Can you predict domestic total gross of a movie based on past movie performance?

Lucia
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Data Sources, Features and Assumptions

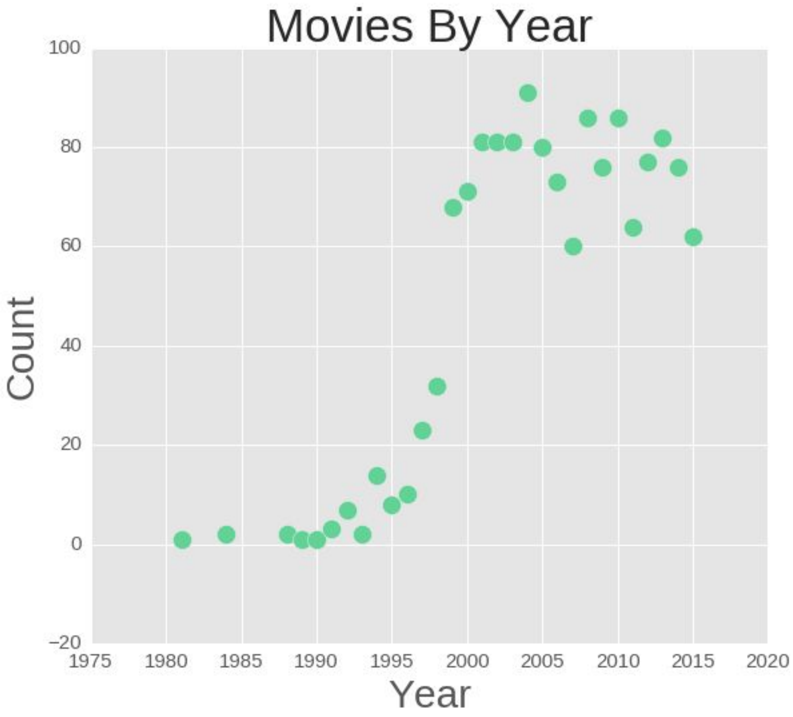
- BOX OFFICE MOJO:

  Domestic Total Gross, Production Budget, Release Date, Widest Release Theaters Count, Genre, Runtime, Rating, Distributor, Director, Producer(s), Actor(s), Writer(s), Composer(s), Cinematographer(s)

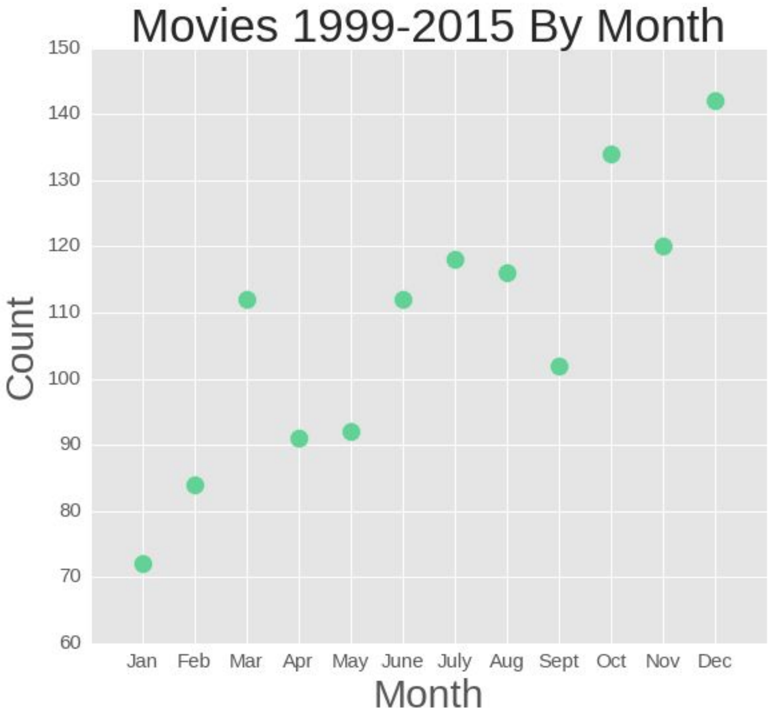
- METACRITIC:

