

# About this Study Guide

First I want to offer you my condolences for having to take this exam. Much of the material is interesting (*I know that is hard to believe*), but there is just too much!! I found myself overwhelmed by the amount of material even though it is the third edition. I spent many late nights working on the first edition of this study guide, and many more revising it for this year.

Enough of the sob story!! If I did my job right, this manual should help you obtain a passing score on your first attempt. After all, one time to study for this exam is definitely enough.

This manual is consistent with the syllabus for the 2009 exam. The SOA changed the syllabus from the prior year, but not too much.

The JAM Study Guide is divided into three major parts.

1. Detailed Outline of Each Section (1 to 5)

I tried to highlight the main points and clarify the confusing sections. Use this part of the manual when you are reading and outlining the material (see the "Study Method" page). I included sample problems with complete solutions for some of the material. I also recommended problems to work in the chapters. Please take the time to do these. It will really help you better understand the material.

2. Condensed Outline

This is the section I recommend memorizing for the essay portion of the exam (see the "Study Method" page). This outline is very long, but that is just a function of the syllabus size. If it is too much for you to memorize, knock off lists you think are not likely for the exam. Also, some lists you will just "know" without having to memorize. I tried to consolidate lists when a topic was covered in multiple study notes or books.

3. Practice Problems

Don't try these until you have been through the entire material and have worked all the book sample problems. These include questions from prior SOA exams (Course 8V) that are relevant for Financial Economic Theory. Over 30 original essay questions have solutions in a grading outline format. I highly recommend you work all of these before the exam. Also, pay particularly close attention to the grading outline solution so you will know how to structure your answer.

Good luck with your studies. There are many more important things in life than exams, so don't let this monster exam consume all of your time!

# About the Author

## Family

I have been happily married for eighteen years to my wife Bonnie. We are the proud parents of six wonderful children. Seth is thirteen and is in constant motion (body and mind). Madeline is also thirteen and loves to act and hang out with her sisters. Lauren is fourteen and loves sports (especially basketball and running). Katherine is fifteen and simply likes to be with people. Jonathan is sixteen and likes camping, computers, and math (actuarial future??). Sandy is nineteen and quickly becoming a charming lady! (Does that mean I am old??) . You can see the family photo at [www.studyjam.com](http://www.studyjam.com).

## Career

I have now been in the actuarial field for eighteen years. Currently, I am a self-employed actuarial consultant located in Nashville, Tennessee. I work primarily with insurance companies and other parties in product development (life and annuity), asset/liability management, and valuation. Prior to being self-employed I worked at Thornthwaite & Co (an actuarial consulting firm) and two insurance companies: Providian and AmerUs. If you need a consultant, don't hesitate to call!

## Genesis of JAM

In the fall of 1991, I took my final three exams needed to obtain my ASA. Since they were three small exams, I decided to take one small upper level exam just for practice. I studied for the upper level exam like I did in college for essay type tests - read the material several times. I thought I was ready for the exam. In fact, after I took the exam, I thought I had passed! I did pass the three exams needed to obtain my ASA, but I only scored a 3 on the upper level exam. That was a big blow to my confidence. I talked to Terry Reynolds, a fellow student at Providian, about my poor grade. She explained her method for studying for the upper level exams (and even gave me her notes for exams 200 and 220). I used her method with a few modifications for the rest of my upper level exams. It worked for me! In fact, I scored a 10 on 200, 210, and 220 (after that I figured out how not to over study!).

Just Actuarial Material (JAM) was established in 1998 to prepare people for specific SOA essay exams. Starting in 2000 (when the exam system changed) study guides and seminars were offered for Courses 5 and 6, the two essay exams required for all actuaries. The popularity of the JAM products grew over the years through word-of-mouth advertising from satisfied customers. In 2007 JAM began preparing candidates for the essay exams on the SOA Investment track – Financial Economic Theory and Engineering and Advanced Portfolio Management.

