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PROBLEM ONE (Suggested Answers)

The answers were given to students in Session 7, a few days after the problem was due.

When presenting the results of rapid surveys to policy- and decision-makers, graphs tend to have a greater influence than tables. To present graphs in a report, you first must make them in *Powerpoint* (or some other graphics program) and then move them to *Word* (or some other word-processing program), the software typically used to create a report. For this assignment, you have been asked to create three graphs, each with different features, and one table. The figures and table should have a short title that is descriptive, but not overly inclusive. Following the figures or table, you should have a sentence or two that describes what has been presented. An example of what such sentences might read like follow each graph and table.

FIGURE 1

In **Figure 1**, you are to show two different variables. The first variable is the percent of homes in which a bednet was used as <u>reported</u> at the exit interview in December, 2002. This variable should have been analyzed as coming from a simple random sample. As you likely noticed, there were many errors in Table 1 of the Grabowsky et al article. Thus I gave you the standard error and confidence interval formulas so that you could do the correct math. The second variable is the percent of homes in which a bednet was <u>observed</u> in the two-stage cluster survey done five months later in May, 2003. The survey was done with probability proportionate to size (PPS) in the first stage, and should have been done with a constant number of people or households at the second stage. The authors stated neither how many clusters there were, nor how many people or households were sampled per cluster. It appears that they did not use the right statistics software to analyze their community-based survey (this is not entirely clear, since *Epi Info* has a survey module), but in this regard, you had no choice but to use their values.

The requested graph in *Powerpoint* is not easy to produce because you need to add a confidence interval to a vertical bar. To do so, in the top menu left click on *Chart* followed by a left click on *Chart Type*. Scroll down the menu and left click on *Stock*, followed by a click on the first chart sub-type in the second row (see image at right). In the data sheet that accompanies the graph, you need to arrange the data in the following order:

|		A	B
		Before	After
1	Vol	18.7	94.4
2	High	21.4	90.7
3	Low	15.9	96.9
4	Close	18.7	94.4

Notice that *Vol* is used for your variable, presented as a percentage. *Close* is the same value as *Vol*. Notice also that two vertical axises appear, the one on the left being the *y-axis* and the one the right being the *z-axis*.
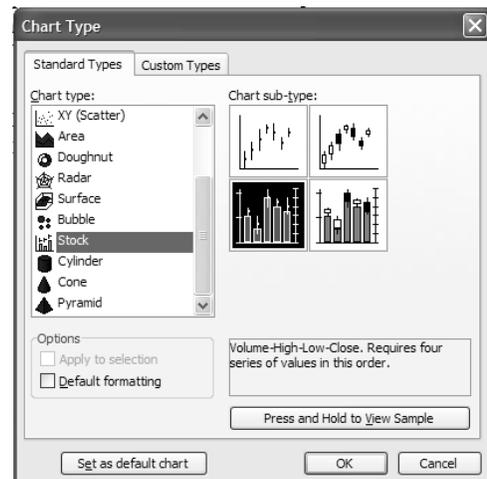
Next, right click on the y-axis and left click on *Format Axis*. Then in the ensuing screen, left click on *Scale* and set *Minimum* to 0, *Maximum* to 100 (i.e., the range of a percentage) and *Major Unit* to 10. Repeat the process for the z-axis and be sure to set the scale exactly the same as for the y-axis. Doing so places the confidence interval in the proper location on each bar. To remove the legend (not need in this graph), left click on the graph then at the top menu, left click on *Chart*, followed by *Chart Options*, followed by *Legend*. Remove the check mark from *Show Legend* (i.e., ☐ Show legend) and return to the graph.

