INTRO AND SIMULATION

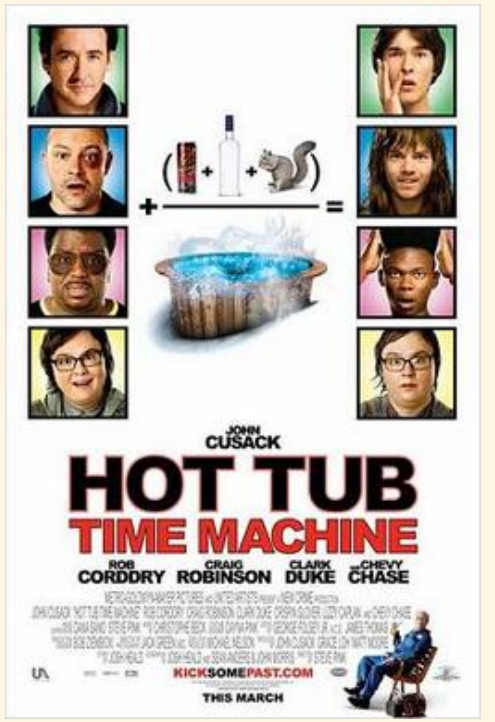
MGMT 675
AI-Assisted Financial Analysis
Kerry Back

MEET YOUR PROF

- At Rice since 2009, in Jones and also Econ Dept.
  - teaching intro to finance, data-driven investments, investments theory, and python for business research
  - to PhDs, MBAs, and Masters in Data Science students
- Previously at Northwestern, Indiana, Washington Univ. in St. Louis, and Texas A&M
- Wrote two textbooks (derivatives and PhD asset pricing theory). Teaching materials, bio, and info about books and research at kerryback.com

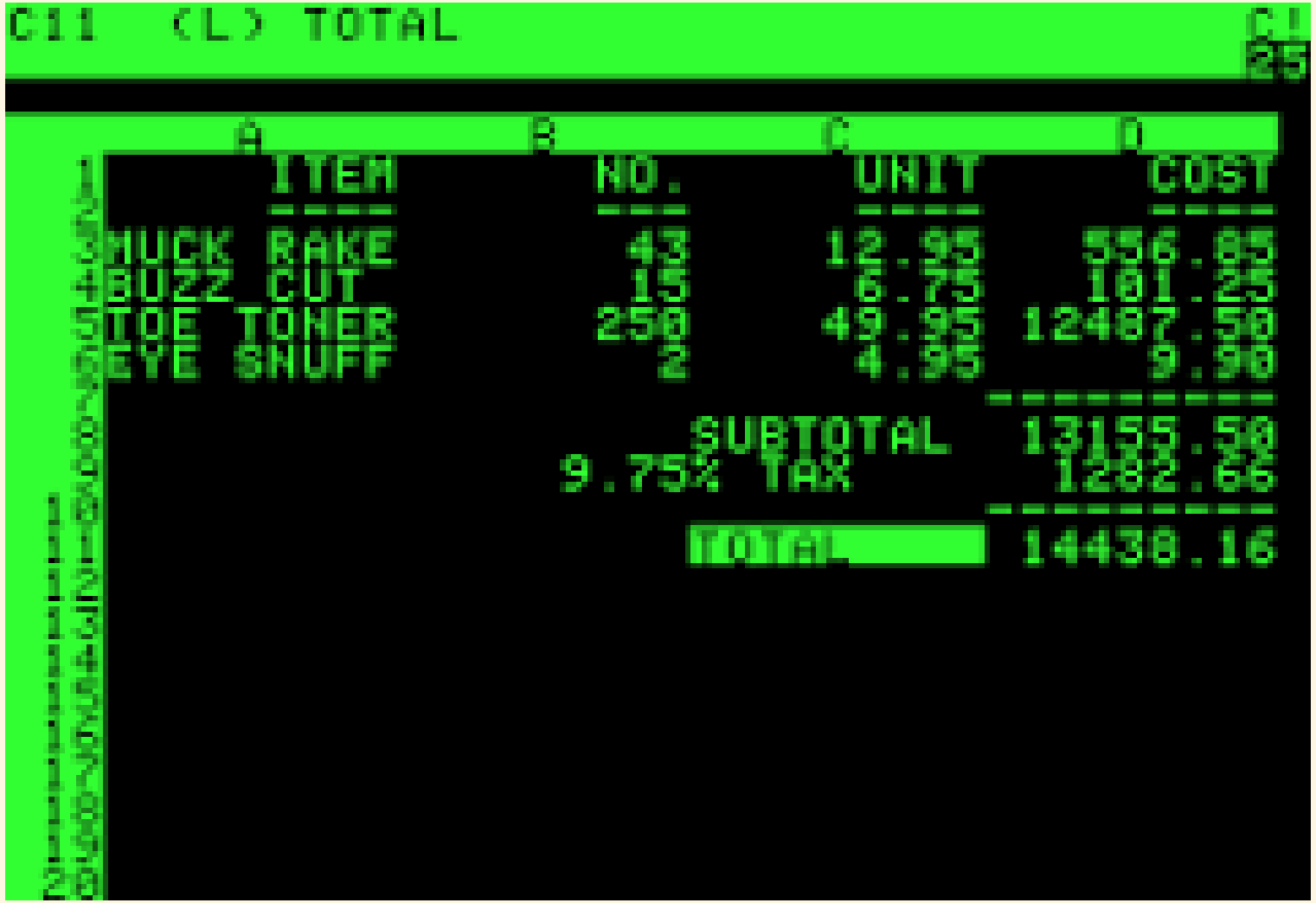
WHY ARE WE HERE?

