HW1 MATH5360

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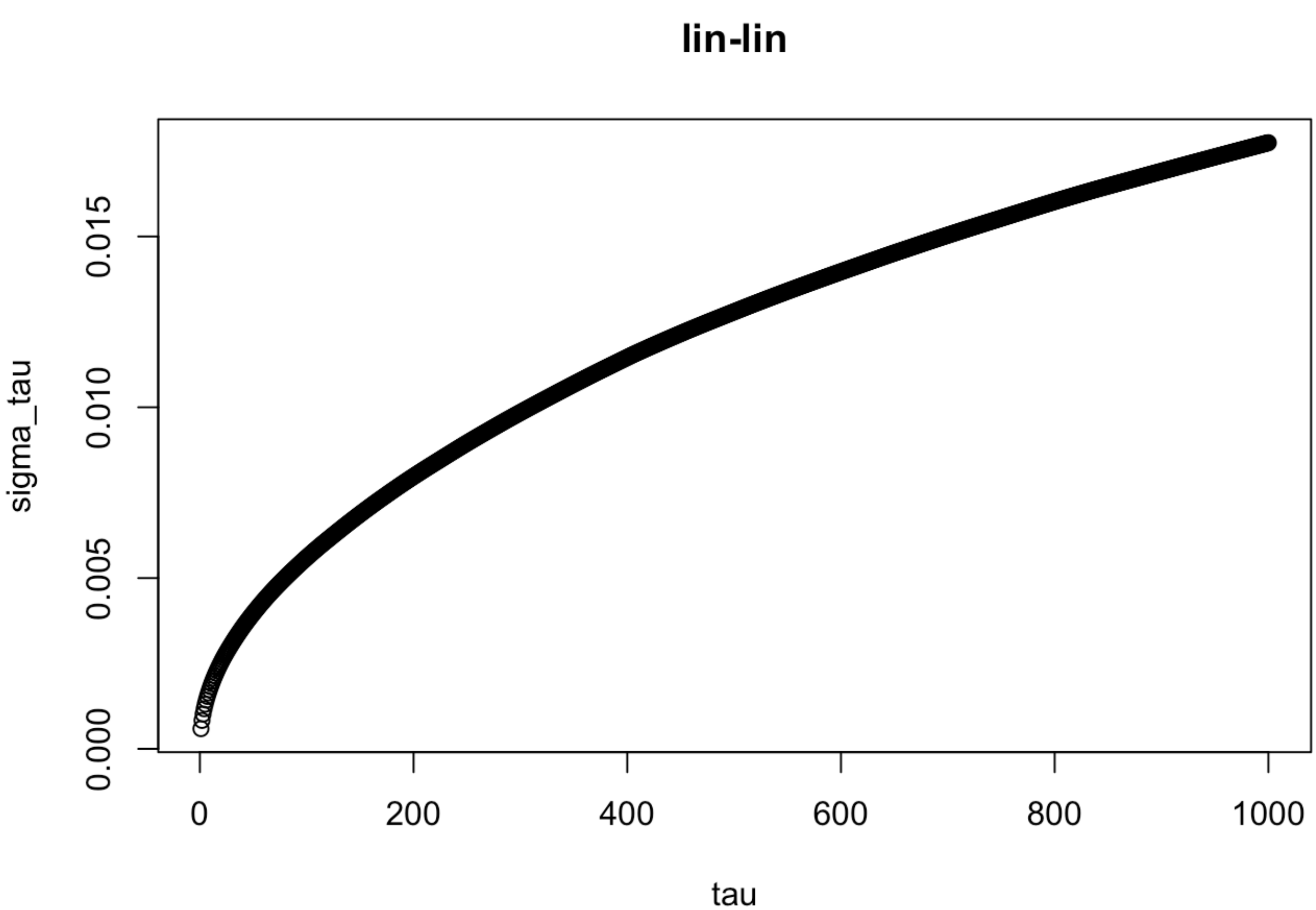
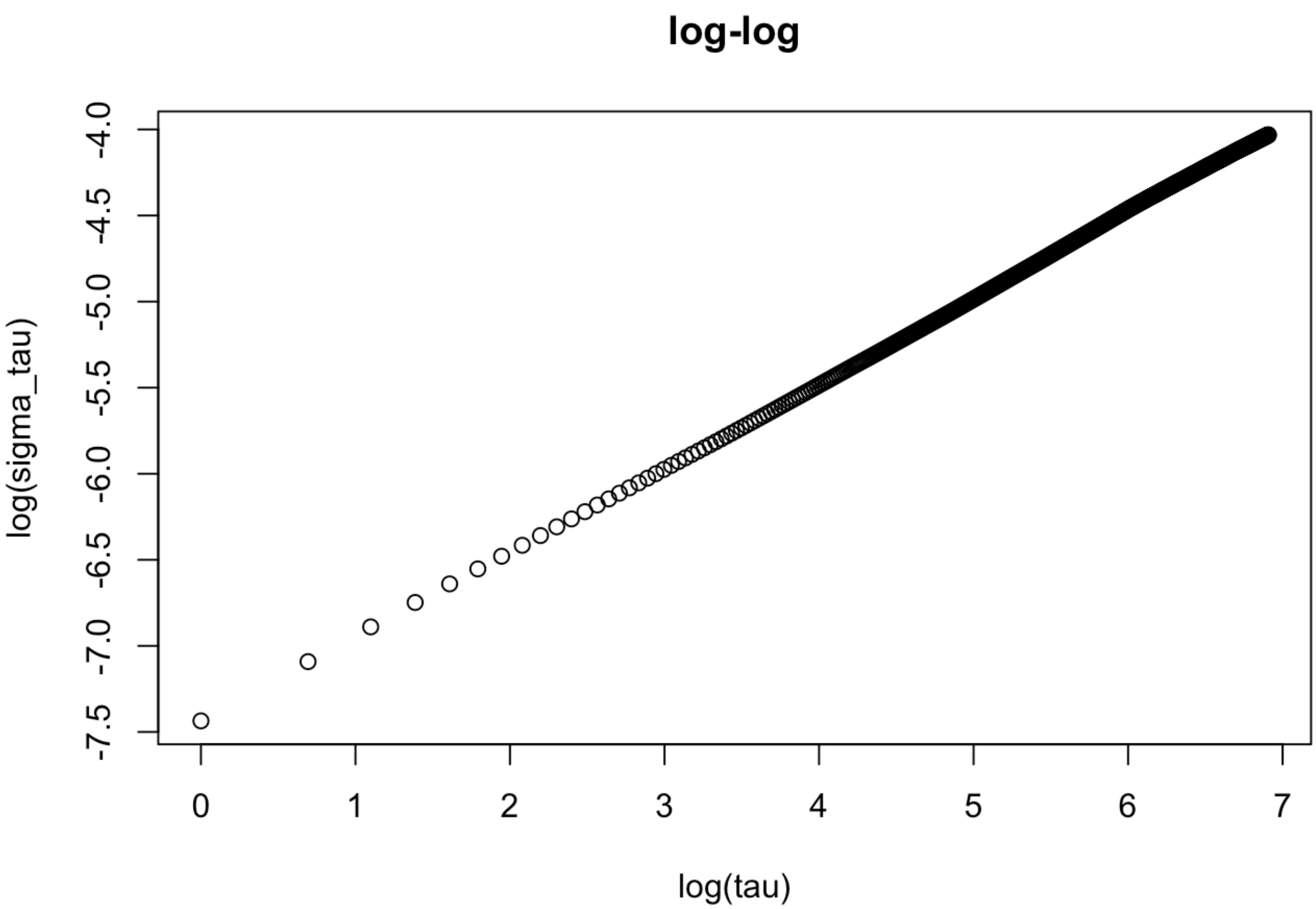
```
data=read.table("ES.asc",header=T,as.is=TRUE,sep=",")

data0<-head(data,1000000)
data1 <-as.data.frame(matrix(0, ncol = 1000, nrow = 1000000))
names(data1) <- paste0('Return', 1:1000)
for (i in 1:1000){
  data1[,i]<-c(rep(NA,i),diff(data0$Close,lag=i)/data0$Close[1:(1000000-i)])
}

sigma_tau <- apply(data1,2,sd,na.rm=TRUE)
tau<- c(1:1000)
plot(tau,sigma_tau,main="lin-lin")
```



```
plot(log(tau),log(sigma_tau),main="log-log")
```



