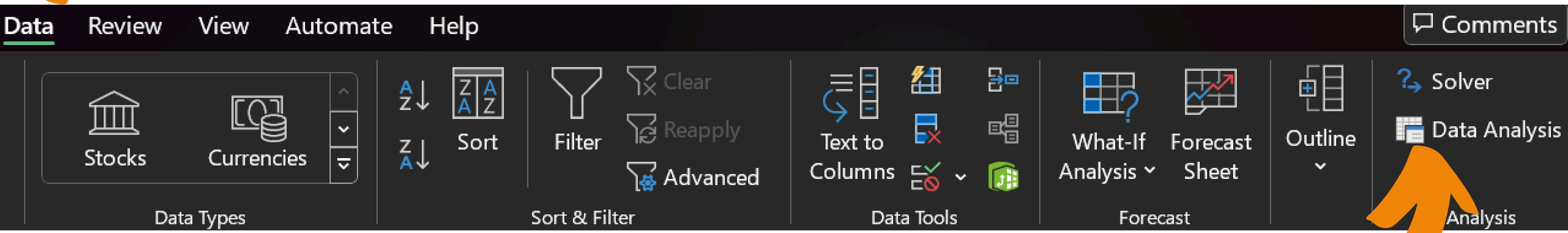
Statistical Analysis

Methodological Questions of Chinese Economic Research

Benedikt Lasar

25.06.2024

Preperations for the Statistics Session



(that's Excel, I hope that's obviously)

Click 'Data' and look if you already have the 'Data Analysis' tool

Preperations for the Statistics Session

If you don’t have the tool yet, please install the add-in:

File
More
Options
Add-ins
Analysis ToolPak

Activate or download the add-in and your’re good to go!

Disclaimer:

This is just a very brief introduction to a complex topic. If you are interested in statistical methods, you will have to put more work into it. This lesson alone is not detailed enough to allow you to write statistics-based papers.

Disclaimer:

Nevertheless, I want to show you that statistics can be a lot easier than you might expact. You don’t need to know any complicated models by heart to use basic statistical tools in your research. It also requires no mathematical skills.

Disclaimer:

Lastly, I am not an expert, just a fan. This is an excerpt of what I have learned over several statistics classes and through my thesis. So, I am *technically* not an expert, but the experts never explain it in a sensible way.

What are we doing here?

well, technically...

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well, technically...

ECONOMETRICS

ECONOMETRICS

It is a combination of economics, mathematics, and statistics

Applied economics is always reliant on econometrics

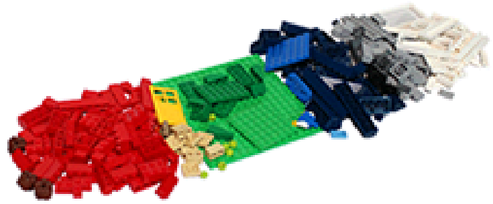
It relies on non-experimental data

Economic models are needed to interpret the results

ECONOMETRICS

1 Data Collection

2 Data Preparation



3 Data Visualization

4 Data Analysis

5 Data Storytelling

Source: https://www.effectivedatastorytelling.com/post/a-deeper-dive-into-lego-bricks-and-data-stories

Why tho?

Why tho?

Because you’re afraid of statistics

I know you’re skipping the statistics part of every paper you read so far. Been there, done that

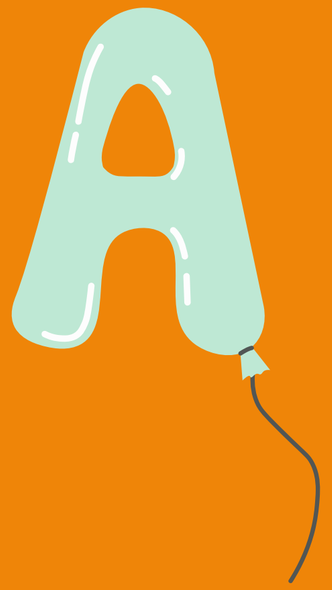
It’s actually quicker and easier to just check the output tables instead of reading the explanation

Why tho?

Better understand the papers you read

Check the quality of your work and the work of others

Do your own research



Basics

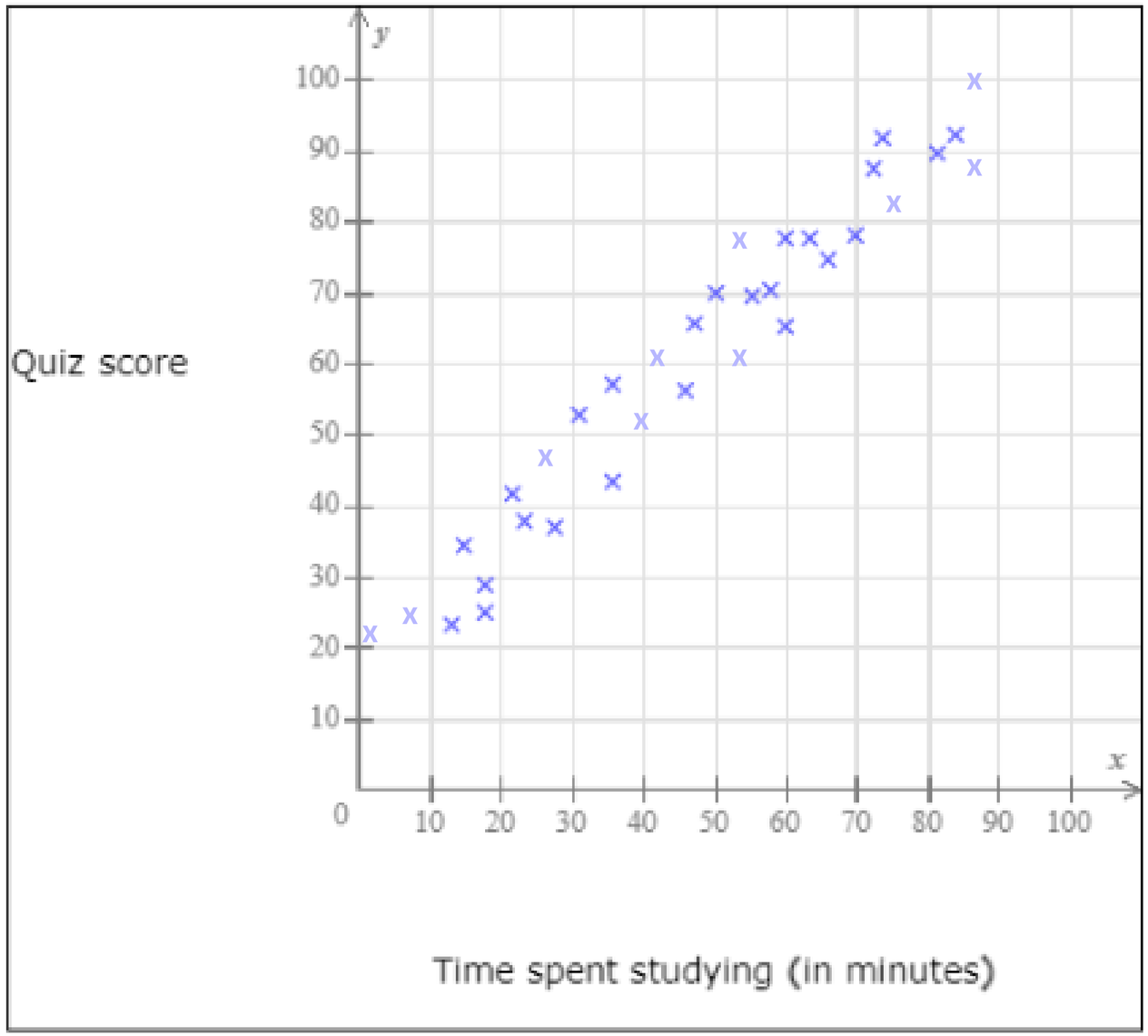
The Basics

What do we want to find out?

The connection between two or more variables

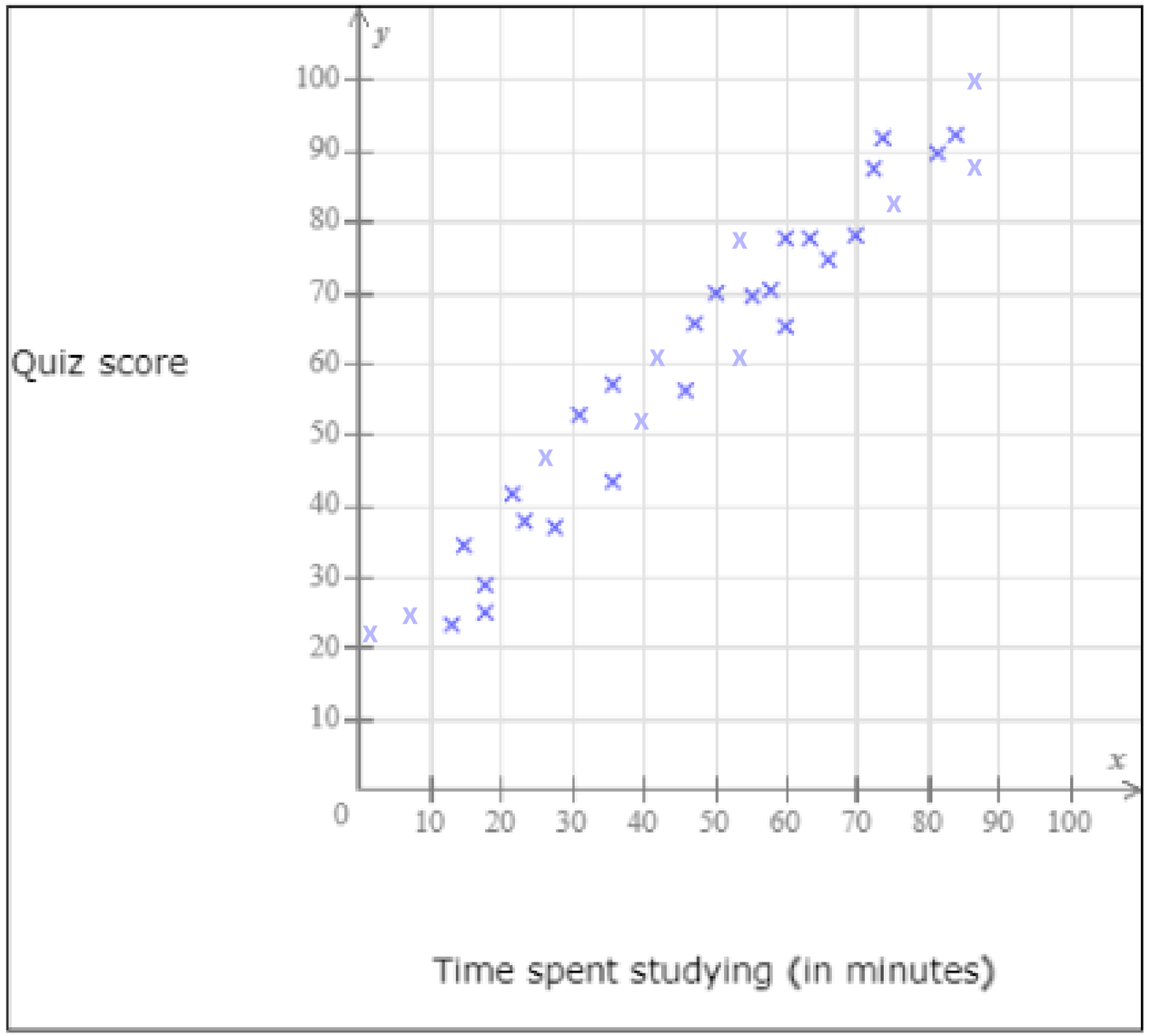
What kind of connection do we hope for?

