Università Commerciale
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PH.D. IN ECONOMICS AND FINANCE A.A. 2015/2016

Advanced Financial Econometrics – Prof. Massimo Guidolin

atr.)

P... e answe... by writing your answers in the spaces provided. 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. In the multiple choice case, report your selection by writing one of the letters A, B, C, D, E, in BLOCK CAPITAL LETTERS. No other answers on the exam paper or indication pointing to potential answers will be taken into consideration.

1

Question 1.

Under the weak form of the expectations hypothesis of riskless interest rates:

(A) If investors have information not captured in the history of spreads, then current long term rates forecast changes in short rates; this provides a justification for the use of government bond spreads to forecast the shape of the forward yield curve.

(B) Typically, one cannot reject the hypotheses that yields are I(1) and spread are I(0) and hence one can employ an error-correction model (ECM) written as:

$$\Delta \mathbf{y}_t = \boldsymbol{\mu} + \sum_{i=1}^{p-1} \mathbf{\Theta}_i \Delta \mathbf{y}_{t-i} + \mathbf{B}\Delta \mathbf{S}_t + \boldsymbol{\epsilon}_t$$

(C) If investors have information not captured in the history of short rates, then rate spreads forecast changes in short rates; this provides a justification for the use of government bond spreads to forecast the shape of the yield curve.

(D) Typically, one cannot reject the hypotheses that yields are I(0) and spread are I(1) and hence one can employ an error-correction model (ECM) written as:

$$\Delta \mathbf{y}_t = \sum_{i=1}^{p-1} \mathbf{\Theta}_i \Delta \mathbf{S}_{t-i} + \mathbf{B}\mathbf{y}_{t-1} + \boldsymbol{\epsilon}_t$$

(E) None of the above.

Answer
C

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Question 2

Which of the following statements is correct?

(A) In general there is no tight link between economic and statistical loss functions, in the sense that forecast functions that do well statistically, may disappoint in economic applications, and viceversa; however, a number of papers have shown that prediction models that can accurately forecast the square of a variable, or that can predict its absolute points tend to be more profitable, i.e., to perform best in terms of economic loss functions based on trading strategies that exploit point forecasts of the variable considered .

(B) In general there is no tight link between economic and statistical loss functions, in the sense that forecast functions that do well statistically, may disappoint in economic applications, and viceversa; however, a number of papers have shown that prediction models that can accurately forecast the sign of a variable, or that can predict its turning points tend to be more profitable, i.e., to perform best in terms of economic loss functions based on trading strategies that exploit point forecasts of the variable considered.

(C) Typically, models that are statistically accurate in predicting a variable also turn out to be economically viable and generally yield high risk-adjusted profits in trading strategies.

(D) Typically, models that are economically useful and yield high risk-adjusted profits in trading strategies tend to also generate accurate predictions when measured according typical statistical criteria.

(E) None of the above.

Answer
B

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Question 3

What is a butterfly strategy and what information does it reveal in option markets?

(A) It is a tool to forecast the slope of the term structure of volatility implied by observed option prices.

(B) Assuming complete markets, a butterfly strategy centered around a strike X is a long-short strategy in either European futures or forwards and it represents a discretized approximation to the discounted Vega of a European call or put with maturity T.

(C) Assuming complete markets, a butterfly strategy centered around a strike X is a long-short strategy in either European calls or puts and it represents a discretized approximation to the discounted Arrow-Debreu price of a state-contigent security that pays out at maturity T when the price of the underlying asset $S_T = X$.

(D) Assuming incomplete markets, a butterfly strategy centered around a strike X is a long-short strategy in either European calls or puts and it represents a discretized approximation to the forward Arrow-Debreu price of a state-contigent security that pays out at maturity when the price of the underlying asset S_T is zero.

(E) None of the above.

