Pemilihan Model dengan Seleksi Metode Backward

NID

2024-05-18

datasets::mtcars

## mpg cyl disp hp drat wt qsec vs am gear carb  
## Mazda RX4 21.0 6 160.0 110 3.90 2.620 16.46 0 1 4 4  
## Mazda RX4 Wag 21.0 6 160.0 110 3.90 2.875 17.02 0 1 4 4  
## Datsun 710 22.8 4 108.0 93 3.85 2.320 18.61 1 1 4 1  
## Hornet 4 Drive 21.4 6 258.0 110 3.08 3.215 19.44 1 0 3 1  
## Hornet Sportabout 18.7 8 360.0 175 3.15 3.440 17.02 0 0 3 2  
## Valiant 18.1 6 225.0 105 2.76 3.460 20.22 1 0 3 1  
## Duster 360 14.3 8 360.0 245 3.21 3.570 15.84 0 0 3 4  
## Merc 240D 24.4 4 146.7 62 3.69 3.190 20.00 1 0 4 2  
## Merc 230 22.8 4 140.8 95 3.92 3.150 22.90 1 0 4 2  
## Merc 280 19.2 6 167.6 123 3.92 3.440 18.30 1 0 4 4  
## Merc 280C 17.8 6 167.6 123 3.92 3.440 18.90 1 0 4 4  
## Merc 450SE 16.4 8 275.8 180 3.07 4.070 17.40 0 0 3 3  
## Merc 450SL 17.3 8 275.8 180 3.07 3.730 17.60 0 0 3 3  
## Merc 450SLC 15.2 8 275.8 180 3.07 3.780 18.00 0 0 3 3  
## Cadillac Fleetwood 10.4 8 472.0 205 2.93 5.250 17.98 0 0 3 4  
## Lincoln Continental 10.4 8 460.0 215 3.00 5.424 17.82 0 0 3 4  
## Chrysler Imperial 14.7 8 440.0 230 3.23 5.345 17.42 0 0 3 4  
## Fiat 128 32.4 4 78.7 66 4.08 2.200 19.47 1 1 4 1  
## Honda Civic 30.4 4 75.7 52 4.93 1.615 18.52 1 1 4 2  
## Toyota Corolla 33.9 4 71.1 65 4.22 1.835 19.90 1 1 4 1  
## Toyota Corona 21.5 4 120.1 97 3.70 2.465 20.01 1 0 3 1  
## Dodge Challenger 15.5 8 318.0 150 2.76 3.520 16.87 0 0 3 2  
## AMC Javelin 15.2 8 304.0 150 3.15 3.435 17.30 0 0 3 2  
## Camaro Z28 13.3 8 350.0 245 3.73 3.840 15.41 0 0 3 4  
## Pontiac Firebird 19.2 8 400.0 175 3.08 3.845 17.05 0 0 3 2  
## Fiat X1-9 27.3 4 79.0 66 4.08 1.935 18.90 1 1 4 1  
## Porsche 914-2 26.0 4 120.3 91 4.43 2.140 16.70 0 1 5 2  
## Lotus Europa 30.4 4 95.1 113 3.77 1.513 16.90 1 1 5 2  
## Ford Pantera L 15.8 8 351.0 264 4.22 3.170 14.50 0 1 5 4  
## Ferrari Dino 19.7 6 145.0 175 3.62 2.770 15.50 0 1 5 6  
## Maserati Bora 15.0 8 301.0 335 3.54 3.570 14.60 0 1 5 8  
## Volvo 142E 21.4 4 121.0 109 4.11 2.780 18.60 1 1 4 2

str(mtcars)

