A summary of the assumptions of multiple regression analysis

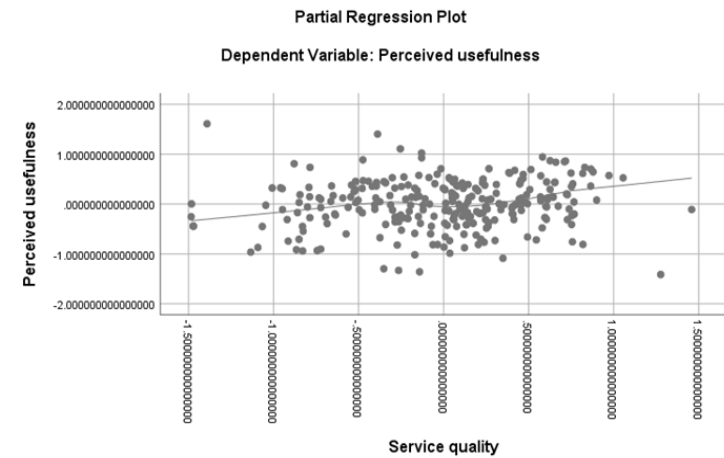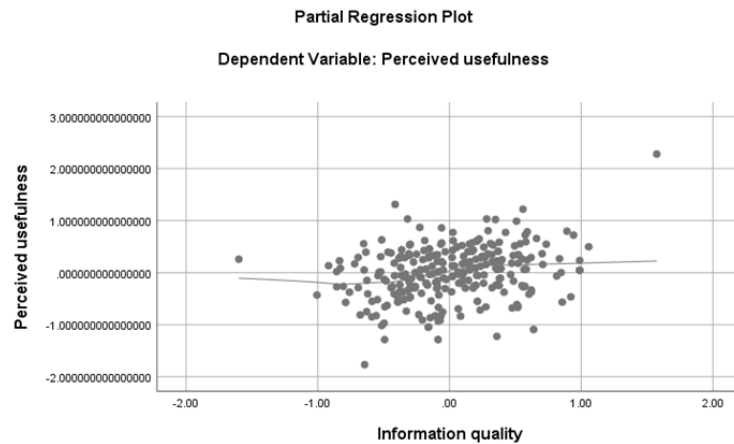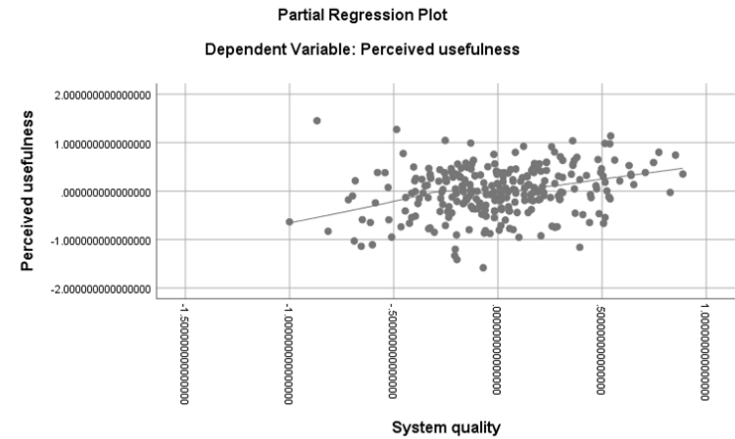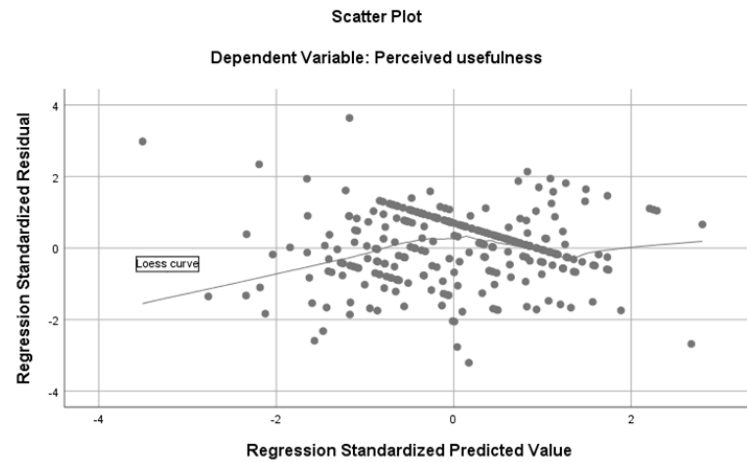|	Assumptions	SPSS Statistics	References
1	1) The dependent variable - an interval or ratio variable 2) Two or more independent variables – nominal, ordinal, interval, or ratio variables		1
2	The linear relationship between (a) the dependent variable and each of independent variables, and (b) the dependent variable and independent variables collectively	1) Visual inspection of the scatterplots and partial regression plots 2) The Loess curve pictured on the scatterplot to detect any nonlinearity	1,2
3	The independence of residuals (or errors)	In model summary table, the Durbin-Watson value between 1.5 and 2.5.	2,3
4	The homogeneity of residual variances (homoscedasticity)	Visual inspection of the scatterplots	1,2,4
5	No significant outliers, high leverage points, and highly influential points	In residual statistics table, Cook's distance $< 4/n$ or < 1	2,6,7,8
6	The normal distribution of residuals	1) The histogram with a superimposed normal curve 2) The normal P-P plot	1,2,5
7	No multicollinearity of the independent variables	In correlations table, 1) correlation coefficients between 0.3 and 0.8 In coefficients table, 2) tolerances > 0.1 and 3) variance inflation factors (VIFs) < 10	1,2,5