Answer
C

Question 4

With reference to the following table, please indicate which of the following statements is/are correct:

	Overall		Expansion		Recession	
Economic variable	R^2_{OS} (%)	Δ (annual %)	R^2_{OS} (%)	Δ (annual %)	R^2_{OS} (%)	Δ (annual %)
Panel A: Unrestricted predictive regression forecasts						
log(*DP*)	−0.05 [0.10]	0.87	−1.24 [0.42]	−1.47	2.41 [0.00]	11.87
log(*DY*)	−0.37 [0.07]	1.18	−2.28 [0.40]	−1.98	3.56 [0.00]	16.17
log(*EP*)	−1.88 [0.28]	0.57	−2.21 [0.31]	−0.41	−1.20 [0.38]	4.99
log(*DE*)	−2.04 [0.97]	−0.44	−1.26 [0.80]	0.06	−3.67 [0.97]	−2.73
SVAR	0.32 [0.17]	−0.11	−0.02 [0.50]	−0.37	1.01 [0.16]	1.08
BM	−1.74 [0.31]	−0.72	−2.56 [0.44]	−2.01	−0.04 [0.28]	5.12
NTIS	−0.91 [0.41]	−0.21	0.50 [0.03]	0.72	−3.82 [0.94]	−4.71
TBL	−0.01 [0.09]	1.53	−0.84 [0.30]	0.24	1.71 [0.10]	7.58
LTY	−1.17 [0.12]	1.29	−2.37 [0.38]	−0.21	1.32 [0.11]	8.38
LTR	−0.08 [0.20]	0.57	−0.85 [0.63]	−0.35	1.52 [0.05]	4.74
TMS	0.06 [0.16]	1.15	−0.40 [0.34]	0.01	1.00 [0.09]	6.49
DFY	−0.04 [0.59]	0.29	−0.06 [0.64]	0.00	−0.01 [0.48]	1.48
DFR	−0.01 [0.38]	0.39	0.12 [0.25]	0.15	−0.28 [0.48]	1.53
INFL	−0.09 [0.50]	0.34	0.10 [0.22]	0.19	−0.48 [0.66]	1.16

(A) The out-of-sample R^2 are systematically higher in expansions that in recession periods.

(B) The out-of-sample certainty equivalent measures are systematically positive and this shows that even though the prediction models are systematically accurate, they can still generate considerable economic value.

(C) A predictive model based on the debt-equity ratio (DE) is systematically the best.

(D) The out-of-sample R^2s are always higher when computed from recession sub-samples vs. when they are computed from expansionary ones.

(E) None of the above (please briefly explain why).

Answer
E

A -> the oos R^2 is not systematically higher in expansion (example log(DY)).

B -> The oos CER isn't systematically positive. $\hat{U} = \mu - \frac{1}{2}\gamma\sigma^2$ => μ & investment based on predictive regression $r_{t+1} = \alpha + \beta x_t$

CER = Δ(annual %) = $\hat{U} - \bar{U}$ where ~~...~~

$\bar{U}$ -> investment based on long term mean.

C -> A predictive model based on (DE) is not the best. Overall SVAR performs better both economically and statistically. So ~~do~~ NTIS does in expansion and log(DP) in recession as well.

D -> they are not always higher (example => INFLATION) even if R^2 of INFL in expansion is not statistically significant.

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Question 5

Pastor and Veronesi (2012, 2013) develop a theory in which political news moves stock prices and in which:

(A) Political uncertainty commands a risk premium that is larger in a stronger economy, it increases the value of the government's implicit put protection, and it increases stock volatilities and correlations, especially when the economy is strong and policy heterogeneity is modest.

(B) Show that learning on the dynamics of dividends increases stock volatilities and causes them to change over time.

√(C) Political uncertainty commands a risk premium that is larger in a weaker economy, it reduces the value of the government's implicit put protection, and it increases stock volatilities and correlations, especially when the economy is weak and policy heterogeneity is large.

(D) Political uncertainty increase inefficiency by restricting banks' decisions that may reduce profits, it adds political criteria in lending decisions, reducing profitability, and it delays or limits the transfer of assets to most efficient managers/firms.

√ (E) None of the above (please briefly explain why).

Answer
C

1

Question 6.

In a diffusion index predictability model (for excess stock returns):

(A) The diffusion index is built on the basis of a latent factor model in which a small number of factors summarize the true variables and estimates of the latent factors then serve as regressors in the predictive regression model; the factor structure thus generates a more reliable signal from a large number of predictors to employ.

