
```
sum(nhanes$modvigmin==0)/nrow(nhanes)
```

```
## [1] 0.07841659
```

```
sum(nhanes$vigmin==0)/nrow(nhanes)
```

```
## [1] 0.8801602
```

```
sum(nhanes$lightmin==0)/nrow(nhanes)
```

```
## [1] 0
```

```
#no diff in modmin by day really except 7th
```

```
nhanes %>% group_by(rep) %>% summarise(m=mean(modvigmin),s=sd(modmin)/sqrt(length(modmin)))
```

```
## # A tibble: 7 3
```

```
##      rep      m      s
```

```
##   <int>   <dbl>   <dbl>
```

```
## 1     1 22.60066 0.3411052
```

```
## 2     2 23.01777 0.3518468
```

```
## 3     3 22.96771 0.3583861
```

```
## 4     4 22.41386 0.3488521
```

```
## 5     5 22.24356 0.3589189
```

```
## 6     6 21.15523 0.3571320
```

```
## 7     7 19.41996 0.3616865
```

```
#no diff in modmin by day really except 7th and 2nd
```

```
nhanes %>% group_by(rep) %>% summarise(m=mean(lightmin),s=sd(lightmin)/sqrt(length(lightmin)))
```

```
## # A tibble: 7 3
```

```
##      rep      m      s
```

```
##   <int>   <dbl>   <dbl>
```

```

## 1      1 258.6827 1.048918
## 2      2 261.5339 1.093391
## 3      3 258.6147 1.096388
## 4      4 258.8213 1.136550
## 5      5 258.2212 1.160056
## 6      6 255.2295 1.186014
## 7      7 244.4119 1.253172

#mondays most vig, fri-sun least, tues-thurs similar
nhanes %>% group_by(rep) %>% summarise(m=mean(vigmin),s=sd(vigmin)/sqrt(length(lightmin)))

## # A tibble: 7  3
##   rep      m      s
##   <int>   <dbl>   <dbl>
## 1     1 0.9411853 0.06110670
## 2     2 0.8115414 0.05276647
## 3     3 0.8965840 0.06021138
## 4     4 0.7660865 0.05689883
## 5     5 0.7392597 0.05397894
## 6     6 0.8310108 0.06361269
## 7     7 0.6902050 0.06106663

anova(lm(modvigmin~as.factor(rep),data=subset(nhanes,rep<6))) #first 5 days are similar, last 1

## Analysis of Variance Table
##
## Response: modvigmin
##              Df    Sum Sq Mean Sq F value Pr(>F)
## as.factor(rep)   4      2902   725.44   0.8288 0.5065
## Residuals      31937 27954416   875.30

```

```
#weekends lower
```

```
nhanes %>% group_by(dow) %>% summarise(m=mean(modvigmin),s=sd(modvigmin)/sqrt(length(modvigmin)))
```

```
## # A tibble: 7 3
```

```
##   dow      m      s
```

```
##   <int>   <dbl>   <dbl>
```

```
## 1     1 17.46672 0.3539009
```

```
## 2     2 23.63394 0.3753241
```

```
## 3     3 23.49455 0.3683897
```

```
## 4     4 23.63173 0.3842220
```

```
## 5     5 23.18340 0.3712310
```

```
## 6     6 22.43408 0.3639320
```

```
## 7     7 19.52794 0.3799264
```

```
#weekends and thursday lower, friday higher
```

```
nhanes %>% group_by(dow) %>% summarise(m=mean(lightmin),s=sd(lightmin)/sqrt(length(lightmin)))
```

```
## # A tibble: 7 3
```

```
##   dow      m      s
```

```
##   <int>   <dbl>   <dbl>
```

```
## 1     1 239.7397 1.171315
```

```
## 2     2 259.8399 1.106457
```

```
## 3     3 260.0095 1.095333
```

```
## 4     4 259.8370 1.102353
```

```
## 5     5 256.6507 1.103868
```

```
## 6     6 263.0100 1.146749
```

```
## 7     7 256.8055 1.218114
```

```
#first day vig
```

```
nhanes %>% group_by(dow) %>% summarise(m=mean(vigmin),s=sd(vigmin)/sqrt(length(lightmin)))
```

```
## # A tibble: 7 3
```

```

##      dow      m      s
##    <int>    <dbl>    <dbl>
## 1      1 0.7239862 0.06502960
## 2      2 0.9462687 0.06184397
## 3      3 0.8742129 0.05357820
## 4      4 0.8859250 0.06278267
## 5      5 0.8446359 0.05683506
## 6      6 0.7264334 0.05487292
## 7      7 0.6707994 0.05419137

anova(lm(modvigmin~as.factor(dow),data=subset(nhanes,dow%in%c(2:6)))) #M-F similar

## Analysis of Variance Table
##
## Response: modvigmin
##
##              Df    Sum Sq Mean Sq F value Pr(>F)
## as.factor(dow)   4      6363  1590.75   1.7992 0.1259
## Residuals      31803 28118692   884.15

#test for weekend effects
anova(lm(modvigmin ~ as.factor(weekend),data=nhanes))

## Analysis of Variance Table
##
## Response: modvigmin
##
##              Df    Sum Sq Mean Sq F value    Pr(>F)
## as.factor(weekend)    1   181096   181096   214.83 < 2.2e-16 ***
## Residuals           42438 35773439    843
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

anova(lm(lightmin ~ as.factor(weekend),data=nhanes))

