



**Università Commerciale
Luigi Bocconi**

**MSc. Finance/CLEFIN
2017/2018 Edition**

Advanced Quantitative Methods for Asset Pricing and Structuring

May 2017 Exam for Non Attending Students

Time Allowed: 95 minutes

Family Name (Surname)	First Name	Student Number (Matr.)

Please answer all questions by choosing the most appropriate alternative and/or by writing your answers in the spaces provided. You need to carefully justify and show your work in the case of “open” questions. There is only one correct answer for each of the multiple choice questions. Correct answers not selected and questions that have been left blank will receive zero points. Only answers explicitly reported in the appropriate box will be considered. No other answers or indications pointing to potential answers will be taken into consideration. In the case of “open” questions, the maximum number of points is indicated.

Question 1. Which of the following statements about implied correlations is FALSE? (1.5 pts)

- ☐ (A) Base correlation can yield negative expected tranche losses
- ☐ (B) Typically, compound correlation depends on pairs of attachment points
- ☒ (C) Typically, implied correlation is consistent at the level of the single tranche
- ☐ (D) Two tranches on the same pool (same maturity) may yield different values of compound correlation

Question 2. Let $I(t) = \int_0^t \phi(u) dW(u)$ be an Itô's integral, where ϕ is an adapted process. Which of the following statements is FALSE? (1.5 pts)

- ☐ (A) $I(t)$ is a martingale
- ☒ (B) The variance of $I(t)$ is given by $\int_0^t \phi^2(u) du$
- ☐ (C) The variance of $I(t)$ is not path dependent
- ☐ (D) The quadratic variation of $I(t)$ is path dependent

Question 3. Consider the standard CDS Index DJ- iTraxx. Which of the following statements is TRUE? (1.5 pts)

- ☐ (A) The one-factor Gaussian copula model is parametrized by a matrix of 7,750 pairwise correlation values
- ☐ (B) The one-factor Gaussian copula model is parametrized by a matrix of 100 pairwise correlation values
- ☐ (C) The one-factor Gaussian copula model is parametrized in terms of a unique pairwise correlation value
- ☒ (D) None of the above

Question 4. Which of the following statements about structural models is FALSE? (1.5 pts)

- ☐ (A) Structural models provide a way of relating credit risk of a firm to its capital structure
- ☐ (B) AT1P models assume the existence of a time-dependent deterministic barrier
- ☒ (C) Short term credit spreads are easy to attain/explain in AT1P structural models
- ☐ (D) In Merton's model, the credit spread is zero before debt maturity

Question 5. Which of the following statements is TRUE? (1.5 pts)

- ☐ (A) Right way risk is the typical risk of monoline insurers
- ☐ (B) An airline entering a swap with an oil producer, where the airline pays fixed and receives the floating crude oil prices is exposed to wrong way risk
- ☐ (C) Wrong way risk is due to the independence between counterparty risk and the risks associated to the underlying exposure
- ☒ (D) None of the above

Question 6. Which of the following statements about diffusion processes is TRUE? (1.5 pts)

- ☒ (A) The Vasicek and the CIR processes (with the same parameters) have the same mean
- ☐ (B) The Vasicek and the CIR processes (with the same parameters) have the same variance
- ☐ (C) The Vasicek process is distributed as a LogNormal distribution
- ☐ (D) The Vasicek process, given to its mean-reverting nature, is a good modeling choice for the stochastic intensity variable

Question 7. Which of the following statements about CVA is TRUE? (1.5 pts)

- ☐ (A) CVA is defined as: $CVA = LGD \mathbb{E}_0[\mathbb{I}_{\tau < T} (V(\tau))^+]$
- ☐ (B) CVA is defined as: $CVA = LGD \mathbb{E}_0[\mathbb{I}_{\tau < T} D(0, \tau)(V(T))^+]$
- ☐ (C) The CVA of an interest rate swap is a linear operation
- ☒ (D) None of the above

Question 8. Which of the following statements about Mapping methods for bespoke portfolios is TRUE? (1.5 pts)

- ☐ (A) The Probability Matching (PM) method is the only method based on a correlation assumption depending on the equivalent strike
- ☒ (B) The Tranche Loss Proportion (TLP) method usually does not require extrapolation
- ☐ (C) In the ATM method, the invariant measure of risk is the strike of the tranche
- ☐ (D) The ATM method works well when taking into account the dispersion of a portfolio

Question 9. Which of the following statements about the One-Factor Gaussian Copula model for a pool of n names is TRUE? (1.5 pts)

- ☐ (A) The model relies on the assumption of independence of single names
- ☐ (B) It can be expressed as a n - dimensional integral
- ☒ (C) The number of free correlation parameters is n
- ☐ (D) None of the above

Question 10. Which of the following statements about the Vasicek's Portfolio Loss model is TRUE? (1.5 pts)

- ☐ (A) The mean of the portfolio loss distribution is a function of ρ
- ☐ (B) The variance of the portfolio loss distribution is a function of ρ^2
- ☐ (C) By the law of large numbers, the portfolio loss distribution is asymptotically normal
- ☒ (D) The Economic Capital is derived under the assumption that all the idiosyncratic risk has been diversified away

Question 11.

1. Complete the following Table in all its parts. (3 pts)

	Structural Models	Reduced Form (intensity-based) Models
Definition of default		

Exogenous/ endogenous		
Calibration to CDS		
Multi-name environment		

2. Explain the meaning of exogenous/endogenous in the table. (2 pts)

Answer.

