QRMS Midterm Exam Review

The midterm exam will cover all units to date except for those not from the textbook, 1A, and 4A. That is, it will cover units 1B, 1C, 1D, 2A, 2B, 3A, 3B, 3E, 4B, 4C, 4D, 5A, 5B, 5C, and 5E, all with approximately equal focus. The exam will consist of approximately 15 questions, meaning that you will have about 5 minutes per question if you use the entire class period. Be sure to plan your time accordingly. I'd suggest practicing and timing yourself in order to see if you're able to do this. In particular, although you are allowed to use your textbook and notes, keep in mind that constantly looking things up can use up lots of time. You will be allowed to use a calculator, your textbook, and any notes you have 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 having a review day in class on Tuesday, March 11th. The exam is on March 13th. As always, 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!

Unit 1B: Propositions and Truth Values

The main idea of this section is combining multiple propositions together; for example, by combining p and q into (p or q). You should be able to construct a truth table involving *not, or, and,* and *conditional* (if...then) statements. (Don't worry about exclusive or: we're more interested in inclusive or from a logical standpoint.) You should also understand the basic idea of the converse, inverse, and contrapositive and how to tell if two given propositions are logically equivalent.

Recommended Problems: 39-40, 47-48, 55-60, 71-72, 87-90, 97-100, 104-109

Unit 1C: Sets and Venn Diagrams

The main idea of this section is describing relationships through the use of sets and how to represent them with Venn diagrams. Focus on translating between English statements and Venn diagrams (in both directions: you should be able to both create a Venn diagram from a textual description and to interpret the information displayed in a Venn diagram. In particular, make sure you understand the set relationships described on p. 40 for subsets, disjoint sets, and overlapping sets and the connection to categorical propositions explored on p. 42. Again, the ideas are more important than the names.) Also, look at how to use Venn diagrams to solve numerical problems.

Recommended Problems: 47-54, 55-62, 63-68, 69-70

Unit 1D: Analyzing Arguments

This section draws together the ideas of 1A-1C, so you should make sure you are comfortable with those sections before studying this one. The main idea is the distinction between inductive and deductive arguments and in how we analyze them. (A good summary is on p. 56.) Know what strength means in terms of inductive arguments and what validity and soundness mean in terms of deductive arguments. Most importantly, you should be able to test validity using Venn diagrams. (I won't ask you to test for validity using truth tables, as this was not covered in the textbook.)

A good way to do this is to look at the general form of the argument: for example, "All S are P. All P are Q. Thus, all S are Q" is always a valid argument, while "All S are P. All Q are P. Thus all S are Q" is not a valid argument. Don't worry about the section "Induction and Deduction in Mathematics" at the end of this unit. Note that since we have more complicated tests for analyzing deductive arguments than we do for inductive arguments, you should probably spend the majority of your time on this unit studying the methods for analyzing deductive arguments.

Recommended Problems: 33-38, 39-46, 57-54, 55-58

Unit 2A: The Problem-Solving Power of Units

First off, make sure you understand how we describe units in English (summarized on p. 85 in the box "Reading Units"). Don't forget how units raised to higher powers work (for example, 1 yd = 3 ft, but 1 yd^2=9 ft^2). Other than that, this section is basically about identifying the units that you are given in the problem and figuring out how to multiply and divide them by the correct conversion factors in order to end up with the desired units for the answer. The process of doing this is summarized on p. 92-93 in the box "Working with Units." While you don't need to memorize any unit conversion factors, bookmarking the appropriate pages in your textbook is a good idea. There won't be any questions on the exam specifically dealing with manipulating fractions, but you should know how to as it will probably be necessary in the unit-manipulation problems like those in chapter 2. A hint for working with these types of problems is to make sure you're explicitly writing out what your units are, so that you can see whether or not their canceling properly; if you don't, it's very easy to put a fraction upside-down, etc. See problems 79-82 for examples of this.

Recommended Problems: 29-36 (there won't be exam problems directly on this idea, but make sure you can do it), 37-48, 49-56, 65-78, 83-86

Unit 2B: Standardized Units: More Problem-Solving Power

Think of this unit as an extension of 2A: it gives more examples of different types of units, but is basically covering the same ideas. You should be able to convert between powers of 10 in the metric system (so you should be able to figure out that 1 km = 1000 m, for example). I'd also suggest memorizing at least the first three rows of Table 2.5 ("Metric Prefixes") on p. 104. You should also know the basic metric units (i.e., meter for length, liter for volume, etc.). You should also make sure you understand what energy, power, density, and concentration mean: it's easier to work with the units if you really understand what's being measured.

Recommended Problems: 53-58, 59-68, 69-70, 75-80

Unit 2C: Problem-Solving Guidelines and Hints

We didn't actually cover this section, but if you're having trouble with the problems in 2A and 2B, reading the hints in this section might help you to better grasp the material. At the least, the four-step problem solving process on p. 119 may give you a general strategy for approaching these sorts of problems.

Unit 3A: Uses and Abuses of Percentages

This section covers three ways of using percentages. You should understand all three. Also, notice that the second and third ways are essentially the same idea in two different contexts: if you understand one, you should understand the other. I will provide the formulas for absolute change, relative change, absolute difference, and relative difference, as well as the formulas in the box on p. 145. Make sure you're comfortable using them and understand what the "new value," "reference value," and "compared value" are referring to. Also, make sure that you understand the difference between "more than" and "of." Note that we don't always use these specific words when we're talking about these ideas. This idea usually comes into play in problems such as Example 10 on p. 145. Beware of shifting reference values, especially in problems of this sort (see Example 12 on p. 147, for example).

