

Analyzing indonesian rice farms

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1 Introduction

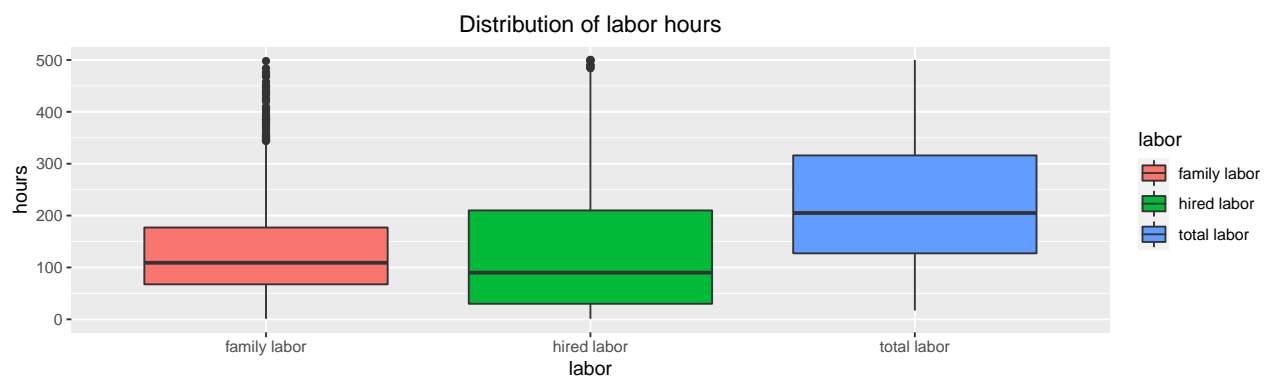
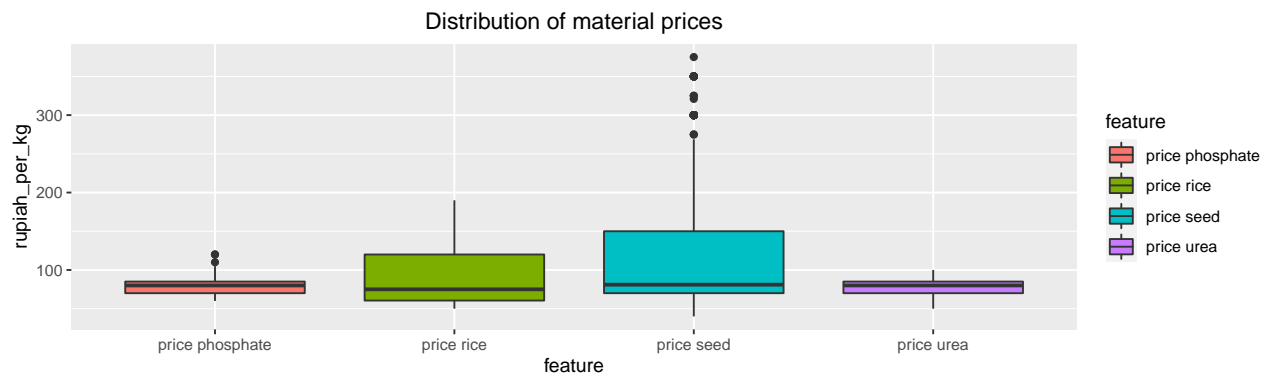
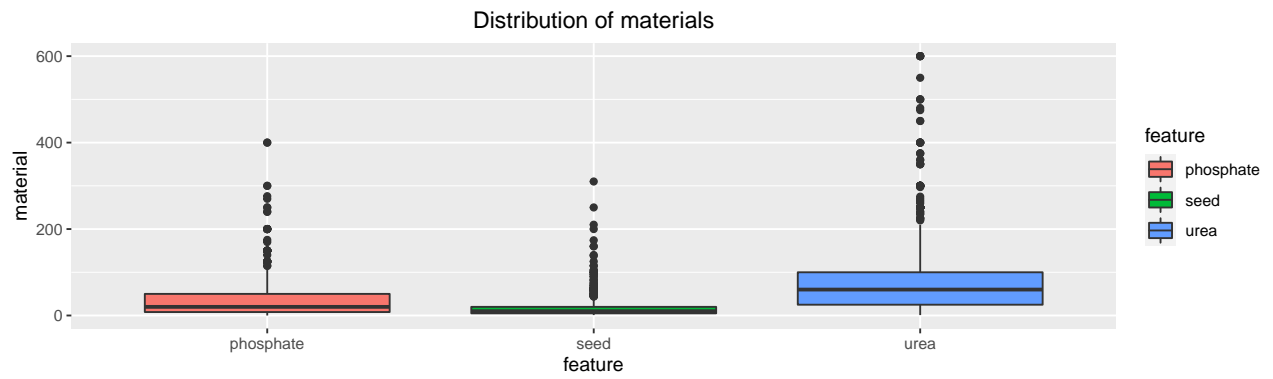
The present data set includes production data for 171 indonesian rice farms. The dataframe contains the following variables:

