

Below you find the questions of the resit exam Advanced Investments and their answers. It should be noted that in some cases, different arguments may be used to back up any conclusion, the list is not exhaustive. The quality of your argumentation (is your answer an actual response to the question, relevant, logically consistent, etc.) is also a substantial part of the grading.

1. Suppose the correlation between UK and Eurozone stocks was positive at first, and then becomes negative. The correlation between UK and US stocks is positive and remains the same.

What would this mean for the portfolio of an investor based in the US? Explain your answer in terms of (changes to) portfolio weights, and assume the initial portfolio contained US, UK and Eurozone stocks with positive weights. (10 points)

Diversification benefits increase, as negative correlations allow for a bigger mitigation of risk, even if the returns are lower. It is likely the portfolio weights will change, though we cannot say how, only that with near certainty, we will still invest in the UK, Eurozone or both. In fact, the negative correlation between eurozone and the US (can be derived via the UK) would imply a bigger investment in the Eurozone

2. If you want to construct an investment portfolio based on the reversal strategy, would it matter if you were facing short sale constraints? Explain your answer. (8 points)

Yes, it would, as in reversal you go long in past (long term) losers and short in (long term) winners, so a short-sale restriction would make this strategy impossible to implement. Of course, one leg (with long positions) is still possible, but then we need to be particularly careful about the relative merits of each leg: it's quite possible the vast majority of profits come from the short sales, and a zero net investment strategy is not possible under those conditions.

3. Suppose there are three investors who each invest in just 5 different stocks (these stocks need not be the same between investors, each chooses from all available stocks). The S&P 500 is their benchmark and proxy for the market portfolio.

One of them (let's call her investor A) judges her results by using the M-squared criterion, the second (let's call him B) uses the Treynor ratio and the third (C) uses the Sharpe-ratio.

Explain:

- if the last two (B and C) would regard investing in stocks as equally risky,
- which risk measures could be used by investor A,
- which investors use a method to evaluate their risk-return trade-off that would be influenced by a negative risk-free rate.

(12 points)

- No, B uses systematic risk, C uses total risk. B will underestimate the risk of his portfolio by a lot, as he has only 5 stocks. This would even happen if their portfolios are identical.
- The  $M^2$  measure can be coupled by just about any risk measure, as the idea is simply to apply leverage so that risk is equal. Variance, beta, LPM – they all allow for this.
- All of them are influenced.  $M^2$  due to the leverage, both Treynor and Sharpe start with excess returns, so returns above the risk-free rate.

4. Assume you have the following Stochastic Discount Factor (SDF):

$$m_{t+1} = -2.54 + 1.07 \cdot R_m$$

With  $R_m$  between -14.21 and +19.75.

a. Explain how this SDF differs from a well-behaved SDF that would follow from the CAPM, Give two reasons why the SDF above is not well-behaved. (8 points)

The linear structure and the factor are actually in line with the CAPM. However, the intercept is negative, so the SDF will be below zero for at least some area around  $R_m=0$ , violating nonsatiation, and the slope coefficient is positive which makes the SDF increasing, thereby violating risk-aversion on a global scale.

b. Explain which factors you should add to the SDF to obtain an SDF that follows the Fama & French (2015) five-factor model; briefly describe these factors too. (8 points)

$R_{size}$ ,  $R_{book-to-market}$ ,  $R_{profitability}$ ,  $R_{investment\ intensity}$ ; which represent a small-minus-big portfolio (size; smaller firms perform better), a high-minus-low portfolio (B/M, for the value anomaly), a robust-minus-weak (profitability) factor, and a conservative-minus-aggressive (investment policy) factor. Each depends on a long-short portfolio.

The next three questions (numbers 5 to 7) require you to explain if the following statements are true or false, **and why you reach that conclusion**:

*NB: the explanation is what's graded: you can get partial credit for the wrong option with a partially correct argumentation, but just the correct option will not yield any points.*

5. "A CRRA-type utility function by definition violates non-satiation, but this is rarely relevant in practical applications of the CAPM." (9 points)

False, the violation ( $SDF < 0$ ) does not have to happen for CRRA, with only deals with the ratio between  $xU'$  and  $U'$ . CRRA is much wider than the CAPM SDF, and unlike the CAPM doesn't have to be based on  $R_m$ .

6. "Incorporating the kurtosis of the return distribution in your model does not mean you account for asymmetry in the return distribution." (9 points)

True, kurtosis is the fourth central moment, so the deviations are raised to the 4<sup>th</sup> power, thereby removing info on their sign, which is needed to deal with asymmetry. Kurtosis does allow you to look at the peakedness and/or tails of the distribution.

7. "There is no tangency portfolio possible in the mean-lower partial moment framework." (9 points)

False. The tangency portfolio, which indicates the place where a line starting from  $R_f$  is tangent to the efficient frontier, is a combination of  $R_f$ , which can exist in the LPM framework, and a bullet of optimal risk-return combinations, which can exist regardless of

risk-measure. The only difference with mean-variance is that instead of variance, you have LPM on one axis. Diversification to minimize the LPM for a given return is still possible, even if it can be more mathematically cumbersome.

**Below you'll find a question with several possible options / answers. Indicate which option best reflects the answer to the question, and explain why.**

*NB: the explanation is what's graded: you can get partial credit for the wrong option with a partially correct argumentation, but just the correct option will not yield any points.*

8. Suppose the investment universe is described by figure 1 below (the numbers in the table are returns, in percentages).

**Figure 1:**

	Probability	Asset 1	Asset 2	Asset 3
State 1	20%	+8%	-5%	+20%
State 2	35%	+7%	-6%	-8%
State 3	45%	-8%	+9%	+5%

What is the least risky portfolio for an investor with an LPM preference structure (order = 2) and a threshold of -3%? Assume no diversification. Explain your answer, show calculations. (6 points)

- A. Asset 1.
- B. Asset 2.
- C. Asset 3.
- D. This cannot be determined.

Calculate the LPMs:

asset 1:  $0.45 * (-8 - (-3))^2 = 0.45 * 25 = 11.25$

asset 2:  $0.2 * (-5 - (-3))^2 + 0.35 * (-6 - (-3))^2 = 0.2 * 4 + 0.35 * 9 = 3.95$

asset 3:  $0.35 * (-8 - (-3))^2 = 0.35 * 25 = 8.75$

9. To optimally profit from the momentum strategy, you should: (5 points)

- A. Buy losers and short winners, and hold this portfolio for 3 years.
- B. Buy losers and short winners, and hold this portfolio for 6 months, then rebalance and repeat.
- C. Buy winners and short losers, and hold this portfolio for 3 years.
- D. Buy winners and short losers, and hold this portfolio for 6 months, then rebalance and repeat.

**D, momentum is a short term strategy and needs rebalancing to ensure you keep investing in recent winners. 3 years already risks capturing the reversal anomaly instead.**

**10.** Which assumption from the CAPM can be dropped without also destroying the results from Modern Portfolio Theory? Explain your answer. (6 points)

- A. There are no taxes or transaction costs.
- B. All assets are infinitely divisible.
- C. Mean and variance are appropriate measures of return and risk.
- D. None of the three other assumptions can be dropped.

The correct answer is D. All other assumptions are needed to describe the behavior of an individual investor, which is what MPT aims to do. The kind of assumptions that would be needed would be assumptions that combine individual behavior, for example that every one is a price taker.