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Regressions

Most commonly used predictive model

Used to describe data and to explain the relationship between variables.

Measures historical relationship between dependent and independent variables

Independent variable – input or cause

Examples: broad market (most common), GDP, Capex

Dependent variable – result being predicted

Examples: stock price (most common), earnings, sales

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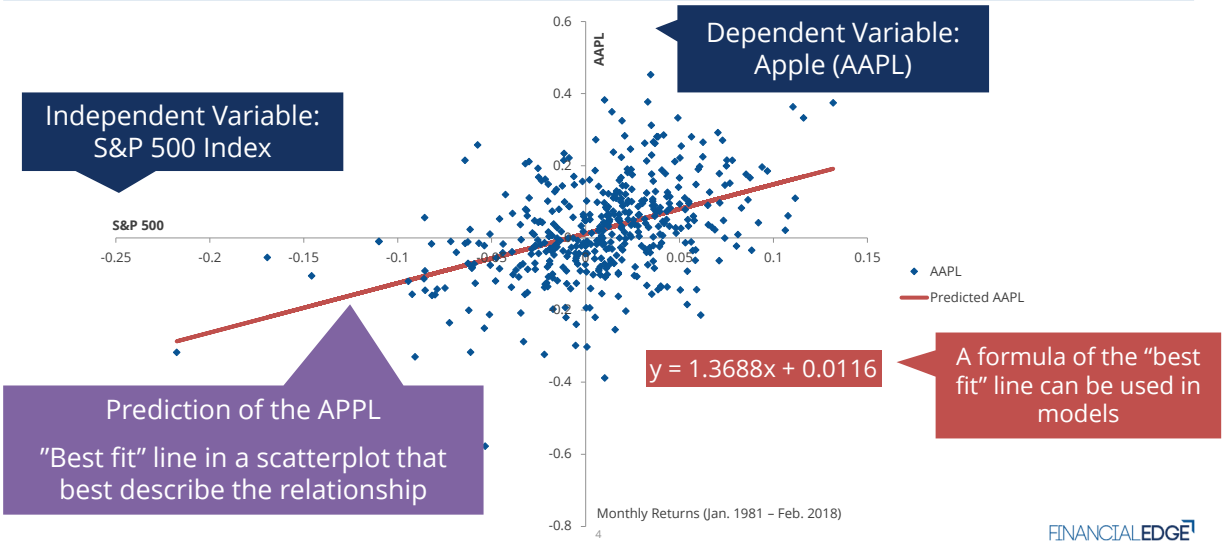
Regressions



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Regressions

Commonly used to describe the returns of an individual security (dependent variable) compared to the returns of the market in general (independent variable).

$$y = 1.3688x + .0116$$

Return on the dependent security (Apple)

$$y = \beta x + \alpha$$

Intercept of the line "Alpha"

Slope of the line "Beta"

Return of the independent security (S&P 500)

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Regressions – Excel Output

The larger the sample the lower the standard error should be

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.436359435
R Square	0.190409557
Adjusted R Square	0.188582039
Standard Error	0.119799253
Observations	445

R^2 - Coefficient of determination

Measures how good a fit

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1.495324044	1.495324044	104.1902536	4.12452E-22
Residual	443	6.357874453	0.014351861		
Total	444	7.853198497			

Alpha

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.011591585	0.005774496	2.007375961	0.045316531	0.000242775	0.022940395	0.000242775	0.022940395
S&P 500	1.36879221	0.134098518	10.20736272	4.12452E-22	1.105243913	1.632340507	1.105243913	1.632340507

Beta: S&P 500 Coefficient

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Regressions – Other Key Points

Usually more than one variable influences a dependent variable	→	Multiple Regression $y = \beta_1 X_1 + \beta_2 X_2 + \ldots \beta_n X_n + \alpha$
Regression models assume a linear relationship (straight line)	→	Security returns are usually modeled as linear
Limitation	→	Parameter instability: relations can change over time

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Monte Carlo Simulations

Statistical method for analyzing random portfolio returns → Also known as Stochastic Modeling, or Probability Analysis

Randomly computer selected annual returns based on assumptions (return, volatility and correlation)

Repeated thousands of times allowing us to see the range of possible outcomes

Does not use straight line estimates – sequence of returns are important

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Example: Sequence of Returns

A retired couple has a $1milion portfolio and wants to know if they have enough to withdraw $125,000 for the next 10 years

Year	% Return	$ Return	Withdrawal	Portfolio Value
				$1,000,000
1	6.6%	$66,000	$(125,000)	$941,000
2	6.6%	$62,106	$(125,000)	$878,106
3	6.6%	$57,955	$(125,000)	$811,061
4	6.6%	$53,530	$(125,000)	$739,591
5	6.6%	$48,813	$(125,000)	$663,404
6	6.6%	$43,785	$(125,000)	$582,189
7	6.6%	$38,424	$(125,000)	$495,613
8	6.6%	$32,710	$(125,000)	$403,324
9	6.6%	$26,619	$(125,000)	$304,943
10	6.6%	$20,126	$(125,000)	$200,069

Avg Return 6.6% (Straight line)

Success!!!