To remove the grid lines, left click on the gridlines (Value Axis Major Gridlines should appear), right click, and left click on *Clear*. To remove the border, left click on the border (Plot Area | should appear) and left click on *Clear*. To remove the printed numbers in the z-axis but keep the numbers in the graph (the graph needs to retain the z-axis scale), left click on the z-axis (Secondary Value Axis | should appear). Then, make sure that no tick marks or tick labels are shown for the z-axis, as demonstrated at right.
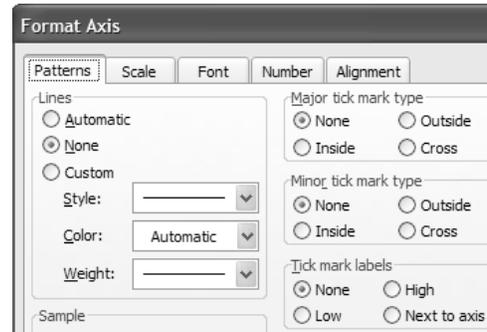
The rest is cosmetic, to be figured out by you.
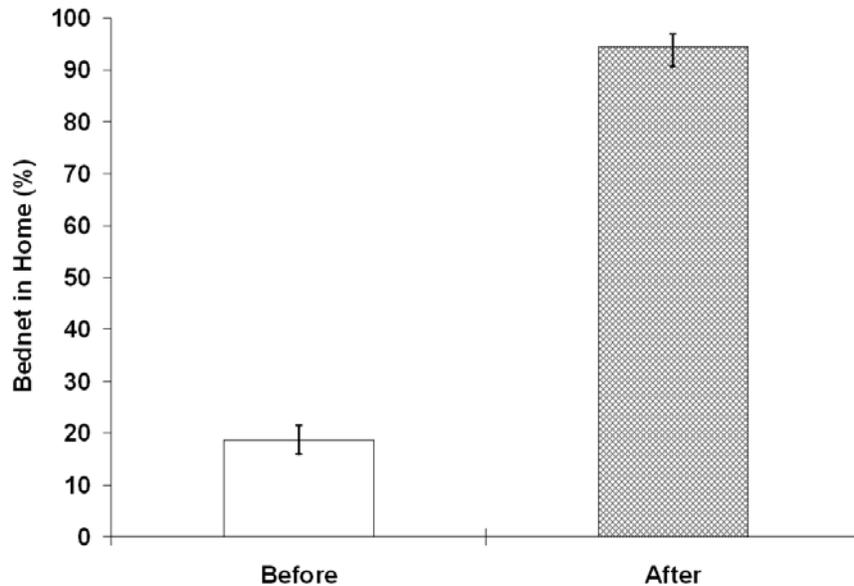
Figure 1. Bednet in home before and after intervention program, Ghana, 2002-03.

Before the measles vaccination campaign was underway, bednets were reported to be present in the home by 18.8 percent (95% confidence interval of 15.9, 21.4) of respondents at an exit interview (see **Figure 1**). Five months after the measles vaccination program, interviewers in a community-based survey observed bednets in 94.4 percent (95% confidence interval of 90.7, 96.9) of the homes.

FIGURE 2

The second figure can be presented in two ways, depending on whether the emphasis is on comparing bednets in the home pre- and post- measles campaign within wealth quintiles, or on

observing the effect that wealth quintile has on reported bednets being in the home.   For the former, I suggest **Figure 2a** that uses bar graphs, while for the latter I suggest **Figure 2b** that uses lines.

