

## MAD 5932-02

# Methods in Interdisciplinary Applications

Exam 1 – February 19, 2007  
50 minutes

Name \_\_\_\_\_

You may use a calculator. Please, show **all your work** and **circle your answers**. State R commands you used.

| Questions | Possible | Actual |
|-----------|----------|--------|
| 1         | 20       |        |
| 2         | 20       |        |
| 3         | 20       |        |
| 4         | 20       |        |
| 5         | 20       |        |
| Total     | 100      |        |

- 1) You have daily 30-year mortgage rate and 10-year Treasury yield data (the first column is the mortgage rate, the second is the 10-year Treasury yields in percent):

```
read.table(url("http://www.math.fsu.edu/~goncharo/MIA/mortgage.txt"))
```

The 10-year Treasury yield is a predictor variable.

- a) Estimate the change in the mean mortgage rate with a 95% confidence interval when Treasury yield increases by 1 (percent).

- b) Conduct a  $t$ -test (with 95% confidence) to determine if the slope coefficient in the linear regression function is **less** than 1. Find the  **$p$ -value**.

- c) Show **graphically** the meaning of the *power* of your test in part b) if “in fact” the increase of the 10-year Treasury yield gives the same increase in the mortgage rate (graph distributions, “hypothesizes”, etc. “Indicate” the power). Compute the power. Comment.

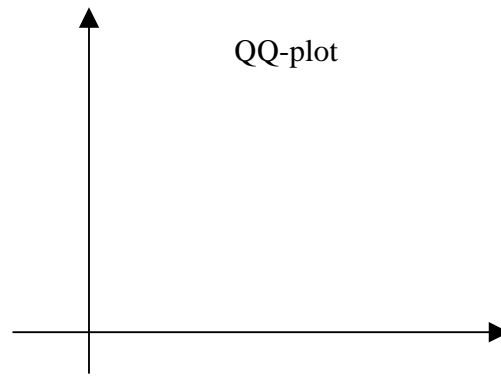
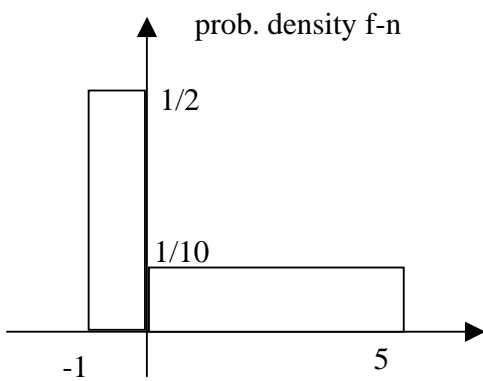
2) Refer to problem 3):

a) Obtain a 95% confidence interval for the mean mortgage rate when the Treasury is 4.4%.

b) Obtain a 95% **prediction** interval for the mortgage rate when the Treasury is 4.4%. Is this interval wider, narrower or the same as in part a)? **Why?**

c) Obtain a Benferroni joint 95% confidence interval for the mortgage rate when the Treasury is 4.4% and 4.6%.

3) A set of random numbers was generated with the distribution given by the density function below. How the qqplot of these random numbers might look like? Graph it!



4) Get the **ordinary** (not weighted) least square estimation for the parameter  $\beta$  in the following regression model:  $Y_i = \beta X_i^{1/2} + \varepsilon_i$ , where  $\varepsilon_i$  are independent  $N(0, X_i)$   $i=1, \dots, n$ . State the criterion and show all the steps.

5) Estimate the parameter  $b$  in the linear regression model above (problem 4) with the help of method of maximum likelihood.

a) What is the distribution of  $Y_i$ ? What is the probability density function of this random variable?

b) What is the likelihood function for one observation  $(X_i, Y_i)$ ?

c) What is the likelihood function for  $n$  observations  $\{(X_i, Y_i)\}_{i=1}^n$ ?

d) What is the MML estimate of  $\beta$ ?