

PAK Study Manual

Foundations of CFE (CFE) Exam
Spring 2022 Edition



PAK Study Manual for CFE Spring 2022



PRODUCT FEATURES

Features	PAK Study Manual	PAK Exam Aid	PAK Flash Cards	PAK Test Aid	PAK Study Manual Package	PAK Online Seminar + PAK Study Manual Package
Summaries	X				X	X
Relevant Past Questions (List)	X				X	X
500+ Practice Questions	X				X	X
10 Mock Questions	X				X	X
Suggested Schedule (Detailed)	X				X	X
Spreadsheets (for Calculations)	X				X	X
PAK Video of the Week	X				X	X
Email Support	X				X	X
110 Mock Questions		X			X	X
700+ Practice Questions		X			X	X
Case Study Analysis		X			X	X
Case Study Questions		X			X	X
Past Questions (Sorted PDFs)		X			X	X
Electronic Flash Cards			X		X	X
PAK Audio + Anki Flash Cards			X		X	X
Condensed Summary			X		X	X
Mock Exam				X	X	X
Bonus materials					X	X
Online Videos						X
Past Question Video						X
Mock Questions						X



PAK STUDY MANUAL

A printed copy of the manual can be purchased separately.

1. Summary (New)

The PAK Study Manual covers the entire Foundations of CFE (CFE) syllabus. Not only does it give you the detailed explanations on conceptual, calculation, and exam materials, but it also fills in the gaps among the topics that are not covered in the source readings. It helps you better understand and master the confusing logics and difficult materials. In addition, it links the similar topics across readings together and connects them to the syllabus so that you can see the whole picture of this exam.

2. Relevant Past CFE/FETE SOA Exam Questions (List)

For each reading, we compose a list of relevant past exam questions (if any) so that you can locate the questions quickly and practice them immediately. This saves your time on searching what materials are relevant to this exam.

3. 500+ Practice Questions

One key point to pass this exam is to "practice" (Practice makes perfect!). Due to this reason, we include many practice questions in each reading to refresh the materials just learnt and to strengthen your knowledge. More practice will be available in the PAK Exam Aid.

4. 10 Mock Exam Questions

The mock exam questions mimic the same difficulty level of the real exam questions. 10 mock exam questions and solutions are included in the PAK Study Manual to challenge your understandings. More practice will be available in the PAK Exam Aid.

5. Suggested Study Schedule (Detailed)

The syllabus is huge. It is very easy to lose track on your study. A clearly defined study schedule and some useful tips are included to help you better manage your schedule.

6. Spreadsheets (for Calculations) (New)

Useful spreadsheets are included to clarify the calculations in the syllabus.

7. PAK Video of the Week (New)

Useful videos (such as explaining calculations, reviewing confusing topics, etc.) will be posted each week.

8. Email Support

Get questions? Please send me an email

“The study materials were very helpful in preparing me for the exam. Most importantly I was better able to apply the things that I learned to exam style questions.”
By Marc Roberts

[Read the whole story](#)

DO YOU KNOW?

The PAK Study Manual and related aids are updated EVERY exam sitting.

You will see the most updated materials, examples, and explanations to help you master the concepts and pass this exam in the first attempt.

PAK FLASH CARDS

A printed copy of the flash cards can be purchased separately.

1. Electronic Flash Cards

- ◇ Summarize the key points in organized format
- ◇ Include pros/cons, definition/description, etc
- ◇ Contain around 400+ front/back flash cards (or 800+ slides)
- ◇ Read them in your smart phone device, tablet device, and/or computer
- ◇ PDF version is also available

2. Audio + Anki Flash Cards

- ◇ You can load them to your smartphone device and listen to them anytime/anywhere you want.
- ◇ An Anki version is available.

3. Electronic Condensed Summary

- ◇ Summarize the key points in outline format
- ◇ Quickly refresh all the important topics in the readings

PAK TEST AID

1. Mock Exam

- ◇ This set of mock exam is different from those mock questions available in the PAK Exam Aid. You can write down your answers and send them to me. I will give you detailed feedbacks on how to improve your exam score

PAK EXAM AID

1. 110 Mock Exam Questions and Solutions (with Case-Study-Related Questions and Spreadsheet-Based Calculations) (New)

The mock exam questions mimic the same difficulty level of the real exam questions. 110 mock exam questions and solutions are included to challenge your understandings. They also include case-study-related questions and spreadsheet-based calculations.