A causal relationship, correlations are not enough



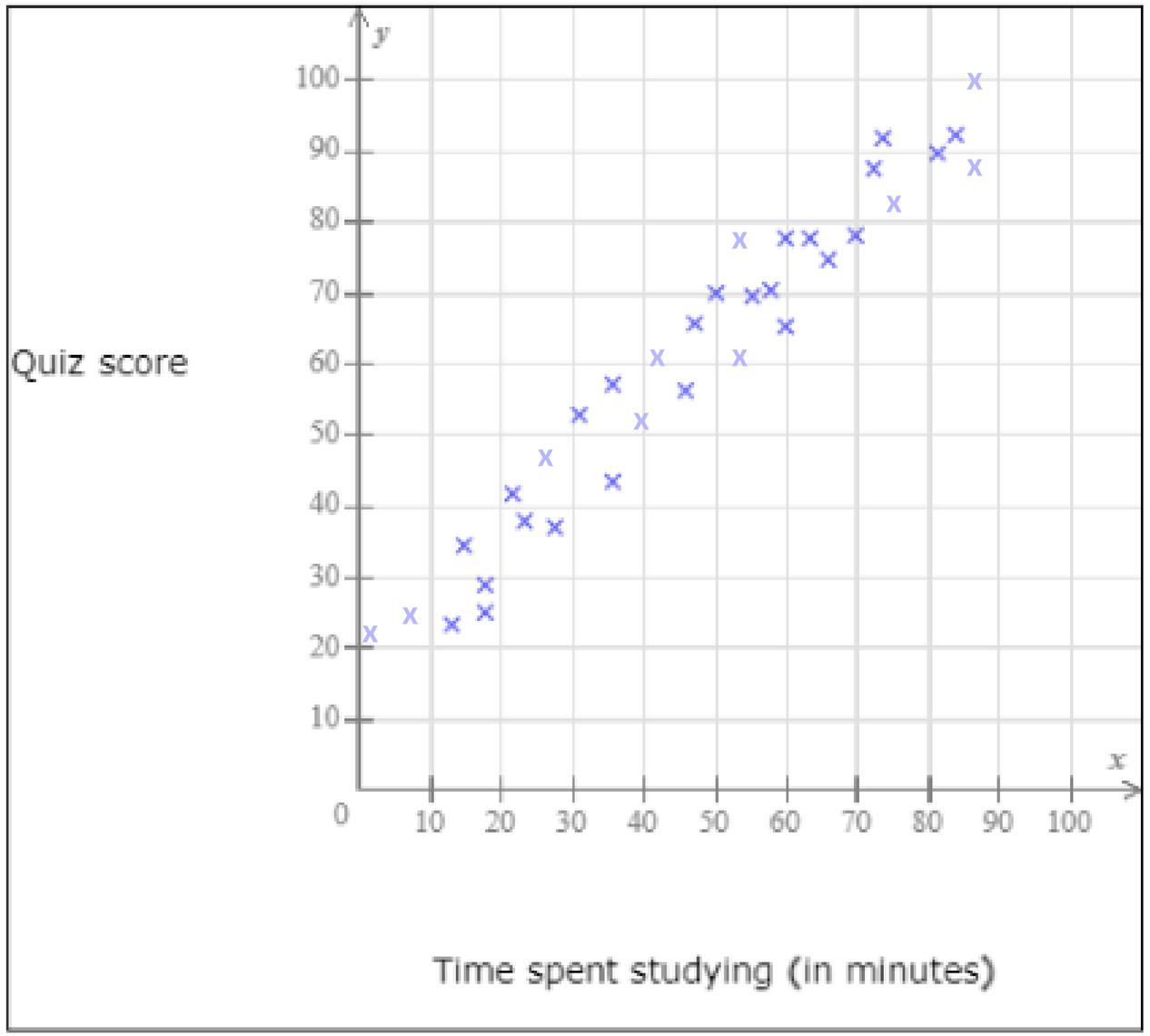
Comparing points scored in a quiz and time studied for said quiz

Picture Source: homework.study.com/explanation/the-scatter-plot-shows-the-time-spent-studying-x-and-the-quiz-score-y-for-each-24-students-a-write-an-approximate-equation-of-the-line-of-best-fit-for-the-data-it-doesn-t-have-to-be-the-exact-line-of-best-fit-b-using-your.html



How much do the average point scores change among students with different study times?

Picture Source: homework.study.com/explanation/the-scatter-plot-shows-the-time-spent-studying-x-and-the-quiz-score-y-for-each-24-students-a-write-an-approximate-equation-of-the-line-of-best-fit-for-the-data-it-doesn-t-have-to-be-the-exact-line-of-best-fit-b-using-your.html



Line of averages is upwardsloping, indicating a clear and apparent positive effect of study time on the point score

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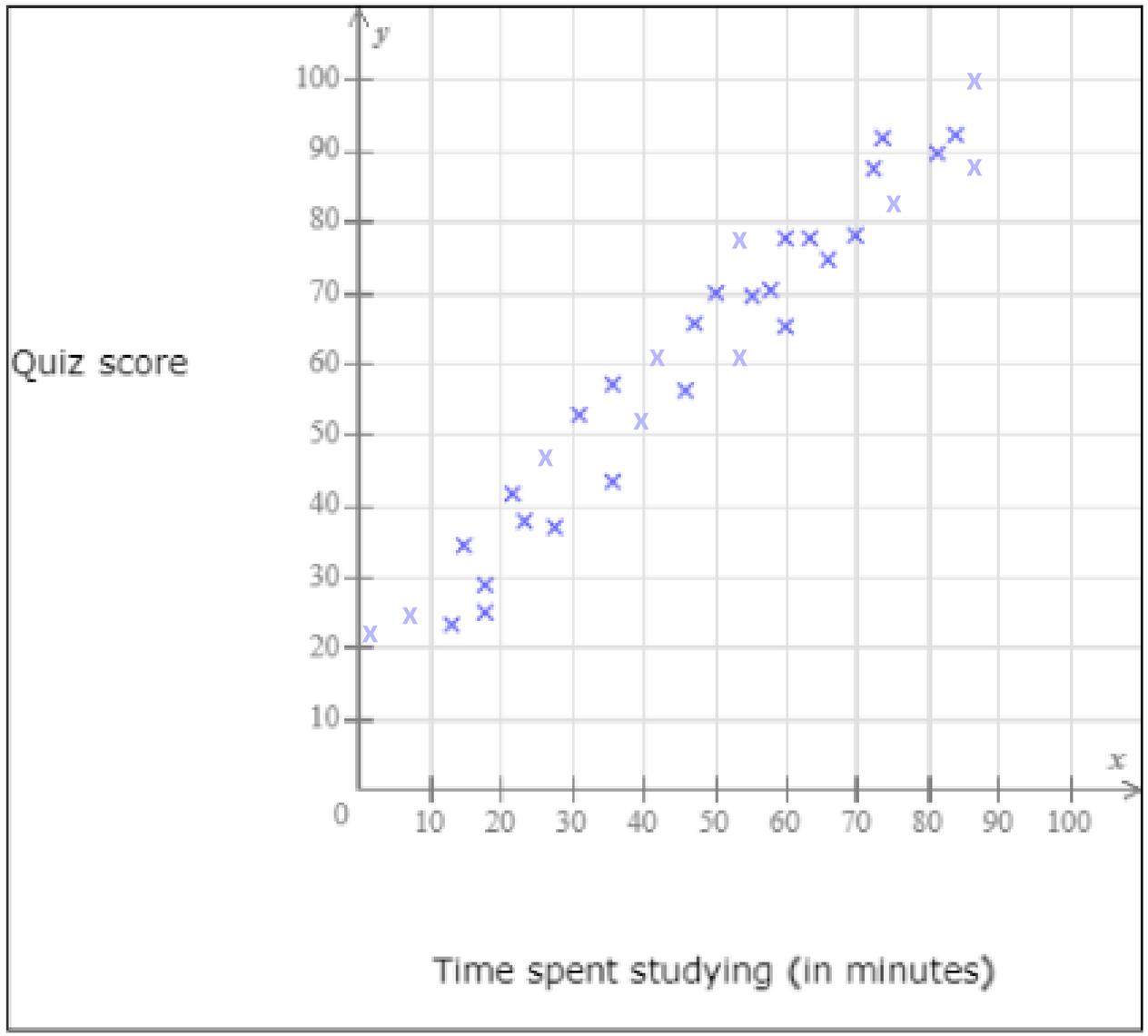

All fun and games, but what do we need that for?

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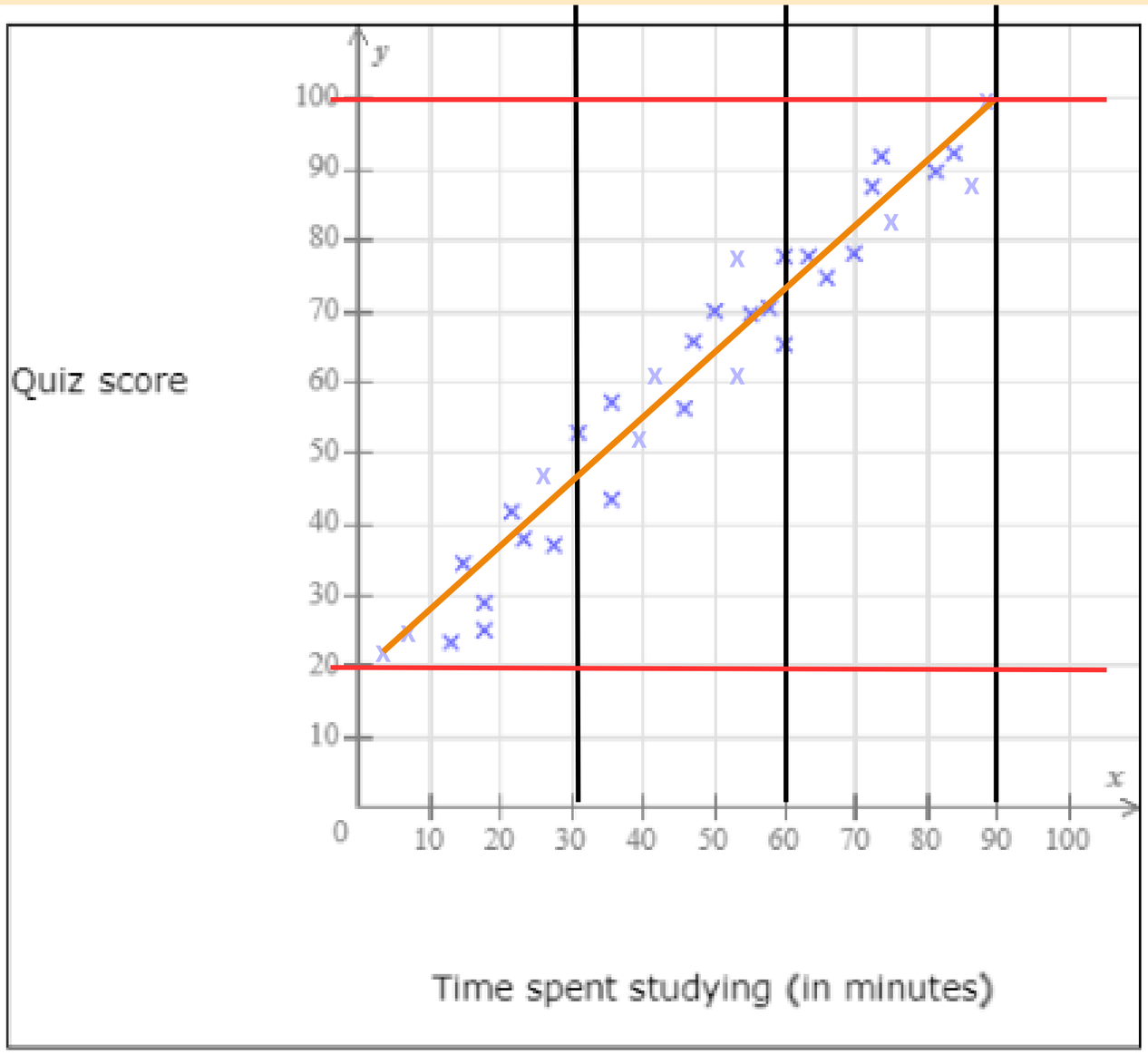


