assignment_6_solution

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```r
# Q1.The joint probability density of two random variables X and Y is f(x,y)
# Then write a R-code to
# (i) check that it is a joint density function or not? (Use integral2())
# (ii) find marginal distribution g(x) at x = 1.
# (iii) find the marginal distribution h(y) at y = 0.
# (iv) find the expected value of g(x, y) = xy.
library(pracma)
f <- function(x,y){
  2*(2*x+3*y)/5
}

intg <- integral2(f,0,1,0,1)
if (intg$Q == 1){
  print("Function is joint density function")
} else{
  print("Function is not joint density function")
}
```

```
## [1] "Function is joint density function"
```

```r
gx <- function(y){
  f(1,y)
}
margX <- integrate(gx,0,1)
print(paste("Marginal distribution g(x) at x = 1 : ",margX$value))
```

```
## [1] "Marginal distribution g(x) at x = 1 :  1.4"
```

```r
gy <- function(x){
  f(x,0)
}
margY <- integrate(gy,0,1)
print(paste("Marginal distribution h(y) at y = 0 : ",margY$value))
```

```
## [1] "Marginal distribution h(y) at y = 0 :  0.4"
```

```r
gxy <- function(x,y){
  x*y*f(x,y)
}
expVal <- integral2(gxy,0,1,0,1)
print(paste("Expected value of g(x, y) = xy : ",expVal$Q))
```

```
## [1] "Expected value of g(x, y) = xy :  0.333333333333333"
```

```r
# Q2.The joint probability mass function of two random variables X and Y is
# f(x,y)={(x+y)/30; x=0,1,2,3; y=0,1,2} Then write a R-code to
# (i) display the joint mass function in rectangular (matrix) form.
# (ii) check that it is joint mass function or not? (use: Sum())
# (iii) find the marginal distribution g(x) for x = 0, 1, 2, 3. (Use:apply())
# (iv) find the marginal distribution h(y) for y = 0, 1, 2. (Use:apply())
# (v) find the conditional probability at x = 0 given y = 1.
# (vi) find E(x), E(y), E(xy), Var(x), Var(y), Cov(x, y) and its correln coeff
f <- function(x,y){
  (x+y)/30
}
pmf_matrix <- matrix(c(f(0,0:2),f(1,0:2),f(2,0:2),f(3,0:2)),
                     nrow = 4, byrow = TRUE)
if (sum(pmf_matrix) == 1){
  print("Function is joint mass function")
} else{
  print("Function is not joint mass function")
}
```

```
## [1] "Function is not joint mass function"
```

```r
g_x <- apply(pmf_matrix, 1, sum)
cat("Marginal distribution g(x) for x = 0, 1, 2, 3 :\n")
```

```
## Marginal distribution g(x) for x = 0, 1, 2, 3 :
```

```r
print(g_x)
```

```
## [1] 0.1 0.2 0.3 0.4
```

```r
h_y <- apply(pmf_matrix, 2, sum)
cat("Marginal distribution h(y) for y = 0, 1, 2 :\n")
```

```
## Marginal distribution h(y) for y = 0, 1, 2 :
```

```r
print(h_y)
```

```
## [1] 0.2000000 0.3333333 0.4666667
```

```r
P_X0_Y1 <- pmf_matrix[1,2]/h_y[2]
print(paste("Conditional probability at x = 0 given y = 1 : ", P_X0_Y1))
```

```
## [1] "Conditional probability at x = 0 given y = 1 :  0.1"
```

```r
x_values <- 0:3
y_values <- 0:2

E_X <- sum(x_values * g_x)
E_Y <- sum(y_values * h_y)
print(paste("E(x): ", E_X))
```

```
## [1] "E(x):  2"
```

```r
print(paste("E(y): ", E_Y))
```

```
## [1] "E(y):  1.26666666666667"
```

```r
E_XY <- 0
for (i in 1:4) {
  for (j in 1:3) {
    E_XY <- E_XY + x_values[i] * y_values[j] * pmf_matrix[i, j]
  }
}
print(paste("E(xy): ", E_XY))
```

```
## [1] "E(xy):  2.4"
```

```r
E_X2 <- sum((x_values^2) * g_x)
Var_X <- E_X2 - E_X^2
print(paste("Var(x): ", Var_X))
```

```
## [1] "Var(x):  1"
```

```r
E_Y2 <- sum((y_values^2) * h_y)
Var_Y <- E_Y2 - E_Y^2
print(paste("Var(y): ", Var_Y))
```

```
## [1] "Var(y):  0.595555555555556"
```

```r
Cov_XY <- E_XY - E_X * E_Y
print(paste("Cov(x,y): ", Cov_XY))
```

```
## [1] "Cov(x,y):  -0.133333333333333"
```

```r
Corr_XY <- Cov_XY / (sqrt(Var_X) * sqrt(Var_Y))
print(paste("Corr(x,y): ", Corr_XY))
```

```
## [1] "Corr(x,y):  -0.172773685116272"
```