

## Math 482/582 T Th 1:40-2:55

**Instructor:** Yu Zhang

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**Office:** EAS Room 286 and Phone Number: x3336

**Text** Mathematical Statistics (3e), by Rice.

**Office hours:** T Th 3:00-4:00 pm or by appointment

**Exams:** 35% on the mid-term and 35% on the final.

**Homework:** Homework will be assigned virtually every class session, and will be due one week from the date of assignment. Homework will take 30%

### Syllabus

Remark: Sections covered on given days are subject to change. This syllabus is meant only as a general outline.

	<b>Section Covered</b>
Weeks 1-2	Review Chapter 1- Chapter 6
Weeks 3-4	Chapter 8
Weeks 5-6	Chapter 9
3/3-3/6	Review and Exam 1
Weeks 8-9	Chapter 11
Weeks 11-12	Chapter 12
Weeks 12-14	Chapters 13 and 14
5/1 -5/8	Review and Exam 2

**Prepare for Exam I**  
**March, 6. 1:40-2:55**

This exam will cover Chapters 8 and 6(another book).

**Be prepared for Ch 8:**

- (1) Be able to find the MLEs when one or two parameters are unknown.
- (2) Be able to use the method of moments to estimate one or two parameters.
- (3) Be able to find Cramer-Rao's lower bound for some models.
- (5) Be able to estimate Cramer-Rao's confidence interval for some parameters.
- (6) Be able to verify unbiasedness for estimators.
- (7) Be able to compare efficiency for two estimators.

**Be prepared for Ch 6:**

- (1) Given a level  $\alpha$ , be able to use the  $p$ -value method to test mean for one or two sided alternatives if  $\sigma$  is known or unknown.
- (2) Given a level  $\alpha$ , be able to find the critical method to make test mean for one or two sided alternatives if  $\sigma$  is known or unknown.
- (3) Be able to compute the powers for one or two sided alternatives if  $\sigma$  is known.
- (4) Be able to find sample size to achieve a given power.
- (5) Be able to do the likelihood ratio test.

**A real example.** During WWII, a very simple statistical procedure was developed for estimating German war production. It was based on serial numbers and proved to be incredibly reliable.

Every piece of German equipment, whether it was V-2 rocket, a tank or just an auto tire, was stamped with a serial number that indicated the order in which it was manufactured. If the total number of, Mark I tanks produced by a certain date was  $N$ , each would bear one of integers 1 to  $N$ . As the war progressed, some of these numbers became known to the Allies, wither by direct capture of a piece of equipment or from the records seized when a command post was overran. For the War department's statistician, the problem was to estimate  $N$  using the same of captured serial numbers

$$1 \leq Y_1 < Y_2 < \dots < Y_n \leq N.$$

Several approaches were proposed. One model assume that the  $n$  serial numbers were of the  $\binom{N}{n}$  possible sets of  $n$  ordered integers from 1 to  $N$  and that each set was equally likely. That is

$$P(Y_1 = y_1 < Y_2 = y_2 < \dots < Y_n = y_n) = \binom{N}{n}^{-1}.$$

The parameter  $N$  was then estimated by adding the average "gap" in the serial numbers to the largest serial number:

$$\hat{N} = Y_{\max} + \frac{1}{n-1} \sum_{i>j} (Y_i - Y_j - 1).$$

So if five tanks were captured and they bore the number 14, 28, 92, 146 and 298, the estimate

$$\hat{N} = 298 + 1/4[(298 - 146 - 1) + \dots + (28 - 14 - 1)] = 368.$$

A second estimator used was a discrete version of modified MLE referred to

$$\hat{H}_1 = \frac{n+1}{n} Y_{\max} - 1.$$

The serial number estimate for German tank in 1942 was 3400, a figure very closed to actual output.

**Prepare for Exam II**  
**May, 13. 1:40-2:55**

This exam will cover Chapters 11, 12 and 14.

**Be prepared for Ch 11:**

- (1) Be able to test the means of two samples (the same or different variances).
- (2) Be able to test two binomial data.
- (3) Be able to find the confidence intervals for two sample problems.
- (4) Be able to test the variances of two samples.

**Be prepared for Ch 12:**

- (1) Be able to test (F-test) means of multiple samples.
- (2) Be able to Tukey's and Fisher's test for sub hypotheses.
- (3) be able to find confidence intervals for multiple samples.

**Be prepared for Ch 14:**

- (1) Be able to find a simple linear regression equation.
- (2) Be able to test  $\beta_1$  and  $\beta_0$ .
- (3) Be able to find the confidence intervals for  $\beta_1$  and  $\beta_0$ .
- (4) Be able to find the correlation coefficient and test it.
- (5) Be able analysis the residuals of samples.
- (6) Be able to find a multiple linear regression equation.
- (7) Be able to test (F and t-tests)  $\beta_i$ .
- (8) Be able to find the confendience intervals for  $\beta_i$ .