  Movie Score

Box Office Mojo -- founded in 1999

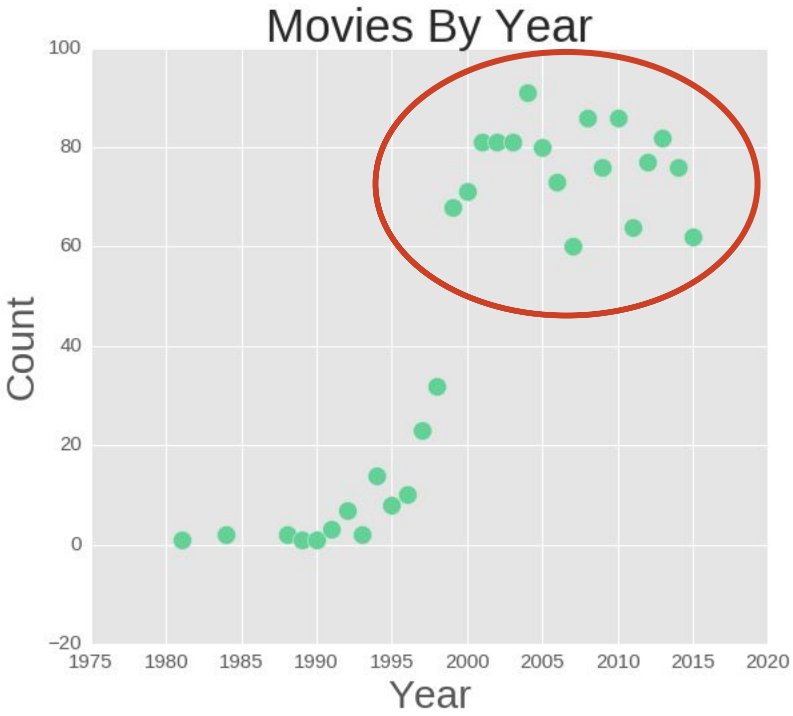


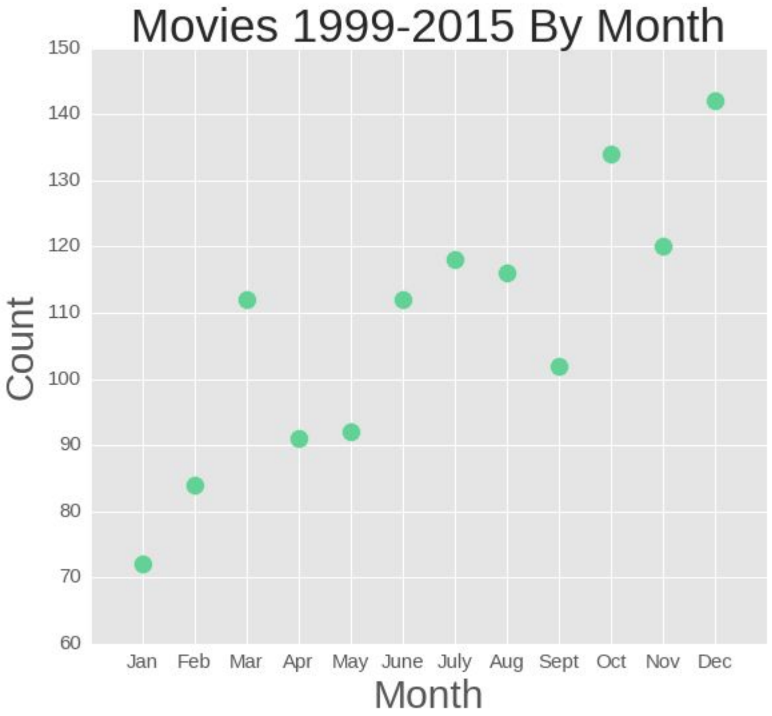
Movies By Year



Movies 1999-2015 By Month

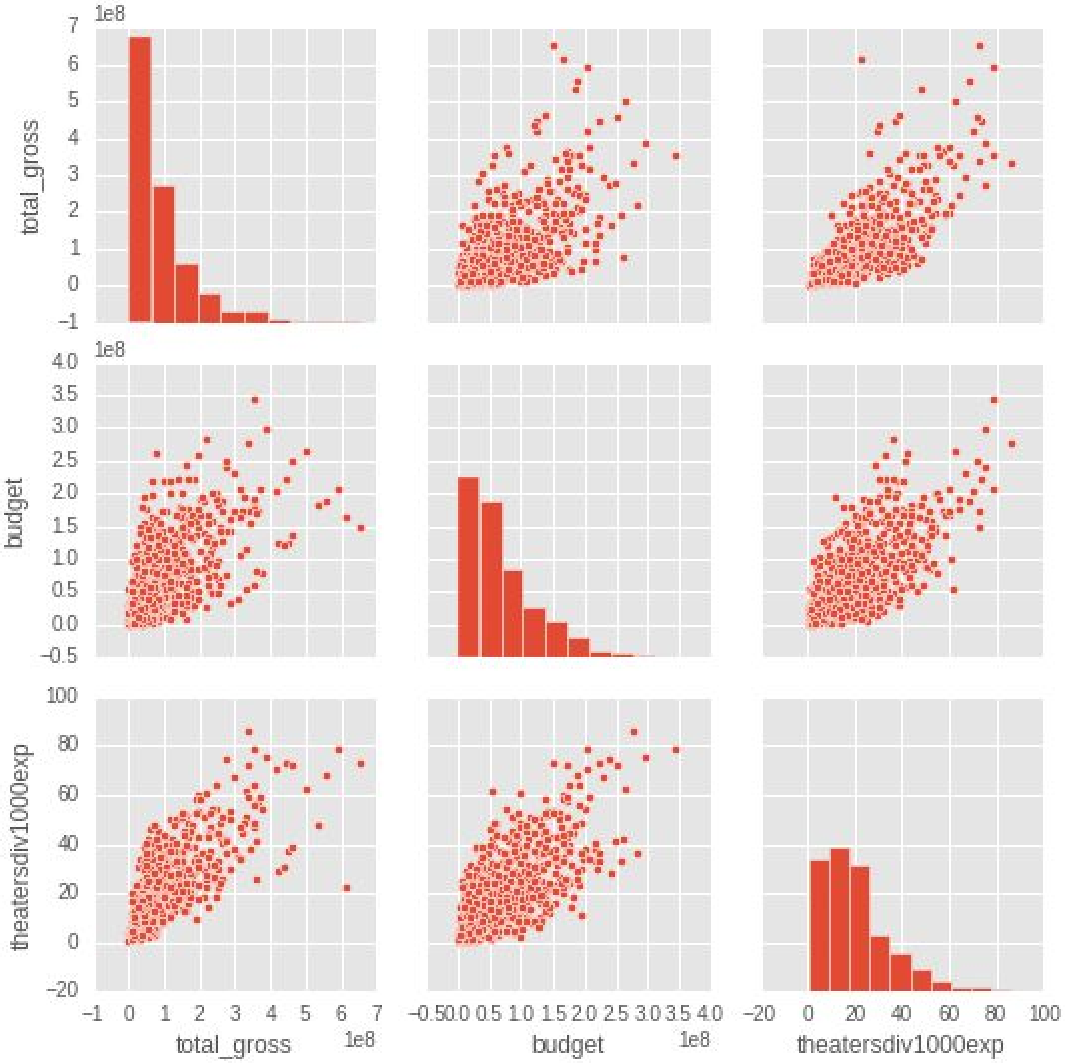
Box Office Mojo -- founded in 1999


Movies By Year


Movies 1999-2015 By Month

Correlations

	Domestic Total Gross	Production Budget
Production Budget	0.63	
Theaters	0.75	0.68



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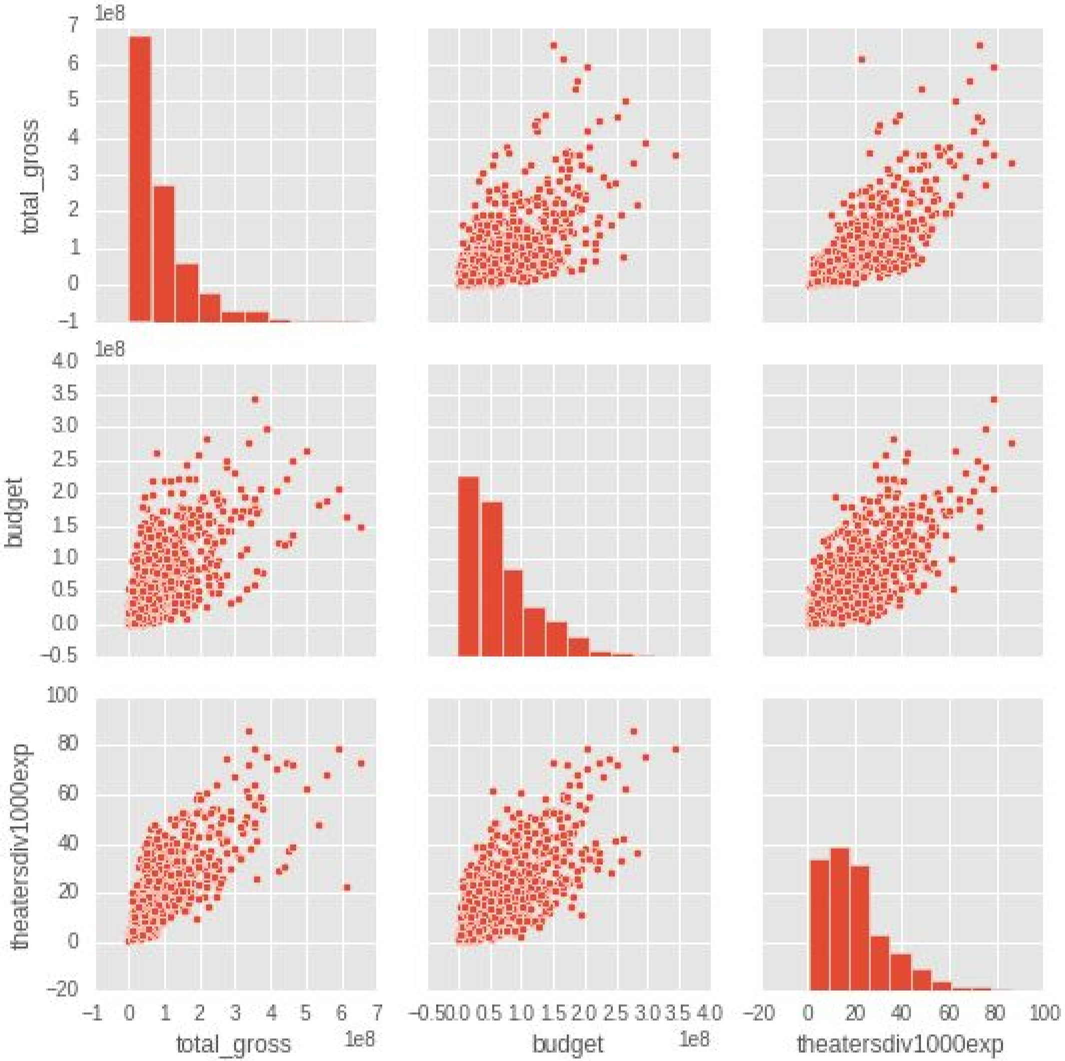

