MATRICOLA / *STUDENT ID* |_|_|_|_|_|_|_|_|

NOME/*NAME* _____

COGNOME/*SURNAME* _____

ANNO DI CORSO/*YEAR OF STUDIES* _____

PROVA DI/*EXAM* _____

CLASSE / *CLASS* _____

DATA) / *DATE* __ _____

**Scrivere in stampatello / *Please print***

**NORME DI COMPORTAMENTO DURANTE LO SVOLGIMENTO DEGLI ESAMI O DI ALTRE PROVE DI VERIFICA DELLA PREPARAZIONE**

Durante la prova d'esame lo studente è tenuto al silenzio, a non avvalersi di alcun ausilio o supporto esterno, sia esso cartaceo o elettronico (es.: manuali, dispense, fogli propri, libri, pubblicazioni, telefoni cellulari, computer palmari o altri dispositivi elettronici), se non espressamente autorizzato dal docente in aula, a non copiare né osservare le prove di altri candidati, a non contattare o tentare di contattare in alcun modo altre persone. Lo studente deve rimanere in aula per tutto e solo il tempo strettamente necessario per lo svolgimento delle sue prove d'esame, salvo diverse disposizioni del docente in aula. Lo studente che abbia necessità di rivolgere domande al docente deve alzare la mano ed attendere che l'esaminatore si avvicini al suo posto.

Al termine della prova, lo studente deve riconsegnare l'elaborato svolto e il testo della prova d'esame al docente esaminatore e lasciare l'aula.

La violazione di tali regole o delle eventuali altre disposizioni indicate dal docente presente al momento della valutazione comporta, in ogni caso, l'annullamento della prova e l'invio, d'ufficio, di una segnalazione alla Commissione Provvedimenti Disciplinari.

Tutte le sanzioni disciplinari sono registrate nella carriera accademica dello studente. La sanzione superiore all'ammonizione comporta la decadenza dai benefici del diritto allo studio (borsa di studio, alloggio etc.).

L'Honor Code e le regole dettagliate per lo svolgimento delle prove d'esame o di altre prove di verifica della preparazione sono pubblicate sul sito dell'Università http://www.unibocconi.it/honorcode .

**RULES OF CONDUCT DURING EXAMS OR OTHER TESTS**

During exams, students must remain quiet and may not use any external support aids, whether paper or digital (e.g. manuals, lecture notes, personal papers, books, publications, cell phones, handheld computers or other electronic devices), if not expressly authorized by the teacher in class. In addition, students may not copy or look at other students' exam paper or contact or attempt to contact other people in any way. Students must remain in the classroom for the whole of the time and only for the time needed to finish his or her exam, unless teachers in class give other orders. Students who have questions for the teacher must raise their hand and wait for the examiner to come to them.

At the end of the exam, students must return the exam script and the exam paper to the examining faculty member and leave the room.
Any breach of these regulations or any other orders given by the faculty member present at the time of the exam will result in the test being cancelled and an official report sent to the Disciplinary Board in all cases.

All disciplinary sanctions will be recorded in the student's academic career. Sanctions greater than a warning will result in forfeiture of benefits for the right to study (scholarships, housing etc.).

The Honor Code and detailed regulations for taking exams and other tests are published on the University website http://www.unibocconi.eu/honorcode.

_____

**Firma: Mi impegno a rispettare le norme sopra descritte e sottoscrivo la mia presenza alla prova d'esame.**
**Signature: I hereby undertake to respect the regulations described above and undersign my presence at the exam.**

Università Commerciale
Luigi Bocconi

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

# Advanced Quantitative Methods for Asset Pricing and Structuring

## May 2018 Exam for Attending Students Time Allowed: 60 minutes

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

Please answer all questions by choosing the most appropriate alternative(s) 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(s) 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 (1.5 pts).** Which of the following statements about CDS calibration is TRUE?

☐ (A) Default frequency and payment frequency are input which can be chosen arbitrarily
☐ (B) The breakeven spread with premium accrued has to be less than the spread without premium accrued
☐ (C) For deterministic intensity models, the O'Kane-Turnbull formula is a good approximation
☐ (D) For deterministic intensity models, the survival probability can become negative

**Question 2 (1.5 pts).** Which of the following statements about AT1P structural models is TRUE?

☐ (A) Default is represented by an exogenous process
☐ (B) The barrier is stochastic
☐ (C) If the asset volatility increases, the value of the barrier decreases
☐ (D) The survival probability can oscillate

**Question 3 (1.5 pts).** Which of the following statements about counterparty risk is TRUE?

☐ (A) It is affected by the counterparty volatility, the contract volatility and the correlation between them

