# Contrasts

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# Contrasts

- Linear combination of parameters
- In R used to determine which estimable functions are shown as factor level effects

# Example Dataset

Table 1: Body Weight and Breed of Beef Cattle Animals

| Animal | Body Weight | Breed |
|---|---|---|
| 1 | 471 | Angus |
| 2 | 463 | Angus |
| 4 | 470 | Angus |
| 7 | 518 | Limousin |
| 8 | 511 | Limousin |
| 9 | 510 | Limousin |
| 10 | 541 | Limousin |
| 3 | 481 | Simmental |
| 5 | 496 | Simmental |
| 6 | 491 | Simmental |

# Contrasts in R

```
(mat_ctr <- contrasts(as.factor(tbl_flem_bw_breed$Breed)))
```

```
##           Limousin Simmental
## Angus            0          0
## Limousin         1          0
## Simmental        0          1
```

# Model Matrix

```
model.matrix(lm(`Body Weight` ~ Breed,
                data = tbl_flem_bw_breed))
```

```
##    (Intercept) BreedLimousin BreedSimmental
## 1            1              0               0
## 2            1              0               0
## 3            1              0               0
## 4            1              1               0
## 5            1              1               0
## 6            1              1               0
## 7            1              1               0
## 8            1              0               1
## 9            1              0               1
## 10           1              0               1
## attr(,"assign")
## [1] 0 1 1
## attr(,"contrasts")
## attr(,"contrasts")$Breed
```

# Estimable Functions

- extend contrasts matrix by one row of all ones for the intercept

```
##             (Intercept) Limousin Simmental
## Angus                 1        0          0
## Limousin              1        1          0
## Simmental             1        0          1
```

# Estimable Functions II

- Inverse of extended contrasts matrix

```
##                Angus Limousin Simmental
## (Intercept)        1         0         0
## Limousin          -1         1         0
## Simmental         -1         0         1
```

- First row: which group means are used for intercept
- Other rows: vectors $q^T$ representing estimable functions

# Validation

- Compute a solution of least squares normal equation
- Use matrix of estimable functions to validate effects estimates

# Default Contrasts

- Per default: `treatment` contrasts
- Factor levels in alphabetical order
- First level corresponds to control, other levels are treatments
- Intercept estimate as mean observation for control group
- Effects estimates as difference between treatment and control solutions of normal equations

# Other Contasts

- Helmert
- sum
- poly

# Custom Contrasts

- Construct own matrix of estimable functions
- Invert that matrix
- Ignore first column
- Use remaining matrix of contrasts as argument in `lm()`