```

```
## Analysis of Variance Table
##
## Response: lightmin
##
##           Df      Sum Sq Mean Sq F value    Pr(>F)
## as.factor(weekend)      1    1042016 1042016   133.48 < 2.2e-16 ***
## Residuals          42438 331295573     7807
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(lm(vigmin ~ as.factor(weekend),data=nhanes))
```

```
## Analysis of Variance Table
##
## Response: vigmin
##
##           Df Sum Sq Mean Sq F value    Pr(>F)
## as.factor(weekend)      1     202 202.477    9.714 0.00183 **
## Residuals          42438 884572   20.844
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
nrep <- (nhanes %>% group_by(id) %>% summarise(n=length(id)))$n
```

```
#m1 <- lme(modvigmin~1,data=nhanes,random=~1/id,correlation=corAR1(form=~1/id),method="ML")
```

```
m1 <- lme(modvigmin~as.factor(rep)+as.factor(dow),data=nhanes,random=~1|id,method="ML")
```

```
re <- rep(unlist(ranef(m1)),nrep)
```

```
nhanes$error <- nhanes$modvigmin - predict(m1)
```

```
eht <- nhanes %>% group_by(id) %>% summarise(e1=error[1],e2=error[2],e3=error[3],e4=error[4],e5=error[5],e6=error[6],e7=error[7])
```

```
# ind <- which(!is.na(eht$e7))
```

```
# boxtest <- rep(0,length(ind))
```

```

# for(i in 1:length(ind)){
#   boxtest[i] <- Box.test(unlist(eht[ind[i],-1]),lag=2,type="Ljung-Box")$p.value
# }
# summary(boxtest)

#lag 1 difference
o1a = c(eht$e1[nrep > 1],eht$e2[nrep > 2],eht$e3[nrep > 3],eht$e4[nrep > 4],eht$e5[nrep > 5],eht$e6[nrep > 6])
o1b = c(eht$e2[nrep > 1],eht$e3[nrep > 2],eht$e4[nrep > 3],eht$e5[nrep > 4],eht$e6[nrep > 5],eht$e7[nrep > 6])
cor(o1a,o1b)

## [1] -0.1000537

#lag 2 diff