(B) The diffusion index is built on the basis of a principal component model in which a small number of factors summarize the true variables and estimates of the principal components then serve as regressors in the predictive regression model; the principal component structure thus generates a less reliable signal from a large number of predictors to employ.

(C) We recognize that data-generating processes for stock returns are subject to parameter instability and deploy one modelling strategy based on Markov switching predictive models.

(D) The diffusion index is built on the basis of a latent factor model in which a small number of variables summarize the true factors and estimates of the variables in the predictive regressions then serve as regressors in the latent factor model; the factor structure thus generates a more reliable signal from a large number of predictors to employ.

(E) None of the above (briefly explain why).

Answer
A

1

Question 7.

Because in currency markets a no-arbitrage relationship implies that $S_{\$/£} = S_{\$/¥}S_{¥/£}$, then:

(A) $R_{\$/£} = R_{\$/¥} + R_{¥/£}$ (where $R_{./.}$ is the continuously compounded return) implies that $Var[R_{\$/£}] = Var[R_{\$/¥}] + Var[R_{¥/£}]$ $+2Cov[R_{\$/¥}, R_{¥/£}]$ and therefore

$$Corr[R_{\$/¥}, R_{¥/£}] \equiv \frac{Cov[R_{\$/¥}, R_{¥/£}]}{\sqrt{Var[R_{\$/¥}]Var[R_{¥/£}]}} = \frac{Var[R_{\$/£}] - Var[R_{\$/¥}] - Var[R_{¥/£}]}{2\sqrt{Var[R_{\$/¥}]Var[R_{¥/£}]}}$$

which implies that an option-implied measure of correlation between two exchange rates is

$$\frac{[\sigma^{IV}_{\$/£}]^2 - [\sigma^{IV}_{\$/¥}]^2 - [\sigma^{IV}_{¥/£}]^2}{2\sigma^{IV}_{\$/¥}\sigma^{IV}_{¥/£}},$$

where $\sigma^{IV}_{./.}$ is an implied volatility.

(B) The ratio implied volatilities, $\sigma^{IV}_{\$/¥}/\sigma^{IV}_{¥/£}$ equals the correlation between the two exchange rates.

(C) $R_{\$/£} = R_{\$/¥} + R_{¥/£}$ (where $R_{./.}$ is the continuously compounded return) implies that $Var[R_{\$/£}] = Var[R_{\$/¥}] - Var[R_{¥/£}]$ $+2Cov[R_{\$/¥}, R_{¥/£}]$ and therefore

$$Cov[R_{\$/¥}, R_{¥/£}] = Var[R_{\$/£}] - Var[R_{\$/¥}] + Var[R_{¥/£}]$$

which implies that an option-implied measure of correlation between two exchange rates is $[\sigma^{IV}_{\$/£}]^2 - [\sigma^{IV}_{\$/¥}]^2 + [\sigma^{IV}_{¥/£}]^2$, where $\sigma^{IV}_{./.}$ is an implied volatility

(D) $R_{\$/£} = R_{\$/¥} + R_{¥/£}$ (where $R_{./.}$ is the continuously compounded return) implies that $Var[R_{\$/£}] = Var[R_{\$/¥}] + Var[R_{¥/£}]$ $+2Cov[R_{\$/¥}, R_{¥/£}]$ and therefore

$$Corr[R_{\$/¥}, R_{¥/£}] \equiv \frac{Cov[R_{\$/¥}, R_{¥/£}]}{Var[R_{\$/¥}]Var[R_{¥/£}]} = \frac{Var[R_{\$/£}] - Var[R_{\$/¥}] - Var[R_{¥/£}]}{Var[R_{\$/¥}]Var[R_{¥/£}]}$$

which implies that an option-implied measure of correlation between two exchange rates is

$$\frac{[\sigma^{IV}_{\$/£}]^2 - [\sigma^{IV}_{\$/¥}]^2 - [\sigma^{IV}_{¥/£}]^2}{[\sigma^{IV}_{\$/¥}\sigma^{IV}_{¥/£}]^2},$$

where $\sigma^{IV}_{./.}$ is an implied volatility.