Year	% Return	$ Return	Withdrawal	Portfolio Value
				$1,000,000
1	-20.0%	$(200,000)	$(125,000)	$675,000
2	6.6%	$44,550	$(125,000)	$594,550
3	6.6%	$39,240	$(125,000)	$508,790
4	6.6%	$33,580	$(125,000)	$417,370
5	33.2%	$138,567	$(125,000)	$430,937
6	6.6%	$28,442	$(125,000)	$334,379
7	6.6%	$22,069	$(125,000)	$231,448
8	6.6%	$15,276	$(125,000)	$121,724
9	6.6%	$8,034	$(125,000)	$4,758
10	6.6%	$314	$(125,000)	$(119,928)

Avg Return 6.6%

Failure!!!

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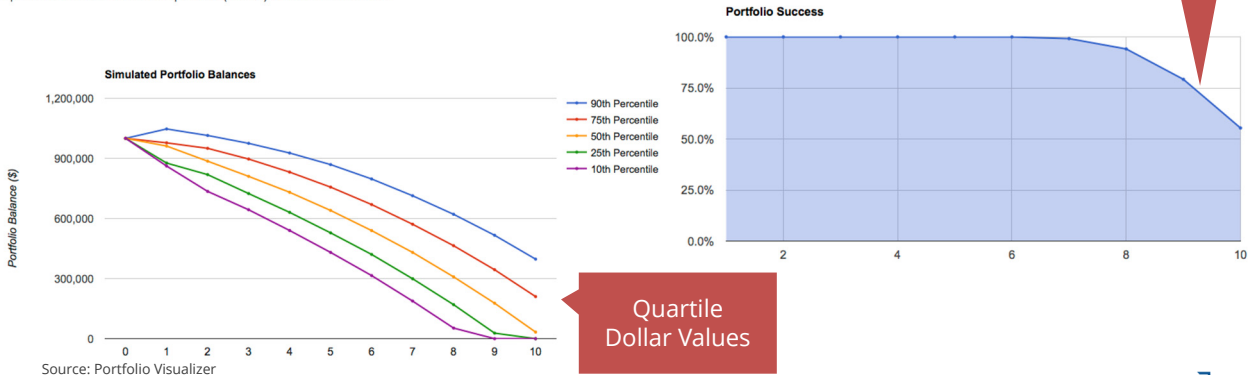
Monte Carlo – Sample Output

	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
Portfolio End Balance (nominal)	$0.00	$0.00	$32,901	$210,116	$397,096
Portfolio End Balance (inflation adjusted)	$0.00	$0.00	$26,122	$168,113	$317,649
Maximum Drawdown	-100.00%	-100.00%	-96.98%	-80.88%	-65.01%
Maximum Drawdown Excluding Cashflows	-18.81%	-17.08%	-8.75%	-6.36%	-5.75%

5537 portfolios out of 10000 simulated portfolios (55.37%) survived all withdrawals.

Quartile Dollar Values

Success Probability



Source: Portfolio Visualizer

Quartile Dollar Values

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Monte Carlo - Limitations

Assumes a normal distribution of returns	That may not always be the case and "tail risk" may be higher
Historical data that may no longer be relevant	Inputs may need to be adjusted to incorporate today's environment
Returns may be overly random	Mean reversion – low returns tend to be followed by higher returns, and vice-versa

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Interpreting Data Analysis

Basic analysis techniques try to identify trends → Using past data to determine future price movement

Technical Analysis	Quantitative Analysis
Uses past price and volume data, often with charts, in decision making	Quantifies price action for into precise algorithmic equations

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Interpreting Data Analysis

Trend Models	→	Technical: Patterns shown in short-term charts indicate a longer-term trend
Mean Reversion	→	Levels eventually move toward the average
Regression Coefficients	→	Market Beta is the most popular, but can also include size, valuation, momentum

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Interpreting Data Analysis

Seasonality	→	Investment decisions based on cycle trends: Jan Effect
Smoothing Past Values	→	N-Period Moving Average; 250 DMA for price, CAPE Ratio
Random Walk	→	Prices move randomly and can't be predicted; strong market efficiency.

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