Assignment ØKA201 Data Analysis part 2025

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My solution to the Data analysis assignment in ØKA 201

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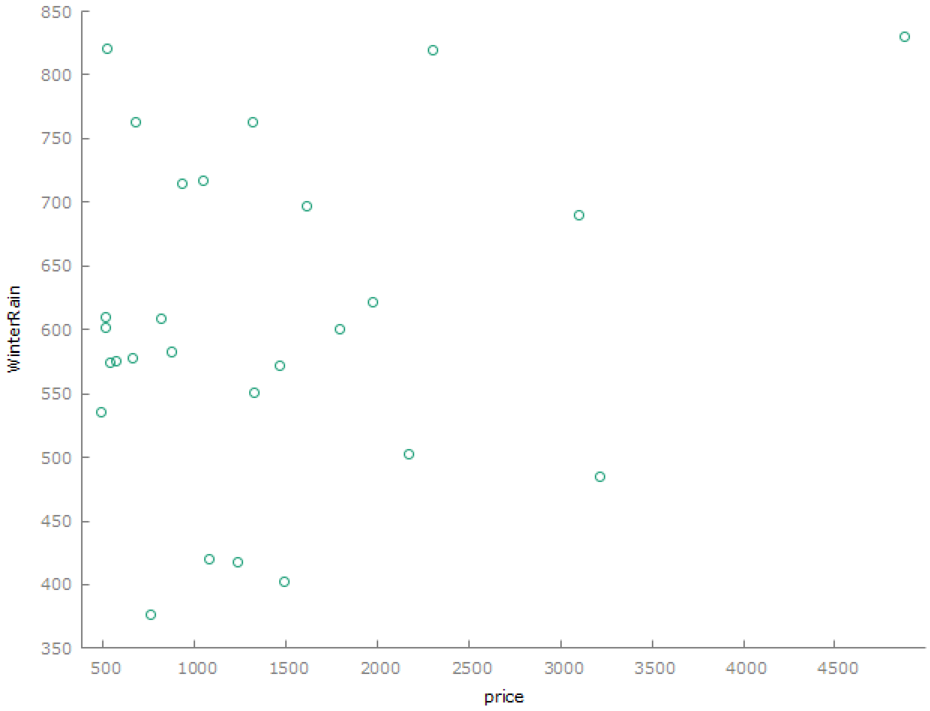
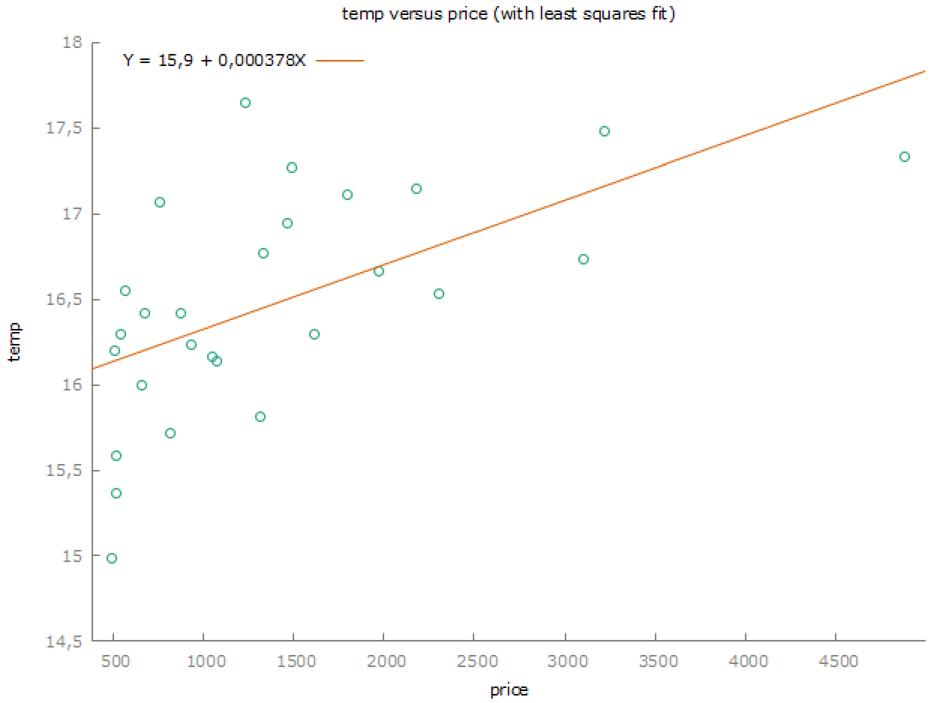
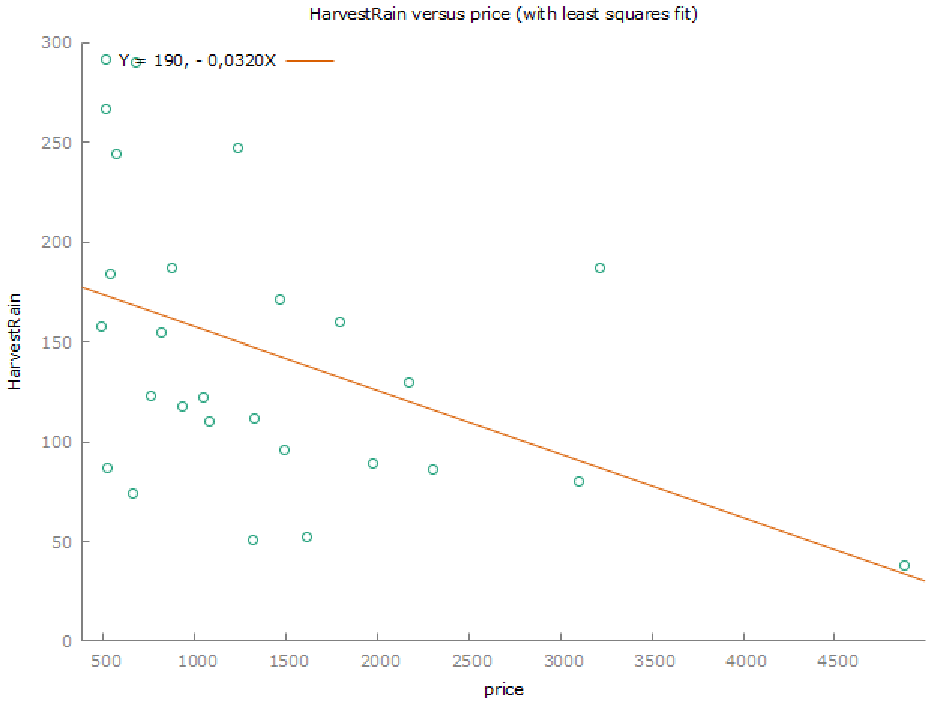
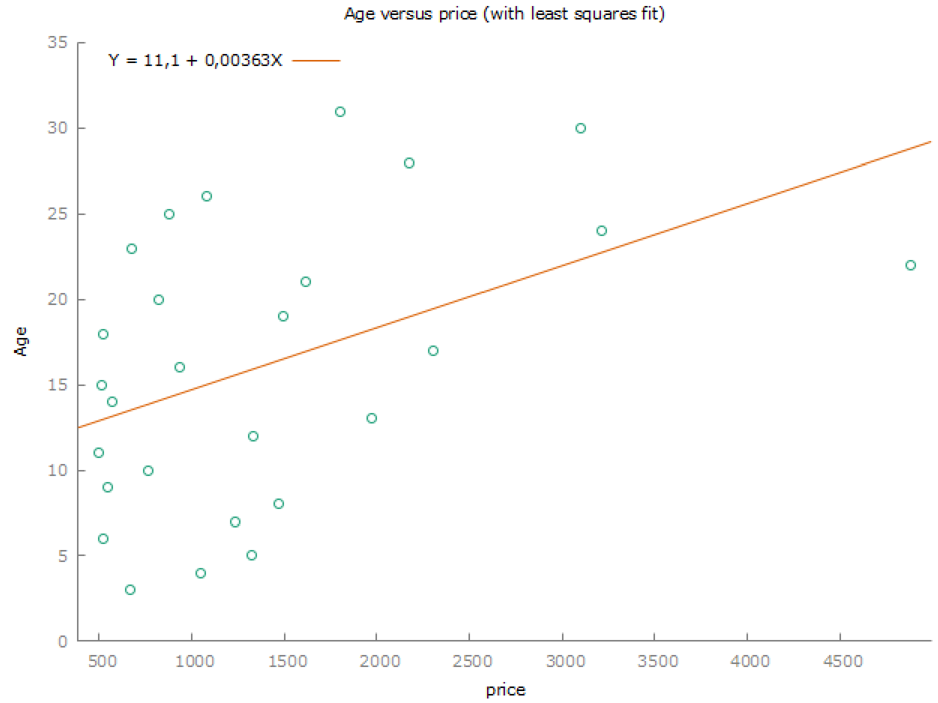
1 Exercise 1:

	Mean	Median	S.D.	Min	Max
price	1405,8	1079,8	1027,2	495,17	4883,9
WinterRain	608,41	600,00	129,03	376,00	830,00
temp	16,478	16,417	0,65919	14,983	17,650
HarvestRain	144,81	123,00	73,066	38,000	292,00
Age	16,185	16,000	8,2464	3,0000	31,000




temp versus price (with least squares fit)
Y = 15,9 + 0,000378X
temp
18
17,5
17
16,5
16
15,5
15
14,5
500
1000
1500
2000
2500
3000
3500
4000
4500
price


HarvestRain versus price (with least squares fit)
Y = 190, - 0,0320X
HarvestRain
300
250
200
150
100
50
0
500
1000
1500
2000
2500
3000
3500
4000
4500
price



2 Exercise 2:

2.1 a) Show output from Gretl

Model 3: OLS, using observations 1952-1980 (T = 27) Missing or incomplete observations dropped: 2 Dependent variable: price

	coefficent	std. error	t-ratio	p-value
const	494,278	402,112	1,229	0,2304
Age	56,3183	22,2218	2,534	0,0179 **

Mean dependent var	1405,800	S.D. dependent var	1027,226
Sum squared resid	21827151	S.E. of regression	934,3907
R-squared	0,204406	Adjusted R-squared	0,172582
F(1, 25)	6,423065	P-value(F)	0,017902
Log-likelihood	−221,9495	Akaike criterion	447,8990

Schwarz criterion	450,4907	Hannan-Quinn	448,6697

2.2 b) Interpret the estimated coefficients

494,278 is the estimated value of the dependent variable (price) when the age is zero.

For every year the wine ages, the estimated price increases by 56,3183. We consider this statistically significant at the most commonly used 5% level of significance, since the p-value of 0.0171 is less than 0.05. This is also marked with two stars in the output from Gretl.

2.3 c) Test whether the regressor has a significant effect on the dependent variable at a 1% level of significance

Null Hypothesis (H): The Age coefficient = 0 (Age does not affect price).

$$H_0 : \beta_1 = 0$$

Alt. Hypothesis (H): The Age coefficient is not equal to 0 (Age does have an effect on price).

$$H_1 : \beta_1 ! = 0$$

Testing on a 1% significance level with a p-value of 0.0179. The p-value is greater than 0.01, which means that we can't reject the null hypothesis at the 1% significance level. In other words, we do not have enough statistical evidence that age has an effect on price at this level of significance.

2.4 d) Make a prediction of the price when the independent variable is equal to its minimum value, mean value, and maximum value

The age is the independent variable. From the dataset we know that 3 is the minimum value, 16,185 is the mean value, and 31 is the maximum value. We also know that the constant is 494,278 and the coefficient for age is 56,3183.

Minimum age:

```
494.278 + (56.3183 * 3)
```

```
[1] 663.2329
```

Mean age:

```
494.278 + (56.3183 * 16.185)
```

```
[1] 1405.79
```

Maximum age:

```
494.278 + (56.3183 * 31)
```

```
[1] 2240.145
```

2.5 e) Calculate a 95% prediction interval for the price of the 1961 vintage

For 95% confidence intervals, t(25, 0,025) = 2,060

	price	prediction	std. error	95% interval
1961	4883,90	1733,28	960,270	-244,433 - 3710,99

Forecast evaluation statistics using 1 observations

Mean Error	3150,6
Root Mean Squared Error	3150,6
Mean Absolute Error	3150,6
Mean Percentage Error	64,51
Mean Absolute Percentage Error	64,51
Theil's U2	0

The 95% interval is [-244,433 - 3710,99]

3 Exercise 3

3.1 a) Show the output from Gretl

Model 1: OLS, using observations 1952-1980 (T = 27)
Missing or incomplete observations dropped: 2
Dependent variable: price

	coefficient	std. error	t-ratio	p-value
const	-15509,0	3379,87	-4,589	0,0001 ***
WinterRain	2,75098	0,965119	2,850	0,0093 ***
Temp	930,787	190,557	4,885	6,97e-05 ***
HarvestRain	-5,04694	1,61682	-3,122	0,0050 ***
Age	39,2126	14,3490	2,733	0,0121 **

Mean dependent var	1405,800	S.D. dependent var	1027,226
Sum squared resid	7238994	S.E. of regression	573,6246
R-squared	0,736141	Adjusted R-squared	0,688166
F(4, 22)	15,34443	P-value(F)	3,93e-06
Log-likelihood	−207,0499	Akaike criterion	424,0999
Schwarz criterion	430,5791	Hannan-Quinn	426,0265

3.2 b) Interpret the estimated slope coefficients

WinterRain: The coefficient is 2.75098, which means the price increases by that amount for each additional unit of WinterRain. We consider this statistically significant at the most commonly used 5% level of significance, since the p-value of 0.0093 is less than 0.05. The p-value of 0.0093 also means it's statistically significant at the 1% level since it's less than 0.001.

Temp: The coefficient is 930.787, which means the price increases by that amount for each additional unit of Temp. We consider this statistically significant at the most commonly used 5% level of significance, since the p-value of 6.97e-05 is less than 0.05. The p-value of 6.97e-05 also means it's statistically significant at the 1% level since it's less than 0.001.

