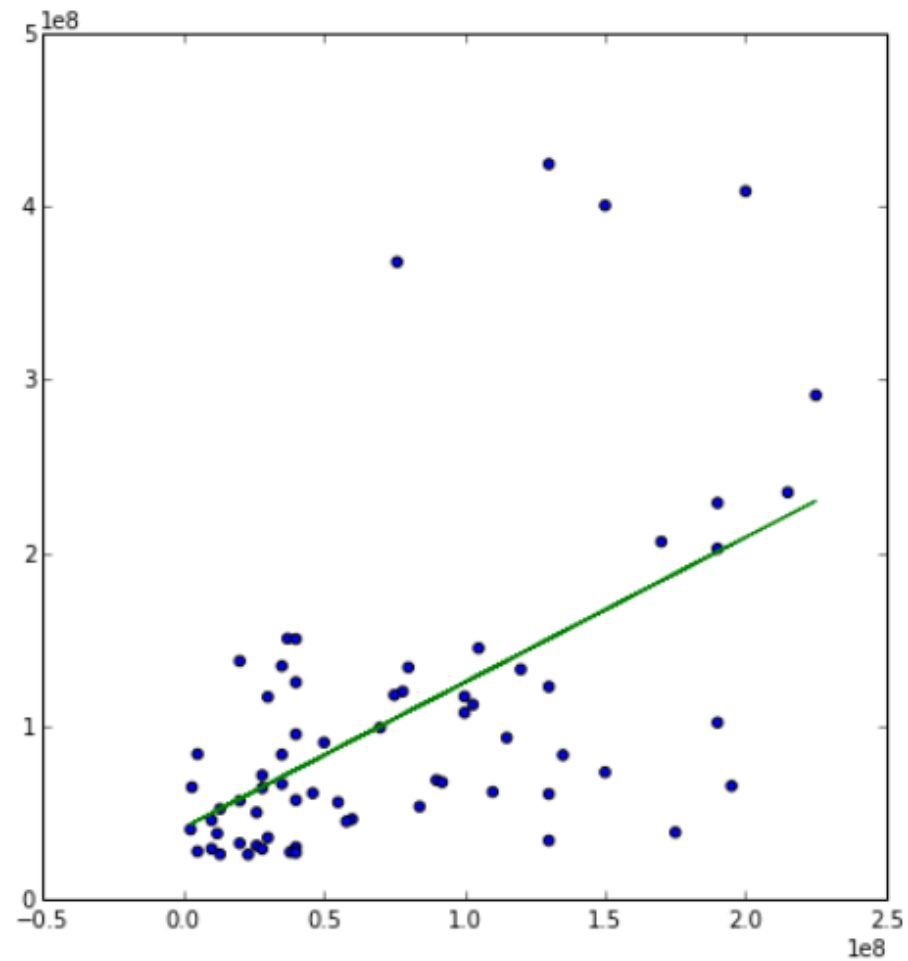


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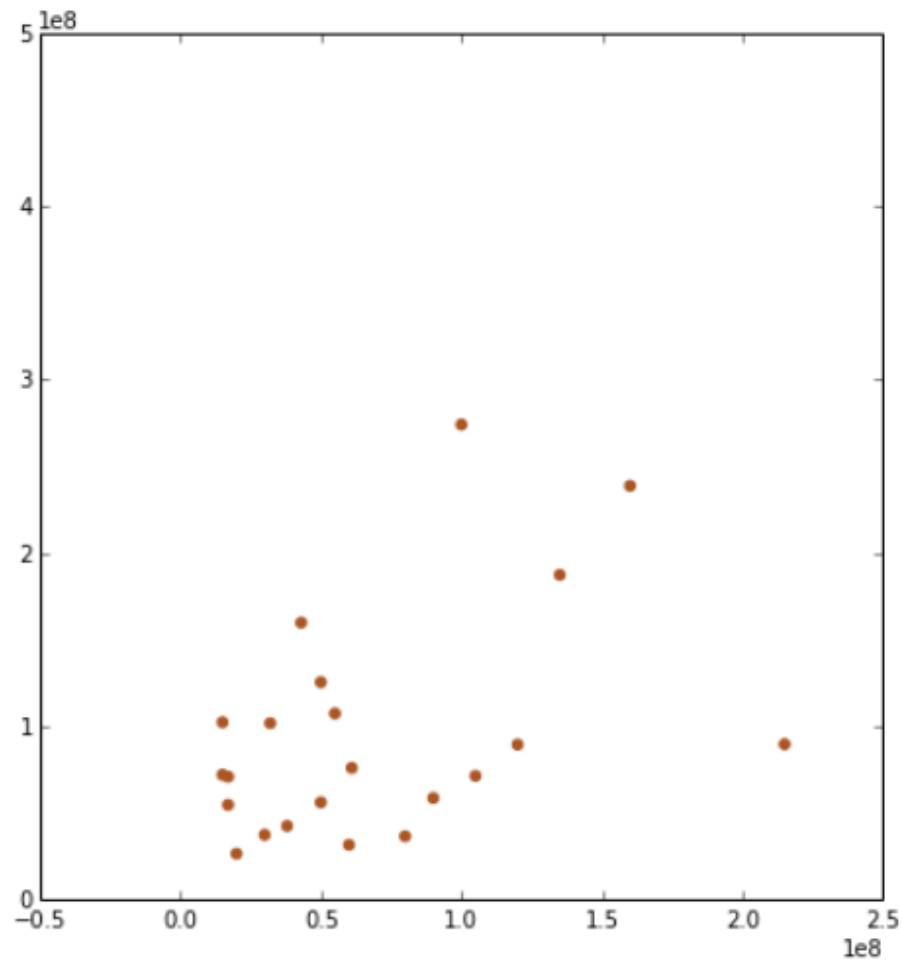