Michael S. Carmody, FSA

# Supplemental Products

## JAM Cards

Over the years many people have told me how index cards have helped them memorize the lists and formulas. Under the new exam structure with very large exams, simply making these index cards can be a very time consuming process. While actually writing your own cards may help you memorize the material, it might not be time-efficient. Because of this, I have created JAM Cards that will be consistent with the Condensed Outline in the Study Guide.

The JAM Cards will have the title of the list on one side and the actual list on the other. A reference at the bottom of each card will link the list to the applicable page in the JAM Study Guide and the source book or study note. The small and compact size of the cards will allow you to carry them with you everywhere. I realize the thought of that may not sound appealing, but the final memorization phase is crucial to passing the exam. Utilizing all of those free moments in the car and waiting in lines could make the difference.

Mnemonics are also included for some of the longer lists. The mnemonic will be related to the list topic to ease the memorization strain. I realize mnemonics do not help everybody memorize lists, so I have included all the cards without mnemonics also. You can simply substitute the mnemonic cards at your discretion. For some, mnemonics will greatly simplify the memorization process.

# General Exam Overview

## Types of Questions

There are primarily three types of questions that are asked on the essay portion of upper level exams:

**1) Regurgitative** - These are the easiest questions to create, grade, and answer. The question is looking for a specific answer from a specific study note. If you know the answer, it will be a piece of cake! If you don't, ... It is best to answer these questions in an outline format. The main points on the outline are usually from a list you have memorized. After you write down the main points you have memorized, you can add the sub-points from your recollection. These have historically been a common type of question on the upper level exams. However, a conscious shift away from this type of question has taken place the last few years.

**2) Problem Type** – These are the questions in which you actually get to use your fine actuarial calculator! The problem may be straightforward and only require formulas from the syllabus. More often than not, the problem will have a twist that will require some extra thought. Problems can even be created from sections of the syllabus that were not problem-oriented. This type of question is common because it requires thinking rather than just memorization.

**3) Creative** – These are the hardest to create, grade, and answer. Usually this will only be part of a problem. For example, if you were asked to evaluate certain methods and give your recommendation, the recommendation part would be creative. There is no “right” answer, only qualitatively “good” and “bad” answers. You usually must have a good grasp of the entire syllabus to write an effective answer.

## General Test-Taking Tips

1. **Answer the Question** – You can write a whole bunch (and even be accurate), but if it doesn't pertain to the question, you won't get credit.
2. **Write the Main Points First** – More credit is given for main points than minor points. Before you go into a lot of detail, get the major points down.
3. **Use Outline Format** – Most questions can be answered better (and more quickly) in an outline format than in a paragraph. Don't waste time writing complete sentences.
4. **Think for Problems** – Problems on the exam will generally require you to think. This is difficult after answering a regurgitative type question in which you relied solely on memory. Be prepared to solve a *new* problem.

# Study Method

Here is the method I recommend to use for Financial Economic Theory and Engineering. It is a slight revision of the method I used when taking the exams under the *old* system. Because of the large amount of material on the exam, I recommend just one thorough reading of the source material rather than two. Obviously you will want to make modifications to fit your needs. Hopefully this will give you some help!

1. Read through the syllabus and edit the detailed outline in this study guide. Take the time to really understand the difficult parts. Work sample problems in appropriate sections (you can find problems in the source material, this manual, and past exams). Feel free to add, delete, or modify the study guide detailed outline to make it have more meaning for you. This should take about 12 weeks.
2. Read though the detailed outline you created in step one. Re-read the source material on sections that are still confusing. Then adjust the detailed outline so it makes more sense for you. Re-work sample problems in sections that you found difficult.
3. Make a very condensed outline to memorize. This will help you answer the regurgitative type questions. There is a limit to how much you can realistically memorize, so take this into account when making your list. The outline should only cover the key phrases needed to answer the main points in a question. The details (which are worth fewer points) can be added at exam time from your general recollection. Without having the key points memorized, a whole question can be blown! You can start with the condensed outline provided in this manual and make your own personal modifications. Modifying this list should only take a few days.
4. Final preparation. During the last two or three weeks before the exam, spend your time memorizing the list, reading and re-reading the detailed outline, and working sample problems. This will prepare you for the various types of exam questions (*and get the test-taking kinks out after a six-month break*). When the exam time comes, you will be ready!