(E) None of the above (briefly explain why).

Answer
A

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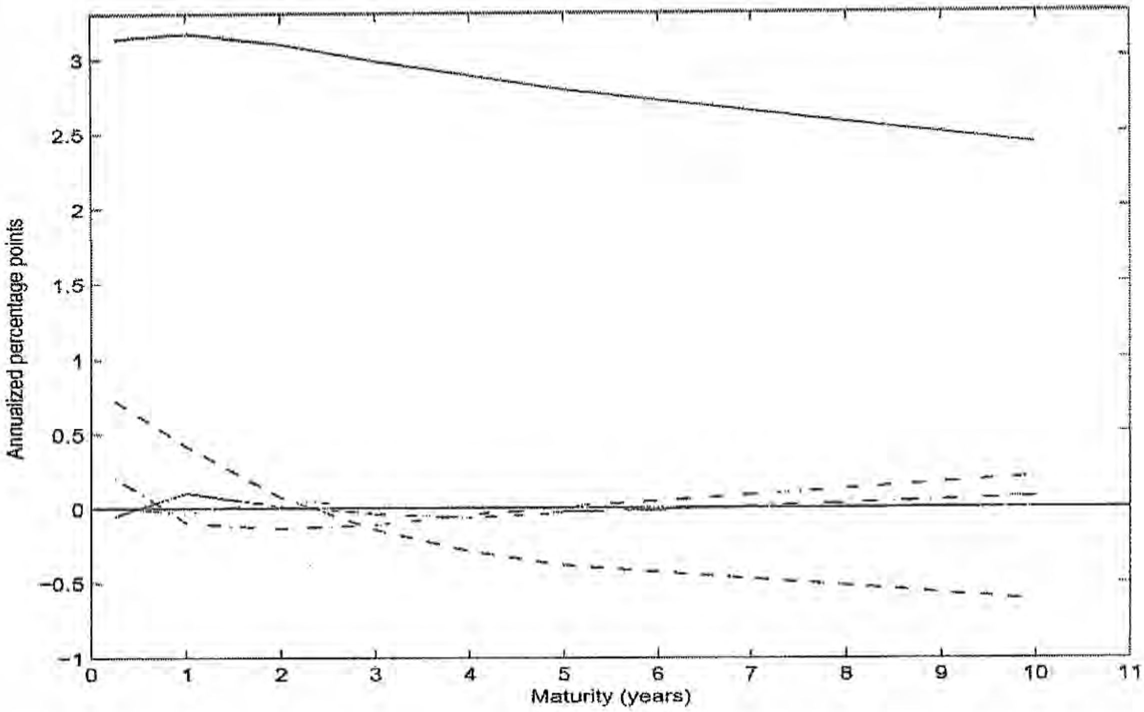
Question 8.

The following graph depicts:



(A) How does the duration of US monthly government bond yields sampled over the period January 1972 - December 2010 changes as a function of their maturity.

(B) The first five principal components (divided by their standard deviation) in US monthly government bond yields sampled over the period January 1972 - December 2010; the first three principal components may be interpreted as "duration" (the solid line), "convexity" (the dashed line), and "vanna" (the dotted-dashed line).

(C) The first five maximum likelihood factors (multiplied by their standard deviation) in US monthly government bond yields sampled over the period January 1972 - December 2010; the first three factors may be interpreted as "level" (the dashed line), "slope" (the solid line), and "curvature" (the dotted-dashed line).

(D) The first five principal components (multiplied by their standard deviation) in US monthly government bond yields sampled over the period January 1972 - December 2010; the first three principal components may be interpreted as "level" (the solid line), "slope" (the dashed line), and "curvature" (the dotted-dashed line).

(E) None of the above (briefly explain why).

Answer
D

1

Question 9.

