

Letter to Prospective Customers, from Jacob McCoy:

The ACE manual was designed with the intent of clarifying complex text (and problems) with explanations in plain-English. This is accomplished via clear and concise summaries of each chapter, author's commentaries for the most difficult ("Greek") material, as well as additional problems not given in the book & answers to problems that are in the book. The study guide has calculations and practice problems integrated with the outline along with an additional 50 pages of practice problems in a special section at the end of the study guide.

I would also like to put in a plug for the ACE seminar. This will be an excellent opportunity for you to enhance your understanding of the syllabus. I will walk through book examples, outline key material, walk through old exam problems, and present ACE SOA type problems. If you are reading 7702 or Investment Guarantees and you feel like you are reading Greek, you might consider purchasing a live or online seminar. I will walk through this challenging material and give you extra practice problems to prepare for the exam. The ACE seminar will help you condense all of the repetition in the syllabus and give you a high level summary. The seminar will combine similar texts so you can learn/review the syllabus in a reasonable amount of time. If you are interested in attending the seminar, contact the actuarialbookstore.com or actexmadriver.com. Space is limited.

Please contact me with any questions at acestudyguide@yahoo.com

ACE DP USA & Canada Study Guide – Sample Chapter

Life Insurance Products and Finance

Chapter 11: Profit Measurement and Analysis

- 1) Introduction
 - a) This chapter will wrap up the concepts and formulas presented in chapter 4-10
 - b) The final step in a pricing model is to calculate earnings & profit measures

The syllabus has other texts and study notes that cover profit measures, however they are simply subsets of this list. On exam day, you need to know the profit measures in this chapter.

- 2) Distributable earnings
 - a) Pre-tax solvency earnings
 - i) $\text{PreTaxSolvEarn}(t) = \text{Pre-tax solvency earnings}$
 - ii) $\text{PreTaxSolvEarn}(t) = \text{ProdCashFlow}(t) + \text{InvIncome}(t) - \text{SolvResInc}(t)$
 - b) After-tax solvency earnings
 - i) $\text{AfterTaxSolvEarn}(t) = \text{PreTaxSolvEarn}(t) - \text{Tax}(t)$
 - c) Adjustment for required capital
 - i) Definitions

- (1) ReqCapInc(t) = Increase in required capital
- (2) ATInvIncRC(t) = After-tax investment income on required capital
- (3) DistEarn(t) = Distributable earnings

ii) Formulas

- (1) $\text{ReqCapInc}(t) = \text{ReqCap}(t) - \text{ReqCap}(t-1)$
- (2) $\text{ATInvIncRC}(t) = \text{InvIncRC}(t) - \text{TaxInvIncRC}(t)$
- (3) $\text{DistEarn}(t) = \text{AfterTaxSolvEarn}(t) - \text{ReqCapInc}(t) + \text{ATInvIncRC}(t)$

iii) When pricing, it's common to only look at a specified time horizon (20 or 30 years). At the end of the horizon all required capital should be released into distributable earnings. This is like a "terminal value" for the product.

3) Stockholder earnings

a) Pre-tax stockholder earnings

- i) $\text{PreTaxStockEarn}(t) = \text{ProdCashFlow}(t) - \text{BenResInc}(t) - \text{DACAmort}(t) + \text{InvIncome}(t) + \text{InvIncRC}(t)$
- ii) $\text{PreTaxStockEarn}(t) = \text{PreTaxSolvEarn}(t) + \text{SolvResInc}(t) - \text{BenResInc}(t) - \text{DACAmort}(t) + \text{InvIncRC}(t)$
- iii) Reminder from chapter 6
 - (1) $\text{DACAmort}(t) = \text{DAC}(t-1) - \text{DAC}(t)$

The term "DAC Amortization" can have many meanings, especially if you have already taken CSP. I prefer to use the term "Decrease in DAC"

b) After-tax stockholder earnings

- i) $\text{AfterTaxStockEarn}(t) = \text{PreTaxStockEarn}(t) - \text{Tax}(t) - \text{TaxInvIncRC}(t) - \text{DefTaxProv}(t)$
- ii) Notice that the increase in required capital has no explicate impact on after tax stockholder earnings. This is a big difference between stockholder earnings and solvency earnings (along with reserve difference and DAC).