Correlations

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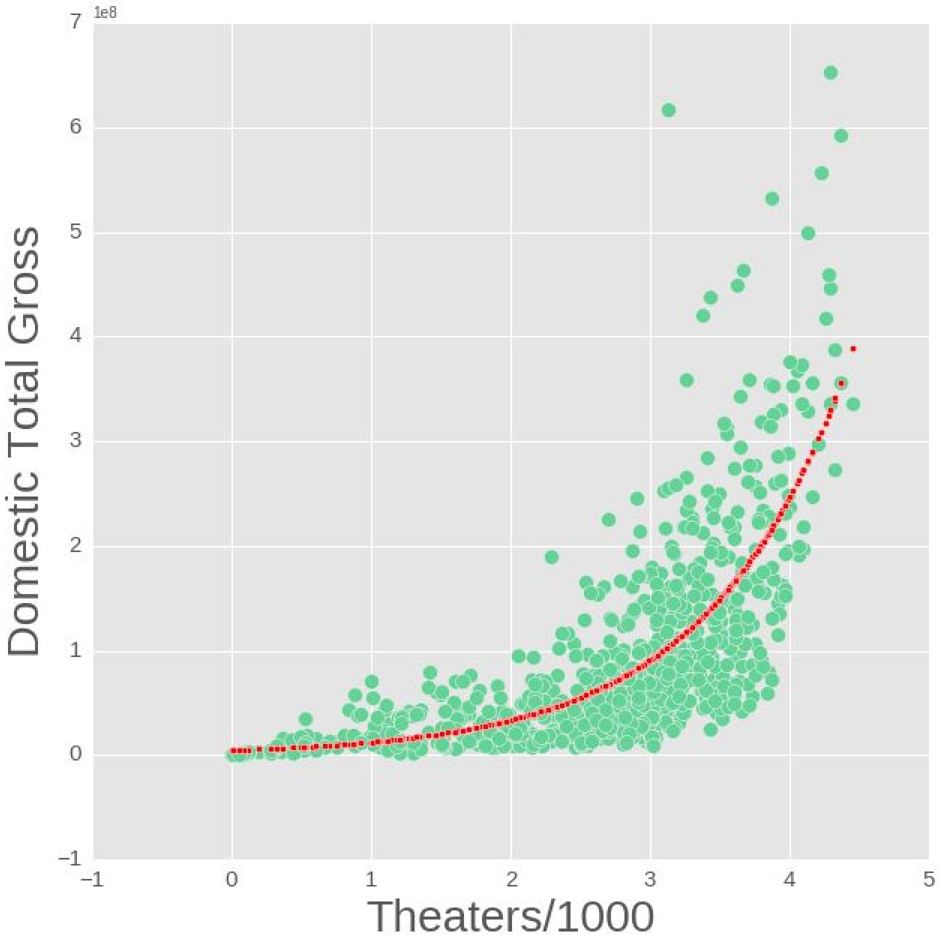
$$\textbf{Total Gross} = 4{,}517{,}793\ \mathbf{e}^{\textbf{Theaters/1000}}$$



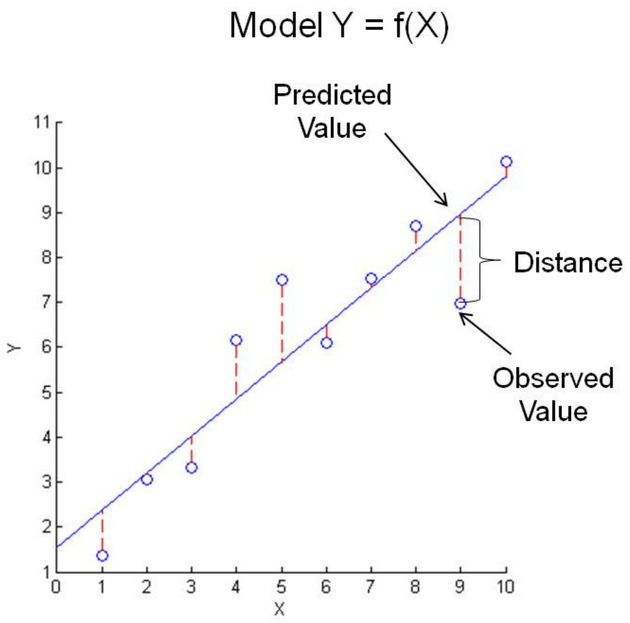
Ordinary Least Squares Models

$$\begin{tikzcd}
 & \mathit{minimize} \sum (y - y')^2 \arrow[dl] \arrow[dr] & \\
\mathbf{b} = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{Y} \arrow[dr] & & \mathbf{b} = \mathbf{C}_{\mathbf{xx}}^{-1}\mathbf{C}_{\mathbf{yx}} \arrow[dl] \\
 & \mathbf{Y}' = \mathbf{bX} &
\end{tikzcd}$$

$$\mathbf{Y} = \mathbf{Y}' + \varepsilon$$

Covariance matrix between Xs and Y

Covariance matrix of Xs



Ordinary Least Squares Models

Domestic Total Gross ~	**Adjusted R^2: training set**	**Adjusted R^2: validation set**	**Durbin-Watson Autocorrelation Test**
Exp(Theaters/1000)	0.77	0.73	1.997

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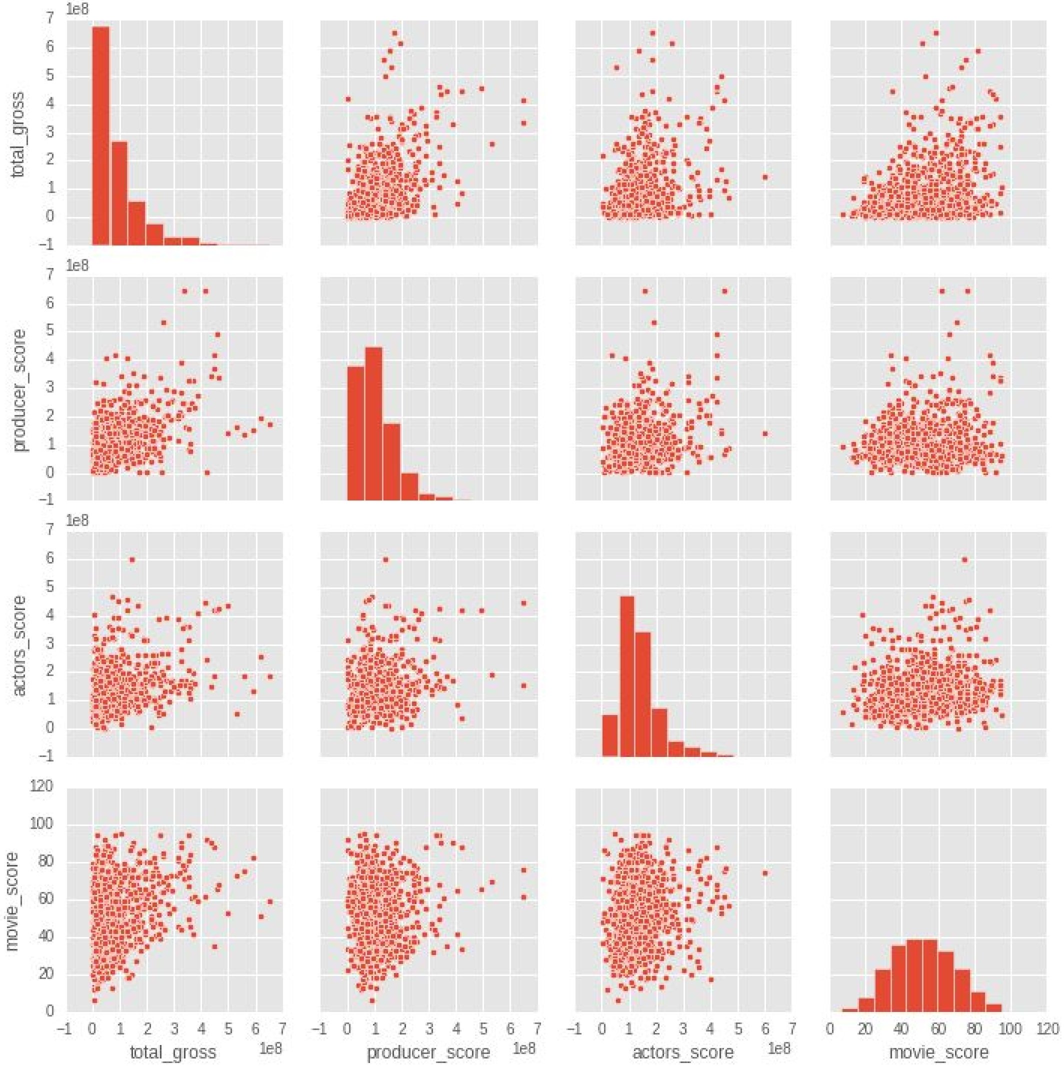
Correlations