References
1. Multiple Regression Analysis Using SPSS Statistics. statistics.laerd.com. https://statistics.laerd.com/spss-tutorials/multiple-regression-using-spss-statistics.php. Accessed March 9, 2021.
2. Introduction to Regression With SPSS Lesson 2: SPSS Regression Diagnostics. stats.idre.ucla.edu. https://stats.idre.ucla.edu/spss/seminars/introduction-to-regression-with-spss/introreg-lesson2/#s6. Accessed March 9, 2021.
3. The Multiple Linear Regression Analysis In SPSS. statisticssolutions.com. https://www.statisticssolutions.com/the-multiple-linear-regression-analysis-in-spss/. Accessed March 20, 2021.
4. Linear Regression Analysis Using SPSS Statistics. statistics.laerd.com. https://statistics.laerd.com/spss-tutorials/linear-regression-using-spss-statistics.php. Accessed March 9, 2021.
5. Testing Assumptions of Linear Regression In SPSS. statisticssolutions.com. https://www.statisticssolutions.com/testing-assumptions-of-linear-regression-in-spss/. Accessed March 22, 2021.

6. Cook's Distance / Cook's D: Definition, Interpretation. statisticshowto.com. https://www.statisticshowto.com/cooks-distance/. Published July 13, 2016. Accessed March 22, 2021.
7. jbstatistics. Leverage and Influential Points in Simple Linear Regression. youtube.com. https://www.youtube.com/watch?v=xc_X9GFVuVU&t=1s&ab_channel=jbstatistics. Published December 23, 2012. Accessed March 20, 2021.
8. Stoltzfus, K. Ch 9 outliers, leverage points. youtube.com. https://www.youtube.com/watch?v=Lwno4mpvSI0&ab_channel=KateStoltzfus. Published October 19, 2020. Accessed March 20, 2021.

