# Assessment Schedule – 2014

# Scholarship Statistics (93201)

## Evidence Statement

**General Principles**:

1. Ignore incorrect answers if alongside correct answers. The exception is contradictory statements.
2. Ignore minor copying errors.

**QUESTION ONE**

**Tasks Q1 (a)**
**Evidence:**
**Figure 1**

- Percentage that are obese in these 70 different countries ranges from close to zero to about 65%. The percentage that have diabetes ranges from 0.2% to about 7%.
- There is no relationship / [accept very weak, positive relationship] between the percentage of the population that are obese and the percentage that have diabetes OR there is a lot of scatter in the graph.

**Figure 2**

- For these 70 countries, GDP per capita ranges from close to zero to about $60 000. There are not many countries with GDP greater than $40 000.
- There is a moderate, positive relationship between GDP per capita and the percentage of the population that have diabetes OR countries with higher GDP per capita tend to have a greater proportion of their population that have diabetes.
- For each extra $10 000 GDP per capita, the proportion of the population that have diabetes increases by about 0.6% on average.
- There is greater scatter for lower values of GDP.

**Figure 3**

- This graph appears to show a moderate, linear relationship between the diabetic rate and life expectancy. The graph shows that countries with a higher diabetic rate tend to have a longer life expectancy. However, this does not make sense – this must be a spurious association.
- Other variables would possibly explain the link shown in the graph – such as countries with a high diabetic rate also tend to have a higher GDP per capita and hence a better standard of living and better health care. These factors would be more likely to explain the higher life expectancy.

**Note:**

1. No credit for Figure 3 if reference to spurious correlation is missed.

**Judgement:**
**S**: Total of three points with at least one from two of the figures.
**P**: One or two points.

**Tasks Q1 (b) (i)**

**Evidence:**

- Prediction: % diabetic = $0.6445 \times 0.5 + 2.1002 = 2.4\%$.
- Figure 1 graph shows little association and also 71% diabetic is outside the range of given data.
- Figure 2 graph shows a moderate relationship, with GDP per capita = $5000 within the range of data values. Therefore, it seems more appropriate to use the relationship shown in Graph 2 to make this prediction.
- This prediction is not very precise as there is a large amount of scatter. Looking at the scatter, a country with GDP per capita = $5000 would be expected to have between 0.2% and 4% of its population diabetic.

**Note:**

**Task Q1 (b) (ii)**
**Evidence**:

- The above prediction would suggest that Nauru (actually 22%) should have between 0.2% and 4% of its diabetic rate if it were similar to the other 70 countries.
- Nauru clearly has different circumstances to these other 70 countries. Some of these factors might be:
    - very small and relatively isolated population
    - poor health care
    - poor diet – a lot of food imported rather than locally grown due to the mining that has taken place
    - the age structure of the population – many of the teenage and younger adults leave the country for education and work, and return as older adults. Older adults are more likely to develop diabetes after years of poor diet.

**Note:**

1. Prediction not correct if averaged out between Figures 1 and 2.

**Judgement**:
**O**: Reasonable prediction with justification along with an appropriate precision comment and comment on the diabetic rate.
**S**: Three of the components correct: prediction, justification, precision discussion in (i) and comment in (ii).
**P**: One or two components.

**Task Q1 (c)**
**Evidence**:

- The (point estimate) for the obesity rate has increased by 2.1% between 2006/7 and 2012/13.
- The overlap of the confidence intervals means that this sample does not provide evidence that there is a real / significant change in the obesity rate over this time.

**Note:**

1. Interval for differences -0.1% < difference in proportions < 4.3% with zero inside not providing evidence of a significant change scores S.

**Judgement**:
**S**: Two points
**P**: One point

**QUESTION TWO**

**Tasks Q2 (a) (i)**
**Evidence:**

- Randomly assigning the students to the two groups means that other factors that are not able to be controlled, and which could affect the outcome of the trial, should be randomly (and hopefully almost equally) present in each group. The use of chance to allocate the students' treatment groups is an attempt to make the characteristics of each group as similar as possible to each other, so that if each group was given the same treatment, the groups should respond in a similar way, on average.

