Exam CheckList

September 26, 2019

Check list of topics covered by Midterm 1:

1. What is the interpretation of the likelihood
2. What is the idea behind the ML estimation method?
3. To construct a likelihood corresponding to a generic sample x_1,...,x_n from an assumed parametric model (continuous or discrete)
4. To construct likelihood for mixture of continuous and discrete
5. To construct likelihood from censored data (fixed/random censoring)
6. Likelihood from regression models: for normal responses and generalized responses in the exponential family. Likelihood for accelerated failure time model
7. What is a pseudo likelihood. When do we use pseudo likelihoods?
8. Marginal likelihood; conditional likelihood; other types of pseudo likelihoods
9. What is the MLE (estimator) for a model parameter? How is it calculated in the case when the model satisfies regularity assn (using log-likelihood) and when the support of the model depends on the parameter (maximizing the likelihood directly).
10. Under regularity assn, be able to verify that MLE is point of maximizer of the log-likelihood
11. Properties of the MLE: reparametrization invariance, asymptotically unbiased
12. Score "function" or vector (gradient of the log-likelihood). Mean and covariance matrix of the score vector
13. Fisher Information (FI) matrix. Total Fisher Information matrix (FI for the entire sample). and the other variants (observed FI, estimated FI). Calculating Fisher Information for various models.
14. Asymptotic normality of the MLE.
15. Asymptotic independence. Variance cost for adding a parameter to a model
16. Calculate the Fisher Information matrix for parameter reparameterization
17. Methods to maximize the likelihood function: analytic methods via profile likelihood. What is the general idea. When is this method appealing?
18. Newton Raphson's method. General idea? Be able to write the iterative step
19. EM algorithm. What problems to apply it to? What is the general idea? Why does it work?
20. Be able to apply EM to problems of similar type to the ones studied in class or in assignments.
21. Hypothesis testing. Classical likelihood based tests - Wald, likelihood ratio test - and their large sample properties.
22. What is the asymptotic null distribution of a test (say Wald)? Why is it useful? How do we use the asymptotic distribution of a test?

23. Know to use Wald, score and LR test to test a hypothesis of the form $\boldsymbol{\theta}=\boldsymbol{\theta}_0$ where $\boldsymbol{\theta}$ is the full model parameter. What is their asymptotic distribution?
24. Know to use Wald, score and LR test to test a hypothesis of the form $\boldsymbol{\psi}=\boldsymbol{\psi}_0$ where $\boldsymbol{\psi}$ is a scalar or vector component of $\boldsymbol{\theta}$ that is of interest. What is their asymptotic distribution?
25. Partition the score vector and Fisher information matrix corresponding to a partition of the full parameter
26. Wald, score and LR test to test a hypothesis of the form $h(\boldsymbol{\theta})=0$ for some function of interest $h(\cdot)$. What is their asymptotic distribution?
27. How do the three tests change under reparameterization. What about their the null distribution.
28. Be able to use the likelihood tests in applications (how to calculate the p-value, and state a conclusion)
29. Confidence regions. Construction of confidence regions by inverting the tests statistics.
30. Construction of confidence regions for a parameter of interest.
31. How to apply these ideas in examples
32. Null hypothesis on the boundary of the parameter space. Be able to identify when does such hypothesis testing pose concerns. Explain intuitively what the issue is and why there is need to adjust the asymptotic null distribution.
33. Define the three modes of convergence for random vectors
34. Relationships between the modes of converges. As well when the component-wise convergence is sufficient for the joint convergence
35. Continuity mapping theorem. Applications.
36. Slutsky theorem. Applications
37. Stochastic O and o symbols
38. CLT
39. Cramér-Wold device.
40. Asymptotic normality property