Energetics

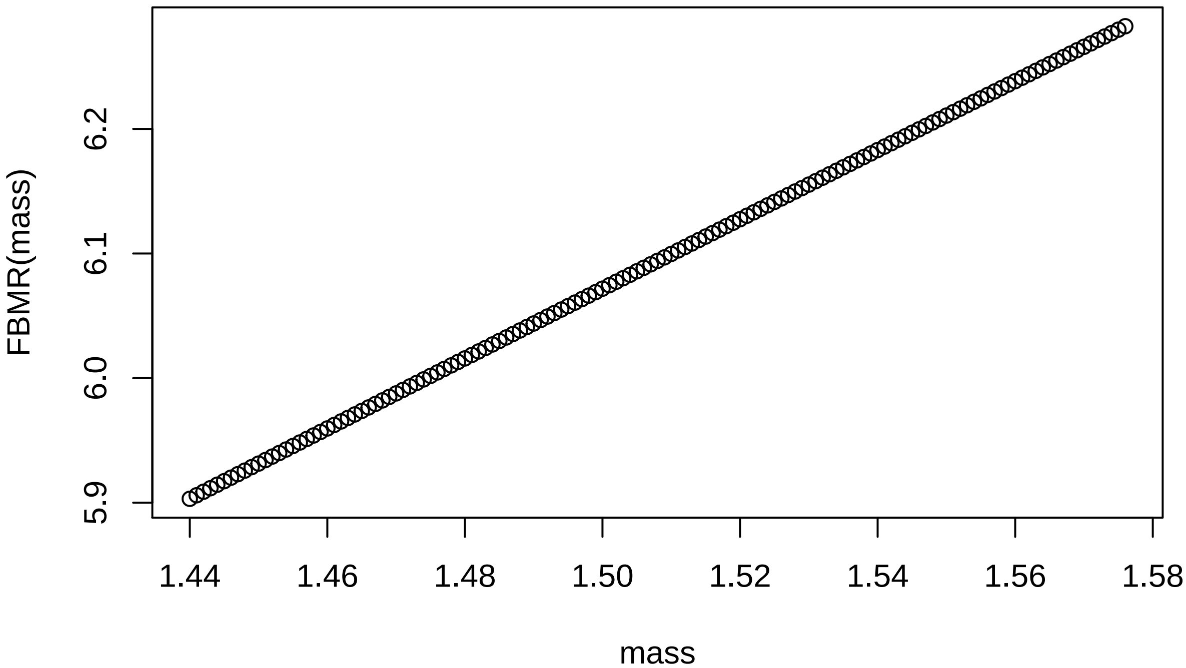
Calculate basal metabolic rate (BMR)

This is the function taken from Humbolt paper

```
FBMR <- function(mass)4.59*mass^0.69
FBMR(1.4)
```

```
## [1] 5.7895
```

```
mass<-(1440:1576)/1000
plot(FBMR(mass)~mass)
```



Using the spreadsheer equation taking into account temperature and windspeed

As I understand it from the spreadsheet this set of equation should calculate the metabolic rate in the same units ()

