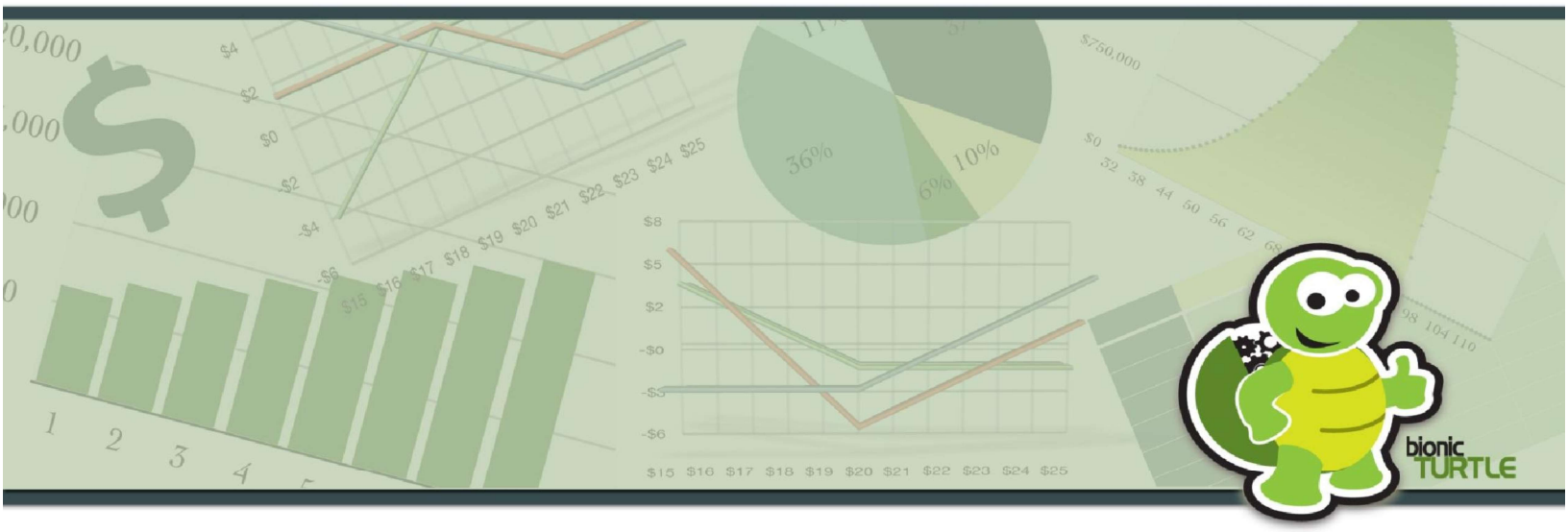


Part 1
Bionic Turtle FRM Full-Length Mock Exam 2

By David Harper, CFA FRM CIPM
www.bionicturtle.com

Candidate Answer Sheet: Mark an X under your answer of choice.

Question #	Answer A	Answer B	Answer C	Answer D
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				

Question #	Answer A	Answer B	Answer C	Answer D
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				

Question #	Answer A	Answer B	Answer C	Answer D
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				
93				
94				
95				
96				
97				
98				
99				
100				

Question 1: Risk typology

The classic risk management process affirms the job of a risk manager to include four activities: identifying risks; analyzing and measuring risks; assessing the impact of risk events; and managing risks. This process culminates in the series of decisions as to how to handle identified risks. Which of the following is (**TRUE** as) a common activity of the risk manager?

a) To either avoid or transfer each risk
b) To quantify every risk in an exact way; i.e., single number
c) To eliminate each risk to the fullest extent possible
d) To help identify where the firm should add risk

Question 2: Stationary Time Series

Below are a set of innovations over ten steps (from initial t = 0 to t = 10) and the first innovation ε(1) = 0.26. The innovations are random Gaussian white noise, ε(t) ~ N(0, σ^2 = 1).

