**

*The cumulative hazard function:*

Note: The hazard function or the cumulative hazard function NOT a probability. They are a measure of risk. The greater the value of the cumulative hazard function, the greater the risk of failure by time t.

Survival analysis has two functions: survival function and hazard function.

From survival function: it is giving the probability of the event of interest has not occurred by duration t.

S(t)= 1-F(t)= integrate from t to inf f(x) dx.

The hazard function is used to illustrate the instantaneous rate of occurrence of the event.

λ(t)= limit dt->0 P( t=<T<t+dt | T>=t)/ dt

The numerator of this function is a conditional probability expression that the event will occur in the time interval [t, t+dt ) based on it does not occur before the time t.

The denominator is the width of the time interval.

Using one dividing another, we can get the average rate of event occurrence per unit of time.

Taking the width of interval down to 0, we can get the instantaneous rate of occurrence.

In other words,

λ(t)= f(t)/S(t) according to the conditional probability.

Because dS(t)= d(1-F(t))=-f(t), we can get the derivative of lambda(t)=-dlog(S(t))/dt

According to such relationship between hazard function and survival function,

We can know that

S(t)= exp (-integrate from 0 to t λ(t) )

And we define the integrate part as Λ(t) , which describe the sum risks you face in the time duration from 0 to t.

According to the concept of expected value: the µ donates the expected value or mean of T, which will be calculated by

µ= integrate from 0 to ∞ t\*f(t) dt

because -f(t) is the derivative of S(t), and S(0)=1& S(∞)=0 ,

µ= integrate from 0 to ∞ S(t) dt (integrate by part).

In other words, the expected value of the waiting time until the occurrence of an event is the integral of survival function.