o2a = c(eht$e1[nrep > 2],eht$e2[nrep > 3],eht$e3[nrep > 4],eht$e4[nrep > 5],eht$e5[nrep > 6])
o2b = c(eht$e3[nrep > 2],eht$e4[nrep > 3],eht$e5[nrep > 4],eht$e6[nrep > 5],eht$e7[nrep > 6])
cor(o2a,o2b)

## [1] -0.1892647

#lag 3 diff
o3a = c(eht$e1[nrep > 3],eht$e2[nrep > 4],eht$e3[nrep > 5],eht$e4[nrep > 6])
o3b = c(eht$e4[nrep > 3],eht$e5[nrep > 4],eht$e6[nrep > 5],eht$e7[nrep > 6])
cor(o3a,o3b)

## [1] -0.2558842

#lag 4 diff
o4a = c(eht$e1[nrep > 4],eht$e2[nrep > 5],eht$e3[nrep > 6])
o4b = c(eht$e5[nrep > 4],eht$e6[nrep > 5],eht$e7[nrep > 6])
cor(o4a,o4b)

## [1] -0.2653008

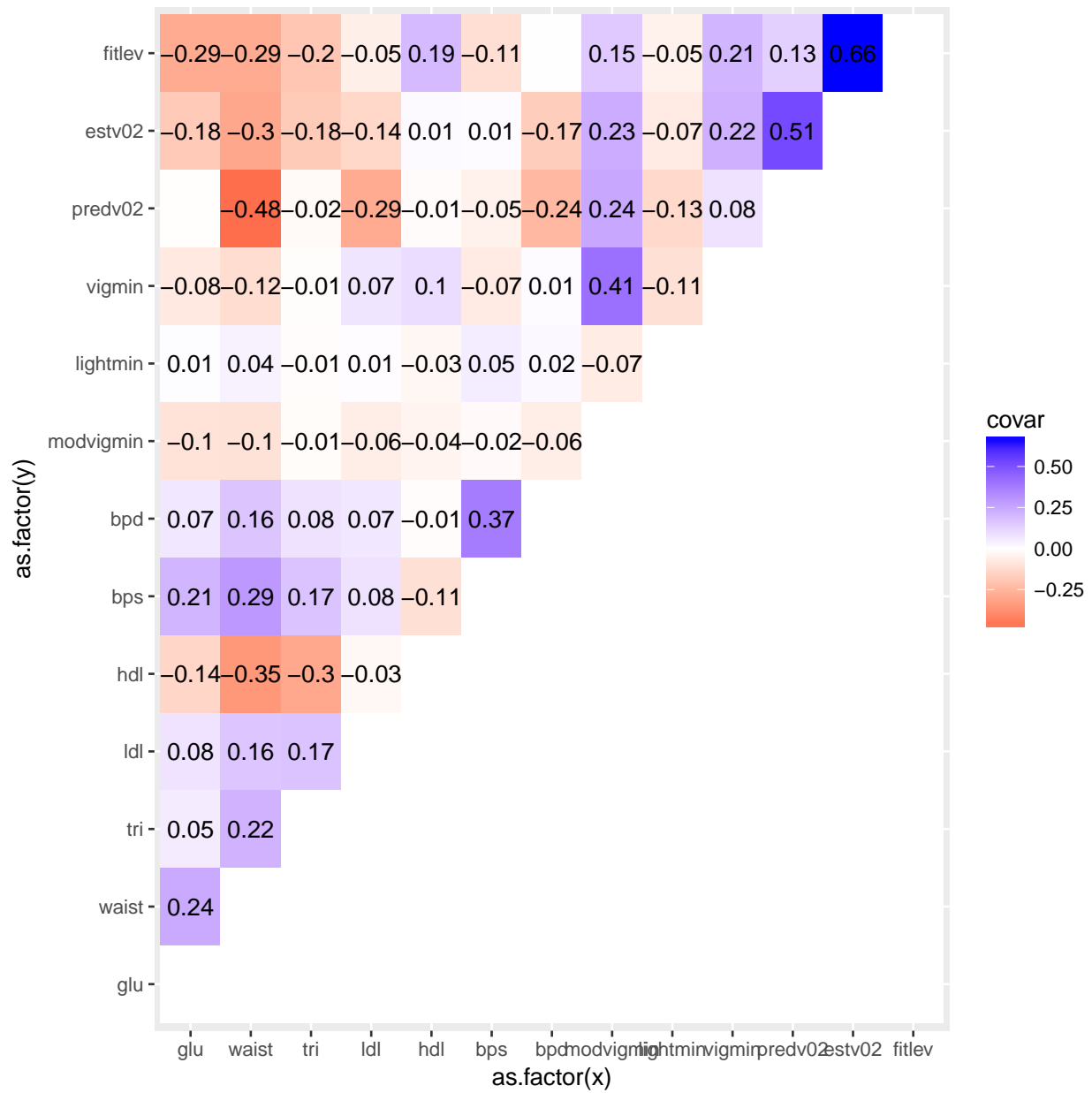
```

```
#lag 5 diff

o5a = c(eht$e1[nrep > 5],eht$e2[nrep > 6])
o5b = c(eht$e6[nrep > 5],eht$e7[nrep > 6])

cor(o5a,o5b)

## [1] -0.1862721
```



```

#multivariate regression on mean observed modvig, light
a <- nhanes %>% group_by(id) %>% summarise(modvig=mean(modvigmin),light=mean(lightmin))
y$modvig <- a$modvig
y$light <- a$light

m3 <- lm(with(y,cbind(glu,waist,tri,hdl,bps,bpd))~y$modvig)
summary(m3)

## Response glu :
##
## Call:
## lm(formula = glu ~ y$modvig)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -62.50 -14.31  -6.71   2.63  440.78
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 107.87227    0.74640 144.524  <2e-16 ***
## y$modvig     -0.18519    0.02181  -8.491  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 32.92 on 3574 degrees of freedom
## (4668 observations deleted due to missingness)
## Multiple R-squared:  0.01977, Adjusted R-squared:  0.0195
## F-statistic: 72.1 on 1 and 3574 DF, p-value: < 2.2e-16
##
##
## Response waist :
```



```
##
## Call:
## lm(formula = waist ~ y$modvig)
##
## Residuals:
```

