

Concordia University  
 Department of Mathematics and Statistics

Course	Number	Section	
STAT	249/2	A	
Examination	Date	Time	Pages
Mid-term	October, 2017	70 Minutes	2
Instructor	Course Examiner	Marks	
M. Singh	E. Duma	40	
<b>Special Instructions:</b>		<b>Closed Book Exam.</b>	
1. Answer ALL questions.			
2. Calculators are allowed.			
3. Full credit will be given only for answering questions clearly & systematically.			

[1+2+2+5] Q1. (a) A large group of people is to be checked for two common symptoms of a certain disease. It is thought that 25% of the people possess symptom  $A$  alone, 35% possess symptom  $B$  alone, 10% possess both symptoms, and the remaining have neither symptom. For one person chosen at random from this group, find the following probabilities:

- i. The person has neither symptom.
- ii. The person has at least one symptom.
- iii. The person has both symptoms, given that he has symptom  $B$ .

(b) Prove the following.

$$\binom{n+1}{k} = \binom{n}{k} + \binom{n}{k-1}$$

[4+6] Q2. Medical histories indicate that different illnesses may produce identical symptoms. Suppose that a particular set of symptoms, denoted  $H$ , occurs only when any one of three illnesses,  $I_1, I_2$  or  $I_3$  occurs. Assume that the simultaneous occurrence of more than one of these illnesses is impossible, and that

$$P(I_1) = 0.02, P(I_2) = 0.05, P(I_3) = 0.10.$$

The probability of developing the set of symptoms  $H$ , given each of these illnesses, are known to be

$$P(H|I_1) = 0.80, P(H|I_2) = 0.95, P(H|I_3) = 0.75.$$

- (a) What is the probability that a person exhibits the symptom,  $H$ .
- (b) Given that a person exhibits the symptom,  $H$ , what is the probability that the person has illness  $I_2$ .

- [3+3+4] Q3. Five balls, numbered 1, 2, 3, 4 and 5, are placed in an urn. Three balls are randomly selected (without replacement) from the five, and their numbers noted. Find the probability distribution of the following.
- (a) The *smallest* of the three sampled numbers
  - (b) The *largest* of the three sampled numbers
  - (c) The *sum* of the three sampled numbers
- [3+4+3] Q4. A missile protection system consists of five radar sets operating independently, each with a probability of 0.95 of detecting a missile entering a zone that is covered by all of the units. If a missile enters the zone, what is the probability that
- (a) what is the probability that exactly four sets will detect the missile.
  - (b) what is the probability that at least three sets will detect the missile?
  - (c) what is the expected number of radar sets detecting the missile.

**GOOD LUCK!**