# Training set

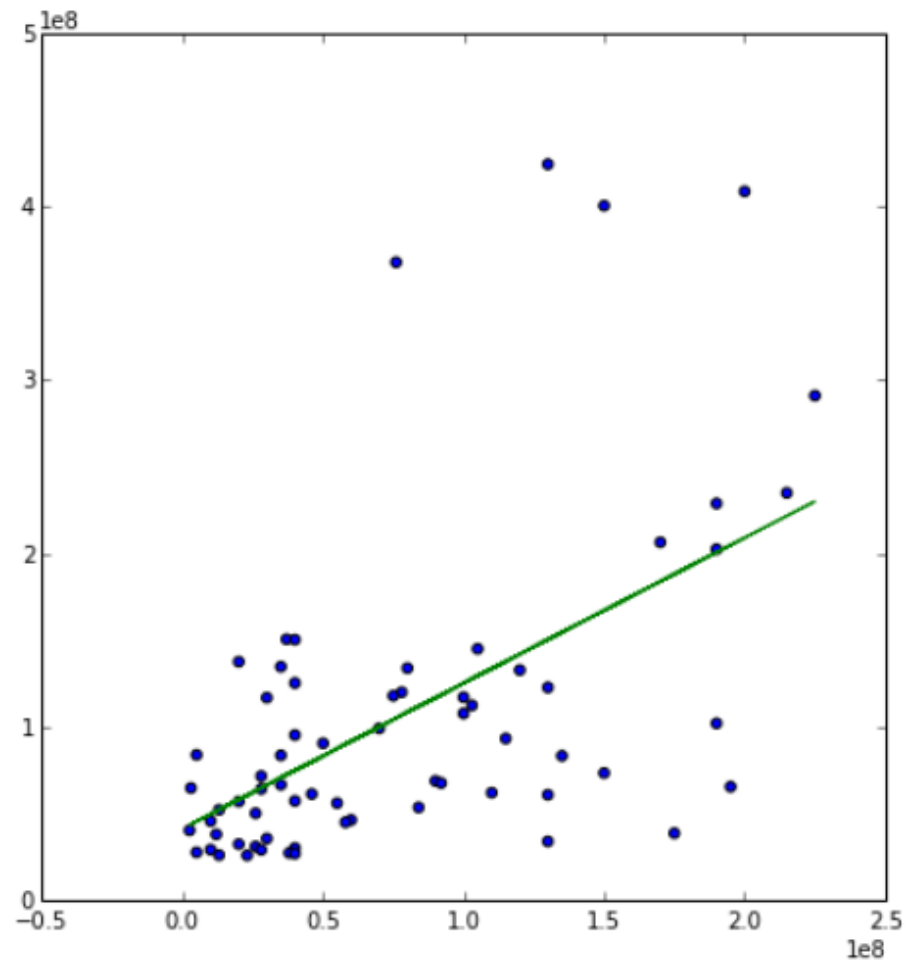
Fit the model



# Test set

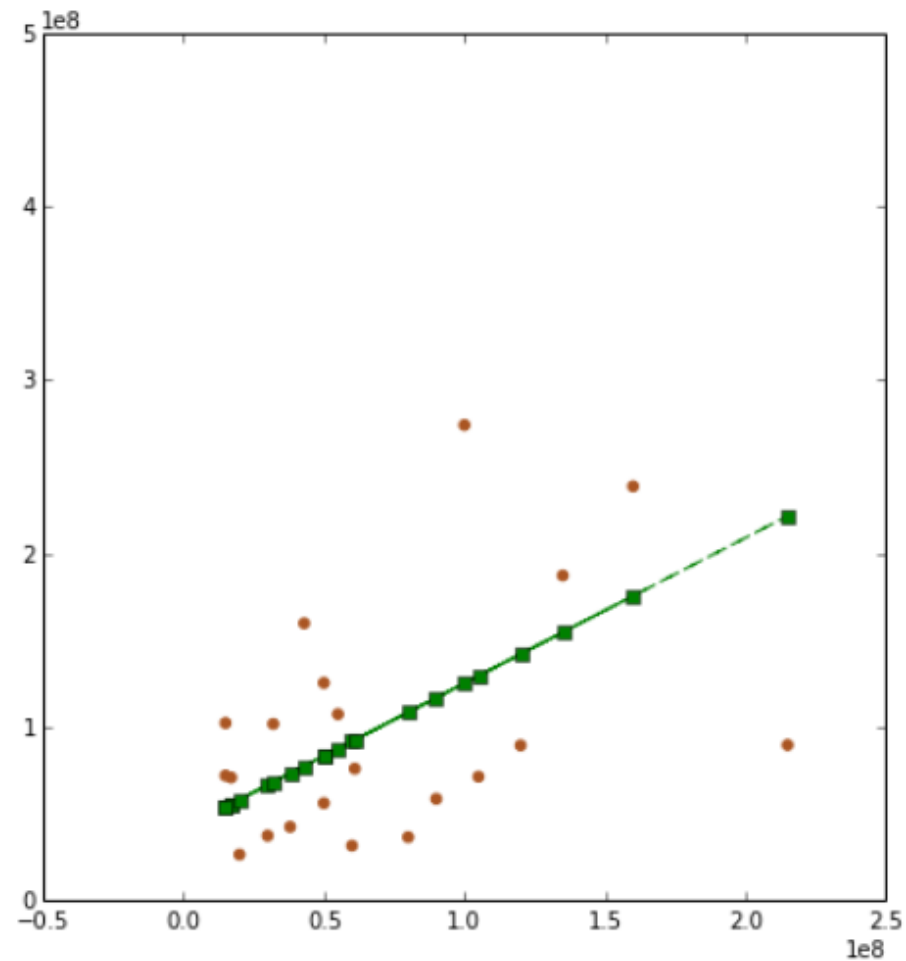


## Training set



## Test set

Use the model to predict y from x

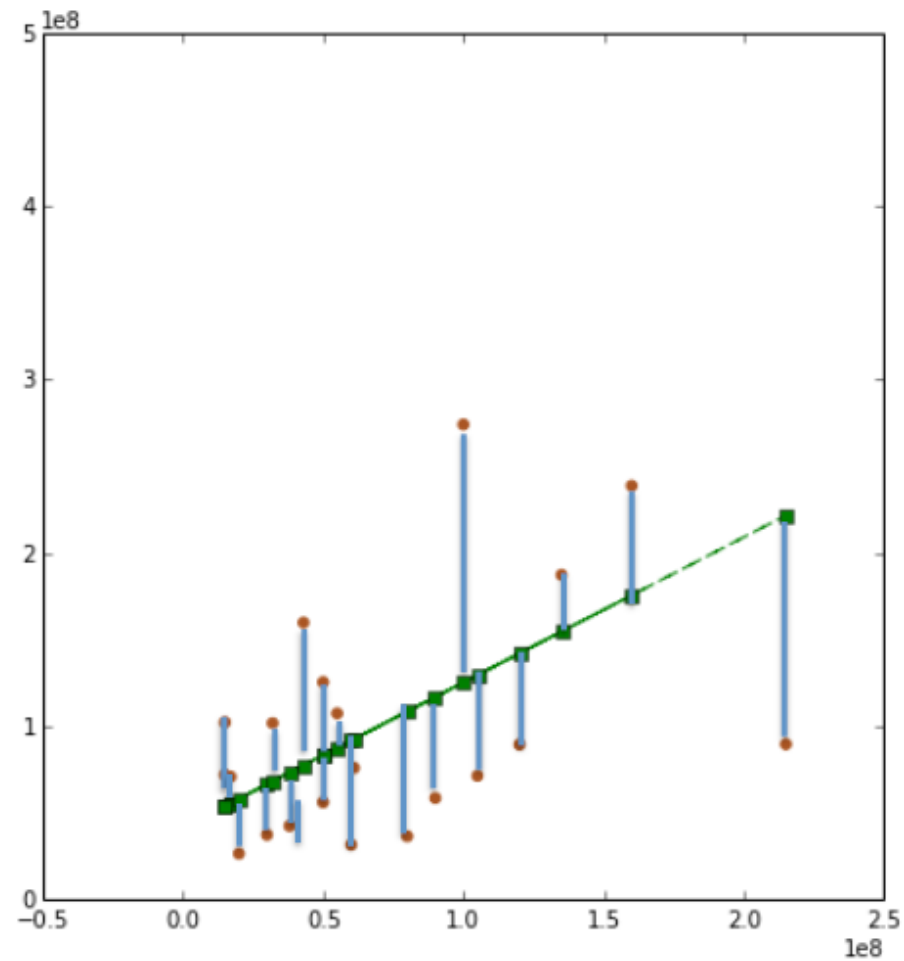
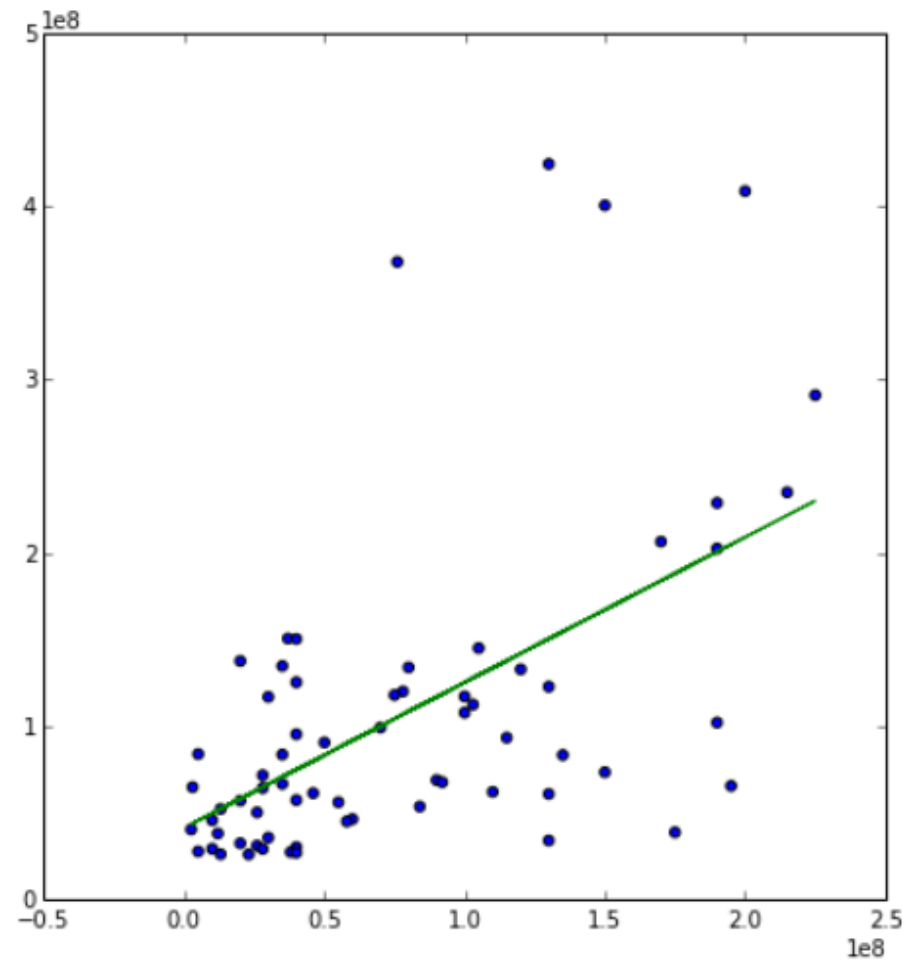