## Daily Study Schedule

Many of you will study more than four months to prepare for this exam. It is important to budget your time carefully. Without a specific plan you may wonder if you are doing enough each day. I strongly recommend you make a daily study schedule so you will be confident your preparation will be complete by October 29<sup>th</sup>. There is a suggested daily study schedule available on my web site. You can download the spreadsheet from [www.studyjam.com](http://www.studyjam.com).

# FEEDBACK

JAM is produced for *you*, the actuarial student. Your opinion is valuable in helping to make the JAM study materials meet your needs. Please take the time to give me some feedback (positive or negative). I would really appreciate any advice on how to improve this manual.

Also, if you find an error in the manual please let me know via email. I will place the corrections on my web site.

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**You can find the errata for this study guide at [www.studyjam.com](http://www.studyjam.com).**

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# Section 1: Modern Corporate Financial Theory

## Overview: Definitions of Capital, Sources and Uses, and Optimal Structure

- a. Explain the various definitions of capital, including regulatory, rating agency and other risk-based capital requirements, the context in which they are appropriate, and how they affect decisions.

## Cost of Capital

- b. Calculate the cost of capital for a venture or a firm using the most appropriate method for given circumstances and justify the choice of method.
- c. Evaluate various profitability measures including IRR, NPV and ROE, etc.

## Economic Capital

- d. Define and compare risk metrics used to quantify economic capital and describe their limitations.
- e. Apply the concept of economic capital and describe methodologies for allocating capital within a financial organization.

## Regulatory and Rating Agency Issues

- f. Identify regulatory capital requirements and describe how they affect decisions.
- g. Identify the goals and methodologies of rating agencies and how their rating activities affect financial institutions and the choice of capital structure.

## Corporate Structure

- h. Recommend a specific legal form of organization and justify the choices.
- i. Recommend specific firm governance measures and justify the recommendation.
- j. Identify sources of agency costs and methods to address them.

# Financial Theory and Corporate Policy (4<sup>th</sup> edition) by Copeland

## Chapter 2: Investment Decisions: The Certainty Case

### Introduction

In the investment decision, must decide how much to not consume today so as to enjoy more consumption in the future

Should maximize expected utility over the planning horizon

Individuals, corporate managers, and public sector managers must all make the allocation between current and future consumption

Initially interest rates are known and constant

Also assume there are no imperfections in capital markets

The firm objective is to maximize the wealth for its shareholders

### Fisher Separation: The Separation of Individual Utility Preferences from the Investment Decision

It is difficult to determine individual utility functions (how happy is happy?)

Assuming no market friction, individuals can delegate investment decisions to firm managers

Managers should choose to invest until the rate of return equals the market-determined rate of return

Maximizing shareholders' wealth is equivalent to maximizing the present value of their lifetime consumption

$$W_0 = C_0^* + \frac{C_1^*}{1+r}$$

This implies the slope of the capital market line is  $-(1+r)$

The individual shareholders all prefer the same investment decisions at the firm (called the unanimity principle)

The individuals can adjust for their risk/reward tolerance by borrowing or lending at the risk-free rate

### The Agency Problem

The shareholders' wealth is the present value of cash flows discounted at the opportunity cost of capital

Owners must find a way to monitor (at a cost) the behavior of managers

Owners must balance the monitoring costs with incentive-type compensation (e.g. stock dividends)

