

# Data Analytics in Business

## Investing Analytics

**Jonathan Clarke, Ph.D**

*Associate Professor*  
Scheller College of Business

Identifying Factors



## Lesson Objectives

**At the end of this lesson, you should be able to:**

- Describe the factors that drive stock returns:
  - Size
  - Value
  - Momentum
  - Profitability
  - Volatility



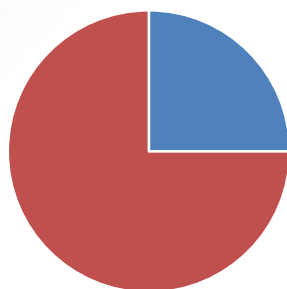
# Which Factors Drive Stock Returns?

- Over the last 50 years, researchers have searched for factors that drive stock returns
- This is difficult work – some factors might appear to work because of [random chance](#) or [data mining](#)
- A handful of factors have stood the test of time. Understanding these factors can make you a better investor



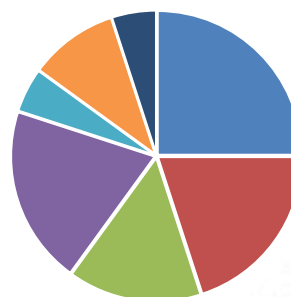
## Our View is Constantly Evolving

View in the 1970s and 1980s



■ Market ■ Firm specific

View today



■ Market ■ Firm specific ■ Value ■ Momentum ■ Size ■ Quality ■ Volatility



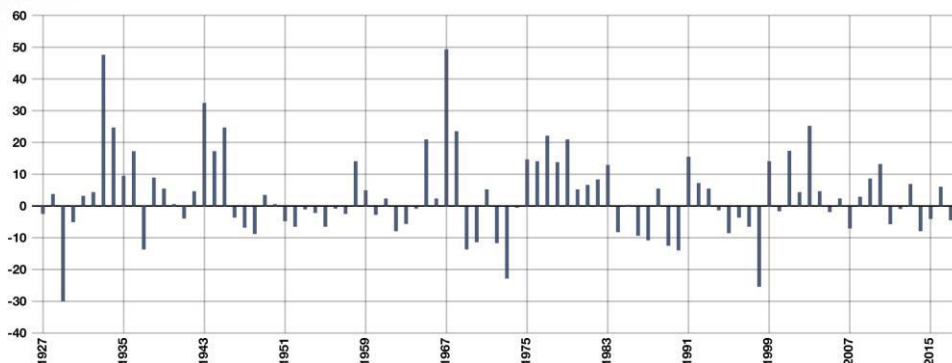
# The Size Effect

- Smaller firms have higher returns than larger firms, on average
  - Discovered by Banz (1981)
- Size is measured via market capitalization (price \* shares outstanding)
  - Apple has a price of \$176 and about 4.6 billion shares outstanding
  - Apple's market cap is over \$800 billion
  - It's one of the largest companies in the world!
- The size effect is economically meaningful!
  - Small cap stocks have outperformed large stocks by about 3% per year since 1927



## The Size Effect Since 1927

Annual Return to Small Cap Stocks Minus Return to Large Cap Stocks



From Ken French's Data library at [https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)



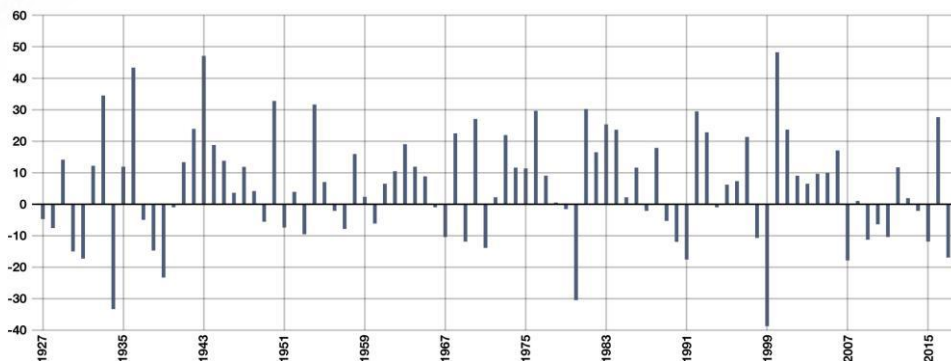
# The Value Effect

- Inexpensive stocks tend to outperform expensive stocks
  - Fama and French (1993)
- A stock's expensiveness is calculated by looking at the book value relative to market value [ the Book to Market ratio (B/M)]
  - A low B/M ratio implies the stock is expensive (Growth)
  - A high B/M ratio implies that the stock is inexpensive (value)
- The value effect is large! Value stocks have outperformed growth stocks by 4.67% per year, on average.