	Domestic Total Gross	Producer Score
Producer Score	0.49	
Actors Score	0.34	0.27
Movie Score	0.31	0.13



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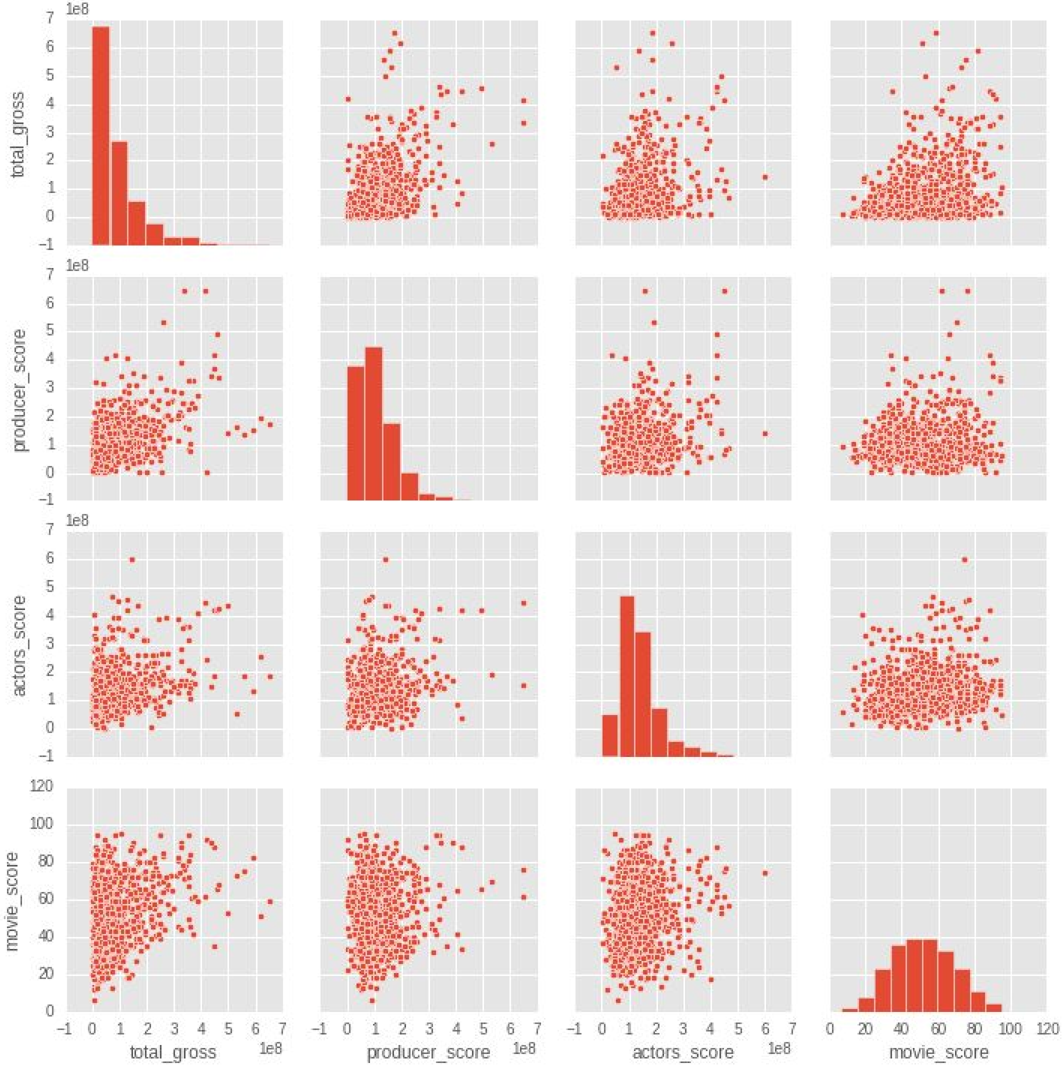

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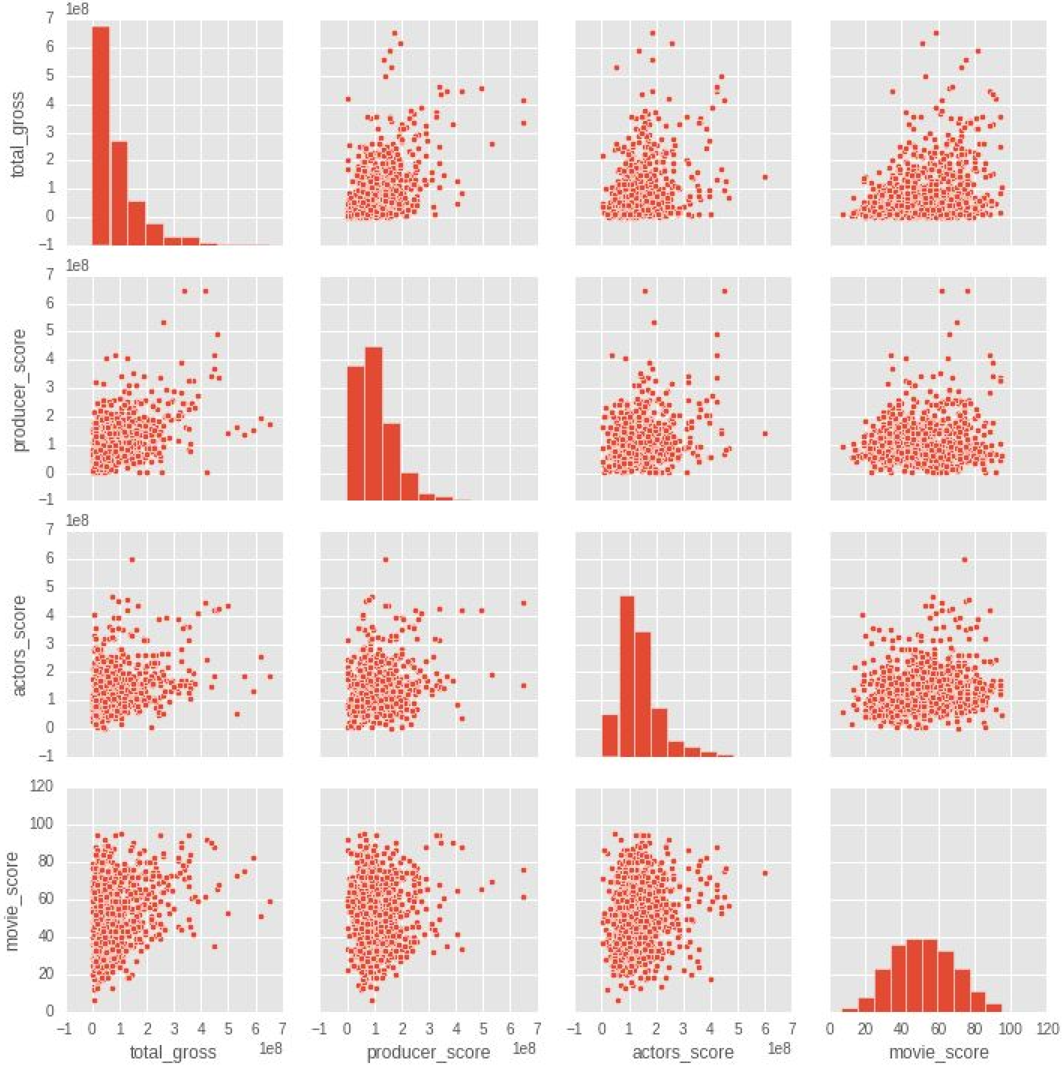