☐ (B) Counterparty exposure at any future time is given by the market value of the portfolio of derivative positions with that counterparty

☐ (C) DVA depends on the positive part of the market value of the derivative positions with the counterparty

☐ (D) Exposure at default is stochastic

**Question 4 (1.5 pts).** Which of the following statements about jump processes is TRUE?

☐ (A) Time inhomogeneous Poisson processes are increasing unit-size jump process, whose increments are independent but no longer identically distributed

☐ (B) Time homogeneous Poisson processes are increasing unit-size jump process, whose increments are independent but no longer identically distributed

☐ (C) Time homogeneous Poisson processes accounts for the term structure of credit spreads

☐ (D) Time inhomogeneous Poisson processes accounts for the volatility of credit spreads

**Question 5 (3 pts).**

Given a term structure of CDS with the following maturities $T = 1, 3, 5, 7, 10$ (years), please write the survival probabilities in a piece-wise constant intensity model.

**Answer**.

**Question 6 (1.5 pts).** The matrix below shows the pair-wise correlations between returns on three different stocks. For simplicity, assume the stocks are characterized by the same volatility and that they do not pay any dividends. Which of the proposed combinations of stocks will allow the highest coupon to be paid out by a Reverse Convertible certificate written on a "worst of" basket of **two only of these three stocks** to be used as its underlying basket?

| | Univeler | Trotter | Brambo |
|---|---|---|---|
| Univeler | 1 | | |
| Trotter | 0.7 | 1 | |
| Brambo | 0.2 | 0.5 | 1 |

☐ (A) Brambo and Univeler followed by Brambo and Trotter
☐ (B) Trotter and Univeler, followed by Brambo and Trotter
☐ (C) Brambo and Unilever, followed by Univeler and Trotter
☐ (D) Trotter and Brambo

**Question 7 (1.5 pts)**. Markus, a structurer at Dutch Robobank, on every Monday produces a newsletter to show to the sales team a number of alternative Bonus Cap certificates, that could be immediately issued (their selling price will be €100). A portion of his latest newsletter, concerning potential Bonus Caps on Fiat, is copied below. In the second column of the table, Markus has reported the Bonus Amount (equal to the Cap Amount). Which of the following statements is the MOST LIKELY?

| **Barrier / Tenor** | 1 year |
|---|---|
| **60%, American** | 117 |
| **70%, American** | 120 |
| **60%, European** | 115 |
| **70%, European** | 112 |

☐ (A) Markus has obviously done a mistake: indeed, we would expect the Bonus (Cap) Amount of a certificate with American Barrier to be lower than that of a certificate with European Barrier, all else being equal
☐ (B) Markus has obviously done a mistake: indeed, we would expect the Bonus (Cap) Amount of a certificate with American Barrier to be equal than that of a certificate with European Barrier, all else being equal
☐ (C) Markus has obviously done a mistake: indeed, we would expect the Bonus (Cap) Amount of a certificate to become higher when we lower the barrier, all else being equal
☐ (D) Markus has obviously done a mistake: indeed, we would expect the Bonus (Cap) Amount of a certificate to become lower when we lower the barrier, all else being equal

**Question 8 (1.5 pts).** Which of the following statements is the LEAST LIKELY?

☐ (A) A Turbo certificate implies a leverage that is function of the level of the underlying, given a fixed strike

☐ (B)The major drawback of a Fixed Leverage Certificate is the "compounding effect"

☐ (C) A Fixed Leverage certificate is characterized by a constant leverage ratio

☐ (D)All of the above statements are correct

**Question 9 (3 pts)**. Kirilo, a senior structurer at PJ Dorman Bank, has been asked to structure an equity protection certificate on the FTSE MIB (with full capital protection and a tenor of 3 years). Unfortunately, as the relevant ZCB costs €98 and a 3-year ATM call option on the FTSE MIB is worth €6, it is not possible to offer an unlimited one-to-one participation rate to the positive performance of FTSE MIB.

- What is the maximum participation rate that the product can offer, given an initial selling price of € 100 and why?
- Draw the payoff of an alternative product that offers a 100% participation rate to the positive performance of the FTSE MIB, but up to a certain cap (assume it to be equal to 20%). Discuss how this product can be replicated. Also discuss the sign of the vega *at issuance* of this structure.