For a bar graph, I prefer chart types that are not three-dimensional, feeling that depth often takes away from the main message of the graph. This is a personal choice based on aesthetics, however, rather than a recommendation. The Column chart types selected in *Powerpoint* as shown to the right. Notice in **Figures 2a** and **2b** below that I have included the country and years where and when the study took place.
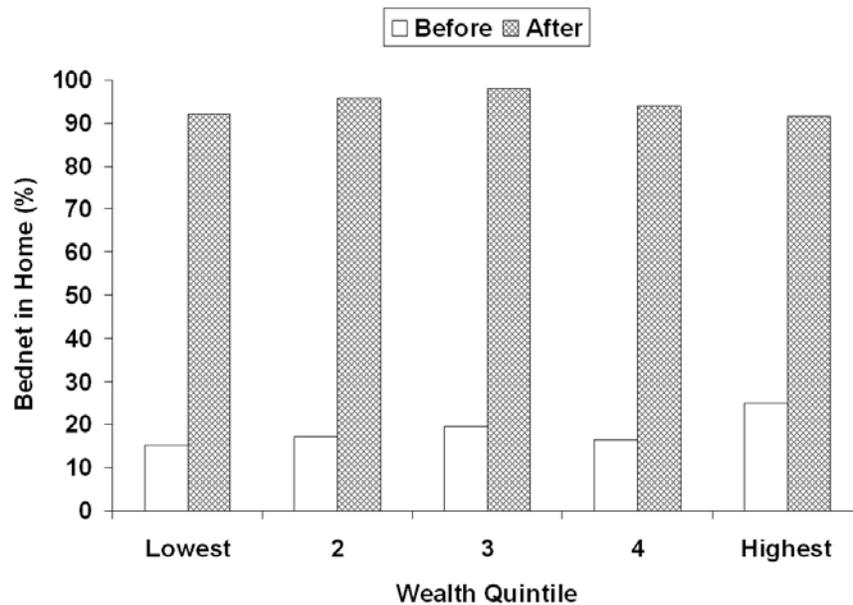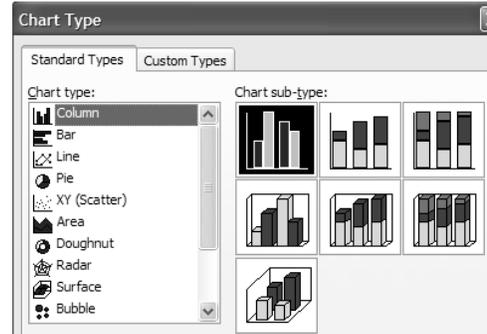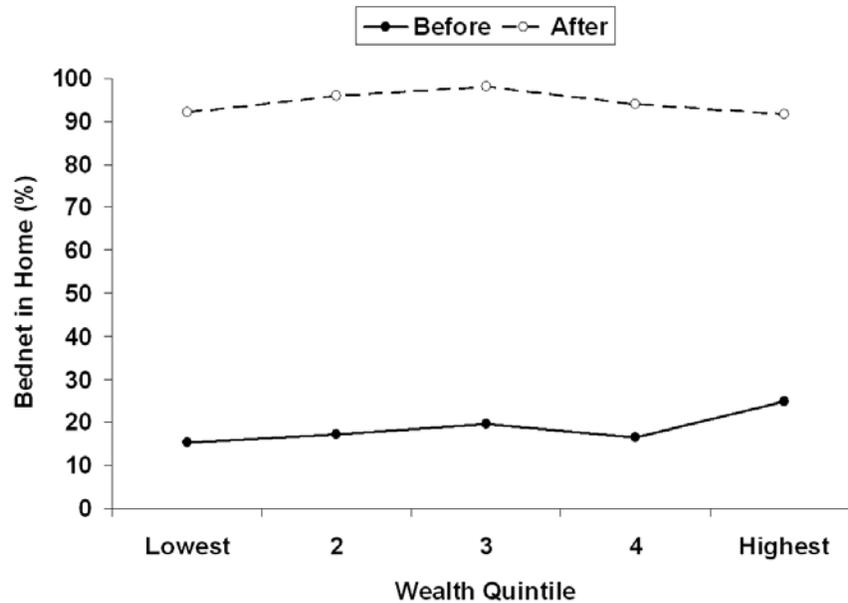

Figure 2a. Bednet in home by wealth quintile before and after intervention program, Ghana, 2002-03.

Household wealth was assessed before and after the measles vaccination program using the standard scoring scheme of the Ghana Demographic Health Surveys (reference). Household wealth was then divided into five categories from lowest to highest, each describing 20% of the households. The presence of bednets five months after the intervention was greatly increased in homes, with dramatic improvement evident in all wealth-categories (see **Figure 2a**).

For a line graph, I prefer dashed lines with open circles and whole lines with closed circles, although again this a personal choice rather than a recommendation. The Line chart types available in *Powerpoint* are shown to the right. To create the line and circle styles, left click on each line, right click and left click on *Format Data Series*. I typically use lines that have a medium weight and circles that are 7 points, wanting them to show up well in a printed figure.
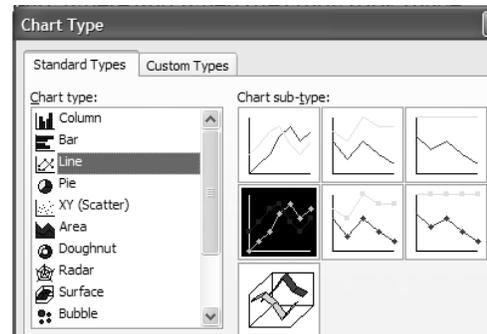
Figure 2b. Bednet in home by wealth quintile before and after intervention program, Ghana, 2002-03.

