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Probability and Statistics(UCS410) Exp. sheet 06 (Joint probability mass and density functions)

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(1) The joint probability density of two random variables X and Y is

$$f(x,y) = \begin{cases} 2(2x+3y)/5; & 0 \le x, y \le 1 \\ 0; & \textit{elsewhere} \end{cases}$$

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 $g(x, y) = xy$.

```
f<-function(x,y){
  2*(2*x+3*y)/5
}
I<-integral2(f, xmin=0, xmax=1, ymin=0, ymax=1)
print(I)
gx<-function(y){
  f(1,y)
}
g_x<-integrate(gx, 0, 1)
print(g_x$value)
hy<-function(x){
  f(x,0)
}
h_y<-integrate(hy, 0, 1)
print(h_y$value)
g<-function(x,y){
  x*y*f(x,y)
}
I2<-integral2(g, xmin=0, xmax=1, ymin=0, ymax=1)
print(I2)
```

```
> source("~/R/Assignment6/Q1.R")
$Q
[1] 1

$error
[1] 6.938894e-17

[1] 1.4
[1] 0.4
$Q
[1] 0.3333333

$error
[1] 5.89806e-17
```

(2) 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 $E(x)$, $E(y)$, $E(xy)$, $V\,ar(x)$, $V\,ar(y)$, $Cov(x, y)$ and its correlation coefficient.

```
f<-function(x,y){
  (x+y)/30
}
m<-matrix(c(f(0,0:2), f(1,0:2), f(2,0:2), f(3,0:2)), nrow = 4, ncol = 3, byrow = TRUE)
print(m)
if(sum(m)==1){
  print("It is a joint mass function");
} else{
  print("It is not a joint mass function");
}
gx<-apply(m, 1, sum)
print(gx)
hy<-apply(m, 2, sum)
print(hy)
print(m[1,2]/hy[2])
x<-c(0,1,2,3)
y<-c(0,1,2)
ex<-sum(x*gx)
print(ex)
ey<-sum(y*hy)
print(ey)
f2<-function(x,y){
  x*y*(x+y)/30
}
n<-matrix(c(f2(0,0:2), f2(1,0:2), f2(2,0:2), f2(3,0:2)), nrow = 4, ncol = 3, byrow = TRUE)
exy<-sum(n)
print(exy)
ex2<-sum(x*x*gx)
varx<-ex2-ex^2
print(varx)
ey2<-sum(y*y*hy)
vary<-ey2-ey^2
print(vary)
cov_xy<-exy-ex*ey
print(cov_xy)
cc_xy<-cov_xy/sqrt(varx*vary)
print(cc_xy)
```

```
> source("~/R/Assignment6/Q2.R")
           [,1]       [,2]       [,3]
[1,] 0.00000000 0.03333333 0.06666667
[2,] 0.03333333 0.06666667 0.10000000
[3,] 0.06666667 0.10000000 0.13333333
[4,] 0.10000000 0.13333333 0.16666667
[1] "It is a joint mass function"
[1] 0.1 0.2 0.3 0.4
[1] 0.2000000 0.3333333 0.4666667
[1] 0.1
[1] 2
[1] 1.266667
[1] 2.4
[1] 1
[1] 0.5955556
[1] -0.1333333
[1] -0.1727737
>
```