STAT 231 Tutorial Test 2
Wednesday November 2 in your scheduled tutorial time.
You may ONLY write in your assigned tutorial time.

Seating is predetermined so please check your seat assignment at
https://odyssey.uwaterloo.ca/teaching/schedule
Bring your Watcard. Only Pink-tie or Blue-goggles calculators may be used.

You may bring one (1) **double-sided**, letter sized (8.5 x 11 inches), handwritten page of notes to the test (no photocopies).

Tutorial Test 2 will focus on the material in Sections 4.1-4.5 (**excluding the t distribution**), however you must still know the material from Chapters 1-3.

You should know and understand the following:

Given observed data and a model, determine the maximum likelihood estimate of an unknown parameter (Sections 2.2-2.4)
Invariance property of maximum likelihood estimates. (Theorem 13, page 61)
Definition of a point estimate of a parameter θ (Definition 7, page 47)
Definition of a point estimator of a parameter θ (Definition 22, page 109)
Sampling distribution of an estimator (Section 4.2)

Relative likelihood function (Definition 23, page 113)
log relative likelihood function (Definition 25, page 114)
100p% likelihood interval (Definition 24, p. 114)
How to obtain likelihood intervals **from a graph** of the relative likelihood function or the log relative likelihood function
Behaviour of likelihood functions, log relative likelihood functions, and likelihood intervals as the sample size increases (page 114)
Interpretation of likelihood intervals (Table 4.2, page 116)

In particular, you should know how to construct the relative likelihood functions for each of the following:
Binomial(n,θ); Geometric(θ); Negative Binomial(k,θ); Poisson(θ); Exponential(θ);
$G(\mu,\sigma)$, σ known; $G(\mu,\sigma)$, μ known

Definition of coverage probability (Definition 26, page 116)
Definition of a confidence interval (Definition 27, page 117)
Interpretation of a 100p% confidence interval (page 118)
Behaviour of the width of a confidence interval as the sample size increases (page 118)
Definition of a pivotal quantity (Definition 28, page 118)
100p% confidence interval for the mean of a Gaussian distribution with known standard deviation (Example 4.4.2, pages 119)
Approximate 100p% confidence interval for the Binomial proportion (Example 4.4.3, pages 120)
Choosing a sample size for a Binomial experiment (Example 4.4.5, pages 121-122)

$\chi^2(k)$ distribution and its properties (Section 4.5):

1) the relationship between a $\chi^2(1)$ random variable and a $N(0,1)$ random variable (Theorem 30, p. 125) and how to use this relationship to calculate $\chi^2(1)$ probabilities (Useful Results, page 126)

2) the relationship between a $\chi^2(2)$ random variable and an $Exponential(2)$ random variable and how to use this relationship to calculate $\chi^2(2)$ probabilities (Useful Results, page 126)

3) the shape of $\chi^2(k)$ pdf for $k > 2$ and the fact that it has a maximum value at $x = k - 2$

4) the mean and variance of a χ^2 random variable

5) the distribution of a sum of independent χ^2 random variables (Theorem 29, page 125)

6) the distribution of a sum of independent $G(0,1)$ squared random variables (Corollary 31, page 126)

7) how to read the χ^2 tables in the Course Notes (Chapter 4, Problem 17)

8) the approximate distribution of a $\chi^2(k)$ random variable for $k > 30$ and how to use this to calculate approximate $\chi^2(k)$ probabilities for $k > 30$

There will also be short answer and multiple choice questions on the R code used in Assignments 1 and 2.

In preparation for the test you should do the following end-of-chapter problems:

Chapter 4, Problems: 1-17