



General Exam Info

Exams are a way for you to show me what you have learned (and please show all your steps so I can see this!) and to give you a sense of accomplishment! They are meant to be challenging and not just homework problems with the numbers changed. I really want to prepare you for university level math classes—so some exams may be longer or more challenging than others. Remember that I do grade fairly and my goal is to push you to succeed and excel in this class. I often give hints in class as to exam problems (another great reason to come to class!), and I will post study guides along with the best way to review for each exam.

- Four exams are given during the semester—check our schedule for the exact dates.
- **Attendance required for all exams** and there are “**No Make-up Exams**” for any reason. However, I may replace the lowest exam score, regardless of the reason, with your final exam score provided the final exam score is higher than your lowest exam score and all assignments are turned-in on time.
- Your valid **GCC student ID** or a valid **government ID** is REQUIRED for all exams.
- During the exams—you will be required to leave your backpack and all non test items at the front of the room, including cell phones and smart watches. Only your pencil/eraser and calculator will be allowed during the exam, and there will be a calculator check. Should you need to leave during the exam please ask for permission first before leaving and leave your cell phone with me. Not doing these things could result in a 0 on your exam.
- Once the exam is returned, any problem you would like me to revisit must be brought to my attention by the next class session.
- **Always keep your exams!**
- **Covid19 Update: Due to the current pandemic we will be taking the test online. Please consult Canvas announcement for detailed test taking instructions.** Thank you all for continuing to work hard during such a tough situation. I very proud of all of you!

Exam 2 Specific Info

- The exam is scheduled for the end of the class period, the last 80 minutes.
- Almost all questions have multiple parts
- This test will be closed book, no notes.
- You will need a calculator (only Ti84/+/-CE allowed)—you won’t be able to use your phone.
- You need to know what all the various terms in **bold** mean, but you don’t need to memorize definitions. I’m not going to ask you to “Define ...”. Instead I ask you questions that use those terms.
- **Material covered: 4.1–4.4, 5.1–5.4, 6.1–6.2**
- Old material: You still need to know Chapter 1–3 material, especially Chapter 3 material.
- $(M \rightarrow E)$ “**Math to English**” If you see this, it just means that I would like you to write your answer in a complete sentence and include all relevant **units**.
- Types of Questions to expect:
 - True-False
 - Circle the right answer
 - Fill-in the blank
 - Multiple-choice
 - Short response

Chapter 4

• Scatter Plots

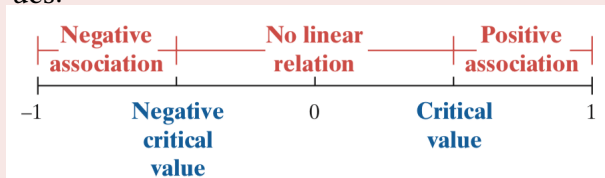
- **explanatory variable:** x (or predictor var)
- **response variable:** y
- **scatter plot (diagram)**
- **CALC:** Enter data into lists (L1=explanatory, L2=response) » Stat Plot (2nd + Y=) » ON » Type: select scatter plot icon » Choose: Xlist=L1 and Ylist=L2 » Select Zoom: 9

• Correlation

- **linear relationship** vs **non-linear relationship**
- **positive association**
- **negative association**
- **(linear) correlation coefficient:** r
 - * $-1 \leq r \leq 1$
 - * perfect linear fit: ± 1
 - * $r \approx 0$ no linear relationship (chaos)
 - * $r \approx \pm 1$ good linear relationship
 - * not resistant
 - * **CALC:** Enter data into lists (L1=explanatory, L2=response) » Stats » Calc » 8. LinReg(a+bx)

Note: must set-up Diagnostics ON first

- Testing for a linear relation using Critical Values:



- **lurking variable**

• Marginal Distributions

- **contingency table** or **two-way table**
- **margins:** totals or relative frequency

• Conditional Distributions

- relative frequency of each category (margins and inside each cell)

• Simpson's Paradox: association between goes away when a third variable is introduced

• (Least-Squares) Regression Line

- Regression line: $\hat{y} = a + bx$
- **CALC:** Enter data into lists (L1=explanatory, L2=response) » Stats » Calc » 8. LinReg(a+bx)
- **Rounding Rules:** four decimal places
- **Slope** b .
- Interpretation of slope
- **Y-intercept** a .
- Interpretation of y-int
- **Residuals:** observed - predicted $R = y - \hat{y}$
 - * **observed values** y .
 - * **predicted values** \hat{y} .

