

# 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](http://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

C11 (L) TOTAL				C1
				25
	A	B	C	D
	ITEM	NO.	UNIT	COST
	-----	----	----	----
	HUCK RAKE	43	12.95	556.85
	BUZZ CUT	15	6.75	101.25
	TOE TONER	250	49.95	12487.50
	EYE SNUFF	2	4.95	9.90
				-----
			SUBTOTAL	13155.50
			9.75% TAX	1282.66
				-----
			TOTAL	14438.16

VisiCalc, released for Apple II in 1979



A:A1: 'EMP' MENU

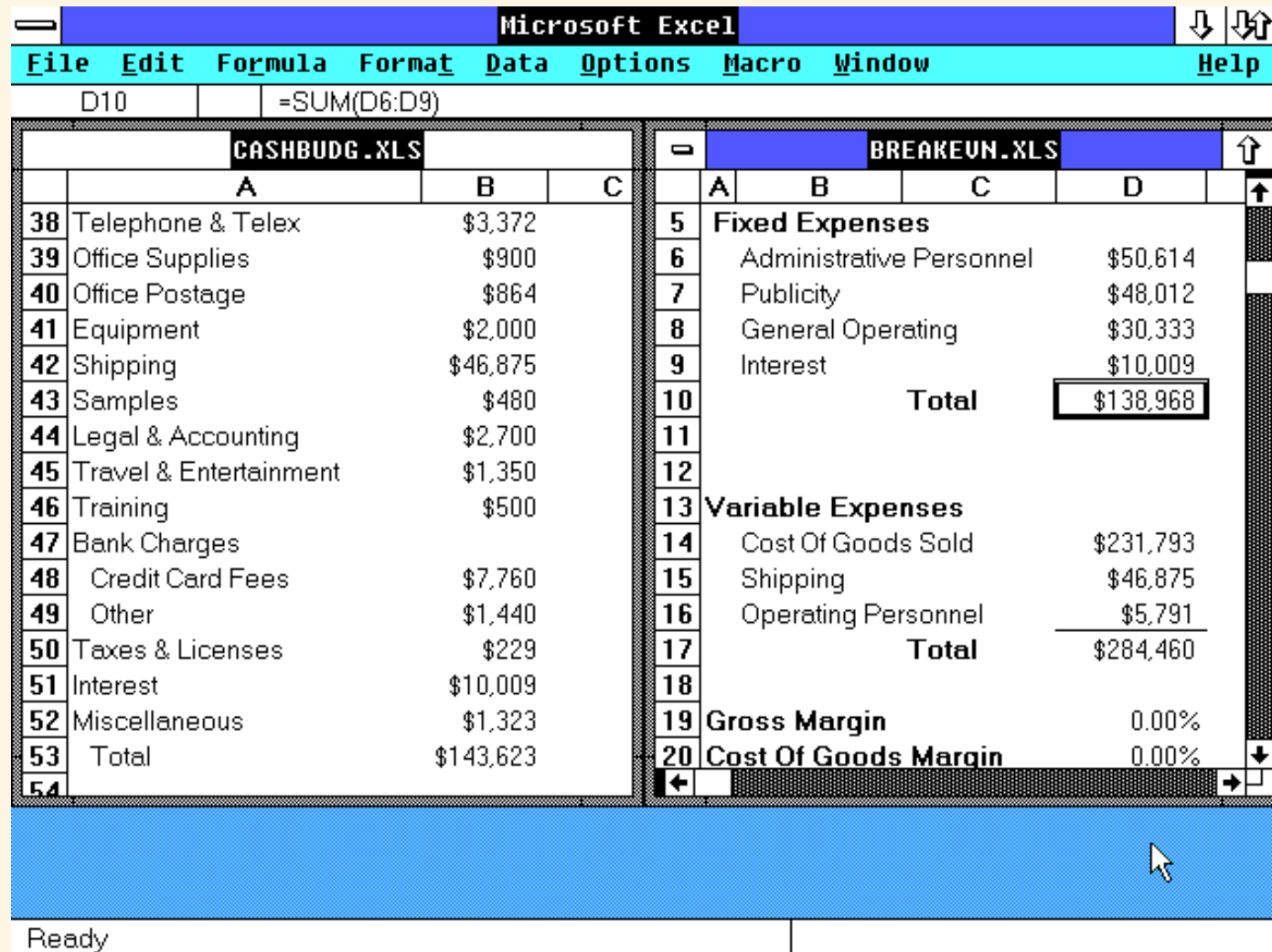
Worksheet Range Copy Move File Print Graph Data System Quit  
Global Insert Delete Column Erase Titles Window Status Page Hide

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	Caesar	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

