**Questions** 15 to 19 refer to the following information.

Four single-sex and two co-educational schools in Melbourne, Australia, were asked to participate in a recent study designed to examine adolescents' attitudes towards confidentiality in the school counselling situation. All six schools were private schools. Three of the single-sex schools agreed to take part; one of the single-sex schools and both of the co-educational schools declined to take part in the study.

The students were advised that participation was voluntary and anonymous, and that they were free to withdraw from the study at any time.

Questionnaires were completed in school. Some results from the study are given in Table 1 below. It shows the percentage of students (aged 14–18 years) agreeing, disagreeing, or unsure as to whether the school counsellor should tell parents in situations of contraceptive use, and/or pregnancy.

There were 174 female respondents and 221 male respondents.

| Situation | Response: Agree % | Disagree % | Unsure % | Sample size |
|---|---|---|---|---|
| **Contraception** | | | | |
| females | 13 | 79 $\hat{p}_c = .79$ | 8 $\hat{p}_f = .08$ | 174 |
| males | 33 | 52 | 15 $\hat{p}_m = .15$ | 221 |
| **Pregnancy** | | | | |
| females | 15 | 74 $\hat{p}_p = .74$ | 11 | 174 |
| males | 41 $\hat{p}_a = .41$ | 43 $\hat{p}_a = .43$ | 16 | 221 |

Table 1: Adolescents' Attitudes Towards Confidentiality

Let $p_{contra}$ be the proportion of Australian female students (aged 14–18 years) who disagree that a counsellor should tell parents in situations of contraceptive use

and $p_{preg}$ be the proportion of Australian female students (aged 14–18 years) who disagree that a counsellor should tell parents in situations of pregnancy

15. Information from Table 1 is used to construct a 95% confidence interval for the difference $p_{contra} - p_{preg}$. The formula for the standard error of the estimate, $se(\hat{p}_{contra} - \hat{p}_{preg})$, would be calculated using the sampling situation described as:

a, b or c

sit(c)

n=174

~~(1)~~ ~~two~~ independent samples of sizes 221 and 174.

~~(2)~~ one sample of size 221, several response categories.

(3) one sample of size 174, many yes/no items.

(4) one sample of size 221, many yes/no items.

~~(5)~~ one sample of size 174, several response categories.

Let $p_{female}$ be the proportion of all Australian female secondary school students (aged 14–18 years) who are unsure whether a counsellor should tell parents in situations of contraceptive use

and $p_{male}$ be the proportion of all Australian male secondary school students (aged 14–18 years) who unsure whether a counsellor should tell parents in situations of contraceptive use

The results from the study are used to conduct a 2-tailed test for no difference between $p_{female}$ and $p_{male}$.

a, b or c

16. For the purpose of calculating $se(\hat{p}_{female} - \hat{p}_{male})$, the sampling situation can be described as:

sit(a)

(1) one sample of size 174, several response categories.

(2) one sample of size 174, many yes/no items.

(3) two independent samples of sizes 221 and 174.

(4) one sample of size 221, several response categories.

(5) one sample of size 221, many yes/no items.

$n_f = 174$

$n_m = 221$

Let $p_{agree}$ be the proportion of all Australian male secondary school students (aged 14–18 years) who agree that a counsellor should tell parents in situations of pregnancy

and $p_{disagree}$ be the proportion of all Australian male secondary school students (aged 14–18 years) who disagree that a counsellor should tell parents in situations of pregnancy

The results from the study are used to conduct a 2-tailed test for no difference between $p_{agree}$ and $p_{disagree}$.

$H_0: p_a - p_d = 0$

$H_1: p_a - p_d \neq 0$

17. An estimate of the difference between $p_{agree}$ and $p_{disagree}$ is:

(1) −1.9

(2) −0.02

(3) −0.2

(4) −0.59

(5) −0.19

$\hat{p}_a - \hat{p}_d = .41 - .43 = -.02$

a, b or c

18. For the purpose of calculating $se(\hat{p}_{agree} - \hat{p}_{disagree})$, the sampling situation can be described as:

sit(b)

$n = 221$

~~(1)~~ one sample of size ~~395~~, several response categories.

~~(2)~~ one sample of size ~~395~~, many yes/no items.

