

INTRO AND SIMULATION

MGMT 675

AI-Assisted Financial Analysis

Kerry Back

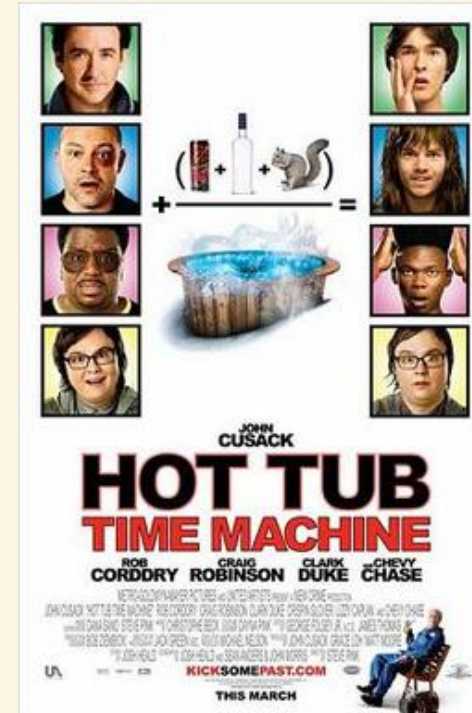


MEET YOUR PROF

- 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

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

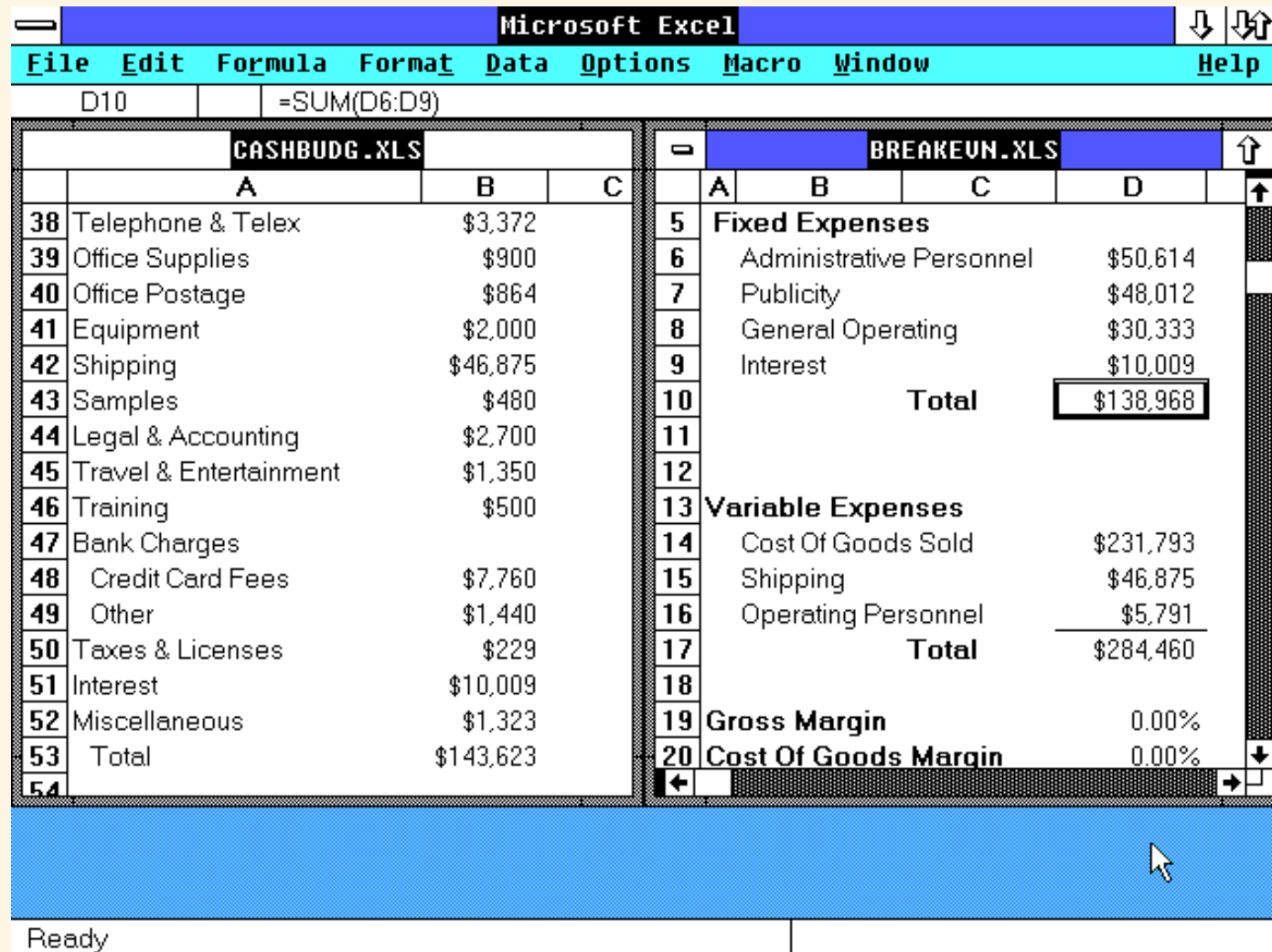
A:A1: 'EMP' MENU

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



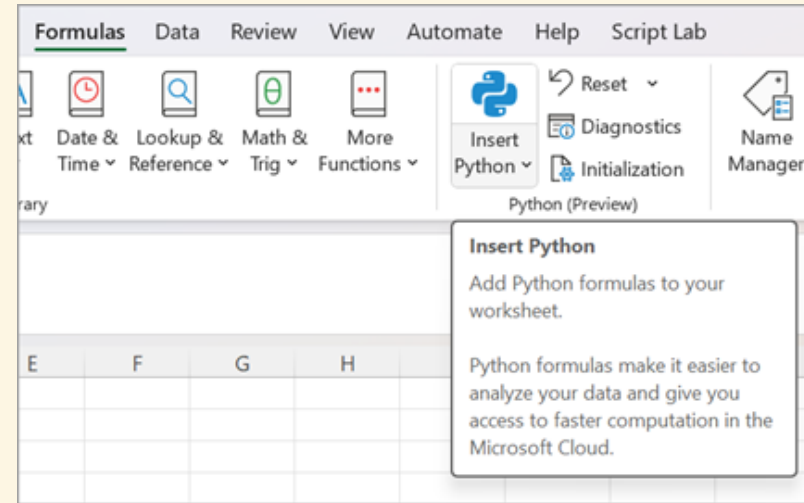
Microsoft Excel, released for Windows in 1987

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 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
```

RETIREMENT PLANNING AND SIMULATION

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.

TWO-STAGE GROWTH MODEL

- 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 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.