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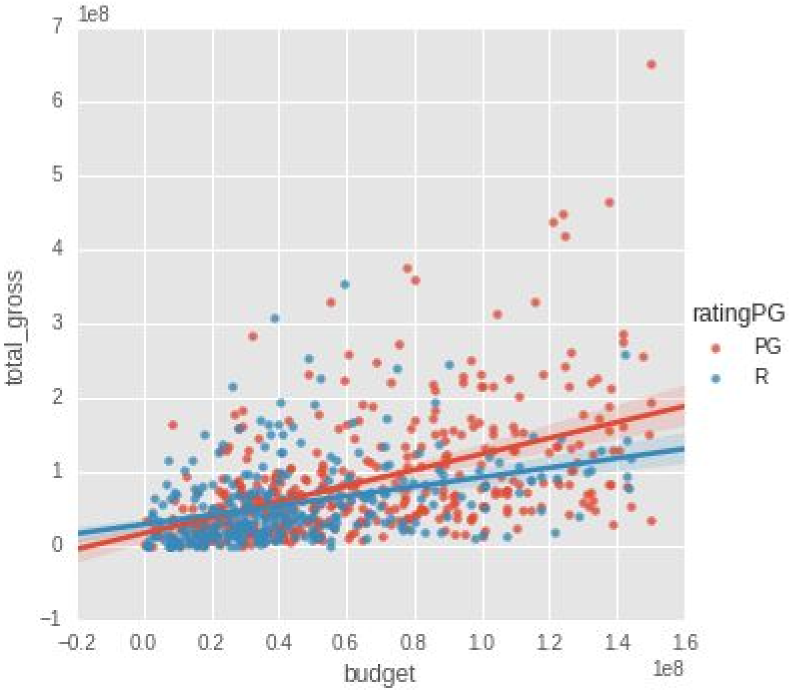
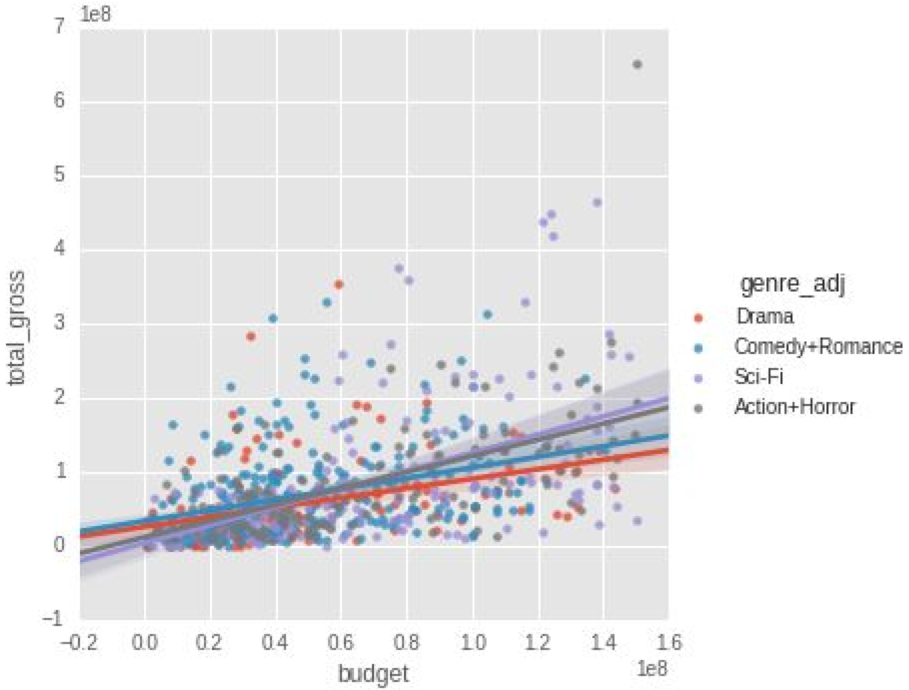
Budget	0.68	0.70	2.004
Budget + Producers	0.71	0.72	2.036
Budget + Producers + Actors	0.71	0.73	2.017

Movie Rating, Genre ?





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Budget + Producers + Actors + Budget*Rating + Budget*Genre	0.72	0.73	1.998

Ordinary Least Squares Models

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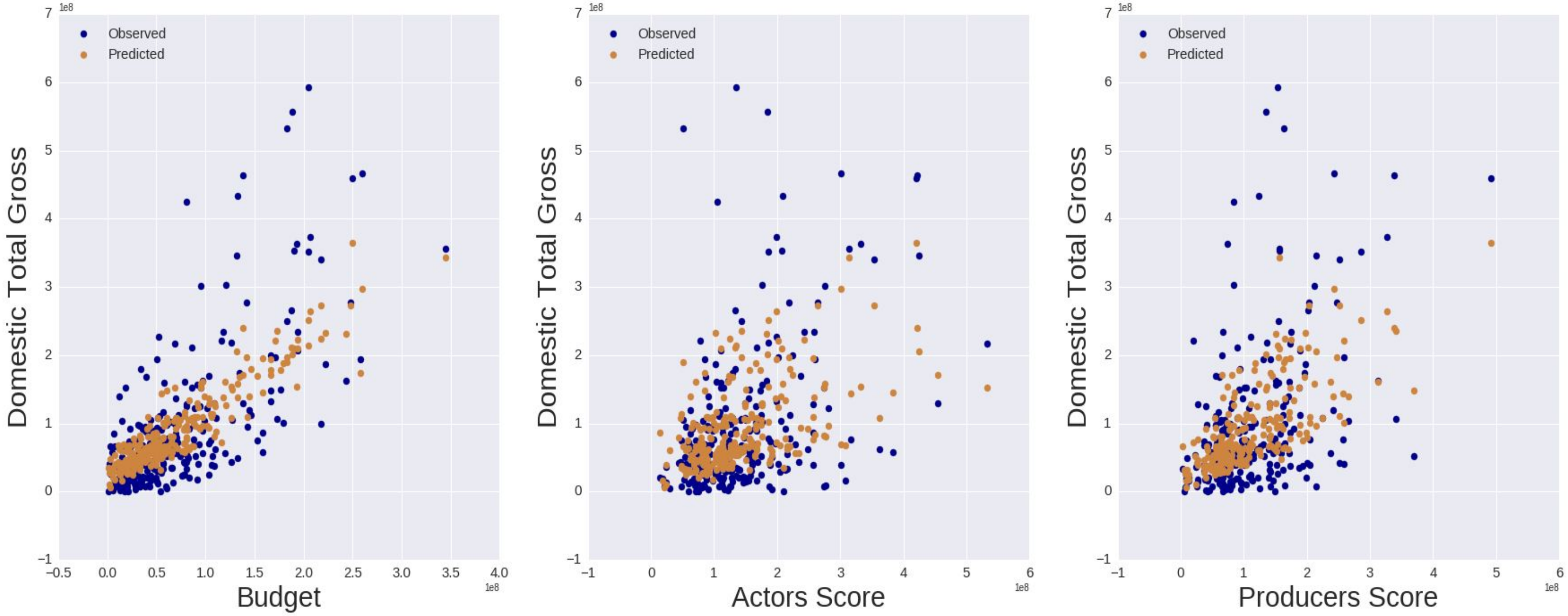
Budget + Producers + Actors	0.71	0.73	2.017
Budget + Producers + Actors + Budget*Rating + Budget*Genre	0.72	0.73	1.998
Movie Score + Runtime + Year + Exp(Theaters)	0.81	0.76	1.998

