library(MASS)  
attach(Boston)  
model\_zn <- lm(crim ~ zn)  
summary(model\_zn)

##   
## Call:  
## lm(formula = crim ~ zn)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.429 -4.222 -2.620 1.250 84.523   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 4.45369 0.41722 10.675 < 2e-16 \*\*\*  
## zn -0.07393 0.01609 -4.594 5.51e-06 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 8.435 on 504 degrees of freedom  
## Multiple R-squared: 0.04019, Adjusted R-squared: 0.03828   
## F-statistic: 21.1 on 1 and 504 DF, p-value: 5.506e-06

model\_indus <- lm(crim ~ indus)  
summary(model\_indus)

##   
## Call:  
## lm(formula = crim ~ indus)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -11.972 -2.698 -0.736 0.712 81.813   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -2.06374 0.66723 -3.093 0.00209 \*\*   
## indus 0.50978 0.05102 9.991 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 7.866 on 504 degrees of freedom  
## Multiple R-squared: 0.1653, Adjusted R-squared: 0.1637   
## F-statistic: 99.82 on 1 and 504 DF, p-value: < 2.2e-16

chas <- as.factor(chas)  
model\_chas <- lm(crim ~ chas)  
summary(model\_chas)

##   
## Call:  
## lm(formula = crim ~ chas)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -3.738 -3.661 -3.435 0.018 85.232   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 3.7444 0.3961 9.453 <2e-16 \*\*\*  
## chas1 -1.8928 1.5061 -1.257 0.209   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 8.597 on 504 degrees of freedom  
## Multiple R-squared: 0.003124, Adjusted R-squared: 0.001146   
## F-statistic: 1.579 on 1 and 504 DF, p-value: 0.2094

model\_nox <- lm(crim ~ nox)  
summary(model\_nox)

##   
## Call:  
## lm(formula = crim ~ nox)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -12.371 -2.738 -0.974 0.559 81.728   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -13.720 1.699 -8.073 5.08e-15 \*\*\*  
## nox 31.249 2.999 10.419 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 7.81 on 504 degrees of freedom  
## Multiple R-squared: 0.1772, Adjusted R-squared: 0.1756   
## F-statistic: 108.6 on 1 and 504 DF, p-value: < 2.2e-16

model\_rm <- lm(crim ~ rm)  
summary(model\_rm)

##   
## Call:  
## lm(formula = crim ~ rm)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -6.604 -3.952 -2.654 0.989 87.197   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 20.482 3.365 6.088 2.27e-09 \*\*\*  
## rm -2.684 0.532 -5.045 6.35e-07 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 8.401 on 504 degrees of freedom  
## Multiple R-squared: 0.04807, Adjusted R-squared: 0.04618   
## F-statistic: 25.45 on 1 and 504 DF, p-value: 6.347e-07

model\_age <- lm(crim ~ age)  
summary(model\_age)

##   
## Call:  
## lm(formula = crim ~ age)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -6.789 -4.257 -1.230 1.527 82.849   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -3.77791 0.94398 -4.002 7.22e-05 \*\*\*  
## age 0.10779 0.01274 8.463 2.85e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 8.057 on 504 degrees of freedom  
## Multiple R-squared: 0.1244, Adjusted R-squared: 0.1227   
## F-statistic: 71.62 on 1 and 504 DF, p-value: 2.855e-16

model\_dis <- lm(crim ~ dis)  
summary(model\_dis)

##   
## Call:  
## lm(formula = crim ~ dis)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -6.708 -4.134 -1.527 1.516 81.674   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 9.4993 0.7304 13.006 <2e-16 \*\*\*  
## dis -1.5509 0.1683 -9.213 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 7.965 on 504 degrees of freedom  
## Multiple R-squared: 0.1441, Adjusted R-squared: 0.1425   
## F-statistic: 84.89 on 1 and 504 DF, p-value: < 2.2e-16

model\_rad <- lm(crim ~ rad)  
summary(model\_rad)

##   
## Call:  
## lm(formula = crim ~ rad)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -10.164 -1.381 -0.141 0.660 76.433   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -2.28716 0.44348 -5.157 3.61e-07 \*\*\*  
## rad 0.61791 0.03433 17.998 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 6.718 on 504 degrees of freedom  
## Multiple R-squared: 0.3913, Adjusted R-squared: 0.39   
## F-statistic: 323.9 on 1 and 504 DF, p-value: < 2.2e-16

model\_tax <- lm(crim ~ tax)  
summary(model\_tax)