LET'S DO SOME TIME TRAVELING

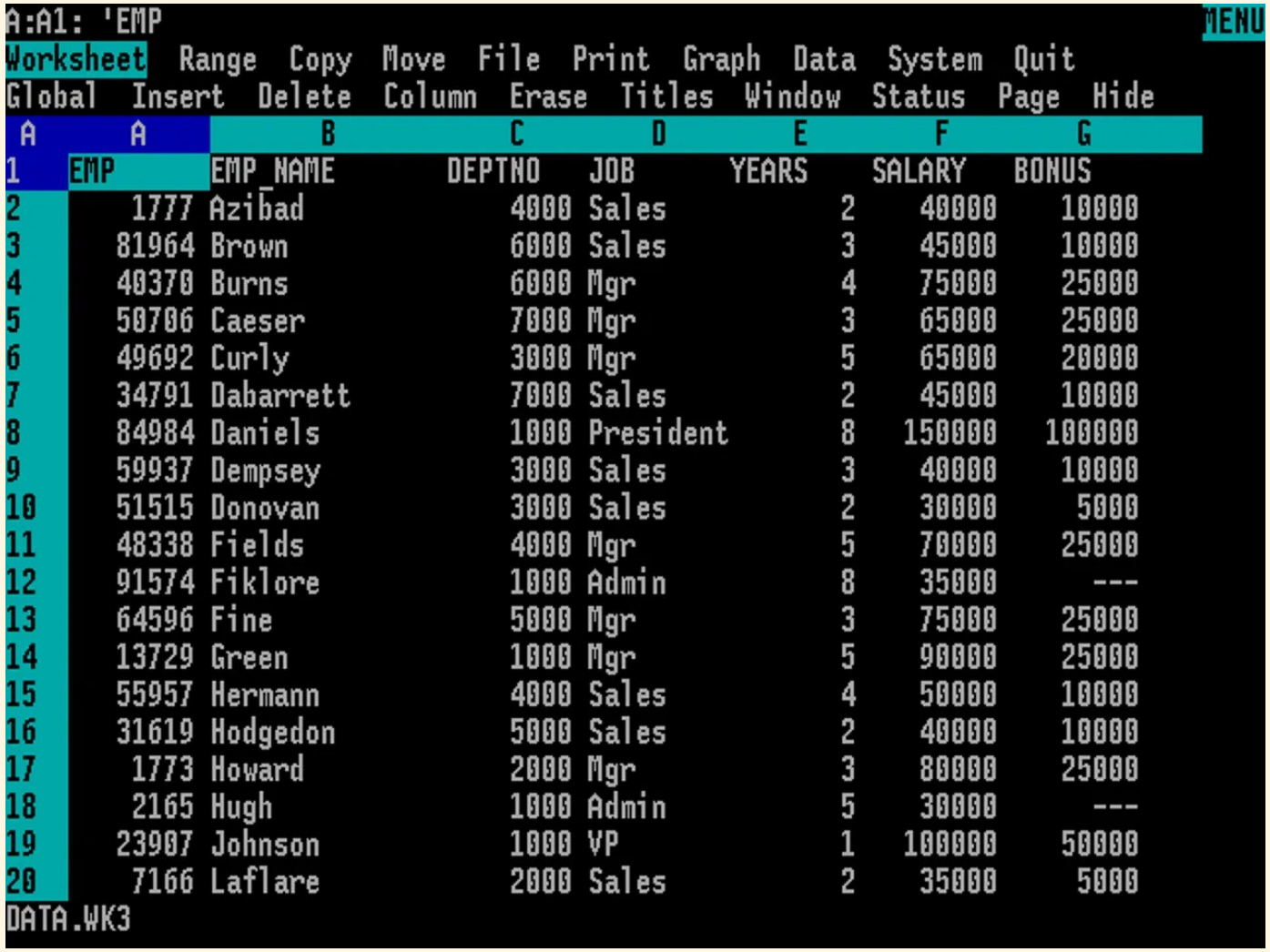


First hand-held calculator, introduced by Texas Instruments in 1972

First financial calculator, introduced by HP in 1973



VisiCalc, released for Apple II in 1979



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A:A1: 'EMP                                                              MENU
Worksheet  Range  Copy  Move  File  Print  Graph  Data  System  Quit
Global  Insert  Delete  Column  Erase  Titles  Window  Status  Page  Hide
 A      A          B          C        D        E        F        G
1    EMP        EMP_NAME       DEPTNO   JOB      YEARS    SALARY   BONUS
2        1777 Azibad              4000 Sales            2    40000    10000
3       81964 Brown               6000 Sales            3    45000    10000
4       40370 Burns               6000 Mgr              4    75000    25000
5       50706 Caeser              7000 Mgr              3    65000    25000
6       49692 Curly               3000 Mgr              5    65000    20000
7       34791 Dabarrett           7000 Sales            2    45000    10000