## The Value Effect Since 1927

Annual Return to High B/M Stocks Minus Low B/M Stocks



From Ken French's Data library at [https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)

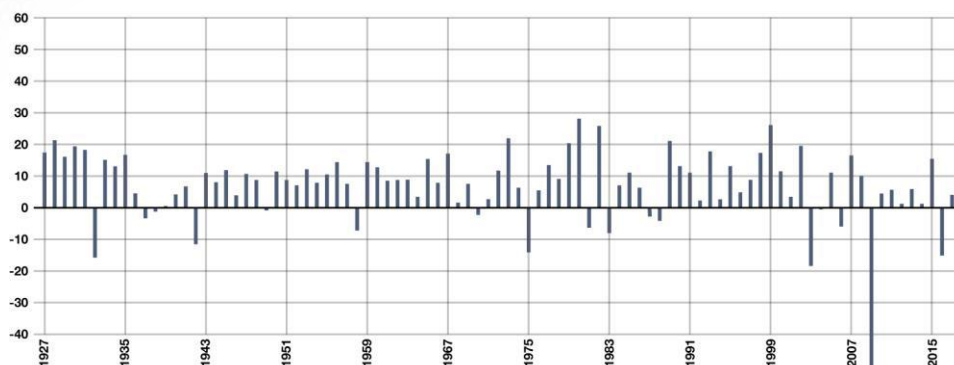


# The Momentum Effect

- The momentum effect is the tendency of stocks that have performed well over the past year to continue to perform well
  - Past winners outperform past losers
  - Originally attributed to Jegadeesh and Titman (1992)
- The effect is large!
  - Past winners outperform past losers by about 9.23% per year

## The Momentum Effect Since 1927

Annual Return to Wining Stocks Minus Return to Losing Stocks

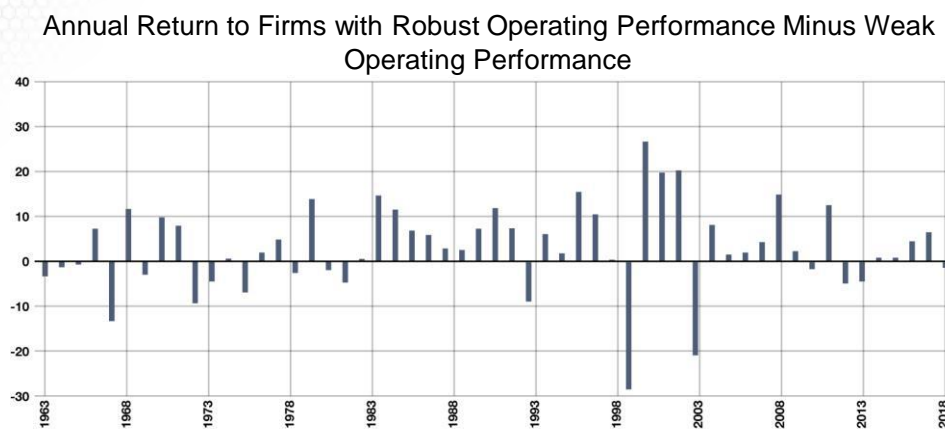


From Ken French's Data library at [https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)

# The Profitability Effect

- Profitable stocks tend to outperform unprofitable stocks
  - Attributed to Fama and French (2015)
- Stocks with robust operating performance outperform those with weak performance by about 3.2% per year

