In [1]:
```
#load libraries----
library(tidyverse)
library(MASS)
library(msme)
library(lmtest)
library(gridExtra)
```

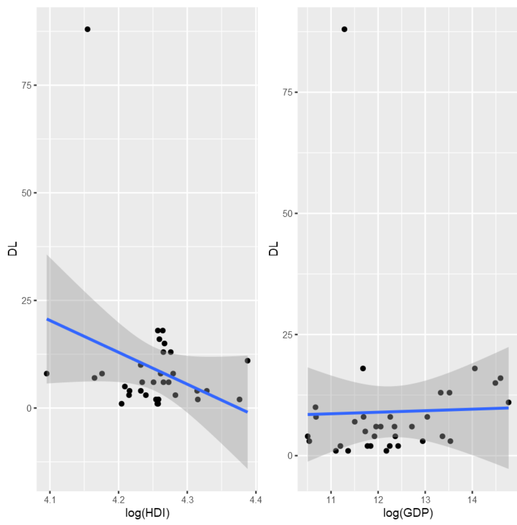
```
Warning message:
"package 'tidyverse' was built under R version 3.6.3"-- Attaching packages ---------------------------------------- tidyverse 1.3.0 --
v ggplot2 3.3.0     v purrr   0.3.3
v tibble  2.1.3     v dplyr   0.8.5
v tidyr   1.0.2     v stringr 1.4.0
v readr   1.3.1     v forcats 0.4.0
Warning message:
"package 'ggplot2' was built under R version 3.6.3"Warning message:
"package 'tibble' was built under R version 3.6.3"Warning message:
"package 'tidyr' was built under R version 3.6.3"Warning message:
"package 'purrr' was built under R version 3.6.3"Warning message:
"package 'dplyr' was built under R version 3.6.3"-- Conflicts ------------------------------------------- tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()

Attaching package: 'MASS'

The following object is masked from 'package:dplyr':

    select

Loading required package: lattice
Loading required package: zoo

Attaching package: 'zoo'

The following objects are masked from 'package:base':

    as.Date, as.Date.numeric


Attaching package: 'gridExtra'

The following object is masked from 'package:dplyr':

    combine
```

In [2]:
```
#read data----
hloss_deaths <- read.csv("hloss-deaths.csv", header = TRUE, sep = ",",
                         stringsAsFactors = FALSE) %>% as_tibble()
hloss_deaths
```

province	start	end	nyearoccur	noccur	deaths	avoccur	DL	HDI	GDP
ACEH	2008	2017	10	24	55	2	6	71.19	155912.32
BALI	2011	2018	4	7	16	2	4	74.77	234430.72
BANTEN	2008	2018	10	16	132	2	13	71.95	614906.61
BENGKULU	2012	2016	3	3	4	1	1	70.64	66412.90
DI YOGYAKARTA	2010	2017	4	5	7	1	2	79.53	129877.46
DKI JAKARTA	2008	2018	8	13	87	2	11	80.47	2599173.75
GORONTALO	2009	2017	8	11	23	1	3	67.71	37736.27
JAMBI	2010	2018	6	10	14	2	2	70.65	208378.56
JAWA BARAT	2008	2018	11	56	162	5	15	71.30	1962231.58
JAWA TENGAH	2008	2018	11	68	199	6	18	71.12	1268700.97
JAWA TIMUR	2008	2018	11	57	175	5	16	70.77	2189783.70
KALIMANTAN BARAT	2008	2018	7	9	9	1	1	66.98	194032.85
KALIMANTAN SELATAN	2008	2016	7	21	45	3	6	70.17	171935.75
KALIMANTAN TENGAH	2008	2017	4	5	8	1	2	70.42	138740.72
KALIMANTAN TIMUR	2008	2018	9	23	35	3	4	75.83	638116.90
KALIMANTAN UTARA	2014	2017	3	3	4	1	1	70.56	86058.89
KEP. BANGKA BELITUNG	2013	2017	3	4	7	1	2	70.67	73069.31
KEPULAUAN RIAU	2013	2018	2	3	4	2	2	74.84	249076.91
LAMPUNG	2008	2018	8	20	51	2	6	69.02	333681.43
MALUKU	2008	2018	6	13	60	2	10	68.87	43064.61
MALUKU UTARA	2011	2012	2	2	9	1	4	67.76	36497.64
NUSA TENGGARA BARAT	2011	2018	7	20	33	3	5	67.30	123871.68
NUSA TENGGARA TIMUR	2008	2018	11	33	81	3	7	64.39	99087.25
PAPUA	2008	2017	6	9	45	2	8	60.06	210659.81
PAPUA BARAT	2010	2016	2	2	175	1	88	63.74	79644.47
RIAU	2008	2017	5	8	15	2	3	72.44	755274.29
SULAWESI BARAT	2008	2013	5	9	42	2	8	65.10	43545.48
SULAWESI SELATAN	2008	2018	10	41	84	4	8	70.90	462341.96
SULAWESI TENGAH	2008	2017	9	16	32	2	4	68.88	150636.32
SULAWESI TENGGARA	2010	2017	5	11	90	2	18	70.61	118092.66
SULAWESI UTARA	2008	2017	8	14	67	2	8	72.20	119543.61
SUMATERA BARAT	2008	2018	11	26	61	2	6	71.73	230528.81
SUMATERA SELATAN	2010	2017	5	10	13	2	3	69.39	419723.11
SUMATERA UTARA	2008	2018	10	38	134	4	13	71.18	741192.69

In [5]:
```
#eda----
ipm_plot <- hloss_deaths  %>%
  ggplot(aes(log(HDI), DL)) + geom_point() + geom_smooth(method = "lm")
gdp_plot <- hloss_deaths  %>%
  ggplot(aes(log(GDP), DL)) + geom_point() + geom_smooth(method = "lm")
grid.arrange(ipm_plot, gdp_plot, ncol = 2)
```

```
`geom_smooth()` using formula 'y ~ x'
`geom_smooth()` using formula 'y ~ x'
```



In [7]:
```
#poisson model
mdl_poiss_ <- glm(DL ~ HDI + log(GDP),
                  family = poisson, data = hloss_deaths)
P__disp(mdl_poiss_)
```

pearson.chi2	456.982203670259
dispersion	14.741361408718

In [8]:
```
#negative-binomial model
mdl_ <- glm.nb(DL ~ HDI + log(GDP), data = hloss_deaths)
summary(mdl_)
lmtest::lrtest(mdl_)
```

```
Call:
glm.nb(formula = DL ~ HDI + log(GDP), data = hloss_deaths, init.theta = 1.627862937,
    link = log)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.9553  -0.8332  -0.2419   0.1538   3.0665

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)  8.34348    2.74805   3.036  0.00240 **
HDI         -0.15307    0.04362  -3.509  0.00045 ***
log(GDP)     0.36530    0.14600   2.502  0.01234 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for Negative Binomial(1.6279) family taken to be 1)

    Null deviance: 47.406  on 33  degrees of freedom
Residual deviance: 34.090  on 31  degrees of freedom
AIC: 217.58

Number of Fisher Scoring iterations: 1


              Theta:  1.628
          Std. Err.:  0.438

 2 x log-likelihood:  -209.583
```

#Df	LogLik	Df	Chisq	Pr(>Chisq)
4	-104.7915	NA	NA	NA
2	-110.5444	-2	11.50574	0.003173657