2. 700+ Practice Questions

One key point to pass this exam is to "practice" (Practice makes perfect!). Due to this reason, we include many practice questions in each reading to refresh the materials just learnt and to strengthen your knowledge. They are different from the practice question set in the manual.

3. Case Study Analysis (New)

The SOA provide a case study for this exam. We will conduct a detailed analysis on the case study and give you many ideas on how the materials in the syllabus can be linked to the case study, and help you better prepare for the exam.

4. Case Study Practice Questions (New)

A set of case-study-related practice questions is included to help students better understand how to answer case study questions.

5. Past SOA Exam Questions (from All FSA Tracks) Relevant to This Exam

This set not only includes the past exam questions from the CFE/FETE exam, but also includes the past exam questions from all the other FSA exam tracks (e.g. FETE, APM, CSP, DP, etc). It helps you better understand how the materials were tested and gets you familiar with the SOA exam question style.

DO YOU KNOW?

You can find the most updated information about the PAK Study Manual and related aids under the "Announcement" section on the front page of the PAK website.

"The PAK study package is fantastic! Paul and Eddy are very helpful and quick to answer any questions" By Sarah Bryant

[Read the whole story](#)

RELEASE SCHEDULE

Features	PAK Study Manual	PAK Exam Aid	PAK Flash Cards	PAK Test Aid	PAK Study Manual Package	PAK Online Seminar + PAK Study Manual Package
Summaries	11/15				11/15	11/15
Relevant Past Questions (List)	12/15				12/15	12/15
500+ Practice Questions	12/15				12/15	12/15
10 Mock Questions	11/15				11/15	11/15
Suggested Schedule (Detailed)	11/15				11/15	11/15
Spreadsheets (for Calculations)	12/15				12/15	12/15
PAK Video of the Week	12/15				12/15	12/15
Email Support	Anytime				Anytime	Anytime
110 Mock Questions*		2/15			2/15	2/15
700+ Practice Questions		2/15			2/15	2/15
Case Study Analysis*		2/15			2/15	2/15
Case Study Questions*		2/15			2/15	2/15
Past Questions (Sorted PDFs)		12/15			12/15	12/15
Electronic Flash Cards			12/15		12/15	12/15
PAK Audio + Anki Flash Cards			2/15		2/15	2/15
Condensed Summary			12/15		12/15	12/15
Mock Exam				3/15	3/15	3/15
Bonus materials					To be announced	To be announced
Online Videos						11/15
Past Question Video						2/15
Mock Questions						2/15

* The release schedule of these items may be changed. It depends on when the SOA will release the new case study.



DO YOU KNOW?

If you are not sure which exam track to take, or how it can advance your career, you can send an email to Paul or Eddy and discuss your situation with them. They will share their work experience with you so that you can make your decision informatively.

PAK ONLINE SEMINAR

1. Over 80 videos to clarify and explain the key concepts/calculations in the readings of the entire syllabus
2. Discuss the past exam questions and what questions might be asked on the upcoming exam
3. Videos reviewing exam tips and techniques that can help you to maximize your score
4. Review the new version of the case study and discuss which sections are important, and how they might be tested
5. Contain condensed outlines for each reading
6. Review the lectures and study at your own pace, on any PC, Mac, smartphone, and/or tablet device
7. Instructor support via email and PAK Forum support to help you to clarify any section of the syllabus
- 8. Free access for 2nd attempt**

SAMPLES?

You can find more samples on the [PAK](#) website.

IMPORTANT NOTES

1. Please note that all products are in electronic (PDF) format. **No** hard copy is provided.
2. Once you make a purchase (please use your work email address), we will send you a confirmation email within 1 business days. Once the files are available, we will send them to you through email. Please make sure that you put the correct email address when you purchase the PAK products. **If you do not receive the confirmation email, please send us an email (services@pakstudymanual.com).**
3. Please check your “junk” mailbox. Sometimes, our email is blocked.