## Shareholder Wealth Maximization

### Dividends vs. Capital Gains

Shareholder wealth could be defined as the present value of future dividends

$$S_0 = \sum_{t=1}^{\infty} \frac{Div_t}{(1+k_s)^t}$$

The above formula works if the dividends and discount rates are known with certainty

The effect of capital gains is effectively in the formula above

If the dividend stream is growing at a rate  $g$ ,

$$S_0 = \frac{Div_1}{k_s - g}$$

### The Economic Definition of Profit

Economic profits equal the mean rates of return in excess of the opportunity cost for funds

To determine this, must know the timing of the cash flows and the opportunity cost

In this section, dividends include any cash flows that *could* be paid to shareholders; this includes items such as capital gains, spin-offs to shareholders, and repurchase of shares

Assume you have an all-equity firm in a no-tax environment

The sources of funds are revenues ( $Rev$ ) and sale of new equity ( $m$  shares at  $S$  dollars per share)

The uses of funds are wages, salaries, materials, and services ( $W \& S$ ); investment ( $I$ ); and dividends ( $Div$ )

For each time period,

$$Sources = Uses$$

$$Rev_t + m_t S_t = Div_t + (W \& S)_t + I_t$$

Assuming no new equity is issued,

$$Div_t = Rev_t - (W \& S)_t - I_t$$

$$S_0 = \sum_{t=1}^{\infty} \frac{Rev_t - (W \& S)_t - I_t}{(1+k_s)^t}$$

The accounting definition does not deduct gross investment; rather, it deducts a portion as depreciation (dep)

$$NI_t = Rev_t - (W \& S)_t - dep_t$$

Can reconcile the two definitions by realizing the change in asset book value during the year is the gross investment less the depreciation

$$\Delta A_t = I_t - dep_t$$
$$S_0 = \sum_{t=1}^{\infty} \frac{NI_t - \Delta A_t}{(1 + k_s)^t}$$

The economic definition focuses on the actual timing of cash flows

Managers should not just try to maximize earnings per share, which is based on accounting profits; rather, should maximize shareholder value

For example, FIFO (first-in, first-out) accounting method results in higher earnings per share but lower cash flows because more is paid in taxes

So LIFO (last-in, first-out) is better for shareholder value even if it is worse for earnings per share

### **Capital Budgeting Techniques**

Problems for managers making investment decisions

1. Searching out new opportunities in the market
2. Estimating expected cash flows of projects
3. Evaluating projects according to sound decision rules

Criteria for essential property of maximizing shareholder value

1. All cash flows should be considered
2. Cash flows should be discounted at the opportunity cost of funds
3. Select from mutually exclusive projects the one that maximizes shareholders' wealth
4. Consider one project independently from others (value-additivity principle)

Summing the values of all the projects will compute the firm value

Widely used capital budgeting techniques

1. Payback method
2. Accounting rate of return (ARR)
3. Net present value (NPV)

This is the only method consistent with shareholder maximization

4. Internal rate of return

### Cash flows for four mutually exclusive projects

Year	A	B	C	D	PV Factor @10%
0	-1000	-1000	-1000	-1000	1.000
1	100	0	100	200	0.909
2	900	0	200	300	0.826
3	100	300	300	500	0.751
4	-100	700	400	500	0.683
5	-400	1300	1250	600	0.621

### The Payback Method

Project A has the shortest payback method, only 2 years

However, this method does not consider all the cash flows and does not discount them

This violates the first two criteria for maximizing shareholder value

### The Accounting Rate of Return (ARR)

The ARR is the average after-tax profit divided by the initial cash outlay

Similar to the return on assets (ROA) and the return on investment (ROI)

Assuming the cash flows in the table above are profits, the average after-tax profit for project A is:

$$\frac{-1000 + 100 + 900 + 100 - 100 - 400}{5} = -80$$

And the ARR is  $-80 / 1000 = -8\%$

Project B has the highest ARR at 26%

The problems for the ARR method is it uses accounting profits instead of cash flows and does not consider the time value of money