**Question 10 (1.5 pts)**. The basic intuition and results of a liquidity model based on stochastic holding periods are:

☐ (A) Due to changing market liquidity conditions, desks operate along a "calendar time" that may strongly differ from their operational time and this will affect the profits and losses (P&L) from managing their portfolios; as a result, mixing portfolio return scenarios under random stochastic holding periods creates mixtures of distributions for the portfolio P&L, allowing for time-varying means and variances in predicted performances

☐ (B) Due to changing market liquidity conditions, desks operate along an "operational time" that may strongly differ from calendar time and this will affect the profits and losses (P&L) from managing their portfolios; however, as partially applied by regulators, the point of the resulting models can be effectively captured by simply stretching the holding period to calculate market VaR and ES to exceed one day, for instance to ten business days instead of one

☐ (C) Due to changing market liquidity conditions, desks operate along an "operational time" that may strongly differ from calendar time and this will affect the profits and losses (P&L) from managing their portfolios; as a result, mixing portfolio return scenarios under random stochastic holding periods creates mixtures of distributions for the portfolio P&L, allowing for skewness, heavy tails and extreme scenarios in predicted performances

☐ (D) Due to changing market liquidity conditions, desks operate along an "operational time" that may strongly differ from calendar time and this will affect the profits and losses (P&L) from managing their portfolios; as a result, through weighted sums of portfolio return scenarios under random stochastic holding periods creates mixtures of distributions for the portfolio P&L, allowing for conditional heteroskedastic effects that however will be of a symmetric type

**Question 11 (1.5 pts)**. With reference to the Monte Carlo approximation of the Vega of a structure with strike K, time-to-maturity $\tau$, which of the following statements is the MOST LIKELY?

☐ (A) The formula to be applied is

$$\nu \equiv \lim_{h \to 0} \frac{O(S_t + h, \sigma_t; K, \tau) - O(S_t - h, \sigma_t; K, \tau)}{2h}$$

where $O(\sigma_t, S_t; K, \tau)$ is the structure price from some stochastic volatility model with initial price $S_t$. However, the measurement error of the two prices at $\sigma_t + h$ and $\sigma_t - h$ can be large for Monte Carlo simulations and result in an error of $O(1/(hN))$.

☐ (B) The formula to be applied is

$$\nu \equiv \lim_{h \to 0} \frac{O(\sigma_t + h, S_t; K, \tau) - O(\sigma_t - h, S_t; K, \tau)}{2h}$$

where $O(\sigma_t, S_t; K, \tau)$ is the structure price from Black Scholes model with constant volatility $\sigma_t$ and $\sigma_t > h$. However, the measurement error of the two prices at $\sigma_t + h$ and $\sigma_t - h$ can be large for Monte Carlo simulations and result in an error of $O(h/(N^{1/2}))$.

☐ (C) It is not possible to approximate the Vega of a structure using Monte Carlo methods, because these can be just applied to the calculation of the delta of an option or basket of options

☐ (D) The formula to be applied is

$$\nu \equiv \lim_{h \to 0} \frac{O(\sigma_t + h, S_t; K, \tau) - O(\sigma_t - h, S_t; K, \tau)}{2h}$$

where $O(\sigma_t, S_t; K, \tau)$ is the structure price from some stochastic volatility model with initial volatility $\sigma_t$ and $\sigma_t > h$. However, the measurement error of the two prices at $\sigma_t + h$ and $\sigma_t - h$ can be large for Monte Carlo simulations and result in an error of $O(1/(hN^{1/2}))$.

**Question 12 (1.5 pts)**. In an expected power utility portfolio maximization problem (with coefficient of relative risk aversion $\gamma > 1$) in which the asset menu includes a risky asset, cash, and a derivative structure with generic payoff that depends on both the variance and the price of the underlying asset, which of the following statements is the MOST LIKELY?

☐ (A) The optimal demand of the derivative is non-zero if and only markets are incomplete, which means that the structure will be traded as a way to hedge volatility risk, and empirically turns out to strongly depend on the sign and the size of the volatility risk premium; however, because any derivative with payoff that has non-zero Vega may complete the markets, its ex-ante economic value does not specifically depend on its payoff function

☐ (B) The optimal demand of the derivative is non-zero if and only markets are complete, which means that the structure will be traded as a way to statically diversify risk, and empirically turns out to strongly depend on the sign and the size of the equity risk premium; however, because any derivative with payoff that has non-zero Vega may complete the markets, its ex-ante economic value does not specifically depend on its payoff function

☐ (C) The optimal demand of the derivative has one static and one dynamic, hedging component and while the former is always non-zero, the latter is non-zero if and only markets are incomplete, which means that the structure will be traded as a way to hedge volatility risk

☐ (D) The optimal demand of the derivative is non-zero if and only markets are incomplete, which means that the structure will be traded as a way to hedge volatility risk, and empirically turns out to strongly depend on the sign and the size of the volatility risk premium; as one would expect, the ex-ante economic value of the derivative will depend on its payoff function