# Statistics and Data Science II (XCD) CHEAT SHEET

CourseKata

## Basics

```
print("Hello world!")

# assign value to object
myNumber <- 5
# combine values into vector
myVector <- c(1, 2, 3)
# first element in vector
myVector[1]

# arithmetic operations
sum(1, 2, 100), +, -, *, /

# logical operations
>, <, >=, <=, ==, !=, |, &
```

## Summary Tables

```
# compute five-number summary
favstats(~ PriceK, data = Ames)

# create frequency table
tally(TipExperiment$Condition)
tally(~ Condition,
  data = TipExperiment)

# tally by condition
tally(~ YearBuilt < 1900,
  data = Ames)

# two-way frequency table
tally(GarageCars ~ GarageType,
  data = Ames)
```

## Simulation

```
# sample without replacement
sample(TipExperiment, 6)
# sample with replacement
resample(TipExperiment, 10)

# randomize sampling distribution
# of b1s, centered on 0
sdob1 <- do(1000) *
  b1(shuffle(Tip) ~ Condition,
  data = TipExperiment)

# bootstrap sampling distribution
# of b1s, centered on sample b1
sdob1_boot <- do(1000) *
  b1(Tip ~ Condition,
  data = resample(TipExperiment))
```

```
# return TRUE for
# middle 95% of distribution
middle(sdob1$b1, .95)

# randomize sampling distribution
# of PREs
sdoPRE <- do(1000) *
  PRE(shuffle(Tip)~ Condition,
  data = TipExperiment)

# randomize sampling distribution
# of Fs
sdoF <- do(1000) *
  fVal(shuffle(Tip)~ Condition,
  data = TipExperiment)
```

## Data Frame

```
# view first/last six rows
head(TipExperiment)
tail(TipExperiment)

# structure of data frame
str(TipExperiment)
glimpse(TipExperiment)

# select variable (a column)
TipExperiment$Tip
```

```
# select multiple variables
select(Ames, PriceK, PriceR)

# select first row
TipExperiment[1, ]

# find rows that meet condition
TipExperiment[TipExperiment$Tip > 40]
filter(Ames, PriceK > 300)
```

```
# arrange rows by variable
arrange(TipExperiment, Tip)

# sort in a descending order
arrange(TipExperiment, desc(Tip))

# get rid of all cases with any
# missing values
na.omit(Ames)
```

```
# convert quantitative variable
# to categorical
factor(Ames$HasCentralAir)

# convert categorical variable
# to quantitative
as.numeric(Ames$HasCentralAir)
```

## Fitting Models to Data

```
# empty model
empty_model <- lm(PriceK ~ NULL, data = Ames)

# use one expanatory variable
Neighborhood_model <-
  lm(PriceK ~ Neighborhood, data = Ames)

# extract the best fitting b1
b1(PriceK ~ Neighborhood, data = Ames)

# multivariate model
multi_model <-
  lm(PriceK ~ Neighborhood + HomeSizeK,
  data = Smallville)

# model predictions and residuals
Ames$empty_predict <- predict(empty_model)
Ames$empty_resid <- resid(empty_model)
```

## Comparing Models

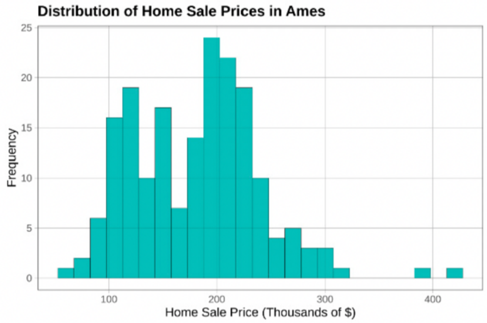
```
pre(Tip ~ Condition, data = TipExperiment)
f(Tip ~ Condition, data = TipExperiment)

# sample F for HomeSizeK
f(PriceK_N_resids ~ Neighborhood +
HomeSizeK,
data = Smallville, predictor = ~HomeSizeK)

# all the model comparisons that can be
# made in relation to the multivariate model
generate_models(multi_model)
```

## Evaluating Models of DGP

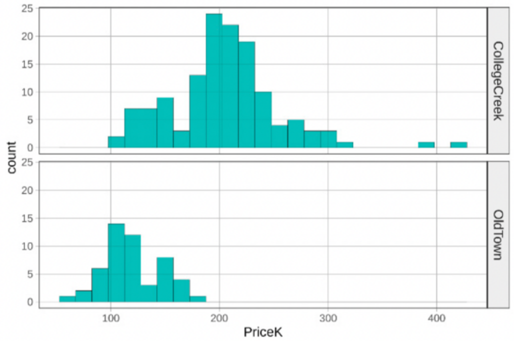
```
# produce ANOVA table
supernova(empty_model)
supernova(multi_model)

# t-test, using pooled variance
t.test(Tip ~ Condition, data =
  TipExperiment, var.equal=TRUE)

# confidence interval
confint(lm(Tip ~ Condition,
  data = TipExperiment))

# pairwise comparison
# corrections: "Bonferroni" or "none"
pairwise(game_model, correction = "Tukey")
```