~~(3)~~ two independent samples of sizes 221 and ~~174~~.

(4) one sample of size 221, several response categories.

(5) one sample of size 221, many yes/no items.

19. The expression for evaluating the $t$-test statistic for the null hypothesis, $H_0$: $p_{agree} - p_{disagree} = 0$, is:

(1) $\dfrac{\hat{p}_{agree} - \hat{p}_{disagree}}{se(\hat{p}_{agree} - \hat{p}_{disagree})}$

$t_0 = \dfrac{\text{est} - \text{hyp val}}{\text{std err}} = \dfrac{\hat{p}_a - \hat{p}_d - 0}{se(\hat{p}_a - \hat{p}_d)}$

(2) $\dfrac{\hat{p}_{agree} - \hat{p}_{disagree}}{\sqrt{se(\hat{p}_{agree})^2 - se(\hat{p}_{disagree})^2}}$

(3) $\dfrac{p_{agree} - p_{disagree}}{se(\hat{p}_{agree}) + se(\hat{p}_{disagree})}$

(4) $\dfrac{p_{agree} - p_{disagree}}{se(\hat{p}_{agree} - \hat{p}_{disagree})}$

(5) $\dfrac{\hat{p}_{agree} - \hat{p}_{disagree}}{se(\hat{p}_{agree}) + se(\hat{p}_{disagree})}$

**Questions 20** to **22** refer to the following information.

Research New Zealand conducts monthly surveys in which they survey a sample of 500 adult New Zealanders, aged 18 years or over. (Assume the surveys use simple random sampling.) In June 2015, the survey included questions on gender equality in such areas as the health system, the education system and in the workplace (ResearchNZ, 2015). One of the questions about a variety of situations was:

> *"In which of the following areas do you feel male and females have equal or different levels of opportunity in New Zealand?"*

With respect to opportunity in Senior Management Levels in the Public Sector, the response to the question has been cross-classified by **Opportunity** and **Sex** in Table 5 below. (Note: The exact numbers of each sex in the survey were not provided. For the purpose of this analysis we will assume that 267 females and 233 males answered this question.)

$n_f$

$n_m$

| | **Opportunity** | | | | |
|---|---|---|---|---|---|
| **Sex** | Men have more | Same/Equal | Women have more | Don't know | **Total** |
| Female | 184 | 70 | 5 | 8 | 267 |
| Male | 93 | 105 | 23 | 12 | 233 |
| **Total** | 277 | 175 | 28 | 20 | 500 |

Table 5: Opportunity in senior management levels in the public sector

We are interested in comparing the proportion of adult New Zealand males who in June 2015 thought men had more opportunity in senior management ($p_{MM}$) and the proportion of adult New Zealand males who in June 2015 thought women had more opportunity in senior management ($p_{MW}$).

20. Use Table 5, page 29, to find the estimate for $p_{MM} - p_{MW}$. step 4!

(1) 0.300
(2) 0.486
(3) 0.329
(4) 0.290
(5) 0.140

$$\hat{p}_{MM} - \hat{p}_{MW} = \frac{93}{233} - \frac{23}{233} = .300 \text{ (3dp)}$$

21. The sampling situation for calculating the standard error of the estimate, se($\hat{p}_{MM} - \hat{p}_{MW}$), is: Sit (b)! $n_m = 233$

(1) ~~two~~ independent samples, one of size 93 and one of size 23.
(2) one sample of size 233, several response categories.
(3) ~~two~~ independent samples, one of size 277 and one of size 28.
(4) one sample of size ~~500~~, several response categories.
(5) one sample of size 233, many ~~yes/no~~ items.

zero not in CI so not a plausible value.

22. A 95% confidence interval for $p_{MM} - p_{MW}$ is (0.22, 0.38). Which **one** of the following statements is **false**?

$p_{MM} > p_{MW}$ by between 22 & 38 %age points

T (1) At the 5% level of significance we can not claim that the observed difference between $\hat{p}_{MM}$ and $\hat{p}_{MW}$ could be due to sampling variability alone.

T (2) At the 5% level of significance we can claim that $p_{MM}$ is higher than $p_{MW}$. p-val < .05 (5%)

T (3) It would be surprising to see a different random sample of the same size at the same time produce a result with $\hat{p}_{MW}$ larger than $\hat{p}_{MM}$.