### Net Present Value (NPV)

The net present value is simply the present value of the free cash flows less the initial investment

$$NPV = \sum_{t=1}^N \frac{FCF_t}{(1+k)^t} - I_0$$

Using the table above, just multiply the product cash flows by the discount factors

Should accept projects that have a NPV greater than zero

Project C has the highest NPV of 530.85

If the projects are mutually exclusive, then only Project C is accepted

If the projects are independent but not mutually exclusive, then accept Projects B, C, and D since they all have positive values

### Internal Rate of Return (IRR)

The IRR is the rate which equates the present value of cash outflows and inflows

Solve for the rate that makes the NPV = 0

$$NPV = 0 = \sum_{t=1}^N \frac{FCF_t}{(1+IRR)^t} - I_0$$

Project D has the highest IRR of 25.4%

Should accept any project that has an IRR greater than the cost of capital

Of course can only accept one project if they are mutually exclusive

### **Comparison of Net Present Value with Internal Rate of Return**

IRR and NPV can lead to different project choices

NPV is appropriate because it uses the market-determined opportunity cost of capital

The IRR method does not discount at the opportunity cost of capital

### The Reinvestment Rate Assumption

The NPV approach assumes shareholders can reinvest at the market-determined opportunity cost of capital

Under the IRR method, it is assumed shareholders can reinvest at the IRR

### The Value-Additivity Principle

IRR does not adhere to the value-additivity principle

The results change when different projects are combined

NPV always follows the value-additivity principle

### Multiple Rates of Return

There will be multiple IRR solutions when the sign changes more than once in a cash flow stream

Could use the opportunity cost of capital to accumulate the positive cash flows in the calculation to eliminate the multiple roots

This makes sense because the cash flows lent to the firm should be at a reasonable rate

### Summary of Comparison of IRR and NPV

Problems with IRR

1. Does not obey value-additivity principle
2. Assumes funds invested in projects have opportunity costs equal to the IRR for the project
3. Cash flows cannot be discounted at the market-determined cost of capital
4. Multiple roots can emerge if the sign of the cash flows change more than once

### **Cash Flows for Capital Budgeting Purposes**

This section adds debt and taxes

Investment funds can be provided by creditors and shareholders

Debt holders expect to receive a stream of payments unless the firm is bankrupt; shareholders get the residual value

Both creditors and shareholders should receive their expected risk-adjusted rates of return

Use the following assumptions in a simplified example

An initial investment of \$1000 is required to buy equipment that will depreciate at \$200 per year for 5 years

The owners will borrow \$500 at 10% interest

The cost of equity is 30%

The table below illustrates the pro forma income statement

Rev	Revenue	1300
- VC	Variable costs	-600
- FCC	Fixed cash costs	0
- dep.	Noncash charges (depreciation)	-200
EBIT	Earnings Before Interest and Taxes	500
- $k_d D$	Interest Expense	-50
EBT	Earnings Before Taxes	450
- T	Taxes @ 50%	-225
NI	Net Income	225

Assuming the residual cash flows continue forever,

$$S = \frac{\text{Residual Cash Flow}}{k_s} = \frac{225}{30\%} = 750$$

The present value of the bondholders' wealth, B, is:

$$B = \frac{\text{Interest Payments}}{k_b} = \frac{50}{10\%} = 500$$

Thus, the market value of the firm, V, is:

$$V = B + S = 1250$$

Define the weighted average cost of capital (WACC) in the following manner:

$$k = WACC = k_b (1 - \tau_c) \left( \frac{B}{B + S} \right) + k_s \left( \frac{S}{B + S} \right) = (0.10)(1 - 0.5)(0.4) + (0.30)(0.6) = 20\%$$