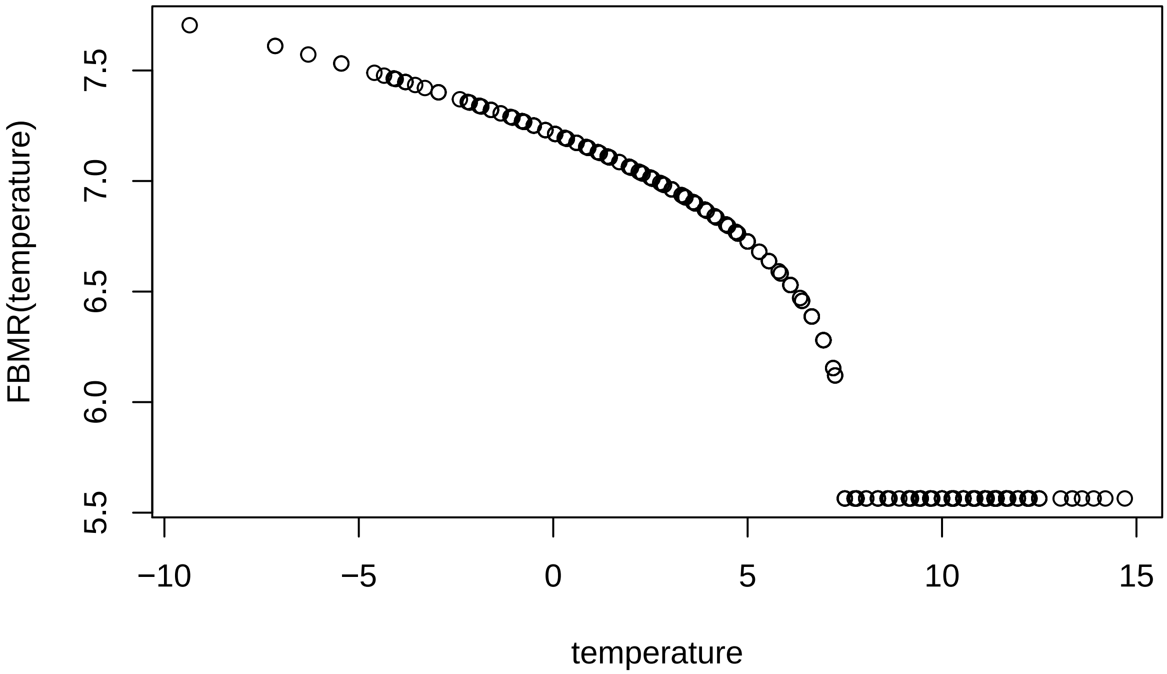
```
FBMR<-function(ftemperature=-10,fwindspeed=2,fmass=1500)
{
TBrant<-7.5
ftemperature[ftemperature>TBrant]<-TBrant
fwindspeed[fwindspeed<0.5]<-0.5
DeltaT<-TBrant-ftemperature
b<-0.0092*fmass^0.66*DeltaT^0.32
a<-4.15-b*sqrt(0.06)
a+b+sqrt(fwindspeed)
}
FBMR(10)
```

```
## [1] 5.564214
```