8       84984 Daniels             1000 President        8   150000   100000
9       59937 Dempsey             3000 Sales            3    40000    10000
10      51515 Donovan             3000 Sales            2    30000     5000
11      48338 Fields              4000 Mgr              5    70000    25000
12      91574 Fiklore             1000 Admin            8    35000      ---
13      64596 Fine                5000 Mgr              3    75000    25000
14      13729 Green               1000 Mgr              5    90000    25000
15      55957 Hermann             4000 Sales            4    50000    10000
16      31619 Hodgedon            5000 Sales            2    40000    10000
17       1773 Howard              2000 Mgr              3    80000    25000
18       2165 Hugh                1000 Admin            5    30000      ---
19      23907 Johnson             1000 VP               1   100000    50000
20       7166 Laflare             2000 Sales            2    35000     5000
DATA.WK3
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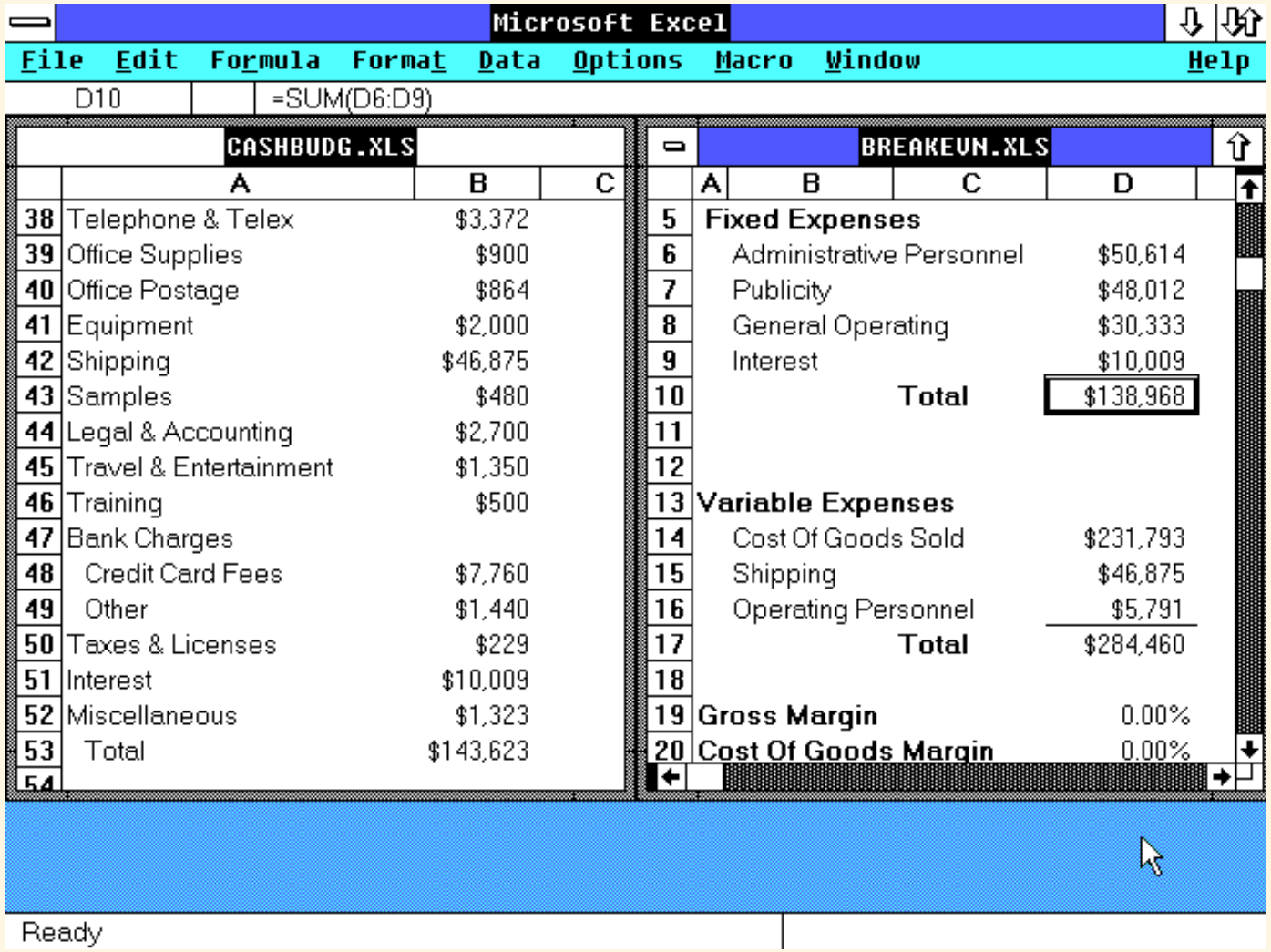
Lotus 1-2-3, released for IBM PC in 1983