**Note:**

**Tasks Q2 (a) (ii)**
**Evidence:**

- At the end of the experiment, 5/42 = 11.9% of Group A and 11/43 = 25.6% of Group B were found to be of normal weight. The difference in percentage of those of normal weight between the two groups = 13.7 percentage points. (0.137 more than Group A).
- The re-randomisation distribution has a tail proportion of 0.084. Of the 1000 differences in group proportions produced by chance acting alone, 84 were as big as, or even bigger than, the observed difference of 0.137 produced in the experiment itself. This shows that chance could be acting alone. A difference of 13.7% or more could occur by chance alone with probability of 8% OR this experiment does not give sufficient ( gives some) evidence (8% is greater than a 5% threshold) to claim that the treatment provided by providing non-curricular activities causes a reduction in the prevalence of overweightness in primary students.

**Note:**

1. A conclusion referring to a 10% tail is acceptable.

**Judgement**
**S:** One point of explanation in (i) and two points for (ii), one involving descriptive statistics and the other a tail proportion.
**P:** One point in either.

**Tasks Q2 (b) (i)**
**Evidence:**

- The median number of sugar-containing drinks consumed was 1 less in the second survey than the first (mean decreased by 0.6).
- The number of sugar-containing drinks consumed by students as reported in the first survey was more varied than in the second. The IQR has decreased from 4 to 2.5; the standard deviation has decreased by 0.5.
- The distribution of number of sugar-containing drinks consumed in the first survey is quite symmetrical, whereas in the second survey the distribution is slightly right skewed, i.e. fewer students are reporting drinking a lot of sugar-containing drinks.

**Note:**

1. Both distributions can be regarded as symmetrical.
2. A comment about the standard deviation decreasing from 2.6 to 2.1 is not acceptable on its own.
3. Score a P if both surveys are mixed up.

**Judgement**
**S**: Three points with one from each of central measures, measures of spread and distributions.
**P:** One or two points.

**Tasks Q2 (b) (ii)**
**Evidence:**

- The bootstrap distribution is made up of 1000 differences between resample means, using bootstrapping from the original samples.
- Bootstrapping involves randomly sampling, with replacement, from the original samples (first and second surveys) until the resample size equals the original sample size.
- The resample means were calculated for each of the 1000 resamples and plotted as a blue line in the upper part of Figure 7.
- The difference in the resample means was calculated for each resample and is plotted in the lower portion of Figure 7 (the bootstrap distribution).
- The central 95% of the differences is chosen as the bootstrap confidence interval (0.19 – 1.24)

**Note:**

1. A clear explanation that is easily followed is to be provided.

**Tasks Q2 (b) (iii)**
**Evidence:**

- It is fairly safe to say that the mean number of sugar-containing drinks after six months of publicity is somewhere between 0.19 and 1.24 less than that before the publicity.

**Note:**

1. Numerical values must be stated.

**Judgement for (ii) and (iii)**

**O**: Correct explanation plus conclusion.
**S:** Correct explanation with only one point missing plus conclusion.
**P**: One of correct explanation OR conclusion.

**QUESTION THREE**

**Tasks Q3 (a)**
**Evidence:**

**Figure 8:**

- Between 2004 and 2013 there was an upwards trend in obesity in both men (25.5% to 29%) and women (26.4% to 29.5%).
- The gap between the % obesity for both men and women narrowed between 2004 and 2013 (0.9% to 0.5%) OR the % obesity for women is higher over the whole period except for 2012 when the obesity % was 28.6%, the same as for men.
- The % obesity for women fluctuated between 2004 and 2013 with lows in 2006, 2009 and 2012 whereas the % obesity for men showed a linear upwards trend.

**Figure 9:**

- Between 2004 and 2013 the % obesity for the 15–24 age grouping showed a linear upwards trend from 12.6% to 22.3%.
- For the 25–34 age grouping, the % obesity rose from 27.6% (2004) to a peak of 33.9% in 2008, then levelled out until 2013 at approximately 32.5%.
- For the 55–64 age grouping, the % obesity has steadily decreased from 37.1% (2004) to 31.9% (2013).

**Note:**

1. Rate increases per year namely 0.39% per year for women and 0.34% per year for men are acceptable as alternatives to giving first and last values.

