# Python in quantitative finance

Wes McKinney[1]

[1]AQR

# Outline

1. Background
   - My perspective
   - Common financial research tools
   - Python's status
2. pandas library
   - Motivation
   - Interactive Demo
   - Related projects
3. Summary and questions

# What is quantitative finance?

- Applying mathematics to model market phenomena
- Identifying statistical or causal relationships in financial data sets
- Building systematic investing strategies
- In recent years: convergence of math, computer science, and economics

# About me and AQR

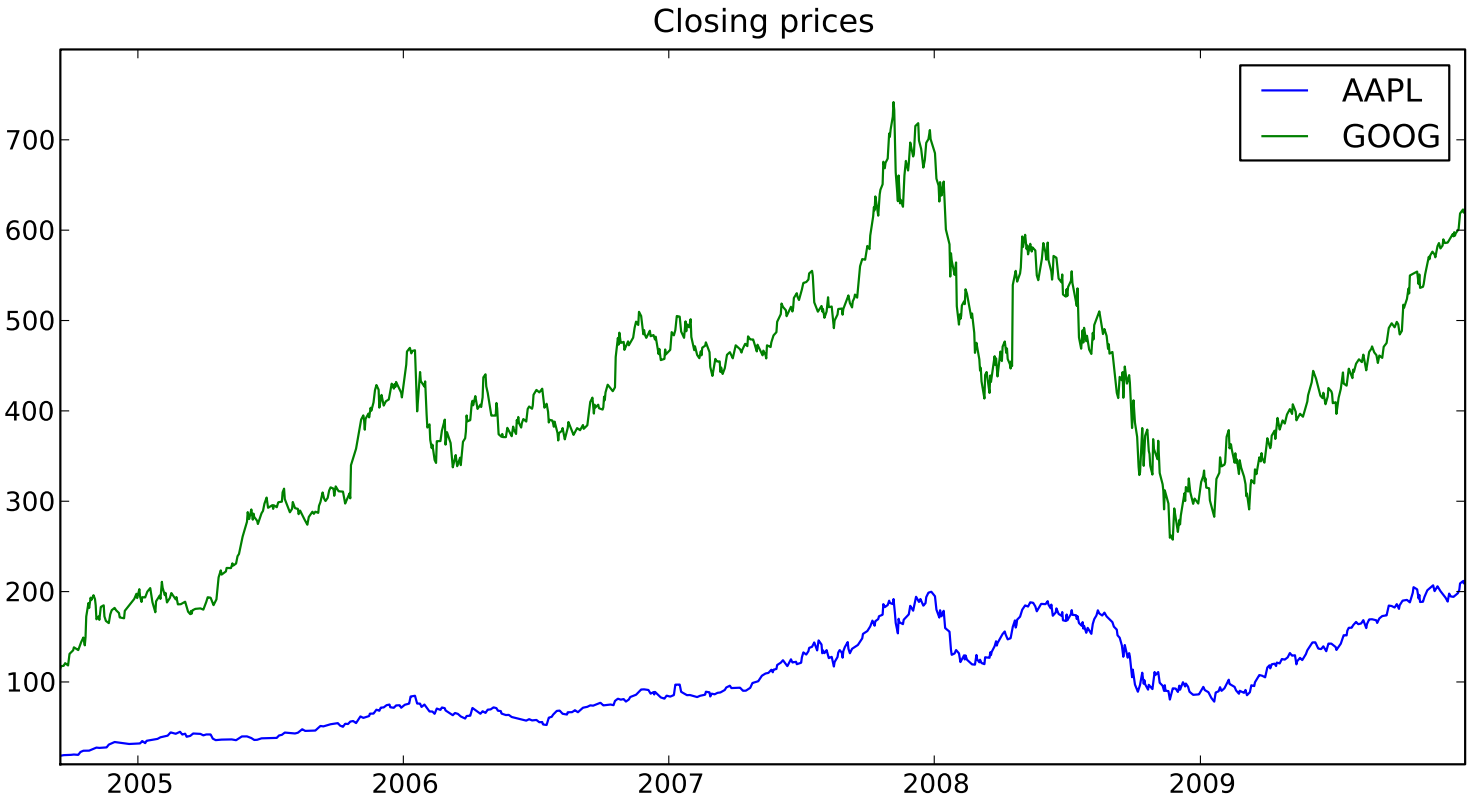
- Me: in the industry for 3 years, math background
- My company: AQR Capital Management
  - Founded in 1998
  - Manages both long-short hedge funds and more traditional long-only products
  - Combines economic intuition with statistical techniques to forecast price movements
  - Research tends to focus on longer-term relative value portfolios

# Common financial research tasks

- Data manipulation
  - Combine and transform raw data series
  - Handle missing observations, time series of different frequencies, other sources of heterogeneity
- Statistical estimation
  - Econometric analysis: linear regression and other more advanced models
  - Measuring and controlling risk: forecasting asset volatility
- Building investing strategies
  - Constructing tradable portfolios from raw data
  - Analyze strategy performance

