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The *R* Workshop

Applying the Integrated Suite of Software Facilities for Statistical Computing and Graphics

University of Georgia
Department of Workforce Education, Leadership, and Social Foundations
College of Education Research Office

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9. Regression

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id	SAT	GEN	GPA
1	388	F	4.0
2	354	F	3.8
3	361	F	3.5
4	329	F	3.1
5	331	M	3.3
6	364	M	3.5
7	399	M	4.0
8	421	F	4.2
9	398	M	3.8
10	383	M	3.7

Regression

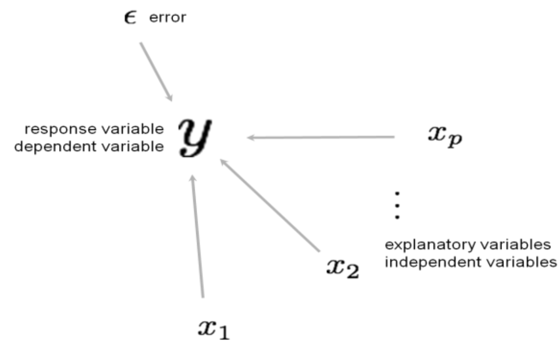
Correlation

- Pearson’s correlation
- Kendall’s tau
- Spearman’s rank correlation

```
SAT <- c(388, 354, 361, 329, 331, 364, 399, 421, 398, 383)
GPA <- c(4.0, 3.8, 3.5, 3.1, 3.3, 3.5, 4.0, 4.2, 3.8, 3.7)
cor(SAT, GPA, method=“pearson”)
cor(SAT, GPA, method=“kendall”)
cor(SAT, GPA, method=“spearman”)
```

Regression

Regression Model



$$y = m(x_1, x_2, \cdots, x_p) + \epsilon$$

where $m(x_1, x_2, \cdots, x_p) = E(y|x_1, x_2, \cdots, x_p)$

and $\epsilon \sim \bullet(0, \sigma^2)$.

Regression

Linear model

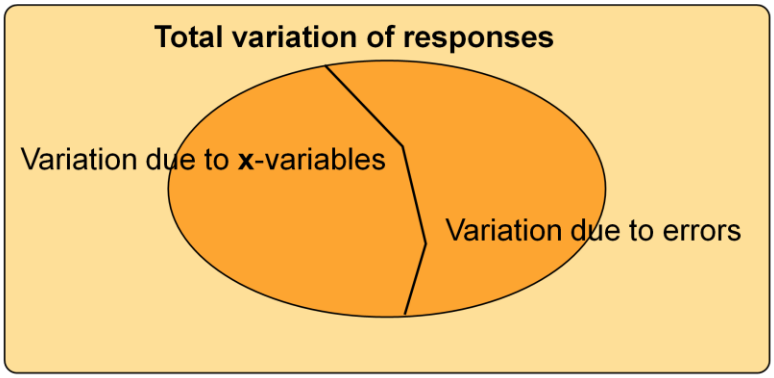
$$m(x_1, x_2, \cdots, x_p) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p$$

the expected change in y per unit change in x_1
when all the other regressors are held constant
: partial regression coefficient

Nonlinear model

(e.g) $m(x) = A \cdot exp(-\beta x)$

Regression



Null hypothesis.: The regression model is **not** significant

F-test again!

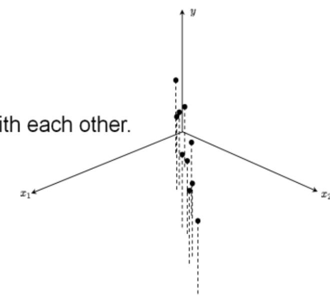
Regression

```
SAT <- c(388, 354, 361, 329, 331, 364, 399, 421, 398, 383)
GEN <- c("F", "F", "F", "F", "M", "M", "M", "F", "M", "M")
GPA <- c(4.0, 3.8, 3.5, 3.1, 3.3, 3.5, 4.0, 4.2, 3.8, 3.7)

par(mfrow=c(1,2))
plot(SAT, GPA)
boxplot(GPA~GEN, xlab="GENDER", ylab="GPA")

res <- lsfit(SAT, GPA)
ls.print(res)

res.no <- lsfit(SAT, GPA, intercept=F)
ls.print(res.no)

t.test(GPA~GEN)

res.lm <- lm(GPA~GEN+SAT)
summary(res.lm)
```

Regression

Multicollinearity

Regressors may have (nearly) linear dependency with each other.



VIF: variance inflation factor

$$\mathrm{VIF}_j > 10$$

Regression

Remedies when multicollinearity is detected:

- ✓ Model re-specification
- ✓ Ridge regression
- ✓ Principal component regression

Regression

Variable Selection

- Stepwise regression

```
> data(state)
> statedata <- data.frame(state.x77,
      row.names=state.abb,check.names=T)
> g <- lm(Life.Exp~., data=statedata)
> summary(g)
> step(g)
```

Regression