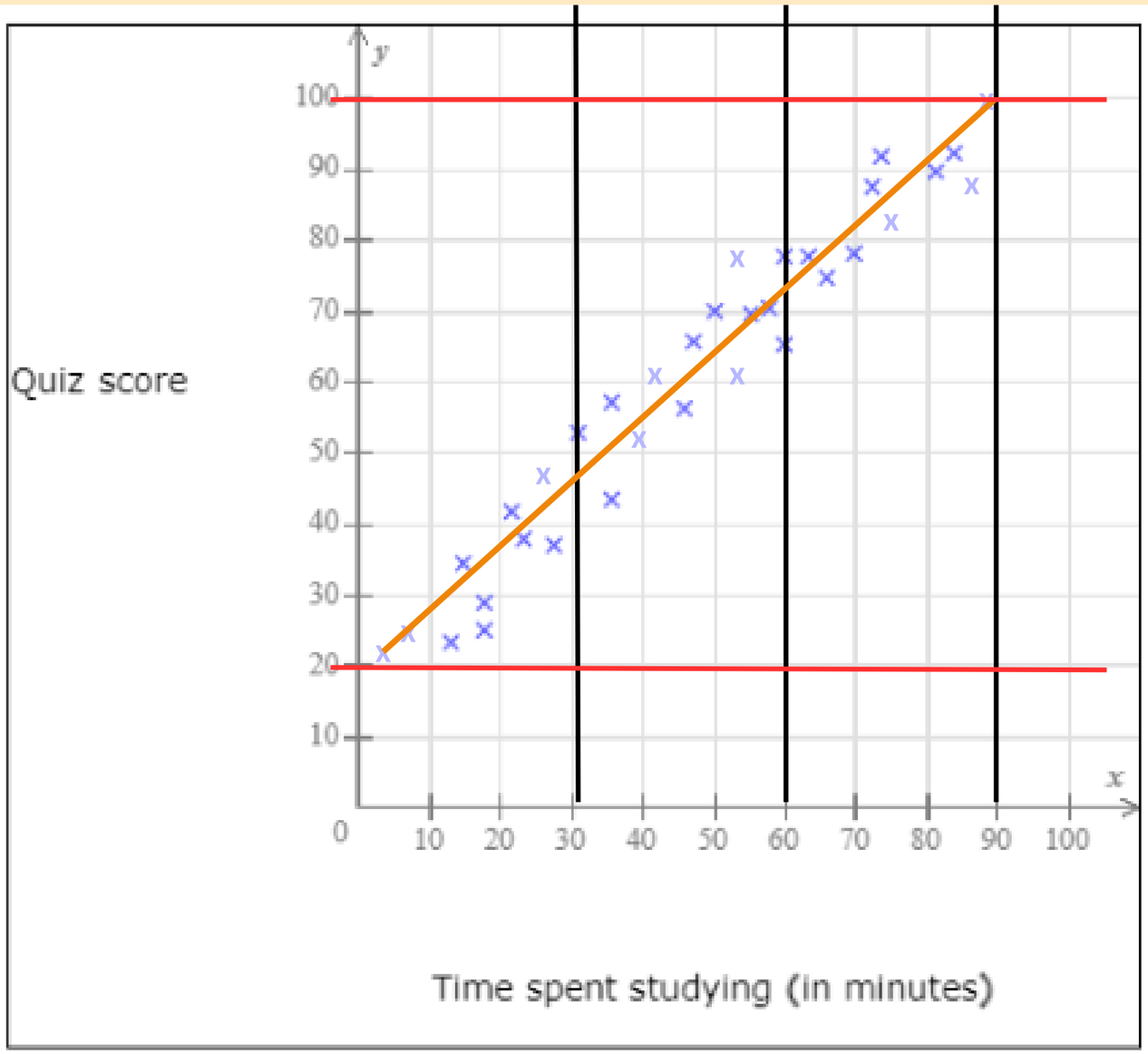
Intercept:

line starts at 20 points

Slope or Regression Coefficient:

80 points / 90 minutes
= 0.89 points per
minutes of studying

Picture Source: homework.study.com/explanation/the-scatter-plot-shows-the-time-spent-studying-x-and-the-quiz-score-y-for-each-24-students-a-write-an-approximate-equation-of-the-line-of-best-fit-for-the-data-it-doesn-t-have-to-be-the-exact-line-of-best-fit-b-using-your.html



Score = 20 + 0.89 * time

Y = ß0 + ß1 * x1

Y = dependent variable
ß0 = intercept
ß1 = slope or regression coefficient
x1 = independent variable

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$$Y = ß0 + ß1x1 + ß2x2 + ß3x3 + ß4x4 + ß5x5 + v1$$

Y = dependent variable

ßo = intercept

ß = regression coefficients

x = independent variables

v= error term

Dummy Variables

Dummies represent categorical data

They take on the values 0 (not present) and 1 (present)

If you want to differentiate between man and women, you assign 1 to women and 0 to men (not women)

Dummy Variables

If you want to differentiate between man and women, you assign 1 to women and 0 to men (not women)

Do not simultainously do a “man” category, where you assign 1 to men and 0 to women (not men)

If you have two dummies that exprss the same concept, you will get faulty results

Warning!

Warning!

We already have left out a couple of important details

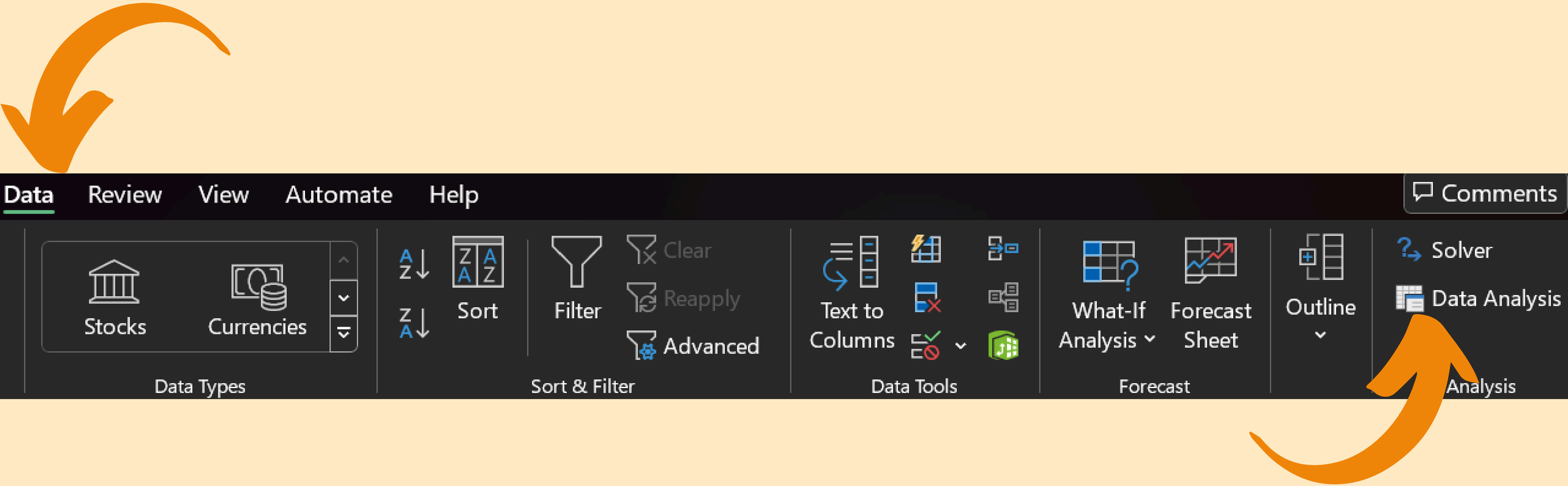
If you want to apply statistical methods in your thesis, read up on the following problems:

Normal distribution, fuzziness, multicollinearity, heteroskedasticity, endogeneity, ect

How to Excel Regression

$$Y = ß0 + ß1x1 + ß2x2 + ß3x3 + ß4x4 + ß5x5 + v1$$

(log) GDP per Capita =
ß0 + ß1 * nominal GDP per Capita growth +
ß2 * Utilized FDI +
ß3 * International Border +
ß4 *Urbanization Rate +
ß5 * Landlocked + v1


Data
Review
View
Automate
Help
Comments
Stocks
Currencies
Data Types
Sort
Filter
Clear
Reapply
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Sort & Filter
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Columns
Data Tools
What-If
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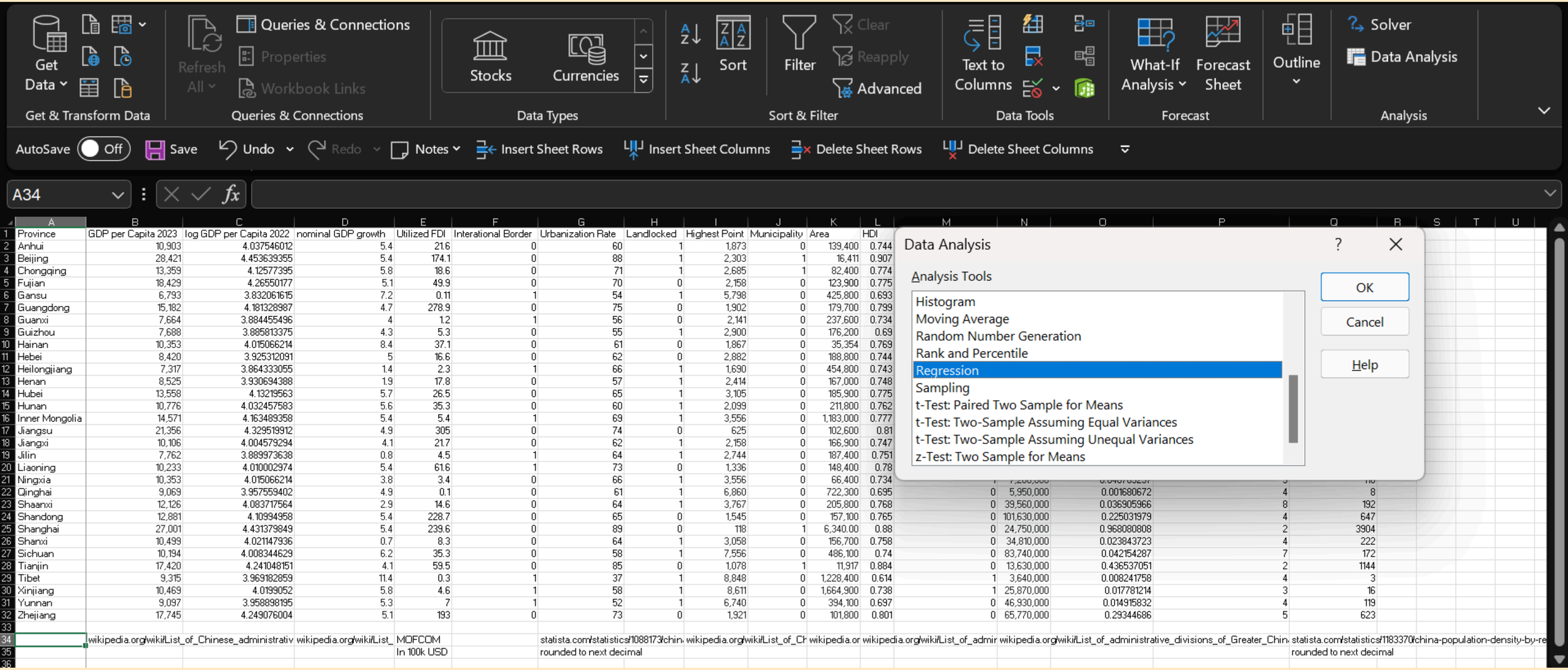
Forecast
Sheet
Forecast
Outline
Solver
Data Analysis
Analysis



