UNIVERSITY OF PENNSYLVANIA
The Wharton School

FNCE 7170/2170:
**FINANCIAL DERIVATIVES**

Prof. Domenico Cuoco — Fall 2025

# Assignment 1
# (Part 1)

> *"Twenty-five years ago it was comparatively easy to acquire a sound knowledge of the general investment field [... but now] the different types of securities have multiplied in number to an almost unlimited extent."* (John Moody, 1910)

## Background

In this assignment you are asked to price the structured notes described in the term sheets in Figures 2 and 3.

*Structured notes* are bonds with coupons or principal payments that depend on the price of an underlying asset (or on a quantity closely related to such a price). Generally, these securities are created by combining a vanilla note with derivatives.

In particular, *Mandatory Convertible Notes* (MCNs) are bonds that receive a given number of shares of a company's stock at maturity instead of the principal payment, while *Contingent Coupon Notes* (CCNs) are bonds with coupons linked to an underlying market variable.

## Working Assumptions

Throughout this Assignment assume that:

- The credit risk of the structured notes was negligible.
- The term structure of (continuously compounded) risk-free rates on March 1, 2024 was as shown in Figure 4.
- The price of XYZ's stock on March 1, 2024 was $250 per share.
- As of March 1, 2024, XYZ was expected to pay a dividend on the 1st of March, June, September and December of each year, starting on June 1, 2024, equal 0.40% of the cum-dividend price per share on each dividend payment date.
- Each dividend payment date coincides with the corresponding ex-dividend date.

## Questions

(a) What was the value on March 1, 2024 of the Vanilla Notes in the term sheet in Figure 1?

(b) What was the value on March 1, 2024 of a claim to the dividend payments on one share of XYZ's stock over the next 3 years?

(c) What was the fair 3-year forward price of XYZ's stock on March 1, 2024?

(d) What was the value on March 1, 2024 of a 3-year forward contract on XYZ's stock with delivery price equal to $250 and unit size?

(e) What was the fair quarterly strike on March 1, 2024 of a 3-year dividend swap on XYZ's stock?

(f) What was the value on March 1, 2024 of a 3-year dividend swap on XYZ's stock with a quarterly strike of $1.00 and unit size?

(g) What position in the Vanilla Notes in the term sheet in Figure 1, together with XYZ derivatives and borrowing or lending at the risk-free rate, could have been used on March 1, 2024 to replicate the cash flows of the Mandatory Convertible Notes in the term sheet in Figure 2?

(h) What was the value on March 1, 2024 of the Mandatory Convertible Notes?

(i) What position in the Vanilla Notes in the term sheet in Figure 1, together with XYZ equity derivatives and borrowing or lending at the risk-free rate, could have been used on March 1, 2024 to replicate the cash flows of the Contingent Coupon Notes in the term sheet in Figure 3?

(j) What was the value on March 1, 2024 of the Contingent Coupon Notes?

**1. General Terms**

| | |
|---|---|
| Description | 3 year Vanilla Notes |
| Issuer | XYZ Corporation (XYZ) |
| Issue Date | March 1, 2024 |
| Maturity Date | March 1, 2027 |
| Nominal Amount | $10,000 per Note |

**2. Principal Payment**

| | |
|---|---|
| Payment Date | March 1, 2027 |
| Principal Amount | 100% of Nominal Amount |

**3. Coupon Payments**

| | |
|---|---|
| Payment Dates | The 1st day in March, June, September and December, from and including June 1, 2024 to and including the Maturity Date |
| Interest Amount | Interest shall accrue on the Nominal Amount at the applicable Coupon Rate on the basis of a 360-day year of twelve 30-day months |
| Coupon Rate | 4% per annum |

Figure 1: Term Sheet for XYZ's Vanilla Notes

**1. General Terms**

| | |
|---|---|
| Description | 3 year Mandatory Convertible Notes |
| Issuer | XYZ Corporation (XYZ) |
| Issue Date | March 1, 2024 |
| Maturity Date | March 1, 2027 |
| Nominal Amount | $10,000 per Note |

**2. Mandatory Conversion**

| | |
|---|---|
| Conversion Date | March 1, 2027 |
| Conversion | On the Conversion Date, the Notes will automatically convert into shares of XYZ's common stock at a conversion price of $250 per share (equivalent to 40 shares per Note). This share settlement will constitute full satisfaction of the Issuer's obligation to repay the principal amount of the Notes |

**3. Coupon Payments**

| | |
|---|---|
| Payment Dates | The 1st day in March, June, September and December, from and including June 1, 2024 to and including the Maturity Date |
| Interest Amount | Interest shall accrue on the Nominal Amount at the applicable Coupon Rate on the basis of a 360-day year of twelve 30-day months |
| Coupon Rate | 4% per annum |

Figure 2: Term Sheet for XYZ's Mandatory Convertible Notes

**1. General Terms**

| | |
|---|---|
| Description | 3 year Contingent Coupon Notes |
| Issuer | XYZ Corporation |
| Issue Date | March 1, 2024 |
| Maturity Date | March 1, 2027 |
| Nominal Amount | $10,000 per Note |

**2. Principal Payment**

| | |
|---|---|
| Payment Date | March 1, 2027 |
| Principal Amount | 100% of Nominal Amount |

**3. Coupon Payments**

| | |
|---|---|
| Payment Dates | The 1st day in March, June, September and December, from and including June 1, 2024 to and including the Maturity Date |
| Coupon Amount | Each coupon payment shall equal 100 times the relevant Dividend Amount |
| Dividend Amount | The dividend payment per share of XYZ's common stock in the quarter ending on each coupon Payment Date |

Figure 3: Term Sheet for XYZ's Contingent Coupon Notes

| Tenor | Rate |
|---|---|
| 3 month | 5.36056% |
| 6 month | 5.17513% |
| 9 month | 5.01501% |
| 12 month | 4.87682% |
| 15 month | 4.75763% |
| 18 month | 4.65493% |
| 21 month | 4.56655% |
| 24 month | 4.49061% |
| 27 month | 4.42551% |
| 30 month | 4.36983% |
| 33 month | 4.32237% |
| 36 month | 4.28209% |

Figure 4: Risk-free rates on March 1, 2024