## 'data.frame': 32 obs. of 11 variables:  
## $ mpg : num 21 21 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 ...  
## $ cyl : num 6 6 4 6 8 6 8 4 4 6 ...  
## $ disp: num 160 160 108 258 360 ...  
## $ hp : num 110 110 93 110 175 105 245 62 95 123 ...  
## $ drat: num 3.9 3.9 3.85 3.08 3.15 2.76 3.21 3.69 3.92 3.92 ...  
## $ wt : num 2.62 2.88 2.32 3.21 3.44 ...  
## $ qsec: num 16.5 17 18.6 19.4 17 ...  
## $ vs : num 0 0 1 1 0 1 0 1 1 1 ...  
## $ am : num 1 1 1 0 0 0 0 0 0 0 ...  
## $ gear: num 4 4 4 3 3 3 3 4 4 4 ...  
## $ carb: num 4 4 1 1 2 1 4 2 2 4 ...

METODE BACKWARD DENGAN FUNGSI R

library(leaps)  
bs <- regsubsets(mpg ~ ., data=mtcars, nvmax = 10, method = "backward") #nvmax jumlah varindependen  
hasil<-summary(bs)

which.min(hasil$cp)#nilai yang muncul menunjukkan model terbaik dengan nilai Cp terendah terdiri dari berapa variabel

## [1] 3

which.min(hasil$bic)# model terbaik dengan nilai BIC terendah

## [1] 3

which.max(hasil$adjr2)#model terbaik dengan nilai R2 tertinggi

## [1] 5

coef(bs,3) #3 adalah jumlah variabel yang dipilih berdasarkan ukuran kebaikan model yang dipilih

## (Intercept) wt qsec am   
## 9.617781 -3.916504 1.225886 2.935837

Berdasarkan Hasil di atas dapat disimpulkan bahwa model terbaiknya adalah: mpg = 9.618 - 3.916 + 1.226 + 2.936

dimana = wt = qsec = am

METODE BACKWARD DENGAN MANUAL #Model Regresi dengan semua variabel independen

model1<-lm(mpg~.,data=mtcars) #model dengan seluruh var independen  
summary(model1)

##   
## Call:  
## lm(formula = mpg ~ ., data = mtcars)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -3.4506 -1.6044 -0.1196 1.2193 4.6271   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 12.30337 18.71788 0.657 0.5181   
## cyl -0.11144 1.04502 -0.107 0.9161   
## disp 0.01334 0.01786 0.747 0.4635   
## hp -0.02148 0.02177 -0.987 0.3350   
## drat 0.78711 1.63537 0.481 0.6353   
## wt -3.71530 1.89441 -1.961 0.0633 .  
## qsec 0.82104 0.73084 1.123 0.2739   
## vs 0.31776 2.10451 0.151 0.8814   
## am 2.52023 2.05665 1.225 0.2340   
## gear 0.65541 1.49326 0.439 0.6652   
## carb -0.19942 0.82875 -0.241 0.8122   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 2.65 on 21 degrees of freedom  
## Multiple R-squared: 0.869, Adjusted R-squared: 0.8066   
## F-statistic: 13.93 on 10 and 21 DF, p-value: 3.793e-07

anova(model1)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## cyl 1 817.71 817.71 116.4245 5.034e-10 \*\*\*  
## disp 1 37.59 37.59 5.3526 0.030911 \*   
## hp 1 9.37 9.37 1.3342 0.261031   
## drat 1 16.47 16.47 2.3446 0.140644   
## wt 1 77.48 77.48 11.0309 0.003244 \*\*   
## qsec 1 3.95 3.95 0.5623 0.461656   
## vs 1 0.13 0.13 0.0185 0.893173   
## am 1 14.47 14.47 2.0608 0.165858   
## gear 1 0.97 0.97 0.1384 0.713653   
## carb 1 0.41 0.41 0.0579 0.812179   
## Residuals 21 147.49 7.02   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#Penyeleksian variabel independen pertama