	AR(1)	MA(1)
Intercept (δ or μ)	0.70	0.70
Weight(ϕ or θ)	0.50	0.50

t	ε(t)		
0	0		
1	0.26	0.9600	0.9600
2	-0.36	0.8200	0.4700
3	1.92	3.0300	2.4400
4	-0.45	?	?
5	-0.30	1.2825	0.1750
6	0.66	2.0013	1.2100
7	-0.05	1.6506	0.9800
8	0.26	1.7853	0.9350
9	0.16	1.7527	0.9900
10	-0.64	0.9363	0.1400

Consider two time series models. The AR(1) model has an intercept, δ, of 0.70, and an AR parameter, φ, of 0.50. The MA(1) model has a mean, μ, of 0.70, and a weight of 0.50. Which of the following is nearest the value at t = 4; i.e., which are the missing values inside the red rectangle?

a) AR(1) = 1.7650 and MR(1) = 1.2100
b) AR(1) = 1.9630 and MR(1) = 1.8550
c) AR(1) = 2.8600 and MR(1) = 2.2570
d) AR(1) = 3.2430 and MR(1) = 2.6800

Question 3: Lookback and Asian (exotic) options

Consider the price of an asset that begins and $30.00 and ends, after 20 periods, lower at $8.55. Also highlighted are its maximum ($39.23) and minimum price ($6.79) during this 20-period life:

Among the following choices, which lookback option has the **HIGHEST** payoff if its life matches the 20-period interval shown?

a) Floating lookback call
b) Floating lookback put
c) Fixed lookback call with strike = $30.00 (mat
d) Fixed lookback put with strike = $30.00 (mat

Question 4: Credit loss distribution

Consider a large $20.0 million portfolio of 100 loans. In its general form, the portfolio's unexpected loss is given by:[1]

$$UL_p \sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n} \omega_i \omega_i \rho_{ij} UL_i UL_j}$$

However, each loan in this portfolio has approximately the same characteristics and size; i.e., the size of each is about $200,000. For modeling purposes, we can set the pairwise correlation coefficient to be constant ρ(i,j) = 0.160 for all i ≠ j. These assumptions greatly simplify the calculation of the portfolio's unexpected loss and each loan's contribution to portfolio risk.

In this situation, which of the following statements is **TRUE**?

a) Apractical problem with using the general form (i.e., specifying the correlation matrix) is that default correlations are very difficult to observe
b) Under the simplifying assumptions, each loan's risk contribution (aka, unexpected loss contribution, ULC) is conveniently 16.0% of its individual unexpected loss, UL
c) If we attempted to estimate the portfolio's unexpected loss by specifying the pairwise correlation matrix of each ρ(i,j), then we would require 100! or 9.3E+157 correlation pairs
d) When estimating the portfolio's unexpected loss and its component contributions, banks prefer these analytical approaches over numerical procedures because the latter are cumbersome and prone to estimation errors

[1] Gerhard Schroeck, Risk Management and Value Creation in Financial Institutions, (New York: Wiley, 2002

Question 5: Primitive risk factors and tail risk

A big part of a risk manager's job is to identify her firm's risk factors. Each of the following statements about risk factors is true **EXCEPT** which is false?

a) Two examples of primary (aka, primitive) risk factors include the return on a broad stock market index and the risk-free spot (aka, zero) interest rate
b) For any risk factors that are represented by categorical or discrete variables, the risk manager should seek to replace them with either interval, ratio, or continuous risk factor variables
c) One of the risk manager's key activities is to deconstruct primitive risk factors into the important loss drivers, the relationship of the loss drivers with each other, and the wider business environment
d) Machine learning, as a subset of artificial intelligence, holds the potential to help risk managers identify the "unknown unknowns" (aka, unk-unks)

Question 6: Regression diagnostics

Below are displayed 15 pairwise (X,Y) trials. The simple regression line based on all 15 observations is given by Y1 = 0.488 + 0.425*X. We consider the possibility that the 12th Trial, given by point (X = 2.50, Y = -3.00) might be an outlier. If this point is removed, then the regression based on the remaining 14 observations is given by Y2 = 0.761 + 0.574*X. These results are displayed, including selected summary statistics.

