MF 840 – Spring 2018
Study Guide for the Second Partial Exam
Version – May 1st

Seating Instructions – Reminders on Cheating

- The exam is 3 pm – 5 pm on Wednesday May 8th, both sections together, in HAR 105. Make sure to arrive a few minutes early. We will try to have 2 hours for the exam but we must be out by 5pm. We will only start when everybody is seated according to rules.

- Leave at least **two** seats empty or the ailes on **each** side of you. If you don't follow this, you will have to move and you will delay the start of the exam for everybody.

- **All bags, phones, and coats** (We are in May, NO COATS !!) to be left against the wall, not at your place. You will take only your writing instruments and a basic calculator. **You can not have your phones with you during the exam**, they must be in your bag at the front. The exam will not start before we are sure of that.

- The exam is **closed everything**.

- No phone or any internet connectable device or computer. Do not forget your calculator, we will not let you use your phone as a replacement. You can not share calculators. Make sure to charge your calculators

- Follow exactly the instructions that will be given for leaving the room at the end.

- **Any communication with anybody between 8:00am and 11:45am will be considered cheating and reported to the disciplinary committee for action.**

- **You can not leave the room unaccompanied. It will be considered cheating**

Instructions and Recommendations

- The exam is not on blue books. You will answer on the space provided on the exam itself.

- The exam will have a fair number of independent questions. Some are algebraic or number calculations, as in class or a bit different. Some are discussion questions involving a concise but complete justification of the answer to check that you understood the discussion in class.

- Answering the discussion questions does not require more than the allocated space (1/2 page typically). If you think you don't have enough space, you are making it too complicated.

- The back of the exam is exclusively for your scratch work. **The back of the exam will not be read or graded even if it has correct work**. We only read and grade what is in the alloted space. **There will be no exception**.

- Discussion questions may have a True / False feature: If part of a statement is correct and part is False, label the statement as False. In your discussion, identify clearly what is correct, what is false. and why. If you say True, explain why the whole thing is true.

- The topics to review include 1) what we did in class 2) the required readings and 3) the first two problem sets. If you make sure that you understand, can do the proofs, and can use all the material in the lecture notes, you are in top shape. The lecture notes include the R files in the lecture notes folder.

- Since the exam is closed notes, knowing the needed formula has value! Make sure to write a formula if you are asked to, it may be easy points and partial credit.

- Verbosity will not be rewarded. Correct statements or formulas not directly related to the question get no points. If you write the correct answer and also write incorrect statements, points will be deducted.

General guidelines

- Formulas to know: every formula or definition in blue or red or bold face. Specific guidelines may override this either way, read the specific guide below.

- The outline below reinforces the most important concepts to check during your studying. But you should be comfortable with all we discussed in class.

- Able to reproduce the proofs that we did in class and in the notes. Some proofs may be excluded in the specific guidelines below, otherwise be able to prove everything.

- R Code: You may have R code questions directly related to the homework and the R files in the Lecture note folder. You need to review the R files in the Lecture Notes Folder, they are lecture notes designed to implement and learn the concepts, as we used them in class. I want to know that you can tell an interviewer how you would code a Wald test, a SUR estimate or covariance matrix, a GLS or MLE. I will not ask about weird sorting or making nice plots, though you should know that too by now ☺.

- Understand all the problems and solutions in the problem sets, including the discussion questions.

Specific Topics guidelines

Below is an outline of especially important topics. The last topics will be finalized after the final lecture

For the densities, you should know the normal density of course, and the kernels of the inverted gamma, the kernel of the general multivariate and univariate Student-t.
If you need the normalization constants, I will give them to you.