model1<-lm(mpg~cyl+disp+hp+drat+wt+qsec+vs+am+gear+carb,data=mtcars)  
anova(model1)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## cyl 1 817.71 817.71 116.4245 5.034e-10 \*\*\*  
## disp 1 37.59 37.59 5.3526 0.030911 \*   
## hp 1 9.37 9.37 1.3342 0.261031   
## drat 1 16.47 16.47 2.3446 0.140644   
## wt 1 77.48 77.48 11.0309 0.003244 \*\*   
## qsec 1 3.95 3.95 0.5623 0.461656   
## vs 1 0.13 0.13 0.0185 0.893173   
## am 1 14.47 14.47 2.0608 0.165858   
## gear 1 0.97 0.97 0.1384 0.713653   
## carb 1 0.41 0.41 0.0579 0.812179   
## Residuals 21 147.49 7.02   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model2<-lm(mpg~carb+cyl+disp+hp+drat+wt+qsec+vs+am+gear,data=mtcars)  
anova(model2)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 48.6615 6.880e-07 \*\*\*  
## cyl 1 492.11 492.11 70.0654 3.955e-08 \*\*\*  
## disp 1 51.66 51.66 7.3546 0.01306 \*   
## hp 1 1.80 1.80 0.2568 0.61763   
## drat 1 27.13 27.13 3.8632 0.06272 .   
## wt 1 44.79 44.79 6.3765 0.01968 \*   
## qsec 1 3.35 3.35 0.4764 0.49763   
## vs 1 0.12 0.12 0.0167 0.89840   
## am 1 14.48 14.48 2.0610 0.16584   
## gear 1 1.35 1.35 0.1926 0.66521   
## Residuals 21 147.49 7.02   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model3<-lm(mpg~carb+gear+cyl+disp+hp+drat+wt+qsec+vs+am,data=mtcars)  
anova(model3)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 48.6615 6.88e-07 \*\*\*  
## gear 1 485.19 485.19 69.0804 4.44e-08 \*\*\*  
## cyl 1 64.05 64.05 9.1197 0.006518 \*\*   
## disp 1 33.25 33.25 4.7346 0.041124 \*   
## hp 1 0.72 0.72 0.1028 0.751712   
## drat 1 10.98 10.98 1.5627 0.225023   
## wt 1 26.73 26.73 3.8060 0.064540 .   
## qsec 1 5.22 5.22 0.7436 0.398242   
## vs 1 0.08 0.08 0.0118 0.914687   
## am 1 10.55 10.55 1.5016 0.233990   
## Residuals 21 147.49 7.02   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model4<-lm(mpg~carb+gear+am+cyl+disp+hp+drat+wt+qsec+vs,data=mtcars)  
anova(model4)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 48.6615 6.88e-07 \*\*\*  
## gear 1 485.19 485.19 69.0804 4.44e-08 \*\*\*  
## am 1 33.15 33.15 4.7202 0.041404 \*   
## cyl 1 59.35 59.35 8.4501 0.008432 \*\*   
## disp 1 24.24 24.24 3.4519 0.077255 .   
## hp 1 1.96 1.96 0.2784 0.603310   
## drat 1 4.57 4.57 0.6502 0.429064   
## wt 1 16.90 16.90 2.4064 0.135780   
## qsec 1 11.26 11.26 1.6027 0.219380   
## vs 1 0.16 0.16 0.0228 0.881423   
## Residuals 21 147.49 7.02   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model5<-lm(mpg~carb+gear+am+vs+cyl+disp+hp+drat+wt+qsec,data=mtcars)  
anova(model5)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 48.6615 6.88e-07 \*\*\*  
## gear 1 485.19 485.19 69.0804 4.44e-08 \*\*\*  
## am 1 33.15 33.15 4.7202 0.04140 \*   
## vs 1 39.93 39.93 5.6852 0.02662 \*   
## cyl 1 20.95 20.95 2.9825 0.09885 .   
## disp 1 23.22 23.22 3.3063 0.08331 .   
## hp 1 2.55 2.55 0.3635 0.55304   
## drat 1 4.61 4.61 0.6565 0.42687   
## wt 1 18.31 18.31 2.6066 0.12135   
## qsec 1 8.86 8.86 1.2621 0.27394   
## Residuals 21 147.49 7.02   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model6<-lm(mpg~carb+gear+am+vs+qsec+cyl+disp+hp+drat+wt,data=mtcars)  
anova(model6)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 48.6615 6.88e-07 \*\*\*  