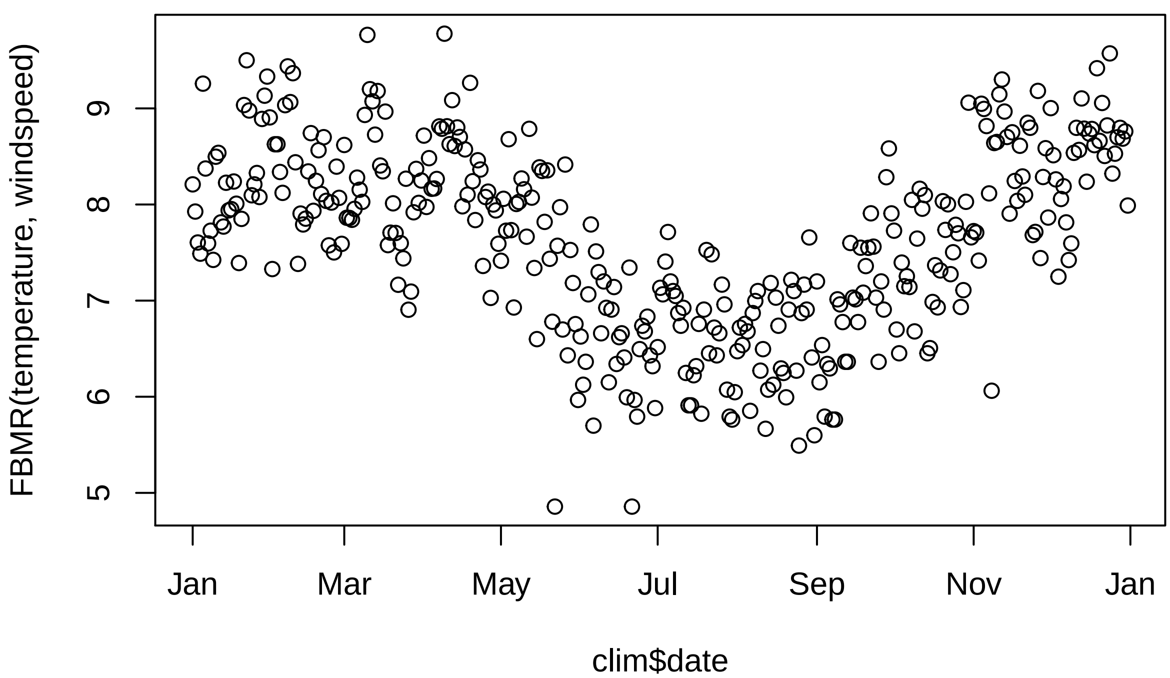
Testing against a year's climate data

I haven't got data for the whole of 2016.

```
clim<-subset(clim,as.numeric(format(clim$date,'%Y'))==2015)
temperature<-(clim$tmin+clim$tmax)/20
windspeed<-clim$avwind/10
plot(temperature,FBMR(temperature))
```

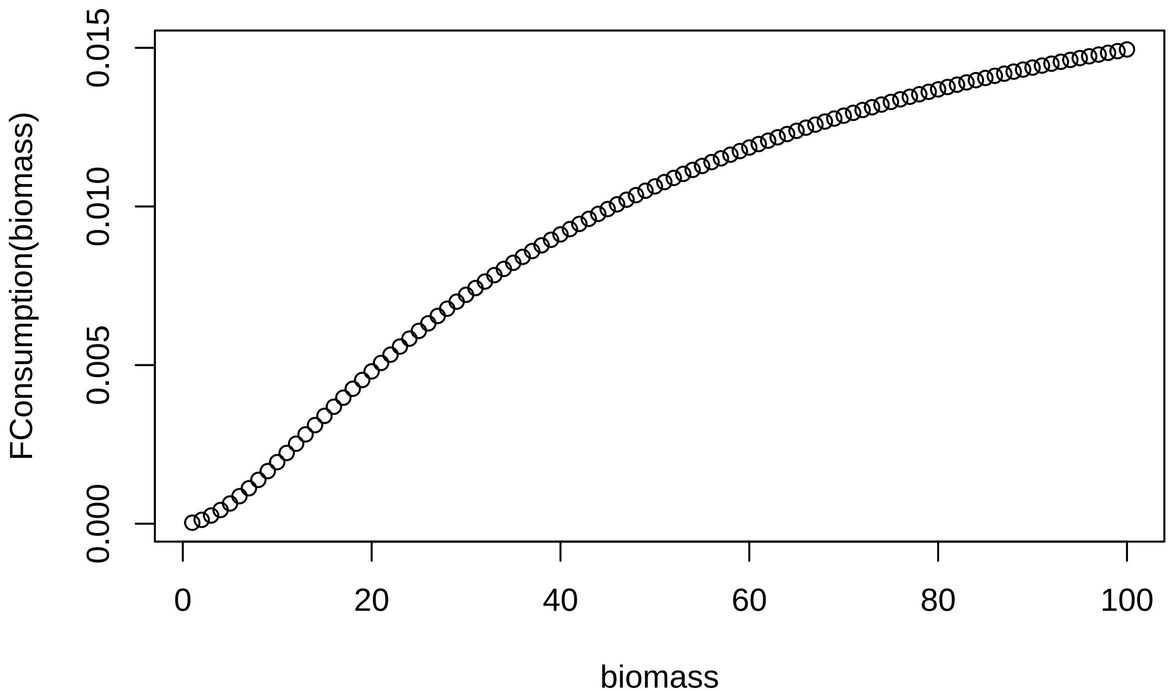



```
plot(clim$date,FBMR(temperature,windspeed))
```



