

HW2

Data and Packages

```
library(tidyverse)
library(MASS)
library(broom)
```

Warning: package 'broom' was built under R version 4.3.3

```
library(olsrr)
```

Warning: package 'olsrr' was built under R version 4.3.3

```
library(kableExtra)
d <- read_csv("dat_turan.csv")

d <- d |>
  rename(
    twa_map = `TWA MAP`,
    twa_map1 = `TWA MAP1`,
    twa_map2 = `TWA MAP2`,
    min_saO2 = `Min Sao2`,
    preop_ah_m = `Preop AntiHyper Med`,
    type_surg = `Type Surg`
  )
```

Table 2

```
# full_mod <- lm(twa_map ~ Sleeptime + min_sa02 + Age + Female + BMI + Smoking +
#               Diabetes + Hyper + CAD + preop_ah_m + CPAP + type_surg,
#               data = d)
#
# ols_step_backward_p(full_mod, p_val = 0.2)

primary_analysis_mod1 <- lm(twa_map ~ Sleeptime + Smoking + CAD, data = d)

tidy(primary_analysis_mod1, conf.int = TRUE, conf.level = 0.975) |>
  kable(digits = 3)
```

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	87.807	0.977	89.910	0.000	85.606	90.008
Sleeptime	-0.018	0.027	-0.673	0.502	-0.080	0.043
SmokingYes	3.902	1.320	2.956	0.003	0.927	6.876
CADYes	-4.439	2.237	-1.984	0.048	-9.481	0.603

```
primary_analysis_mod2 <- lm(twa_map ~ min_sa02 + Smoking + CAD, data = d)

tidy(primary_analysis_mod2, conf.int = TRUE, conf.level = 0.975) |>
  kable(digits = 3)
```

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	77.069	5.035	15.307	0.000	65.722	88.416
min_sa02	0.129	0.061	2.117	0.035	-0.008	0.267
SmokingYes	4.234	1.307	3.239	0.001	1.288	7.180
CADYes	-4.004	2.231	-1.795	0.074	-9.032	1.024

```
expl_1_mod1 <- lm(twa_map1 ~ Sleeptime +
                  Smoking + CAD + Age + Female + Race + type_surg, data = d)

tidy(expl_1_mod1, conf.int = TRUE, conf.level = 0.9875) |>
  kable(digits = 3)
```

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	82.610	3.950	20.912	0.000	72.676	92.545

term	estimate	std.error	statistic	p.value	conf.low	conf.high
Sleeptime	-0.051	0.030	-1.681	0.094	-0.127	0.025
SmokingYes	-0.117	1.492	-0.078	0.938	-3.868	3.635
CADYes	-2.279	2.521	-0.904	0.367	-8.618	4.061
Age	0.062	0.068	0.915	0.361	-0.108	0.233
FemaleYes	-2.700	1.581	-1.707	0.089	-6.677	1.277
RaceCaucasian	-4.965	1.727	-2.875	0.004	-9.308	-0.623
RaceOther	3.748	4.466	0.839	0.402	-7.483	14.978
type_surgGastroenterostomy	1.007	1.840	0.547	0.585	-3.619	5.633
type_surgGastroplasty	-	6.942	-1.543	0.124	-	6.745
	10.711				28.168	
type_surgRemoval of gastric restrictive device	-	8.567	-2.280	0.023	-	2.008
	19.536				41.080	

```
expl_1_mod2 <- lm(twa_map1 ~ min_saO2 +
                  Smoking + CAD + Age + Female + Race + type_surg, data = d)

tidy(expl_1_mod2, conf.int = TRUE, conf.level = 0.9875) |>
  kable(digits = 3)
```

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	63.304	7.377	8.581	0.000	44.752	81.856
min_saO2	0.213	0.070	3.043	0.003	0.037	0.389
SmokingYes	0.045	1.470	0.031	0.975	-3.651	3.741
CADYes	-1.783	2.496	-0.714	0.476	-8.061	4.496
Age	0.089	0.068	1.308	0.192	-0.082	0.259
FemaleYes	-3.106	1.570	-1.978	0.049	-7.053	0.842
RaceCaucasian	-5.285	1.711	-3.089	0.002	-9.588	-0.983
RaceOther	3.357	4.415	0.760	0.448	-7.747	14.460
type_surgGastroenterostomy	1.906	1.840	1.036	0.301	-2.721	6.533
type_surgGastroplasty	-	6.855	-1.471	0.142	-	7.156
	10.083				27.321	
type_surgRemoval of gastric restrictive device	-	8.466	-2.178	0.030	-	2.852
	18.440				39.731	

```
expl_2_mod1 <- lm(twa_map2 ~ Sleeptime + Smoking + CAD , data = d)

tidy(expl_2_mod1, conf.int = TRUE, conf.level = 0.9875) |>
  kable(digits = 3)
```

