MFE5130 – Financial Derivatives

First Term, 2018-19

Class Activity (6-September-2018) (Solution)

Important Notes:

1. This class activity is counted toward to your class participation score. **Fail** to hand in this class activity worksheet in the class will receive **0 score** for that class.
2. **0 mark** will be received if you leave the solution blank.

Name:	Student No.:

Consider a Market-Linked Certificates of Deposit (MLCD) by Morgan Stanley Bank, N.A., the summary terms of the MLCD are given as follows:

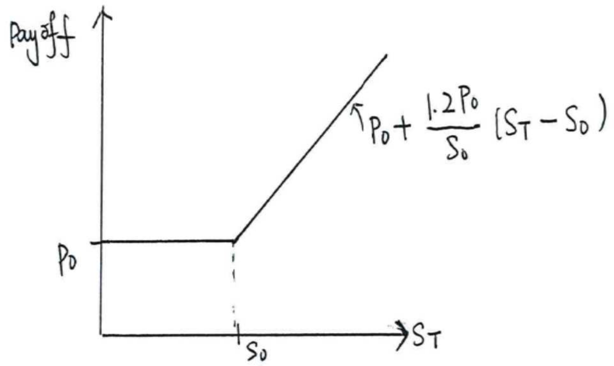
SUMMARY TERMS	
Issuer:	Morgan Stanley Bank, N.A.
Deposit amount:	$1,000 per CD
Pricing date / Original issue date:	August 28, 2018 / August 31, 2018
Maturity date:	September 2, 2020, subject to postponement in the event of a market disruption event
Interest:	None
Index:	Morgan Stanley MAP Trend Index
Payment at maturity:	A cash payment of $1,000 for each $1,000 CD *plus* the supplemental amount, if any
Supplemental amount:	The supplemental amount payable at maturity per $1,000 CD will equal: • if the index return is *positive* (the final index value is *greater than* the initial index value), the *product* of (a) $1,000, (b) the index return and (c) the participation rate, or • if the index return is *zero or negative* (the final index value is *less than or equal to* the initial index value), $0.
Participation rate:	105% to 120%. The actual participation rate will be determined on the pricing date.
Index return:	(final index value – initial index value) / initial index value
Maximum supplemental amount:	None
Initial index value:	The index closing value on the pricing date
Final index value:	The index closing value on the final observation date
Final observation date:	August 28, 2020, subject to postponement for non-index business days and certain market disruption events
CUSIP:	61765QHR3
Minimum deposit size:	$1,000 and increments of $1,000 in excess thereof.
Limited early withdrawals:	At par, only upon death or adjudication of incompetence of a beneficial holder of the CDs. For information about early withdrawals and the limitations on such early withdrawals, see "Additional Information About the CDs—Additional Provisions—Additional information regarding early withdrawals" in the accompanying disclosure supplement.

1. What financial asset or index is used to determine the return of the MLCD?

   Morgan Stanley MAP Trend Index

2. Let P_0 be the amount initially invested in the MLCD. Suppose S_0 and S_T be the value of the underlying asset at time 0 and the maturity date T respectively. Assume the participation rate is 120%. Write down the payoff of the MLCD at time T and also draw the corresponding payoff the diagram.

$$
\begin{aligned}
\text{Payoff at } T &= P_0\left[1+1.2\times\max\left(0,\frac{S_T-S_0}{S_0}\right)\right] \\
&= P_0\left[1+\frac{1.2}{S_0}\times\max\left(0,S_T-S_0\right)\right] \\
&= P_0+\frac{1.2P_0}{S_0}\max\left(0,S_T-S_0\right).
\end{aligned}
$$



3. How do you use the basic financial derivatives and/or assets to replicate the MLCD?

   From (2), the MLCD can be replicated by buying a zero-coupon bond with the face value of P_0 and maturity at T and long $\frac{1.2P_0}{S_0}$ units of call option with the strike price of S_0 and the maturity at T.

   Let B and C the price of the zero-coupon bond and call option respectively.

   The cash-flow table of the replicating portfolio is given by

	$t = 0$	$t = T$
Buying a zero-coupon bond with the face value P_0	$-B$	P_0
$\frac{1.2P_0}{S_0}$ units of call option	$-\frac{1.2P_0}{S_0}C$	$\frac{1.2P_0}{S_0}\max\left(0, S_T - S_0\right)$
Total	$-\left(\frac{1.2P_0}{S_0}C + B\right)$	$P_0 + \frac{1.2P_0}{S_0}\max\left(0, S_T - S_0\right)$

From the above table, we see that the payoff of the MLCD is replicated by the payoff of this portfolio.

For fair pricing (no arbitrage), the cost of the MLCD should be the same as this portfolio. That is,

$$\frac{1.2P_0}{S_0}C + B = P_0.$$

4. What are the risks of the MLCD?

   The risk of losing the interest of your investment P_0. Also, the investors of the MLCD bear the credit risk of the issuer.