c) Return on equity

- i) $\text{ROE} = \text{After-tax stockholder earnings} / \text{equity base}$
- ii) Two options for equity base
 - (1) Beginning of year equity
 - (2) Average of beginning of year and end of year equity

Notice that the book is throwing around different words such as "surplus" & "equity". They both mean the same thing, but in common practice "surplus" is referring to a statutory item and "equity" is referring to a GAAP item.

iii) Definitions

- (1) $\text{StockAssets}(t) = \text{Stockholder assets at the end of the year}$
- (2) $\text{StockLiabilities}(t) = \text{Stockholder liabilities at the end of the year}$
- (3) $\text{StockEquity}(t) = \text{Stockholder equity at the end of the year}$

iv) Formulas

(1) $\text{StockAssets}(t) = \text{SolvRes}(t) + \text{ReqCap}(t) + \text{DAC}(t)$

(2) $\text{StockLiabilities}(t) = \text{BenRes}(t) + \text{DefTaxLiab}(t)$

(3) $\text{StockEquity}(t) = \text{StockEquity}(t-1)$ **OR**

(a) $\text{Average}(\text{StockEquity}(t-1), \text{StockEquity}(t))$

(4) $\text{ROE}(t) = \text{AfterTaxStockEarn}(t) / \text{EquityBase}(t)$

- v) This formula will give an annual ROE, when pricing you can also take the present value of all future $\text{AfterTaxStockEarn}(t)$ and the present value of all future $\text{EquityBase}(t)$ to get a “weighted average ROE”.

4) Selection of profit goals

a) Basic questions when selecting profit goals:

- i) What accounting basis should be used?
- ii) How should risk be reflected in the profit goals?
- iii) What rate to discount future values?

b) Choice of accounting basis

- i) Should solvency earnings or stockholder earnings be used?
- ii) Choice of accounting basis depends on the audience:
 - (1) Regulators and rating agencies would want solvency accounting
 - (2) Stockholders will want to see stockholder accounting

c) Reflecting risk in profit goals

- i) Could use best estimate assumptions in pricing and then set profit goal to reflect the degree of risk
- ii) When there is little risk in a product, the profit goal should be lower. When there is a lot of risk in a product, the profit goal should be increased to reflect the degree of risk.
- iii) Ways to reflect the degree of risk when pricing a product:
 - (1) Use a formula that calculates a profit margin given the degree of risk
 - (2) The profit margin could be set to reflect the estimated degree of risk
 - (3) Sensitivity analysis could be performed to estimate the degree of risk
- iv) When selecting assumptions, it's important to consider risk that is not reflected in experience – such as catastrophic events

d) Choice of discount rates and rates of return

- i) The rate used to discount future profits will be influenced by:
 - (1) Company's cost of capital
 - (a) Look at weighted average cost of capital and cost of marginal capital
 - (b) Should consider all sources of capital such as: equity, debt, reinsurance, etc
 - (2) Returns on similar investments
 - (a) What are similar products earning?

- (b) Must make sure that similar investments have the same risk as the current project
 - (3) Current and future capital position
 - (a) Basic economics -- If the supply of capital is low, the required return will increase
 - (4) How discounting will be used
 - (a) When discounting to determine if the product's rate of return is acceptable, use the cost of capital
 - ii) Common choices for discount rates
 - (1) Cost of capital
 - (a) Commonly used as a target rate of return
 - (b) Has good appeal since the "risk" is already built in
 - (c) May be hard to determine for mutual companies
 - (2) After-tax rate on investments
 - (a) Low rate of return so it should not be used as a profit goal
 - (b) Can be used to discount profits when it is desired to give more weight to the early years and less weight to the later years
 - (3) Pre-tax rate on investments
 - (a) No theoretical basis
 - (4) Risk free rate
 - (a) Would need to reflect risk somewhere else since no risk in the discount rate
- 5) Present values
- a) Definitions
 - i) $PV(\text{Variable}, n) = \text{present value of } n \text{ years of Variable}(t)$
 - ii) $PVPrem(n) = \text{present value of } n \text{ years of premium}$
 - iii) $n = \text{the final policy year for calculations}$

