# Based on the article "Exact Bayesian Analysis of Two Proportions"

# wherever practical the same notations as in the article are used.
# compute Bayesian median and confidence interval for RD, RR, and OR
# by Alexandre Buer, Cytel Corp. 2014

bayesCI <- function(c0, s0, c1, s1, alpha) {
  # use beta(1,1) for both beta_0 and beta_1
  a0 = 1; b0 = 1; a1 = 1; b1 = 1
  beta0 <- function(x) { dbeta(x, a0+c0, b0+s0-c0) }
  BETA1 <- function(x) { pbeta(x, a1+c1, b1+s1-c1) }
  FPint <- function(fp) {
    integrate(function(R0) { BETA1(fp(R0)) * beta0(R0)}, 0, 1)  # article prescribes here Rmin and Rmax
    # but using (0, 1) allows to reproduce Table 1 for RD
  }
  # force fp function to return a number between 0 and 1
  clip01 <- function(x) { (x > 0)*x - (x-1 > 0)*(x-1) }
  #   print("  Table 1  "); print("RD    F(RD)"
  #   F_RD <- function(RD) {
  #     FPint( function(r0) clip01(r0 + RD) )
  #   }
  
  rd_range = seq(-1, 1, length.out=41)
  for (rd in rd_range) {
    fixed <- as.numeric(F_RD(rd)$value)
    cat(rd, fixed, sep=" ", fill=TRUE)
  }
  F_OR <- function(OR) {
    FPint(function(r0) {clip01(OR*r0/(1+(OR-1)*r0)) } )
  }
  # pname is the name of measure, fp(P, R0) = R1 is the measure function
  # (Plow,Pup) form the search domain for the parameter P, e.g. for RD (-1,1)
  compCI <- function(pname, fp, plow, pup){
    cat(pname, "  ")
    FP <- function(P) { FPint( function(r0) { clip01(fp(P, r0)) } )
      for (val in c(0.5*alpha, 0.5, 1-0.5*alpha )) {
        rd <- as.numeric(
          uniroot(function(x) FP(x)$value - val,
                     lower = plow, upper = pup, tol = 1e-9)$root)
        cat(sprintf("%.5f", rd), "  ", fill = TRUE)
      }
    }
    cat("measure", "low", "median", "high", "confidence", sep = " ", fill = T)
  }

  compCI("RD", function(p,r) {r+p}, -1, 1)  # Risk Difference RD
  compCI("RR", function(p,r) {r*p}, 1e-6, 1e6)  # Risk Ratio P=RR, r=R0
  compCI("OR", function(p,r) {p*r/(1+(p-1)*r)}, 1e-6, 1e6)  # Odds Ratio P=OR, r=R0
}

# measure, "low", "median", "high", "confidence", sep = " ", fill = T)
compCI("RD", function(p,r) {r+p}, -1, 1)  # Risk Difference RD
compCI("RR", function(p,r) {r*p}, 1e-6, 1e6)  # Risk Ratio P=RR, r=R0
compCI("OR", function(p,r) {p*r/(1+(p-1)*r)}, 1e-6, 1e6)  # Odds Ratio P=OR, r=R0

bayesCI(5, 20, 8, 10, 0.05)
bayesCI(5, 20, 8, 10, 0.01)
bayesCI(5, 20, 8, 10, 0.001)
cat("Risk measures for r1=8/24 and r0 = 9/53 as per table 2 (Phenoxy acid) and fig. 3")
bayesCI(9, 53, 8, 24, 0.05)
cat("Risk measures for r1=3/19 and r0 = 0/44 as per table 2 (Cholophenols)")
bayesCI(0, 44, 3, 19, 0.05)