

M9 Problem Set: One Way ANOVA for TAs

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Consider an example in which a researcher is investigating the **impact of metal contamination on the diversity of species found in sessile marine invertebrates** such as sponges, bryozoans, and sea squirts. The researcher aims to determine whether **copper reduces species richness**, while **also considering the potential influence of substrate orientation, whether vertical or horizontal**, on invertebrate richness.

To address this, they conducted an experiment where species richness was assessed in replicate samples under each of the six combinations of copper enrichment levels (**“None,” “Low,” “High”**) and substrate orientations (**“Vertical,” “Horizontal”**). This experimental design is referred to as factorial, as it encompasses all levels of one treatment within all levels of the other treatment, also known as orthogonal.

The factorial ANOVA will test the following hypotheses:

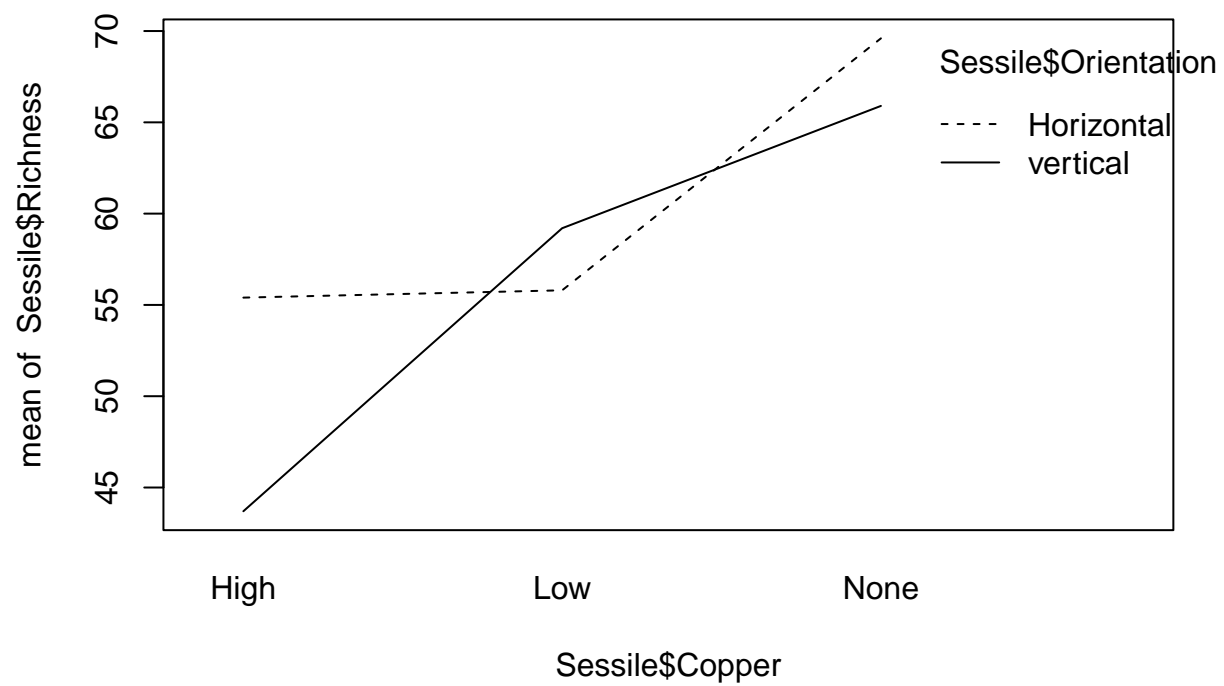
1. Whether there are differences in richness among the three levels of copper enrichment.
2. Whether there are differences in richness among the two levels of substrate orientation.
3. Whether there is an interaction effect between copper enrichment and substrate orientation, indicating whether the effect of copper on richness depends on the orientation of the substrate.

```
Sessile <- read.csv(file = "Sessile.csv", header = TRUE)
```

```
Sessile.aov <- aov(Richness ~ Copper + Orientation + Copper:Orientation, data = Sessile)
summary(Sessile.aov)
```

```
##              Df Sum Sq Mean Sq F value    Pr(>F)
## Copper          2   3330   1665.0   192.53 < 2e-16 ***
## Orientation      1    240    240.0    27.75 2.46e-06 ***
## Copper:Orientation 2    571    285.3    33.00 4.34e-10 ***
## Residuals       54    467     8.6
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
interaction.plot(Sessile$Copper, Sessile$Orientation, Sessile$Richness)
```



References: <https://environmentalcomputing.net/statistics/linear-models/anova/anova-factorial/>