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	88.900	1.056	84.191	0.000	86.245	91.555
Sleeptime	-0.017	0.030	-0.561	0.575	-0.091	0.058
SmokingYes	4.350	1.427	3.047	0.003	0.761	7.938
CADYes	-5.055	2.419	-2.090	0.038	-11.136	1.026

```
expl_2_mod2 <- lm(twa_map2 ~ min_sa02 + Smoking + CAD , data = d)

tidy(expl_2_mod2, conf.int = TRUE, conf.level = 0.9875) |>
  kable(digits = 3)
```

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	77.547	5.444	14.244	0.000	63.859	91.234
min_sa02	0.137	0.066	2.077	0.039	-0.029	0.303
SmokingYes	4.730	1.414	3.346	0.001	1.176	8.284
CADYes	-4.580	2.412	-1.899	0.059	-10.645	1.485

Here we can see that the coefficients for percentage of TST spent at Sao2 < 90% and Minimum nocturnal Sao2 are very similar to the published model results. The coefficient of Minimum nocturnal Sao2 is of course flipped about 0 as the interpretation of the coefficient is for a one percentage point decrease as opposed to an increase. The estimate for sleeptime is slightly off as well, but the difference is negligible, even though the estimate is on the opposite side of 0, the CI includes 0 in both the original and this reproduced model.

Backwards selection was used to identify the necessary predictors in this model, the paper describes which variables are used so the reproduced model simply uses those predictors described. However a piece of code of the form of the one commented above would accomplish the same thing.

Secondary Analysis

“One hundred fifty-three (54%) patients were given vasopressor intraoperatively.”

```
d |>
  summarise(percent_vasopressor = sum(Vasopressor == "Yes")/nrow(d))
```

```
# A tibble: 1 x 1
  percent_vasopressor
      <dbl>
1             0.544
```

Receiving vasopressor was not significantly associated with either percentage of total sleep time spent at Sao2 less than 90% (P = 0.86) or minimum nocturnal Sao2 (P = 0.39). The estimated odds ratio of receiving vasopressor was 1.00 (97.5% CI, 0.99 to 1.01) for each 1% absolute increase in percentage of total sleep time spent at Sao2 less than 90% and 1.01 (0.98 to 1.04) for each 1% absolute decrease in minimum nocturnal Sao2.

```
d <- d |>
  mutate(vaso_bin = ifelse(Vasopressor == "Yes", 1, 0))

tst_mod <- glm(vaso_bin ~ Sleptime + Smoking + BMI + Age +
               CAD + Hyper + type_surg, family = binomial, data = d)
summary(tst_mod)
```

Call:

```
glm(formula = vaso_bin ~ Sleptime + Smoking + BMI + Age + CAD +
     Hyper + type_surg, family = binomial, data = d)
```

Coefficients:

	Estimate	Std. Error	z value
(Intercept)	-1.438717	1.144842	-1.257
Sleptime	0.001468	0.005837	0.251
SmokingYes	-0.616616	0.283473	-2.175
BMI	-0.029409	0.018088	-1.626
Age	0.049053	0.013986	3.507
CADYes	1.187418	0.545928	2.175
HyperYes	0.376277	0.288202	1.306
type_surgGastroenterostomy	0.737794	0.356006	2.072
type_surgGastroplasty	0.279430	1.291907	0.216
type_surgRemoval of gastric restrictive device	14.492423	607.724635	0.024

	Pr(> z)
(Intercept)	0.208864
Sleptime	0.801477
SmokingYes	0.029614 *
BMI	0.103978
Age	0.000453 ***
CADYes	0.029627 *
HyperYes	0.191689
type_surgGastroenterostomy	0.038226 *
type_surgGastroplasty	0.828760
type_surgRemoval of gastric restrictive device	0.980975

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 387.32 on 280 degrees of freedom
Residual deviance: 348.09 on 271 degrees of freedom
AIC: 368.09

