Baylor University
Hankamer School of Business
Department of Finance, Insurance & Real Estate

Risk Management
Dr. Garven
Sample Midterm Exam 2

Name: ________________________

Notes:

1. This exam consists of four problems worth 32 points each. Only three of the four problems need to be completed; for students who complete all four problems, I will count the three highest-scoring problems toward the exam grade.

2. The maximum number of points possible on this exam is 100, consisting of 96 possible points on the problems plus 4 points for legibly writing your name on the cover page in the space provided.

3. If you need extra space for solving any of the problems on this exam, use the extra pages (labeled as "Extra Space for solving Problem #n") that are included with this exam booklet.

4. You may have the entire class period to complete this examination. Be sure to show your work and provide a complete answer for each problem; i.e., in addition to producing numerical results, explain your results in plain English.

Good luck!

Problem 1 (32 points)

An entrepreneur has initial wealth of \$88. Her initial wealth is invested in two buildings, each of which is worth \$40. Her remaining \$8 in initial wealth is invested in cash. Each building has a 25% chance of being destroyed and a 75% chance of not suffering any damage. Because the buildings are located far away from each other, these risks are statistically independent.

Since the entrepreneur has \$8 in cash, she can use some or all of this money to purchase actuarially fair insurance policies to cover her risks. Note that the price for an actuarially fair insurance policy equals the expected value of the payoff (indemnity) provided by the insurance policy.

A. (8 points) Given the entrepreneur's cash resources, if she covers 60% of the first building's potential loss, what is the maximum level of coverage (in terms of proportion of potential loss) that she can purchase against the risk that the second building will be destroyed?

B. (8 points) Given the entrepreneur's cash resources, what is the maximum level of coverage (in terms of proportion of potential loss) for each building that will result in the same premium being paid for each policy?

C. (8 points) Suppose the entrepreneur's utility function is $U(W) = \sqrt{W}$. Show that the entrepreneur is better off if she insures both buildings at the same level of coverage (for a total premium of \$8) than she would be if she implemented the risk management strategy implied in Part 1 of this problem.

D. (8 points) Explain *why* the expected utility of having the same level of coverage on both buildings is higher than the expected utility of having different levels of coverage.

Extra Space for solving Problem #1:

Problem 2 (32 points)

Consider a society with three kinds of drivers: safe, careless, and crazy. There is an equal number of each of these drivers, and each driver has initial wealth of \$150 and utility $U(W) = \sqrt{W}$. In any given year, a safe driver gets into an accident with probability $p_s = 0.1$; a careless driver gets into an accident with probability $p_d = 0.2$, and a crazy driver gets into an accident with probability $p_c = 0.3$. An accident leads to repair costs of \$50, and has no other consequences.

Suppose that an insurance company offers full coverage insurance policies to these drivers; i.e., when accidents occur, claim payments of \$50 are made which fully cover repair costs. The drivers decide whether to purchase these full coverage policies.

A. (8 points) Suppose the insurance company can distinguish between the three types of drivers, and offers each driver an actuarially fair full coverage insurance policy based on his or her accident probability. Which of the drivers will buy such a policy?

B. (8 points) Now suppose that although the insurance company cannot distinguish between the three types of drivers, it decides to offer to offer a full coverage insurance policy to all drivers for a price of \$10. Show that safe drivers are not willing to purchase such a policy, whereas careless and crazy drivers will purchase such a policy.

C. (8 points) Since safe drivers are not willing to purchase the policy described in part B, the insurance company decides to increase the price of the policy, hoping to not lose money. This time, it offers a full coverage insurance policy for a price of \$15. Show that safe and careless drivers are not willing to purchase such a policy, whereas crazy drivers will purchase such a policy.

D. (8 points) This problem illustrates how adverse selection can limit insurability; here, even though safe and careless drivers are risk averse and would certainly be interested in purchasing coverage, the presence of the crazy drivers makes this challenging. Explain how offering partial coverage to safe and careless drivers can solve this problem.

