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K068

Probability & Statistics Lab-4

1.library(moments)

x = c(0,1,2)

p = c(1/3,1/3,1/3)

m0 = 1

m1 = sum(x*p)

m2 = sum(x*x*p)

m = c(m0,m1,m2)

raw2central(m)

print(m)

```
> library(moments)
> x = c(0,1,2)
> p = c(1/3,1/3,1/3)
> m0 = 1
> m1 = sum(x*p)
> m2 = sum(x*x*p)
> m = c(m0,m1,m2)
> raw2central(m)
[1] 1.0000000 0.0000000 0.6666667
> print(m)
[1] 1.000000 1.000000 1.666667
> 
```

1. $MGF = e^{t0}\,1/3 + e^{t}\,(1/3) + e^{2t}\,(1/3)$

$= 1/3\,(1 + e^{t} + e^{2t})$

Raw moments – $\mu_1' = E(x^1) = \sum x P_x$

$= 0(1/3) + 1(1/3) + 2(1/3)$

$= 1$

$\mu_2' = E(x^2) = \sum x^2 P_x$

$= 0 + 1/3 + 4/3$

$= 5/3$

$= 1.667$

$\mu_3' = E(x^3) = \sum x^3 P_x$

$= 1/3 + 8/3$

$= 9/3$

$= 3$

$\mu_4' = E(x^4) = \sum x^4 P_x$

$= 1/3 + 16/3$

$= 17/3$

$= 0.66$

Central moments $\mu_1 = 0$

$\mu_2 = \mu_2' - (\mu_1')^2$

$= 5/3 - (1)^2$

$= 2/3$

$\mu_3 = \mu_3' - 3\mu_1'\mu_2' + 2\mu_1'^3$

$= 3 - 3(5/3) + 2(1)^3$

$= 3 - 5 + 2$

$= 0$

$\mu_4 = 2/3$

```
2.library(moments)

m = c(1,2,10,-30)

a = raw2central(m)

print(a)

mean = 5

print(mean)

variance=a[3]

print(variance)

skewness=a[4]

print(skewness)
```

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```
> library(moments)
> m = c(1,2,10,-30)
> a = raw2central(m)
> print(a)
[1]   1   0   6 -74
> mean = 5
> print(mean)
[1] 5
> variance=a[3]
> print(variance)
[1] 6
> skewness=a[4]
> print(skewness)
[1] -74
>
```

2. $\mu_r = E((x-P)^r)$

$= E((x-3)^r)$

$\mu_1^3 = E(x-3)$

$2 = E(x) - E(3)$

$2 = E(x) - 3$

$E(x) = 2+3 = 5$

$\mu_2 = \mu_2' - (\mu_1)^2$

$= 10 - (2)^2$

$= 10 - 4$

$= 6 \Longrightarrow$ Variance

$\mu_3 = \mu_3' - 3\mu_1'\mu_2' + 2\mu_1^3$

$= (-30) - 3(2)(10) + 2(2)^3$

$= -74 \Longrightarrow$ skewness

3.x = c(0,1,2,3)

p = 1/8*choose(3,x)

m0 = 1

m1 = sum(x*p)

m2 = sum(x*x*p)

m3 = sum(x*x*x*p)

m = c(m0,m1,m2,m3)

y = raw2central(m)

print(y)

mean = m1

print(mean)

variance = y[3]

print(variance)

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```
> x = c(0,1,2,3)
> p = 1/8*choose(3,x)
> m0 = 1
> m1 = sum(x*p)
> m2 = sum(x*x*p)
> m3 = sum(x*x*x*p)
> m = c(m0,m1,m2,m3)
> y = raw2central(m)
> print(y)
[1] 1.00 0.00 0.75 0.00
> mean = m1
> print(mean)
[1] 1.5
> variance = y[3]
> print(variance)
[1] 0.75
>
```

3. $M_x(t) = E(e^{tx})$

$= \Sigma e^{tx} p_x$

$= e^{t0}(1/8) + e^{t}(3/8) + e^{2t}(3/8) + e^{3t}(1/8)$

$M_x(t) = \frac{1}{8} + e^{t}\frac{3}{8} + e^{2t}\frac{3}{8} + e^{3t}\frac{1}{8}$