MORE INFORMATION

Want more information? Please contact us at eddy.chan@pakstudymanual.com, paulpeterson@pakstudymanual.com, or visit www.pakstudymanual.com

COMMENTS FROM THE PAST CANDIDATES

You can find more comments from the past candidates here: [PAK Testimonials](#).

WHERE TO PURCHASE PAK PRODUCTS

The PAK products are available at [Actex](#), and [Actuarial Bookstore](#).

Frequent Answer Questions

Do You Need to Read the Source Readings?

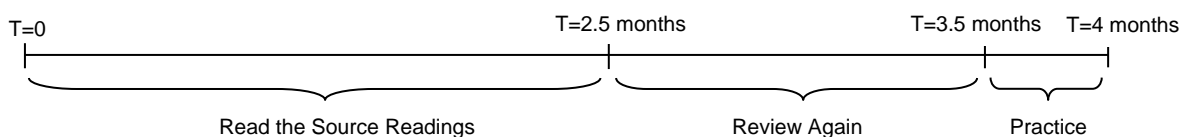
Unlike the preliminary exams, reading the source readings (textbooks, SOA study notes, and online readings) is ***a must*** in the FSA exams. PAK Study Manual can help you understand the materials faster and memorize them quickly so that in the time-limited environment, you can be well-prepared for the exam.

How Much Time is Needed to Study for This Exam?

This varies by person. Usually it will take one 350-400 hours to study for a FSA exam (5-hour). Please expect to spend the same amount of time for the CFE exam.

Study Schedule

From the date the SOA release the new syllabus to the exam date, there are around 4 months to study. How to plan your study schedule?



Read the Source Readings

Assume you take the CFE exam in this exam sitting. In general, it will take one 2 to 2.5 months to finish them. To study more efficiently, we highly suggest you following the steps below:

Step 1: Define Your Own Study Schedule

- Use the suggested study schedule as a reference
- Prepare your own study schedule (*Target 20-30 pages @weekday and 50-60 pages @weekend*)
- Expect to read the whole syllabus and the past exams 2 or 3 times before the exam

Step 2: Read the Source Readings Together with the PAK Study Manual

- Write down your notes in the study manual
- Highlight all the key points there (*Will be used for memorization later*)
- Label any calculations that you will go over again later
- Go over the related past exam questions once you finish that reading

Step 3: Practice the SOA Past Papers

- Practice them once you finish your first-round of readings (*use the PAK Exam Aid*)
- Understand how the topics were tested and how the questions were answered

Review Again

After completing the three steps above, you probably have a general idea about how the exam looks like. Now you should review the source readings again but this time focus more on the key topics, clarify the confusing concepts/calculations, think of what can be tested and read them carefully (use our mock exam questions)

Practice

The last month is the most critical month. Here are the steps:

- Practice the past exams and our mock questions to identify what you still do not know
- Go back to the readings and find your answers (*or send us an email if you need help*)
- Start memorizing the key points (*use the PAK Flash Cards*)
- Use the PAK Test Aid to test your knowledge (*Send us your answers and we will give you detailed feedbacks on how to improve your score in the exams*)

More Information

We will explain how to prepare for this exam in much more details in the PAK Study Manual.

Any Questions?

We know you probably have a lot of questions in your mind regarding the exam or choosing study aids. Please feel free to contact us at eddy.chan@pakstudymanual.com or paulpeterson@pakstudymanual.com.

F-131-16: Heavy Models, Light Models And Proxy Models (sections 1-5 & 7, excluding Appendices)
 (by The Proxy Model Working Party)

Key Points

Key Points in This Reading

SAMPLE

1. Understand what heavy model and proxy model are.
2. Understand how to construct and use the proxy model.
3. Understand how to evaluate the proxy model (e.g. methods, distribution accuracy vs. scenario accuracy, etc).
4. Understand how to calibrate the proxy model.
5. Understand how to choose optimizing formula components or optimizing the whole formula.

