CAS Applied Statistics ETH Zürich

Zertifikatsgespräch

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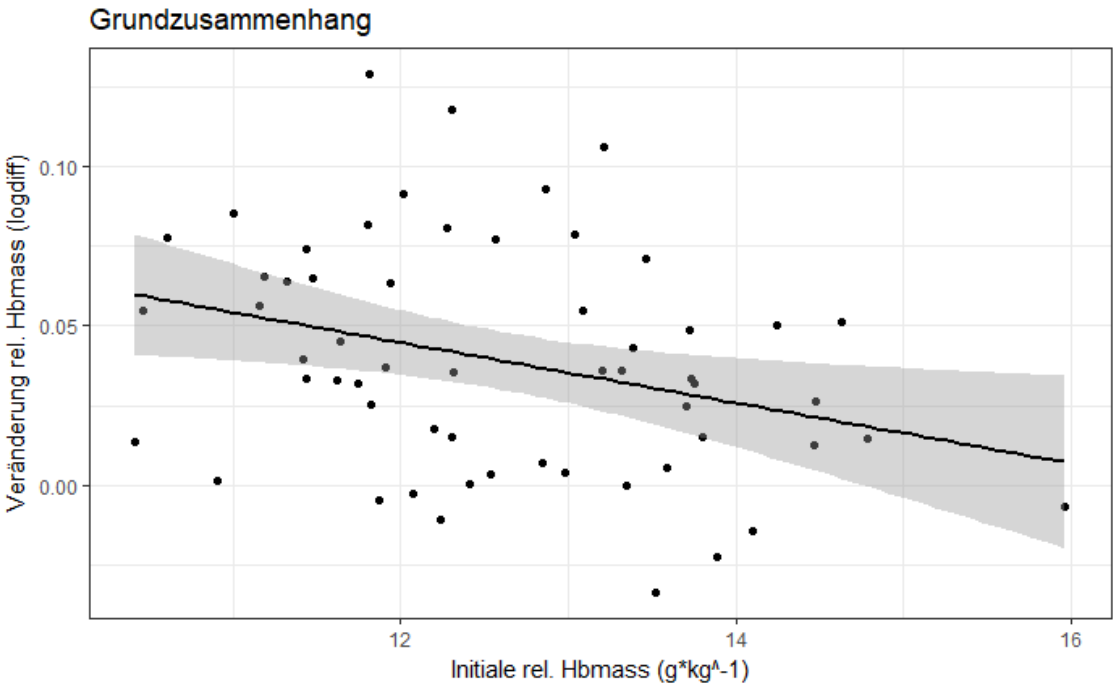
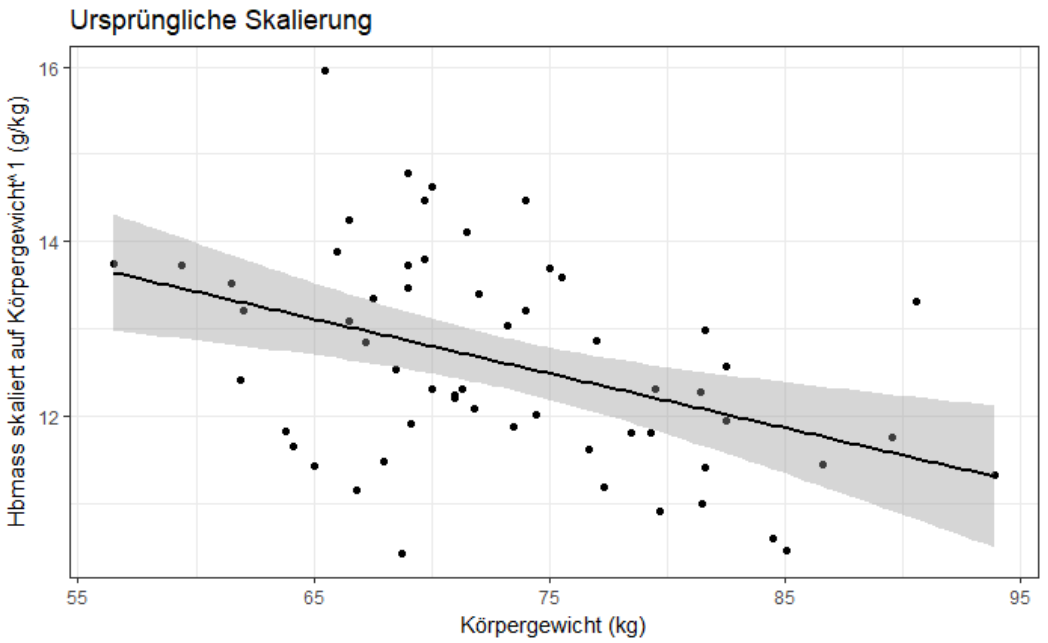
Problem: **Reaktion auf Höhentraining**