## gear 1 485.19 485.19 69.0804 4.44e-08 \*\*\*  
## am 1 33.15 33.15 4.7202 0.04140 \*   
## vs 1 39.93 39.93 5.6852 0.02662 \*   
## qsec 1 6.46 6.46 0.9195 0.34850   
## cyl 1 14.55 14.55 2.0711 0.16486   
## disp 1 23.43 23.43 3.3359 0.08203 .   
## hp 1 2.29 2.29 0.3267 0.57369   
## drat 1 4.76 4.76 0.6779 0.41956   
## wt 1 27.01 27.01 3.8463 0.06325 .   
## Residuals 21 147.49 7.02   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model7<-lm(mpg~carb+gear+am+vs+qsec+wt+cyl+disp+hp+drat,data=mtcars)  
anova(model7)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 48.6615 6.88e-07 \*\*\*  
## gear 1 485.19 485.19 69.0804 4.44e-08 \*\*\*  
## am 1 33.15 33.15 4.7202 0.041404 \*   
## vs 1 39.93 39.93 5.6852 0.026619 \*   
## qsec 1 6.46 6.46 0.9195 0.348505   
## wt 1 61.18 61.18 8.7106 0.007622 \*\*   
## cyl 1 1.05 1.05 0.1489 0.703505   
## disp 1 0.71 0.71 0.1005 0.754340   
## hp 1 7.49 7.49 1.0663 0.313538   
## drat 1 1.63 1.63 0.2317 0.635278   
## Residuals 21 147.49 7.02   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model8<-lm(mpg~carb+gear+am+vs+qsec+wt+drat+cyl+disp+hp,data=mtcars)  
anova(model8)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 48.6615 6.88e-07 \*\*\*  
## gear 1 485.19 485.19 69.0804 4.44e-08 \*\*\*  
## am 1 33.15 33.15 4.7202 0.041404 \*   
## vs 1 39.93 39.93 5.6852 0.026619 \*   
## qsec 1 6.46 6.46 0.9195 0.348505   
## wt 1 61.18 61.18 8.7106 0.007622 \*\*   
## drat 1 3.25 3.25 0.4628 0.503742   
## cyl 1 0.27 0.27 0.0384 0.846577   
## disp 1 0.51 0.51 0.0722 0.790713   
## hp 1 6.84 6.84 0.9739 0.334955   
## Residuals 21 147.49 7.02   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model9<-lm(mpg~carb+gear+am+vs+qsec+wt+drat+hp+cyl+disp,data=mtcars)  
anova(model9)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 48.6615 6.88e-07 \*\*\*  
## gear 1 485.19 485.19 69.0804 4.44e-08 \*\*\*  
## am 1 33.15 33.15 4.7202 0.041404 \*   
## vs 1 39.93 39.93 5.6852 0.026619 \*   
## qsec 1 6.46 6.46 0.9195 0.348505   
## wt 1 61.18 61.18 8.7106 0.007622 \*\*   
## drat 1 3.25 3.25 0.4628 0.503742   
## hp 1 3.64 3.64 0.5177 0.479758   
## cyl 1 0.06 0.06 0.0091 0.924772   
## disp 1 3.92 3.92 0.5576 0.463489   
## Residuals 21 147.49 7.02   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model10<-lm(mpg~carb+gear+am+vs+qsec+wt+drat+hp+disp+cyl,data=mtcars)  
anova(model10)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 48.6615 6.88e-07 \*\*\*  
## gear 1 485.19 485.19 69.0804 4.44e-08 \*\*\*  
## am 1 33.15 33.15 4.7202 0.041404 \*   
## vs 1 39.93 39.93 5.6852 0.026619 \*   
## qsec 1 6.46 6.46 0.9195 0.348505   
## wt 1 61.18 61.18 8.7106 0.007622 \*\*   
## drat 1 3.25 3.25 0.4628 0.503742   
## hp 1 3.64 3.64 0.5177 0.479758   
## disp 1 3.90 3.90 0.5554 0.464376   
## cyl 1 0.08 0.08 0.0114 0.916087   
## Residuals 21 147.49 7.02   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#Penyeleksian kembali variabel independen berikutnya

