PTS critical numbers practice questions

Things to note before starting these:

- Any questions, email Jemmerson1@sheffield.ac.uk or Cholt2@sheffield.ac.uk
- Made by a second year (so not a professional!)
- There may be mistakes!
- All numbers and trends are completely made up and bare no relevance to the real world.

Question 1

A group of researchers want to investigate whether there is a link between an individual going on increased holidays abroad each year and their risk of developing basal cell carcinoma (a type of skin cancer).

i. Of the following, which is the most likely confounding factor?

   a. Socio-economic status
   b. Getting sunburnt
   c. Age
   d. BMI

ii. What would be the most appropriate study design to explore this link?

   a. RCT
   b. Case control study
   c. Cohort study
   d. Cross sectional study

The researchers tweak their study and their new research question is as follows:

"Does more than 1hr of sunlight exposure per day (without sun-cream) increase the risk of developing basal cell carcinoma?"

iii. What does PICO stand for?

iv. Which part of PICO is missing from this research question?

Here are the results from the study:

	>1hr average sunlight exposure per day	<1hr average sunlight exposure per day	Total
BCC 5yrs later	28	90	118
No BCC 5yrs later	212	555	767
Total	240	645	885
BCC = basal cell carcinoma.			

v. How many times **more** likely is developing basal cell carcinoma over 5years if you have >1hr sunlight exposure per day compared to <1hr sunlight exposure?

The P value for this result was 0.032.

vi. Define the P value.

To extend on this study, researchers decided to investigate whether there was a statistically significant link between age and the average number of times people went abroad each year.

The null hypothesis for this study was "*the average number of times someone goes on holiday is no different for 20-24yr olds compared to 25-29yr olds*".

vii. Is this an appropriate null hypothesis?

a. True

b. False

The results were as follows

- 20-24yr olds had an average of 2.40 holidays per year (95% CI: 2.35-2.45)
- 25-29yr olds had an average of 2.32 holidays per year (95% CI: 2.26-2.38)

viii. The researchers conclude the P value for this hypothesis is greater than 0.05. Are they correct in this statement? Why?

Standard error and confidence intervals are calculated by the following equations:

$$SE = \frac{Standard\ deviation}{\sqrt{n}} \qquad 95\%\ CI = mean \pm (1.96 \times SE)$$

ix. The confidence interval for the 25-29yr old group is wider than the 20-24yr old group. What does this say about the standard error?

x. What are 2 assumptions of standard error?

Question 2

In a new study, researchers are investigating whether there is a link between the average step length and the volume of cerebellar degeneration.

This can be modelled by the equation y = a + bx

Where:

- Y is average step length (cm)
- X is the volume of cerebellar degeneration (mm^3)
- A is the intercept and B is the coefficient.

i. State the dependent variable and the independent variable.

The trend researchers observe is as follows:

$Y = 0.1 + 4.3x$

Where B has a 95% confidence interval: 4.11-4.49 and a P value of <0.001 (statistically significant).

ii. What would the null hypothesis state B is?

The researchers wish to account for the following, potential confounding factors:

- Age
- BMI

This changes their results to:

	Coefficient	95% CI	P-value (of coefficient)
Intersect, a	0.13	0.08, 0.18	0.002
Cerebellar degeneration X_1	2.11	2.00,2.22	0.03
Age X_2	11.9	10, 13.8	0.01
BMI X_3	0.48	-0.11, 1.07	0.81

iii. Is there a link between either age or BMI with the average step length?

The researchers also want to account for gender, as shown in the new table below.

	Coefficient	95% CI	P-value (of coefficient)
Intersect, a	0.12	0.07, 0.17	0.002
Cerebellar degeneration X_1	2.13	2.01,2.21	0.032
Age X_2	11.9	10, 13.8	0.01
BMI X_3	0.49	-0.11, 1.07	0.79
Female	(ref) 0		
Male	1.16	0.08, 2.24	0.049

iv. Interpret whether gender is associated with a decreased step length.

