QRMS Final Exam Review

The final exam will be cumulative. In addition to the sections on the previous exam, it will cover 6A, 6B, 6C, 6D, 7A, 7B, 7C, 7E, 8A, 8B, 8D, 9B, and 9C. This review sheet will cover the latter sections, so you should look at the previous review sheet in addition to this one. Also, if you haven't gotten the solutions to the midterm exam yet, ask me for a copy: seeing what you did wrong on the midterm (and how to do it correctly) will help ensure that you don't make the same mistakes again on the final. I haven't written it yet (and thus don't have precise details), but the final exam will be a mixture of multiple-choice and short-answer questions, with the questions from Chapters 1 through 5 primarily as multiple choice and Chapters 6 through 9 primarily as short answer. The exam will be weighted towards the material covered since the midterm, but the weighing will be slight enough that you won't want to focus exclusively on the later material. You will be allowed to use a calculator and your textbook and notes/HW/etc. on the exam. I've indicated the ranges of problems in each section that cover the key ideas below; you should not feel the need to do every problem, but should rather look at the common themes underlying each grouping of problems to ensure that you are comfortable doing problems of this sort. Problems on the exam may not look exactly like the review problems, but you should be able to do the exam problems if you understand the review problems. We will be reviewing for the complete last week of class; please come with questions.

I will be available for office hours after each class. In addition, consider asking questions at the UMRC help lab (in MATH 175) or in the QRMS Open Office hours (`http://math.colorado.edu/qrms/OfficeHours.htm`). Also, I can answer individual questions via e-mail. And don't forget that the solutions manual is on two-hour reserve in Norlin (under author Gillett and title *Instructor's Guide and Solutions Manual*). Good luck!

A Note on Memorization, etc.

Since you are allowed to use your textbook, you do not technically need to memorize any formulas for this exam. However, don't forget that it takes time to look things up, so it might be a good idea to memorize a few of the more basic formulas and it's almost certainly worth at least memorizing/understanding the definitions of the various terms we've used. I would suggest either bookmarking the chapter summaries and major tables (unit conversions, percentiles for z-scores, and so on) or making your own summaries for easy access. As some of you discovered on the midterm, trying to look up everything can take more time than you have: while the final will be a more reasonable length that the midterm, needing to look up everything is still not advised.

Unit 6A: Characterizing Data

This section focuses on a few different methods for characterizing data. Make sure you understand the following and know how to compute them: mean, median, mode. You should also know what outliers are and how we describe distributions in terms of their number of peaks, symmetry/skewness, and variation.

Recommended Problems: 23-30, 37-44

Unit 6B: Measures of Variation

This section introduces three ways of measuring variation: the range, the five-number summary, and the standard deviation. You should know how to compute them and how to interpret what they mean. For standard deviation, this is connected with Unit 6C, which describes it in more depth. Don't worry about the approximation formulas (range rule of thumb, etc.) at the end of this section.

Recommended Problems: 4-8, 17-20, 25-28(a,b), 29-30

Unit 6C: The Normal Distribution

Know how to tell if a distribution is normal (see the conditions on p. 425) and know how to work with a normal distribution. A normal distribution is defined entirely by its mean and its standard deviation; you should understand how and why this is the case. You may use the 68-95-99.7 rule on the exam if it's applicable (so, for example, if a question asks about data exactly 1, 2, or 3 standard deviations away from the mean). If you missed the quiz problem on this rule, it's definitely worth reviewing what it says.

Recommended Problems: 1-3, 5, 8-10, 11-14, 21-22, 29-30, 31-40

Unit 6D: Statistical Inference

There are three ideas covered here. 1) Statistical significance: we haven't talked about how to compute p-values, so you can't do much with this quantitatively, but you should understand what it's about at a qualitative level. Quantitatively, think about what statistical significance at the 0.05 and 0.01 levels means in terms of our work with probability in Chapter 7. This idea was also an important theme in the fourth project. 2) Margin of Error and Confidence Intervals: Know what these are. Know how to compute them. Look at how they relate to the size of the sample. 3) Hypothesis Testing: Again, we mainly discussed this qualitatively, but you should know what a null hypothesis and alternative hypothesis are, and how this relates to statistical significance.

Recommended Problems: 1-10, 11-18, 35-42, 43-48, 49-54, 57-58 (1-18 are all worth doing; I'd suggest just picking a few each from 35-42, 43-48, and 49-54)

Unit 7A: Fundamentals of Probability

This section provides the basics of probability on which the rest of the chapter is built. The method of finding probabilities by listing outcomes is a good one for simple problems, so you should consider it first in cases where the number of outcomes is small. Also, many of the more complicated techniques in later sections come down to this sort of method in their final step, so I'd suggest becoming quite familiar with this before studying the rest of the chapter. You don't need to study the sections on "Empirical Probabilities," "Subjective Probabilities," or "Stating the Odds" for the exam.