Recommended Problems: 43-48, 55-60, 63-66, 67-72, 73-76, 81-84, 87-94, 95-98

Unit 3B: Putting Numbers in Perspective

You should know what scientific notation is and how to work with it, how to estimate using orders of magnitude, and how to achieve perspective through comparisons and scale ratios.

Recommended Problems: 31-32, 33-38, 39-40, 45-50, 59-67

Unit 3E: How Numbers Deceive: Polygraphs, Mammograms, and More

Note that we only covered pages 199-205 in this section (up to "Political Math"). The important thing here is to understand and be able to recognize the ways in which numbers can be deceptive. We discussed Simpson's paradox and the relationships between true/false positives/negatives, both of which deal with errors in thinking regarding percentages. Computationally, you should understand how Examples 1-4 were done. However, in addition to being able to work with these sorts of issues, make sure you understand what's going on behind the scenes and what the percentages are telling us in each case (e.g., the polygraph example in the book shows that a 90% accurate polygraph may be wrong on 91.7% of the people it accuses: why is this the case?) The Quick Quiz and Review Questions at the start of the exercises may help you to understand these ideas better.

Recommended Problems: 1-8, 11-13, 21-29

Unit 4B: The Power of Compounding

The main thing you need to be able to do here is figure out which formulas to use: we have simple interest, compounding interest, and continuously compounding interest; you should be able to figure out from the situation in any given problem which of these is called for. Other than that, just make sure that you know how to put the numbers into your calculator correctly. Note that the compound interest formula on p. 231 is the same as the one on p. 235 except that the first assumes $n = 1$ and the latter works for any n; thus, if you want one fewer formula to work with, you can ignore the one on p. 231 and just set $n = 1$. Also, know the difference between APY and APR.

Recommended Problems: 41-44, 47-52, 53-60, 61-64, 65-70, 71-74 (note that quite a few of these problems are very similar, so you probably don't need to work too many of them to get the main ideas down)

Unit 4C: Savings Plans and Investments

As with 4B, the biggest idea here is knowing how to use the new formula (on p. 247). If you missed the retirement problem on the quiz a couple of weeks back, take a look at Example 4 on p. 251. Finally, we have a couple of formulas for total and annual return on p. 253. Make sure you know how to use all three of the mentioned formulas. Don't worry about the material on pages 256-264: while it's worth knowing, you won't be tested on it.

Recommended Problems: 49-52, 53-58, 59-66

Unit 4D: Loan Payments, Credit Cards, and Mortgages

Your preparations for this unit should be similar to your preparation for Unit 4C. The main result is the loan payment formula, so you should know how to work with it and how it can help you make choices between different options (for example, Example 3 on p. 274). Also, know how to calculate the total interest paid over the course of a loan and the terminology for mortgages on p. 278 (and how to work with them, of course). Note that we didn't cover closing costs and points on mortgages, so I won't test you on these

Recommended Problems: 24-34, 39-42, 47-50, 51-54

Unit 5A: Fundamentals of Statistics

Chapter 5 is quite different from chapter 4: we don't have as many formulas and have quite a few more terms to work with. Essentially, it's worth knowing everything that's in a shaded box (i.e., definitions, guidelines, etc.). The best way to study for this section is to work with the terms in it: look at the studies in the exercises and figure out how they're taking samples, dealing with blinding, etc. You could also practice this by looking at studies in the news, say. Finally, you should know the relationship between confidence intervals, sample statistics, and margins of error.

Recommended Problems: 25-30, 31-36, 39-44, 45-50, 51-56, 57-60, 65-70 (since the ideas of this section cannot be learned by rote, it's probably worthwhile to do as many of these as you have time for as practice)

Unit 5B: Should You Believe a Statistical Study?

Make sure you understand the various types of bias discussed in this section and that you're able to identify them in summaries of studies. This section is essentially on critical thinking, so focus on thinking about how studies could possibly be flawed. The most common flaws are:

1. Doing the wrong type of study (e.g, observational instead of an experiment),
2. Selection bias,
3. Participation bias,
4. Vaguely defined or misdefined variables,
5. Confounding variables, and
6. Unfairly worded questions.

Some of these have names given by the book and some don't; focus on what they mean more than what they're called, but be able to describe the different problems clearly enough that I'll know

what you're talking about.

Recommended Problems: 19-30, 31-36, 37-46 (do as many as time permits)

Unit 5C: Statistical Tables and Graphs

As the name suggests, the idea here is converting between tables and graphs. In other words, you'll want to be able to make a graph from the information in a table and to interpret the meaning of the information shown in a table or a graph. Also, make sure you understand relative frequency, cumulative frequency, and binning. I won't ask you to draw pie charts, since they're difficult to do by hand. Make sure you label your graphs with the labels listed on p. 353. This section is less important than some of the others we've covered, so you needn't devote too much time to it: just get the basics.

Recommended Problems: 25-26, 35-36, 47-55

Unit 5E: Correlation and Causality

First off, repeat to yourself several times "Causation does not imply causality." Know what correlation and causality are. Know how to construct a scatter diagram to establish a positive or negative correlation. Know the three possible explanations for a correlation on p. 386 and the guidelines for establishing causality. Be able to make informed opinions about whether correlations and/or causation exists between variables.

Recommended Problems: 23-26, 27-34 (you can also think about causality for these), 35-40, 41-47

A Note on Memorization

As you're allowed to use notes and your books, you don't technically have to memorize anything. However, if you attempt the exam by looking up everything as you use it, you'll probably run out of time. At the very least, I'd suggest copying down some of the more important formulas (especially in 3A and chapter 4) and bookmarking things you'll need to reference (such as the tables of conversion factors and temperature formulas in chapter 2). Also, learning the vocabulary is a very good idea. As a general rule, the more you have memorized, the less time you'll spend looking things up and the mroe time you'll have to actually solve the problems.

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.