model.11<-lm(mpg~disp+hp+drat+wt+qsec+vs+am+gear+carb,data=mtcars)   
anova(model.11)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## disp 1 808.89 808.89 120.5870 2.141e-10 \*\*\*  
## hp 1 33.67 33.67 5.0187 0.035500 \*   
## drat 1 30.15 30.15 4.4943 0.045524 \*   
## wt 1 70.51 70.51 10.5112 0.003741 \*\*   
## qsec 1 12.71 12.71 1.8945 0.182540   
## vs 1 0.22 0.22 0.0334 0.856600   
## am 1 20.46 20.46 3.0497 0.094702 .   
## gear 1 1.35 1.35 0.2018 0.657705   
## carb 1 0.52 0.52 0.0775 0.783258   
## Residuals 22 147.57 6.71   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model.12<-lm(mpg~carb+disp+hp+drat+wt+qsec+vs+am+gear,data=mtcars)   
anova(model.12)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 50.9511 3.711e-07 \*\*\*  
## disp 1 529.45 529.45 78.9296 9.925e-09 \*\*\*  
## hp 1 0.30 0.30 0.0441 0.83561   
## drat 1 40.36 40.36 6.0162 0.02257 \*   
## wt 1 35.55 35.55 5.2991 0.03118 \*   
## qsec 1 8.50 8.50 1.2664 0.27257   
## vs 1 0.22 0.22 0.0327 0.85810   
## am 1 20.51 20.51 3.0575 0.09431 .   
## gear 1 1.82 1.82 0.2715 0.60754   
## Residuals 22 147.57 6.71   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model.13<-lm(mpg~carb+gear+disp+hp+drat+wt+qsec+vs+am,data=mtcars)  
anova(model.13)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 50.9511 3.711e-07 \*\*\*  
## gear 1 485.19 485.19 72.3308 2.107e-08 \*\*\*  
## disp 1 95.83 95.83 14.2859 0.001031 \*\*   
## hp 1 1.43 1.43 0.2135 0.648584   
## drat 1 11.74 11.74 1.7502 0.199433   
## wt 1 21.69 21.69 3.2327 0.085918 .   
## qsec 1 8.98 8.98 1.3392 0.259583   
## vs 1 0.00 0.00 0.0003 0.986518   
## am 1 11.84 11.84 1.7645 0.197684   
## Residuals 22 147.57 6.71   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model.14<-lm(mpg~carb+gear+am+disp+hp+drat+wt+qsec+vs,data=mtcars)  
anova(model.14)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 50.9511 3.711e-07 \*\*\*  
## gear 1 485.19 485.19 72.3308 2.107e-08 \*\*\*  
## am 1 33.15 33.15 4.9423 0.036794 \*   
## disp 1 81.01 81.01 12.0766 0.002148 \*\*   
## hp 1 3.36 3.36 0.5009 0.486520   
## drat 1 5.51 5.51 0.8214 0.374601   
## wt 1 12.52 12.52 1.8672 0.185604   
## qsec 1 15.68 15.68 2.3380 0.140505   
## vs 1 0.27 0.27 0.0400 0.843258   
## Residuals 22 147.57 6.71   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model.15<-lm(mpg~carb+gear+am++vs+disp+hp+drat+wt+qsec,data=mtcars)  
anova(model.15)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 50.9511 3.711e-07 \*\*\*  