Extra Space for solving Problem #2:

Problem 3 (32 points)

The following table lists the state-contingent returns on Security A ($r_{A,s}$) and Security B ($r_{B,s}$):

State of Economy	p_s	$r_{A,s}$	$r_{B,s}$
Bust	50%	-0.2000	+0.2500
Boom	50%	+0.4000	-0.0500

A. What are the expected returns for Security A and Security B?

B. What are the standard deviations of the returns for Security A and Security B?

C. Find the expected return and standard deviation for the least risky combination of Security A and Security B. What is the composition of this portfolio (i.e., find the security weights w_A and w_B)?

D. Suppose your initial wealth is \$1,000 and that you can borrow or lend up to \$1,000 at the riskless rate of interest of 3% during the course of the next year. Given this information, describe the most profitable *riskless* trading strategy which can be implemented, and calculate the profit from implementing this strategy.

Extra Space for solving Problem #3:

Problem 4 (32 points)

Suppose you have two stocks in your portfolio, *Maximus* and *Minimus*. The expected return of *Maximus* is 20% and the expected return of *Minimus* is 12%. The standard deviation of *Maximus* is 42% and the standard deviation of *Minimus* is 28%. The correlation between the two securities is zero. Suppose the riskless asset has an expected return of 4%.

A. (8 points) What is the mean and standard deviation of the minimum variance portfolio combination of *Maximus* and *Minimus*?

B. (8 points) Which has the highest Sharpe ratio, *Maximus*, *Minimus* or the minimum variance portfolio combination of *Maximus* and *Minimus*?

C. (8 points) Suppose the correlation between *Maximus* and *Minimus* is -1. If this were the case, there would be an arbitrage opportunity, since a combination of *Maximus* and *Minimus* exists that is riskless and yields a higher expected return than the riskless asset. Describe the characteristics of a portfolio strategy that would enable you to generate positive profits without having to bear any risk or put up any of your own money. Assume that there are no restrictions on short sales or margin requirements.

D. Now suppose the expected return to the market portfolio is 14%, and the standard deviation of the market portfolio is 25%. Assuming that the CAPM holds, what are the betas for *Maximus* and *Minimus*?

Extra Space for solving Problem #4:

Midterm Exam #2 Formula Sheet

Expected Utility

$$E\left(U(W)\right) = \sum_{s=1}^{n} p_s U(W_s).$$

Demand for Insurance

State-Contingent Wealth: $W_s = W_0 - E(I)(1+\lambda) - L_{u,s}$, where

- W_0 = initial wealth;
- $E(I)$ = expected value of the indemnity;
- $\lambda = \%$ premium loading (note: insurance is actuarially fair if $\lambda = 0$);
- $E(I)(1+\lambda)$ = price of insurance, also known as the "insurance premium"; and
- $L_{u,s}$ = the uninsured loss (note: under full coverage, $L_{u,s} = 0$, under coinsurance, $L_{u,s} = (1-\alpha)L_s$ (where α is the coinsurance rate), and under a deductible policy, $L_{u,s} = L_s - Max(L_s - d, 0)$, where d is the deductible.

Portfolio and Capital Market Theory

- σ_i = standard deviation of returns on asset i;
- σ_{ij} = covariance between i and j;
- ρ_{ij} = correlation between i and $j = \sigma_{ij}/\sigma_i\sigma_j$;
- w_i = proportion of portfolio p invested in asset i (note: $\sum_{i=1}^{n} w_i = 1$);
- $E(r_p)$ = expected portfolio return $= \sum_{i=1}^{n} w_i E(r_i)$; if $n = 2, E(r_p) = w_1 E(r_1) + w_2 E(r_2)$;
- σ_p^2 = portfolio variance $= \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j \sigma_{ij}$; when $n = 2$, $\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\sigma_{ij}$;
- r_f = the expected rate of return on a risk-free asset;
- $E(r_m)$ = the expected rate of return on the market portfolio;
- σ_m = the standard deviation of return on the market portfolio;
- Capital Market Line: $E(r_p) = r_f + \left[\frac{E(r_m) - r_f}{\sigma_m}\right]\sigma_p$ for mean-variance efficient portfolios;
- $\beta_i = \sigma_{im}/\sigma_m^2$;
- Capital Asset Pricing Model: $E(r_i) = r_f + \left[E(r_m) - r_f\right]\beta_i$ for individual securities; and
- Sharpe Ratio: $\frac{E(r_j) - r_f}{\sigma_j}$.