## The Profitability Effect Since 1964

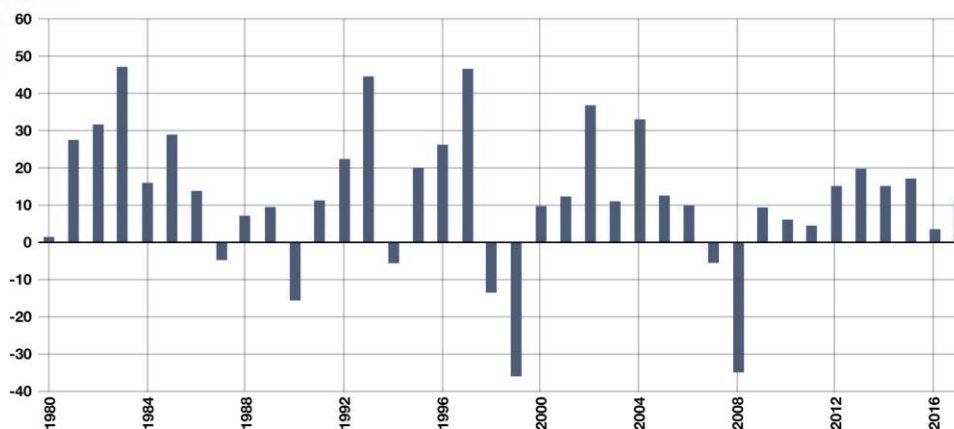


From Ken French's Data library at [https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)

## Risk Effect

- Low beta assets outperform high beta assets
  - Betting against beta
  - Frazzini and Pedersen (2014)
  - Similar results hold when considering the standard deviation of past returns
- The effect is about 12.2% per year since 1980

## Yearly Returns to the Betting-Against-Beta Strategy



## These Effects are Important for Investors!

- We can construct better portfolios for investors
- We can tell what has driven a fund's historical performance
- The 'smart beta' revolution



## Summary

1. Prior academic research has uncovered a number of fundamental factors that drive stock returns:
  - Size
  - Value
  - Momentum
  - Profitability
  - Volatility





# Data Analytics in Business

## Investing Analytics

**Jonathan Clarke, Ph.D**

*Associate Professor*  
Scheller College of Business

Interpreting Factor Regressions



## Lesson Objectives

**At the end of this lesson, you should be able to:**

- Run factor regressions in R
- Interpret the output of factor regressions
- Describe applications of factor investing



# Factors that Drive Stock Returns

From the previous lesson, there are a number of factors that drive stock returns:

1. **Beta:** The traditional market beta
2. **Size:** Small stocks tend to generate higher returns than large-cap stocks
3. **Value:** Inexpensive stocks outperform expensive stocks
4. **Momentum:** Stocks that have performed well in the previous year continue to perform well
5. **Quality:** High quality stocks (highly profitable) stocks tend to outperform
6. **Risk:** Stocks with low betas have traditionally generated higher returns



## Summarizing the Factors

Factor	Notation	Cite	Magnitude since 1980 (per month)
Market Beta	$r^m - r^f$	<b>Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk</b> , William Sharpe (1964), Journal of Finance 19 (3), 425-442.	0.68%
Size	SMB	<b>The Cross-Section of Expected Stock Returns</b> , Eugene Fama and Kenneth French (1992), Journal of Finance 47(2), 427-465.	0.12%
Value	HML	<b>The Cross-Section of Expected Stock Returns</b> , Eugene Fama and Kenneth French (1992), Journal of Finance 47(2), 427-465.	0.27%
Momentum	MOM	<b>Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency</b> , Narasimhan Jegadeesh and Sheridan Titman (1993), Journal of Finance 48 (1), 65-91	0.59%
Risk	BAB	<b>Betting Against Beta</b> , Andrea Frazzini and Lasse Heje Pederson (2014), Journal of Financial Economics 111 (1), 1-25.	0.48%
Quality	QMJ	<b>Quality Minus Junk</b> , Cliff Asness, Andrea Frazzini, and Lasse Heje Pederson (2019), Review of Accounting Studies, 24 (1), 34-112.	0.90%