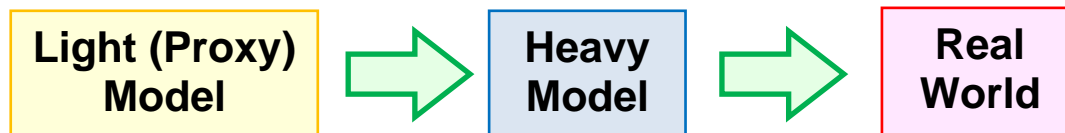
1. Introduction

Use Heavy Models to Describe the Real World

- Traditional (actuarial) models used for insurer's balance sheet calculations are complex functions of millions of inputs, with perhaps hundreds of stochastic inputs.
- However, the regulations and management do not stop there.
- Insurers must derive "Solvency Capital Requirement" which requires them to repeat these calculations under many different scenarios so as to have a high degree of confidence of meeting their "realistic balance sheet" in extreme adverse scenarios.
- While computational power has increased exponentially over the last several years, it would seem our demand for financial calculations have increased as an exponential of an exponential.

Three Basic Methodologies To Meet the Demands for Financial Calculations

1. Vastly enhancing modeling and computing capacity to try and carry out 'stochastic on stochastic' runs.
2. Speeding up and optimizing models
3. Building 'light' or 'proxy' models that largely replicate the 'heavy' models but run much quicker.



- Proxy models or light models are developed to mimic the heavy models (basically they model other models).
- These light models can then be used to explore more scenarios.

- Heavy models are developed that best fit reality (within computing constraints) so as to come up with our "realistic" balance sheet based on today's market conditions, but involving lots of different future outcomes.
- These models cannot be run as often as required

	Proxy Model	Heavy Model
Complexity	○ The least complex	○ The most complex
Computational Time	○ The fastest	○ The slowest
Accuracy	○ Less accurate	○ More accurate
Agility	○ More agile	○ Less agile
Example	○ Polynomials	○ Cashflow projection model

2. Background

A Brief History of Modeling Techniques

Cashflow Models

- They include deterministic formulae (comprising mainly of commutation functions).
- A vector of cash flows and a vector of discount rate were combined via a dot product to derive a present value.
- The process was easily generalized to several vectors to include other factors such as lapses.

Memorization: Advantages and Disadvantages

The Advantages of Cashflow Models

1. It was easier to model complex systems of cashflows and allow for path dependency.
2. They allow cash flows to vary with discount rates, or for any of the different elements to interact.
3. They allow evaluation at multiple time-points throughout the projection period.
4. They allow evaluation of other statistics of interest, not just of cashflows but also net asset and liability positions (address liquidity issues).

Stochastic Models

- They are used to fulfill the regulatory demand for the recognition of options and guarantees.
- They focus on the evaluation of liabilities and their guarantees at one moment in time (so-called "Time zero").
- This can be regarded as a step backward.
- We regressed from multiple time-point evaluations to a single time-point evaluation of the liabilities, i.e. the deterministic cashflow model providing values at each time-step along a single path was replaced by stochastic cashflow models providing the single stochastic value at time zero derived from the outcome of a large number of paths.
- The capability and ability to perform projections of liability values became more limited because the valuations at a single point in time were so complicated.
- These models were relatively slow.
- For the more complex insurance liabilities, the number of scenarios that can be run in any one valuation exercise remains limited by computational power.

Why are Proxy Models Needed?

Increasing Demand on Cashflow Models

- While computational power has increased dramatically in recent years, the demand for scenario analysis (on cashflow models) has increased exponentially quicker.
- Solvency II has led a number of life and general insurers to develop internal capital models, in which hundreds of thousands of potential scenarios are produced reflecting a range of possible outcomes for economic and insurance risks.
- Within each of these scenarios, the insurer revalues its balance sheet, and the solvency capital requirement is set so as to ensure solvency in all but a one in two-hundred year event.
- In other words, the 'tail' of the capital distribution needs to be covered.

