Lab 2

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Modeling noise

- What can you see on this image?

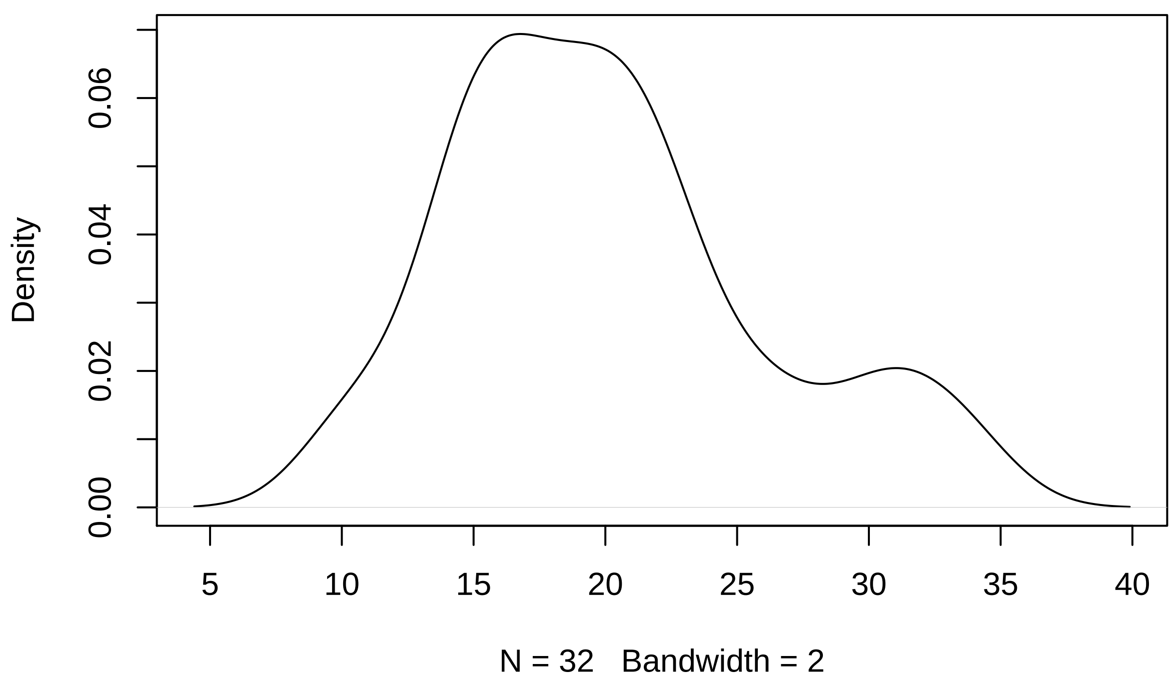
Modeling noise

- What can you see on this image?
- To what extenct you can be sure that there is something behind the noise?

Analysis of variance

- ANOVA is behind most of the modern statistical methods
- Even very advanced statistical methods - like SEM - can be regarded as form of ANOVA
- Main goal of ANOVA is to divide randomness in the data, and assess to what excent the randomness can be modelled by data analyst

Analysis of variance - null-model



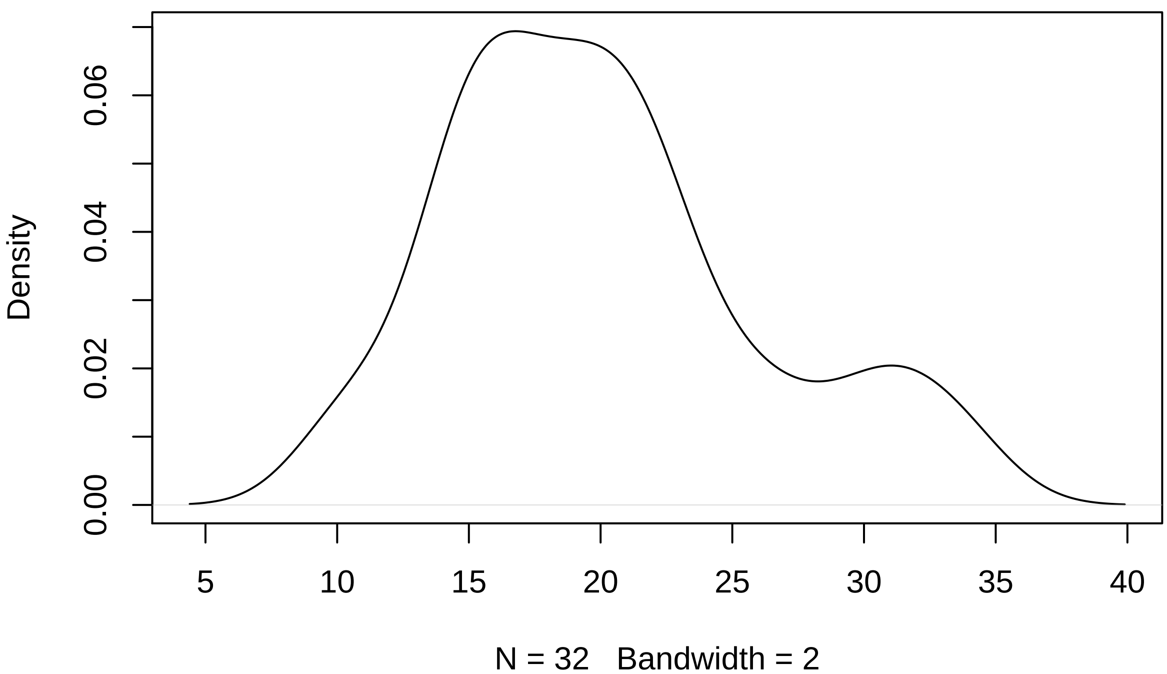
Analysis of variance - null-model

- Suppose you have collected as sample of N = 32 values of some variable
- Without any other information you can model such variable as:
- $y_i = \mu + \epsilon_i$
- y_i is value of the variable for person i, for i in $1, ..., 32$
- μ is the sample mean
- ϵ_i is deviance from the sample mean of a value for person i, for i in $1, ..., 32$
- we usually call ϵ_i a residual