According to Cook's distance, is the 12th Trial an outlier?

a) No, beca
b) No, because its Cook's distanc
c) Yes, because its Cook's distan
d) Yes, because its Cook's distan

All 15 observations: Y1 = 0.488 + 0.425 * X
14 observations (excludes 12th trial): Y2 = 0.761 + 0.574 * X

Trial	X	Y	Y1	Y2	$(Y1-Y2)^2$	(Y1 - Y)	$(Y1 - Y)^2$
1	-3.00	-0.89	-0.79	-0.96	0.030	0.103	0.011
2	-2.50	-1.36	-0.57	-0.67	0.010	0.782	0.612
3	-2.00	0.05	-0.36	-0.39	0.001	-0.416	0.173
4	-1.50	-0.12	-0.15	-0.10	0.002	-0.032	0.001
5	-1.00	-0.99	0.06	0.19	0.015	1.050	1.102
6	-0.50	0.69	0.28	0.47	0.039	-0.411	0.169
7	0.00	1.22	0.49	0.76	0.074	-0.731	0.535
8	0.50	1.48	0.70	1.05	0.120	-0.777	0.604
9	1.00	1.38	0.91	1.33	0.177	-0.468	0.219
10	1.50	2.75	1.13	1.62	0.245	-1.628	2.651
11	2.00	2.13	1.34	1.91	0.324	-0.792	0.627
12	**2.50**	**-3.00**	**1.55**	**2.19**	**0.414**	**4.552**	**20.717**
13	3.00	2.59	1.76	2.48	0.515	-0.827	0.683
14	3.50	1.65	1.98	2.77	0.627	0.324	0.105
15	4.00	2.92	2.19	3.06	0.750	-0.730	0.532
Average	0.500	0.701	0.701	1.047	0.223	0.000	s^2= 1.916
Sum					3.341	0.000	28.740

Question 7: Option spread strategies

Assume the current price of a stock is $30.00 and imagine that we can only trade the following four options at two strike prices:

- At a strike price of $28.00, we can employ either a call or a put, where c(K=28.00) = $3.98 and p(K=28.00) = $1.46
- At a strike price of $32.00, we can employ either a call or a put, where c(K=32.00) = $2.05 and p(K=32.00) = $3.46

Each of these prices is approximately accurate for a six-month option when the volatility is 31.2% (but these details are not necessary to answer the question). If we want to implement a bull spread, how could we do that?

a) We cannot create a bull spread with these options
b) Long the call with strike of 32.00 plus Short the put with strike of 28.00
c) Long the call with strike of 28.00 plus Short the call with strike of 32.00; or Long the put with strike of 28.00 plus Short the put with strike of 32.00
d) Long the call with strike of 32.00 plus Short the call with strike of 28.00; or Short the put with strike of 28.00 plus Long the put with strike of 32.00

Question 8: Internal rating systems & external credit ratings

Finlux International seeks to build an internal rating system for its considerable credit portfolio and assigns the project to a team including Alice, Bob, Chris, and Denise. In order to cast a wide net for ideas, each of the team members builds a mini-prototype:

I. Alice (A) developed an internal migration matrix based on a sample taken during a recession such that (related) her probabilities are not Markovian, yet to retrieve 5-year cumulative default probabilities she raises the matrix to the fifth power (i.e.., 5-year cumulative matrix = M^5) a calculation that might be valid if her probabilities were Markovian
II. Bob (B), in order to maximum the universe of rated bonds, combines ratings for all of the major agencies across industries, countries, asset classes
III. III Chris (C) uses a method of polling the salespeople who originate the loans on the theory that these are the people with the best "on the ground" knowledge of credit risk
IV. Denise (D) mixed at-the-point-in-time and through-the-cycle ratings because she was unaware of which methodological assumption applied to each sourced dataset

Which of the following **accurately** matches each team member to the bias that afflicts their approach?

a) Country A is the most likely to default because debt above 100% is highly predictive of default and overwhelms the other indicators
b) Country B is the most likely to default because it is the only country with three (out of four) negative indicators
c) Country C is the most likely to default because it has an autocratic government
d) It is unclear: each has two negative (and two positive) indicators; further, quantification of this scorecard is an insufficient predictor

Question 9: Risk management building blocks

One of the risk management building blocks is enterprise risk management (ERM). Which of the following is **TRUE** as a feature or implication of ERM?

a) ERM encourages organizational silos to sharpen their self-identities
b) ERM supports a firm's 360-degree view of risk which requires multiple tools
c) ERM enables a complex firm to summarize its overall risk into a single number
d) ERM replaces instances of judgment with the application of statistical science

Question 10: Multiple regression

Sally is a portfolio manager at an investment management firm. She wants to test her primary equity portfolio's reaction to the factors in the Fama-French three-factor model. She collected excess returns (i.e., net of the risk-free rate) over the last eight years, so that the sample size, n = 96 months. The response (aka, explained, dependent) variable is the portfolio's excess return. The three explanatory variables are the market factor (MKT), the size factor (SMB), and the value factor (HML). The size factor captures the excess return of small capitalization stocks (SMB = "small minus big") and the value factor captures the excess returns of value stocks (HML = "high book-to-market minus low book-to-market")'. Sally's regression results are displayed below.

