

**PRACTICE SECOND MIDTERM EXAM**

- 1.** You are taking a course that was taught many times in the past. So far 10,000 students have taken it. The only grades given in this course are As and Bs (no + or –). In the past the instructor has always given As to 20% of the class. The instructor gives a midterm that she grades as either "Pass" (P) or "Fail" (F). In the past, of the students who received an A in the course, 75% had received a P in the midterm. Of the students who received a B in the course, 50% had failed the midterm.

**(a)** Fill in the following table for the 10,000 students who took this course in the past.

Total number of students	10,000
Number of students who got an A	
Number of students who got a B	
Number of students who got P in midterm and A in the course	
Number of students who got F in midterm and A in the course	
Number of students who got P in midterm and B in the course	
Number of students who got F in midterm and B in the course	

- (b)** At the very beginning of the course, what is the probability that you will get an A?
- (c)** If you get a P in the midterm, how likely is it that you will get an A?
- (d)** If you get an F in the midterm, how likely is it that you will get a B?
- (e)** At the beginning of the course, what is the probability that you will get a P in the midterm and an A in the course?

**2.** You are a doctor. Whenever you have a patient whose symptoms are consistent with different causes, your approach is to treat the most likely cause. You are now seeing a patient whose symptoms are consistent with only three, equally serious, diseases: globoma, popitis and flapemia. In the past, of all the patients with these symptoms, 80% had globoma, 10% popitis and 10% flapemia. Each disease has its own treatment which is ineffective against the other two diseases. A costly test is available, called the ET scan, which would for sure be positive if the patient had popitis and for sure be negative if the patient had flapemia, that is,  $P(+|P)=1$  and  $P(-|F)=1$ . On the other hand, if the patient has globoma then the ET scan will be positive in 70% of the cases and negative in 30% of the cases. If the ET test is the only test you could do, should you do it? Why, or why not?

**3.** You are facing the following decision problem, where the numbers are von Neumann-Morgenstern utilities:

probability	$\frac{1}{3}$	$\frac{1}{12}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{1}{6}$
state $\rightarrow$	$s_1$	$s_2$	$s_3$	$s_4$	$s_5$
act $\downarrow$					
$a$	5	5	4	2	2
$b$	6	1	6	1	1
$c$	0	4	1	5	0

(a) What action will you choose?

(b) Suppose you are offered partial information, represented by the partition

$$\{\{s_1, s_2, s_3\}, \{s_4, s_5\}\}.$$

(b.1) What action will you choose if you receive information  $\{s_1, s_2, s_3\}$ ?

(b.2) What action will you choose if you receive information  $\{s_4, s_5\}$ ?

(b.3) By how much does your utility increase if the above information is made available to you for free, relative to the case of no information?