## gear 1 485.19 485.19 72.3308 2.107e-08 \*\*\*  
## am 1 33.15 33.15 4.9423 0.03679 \*   
## vs 1 39.93 39.93 5.9527 0.02321 \*   
## disp 1 43.15 43.15 6.4322 0.01882 \*   
## hp 1 3.47 3.47 0.5168 0.47979   
## drat 1 4.69 4.69 0.6996 0.41192   
## wt 1 17.03 17.03 2.5382 0.12539   
## qsec 1 10.09 10.09 1.5047 0.23292   
## Residuals 22 147.57 6.71   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model.16<-lm(mpg~carb+gear+am+vs+qsec+disp+hp+drat+wt,data=mtcars)  
anova(model.16)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 50.9511 3.711e-07 \*\*\*  
## gear 1 485.19 485.19 72.3308 2.107e-08 \*\*\*  
## am 1 33.15 33.15 4.9423 0.03679 \*   
## vs 1 39.93 39.93 5.9527 0.02321 \*   
## qsec 1 6.46 6.46 0.9628 0.33715   
## disp 1 37.54 37.54 5.5967 0.02722 \*   
## hp 1 2.65 2.65 0.3954 0.53595   
## drat 1 4.74 4.74 0.7072 0.40942   
## wt 1 27.03 27.03 4.0293 0.05716 .   
## Residuals 22 147.57 6.71   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model.17<-lm(mpg~carb+gear+am+vs+qsec+wt+disp+hp+drat,data=mtcars)  
anova(model.17)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 50.9511 3.711e-07 \*\*\*  
## gear 1 485.19 485.19 72.3308 2.107e-08 \*\*\*  
## am 1 33.15 33.15 4.9423 0.036794 \*   
## vs 1 39.93 39.93 5.9527 0.023214 \*   
## qsec 1 6.46 6.46 0.9628 0.337147   
## wt 1 61.18 61.18 9.1204 0.006296 \*\*   
## disp 1 0.10 0.10 0.0152 0.902982   
## hp 1 8.70 8.70 1.2974 0.266936   
## drat 1 1.98 1.98 0.2956 0.592144   
## Residuals 22 147.57 6.71   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model.18<-lm(mpg~carb+gear+am+vs+qsec+wt+drat+disp+hp,data=mtcars)  
anova(model.18)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 50.9511 3.711e-07 \*\*\*  
## gear 1 485.19 485.19 72.3308 2.107e-08 \*\*\*  
## am 1 33.15 33.15 4.9423 0.036794 \*   
## vs 1 39.93 39.93 5.9527 0.023214 \*   
## qsec 1 6.46 6.46 0.9628 0.337147   
## wt 1 61.18 61.18 9.1204 0.006296 \*\*   
## drat 1 3.25 3.25 0.4846 0.493638   
## disp 1 0.17 0.17 0.0259 0.873577   
## hp 1 7.36 7.36 1.0977 0.306150   
## Residuals 22 147.57 6.71   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

model.19<-lm(mpg~carb+gear+am+vs+qsec+wt+drat+hp+disp,data=mtcars)  
anova(model.19)

## Analysis of Variance Table  
##   
## Response: mpg  
## Df Sum Sq Mean Sq F value Pr(>F)   
## carb 1 341.78 341.78 50.9511 3.711e-07 \*\*\*  
## gear 1 485.19 485.19 72.3308 2.107e-08 \*\*\*  
## am 1 33.15 33.15 4.9423 0.036794 \*   
## vs 1 39.93 39.93 5.9527 0.023214 \*   
## qsec 1 6.46 6.46 0.9628 0.337147   
## wt 1 61.18 61.18 9.1204 0.006296 \*\*   
## drat 1 3.25 3.25 0.4846 0.493638   
## hp 1 3.64 3.64 0.5421 0.469361   
## disp 1 3.90 3.90 0.5815 0.453808   
## Residuals 22 147.57 6.71   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1