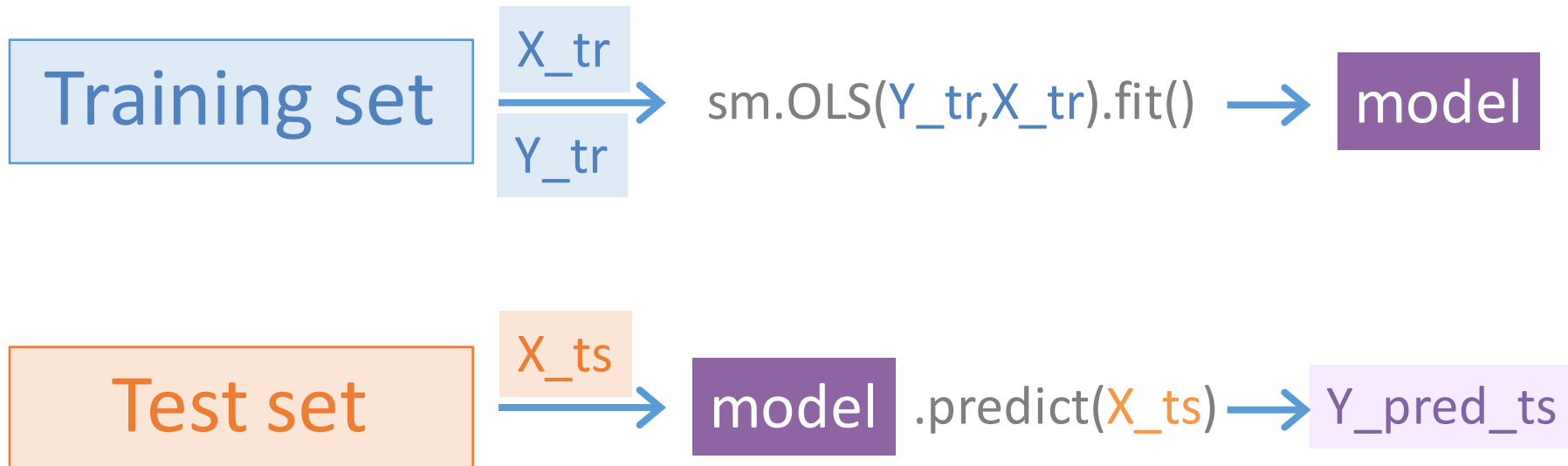
Training set

Test set

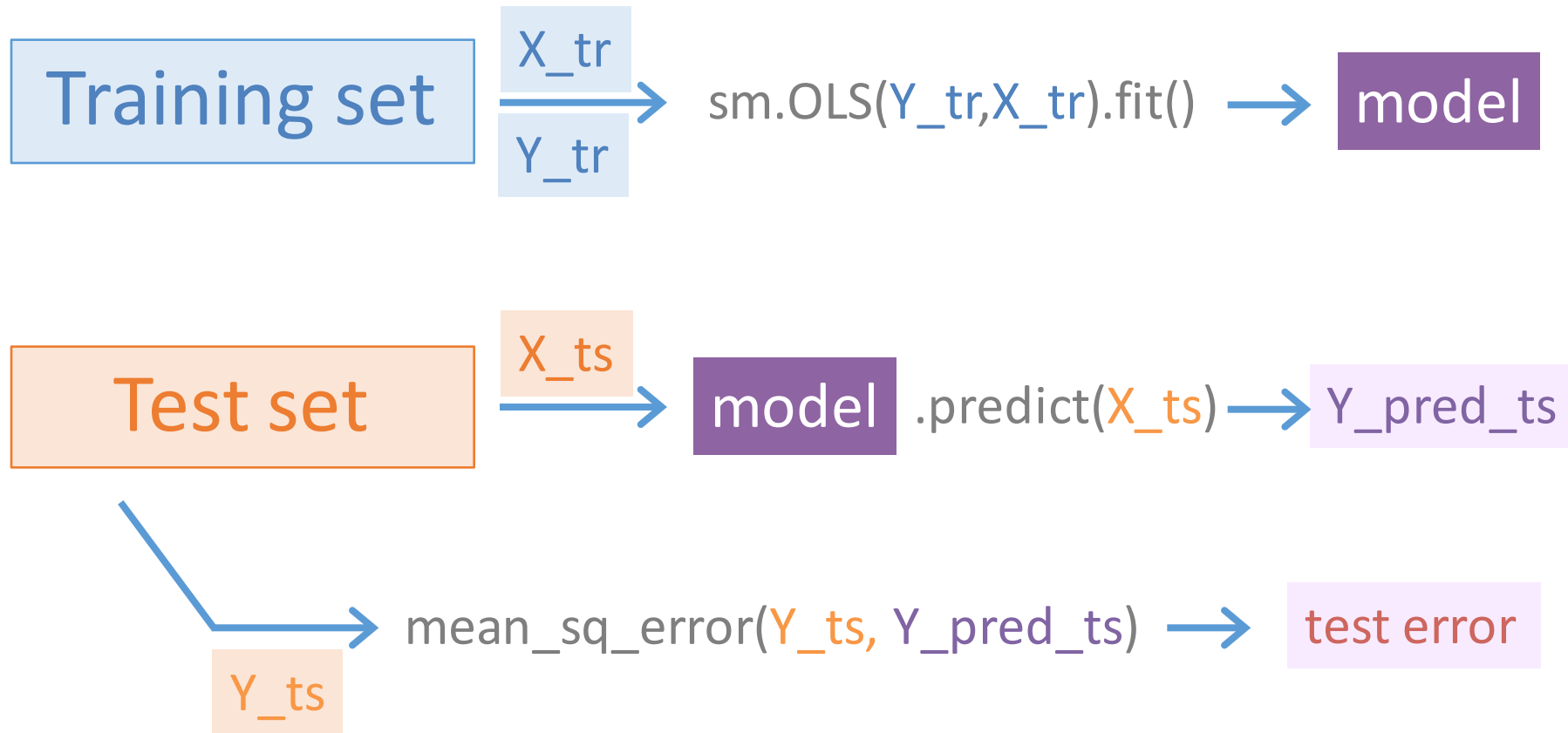
Measure the error



# Training and test sets



# Training and test sets



# Cross validation

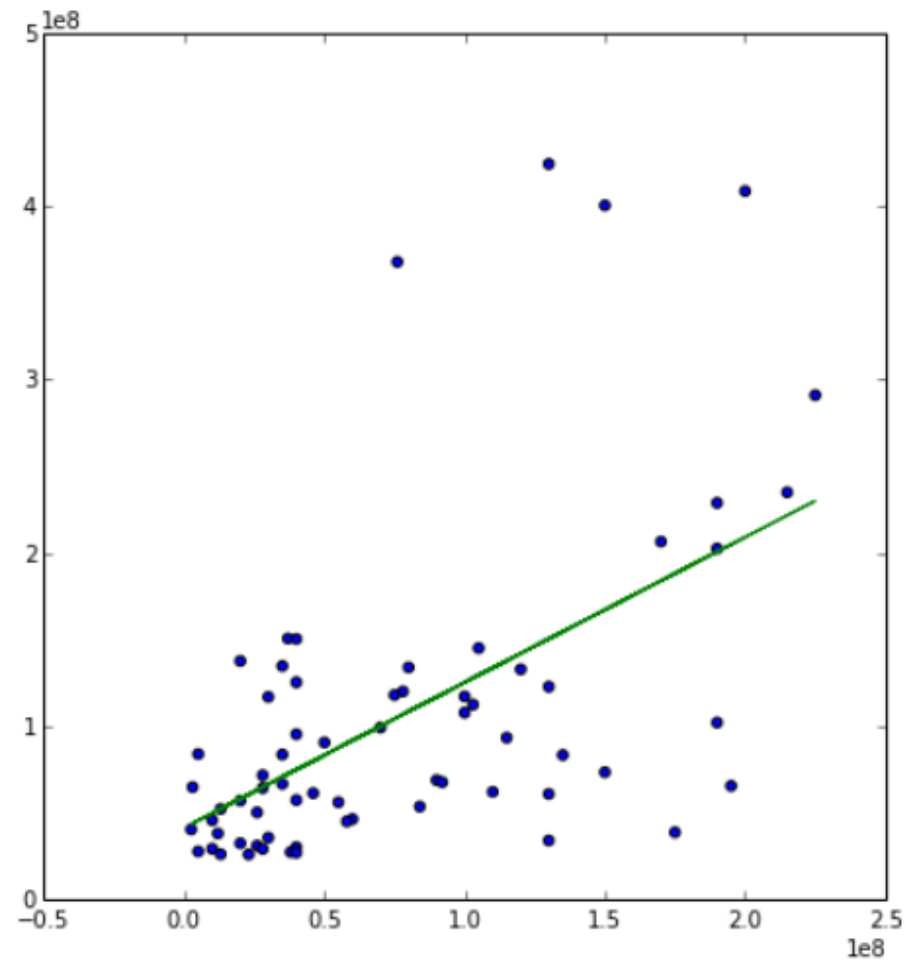
What's better than a single test set?

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0	2013-11-22	The Hunger Games: Catching Fire	130000000	424668047	Francis Lawrence	PG-13	146
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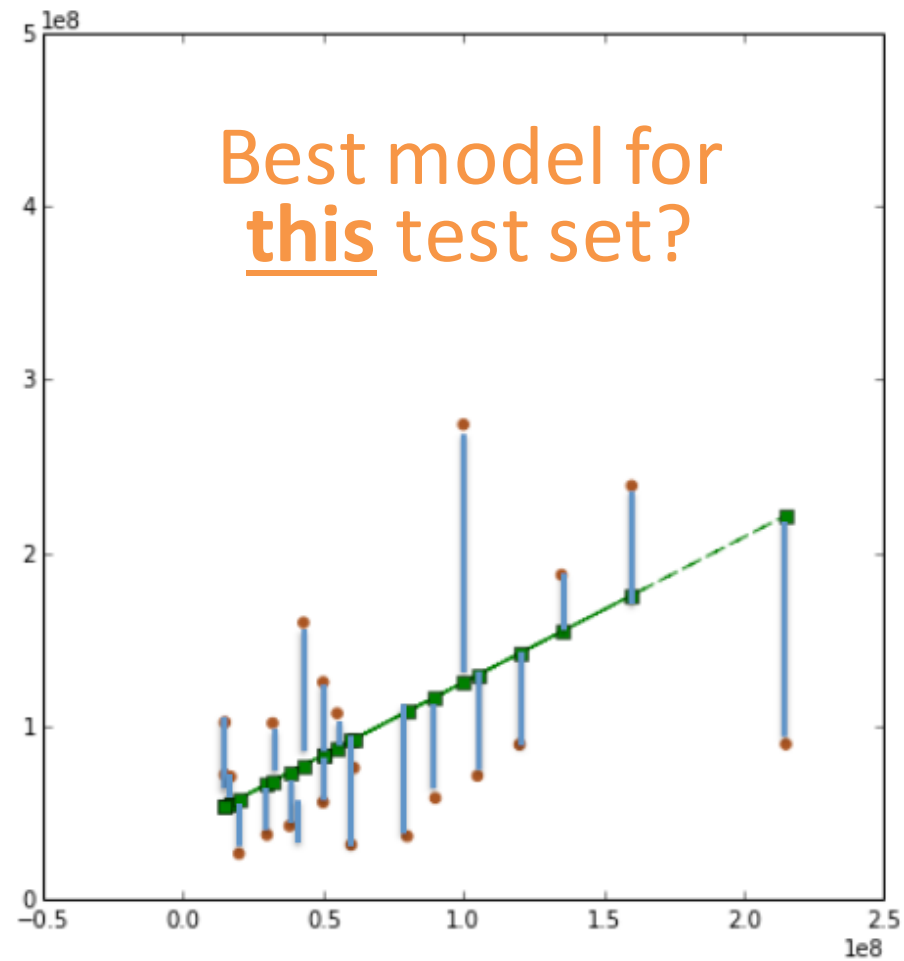
Training  
set