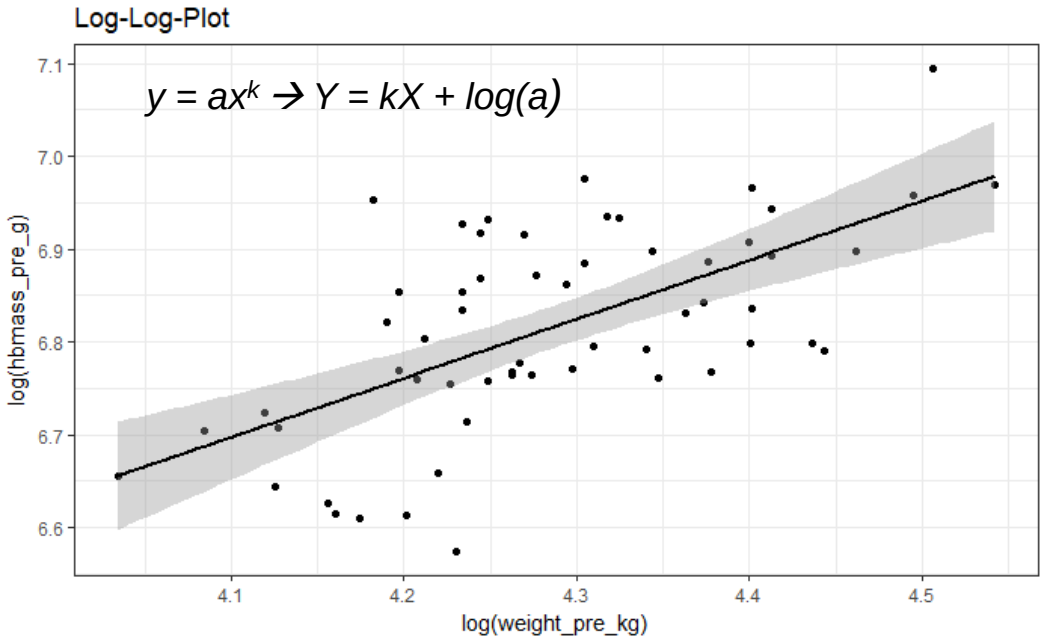
Anstieg relative Hb-Masse ~ Initiale relative Hb-Masse ?




```
Call:
lm(formula = hbm_rel_log_diff ~ hbm_init_1_center, data = dat_init)

Residuals:
     Min       1Q   Median       3Q      Max
-0.06408 -0.02503 -0.00344  0.02040  0.08239

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       0.039087   0.004526   8.637    7e-12 ***
hbm_init_1_center -0.009437   0.003777  -2.498   0.0154 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.03447 on 56 degrees of freedom
Multiple R-squared:  0.1003,    Adjusted R-squared:  0.08421
F-statistic: 6.241 on 1 and 56 DF,  p-value: 0.01544
```