Number of Fisher Scoring iterations: 13

```
min_mod <- glm(vaso_bin ~ I(-min_sa02) + Smoking + BMI + Age +  
               CAD + Hyper + type_surg, family = binomial, data = d)  
summary(min_mod)
```

Call:

```
glm(formula = vaso_bin ~ I(-min_sa02) + Smoking + BMI + Age +  
     CAD + Hyper + type_surg, family = binomial, data = d)
```

Coefficients:

	Estimate	Std. Error	z value
(Intercept)	-0.14562	1.88793	-0.077
I(-min_sa02)	0.01190	0.01336	0.890
SmokingYes	-0.62842	0.28215	-2.227
BMI	-0.03305	0.01834	-1.802
Age	0.04649	0.01421	3.271
CADYes	1.15691	0.54735	2.114
HyperYes	0.36592	0.28771	1.272
type_surgGastroenterostomy	0.71094	0.35629	1.995
type_surgGastroplasty	0.26610	1.28953	0.206
type_surgRemoval of gastric restrictive device	15.49539	992.10757	0.016

	Pr(> z)
(Intercept)	0.93852
I(-min_sa02)	0.37329
SmokingYes	0.02593 *
BMI	0.07153 .
Age	0.00107 **
CADYes	0.03455 *
HyperYes	0.20344
type_surgGastroenterostomy	0.04600 *
type_surgGastroplasty	0.83651
type_surgRemoval of gastric restrictive device	0.98754

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 387.32 on 280 degrees of freedom
Residual deviance: 347.35 on 271 degrees of freedom
AIC: 367.35

Number of Fisher Scoring iterations: 14

Here are the exponentiated coefficients (representing odds ratios) and CIs from the previous models.

```
exp(tst_mod[["coefficients"]][["Sleeptime"]])
```

```
[1] 1.001469
```

```
exp(confint.default(tst_mod, level = 0.975)[["Sleeptime"], ])
```

```
1.25 % 98.75 %  
0.9884521 1.0146566
```

```
exp(min_mod[["coefficients"]][["I(-min_saO2)"]])
```

```
[1] 1.011968
```

```
exp(confint.default(min_mod, level = 0.975)[["I(-min_saO2)", ])
```

```
1.25 % 98.75 %  
0.9821078 1.0427369
```

The estimated average change in the total dose of vasopressor was -3 (97.5% CI, -14 to 8) g for each 1% absolute increase in the percentage of total sleep time spent at Sao2 less than 90% ($P = 0.59$), after adjusting for age, sex, and preoperative use of antihypertensive medications. The estimated change in the dose was 9 (-16 , 34) g for each 1% absolute decrease in the minimum nocturnal Sao2 ($P = 0.41$), after adjusting for age, sex, smoking, diabetes, and preoperative use of antihypertensive medications.

```
d <- d |>
  filter(`Epinephrine` == "No", Vasopressor == "Yes") |>
  mutate(v_tot = `Ephedrine Amt` * 125 + `Phenylephrine Amt`)
```

```
vaso_mod1 <- lm(v_tot ~ Sleptime + Female + Age + preop_ah_m,
  data = d)
summary(vaso_mod1)
```

Call:

```
lm(formula = v_tot ~ Sleptime + Female + Age + preop_ah_m, data = d)
```

Residuals:

Min	1Q	Median	3Q	Max
-1776.3	-935.9	-306.0	604.1	5117.0

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	281.922	573.561	0.492	0.6238
Sleptime	-2.714	4.767	-0.569	0.5700
FemaleYes	-395.123	234.569	-1.684	0.0942 .
Age	21.021	10.568	1.989	0.0486 *
preop_ah_mYes	597.385	238.878	2.501	0.0135 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1282 on 146 degrees of freedom

Multiple R-squared: 0.08593, Adjusted R-squared: 0.06089

F-statistic: 3.431 on 4 and 146 DF, p-value: 0.01031

```
vaso_mod2 <- lm(v_tot ~ I(-min_saO2) + Smoking + Female + Age +
  Diabetes + preop_ah_m, data = d)
summary(vaso_mod2)
```

Call:

```
lm(formula = v_tot ~ I(-min_saO2) + Smoking + Female + Age +
  Diabetes + preop_ah_m, data = d)
```

Residuals:

Min	1Q	Median	3Q	Max
-2007.5	-855.9	-290.5	541.9	5011.5

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	663.100	1061.392	0.625	0.5331
I(-min_sa02)	5.137	10.834	0.474	0.6361
SmokingYes	-316.127	220.949	-1.431	0.1547
FemaleYes	-345.743	232.957	-1.484	0.1400
Age	20.669	11.169	1.851	0.0663 .
DiabetesYes	293.224	223.266	1.313	0.1912
preop_ah_mYes	566.065	238.489	2.374	0.0189 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1276 on 144 degrees of freedom

Multiple R-squared: 0.1057, Adjusted R-squared: 0.06849

F-statistic: 2.838 on 6 and 144 DF, p-value: 0.01216

```
vaso_mod1[["coefficients"]][["Sleeptime"]]
```

```
[1] -2.714288
```

```
confint.default(vaso_mod1, level = 0.975)[["Sleeptime", ]
```

1.25 %	98.75 %
-13.399438	7.970862

```
vaso_mod2[["coefficients"]][["I(-min_sa02)"]]
```

```
[1] 5.137048
```

```
confint.default(vaso_mod2, level = 0.975)[["I(-min_sa02)", ]
```

1.25 %	98.75 %
-19.1465	29.4206

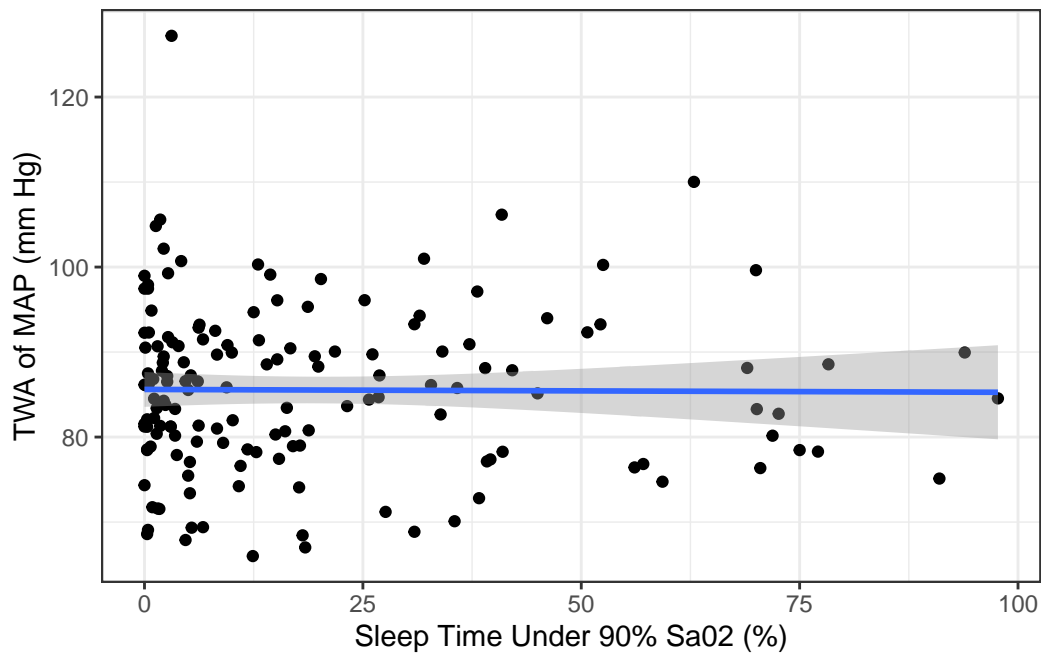
Figure 2

```
# summary(lm(Sleeptime ~ twa_map, data = d))
```

```
d |>
```

```
ggplot(aes(x = Sleeptime, y = twa_map)) +  
  geom_point() +  
  geom_smooth(method = "lm") +  
  theme_bw() +  
  labs(y = "TWA of MAP (mm Hg)", x = "Sleep Time Under 90% SaO2 (%)")
```

`geom_smooth()` using formula = 'y ~ x'



```
d <- d |>
```

```
  filter(min_saO2 > 40)
```

```
# summary(lm(min_saO2 ~ twa_map, data = d))
```

```
d |>
```

```
ggplot(aes(x = min_saO2, y = twa_map)) +  
  geom_point() +  
  geom_smooth(method = "lm") +  
  theme_bw() +  
  labs(y = "TWA of MAP (mm Hg)", x = "Minimum Nocturnal SaO2")
```

```
`geom_smooth()` using formula = 'y ~ x'
```