Cash flows for capital budgeting purposes is free operating cash flows minus taxes on free operating cash flows

$$\begin{aligned} & (\Delta Rev - \Delta VC - \Delta FCC) - \tau_c (\Delta Rev - \Delta VC - \Delta FCC - \Delta dep) - \Delta I \\ & = (\Delta Rev - \Delta VC - \Delta FCC)(1 - \tau_c) + \tau_c \Delta dep - \Delta I \\ & = EBIT(1 - \tau_c) + \Delta dep - \Delta I \end{aligned}$$

Notice the cash flows are independent of the capital structure (debt and equity mix); that is taken into account in determining the WACC

Discounting at the WACC separates the investment decision of the firm from its financing decision

Must assume the capital structure stays constant or the cost of capital would change each period

The definition of cash flows includes working capital requirements

## Relaxing the Assumptions

Will need to introduce uncertainty

Also must account for manager flexibility (e.g. could defer the start date, increase or decrease the scale)

This means the NPV approach systematically undervalues every project

## Recommended Problems

You can certainly work all the problems, but the ones below are particularly valuable in your exam preparation.

1, 4, 5, 8, 9

## Solutions to Recommended Problems

1. First calculate the net income:

Revenue	140,000
Variable and fixed costs	-100,000
Depreciation	-10,000
Earnings Before Interest and Taxes	30,000
Interest Expense	-0
Earnings Before Taxes	30,000
Taxes @ 40%	-12,000
Net Income	18,000

$$\begin{aligned}CF &= (\Delta Rev - \Delta VC - \Delta FCC)(1 - \tau_c) + \tau_c \Delta dep - \Delta I \\ &= (140,000 - 100,000)(1 - 0.4) + (0.4)(10,000) = 28,000\end{aligned}$$

$$CF = EBIT(1 - \tau_c) + \Delta dep - \Delta I = (30,000)(1 - 0.4) + 10,000 - 0 = 28,000$$

$$NPV = \sum_{t=1}^{10} \frac{28,000}{(1.12)^t} - 100,000 = 58,200$$

4. Calculate the net cash flows and discount back at 12% to find the net present value

At time  $t = 0$  (buy new machine, sell old machine, take tax loss on sale)

$$-100,000 + 15,000 + (40,000 - 15,000)(0.4) = -75,000$$

In years 1 to 8 (increase in earnings, tax savings from new depreciation amount)

$$\sum_{t=1}^8 (1.12)^{-t} \left[ (31,000)(1 - 0.4) + \left( \frac{100,000 - 12,000}{8} - \frac{40,000 - 0}{8} \right) (0.4) \right]$$

$$= (4.968)[18,600 + 2400] = 104,328$$

In year 8 (salvage value of new machine)

$$(1.12)^{-8} (12,000) = 4,847$$

Note there is no tax effect because this portion of the investment was never deducted for tax purposes; only 88,000 was deducted over the life of the new machine

$$NPV = -75,000 + 104,328 + 4,847 = 34,175$$

5. Note the financing of the project is irrelevant.

$$NPV = \left[ (3000)(1 - 0.4) + (0.4) \left( \frac{10,000}{5} \right) \right] (2.991) - 10,000 = -2,223.40$$

8. The financing information in this project is also irrelevant.

The annual cash flows are increased due to the revenue increase, cost reduction, and tax savings from the depreciation:

$$[200 + 360](1 - 0.4) + (0.4) \left( \frac{1200}{3} \right) = 496$$

$$NPV = \left\{ \sum_{t=1}^3 (1.10)^{-t} 496 \right\} - 1200 = 33.55$$

9. First calculate the cash flow difference with and without the proposal

$$CF = (\Delta Rev - \Delta VC - \Delta FCC)(1 - \tau_c) + \tau_c \Delta dep$$

$$= (0 - -290 - 0)(1 - 0.5) + (0.5)(180) = 235$$

Then calculate the NPV at the weighted average cost of capital

$$NPV = \left\{ \sum_{t=1}^5 (1.10)^{-t} 235 \right\} - 900 = -9.12$$