Test set

# Training set



# Test set



# Cross validation

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Training  
set

Test set

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Training  
set 2

Test set  
2

# Cross validation

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Test set  
3

Training  
Set 3



# Cross validation

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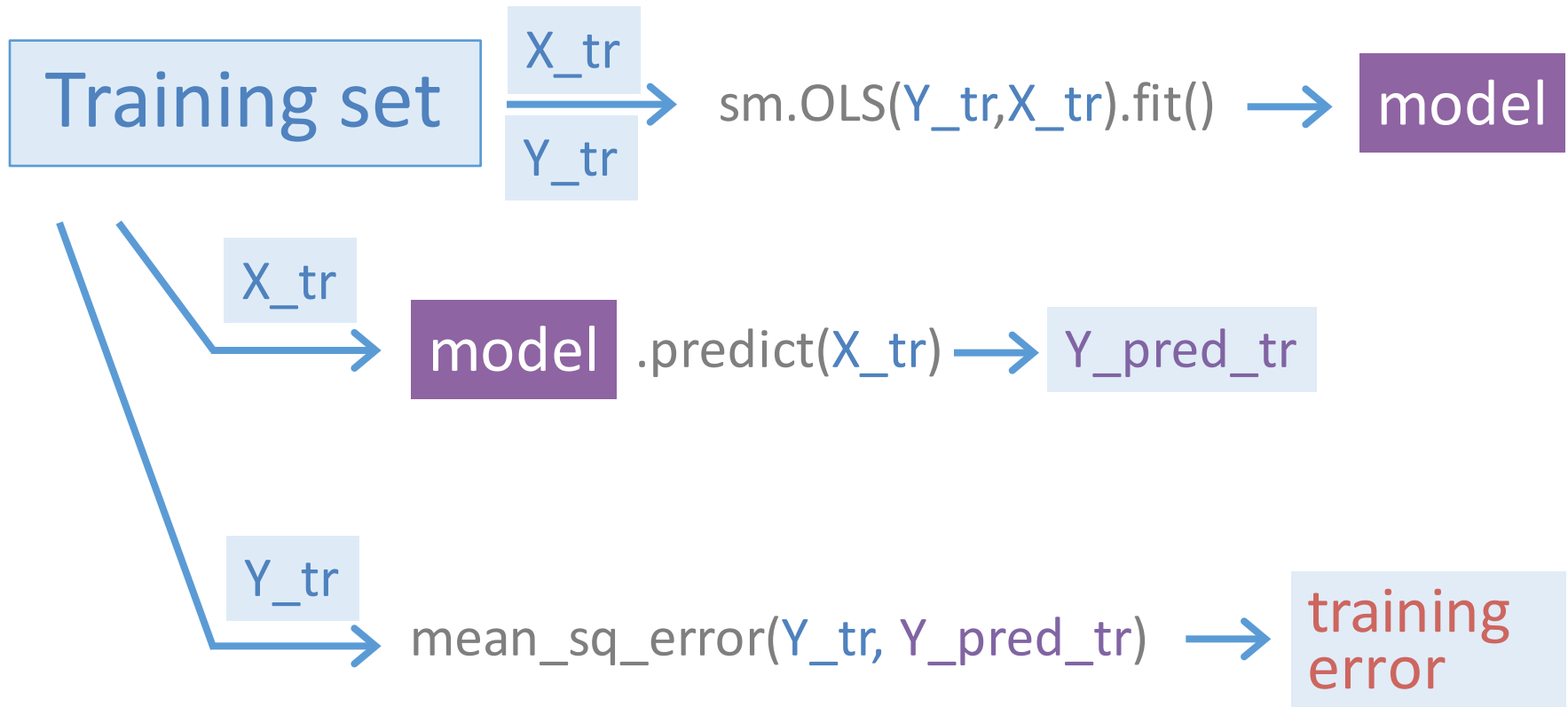
Test set  
4

Training  
Set 4

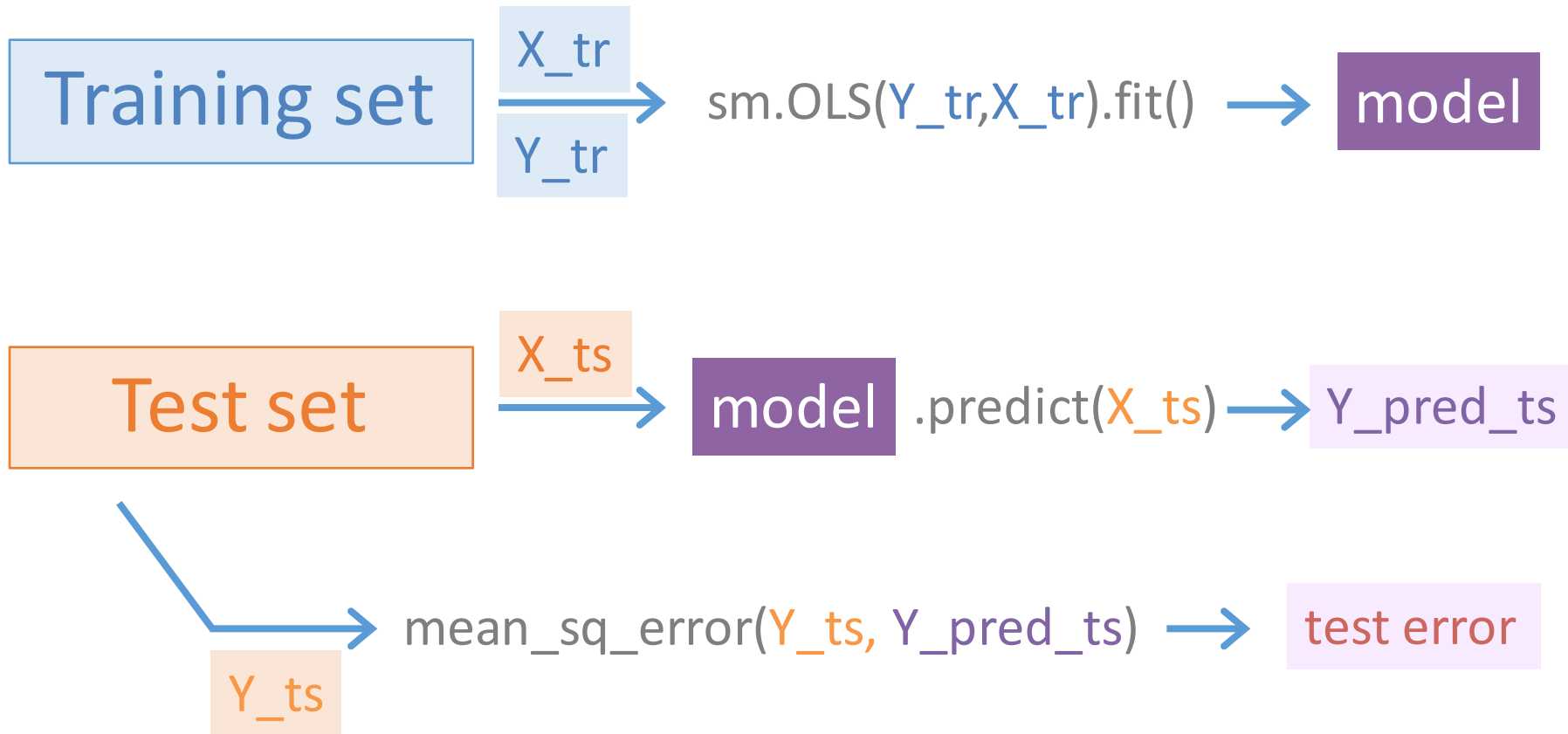
# Diagnostic tools with training and test errors



