Check you understand! Practice Questions...

Questions 1 to **6** refer to the following information.

The Marketing Department of the University of Auckland carried out a survey of New Zealand bank customers. A random sample of 761 customers was selected and these customers were asked a wide range of questions about banks and the services the banks provide. From the responses, measurements were made on many variables. Some of these variables were:

Bank: The main bank used by the customer

cate, nom

— ANZ, BNZ, Westpac (for WestpacTrust), Other (all other banks)

Closeness: The customer's opinion of the closeness of their relationship with their main bank

cate, ord

— Not Close, Quite Close, Very Close

Performance: The customer's opinion of the overall performance of their main bank

cate, ord

— Poor/Fair, Good, Excellent

Two of the questions in the bank survey, each together with a table showing some of the percentage results, are given below.

Closeness:
How close is the relationship you have with your main bank?

Main Bank	Response (Closeness)			Sample size
	Not Close %	Quite Close %	Very Close %	
ANZ	57.3%	33.1%	9.6%	157
BNZ	48.3%	40.8%	10.8%	120
Westpac	48.7%	39.1%	12.2%	230
Other	39.4%	44.9%	15.7%	254
Total Sample	47.3%	40.0%	12.6%	761

p̂ANZ = .573   p̂closer = .427
p̂westpac = .487

Table 1: Responses to closeness of relationship with main bank

Performance:

How would you describe the overall level of performance of your main bank to date?

	Response (Performance)			Sample size
	Poor/Fair %	Good %	Excellent %	
Main Bank				
ANZ	29.9%	52.9%	17.2%	157
BNZ	32.5%	53.3%	14.2%	120
Westpac	24.3%	59.6%	16.1%	230
Other	13.8%	57.1%	29.1%	254
Total Sample	23.3%	56.4%	20.4%	761

Handwritten annotations: $\hat{p}_{perform} = .701$; $\hat{p}_{good} = .533$; $\hat{p}_{excel} = .142$

Table 2: Responses to main bank's performance

Questions 1 to 3 refer to the following additional information.

Let:

p_{ANZ} be the proportion of bank customers, with ANZ as their main bank, who would describe their relationship with ANZ as 'Not Close'

and

$p_{Westpac}$ be the proportion of bank customers, with WestpacTrust (Westpac) as their main bank, who would describe their relationship with Westpac as 'Not Close'.

1. From the information in Table 1, page 19, an estimate of the difference $p_{ANZ} - p_{Westpac}$ is:

    (1) 0.86
    (2) 0.086
    (3) 0.54
    (4) 0.054
    (5) 0.004

    Handwritten: Step 4; $\hat{p}_{ANZ} - \hat{p}_{Westpac} = .573 - .487$

2. A 95% confidence interval is constructed for the difference between p_{ANZ} and $p_{Westpac}$. For the purpose of calculating $se(\hat{p}_{ANZ} - \hat{p}_{Westpac})$, the sampling situation can be described as:

    (1) one sample of size 761, several response categories.
    (2) one sample of size 387, several response categories.
    (3) one sample of size 761, many yes/no items.
    (4) two independent samples of sizes 157 and 230.
    (5) one sample of size 387, many yes/no items.

    Handwritten: $n_{ANZ} = 157$; $n_{Westpac} = 230$

(handwritten top:) $(-1.4, 18.7)$ Zero in CI ∴ is a plausible value!

3. A 95% confidence interval for the difference $p_{ANZ} - p_{Westpac}$ is $(-0.014, 0.187)$.

(handwritten:) $(-1.4, 18.7)$ $p_{ANZ} > p_{Westpac}$

The **best** interpretation of this interval is:

With 95% confidence, the percentage of bank customers, with ANZ as their main bank, who would describe their relationship with ANZ as 'Not Close' is somewhere between:

(handwritten: F)

(1) 1.4 percentage points and 18.7 percentage points higher than the percentage of bank customers, with Westpac as their main bank, who would describe their relationship with Westpac as 'Not Close'. *(handwritten: lower)*

(handwritten: T)

(2) 1.4 percentage points lower and 18.7 percentage points higher than the percentage of bank customers, with Westpac as their main bank, who would describe their relationship with Westpac as 'Not Close'.

(handwritten: F)

(3) 1.4 percentage points and 18.7 percentage points lower than the percentage of bank customers, with Westpac as their main bank, who would describe their relationship with Westpac as 'Not Close'. *(handwritten: lower ... higher)*

(handwritten: F)

(4) 1.4 percentage points higher and 18.7 percentage points lower than the percentage of bank customers, with Westpac as their main bank, who would describe their relationship with Westpac as 'Not Close'.

