Math 21-01 Introductory Statistics Fall 2015
Final Exam Topics

The final exam will be on Thursday, December 17th. Just as before, you will not be allowed to use any calculators, books, or notes. You will be given a formula sheet as well as tables for the Normal, Student, Chi-Square, and Fisher distributions, as well as a table for the critical values of r. The formula sheet you get for the test will contain almost all of the information on the attached formula sheet, but not necessarily in the same order. You should be able to look at a formula and know what to use it for. Answers given on the exam can be left as unsimplified formulas *when appropriate*.

Questions on the exam will cover material from chapters 1-10 of the book, as well as some topics in class that are not in the book. To do well on the exam, you should know the topics and be able to do the types of problems from the homework/in class, as well as feel comfortable working with the Binomial, Poisson, Normal (z), Student (t), Chi-Squared (χ^2), and Fisher (F) Distributions.

The last class is on Friday, December 11th, and has been set aside for review and questions. There is most likely not enough time to review everything listed above, so you should come to class already having looked at this list and ready to ask specifics. There will also be office hours on Monday, December 14th for you to ask more questions, and office hours after the exam is graded on Friday, December 18th. The details will be announced in class/by email.

Topics

Chapter 1

1. The difference between parameters and statistics.

2. The different types of data.

3. Sampling methods.

Chapter 2

1. How to construct/interpret frequency distributions and other graphs.
2. What it means for data to be approximately normal or uniform.

Chapter 3

1. The different measures of center and their properties.

2. The different measures of variation and their properties.

3. How much of the data is within 1,2, or 3 std deviations of the mean if the data is approximately normal.

4. How to estimate how much of the data is within K std. deviations of the mean.

5. How to compare variation from two different data sets.

6. How to compare relative standing for values from two different data sets.

7. What is meant by a percentile and quartile.
8. How to construct/interpret box plots.
9. Methods for determining what values are outliers.

Chapter 4

1. The rare event rule for inferential statistics.

2. What is meant by probability and what concepts go into defining it.

3. Methods for measuring and interpreting probability of an event.

4. What is meant by odds of an event and how to convert to and from probability.

5. How to deal with probabilities of unions, intersections, and conditionals.

6. The difference between an independent event and dependent event as well as when to treat something as independent.

7. Methods of counting with regards to replacement and order.

Non-book Topic (Bayes' Theorem)

1. How to organize statements about conditional probability into a tree diagram.
2. How to compute inverse probability via Bayes' Theorem.

3. What is the Law of Total Probability?

Chapter 5

1. What is meant by a (discrete/continuous) random variable?

2. What is a probability distribution, and what properties does one have?

3. What is the setup for the Uniform, Binomial, and Poisson distributions? What kind of activities do they model?

4. How and when to approximate a binomial distribution using a Poisson distribution.

Chapter 6

1. What is meant by a continuous distribution?

2. Understand the correspondence between area and probability, and be able to do so in the uniform distribution.

3. How does one find probabilities in the a normal distribution?

4. What is meant by a critical value?

5. What is meant by a sampling distribution?

6. What is meant by bias and unbias estimators, and what are important examples of each?

7. What is the central limit theorem?

8. When and how does one use the central limit theorem?

9. How can one reasonably conclude that data is normally distributed?

10. How does one interpret a Normal Quantile Plot?

11. How and when can we approximate a binomial distribution by a normal distribution?

Chapter 7

1. What is a point estimate?

2. What is the proper interpretation of a $1-\alpha$ confidence interval?

3. What is a margin of error?

4. What are the number of degrees of freedom?

5. When constructing confidence intervals, when do you use Normal, Student, or Chi-Square, and how do you use them?

6. What are the requirements to estimate parameters using confidence intervals?

7. How do you construct CIs for proportions, means, variances, and standard deviations.

Chapter 8

1. What is meant by Null and Alternative Hypothesis, and what symbols do we associate with them?

2. What the significance level α, and what are some common alphas to use?

3. What is a test statistic, and what are they in particular cases?

4. What is the critical region? When are our critical regions one-tailed/two-tailed?

5. What is the P-value?

6. What are Type I and Type II errors? How do we denote the probability of each?
   What are confidence and power?

7. What are the requirements to test our hypothesis via test statistics?

8. When do we reject a hypothesis using critical values?

9. When do we reject a hypothesis using P-values?

10. When do we reject a hypothesis using confidence intervals?

11. When are our methods equivalent?

12. What is the exact method for testing a claim about a proportion, and what are the requirements?

Chapter 9

1. When constructing confidence intervals and testing hypothesis for two samples, when do you use Normal, Student, or Fisher disributions, and how do you use them?

2. How do you test hypothesis/construct confidence intervals for two samples?

3. What degrees of freedom do we use when testing claims and constructing confidence intervals for two independent sample means?

4. What degrees of freedom do we use when testing claims and constructing confidence intervals for two dependent sample means?

5. What degrees of freedom do we use when testing claims for two sample variances/standard deviations?

Chapter 10

1. What is a correlation?

2. What is a linear correlation?

3. What is r? What is r^2?

4. How do you test the hypothesis that x and y are linearly correlated?

5. What is a regression line? How do you find one?

6. What are unexplained, explained, and total deviation? How are they related?

7. What are unexplained, explained, and total variation? How are they related?

8. How do you predict a y value for a given x_0 using a linear regression?

9. What is a multiple regression?

10. What is R^2? What is the adjusted R^2?

11. What is a dummy dichotomous variable?

12. What is a (multiple) nonlinear regression?

Extra Topics

You'll have to pay attention in class to get these.
If they require formulas, you will be given the relevant formulas on the test.

