quantitative Finance

for Technology-Driven Investment Decisions

ENGRMGMT & FINTECH 534

Spring 2023

Jake Vestal

Meets Tuesdays: 3:30-6:00pm EST

Lecture 1

Syllabus (on Sakai)

On Sakai!

ALL LECTURES SLIDES ARE ALWAYS POSTED ON SAKAI

- Before class, when possible
- Sometimes after class
  - If that class has a lot of “think about it” question-and-answer slides
  - Or if that class requires some up-to-date market data & analysis that makes it hard to upload beforehand

Difference between FINTECH 535 and 522

FINTECH 522

- Entry Level
- Offered in Spring
- Required by FINTECH program
- Covers a wider array of assets

FINTECH 535

- Maybe a little less Entry Level
- Uses modeling in R and Python a little more
- Not required by FINTECH
- Offered in Fall
- Focused more on stock, bonds, and equity options.

Both

- Require the use of Excel
- **HEAVY** emphasis on understanding Markowitz Portfolio Management & CAPM (first few classes)

The Plan for Today

- Course Requirements / Orientation
- Course Overview
- BASIC FINANCE
    - The Basics
    - Risk, Return, and Compounding
    - The meat and potatoes of *any* finance course

Course Requirements

- No Audits...
- Problem Set Format
  - Submit Excel Spreadsheets on Sakai
  - No late Problem Sets
- Exam Format:
  - Done in Excel
  - In person (new this semester)
  - “Open book” format – but don’t let that fool you!

Grading:

Midterm Exam	30%
Final Exam	45%
Problem Sets and Participation	25%

We will model professional behavior as befits professional people like us

Problem Sets

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Background: Jake Vestal

B.S., Chemical Engineering, minor in Mathematics, NC State

M.E.M., Duke University

Wrote algorithm for ship condition monitoring system on Navy warships for fuel savings & performance

Data Analysis consultant

Machine learning for materials characterization and monitoring (concrete, soil, fuel) ? machine learning for funds management for high net worth individuals

Compounding

Definition: A financial instrument is said to be **compounded** when its new value (principal) is re-calculated by applying a % rate.

Expressed as a **rate** in terms of %/time

The names given -- **discount** rate, **interest** rate, rate of **return**, etc… all depend on context, but have the same conceptual meaning.

Some example interest rates:

,

,

All have:

- ☐ A **Value** (5, 0.64, 0.3)
- ☐ A **Basis** (yearly, daily, continuous)

Compounding

Expressed as a **rate** in terms a numeric value and a time basis.

- The **value** component tells you how much the instrument's value changes
- The **basis** component how often, in time, that change is realized (i.e., *compounded*)

For Example:

Consider the value of **$1,000** in an account that earns an interest rate of **1.2%/year**.

START: (Year 0)	**The Next Day:** (Year 0)	**11 Months Later:** (Year 0)	**18 Months Later:** (Year 1)	**40 Months Later:** (Year 3)
	no compounding	no compounding		

Discrete Compounding

Implicitly, we've just been using the definition of **discrete compounding**
(new principal is calculated every period)

compounding rate [%/time period]

Number of periods

Starting principal [$]

Ending principal [$]

Starting period (0)

Discrete Compounding example (
quarterly -> annual)

Consider an interest rate of 3

What is the equivalent annual rate?

Find r_{ann} that satisfies:

=

Discrete Compounding example (annual -> quarterly)

Consider an interest rate of

What is the equivalent effective quarterly (compounded 4x per year) rate?

Find r_{qtr} that satisfies:

=

Discrete Compounding (formal definition)

Rate is broken out into its **value** and **basis**

now means **frequency**

time (1 yr, 2 yr, etc)

compounding rate value [%]

Ending principal [$]

Starting principal [$]

compounding frequency [1/month, 1/yr, 1/qtr…]

Continuous Compounding

We want to know the principal at ANY continuous time *t*

In other words *m*, the compounding frequency [1/month, 1/yr, 1/qtr…] approaches infinity

We're interested in an infinitely high compounding frequency:

Let .

By definition:

Compound Interest formula.

Nominal & Effective Interest Rates

Nominal: Usually calculated simply, but must read the fine print

(See **Handout 2**)

For Example:

Well and good… but…

???

START:
(qtr 0)

Qtr 1:

Qtr 2:

Qtr 3:

Qtr 4:

(the multiple)

Effective:
The rate that is actually realized.

Nominal & Effective Interest Rates

Bottom Line:

Nominal: Used in marketing (not everyone will bother to calculate out the effective rate), (rough) mental estimation

Effective: The real one.

Course Convention: %/yr CCR Implied Basis

Any rate (return, interest, discount, etc) mentioned on its own, without a basis, is understood to mean

% / year, effective, continuously compounded.

- Allows us to compare the returns of different investments, financial instruments & products
- Common practice in financial industry
- Any interest rate represented in this form is said to be "**annualized**" (written on a per-year basis).

Would you rather have 3% compounded quarterly (discrete), or 12% compounded annually (discrete)?

Answer:

Let’s use Handout 2

Interest Rates

Bottom Line:

Any interest rate can be converted to / understood as an equivalent effective annualized, continuously compounded rate.

IRR

Need for homework.

Let’s take a look at Handout 1 (Resources section on Sakai)

Using Solver

Need for homework.

Let’s do an example in Excel