(handwritten: F)

(5) -1.4% and 18.7%.

(handwritten: Same words!)

Questions 4 and **5** refer to the following additional information.

Consider only customers with **ANZ** as their main bank.

Let:

p_{Close} be the proportion who would describe their relationship with ANZ as either 'Quite Close' or 'Very Close'

and

$p_{Perform}$ be the proportion who would describe the ANZ performance as 'Good' or 'Excellent'.

Information from Tables 1 and 2, pages 19 and 20, is used to conduct a two-tailed t-test for no difference between p_{Close} and $p_{Perform}$. *(handwritten: 4. $p_{Close} - p_{Perform}$)*

JH(c)! n=157

4. The formula for the standard error of the estimate, $se(\hat{p}_{Close} - \hat{p}_{Perform})$, is:

    (1) two independent samples of sizes 157 and 174.   *a*

    (2) one sample of size 157, several response categories.   *b*

    (3) one sample of size 761, many yes/no items.   *c*

    (4) one sample of size 157, many yes/no items.   *c*

    (5) one sample of size 761, several response categories.   *b*

5. The expression for evaluating the test statistic for the null hypothesis, H_0: $p_{Close} - p_{Perform} = 0$, is:

    (1) $\dfrac{p_{Close} - p_{Perform}}{se(\hat{p}_{Close}) + se(\hat{p}_{Perform})}$

    (4) $\dfrac{\hat{p}_{Close} - \hat{p}_{Perform}}{se(\hat{p}_{Close}) + se(\hat{p}_{Perform})}$

    (2) $\dfrac{\hat{p}_{Close} - \hat{p}_{Perform}}{se(\hat{p}_{Close} - \hat{p}_{Perform})}$

    (5) $\dfrac{p_{Close} - p_{Perform}}{se(\hat{p}_{Close} - \hat{p}_{Perform})}$

    (3) $\dfrac{\hat{p}_{Close} - \hat{p}_{Perform}}{\sqrt{se(\hat{p}_{Close})^2 - se(\hat{p}_{Perform})^2}}$

$t_0 = \dfrac{est - hyp\,val}{std\,err}$

$= \dfrac{\hat{p}_{clox} - \hat{p}_{perform} - 0}{se(\hat{p}_{clox} - \hat{p}_{perform})}$

Question 6 refers to the following additional information.

Consider only customers with **BNZ** as their main bank.

Let:

    p_{Good} be the proportion who would describe the BNZ performance as 'Good'.

and

    $p_{Excellent}$ be the proportion who would describe the BNZ performance as 'Excellent'.

JH(b)! n=120

6. Using information from Table 2, page 20, the formula for the standard error of the estimate, $se(\hat{p}_{Good} - \hat{p}_{Excellent})$, is:

    (1) one sample of size 120, several response categories.   *b*

    (2) one sample of size 761, many yes/no items.   *c*

    (3) two independent samples of sizes 157 and 174.   *a*

    (4) one sample of size 761, several response categories.   *b*

    (5) one sample of size 120, many yes/no items.   *c*

Questions 7 to 14 refer to the following information.

In 2015 Research New Zealand published the report 'Gender Equality in New Zealand' which was based on a public opinion survey completed in June 2015.

The survey was conducted by telephone with a nationally-representative sample of 500 New Zealanders aged 18 or over. You may consider the sample as a random sample of 500 adult New Zealanders.

⊛ restart @ 12.45pm

Two of the questions in the survey were:

> In your personal opinion, are males and females in New Zealand treated the same way in the work place?

and

> In your personal opinion, are males and females in New Zealand treated the same way in business?

$\hat{p}_{workplace} = .46$ $\hat{p}_{business} = .32$

Responses to the above questions are summarised in Table 3 and Figure 1.

	Males treated more favourably	Treated the same	Don't know	Females treated more favourably
In the workplace	45% *	46% *	6%	4% *
In business	62% **	32% **	5%	2% **

Note: Totals may not sum to 100% due to rounding

Table 3: Gender equality questions' responses

c.f. Q9   c.f. Q8   same info

■ Males treated more favourably   ■ Same, equal   ■ Don't know   ■ Females treated more favourably