T (4) The proportion of adult New Zealand males who thought that men have more opportunities is estimated to be between 22 and 38 percentage points higher than the proportion of adult New Zealand males who thought that women have more opportunities.

F (5) The margin of error for this survey is ~~of~~ ~~0.16~~ 0.08

Width of CI = .38 − .22 = .16

$$\text{moe} = \frac{\text{width of CI}}{2} = \frac{.16}{2} = .08$$

$$\text{est} \pm \underbrace{t \times \text{se(est)}}_{\text{moe}}$$

23. Which **one** of the following statements about a *P-value* is **false**?

F (1) The larger a *P-value*, the ~~stronger~~ weaker the evidence against the null hypothesis.

T (2) A *P-value* measures the strength of evidence against the null hypothesis.

T (3) A relatively large test statistic results in a relatively small *P-value*.

T (4) A *P-value* is the conditional probability of observing a test statistic as extreme as that observed or even more so, if the null hypothesis were true.

T (5) A *P-value* says nothing about the size of an effect or difference.

**Questions 24** to **29** refer to the following information.

*The Washington Post, The Henry J Kaiser Family Foundation* and *Harvard University* conducted a poll (8 March – 22 April, 2001) 'to gauge the racial attitudes of American adults'. The telephone poll surveyed 1709 adults including 779 whites, 323 African Americans, 315 Hispanics and 254 Asian Americans. Assume this sample of 1709 adults is a random sample of American adults. Two of the questions in the survey were:

**Question 1:**
Do you feel that African Americans have more, less or about the same opportunities in life as whites have?

and

**Question 2:**
Do you feel that Asian Americans have more, less or about the same opportunities in life as whites have?

The percentage results for these two questions are shown in Table 6 below.

| | Response | | | | Sample size |
|---|---|---|---|---|---|
| | More % | Less % | Same % | Unsure % | |
| **Question 1** | $\hat{p}_{more}=.13$ | $\hat{p}_{less}=.27$ | | | |
| White | 13 | 27 | 58 | 2 | 779 |
| African American | 1 | 74 | 23 | 2 | 323 |
| Hispanic | 8 | 46 | 44 | 2 | 315 |
| Asian American | 10 $\hat{p}_{q1}=.1$ | 44 | 39 | 7 | 254 |
| Total Sample | 11 | 35 | 51 | 2 | 1709 |
| **Question 2** | | | | | |
| White | 13 $\hat{p}_{w}=.13$ | 14 | 70 | 4 | 779 |
| African American | 15 | 38 | 39 | 8 | 323 |
| Hispanic | 18 | 24 | 55 | 3 | 315 |
| Asian American | 7 $\hat{p}_{q2}=.07=\hat{p}_{A}$ | 34 | 53 | 5 | 254 |
| Total Sample | 14 | 18 | 63 | 4 | 1709 |

**Table 6:** Americans' responses to racial attitudes survey

Let $p_{more}$ be the proportion of whites who feel that African Americans have more opportunities in life than whites have

Q1!

and $p_{less}$ be the proportion of whites who feel that African Americans have less opportunities in life than whites have.

Note that these two proportions describe two of the whites' responses to **Question 1**.

24. An estimate of the difference between $p_{more}$ and $p_{less}$ is:

(1) 0.018
(2) -0.01
(3) -0.14
(4) 0.01
(5) -0.10

$\hat{p}_{more} - \hat{p}_{less} = .13 - .27$
$= -.14$

25. Information from Table 2, page 21, is used to construct a 95% confidence interval for the difference $p_{more}$ - $p_{less}$. For the purpose of calculating $se(\hat{p}_{more} - \hat{p}_{less})$, the sampling situation can be described as:

sit(b)!
n=779

(1) ~~two~~ independent samples of sizes 779 and 254.
(2) one sample of size 779, several response categories.
(3) one sample of size ~~1709~~, many ~~yes/no~~ items.
(4) one sample of size ~~1709~~, several response categories.
(5) one sample of size 779, many ~~yes/no~~ items.

zero out of CI! ∴ $p_{more} < p_{less}$

26. A 95% confidence interval for the difference $p_{more}$ - $p_{less}$ is (-0.1833, -0.09668). The **best** interpretation of this interval is:

(-18, -10) percentage points

With 95% confidence, the percentage of whites who feel that African Americans have more opportunities in life than whites have is somewhere between:

$p_{more}$

(1) 10 percentage points ~~higher~~ than and 18 percentage points lower than the percentage who feel that African Americans have less opportunities in life than whites have. $p_{less}$
(2) 10 and 18 percentage points.
(3) 10 and 18 percentage points ~~higher~~ than the percentage who feel that African Americans have less opportunities in life than whites have. $p_{less}$
(4) 10 percentage points ~~lower~~ than and 18 percentage points ~~higher~~ than the percentage who feel that African Americans have less opportunities in life than whites have. $p_{less}$
(5) 10 percentage points and 18 percentage points lower than the percentage who feel that African Americans have less opportunities in life than whites have. $p_{less}$

**Questions** 27 and 28 refer to the following additional information.

Let $p_{question1}$ be the proportion of Asian Americans who feel that African Americans have more opportunities in life than whites have
Q1

and $p_{question2}$ be the proportion of Asian Americans who feel that Asian Americans have more opportunities in life than whites have.
Q2

Information from Table 2, page 21, is used to conduct a 2-tailed test for no difference between $p_{question1}$ and $p_{question2}$.

$H_0: p_{Q1} - p_{Q2} = 0$ vs. $H_1: p_{Q1} - p_{Q2} \neq 0$

27. The formula for the standard error of the estimate, $se(\hat{p}_{question1} - \hat{p}_{question2})$, is:

(1) two independent samples of sizes 323 and 254.
(2) one sample of size 254, several response categories.
(3) one sample of size 323, many yes/no items.
(4) one sample of size 323, several response categories.
(5) one sample of size 254, many yes/no items.

sit(c)!
n=254

step 2

28. The expression for evaluating the test statistic for the null hypothesis, $H_0$: $p_{question1} - p_{question2} = 0$, is:

(1) $\dfrac{\hat{p}_{question1} - \hat{p}_{question2}}{se(\hat{p}_{question1}) + se(\hat{p}_{question2})}$

(2) $\dfrac{\hat{p}_{question1} - \hat{p}_{question2}}{\sqrt{se(\hat{p}_{question1})^2 - se(\hat{p}_{question2})^2}}$

(3) $\dfrac{p_{question1} - p_{question2}}{se(\hat{p}_{question1}) + se(\hat{p}_{question2})}$

(4) $\dfrac{\hat{p}_{question1} - \hat{p}_{question2}}{se(\hat{p}_{question1} - \hat{p}_{question2})}$

(5) $\dfrac{p_{question1} - p_{question2}}{se(\hat{p}_{question1} - \hat{p}_{question2})}$

$t_0 = \dfrac{\text{est.} - \text{hyp.val.}}{\text{std err.}} = \dfrac{\hat{p}_{Q1} - \hat{p}_{Q2} - 0}{se(\hat{p}_{Q1} - \hat{p}_{Q2})}$

**Question** 29 refers to the following additional information.

Let $p_{WhiteQ2}$ be the proportion of Whites who feel that Asian Americans have more opportunities in life than whites have
W

and $p_{AsianQ2}$ be the proportion of Asian Americans who feel that Asian Americans have more opportunities in life than whites have.
A

29. If we use information from Table 2, page 21, for the purpose of calculating $se(\hat{p}_{WhiteQ2} - \hat{p}_{AsianQ2})$, then the sampling situation can be described as:

(1) two independent samples of sizes 779 and 254.
(2) one sample of size 254, several response categories.
(3) one sample of size 779, many yes/no items.
(4) one sample of size 254, many yes/no items.
(5) one sample of size 779, several response categories.

sit(a)!
$n_W = 779$
$n_A = 254$

30. Which **one** of the following statements is **false**?

T (1) In hypothesis testing, statistical significance does not imply practical significance.

size of diff comes from CI!

F (2) In a hypothesis test for no difference between two proportions, a very small *P-value* indicates a ~~very~~ ~~large~~ difference in the proportions.

T (3) In hypothesis testing, a non-significant test result does not imply that $H_0$ is true.

T (4) In hypothesis testing, large samples can lead to small *P-values* without the results having any practical significance.