Portfolio excess returns regressed against MKT + SMB + HML
i.e., Fama-French three-factor model

Coefficient	Estimate	Std Error	t-stat	p value
(Intercept)	**0.027**	**0.006**	**4.65**	**1.11×10^{-5}**
MKT	**0.502**	**0.100**	**5.03**	**2.44×10^{-6}**
SMB	**−0.703**	**0.097**	**−7.28**	**1.09×10^{-10}**
HML	**−0.277**	**0.102**	**−2.70**	**8.20×10^{-3}**

Which of the following descriptions of her portfolio is the **most accurate**?

a) Her small capitalization, value-oriented low-beta portfolio has not generated alpha
b) Her large capitalization, growth-oriented high-beta portfolio has not generated alpha
c) Her large capitalization, growth-oriented low-beta portfolio has generated significantly positive alpha
d) Her small capitalization, value-oriented high-beta portfolio has generated significantly positive alpha

Question 11: Properties of stock options

Consider an at-the-money (ATM) stock option with a strike price of $50.00 and six months time to expiration; i.e., S(0) = K = $50.00 and T = 0.5 years. Now imagine the following four variations (I., II., III. and IV) on this option:

I. It is a European CALL option on a non-dividend-paying stock while the risk-free rate is 3.0%
II. it is a European CALL option on a stock that pays 1.60% dividend yield (D = $0.40) while the risk-free rate is 3.0%
III. It is a European PUT option on a stock that pays 1.60% dividend yield (D = $0.40) while the risk-free rate is 3.0%
IV. It is a European PUT option on a stock that pays 1.60% dividend yield (D = $0.40) while the risk-free rate is ZERO!

For the three variations where the stock pays a continuous 1.60% dividend, the equivalent present value (over the life of the option) is given by the lump sum, D = $0.40. For those interested, although it is beyond the scope of this question, this translation is given by the following: the PV of dividend, D = -S(0)*[exp(-q*T)-1]; in this case, D = $50.00*[exp(-0.0160*0.5)-1] = $0.3980.

Each of the above options has a different minimum value (aka, lower bound). However, among the four, which has the **LOWEST** minimum value?

a) (I.) European call option on non-dividend stock and risk-free rate of 3.0%
b) (II.) European call option on 1.60% dividend stock and risk-free rate of 3.0%
c) (III.) European put option on 1.60% dividend stock and risk-free rate of 3.0%
d) (IV.) European put option on 1.60% dividend stock and risk-free rate of zero

Question 12: Predicting sovereign default

As of the twentieth century (i.e., beginning 1900 and afterward), each of the following is TRUE about the consequences of sovereign default **EXCEPT** which is false?

a) Renders banking system more fragile: the probability of a banking crisis increases in countries that have defaulted
b) Increased probability of military occupation: subsequent to default, the probability of a military show of force increases by 25.0%
c) Negative impact on economy: real GDP tends to drop between 0.5% and 2.0% albeit the decline is short-lived and mostly in the first year subsequent to default
d) Negative impact on trade: export industries tend to be particularly hurt by sovereign default; one study indicates a drop of 8.0% in bilateral trade subsequent to default

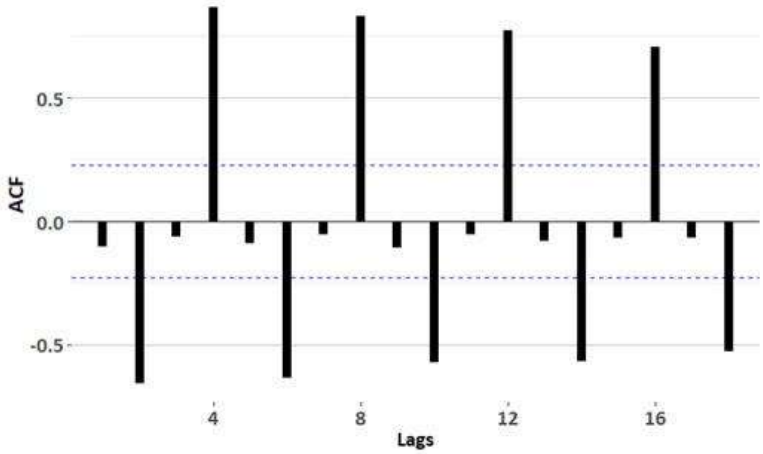
Question 13: Risk appetite and hedging

According to GARP, "a recent trend among corporations is to use a board-approved risk appetite to guide management and (potentially) to inform investors." Which of the following statements is **TRUE** about the firm's risk appetite?