The 4ᵗʰ assumption for homoscedasticity

Assumptions of multiple regression analysis 1

The 2ⁿᵈ assumption for linearity

Scatter Plot

Dependent Variable: Perceived usefulness

Partial Regression Plot

Dependent Variable: Perceived usefulness

System quality

Partial Regression Plot

Dependent Variable: Perceived usefulness

Information quality

Partial Regression Plot

Dependent Variable: Perceived usefulness

Service quality

The 6th assumption for the normal distribution of residuals
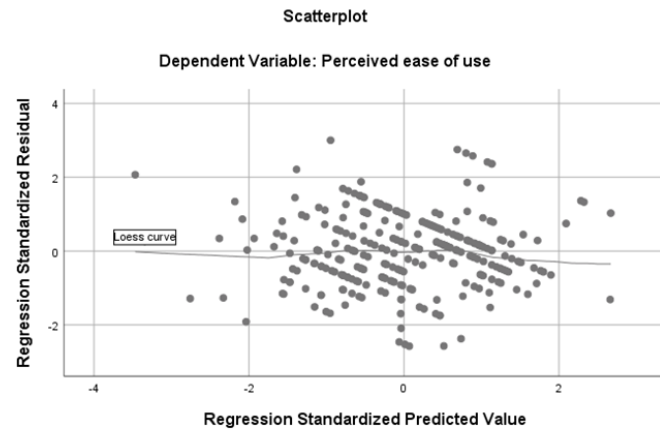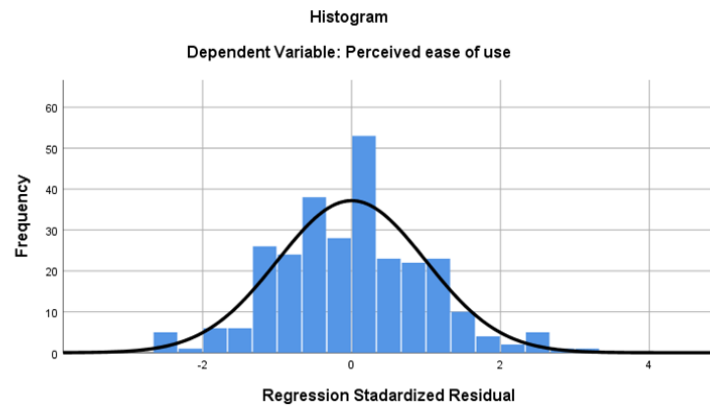
Assumptions of multiple regression analysis 2

