Example: For the first sample from the samples with $n = 5$, we had $s^2 = 166.41$.

Test whether or not $\sigma^2 = 200$.

1. *The hypothesis:* H_0: $\sigma^2 = 200$, vs H_1: $\sigma^2 \neq 200$
2. *The assumptions:* Independent observations

   normal distribution
3. *The α-level:* $\alpha = 0.05$

4. *The test statistic:*

$$\chi^2 = \frac{(n-1)s^2}{\sigma^2}$$

5. *The critical region:* Reject H_0: $\sigma^2 = 200$ if the value calculated for χ^2 is not between
$\chi^2_{0.025}(4) = 0.484$, and
$\chi^2_{0.975}(4) = 11.143$

6. *The Result:*

$$\chi^2 = \frac{(n-1)s^2}{\sigma^2} = \frac{4(166.41)}{200} = 3.33$$

7. *The conclusion:* Accept H_0: $\sigma^2 = 200$.

Prediction of Depressive Distress in a Community Sample of Women: The Role of Sexual Orientation

LESBIANS AND DEPRESSION

METHODS

Study Design and Data Collection

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TABLE 3—Study Predictor Variables, by Sexual Orientation

	Lesbians (n = 133)	Heterosexuals (n = 219)
Dependent variable, No. (%)		
Ever received therapy	429 (156)**	557 (82)
Ever received for depression	393 (58)	500 (6.2)
Suicidal ideation	390 (51)**	494 (36)
Suicide attempts	91 (23)*	33 (8.3)
Predictor variable		
Childhood sexual abuse, No. (%)	535 (302)**	41 (18)
Physical abuse, No. (%)	340 (85)	514 (85)
Exposure to violence (mean/standard, No. (%)	613 (85)	599 (83)
Vulnerability to response to stress (mean/mean or others), No. (%)	907 (59%)	907 (57%)
Global stress index, mean (SD)	50 (5.8)	57 (7.0)
Positive coping strategies, mean (SD)	3.5 (1.5)	5.5 (1.0)

Note. Bisexuals, on which participants were based only because of missing data on some variables, known as the CD range from 0 to 10, with higher scores indicating more positive response and severity of the stressors. Positive coping strategies scores range from 0 to 11, with higher scores representing more frequent use of a variety of positive coping strategies in response to stress.
*$P < .05$; **$P < .001$.

had "received therapy or counseling for an emotional or mental health problem" at some point in their life (Table 3). This rate was significantly higher than among heterosexual women (56%; $\chi^2_{1,1} = 6.9$, $P < .05$). However, rates of received therapy or counseling did not differ for lesbians (39%) and heterosexual women (50%; $\chi^2_{1,1} = 2.96$, not significant).

Treatment for depression. Similar percentages of lesbians (56%) and heterosexual women (50%) reported that they had sought therapy or counseling for depression. The majority of lesbians and 39% of heterosexual women reported that they had been prescribed medication for a mental or emotional problem. Among those who had received medication, 69% of lesbians and 75% of heterosexual women reported taking an antidepressant medication at some point. The majority of women who reported seeking help for sadness or depression (90%) also reported receiving antidepressants. More than half of the total sample of lesbians (59%) and heterosexual women (52%) reported at least one of these 3 indicators of past treatment for depression.

Suicidal ideation and suicide attempts. Significant differences were found between lesbians and heterosexual women in regard to reports of whether they had seriously considered committing suicide and whether they had actually attempted suicide at some point. Fifty-one percent of lesbians and 36% of heterosexual women reported seriously considering suicide at some point in their past ($P < .001$). Most suicide attempts among women do not clearly correspond between the ages of 15 and 24 years. More than twice as many lesbians as heterosexual women in this age group reported suicide attempts (8% vs 3%).

Predictors of Depressive Distress

Physical and sexual abuse. Although lesbians and heterosexual women were equally likely to report that they had been victims of nonsexual physical violence (85% and 83%, respectively), significantly more lesbians (31%) than heterosexual women (14%) reported experiencing childhood sexual abuse ($P < .001$). Because our analyses included only women who had experienced forced sex before the age of 18 years (rates were 46% and 41%, respectively, of all lesbians and heterosexual women who reported any nonconsensual sex), these rates probably underestimate the severity of lesbians and heterosexual women who actually experienced childhood sexual abuse.

Global stress. Overall stress scores on the global stress index were in the lower range and did not differ according to sexual orientation. Mean stress index scores were 57 (SD = 7.0) for heterosexual women and 50 (SD = 6.0) for lesbians ($t_{1,1} = 0.57$). Note.

Perceived stress. No differences were found between the lesbians and heterosexual women in terms of level of perceived stress. The majority of lesbians (85%) and heterosexual women (83%) reported moderate to extreme levels of perceived stress ($\chi^2_{1,1} = 1.1$, NS). The only statistically significant difference in sources of stress for lesbians and heterosexual women involved childhood ($\chi^2_{1,1} = 5.0$, $P < .001$) and sexual adversity ($\chi^2_{1,1} = 22$, $P < .001$); more heterosexual women rated childhood as moderately or extremely stressful, and more lesbians rated sexual adversity as moderately or extremely stressful.