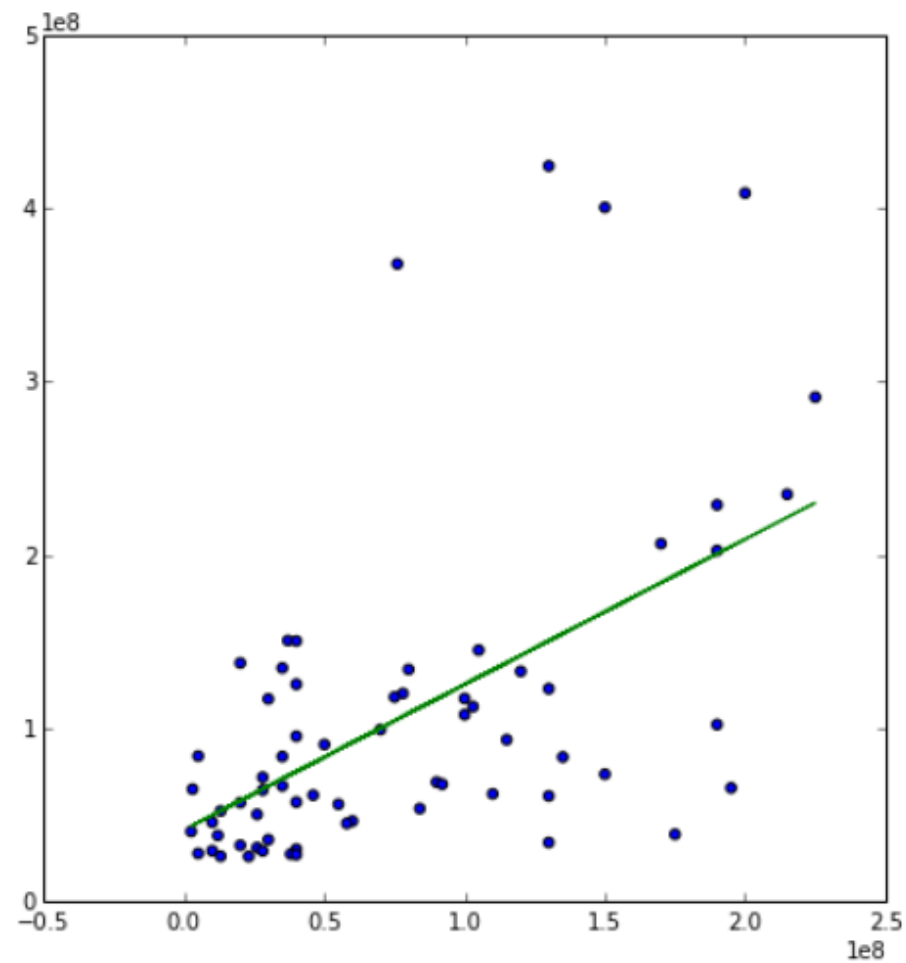
# Calculating Training error



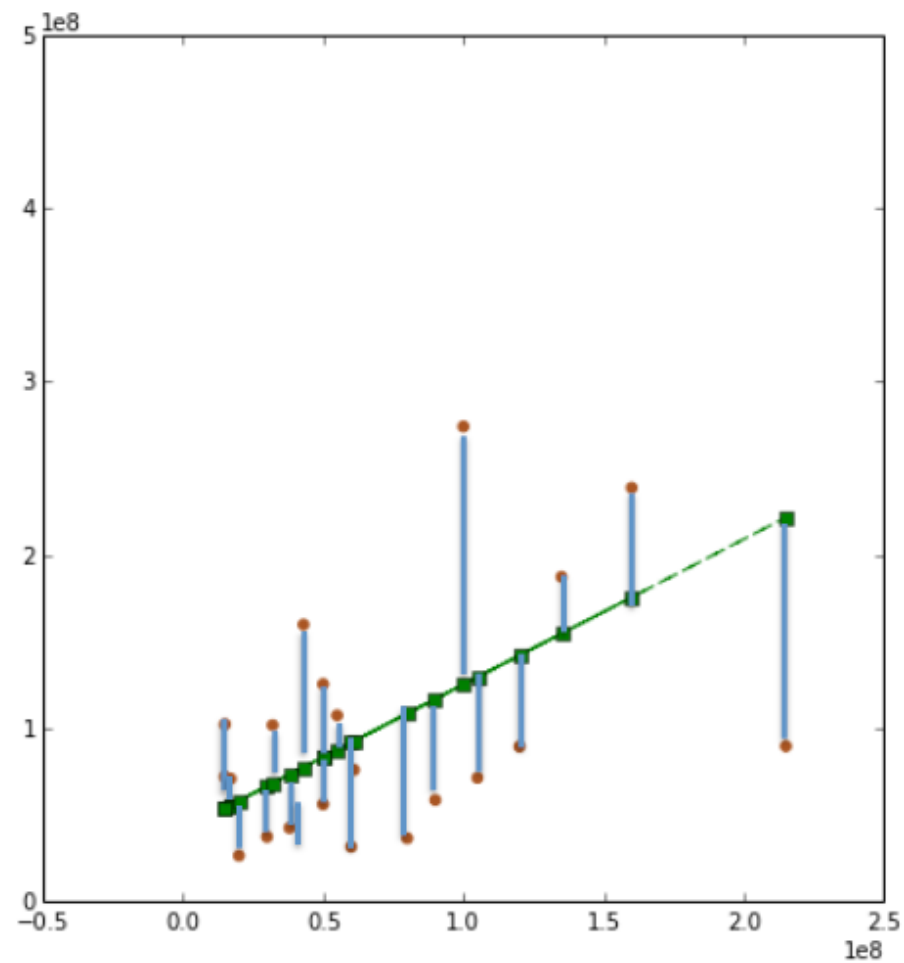
# Calculating test error



# Training set

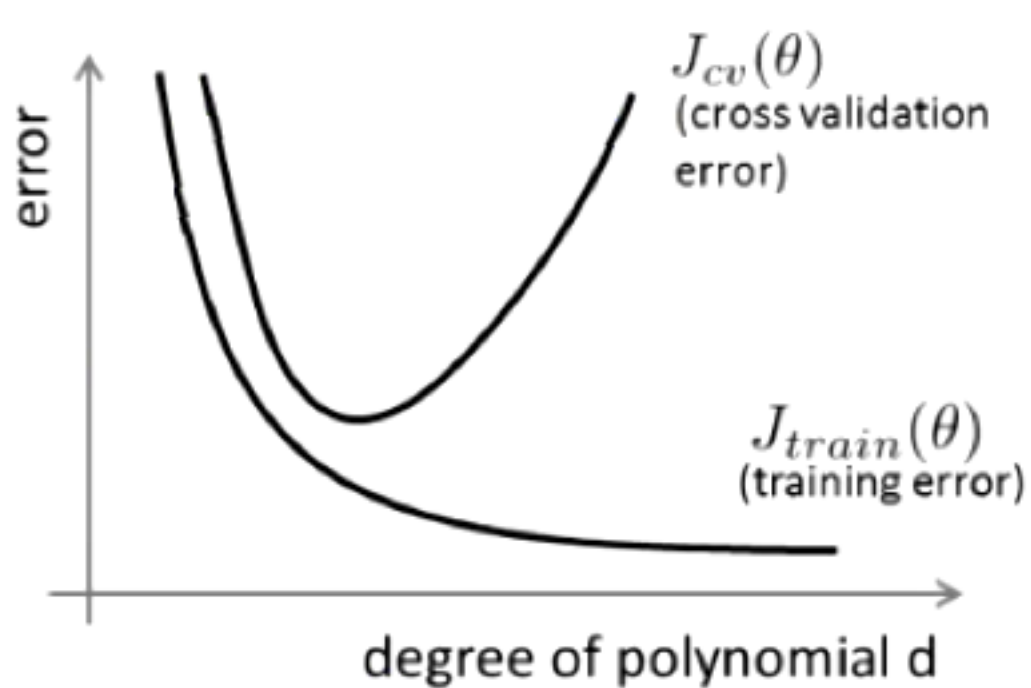


# Test set



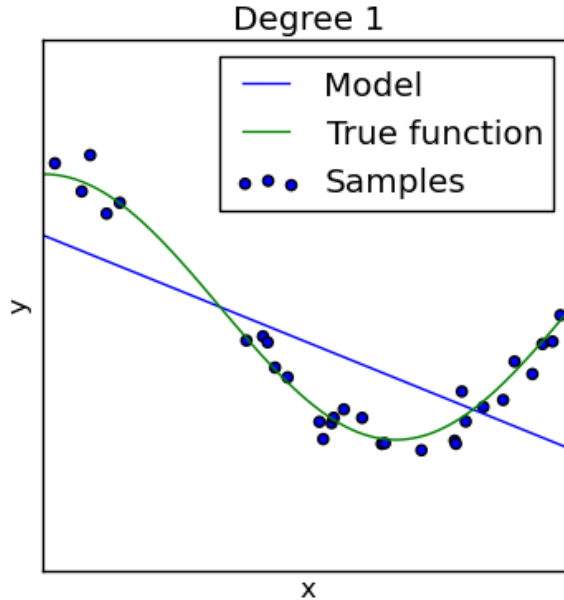
# Diagnostic tool I

## Errors vs. model complexity

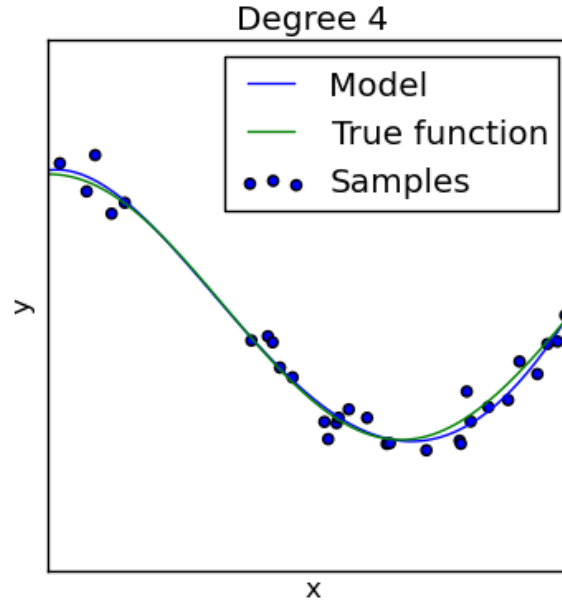