Formula Sheet

Chapter 3

- $\bar{x} = \frac{\sum x}{n}$
- $s^2 = \frac{\sum(x-\bar{x})^2}{n-1} = \frac{n(\sum x^2)-(\sum x)^2}{n(n-1)}$
- $\sigma^2 = \frac{\sum(x-\mu)^2}{N}$
- $CV = \frac{\sigma}{\mu} = \frac{s}{\bar{x}}$
- $Z = \frac{x-\mu}{\sigma} = \frac{x-\bar{x}}{s}$
- $Q_3 - Q_1$

Chapter 4

- ${}_nP_r = \frac{n!}{(n-k)!}$
- ${}_nC_r = \frac{n!}{k!(n-k)!}$

Chapter 5

- $\mu = \sum xp(x)$
- $\sigma^2 = \sum(x-\mu)^2 p(x) = \sum x^2 p(x) - \mu^2$
- $\mu \pm 2\sigma$
- $P(x) = {}_n\,C_x p^x (1-p)^{n-x}$
- $\mu = np$
- $\sigma^2 = np(1-p)$
- $P(x) = \frac{\mu^x}{(\mu!)e^x}$
- $\sigma = \sqrt{\mu}$

Chapter 6

- $z = \frac{x-\mu}{\sigma}$
- $\mu_{\bar{x}} = \mu$
- $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$
- $z = \frac{\bar{x}-\mu}{\frac{\sigma}{\sqrt{n}}}$
- $\sqrt{\frac{N-n}{N-1}}$

Chapter 7

- $E = z_{\alpha/2}\sqrt{\frac{\hat{p}\hat{q}}{n}}$
- $n = \frac{[z_{\alpha/2}]^2\hat{p}\hat{q}}{E^2}$
- $n = \frac{[z_{\alpha/2}]^2(0.25)}{E^2}$
- $E = z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$
- $n = \left(\frac{z_{\alpha/2}\sigma}{E}\right)^2$
- $t = \frac{\overline{x}-\mu}{\frac{s}{\sqrt{n}}}$
- $E = t_{\alpha/2}\frac{s}{\sqrt{n}}$
- $\chi^2 = \frac{(n-1)s^2}{\sigma^2}$

Chapter 8

- $z = \frac{\hat{p}-p}{\sqrt{\frac{pq}{n}}}$
- $z = \frac{\overline{x}-\mu}{\frac{\sigma}{\sqrt{n}}}$
- $t = \frac{\overline{x}-\mu}{\frac{s}{\sqrt{n}}}$
- $\chi^2 = \frac{(n-1)s^2}{\sigma^2}$

Chapter 9

- $\overline{p} = \frac{x_1+x_2}{n_1+n_2}$
- $z = \frac{(\hat{p}_1-\hat{p}_2)-(p_1-p_2)}{\sqrt{\frac{\bar{p}\bar{q}}{n_1}+\frac{\bar{p}\bar{q}}{n_2}}}$
- $E = z_{\alpha/2}\sqrt{\frac{\hat{p}\hat{q}}{n_1}+\frac{\hat{p}\hat{q}}{n_2}}$
- $t = \frac{(\overline{x_1}-\overline{x_2})-(\mu_1-\mu_2)}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}}$
- $E = t_{\alpha/2}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}$
- $z = \frac{(\overline{x_1}-\overline{x_2})-(\mu_1-\mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}}}$
- $E = t_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}}$
- $s_p^2 = \frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{(n_1-1)+(n_2-1)}$

- $t = \frac{(\overline{x_1}-\overline{x_2})-(\mu_1-\mu_2)}{\sqrt{\frac{s_p^2}{n_1}+\frac{s_p^2}{n_2}}}$
- $E = t_{\alpha/2}\sqrt{\frac{s_p^2}{n_1}+\frac{s_p^2}{n_2}}$
- $t = \frac{\overline{d}-\mu_d}{\frac{s_d}{\sqrt{n}}}$
- $E = t_{\alpha/2}\frac{s_d}{\sqrt{n}}$
- $F = \frac{s_1^2}{s_2^2}$

Chapter 10

- $r = \frac{n(\sum xy)-(\sum x)(\sum y)}{\sqrt{n(\sum x^2)-(\sum x)^2}\sqrt{n(\sum y^2)-(\sum y)^2}}$
- $b_0 = \overline{y} - b_1\overline{x} = \frac{(\sum y)(\sum x^2)-(\sum x)(\sum xy)}{n(\sum x^2)-(\sum x)^2}$
- $b_1 = r\frac{s_y}{s_x} = \frac{n(\sum xy)-(\sum x)(\sum y)}{n(\sum x^2)-(\sum x)^2}$
- $\sum(y-\overline{y})^2 = \sum(\hat{y}-\overline{y})^2 + \sum(y-\hat{y})^2$
- $s_e^2 = \frac{\sum y^2 - b_0\sum y - b_1\sum xy}{n-2} = \frac{\sum(y-\hat{y})^2}{n-2}$
- $E = t_{\alpha/2}s_e^2\sqrt{1+\frac{1}{n}+\frac{n(x_0-\overline{x})^2}{n(\sum x^2)-(\sum x)^2}}$
- $adj\ R^2 = 1 - \frac{n-1}{n-(k+1)}(1-R^2)$