In the workplace: 45%, 46%, 6%
In business: 62%, 32%, 5% 1%
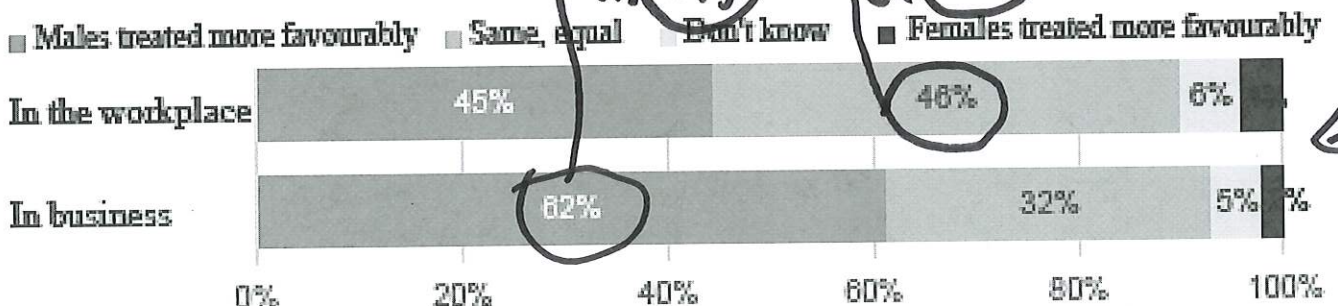
Note: Totals may not sum to 100% due to rounding

Figure 1: Gender equality questions' responses

this is a Ch 1 question!

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

   T

   (1) While 46% of the respondents believe that, in the **workplace**, males and females are treated the same; 45% believe males are treated more favourably compared to only 4% who believe females are treated more favourably.

   ⇨ see %ages with stars (*) on table above

T

(2) A respondent in this survey was nearly twice as likely to believe that, in **business**, males are treated more favourably than to believe that males and females are treated the same.

[handwritten: 62%. 62/32 ≅ 1.94 (2dp) 32%.]

F **(3)** The percentage of respondents who believe that males and females are treated the same in **business** is higher than the percentage of respondents who believe they are treated the same in the **workplace**.

[handwritten: 46% 32%]

T **(4)** A respondent in this survey was almost as likely to believe that, in the **workplace**, males are treated more favourably as to believe that males and females are treated the same.

[handwritten: 46% 45%]

T **(5)** While 32% of the respondents believe males and females are treated the same in **business**; 62% believe males are treated more favourably compared to only 2% who believe females are treated more favourably.

[handwritten: see %ages with 2 stars (**) on table above]

8. From the survey responses, we may report that 46% of adult New Zealanders hold the opinion that males and females are treated **the same way** in the **workplace**, with a margin of error of 4.37% (calculated for a 95% confidence level).

[handwritten: story type 2. P [est ± t × se(est) moe]

Which **one** of the following statements is **correct**?

With 95% confidence, we may estimate that the percentage of adult New Zealanders who hold this opinion is somewhere between:

(1) 43.82% and 48.19%   (4) 32.89% and 59.11%

(2) 41.63% and 50.37%   (5) 37.43% and 54.56%

(3) 2.3% and 89.7%

[handwritten: 46% ± 4.37% → [41.63, 50.37]]

9. From the survey responses, we may estimate that 62% of adult New Zealanders hold the opinion that males are treated **more favourably** than females in **business**. The standard error associated with this estimate is 0.0217.

[handwritten: p̂, se(p̂), another story type 2.]

Which **one** of the following statements is **true**?

With 95% confidence, we estimate that the proportion of adult New Zealanders who hold this opinion is somewhere between:

(1) $0.62 - (2.5 \times 0.0217)$ and $0.62 + (2.5 \times 0.0217)$

(2) $0.62 - 0.0217$ and $0.62 + 0.0217$

(3) $0.62 - (1.5 \times 0.0217)$ and $0.62 + (1.5 \times 0.0217)$

(4) $0.62 - (3 \times 0.0217)$ and $0.62 + (3 \times 0.0217)$

(5) $0.62 - (1.96 \times 0.0217)$ and $0.62 + (1.96 \times 0.0217)$

[handwritten: est ± t × se(est) → p̂ ± t × se(p̂)]

[handwritten: 24]

*[handwritten: → p̂ − t × se(p̂) and p̂ + t × se(p̂)
→ .62 − 1.96 × .0217 & .62 − 1.96 × .0217]*

Questions 10 to **14** refer to the following additional information.

Let:

$p_{Workplace}$ be the proportion of adult New Zealanders who hold the opinion that males and females are treated the same way in the workplace

and

$p_{Business}$ be the proportion of adult New Zealanders who hold the opinion that males and females are treated the same way in business.