variable	description	expressions
id	unique identifier for a farm	unique id
time	unique identifier for a specific growing season	1 - 6
size	total production area in hectares	0.01 - 5.322
status	status of property rights	“owner”, “share”, “mixed”
varieties	rice seed varieties	“trad”, “high”, “mixed”
bimas	bimas-status of the farmers	“no”, “yes”, “mixed”
seed	seed in kilogram	1 - 1250 kg
urea	urea in kilogram	1 - 1250 kg
phosphate	phosphate in kilogram	0 - 700 kg
pesticide	pesticide cost in Rupiah	0 - 62600 r
pseed	price of seed in Rupiah per kg	40 - 375 r/kg
purea	price of urea in Rupiah per kg	50 - 100 r/kg
pphosph	price of phosphate in Rupiah per kg	60 - 120 r/kg
hiredlabor	hired labor in hours	1 - 4536 h
famlabor	family labor in hours	1 - 1526 h
totlabor	total labor (excluding harvest labor)	1 - 4774 h
wage	labor wage in Rupiah per hour	30 - 175.35 r/h
goutput	gross output of rice in kg	42 - 20960 kg
noutput	gross output minus harvesting cost	42 - 17610 kg
price	price of rough rice in Rupiah per kg	50 - 190 r/kg
region	region of the farm	

As present in the table, the data set consists of 16 numeric variables and 4 categorical variables. The target variable for the regression modeling will be *goutput*, what represents the gross output of rice in *kg* for the respective rice farm. The variable *noutput* is a linear transformation of *goutput* as it represents *goutput* decreased by the harvesting costs. Therefore it is not used for the modeling because it would violate the multicollinearity assumption. In the following some explorative data analysis will be made to get to get a first impression of the distribution of the individual variables.