**Judgement**
**S:** Three distinct points with at least one from each graph.
**P:** One or two distinct points.

**Tasks Q3 (b)**
**Evidence:**
**Men**
Extrapolating the upwards trend for men we get:
2011: 28.2, 2012: 28.6, 2013: 29.0, 2014: 29.4, 2015: 29.8%.
Trend is consistent so forecast for 2015= **29.8%.**
**Women**
Working out "three yearly" averages for the women over the most recent "three year cycles" 2008 to 2010 and 2011 to 2013 we get 28.1 and 29.0 respectively. Extrapolating for the next three year cycle we get 29.9. Then taking the difference between the mean and actual values, we get for each year (actual – mean): +0.1, –0.7, +0.5, –0.1, –0.4 and +0.5.
Then extrapolating the middle values –0.7, -0.4 we get -0.1 for the 2015 adjustment.
Forecast for 2015 is 29.9 – 0.1 = **29.8%.**
Validity is good:

- Consistent upwards trend that is likely to continue for a few years at least.
- Fluctuations appear to follow a diminishing pattern for the women.
- Prediction isn't too far into the future, and all trends appear to be consistent.

**Note:**

1. Any reasonable method for obtaining the forecasts is acceptable.
2. Only one validity comment is required in answer.
3. Not correct if method for obtaining forecast isn't clearly shown.
4. Trend line $y = 0.315x + 25.206$ can be fitted with $x = 4$ corresponding to 2004. With an adjustment of – 0.533 for the cycles a forecast of 29.398% is obtained for the women in 2015. Cycle fluctuations need to be taken into account.

**Judgement**
**S:** Reasonable forecasts and validity comment.
**2P**: One forecast with an appropriate validity comment is correct.
**P:** **One of**: a forecast, one validity comment **or** two forecasts.

**Tasks Q3(c)**
**Evidence:**

(i) There are physiological differences between men and women.
(ii) Changes are fairly small, and it would be likely that the two surveys took different time points within the two years for the comparisons of increases and decreases in obesity.

**Note:**

1. For (ii) the difference could also be the result of sampling variation.

**Tasks Q3 (d)**
**Evidence:**

| Age group | Percentage change |
|---|---|
| 15–24 | $(22.3 - 12.6)/12.6 \times 100 = +77.0\%$ |
| 35–44 | +18.8% |
| 55–64 | –14.0% |

Age grouping 15–24 increased in obesity by the most at 77% of the 2004 value, and 55–64 was the only group to decrease in obesity by 14% of the 2004 value.

**Note:**

1. Must show some calculation to justify comparison relating to the % change of the 2004 value.
2. Index numbers can be calculated for a comparison. These work out to be 177.0, 118.8, and 86.0 for each age group respectively on a base of 100.

**Judgement based on (c) and (d).**
**O:** Both parts in (c) correct and (d) correct with appropriate comparison.
**S:** Either both parts in (c) correct, or (d) correct with appropriate comparison.
**P:** One part in (c) correct, or either calculations or comment in (d) correct.

**QUESTION FOUR**

**Task Q4 (a)**
**Evidence:**
We use the Binomial probability distribution directly as we have two outcomes, obese or not, fixed number of trials, $n = 1000$, there is a fixed probability 0.386 of an individual being obese and we assume independence of obesity or not between individuals (4 characteristics).
Answer is 0.0489.
**Note:**

1. Using normal approximation to binomial with Mean = $0.386 \times 1000 = 386$ and
   Standard Deviation = $\sqrt{}(1000 \times 0.386 \times 0.614) = 15.395$. As both np and nq > 5.
   $\Pr(X \leq 360) = \Pr(Z \leq (360 - 386)/15.395) = \Pr(Z \leq -1.689) = 0.5 - 0.4516 = 0.0484$.
2. Must have at least 3 out of the 4 characteristics in context of a binomial for correct justification.

**Judgement**
**S:** Correct answer with justification
**P:** Correct answer or justification**.**

**Task Q4 (b)**
**Evidence:**
Let A = event person is aged between 65 and 74 and B= event person is obese.
Construct the following frequency table:

| | A | Not A | Total |
|---|---|---|---|
| B | 192 507 | 922 493 | 1 115 000 |
| Not B | 306 215 | 2 141 085 | 2 447 300 |
| Total | 498 722 | 3 063 578 | 3 562 300 |

Probability that a randomly chosen obese person is aged between 65 and 74 = 192 507/1 115 000 = 0.1727
**Note:**

