In [1]:
```
df <- read.table('gauge.txt',head=T)
head(df)
```

density	gain
0.686	17.6
0.686	17.3
0.686	16.9
0.686	16.2
0.686	17.1
0.686	18.5

Basic Infos

In [2]:
```
summary(df)
```

```
    density            gain      
 Min.   :0.0010   Min.   : 16.20  
 1st Qu.:0.1480   1st Qu.: 37.80  
 Median :0.3180   Median : 88.25  
 Mean   :0.3311   Mean   :142.57  
 3rd Qu.:0.5080   3rd Qu.:203.50  
 Max.   :0.6860   Max.   :436.00  
```

In [3]:
```
unique(df$density)
```

0.686 0.604 0.508 0.412 0.318 0.223 0.148 0.08 0.001

In [4]:
```
nrow(df)
```

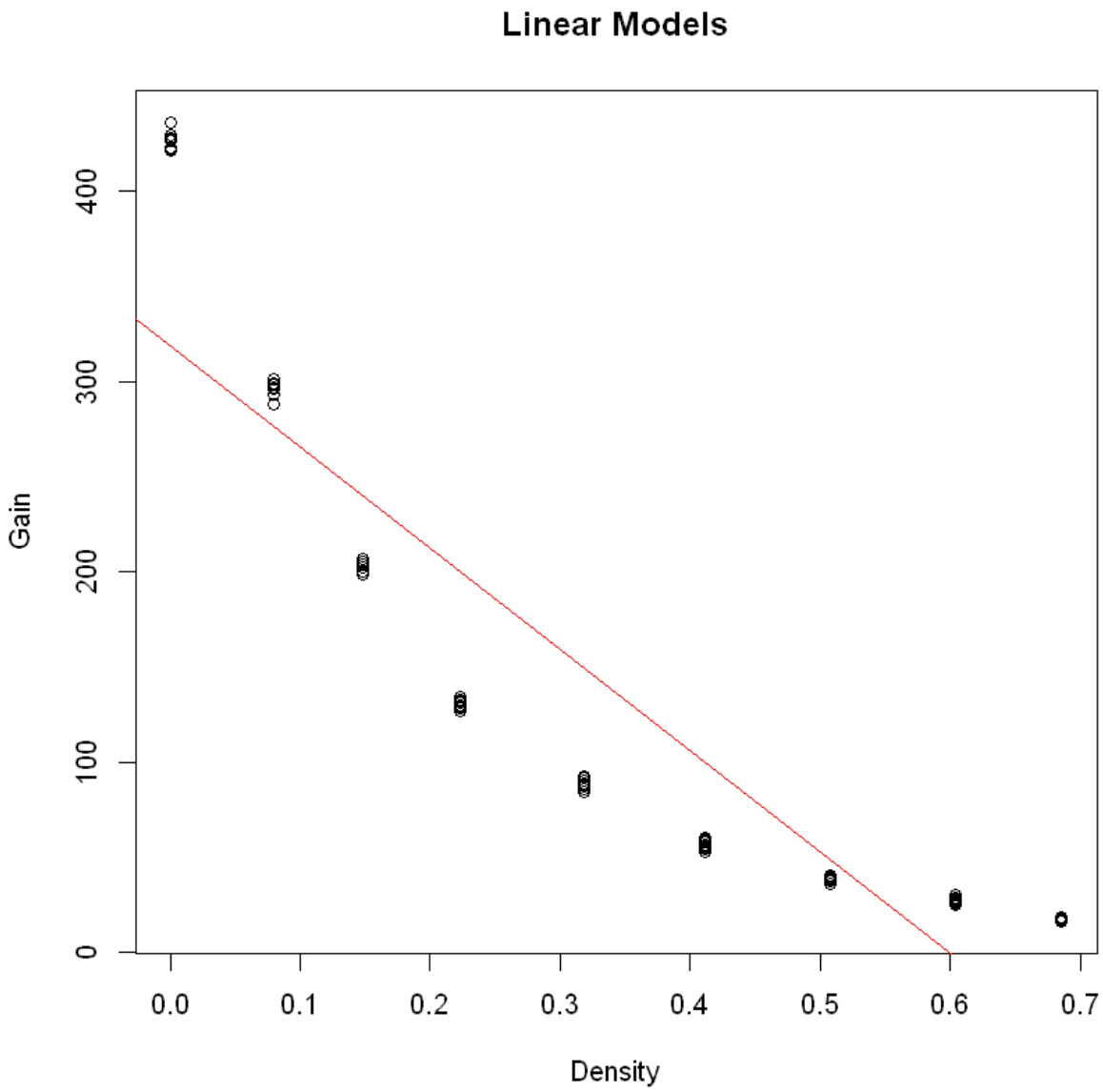
90

In [5]:
```
fit1 <- lm(gain~density,df)
fit1
```

```
Call:
lm(formula = gain ~ density, data = df)

Coefficients:
(Intercept)      density  
      318.7       -532.0  
```

In [9]:
```
plot(df, main='Linear Models', xlab = 'Density', ylab = 'Gain')
abline(fit1,col = 'red')
```



