



Understanding the linkage between Gender Diversity and Hollywood Box Office Outcomes

Mallory Banks, METIS: Regression Analysis
Project 2

Introduction: A Study of Gender Diversity in Hollywood

Problem Statement and Objectives:

- The question around this analysis is understanding the link between diversity of movie casts and production to the overall financial outcome for the movie.
- Hypothetically, the client could be the movie industry in at least the United States. In my mind, this analysis is commissioned by “The Academy” from my boutique analytics firm as a reactionary action to the “Oscars So White” controversy of 2015. This analysis would have been done in 2020 , but with the Covid 19 Pandemic, it was pushed to 2022 and will help to illuminate trends around diversity (in front of and behind) and how it impacts movie success as well as other important features and factors of film. Because of the lack of Racial and Ethnic Data cataloged in the film industry, we’d begin with Gender Diversity with intent to build further I Imagine that this presentation would serve as a “Check In” With Data Team for recommendations on Next Steps





Methodology

Collection: Data from Top 200 Highest Grossing Movies Scraped from boxofficemojo from 2009 to 2018. This was then joined to a dataset I sourced from another GitHub user documenting actor, producer, writer, and director diversity for these films. Data was then wrangled and cleaned.

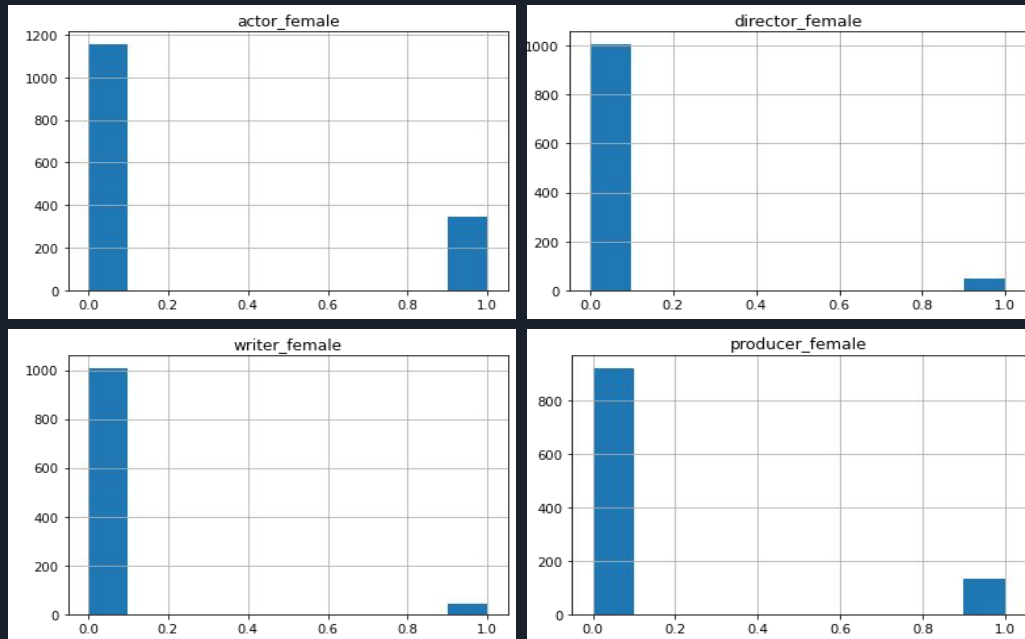
Initial Regression: Through OLS (ordinary least squares) regression identify the fundamental drivers (Budget, Release Size, Opening, Producer Gender etc.) of box office outcomes.