	Min	1Q	Median	3Q	Max
	-37.507	-10.795	-1.156	9.475	58.162

```
##
## Coefficients:
```

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	100.19115	0.34288	292.20	<2e-16 ***
y\$modvig	-0.12379	0.01002	-12.36	<2e-16 ***

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.12 on 3574 degrees of freedom
## (4668 observations deleted due to missingness)
## Multiple R-squared:  0.04096, Adjusted R-squared:  0.0407
## F-statistic: 152.7 on 1 and 3574 DF,  p-value: < 2.2e-16
##
##
## Response tri :
```

	Min	1Q	Median	3Q	Max
	-121.18	-65.00	-30.59	27.40	2585.85

```
##
## Call:
## lm(formula = tri ~ y$modvig)
##
## Residuals:
```

	Min	1Q	Median	3Q	Max
	-121.18	-65.00	-30.59	27.40	2585.85

```
##
## Coefficients:
```

```

##           Estimate Std. Error t value Pr(>|t|)
## (Intercept) 154.32305      2.85134  54.123  < 2e-16 ***
## y$modvig    -0.40685      0.08331  -4.883 1.09e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 125.7 on 3574 degrees of freedom
## (4668 observations deleted due to missingness)
## Multiple R-squared:  0.006628, Adjusted R-squared:  0.00635
## F-statistic: 23.85 on 1 and 3574 DF,  p-value: 1.089e-06
##
##
## Response hdl :
##
## Call:
## lm(formula = hdl ~ y$modvig)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -38.675 -11.922  -2.698   9.320 132.359
##
## Coefficients:
##           Estimate Std. Error t value Pr(>|t|)
## (Intercept)  55.6949      0.3695 150.740  <2e-16 ***
## y$modvig     -0.0233      0.0108  -2.158   0.031 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 16.29 on 3574 degrees of freedom
## (4668 observations deleted due to missingness)
## Multiple R-squared:  0.001302, Adjusted R-squared:  0.001022

```