Question 3

Researchers want to evaluate the outcomes of a new radical surgical procedure as opposed to palliative care. They record the number of deaths which occur during 2years

They conduct a clinical trial and here are the results:

	Surgery	Palliative care	Total
Death within 2yrs	3	9	12
Alive after 2yrs	41	60	101
Total	44	69	113

i. Calculate the absolute risk difference of death with surgery compared to palliative care?

ii. What are the odds of dying within 2 years for patients who had surgery and in the palliative group?

iii. What is the odds ratio of dying within 2yrs with surgery compared to receiving palliative care?

iv. Fill in the gaps:

"The odds of death are ……% lower with surgery compared to palliative care"

Answers

Question 1

i. B. People who go on holiday abroad could potentially be more likely to get sunburnt, and getting sunburnt is associated with higher incidences of skin cancer. Getting sunburnt is therefore both related to the outcome (skin cancer) and the characteristic of interest (travelling abroad more).

ii. B. Find all the people with skin cancer, then look back in time and see how frequently they went on holiday in the past. Case control studies are good for initially finding a link. An RCT is not the best answer as it would be too expensive, potentially unethical exposing people to sunlight. A cohort study (C) may identify a link however it would take a very long time (expensive) as skin cancer is generally related to years of exposure. A cross sectional study (D) would not really make sense here.

iii. Any variation of the following is correct.

- P – Patient of population
- I – intervention or indicator (exposure, treatment, or procedure)
- C – Comparison or control (that which is compared against the intervention)
- O – outcome (endpoint of interest)

iv. P, the population is not specified. As an example, the research question would read better if it were phrased:

"Does more than 1hr of sunlight exposure per day (without sun-cream) increase the risk of developing basal cell carcinoma in 20-30yr old Caucasians?"

v. There is a 17% increased risk of developing BCC with more than 1hr exposure compared to <1hr exposure.

28/240 = 0.12 (risk of BCC with >1hr sunlight)

90/645 = 0.14 (risk of BCC with <1hr sunlight)

0.14/0.12 = 1.17. 1 is used as a reference so 1.17-1 = 0.17. This means there is a 17% increased risk of developing BCC with more than 1hr sunlight exposure compared to <1hr sunlight exposure.

vi. A p-value is the probability of obtaining your results or results more extreme, if the null hypothesis is true

vii. True – "the null is dull", assumes there is no significant link/change

viii. They are correct in this statement. The 95% confidence intervals overlap. This means there is a 95% chance that the means are NOT significantly different to each other, therefore we CANNOT reject the null hypothesis.

ix. The standard error is greater for the 25-29yr group.

Standard error effectively "the likely distance away your sample mean is from the true population mean". The greater the SE, the wider the bounds are going to be and the less precise your sample mean. In this instance, the greater bounds for the 25-29 group is likely due to a smaller sample size compared to the 20-24 group (or it could be due to a greater standard deviation in this group).

x. Data are normally distributed and there is a sufficient sample size

Question 2

i. Easy to get these mixed up, but as a rule of thumb:

Y is the **outcome variable/dependent variable/response variable**, the variable we are estimating/predicting, in the example it is the average step length, this is what we are interested in.

X is the **predictor/independent variable /explanatory variable**, the variable using to estimate the outcome. Our example is cerebellar degeneration.

ii. 0. The coefficient/gradient of 4.3 has been calculated from a sample and is therefore an estimate of the population. As such, you can still have a 95% confidence interval and a P value. The null hypothesis would be that the gradient is 0, or there would be no gradient on the graph (in other words, there is NO link between step length and cerebellar degeneration). For us to except the null hypothesis, the 95% CI would overlap with 0, and the P value be >0.05, in this instance it does not.

iii. There is a statistically significant link for age since the P value is <0.05 and the confidence interval does not overlap 0. There is not a statistically significant link for BMI since the P value is >0.05 and the confidence interval does overlap 0.

iv. Being male is a statistically significant predictor of a longer step length denoted by the P value <0.05 and the confidence interval overlapping 0. It is *greater* step length because the coefficient is above 1.

Question 3

i. Risk of death in surgery group is 3/44 = 0.068
Risk of death in palliative group is 9/69 = 0.13
Absolute risk difference is 0.068 – 0.13 = **-0.062**
The risk of death is 6.2% less with surgery rather than the palliative group.

ii. Surgery group - 3/41 = 0.073

Palliative care group - 9/60 = 0.15

iii. Odds ratio is 0.073/0.15 = 0.49

iv. The odds of death are 51% lower with surgery compared to palliative care.

We can almost say the odds of death are half with surgery compared to palliative care.