Lotus 1-2-3, released for IBM PC in 1983





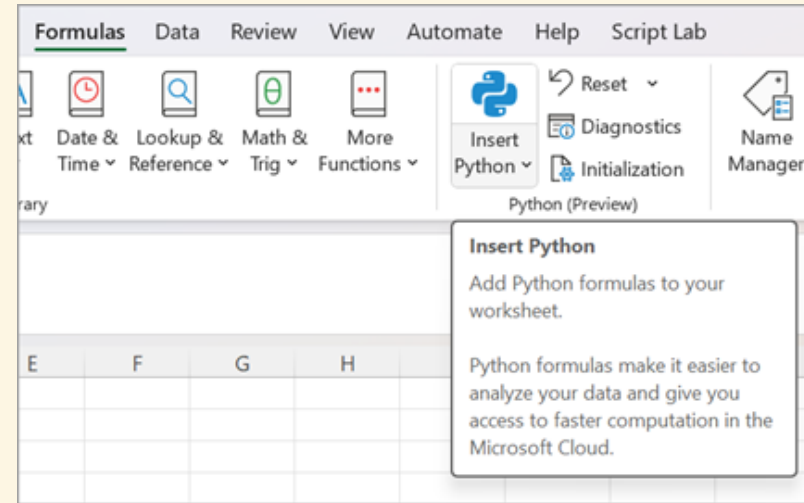
Microsoft Excel, released for Windows in 1987

# TODAY'S TOOLS

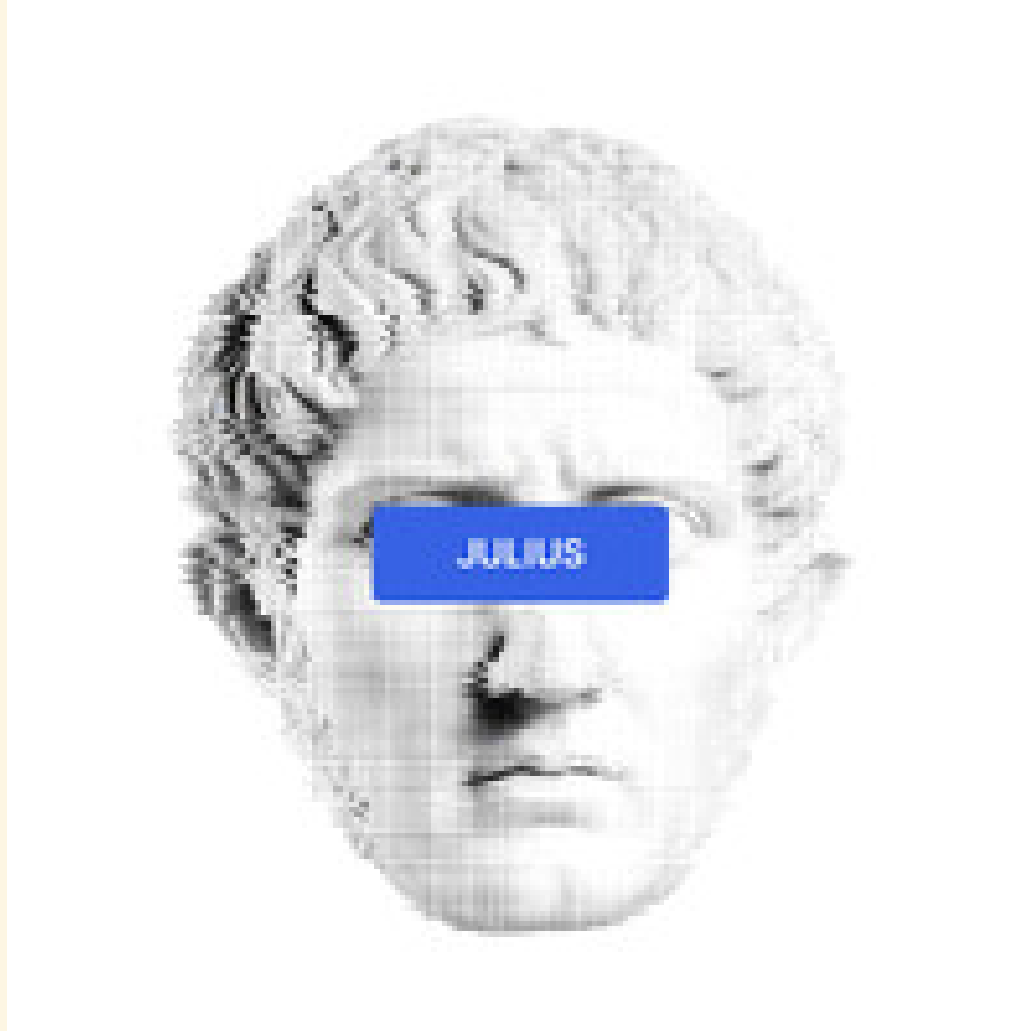


- Will Excel survive?
- Will Excel retain its dominance?

# MAYBE ...



# 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 interface to ChatGPT4
- Julius executes code (and debugs via ChatGPT4).
- Provides links to images, tables, datasets it creates
- Provides download of code (and conversation) as Jupyter notebook
- 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 CHATS

- 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 I

- 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.

# MONTE-CARLO ENTERPRISE VALUATION II

- TBD