In David and Veronesi (2013) the SDF assumed is:

(A) A mixture between nominal and real SDF,

$$\frac{M_T}{M_t} = e^{\rho(T-t)} \left(\frac{C_T}{C_t}\right)^{\gamma} \left(\frac{Q_T}{Q_t}\right)^{\delta}$$

where under money illusion $\delta > 0$ and a nominal SDF is used to discount real quantities; David and Veronesi use SMM to estimate $\hat{\delta} = 0.81$ (with standard error of 0.35), which implies a small amount of money illusion because $\delta < 1$.

(B) A mixture between nominal and real SDF,

$$\frac{M_T}{M_t} = e^{-\rho(T-t)} \left[\ln\left(\frac{C_T}{C_t}\right)^{-\gamma} + \ln\left(\frac{Q_T}{Q_t}\right)^{-\delta}\right]$$

where under money illusion $\delta \neq 0$ and a nominal SDF is used to discount real quantities; David and Veronesi use GMM to estimate $\hat{\delta} = 0.81$ (with standardized variance of 0.35), which implies a negligible amount of money illusion.

(C) A mixture between nominal and real SDF,

$$\frac{M_T}{M_t} = e^{-\rho(T-t)} \left(\frac{C_T}{C_t}\right)^{-\gamma} \left(\frac{Q_T}{Q_t}\right)^{-\delta}$$

where under money illusion $\delta \neq 0$ and a nominal SDF is used to discount real quantities; David and Veronesi use SMM to estimate $\hat{\delta} = 0.81$ (with standard error of 0.35), which implies a substantial amount of money illusion.

(D) A mixture between stochastic and deterministic SDF,

$$\frac{M_T}{M_t} = e^{-\rho(T-t)} \left(\frac{C_T}{C_t}\right)^{-\gamma} \left(\frac{Q_T}{Q_t}\right)^{-\delta}$$

where under money illusion $\delta \neq 0$ and a stochastic SDF is used to discount deterministic quantities; David and Veronesi use SMM to estimate $\hat{\delta} = 0.81$ (with standard error of 0.35), which implies a substantial amount of money illusion.

(E) None of the above (briefly explain why).

Answer
C

~~A mixture between nominal and real SDF~~

0

Question 10.

Suppose that the unique SDF in complete markets has a monthly variance of 0.001, a correlation with a predictor (z_t) of 0.7, and that the risk free-rate is 2% per annum. Under the special assumptions on the SDF made by Kan and Zhou (2007), which of the following statements is correct?

(A) The maximum monthly predictive regression R^2 one can expect under a rational, no-arbitrage SDF model is 0.10%.

(B) No predictability can be found as this is ruled out by the uniqueness of the SDF, which is necessary and sufficient to market completeness.

(C) The maximum monthly predictive regression R^2 one can expect under a rational, no-arbitrage SDF model is a tiny 0.05%.

(D) The maximum monthly predictive regression R^2 one can expect under a rational, no-arbitrage SDF model is 0.59%.

(E) None of the above (briefly explain why).

$R^2 \leq R_g^2\, \rho_{z,m_t}\, \mathrm{Var}(m_t(z_t))$

Answer
~~E~~

C

$$\begin{cases} R_g^2 = (1+0.02/12) \\ \rho_{z,m_t} = 0.7 \\ \mathrm{Var}(m_t(z_t)) \end{cases} \Rightarrow \boxed{R^2 \leq 0.07\%}$$

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Question 11.

What is the meaning of Carr and Wu's (2016) partial differential equation to an institutional investor that manages his derivatives book?

$$-B_t = \mu_t B_\sigma + \frac{1}{2} v_t S_t^2 B_{SS} + \rho_t \omega_t \sqrt{v_t} S_t B_{S\sigma} + \frac{1}{2} \omega_t^2 B_{\sigma\sigma}$$

(A) It is a no-arbitrage non-linear relationship in the "greeks" theta, vega, gamma, vanna, and volga that is used to test whether the book of the trader/institution is actually profitable and represents a generalization of the famous Heston's PDE.

