

Predictive Power of the NFL Combine

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Motivation and Background



Motivation

- **NFL Combine results have been disputed for years**
- **Current studies find little to no predictive power**
 - From Yuva Chandana at *The Sideline Catch*, “Combine results lack any prediction power for neither draft order nor NFL performance. Raw athleticism may not be as important as people make it to be at the professional level.”
- **Has been used since 1982 with very little changes**
 - Allows for consistent, unique data
- **Very popular among fans**
- **Fantasy football observations**
 - Inconsistent scouting makes fantasy football hard to predict
- **But...does the combine work?**



Our Referenced Literature:

Does the NFL Combine matter?

Predictive Power of NFL Combine



02

Data Collection

Data Wrangling

- NFL Combine data from Kaggle (2014-2018) - Running backs and wide receivers
- NFL Data on the following statistics from Pro Football Reference:
 - Height
 - Weight
 - Yards from Scrimmage (YScm) in first 3 NFL seasons
 - Yards from Scrimmage (YScm) for career
- Merged combine data into one larger dataset
 - 188 total observations with full combine data



03

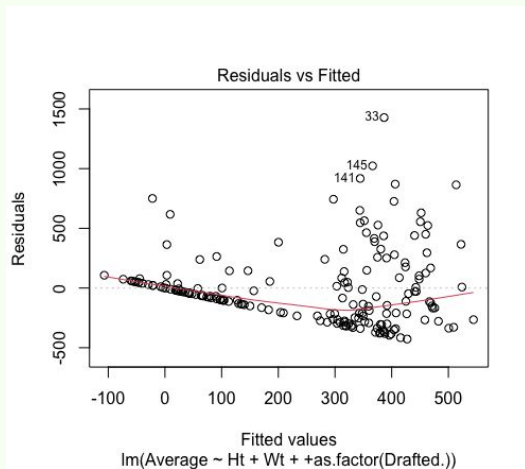
EDA and MLR

Multiple Linear Regression Analysis – Average Yards

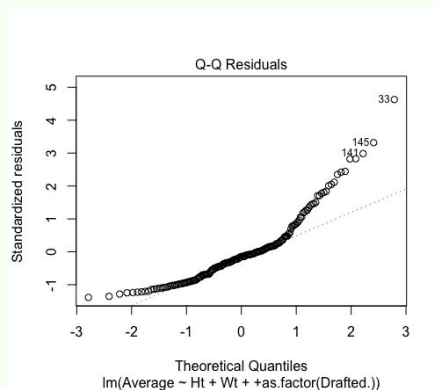
- Exploratory Data Analysis
 - Significant correlations: Avg~Drafted (0.4549)
- Started with full model (Adjusted R-squared: 0.2167)
 - Significant variables (used T-value and P-value): Weight, drafted
 - 40yd dash coefficient was very negative
- Model selection process
 - Backwards elimination (step() function in STATs package)
 - Height, weight, drafted → Adjusted R-squared: 0.2312
 - Best subsets
 - Height, weight, drafted → Adjusted R-squared: 0.2312, CP (estimates size of the bias) = 0.587

Chosen model: (average yards ~ height + weight + drafted)

Model Conditions



- Resids versus fits - Problems with zero mean and constant variance (uneven scatter)
- QQ plot - Deviation from normality (from normal curve)
- No concerning VIFs - Lack of multicollinearity



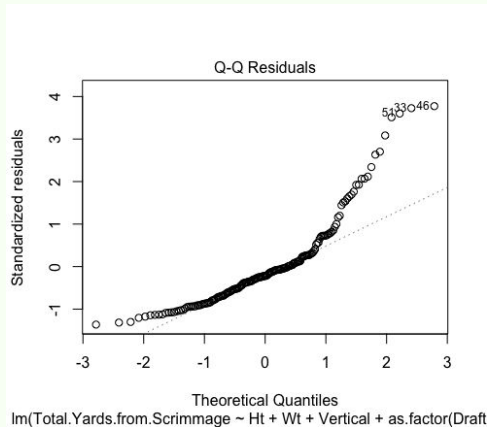
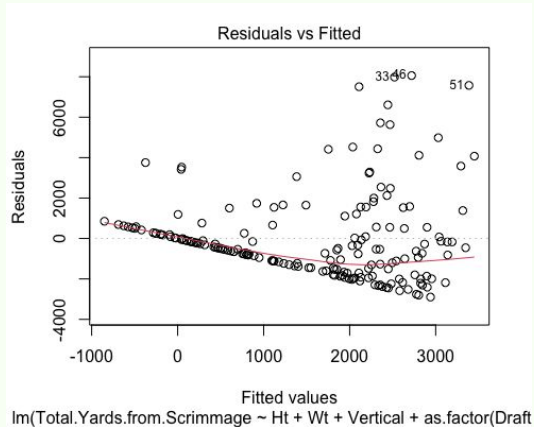
Variable	VIF
Ht	1.4062
Wt	1.4081
Drafted	1.0132

Multiple Linear Regression Analysis – Total Career Yards

- Started with full model (Adjusted R-squared: 0.1784)
 - Significant variables (used T-value and P-value): Weight, drafted
 - Height and 40yd dash coefficients were negative, 40yd very negative
- Model selection process
 - Backwards elimination (step() function in STATs package)
 - Height, weight, 40yd, vertical jump, drafted → Adjusted R-squared: 0.1963
 - Best subsets
 - Height, weight, vertical jump, drafted → Adjusted R-squared: 0.196, CP = 1.12

Chosen model: (total yards ~ height + weight + vertical jump + drafted)