a) Risk appetite is the total amount of risk a firm can bear without becoming insolvent
b) In practice, the risk appetite should be focused on a single thing: one broad, durable philosophical statement that avoids linkages to the firm's day-to-day risk management operations because these are bound to change
c) Although risk appetite has an upper bound (an upper trigger), it is similar to a one-sided confidence interval: there is no such thing as a lower bound (a lower trigger) on risk appetite given that less risk is better
d) Arisk appetite includes the mechanisms (e.g., detailed policy, business-specific risk statements, and a framework for risk limits) that link a top-level statement to the firm's day-to-day risk management operations

Question 14: Stationary Time Series

Shown below is the autocorrelation function (ACF) for a time series object that contains the total quarterly beer production in Australia (in megalitres) from 1956:Q1 to 2010:Q2 (source: *https://cran.r-project.org/web/packages/fpp2/index.html*).



About this ACF and its implications, each of the following statements is true **EXCEPT** which statement is false?

a) ρ(1) and ρ(3) are insignificant
b) This time series is a white noise process
c) This ACF is compatible with a seasonal time series
d) This time series is a non-stationary process because it violates a property of covariancestationarity

Question 15: Chooser and barrier (exotic) options

A non-dividend paying stock is currently trading at a price $35.00 when its volatility is 30.0% and the risk-free rate is 3.0%. Consider a chooser option with a strike price of $30.00 that gives the holder the right to choose (a call or put option) in three months and the chosen option, at that point in time, will have a remaining time to maturity of nine months; i.e., T1 = +0.25 years and T2 = +1.0 years. The price of this chooser is $7.710. Which of the following changes, ceteris paribus, will **INCREASE** the value of this chooser?

a) Dividend increase to 4%
b) Volatility decrease to 20%
c) Stock drops to $30.00
d) Increase T1 to six months

Question 16: Key rates versus partial-01s vs forward-buckets

The exhibit below combines Tuckman's Tables 5.6 and 5.7. The situation starts with the underlying trade: a 5×10 payer swaption struck at 4.044% (which gives the buyer the right to buy a fixed rate of 4.044% on a 10-year EUR swap in five years such that the underlying security in this option is a 10-year swap). This initial swaption trade is highlighted in light blue below. Additionally, the forward-bucket exposures of four swaps are shown in the upper panel. The lower panel highlights three different hedges (discussed in Tuckman) and their respective implied net positions:

About these hedges, which of the following statements is **TRUE**?

a) Hedge #1 is exposed to the risk
b) Hedge #2 is exposed to the risk
c) Hedge #3 is the best hedge
d) As rates increase, the value of th decreases

Forward-Bucket Exposures of Selected EUR-Denominated Securities
(Tuckman Tables 5.6 and 5.7)

		Forward-Bucket Exposures				
Security	**Rate**	**0-2**	**2-5**	**5-10**	**10-15**	**All**
5×10 payer swaption	**4.044%**	**0.0010**	**0.0016**	**-0.0218**	**-0.0188**	**-0.0380**
5 year swap	2.120%	0.0196	0.0276	0.0000	0.0000	0.0472
10 year swap	2.943%	0.0194	0.0269	0.0394	0.0000	0.0857
15 year swap	3.290%	0.0194	0.0265	0.0383	0.0323	0.1165
5×10 swap	4.044%	0.0000	0.0000	0.0449	0.0366	0.0815