Perceived support. Differences were observed between lesbians and heterosexual women in terms of perceived lack of support. More heterosexual women (17%) than lesbians (3%) reported an absence of social support ($\chi^2_{1,1} = 5.8$, $P < .05$).

Coping strategies and responses to stress. Overall, use of positive coping strategies was low among both lesbians and heterosexual women (range of 3.4 on the 12-point stress scale, SD = 1.5). Whereas similar (and moderate) level percentages of lesbians (21%) and heterosexual women (31%) reported talking to someone (not feelings sharing issues of stress, lesbians were more likely to report never using talking as a coping strategy (46% vs 19%; $\chi^2_{1,1} = 11.6$, $P < .001$).

Moreover, fewer lesbians (19%) than heterosexual women (37%) reported doing something that helped they were stressed ($\chi^2_{1,1} = 7.4$, $P < .05$) or using exercise as a coping strategy (36% vs 63%). Only 7% of lesbians and 9% of heterosexuals reported overeating/drinking alcoholic. A higher percentage of heterosexual women (23%) than lesbians (5%) reported increasing overtly emotional or expressive to stress, but this difference was not statistically significant ($\chi^2_{1,1} = 4.0$, $P < .05$).

Multivariate Predictive Models of Depressive Distress

Only variables significantly related to at least 1 of the indicators of depressive distress in the bivariate analyses were included in the multivariate analyses. Demographic characteristics examined included orientation level (1—

TABLE 3—Study Predictor Variables, by Sexual Orientation

	Lesbians (n = 550)	Heterosexuals (n = 279)
Dependent variable, No. (%)		
Ever received therapy	429 (78)**	157 (56)
Ever treated for depression	264 (48)	109 (42)
Suicidal ideation	280 (51)**	101 (38)
Suicide attempts	91 (22)*	22 (13)
Predictor variable		
Childhood sexual abuse, No. (%)	165 (30)**	45 (16)
Physical abuse, No. (%)	246 (45)	114 (41)
Blackouts or extreme stress brawl, No. (%)	461 (55)	229 (83)
Emotionality in response to stress (sometimes or often), No. (%)	367 (69%)	207 (75%)
Global stress index, mean (SD)	36 (6.8)	37 (7.0)
Positive coping strategies, mean (SD)	3.3 (1.8)	3.6 (1.9)

Note. Numbers on which percentages were based vary because of missing data on some variables. Scores on the GSI range from 0–54, with higher scores reflecting both greater number and severity of life stressors. Positive coping strategies scores range from 0–12, with higher scores representing more frequent use of a variety of possible coping strategies in response to stress.

*P ≤ .01; **P ≤ .001

The Question

Table 3 indicates that the mean Global Stress Index for Lesbians is 16 with SD = 6.8. Suppose that previous work in this area had indicated that the SD for the population was about $\sigma = 10$. Hence, we would be interested in testing whether or not $\sigma^2 = 100$.

1. *The hypothesis:* $H_0: \sigma^2 = 100$, vs $H_1: \sigma^2 \neq 100$

2. *The assumptions:* Independence, normal distribution

3. *The α-level:* $\alpha = 0.05$

4. *The test statistic:*
$$\chi^2 = \frac{(n-1)s^2}{\sigma^2}$$

5. *The critical region:* Reject $H_0: \sigma^2 = 100$ if the value calculated for χ^2 is not between
$\chi^2_{0.025}(449) = 392.2$, and
$\chi^2_{0.975}(449) = 509.5$

6. *The Result:*
$$\chi^2 = \frac{(n-1)s^2}{\sigma^2} = \frac{449(46.24)}{100} = 207.62$$

7. *The conclusion:* Reject $H_0: \sigma^2 = 100$.

Module 25: Confidence Intervals and Hypothesis Tests for Variances for One Sample

This module discusses confidence intervals and hypothesis tests for variances for the one sample situation.

The Situation

Earlier we selected from the population of weights numerous samples of sizes n = 5, 10, and 20 where we assumed we knew that the population parameters were:

$$\mu = 150 \text{ lbs},$$
$$\sigma^2 = 100 \text{ lbs}^2,$$
$$\sigma = 10 \text{ lbs}.$$

For the population mean μ, point estimates, confidence intervals and hypothesis tests were based on the sample mean $\bar{x}$ and the normal or t distributions.

For the population variance σ^2, point estimates, confidence intervals and hypothesis tests are based on the sample variance s^2 and the chi-squared distribution for

$$\frac{(n-1)s^2}{\sigma^2} = \frac{SS(x)}{\sigma^2} = \chi^2$$

For a 95% confidence interval, or $\alpha = 0.05$, we use

$$C\left[\frac{(n-1)s^2}{\chi^2_{1-\alpha/2}} < \sigma^2 < \frac{(n-1)s^2}{\chi^2_{\alpha/2}}\right] = 0.95$$

For hypothesis tests we calculate

$$\chi^2 = \frac{(n-1)s^2}{\sigma^2}$$

and compare the results to the χ^2 tables.