1. Any other suitable method is acceptable.
2. Accept 17.27%.

**Judgement**
**S:** Correct answer
**P**: Some indication of correct method.

**Task Q4(c)**
**Evidence:**
Consider a person in the 65 to 74 age bracket:
Probability person is obese = 192 507/498 722 from Table in (b) = 0.386
Consider a person not in the 65 to 74 age bracket:
Probability person is obese = 922 493/3 063 578 from Table in (b) = 0.301
So a person aged between 65 and 74 is 0.386/0.301= 1.28 times as likely to be obese compared with a person not in that age bracket.
**Note:**

1. Any other suitable method is acceptable.
2. Can get 0.386 directly from the question.
3. 0.28 times more likely not correct.
4. 28% more likely is acceptable.
5. Relative Risk of 1.282 acceptable as correct.

**Judgement**
**O:** Correct answer.
**S**: Correct probabilities of being obese when in corresponding age bracket.
**P**: Some indication of correct method.

**QUESTION FIVE**

**Tasks Q5**
**Evidence (Must refer to table or graph** or **give the actual figures but be not observations):**

**5(a)(i) Obesity**

- Figure 1 shows an increase in the prevalence of overweight between all income tertiles for both China and Brazil.
- The annual rates in the increase in the prevalence of overweight were 0.5% Brazil, 0.2% China and 0.6% United States.
- Table 1 shows significant increases in obesity between Brazil, China and United States where the confidence intervals don't overlap and the difference is classed as significant.

**5(a)(ii) Underweight**

- Table 1 shows significant decreases in underweights for all between Brazil and the United States where the confidence intervals don't overlap and the difference is classed as significant.
- Underweights decreased in Brazil from 14.8% to 8.6% over 1974 to 1997 while underweights decreased in China from 14.5% to 13.1% over 1991 to 1997.
- In children aged 6 to 9 years, Table 1 shows a significant decrease in the % underweight between 1974 to 1997 and 1991 to 1997 for both Brazil and China respectively. The confidence intervals don't overlap, and the difference is classed as significant.

**Q5(b) Improvement to Table 1**

- Construct confidence intervals for the percentage change in obesity between the time periods for each country. Categories are better defined.

**Q5(b) Improvement to Figure 1**

- Make the graph less cluttered by constructing line graphs (3) for each income tertile over the four countries. Confidence intervals aren't showing up fully and need to be made clearer.

**Q5(c) Application Table 1**

- By observing the confidence intervals, changes can be concluded if there is a significant movement away from zero. If both limits are negative, then this points to a decrease in obesity, whereas both limits being positive points to an increase in obesity.

**Q5(c) Application Figure 1**

- The slope of the line would show either an increase or a decrease in obesity. The amount of slope would provide a good comparison between the countries given that the data would cover the same time periods. If not, we could compensate between the unequal time periods.

**Note:**

1. Several evidence pieces are possible for Q5 (a). Statements need to **compare two countries and be of a trend type**.
2. Answer to (c) has to be read in conjunction with answer to (b).
3. At most two pieces of evidence is acceptable in each of (i) and (ii) from text, table and graph in part (a).
4. The evidence must be non-repetitive.

**Judgement**
**O +2S:** Nine or ten points
**O:** Seven or eight points with at least one for (c).
**2S:** Six points with at least one from (b). If seven or eight points with none from (c) score 2S.
**S+P:** Five points. If six points with none from (b) score S + P.
**S:** Four points
**3P:** Three points
**2P:** Two points
**P:** One point
**N**: No points.

**Scoring for each Question**

Each question part within a question is scored as:
**N** = No meaningful work, insufficient or incorrect answer.
**P** = partially correct to a predetermined level.
**S** = totally correct to a scholarship level.
**O** = totally correct to an outstanding level.
The codes are put together for each question and then converted to a mark out of eight according to the following table:

| Mark | Codes |
|---|---|
| 8 | O + 2S, O + S + P, O + S + 2P, O + 2S + P |
| 7 | O, O + P, O + 2P, O + S, 3S |
| 6 | 2S, 2S + P, 2S + 2P |
| 5 | S + P, S + 2P, S + 3P |
| 4 | S, 4P |
| 3 | 3P |
| 2 | 2P |
| 1 | P |
| 0 | N |

The marks for each question are totalled to give an overall mark. Best possible overall mark is 40.