## Factor Regressions

- We typically estimate factor models using linear regression:
  - The dependent variable is typically the fund's excess return above the risk free rate
  - The factors are typically the independent variables
- The typical specification is of the following form:

$$r_t^{\text{fund}} - r_t^f = \alpha + \beta_1(r_t^m - r_t^f) + \beta_2SMB_t + \beta_3HML_t + \beta_4MOM_t + \beta_5BAB_t + \beta_6QMJ_t + \varepsilon_t$$



## Interpreting Factor Regressions

The coefficients on Mkt-rf; SMB; HML; MOM; BAB; and QMJ tell us about exposure to the different factors

- A positive coefficient on SMB indicates that the fund is tilted toward small cap stocks
- A positive coefficient on HML indicates that the fund is tilted toward value stocks
- A positive coefficient on MOM indicates that the fund is tilted toward high momentum stocks
- A positive coefficient on QMJ indicates that the fund is tilted toward profitable stocks
- A positive coefficient on BAB indicates that the fund is tilted toward safe stocks

The intercept tells us about the skill of the fund manager

- A positive (negative) and significant coefficient indicates that the fund manager has outperformed (underperformed)



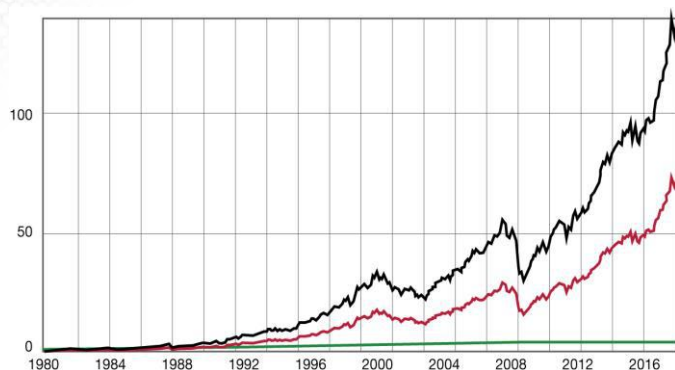
## Data Snapshot of Monthly Factor Data

Date	Fund- <i>r</i> f	Mkt- <i>r</i> f	SMB	HML	MOM	QMJ	BAB
1/31/1980	0.016	0.055	0.017	0.018	0.075	-0.027	0.026
2/29/1980	-0.026	-0.012	-0.018	0.007	0.079	-0.020	-0.015
3/31/1980	-0.102	-0.066	-0.066	-0.011	-0.096	0.047	-0.047
4/30/1980	0.005	0.009	0.009	0.011	-0.004	-0.034	0.021
5/31/1980	0.071	0.022	0.022	0.004	-0.011	0.007	0.037
6/30/1980	0.006	0.017	0.017	-0.009	0.016	-0.011	0.037
7/31/1980	0.098	0.043	0.043	-0.064	0.004	0.035	-0.009
8/31/1980	0.002	0.039	0.039	-0.026	0.032	-0.001	0.015
9/30/1980	0.029	0.009	0.009	-0.047	0.054	0.012	0.013
10/31/1980	0.010	0.024	0.024	-0.028	0.074	0.005	-0.002
11/30/1980	0.055	-0.034	-0.034	-0.084	0.153	0.010	-0.063
12/31/1980	0.006	-0.003	-0.003	0.027	-0.066	0.009	0.009

\*This data is contained in the FactorExample.csv file on Canvas



## What Drove the Performance of this Mutual Fund?



This mutual fund has clearly outperformed the overall stock market, but can we say something about why it outperformed?



# Estimating the Regression in R

A few notes:

1. I like to use the stargazer library to display linear regressions
2. The below code runs series of factor models using 1, 3, 4, and then 6 factors. This allows for some useful comparisons

**R code:**

```
# load data
setwd("C:/Users/jc414/Dropbox (GaTech)/Computer/Desktop/OnlineInvesting")
library(stargazer)
data<-read.csv("FactorExample.csv")
#Run factor models
factor1<-lm(Contra.rf~Mkt_rf,data=data)
factor3<-lm(Contra.rf~Mkt_rf+SMB+HML,data=data)
factor4<-lm(Contra.rf~Mkt_rf+SMB+HML+Mom,data=data)
factor6<-lm(Contra.rf~Mkt_rf+SMB+HML+Mom+BAB+QMJ,data=data)
stargazer(factor1,factor3,factor4,factor6,align=TRUE,type="html",out='factorModelFull.html')
```