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Province	GDP per Capita 2023	log GDP per Capita 2022	nominal GDP growth	Utilized FDI	Interational Border	Urbanization Rate	Landlocked	Highest Point	Municipality	Area	HDI					
2	Anhui	10,903	4.037546012	5.4	21.6	0	60	1	1,873	0	139,400	0.744					
3	Beijing	28,421	4.453639355	5.4	174.1	0	88	1	2,303	1	16,411	0.907					
4	Chongqing	13,359	4.12577395	5.8	18.6	0	71	1	2,685	1	82,400	0.774					
5	Fujian	18,429	4.26550177	5.1	49.9	0	70	0	2,158	0	123,900	0.775					
6	Gansu	6,793	3.832061615	7.2	0.11	1	54	1	5,798	0	425,800	0.693					
7	Guangdong	15,182	4.181328987	4.7	278.9	0	75	0	1,902	0	179,700	0.799					
8	Guanxi	7,664	3.884455496	4	1.2	1	56	0	2,141	0	237,600	0.734					
9	Guizhou	7,688	3.885813375	4.3	5.3	0	55	1	2,900	0	176,200	0.69					
10	Hainan	10,353	4.015066214	8.4	37.1	0	61	0	1,867	0	35,354	0.769					
11	Hebei	8,420	3.925312091	5	16.6	0	62	0	2,882	0	188,800	0.744					
12	Heilongjiang	7,317	3.864333055	1.4	2.3	1	66	1	1,690	0	454,800	0.743					
13	Henan	8,525	3.930694388	1.9	17.8	0	57	1	2,414	0	167,000	0.748					
14	Hubei	13,558	4.13219563	5.7	26.5	0	65	1	3,105	0	185,900	0.775					
15	Hunan	10,776	4.032457583	5.6	35.3	0	60	1	2,099	0	211,800	0.762					
16	Inner Mongolia	14,571	4.163489358	5.4	5.4	1	69	1	3,556	0	1,183,000	0.777					
17	Jiangsu	21,356	4.329519912	4.9	305	0	74	0	625	0	102,600	0.81					
18	Jiangxi	10,106	4.004579294	4.1	21.7	0	62	1	2,158	0	166,900	0.747					
19	Jilin	7,762	3.889973638	0.8	4.5	1	64	1	2,744	0	187,400	0.751					
20	Liaoning	10,233	4.010002974	5.4	61.6	1	73	0	1,336	0	148,400	0.78					
21	Ningxia	10,353	4.015066214	3.8	3.4	0	66	1	3,556	0	66,400	0.734					
22	Qinghai	9,069	3.957559402	4.9	0.1	0	61	1	6,860	0	722,300	0.695	0	5,950,000	0.001680672	4	8
23	Shaanxi	12,126	4.083717564	2.9	14.6	0	64	1	3,767	0	205,800	0.768	0	39,560,000	0.036905966	8	192
24	Shandong	12,881	4.10994958	5.4	228.7	0	65	0	1,545	0	157,100	0.765	0	101,630,000	0.225031979	4	647
25	Shanghai	27,001	4.431379849	5.4	239.6	0	89	0	118	1	6,340.00	0.88	0	24,750,000	0.968080808	2	3904
26	Shanxi	10,499	4.021147936	0.7	8.3	0	64	1	3,058	0	156,700	0.758	0	34,810,000	0.023843723	4	222
27	Sichuan	10,194	4.008344629	6.2	35.3	0	58	1	7,556	0	486,100	0.74	0	83,740,000	0.042154287	7	172
28	Tianjin	17,420	4.241048151	4.1	59.5	0	85	0	1,078	1	11,917	0.884	0	13,630,000	0.436537051	2	1144
29	Tibet	9,315	3.969182859	11.4	0.3	1	37	1	8,848	0	1,228,400	0.614	1	3,640,000	0.008241758	4	3
30	Xinjiang	10,469	4.0199052	5.8	4.6	1	58	1	8,611	0	1,664,900	0.738	1	25,870,000	0.017781214	3	16
31	Yunnan	9,097	3.958898195	5.3	7	1	52	1	6,740	0	394,100	0.697	0	46,930,000	0.014915832	4	119
32	Zhejiang	17,745	4.249076004	5.1	193	0	73	0	1,921	0	101,800	0.801	0	65,770,000	0.29344686	5	623
33																	
34		wikipedia.org/wiki/List_of_Chinese_administrativ		wikipedia.org/wiki/List_	MOFCOM		statista.com/statistics/1088173/chin		wikipedia.org/wiki/List_of_Ch		wikipedia.or		wikipedia.org/wiki/List_of_admir		wikipedia.org/wiki/List_of_administrative_divisions_of_Greater_Chin		statista.com/statistics/1183370/china-population-density-by-re
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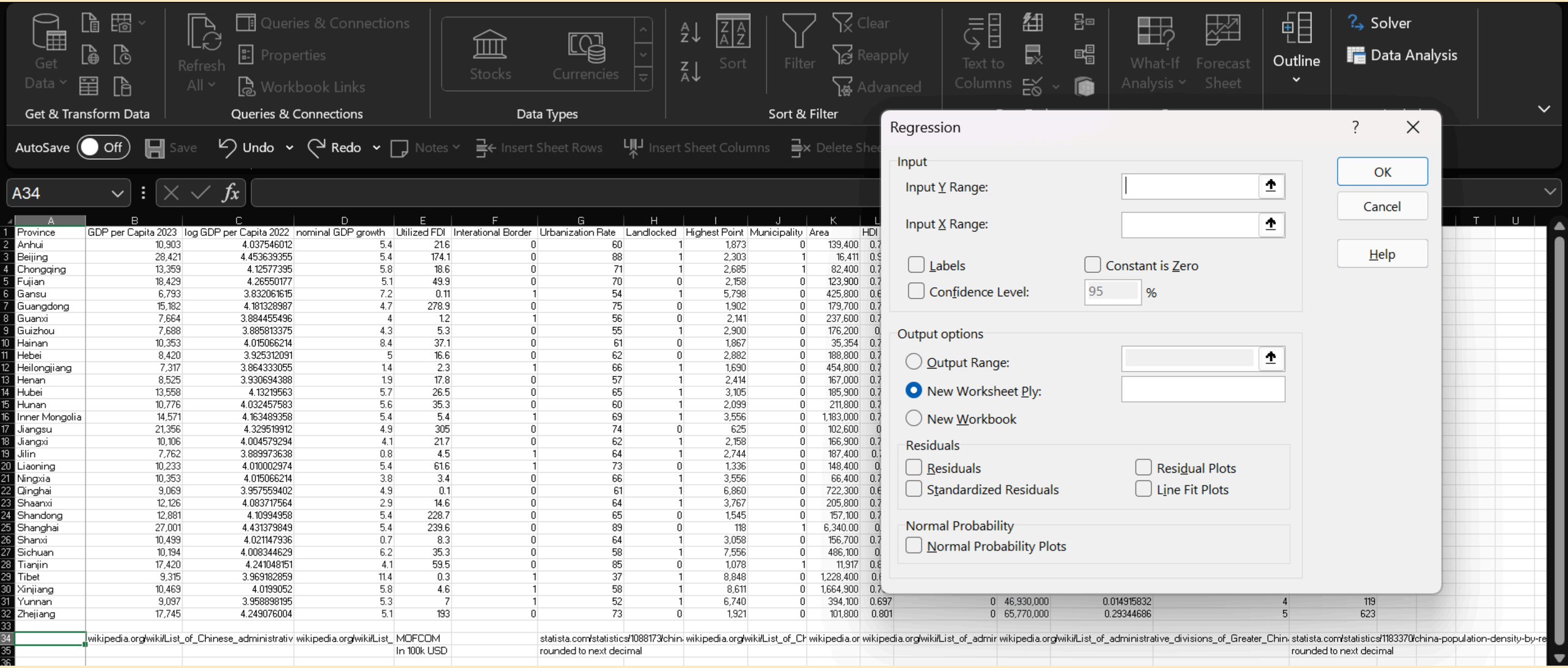

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11	Hebei	8,420	3.925312091	5	16.6	0	62	0	2,882	0	188,800	0.7
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33												
34		wikipedia.org/wiki/List_of_Chinese_administrativ		wikipedia.org/wiki/List_	MOFCOM		statista.com/statistics/1088173/chin		wikipedia.org/wiki/List_of_Ch		wikipedia.or	
35					In 100k USD		rounded to next decimal					

	M	N	O	P	Q
1					
2	0	46,930,000	0.014915832	4	119
3	0	65,770,000	0.29344686	5	623
34	wikipedia.org/wiki/List_of_admir	wikipedia.org/wiki/List_of_administrative_divisions_of_Greater_Chin			statista.com/statistics/1183370/china-population-density-by-re
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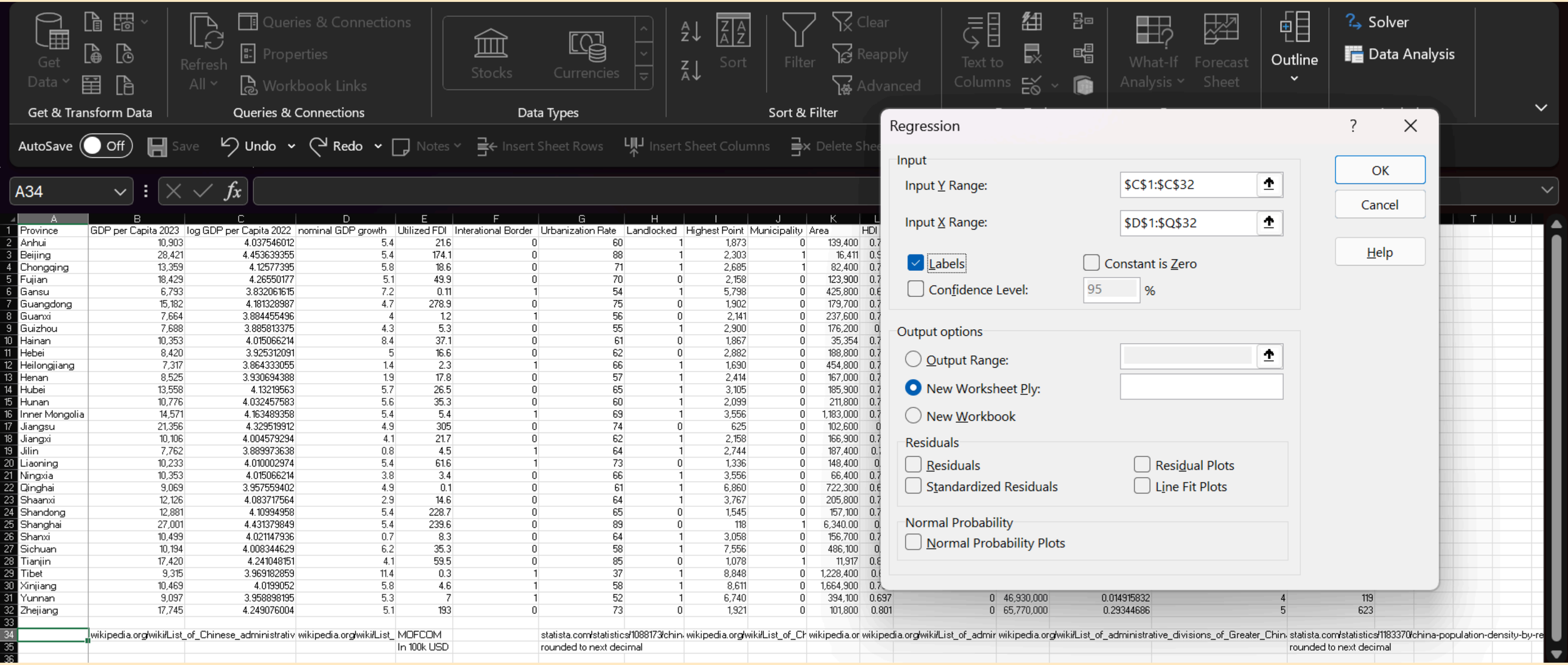