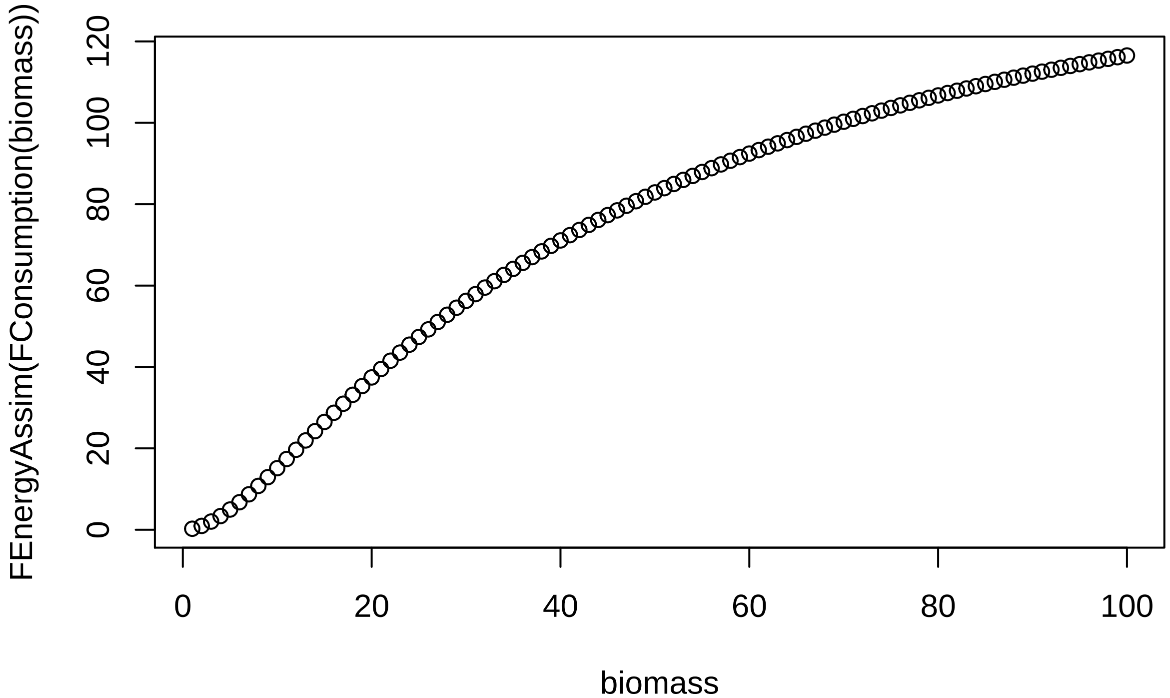
Consumption function from the Humbolt paper

```
biomass<-1:100
FConsumption<-function(fbiomass)100*0.01028*(1-exp(-0.105*fbiomass))*(1.0373*(1-exp(-0.0184*fbiomass))/(
plot(FConsumption(biomass)~biomass)
```