##   
## Call:  
## lm(formula = crim ~ tax)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -12.513 -2.738 -0.194 1.065 77.696   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -8.528369 0.815809 -10.45 <2e-16 \*\*\*  
## tax 0.029742 0.001847 16.10 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 6.997 on 504 degrees of freedom  
## Multiple R-squared: 0.3396, Adjusted R-squared: 0.3383   
## F-statistic: 259.2 on 1 and 504 DF, p-value: < 2.2e-16

model\_ptratio <- lm(crim ~ ptratio)  
summary(model\_ptratio)

##   
## Call:  
## lm(formula = crim ~ ptratio)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -7.654 -3.985 -1.912 1.825 83.353   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -17.6469 3.1473 -5.607 3.40e-08 \*\*\*  
## ptratio 1.1520 0.1694 6.801 2.94e-11 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 8.24 on 504 degrees of freedom  
## Multiple R-squared: 0.08407, Adjusted R-squared: 0.08225   
## F-statistic: 46.26 on 1 and 504 DF, p-value: 2.943e-11

model\_black <- lm(crim ~ black)  
summary(model\_black)

##   
## Call:  
## lm(formula = crim ~ black)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -13.756 -2.299 -2.095 -1.296 86.822   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 16.553529 1.425903 11.609 <2e-16 \*\*\*  
## black -0.036280 0.003873 -9.367 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 7.946 on 504 degrees of freedom  
## Multiple R-squared: 0.1483, Adjusted R-squared: 0.1466   
## F-statistic: 87.74 on 1 and 504 DF, p-value: < 2.2e-16

model\_lstat <- lm(crim ~ lstat)  
summary(model\_lstat)

##   
## Call:  
## lm(formula = crim ~ lstat)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -13.925 -2.822 -0.664 1.079 82.862   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -3.33054 0.69376 -4.801 2.09e-06 \*\*\*  
## lstat 0.54880 0.04776 11.491 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 7.664 on 504 degrees of freedom  
## Multiple R-squared: 0.2076, Adjusted R-squared: 0.206   
## F-statistic: 132 on 1 and 504 DF, p-value: < 2.2e-16

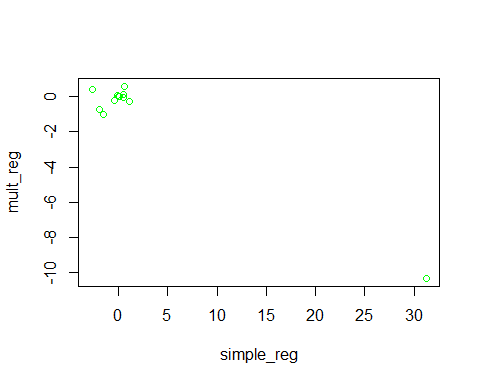
model\_medv <- lm(crim ~ medv)  
summary(model\_medv)

##   
## Call:  
## lm(formula = crim ~ medv)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -9.071 -4.022 -2.343 1.298 80.957   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 11.79654 0.93419 12.63 <2e-16 \*\*\*  
## medv -0.36316 0.03839 -9.46 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 7.934 on 504 degrees of freedom  
## Multiple R-squared: 0.1508, Adjusted R-squared: 0.1491   
## F-statistic: 89.49 on 1 and 504 DF, p-value: < 2.2e-16

model\_all <- lm(crim ~ ., data = Boston)  
summary(model\_all)

##   
## Call:  
## lm(formula = crim ~ ., data = Boston)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -9.924 -2.120 -0.353 1.019 75.051   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 17.033228 7.234903 2.354 0.018949 \*   
## zn 0.044855 0.018734 2.394 0.017025 \*   
## indus -0.063855 0.083407 -0.766 0.444294   
## chas -0.749134 1.180147 -0.635 0.525867   
## nox -10.313535 5.275536 -1.955 0.051152 .   
## rm 0.430131 0.612830 0.702 0.483089   
## age 0.001452 0.017925 0.081 0.935488   
## dis -0.987176 0.281817 -3.503 0.000502 \*\*\*  
## rad 0.588209 0.088049 6.680 6.46e-11 \*\*\*  
## tax -0.003780 0.005156 -0.733 0.463793   
## ptratio -0.271081 0.186450 -1.454 0.146611   
## black -0.007538 0.003673 -2.052 0.040702 \*   
## lstat 0.126211 0.075725 1.667 0.096208 .   
## medv -0.198887 0.060516 -3.287 0.001087 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 6.439 on 492 degrees of freedom  
## Multiple R-squared: 0.454, Adjusted R-squared: 0.4396   
## F-statistic: 31.47 on 13 and 492 DF, p-value: < 2.2e-16