b) Formulas

$$PV(\text{Variable}, n) = \sum_{t=1}^n \text{Variable}(t) \times \text{DiscFactor}(t)$$

$$PV \text{ Pr em}(n) = \sum_{t=1}^n \text{Pr emium}(t) \times \text{DiscFactor}(t - 1)$$

$$PV \text{ Pr ofit}(n) = PV(\text{Pr ofit}, n)$$

- c) "Profit" could be any of the following:
 - (1) Pre-tax solvency earnings
 - (2) After-tax solvency earnings
 - (3) Distributable earnings
 - (4) Pre-tax stockholder earnings
 - (5) After-tax stockholder earnings

- d) Discounting negative profits
- i) Large losses in the future may require the company to borrow money. This “borrowed” money should be discounted at a rate equal to the cost of borrowing funds
 - ii) Definitions
 - (1) $i(t)$ = the discount rate normally applied to discounting future profits
 - (2) $j(t)$ = the discount rate applied to the future negative PV of future profits
 - (3) $PVFP(t)$ = present value of future profits including the current profit
 - iii) Process
 - (1) Start with the last time period and work backwards
 - (2) Discount $PVFP(t)$ back at $i(t)$ for each time period and add in the profit
 - (3) If the $PVFP(t)$ goes negative, discount back with $j(t)$ NOT $i(t)$
 - iv) Formulas
 - (1) If $PVFP(t) > 0$

$$PVFP(t-1) = \frac{PVFP(t)}{1+i(t)} + Profit(t-1)$$

- (2) If $PVFP(t) \leq 0$

$$PVFP(t-1) = \frac{PVFP(t)}{1+j(t)} + Profit(t-1)$$

This formula will be used when calculating generalized ROI

6) Profit measures

Different companies will use different profit measures. Most common are embedded value, ROI, ROE, and profit as a percent of premium.

- a) Embedded value
 - i) Embedded value equals the present value of profit, discounted at the hurdle rate
 - ii) Key decision: what is the hurdle rate?
 - (1) The hurdle rate is the rate of return that the owners expect
 - (2) Should be in line with the weighted average cost of capital
 - (3) Should be consistent with return available on alternative investments
 - iii) The goal of pricing is to maximize embedded value
 - iv) Formula
 - (1) $EmbeddedValue(n) = PV(Profit,n)$
 - (2) Usually use distributable earnings

- b) Return on investment
 - i) ROI is the discount rate that makes the present value of profits to equal zero
 - ii) ROI will not make sense for a product that does not have a large first year strain
 - iii) Will not be able to calculate ROI for a product that is profitable in all years
 - iv) Simple ROI
 - (1) Formula

$$0 = \sum_{t=1}^n Profit(t) \times (1 + ROI)^{-t}$$

- (2) In practice, ROI will be solved for over 20-30 years using a computer
- (3) For an exam, the SOA could make you solve for an ROI over a 3-5 year period of time. Make sure you bring a calculator to the exam that can solve for a discount rate given a stream of payments.

- v) Multiple ROIs
 - (1) If there are future losses, then there will be multiple ROIs. In this case you will need to use the generalized ROI method.
- vi) Generalized ROI
 - (1) The generalized ROI method was presented earlier. Instead of discounting negative PVFP at the ROI, discount them at rate “j(t)”.

