TUTORIAL EXERCISE PACKAGE - 2013

MATH1015 - BIOSTATISTICS

Semester 1	**Tutorial Week 4**	2013

$$\mathrm{E}(X) = \sum_i x_i p(x_i); \quad \mathrm{E}(X^2) = \sum_i x_i^2\, p(x_i); \quad \mathrm{Var}(X) = E(X^2) - E(X)^2$$

$$E(aX + b) = aE(X) + b; \quad \mathrm{Var}(aX + b) = a^2\mathrm{Var}(X)$$

Tutorial discussion: Q3, Q5, Q6 and Q9 marked with *

1. (**Multiple choice**) A man can hit a target with probability 1/4. If he fires 4 shots in succession, what is the probability that the target will be hit?

(a) 1 (b) $\frac{1}{256}$ (c) $\frac{81}{256}$ (d) $\frac{175}{256}$ (e) $\frac{144}{256}$

2. (**Multiple choice**) A six-sided die is loaded in such a way that an even number is twice as likely to occur as an odd number. The die is thrown two times. The probability that a total of 5 is observed is:

(a) 1/9 (b) 4/81 (c) 2/9 (d) 2/81 (e) 8/81.

3. *Four mice, A, B, C and D, are placed in the centre of a maze which has five exits and behave independently. Each mouse is equally likely to leave the maze through any one of the five exits.

(a) What is the probability that all come out the same exit?

(b) What is the probability that A, B and C come out the same exit, and D comes out a different exit?

4. When Mendel crossed a tall strain of pea with a dwarf strain of pea, he found that $\frac{3}{4}$ of the offspring were tall and $\frac{1}{4}$ were dwarf. Suppose five such offsprings were selected at random. Find the probability that all of these offsprings were tall.

5. *Let X be the number of 'tall offsprings' in a random sample of 5 in Q4.

(a) Explain why the distribution of X is discrete valued. What are the possible values of X?

(b) Find the probability distribution of X by filling ? entries of the following table:

x	?	?	?	?	?	?
$P(X = x)$	?	?	?	?	?	?

6. *Let X be a discrete random variable. Complete the ? entry from the following table:

i	0	1	2	3	4
p_i	0.17	0.36	0.31	?	0.03

Find

(a) $\mathrm{E}(X)$ (b) $\mathrm{E}(X^2)$ (c) $\mathrm{Var}(X)$

7. The number, X, of bacterial colonies which develop on a small dish of nutrient in an infested environment is described by the following probability distribution:

i	0	1	2	3	4
p_i	0.05	0.10	0.30	0.40	0.15

Calculate the expected number of colonies on a dish of nutrient in this environment. How do you interpret this value?

Use R to answer Q8 and Q9

8. Consider data in IronRetained.txt on the course website. The first three columns give the percentages of iron retained for each mouse after receiving 3 concentrations 10.2, 1.2 and 0.3 of iron, Fe^{2+} as shown. Similarly, the next three columns for iron, Fe^{3+}.

(a) Enter the data in R using the command
`x=read.table(file=url("http://www.maths.usyd.edu.au/math1015/r/IronRetained.txt"),skip=3)`

(b) Find the mean and median for each column and comment.

(c) Draw six boxplots (one for each column) on the same page and comment. (Hint: use `boxplot(x)`).

9. *The `hospital` data of discharged patients contains the following columns:

```
Column  Label
1       ID no.
2       Duration of hospital stay
3       Age
4       Sex  1=male  2=female
5       First temperature following admission
6       First WBC(x1000) following admission
7       Received antibiotic 1=yes  2=no
8       Received bacterial culture 1=yes  2=no
9       Service 1=med 2=surg.
```

Read the data using

```
dat=read.table(file=url("http://www.maths.usyd.edu.au/math1015/r/hospital.txt"),skip=1)
anti=dat[,7]
bac=dat[,8]
```

Let A denote the event of receiving antibiotic and B denote the event of receiving bacterial culture for a discharged patient.

(a) Use the data to estimate the probability that a discharged patient receives both antibiotic (`anti`) and bacterial culture (`bac`) treatments. Are the events A and B *mutually exclusive*?

Hint: use `length(anti[anti==1 & bac==1])` to count the number of discharged patients receiving both treatments.

(b) Use the data to estimate the probabilities that a discharged patient receives
(i) antibiotic $P(A)$; (ii) bacterial culture $P(B)$; (iii) both $P(AB)$.

Are the events A and B *independent*?

Semester 1 | Problem Sheet Week 4 | 2013

1. Two unbiased dice are thrown. Write out the 36 outcomes to which equal probability are assigned and use counting methods to find the probability that the total showing

(a) exceeds 9 (b) is at most 5 (c) is odd.

2. The following table shows the probability distribution of X, where $p_i = P(X = i)$.

i	1	2	3	4	Total
p_i	0.35	0.30	0.25	0.10	1.00

Find $E(X)\,, E(\frac{1}{X})\,, E(X^2)\,, Var(X)\,.$

3. A nutrient is sprayed with a mild antibiotic in Q7 (tutorial section), the probability distribution is assessed to be the following:

i	0	1	2	3	4
p_i	0.21	0.43	0.21	0.12	0.03

What reduction in the *expected* number of colonies has the antibiotic achieved?