

Mathematics 376 – Probability and Statistics 2
Review Sheet, Final Exam
April 27, 2010

General Information

The final examination for this course will be given at 2:30 p.m. on Saturday, May 8 in our regular class room, Swords 328. The exam will be roughly one and a half times the length of one of the midterms. You will have the full three hour period from 2:30 pm to 5:30 pm to work on it if you need that much time. As was true for the midterms, I will let you bring an 8.5 by 11 sheet of paper to the exam containing any information you want and you may consult it at any time. Copies of any necessary tables will also be provided. Even more so than on the midterms, of course, it will be necessary to prepare carefully; you don't want to have to search for every formula you need or a similar examples to help you get started on every problem. You will be pressed for time to complete the exam if you are doing that.

Topics to be Covered

- 1) Sampling distributions related to the normal distribution (χ^2, t, F distributions) – know how to tell when a random variable has one of these distributions, how to use the tables for each in the text, etc.
- 2) Point estimators for distribution parameters, bias, mean square error, standard error. Be sure you understand Table 8.1 on page 397 of the text, where all the entries come from, and how they are used. *Be aware that this table covers only the large sample case. The confidence intervals and tests for means and difference of means in the small sample case are slightly different because of the hypotheses needed to assure the relevant statistic has a t -distribution. Review Section 8.8 if this is not clear.* Also be able to analyze estimators to determine whether they are biased or not, construct unbiased estimators, etc.
- 3) The pdf's for order statistics (especially the sample maximum and minimum), and how they can be used for estimation problems, especially in conjunction with:
- 4) The method of moments and the method of maximum likelihood for deriving estimators. (The other material we discussed in Chapter 9 on consistency of estimators, sufficient statistics, etc. will not appear on the exam.)
- 5) Hypothesis testing – the general concepts: null hypothesis, alternative hypothesis, test statistic, rejection region, Type I error probability ($= \alpha$, or level of test), Type II error probability ($= \beta$), attained significance level (p -value of a test), interpretation of results.
- 6) The connection between confidence intervals and rejection/“acceptance” regions for tests.
- 7) Large sample (z -) tests and related confidence intervals for means and proportions. Questions here might also ask you to design tests with a given α -value to achieve a certain β -value by selecting sample size appropriately.
- 8) Small sample (t -) tests for means and related confidence intervals.

- 9) χ^2 -tests for variances and related confidence intervals; F -tests for ratios of variances and related confidence intervals.
- 10) Least squares estimation for linear models of the form $Y = \beta_0 + \beta_1 x_1 + \cdots + \beta_k x_k + \varepsilon$. The kinds of questions I might ask here will be of two types:
- Be prepared to compute the least squares estimators for the coefficients β_i in a “small” simple regression ($k = 1$) example (say with $n \leq 10$ or so) with a calculator (Maple will not be available!). Also know how to carry out hypothesis tests on the β_i in this case as in some of the questions from the final lab.
 - I might also ask you to set up the normal equations for the least squares estimators in a multiple regression ($k \geq 2$) example or answer some general questions about hypothesis testing in that situation. I will not ask any computational questions there, however.

Suggestions on How to Study

Start by reading the above list of topics carefully. If there are terms there that are unfamiliar or for which you cannot give the precise definition review them. Reread the class notes. *Everything on the final will be similar to something we have discussed at some point this semester.* Also look back over your graded problem sets and exams. If there are problems that you did not get the first time around, try them again now. Then go through the suggested problems from the review sheets. If you have worked these out previously, it is not necessary to do them all again. But try a representative sample “from scratch”. Don’t just look over your old solutions and nod your head if it looks familiar. Practice thinking through the logic of how the solution is derived again.

Suggested Review Problems

Look at the problems from the two previous review sheets for the topics 1 - 9 above. For the last one (regression and hypotheses concerning the regression coefficients): From Chapter 11/4, 14, 31, 63 (“linearize the model” means to take the logarithm of both sides of $E(Y) = \alpha_0 e^{-\alpha_1 x}$ as $\ln(E(Y)) = \ln(\alpha_0) - \alpha_1 x$ and do the regression with the data points $(x_i, \ln(y_i))$ to estimate $\beta_0 = \ln(\alpha_0)$ and $\beta_1 = -\alpha_1$), 69, 72 (Exam question could be “How would you set up a test of $H_0 : \beta_2 = 0$ vs. $H_a : \beta_2 \neq 0$ ”).

Review Session

If there is interest, I would be happy to run a review session after the end of classes. As of now, I am free all day Wednesday, May 5 and Thursday, May 6. We can discuss this in our last class meeting.