- c) Weighted average return on equity
 - i) Annual ROE formula was presented earlier. That can be cumbersome since there could be 30 years of ROEs to look at
 - ii) The weighted average ROE method boils the annual ROEs down to one number
 - iii) It’s called “weighted” because this methods weights the ROE’s using the discount rate – the earlier ROE’s get more weight
 - iv) Use expected growth rate to discount ROEs
 - v) Formula

$$WtdAvgROE(n) = \frac{PV(AfterTaxStockEarn, n)}{PV(EquityBase, n)}$$

- d) Profit as a percent of premium
 - i) One of the most commonly used profit measures (it’s easy to explain)
 - ii) Use pre-tax or after-tax rates interest rates to discount

$$Profit \% Premium(n) = \frac{PV Profit(n)}{PV Premium(n)}$$

- e) Profit as a percent of assets
 - i) Also referred to as “return on assets” or ROA
 - ii) Common profit measure for investment products or annuities
 - iii) Need to match up the profit measure with the appropriate assets

ROA Profits	ROA Assets
After-tax Solvency Earnings	Solvency Reserves
Distributable Earnings	Solvency Reserves + RC
After-tax Stockholder Earnings	Solvency Reserves + RC + DAC

iv) Formula

$$ROA(n) = \frac{PV \text{ Profit}(n)}{PV(\text{Assets}, n)}$$

- f) Profit as a percent of revenue
 - i) Similar to profit as a percent of premium, but use revenue instead of premium
 - ii) May be appropriate for products where premium is not the main source of revenue (investment products, UL, or VUL)
 - iii) Should NOT be used to compare profitability of different types of products
- g) Profit as a percent of risk charges
 - i) No standard definition of “risk charges”, but here are two options:
 - (1) Mortality, lapse, and investment components
 - (2) Percent of required capital
 - ii) It can be difficult to interpret and explain the results
 - iii) The advantage of this method is that profitability is linked to the risk of the business
- h) Accumulated profit as a percentage of reserves
 - i) Mainly used in the past by mutual companies
 - ii) Accumulate profits for the first 20 years, then divide by reserves at year 20
 - iii) General formula for accumulation (Use after tax interest rate to accumulate profits)

$$Accum \text{ Profit}(n) = \sum_{t=0}^n \text{Profit}(t) \times AccumFactor(t)$$

$$Accum \text{ Profit}(t) = Accum \text{ Profit}(t-1) \times (1 + i(t)) + \text{Profit}(t)$$

iv) Formula

$$Accum \text{ ProfitPCT}(t) = \frac{Accum \text{ Profit}(n)}{Res(n)}$$

- i) Breakeven year
 - i) Breakeven year is the first year that accumulated profits turn positive
 - (1) Profits should not only turn positive, they should stay positive
 - ii) A large breakeven year means that the product is more risky than a product with a short breakeven year
 - iii) Modified breakeven year is the first year that accumulated profits turn positive, assuming that all policies lapse at the end of the year

This makes sense since breakeven year is a measure of lapse risk. Modified breakeven year is then a more accurate measure of lapse risk.

- iv) A long breakeven year may be acceptable for mutual companies since the goal of mutual insurance is to return profits to policyholders
- j) New Business strain
 - i) Strain is the first year loss incurred by a product
 - ii) Often measured against first year premium
 - iii) If there are losses in years two and three, take the PV(losses) and divide it by the first year premium
 - iv) Formula

$$NBStrain = \frac{DistEarn (1)}{Pr emium (1)}$$

- k) Summary profit measures
 - i) Choosing a profit goal is very important
 - ii) Many decisions are made based on profit measures/goals
 - iii) Profit goals must:
 - (1) Fit the company's strategy
 - (2) Allow the company to compete
 - (3) Provide long term financial results that allow the company to grow and reward its owners
 - (4) Be tracked at the total company level and the business unit level

7) Pricing model

This chapter's pricing model is completely messed up. See errata. I do think working through this has value.

8) Exercises

a) Answer 11.2 should be:

t	InvIncRC(t)	TaxInvIncRC(t)	AfterTaxSolvEarn(t)	DistEarn(t)
1	0.00	0.000	-7.00	-10.00
2	0.18	0.054	1.75	0.88
3	0.24	0.072	1.40	0.57

b) I don't think calculating 20 years of PVFP is worth your time, but do look at the solutions and make sure that you are comfortable with the first few years of calculations. You could also put these into a spreadsheet and calculate the answers, but keep in mind that on exam day you will not have excel.

c) Exercises 11.9 and 11.10 are a waste of time