Refined Regression: Validated Linear Model and Cross Validated to confirm efficacy of Model

Pinpoint Areas of Focus: the Goal here is not necessarily to predict Box Office Outcomes, but to Understand which, if any, variables relating to gender are influential in Box Office Outcomes for Hollywood Films

The Distribution of Gender Diversity in Films Released from 2009-2018 is limited in front of the Camera and Behind

When Looking at the Top-Billed Lead Actors, Lead Producers, Main Writers, and Directors We See a High Skew for Male Gender Identity in All of These Roles



Available Features for Prediction for Domestic Gross

(* connotes initial influence on Predicting box office success)

Variable	Description
Theater_Num*	Number of Theaters Movies Was Released to
Inter_Gr*	International Gross
Length*	The Length of Time the Movie Remained in Theaters
Open_Num*	The Opening Gross of the Film
Budget*	The Budget of the Film
runtime*	The length of Film Time
director_female	Binary Dummy Variable based on Director Gender Info
actor_female*	Binary Dummy Variable based on Actor Gender Info
producer_female*	Binary Dummy Variable based on Producer Gender Info
writer_female	Binary Dummy Variable based on Writer Gender Info

OLS Regression Refined

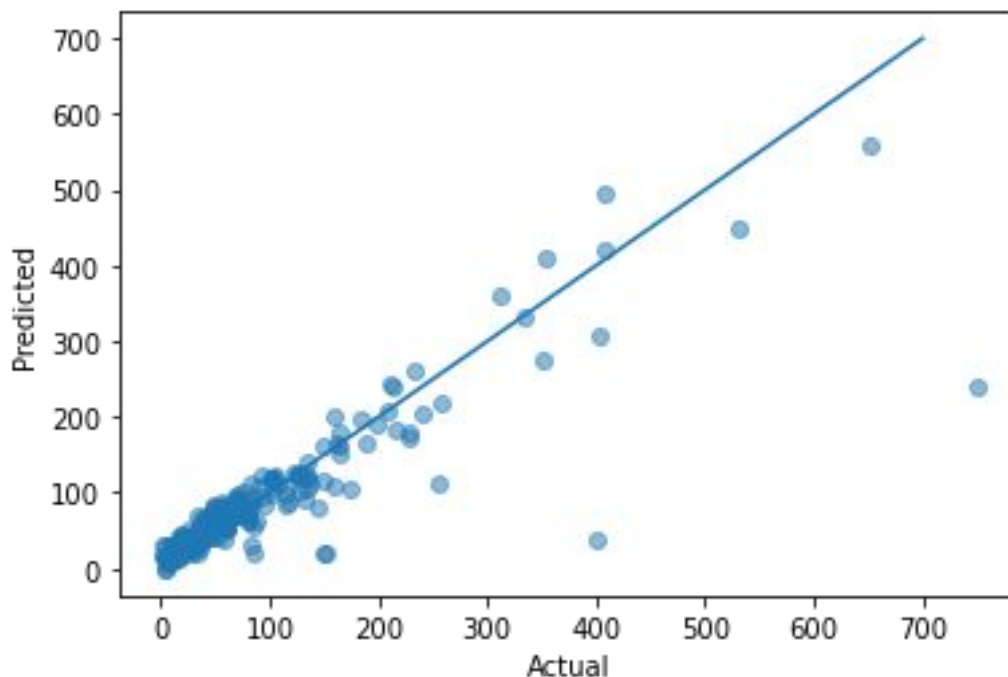
	coef	std err	t	P> t	[0.025	0.975]
Intercept	-1.9472	2.660	-0.732	0.464	-7.166	3.272
Inter_Gr	0.2145	0.010	20.536	0.000	0.194	0.235
Length	0.4034	0.057	7.048	0.000	0.291	0.516
Open_Num	0.0002	5.78e-06	32.761	0.000	0.000	0.000
Budget	-0.0960	0.027	-3.532	0.000	-0.149	-0.043
producer_female	8.6860	2.950	2.944	0.003	2.897	14.475

Omnibus:	565.471	Durbin-Watson:	1.748
Prob(Omnibus):	0.000	Jarque-Bera (JB):	11257.481
Skew:	2.018	Prob(JB):	0.00
Kurtosis:	18.501	Cond. No.	1.11e+06

R-squared:	0.868
Adj. R-squared:	0.867
F-statistic:	1372.
Prob (F-statistic):	0.00
Log-Likelihood:	-5127.4
AIC:	1.027e+04
BIC:	1.030e+04

Predicted vs. Actual Domestic Revenue

Predicted vs Actual Domestic Gross Revenue for American Made Movies 2009-2018(Millions)





Conclusions

Conclusions

- When Looking at Impactful Predictive Levers for Box Office Success (Domestically) for Movies released 2009-2018, we were able to see movies where women were the **Top Billed Producer** contributing significantly to the success of the Film from a Domestic Box Office Perspective
- However, the overall presence of Gender Diversity (Including Executive producers) is woefully small. Smaller still are those women leading Director and Writer's Rooms.