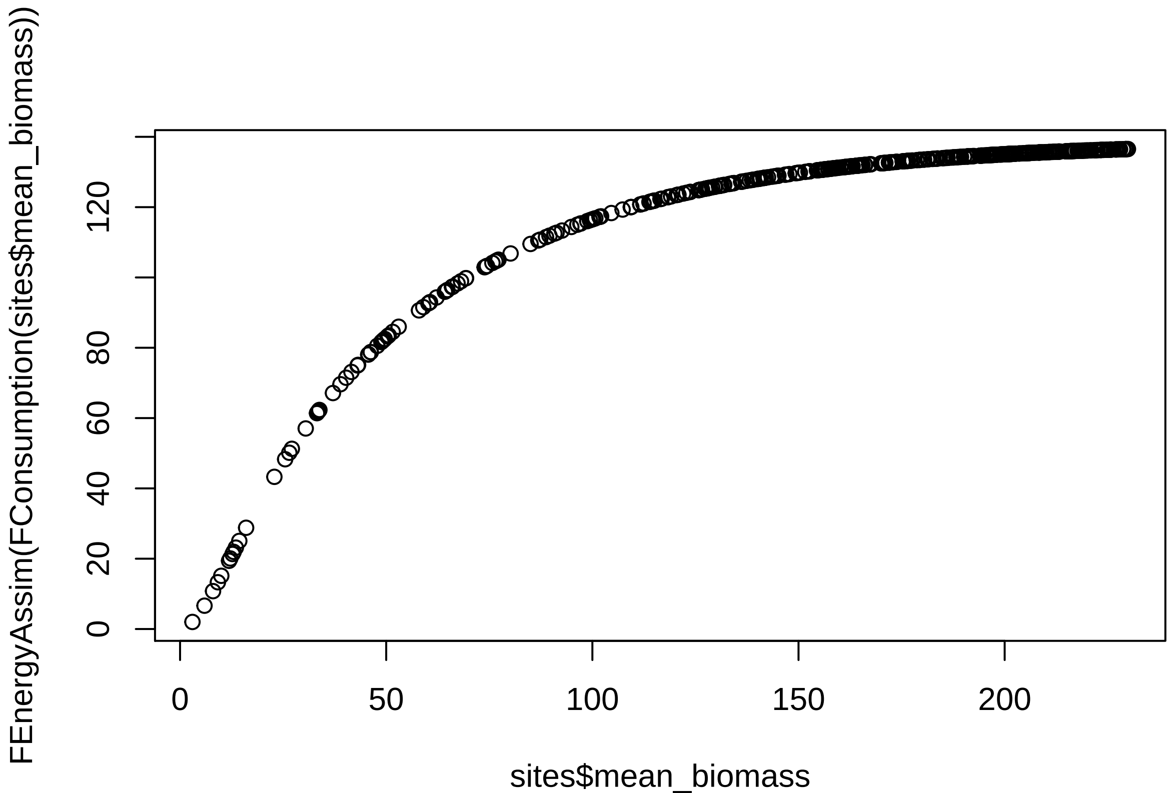


Converting into energy assimilated

```
FEnergyAssim<-function(consumption, a=0.464, E= 16.8)consumption*a*E*1000
plot(FEnergyAssim(FConsumption(biomass))~biomass)
```



```r
plot(FEnergyAssim(FConsumption(sites$mean_biomass))~sites$mean_biomass)
```



A Utility function to calculate day or night

Use the insol package. This produces an object with sunrise and sunset times, so if the hour falls between them it is day.

```r
FIsDay<-function(tm,Lat=55.32,Lon=-162.8)
{
hr<-as.numeric(format(tm, format='%H'))
day_len<-data.frame(daylength(Lat, Lon,JD(tm), tmz=-10))
isday<-ifelse(hr>day_len$sunrise & hr< day_len$sunset,"Day","Night")
isday}

tm<-FMakeTime(2016,1,1,10)
FIsDay(tm)
```

```
## [1] "Day"
```

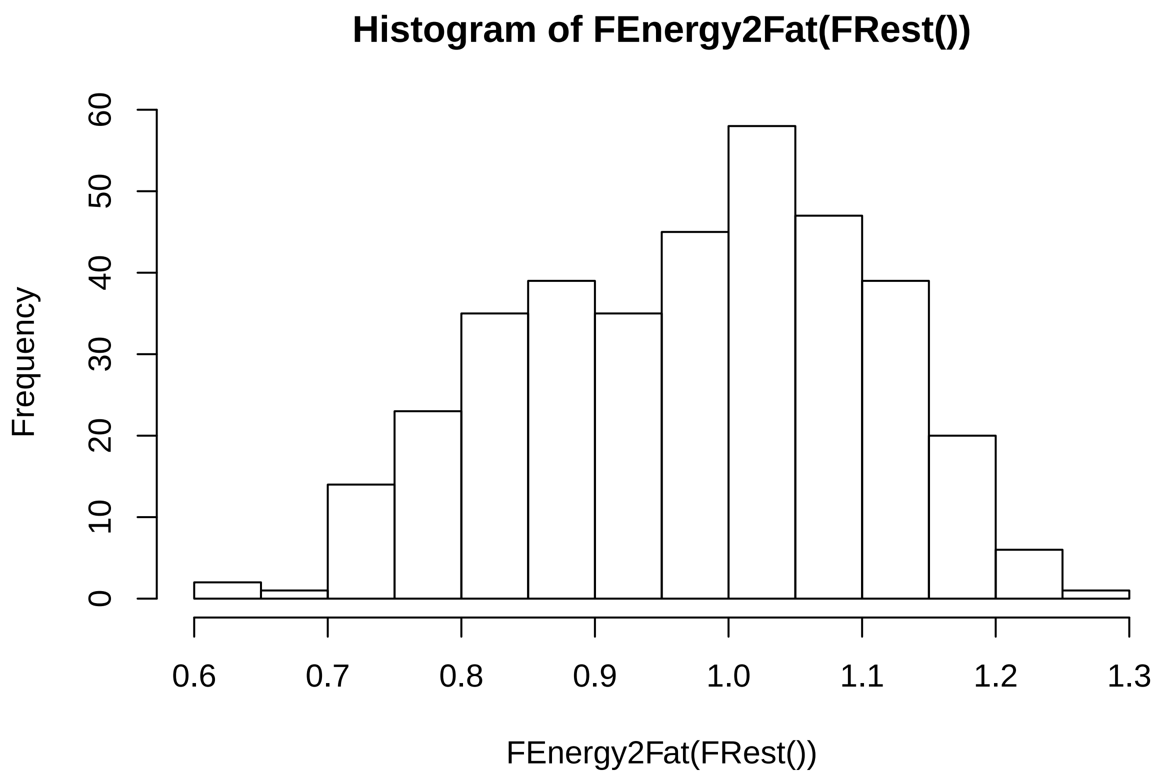
```r
tm<-FMakeTime(2016,1,1,7)
FIsDay(tm)
```

```
## [1] "Night"
```