Limited Technological Supply

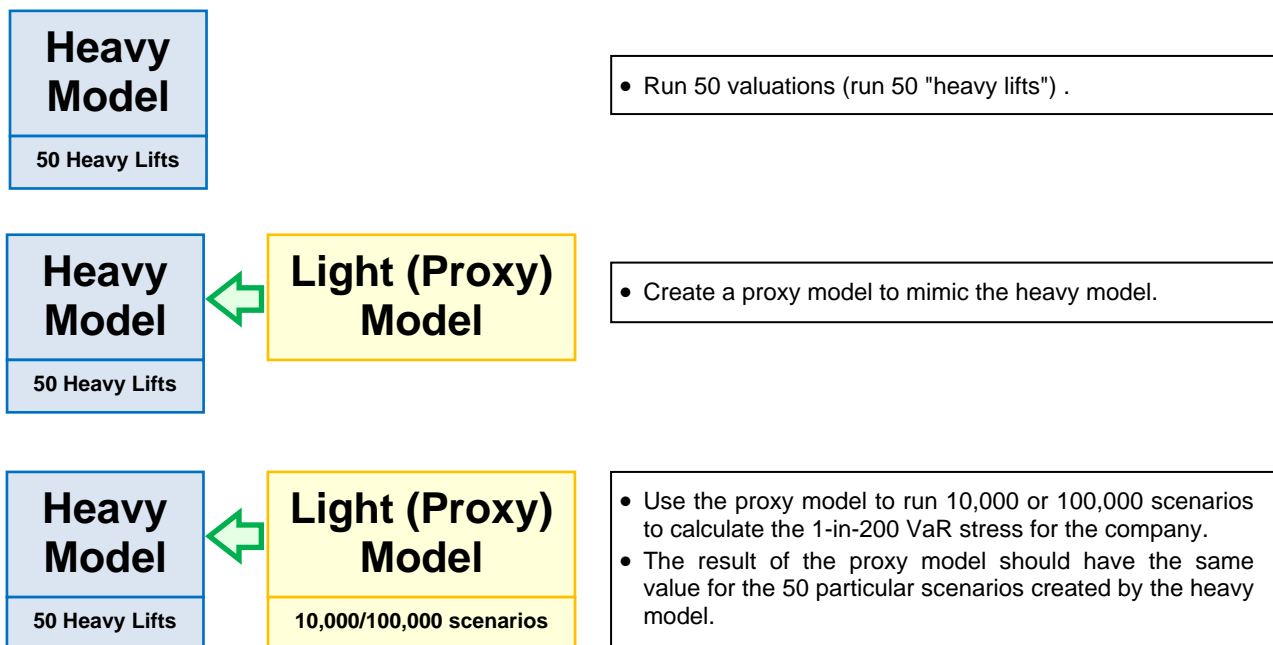
- The challenge remains as to how to revalue a balance sheet in thousands of different scenarios within a short space of time.
- The calculation of liabilities itself is a complicated process, and computing capacity is finite.
- A number of simplifications are needed and the trick is to ensure that the accuracy of the result is not compromised.
- As far as cashflow models are concerned, the modelling demand has finally overtaken technological supply.
- This has led to the introduction of replicating formulae and other proxy models in order to replicate the more complex cashflow models and thus cope with the increased demand.
- The proxy models that are used to bridge the gap between the demand placed on cashflow models and the limited technology providing it.

What is a Proxy Model?

- Heavy models approximate reality
- Proxy models approximate heavy models.
- The distinction of a proxy model is that it models another model (heavy model).

Example: Capital Requirement Modeling

- 50 valuations under various scenarios are run for a typical company.
- This relatively low number arises because each valuation is quite involved, representing calibration of scenarios across interest rates, equity markets, currencies, lapse assumptions, mortality, and so on.
- However, these 50 valuations are not sufficient to deduce a 1-in-200 stress for the company by themselves.
- The desire is to test many more scenarios, say 10,000 or 100,000.
- However, the technology does not allow so many different valuations.
- So a proxy model is developed and employed.
- The proxy model (1) can be run quickly, (2) is designed to reproduce the 50 valuations, and (3) provides values for other combinations of the underlying variables.
- The 10,000 or 100,000 scenarios to calculate the 1-in-200 Value-at-Risk (VaR) stress for the company (the Solvency Capital Requirement in Solvency II) are run using this proxy model.

Example: Capital Requirement Modeling**Jargon**

- The jargon for the complex model is a "heavy model" or a "heavy lift".
- The proxy model is called a "light model".
- For example, in the above example, 50 heavy lifts were used to calibrate a light model (or proxy model) in order to run 100,000 scenarios.

Note: Remember this jargon. The exam question may use this jargon in the content of the question.

Memorization: Definition**The Definition of Proxy Models**

- They are the models that approximate a more complex model.