Histogram

Dependent Variable: Perceived ease of use
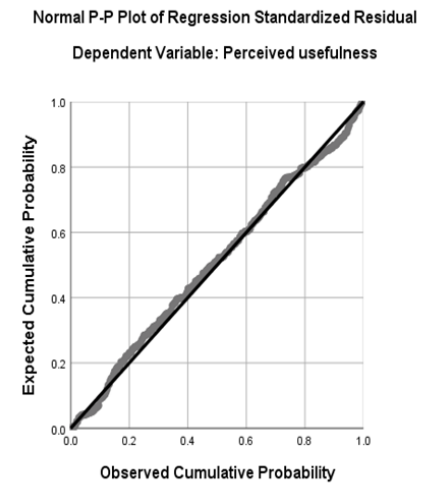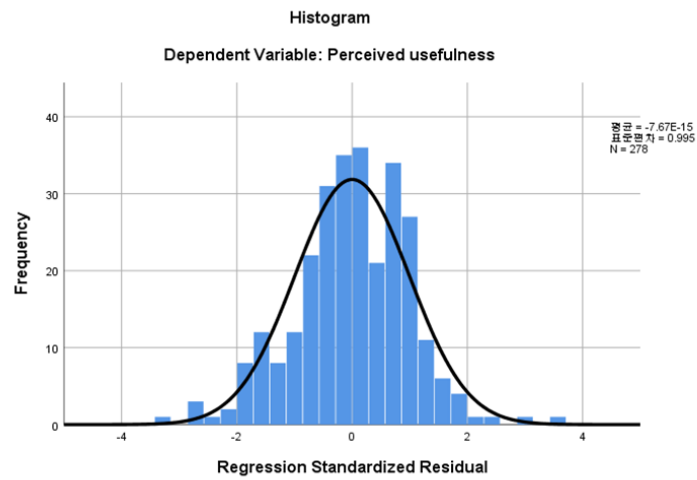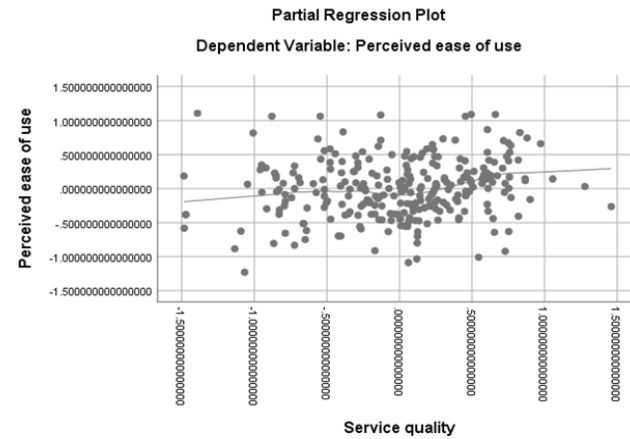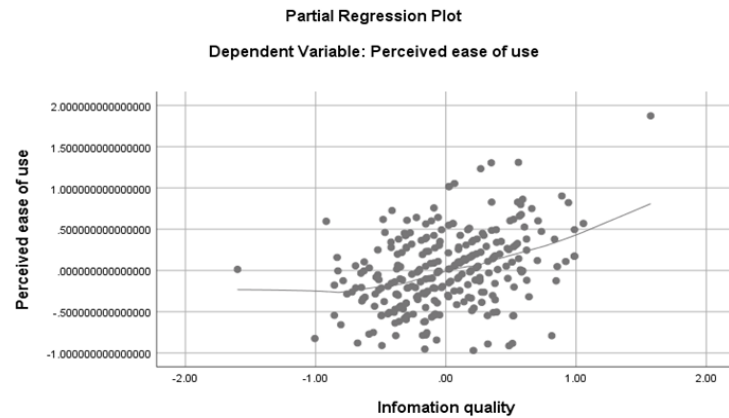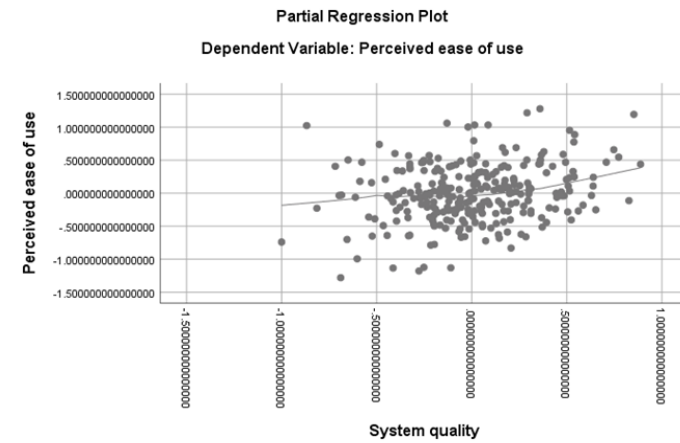
Normal P-P Plot of Regression Standardized Residual

Dependent Variable: Perceived ease of use
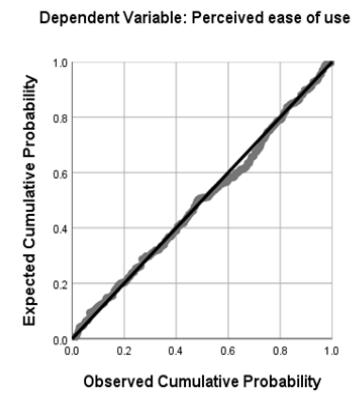
Hierarchical multiple regression analysis 1

Independent variables: system quality, information quality, and service quality

Dependent variable: Perceived usefulness

Descriptive Statistics

	Mean	Std. Deviation	N
Perceived usefulness	3.661630695443649	.604288905186621	278
System quality	3.284291248320027	.439863989551215	278
Information quality	3.5067	.57995	278
Service quality	3.129376498800959	.674065687956267	278

The 1st output for correlations of the IVs and the DV

Correlations

		Perceived usefulness	System quality	Information quality	Service quality
Pearson correlation	Perceived usefulness	1.000	.523	.541	.437
	System quality	.523	1.000	.610	.550
	Information quality	.541	.610	1.000	.534
	Service quality	.437	.550	.534	1.000
Significance (1-tailed)	Perceived usefulness	.	.000	.000	.000
	System quality	.000	.	.000	.000
	Information quality	.000	.000	.	.000
	Service quality	.000	.000	.000	.
N	Perceived usefulness	278	278	278	278
	System quality	278	278	278	278
	Information quality	278	278	278	278
	Service quality	278	278	278	278