• Residuals

- **coefficient of determination** R^2 .
 - * $R^2 = 0$: line no explanatory value (linear model not helpful to predict)
 - * $R^2 = 1$: line explains 100% of variation of response (linear model IS helpful to predict)
 - * How to compute: $R^2 = r^2$, ie. square the correlation coefficient
- **Deviation**
 - * **explained deviation:** $\hat{y} - \bar{y}$
 - * **unexplained deviation:** $y - \hat{y}$
 - * **total deviation:** $y - \bar{y}$
- When looking at a residual plot: if there's no pattern then linear model is appropriate! Otherwise, linear model is NOT appropriate!
- **CALC:** Enter data into lists (L1=explanatory, L2=response) » Stat Plot (2nd+Y=) » for Ylist: choose RESID (2nd+Stat+8.)
- **Influential observation**

Chapter 4

For the following I may ask you multiple choice/true-false/circle the right answer types of questions but mostly you'll see free-response questions similar to the worksheet problems:

- Be able to calculate scatter plots on your calculator; interpret graphs of data
- Be able to determine the correlation coefficient using your calculator and whether two variables are linearly related or not.
- Be able to determine the linear regression equation using your calculator; understand the interpretation of slope and the y-intercept; know the notation of observed vs predicted values; be able to compute predicted values (know when to use linear model vs using average)
- Find and interpret the coefficient of determination

Chapter 5

• Set Theory

- **set notation:** { things }.
- **sample space** S .
Ex: $S = \{HH, HT, TH, TT\}$,
Ex: $S = \{1, 2, 3, 4, 5, 6\}$, etc

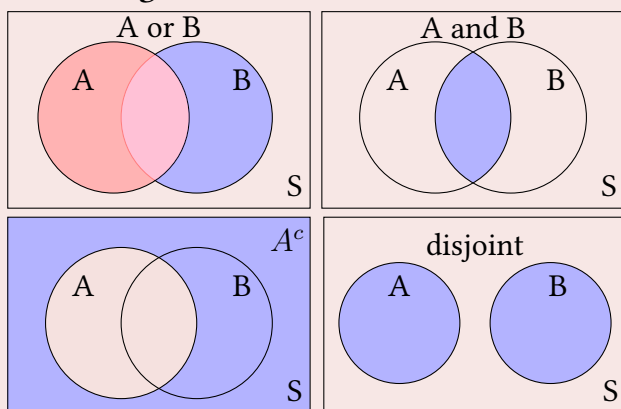
• events: A, B, C, \dots

- Ex: $E = \{2, 4, 6\}$ = “rolling an even #”

• simple events

- Ex: $A = \{5\}$ = “rolling a 5”

• Venn Diagrams



• Probability

– Classical/Theoretical Probability

$$P(A) = \frac{\# \text{outcomes in } A}{\# \text{outcomes in } S}$$

– Empirical Probability

$$P(A) = \frac{\# \text{occurrences of } A}{\# \text{of trials } n}$$

– Subjective Probability

- Rounding rule for probability: 3 sig figs
- Probabilities can be written as decimals, fractions, and percentages. But decimals are preferred.

$$0 \leq P(A) \leq 1$$

- Impossible events: $P(A) = 0$
- Certain events: $P(A) = 1$

• Independent vs Dependent events

• Probability Rules

– Sum Rule

General:

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

Disjoint: $P(A \text{ or } B) = P(A) + P(B)$

– Using “and” in one selection:

$$P(A \text{ and } B) = \frac{\#A \text{ and } B}{\#S}$$

– Multiplication Rule

A, B indep. $\rightarrow P(A \text{ and } B) = P(A) * P(B)$

A, B dep. $\rightarrow P(A \text{ and } B) = P(A) * P(B|A)$

– Complement Rule $P(A^c) = 1 - P(A)$

- Probability of Disjoining sets: $P(A \text{ and } B) = 0$ when A and B are disjoint

• Using Probability to determine significance:

- $P(x \text{ or more}) \leq 0.05 \rightarrow x$ is significantly high
- $P(x \text{ or less}) \leq 0.05 \rightarrow x$ is significantly low

• “At least one” Trick

$$P(\text{at least one}) = 1 - P(\text{none})$$

• Conditional Probability

$$P(B|A) = \frac{P(A \text{ and } B)}{P(A)} = \frac{\frac{\#A \text{ and } B}{\#S}}{\frac{\#A}{\#S}} = \frac{\#A \text{ and } B}{\#A}$$

• How to select correct probability rule?

