Assignment 1

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Task 1

A multiple linear regression model has been estimated to study the relation- ship between $Y =$ violent crime rate (per 100,000 people), $X_1 =$ poverty rate (percentage with income below the poverty line) and $X_2 =$ percentage living in urban area. Data are collected in 51 cities in the U.S.

The relevant equations that relate estimate, standard error, T-statistic, R-squared and Sum of Squares of residuals, regression and total are folloqwing.

$$\frac{\beta_i}{se(\beta_i)} = T_i \qquad R^2 = \frac{\text{SSreg}}{\text{SST}} = 1 - \frac{\text{SSR}}{\text{SST}} \qquad \text{SST} = \text{SSreg} + \text{SSR}$$

Using these we just plug in the corresponding information that is already provided and compute the missing values.

```
a <- -498.683 / 140.988
b <- 4.885 * 6.677
c <- 9.112 / 6.900
d <- 1841257.15 / (1 - 0.5708)
e <- d - 1841257.15
```

The table below reports the output with filled in missing information.

	Est.	s.e.	t-value	p-value
Intercept	-498.683	140.988	[a] -3.537	0.009
X_1	[b] 32.617	6.677	4.885	0.001
X_2	9.112	[c] 1.321	6.900	0.001
R^2	0.5708			
SSreg	[e] 2448718			
SSR	1841257.15			
SSTotal	[d] 4289975			

The the coefficient of determination R^2 is 0.5708. This value measures the proportion of the variance in Y explained by the model. Hence, 57.08 % of the sample variability of Y can be explained by the linear combination of X_i'S given the sample data.

To compute the overall F-test we use the equation below and the statistic then follows an F distribution with corresponding degrees of freedom.

$$F = \frac{\text{SSreg} \,/\, p}{\text{SSR} \,/\, (n - (p+1))} \sim F_{n,n-(p+1)}$$

The data are collected in 51 cities, so $n = 51$ and we have 2 predictors, so $p = 2$. Other values we can easily obtain from the filled table above.

```
(f = (e / 2) / (181257.15 / (51-(2+1)) ))

## [1] 324.2312
```

Hence the F-statistic has a value of 324.2311914. To interpret this, the global F-test, tests a null hypothesis that all regression coefficients are simultaneously 0. In a mathematical notation $H_0 : \beta_1 = \beta_2 = 0$. To evaluate the test, we can compute its p-value. It is a quantile of the corresponding F-distribution for the given statistic or mass under the distribution.

```
(p = pf(f,2,48,lower.tail = FALSE))

## [1] 1.319003e-28
```

Task 2

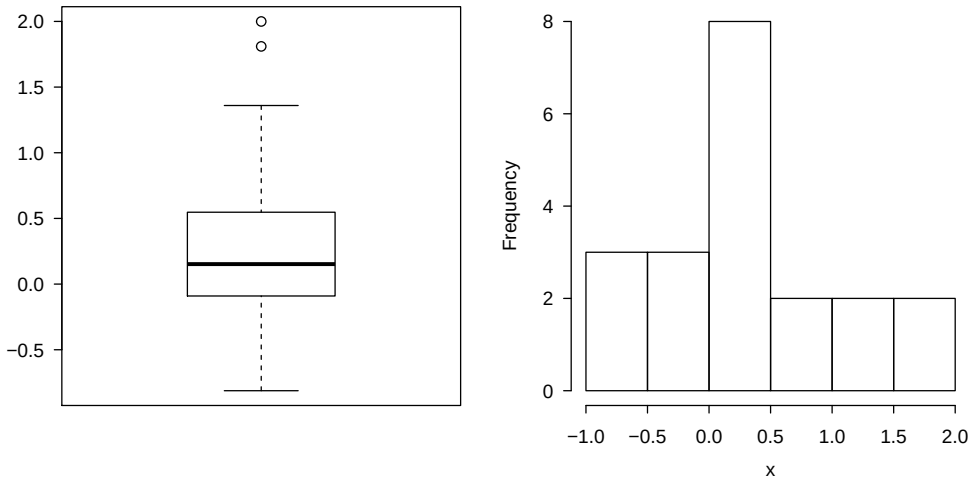
Task Template

You can test if **knitr** works with this minimal demo. OK, let's get started with some boring random numbers:

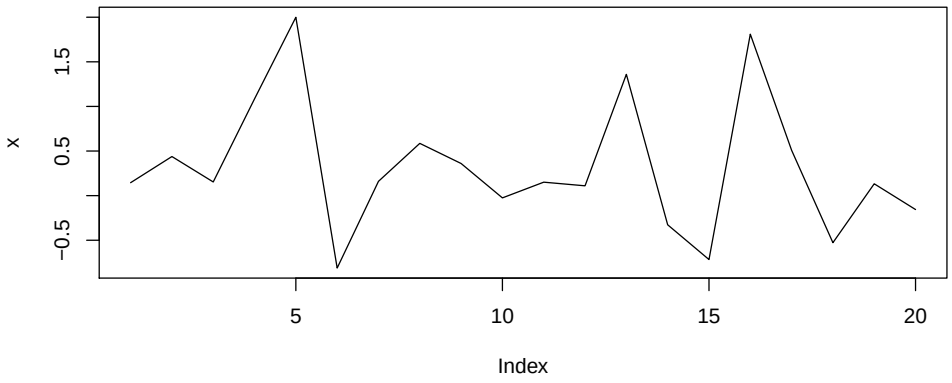
```
set.seed(1121)
(x=rnorm(20))

##  [1]  0.1449583  0.4383221  0.1531912  1.0849426  1.9995449 -0.8118832  0.1602680
##  [8]  0.5858923  0.3600880 -0.0253084  0.1508809  0.1100824  1.3596812 -0.3269946
## [15] -0.7163819  1.8097690  0.5084011 -0.5274603  0.1327188 -0.1559430

mean(x);var(x)

## [1] 0.3217385
## [1] 0.5714534
```

The first element of `x` is 0.1449583. Boring boxplots and histograms recorded by the PDF device:

```
par(mar=c(4,4,.1,.1),cex.lab=.95,cex.axis=.9,mgp=c(2,.7,0),tcl=-.3,las=1)
boxplot(x)
hist(x,main='')
```



Do the above chunks work? You should be able to compile the TEX The first element of `x` is 0.1449583. Boring boxplots and histograms recorded by the PDF device:



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