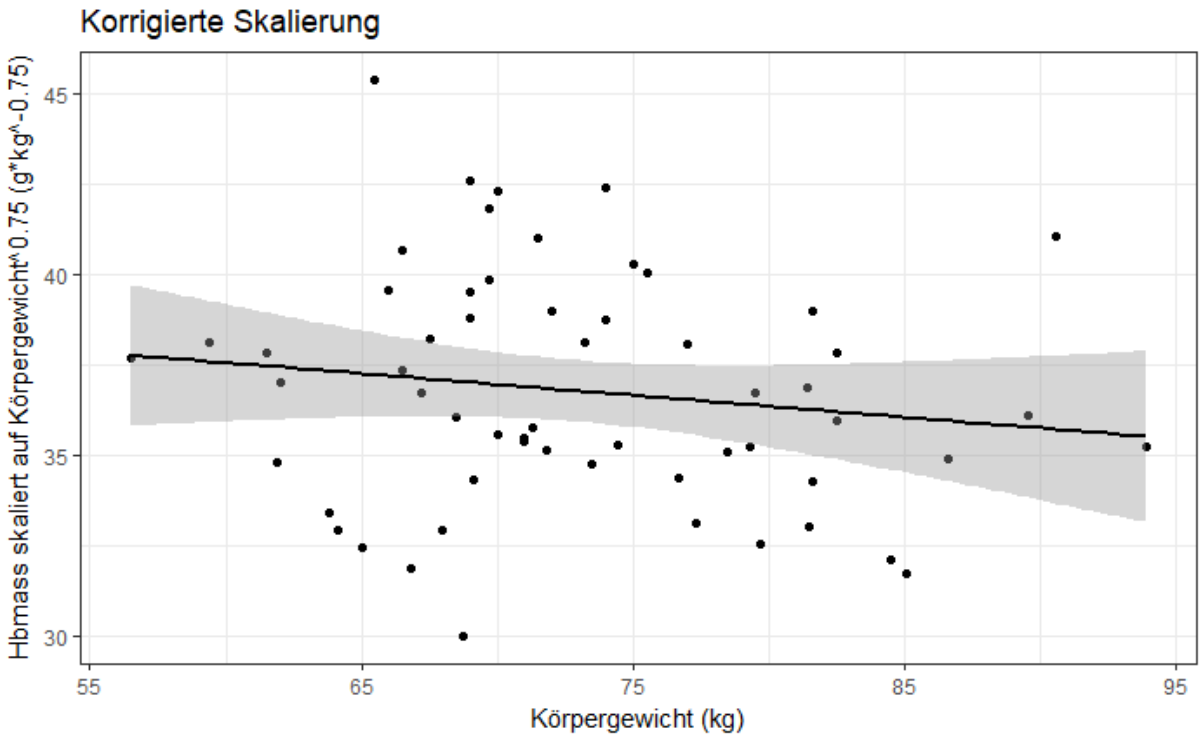
Argument 1: **Skalierung Hb-Masse - Gewicht**





	2.5 %	97.5 %
(Intercept)	3.1797862	5.0023073
log(weight_pre_kg)	0.4231675	0.8482931

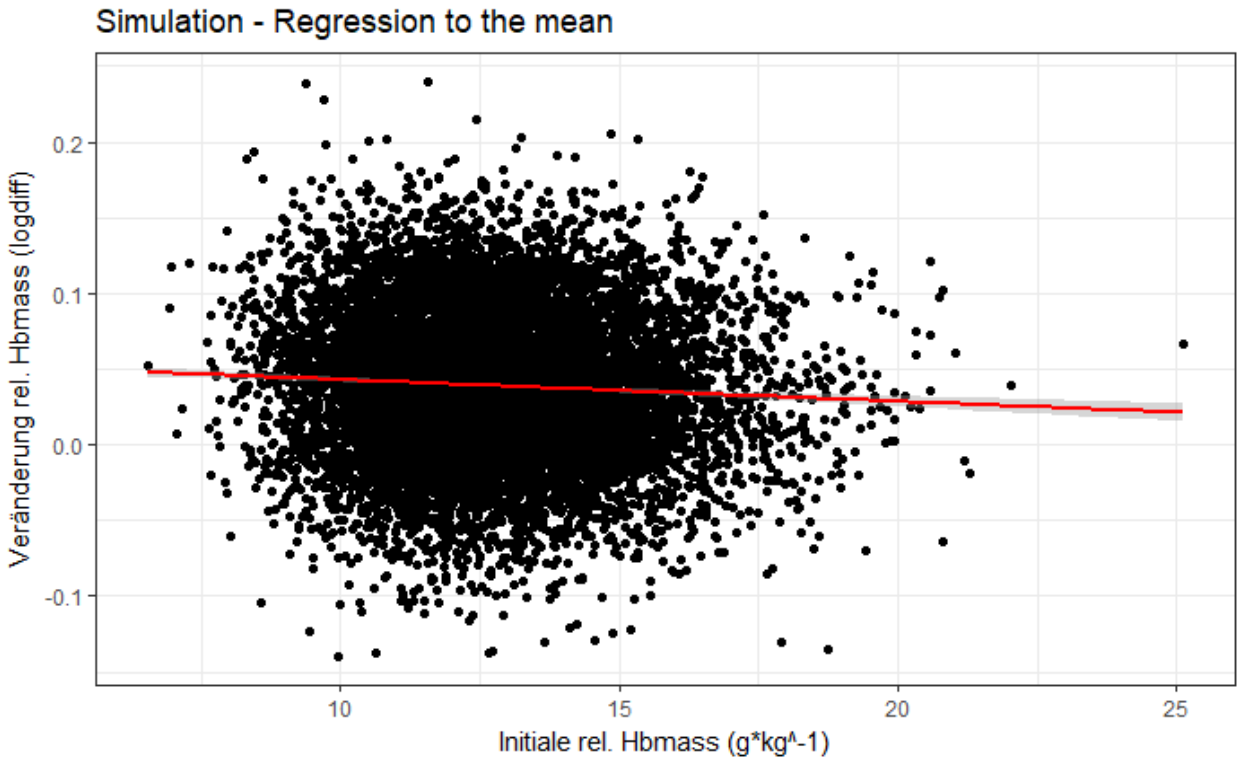
Argument 1: **Skalierung Hb-Masse - Gewicht**