3. Designing and Choosing a Model

Types of Model

General Setting

- Suppose we have N risk drivers, R_1, \dots, R_N which take on the values $r_1(s), \dots, r_N(s)$ for scenario s and each scenario produces value $y(s)$.
- We would like to fit this with a proxy function, so we select a number of basis functions of the risk drivers, $X_k(r_1, \dots, r_N)$ for $k=1, \dots, K$.

Item	Notation
N risk drivers	R_1, \dots, R_N
The values of N risk drivers	$r_1(s), \dots, r_N(s)$ for scenario s
The value of the scenario s	$y(s)$
A number of basis functions (1 to K) of the risk drivers	$X_k(r_1, \dots, r_N)$ for $k=1, \dots, K$
The value of coefficient for basis function k	β_k

Polynomial Proxy Function

- For a polynomial proxy function, the functions X_k are polynomials in the risk drivers r_1, \dots, r_N .

Stone-Weierstrass Mathematical Theorem

- If the degree of the polynomials is high enough, then any continuous function can be fitted to an arbitrary degree of accuracy.

Portfolio Replicating Model

- For a portfolio replicating model, the functions, X_k , are assumed to be bond-pricing formulas or other security pricing formulas.
- The risk drivers (r_1, \dots, r_N) refer to financial markets, such as interest rates, corporate spreads, equity prices, volatilities, currencies, and so forth.

Calculate the Portfolio (Scenario) Values

- No matter which basis functions X_k are selected, the next step is to find the proper combination of these that *best* reproduce the values for each portfolio.
- In other words, one must solve for β_1, \dots, β_k in the following system of equations:

$$\text{Formulaic form: } \sum_{k=1, \dots, K} \beta_k X_k(r_1(s), \dots, r_N(s)) = y(s) \quad (\text{for scenarios } s=1, \dots, S \text{ where } S \geq K)$$

$$\text{Matrix form: } \beta X = y$$

Cautions

- Where $S > K$, we have an over-determined system for which an exact solution is usually not possible, thus requiring a *best* solution be determined
- The above system of equations is linear in the β_1, \dots, β_k for any choice of the basis functions, X_1, \dots, X_K (not just polynomial function).
- When the basis functions, X_1, \dots, X_K are polynomials, this is the replicating polynomial proxy function.
- When the basis functions are market security functions of market risk drivers, then this represents the replicating portfolios proxy model.

The Radial Basis Methodology

- It uses the values of the scenarios themselves as the basis functions.
- It assumes that the proxy function is a function of the “distance” between point considered and the fitting scenarios.
- The trick is to get the correct weighting between 'local' effects (where the scenarios near the point being considered influence that point's value) and 'global' effects (where the scenarios further from the point considered have an impact).

Least Squares Monte-Carlo (LSMC)

- It is a method characterized by its method of calibration, making use of a large number of scenario results, $y(s)$, the number being large in relation to the number of basis functions, X_k .

Use of the Model

We Should Consider the Intended Use(s) of a Proxy Model Before Building It

- A proxy model is a less complex version of heavy model.
- The purpose of a proxy model is to mimic the key behaviors in the heavy model, but the loss in complexity is accompanied by a loss in the ability to reproduce some of the other behaviors.
- This will often be required so as to maintain the proxy model's value in terms of speed and accuracy.
- Thus, it is important that the intended use of a proxy model is considered before choosing, designing and then building the model since subsequent attempts to adapt it may not be possible or may be at the expense of the original purpose.
- Furthermore, the model may be used for purposes for which it is simply not suitable.

Example: The Use of Proxy Models in Capital Measurement and Management

- Proxy models are used in capital management to provide a proxy full distribution from which appropriate percentile results can be drawn (such as the 99.5th percentile or 1-in-200).
- Despite a primary interest in the capital distribution, it is often the individual scenario results that draw most attention because a comparison between primary and proxy scenario results is often the only way of assessing accuracy of the proxy.
- Care must be taken as some proxy models may be ill-suited to this use, being very inaccurate at the individual scenario level.
- However, a model need not be accurate at the scenario level for it to provide an accurate description of the capital distribution and likewise an accurate assessment of required capital.