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19	Jilin	7,762	3.889973638	0.8	4.5	1	64	1	2,744	0	187,400	0.7
20	Liaoning	10,233	4.010002974	5.4	61.6	1	73	0	1,336	0	148,400	0.
21	Ningxia	10,353	4.015066214	3.8	3.4	0	66	1	3,556	0	66,400	0.7
22	Qinghai	9,069	3.957559402	4.9	0.1	0	61	1	6,860	0	722,300	0.6
23	Shaanxi	12,126	4.083717564	2.9	14.6	0	64	1	3,767	0	205,800	0.7
24	Shandong	12,881	4.10994958	5.4	228.7	0	65	0	1,545	0	157,100	0.7
25	Shanghai	27,001	4.431379849	5.4	239.6	0	89	0	118	1	6,340.00	0.
26	Shanxi	10,499	4.021147936	0.7	8.3	0	64	1	3,058	0	156,700	0.7
27	Sichuan	10,194	4.008344629	6.2	35.3	0	58	1	7,556	0	486,100	0.
28	Tianjin	17,420	4.241048151	4.1	59.5	0	85	0	1,078	1	11,917	0.8
29	Tibet	9,315	3.969182859	11.4	0.3	1	37	1	8,848	0	1,228,400	0.6
30	Xinjiang	10,469	4.0199052	5.8	4.6	1	58	1	8,611	0	1,664,900	0.7
31	Yunnan	9,097	3.958898195	5.3	7	1	52	1	6,740	0	394,100	0.697
32	Zhejiang	17,745	4.249076004	5.1	193	0	73	0	1,921	0	101,800	0.801
33												
34		wikipedia.org/wiki/List_of_Chinese_administrativ		wikipedia.org/wiki/List_	MOFCOM		statista.com/statistics/1088173/chin		wikipedia.org/wiki/List_of_Ch		wikipedia.or	
35					In 100k USD		rounded to next decimal					
36												

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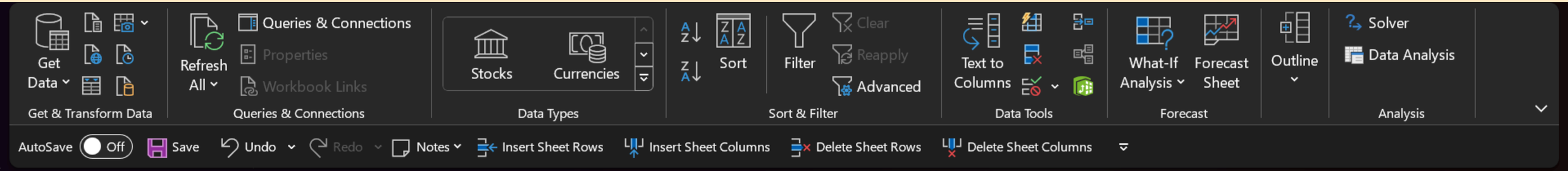
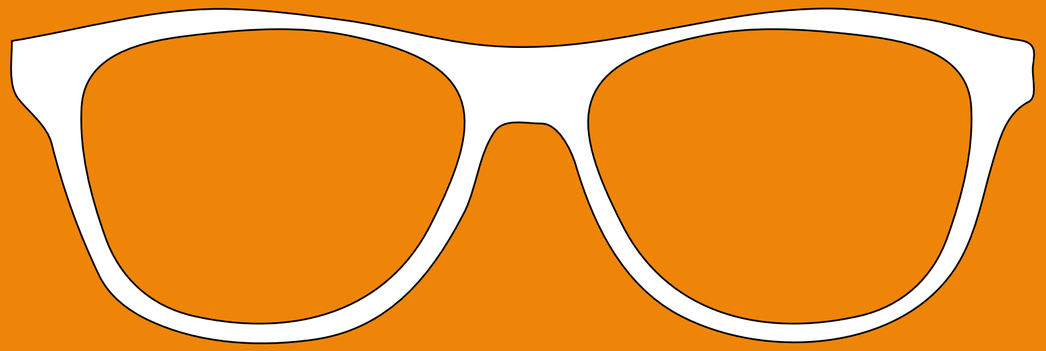
31	0	46,930,000	0.014915832	4	119				
32	0	65,770,000	0.29344686	5	623				
33									
34	wikipedia.org/wiki/List_of_admir	wikipedia.org/wiki/List_of_administrative_divisions_of_Greater_Chin			statista.com/statistics/1183370/china-population-density-by-re				
35					rounded to next decimal				
36									



U34

	A	B	C	D	E	F	G	H	I
1	SUMMARY OUTPUT								
2									
3	*Regression Statistics*								
4	Multiple R	0.9475267							
5	R Square	0.89780685							
6	Adjusted R Square	0.80838785							
7	Standard Error	0.07031837							
8	Observations	31							
9									
10	ANOVA								
11		*df*	*SS*	*MS*	*F*	*Significance F*			
12	Regression	14	0.695054248	0.04964673	10.0404479	2.0212E-05			
13	Residual	16	0.079114769	0.00494467					
14	Total	30	0.774169017						
15									
16		*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
17	Intercept	2.03802221	0.69894737	2.91584502	0.01010309	0.55631997	3.51972444	0.55631997	3.51972444
18	nominal GDP growth	0.01927687	0.011328295	1.70165694	0.10816741	-0.00473804	0.04329178	-0.00473804	0.04329178
19	Utilized FDI	0.00118893	0.000475905	2.49824545	0.02375793	0.00018005	0.0021978	0.00018005	0.0021978
20	Interational Border	-0.06987477	0.039006582	-1.79135858	0.09216886	-0.15256503	0.01281548	-0.15256503	0.01281548
21	Urbanization Rate	-0.00080828	0.005705294	-0.14167223	0.88910741	-0.01290297	0.0112864	-0.01290297	0.0112864
22	Landlocked	0.03494292	0.045657398	0.76532869	0.45521769	-0.06184644	0.13173228	-0.06184644	0.13173228
23	Highest Point	8.1071E-06	1.26754E-05	0.63959261	0.53148932	-1.8764E-05	3.4978E-05	-1.8764E-05	3.4978E-05
24	Municipality	-0.02801687	0.078288002	-0.35786932	0.72511846	-0.19398002	0.13794628	-0.19398002	0.13794628
25	Area	4.3711E-09	7.60128E-08	0.05750428	0.95485553	-1.5677E-07	1.6551E-07	-1.5677E-07	1.6551E-07
26	HDI	2.5930242	1.279471994	2.02663615	0.05970242	-0.11933526	5.30538366	-0.11933526	5.30538366
27	Autonomous Province	0.03696043	0.050183096	0.73651164	0.47208107	-0.06942298	0.14334385	-0.06942298	0.14334385
28	Population	-1.9516E-09	1.17577E-09	-1.65980419	0.11642278	-4.4441E-09	5.4097E-10	-4.4441E-09	5.4097E-10
29	Utilized FDI per Capita	-0.34498442	0.355144711	-0.97139113	0.34581061	-1.09785758	0.40788873	-1.09785758	0.40788873
30	Number of Provinces Bodered	0.00517604	0.011371519	0.45517567	0.65509857	-0.0189305	0.02928258	-0.0189305	0.02928258
31	Population Density	5.12E-05	5.99592E-05	0.85391097	0.40575794	-7.5908E-05	0.00017831	-7.5908E-05	0.00017831

How to Read Regression Results



Regression Output Table

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.915874304
R Square	0.83882574
Adjusted R Square	0.789772705
Standard Error	0.073654929
Observations	31

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	7	0.649392899	0.092770414	17.10038392	9.82675E-08
Residual	23	0.124776118	0.005425049		
Total	30	0.774169017			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	3.14779984	0.208812264	15.07478432	2.06127E-13	2.715838761	3.579760918	2.715838761	3.579760918
nominal GDP growth	0.022883617	0.009015909	2.538137556	0.018376518	0.004232788	0.041534445	0.004232788	0.041534445
Utilized FDI	0.000572133	0.000227463	2.515276682	0.01933087	0.000101589	0.001042677	0.000101589	0.001042677
Interational Border	-0.048146856	0.033179093	-1.451120326	0.160249916	-0.11678304	0.020489327	-0.11678304	0.020489327
Urbanization Rate	0.01126653	0.002832581	3.977478603	0.000594891	0.00540689	0.01712617	0.00540689	0.01712617
Landlocked	0.045988881	0.041440363	1.109760564	0.278570866	-0.039737042	0.131714803	-0.039737042	0.131714803
Highest Point	7.11612E-06	9.76394E-06	0.728816235	0.473470569	-1.30821E-05	2.73144E-05	-1.30821E-05	2.73144E-05
Municipality	0.004459406	0.063858304	0.069832824	0.944930342	-0.127641561	0.136560372	-0.127641561	0.136560372

Regression Output Table

SUMMARY OUTPUT

R Square	0.83882574
Adjusted R Square	0.789772705
Observations	31

Significance F
9.82675E-08

	Coefficients	*P-value*
Intercept	3.14779984	2.06127E-13
nominal GDP growth	0.022883617	0.018376518
Utilized FDI	0.000572133	0.01933087
Interational Border	-0.048146856	0.160249916
Urbanization Rate	0.01126653	0.000594891
Landlocked	0.045988881	0.278570866
Highest Point	7.11612E-06	0.473470569
Municipality	0.004459406	0.944930342

Regression Output Table

SUMMARY OUTPUT

R Square	0.83882574
Adjusted R Square	0.789772705
Observations	31

Significance F
9.82675E-08

	Coefficients	*P-value*
Intercept	3.14779984	2.06127E-13
nominal GDP growth	0.022883617	0.018376518
Utilized FDI	0.000572133	0.01933087
Interational Border	-0.048146856	0.160249916
Urbanization Rate	0.01126653	0.000594891
Landlocked	0.045988881	0.278570866
Highest Point	7.11612E-06	0.473470569
Municipality	0.004459406	0.944930342

R Squared

How much of the variation in the dependent variable is explained by the independent variables

In our example, R Squared is 0.83882574

83.88 percent of the variation in the (log) GDP per capita of Chinese provinces is explained by the nominal GDP growth, Utilized FDI, ect.

R Squared

Which of the following R Square values is the most desirable?

A) 0.18326755
B) 0.34278910
C) 0.73356691

What does an R Square value of 0.93771268 tell us?

What would you recon is the lowest acceptable R Squared?

Regression Output Table

SUMMARY OUTPUT

R Square	0.83882574
Adjusted R Square	0.789772705
Observations	31

Significance F
9.82675E-08

	Coefficients	*P-value*
Intercept	3.14779984	2.06127E-13
nominal GDP growth	0.022883617	0.018376518
Utilized FDI	0.000572133	0.01933087
Interational Border	-0.048146856	0.160249916
Urbanization Rate	0.01126653	0.000594891
Landlocked	0.045988881	0.278570866
Highest Point	7.11612E-06	0.473470569
Municipality	0.004459406	0.944930342

Adjusted R Squared

There is a problem with the R Squared indicator: it rises with every independent variable you add. Therefore, there is a possibility to artificially increase R Squared with irrelevant independent variables

The Adjusted R Squared indicator accounts for this by including the number of independent variables.The acual variability in the dependent variableis therefore close to this value

In our example, Adjusted R Squared is 0.789772705

Adjusted R Squared

Why do you need to report the Adjusted R Squared value alongside the R Squared value?

Is the Adjusted R Squared usually higher or lower than the R Squared? Or is either always the case?