			Forward-Bucket Exposures				
	Security or Portfolio		**0-2**	**2-5**	**5-10**	**10-15**	**All**
(i)	**5×10 payer swaption (exposure)**		**0.0010**	**0.0016**	**-0.0218**	**-0.0188**	**-0.0380**
	Hedge #1	**Long**					
(ii)	Long 10 year swap	**44.34%**	0.0086	0.0119	0.0175	0.0000	0.0380
(iii)	*Net Position*		**0.0096**	**0.0135**	**-0.0043**	**-0.0188**	**0.0000**
	Hedge #2	**Long**					
(iv)	Long 5×10 swap	**46.66%**	0.0000	0.0000	0.0210	0.0171	0.0380
(v)	*Net Position*		**0.0010**	**0.0016**	**-0.0008**	**-0.0017**	**0.0000**
	Hedge #3	**Long**					
(vi)	Long 15 year swap	**57.55%**	0.0112	0.0153	0.0220	0.0186	0.0670
(vii)	Short 5 year swap	**-61.55%**	-0.0121	-0.0170	0.0000	0.0000	-0.0291
(viii)	*Net Position*		**0.0001**	**-0.0001**	**0.0002**	**-0.0002**	**0.0000**

Question 17: Risk management governance

The global financial crisis (GFC) of 2007 to 2009 engendered regulatory responses to corporate risk governance. Below are summarized ten key developments. The first Sarbanes-Oxley (SOX) occurred prior to the GFC but is listed for context. The others are grouped naturally into three responses: Basel III and BCBS, Dodd-Frank, and the European response.

I. Prior to the GFC, Sarbanes-Oxley (SOX) required that the CEO and CFO affirm the accuracy of financial disclosures.

Basel III and BCBS:

II. Basel III (BIII) was a direct response to the GFC. BIII limited core Tier 1 capital to common equity and retained earnings. BIII also imposed new ratios for short-term liquidity (i.e., LCR) and long-term liquidity (i.e., NSFR).
III. Basel III designed a macroprudential overlay that included a 3.0% leverage ratio; countercyclical capital buffer (CCCB; aka, CCyB); and total loss-absorbing capital (TLAC) standards applicable to G-SIBs.
IV. The Basel III framework was revised again in 2016 with the Fundamental Review of the Trading Book (FRTB; aka, part of Basel IV) which included enhanced disclosure requirements.
V. The Basel Committee on Banking Supervision (BCBS) issued Corporate Governance Principles for Banks which--in addition to identifying the importance of an independent risk management function--defines roles for the board, board risk committees, senior management, CROs and internal auditors

Dodd-Frank:

VI. The 2010 Dodd-Frank Act strengthened the regulatory reach of the Fed; ended too-bigtoo-fail (TBTF); launched overhaul of derivatives markets; introduced the Volcker Rule; created the Consumer Financial Protection Bureau (CFPB).
VII. The Dodd-Frank Act also instituted a new approach to scenario analysis and stress testing that included: a top-down approach with macroeconomic scenarios unfolding over several quarters; a focus on the effects of macroeconomic downturns on a series of risk types, including credit risk, liquidity risk, market risk, and operational risk; an approach that is computationally demanding, because risk drivers are not stationary, as well as realistic, allowing for active management of the portfolios; a stress testing framework that is fully incorporated into a bank's business, capital, and liquidity planning processes; and an approach that not only looks at each bank in isolation but across all institutions. This allows for the collection of systemic information showing how a major common scenario would affect the largest banks collectively.

The European response:

VIII. For banks in Europe, the Supervisory Review and Evaluation Process (SREP) introduced three new principles to banking supervision: (i) A forward-looking emphasis on the sustainability of each bank's business model, including during conditions of stress; (ii) An assessment methodology based on best practices within the banking industry, and (iii) An expectation that every bank will ultimately operate under the same standards.
IX. The two key components of SREP are (i) the internal capital adequacy assessment process (ICAAP) and (ii) the internal liquidity adequacy assessment process (ILAAP). The ICAAP incorporates scenario analysis and stress testing; it outlines how stress

testing supports capital planning. The ILAAP incorporates potential losses from asset liquidations and increased funding costs during stressful periods.