## The Intercept Indicates the Fund's Skill

Dependent variable:				
	1	2	3	4
Mkt_rf	0.901*** (0.019)	0.885*** (0.020)	0.913*** (0.019)	0.914*** (0.022)
SMB		0.048* (0.029)	0.042 (0.027)	0.038 (0.030)
HML		-0.048 (0.030)	-0.004 (0.029)	-0.070** (0.032)
MOM			0.132*** (0.018)	0.096*** (0.019)
BAB				0.150*** (0.025)
QMJ				-0.011 (0.045)
Constant	0.002*** (0.001)	0.002*** (0.001)	0.001 (0.001)	0.0004 (0.001)
Observations	462	462	462	462
R2	0.833	0.835	0.852	0.863
Adjusted R2	0.832	0.834	0.851	0.861
Residual Std. Error	0.018 (df=460)	0.018 (df=458)	0.017 (df=457)	0.016 (df=455)
F Statistic	2,288.618*** (df=1;460)	773.355*** (df=3;458)	658.014*** (df=4;457)	478.797*** (df=6;455)

\*p < 0.1; \*\*p < 0.05; \*\*\*p < 0.01

The coefficients on the six factors tell us what is driving the fund's performance.

Four coefficients are significant:

- Mkt\_rf: The fund has a market beta of 0.914.
- HML: The fund is tilted away from value stocks
- MOM: The fund is tilted toward high momentum stocks
- BAB: The fund is tilted toward safe stocks (those with low beta)



## The Intercept Indicates the Fund's Skill

Dependent variable:				
	Contra.rf			
	1	2	3	4
Mkt_rf	0.901*** (0.019)	0.885*** (0.020)	0.913*** (0.019)	0.914*** (0.022)
SMB		0.048* (0.029)	0.042 (0.027)	0.038 (0.030)
HML		-0.048 (0.030)	-0.004 (0.029)	-0.070** (0.032)
MOM			0.132*** (0.018)	0.096*** (0.019)
BAB				0.150*** (0.025)
OMJ				-0.011 (0.045)
Constant	0.002*** (0.001)	0.002*** (0.001)	0.001 (0.001)	0.0004 (0.001)
Observations	462	462	462	462
R2	0.833	0.835	0.852	0.863
Adjusted R2	0.832	0.834	0.851	0.861
Residual Std. Error	0.018 (df=460)	0.018 (df=458)	0.017 (df=457)	0.016 (df=455)
F Statistic	2,288.618*** (df=1,460)	773.335*** (df=3,458)	658.014*** (df=4,457)	478.797*** (df=6,455)

\*p < 0.1; \*\*p < 0.05; \*\*\*p < 0.01

- The Constant term captures alpha: the measure of skill for the fund
- A positive alpha indicates the fund manager is outperforming the regression-based benchmark
- In the specification (1), the fund is outperforming by 0.2% per month
- After adjusting for all of the factors, the alpha is only 0.04% per month and not significant

## Takeaways from the Factor Regression

- The factor regression framework allows us to uncover the driving forces behind this fund's outperformance
- In particular, this fund performed well because of its exposure to high momentum (MOM) and low risk stocks (BAB)

## Factor Investing is Becoming Popular

- Blackrock, Fidelity, Invesco, and Vanguard are all active in the factor investing space
- Blackrock estimates [that by 2022 approximately \\$3.4 trillion will be invested in factor-based strategies](#)

A couple of words of caution:

1. As investors invest more money into these factors, the performance might dissipate
2. Each of these factors has experienced prolonged periods of underperformance



## Example: The Underperformance of Value

- Between 2009 and 2018, the average annual premium on value stocks was - 2.33%. [That is, value stocks underperformed!](#) There has been talk that the value premium is dead
- Between 1927 and 2008, the average premium on value stocks was 5.52% per year. However, the annual standard deviation was 14.35%. It's consequently not that unusual that we would observe this level of underperformance

**Main point: You may need to be patient with some of these factors**





## Summary

1. Factor regressions allow us to understand the drivers of a fund's return.
2. The intercept from the factor regression allow us to assess the fund's skill.