# Diagnostic tool to detect under/overfitting

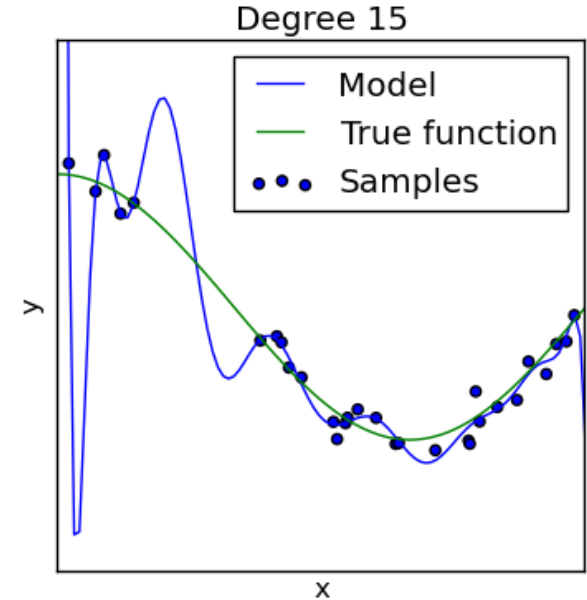
## Underfitting



## Just Right

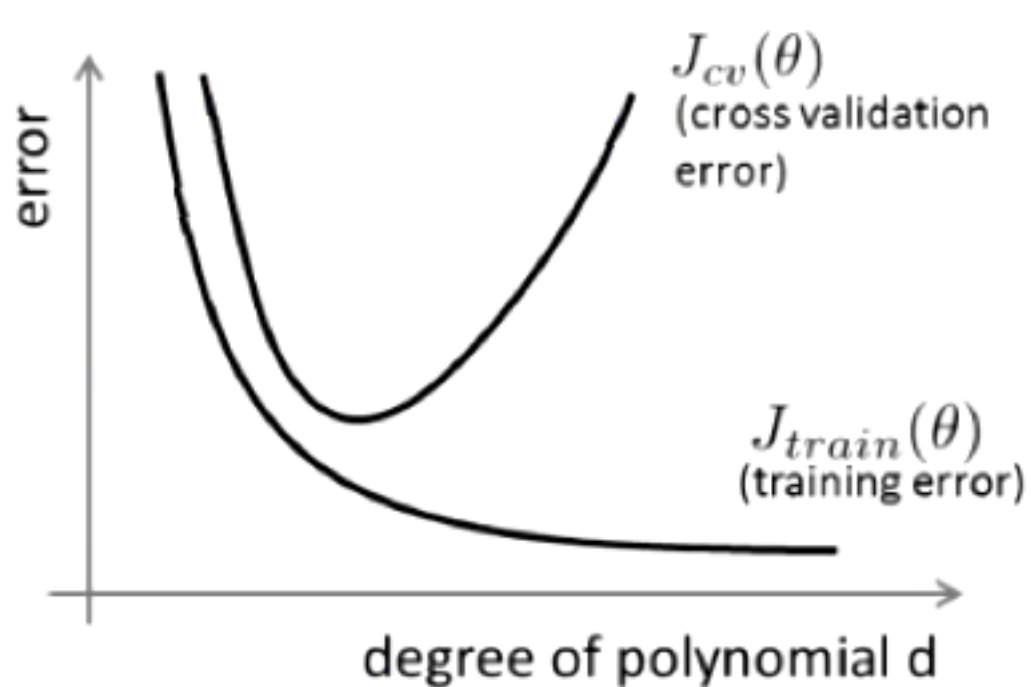


## Overfitting



# Diagnostic tool I

## Errors vs. model complexity

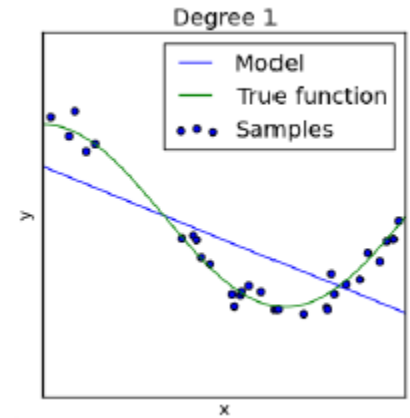
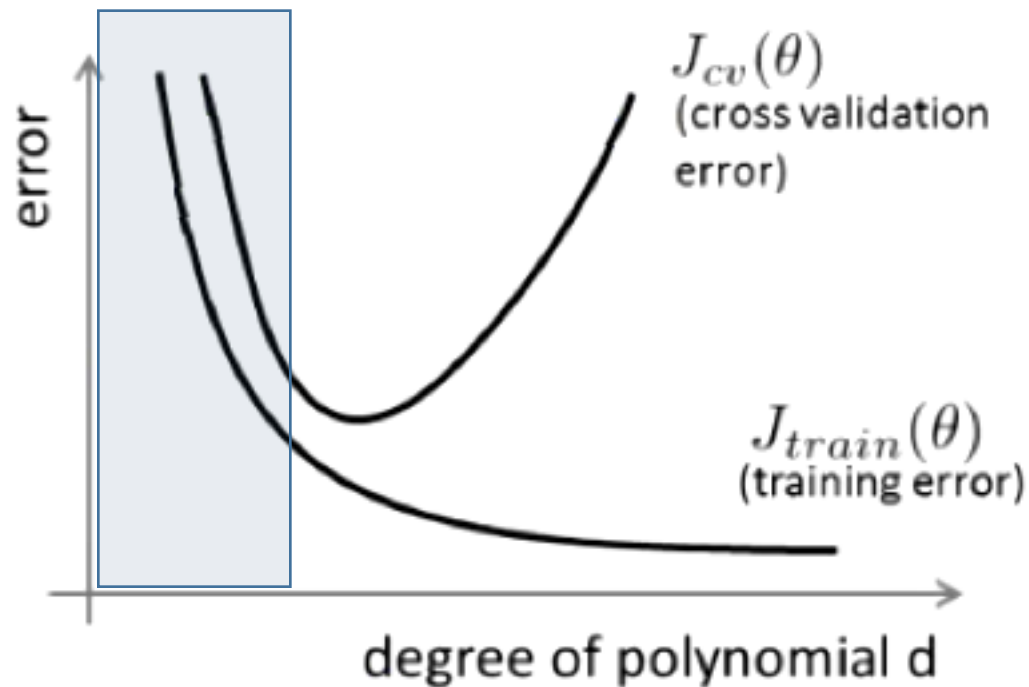


Evaluating MULTIPLE models

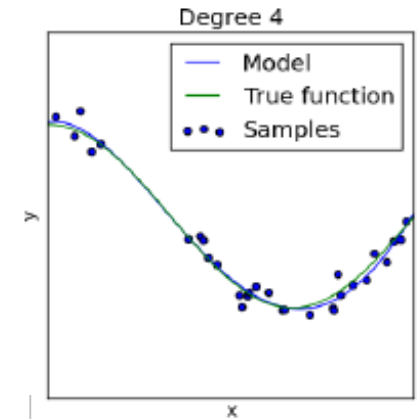
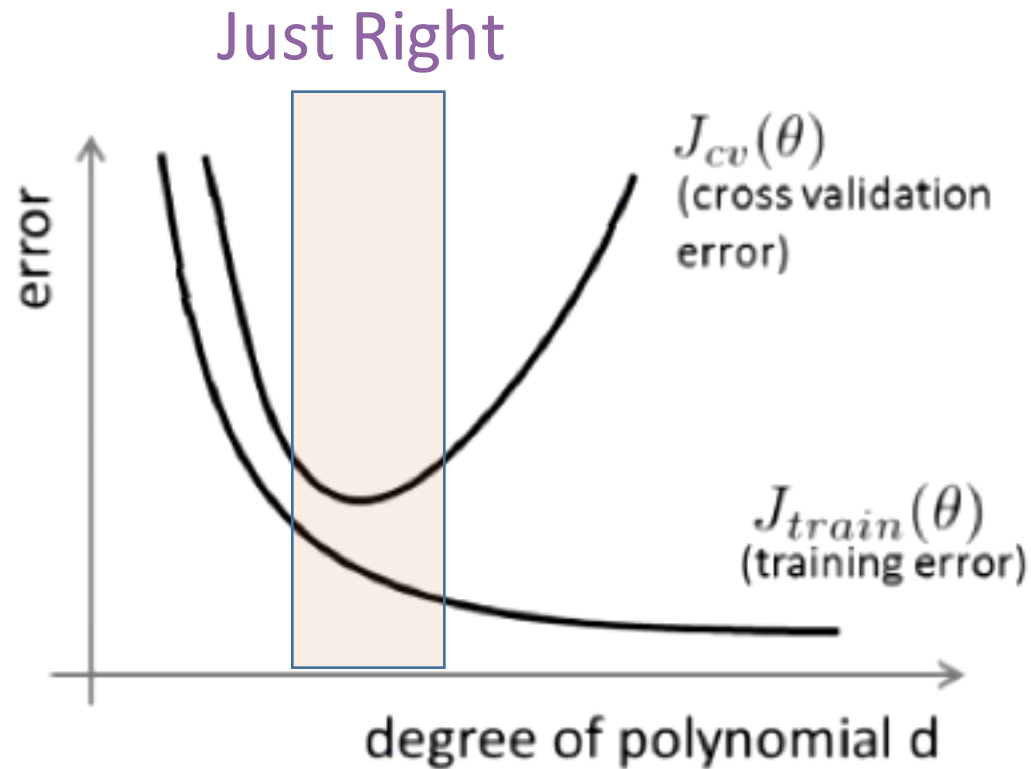