Population of Weights Example

$n = 5,\ \bar{x} = 153.0,\ s = 12.9,\ s^2 = 166.41$

$s^2 = 166.41$ is sample estimate of $\sigma^2 = 100$

$s = 12.9$ is sample estimate of $\sigma = 10$

For a 95% confidence interval, we use

$$C\left[\frac{(n-1)s^2}{\chi^2_{0.975}} < \sigma^2 < \frac{(n-1)s^2}{\chi^2_{0.025}}\right] = 0.95$$

$\chi^2_{0.975(4)} = 11.143$

$\chi^2_{0.025(4)} = 0.484$

$df = n - 1 = 4$

$$C\left[\frac{(n-1)s^2}{\chi^2_{0.975}} < \sigma^2 < \frac{(n-1)s^2}{\chi^2_{0.025}}\right] = 0.95$$

$$C\left[\frac{(5-1)(166.41)}{11.143} < \sigma^2 < \frac{(5-1)(166.41)}{0.484}\right] = 0.95$$

$$C\left[\frac{665.64}{11.143} < \sigma^2 < \frac{665.64}{0.484}\right] = 0.95$$

$$C\left[59.74 < \sigma^2 < 1,375.29\right] = 0.95$$

$$Length = 1,315.55 lbs^2$$

Other Samples

From the Population of weights, for n = 5, we had

$\bar{x}_2 = 146.4$	$s_2 = 5.4$	$s_2^2 = \mathbf{29.16}$
$\bar{x}_3 = 153.2$	$s_3 = 18.6$	$s_3^2 = \mathbf{345.96}$
$\bar{x}_4 = 149.0$	$s_4 = 8.1$	$s_4^2 = \mathbf{65.61}$
$\bar{x}_5 = 153.6$	$s_5 = 7.7$	$s_5^2 = \mathbf{59.29}$

95% CI for σ^2, n = 5, df = 4

$$s_2^2 \quad C\left[\frac{4(29.16)}{11.143} < \sigma^2 < \frac{4(29.16)}{0.484}\right] = C\left[10.47 < \sigma^2 < 240.99\right] = 0.95$$

$$\text{Length} = 230.52\ lbs^2$$

$$s_3^2 \quad C\left[\frac{4(345.96)}{11.143} < \sigma^2 < \frac{4(345.96)}{0.484}\right] = C\left[124.19 < \sigma^2 < 2,859.17\right] = 0.95$$

$$\text{Length} = 2,734.98\ lbs^2$$

s_4^2 $$C\left[\frac{4(65.61)}{11.143} < \sigma^2 < \frac{4(65.61)}{0.484}\right] = C\left[23.55 < \sigma^2 < 542.23\right] = 0.95$$

$$\text{Length} = 518.68 \; lbs^2$$

s_5^2 $$C\left[\frac{4(59.29)}{11.143} < \sigma^2 < \frac{4(59.29)}{0.484}\right] = C\left[21.28 < \sigma^2 < 490.00\right] = 0.95$$

$$\text{Length} = 468.72 \; lbs^2$$

For n = 20, we had

$\bar{x}_1 = 151.6$	$s_1 = 10.2$	$s_1^2 = 104.04$
$\bar{x}_2 = 151.3$	$s_2 = 8.4$	$s_2^2 = 70.55$
$\bar{x}_3 = 150.4$	$s_3 = 11.4$	$s_3^2 = 129.96$
$\bar{x}_4 = 151.4$	$s_4 = 11.5$	$s_4^2 = 132.25$
$\bar{x}_5 = 150.1$	$s_5 = 8.4$	$s_5^2 = 70.56$

95% CIs for σ^2, n = 20, df = 19

$$C\left[\frac{(n-1)s^2}{\chi^2_{0.975}=32.852} < \sigma^2 < \frac{(n-1)s^2}{\chi^2_{0.025}=8.907}\right] = 0.95$$

s_1^2 $$C\left[\frac{19(104.04)}{32.852} < \sigma^2 < \frac{19(104.04)}{8.907}\right] = C\left[60.17 < \sigma^2 < 221.93\right] = 0.95$$

Length = 161.76 lbs^2

s_2^2 $$C\left[\frac{19(70.55)}{32.852} < \sigma^2 < \frac{19(70.55)}{8.907}\right] = C\left[40.80 < \sigma^2 < 149.44\right] = 0.95$$

s_3^2 $$C\left[\frac{19(129.96)}{32.852} < \sigma^2 < \frac{19(129.96)}{8.907}\right] = C\left[75.16 < \sigma^2 < 277.22\right] = 0.95$$