Chapter 1 (Definitions)

Parameter	Statistic
μ population mean	$\bar{x}$ sample mean
σ population standard deviation	s sample standard deviation
σ^2 population variance	s^2 sample variance
P population proportion	$\hat{p}$ sample proportion

Chapter 2 and 3 (Descriptive Statistics)

Find the mean, median, mode, midrange, standard deviation, and variance given raw data. **TI-83/84 Stat, Calc, 1-varstats L1** gives you most of this information (L1 is where you entered your data)

Find the mean (weighted mean), median, mode, standard deviation, and variance in a frequency table. **TI-83/84 Stat, Calc, 1-varstats L1,L2** gives you most of this information (L1 is your class midpoints and L2 is your frequency)

You can get your **variance by squaring the <u>unrounded</u> standard deviation**. After the 1-varstats go to VARS, statistics and scroll down to select Sx and press enter. Select the x^2 button to square the unrounded standard deviation and press enter.

Find relative frequency, cumulative frequency, class boundaries, class midpoints, class width, upper and lower class limits from a frequency table.
Construct a histogram, frequency polygon, pie chart,…
Know how to use the Empirical Rule

Chapter 4 (Probability)

$0 \le P(A) \le 1$
$P(A) + P(\bar{A}) = 1$

Find probability of A **<u>or</u>** B
P(A or B) = P(A) + P(B) if the events are mutually exclusive
P(A or B) = P(A) + P(B) - P(A and B) if the events are not mutually exclusive

Find probability of A **<u>and</u>** B
If A and B are dependent:

$$P(A \quad and \quad B) = P(A) \cdot P(B \mid A)$$

If A and B are independent:

$$P(A \quad and \quad B) = P(A) \cdot P(B)$$

Find probability of B **given** A

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

Find the probability of "at least one"

P(at least one) = 1 – P(none)

Know what's in a deck of cards as I will use it to ask you probability questions.
Review all probability questions asked in homework, quizzes, and exams.

<u>Counting rules</u>:

Permutations
TI 83/84: enter your value for n, MATH, right arrow to PRB, scroll down to nPr, press enter, then enter the value for r, press enter.

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

Combinations:
TI 83/84: enter your value for n, MATH, right arrow to PRB, scroll down to nCr, press enter, then enter the value for r, press enter.

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

Chapter 5 (Probability Distributions)

Find expected values $E = \sum x \cdot p(x)$ know what it means for E = 0, E > 0, and E < 0

Find the mean of a probability distribution $\mu = \sum x \cdot p(x)$

Find the standard deviation of a probability distribution $\sigma = \sqrt{\sum x^2 \cdot p(x) - \mu^2}$

Find the VARIANCE of a probability distribution σ^2

Find the missing value in a probability distribution table. Remember that $\sum p(x) = 1$

TI-83/84: Finding mean and standard deviation of a probability distribution table
Enter x into L1 and P(x) into L2 then go to STAT, CALC and select 1-varstats L1,L2 ($\bar{X}$ is the mean and σ_X is the standard deviation)

(Binomial Probability Distributions)

Find the mean of a BINOMIAL probability distribution $\mu = np$

Find the standard deviation of a BINOMIAL probability distribution $\sigma = \sqrt{npq}$

Find the VARIANCE of a BINOMIAL probability distribution σ^2

<u>Keywords:</u> "exactly", "at least", "at most"
You will be asked to find the probability of exactly, at least or at most. You can use your TI-83/84, the binomial tables or your binomial formula.

Example if you are using the TI -83/84:
Given n = 10, p =.25
a) find probability of exactly 3 use BinomPDF(10, .25, 3)
b) find probability of at least 3 use 1-BinomCDF(10, .25, 2)
c) find the probability of at most 3 use BinomCDF(10, .25, 3)

Note: at least 3 means x = 3,4,5,6,7,8,9,10 at most 3 means x = 0,1,2,3
To get BinomPDF or BinomCDF you need to go to 2nd VARS and scroll down.

Chapter 6 (Normal Distributions)

<u>Area under the curve represents probability</u>

Given the mean and standard deviation you are asked to find the probability.

Use $z = \dfrac{x-\mu}{\sigma}$ then go to table A-2 to find area under the curve

TI-83/84: 2nd VARS select normalCDF(left z, right z) also gives probability

Given the mean, standard deviation, and *sample size "n"* you are asked to find the probability.

use $z = \dfrac{\bar{x}-\mu}{\sigma/\sqrt{n}}$ then go to table A-2 to find area under the curve

TI-83/84: 2nd VARS select normalCDF(left z, right z) also gives probability

When asked to find the value that separates the top __% from the bottom __%

Use $x = \mu + (z \cdot \sigma)$

The bottom % represents the left area that will give you z (use table A-2)

TI-84: 2nd VARS select invnorm(area to left) also gives z value. Take this value and plug it into the formula above.