# Diagnostic tool I

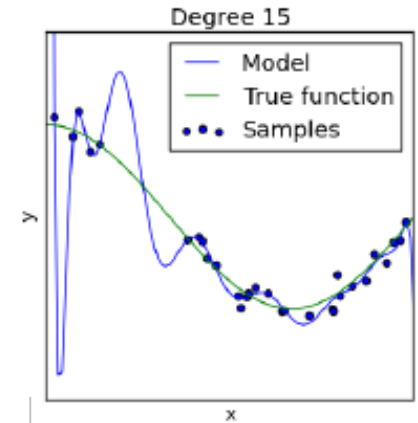
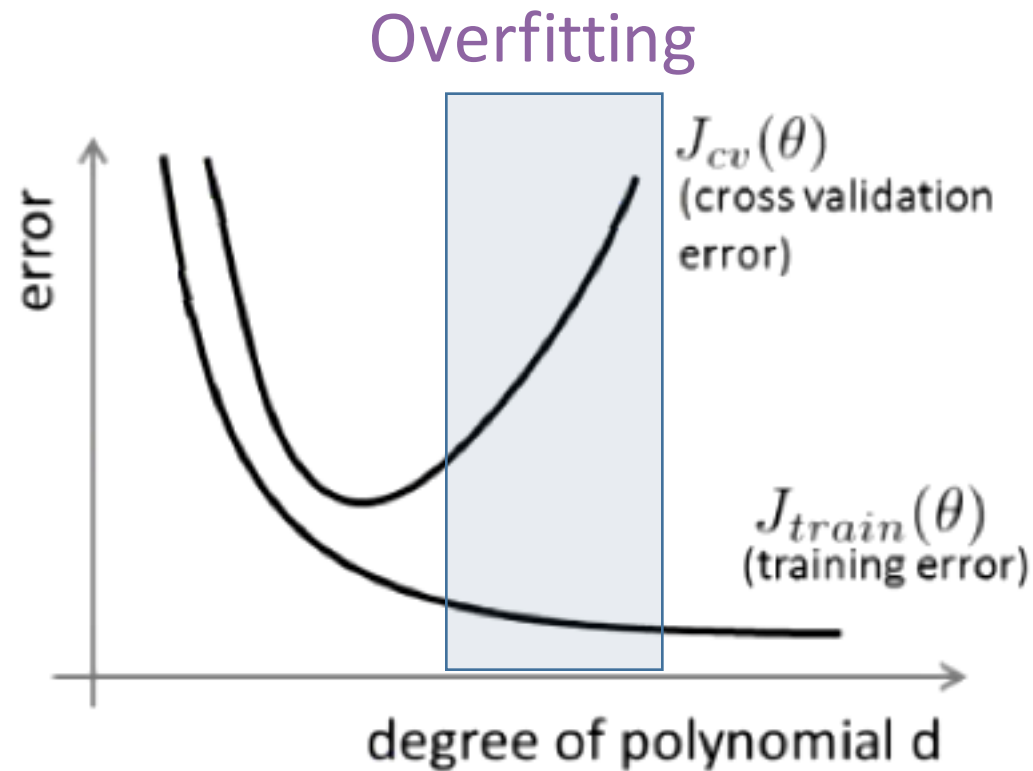
## Underfitting



# Diagnostic tool I

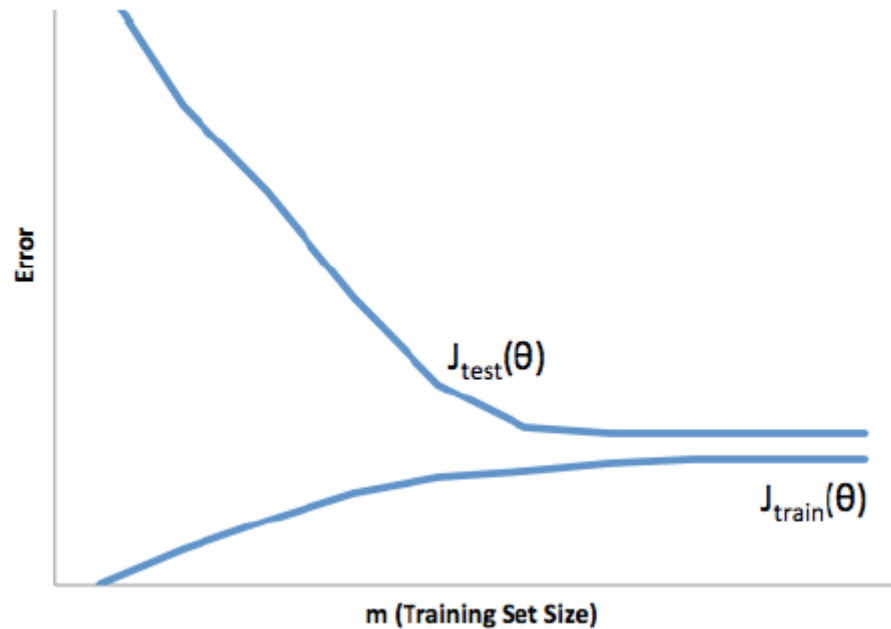


# Diagnostic tool I



# Diagnostic tool II

Learning curve  
Errors vs size of training set

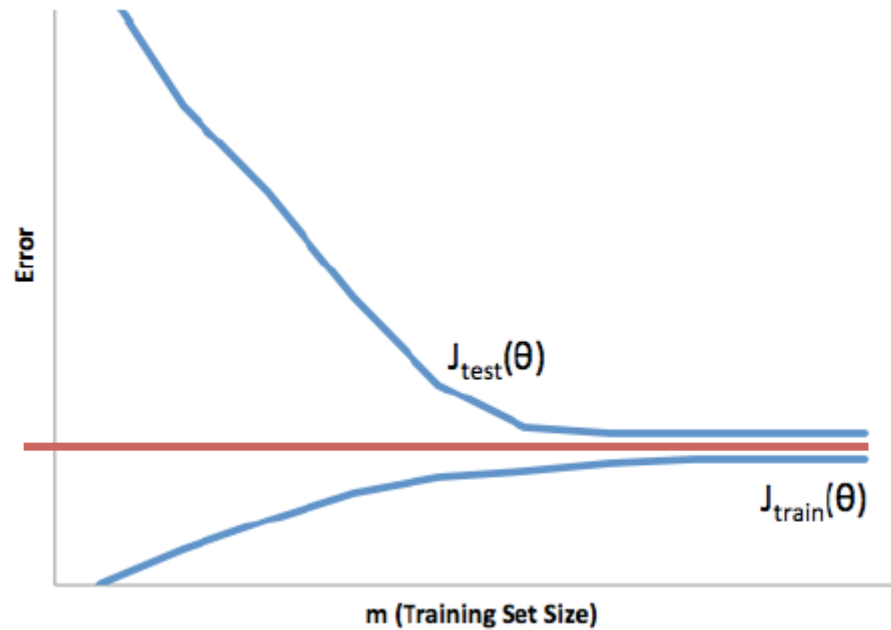


For a SINGLE model form

# Diagnostic tool II

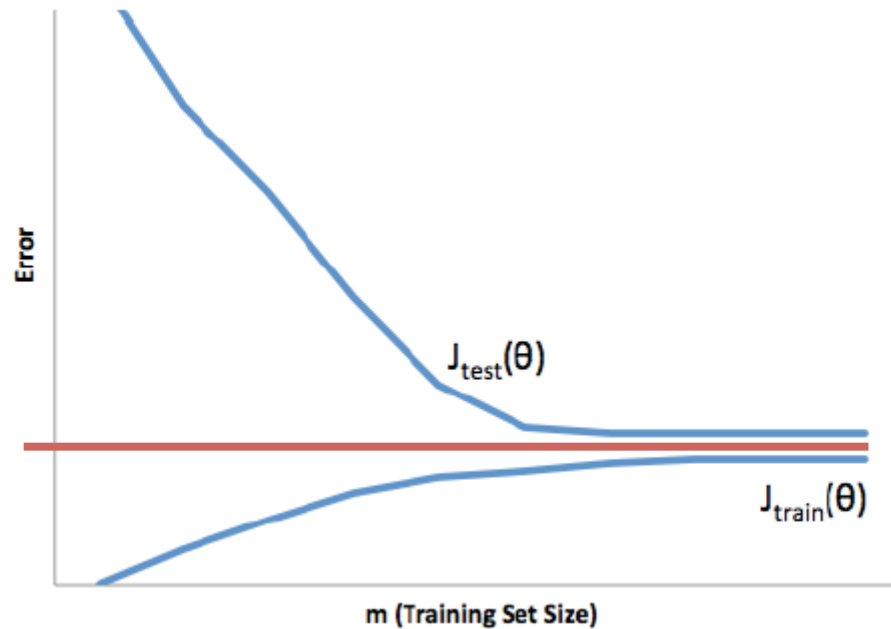
For a SINGLE model form

Is the converged  
error high/low?