T (5) In a hypothesis test for no difference between two proportions, a two-sided test should be used when the idea of doing the test has been triggered as a result of looking at the data.

31. Which **one** of the following statements is **false**?

T (1) In a *t*-test for no difference between two proportions, being able to demonstrate that the difference was of practical significance (importance) would almost always imply statistical significance.

T (2) In hypothesis testing, large samples can lead to small *P-values* without the results having any practical significance (importance).

T (3) In hypothesis testing, statistical significance does not imply practical significance (importance).

F (4) In a hypothesis test for no difference between two proportions, a very small *P-value* always indicates a ~~very~~ ~~large~~ difference in the proportions. size of diff comes from CI!

T (5) In hypothesis testing, a nonsignificant test result does not imply that the null hypothesis is true.

32. Which **one** of the following statements about significance tests is **false**?

T (1) Formal tests can help determine whether effects we see in our data may just be due to sampling error.

T (2) The *P-value* associated with a two-sided alternative hypothesis is obtained by doubling the *P-value* associated with a one-sided alternative hypothesis.

T (3) The *P-value* says nothing about the size of an effect. CI does!

F (4) The data should be carefully examined in order to determine whether the alternative hypothesis needs to be one-sided or two-sided. theory or prior info

T (5) A large *P-value* says the null hypothesis is believable based on the evidence (the data) presented.

**Questions 33** to **37** refer to the following information. $n_m$

The *New Zealand Herald* (3 November 2016) reported a study that explored what people wanted in a relationship where 2000 British adults who were in a heterosexual relationship were surveyed. The actual numbers of females and males were not provided in the article so we will suppose that 850 males and 1150 females responded to the survey. You may assume that these 2000 respondents are a random sample of all British adults in a relationship. $n_f$

Let:

$p_M$ be the proportion of British **men** in a heterosexual relationship who would describe their partner as their best friend

and

$p_W$ be the proportion of British **women** in a heterosexual relationship who would describe their partner as their best friend. stat sig @ 5% level

Using a *t*-procedure, a 95% confidence interval for $p_M - p_W$ is (0.06, 0.14).

zero not in CI ∴ is not a plausible val: i.e. $p_M > p_W$

33. Which one of the following statements is false? p-val < .05 (5%)

T (1) Since we are dealing with proportions, the degrees of freedom for obtaining the t-multiplier used for this confidence interval are ∞.

T (2) The estimate of $p_M - p_W$ is 10% * and the margin of error is 4%. **

T (3) The standard error of $\hat{p}_M - \hat{p}_W$ is smaller than the margin of error of this confidence interval. moe = t × se(est)

F (4) The corresponding 99% confidence interval would have ~~a larger~~ the same standard error ~~than~~ as this confidence interval.

T (5) The corresponding 90% confidence interval would not contain 0.

stat sig @ 5% level ∴ also stat sig @ 10% level!

34. When considering this confidence interval and a two-tailed *t*-test for no difference between $p_M$ and $p_W$, which **one** of the following statements is **false**?

T (1) With 95% confidence we estimate that the proportion of British men $p_M$ who would describe their partner as their best friend is somewhere between 6 and 14 percentage points higher than the corresponding $p_W$ proportion of British women.

T (2) The observed difference between the two proportions is significant at the 5% level of significance.

T (3) There is evidence against the proportion of British men who would $p_M$ describe their partner as their best friend being the same as the corresponding proportion of British women. $p_W$

F (4) It is plausible that there is ~~no~~ a difference between the proportion of British men who would describe their partner as their best friend and the corresponding proportion of British women.

T (5) It is not believable that a higher proportion of British women would describe their partner as their best friend than the corresponding proportion of British men.