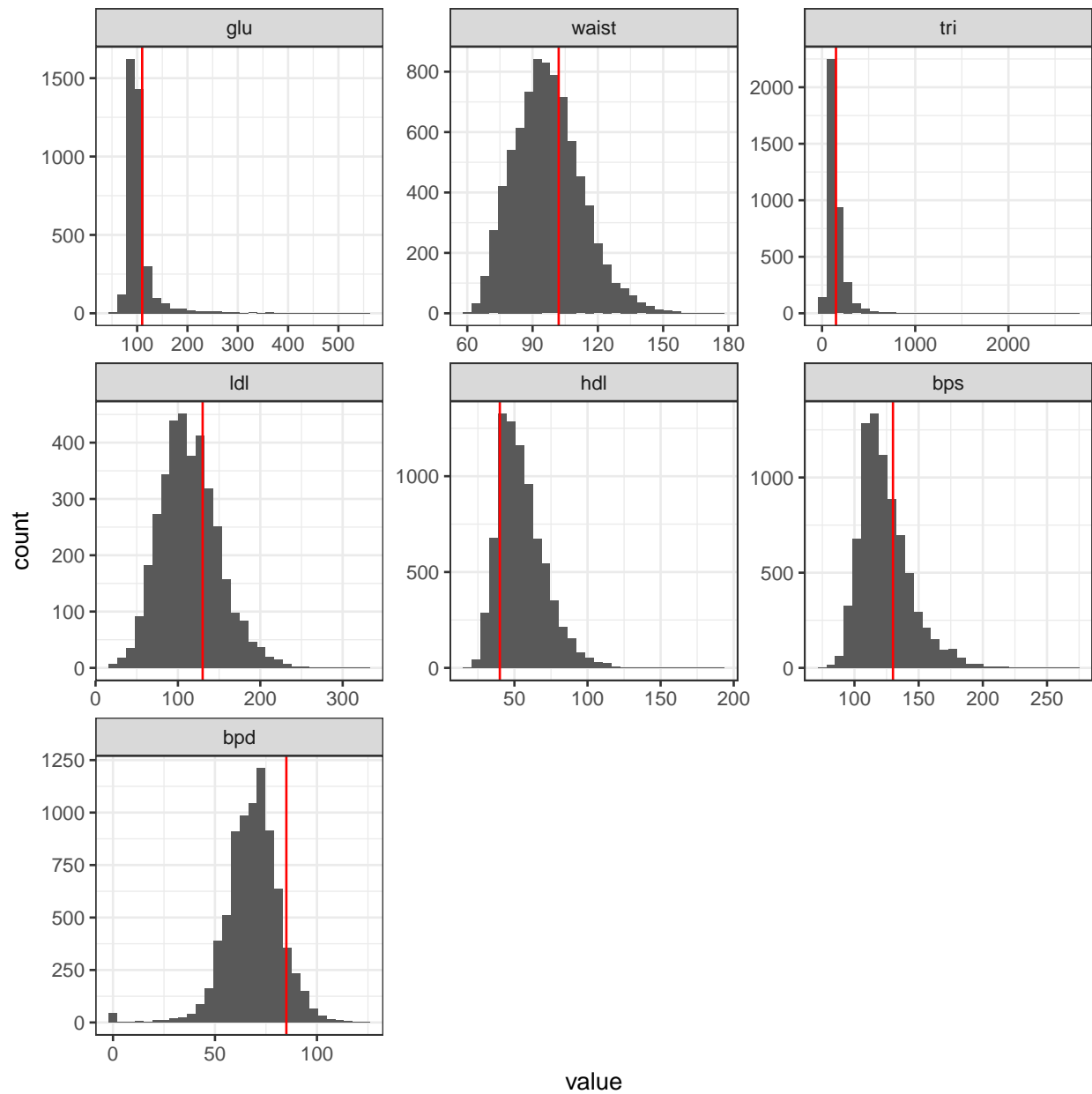
```
## F-statistic: 4.658 on 1 and 3574 DF,  p-value: 0.03097
##
##
## Response bps :
##
## Call:
## lm(formula = bps ~ y$modvig)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -44.510 -13.122  -2.921   10.172   93.694
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 126.33975     0.43377   291.26  <2e-16 ***
## y$modvig     -0.13340     0.01267  -10.53  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 19.13 on 3574 degrees of freedom
## (4668 observations deleted due to missingness)
## Multiple R-squared:  0.03006, Adjusted R-squared:  0.02979
## F-statistic: 110.8 on 1 and 3574 DF,  p-value: < 2.2e-16
##
##
## Response bpd :
##
## Call:
## lm(formula = bpd ~ y$modvig)
##
## Residuals:
```

```
##      Min      1Q  Median      3Q      Max
## -68.064  -7.423   0.529   8.164  47.533
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  67.729506   0.310267  218.294  <2e-16 ***
## y$modvig      0.013836   0.009066   1.526    0.127
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.68 on 3574 degrees of freedom
## (4668 observations deleted due to missingness)
## Multiple R-squared:  0.0006513, Adjusted R-squared:  0.0003717
## F-statistic: 2.329 on 1 and 3574 DF,  p-value: 0.1271
```

```
## Using as id variables
```

```
## 'stat_bin()' using 'bins = 30'. Pick better value with 'binwidth'.
```

```
## Warning: Removed 14799 rows containing non-finite values (stat_bin).
```



```
## 'stat_bin()' using 'bins = 30'. Pick better value with 'binwidth'.
## 'stat_bin()' using 'bins = 30'. Pick better value with 'binwidth'.
## 'stat_bin()' using 'bins = 30'. Pick better value with 'binwidth'.
```