Regression Output Table

SUMMARY OUTPUT

R Square	0.83882574
Adjusted R Square	0.789772705
Observations	31

Significance F
9.82675E-08

	Coefficients	*P-value*
Intercept	3.14779984	2.06127E-13
nominal GDP growth	0.022883617	0.018376518
Utilized FDI	0.000572133	0.01933087
Interational Border	-0.048146856	0.160249916
Urbanization Rate	0.01126653	0.000594891
Landlocked	0.045988881	0.278570866
Highest Point	7.11612E-06	0.473470569
Municipality	0.004459406	0.944930342

Observations

Simple regression analysis requires at least 30 observations

This ensures adequate statistical power to detect meaningful relationships between the dependent and independent variables

Estimates become more robust a more observations one includes

Findings can be generalized more easily if the sample size is bigger

Regression Output Table

SUMMARY OUTPUT

R Square	0.83882574
Adjusted R Square	0.789772705
Observations	31

Significance F
9.82675E-08

	Coefficients	*P-value*
Intercept	3.14779984	2.06127E-13
nominal GDP growth	0.022883617	0.018376518
Utilized FDI	0.000572133	0.01933087
Interational Border	-0.048146856	0.160249916
Urbanization Rate	0.01126653	0.000594891
Landlocked	0.045988881	0.278570866
Highest Point	7.11612E-06	0.473470569
Municipality	0.004459406	0.944930342

Significance F

Tells you whether the regression model is useful in explaining the variability in the dependent variable

If Significance F is smaller than 0.05, the overall model is statistically significant (the chance that the model actually does not predict any variance is smaller than 5 percent)

If Significance F is bigger than 0.05, the model is statistically insignificant and there is no need to proceed with the interpretation of the model

Significance F

We usually differentiate between the 5 percent level (0.05 and below), the 1 percent level (0.01 and below), and the 0.1 percent level (0.001 and below)

This can help you to interpet the statistical significance of the model of any study. Significance levels are often denoted by asterisks:
(*) for the 5, (**) for the 1, and (***) for the 0.1 percent level

In our case, Significance F is at 9.82675E-08 (0.000000098267 5)

Significance F

Does a Significance F value of 9.82675 indicate statistical significance?

At what level of significance are the Significance F values below?

A) 0.0324450
B) 0.5673309
C) 7.9931E-05

What does a Significance F value of 0.02134 tell you?

Regression Output Table

SUMMARY OUTPUT

R Square	0.83882574
Adjusted R Square	0.789772705
Observations	31

Significance F
9.82675E-08

	Coefficients	*P-value*
Intercept	3.14779984	2.06127E-13
nominal GDP growth	0.022883617	0.018376518
Utilized FDI	0.000572133	0.01933087
Interational Border	-0.048146856	0.160249916
Urbanization Rate	0.01126653	0.000594891
Landlocked	0.045988881	0.278570866
Highest Point	7.11612E-06	0.473470569
Municipality	0.004459406	0.944930342

P-value

Similar to Significance F, which tells us if the whole model is significant, the P-value enables us to assess the significance of the independent variables

The same levels apply here as well

If the P-value is above the 5 percent significance level, it does not have to be interpreted and can be disregarded

P-value

Which of the variables in our case are significant? At what level of significance are they?

	P-value
Intercept	2.06127E-13
nominal GDP growth	0.018376518
Utilized FDI	0.01933087
Interational Border	0.160249916
Urbanization Rate	0.000594891
Landlocked	0.278570866
Highest Point	0.473470569
Municipality	0.944930342

Regression Output Table

SUMMARY OUTPUT

R Square	0.83882574
Adjusted R Square	0.789772705
Observations	31

Significance F
9.82675E-08

	Coefficients	*P-value*
Intercept	3.14779984	2.06127E-13
nominal GDP growth	0.022883617	0.018376518
Utilized FDI	0.000572133	0.01933087
Interational Border	-0.048146856	0.160249916
Urbanization Rate	0.01126653	0.000594891
Landlocked	0.045988881	0.278570866
Highest Point	7.11612E-06	0.473470569
Municipality	0.004459406	0.944930342

Coefficients (Slope)

Coefficients represent the average expected change in the dependent variable following a one-unit change in the independent variable, all else being equal

In our table, we find that the independent variable ‘Urbanization Rate’ has a coefficient of ~ 0.0113

Thus, if the urbanization rate of a province rises by one unit while all other variables stay unchanges, we can expect the (log) GDP per Capita to rise 0.0113 points

Coefficients (Slope)

If an independent variable is a dummy variable, coefficients represent the difference in the average response between the reference category (coded 0) and the category represented by the dummy variable (coded 1)

In our example, we see that the independent variable ‘International Border’ has a coefficient of ~ -0.0481. Provinces with international borders are coded as 1, while those without are coded as 0

Coefficients (Slope)

Thus, if a province has an international border, its (log) GDP per Capita is, on average and all else being equal, 0.0481 points smaller than the average (log) GDP per Capita of provinces without international borders

Lastly, we also receive our intercept, which tells us how high the average (log) GDP per Capita of a Chinese province is without the influence of any of the independent variables

Coefficients (Slope)

Choose one of the coefficients and interpret its value. You can ignore the P-value for this exercises

Municipality and landlocked are dummy variables

	Coefficients
Intercept	3.14779984
nominal GDP growth	0.022883617
Utilized FDI	0.000572133
Interational Border	-0.048146856
Urbanization Rate	0.01126653
Landlocked	0.045988881
Highest Point	7.11612E-06
Municipality	0.004459406

Coefficients (Slope)

We can see that the independent variable **A** has a coefficient of **B** points. Thus, if **A** risies by one unit, all else being equal, the average (log) GDP per Capita rises **B** points.

	Coefficients
Intercept	3.14779984
nominal GDP growth	0.022883617
Utilized FDI	0.000572133
Interational Border	-0.048146856
Urbanization Rate	0.01126653
Landlocked	0.045988881
Highest Point	7.11612E-06
Municipality	0.004459406

Regression Output Table

Regression Statistics	
Multiple R	0.915874304
R Square	0.83882574
Adjusted R Square	0.789772705
Standard Error	0.073654929
Observations	31

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	7	0.649392899	0.092770414	17.10038392	9.82675E-08
Residual	23	0.124776118	0.005425049		
Total	30	0.774169017			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	3.14779984	0.208812264	15.07478432	2.06127E-13	2.715838761	3.579760918	2.715838761	3.579760918
nominal GDP growth	0.022883617	0.009015909	2.538137556	0.018376518	0.004232788	0.041534445	0.004232788	0.041534445
Utilized FDI	0.000572133	0.000227463	2.515276682	0.01933087	0.000101589	0.001042677	0.000101589	0.001042677
Interational Border	-0.048146856	0.033179093	-1.451120326	0.160249916	-0.11678304	0.020489327	-0.11678304	0.020489327
Urbanization Rate	0.01126653	0.002832581	3.977478603	0.000594891	0.00540689	0.01712617	0.00540689	0.01712617
Landlocked	0.045988881	0.041440363	1.109760564	0.278570866	-0.039737042	0.131714803	-0.039737042	0.131714803
Highest Point	7.11612E-06	9.76394E-06	0.728816235	0.473470569	-1.30821E-05	2.73144E-05	-1.30821E-05	2.73144E-05
Municipality	0.004459406	0.063858304	0.069832824	0.944930342	-0.127641561	0.136560372	-0.127641561	0.136560372

Regression Output Table

Regression Statistics	
Multiple R	0.895798084
R Square	0.802454207
Adjusted R Square	0.753067759
Standard Error	0.07982633
Observations	31

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	6	0.621235185	0.103539197	16.24846971	2.14941E-07
Residual	24	0.152933832	0.006372243		
Total	30	0.774169017			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	3.45640024	0.139758914	24.73116122	1.37751E-18	3.167952018	3.744848462	3.167952018	3.744848462
Urbanization Rate	0.006471698	0.002202293	2.9386184	0.007176735	0.001926389	0.011017007	0.001926389	0.011017007
Autonomous Province	0.071334297	0.043985215	1.621778963	0.117915859	-0.019446726	0.162115319	-0.019446726	0.162115319
Population	5.37657E-10	5.56611E-10	0.965946014	0.343704626	-6.11133E-10	1.68645E-09	-6.11133E-10	1.68645E-09
Utilized FDI per Capita	0.628706216	0.174814304	3.596423184	0.001450451	0.267907225	0.989505207	0.267907225	0.989505207
Number of Provinces Bodered	0.021151396	0.010043801	2.105915376	0.045857505	0.000422009	0.041880783	0.000422009	0.041880783
Population Density	-6.64632E-05	4.5181E-05	-1.471043006	0.154270478	-0.000159712	2.67858E-05	-0.000159712	2.67858E-05

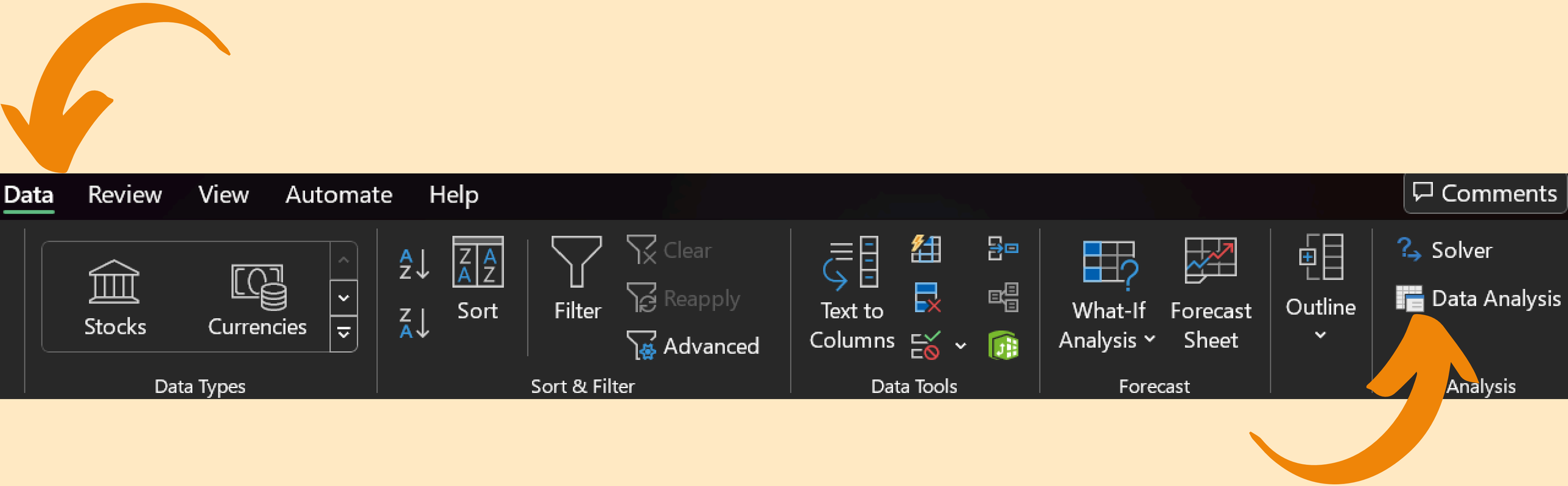
Your Turn

Your Turn

Download the Excel data sheet I uploaded in our WueCampus room

Try to experiment with different dependent and independent variables and try to understan the output tables