- When making one selection: use either Classical, Empirical probability, or conditional probability
- When making two (or more) selections:
 - * If using “OR”: are events mutually exclusive?
 - * If using “AND”: are events independent?
 - * If using “AT LEAST ONE”: use at least one trick

Chapter 5

For the following I may ask you multiple choice/true-false/circle the right answer types of questions but mostly you’ll see free-response questions similar to the worksheet problems:

- Be able to distinguish between classical/theoretical, relative frequency, and subjective probabilities.
- Be able to identify events as impossible or certain.
- Be able to use set notation to express: sample space, events, and simple events
- Be able to compute probabilities from the definition and using the Sum rule, Multiply rule, and Complement rule
- Understand the difference between the **two formulas using “and”**: Use $P(A \text{ and } B) = \frac{\#A \text{ and } B}{\#S}$ when making **one selection** (ex: probability of drawing one card that’s a heart and Queen); Use $P(A \text{ and } B) = P(A) * P(B|A)$ when making **two selections** (ex: probability of selecting two blue balls from a bag that contains....)
- Understand when events are independent vs dependent and how this effects probabilities using conditional probabilities
- Study all of the examples from the worksheets carefully! Be prepared to information given to you in table.

• Random Variables X

• Discrete vs Continuous Random Variables

• Probability Distributions for a RV X

- as a list of all probabilities
- as a table of values
- as a histogram

– Requirements

1. $\sum P(x) = 1$
2. $0 \leq P(x) \leq 1$

• Formulas for Probability Distributions

mean: $\mu = \sum [x \cdot P(x)]$

variance: $\sigma^2 = \sum [x^2 \cdot P(x)] - \mu^2$

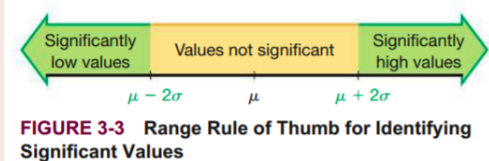
standard deviation: $\sigma = \sqrt{\sum [x^2 \cdot P(x)] - \mu^2}$

• Expectation $E(X) = \sum [x \cdot P(x)]$

- key point: the “long run behavior” or “many/large sample”
- expectation is also called the mean. So the mean tells us the long run expectations

• Range Rule of Thumb:

- **Significantly Low:** value $< \mu - 2\sigma$
- **Significantly High:** value $> \mu + 2\sigma$
- **Not Significant:** $\mu - 2\sigma < \text{value} < \mu + 2\sigma$



• Binomial Probability Distributions

– Requirements

1. fixed number of trials
2. trials are independent
3. **only two** outcomes (“success” or “failure”)
4. probability of success of each trial remains the same

– Notation

- * n total number of trials
- * p be the probability of a single success
- * q be the probability of a single failure. (NOTE: $q = 1 - p$)
- * x be the number of successful trials of X . So notice that x can take values from 0 up to n , i.e. $x = 0, 1, 2, 3, \dots, n$.

• Binomial Probability Formula

- Let $P(X = x)$ denote the **probability of exactly x successful trials out of n in a binomial probability distribution**, then

$$P(X = x) = {}_n C_x p^x q^{n-x}$$

CALC: $P(X = x) = \text{binompdf}(n, p, x)$

• Formulas for Binomial Distribution

- $\mu = np$ $\sigma^2 = npq$ $\sigma = \sqrt{npq}$
- Recall: the range rule of thumb