simple\_reg <- vector("numeric",0)  
simple\_reg <- c(simple\_reg, model\_zn$coefficient[2])  
simple\_reg <- c(simple\_reg, model\_indus$coefficient[2])  
simple\_reg <- c(simple\_reg, model\_chas$coefficient[2])  
simple\_reg <- c(simple\_reg, model\_nox$coefficient[2])  
simple\_reg <- c(simple\_reg, model\_rm$coefficient[2])  
simple\_reg <- c(simple\_reg, model\_age$coefficient[2])  
simple\_reg <- c(simple\_reg, model\_dis$coefficient[2])  
simple\_reg <- c(simple\_reg, model\_rad$coefficient[2])  
simple\_reg <- c(simple\_reg, model\_tax$coefficient[2])  
simple\_reg <- c(simple\_reg, model\_ptratio$coefficient[2])  
simple\_reg <- c(simple\_reg, model\_black$coefficient[2])  
simple\_reg <- c(simple\_reg, model\_lstat$coefficient[2])  
simple\_reg <- c(simple\_reg, model\_medv$coefficient[2])  
mult\_reg <- vector("numeric", 0)  
mult\_reg <- c(mult\_reg, model\_all$coefficients)  
mult\_reg <- mult\_reg[-1]  
plot(simple\_reg, mult\_reg, col = "green")



cor(Boston[-c(1, 4)])

## zn indus nox rm age dis  
## zn 1.0000000 -0.5338282 -0.5166037 0.3119906 -0.5695373 0.6644082  
## indus -0.5338282 1.0000000 0.7636514 -0.3916759 0.6447785 -0.7080270  
## nox -0.5166037 0.7636514 1.0000000 -0.3021882 0.7314701 -0.7692301  
## rm 0.3119906 -0.3916759 -0.3021882 1.0000000 -0.2402649 0.2052462  
## age -0.5695373 0.6447785 0.7314701 -0.2402649 1.0000000 -0.7478805  
## dis 0.6644082 -0.7080270 -0.7692301 0.2052462 -0.7478805 1.0000000  
## rad -0.3119478 0.5951293 0.6114406 -0.2098467 0.4560225 -0.4945879  
## tax -0.3145633 0.7207602 0.6680232 -0.2920478 0.5064556 -0.5344316  
## ptratio -0.3916785 0.3832476 0.1889327 -0.3555015 0.2615150 -0.2324705  
## black 0.1755203 -0.3569765 -0.3800506 0.1280686 -0.2735340 0.2915117  
## lstat -0.4129946 0.6037997 0.5908789 -0.6138083 0.6023385 -0.4969958  
## medv 0.3604453 -0.4837252 -0.4273208 0.6953599 -0.3769546 0.2499287  
## rad tax ptratio black lstat medv  
## zn -0.3119478 -0.3145633 -0.3916785 0.1755203 -0.4129946 0.3604453  
## indus 0.5951293 0.7207602 0.3832476 -0.3569765 0.6037997 -0.4837252  
## nox 0.6114406 0.6680232 0.1889327 -0.3800506 0.5908789 -0.4273208  
## rm -0.2098467 -0.2920478 -0.3555015 0.1280686 -0.6138083 0.6953599  
## age 0.4560225 0.5064556 0.2615150 -0.2735340 0.6023385 -0.3769546  
## dis -0.4945879 -0.5344316 -0.2324705 0.2915117 -0.4969958 0.2499287  
## rad 1.0000000 0.9102282 0.4647412 -0.4444128 0.4886763 -0.3816262  
## tax 0.9102282 1.0000000 0.4608530 -0.4418080 0.5439934 -0.4685359  
## ptratio 0.4647412 0.4608530 1.0000000 -0.1773833 0.3740443 -0.5077867  
## black -0.4444128 -0.4418080 -0.1773833 1.0000000 -0.3660869 0.3334608  
## lstat 0.4886763 0.5439934 0.3740443 -0.3660869 1.0000000 -0.7376627  
## medv -0.3816262 -0.4685359 -0.5077867 0.3334608 -0.7376627 1.0000000