(B) It is a system of four equations in four unknowns, the "greeks" theta, vega, gamma, vanna, and volga, to be solved to find the equilibrium price of any option. NO

(C) It is a no-arbitrage linear relationship in the "greeks" delta, vega, level, slope, and curvature that is used to test whether the book of the trader/institution is actually hedged and represents a generalization of the famous Diebold and Li's stochastic differential equation. NO

(D) It is a no-arbitrage linear relationship in the "greeks" theta, vega, gamma, vanna, and volga that is used to test whether the book of the trader/institution is actually hedged and represents a generalization of the famous Black and Scholes' PDE.

(E) None of the above (briefly explain why).

Answer
D

Question 13

A

One typical way to implement the nonparametric estimation of risk-neutral densities from option prices using Breeden and Litzenberger's results consists of:

(A) Using a simple but flexible ad-hoc BS (AHBS) model to construct the density forecast off a BS implied volatility curve, for instance by estimating a *nth*-order polynomial on BS call and put prices as a function of strike and maturity, to obtain fitted BSIV option values across a grid of strikes; the option-implied density can be obtained using the numerical second derivative formula.

(B) Using Heston's model to estimate its risk-neutral parameters from option prices, to then simulate a set of fixed maturity implied volatilities across a grid of strikes; call prices can then be obtained using the BS formula and the option-implied density can be obtained using the numerical second derivative formula. no

(C) Using a simple but flexible ad-hoc BS (AHBS) model to construct the density forecast off a BS implied volatility curve, for instance by estimating a *nth*-order polynomial on implied BS volatility as a function of strike and maturity, to obtain fitted BSIV values and then using this estimated polynomial, to generate a set of fixed maturity implied volatilities across a grid of strikes; call prices can then be obtained using the BS formula and the option-implied density can be obtained using the numerical second derivative formula.

(D) Using Hull and White's model to estimate its physical measure parameters from option prices, to apply risk premium adjustments that derive from assumptions on the nature of the stochastic discount factor, to then simulate a set of fixed maturity implied volatilities across a grid of strikes; call prices can then be obtained using the Gram-Charlier's formula and the option-implied density can be obtained using the numerical second derivative formula.

(E) None of the above (briefly explain why).

Answer
C

Question 12

Consider the error squared loss function:

$$L_{Sq}(x_R, x_F) \equiv k \cdot (x_R - x_F)^2, \quad k > 0.$$

Please indicate which of the following statements is/are correct:

(A) Under rationality, this loss must result from an objective (utility) function $U(\cdot,\cdot) : X \times A \to \mathbb{R}^1$ with strictly monotonic optimal action $\alpha(\cdot)$ will generate $L_{Sq}U(\cdot,\cdot)$ if and only if $U(x,\alpha) \equiv f(x) - k(x - g(\alpha))^2$ for some function $f(\cdot) : X \to \mathbb{R}^1$ and monotonic function $g(\cdot) : A \to X$; such quadratic utility functions appear to be rather odd in most economic applications.

(B) Under rationality, this loss must result from an objective (utility) function $U(\cdot,\cdot) : X \times A \to \mathbb{R}^1$ with strictly monotonic optimal value function $\alpha(\cdot)$ will generate $L_{Sq}U(\cdot,\cdot)$ if and only if $U(x,\alpha) \equiv k \cdot f(x)|x - g(\alpha)|$ for some function $f(\cdot) : X \to \mathbb{R}^1$ and monotonic function $g(\cdot) : A \to X$; such absolute value functions appear to be rather odd in most economic applications.

(C) Under rationality, this loss must result from an objective (utility) function $U(\cdot,\cdot) : X \times A \to \mathbb{R}^1$ with strictly monotonic optimal value function $\alpha(\cdot)$ will generate $L_{Sq}U(\cdot,\cdot)$ only if $U(x,\alpha) \equiv -\int f(x)dx + \frac{1}{3}k \cdot (x - g(\alpha))^3$ for some function $f(\cdot) : X \to \mathbb{R}^1$ and monotonic function $g(\cdot) : A \to X$; clearly $-dU(x,\alpha)/dx = f(x) - k \cdot (x - g(\alpha))^2$ which gives the link between the loss function and the underlying utility function.

(D) The error squared loss function is completely general and under rationality result from very general monotone increasing and concave utility functions.

(E) None of the above (briefly explain why).

Answer
~~D~~ A