HarvestRain:The coefficient is -5.04694, which means the price decreases by that amount for each additional unit of HarvestRain. We consider this statistically significant at the most commonly used 5% level of significance, since the p-value of 0.0050 is less than 0.05. The p-value of 0.0050 also means it's statistically significant at the 1% level since it's less than 0.001.

Age: The coefficient is 39.2126, which means the price increases by that amount for each additional unit of Age. We consider this statistically significant at the most commonly used 5% level of significance, since the p-value of 0.0121 is less than 0.05. The p-value of 0.0121 also means it's **not** statistically significant at the 1% level since it's higher than 0.001.

3.3 c) Compare with what you found in Exercise 2

Looking at age just like we did in exercise 2, we see that the coefficient is now 39,2126. In exercise 2, it was 56,3183. The difference is that in exercise 2, we didnt take WinterRain, Temp and HarvestRain into consideration. These other variables were unknown.

We see now that the age increases less per unit compared to exercise 2 when we add the other variables to the equation. The difference is that we now estimate what effect one unit of age will have on the price, given that WinterRain, Temp and HarvestRain are the same.

The p-value has decreased slightly, but not enough to push it below the 1% significance level.

4 Exercise 4

4.1 a) Show the output from Gretl

Model 2: OLS, using observations 1952-1980 (T = 27)
Missing or incomplete observations dropped: 2
Dependent variable: price

	coefficient	std. error	t-ratio	p-value	
const	−13319,6	3910,53	−3,406	0,0023	***
Temp	902,820	236,963	3,810	0,0009	***
DUM	−815,924	394,606	−2,068	0,0496	**

Mean dependent var	1405,800	S.D. dependent var	1027,226
Sum squared resid	15211368	S.E. of regression	796,120

R-squared	0,445550	Adjusted R-squared	0,399345
F(2, 24)	9,643056	P-value(F)	0,000844
Log-likelihood	−217,0745	Akaike criterion	440,1490
Schwarz criterion	444,0365	Hannan-Quinn	441,3050

4.2 b) Explain how high levels of rainfall in the harvest season can affect prices through fixed effects, and through interaction effects with temperature, based on the estimated model.

This model includes a dummy variable which is a fixed effect. In this case it's used to capture the effect of rainfall above 200mm. When the rainfall is above this threshold, it predicts a decrease in the price with - 815,924.

When it comes to the interaction with temperature, there is a possibility that high levels of rainfall means cooler temperatures. Seeing as a single unit of Temp estimates an increase in price of 902,820, we can say that higher temperatures are connected to higher prices. This means that if high rainfall affects the temperature in a negative way, it could lower the price.

5 Exercise 5

5.1 a) Calculate the residual for the 1961 vintage using Model 1, Model 2, and Model 3

The actual price of the 1961 vintage is 4,883.903, WinterRain is 830, temp is 17,3333, HarvestRain is 38, and Age is 22.

Model 1:
Price =

```
494.278 + (56.3183 * 22)
```

```
[1] 1733.281
```

Residual for model 1 =

```
4883.903 - 1733.281
```

```
[1] 3150.622
```

Model 2:
Price =

```
-15509.0+(2.75098*830)+(930.787*17.3333)+(-5.04694*38)+(39.2126*22)
```

```
[1] 3578.817
```

Residual for model 2 =

```
4883.903 - 3578.817
```

```
[1] 1305.086
```

Model 3:
Price =

```
-13319.6+(902.820*17.333)+(-815.924*0)
```

```
[1] 2328.979
```

Residual for model 3 =

```
4883.903 - 2328.979
```

```
[1] 2554.924
```

5.2 b) Comment on what you found in a), and this, in addition to other relevant information to discuss briefly which model you would prefer to use for predicting Bordeaux vintage wine prices

The residual for model 1 is quite large. This model only considers the age of the wine, and the model is probably too simple to correctly estimate the actual price of the 1961 vintage. The 1961 vintage is the most expensive out of all the wines, so the model probably needs more variables to correctly predict the price.

The residual for model 2 is still large, but considerably less than for model 1. This model includes all the variables we have available. Still, it predicts a moderate price for the 1961 vintage, compared to the actual price. However, seeing as the 1961 vintage is such an outlier, it would probably be impossible to correctly predict the price.

Model 3 faces the same challenges as model 1 and the residual is pretty large. There are not enough variables. It also mainly focuses on the outliers with high rainfall which are wines that usually are cheap. Another challenge with this model is that it doesn't differentiate rainfalls between 0 and 200.

Based on the residuals I would prefer model 2 for predicting Bordeaux vintage wine prices. While the residual is still big, it's hard to predict outliers. Some outliers are even such anomalies that a model that predicts it right might be worse for predicting other Bordeax vintage wine prices. However, model 2 can still be improved by adding additional variables.