Ordinary Least Squares - Predictive Model

Domestic Total Gross ~	Adjusted R^2: training set	Adjusted R^2: validation set	Durbin-Watson Autocorrelation Test
Exp(Theaters/1000)	0.77	0.73	1.997
Budget	0.68	0.70	2.004
Budget + Producers	0.71	0.72	2.036
Budget + Producers + Actors	0.71	0.73	2.017
Budget + Producers + Actors + Budget*Rating + Budget*Genre	0.72	0.73	1.998
Movie Score + Runtime + Year + Exp(Theaters)	0.81	0.76	1.998

Predictions

$R^2 = 0.78$

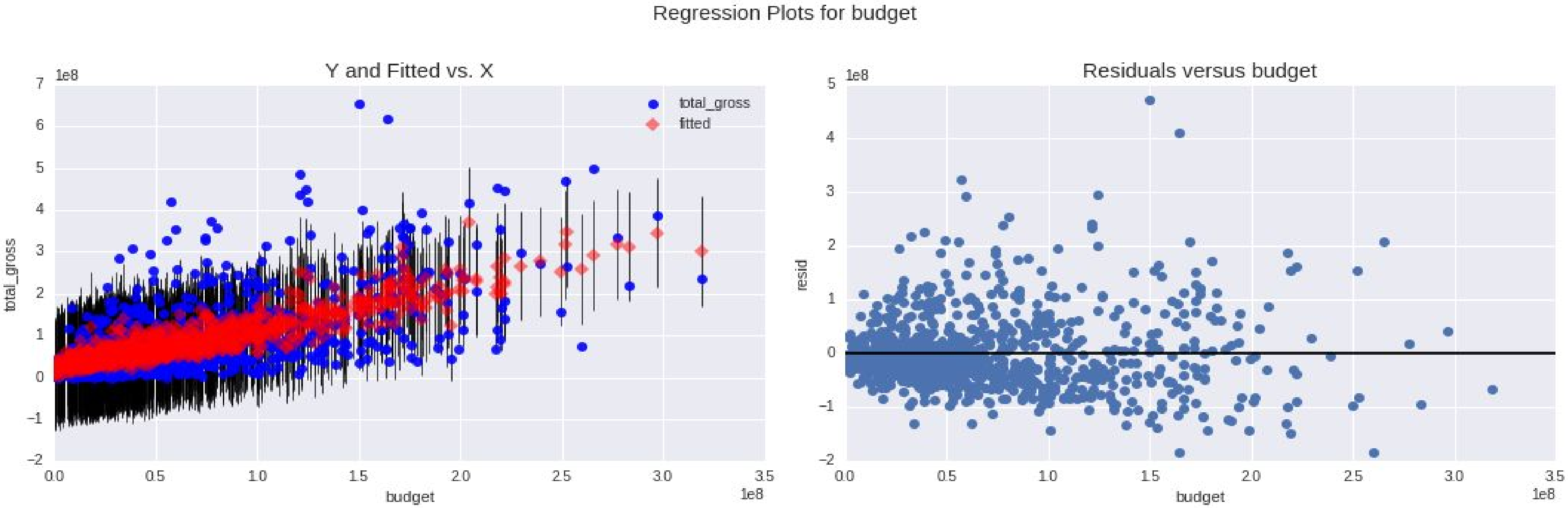


Model Coefficients

B_{budget} = 0.85 with 95%CI [0.76,0.94] “width” 0.18

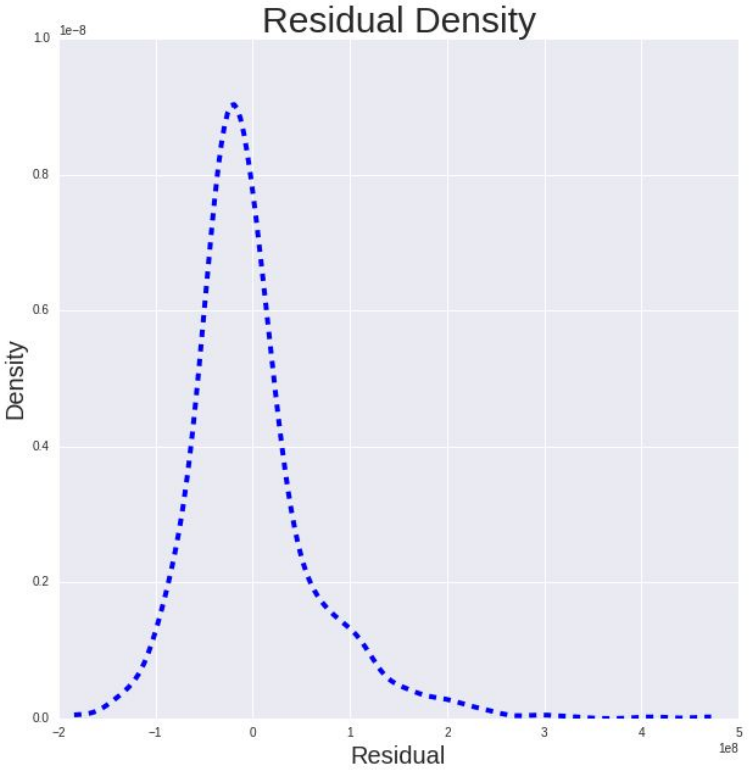
B_{actors} = 0.11 with 95%CI [0.06,0.16] “width” 0.10

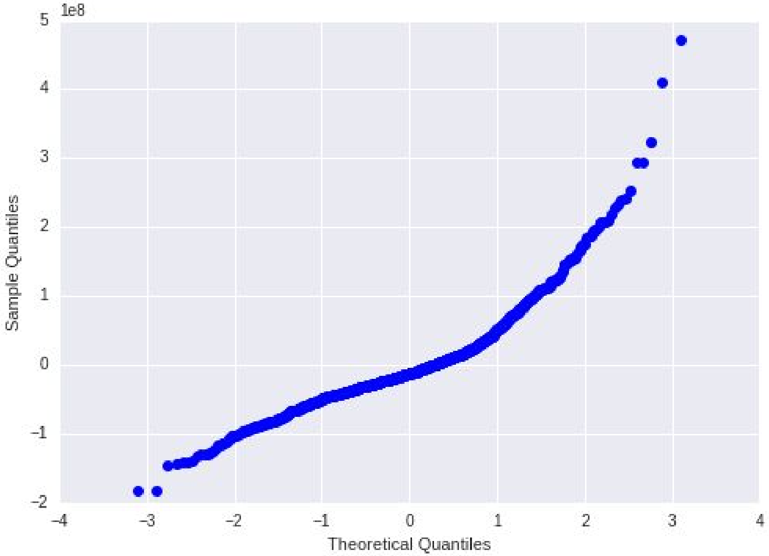
$B_{producer}$ = 0.22 with 95%CI [0.16,0.28] “width” 0.12