Model Conditions



- Resids versus fits - Problems with zero mean and constant variance (uneven scatter)
- QQ plot - Deviation from normality (from normal curve)
- No concerning VIFs - Lack of multicollinearity
- Conditions violated similarly (if not slightly worse) than the average yards model

Variable	VIF
Ht	1.3940
Wt	1.3986
Vertical	1.1511
Drafted	1.1629

Regression Conclusions

- Conditions not met well for either model - Model may not provide accurate insights
 - Zero mean, constant variance, normality
- No combine metrics were significant at the 10% level (only height, weight, and drafted)
- VIFs show no concerns with multicollinearity
- No large difference between the two models - Need more metrics (maybe college statistics)
 - Could first three years be predictive of a whole career?
- Confirms previous findings on lack of predictability of combine data on NFL performance
- Possibility of Omitted Variable Bias (not including college data, team performance data)

Ridge Regression

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A solution to overfitting and mitigating
OVB

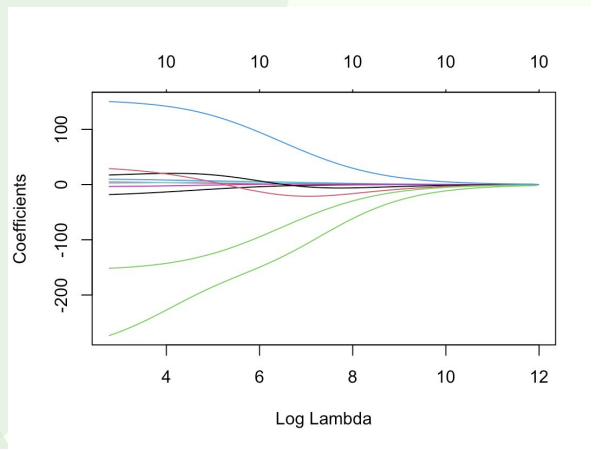
modified HKB estimator is 17.74862
modified L-W estimator is 21.53603
smallest value of GCV at 0

Why Ridge Regression?

- High Hoerl-Kennard-Baldwin (HKB) and Lawless-Wang (L-W) estimators
 - HKB was ~17, LW was ~21
- Suggests a significant need for regularization
- Indicate high levels of multicollinearity
- Data is likely suffering from overfitting

Ridge regression (Hoerl and Kennard 1970) controls the estimated coefficients by adding $\lambda \sum_{j=1}^p \beta_j^2$ to the objective function.

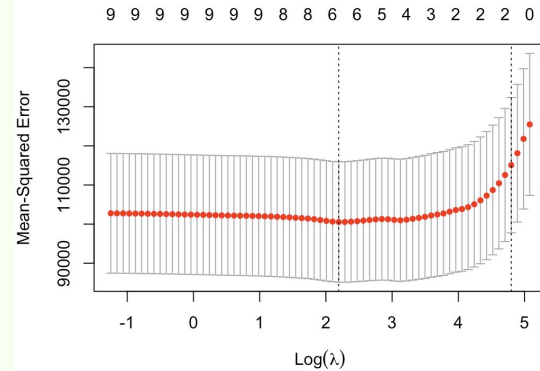
$$\text{minimize } \left(SSE + \lambda \sum_{j=1}^p \beta_j^2 \right) \quad (6.3)$$



Ridge Regression using `glmnet()` as illustrated in Chapter 6 of the textbook

`cv.glmnet()`, which automatically performs k-fold cross validation to assist with generalizability and get our optimal λ of 8.97

Use that to find our coefficients



	<code>s0</code>
(Intercept)	1721.139676
Ht	-19.413557
Wt	4.985735
X40yd	-286.872085
Vertical	10.059167
Bench	1.909024
Broad.Jump	-3.756456
X3Cone	16.029154
Shuttle	31.134345
as.factor(Drafted.)0	-156.643891
as.factor(Drafted.)1	148.681142

$R^2 = 0.254$

Conclusions and Future Work

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Conclusions

- **Combine data is a poor predictor of NFL success**
 - No significant relationships between any combine drill and average YScm
- **Ridge regression improved R2 slightly**
 - Not enough to say that our model is complete
 - Clearly still high chance of OVB
- **Ridge regression appears to have been appropriate**
 - Reduced our degree of overfitting
 - HKB and LW decreased by 8-10 each
- **Still a possibility of OVB**
- **Our hypothesis of a lack of predictive power is confirmed**

Potential Future Applications/Ideas

- **Use a larger data set to confirm results**
 - Use more years of combine data (many combine participants do not have long careers)
- **Apply prediction test to individual teams**
 - Are certain teams better than others at drafting/scouting?
 - 49ers don't use as much combine data
 - Rams have had recent 5th round success
 - What do the teams better at drafting/scouting have in common?
- **Use college in-game performance data**
 - Likely best predictor of NFL success
 - Also one of the most used scouting tools by NFL teams
 - Could use it to predict initial success and career success
- **Apply more ML/Statistical methods**
 - Principal Component Analysis (PCA) - Popular dimensionality reduction technique
- **Apply Nonparametric analyses**

References

- <https://thesidelinecatch.com/2023/03/05/does-the-nfl-combine-matter/#:~:text=The%20study%20stated%20that%2C%20%E2%80%9Cit,be%20at%20the%20p,rofessional%20level.%E2%80%9D>
- [https://journals.lww.com/nsca-jscr/Fulltext/2016/05000/Predictive Value of National Football League.25.aspx](https://journals.lww.com/nsca-jscr/Fulltext/2016/05000/Predictive_Value_of_National_Football_League.25.aspx)
- <https://www.silverandblackpride.com/2023/3/4/23625519/raiders-nfl-combine-quarterbacks-anthony-richardson-cj-stroud-will-levis>
- <https://bradleyboehmke.github.io/HOML/regularized-regression.html>