The presence of bednets five months after the intervention was greatly increased in homes, with dramatic improvement evident in all wealth-categories. While before the vaccination program there was a small but statistically observable increase ($p= 0.06$) in bednets in wealthier compared to poorer homes, there was no statistically significant difference ($p=0.79$) by household wealth observed after the vaccination campaign.
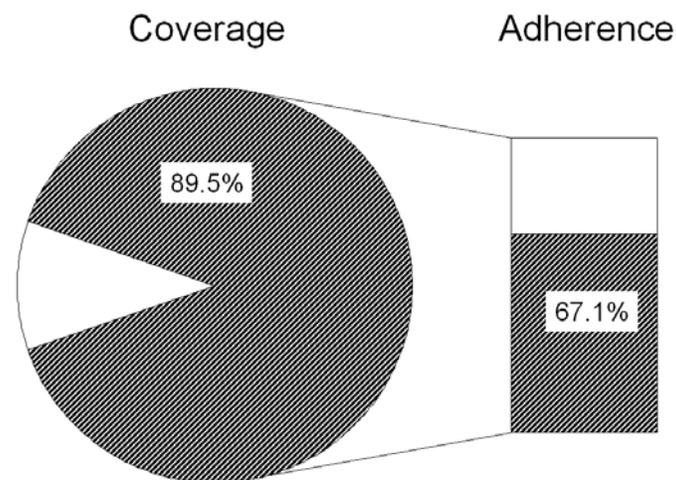
FIGURE 3

Grabowsky et al on page 199 of the article commented, "For this project, we demonstrated high levels of coverage (89.5%) and adherence (68.3%)..." On the same page, they defined *coverage* as the proportion of <u>households</u> with insecticide-treated nets, and the *adherence* as the proportion of <u>individuals</u> properly using insecticide-treated nets each night. It was not clear from their sampling design if there was only one sampled person per household, allowing households and individuals to be mixed in the analysis. Their estimate of *coverage* comes from Table 1 on page 198, in which they stated that 222 of 248 individuals (89.5%) reported <u>receiving</u> insecticide-treated nets, which may be different than <u>having</u> insecticide-treated nets since some reported having sold the insecticide-treated nets. Their estimate of *adherence* also comes from Table 1, but for the line, "bednet observed over bed," rather than the line, "child slept under campaign ITN during previous night" as their definition of adherence seems to suggest. Finally, the denominators in their various figures do not match up, making it difficult to compare one category to another. For instance, the *coverage* question was reported for 248 children (i.e., 222/248), while the *adherence* question was reported for either 249 children (i.e., 170/249) or 254 children (i.e., 153/254).

A more consistent definition of *coverage* might be the percentage of individuals with insecticide-treated nets <u>available</u> in their household. This is different from both the percentage who said they received an insecticide-treated net (i.e., 222/248 or 89.5%) and the percentage with a bednet (which may or may not be insecticide-treated) observed in the home (i.e., 234/248 or 94.4%).

Adherence is usually viewed as conditional on *coverage*. That is, *adherence* is measured as the percentage of covered individuals (i.e., those with an insecticide-treated net available in the home) who currently use the intervention (i.e., slept under an insecticide-treated net during the previous night). If we assume the survey was of 248 children and that 222 had an insecticide-treated bednet available in the home, *coverage* would be 89.5%. If we further assume that the 248 children in the *coverage* analysis were similar to the 254 children who were included in "Child slept under campaign ITN during previous night," then we could derive *x*, the expected number of children who slept under campaign ITN during previous night in the sample of 248 as...

$$\frac{153}{254} = \frac{x}{248}$$

with *x* being 149. Thus while *coverage* is 222/248 or 89.5%, *adherence* would be 149/222 or 67.1%. Using these definitions, the graph of coverage and adherence is shown in **Figure 3**.

Figure 3. Population coverage of insecticide-treated bednet (ITN) and proper ITN nightly adherence, Ghana, 2002-03.

While the population *coverage* of insecticide-treated bednets being available in homes was 89.5%, *adherence* as measured by actual use during the previous night among those who had insecticide-treated bednets was only 67.1% (see **Figure 3**).

Note 1: Figure 3 makes clear that *adherence* is measured among those who are *covered*.

Note 2: Figure 3 could also have been created using the Grabowsky et al numbers of 89.5% and 68.3%, although the graph would not show 68.3% as a subset of 89.5%.