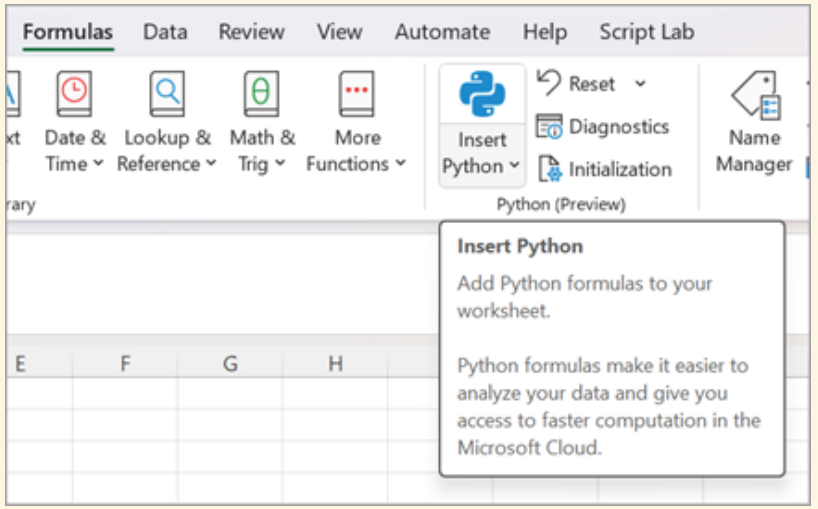
Microsoft Excel, released for Windows in 1987