Chapter 7 (Confidence Intervals – one population)

Remember that confidence intervals have two tails

Wording	Parameter	Formula used	critical value	TI 84 select STAT then TESTS
find a ___% confidence interval for the population mean (σ known)	μ (σ known)	$\bar{x} - E < \mu < \bar{x} + E$ $E = z_{\alpha/2} \cdot \frac{\sigma}{\sqrt{n}}$	Table A-2	Z-interval
find a ___% confidence interval for the population mean (σ not known)	μ (σ unknown)	$\bar{x} - E < \mu < \bar{x} + E$ $E = t_{\alpha/2} \cdot \frac{s}{\sqrt{n}}$	Table A-3	T-interval
find a ___% confidence interval for the population standard deviation	σ	$\sqrt{\frac{(n-1)s^2}{\chi_R^2}} < \sigma < \sqrt{\frac{(n-1)s^2}{\chi_L^2}}$	Table A-4	--------
find a ___% confidence interval for the population proportion	P	$\hat{p} - E < P < \hat{p} + E$ $E = z_{\alpha/2} \cdot \sqrt{\frac{\hat{p}\hat{q}}{n}}$	Table A-2	1-propZint

Common Critical values:

Confidence Intervals	Critical Value
.90	1.645
.95	1.96
.99	2.575
.98	2.33

Sample Size Determination: Find the sample size needed to ……

$n = \frac{(z_{\alpha/2})^2 (0.25)}{E^2}$	Use when σ, $\hat{p}$ and $\hat{q}$ are not given
$n = \frac{(z_{\alpha/2})^2 \hat{p}\hat{q}}{E^2}$	Use when $\hat{p}$ and $\hat{q}$ are given
$n = \left[\frac{z_{\alpha/2} \cdot \sigma}{E} \right]^2$	Use when σ is given

When finding sample size ALWAYS round up.
Example: n = 134.01 would be n = 135

Chapter 8 (Hypothesis testing – one population)

Wording: "test the claim that…."

1) **The hypothesis is broken into 2 parts**

H_0 - null hypothesis
H_1 - alternate hypothesis

If the claim has the word "is" then it goes in the H_0
If the claim has the words "greater than", "less than", "different from" then it goes in the H_1

It is important where you put the claim because you will be coming back to this as you are deciding on how to word your final conclusion.

WORDING	SYMBOL
IS	= (ALWAYS IN THE H_O)
DIFFERENT FROM	$\neq$
GREATER THAN	>
LESS THAN	<

One of three population parameters will be tested. The population parameters are mean (μ), standard deviation (σ), *and* proportion (P)

2) **Calculate the test statistic**

There are 4 test statistics - the population parameter being tested determines which test statistic you will use.

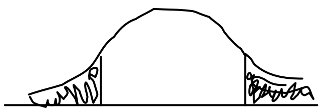
PARAMETER BEING TESTED	TEST STATISTIC USED	TI-84 select STAT, TESTS
μ (σ known)	$z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$	Z-test
μ (σ unknown)	$t = \frac{\bar{x} - \mu}{s / \sqrt{n}}$	T-test
σ	$\chi^2 = \frac{(n-1)s^2}{\sigma^2}$	-------------
P	$z = \frac{\hat{p} - p}{\sqrt{pq/n}}$	1-propZtest

3) **Find your Critical Region**

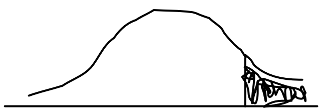
Determine how many tails you are working with. Is it a two tailed, left tailed or right tailed? This depends on your set up in the H_1 (alternate hypothesis)

Example:

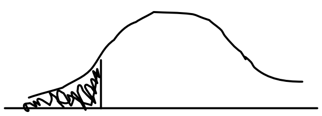
H_0: $\mu = 3$ H_1: $\mu \neq 3$	H_0: $\mu = 3$ H_1: $\mu > 3$	H_0: $\mu = 3$ H_1: $\mu < 3$
$\neq$ means you will be working with TWO TAILS	> means you will be working with A RIGHT TAIL	< means you will be working with A LEFT TAIL



Two tails – divide significance level α by 2



Right tail



Left tail

In all cases, the shaded region is known as the CRITICAL REGION. If your test statistic falls in the critical region then you will REJECT the H_0

Remember that the significance level α represents <u>the area</u> in the shaded region.