TABLE 1

Grabowsky et al presented data in Table 2 that do not fit together. Usually the "exposure" variable (or the one that comes earlier in time), is presented in the left side of a two-by-two table with two rows (such as "yes" or "no", "exposed" or "unexposed") and the "outcome" variable (or the one that follows in time) is presented at the top of the table with two columns (such as "yes" or "no", "disease" or "no disease"). Table 2 in Grabowsky is presented in the opposite way with the "outcome" variable on the left with two rows and the "exposure" variable on top in the two columns. Also, the authors mention that the risk ratio in Table 2 is 2.20, while the risk ratio as presented in Table 2 appears to be 1.28. Finally, the authors present the risk of receiving vaccination as 8.52 and 3.33 for those receiving or not receiving ITN respectively (with no units stated), while the calculated risk of receiving vaccination in Table 2 appears to be 196/199 or 98.5% versus the 20/26 or 76.9%.   A better orientation of Table 2 in the article is shown below in **Table 1**.

Who is in the sample?

On page 197 (column 1, paragraph 4), Grabowsky et al point out that their analysis is of two groups of children. For most of these analyses, they including all children, 59 months or younger (i.e., < 5 years). This is the group that was reported in their Table 1. For the analysis of measles vaccination and ITN receiving, they limited the sample to children who were aged 9 through 59 months. Thus children in the first 8 months of life were left out of the final analysis reported in Table 2 (p. 198). This seems to explain why there are 248-254 children in the denominators in Table 1 versus 225 children in the denominator in Table 2. But then things get more confusing. On page 298 (column 1, paragraph 1), the authors mention that 204 of 219 children (93.2%), aged 9 months to 5 years were vaccinated against measles. This is in conflict with 216 of 225 (96.0%) vaccinated with measles in Table 2. The denominator should be either 219 or 225. It is not clear why these numbers differ. For the sake of this homework problem (i.e., an exercise that stresses style as well as content), you can assume that the numbers in Table 2 are valid. Thus the table with "four values, two risks, one risk ratio and a 95% confidence interval" (as asked for in Problem 1), should appear as **Table 1** below.

Table 1. Impact of receipt of measles vaccine on receipt of insecticide-treated bednet (ITN) as reported by caregivers in a population-based survey, Ghana, 2003

Received measles vaccination	Received ITN* Yes	Received ITN* No	Risk (%)	Risk Ratio (95% CI)
Yes	196	20	90.7	2.72 (1.08, 6.86)
No	3	6	33.3	

Note: the 95% confidence analysis is likely too narrow, since the analysis did not take into account the increased variance of a cluster survey.

Children vaccinated against measles were 2.72 times more likely five months later to have a caretaker report they had received an insecticide-treated bednet than children who were not

vaccinated. The 95% confidence interval is very wide, however, ranging from 1.08 to 6.86 times greater risk. Moreover, the confidence interval would probably have been wider, if the proper statistical test had been used.

Moving Images from *Powerpoint* to *Word*

Once the slides are created in *Powerpoint*, they need to be moved to *Word* as graphic images. To do so, use the *Save As* command and set the *Save as Type* to *JPEG File Interchange Format*. Next open *Word* and at the place where you want to the figure to appear, click on the top menu *Insert* followed by *Picture* followed by *From File*.   The image will appear, but likely too large and certainly with no caption. To create the desired size, right click with your mouse on the image, left click with your mouse on *Format Picture* and finally, left click with your mouse on *Size*. Be sure that the your aspect ratio is locked so that the slide width and height remain in proportion to your original slide. To add a caption underneath (i.e., the usually location in a report), right click on the image and left click on *Caption*.

Conclusion

Graphs and tables are intended to help others understand the findings of rapid surveys. The data, however, should be true to the underlying study population, not subject to sampling, calculation and presentation errors. It is not clear if Grabowsky et al conducted an unbiased survey, since important points were left out of the Methods section. Furthermore, it appears that they used the wrong statistical tests, presenting overly narrow confidence intervals (at least for some of their analyses) and made many calculation errors that undermine the credibility of their findings.

REFERENCE

Grabowsky M, Nobiya T, Ahun M, Donna R, Lengor M, Zimmerman D, Ladd H, Hoekstra E, Bello A, Baffoe-Wilmot A, Amofah G. Distributing insecticide-treated bednets during measles vaccination: a low-cost means of achieving high and equitable coverage. *Bulletin of the World Health Organization* 83(3),195-201, 2005.