## Visualizations

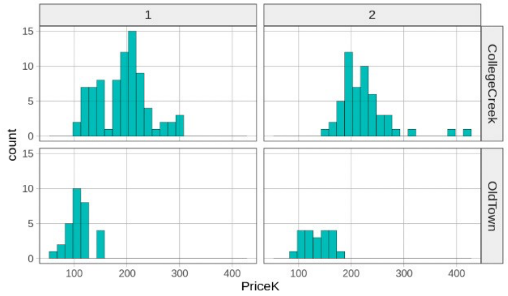
```
gf_histogram(~ PriceK, data = Ames) %>%
# change labels
  gf_labs(title = “Distribution of Home Sale
  Prices in Ames”, x =  “Home Sale Price
  (Thousands of $)”, y = “Frequency”)
```



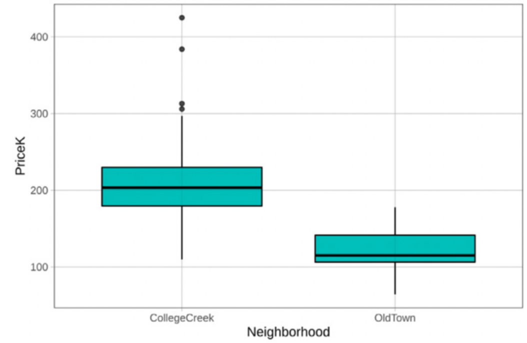
```
# faceted grid of histograms
gf_histogram(~ PriceK, data = Ames) %>%
  gf_facet_grid(Neighborhood ~ .)
```



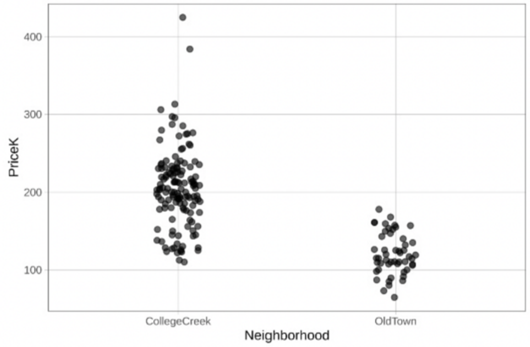
```
gf_histogram(~ PriceK, data = Ames) %>%
 gf_facet_grid(Neighborhood ~ Floors)
```



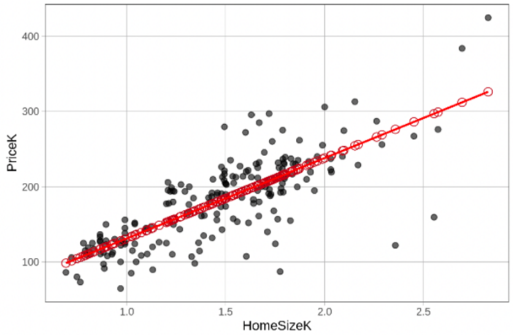
```
gf_boxplot(PriceK ~ Neighborhood, data = Ames)
```



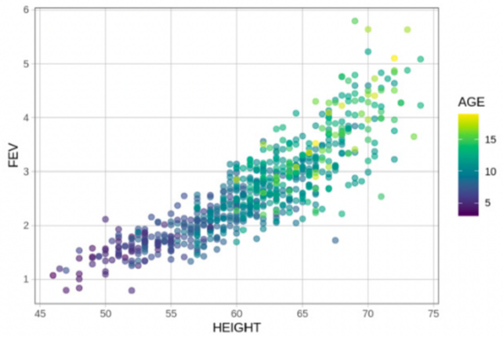
```
gf_jitter(PriceK ~ Neighborhood, data = Ames)
```



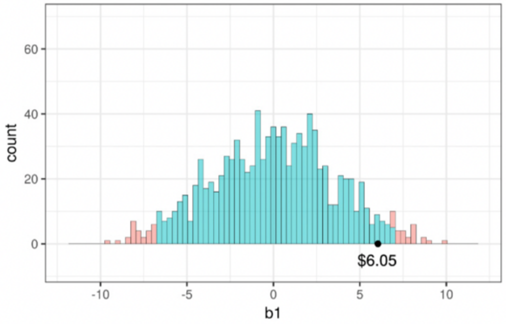
```
gf_point(PriceK ~ HomeSizeK, data = Ames) %>%
 # add model predictions as red points
 gf_point(prediction ~ HomeSizeK , shape = 1,
 size = 3,  color = “firebrick”) %>%
 # add best fitting model as a red line
 gf_model(HomeSizeK_model, color =  “red”)
```



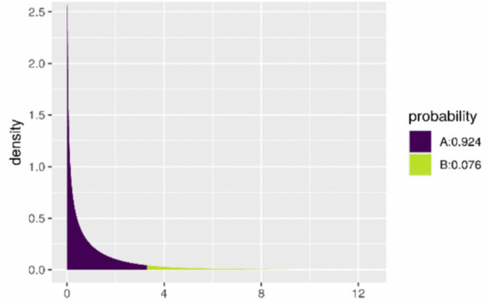
```
gf_point(FEV ~ HEIGHT, color = ~Age,
  data = fevdata)
```



```
# sampling distribution of b1
gf_histogram(~b1, data = sdob1,
 fill = ~middle(b1, .95)) %>%
 # modify the limits on x- and y-axes
 gf_lims(x = c(-12, 12), y = c(0, 70))
```



```
# F-distribution depicting p-value
sample_F <- fVal(Tip ~ Condition,
  data = TipExperiment)
xpf(sample_F, df1 = 1, df2 = 42)
```


density
probability
A:0.924
B:0.076