• Cumulative Probabilities

$$01 \dots x \dots n \quad P(X \leq x) = \text{binomcdf}(n, p, x)$$

$$01 \dots x \dots n \quad P(X < x) = \text{binomcdf}(n, p, x - 1)$$

$$01 \dots x \dots n \quad P(X \geq x) = 1 - \text{binomcdf}(n, p, x)$$

$$- 01 \dots x \dots n \quad P(X \leq x) = 1 - \text{binomcdf}(n, p, x)$$

For the following I may ask you multiple choice/true-false/circle the right answer types of questions but mostly you’ll see free-response questions similar to the worksheet problems:

- Be able to distinguish between discrete and continuous random variables.
- Be able to determine whether or not information given represents a probability distribution.
- Be able to build a probability distribution for a given random variable. (Ex: a) X = number of Heads that come up out of 4 coin flips, b) X = number of girls that a family has if they plan to have 4 children)
- Be able to recognize if a probability distribution is binomial so that you can use binompdf or binomcdf. Also, know the four requirements needed for a binomial distribution.
- Be able to compute probabilities of binomial distributions for a single value of x and multiple values of x using the rules of probability (including “at least one”, “or”, “and” etc).
- Be able to create a table or histogram for a binomial probability distribution using your calculator.
- Be able to compute expectations and know the significance of expectation.
- Be able to compute the mean, standard deviation, and variance given a probability distribution.
- Be able to recognize if a value is significantly low or high using the range rule of thumb.

Calculator Skills you must know

- **STATS** Edit lists, clear lists
 - **1-Var Stats** use to compute mean, standard deviation, 5 number summary
 - **Stat plot** use to plot scatter plots and residuals
 - Scatter Plot: Enter data into lists (L1=explanatory, L2=response) » Stat Plot (2nd + Y=) » ON » Type: select scatter plot icon » Choose: Xlist=L1 and Ylist=L2 » Select Zoom: 9
 - Residuals: similar to scatter plot except choose Ylist=RESID (List (2nd+Stat) » NAMES » 8. RESID)
 - **Calc** use to calculate regression line and correlation coefficient
 - Regression Line and Correlation Coefficient: Enter data into lists (L1=explanatory, L2=response) » Stats » Calc » 8. LinReg(a+bx)
- Note: must set-up Diagnostics ON first
- **2nd+VARS** Distributions → binompdf(n,p,x) and binomcdf(n,p,x)
 - **2nd+ENTER** Trick!

Practice Test

Note: solutions to all review and test exercises are available at the back of the book!

- **Chapter 4**
 - Review Exercises, p. 238–241: # 1, 2 & 4 & 10, 3 & 5 & 11, 7–9, 15
 - Chapter Test, p. 242–243: # 1–4, 8
- **Chapter 5**
 - Review Exercises, p. 309–311: # 6–11, 13, 14, 16
 - Chapter Test, p. 311–312: # 12, 13
- **Chapter 6**
 - Review Exercises, p. 350–352: # 1, 2, 3, 4, 5, 6, 8
 - Chapter Test, p. 352–353: # 1, 2, 3, 4, 7

Formula Sheet for Exam 2

- | | |
|--|---|
| • $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ | • $\mu = \sum [x \cdot P(x)]$ |
| • $P(A \text{ and } B) = P(A) * P(B)$ | • $\sigma^2 = \sum (x - \mu)^2 \cdot P(x)$ |
| • $P(A \text{ and } B) = P(A) * P(B A)$ | • $\sigma = \sqrt{\sum [x^2 \cdot P(x)] - \mu^2}$ |
| • $P(B A) = \frac{P(A \text{ and } B)}{P(A)}$ | • $E(X) = \sum [x \cdot P(x)]$ |

NOTE ON “AND”

There's two different formulas that we use when computing probabilities of events using the word “and.” the distinction is easy to remember if you differentiate between them using the following:

- when making **one selection using two categories** use:

$$P(A \text{ and } B) = \frac{\#(A \text{ and } B)}{\#S}$$

For example, you use this formula to compute the probability of drawing one card that is a Club and Queen.

- when making **two selections (repeating the same thing)** use:

$$P(A \text{ and } B) = P(A) * P(B|A)$$

For example, let's say you have a bag with 50 candies of three different colors (R, G, B). You use this formula to compute the probability of getting two red candies when you make two selections.

Note that to compute $P(B|A)$ you need to know whether the events A and B are independent or dependent since it effects the probability. In the candy example, it depends whether or not you are making selections with (independent) or without replacement (dependent).