

Example Problems for Lecture on Quantitative Tools for Reliability Analysis (Discrete Case)

ECE 60872/CS 590 –Fault-Tolerant Computer System Design School of Electrical and Computer Engineering Purdue University Fall 2017

1. Bayes' Rule

A communication channel carries a 0 or a 1. The channel is faulty and therefore sometimes a 0 is received as 1 and vice-versa. For the channel, the probability that a transmitted 0 is received correctly is 0.94, and the probability that a transmitted 1 is received correctly is 0.91. Also, the probability that a 0 is transmitted is 0.45.

If a signal is sent, determine:

- (i) Probability that a 1 is received
- (ii) Probability that a 0 is received
- (iii) Probability that a 1 was transmitted given that a 1 was received
- (iv) Probability of error

2. Total probability

The system can fail under two conditions: the temperature becomes too hot (E1) or there are too many requests coming in (E2). If E1 happens, then the probability of the system failing is 0.05 and if E2 happens, then the probability is 0.1. The probabilities of E1 and E2 are respectively 0.3 and 0.4. What is the reliability of the system?

3. Reliability computation of TMR

There are three components, two of which are required to be working for the system to function properly. The outputs from the 3 components are fed into a majority voter. If the probability of an individual component working correctly is R , what is the reliability of the system? Under what condition is this better than a non-redundant system?

4. Correlated failures

I have built an application that employs two web servers – an Apache Web Server and one called Nginx. As long as either web server is functional, my customers will be able to access content and perform transactions. The two web servers share some components (file handling, PHP interpreter) and therefore their failures are *not* uncorrelated.

$\Pr(\text{Apache WS working}) = 0.95$

$\Pr(\text{Nginx working}) = 0.97$

If one of the web server fails, then the probability of the other failing is increased by 20%.

What is the likelihood that my application works correctly?

If the two web servers had completely separate code bases, what would be the probability of my application working correctly?