In [10]:
```
summary(predict(fit1,df))
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
-46.22   48.47  149.54  142.57  239.97  318.17 
```

In [11]:
```
summary(resid(fit1))
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
 -73.08  -44.29   -9.72    0.00   30.82  117.83 
```

Too much residuals, according to the graph might be polynimial/inverse/logrithmic relationship

Using Generalized Linear Models (logrithmic relationship):

In [23]:
```
options(warn = -1)
```

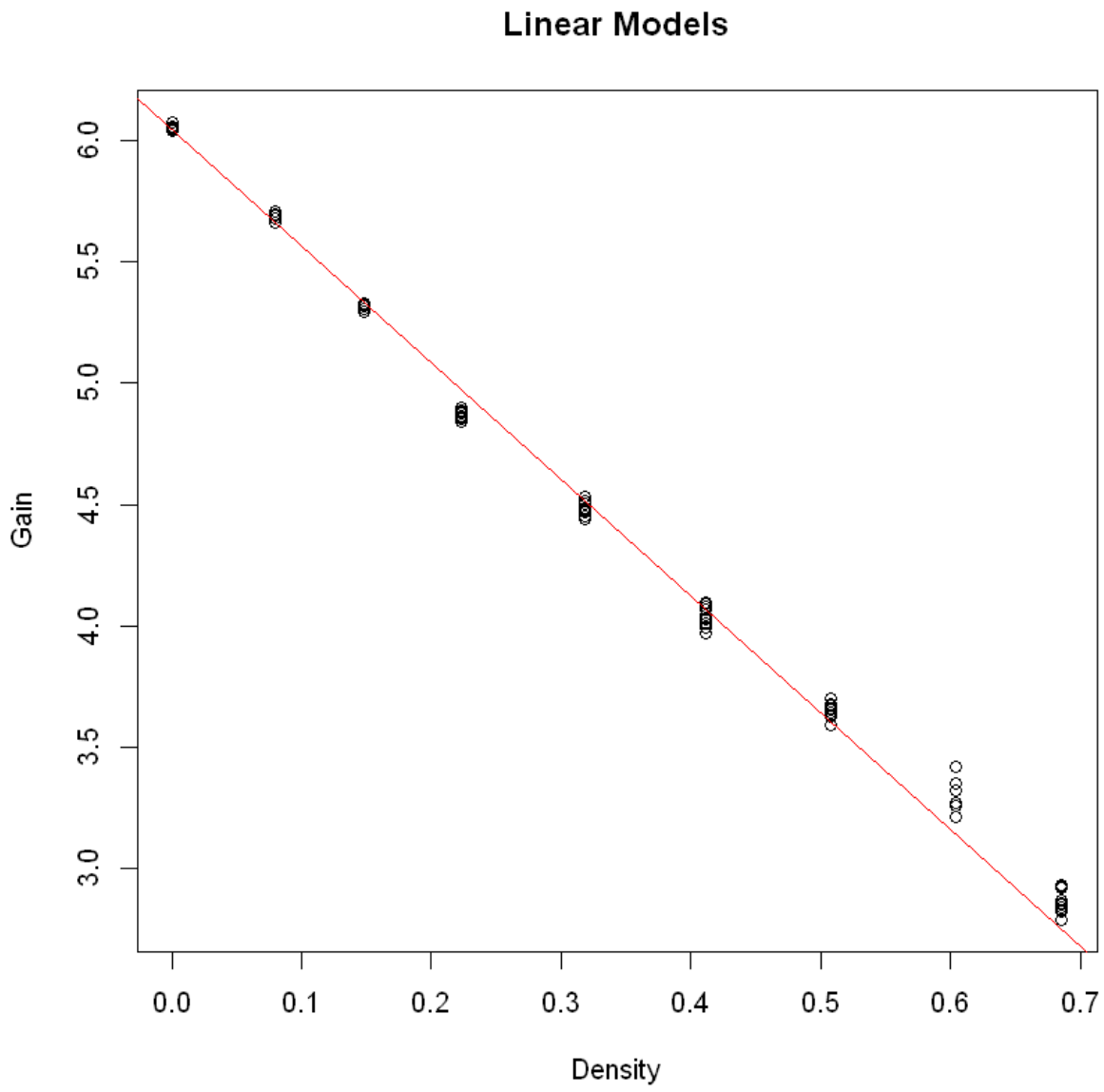
In [24]:
```
fit2 <- glm(gain~density,df,family=poisson)
fit2
```

```
Call:  glm(formula = gain ~ density, family = poisson, data = df)

Coefficients:
(Intercept)      density  
      6.045       -4.810  

Degrees of Freedom: 89 Total (i.e. Null);  88 Residual
Null Deviance:      10320 
Residual Deviance: 34.58        AIC: Inf
```

In [25]:
```
plot(df$density,log(df$gain),main='Linear Models', xlab = 'Density', ylab = 'Gain
abline(fit2,col='red')
```