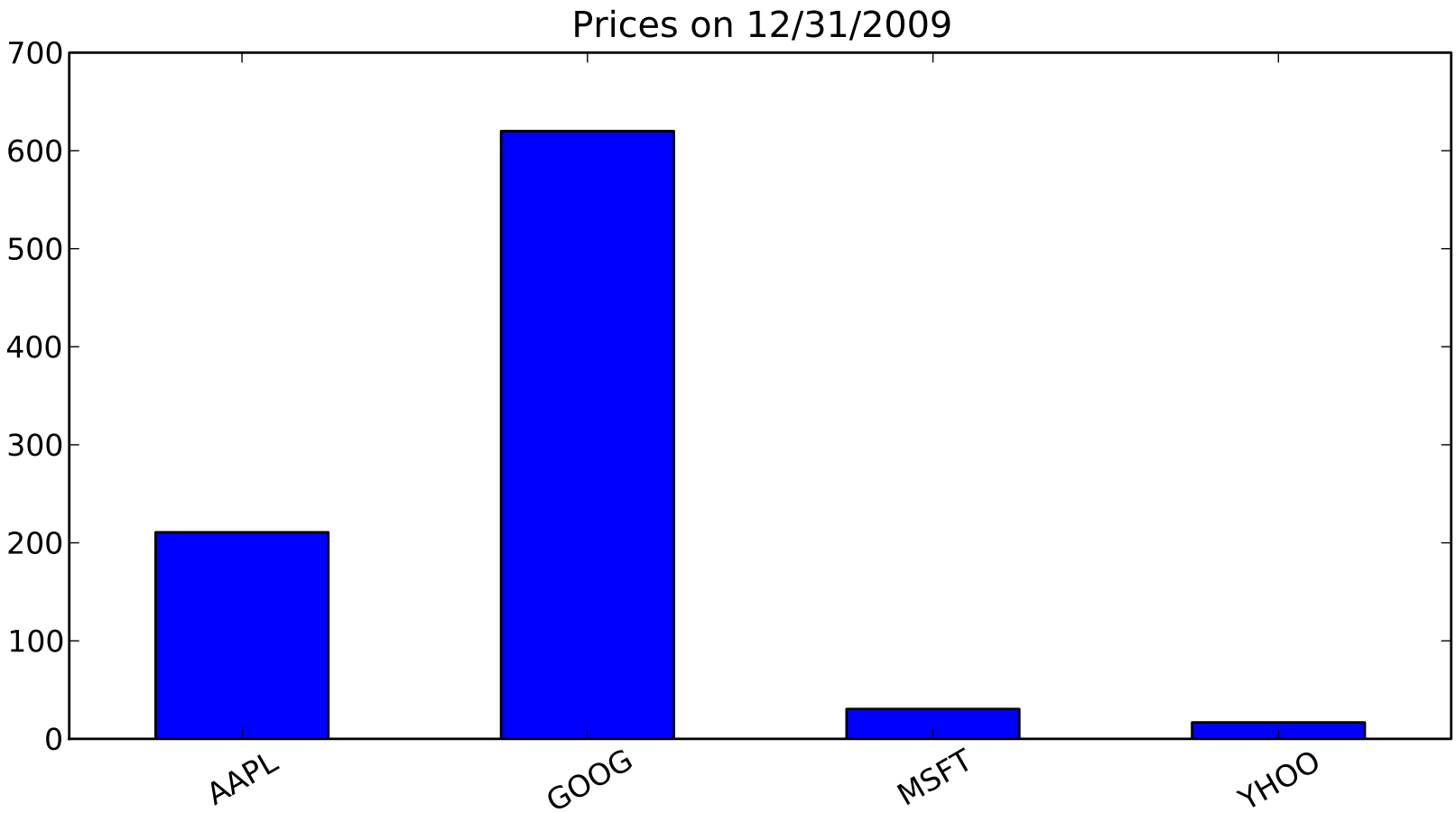
# Basic units of financial data

- Time series (TS): data points through time for one data field



# Basic units of financial data

- Cross section (XS): data points for many fields at **single** point in time



# Widely used research languages

- Commercial: MATLAB, Stata, eViews, etc.
- R
  - Popular among statisticians, econometricians, and time series analysis practitioners
  - Abundance of open-source packages on CRAN
  - Already available to Python programmers via **rpy**
- Research and implementation language are frequently not the same

# How about Python?

- Many excellent mature building blocks for doing finance work
  - numpy array / matrix functionality is flexible, powerful
  - scipy provides statistical functionality, optimization, other solvers
- IPython + matplotlib for interactive research / data visualization
- Can mix low-level code (C, Fortran, Cython / Pyrex) to boost performance
- Python language is great for building systems (expressiveness, debuggability, deployment)

# Where are Python and NumPy weak (for finance)?

- Relatively thin on statistical modeling / econometrics libraries
  - **scikits.statsmodels** and other projects are helping change that
- Many tools assume "clean" data sets; most often not the case
- Chicken and egg problem: less financial community presence
- Few tools specifically for time series and cross-sectional data

- **My goal:** help Python become a more compelling choice for finance work and other statistical applications

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# pandas project background

- Born of practicality at AQR in 2008
- Idea: data structures for labeled data; lightweight and easy-to-visualize
- Link identifiers (dates, tickers, etc.) to standard NumPy arrays
- Handles both TS and XS data with no fuss
- Makes very few assumptions about data cleanliness (built with NaN-handling from ground up)
- Core indexing mechanism deals with data alignment, easy reshaping
- Etymology: **pan**el **da**ta system
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# What's in the library?

- Flexible NumPy-based data structures for 1, 2, and 3 dimensional data
- Common time series statistical operators
  - example: moving {sum, average, std, skewness}
- Nascent integrated econometrics / statistical regression library

# Demo

# Some related projects

- scikits.statsmodels
- scikits.timeseries
- tabular
- la (larry: labeled array object)

# Ideas for future

- Expand existing functionality to address other applications
- Implement more statistical models / wrap scikits.statsmodels classes
- Develop seamless **rpy** interface to leverage CRAN wealth
- Better / more efficient IO functions for getting data into pandas

# Questions / Thanks

- Contact: wesmckinn@gmail.com
- Website: pandas.sourceforge.net
- Download from Python package index
- AQR website: www.aqr.com

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