$= \frac{1}{8}\{1 + 3e^{t} + 3e^{2t} + e^{3t}\}$

$M_r' = \frac{d^r}{dt^r} M_x(t) \Big|_{t=0}$

$M_1' = \frac{d}{dt} M_x(1) \Big|_{t=0}$

$M_1' = \frac{d}{dt}\frac{1}{8}(1 + 3e^{t} + 3e^{2t} + e^{3t})$

$= \frac{1}{8}(0 + 3e^{t} + 6e^{2t} + 3e^{3t})\Big|_{t=0}$

$= \frac{3}{8}e^{2t} + \frac{6}{8}e^{2t} + \frac{3}{8}e^{t}$

$= \frac{3}{8} + \frac{6}{8} + \frac{3}{8} = \frac{12}{8}$

$= \frac{3}{2} = 1.5 \Rightarrow$ Mean

$M_2' = \frac{d^2}{dt^2}\frac{1}{8}(1 + 3e^{t} + 3e^{2t} + e^{3t})$

$= \frac{1}{8}\frac{d}{dt}(0 + 3e^{t} + 6e^{2t} + 3e^{3t})$

$= \frac{1}{8}(3e^{t} + 12e^{2t} + 9e^{t})\Big|_{t=0}$

$= \frac{1}{8}(3 + 12 + 9)$

$= \frac{24}{8}$

$= 3$

$M_2 = M_2' - (M_1')^2$

$= 3 - (1.5)^2$

$= 3/4$

$= 0.75 \rightarrow$ variance

4.x = c(-2,3,1)

p = c(1/3,1/2,1/6)

m0 = 1

m1 = sum(x*p)

m2 = sum(x*x*p)

m3 = sum(x*x*x*p)

m4 = sum(x*x*x*x*p)

m = c(m0,m1,m2,m3,m4)

y = raw2central(m)

print(y)

mean=m1

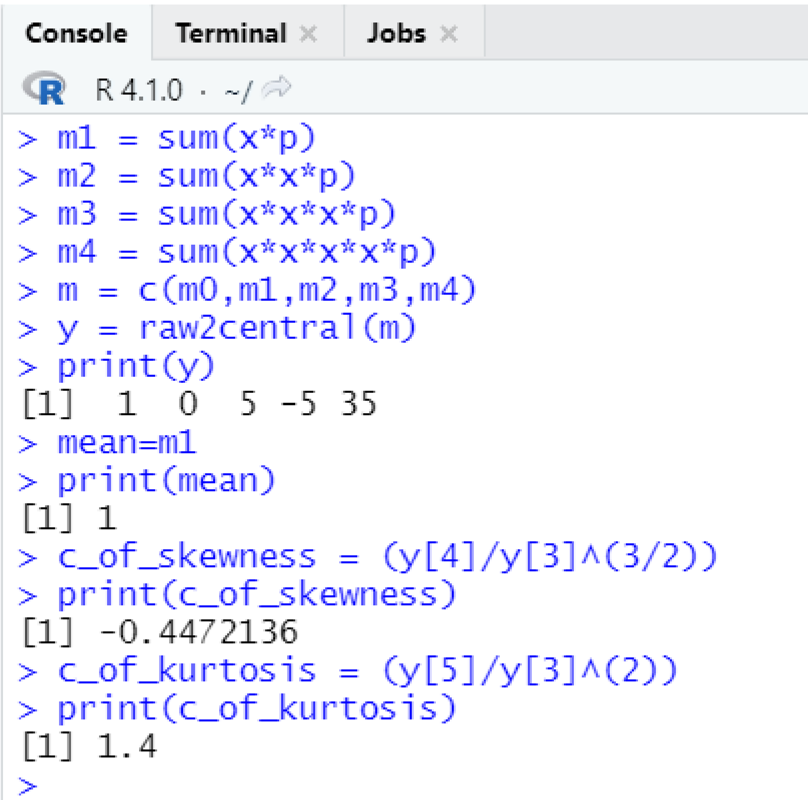
print(mean)

c_of_skewness = (y[4]/y[3]^(3/2))

print(c_of_skewness)

c_of_kurtosis = (y[5]/y[3]^(2))

print(c_of_kurtosis)



```
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> m1 = sum(x*p)
> m2 = sum(x*x*p)
> m3 = sum(x*x*x*p)
> m4 = sum(x*x*x*x*p)
> m = c(m0,m1,m2,m3,m4)
> y = raw2central(m)
> print(y)
[1]  1  0  5 -5 35
> mean=m1
> print(mean)
[1] 1
> c_of_skewness = (y[4]/y[3]^(3/2))
> print(c_of_skewness)
[1] -0.4472136
> c_of_kurtosis = (y[5]/y[3]^(2))
> print(c_of_kurtosis)
[1] 1.4
>
```

4. Raw moments : $\mu_r' = E(x^r) = \sum x^r p_x$

$\mu_0' = 1$

$\mu_1' = \sum x p_x$

$= (-2)(1/3) + 3(1/2) + 1(1/8)$

$= 1$

$\mu_2' = \sum x^2 p_x$

$= (4)(1/3) + 9(1/2) + 1(1/6)$

$= 6$

$\mu_3' = \sum x^3 p_x$

$= (-8)(1/3) + 24(1/2) + 1(1/6)$

$= 11$

$\mu_4' = \sum x^4 p_x$

$= 16(1/3) + 81(1/2) + 1(1/6)$

$= 46$

$\mu_1 = 0$

$\mu_2 = 5$

$\mu_3 = -5$

$\mu_4 = 35$

coeff. of skewness $= \frac{-5}{5^{3/2}} = -0.4472$

coeff. of kurtosis $= \frac{-5}{(-5)^2} = \frac{5}{25}$

$= \frac{1}{5}$

$= 1.4$