X. European banks with assets of EUR 30 billion and above must run European Banking Authority (EBA) stress tests. These stress tests are run at the consolidated banking group level (insurance activities are excluded). Two supervisory macroeconomic scenarios covering a three-year period are provided by the regulator: a baseline scenario and an adverse scenario

In regard to the above list of regulatory responses to the GFC, which of the following statements is **TRUE**?

a) The Basel III events (i.e., II to IV) are incorrectly summarized
b) The Dodd-Frank Act is (i.e., VI and VI) is incorrectly summarize
c) The European regulatory response to the GFC (i.e., VIII to X) is incorrectly summarized
d) All three responses (Basel III, the Dodd-Frank Act, and the European regulatory response) are correctly summarized

Question 18: Linear regression models

Debra is an analyst at a governmental agency. Her boss asked her to investigate whether the Phillips curve applies during high-inflation regimes. To answer the question, Debra collected data from the FRED database at the St. Louis Fed (https://fred.stlouisfed.org/). The Phillips curve describes an inverse relationship between unemployment rates and inflation rates; https://en.wikipedia.org/wiki/Phillips_curve. Debra collected monthly data and she regressed the inflation rate against the unemployment rate (conditional on high-inflation regimes simply for narrative purposes). Her independent variable is the unemployment rate (FRED code: UNRATE) and here, the dependent variable is the Inflation rate (CPIAUCSL). The units are percentages not decimals; e.g., the dataset includes the month of January in 1982 when the unemployment rate was 8.90 and the inflation rate was 6.38. Her regression results are presented here.

Inflation Rate (CPIAUCSL) regressed against Unemployment Rate (UNRATE)
1980 to 2020 Monthly but conditioned on high inflation regimes[1]

Coefficient	Estimate	Std Error	t-stat	p value
(Intercept)	**16.388**	**0.473**	**34.647**	**2.33×10^{-30}**
Unemployment	**−1.106**	**0.056**	**−19.843**	**1.19×10^{-21}**

[1] Filtered on months with inflation >4.3% deliberately to generate regression results

Source: FRED at https://fred.stlouisfed.org/

Debra wants to know if an inverse relationship is observed. Which of the following statements about the regression is **TRUE**?

a) The regression is not useful because the intercept is too far away from (different than) zero
b) The pattern of the standard errors, t-statistics, and p-values suggest there is a violation in some assumption(s) of the classical linear regression model (CLRM)
c) There is an inverse relationship because, for each unit increase in the unemployment rate (i.e., +1.0%), the inflation rate is expected to decrease on average by 1.10%
d) There is not an inverse relationship because, for each unit increase in the unemployment rate (i.e., +1.0%), the inflation rate is expected to increase on average by 5.60%

Question 19: US Treasury bonds

[This is tedious and difficult. Inspired by the final LO above and Hull's[2] EOC Question 6.11] Today it is December 31, 2018. The cheapest-to-deliver bond in an August 2019 Treasury bond futures contract is a 9.0% coupon bond, and delivery is expected to be made on August 28, 2019. Coupon payments on the bond are made on April 2 and October 2 each year. In this case, therefore, as of settlement today (December 31, 2018) there were 90 days since the last coupon and there will be 92 days until the next coupon. Delivery will be in 240 days (and subsequent coupon date 35 days after delivery, or 275 days from today). The term structure is flat, and the rate of interest with continuous compounding is 3.0% per annum. The conversion factor for the bond is 1.380. The current quoted bond price (for this bond which is assumed to be the cheapest to deliver) is $115.00.

What is the quoted futures price for the contract?

a) $73.59
b) $80.70
c) $94.75
d) $106.44

Question 20: Multi-factor interest rate risk models

Suzanne the Risk Analyst is building an interest rate term structure and she is evaluating various candidate models. Her first candidate is Tuckman's Model 1[3] (aka, normally distributed rates and no drift) which has the advantage of extreme simplicity and is specified by (Tuckman 9.1)[3]: dr σ*dw. Her colleague Peter observes this is a single-factor model: the model's only factor is the short-term interest rate.

Among the following, which is probably the **strongest** criticism against this model as a single-factor model?

a) It compels us to assume yield to maturity (YTM) as the interest rate
b) Asingle-factor model incorporates yield volatility but cannot capture the convexity effect
c) It implies a parallel shift: if we shock the short rate by X basis points, it assumes all rates shock by X basis points
d) It necessarily must assume a perfectly flat term structure; aka, the flat yield curve assumption that is common for exams but unrealistic

[2] John C. Hull, Options, Futures, and Other Derivatives, 10th Edition (New York: Pearson Prentice Hall, 2017)
[3] Bruce Tuckman's Fixed Income Securities, 3rd Edition (Hoboken, NJ: John Wiley & Sons, 2011)

