Bryan Routledge
Tepper School of Business
Carnegie Mellon University
Pittsburgh, PA 15213

http://sulawesi.tepper.cmu.edu
GSIA Room 305
routledge@cmu.edu
Phone: 412.268.7588
Mobile: 412.573.9751
Skype: bryanroutledge
Course Canvas Page: **https://cmu.instructure.com/courses/2141**

Mondays 145/NY1

What is Finance?

What is Finance? This is perhaps an odd way to start. After all, you are here for a Masters of Science in Computational Finance. Many of the other classes you take will provide you with specialized knowledge (world-class, knowledge, in my unbiased opinion). However, this course will provide you with an overview of finance that will help you to organize the more specialized knowledge to come.

So, what is finance? Finance is the efficient allocation of resources across time and risk. Think of people (individuals) saving for retirement, businesses (corporations) investing in new factories, and the stock market that connects these two groups. The result (equilibrium) of this mix of individuals, corporations, and markets is financial prices (bond, stock prices) and returns (e.g., interest rates, rate of return). The key result of this interaction for you in your computational finance quant career is risk and risk premiums.

The three groups:

○ Corporations invest in real projects (build a factory, r&d, start a new business). This investment is often called "capital budgeting." To fund the investment corporations raise money by selling securities (debt, equity). This is called "capital structure." Together, the investment decisions and the capital structure decisions determine the payments to investors (dividends, interest). These payments are random and is a big source of "risk."

○ Individuals save and invest to smooth consumption across time (save for retirement, borrow to buy a house) or smooth consumption across risk-outcomes (save for a "rainy day" or insurance). Ultimately, individuals are the owners of corporations and must bear the randomness (risk) of those cash flows. How investors can hedge and cope with the risk determines the level "risk premium" required for that risk.

○ Financial institutions (markets) match the individual saving/borrowing needs of individuals with the investing/cash-flow needs of corporations. The term financial market is covering a lot of activities. For example, stock exchanges (The NYSE), commercial banks (PNC), investment banks (Goldman Sachs), real-estate agents (Howard Hanna), fintech (Equity Zen), are all examples of institutions involved. Financial markets are an important component to risk and risk premiums. First, directly via the ability to buy low and sell high and minimize transaction costs. Secondly, the market structure is also important for extracting and using information. Finally, the market structure drives the "liquidity" (ability to trade) and can mitigate or magnify other risks.

What is MSCF Finance – $MSC(F)^2$

For $MSC(F)^2$, we will hit on all three parts – individuals, corporations, and institutions. The central theme will be understanding the determinants of risk premiums. We will start with a definition and some empirical facts in our first meeting. For now, define the risk premium as:

$$E[\tilde{r}_{i,t+1} - r_{f,t+1}].$$

The pieces of that equation are:

○ $r_{f,t+1}$ is the "risk-free" rate you can earn by holding a bond (say a short term US government bond). Since the pay-out is a known constant (with

some assumptions), this return is risk-free. Notice the subscript $t+1$. This denotes that this risk-free rate does change over time. This variation is a big driver of what you will study in Fixed Income.

○ $\tilde{r}_{i,t+1}$ is the "random" stochastic variable (process) you earn from holding asset i, say a share or Amazon or a forward contract on a barrel of oil, from period t to $t+1$. There are two types of risk premiums of interest. One is the "cross section" that looks at how/why the risk premium of stock i compares to stock j. The second is for aggregate asset classes like equity, bonds, or commodities. For example, the equity risk premium looks at returns to a broad portfolio of stocks.

○ The E is the expectations operator. Modeling and estimating the statistical properties to estimate expectations is a topic in Financial Data Science. Notice that the E here is "physical" or "empirical" or "p-measure." When you get into Multi-Period Asset Pricing you will focus on the "risk neutral measure" or "q-measure" and the expectation will be taken with distorted probabilities. In fact, the difference between "p-measure" and "q-measure" precisely characterizes the risk premium we study in our class.

○ Here I have written it as "unconditional" so you can think of this as the "on average" how much to (say) stocks out-perform bonds (from data, about 6% per year). We will also talk about "conditional" equity risk premium (i.e, the equity risk premium is higher in recession).