Resting

Assume 20% over BMR. Add time argument in seconds. Returns energy used in KJoules.

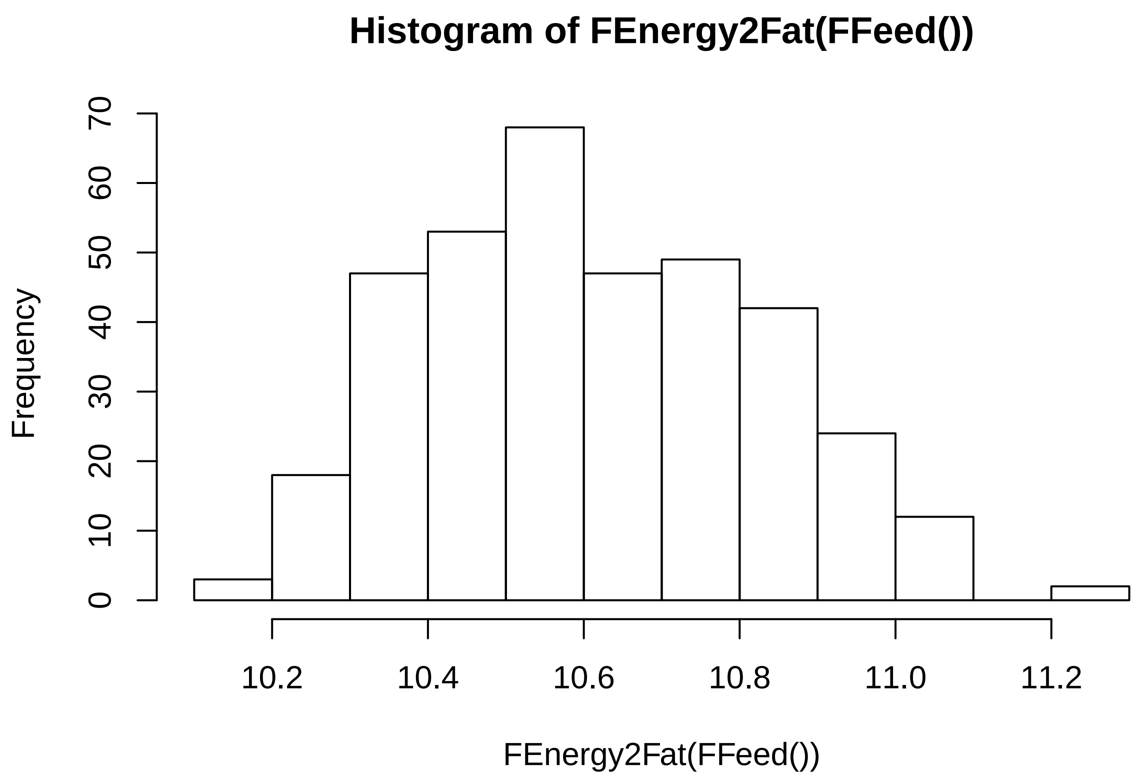
```
BMR<-FBMR(temperature,windspeed,fmass=1700)

FRest<-function(fbmr=BMR,ftime=3600)
{1.2*fbmr*ftime/1000}

hist(FEnergy2Fat(FRest()))
```