Recommended Problems: 23-30, 31-38, 39-48, 57-64, 65-66

Unit 7B: Combining Probabilities

This section gives techniques for computing more complicated probabilities by combining simpler ones. Note that *every* formula in this section has assumptions; that is, you need a different formula depending on whether or not events are independent, mutually exclusive, etc. Thus, you'll always want to begin by making sure that these hypotheses are satisfied before you start your computations. Note that P(B given A) can be calculated using 7A methods: just restrict the outcomes in the denominator to those in which A occurs and those in the numerator to those in which both A and B occur. Also, don't forget that some questions can be answered by common sense (for example, you could use the "or" formula to calculate the probability that a die roll will be either even or odd, or you could just notice that this is clearly 100%). *Make sure you understand the assumptions for each formula, and make sure you're using the proper formula before beginning work on these problems.*

Recommended Problems: 1-5, 15, 21-28, 29-36, 37-44, 45-48, 49-54, 55-60 (again, you probably don't need to do every problem here, but make sure you try some from each group)

Unit 7C: The Law of Large Numbers

The basic idea here is pretty simple: if you try something many times, it should work on average about as often as the probability says it should. For expected value, start by listing all possible outcomes, the probability of each, and the "value" of each, and then just plug in to the formula. Note also that although many of the examples in the book deal with gambling games, this idea is applicable in other situations as well.

Recommended Problems: 25-28, 29-30, 35, 41-44, 45-48

Unit 7E: Counting and Probability

This section is similar to 7B: it gives us new tools for calculating certain types of probabilities (or just count certain quantities), but each involves certain assumptions that have to be checked before we begin. The most important things to check are whether an item is allowed to be selected more than once and whether order matters. Don't let yourself get flustered by this one; many find it un-intuitive, but it isn't that difficult. Just ask yourself whether changing the order would affect anything (and make sure you understand what it is you're ordering). For example, rearranging the members on a committee wouldn't affect anything because the important thing is whether or not they're on the committee, so order doesn't matter here. On the other hand, rearranging the grades that students got on exams would certainly matter to the students whose grades were changed, so order would matter here. And while it's good to understand how the formulas are derived, I suggest computing them with your calculator whenever possible. The book doesn't focus too much on the connection back to probability, but this is an important idea. As we saw in class, this basically is just combining 7A and 7E together: describe in words what the top and bottom of your fraction should be, and then use appropriate techniques to calculate the number of ways each can happen. Note that you usually want to work with the top and bottom of the fraction separately when doing this.

Recommended Problems: 1-10, 33-50, 57-64
By the way: 64 can be done using our counting formulas, but it's quite tricky. However, you should be able to figure out the answer to it intuitively. If you want a challenge, try to find a way to do it using the counting formulas. *Hint:* it involves adding together the result of many different computations.

Unit 8A: Growth: Linear versus Exponential

Know the difference between linear and exponential growth and how the idea of repeated doubling works. The "parables" may be helpful in understanding the basic ideas, but you don't need to study them specifically.

Recommended Problems: 19-26

Unit 8B: Doubling Time and Half-Life

Know how to work with doubling time and half-life. Note that we have both approximate formulas and exact formulas. You are free to use the approximate formulas in any circumstance where they're valid. If you aren't sure whether the approximate formulas are valid in a certain instance, play it safe and use the exact version. Also, it's good to know the logarithm rules mentioned in this section. You can avoid using them some of the time by using your calculator, but they come in handy for some of the problems in 9C. Note also that if we're trying to find the "percentage left" in a half-life problem, the initial value should be 1 (since $1 = 100\%$).

Recommended Problems: 35-42, 47-50, 51-58, 59-62, 63-66

Unit 8D: Logarithmic Scales

First off, make sure you understand what a logarithmic scale is; once you've gotten the basic idea, most of this is just plugging numbers into the appropriate formulas. Also, make sure you understand the inverse square law; using your intuition about how sound works in real life may be helpful here.

Recommended Problems: 19-24, 25-30, 31-34, 35-42

Unit 9B: Linear Modeling

Know how to construct and use a linear model. Pages 575-581 are most important here; the first part of the unit is primarily an introduction to the ideas generalized here. I won't ask you to display models graphically on the exam.

Recommended Problems: 27-32, 33-38, 39-44

Unit 9C: Exponential Modeling

You should think about this section in the same way that you think about 9B. It's modeling a different type of growth, so the equations are different, but the underlying ideas are the same. Compound interest (from chapter 4) is an example of exponential growth, so you may find it easier to understand this material by thinking similarly to the way you think about compound interest. Doing problems like Examples 5-7 and Exercises 51-54 may require you to solve for a quantity that is in an exponent or in a logarithm; see the box on page 588 for how to do these problems.

Recommended Problems: 37-44 (part (a) only), 51-54 (since there aren't very many problems similar to 51-54, you can get more practice on these if desired by picking a value for Q in 37-44 and solving for t)

If you have any questions on what you need to know, what information I'll give you on the exam, or on how to do any of these problems, please let me know. Note that I've grouped similar problems together in the above list, so it's probably best to try a few problems from each grouping rather than starting at the top and working through all of them, since you may run out of time and miss critical ideas if you try this.