Take note of some things you found interesting, we will discuss your results in the end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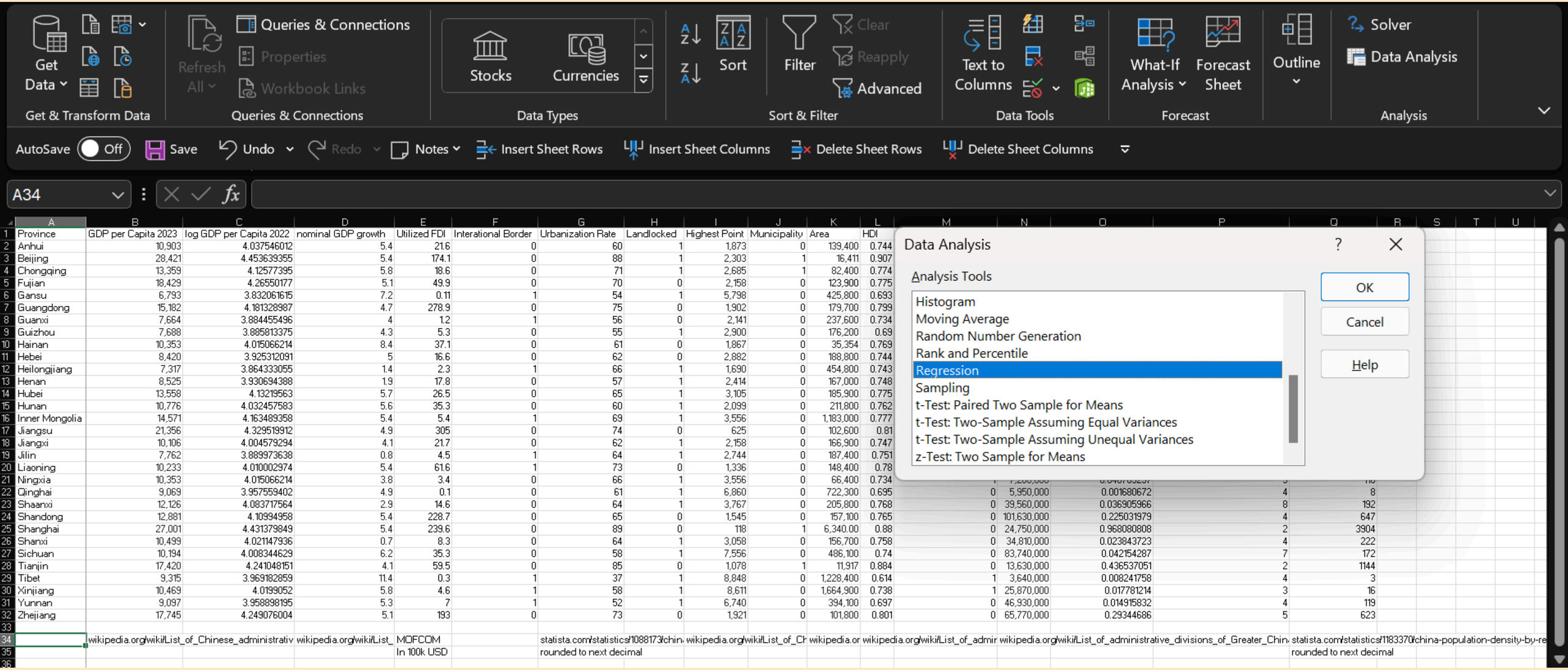
Solver
Data Analysis
Analysis



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Province	GDP per Capita 2023	log GDP per Capita 2022	nominal GDP growth	Utilized FDI	Interational Border	Urbanization Rate	Landlocked	Highest Point	Municipality	Area	HDI					
2	Anhui	10,903	4.037546012	5.4	21.6	0	60	1	1,873	0	139,400	0.744					
3	Beijing	28,421	4.453639355	5.4	174.1	0	88	1	2,303	1	16,411	0.907					
4	Chongqing	13,359	4.12577395	5.8	18.6	0	71	1	2,685	1	82,400	0.774					
5	Fujian	18,429	4.26550177	5.1	49.9	0	70	0	2,158	0	123,900	0.775					
6	Gansu	6,793	3.832061615	7.2	0.11	1	54	1	5,798	0	425,800	0.693					
7	Guangdong	15,182	4.181328987	4.7	278.9	0	75	0	1,902	0	179,700	0.799					
8	Guanxi	7,664	3.884455496	4	1.2	1	56	0	2,141	0	237,600	0.734					
9	Guizhou	7,688	3.885813375	4.3	5.3	0	55	1	2,900	0	176,200	0.69					
10	Hainan	10,353	4.015066214	8.4	37.1	0	61	0	1,867	0	35,354	0.769					
11	Hebei	8,420	3.925312091	5	16.6	0	62	0	2,882	0	188,800	0.744					
12	Heilongjiang	7,317	3.864333055	1.4	2.3	1	66	1	1,690	0	454,800	0.743					
13	Henan	8,525	3.930694388	1.9	17.8	0	57	1	2,414	0	167,000	0.748					
14	Hubei	13,558	4.13219563	5.7	26.5	0	65	1	3,105	0	185,900	0.775					
15	Hunan	10,776	4.032457583	5.6	35.3	0	60	1	2,099	0	211,800	0.762					
16	Inner Mongolia	14,571	4.163489358	5.4	5.4	1	69	1	3,556	0	1,183,000	0.777					
17	Jiangsu	21,356	4.329519912	4.9	305	0	74	0	625	0	102,600	0.81					
18	Jiangxi	10,106	4.004579294	4.1	21.7	0	62	1	2,158	0	166,900	0.747					
19	Jilin	7,762	3.889973638	0.8	4.5	1	64	1	2,744	0	187,400	0.751					
20	Liaoning	10,233	4.010002974	5.4	61.6	1	73	0	1,336	0	148,400	0.78					
21	Ningxia	10,353	4.015066214	3.8	3.4	0	66	1	3,556	0	66,400	0.734					
22	Qinghai	9,069	3.957559402	4.9	0.1	0	61	1	6,860	0	722,300	0.695	0	5,950,000	0.001680672	4	8
23	Shaanxi	12,126	4.083717564	2.9	14.6	0	64	1	3,767	0	205,800	0.768	0	39,560,000	0.036905966	8	192
24	Shandong	12,881	4.10994958	5.4	228.7	0	65	0	1,545	0	157,100	0.765	0	101,630,000	0.225031979	4	647
25	Shanghai	27,001	4.431379849	5.4	239.6	0	89	0	118	1	6,340.00	0.88	0	24,750,000	0.968080808	2	3904
26	Shanxi	10,499	4.021147936	0.7	8.3	0	64	1	3,058	0	156,700	0.758	0	34,810,000	0.023843723	4	222
27	Sichuan	10,194	4.008344629	6.2	35.3	0	58	1	7,556	0	486,100	0.74	0	83,740,000	0.042154287	7	172
28	Tianjin	17,420	4.241048151	4.1	59.5	0	85	0	1,078	1	11,917	0.884	0	13,630,000	0.436537051	2	1144
29	Tibet	9,315	3.969182859	11.4	0.3	1	37	1	8,848	0	1,228,400	0.614	1	3,640,000	0.008241758	4	3
30	Xinjiang	10,469	4.0199052	5.8	4.6	1	58	1	8,611	0	1,664,900	0.738	1	25,870,000	0.017781214	3	16
31	Yunnan	9,097	3.958898195	5.3	7	1	52	1	6,740	0	394,100	0.697	0	46,930,000	0.014915832	4	119
32	Zhejiang	17,745	4.249076004	5.1	193	0	73	0	1,921	0	101,800	0.801	0	65,770,000	0.29344686	5	623
33																	
34		wikipedia.org/wiki/List_of_Chinese_administrativ		wikipedia.org/wiki/List_	MOFCOM		statista.com/statistics/1088173/chin		wikipedia.org/wiki/List_of_Ch		wikipedia.or		wikipedia.org/wiki/List_of_admir		wikipedia.org/wiki/List_of_administrative_divisions_of_Greater_Chin		statista.com/statistics/1183370/china-population-density-by-re
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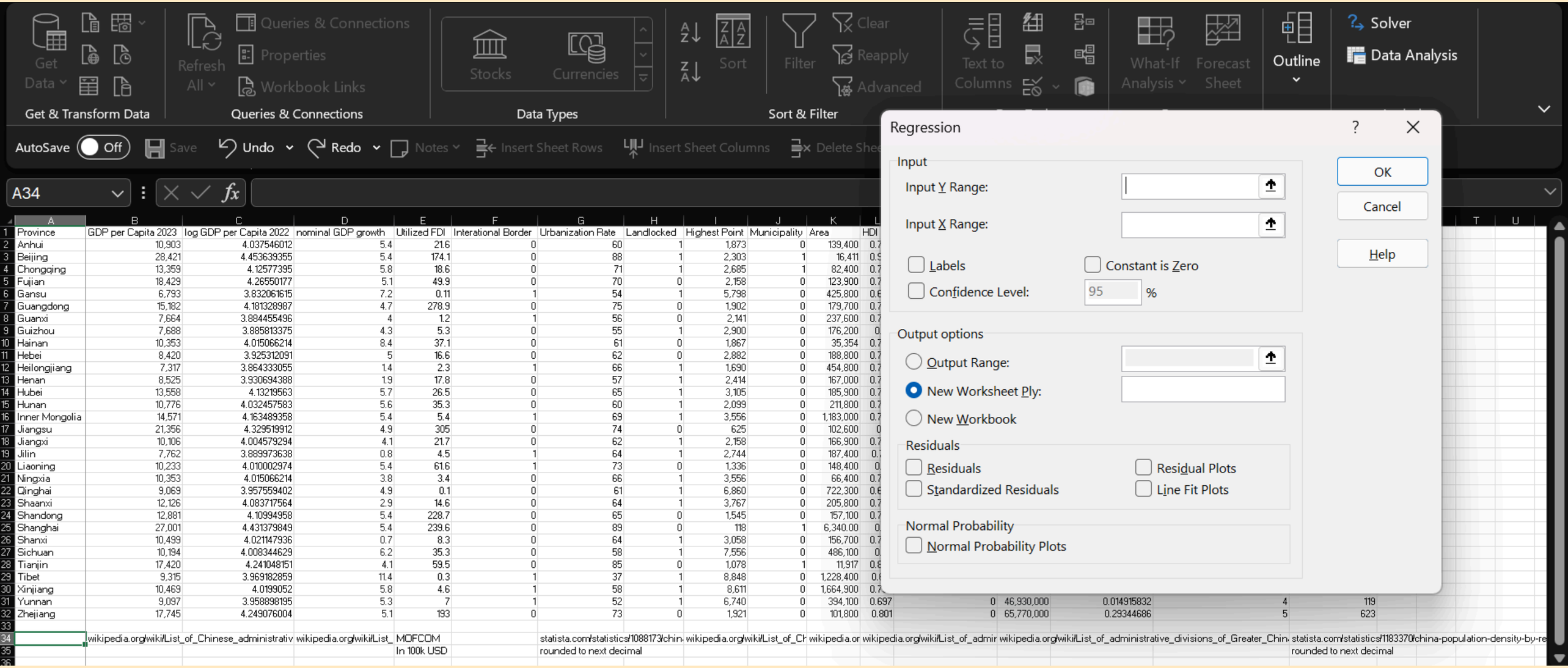