Question 21: Credit risk transfer mechanisms

The Acme Investment Trading Company perceives the credit risk of a certain public retailer is mispriced by the market. Acme is considering buying or selling a credit default swap (CDS) for the purpose of speculating on this view with respect to the retailer's credit profile. In comparison to buying or shorting the retailer's cash bond, Acme has already identified an advantage to the CDS: it has better liquidity. On the other hand, which of the following is a **disadvantage** of the CDS?

a) The CDS will introduce a new counterparty risk and legal risk
b) The CDS will introduce basis risk because Acme, who cannot be naked, will need to also purchase the retailer's bond(s) that are referenced by the CDS
c) Although the CDS is a good vehicle for expressing Acme's view on the retailer's default risk, it will not adjust for mere credit deterioration
d) Unlike credit ratings which are frequently updated, Acme will need to wait until it sells the CDS in order to obtain price discovery with respect to a change in retailer's credit risk

Question 22: P-value and confidence intervals

Mary belies that the average net promoter score (NPS) in financial services, as a population, is at least 50. Her one-sided null hypothesis is H0: μ(NPS) ≤ 50 and her alternative hypothesis is HA: μ(NPS) > 50. Among a collected sample of 40 firms, her staff observes a sample average NPS of 53.60 with a standard deviation of 9.0. Her staff informs her that the test statistic is 2.53 and the two-sided p-value is 1.556% per the Excel function T.DIST.2T(2.530, 39) = 0.015563. Their report also includes these 95.0% critical t-values: T.INV(0.95, 39) = 1.685 and T.INV.2T(0.050, 39) = 2.023; as expected, these values are slightly higher than, respectively, the critical Z-values of 1.645 and 2.33. Each of the following is true **EXCEPT** which is false?

a) The power of Mary's one-sided test is 99.22%
b) The one-sided 95.0% confidence interval is [51.2, ∞)
c) Mary can reject a one-sided null hypothesis, H0: μ(NPS) ≤ 50, with 95.0% confidence
d) Mary can reject a one-sided null hypothesis, H0: μ(NPS) ≤ 50, with 99.0% confidence

Question 23: Eurodollar futures contracts & duration-based hedging

It is August and Sally is a fund manager with $50.0 million invested in government bonds who is worried that interest rates are expected to be volatile over the next quarter (note: this question is inspired by Hull's EOC Problem 6.18). She decides to use the December Treasury bond ("T-bond") futures contract to hedge the value of the portfolio. The current futures price is 108-00 or $108.00. Because each contract is for the delivery of $100,000 face value of bonds, the futures contract price is therefore $108,000.00. Suppose the modified duration of the bond portfolio in three months will be 13.0 years. The cheapest-to-deliver (CTD) in the T-bond contract is anticipated to be a bond with 18.0 years to maturity that pays a 5.0% semi-annual coupon; at maturity, the duration of this CTD bond is expected to be about 12.0 years.

However, the manager does not want to completely neutralize duration. Rather, she wants to REDUCE the portfolio's duration by 7.0 years, from 13.0 years to 6.0 years. About how many T-bond futures contracts should she trade to achieve this reduction in duration of the net portfolio?

a) 15 contracts
b) 270 contracts
c) 333 contracts
d) 502 contracts

Question 24: Effective duration and convexity

The exhibit below modifies Tuckman's Table 4.2[4] and shows the prices on May 28, 2019 for two instruments: 10-year U.S. note futures contracts, TYU0, and call options with a strike of 120 on the same futures contracts, TYU0C 120.

What is the effective duration of, respectively, the futures, TYU0, and the options, TYU0C 120?

a) 4.2 and 106.3 years
b) 8.4 and 212.5 years
c) 33.5 and 850.1 years
d) 41.8 and 1,062.6 years

Selected Model Prices and Durations for TYU0 [Futures] and TYU0C 120 [Option] as of May 28, 2019 (modified Tuckman Table 4.2)

7-year Par Rate	TYU0	Duration	TYU0C 120	Duration
3.690%	$120.100		$1.680	
3.750%	$119.500	?	$1.490	?
3.810%	$118.900		$1.300	

[4] Bruce Tuckman, Fixed Income Securities, 3rd Edition (Hoboken, NJ: John Wiley & Sons, 2011