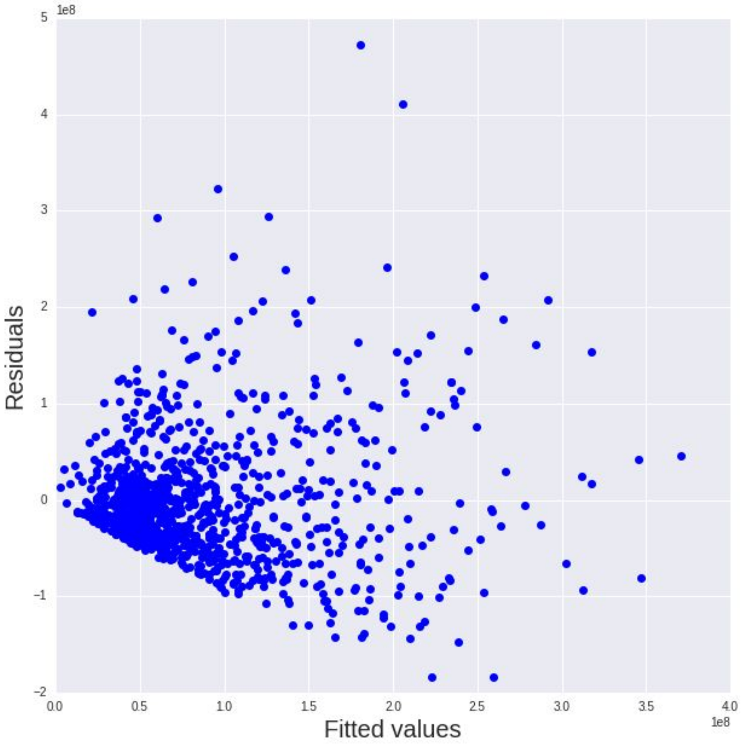
Movie Title	Domestic Total Gross	Budget	Release Date	Movie Score
Jurassic World	6.522706e+08	150000000.0	2015-06-12	59
Star Wars: Episode I - The Phantom Menace	6.164563e+08	164450000.0	1999-05-19	51
The Dark Knight	5.920133e+08	205350000.0	2008-07-18	82
Shrek 2	5.559451e+08	189000000.0	2004-05-19	75
Spider-Man	5.328924e+08	183480000.0	2002-05-03	73
Pirates of the Caribbean: Dead Man's Chest	4.995127e+08	265500000.0	2006-07-07	53

Assumptions: Normal distribution of errors





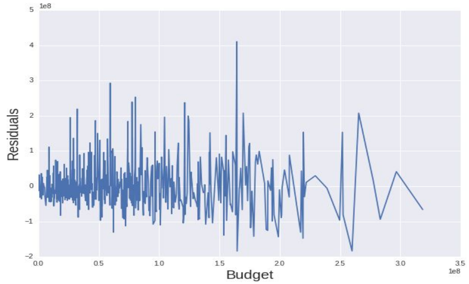
Assumptions: Homoskedasticity

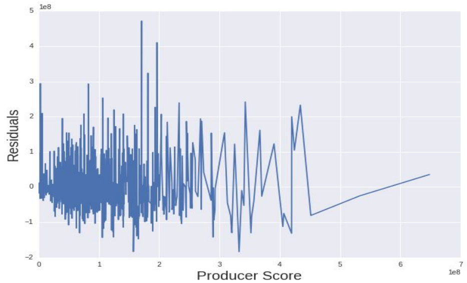


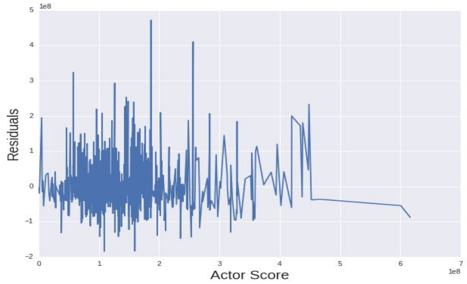
White Test:

OLS(Errors ~ X)

R^2=0



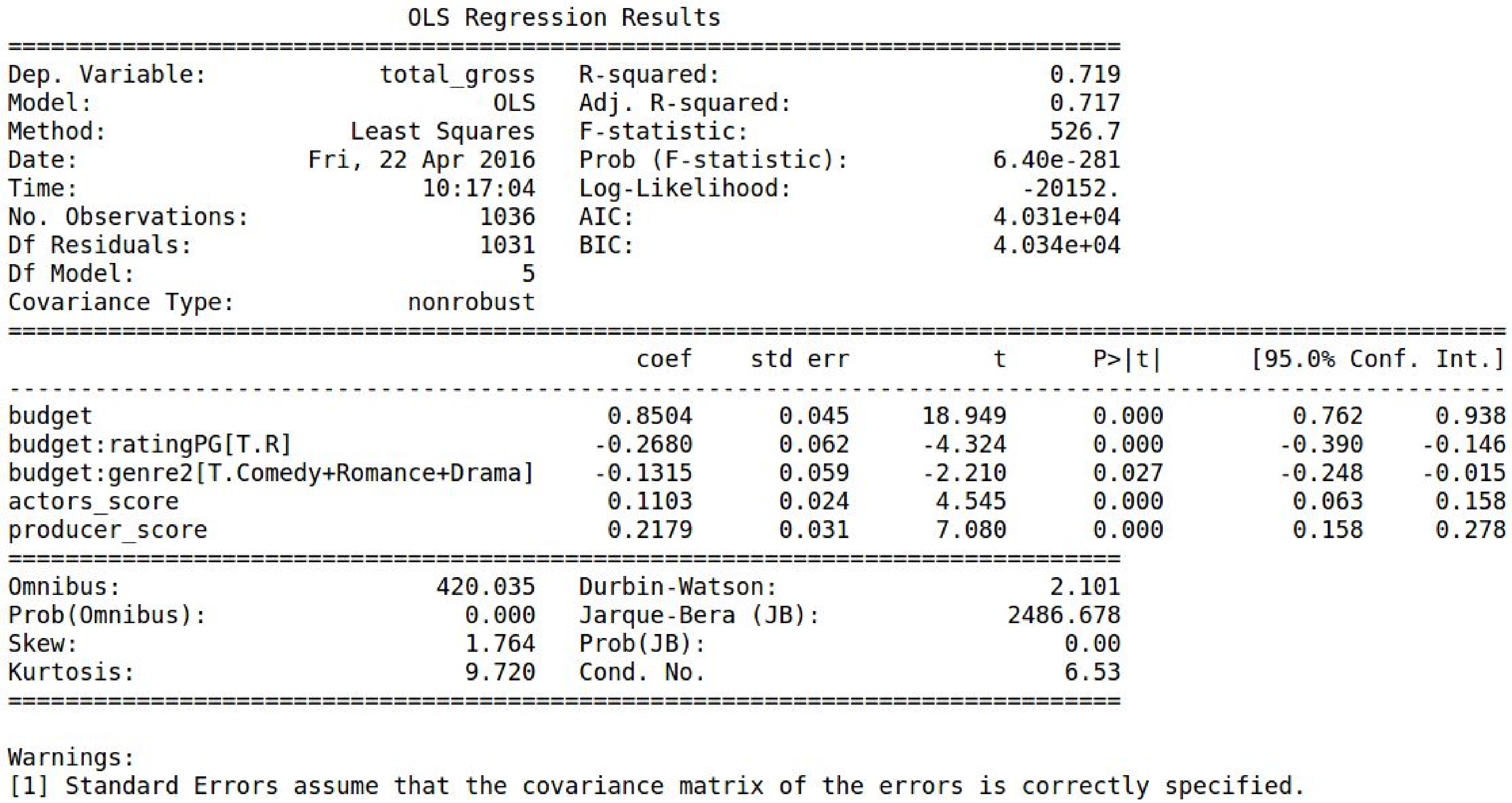




Model: BLUE

- Linear in parameters
- No exact multicollinearity
- Fixed covariates (X’s)
- Number of observations (1036) > Number of parameters (4)
- Mean residual error: nonzero, negative = systematically underestimating values (by -1,193,706)
- Homoskedasticity, Var(error$_i$) = const
- No autocorrelation, Cov(error$_i$, error$_j$) = 0, Durbin-Watson test close to 2

Thank you !