After you determine the critical region, find the critical values. Critical values separate the critical region from the non-critical region. Then you will see where your test statistic falls in comparison to the critical values.

Finding critical values: You need to decide which table you will be using. Is it A-2, A-3 or A-4? The table below should help in making that decision.

PARAMETER BEING TESTED	TEST STATISTIC USED	USING α OBTAIN CRITICAL VALUES FROM THE GIVEN TABLE
μ (σ known)	$z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$	A-2 Invnorm of left area also gives you your critical value
μ (σ unknown)	$t = \frac{\bar{x} - \mu}{s / \sqrt{n}}$	A-3
σ	$\chi^2 = \frac{(n-1)s^2}{\sigma^2}$	A-4
P	$z = \frac{\hat{p} - p}{\sqrt{pq/n}}$	A-2 Invnorm of left area also gives you your critical value

You will be using the significance level α and the appropriate table to find your critical values.

4) **Conclusion**
In your book you will find a chart that will help you with your conclusion.
It starts by asking if the original claim contains equality. Does your claim have the "=" symbol? If so it is in the H_0. If it does not have the "=" symbol then it's in the H_1. Continue with the chart to get the CORRECT conclusion.

Remember that you will either reject H_0 or fail to reject H_0
H_0 is rejected when the test statistic falls within the critical region.

USING THE P-VALUE METHOD:

1) Set up the hypothesis
   H_0 - null hypothesis
   H_1 - alternate hypothesis

2) Test statistic
3) Find the p-value
4) Conclusion

   H_0 is rejected when the p-value $\leq \alpha$. That means that the p-value has to be less than or equal to the significance level.

5) Wording of final conclusion: Write your conclusion in non technical terms - use the chart in your book

Use your calculator to find the p-value. Follow the chart below.

PARAMETER BEING TESTED	CALCULATOR COMMAND to find p-value
μ (σ known)	Stat, tests, z-test
μ (σ unknown)	Stat, tests, t-test **
σ	*See note below
P	Stat, tests, 1propz-test

* Other ways to find p-values when you know the test statistic (χ^2 and t)

RIGHT TAILED TEST: . 2nd, VARS, $\chi^2 cdf$ ( ), x2cdf(x2,E99,n-1) note: to get E press 2nd, EE
LEFT TAILED TEST: . 2nd, VARS, $\chi^2 cdf$ ( ), x2cdf(0,x2,n-1)
TWO TAILED TEST: take the smallest of the two above and multiply by 2

RIGHT TAILED TEST: 2nd, vars, tcdf(t,E99,n-1)
LEFT TAILED TEST: 2nd, vars, tcdf(-E99,t,n-1)
TWO TAILED TEST: 2nd, vars, the answer for the right tailed test and multiply it by two

Chapter 9 (Hypothesis testing – two populations)

"test the claim that…."

	PARAMETER BEING TESTED	TEST STATISTIC USED	TI-84 select STAT, TESTS
Two Proportions	P_1 , P_2	$z = \dfrac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\dfrac{\overline{p}\overline{q}}{n_1} + \dfrac{\overline{p}\overline{q}}{n_2}}}$	2-propZtest
Two Means – independent (two different groups)	μ_1 , μ_2	$t = \dfrac{(\overline{x}_1 - \overline{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\dfrac{s_1^{\ 2}}{n_1} + \dfrac{s_2^{\ 2}}{n_2}}}$ where df = smaller of n_1-1 or n_2-1 σ_1 and σ_2 unknown and not assumed equal	2-sampTtest
Two Means – matched pairs (same group **before** and **after**)	μ_d where d = x-y X = before Y = after	$t = \dfrac{\overline{d} - \mu_d}{s_d / \sqrt{n}}$ where df $= n - 1$	T-test (on the differences "d")

Chapter 9 (Confidence Intervals – two populations)

"Construct a ___% confidence interval for the…"

	Confidence interval for	Formula USED	TI-84 select STAT, TESTS
Two Proportions	$P_1 - P_2$	$(\hat{p}_1 - \hat{p}_2) - E < p_1 - p_2 < (\hat{p}_1 - \hat{p}_2) + E$ where $E = z_{\alpha/2}\sqrt{\dfrac{\hat{p}_1\hat{q}_1}{n_1} + \dfrac{\hat{p}_2\hat{q}_2}{n_2}}$	2-propZint
Two Means – independent (two different groups)	$\mu_1 - \mu_2$	$(\overline{x}_1 - \overline{x}_2) - E < (\mu_1 - \mu_2) < (\overline{x}_1 - \overline{x}_2) + E$ where $\mathrm{E} = t_{\alpha/2}\sqrt{\dfrac{s_1^{\ 2}}{n_1} + \dfrac{s_2^{\ 2}}{n_2}}$ df = smaller of n_1-1 or n_2-1 σ_1 and σ_2 unknown and not assumed equal	2-sampTint
Two Means – matched pairs (same group **before** and **after**)	μ_d where d = x-y X = before Y = after	$\overline{d} - E < \mu_d < \overline{d} + E$ where $E = t_{\alpha/2} \cdot \left(s_d / \sqrt{n} \right)$ df $= n - 1$	T-interval (on the differences "d")