# Diagnostic tool II

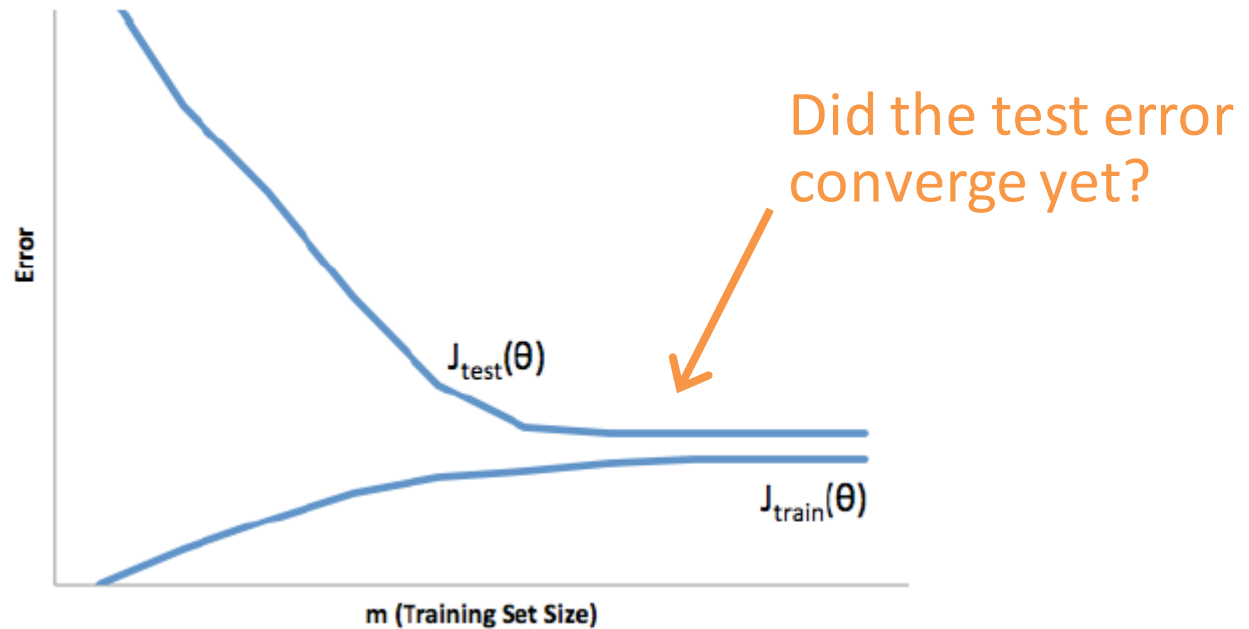
For a SINGLE model form



Is the converged error high/low?  
(compared to another model's learning curve)

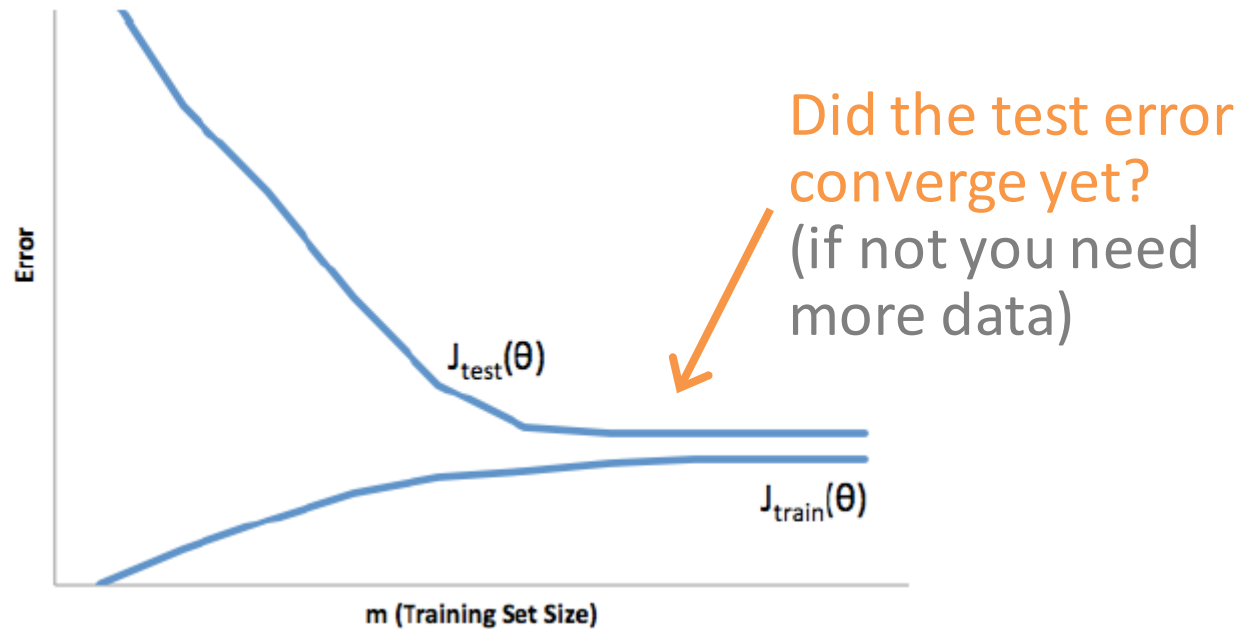
# Diagnostic tool II

For a SINGLE model form



# Diagnostic tool II

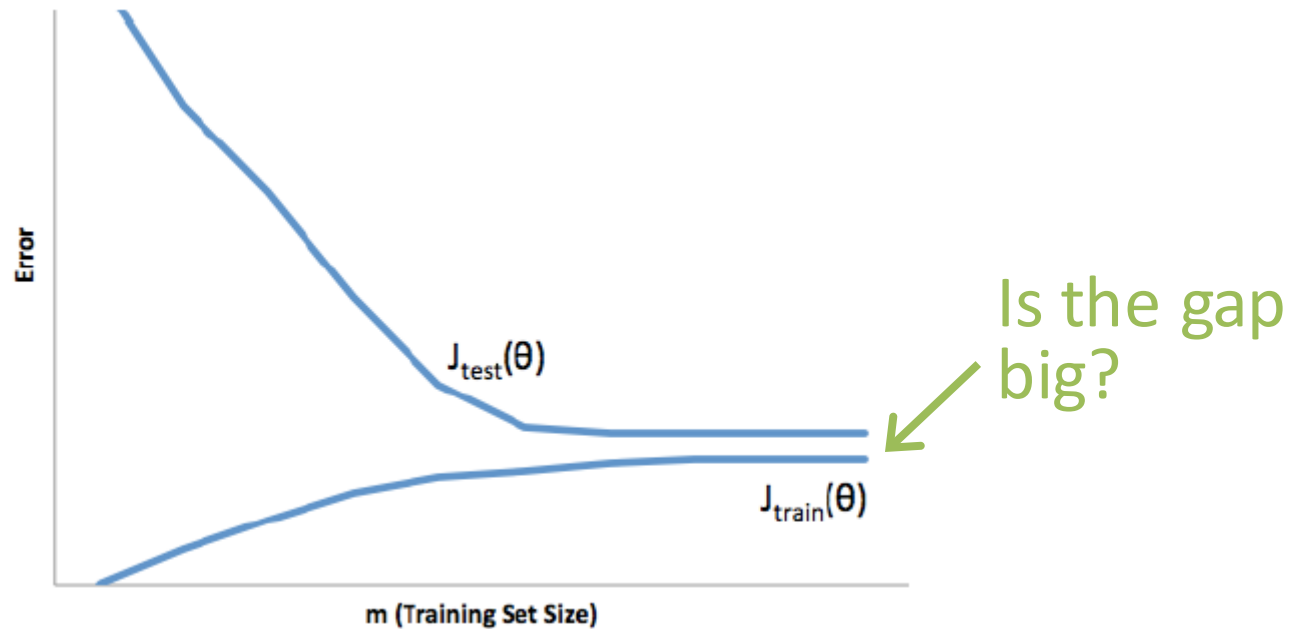
For a SINGLE model form





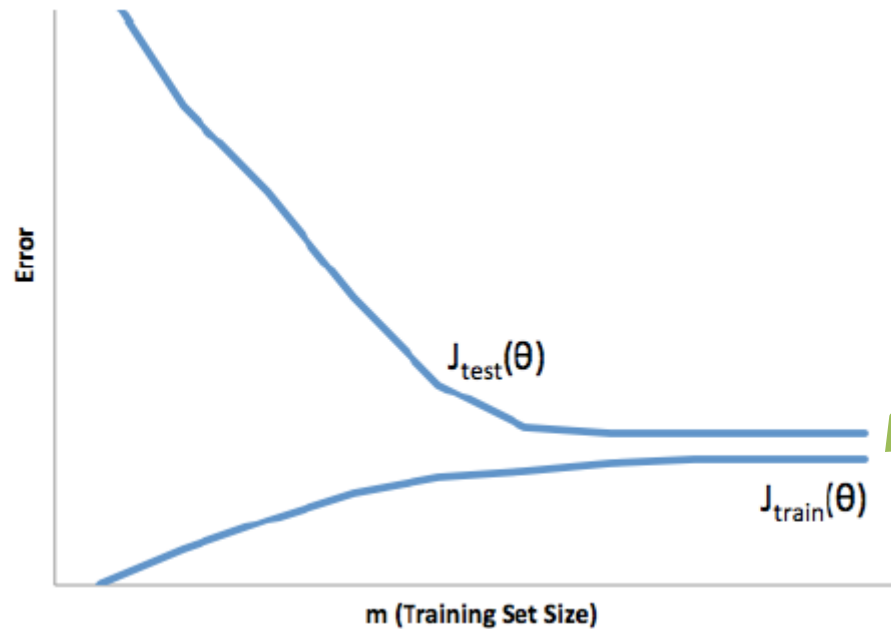
# Diagnostic tool II

For a SINGLE model form



# Diagnostic tool II

For a SINGLE model form



Is the gap  
big?  
(big gap  
means  
overfit)

How many test sets?

How often can we use them?

Train / Test

Cross-validation

Train / Validate / Test

Hold-out test set