Complexity Versus Accuracy

Tradeoff Between Complexity/Accuracy and Runtime

- The complexity of a proxy model can be increased
 1. By increasing the complexity of those formula elements, X_1, \dots, X_K , or
 2. By increasing the number of elements, K .
- Increasing complexity (more sophisticated formula elements or an increased number of formula elements) is associated with greater accuracy but this will often lead to slower runtime.

Tradeoff Between Complexity and Calibration

- There is a trade-off between complexity of formula elements and ease of calibration, i.e. for a given level of accuracy, as the complexity of the formula elements (X_k) reduce, the number of required elements (K) increase and the model becomes more difficult to calibrate.
- This is an important consideration when choosing a model and shows how the choice between accuracy and complexity will not only influence results but the implementation process as well.

Intuition

- The final choice is to determine how intuitive we want the model (formula structure) to be.

Two Extreme Cases

Case	Description
Polynomial (Pure Descriptive) Method	<ul style="list-style-type: none"> ○ One could be agnostic to intuition and prioritize the descriptive power of the model (focus only on the model result). ○ This may lead to the use of polynomial fitting, which provides tight bounds within a given range, but where the coefficients (and in particular changes from one year to next) are not intuitive. ○ For example, if the coefficient of $x^2 y$ changed from -652 to 1,456 from one year to next, this information may not necessarily prove insightful, even though the overall polynomial fits can be shown to fit well over a given range.
Intuitive Method	<ul style="list-style-type: none"> ○ One may try and use a more intuitive formula structure such as a portfolio of financial instruments / options or commutation functions, each component of which may have an intuitive meaning. ○ For example, a set of with profit liabilities may be represented by a series of portfolio put options, with each option roughly corresponding to a block of business sharing similar characteristics and maturing in the same year. ○ In this case, the movement of the coefficients of the respective options from year to year do provide valuable additional insight.

Intuitive Methods

Advantage	Description
Ease to use and interpret	<ul style="list-style-type: none"> ○ Intuitive methods can ease embedding of capital metrics into business as usual processes, as the components have meaning and the coefficients provide insight.
Powerful	<ul style="list-style-type: none"> ○ Intuitive methods are more powerful when there is sufficient knowledge of the problem at hand (i.e. knowledge of the products and liabilities being analyzed), as well as resources to design a neat (but potentially more complex) formula structure. ○ When approaching a problem with little knowledge about the products / liabilities, a polynomial method can be used as a general (albeit brute force) method, that would approximately work in a large number of situations.
Work well outside of the fitting points	<ul style="list-style-type: none"> ○ Another advantage of intuitive methods is their behavior outside of their fitting points. ○ A replicating portfolio can be expected to behave broadly sensibly outside of its 'reliable range'. ○ A classic criticism of pure descriptive methods such as polynomial fitting is that it may run through all the known points but vary widely between these points (interpolation), or diverge from expectations outside the fitted range of these points (extrapolation).

The rest of the summary is available only in the PAK Study Manual.

SOA CFE Past Exam Questions Related To This Reading

2019 CFE Fall Q11 (Must Read)
 2019 CFE Spring Q2d (Must Read)
 2019 CFE Spring Q9a-d (Must Read)
 2018 CFE Fall Q6a-d (Must Read)
 2018 CFE Fall Q9b-c (Must Read)
 2018 CFE Spring Q9f (Must Read)
 2017 CFE Spring Q9 (Must Read)
 2016 CFE Fall Q10a, d-e (Must Read)

PAK Study Manual (Practice Questions)
for CFE Spring 2022
(Sample)

Note

1. 500+ Practice Questions/Solutions are included in the PAK Study Manual.

Textbook Reading: Corporate Finance Ch.8**Data for Q1**

Suppose XYZ has an investment opportunity. It requires an initial investment of \$120 today. XYZ's tax rate is 25%. The investment will generate the following cash flows one year later. Calculate the unlevered net income at time 1.

Sales	200
Cost of Goods Sold	60
Selling, Gen, & Admin	25
R&D	20
Depreciation	15

Q2: Describe opportunity costs.

Q3: Describe cannibalization.

Data for Q4

Continue from the data for Q1. Opportunity costs increase the selling, general, and administrative expenses by \$13. Cannibalization reduces the sales of existing products by \$20 and the cost of goods sold \$9. Calculate the new unlevered net income at time 1.

