Bayes, HW 3

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1. Marginals from the Dirichlet

Let $\theta \sim \text{Dirichlet}(\alpha)$ where both θ and α are k dimensional.

What is $E(\theta_i)$?

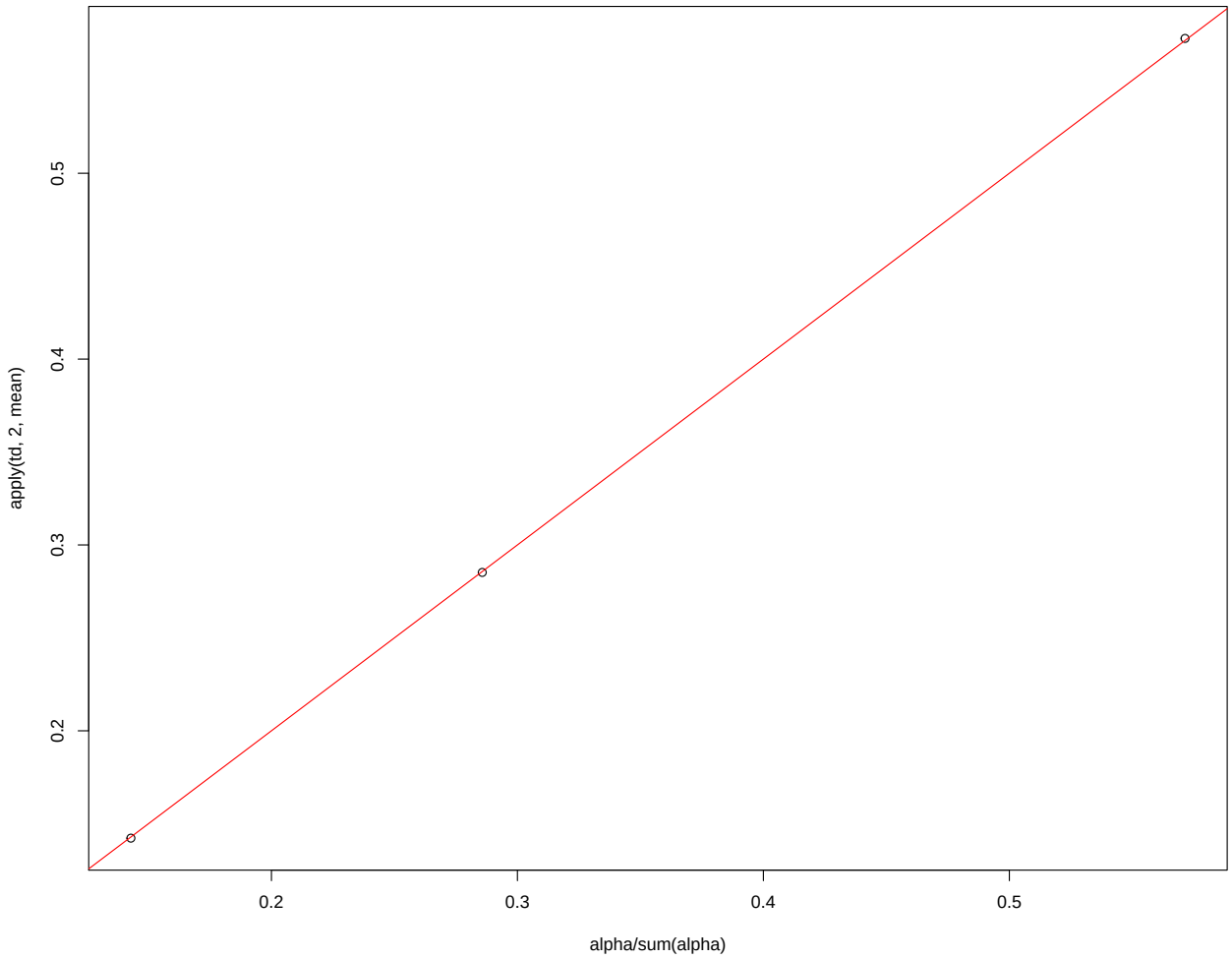
Rob is guessing

$$\theta_i \sim \text{Beta}(\alpha_i, \sum_{j \neq i} \alpha_j)$$

is he right?

If he is right then $E(\theta_i) = \alpha_i / \sum \alpha_i$.

```
ddir=function(alpha) {
   k = length(alpha)
   gdrs = rep(0,k)
   for(i in 1:k) gdrs[i] = rgamma(1,alpha[i])
   return(gdrs/sum(gdrs))
}
alpha = c(5,10,20)
k=length(alpha)
nd=500
td = matrix(0.0,nd,k)
set.seed(99)
for(i in 1:nd) td[i,]=ddir(alpha)
plot(alpha/sum(alpha),apply(td,2,mean))
abline(0,1,col="red")
```



2. Testing Independence

We tested the independence of gender and tenure in the simple data set where 6 of 15 men and 0 of 3 women received tenure.

We just tried one simple prior.

Use the insight gained in the previous question to try a few other priors and see how sensitive the results are to the choice of prior.

3. Multivariate Normal

Using the countries data, let's model the joint distribution of the returns from France, UK, Germany, and Denmark and multivariate normal.

We estimate the mean and variance using the sample quantities and just act is if they were true.

```
> cd = read.csv("conret.csv")
> cd = cd[,c(8,22, 9,6)]
> names(cd)
[1] "france"  "uk"      "germany" "denmark"
> Sigma = cov(cd)
> mu = apply(cd,2,mean)
> Sigma
             france          uk     germany     denmark
france  0.003018198 0.001629342 0.002185964 0.001404267
uk      0.001629342 0.002527332 0.001559231 0.001373364
germany 0.002185964 0.001559231 0.003149074 0.001813719
denmark 0.001404267 0.001373364 0.001813719 0.002746905
> mu
    france         uk    germany    denmark
0.01383178 0.01168224 0.01289720 0.01401869
```

What is the correlation between germany and denmark?

Conditional on (france, uk) what is the correlation between germany and denmark?