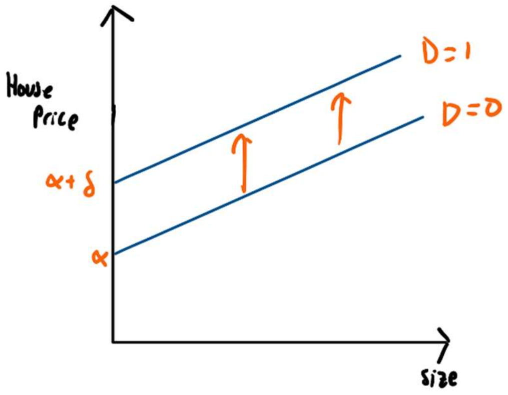
Chow Tests

If we analyse the two relationships discussed in the last section between house prices for both desirable and undesirable neighbourhoods, we can perform a chow test to test for significance in the differences between both regression lines:



A desirable neighbourhood sits **higher** on the price axis since every price in this area **exceeds every price in undesirable neighbourhoods** at every given house size

However, a chow test is used to test if, despite their variations, the differences are **actually statistically significant or if the same regression model could suffice in describing both areas**

Chow Test

The chow test is a **special form of a dummy variable test** and accounts for fluctuating data in a sample **without the need to construct intercept or slope dummies**

The chow test, as usual with a hypothesis test, is set up as follows (**NOTE P_Di is the regression equation for desirable area price, whilst P_{DU}i is regression equation for undesirable area price**)

$$H_0: P_D i = P_{DU} i = \alpha i + \beta x i + \varepsilon i$$

$$H_1: P_D i \neq P_{DU} i$$

If the **null hypothesis** was true, then both regression equations would be **statistically indifferent** and the two sets of sample data could be **pooled as one set** for one regression model

If the **alternative hypothesis** were true, then **the intercept and/or slope dummies for both regression equations will differ** and hence **cannot be pooled**

To test H_0, a pooled equation is estimated using the **two samples together** to see if the **intercepts and/or slopes significantly differ**

Example of a Chow Test

The chow test is **very similar to the F test** discussed in previous section on 'multiple regression' **with a restricted and unrestricted model**

However in this case, the restrictions aren't based around the idea that **additional variables are insignificant**, but rather that the **difference between two data samples are insignificant**

Let's consider two data sets, **one from a slightly more desirable street, and one from a less desirable street:**

Sample no.	Size	Desirable Area?	Price
1	8	Yes	10
2	8	No	8
3	6	Yes	8
4	5	No	5
5	7	No	6
6	3	Yes	3
7	4	No	3
8	2	Yes	2
9	9	No	8
10	3	Yes	4

The data will be split into **two subsamples of 5 observations (one for desirable, one for not desirable)**

The chow test is an F-test with the following formula:

$$F_{\text{df1,df2}} = \frac{(rRSS - uRSS) \div r}{uRSS \div (n-k)}$$

Where:

n = **total number of observations** (which is **10** here)
k = **total number of parameters** (with the sample split in half there are two models, hence there are **4** parameters)
r = **number of restricted parameters** (if the restriction is enforced and the data is treated as one set of observations then there are 2 parameters, but without the restriction there are 4 parameters - hence restricted parameters = 4-2 = **2**)
rRSS = **restricted residual sum of squares** (sum of errors squared if the data were to be **combined** into one model)
uRSS = **unrestricted residual sum of squares** (sum of errors squared of **both subsamples added together**)

We can calculate rRSS and uRSS using Toolpak on excel, where **one regression is performed on all 10 samples**, and **another two are performed on each individual subsample** (RSS_1 and RSS_2)

rRSS = 11.6
uRSS = $RSS_1 + RSS_2$ = 0.786 + 1.20 = 1.986

We can now **calculate the test statistic**:

$$F = \frac{(11.6 - 1.986) \div 2}{1.986 \div (10-4)} = 14.5$$

Using df1 = r = 2 and df2 = n-k = 6 gives a critical value of **5.14 at the 5% significance level**

Since the **test statistic exceeds the critical value**, we have enough evidence to **reject the null hypothesis** and can assume that the **desirability of the neighbourhood has a significant impact on the price of the house.**

Hence **we should not use one regression model to explain all 10 observations**, but rather we must separate them into **two subsamples of desirable and undesirable area**