

Hubble

```
library(RCurl)
```

```
## Loading required package: bitops
```

```
download.file("https://raw.githubusercontent.com/MohamedElashri/Hubble/main/Data/data.csv",destfile="da
```

```
z_theme <- function() {  
  theme_bw(base_size=9) +  
    #Background and Grid formatting  
    theme(panel.background=element_rect(fill="#000000", color="#000000")) +  
    theme(plot.background=element_rect(fill="#000000", color="#000000")) +  
    theme(panel.border=element_rect(color="#252525")) +  
    theme(panel.grid.major=element_blank()) +  
    theme(panel.grid.minor=element_blank()) +  
    #Legend formatting  
    theme(legend.background = element_rect(fill="#000000")) +  
    theme(legend.text = element_blank()) +  
    theme(legend.title= element_blank())+  
    theme(legend.position="none")+  
    #Axis & Title Formatting  
    theme(plot.title=element_text(color="#D9D9D9", size=20, vjust=1.25)) +  
    theme(plot.subtitle=element_text(size=12,color="#BDBDBD", vjust=0)) +  
    theme(plot.caption=element_text(size=12,color="#BDBDBD", vjust=0)) +  
    theme(axis.ticks=element_blank()) +  
    theme(axis.text.x=element_text(size=14,color="#BDBDBD")) +  
    theme(axis.text.y=element_text(size=14,color="#BDBDBD")) +  
    theme(axis.title.x=element_text(size=16,color="#BDBDBD", vjust=0)) +  
    theme(axis.title.y=element_text(size=16,color="#BDBDBD", vjust=1.25))  
}
```

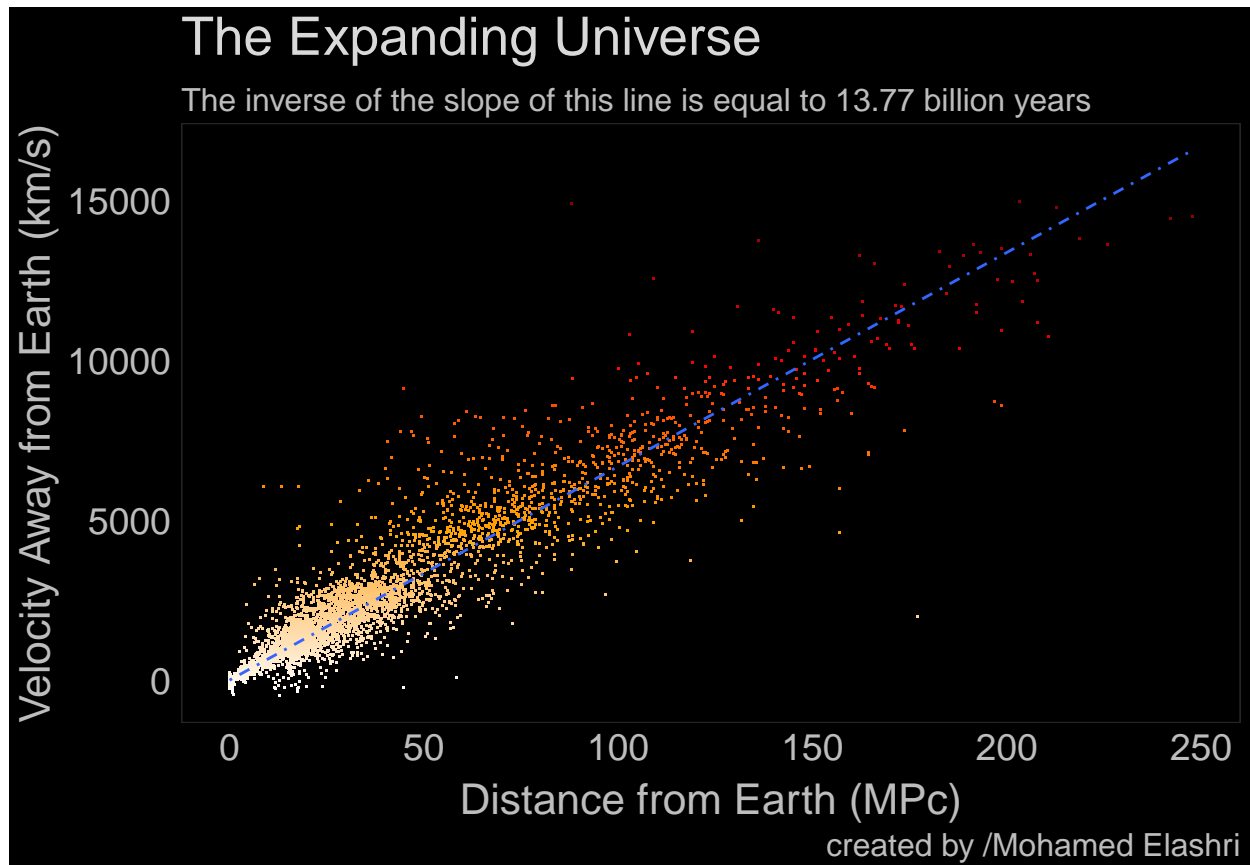
```
galaxies <- read.csv("data.csv")
```

```
library(ggplot2)  
# Convert Distance Modulus to MegaParsecs  
galaxies$distmpc<-10^(1+galaxies$mod0/5)/1e6  
# Convert Parsecs to Kilometers  
galaxies$dist<-galaxies$distmpc*3.085678e+13*1e6
```

```
# Use close galaxies for our estimation  
# galaxies2<-subset(galaxies,vgsr<=15000)  
galaxies2<-subset(galaxies,distmpc<=250&vgsr<=15000)
```

```
ggplot(galaxies2,aes(distmpc,vgsr))+  
  geom_point(shape=".",aes(color=vgsr))+  
  scale_color_gradientn(colours=c("white","orange","red","darkred"))+  
  geom_smooth(method=lm,formula=y~x+0,linetype=4,size=.5,se=F)+  
  # scale_x_continuous(limits=c(0,6.15e21))+  
  # scale_y_continuous(limits=c(-500,15000))+  
  labs(title="The Expanding Universe",  
        subtitle="The inverse of the slope of this line is equal to 13.77 billion years",  
        x="Distance from Earth (MPc)",  
        y="Velocity Away from Earth (km/s)",
```

```
caption="created by /Mohamed Elashri")+
z_theme()
```



```
ggsave("galaxies.png",dpi=100, height=6, width=9, type="cairo-png")
# Accepted value for Age of Universe:
accage<-13.799e9 # Years

# Calculate the age of the universe:
calcage<-lm(dist~vgsr+0,data=galaxies2)$coefficients[1]/60/60/24/365.24
paste("Age of Universe:",signif(calcage,5),"years")

## [1] "Age of Universe: 1.3734e+10 years"

paste("Relative Error from accepted Age: ",
      signif(100*(calcage-accage)/accage,5)
      ,"%",sep="")

## [1] "Relative Error from accepted Age: -0.47185%"
```