BRIEF SOLUTIONS

Basic Probability

WEEK THREE

This worksheet relates to chapter four of the text book (Statistics for Managers 4th Edition).

This topic is the one many students find the most difficult. Work hard and be persistent. Remember, practice makes perfect.

DISCUSSION QUESTIONS

1. What is the difference between statistically dependent and statistically independent events? Come up with examples of each.

2. What is mutually exclusive? What is collectively exhaustive? Provide Examples.

The questions can look rather simple to start off with but the exam questions can be pretty tricky, so you need to **understand** each of the rules…

UNDERSTANDING THE RULES

Term	May be read as	Formula
Simple Probability	Probability of A	$P(A) = \frac{A}{T}$
Addition Rule	Probability of A or B	P(A or B) = P(A) + P(B) – P (A and B)
Conditional Probability	Probability of A given B	$P(A \mid B) = \frac{P(AandB)}{P(B)}$
Multiplication Rule	Probability of A and B	P (A and B)= P (A | B) x P(B)
Complementary Event Rule	The complement of A or the probability of NOT A	$P(A') = 1 - P(A)$

CALCULATION QUESTIONS

1. A research study investigating the relationship between smoking and heart disease in a sample of 800 men over 50 years of age provided the following data:

	Smoker	Non-smoker	Total
Heart Disease	50	30	80
No Heart Disease	150	570	720
Total	200	600	800

(a) Construct a joint probability table for this data.

	S Smoker	S' Non-smoker	Total
Heart Disease H	**0.0625**	**0.0375**	**0.1**
No Heart Disease H'	**0.1875**	**0.7125**	**0.9**
Total	**0.25**	**0.75**	**1**

Joint probability tables are emphasised in lectures, but for some students drawing a Venn diagram or a tree diagram can help with understanding. You should, however, use joint probability tables for working.

(b) Interpret one of the joint probabilities.

Eg. The probability of having heart disease and being a smoker is equal to 0.0625 ie. $P(H \cap S) = 0.0625$

NB. Recognise the difference between joint and marginal probabilities..

(c) Given that a man over 50 years is a non-smoker, what is the probability that he has heart disease?

$$P(H \mid S') = \frac{P(H \cap S')}{P(S')}$$
$$= \frac{0.375}{0.75}$$
$$= 0.05$$

2. There are two locations in town (north and south) under consideration for a new restaurant, but only one location will actually become available. If it is built in the north, the restaurant stands a 90% chance of surviving its first year. However, if it is built in the south, its chance of survival is only 65%. It is estimated that the chance of the northern location being available is 40%.

(a) Write down all the information you have been given.

Let N=north, S=south, F=survives first year

P(N) = **0.4**

P(F| N) = **0.9**

P(F| S) = **0.65**

P(N and F) = **0.36**

P(N and F') = **0.04**

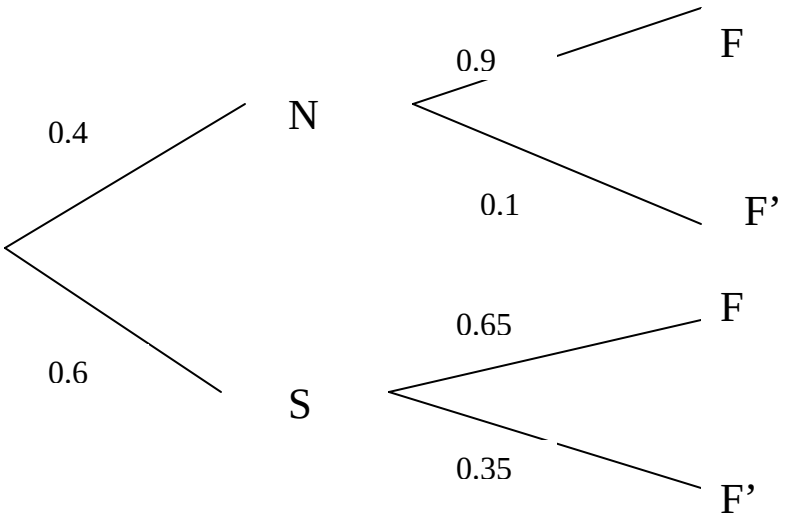
P(S and F) = **0.39**

P(S and F') = **0.21**

(b) Put this information into a joint probability table

	N	**S**	**Total**
F	**0.36**	**0.39**	**0.75**
F'	**0.04**	**0.21**	**0.25**
Total	**0.4**	**0.6**	**1**

(c) Draw a tree diagram and include conditional and joint probabilities



(d) Find the probability that the restaurant will survive it's first year.

P(F) = 0.75

(e) Find the probability that the restaurant is built in the south and is successful.

P(S∩F) = 0.39

(f) Find the probability that the restaurant is in the south given that it is successful.

P(S| F) = P(S∩F)/P(F) = 0.39/0.75 = 0.52

(g) Find the probability of failure given that the restaurant is in the north.

$P(F' \mid N) = P(F' \cap N)/P(N) = 0.04/0.4 = 0.1$

MULITPLE CHOICE QUESTIONS

1. The probability that a sum of seven appears in a single toss of a pair of fair dice is

   (a) 1/6
   (b) 5/6
   (c) 1/36
   (d) 0
   (e) 1/10

2. The probability of drawing three aces from a pack of cards is _____ the probability of drawing the 8 of hearts, then the three of diamonds, then the queen of clubs.

   (a) greater than
   (b) less than
   (c) equal to

3. Events M and Q are mutually exclusive. Which of the following is TRUE?

   (a) M and Q are also independent
   (b) P(M).P(Q) = P(M and Q)
   (c) P(M or Q) = P(M) + P(Q)
   (d) P(M or Q) = 1 – P(M and Q)

Mid Semester, April 2005

4. Which of the following statements are true?

1. the rows and columns of a contingency table subdivide the sample space into mutually exclusive and collectively exhaustive events
2. collectively exhaustive events must be mutually exclusive
3. if events A and B satisfy P(A| B)=P(A), then the two events are statistically independent

(a) 1 only
(b) 3 only
(c) 2 and 3 only
(d) **1 and 3 only**

Final, June 2004

Please give your PASS Leaders feedback on how your tutorials and lectures are going. If you don't provide us with feedback on what is good and what can be improved we won't know what needs to be changed.

If you would like to suggest ways your PASS leader can improve please email Naomi at pass-stats@economics.uq.edu.au. The PASS leaders will not be told who gave the suggestion

notes