Case Study 1
Legal advertising–Does it pay?

A law suit between two former law partners:
- Partner A: specializes in personal injury (PI);
- Partner B: specializes in workers’ compensation (WC).

Advertising was focused on PI. But partner A claimed that the ads also resulted in more cases in worker’s compensation, hence partner B should share the ads expenses.

Research question:
Do data support partner A’s claim?
Available data for 48 months:
- Advertising expenditure;
- Number of new PI cases;
- Number of new WC cases.

Because the effect of advertising is not immediate, focus was on total expenditure over previous 6 months.
Display the data

```r
# load in data
setwd("~/Dropbox/teaching/2015Fall/R_datasets/Cases")
load("LEGALADV.Rdata")

par(mfrow=c(1,2)) # 1 by 2 plots
plot(NEWPI~ADVEXP6,data=LEGALADV,pch=20,ylim=c(0,70))
plot(NEWWC~ADVEXP6,data=LEGALADV,pch=20,ylim=c(0,70))
```
Scatter plots

Case Study 1
Analysis plan

For each type of case, fit a linear model

\[ E(Y) = \beta_0 + \beta_1 X, \]

where \( Y \) is \( Y_{PI} \) or \( Y_{WC} \), and \( X \) is advertising expenditure.

Test the significance of the association of \( Y \) with \( X \).

Examine the confidence interval for each slope.
In-class task 1:

- Use the data: LEGALADV[-k,], k is your group number
- Fit the model:
  \[ EY_{PI} = \beta_0 + \beta_1 X, \]
  where \( X \) is ads expenditure in previous 6 months.
- Report:
  1. The least squares line
  2. The confidence interval for \( \beta_1 \)
  3. Result of the test \( \beta_1 = 0 \)
In-class task 2:

- Use the data: LEGALADV[-48,]
- Fit the model:
  \[ EY_{WC} = \beta_0 + \beta_1 X, \]

  where \( X \) is ads expenditure in previous 6 months.

- Report:
  1. The least squares line
  2. The confidence interval for \( \beta_1 \)
  3. Result of the test \( \beta_1 = 0 \)
R code for task 2

```r
# load in data
setwd("~/Dropbox/teaching/2015Fall/R_datasets/Cases")
load("LEGALADV.Rdata")

fit2 <- lm(NEWWC~ADVEXP6, data=LEGALADV[-48,])
summary(fit2)
confint(fit2)
```
Conclusions:

- The number of new PI cases is significantly related to advertising.
- The number of new WC cases is not significantly related to advertising.

A court ruled that partner A should “bear the brunt of the advertising expenditures.”
Remarks:

- The relation between number of cases new WC cases and cumulative ads expenditure over previous 6 months seems *nonlinear*.
- The histogram of monthly ads expenditure shows that the ads expenditure on months 43 and 46 are quite extreme.
- There is one observation of monthly ads expenditure that is *negative*.
- Question: what happens if the last 5 observations (that involve months 43 and 46) are removed from the analysis?
Histogram of monthly ads expenditure

Histogram of LEGALADV$TOTADV

Frequency

LEGALADV$TOTADV

0 20000 40000 60000
0 2 4 6 8