TODAY'S TOOLS

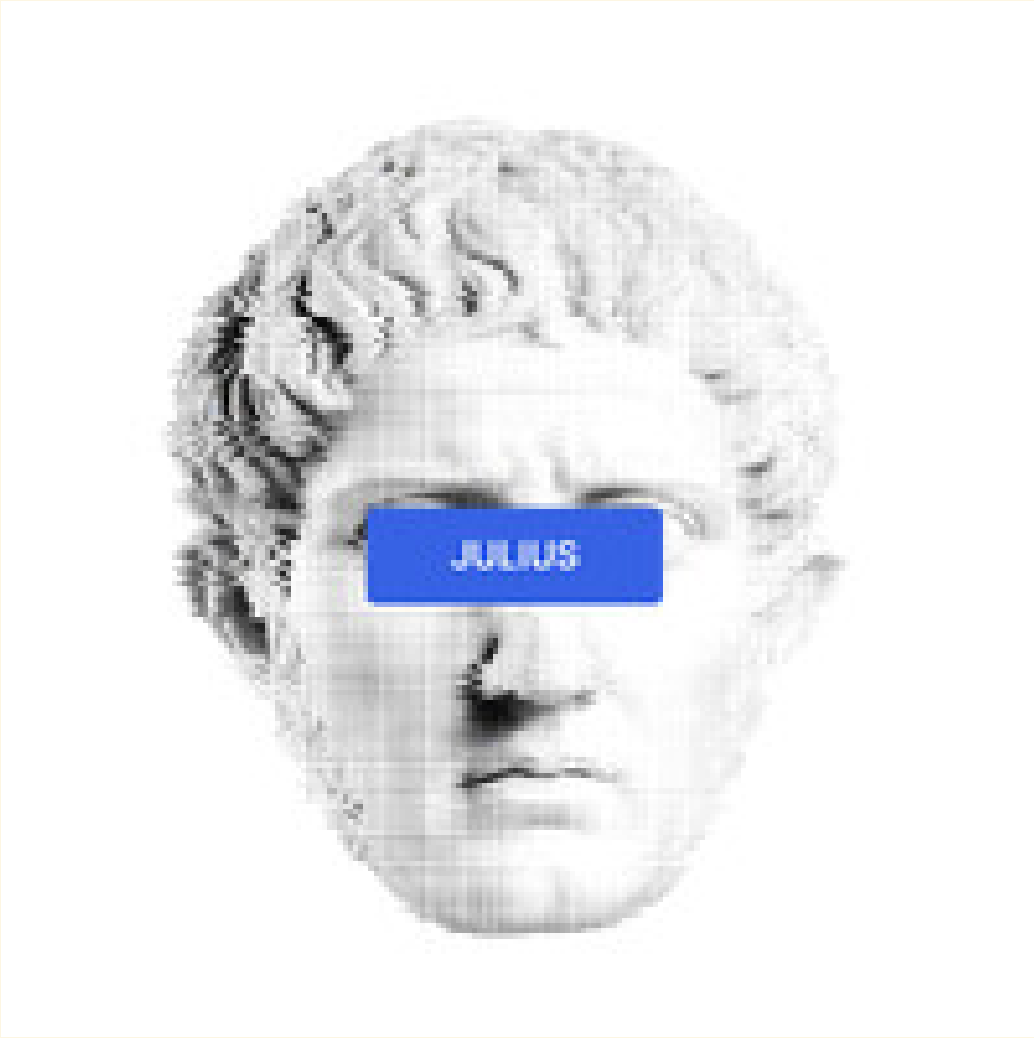
- Will Excel survive?
- Will Excel retain its dominance?

MAYBE ...

Copilot
A whole new way to work


Formulas
Data
Review
View
Automate
Help
Script Lab
Date & Time
Lookup & Reference
Math & Trig
More Functions
Insert Python
Reset
Diagnostics
Initialization
Name Manager
Python (Preview)
Insert Python
Add Python formulas to your worksheet.
Python formulas make it easier to analyze your data and give you access to faster computation in the Microsoft Cloud.
E
F
G
H

THE BEST WE HAVE TODAY (I THINK)



GET A JULIUS ACCOUNT

- Free account has very strict message limit
- Basic allows 250 messages per month. Maybe enough?
- Essential allows unlimited messages.
- 50% academic discount. Sign up using your Rice email and enter the promo code STUDY2024.