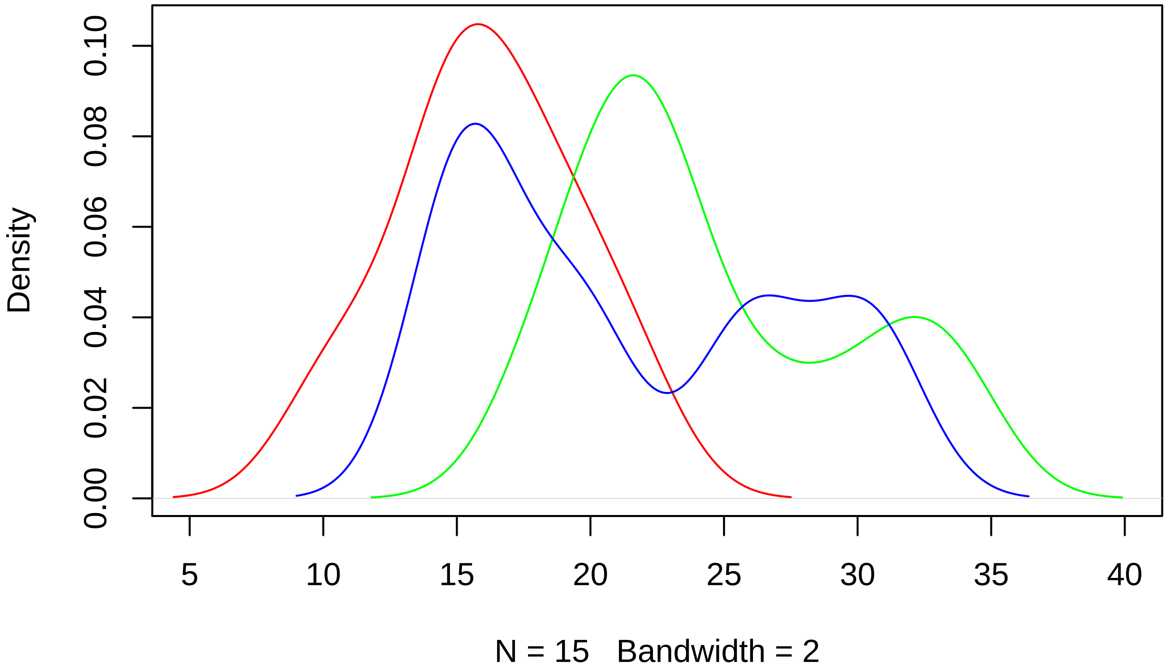
Analysis of variance - total sum of squares

- we can use ϵ_i to calculate a sample variance, σ^2
- or TOTAL SUM OF SQUARES, $TSS = \sum_{i=1}^{N} \epsilon_i^2$
- the smaller the value of variance, the more we can be sure about conclusions we draw from the data
- hence our goal is to somehow minimize the variance in the data

Analysis of variance - simple model



Analysis of variance - simple model



Analysis of variance - simple model

- $y_{ij} = \mu + \alpha_j + \epsilon_{ij}$
- α_j is a deviance of group j mean from a total sample mean, for j in $1, ..., 3$
- ϵ_{ij} is deviance from the group mean of a value for person i in group j
- we can use α_j to calculate MODEL SUM OF SQUARES, $MSS = \sum_{j=1}^{K} n_j * \alpha_j^2$, where n_j is number of observations in group j
- moreover, we can use ϵ_{ij}, to calculate RESIDUAL SUM OF SQUARE, $RSS = \sum_{j=1}^{K} \sum_{i=1}^{n} \epsilon_{ij}^2$

F-ratio

- how can we compare variation assumed by model to residual variation
- so far we have MSS, and RSS, but the sizes we used to calculate this values differ
- we can eliminate this bias by dividing each value by respective value of degrees of freedom
- we then obtain MEAN SQUARES for model, MS_M, and RESIDUAL MEAN SQUARE, MS_R
- F-ratio is simply a ratio of MS_M to MS_R, $F = \frac{MS_M}{MS_R}$

ANOVA table

	Df	SS	MS	F	p
Model	2	483.24	241.62	10.90	<0.001
Residuals	29	642.80	22.17		

What p-value actually means?

- Suppose that your model actually does not matter and expected value of our variable is the same across all groups
- Suppose that you have performed not one, but 1000 studies, where you collected a sample of the same size as in original one
- How frequently you should observe the value of F at least as big as the one you observed in your study?
- If p is less than some determined and well established value, e.g. 0.05, you can say that the results of your study are in some way remarkable
- You will probably reject null hypothesis, H_0 of no difference of means in favor of H_1
- You can also say, that your model is actually better that no model at all (null-model)

How important is your model? - η^2

- Usually you should also answer how important is your model and how good it is in differentiating actual singal from noise
- One value you can use to obtain such information is to look at proportion of total variance explained by your model
- η^2 is a value you can use to estimate such proportion
- $\eta^2 = \frac{MSS}{TSS} = \frac{MSS}{MSS+RSS}$