Probability Calculations

# Introduction

This document presents the probability calculations of the Term Assignment[1] in the course TFE4140 Modelling and Analysis of Digital Systems, Spring 2014. What are presented are the detailed solutions of sub-problem 5 in the Term Assignment.

# The Calculations

According to the Term Assignment, a microcontroller is expected to work for 6 years before failing. What is to be calculated are:

* The mathematical expression of max one error after *t* time
* The mathematical expression of max two errors after *t* time
* The mathematical expression of at least three errors after *t* time
* The Mean Time To Failure (MTTF) for the Liaison system

**Chance for a failure in a controller after time t when T = 6:**

**Probability for a number r failures of n controllers:**

Since n = 4, Q(r) will be:

Note that:

**Probability for max 1 error (written as P(Max (1))) after t time can be expressed as:**

P(Max(1)) = Q(4)+Q(3).

**Probability for max 2 errors after t time can be expressed as:**

P(Max(2)) = Q(4)+Q(3) + Q(2) = P(Max(1))+Q(2)

**Probability for error in at least 3 (written as P(Least(3))controllers can be expressed as:**

The reason this works is that at least 3 errors are the same as 3 OR 4 errors.

That would be Q(3) + Q(4). Since Q(0) + … + Q(4) = 1, subtracting Q(0), Q(1) and Q(2) from 1 should provide the answer. The total probability of Q(0) + Q(1) + Q(2) is already expressed in P(Max(2)). Therefore, P(Least(3)) = 1 – P(Max(2)).

**Mean time to failure:**

The assumption is that when 3 microcontrollers have failed, the entire system has failed. As long as 2 or more controllers are working, the system works. R(t) must then be P(Max(2))

Estimated mean time to failure is 6,5 years.

# Summary

# Sources:

[1] TFE4140 Modelling and Analysis of Digital Systems Term Assignment 2014