* est is midpoint of CI: $\frac{.14+.06}{2} = .1 = 10\%$

** moe is half of CI width: $\frac{.14-.06}{2} = .04 = 4\%$

**Questions 35** to **37** refer to the following additional information.

The *New Zealand Herald* article also included a list of "The 30 things women really want from a man in a relationship". Some of these things are listed in Table 7. Recall that 2000 British adults (850 males and 1150 females) responded to the survey.

| | | |
|---|---|---|
| 1 | Makes you feel safe | 66% |
| 2 | Completely trusts you | 62% |
| 3 | Truly appreciates everything you do | 59% |
| 4 | Is a good laugh | 51% |
| ⋮ | ⋮ | ⋮ |
| 30 | Never leaves the car without petrol | 12% |

$\hat{p}_{safe} = .66$

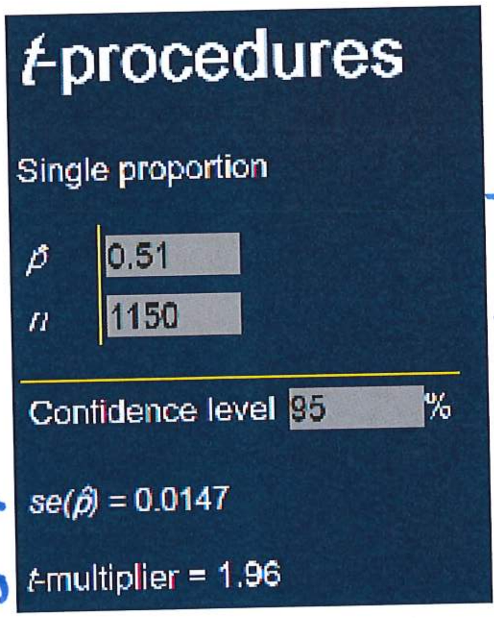
$\hat{p}_{trust} = .62$

$\hat{p}_{laugh} = .51$

Table 7: What women want from a man in a relationship

Let $p_{\text{Laugh}}$ be the proportion of British women in a heterosexual relationship who really want their male partner to be a good laugh (option 4 in Table 7).

The required information to find a 95% confidence interval for $p_{\text{Laugh}}$ is shown in Figure 2.




est ± t × se(est)

$\hat{p} \pm t \times se(\hat{p})$

$.51 \pm 1.96 \times .0147$

(.481, .539)

Figure 2: Screen-shot of the *t*-procedures tool

35. The 95% confidence interval for $p_{\text{Laugh}}$ is:

(1) (−0.539, 0.539)

(2) (−0.481, 0.539)

(3) (−1.450, 2.470)

(4) (0.495, 0.563)

(5) (0.481, 0.539)

→ C.f. definition of standard error of an

36. Which **one** of the following statements about the value $se(\hat{p}_{Laugh}) = 0.0147$ is **true**? estimate, blue page 20, chapter 6.

T (1) 0.0147 approximately measures the average distance between the proportion of women who want their male partner to be a good laugh in a sample of 1150 women over all possible samples of 1150 women, and the corresponding population proportion.

F (2) 0.0147 approximately measures the average distance between the responses of the 1150 women in the survey who want their male partner to be a good laugh, and the corresponding population proportion. $sd(\hat{p}_{Laugh})$ → i.e. the std deviation

F (3) 0.0147 approximately measures the average of all sample proportions (size 1150) of women in population who want their male partner to be a good laugh.

F (4) 0.0147 estimates the difference between the men and women in the survey who want their male partner to be a good laugh.

F (5) 0.0147 estimates the difference between the men and women in the population who want their male partner to be a good laugh.

37. Refer to options 1 and 2 in Table 7, page 36, and let:

$p_{Safe}$ be the proportion of British women in a heterosexual relationship who want their male partner to make them feel safe

and

$p_{Trust}$ be the proportion of British women in a heterosexual relationship who want their male partner to completely trust them.

For the purposes of calculating $se(\hat{p}_{Safe} - \hat{p}_{Trust})$, the sampling situation can be described as: sit(c)!

c (1) one sample of size 2000, many yes/no items.

c (2) one sample of size 1150, many yes/no items. $n_f = 1150$

b (3) one sample of size 2000, several response categories.

a (4) two independent samples of sizes 1150 and 850.

b (5) one sample of size 1150, several response categories.

38. Which **one** of the following statements about hypothesis testing is **false**?

F (1) We make hypotheses about ~~sample estimates~~. pop. parameters.

T (2) In the *t*-test, the null hypothesis, $H_0$, always involves an "=" sign.

T (3) We investigate whether a hypothesised value is plausible in light of our sample data.

T (4) If we get a *t*-test statistic with a value of 3, we know the sample estimate is 3 standard errors above the hypothesised value.

T (5) A large *P-value* does not imply that $H_0$ is true.