Recommendations

- Creation of Task force to understand how to increase Women in Leading Roles in front of and behind the camera. This is not just a "Good Will" experiment but also one that has the potential to influence the Film Industry Bottom Line. With folks slower to get to the theater and the popularity of streaming, focusing on Diversity in production can be a way to encourage movie going experiences
- Additionally, data rigor around accounting for and recording this data should be a priority as we continue to focus on multiple dimensions of diversity



Future Work

- This work would be further fleshed out and improved with the inclusion of Racial and Ethnic Diversity as well as LGBTQ+ representation.
- This data is not well documented or available to the public, once data efficacy issues are address the more robust model may be created to understand the effect of multiple dimensions of diversity on Box Office Success (Ex: What would it look like to re-view drivers as a function of Intersectional Identity?)
- Additionally Random Forest may work well for this- Especially if we designate “Block Buster” vs “Indie” Movies Revenues
 - How often are Women Leading in front of or Behind the Camera depending on Movie Type
- Is there any data on movie goer gender?
 - How might we understand Genre as a function of Movie Goer attendance? Are Female Movie goers more or less likely to see a Sci/Fi or Action film as other gender identities for example?



Questions?

Appendix



VIF From First OLS - Further Variable Isolation

Problematic

	feature	VIF
0	Theater_Num	13.854880
1	Inter_Gr	4.643573
2	Length	5.760708
3	Open_Num	5.099832
4	Budget	5.646426
5	runtime	12.601932
6	director_female	1.177477
7	writer_female	1.184299
8	producer_female	1.178359
9	actor_female	1.388489


Much Better after dropping
Several Interacting Variables -
Minimal Regression Problem

	feature	VIF
0	Length	2.206347
1	Budget	3.785082
2	actor_female	1.262689
3	producer_female	1.162903
4	Open_Num	3.162333

OLS Regression 2

Dep. Variable:	Domestic_Gr	R-squared:	0.815
Model:	OLS	Adj. R-squared:	0.814
Method:	Least Squares	F-statistic:	922.9
Date:	Wed, 23 Feb 2022	Prob (F-statistic):	0.00
Time:	16:04:29	Log-Likelihood:	-5303.4
No. Observations:	1053	AIC:	1.062e+04
Df Residuals:	1047	BIC:	1.065e+04
Df Model:	5		
Covariance Type:	nonrobust		

	coef	std err	t	P> t	[0.025	0.975]
Intercept	-13.9426	3.189	-4.372	0.000	-20.200	-7.685
Length	0.5041	0.067	7.478	0.000	0.372	0.636
Open_Num	0.0003	5.65e-06	45.327	0.000	0.000	0.000
Budget	0.1673	0.029	5.726	0.000	0.110	0.225
actor_female	5.9338	2.853	2.080	0.038	0.336	11.532
producer_female	7.4180	3.509	2.114	0.035	0.533	14.303
Omnibus:	1118.464	Durbin-Watson:	1.809			
Prob(Omnibus):	0.000	Jarque-Bera (JB):	105854.328			
Skew:	4.925	Prob(JB):	0.00			
Kurtosis:	51.121	Cond. No.	1.12e+06			



Simple Cross Validation for Linear Regression With Target Variables

Initial Linear Regression Model severely overfit using r^2 metric

R^2 Train ->

0.8362516820751223

R^2 Test ->

0.759985840473083

After Removing “actor_female” as interacting Variable and Re-Testing
Other Gross Metrics New Linear Model Emerged with “Inter_Gr” Added

R^2 Train ->

0.8624789434939415

R^2 Test ->

0.8718353997907384

Heteroskedasticity Problems - Plotted Residuals not Eased by log, square transformations