Feeding

Assume use twice BMR while feeding.

```
FFeed<-function(fbmr=BMR,ftime=3600,fbiomass=100){
EGain<-FEnergyAssim(FConsumption(fbiomass))*ftime/1000
EUse<-2*fbmr*ftime/1000
EGain-EUse
}
hist(FEnergy2Fat(FFeed()))
```



Maximum energy per day

According to the Humbolt paper this is given by

```
FMaxDaily<-function(mass)1713*mass^0.72
FMaxDaily(1500)/1000
```

```
## [1] 331.5454
```

```
FFeed()[1]
```

```
## [1] 359.3228
```

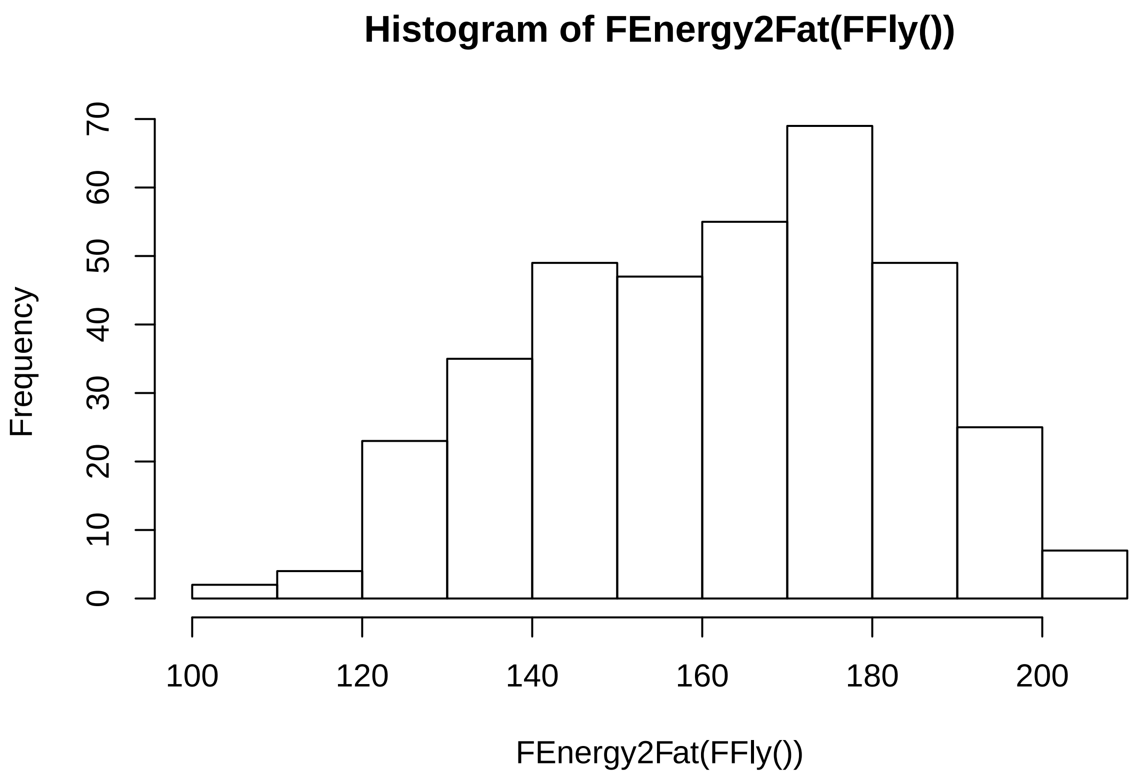
So using these formulae the birds can get enough energy for a whole day from just one hour's intensive feeding. This seems much too high. However this assumes that an hour feeding is completely dedicated to intensive feeding activity, which is unrealistic.

Flying

Assume velocity of 60km per second and overhead for take off for all flights equivalent to a minute's flight time. Use 12 times BMR.

```
FFlightTime<-function(fspeed=60,fdistance=1000000)
{
  speedms<-fspeed/3.6
  ftime<-fdistance/speedms+60
}
FFly<-function(fbmr=BMR,ftime=FFlightTime()){
  EUse<-12*fbmr*ftime/1000
  EUse
```

```r
  }

hist(FEnergy2Fat(FFly()))
```




```r
save(list=ls(),file="/home/rstudio/morph/scripts/functions.rob")
```