Quantitative methods
Final exam - 2016

Task 1 (**5 points**)**.**

A standard 52 card deck contains 4 suits (hearts, diamonds, clubs, spades) and each suit contains 13 cards. A gin hand consists of ten cards from a 52 card deck. Assume each hand of 10 cards is equally likely.

(a) Find the probability that all 10 cards are in the same suit (**2 point**).

(b) Find the probability that exactly 4 cards are in one suit and 3 cards in two other suits (**3 points**).

Task 2 (**5 points**)**.**

Urn A contains 3 white balls and 2 black balls. Urn B contains 1 white ball and 4 black balls. A ball is drawn at random from urn A and placed into urn B. Urn B is thoroughly mixed and a ball is drawn.

(a) Suppose a white ball is drawn from urn B. What is the probability that the ball transferred from urn A is white (**2 points**)?

(b) Suppose a black ball is drawn from urn B. Now, what is the probability that the ball transferred from urn A is white (**3 points**)?

Task 3 (**5 points**)**.**

A shipment of 10,000 parts for manufacturing widgets has arrived at Acme. There are 50 defective parts in the shipment. Acme plans to test 100 randomly chosen parts and will reject the batch if it finds more than two defective parts. Let X be the random variable which denotes the number of defective parts in the 100 sampled.

(a) What type of distribution best models X? State the relevant parameters for this distribution. State any assumption you think relevant in deciding the best distribution. (**2 points**)**.**

(b) Find the probability that the batch is returned by Acme (**3 points**).

Task 4 (5 points).

The researcher tries to analyse the increase in production level of the country depending on monetary base.

(a) Describe the possible model and mention about possible problems of estimation (**3 points**).

(b) Which solutions would you recommend to the researcher (**2 points**)?

Task 5 (20 points).

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Your company plans to extend trading activity with Brazil. The exchange rate of Brazilian real (BLR, national currency) to USD plays an important role in successful development of this plan. Your assistant prepared a dataset with following parameters:

1. *INFLATION_USA – cpi in USA, % per quarter;*
2. *INFLATION_BRAZIL – cpi in Brazil, % per quarter;*
3. *UNEMPLOYMENT_RATE_USA – unemployment in USA, %;*
4. *UNEMPLOYMENT_RATE_BRAZIL - unemployment in Brazil, %;*
5. *TOTAL_TRADE – level of trade between USA and Brazil, USD;*
6. *M2_BRAZIL – money supply in Brazil, BLR;*
7. *M2_USA - money supply in USA, USD;*
8. *WORLD_PRICE_FOR_IRON_ORE – world prices for iron ore, USD;*
9. *GDP_USA – GDP in USA, USD;*
10. *GDP_BRAZIL – GDP in Brazil, USD;*
11. *FDI_BRAZIL – foreign direct investment to Brazil, USD;*
12. *AGRICULTURE_BRAZIL – export of agriculture production from Brazil, USD;*
13. *BRL_USD – exchange rate of BRL for 1 USD.*

Part A

1. Estimate the linear regression, which can explain how exchange rate can be influenced by inflation in Brazil, trade with USA, prices for iron ore. Test model for significance and coefficient significance (**2 points**).

2. Test the model for autocorrelation, heteroscedasticity, stability, multicollinearity, normality of residuals (**2 points**).

3. Test if a variable M2_BRAZIL should be added to model (**2 points**).

4. Check the necessity to add seasonality to the model (**2 points**).

5. Calculate the forecasts of exchange rate BRL_USD for 4 quarters of 2016 (**2 points**).

Part B

1. Formulate a realistic hypothesis about the relationship between exchange rate and other existing parameters, including dummy variables. Estimate a regression model based on the hypothesis. Test model for significance and other tests. In case of failing tests provide better model **(7 points)**.

2. Calculate the forecasts of exchange rate BRL_USD for 4 quarters of 2015 based on the data till 2014:4. Compare the forecasts with actual values (**3 points**).