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MTH 4106

Introduction to Statistics

Practical 5

7 February 2012

Today we will use Minitab's inbuilt information about the Binomial distribution to calculate and plot power curves for hypothesis tests about a proportion. Be sure to complete Practical 4 before you start this one.

1 (One-sided test in the pizza example) In this example, $X \sim \text{Bin}(20, p)$, where we do not know what p is. Our null hypothesis is that $p \geq 0.2$; the alternative hypothesis is that $p < 0.2$.

We are going to consider the following rejection regions:

$$\{0\} \quad \{0, 1\} \quad \{0, 1, 2\} \quad \{0, 1, 2, 3\}$$

and the following values of p :

$$0.05 \quad 0.10 \quad 0.15 \quad 0.20 \quad 0.25 \quad 0.30 \quad 0.35.$$

Step 1 Put the integers 0, ..., 3 into a column.

Step 2 For $p = 0.05$, calculate the cumulative distribution function of X if $X \sim \text{Bin}(20, p)$, for values up to 3, and put this into a column called `cdf05`.

Step 3 Create similar columns for the other six values of p .

Step 4 Make another column called `prob` with these seven values of p in order.

Step 5 The first row of columns `cdf05`–`cdf35` shows $\gamma(p)$ for the test $X = 0$; the second row of those columns shows $\gamma(p)$ for the test $X \leq 1$; and so on. In order to plot these power curves, we need to turn these rows into columns. Do this with

`Data → Transpose Columns...`,

then select columns `cdf05` to `cdf35`, and choose to store **after last column in use**.

Step 6 You should now have four columns giving the power function γ , one column for each rejection region. Name these columns `power0` to `power3`.

Step 7 Draw a graph plotting these four power curves against the values of p in the column **prob**. Plot them all on the same graph. Choose the option ‘**With Connect Lines**’ so that the symbols in each curve are joined up.

Step 8 Print this graph and insert it in your lecture notes in an appropriate place. You can either print it directly from the **File** menu, or save it (as a graph, or in the **Report Pad**) and then print it later.

2 (Erasing data and graphs) Make sure that you have saved and/or printed all that you want from the pizza example. Now you need to make some space in Minitab, so close down all the graphs and delete the columns of data by using

Data → **Erase Variables**...

3 (Two-sided test in the coin example) In this example, $X \sim \text{Bin}(20, p)$, where we do not know what p is. Our null hypothesis is that $p = 0.5$; the alternative hypothesis is that $p \neq 0.5$.

We are going to consider the following tests:

(a) $X \leq 4$ or $X \geq 16$ (b) $X \leq 5$ or $X \geq 15$ (c) $X \leq 6$ or $X \geq 14$

and the following values of p :

0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9

Step 1 Create a column containing the integers 4, 5 and 6.

Step 2 For each of the nine values of p above, create a column showing the cumulative distribution function of X if $X \sim \text{Bin}(20, p)$, for the values 4, 5 and 6.

Step 3 Suppose that $X \sim \text{Bin}(20, 0.3)$ and that $Y = 20 - X$. What is the distribution of Y ? How can you use the information on the screen to calculate $\mathbb{P}(X \leq 4 \text{ or } X \geq 16)$?

Step 4 Create nine more columns, one for each value of p , with three rows each, such that the first row shows the probability that (a) is true for that value of p , and the second and third rows show the analogous probabilities for tests (b) and (c).

Step 5 Use this information to plot the power curves for the three tests. Save and/or print the graph and keep it to complete the Feedback question on Assignment 5 (next week).