	Structural Models	Reduced Form (intensity based) Models
Definition of default	<p>Default is defined in terms of:</p> <ol style="list-style-type: none"> 1. Stochastic process of the asset value of the firm 2. Definition of the default barrier 3. Definition of the default time (e.g. first passage time, barrier breach at maturity ...) 	<p>Default is defined in terms of:</p> <ol style="list-style-type: none"> 1. Default time = the first jump time of a Poisson process 2. Hazard rate = probability of a default occurring in an infinitesimal time interval $[t, t+dt)$, not having occurred before t
Exogenous/ endogenous	Endogenous	Exogenous jump process
Calibration to CDS	In general, difficult to calibrate to CDS. Analytically tractable first passage time models calibrate on volatility of the asset value and parameters of the barrier	Easy to calibrate to CDS through a bootstrapping algorithm which gives as output the intensity
Multi-name environment	Natural extension to the multi-name environment through the copula approach	Difficult to extend to the multi-name environment. Too low levels of dependence.

2. Exogenous/endogenous: see Lecture “Reduced Form (Intensity) Models” (slides 7/59 and 59/59)

Question 12. Esteban works as a structurer at Gordon Socks Bank. He has been asked to provide some ideas of structured products to showcase in occasion of a meeting with potential clients. He is considering three possible underlyings. Considering the characteristics of each underlying provided below, which of the following statements is most appropriate? (1.5 pts)

<i>Underlying</i>	<i>Volatility</i>	<i>Dividend yield</i>
Eurostoxx 50	22%	1.30%
S&P 500	17%	1.00%
Ftse Mib	25%	2.00%

- ☐ (A) An Equity Protection certificate (with capital protection equal to 100%) that has Eurostoxx 50 as underlying will most likely have a higher participation to upside than an otherwise similar product that has S&P 500 as underlying
- ☒ (B) A Bonus Cap certificate with European barrier that has the Ftse Mib as underlying will pay a higher Bonus than an otherwise similar certificate that has the S&P 500 as its underlying
- ☐ (C) An Equity Protection certificate (with capital protection equal to 100%) that has Ftse Mib as underlying will most likely have a higher participation to upside than an otherwise similar product that has S&P 500 as underlying
- ☐ (D) A Bonus Cap certificate with European barrier that has the S&P 500 as underlying will have a higher Bonus than an otherwise similar product that has Eurostoxx 50 as underlying
- ☐ (E) None of the above

Question 13. You are pricing a Bonus Cap with an American barrier (observed continuously, at intra-daily frequency) using Monte Carlo simulations and assuming that the stochastic process for the underlying follows a log-normal random walk. You are assuming a time step t equal to one day (i.e., you are simulating the market closing price every day) Which of the following statement is most appropriate. (1.5 pts)

- ☐ (A) Because for a log-normal random walk we have an exact discretization scheme, you will only introduce an error $O(N^{-1/2})$ due to the fact that you are using a finite number of simulations; such an error will decrease as the number of simulations increases
- ☐ (B) Because for a log-normal random walk we cannot exploit an exact discretization scheme, you will introduce an error $O(\delta t)$ due to discretization and an error $O(N^{-1/2})$ due to the fact that you are using a finite number of simulations
- ☒ (C) Although for a log-normal random walk we have an exact discretization scheme, the fact that the barrier is observed continuously intraday but you are simulating the price at the end of the day, leads to introducing an error of magnitude $O(\delta t)$, due to discretization and an error $O(N^{-1/2})$ due to the fact that you are using a finite number of simulations
- ☐ (D) None of the above

Question 14. You have just received a complaint from a client about a Bonus Cap that is currently trading on the secondary market (and whose European barrier has not been crossed). He is arguing that, despite the price of the stock has been increasing, the price of the certificate has not increased, instead it has been slowly declining. What is the most likely explanation? (1.5 pts)

- ☐ (A) A Bonus Cap certificate is inversely related to the price of the underlying and so there is no reason to complain
- ☐ (B) This Bonus Cap is mispriced and the client is right to complain
- ☐ (C) A Bonus Cap certificate is positively related to the price of underlying but negatively related to the volatility; therefore it is possible that volatility has been decreasing so that its effects may be more than compensating the effects of the increase in the price of the underlying
- ☒ (D) A Bonus Cap certificate is positively related to the price of underlying but negatively related to its volatility; therefore it is possible that volatility has been increasing so that its effects may be more than compensating the effects of the increase in the price of the underlying

Question 15. With reference to Fixed Leverage investment certificates (ICs) vs. Turbos which of the following statements is most likely correct? (1.5 pts)

- ☒ (A) Because of the compounding effect, when volatility is high, the performance of fixed leverage ICs tends to significantly diverge from the performance of the underlying; the compounding effect is a drawback of Fixed Leverage certificates
- ☐ (B) Because of the compounding effect, when volatility is low, the performance of fixed leverage ICs tends to significantly diverge from the performance of the underlying; the compounding effect is a drawback of Fixed Leverage certificates
- ☐ (C) Because of the compounding effect, when volatility is high, the performance of Turbos tends to significantly diverge from the performance of the underlying; the compounding effect is a drawback of Turbos
- ☐ (D) Because of the compounding effect, when volatility is low, the performance of Turbos tends to significantly diverge from the performance of the underlying; the compounding effect is a drawback of Turbos

Question 16. Bea has bought an Equity Protection certificate with 100% protection and 100% participation to the positive performance of a *basket* of stocks. Draw the payoff and describe how this is constructed. In addition, discuss how the price of the certificate will move if the correlation among the stocks decreases. (3pt)

Answer:

The equity protection certificate bought by Bea is a combination of a long position in a ZCB and a long position in an ATM call on the basket of stocks. When the correlation between the stocks decreases the call option becomes cheaper and thus the price of the equity protection certificate decreases.

Recall that the volatility of a basket of stocks increases when the correlation increases and that a call option has positive vega.