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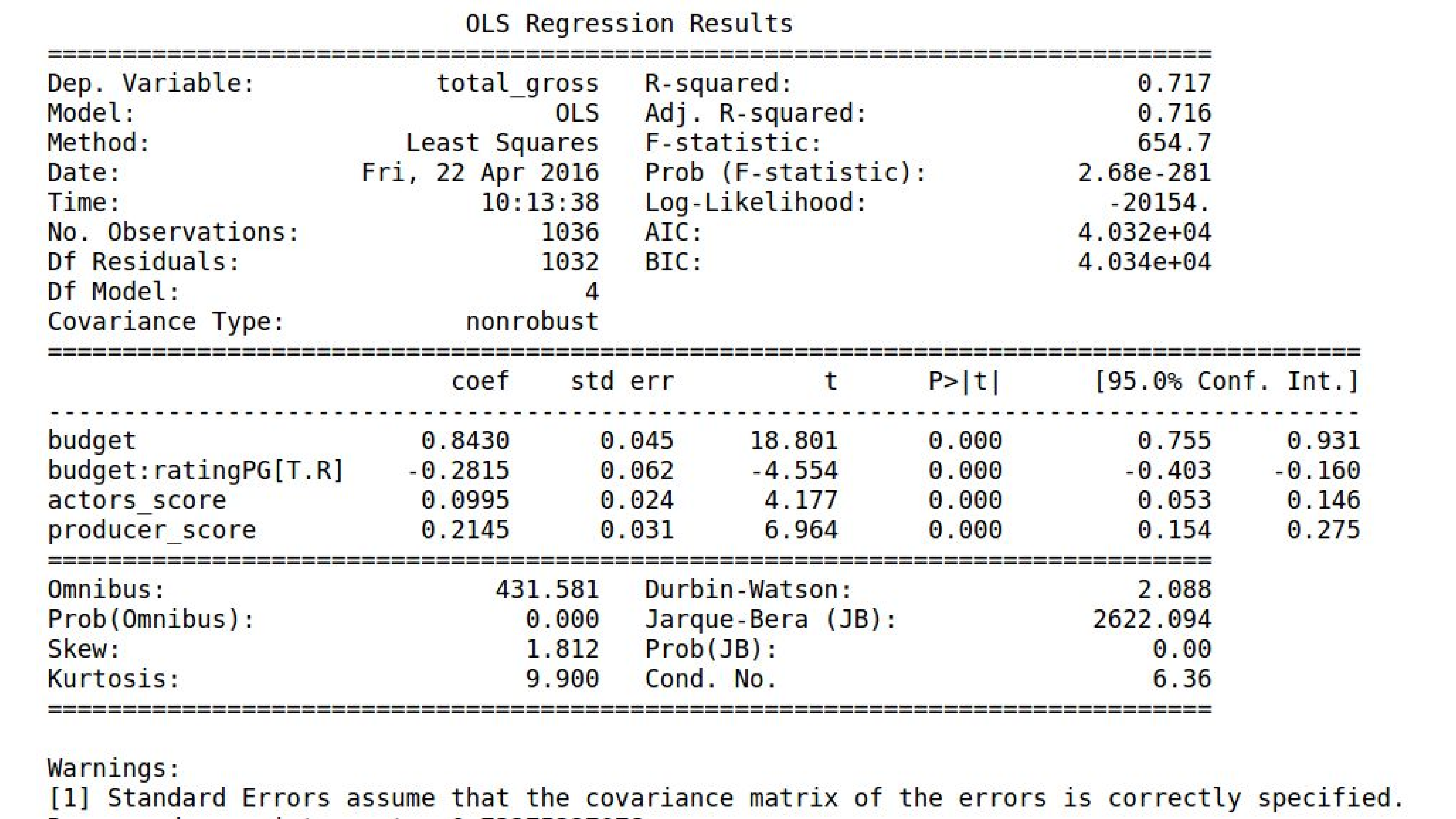
                            OLS Regression Results
==============================================================================
Dep. Variable:            total_gross   R-squared:                       0.719
Model:                            OLS   Adj. R-squared:                  0.717
Method:                 Least Squares   F-statistic:                     526.7
Date:                Fri, 22 Apr 2016   Prob (F-statistic):          6.40e-281
Time:                        10:17:04   Log-Likelihood:                -20152.
No. Observations:                1036   AIC:                         4.031e+04
Df Residuals:                    1031   BIC:                         4.034e+04
Df Model:                           5
Covariance Type:            nonrobust
=========================================================================================================
                                           coef    std err          t      P>|t|      [95.0% Conf. Int.]
---------------------------------------------------------------------------------------------------------
budget                                   0.8504      0.045     18.949      0.000         0.762     0.938
budget:ratingPG[T.R]                    -0.2680      0.062     -4.324      0.000        -0.390    -0.146
budget:genre2[T.Comedy+Romance+Drama]   -0.1315      0.059     -2.210      0.027        -0.248    -0.015
actors_score                             0.1103      0.024      4.545      0.000         0.063     0.158
producer_score                           0.2179      0.031      7.080      0.000         0.158     0.278
==============================================================================
Omnibus:                      420.035   Durbin-Watson:                   2.101
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             2486.678
Skew:                           1.764   Prob(JB):                         0.00
Kurtosis:                       9.720   Cond. No.                         6.53
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```



```
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Dep. Variable:            total_gross   R-squared:                       0.717
Model:                            OLS   Adj. R-squared:                  0.716
Method:                 Least Squares   F-statistic:                     654.7
Date:                Fri, 22 Apr 2016   Prob (F-statistic):         2.68e-281
Time:                        10:13:38   Log-Likelihood:                -20154.
No. Observations:                1036   AIC:                         4.032e+04
Df Residuals:                    1032   BIC:                         4.034e+04
Df Model:                           4
Covariance Type:            nonrobust
========================================================================================
                           coef    std err          t      P>|t|      [95.0% Conf. Int.]
----------------------------------------------------------------------------------------
budget                   0.8430      0.045     18.801      0.000         0.755     0.931
budget:ratingPG[T.R]    -0.2815      0.062     -4.554      0.000        -0.403    -0.160
actors_score             0.0995      0.024      4.177      0.000         0.053     0.146
producer_score           0.2145      0.031      6.964      0.000         0.154     0.275
==============================================================================
Omnibus:                      431.581   Durbin-Watson:                   2.088
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             2622.094
Skew:                           1.812   Prob(JB):                         0.00
Kurtosis:                       9.900   Cond. No.                         6.36
==============================================================================

Warnings:
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```