Q5: Describe sunk costs.

Q6: Explain why it is difficult to estimate revenues and costs in the real world.

Data for Q7-Q8

Continue from the data for Q1. Suppose the investment will generate the cash flows at the end of each year for three years. This requires an additional investment on net working capital of \$15 at year 1 and 2.

Q7: Calculate the free cash flow each year.

Q8: Calculate the tax shield each year.

Data for Q9-Q10

Continue from the data for Q7. The free cash flow of the investment beyond year 3 is expected to grow at a rate of 4% per year. Assume the cost of capital is 9%.

Q9: Calculate the continuation value at year 3.

Q10: Calculate the NPV at year 0.

Data for Q11-Q15

ABC Bicycle Inc. creates a new program to sell bicycles through local shopping mall. The program generates a sales of \$60,000 each year for five years. Its annual cost of goods sold is 20,000. 10% of the sales will be paid in credit and 20% of the cost of goods sold will be paid in credit. An account receivable and an account payable are established to record these items. The marketing cost of this program is \$5,000 annually. It needs to hire one additional staff to administrate the program and the annual salary of this position is \$10,000. All these cash flows incurs at the end of the year.

The initial capital expenditure is \$10,000 at time 0. The \$10,000 is used to purchase display equipment and computer system. Those items will be depreciated at MACRS depreciation rates (20% at time 0, 32% at time 1, 19.2% at time 2, 11.52% at time 3, 11.52% at time 4, 5.76% at time 5). It also sets aside a cash of \$2000 at time 0 to pay for unexpected set-up expenses. The after-tax salvage value of the equipment and computer system after 5 year is \$2,000. Its tax rate is 25%. The discount rate to discount this program is 10%.

Q11: Calculate the unlevered net income each year.

Q12-Q15 are not shown in this sample.

Textbook Reading: Corporate Finance Ch.8

Q1-Q6 are not shown in this sample.

S7:

$$\begin{aligned} \text{FCF} &= (\text{Revenues} - \text{Costs} - \text{Depreciation}) \times (1 - \tau_c) + \text{Depreciation} - \text{CapEx} - \Delta\text{NWC} \\ &= (\text{Revenues} - \text{Costs}) \times (1 - \tau_c) - \text{CapEx} - \Delta\text{NWC} + \text{Depreciation} \times \tau_c \end{aligned}$$

	<u>Year 0</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>
(+) Unlevered Net Income	0	60	60	60
(+) Depreciation		15	15	15
(-) Capital Expenditures	120			
(-) Increases in NWC		15	15	
(=) FCF	-120	60	60	75

S8:

	<u>Year 0</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>
(+) Depreciation		15	15	15
(x) Tax rate at 25%		x 25%	x 25%	x 25%
(=) Tax Shield	0	3.75	3.75	3.75

S9:

$$\text{Continuation Value at Year 3} = \frac{\text{FCF}_3 \times (1 + g)}{r - g} = \$75 \times \frac{1.04}{0.09 - 0.04} = \$1560$$

S10:

	<u>Year 0</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>
(=) FCF	-120	60	60	75
(+) Continuation Value				1560
(=) FCF	-120	60	60	1635
(=) NPV @9%	1248.07			

S11:

	<u>Year 0</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>	<u>Year 5</u>	<u>Year 6</u>
(+) Sales	-	60,000	60,000	60,000	60,000	60,000	-
(-) COGS	-	20,000	20,000	20,000	20,000	20,000	-
(=) Gross Profit	-	40,000	40,000	40,000	40,000	40,000	-
(-) Selling, Gen, & Admin	-	15,000	15,000	15,000	15,000	15,000	-
(-) R&D	-	-	-	-	-	-	-
(-) Depreciation	2,000	3,200	1,920	1,152	1,152	576	-
(=) EBIT	(2,000)	21,800	23,080	23,848	23,848	24,424	-
(-) Income Tax @ 25%	(500)	5,450	5,770	5,962	5,962	6,106	-
(=) Unlevered Net Income	(1,500)	16,350	17,310	17,886	17,886	18,318	-

Q12-Q15 are not shown in this sample.