Lighting experiment

S1. Simulate lighting data

```
sim.light <- function(T,lambda=0.8,p=0.9){
  wt = NULL
  tau = NULL
  obs = NULL
  ot=0
  i = 1
  j=1
  while(sum(wt)<T){
   wt[i] = rexp(1,rate = lambda)
   tau[i] = rbinom(1,1,prob=p)
   ot = ot+wt[i]
   if(tau[i]==1){
     obs[j] = ot
     ot = 0
     j=j+1
   }
   i=i+1
  }
  d = length(wt)
  wt = wt[-d]
  tau = tau[-d]
  #wt[d] = T-sum(wt)
  return(list(wt=wt,tau=tau,obs=obs))
}


l1 = sim.light(50,p=0.5)
l1
```

```
## $wt
##  [1] 1.40408369 1.26563765 1.30243816 1.18544307 1.89434943 0.52583030
##  [7] 1.27121893 1.92001770 0.14802447 0.15401739 0.35347079 0.36464058
## [13] 2.12764823 1.42720890 2.35224897 0.37731101 1.02505642 1.31854135
## [19] 0.04831676 2.14710251 0.43111674 0.88971719 0.52121886 1.33385722
## [25] 2.49601305 0.72301454 0.41398573 0.31092721 0.13350846 0.45353800
## [31] 0.09735772 0.44886304 0.37720710 1.21418150 0.11266688 0.63887215
## [37] 1.24591377 0.25388741 0.45423785 0.25675101 0.51521482 1.63435238
## [43] 1.22331928 2.56672051 6.05099803 2.03451493
##
## $tau
##  [1] 1 0 1 0 0 0 1 0 1 0 0 0 0 1 1 1 1 1 0 0 1 1 0 0 0 0 0 0 0 0 1 1 0 1 0 1
## [36] 0 0 0 1 0 0 1 1 0 0 0
##
## $obs
##  [1] 1.40408369 2.56807581 4.87684173 2.06804216 4.42698590 2.35224897
##  [7] 0.37731101 1.02505642 1.31854135 2.62653601 0.88971719 6.38606308
## [13] 0.09735772 0.82607014 1.32684838 2.59291119 2.40631820 1.22331928
```

S.1.1 Calculate MLE

```
llik.light <- function(light,par){
  lambda = par[1]
  p = par[2]
  exp = dexp(x=light$wt,rate=lambda,log=T)
  bin = dbinom(x=sum(light$tau),size=length(light$tau),prob=p,log=TRUE)
  llik = sum(exp)+bin
  if(p>1 | p<0){
    llik = -Inf
  }
  return(llik)
}
mle.light <- function(light,init_par = c(2,1)){
  p = sum(light$tau)/length(light$tau)
  lambda = 1/mean(light$wt)
  #optim(par=c(0.5,0.5),fn=llik.light,lower=c(0,0),light=light, upper = c(5,1),method="L-BFGS-B")
  return(list(lambda=lambda,p=p))
}
l1
```

```
## $wt
##  [1] 1.40408369 1.26563765 1.30243816 1.18544307 1.89434943 0.52583030
##  [7] 1.27121893 1.92001770 0.14802447 0.15401739 0.35347079 0.36464058
## [13] 2.12764823 1.42720890 2.35224897 0.37731101 1.02505642 1.31854135
## [19] 0.04831676 2.14710251 0.43111674 0.88971719 0.52121886 1.33385722
## [25] 2.49601305 0.72301454 0.41398573 0.31092721 0.13350846 0.45353800
## [31] 0.09735772 0.44886304 0.37720710 1.21418150 0.11266688 0.63887215
## [37] 1.24591377 0.25388741 0.45423785 0.25675101 0.51521482 1.63435238
## [43] 1.22331928 2.56672051 6.05099803 2.03451493
##
## $tau
##  [1] 1 0 1 0 0 0 1 0 1 0 0 0 0 1 1 1 1 1 0 0 1 1 0 0 0 0 0 0 0 0 1 1 0 1 0 1
## [36] 0 0 0 1 0 0 1 1 0 0 0
##
## $obs
##  [1] 1.40408369 2.56807581 4.87684173 2.06804216 4.42698590 2.35224897
##  [7] 0.37731101 1.02505642 1.31854135 2.62653601 0.88971719 6.38606308
## [13] 0.09735772 0.82607014 1.32684838 2.59291119 2.40631820 1.22331928
```

```
mle.light(l1,init_par=c(1,0.5))
```

```
## $lambda
## [1] 0.9303349
##
## $p
## [1] 0.3913043
```

```
n=100
L = vector(mode='numeric',length = n)
P = vector(mode='numeric',length = n)
for(i in 1:n){
  li = sim.light(T=50)
  ml = mle.light(light = li)
  L[i] = ml$lambda
```

```
  P[i] = ml$p
}

summary(L)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.4868  0.7270  0.8175  0.8137  0.8942  1.1127
```

```
summary(P)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.7556  0.8632  0.9024  0.8977  0.9348  1.0000
```

Incomplete data

Option 1. The current way

```
rec.light <- function(obslight,lambda,p){
  dt = obslight
  for(i in 1:length(dt)){
    t = dt[i]

  }
}
```

Option 2. topoloy first

```
sim.miss.light <- function(obslight,lambda,p){
  dt = obslight
  j = 1
  for(i in 1:length(dt)){

    to = m = 0
    while(to == 0){
      to = rbinom(1,1,p)
      top[j] = to
      j = j+1
      if(to == 0) m <- m+1
    }

  }
}
```