Statistical Methods in Psychology

Psychology 302 — Winter, 1991

Text: Gravetter & Wallnau, *Statistics for the Behavioral Sciences* (2nd Ed).

Tentative Schedule:

Week	Readings (Chap.)	Exams
Jan 7-9-11	1, 2	
Jan 14-16-18	3, 4	
Jan 21-23-25	5, 6	
Jan 28-30-Feb 1	7, 8 (skip 8.4)	
Feb 4-6-8	9, 10	Exam #1 Fri, Feb 8 (Ch. 1-8)
Feb 14-16-18	12 (skip 12.4), 11 (skip 11.4)	
Feb 21-23-25	13, 15	
Feb 28-30-Mar 1	16	Exam #2 Fri, Mar 1 (Ch 1-15)
Mar 4-6-8	17	
Mar **13**	Final Exam Wed, 10:15 (Ch 1-13 & 15-17)	

Exams: Exams #1 and #2 will be 50-min. closed-book exams. The final will be a 2-hour open-book exam. Calculators may be used on exams, but you cannot have a fancy statistical calculator do all the work for you. That is, to receive credit for a non-trivial problem, you must show each step of your calculations on the exam. Exams are cumulative, but emphasize recent material.

Homework: There will be weekly homework assignments. These will be recorded for completeness, but will not be graded. You are responsible for grading your own homework and identifying your own errors during lab sessions. To receive credit for a homework assignment, you must hand it in during the lab. Past experience demonstrates that homework is an important learning experience. The number of homework assignments completed is highly correlated with performance on exams.

Laboratories: During lab sessions, the TA will answer questions concerning the text and lectures, discuss homework problems, collect homework, give practice quizzes, and help you review for exams.

Grading: Course grades will be based approximately 25% on each midterm exam and 50% on the final. However, homework will be taken into account in borderline cases. (For example a student with a high C+ average on exams who completed and turned in all homework would receive a B-.) University regulations regarding incompletes will be strictly followed.

		Office	Phone	Hours
Lecturer:	Douglas Hintzman	307 Straub	x64906	Tuesday 9:30-11 Wednesday 2-3:30
TA:	Robin-Ann Cogburn	474 Straub	x64964	Tuesday 12:30-2 Thursday 10-11

Psychology 302 Homework Assignments Hintzman

Chapter 1 (p. 22-) #10-13, 15, 16-18, 20, 22-23, 26-29.

Chapter 2 (p. 52-) #4-7, 9, 12-14, 19-20, 23, 26-27.

Chapter 3 (p. 76-) #3, 6-8, 10-12, 15, 17, 19, 21, 26-27, 30.

Chapter 4 (p. 102-) #2, 4-6, 12, 14-15, 17-19, 23, 26-27, 30.

Chapter 5 (p. 122-) #1-2, 6, 12-13, 16-17, 19, 21, 23-24.

Chapter 6 (p. 148-) #2-6, 8, 10, 13, 16-18, 24-25,27.

Chapter 7 (p. 166-) #5, 7, 9, 11, 13, 16, 19, 21,25-27.

Chapter 8 (p. 191-) #2, 4, 6, 15, 21, 26.

Also, read the supplement on the *normal approximation to the binomial* (last page), and work the following problems:

1. A random sample of 10,000 Alaskans consists of 5,080 males and 4,920 females. Based on this sample, test the hypothesis that exactly half of all Alaskans are males. Use $\alpha = .05$.

2. According to national figures, the proportion of college students that are left-handed is .20. Violet conducts a survey of 2,000 Architecture majors, and finds that 430 are left-handed. Can she conclude that Architecture majors are more likely to be left-handed than other students are? Use $\alpha = .01$.

3. Ace Airlines claims that 70% of its planes are "on time." A disbelieving traveler obtains data from a randomly selected 200 Ace flights. Only 60% of the sample are on time. Based on these data, can the traveler conclude that Ace's claim is false? Use $\alpha = .05$.

Chapter 9 (p. 216-) #1-3, 6, 11-12,17, 26.

Also, reread the supplement on the *normal approximation to the binomial,* and work the following:

1. Roger has obtained a wooden nickel. He flips it 800 times, and it comes up Heads 450 times. Find the 95% confidence interval for the probability of heads for this coin.

2. In a pre-election poll, 100 potential voters, selected at random, are asked whether they favor a ballot measure designed to triple University tuition. Forty say they support the measure and sixty say they oppose it. Find the 90% confidence interval for the proportion of all potential voters who are in favor of the measure.

Chapter 10 (p. 236-) #2,6,9,11, 16, 21.

Also, work these problems:

1. Happy Hound Hot Dogs are advertised as containing an average of 10 grams of fat. Fat content is measure in a random sample of 25 of the weiners. The sample has a mean fat content of 15 grams and and standard deviation of 5 grams. Based on this sample, can the advertising claim be rejected? Use $\alpha = .05$.

2. The U.S. Census says that the average American woman has been married 1.4 times. A random sample of Eugene women yields the following frequency distribution:

Number of Marriages	frequency
5	1
4	0
3	8
2	53
1	198
0	32

Use these data to decide whether Eugene women differ from the U.S. Census figure in terms of how often they have been married. Use $\alpha = .01$.

Chapter 12 (p. 284-) #1, 5, 13, 14, 22, 24.

Chapter 11 (p. 262-) # 3, 5-7, 9, 10, 12, 19.

