ConditionalEVaR

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Define Library

Define problem

```
X = list()
X[[1]] = list(stats = list(), df = data.frame(x = c(1,2,3,4),
                                              p = c(0.1,0.2,0.5,0.2)))
X[[2]] = list(stats = list(), df = data.frame(x = c(50,60,70,80),
                                              p = c(0.5,0.3,0.1,0.1)))
X[[3]] = list(stats = list(), df = data.frame(x = c(1,2,10,50),
                                              p = c(0.5,0.3,0.1,0.1)))
X[["n"]] = length(X)
X[["prob"]] = c(0.1,0.8,0.1)
```

```
lambda=0.3
# EVaR_analysis = function(X,lambda=0.3){

  joint_prob = data.frame(x = c(sapply(1:X$n,function(i) X[[i]]$df$x)),
                          p = c(sapply(1:X$n,function(i) X[[i]]$df$p*X[["prob"]][i])))
  joint = aggregate(joint_prob$p,list(joint_prob$x),FUN = sum)
  X[["joint"]] = list(stats = list(), df = data.frame(x=joint$Group.1,p=joint$x))
  # Usually we will required to solve for beta
  beta = 0.0685626105168434

  X[["joint"]]$df$Z_hat = exp(-beta*X[["joint"]]$df$x)
  X[["joint"]]$stats$C = sum(X[["joint"]]$df$p * X[["joint"]]$df$Z_hat)
  X[["joint"]]$df$Z = X[["joint"]]$df$Z_hat / X[["joint"]]$stats$C
  X[["joint"]]$stats$ERM = ERM(X[["joint"]]$df$x,alpha=beta,prob=X[["joint"]]$df$p)
  X[["joint"]]$stats$EVaR = X[["joint"]]$stats$ERM + log(lambda)/beta
  # Method 2 to compute EVaR
  X[["joint"]]$stats$EVaR2 = sum(X[["joint"]]$df$p*X[["joint"]]$df$Z*X[["joint"]]$df$x)


  # we will required to optimize for beta on the joint distribution
  for (i in 1:X$n){
    X[[i]]$df$Z_hat = exp(-beta*X[[i]]$df$x) # exp(-bx)
    X[[i]]$stats$C = sum(X[[i]]$df$p * X[[i]]$df$Z_hat)
    X[[i]]$df$Z = X[[i]]$df$Z_hat / X[[i]]$stats$C # exp(-bx)/E[exp(-bx)]

    X[[i]]$stats$Xi = X[[i]]$stats$C/X[["joint"]]$stats$C
    X[[i]]$stats$linL = lambda * X[[i]]$stats$Xi
    X[[i]]$stats$trueL = exp(-sum(X[[i]]$df$p*X[[i]]$df$Z*log(X[[i]]$df$Z)))
    X[[i]]$stats$ERM = ERM(X[[i]]$df$x,alpha=beta,prob=X[[i]]$df$p)
    # Method 3 to compute EVaR
```

```
    X[[i]]$stats$TrueEVaR = X[[i]]$stats$ERM + log(X[[i]]$stats$linL)/beta
    X[[i]]$stats$CondEVaR = X[[i]]$stats$ERM + log(X[[i]]$stats$trueL)/beta
  }

  # Method 4 to compute EVaR
  X[["joint"]]$stats$EVaR4 = sum(X$prob * sapply(1:X$n,function (i) X[[i]]$stats$Xi) *
                                   sapply(1:X$n,function (i) X[[i]]$stats$CondEVaR))

  X
```

```
## [[1]]
## [[1]]$stats
## [[1]]$stats$C
## [1] 0.8268176
##
## [[1]]$stats$Xi
## [1] 4.624794
##
## [[1]]$stats$linL
## [1] 1.387438
##
## [[1]]$stats$trueL
## [1] 0.9981798
##
## [[1]]$stats$ERM
## [1] 2.773686
##
## [[1]]$stats$TrueEVaR
## [1] 7.549743
##
## [[1]]$stats$CondEVaR
## [1] 2.747114
##
##
## [[1]]$df
##   x   p     Z_hat         Z
## 1 1 0.1 0.9337350 1.1293119
## 2 2 0.2 0.8718610 1.0544781
## 3 3 0.5 0.8140872 0.9846031
## 4 4 0.2 0.7601417 0.9193583
##
##
## [[2]]
## [[2]]$stats
## [[2]]$stats$C
## [1] 0.02236598
##
## [[2]]$stats$Xi
## [1] 0.1251038
##
## [[2]]$stats$linL
## [1] 0.03753115
##
## [[2]]$stats$trueL
```

```
## [1] 0.8753626
##
## [[2]]$stats$ERM
## [1] 55.42692
##
## [[2]]$stats$TrueEVaR
## [1] 7.549743
##
## [[2]]$stats$CondEVaR
## [1] 53.48538
##
##
## [[2]]$df
##    x   p       Z_hat         Z
## 1 50 0.5 0.032447544 1.4507544
## 2 60 0.3 0.016346252 0.7308534
## 3 70 0.1 0.008234829 0.3681855
## 4 80 0.1 0.004148498 0.1854825
##
##
## [[3]]
## [[3]]$stats
## [[3]]$stats$C
## [1] 0.782048
##
## [[3]]$stats$Xi
## [1] 4.374376
##
## [[3]]$stats$linL
## [1] 1.312313
##
## [[3]]$stats$trueL
## [1] 0.9042432
##
## [[3]]$stats$ERM
## [1] 3.585615
##
## [[3]]$stats$TrueEVaR
## [1] 7.549743
##
## [[3]]$stats$CondEVaR
## [1] 2.117513
##
##
## [[3]]$df
##    x   p      Z_hat          Z
## 1  1 0.5 0.93373500 1.19396118
## 2  2 0.3 0.87186104 1.11484334
## 3 10 0.1 0.50377471 0.64417362
## 4 50 0.1 0.03244754 0.04149047
##
##
## $n
## [1] 3
```

```
##
## $prob
## [1] 0.1 0.8 0.1
##
## $joint
## $joint$stats
## $joint$stats$C
## [1] 0.1787794
##
## $joint$stats$ERM
## [1] 25.10994
##
## $joint$stats$EVaR
## [1] 7.549743
##
## $joint$stats$EVaR2
## [1] 7.549743
##
## $joint$stats$EVaR4
## [1] 7.549743
##
##
## $joint$df
##    x    p       Z_hat          Z
## 1  1 0.06 0.933734997 5.22283470
## 2  2 0.05 0.871861044 4.87674354
## 3  3 0.05 0.814087169 4.55358611
## 4  4 0.02 0.760141680 4.25184271
## 5 10 0.01 0.503774715 2.81785739
## 6 50 0.41 0.032447544 0.18149492
## 7 60 0.24 0.016346252 0.09143255
## 8 70 0.08 0.008234829 0.04606141
## 9 80 0.08 0.004148498 0.02320457
# }
```