	A	B	C	D	E	F	G	H	I	J	K	L
1	Province	GDP per Capita 2023	log GDP per Capita 2022	nominal GDP growth	Utilized FDI	Interational Border	Urbanization Rate	Landlocked	Highest Point	Municipality	Area	HDI
2	Anhui	10,903	4.037546012	5.4	21.6	0	60	1	1,873	0	139,400	0.7
3	Beijing	28,421	4.453639355	5.4	174.1	0	88	1	2,303	1	16,411	0.9
4	Chongqing	13,359	4.12577395	5.8	18.6	0	71	1	2,685	1	82,400	0.7
5	Fujian	18,429	4.26550177	5.1	49.9	0	70	0	2,158	0	123,900	0.7
6	Gansu	6,793	3.832061615	7.2	0.11	1	54	1	5,798	0	425,800	0.6
7	Guangdong	15,182	4.181328987	4.7	278.9	0	75	0	1,902	0	179,700	0.7
8	Guanxi	7,664	3.884455496	4	1.2	1	56	0	2,141	0	237,600	0.7
9	Guizhou	7,688	3.885813375	4.3	5.3	0	55	1	2,900	0	176,200	0.
10	Hainan	10,353	4.015066214	8.4	37.1	0	61	0	1,867	0	35,354	0.7
11	Hebei	8,420	3.925312091	5	16.6	0	62	0	2,882	0	188,800	0.7
12	Heilongjiang	7,317	3.864333055	1.4	2.3	1	66	1	1,690	0	454,800	0.7
13	Henan	8,525	3.930694388	1.9	17.8	0	57	1	2,414	0	167,000	0.7
14	Hubei	13,558	4.13219563	5.7	26.5	0	65	1	3,105	0	185,900	0.7
15	Hunan	10,776	4.032457583	5.6	35.3	0	60	1	2,099	0	211,800	0.7
16	Inner Mongolia	14,571	4.163489358	5.4	5.4	1	69	1	3,556	0	1,183,000	0.7
17	Jiangsu	21,356	4.329519912	4.9	305	0	74	0	625	0	102,600	0
18	Jiangxi	10,106	4.004579294	4.1	21.7	0	62	1	2,158	0	166,900	0.7
19	Jilin	7,762	3.889973638	0.8	4.5	1	64	1	2,744	0	187,400	0.7
20	Liaoning	10,233	4.010002974	5.4	61.6	1	73	0	1,336	0	148,400	0.
21	Ningxia	10,353	4.015066214	3.8	3.4	0	66	1	3,556	0	66,400	0.7
22	Qinghai	9,069	3.957559402	4.9	0.1	0	61	1	6,860	0	722,300	0.6
23	Shaanxi	12,126	4.083717564	2.9	14.6	0	64	1	3,767	0	205,800	0.7
24	Shandong	12,881	4.10994958	5.4	228.7	0	65	0	1,545	0	157,100	0.7
25	Shanghai	27,001	4.431379849	5.4	239.6	0	89	0	118	1	6,340.00	0.
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27	Sichuan	10,194	4.008344629	6.2	35.3	0	58	1	7,556	0	486,100	0.
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32	Zhejiang	17,745	4.249076004	5.1	193	0	73	0	1,921	0	101,800	0.801
33												
34		wikipedia.org/wiki/List_of_Chinese_administrativ		wikipedia.org/wiki/List_	MOFCOM		statista.com/statistics/1088173/chin		wikipedia.org/wiki/List_of_Ch		wikipedia.or	
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2	0	46,930,000	0.014915832	4	119
3	0	65,770,000	0.29344686	5	623
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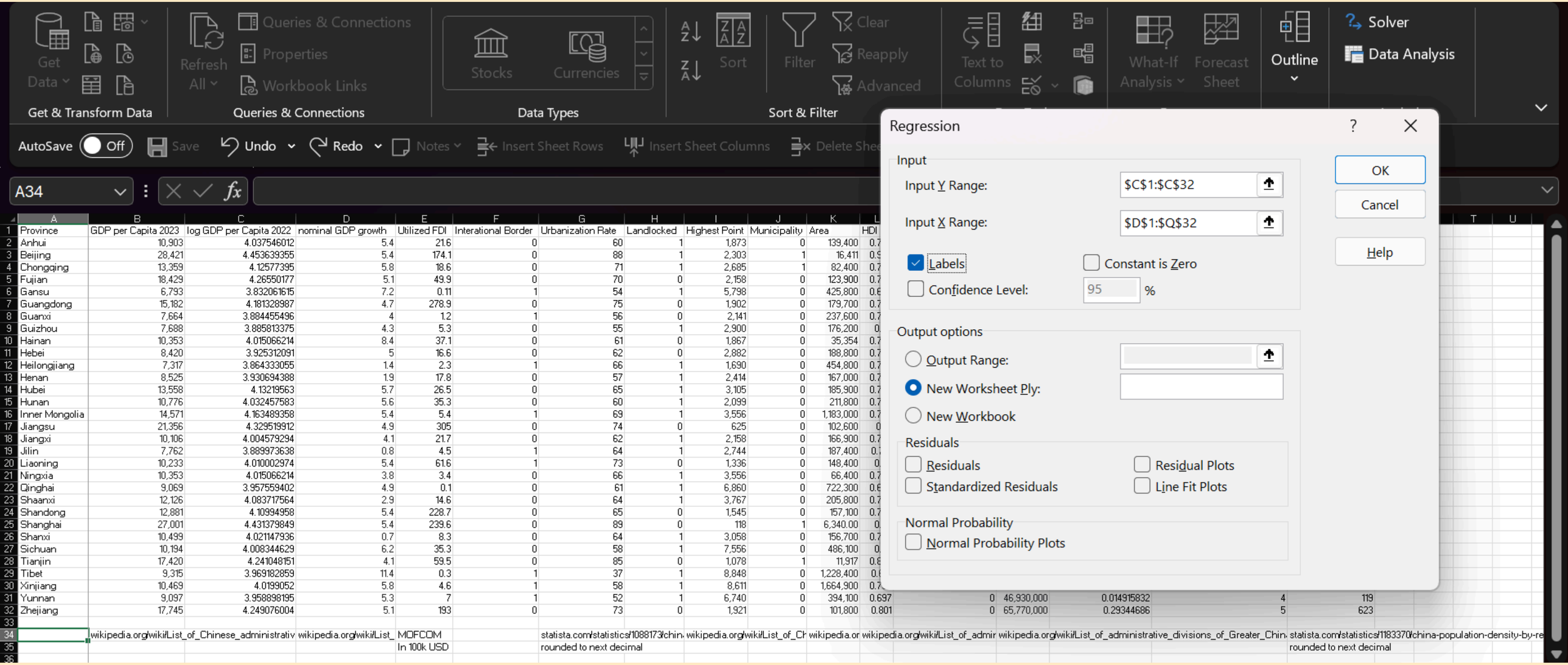

	A	B	C	D	E	F	G	H	I	J	K	L
1	Province	GDP per Capita 2023	log GDP per Capita 2022	nominal GDP growth	Utilized FDI	Interational Border	Urbanization Rate	Landlocked	Highest Point	Municipality	Area	HDI
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3	Beijing	28,421	4.453639355	5.4	174.1	0	88	1	2,303	1	16,411	0.9
4	Chongqing	13,359	4.12577395	5.8	18.6	0	71	1	2,685	1	82,400	0.7
5	Fujian	18,429	4.26550177	5.1	49.9	0	70	0	2,158	0	123,900	0.7
6	Gansu	6,793	3.832061615	7.2	0.11	1	54	1	5,798	0	425,800	0.6
7	Guangdong	15,182	4.181328987	4.7	278.9	0	75	0	1,902	0	179,700	0.7
8	Guanxi	7,664	3.884455496	4	1.2	1	56	0	2,141	0	237,600	0.7
9	Guizhou	7,688	3.885813375	4.3	5.3	0	55	1	2,900	0	176,200	0.
10	Hainan	10,353	4.015066214	8.4	37.1	0	61	0	1,867	0	35,354	0.7
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12	Heilongjiang	7,317	3.864333055	1.4	2.3	1	66	1	1,690	0	454,800	0.7
13	Henan	8,525	3.930694388	1.9	17.8	0	57	1	2,414	0	167,000	0.7
14	Hubei	13,558	4.13219563	5.7	26.5	0	65	1	3,105	0	185,900	0.7
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17	Jiangsu	21,356	4.329519912	4.9	305	0	74	0	625	0	102,600	0
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19	Jilin	7,762	3.889973638	0.8	4.5	1	64	1	2,744	0	187,400	0.7
20	Liaoning	10,233	4.010002974	5.4	61.6	1	73	0	1,336	0	148,400	0.
21	Ningxia	10,353	4.015066214	3.8	3.4	0	66	1	3,556	0	66,400	0.7
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29	Tibet	9,315	3.969182859	11.4	0.3	1	37	1	8,848	0	1,228,400	0.6
30	Xinjiang	10,469	4.0199052	5.8	4.6	1	58	1	8,611	0	1,664,900	0.7
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32	Zhejiang	17,745	4.249076004	5.1	193	0	73	0	1,921	0	101,800	0.801
33												
34		wikipedia.org/wiki/List_of_Chinese_administrativ		wikipedia.org/wiki/List_	MOFCOM		statista.com/statistics/1088173/chin		wikipedia.org/wiki/List_of_Ch		wikipedia.or	
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31	0	46,930,000	0.014915832	4	119				
32	0	65,770,000	0.29344686	5	623				
33									
34	wikipedia.org/wiki/List_of_admir	wikipedia.org/wiki/List_of_administrative_divisions_of_Greater_Chin			statista.com/statistics/1183370/china-population-density-by-re				
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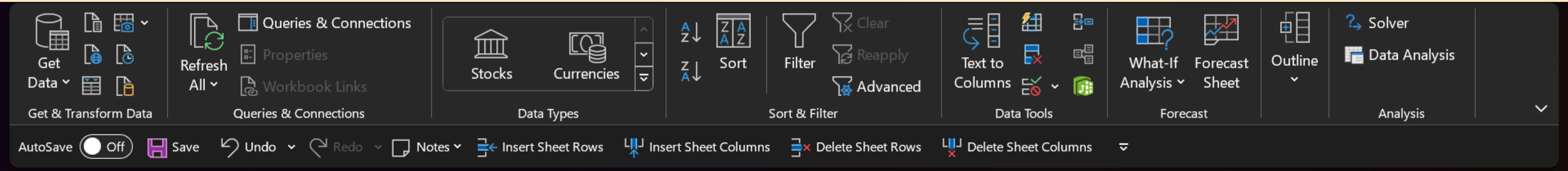

U34

	A	B	C	D	E	F	G	H	I
1	SUMMARY OUTPUT								
2									
3	*Regression Statistics*								
4	Multiple R	0.9475267							
5	R Square	0.89780685							
6	Adjusted R Square	0.80838785							
7	Standard Error	0.07031837							
8	Observations	31							
9									
10	ANOVA								
11		*df*	*SS*	*MS*	*F*	*Significance F*			
12	Regression	14	0.695054248	0.04964673	10.0404479	2.0212E-05			
13	Residual	16	0.079114769	0.00494467					
14	Total	30	0.774169017						
15									
16		*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
17	Intercept	2.03802221	0.69894737	2.91584502	0.01010309	0.55631997	3.51972444	0.55631997	3.51972444
18	nominal GDP growth	0.01927687	0.011328295	1.70165694	0.10816741	-0.00473804	0.04329178	-0.00473804	0.04329178
19	Utilized FDI	0.00118893	0.000475905	2.49824545	0.02375793	0.00018005	0.0021978	0.00018005	0.0021978
20	Interational Border	-0.06987477	0.039006582	-1.79135858	0.09216886	-0.15256503	0.01281548	-0.15256503	0.01281548
21	Urbanization Rate	-0.00080828	0.005705294	-0.14167223	0.88910741	-0.01290297	0.0112864	-0.01290297	0.0112864
22	Landlocked	0.03494292	0.045657398	0.76532869	0.45521769	-0.06184644	0.13173228	-0.06184644	0.13173228
23	Highest Point	8.1071E-06	1.26754E-05	0.63959261	0.53148932	-1.8764E-05	3.4978E-05	-1.8764E-05	3.4978E-05
24	Municipality	-0.02801687	0.078288002	-0.35786932	0.72511846	-0.19398002	0.13794628	-0.19398002	0.13794628
25	Area	4.3711E-09	7.60128E-08	0.05750428	0.95485553	-1.5677E-07	1.6551E-07	-1.5677E-07	1.6551E-07
26	HDI	2.5930242	1.279471994	2.02663615	0.05970242	-0.11933526	5.30538366	-0.11933526	5.30538366
27	Autonomous Province	0.03696043	0.050183096	0.73651164	0.47208107	-0.06942298	0.14334385	-0.06942298	0.14334385
28	Population	-1.9516E-09	1.17577E-09	-1.65980419	0.11642278	-4.4441E-09	5.4097E-10	-4.4441E-09	5.4097E-10
29	Utilized FDI per Capita	-0.34498442	0.355144711	-0.97139113	0.34581061	-1.09785758	0.40788873	-1.09785758	0.40788873
30	Number of Provinces Bodered	0.00517604	0.011371519	0.45517567	0.65509857	-0.0189305	0.02928258	-0.0189305	0.02928258
31	Population Density	5.12E-05	5.99592E-05	0.85391097	0.40575794	-7.5908E-05	0.00017831	-7.5908E-05	0.00017831

Questions

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