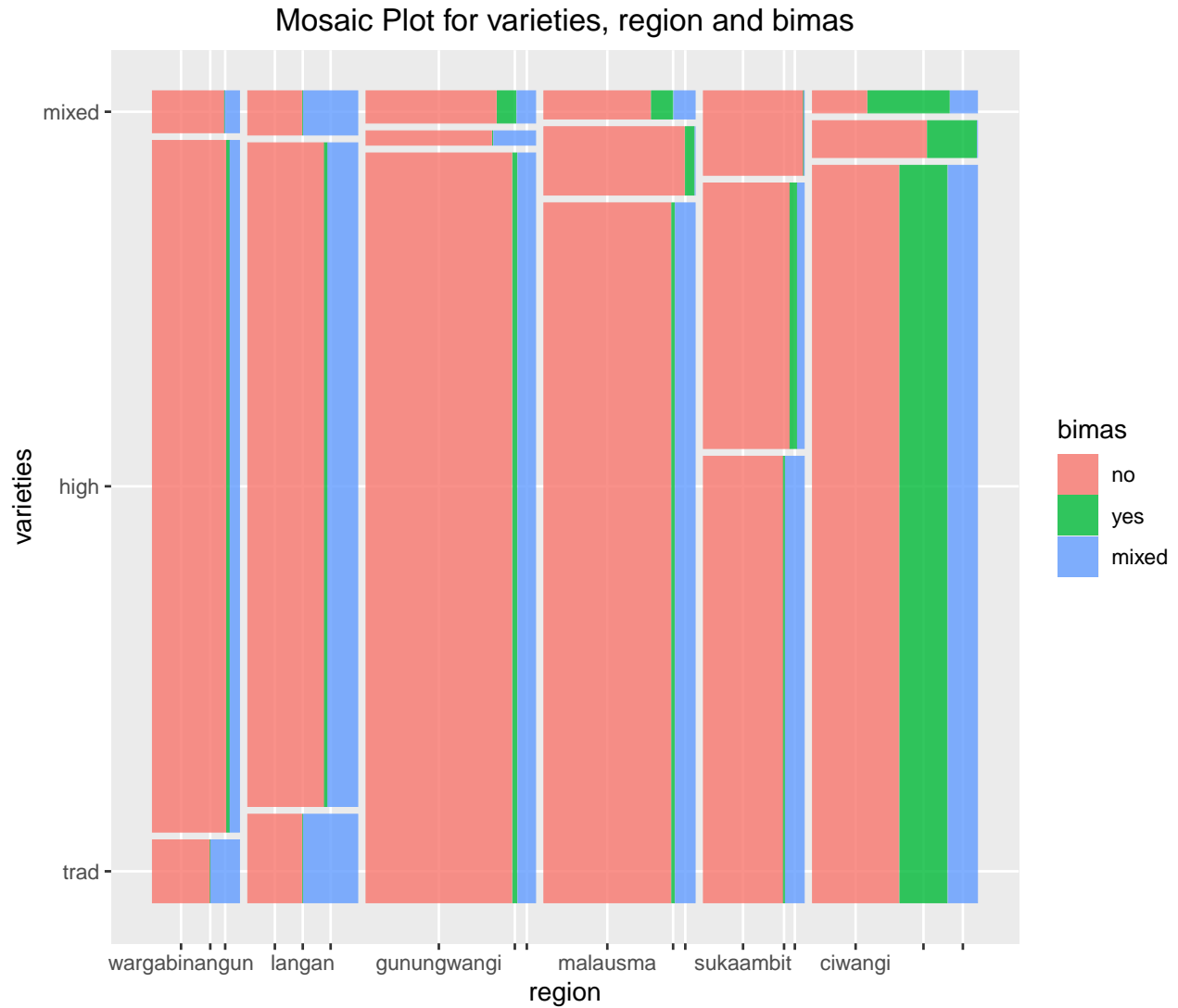
1.1 Numerical Variables

The following figure shows boxplots for the used materials and the prices paid for the materials of the respective rice farms. The boxplots for the materials show, that the distribution of all materials is right-skewed. The spread width of seed is the lowest, followed by phosphate and urea. Therefore *urea* also has the highest variance with 16166 followed by *phosphate* with 2264 and *seed* with 2048. The distribution of *urea* indicates that rice farms in Indonesia may use urea very different, caused by e.g. the bimas-status. The bimas program is a rice intensification program by the government to support local rice production by providing high-yield rice seeds as well as technical assistance. If we look at the prices for phosphate *pphosph* and urea *purea*, we can see a slight left-skewed distribution with low variance (75 for *purea* and 86 for *pphosph*). In contrast to that, the prices for seeds scatter much. The distribution of *pseed* is strongly right-skewed as well as the distribution for the rice price *price*. The price for the rice also scatters, but less than *pseed*. The two prices have a correlation of 0.67. Of course, the price of seeds affects the selling price of rice. The prices may fluctuate due to seasonal or regional factors and have an impact on each other. The distribution of labor hours is also slightly skewed to the right. Overall, the dispersion is lowest for the *famlabor*. For *hiredlabor* and *totlabor* we have a similar spread, but *totlabor* has a higher level overall. This is caused by the *hiredlabor* which is a subset of *totlabor*.



1.1 Categorical Variables

The following mosaic plot shows the distribution of the categorical variables *varietes*, *region* and *bimas*. Overall, all regions are roughly equally represented in the data set. We can detect, that most of the farmers with the *bimas* status *yes* and *mixed* are located in the region *ciwangi*. The distribution of the different varieties is strongly dependent on the region. While the *high* varieties have the biggest share in the regions *wargabinangun* and *langan*, the *traditional* varieties are dominating the regions *gunungwangi*, *malausma* and *ciwangi*. The *mixed* varieties are only used slightly in all regions.



To test wheter the categorical variables have impact on our target variable *goutput*, one- and two-sided anovas are performed. The results of these are summarized in the following table:

formula	F-value	p-value	significant
region	22.981	< 2e-16	yes
varieties	11.764	8.94e-06	yes
bimas	14.817	4.57e-07	yes
region+varietes	3.847	3.96e-05	yes
region+bimas	5.651	2.94e-08	yes
varieties+bimas	0.791	0.531	no
region+varieties+bimas	0.860	0.580	no

The anova outputs show, that all of the categorical variables have a significant effect on *goutput*. The null hypothesis, that the mean of *goutput* is the same across the groups is rejected. The results of the two-sided anovas also show a significant interaction effect on *goutput*. While the interaction effect from the *region* with *varieties* and *bimas* is significant, the interaction effect of *varieties* and *bimas* and the interaction effect of all three variables is not.

2 First Model

3 Third Model

4 Comparision

5 Conclusion