Also, note that $S^2 = SS/df$, so $SS = (df)\,(S^2)$. By making this substitution into the formula for the pooled variance estimate (e.g., bottom of p. 246), you can work the following problems:

1. A major disagreement has broken out concerning which of two brands of waffle has the most syrup-absorbing power. A random sample of 10 Wendy Wonka Waffles absorbs a mean of 17 grams of syrup, with a standard deviation of 4. Comparable figures for random sample of 10 Krusty King Waffles are: mean = 15, standard deviation = 3. Is there a significant difference between the two brands? Use $\alpha = .05$.

2. The mean age for random sample of 15 graduating seniors at Pinkleburgh State College is 25.4 years, and the standard deviation is 4.3. A similar sample of 23 graduating seniors from Our Lady of the Mudflats College, has a mean age of 28.1 and a standard deviation of 8.6. Test the hypothesis that the two colleges do not differ in the age at which students graduate. Use $\alpha = .01$.

Chapter 13 (p. 320-) #1-3, 5-7, 11-12, 15.

Chapter 15 (p. 376-) #1, 3-4, 6, 11, 14.

Chapter 16 (p. 410-) #1-2, 6, 10, 14, 18.

Also, use the information in the following box to work the 3 problems listed below.

> The book gives the following formula for the regression line for predicting Y from X:
>
> $\hat{Y} = bX + a,$ where $b = SP/SS_X$ and $a = \overline{Y} - b\overline{X}$.
>
> This expression for b requires that one knows SP and SS or has the raw data from which they can be computed. It is often more useful to compute predicted values directly from summary statistics (means, standard deviations, and correlations). An alternative formula for the slope of the regression line is
>
> $b = \frac{S_Y}{S_X} r$ (The same formula can be used with population values, by substituting σ and ρ for s and r.)

1. In the nation of Libania married couples have an average of 5 children, with a standard deviation of 2. Their annual income averages 450,000 phooeys, with a standard deviation of 100,000. (The phooey is worth approximately .0002 U.S. dollars.) The correlation between number of children and income is -.40.

   a. If Miney and Mo have 8 children, what is the best estimate of their annual income, in phooeys?

   b. If Al and Alina earn 800 phooeys a year, what is the best estimate of their number of children?

2. Cars sold in the U.S. have an average of 160 horsepower, with a standard deviation of 50. Gas mileage averages 28 mpg, with a standard deviation of 6. The correlation between horsepower and mpg is -.45.

   a. The new Glitzkrieg Luxobarge is rated at 550 hp. What is the best estimate of the car's gas mileage?

   b. Bob insists on buying a car that gets 50 mpg. How much horsepower can he expect to have?

3. The 100 subjects in the Adult Identical Twin study have an average I.Q. of 110, with a standard deviation of 17. The correlation between twins' I.Q.'s in the sample is .80. If Ella has an I.Q. of 140, what is the best estimate of her twin, Edna's I.Q.? (Why shouldn't the best estimate be 140?)

Chapter 17 (p. 436-) #2, 4, 6, 8, 11, 15, 22.

<u>Normal Approximation to the Binomial</u>

For each member of a sample, if the member falls in category A, let X=1, and if not, let X=0. The sum, $\sum X$, over the n sample members gives f_A (the frequency of A). And

$$\bar{X} = \frac{\sum X}{n} = \frac{f_A}{n} = P(A).$$

Thus, a probability is a special case of a mean.

Suppose we want to test a hypotheses about $\pi(A)$, the probability of A in the population the sample came from. P(A) is an estimate of $\pi(A)$, which can be considered a special case of μ. If N is large (and π is not close to 0 or 1), the normal curve can be used.

Testing a hypothesis about μ:	Testing a hypothesis about π:
$z = \dfrac{\bar{X} - \mu}{\sigma_{\bar{X}}}$	$z = \dfrac{P(A) - \pi(A)}{\sigma_P}$

σ_P is called the <u>standard error of the proportion.</u> It is a special case of $\sigma_{\bar{X}}$.

If the null hypothesis gives us a value for π, it also gives us a value for σ_P. This can be demonstrated as follows:

$SS = \sum X^2 - (\sum X)^2/N$. Note that $0^2 = 0$ and $1^2 = 1$, so whenever X takes on only the values 0 and 1, X and X^2 are the same. Thus in this case, $\sum X^2 = \sum X$, and

$SS = \sum X - (\sum X)^2/N$. To get the variance, divide SS by N:

$$\frac{SS}{N} = \frac{\sum X - (\sum X)^2/N}{N} = \frac{\sum X}{N} - \frac{(\sum X)^2}{N^2} = \mu - \mu^2 = \mu(1-\mu),$$ or in this case, $\pi(1-\pi)$.

Thus, $\sigma = \sqrt{\pi(1-\pi)}$, and the standard error of the proportion (mean) is

$$\boxed{\sigma_P = \sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}} = \frac{\sqrt{\pi(1-\pi)}}{\sqrt{n}} = \sqrt{\pi(1-\pi)/n}}$$

Suppose our goal is to obtain an interval estimate of π, based on the value of P we computed from our sample. We can substitute P for π in the above equation. Thus,

$$\sigma_P = \sqrt{P(1-P)/n}$$ and

Confidence interval for μ:	Confidence interval for π:
$\mu = X \pm z_\alpha \sigma_{\bar{X}}$	$\pi = P \pm z_\alpha \sigma_P$