A two-tailed t-test is carried out for no difference between $p_{Workplace}$ and $p_{Business}$. (Assume that it is appropriate to use a t-test.) *i.e. H_0: $p_{workplace} - p_{bus} = 0$*
Use Table 3 and/or Figure 1, page 23, to answer **Questions 10 to 14**.

10. The sampling situation associated with $se(\hat{p}_{Workplace} - \hat{p}_{Business})$ is best described as: *$\sqrt{it}$ (c) !*

   a   (1)   two independent samples both of size 250.
   c   (2)   one sample of size 500, many yes/no items.
   a   (3)   two independent samples both of size 500.   *n = 500*
   b   (4)   one sample of size 250, several response categories.
   b   (5)   one sample of size 500, several response categories.

11. Given that $se(\hat{p}_{Workplace} - \hat{p}_{Business}) = 0.0390$ *std err* the value of the test statistic, t_0, is approximately: *$t_0 = \dfrac{est - hyp\ val}{std\ err}$*

   (1) -4.359 (4) 0.256
   (2) 0.513 (5) -7.692
   (3) 3.590

$= \dfrac{\hat{p}_w - \hat{p}_b - 0}{se(\hat{p}_w - \hat{p}_b)} = \dfrac{(.46 - .32)}{.039} = 3.590$ (3dp)

12. In this t-test, the P-value is 0.0003. Which **one** of the following is an incorrect interpretation of this t-test?   *→ v. st. ev. against H_0.*

   (1)   At the 1% level of significance, there is no evidence of a difference between $p_{Workplace}$ and $p_{Business}$. *p-val < 1% (ie p-val < .01)*
   (2)   It is highly unlikely that sampling variation alone would produce a difference at least as big as the observed difference, $\hat{p}_{Workplace} - \hat{p}_{Business}$.
   (3)   At the 5% level of significance, it can be claimed that there is a difference between $p_{Workplace}$ and $p_{Business}$.
   (4)   The observed difference, $\hat{p}_{Workplace} - \hat{p}_{Business}$, is statistically significant at the 5% level of significance.
   (5)   The observed difference, $\hat{p}_{Workplace} - \hat{p}_{Business}$, is so large that we can not reasonably attribute it to chance alone.

F
T
T
T
T

(handwritten top) → zero not in CI ∴ zero is **not** a plausible val!

13. *(handwritten bracket)* A 95% confidence interval for the difference $p_{Workplace} - p_{Business}$ is (0.0636, 0.2164). Which **one** of the following statements is **true**? *(handwritten: → pw > pb by between 6 & 22 %age points)*
With 95% confidence, the proportion of adult New Zealanders who hold the opinion that males and females are treated the same way in the workplace is: *(handwritten: pw)*

T (1) somewhere between 6 and 22 percentage points higher than the proportion who hold the opinion that males and females are treated the same way in business. *(handwritten: pb)*

F (2) 14 percentage points ~~different from~~ *higher than* the proportion of adult New Zealanders who hold the opinion that males and females are treated the same way in business. *(handwritten: with an moe of 8 %age points · pb)*

F (3) ~~X~~ 14 percentage ~~points different~~ *higher than* from the proportion of adult New Zealanders who hold the opinion that males and females are treated the same way in business. *(handwritten: with moe 8 %age pts · pb)*

F (4) somewhere between 6 percentage points ~~lower than~~ *and* 22 percentage points higher than the proportion of adult New Zealanders who hold the opinion that males and females are treated the same way in business. *(handwritten: pb)*

F (5) ~~6%~~ and the proportion of adult New Zealanders who hold the opinion that males and females are treated the same way in business is ~~22%.~~ *(handwritten: pb)*

(handwritten) CI is for diff in 2 proportions

14. Suppose that *(circled)* a 90% confidence interval for the difference $p_{Workplace} - p_{Business}$ is also to be constructed using the information in Table 3 and/or Figure 1, page 23. *(handwritten: → est ± t × se(est))*

When comparing the 90% confidence interval with the 95% confidence interval given in Question 13, page 26, which **one** of the following statements is **false**?

T (1) The 90% confidence interval will be narrower than the 95% confidence interval.

T (2) The value of the estimate, $\hat{p}_{Workplace} - \hat{p}_{Business}$, for the 90% confidence interval will be the same as that for the 95% confidence interval.

T (3) The margin of error for the 90% confidence interval will be smaller than that for the 95% confidence interval.

F (4) The value of the standard error, se($\hat{p}_{Workplace} - \hat{p}_{Business}$), for the 90% confidence interval will be ~~smaller than~~ *the same as* that for the 95% confidence interval.

T (5) The t-multiplier for the 90% confidence interval will be smaller than that for the 95% confidence interval.