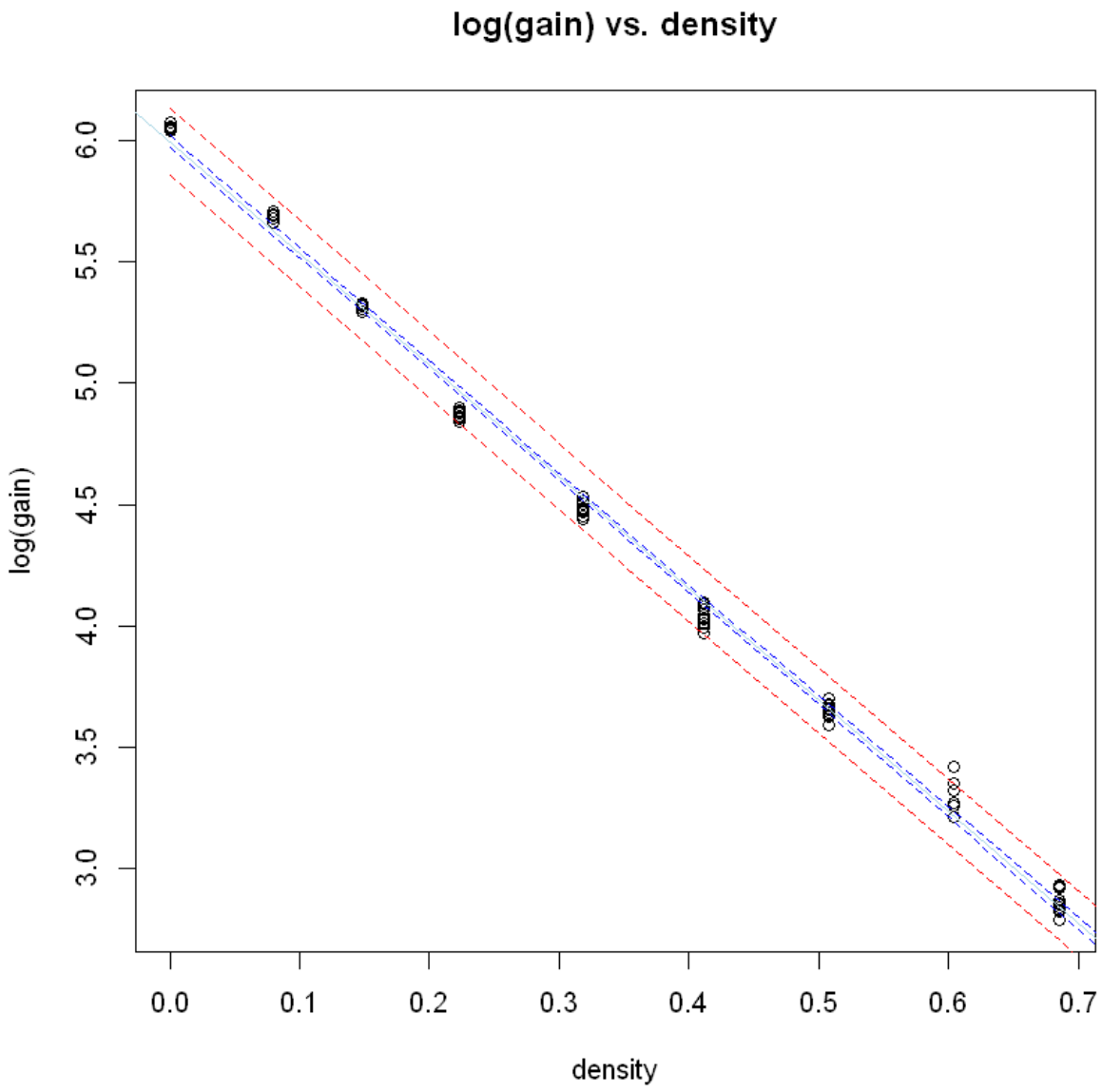
In [26]:
```
summary(resid(fit2))
```

```
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max. 
-1.47188 -0.39416  0.16752  0.04391  0.44932  1.46944 
```

Transformation & CI:

In [27]:
```
df2 <- data.frame(df)
df2$gain <- log(df2$gain)
```

In [29]:
```
x=df2$density
y=df2$gain
pts <- seq(0, 1, length.out=90)
out <- lm(y ~ x)
conf_interval <- predict(out, newdata=data.frame(x=pts), interval="confidence")
plot(x, y, xlab="density", ylab="log(gain)", main="log(gain) vs. density")
abline(out, col="lightblue")
lines(pts, conf_interval[,2], col="blue", lty=2)
lines(pts, conf_interval[,3], col="blue", lty=2)
pred_interval <-  predict(out, newdata=data.frame(x=pts), interval="prediction")
lines(pts, pred_interval[,2], col="red", lty=2)
lines(pts, pred_interval[,3], col="red", lty=2)
```



In [31]:
```
head(conf_interval)
```

fit	lwr	upr
5.997265	5.971953	6.022578
5.945513	5.920785	5.970242
5.893761	5.869610	5.917912
5.842009	5.818429	5.865590
5.790257	5.767239	5.813275
5.738505	5.716041	5.760969

In [ ]:
```

```