If zero is included in your confidence interval then this indicates that there is no difference between the two groups. For Example: -0.25 < $\mu_1 - \mu_2$ < 0.54 You can see that zero is included in the interval this means that $\mu_1 - \mu_2$ = 0 which indicates that $\mu_1 = \mu_2$

Chapter 10 (linear regression)

Find the linear correlation coefficient (r)
Determine if a significant linear correlation exists
Find the best predicted $\hat{y}$ when x is given

- If there is a significant linear correlation then use the regression equation to make predictions.
- If there is NO significant linear correlation then use $\bar{y}$ to make predictions

TI83/84 Instructions:

1. Hit **Stat, Edit.**
2. Enter your data into any two lists, preferably L1 and L2 since they are the default.
3. To create a scatter plot, we need to get into **Stat-Plot**, which is above the **Y=** key, the upper left hand button.
4. Once in **Stat-Plot**, we select the first plot, highlight **On** and hit enter if it is not already turned on, select the first type of plot from the six available, make sure L1 and L2 are the x and y lists unless your data is in another set of lists, and then select the mark we want used.
5. Now, we hit **Zoom**, which is in the middle of the top buttons, and select the **9th option-Zoom Stat**. This will bring up our scatter plot, it **ZOOM**s in on the **STAT**istical data.
6. If it says **Dim Mismatch** or some such error, look at your lists, there may be one more entry in one list than the other, so the **DIM**ensions aren't the same. Or, look in the **Y=** area. If there are any equations in any of the "y=" spots, delete them.
7. Now, to find the line of best fit and correlation coefficient information, we hit **Stat, Calc, 8:LinReg (a+bx).** This will bring up what a=, b=, r squared, and r. (*If r doesn't show up, then hit **2nd, Catalog (above 0), D, DiagnosticsOn, enter, enter.***)
8. Once you have the line of best fit, you can enter it into **Y=** and hit graph to see it fitted onto your data. If it doesn't seem to fit the data, a mistake has occurred somewhere, go find it.

Chapter 11

Testing for independence… STAT, Tests, χ^2 - Test

H_0: one variable INDEPENDENT of second variable
H_1: one variable DEPENDENT of second variable

Test Statistic: $\chi^2 = \sum \frac{(O-E)^2}{E}$ or use TI 83/84

TI 83/84 instructions:

1) 2^{nd} , x^{-1} (on some calculators press MATRIX)
2) Right arrow to EDIT press enter
3) Enter your observed values in matrix and press 2^{nd} QUIT when done
4) Press STAT and right arrow to TEST
5) Select χ^2 - Test then press enter
6) You will see that your expected values are stored in matrix B and your observed values are stored in matrix A. Select calculate at the bottom of your screen and press enter.
7) You should now see your **tests statistic and p-value**.
8) If you want to see your expected value, go to matrix B. 2^{nd} , x^{-1} (on some calculators press MATRIX) select B and press enter twice.

Critical Value: Always right tail. Obtain from table A-4

Goodness-of-Fit Tests….. (with one row of data)

H_0: all probabilities equal (or equal to some claimed amount)
H_1: at least one is different from the others

Test Statistic: $\chi^2 = \sum \frac{(O-E)^2}{E}$

If you wish to use your TI83/84:

1) Enter the observed values (O) into L1
2) Calculate E: Use E = n/k (if all frequencies are equal) and use E = n*p if all frequencies are not equal. Enter E into L2.
3) Now go to STAT, Tests, " χ^2 - GOF Test" where L1 = Observed and L2 = Expected. If your calculator doesn't have this command then you can do the following: $sum((L_1 - E)^2 / E)$ and press enter to get the test statistic. "sum" is under 2^{nd} STAT, right arrow to "math" it's the 5^{th} option. Now press to select it.

Critical Value: Always right tail. Obtain from table A-4

Testing that 3 or more means are equal: STAT, Tests, ANOVA

H_0: $\mu_1 = \mu_2 = \mu_3 = \ldots$
H_1: at least one is different from the others

Enter your data into L1, L2, L3,…. So that it looks like this Anova(L1,L2,L3) press enter.
Now you have your test statistics and p-value