WHAT JULIUS DOES

- Python interpreter and proprietary LLM
- Julius executes and debugs code
- Provides links to images, tables, datasets it creates
- Provides download of conversation (and code) as Jupyter notebook or Word doc
- Allows us to upload our own data
- Can get some online data
- Can install any python libraries not pre-installed

WARM-UP

- Ask Julius to plot the function $y = x^2$
- Ask Julius to plot the payoff diagram of a call option with a strike of 100.
- Ask Julius to get the history of 10-year Treasury yields from FRED and plot them.
- Ask Julius to simulate 30 returns from a normal distribution with mean of 10% and standard deviation of 15% and plot the cumulative compound return.

GOOGLE COLAB

- Download the chat as a notebook.
- Go to https://colab.research.google.com/ and sign in.
- Use File/Open Notebook to open the saved notebook.
- Run the notebook cell by cell or use Runtime/Run All.

- If you want to save figures or tables created by a notebook in Colab, you can
  - mount your Google drive (folder icon on left and then Google drive icon in the top toolbar on left)
  - then execute code to save to "drive/MyDrive/filename.ext"
- To install additional libraries, execute the following, for example, in a code cell:

```
!pip install yfinance
```

TODAY'S TOPICS

- Long-run risk
- Retirement planning
- Retirement planning with simulation
- Monte-Carlo option valuation
- Monte-Carlo enterprise valuation

LONG-RUN RISK

- Ask Julius to simulate how much a $1 investment would grow to in 10 years if the investment return is normally distributed with a mean of 6% and a standard deviation of 20%.
- Ask Julius to calculate the fraction of times the investment outperforms a risk-free return of 1% over 10 years.
- Ask Julius to generate boxplots and histograms of the ending investment account balance.

RETIREMENT PLANNING

- Tell Julius you want to check if a retirement savings plan is feasible.
- Ask Julius what information you need to provide and provide it.
- Ask Julius to calculate the ending balance as a function of the rate of return over some range and plot it.

RETIREMENT PLANNING WITH SIMULATION

- Ask Julius to simulate the retirement plan assuming the annual returns are normally distributed with some mean and variance.
- Ask Julius to describe the distribution of ending account balances and to produce a boxplot and histogram.

MONTE-CARLO OPTION VALUATION

- Tell Julius you want to value a European call option by Monte Carlo. Ask Julius what information you need to provide and provide it.
- Ask Julius to value the same call option using Black-Scholes.
- Ask Julius to value a put option both ways.

ENTERPRISE VALUATION

- Give Julius the following data (from Applied). Then ask what the share price should be.
  - A firm with no debt will have free cash flow of 100M next year.
  - The cash flow will grow by 12% per year for years 2 through 5. Then, it will grow by 3% per year forever.
  - The firm's cost of capital is 10%, and there are 44.75M shares outstanding.

CHECK FOR ERRORS

- It is quite possible that Julius - like any assistant - might misunderstand the timing you want.
- Quickest way to fix mistakes: edit the code.

Check the following:

- There should be five cash flows in the first stage.
- The first cash flow should be 100M (no growth).
- The terminal value should be 100M with 4 years of growth at 12% and 1 year of growth at 3% divided by (10% - 3%).
- The terminal value should be discounted back 5 years.

SENSITIVITY ANALYSIS

Ask Julius to vary the first stage growth rate between 6% and 18% and to plot the share price as a function of the growth rate.

MONTE-CARLO ENTERPRISE VALUATION

- Now ask Julius to simulate the first-stage growth rate from a normal distribution with a mean of 12% and a standard deviation of 3%.
- Ask Julius to compute the share price in each simulation and to describe the share price distribution.
- Ask Julius to produce a histogram of the share price distribution.

A SECOND SOURCE OF UNCERTAINTY

- Tell Julius to model the first-stage growth rate as x + y where x is drawn from a normal distribution with a mean of 12% and a standard deviation and y is a Bernoulli random variable which is 12% with 10% probability and is 0 with 90% probability.
- Ask Julius to compute the share price in each simulation and to describe the share price distribution.
- Ask Julius to produce a histogram of the share price distribution.