the lin-lin looks like kind of logistic function the log-log is almost linear function

```
lin<-lm(sigma_tau~tau)
summary(lin)
```

```
##
## Call:
## lm(formula = sigma_tau ~ tau)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0042509 -0.0005299  0.0002507  0.0007315  0.0009308
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 4.827e-03  5.657e-05   85.31   <2e-16 ***
## tau         1.427e-05  9.791e-08  145.74   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.0008938 on 998 degrees of freedom
## Multiple R-squared:  0.9551, Adjusted R-squared:  0.9551
## F-statistic: 2.124e+04 on 1 and 998 DF,  p-value: < 2.2e-16
```

```
1/(1+exp(-1.635e-05))
```

```
## [1] 0.5000041
```

the estimatation of nu is about 0.5

```
log<-lm(log10(sigma_tau)~log10(tau))
summary(log)
```

```
##
## Call:
## lm(formula = log10(sigma_tau) ~ log10(tau))
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0053351 -0.0028986  0.0000183  0.0025852  0.0183908
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -3.2476257  0.0006472   -5018   <2e-16 ***
## log10(tau)   0.5005192  0.0002487    2013   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.003364 on 998 degrees of freedom
## Multiple R-squared:  0.9998, Adjusted R-squared:  0.9998
## F-statistic: 4.052e+06 on 1 and 998 DF,  p-value: < 2.2e-16
```

From the above summary, the slope of log10(sigma_tau)~log10(tau) and R^2, is 0.4971175 and 0.9996, respectively.

The two plots are close to those charts in handouts. In the regression of log(Sigma^2)~log(tau) in the handouts, slope is 0.97179, and R^2 is 0.99994. The handouts' slope is about 2 times larger than the above result, but the R^2 is close to the above model's result. The possible reason is that the handouts uses sigma^2.

Inference: to the above log model, the p-value of log10(tau)'s coefficient is much less than 0.05, we can reject the null hypothesis that slope=0; therefore, the slope's value is significant.