We will focus on these issues starting at portfolio choice, with a dive into the simple mean-variance model. This will give us some insight into what drives attitudes towards risk (in equilibrium). Next we will look at the source of risk – corporate cash flows. Corporate cash flows that drive equity and corporate bond returns come from the interplay of two decisions: capital budgeting and capital structure. Capital budgeting or investment policy determines the business. What factories does the company build, what r&d do they do? Capital structure determines the debt and equity funding of the company. The key is that this policy determines how the business cash flows (and risk) gets split across debt and equity. Finally, we will look at financial institutions and markets to understand how market structure contributes to risk and risk premiums.

(And $MSC(F)^2$ for 2017 is a new version of this class. So the notes and handouts will come each week. The schedule might also slide a bit as we sort out the new material.)

Learning Objectives

Having completed the course you will:

- ○ Construct a mean-variance optimized portfolio.
- ○ Understand and estimate a company's cost of capital and "benchmark" for a financial manager.
- ○ Evaluate the cash flows of a project to determine the NPV and explain why this is a sensible investment criterion.
- ○ Calculate/Estimate a cash-flow-based fundamental valuation of an equity.
- ○ Describe the determinants of corporate leverage and its implications for valuation, risk, and risk premiums.
- ○ Describe how the the two key features of market design, competition and information, influence trading cost, liquidity, and risk.

Course Material and Resources

The main source for course materials is our Canvas page:
https://cmu.instructure.com/courses/2141

Text Book: Berk/DeMarzo Corporate Finance 43E (2016) Jonathan Berk and Peter DeMarzo

Earlier editions work perfectly fine for our course (and can be cheaper). The alternative book you might have run across is Brealey/Myers/Allen. If you prefer to use this book (i.e., if someone gave you a copy as a gift or you picked one up on the cheap), that is fine. I can point you to the relevant chapters. However, if you are looking to buy a book that will serve for this course and as a basic reference to finance, and in particular, corporation finance, the Berk and DeMarzo book is a good one. In particular, the Berk/Demarzo book will provide a unified framework that is consistent with the more advanced classes you take later on. Some versions of the book come with on-line homework problems. It is also not necessary that you get the version that comes with the on-line material. The extra homework problems the book provides on line are OK, but not crucial and will not be assigned

Course package and Web Site: The course package includes just the lecture slides. These are not intended as a stand-alone resources. They are just to facilitate our class discussion. I will post newspaper clippings if/when interesting. They are likely worth reading and thinking about. However, the specific details are not relevant for exams.

Office Hours: I will post my office hours on the canvas site. However, I am usually here and can usually accommodate questions, so feel free to stop by. However, most of you are not here often, so feel free to email questions or book a meeting. We can meet via skype, google hangouts, phone, ... whatever suits.

Requirements and Evaluation

Class Participation = 5%
Assignments   = 25%
Midterm Exam   = 20%
Final Exam   = 50%

Participation: You must attend class. Ask some questions and answer some others. Participate in the discussions. Learning happens when you interact with the material. In class, this means dialogue. In order to learn the material and do well on the exam, class attendance is important and therefore mandatory. This is just a small (tiny!) incentive.

(When you speak, please remember to push your microphone button, pause a half a second, say your name, and then speak. That way people from NY and Pittsburgh can all interact together.)

Assignments: Assignments and cases are designed to help you learn and understand the material. Working in small groups is an effective way of learning the material and is encouraged. You may hand in the assignments individually or in groups. A group size of about three or four seems best. However, you are welcome to choose any size group you like (larger or smaller than three is fine). There is also no need to stay in the same group for each assignment. When you turn in your groups assignment, just list all the group members on the first page. Assignments and cases are due at the beginning of your class. Late assignments cannot be accepted.

The assignments will be a mix of "homework-like" and "case-like" problems – I will try to flag the type in the question. The "homework-like" are relatively straightforward tasks that will be familiar from class. The "case-like" problems are more applied and can be more ambiguous. For example, we will do an equity valuation. The spreadsheet part of this task uses the material on valuation via discounting we cover. But building an economic model of the sales growth of a real company is not straightforward, requires judgement, and is fraught with ambiguity. Do not let this deter you. All this complexity and ambiguity requires some practice to get use to. But that is also a feature of all the interesting problems you will face in your career.

Assignments, particularly the ones that are more case-like, are an excellent chance to learn and practice your presentation skills. Give some thought to how the answer looks. (See the note with more detailed suggestions on presentation on the Canvas page). To be clear: When you hand in your (or your group's) homework, expect to deliver professional-looking assignments.