Einfluss **neu skalierter** initialer Hbmass im Grundzusammenhang:

```
Call:
lm(formula = hbm_075_log_diff ~ hbm_init_075_center, data = dat_init)

Residuals:
      Min        1Q    Median        3Q       Max
-0.065748 -0.027837 -0.002426  0.020810  0.068512

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)          0.038919   0.004305   9.040 1.55e-12 ***
hbm_init_075_center -0.002123   0.001343  -1.581     0.12
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.03279 on 56 degrees of freedom
Multiple R-squared:  0.04271,   Adjusted R-squared:  0.02562
F-statistic: 2.499 on 1 and 56 DF,  p-value: 0.1196
```

Argument 2: **«Regression to the mean»**




```
Call:
lm(formula = logdiff_hbmrel_sim ~ hbmrel_pre_measured_sim)

Residuals:
      Min        1Q    Median        3Q       Max
-0.183248 -0.033180  0.000432  0.032983  0.199630

Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)               0.0572958  0.0031239  18.341  < 2e-16 ***
hbmrel_pre_measured_sim -0.0014341  0.0002425  -5.914 3.45e-09 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.04921 on 9998 degrees of freedom
Multiple R-squared:  0.003486,  Adjusted R-squared:  0.003386
F-statistic: 34.98 on 1 and 9998 DF,  p-value: 3.447e-09
```

Argument 3: **Einfluss Gewichtsveränderung**

Anstieg **relative** Hb-Masse ~ Initiale relative Hb-Masse

```
Call:
lm(formula = hbm_rel_log_diff ~ hbm_init_1_center + weight_log_diff,
    data = dat_init)

Residuals:
      Min        1Q    Median        3Q       Max
-0.046547 -0.021776 -0.002974  0.019622  0.065920

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       0.037981   0.003671  10.347 1.62e-14 ***
hbm_init_1_center -0.002872   0.003283  -0.875    0.385
weight_log_diff   -0.907333   0.164613  -5.512 9.75e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.02791 on 55 degrees of freedom
Multiple R-squared:  0.4204,    Adjusted R-squared:  0.3994
F-statistic: 19.95 on 2 and 55 DF,  p-value: 3.058e-07
```

Vergleich Modelle:

```
Analysis of Variance Table

Model 1: hbm_rel_log_diff ~ weight_log_diff
Model 2: hbm_rel_log_diff ~ hbm_init_1_center + weight_log_diff
  Res.Df      RSS Df  Sum of Sq      F Pr(>F)
1     56 0.043447
2     55 0.042850  1 0.00059646 0.7656 0.3854
```

Limitationen / Alternativen

Limitationen / Probleme	Lösungen / Alternativen
Korrelation vs. Kausalität?! Weitere Confounder möglich (wie Gewicht)	• **RCT** mit «eingestellter» hoher und tiefer initialer Hb-Masse (Ethik?!) • Ethischer: **Blocking** nach Sportarten, Altersgruppen, Trainingsalter, etc.
Offensichtlicher Confounder: **Verhältnis Fett- / Magermasse**	**Skalierung** von Hb-Masse auf Magermasse (biologisch) sinnvoll