Georgia  
Tech

## Data Analytics in Business

### Investing Analytics

**Jonathan Clarke, Ph.D**

*Associate Professor*  
Scheller College of Business

Concluding Thoughts



Georgia  
Tech

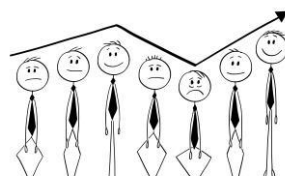


# Analytics Plays a Big Role in Finance and Investing

We deal with huge datasets capturing stock returns; firm performance; and even investor sentiment



Financial Statements and Financial Ratios			
	Actual	Budget	Last Year
Revenue	434,251	407,803	408,800
Expenses	411,822	396,535	398,500
Profit	22,429	11,268	10,300



Finance professionals spend a great deal of time teasing out relations between these different types of data



## We Covered 3 Core Concepts in our 3 Modules

1. Quantifying prices in financial markets
2. Identifying superior performance in financial markets
3. Describing the driving forces of returns in stock markets



## Topic 1: Quantifying Financial Prices

In module one, we quantified ways to think about stock and mutual fund prices:

- Simple and compound returns
- Standard deviation
- Beta
- $R^2$
- Drawdown



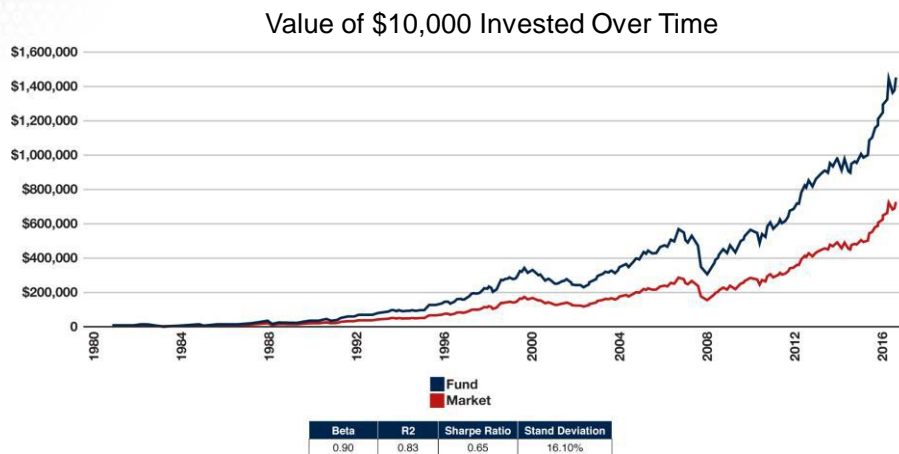
## Topic 2: Measuring Superior Performance

In module 2, we looked at ways to identify superior performance:

- Comparison to an appropriate benchmark
- Sharpe Ratio
- Treynor Ratio
- Jensen's Alpha



## You Will Likely See these Measures When Examining Your own Portfolio



Georgia  
Tech

## Topic 3: Identifying the Drivers of Returns

We looked at the factors that drive stock returns:

- Size
- Value
- Momentum
- Profitability
- Volatility

Georgia  
Tech

## You Will Likely be Investing in Funds that use these Trading Strategies

Some examples:

- iShares Edge MSCI USA Quality ETF (QUAL)
- AQR Large Cap Momentum Style Fund (AMOMX)
- Vanguard Small-Cap Index Fund (NAESX)
- Fidelity Large Cap Value Enhanced Index Fund (FLVEX)

I hope you have a good sense of the strategies behind these funds



## We've Just Covered the Basics

Recommend texts for future reading:

[Efficiently Inefficient: How Smart Money Invests and Market Prices are Determined](#) by Lasse Pederson

[Asset Management: A Systematic Approach to Factor Investing](#) by Andrew Ang

Both books are written by industry leaders!



# Summary

1. Analytical methods play a big role in investing.
2. Analytics allow us:
  - To measure the risk, return, and performance of different asset classes.
  - Understand the drivers of asset class performance.