- Bayes Intro 1
    - Major concepts: prior, posterior, likelihood, marginal likelihood
    - Diffuse Prior: improper priors on β, σ, proof on P.7
    - Proof of the limit of the posterior density in large sample (P.12)
    - Two ways to have truncated priors (rescale an unbounded density, beta density)
    - Conjugate Prior, Poisson – Gamma example proof P. 16-17

- Bayes Intro 2 – Regression and mean problem
  - Diffuse priors: Be able to know and prove everything.
  - Normal-Gamma conjugate prior for sample mean problem, we did $\mu|\sigma,D$ on the blackboard and you can find $\sigma|D$ in the odds ratio lecture note section 6.5 (the do-not-forget-mes). Be able to do these proofs.
  - Normal-Gamma for regression (β,σ) proofs. I will not ask the detail of going from [3] to [4], or going from [5] to the bottom of P.8. But you must be able to write P.5 and explain that the posterior kernel becomes the equation at the bottom of P.8
  - Know the final equation at the bottom of P.8 and be able to explain the meaning of the 3 terms in the σ posterior, and the $\beta|\sigma$ posterior
  - How to find the posterior degrees of freedom ν_1 and the posterior s_1^2 with normal-Gamma prior
  - Know the magic integral result that goes from the normal to the Student-t
  - Relations between: Gamma (precision), Inverse Gamma (variance), Inverted gamma (standard deviation), and how to go from one to the other by the change of variable formula.
  - G-prior, Ridge estimate as a Bayesian posterior mean, LASSO estimate

- Bayesian Intro 3 - Estimation and Prediction
  - Bayesian estimation, the concept of Loss function and expected Loss (what is random in Bayesian versus Classical statistics)
  - I will not ask the proofs in P4, we looked at them in some ways in MF793
  - Ignore P.6-7 for the exam
  - Theoretical proof of the density of yF, be able to integrate β,σ out to prove [1] P.9
  - Direct i.i.d. Monte-Carlo simulation of the posterior and predictive densities
  - Remember the trick on P.11 (column 5) to get more precise MC estimate of the mean

- MCMC - Numerical accuracy
  - For both ii.d and non-iid Monte Carlo samples
  - Know the formulas and be able to do computations.

- Bayesian Intro 4 - Odds Ratios
  - General Definition, comparison with classical test (The p-value is NOT $p(H_0|D)$
  - Comparison with classical test. Know the proof P.8, be able to fill in tables like P.16, 17 to dicuss the difference between the t-statistic p-value and $p(H_0|D)$
  - I will not ask to prove or to know (3) P.15 but the top of P.14 has important result for the posterior sum of squares in the μ, σ problem.
  - using a conjugate prior
  - Understand relation between LRT, AIC and odds ratios, no proof asked, only discussion
  - Must know the Savage Density Ratio formula and the Setup conditions P. 21, 22. Be able to apply.

- Clearly HW3 is crucial for all of the above.

- Fama-McBeth two-step procedure and associated issues

- MCMC methods – when direct MC sampling fails
  - For all of these, you need to be able to describe the algorithm, what it does, why it works, the burn-in if there is, how to check things are OK, and what can go wrong,
  - Accept / Reject: finding c!
  - Gibbs Sampling, Describe, (I will not ask Hammersley-Clifford)
  - Data Augmentation. Missing data example with an AR(1) was done on blackboard

- Independence and Random-Walk Metropolis. Know, explain, describe, how to understand the percentage of repeats.

- Factorization of Covariance Matrices
  - The Factor Model
  - Principal Component analysis vs MLE Factor Estimation
  - Second Step: estimation of the factor scores. How do we do it?
  - Asymptotic Principal Component analysis
  - Need to know formula for Principal components and how to find the Bs
  - Need to know second step proof.

This will be finalized after the last class

- Multivariate GARCH - Basic SV model – Extensions - The Student-t
  - Why it is difficult to estimate by likelihood method
  - Conditional densities for Gibbs Sampling: Smoothed volatilities

Readings

The AZ chapters and the Koop chapter material that cover the same topics as the lecture notes are relevant. My Bayesian Finance chapter is not required for the test, but reading it has certainly helped you put Bayesian analysis within an empirical finance perspective.