Please note: All assignments will be submitted (a PDF) on Canvas.

Exams: The exam will be roughly 50% qualitative and 50% quantitative. Note: the midterm will be a one-hour, in-class exam (that is, after the one hour exam we will press on to more material). The mid-term comes mid-course but it usually seems early. As a result, it tends to be a bit easier than the final. The exams will be closed book. Only a calculator is needed. Please check the exam schedule to ensure there are no conflicts. A make-up exam is permitted only if there are serious and unusual extenuating circumstances. For example, the school's policy is to not reschedule exams for job interviews or vacations. If you have any questions or concerns about this, please see me as soon as possible.

Other Policies and Procedures

Just to be clear. Please do not consult past editions of this course. For assignments and cases, you can and should chat and consult with your colleagues. However, the final result must be your own (or own groups) work. Looking for past years solutions for hints is not appropriate. If you are unsure if something is correct or allowed, please ask.

Finally, I appreciate your help with the following. Please, arrive on time. This is not the sort of course where laptop use during class is helpful (for assignments

and cases, laptops will be humming.) I would appreciate it if you focus on asking questions and making comments rather than computing. I have no hard evidence on this, but I have heard through several sources that people occasionally surf the web or check e-mail during class. While this is just a rumor, lets be clear: No web surfing, e-mailing, twittering during class! Each of these issues seems a bit trivial. However, lectures are more productive (and, for me, more fun) if they include active discussion. All of these items are suggestions of students who have previously taken the course.

A Reminder from CMU Provost Laurie Weingart

"... Take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at `http://www.cmu.edu/counseling/`. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help... "

Topics, Schedule, and To-do's

See the Canvas Page for the most up-to-date version.

1 2017-08-28   **Risk Premiums and Portfolios**

- Risk and Risk premiums

  - Empirical Facts - Returns by asset class

- Portfolio Choice – Investor Perspective on Risk

  - Consumption and Saving
  - Potfolio Selection
  - Means, variances, and co-variances

2 2017-09-11   **Equilibrium and Portfolio choice**

- Cross section of risk premiums

  - The Capital Asset Pricing Model (CAPM)
  - Understanding the "cross-section" determinants of risk premiums (Why is this stock more "risky"?)
  - Factor Model and Equilibrium

- Aggregate Risk Premium

  - The equity risk premium
  - Asset class risk premiums

Due: Assign 1

3 2017-09-18   **Cash-Flow Risk and Corporate Decision Making**

- Net Present Value

    - Seperating "ownership" and "control"
    - NPV and corporate investing
    - (NPV and/vs arbitrage)

- Cost of Capital

    - Discounted Cash Flows (DCF)
    - Risk-Adjusted Discounting
    - Practice of "capital budgeting" (corporate investing)

Due: Assign 2

4 2017-09-25   **(1) Midterm Exam [first hour] - (2) Fundamental and Quantitative Equity Strategies**

- How do you "value" a stock

    - Basics of a "fundamental" cash-flow-based valuation of a company
    - Everybody needs to learn accounting! We only have time for a quick skim. Accounting statemetns is where you get information.
    - How does "fundamental" compare to "quant" equity strateguies?

5 2017-10-02   **Corporation Finance Capital Structure**

○ Debt Policy

  ○ The (crucial!) difference between investment policy that determines the cash flows to the "business" and capital structure that deterines the cash flows to the equiry or debt investor.
  ○ Debt policy - The "Miller Modigliani Theorem"
  ○ Debt policy - In Practice

6 2017-10-09 **Financial Markets - Trading**

  ○ Information and Competition

    ○ Markets are a type of "auction."
    ○ What determines the difference between "value" of the secruity and your "bid" (or "ask")
    ○ How does this influence the prices (and returns) we see

  ○ "Efficient Market Hypothesis"

    ○ Empirical evidence on the information in financial prices

  Due: Assign 3

7 2017-10-16 **Financial Markets - Intermediation**

- What is "Liqudity"?
- Market Types

  - Centralized verus decentralized trading

- Financial intermediation and innovation

  - Asset backed securities
  - Fintech

Due: Assign 4

2017-09-25	**Midterm**
17:30-18:30	In class 1 hour
2017-10-21	**Final Exam**
12:00-14:00	2 hours