The 2nd output for R, R^2, & adjusted R^2

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std.Error of the Estimates	R Square Change	F Change	df1	df2	Sig. of F Change	Durbin-Watson
					Statistics Change					
1	.523[a]	.274	.271	.515986876857453	.274	103.920	1	276	.000	
2	.593[b]	.352	.347	.488311475807434	.078	33.172	1	275	.000	
3	.601[c]	.362	.355	.485415330899806	.010	4.291	1	274	.039	1.705

a. Predictors: (Constant), System quality

b. Predictors: (Constant), System quality, Information quality

c. Predictors: (Constant), System quality, Information quality, Service quality

d. Dependent variable: Perceived usefulness

The 3rd assumption for non-autocorrelation in the DV

The 3rd output for the model's significance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	27.668	1	27.668	103.920	.000[b]
	Residual	73.483	276	.266		
	Total	101.151	277			
2	Regression	35.578	2	17.789	74.602	.000[c]
	Residual	65.573	275	.238		
	Total	101.151	277			
3	Regression	36.589	3	12.196	51.760	.000[d]
	Residual	64.562	274	.236		
	Total	101.151	277			

a. Dependent variable: Perceived usefulness

b. Predictors: (Constant), System quality

c. Predictors: (Constant), System quality, Information quality

The 4th (last) output for B, β, & t values   The 7th (last) assumption for the non-multicollinearity of the IVs

d. Predictors: (Constant), System quality, Information quality, Service quality

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	β			Tolerance	VIF
1	(Constant)	1.302	.234		5.574	.000		
	System quality	.719	.070	.523	10.194	.000	1.000	1.000
2	(Constant)	.984	.228		4.320	.000		
	System quality	.423	.084	.308	5.018	.000	.627	1.594
	Information quality	.368	.064	.353	5.759	.000	.627	1.594
3	(Constant)	.979	.226		4.324	.000		
	System quality	.361	.089	.263	4.063	.000	.557	1.795
	Information quality	.327	.067	.313	4.908	.000	.571	1.751
	Service quality	.112	.054	.125	2.072	.039	.635	1.575

a. Dependent variable: Perceived usefulness

Residual Statistics[a]

	Max.	Min.	Mean	Std. Deviation	N
Estimates	2.387212991714478	4.679870605468750	3.661630695443648	.363440456922103	278
Standardized Estimates	-3.507	2.802	.000	1.000	278
Std. Error of Estimates	.030	.138	.056	.017	278
Adjusted Estimates	2.312994003295898	4.678466796875000	3.661205858305133	.364849426272036	278
Residuals	-1.556544184684753	1.765461444854736	-.000000000000004	.482779572065669	278
Standardized Residuals	-3.207	3.637	.000	.995	278
Studentized Residual	-3.250	3.793	.000	1.005	278
Deleted Residuals	-1.598704934120178	1.920138359069824	.000424837138513	.492851229810599	278
Studenized Deleted Residuals	-3.308	3.890	.000	1.010	278

Mahalanobis's Distance	.040	21.317	2.989	2.757	278
Cook's Distance	.000	.315	.005	.021	278
Centered Leverage Values	.000	.077	.011	.010	278

a. Dependent variable: Perceived usefulness

The 5th assumption for no highly influential points in the DV

Hierarchical multiple regression analysis 2

Independent variables: system quality, information quality, and service quality

Dependent variable: Perceived ease of use

Descriptive Statistics

	Mean	Std. Deviation	N
Perceived ease of use	3.571942446043166	.563301524928929	278
System quality	3.284291248320027	.439863989551215	278
Information quality	3.5067	.57995	278
Service quality	3.129376498800959	.674065687956267	278

Correlations

		Perceived ease of use	System quality	Information quality	Service quality
Pearson correlation	Perceived ease of use	1.000	.549	.608	.482
	System quality	.549	1.000	.610	.550
	Information quality	.608	.610	1.000	.534
	Service quality	.482	.550	.534	1.000
Significance (1-tailed)	PE mean	.	.000	.000	.000
	System quality	.000	.	.000	.000
	Information quality	.000	.000	.	.000
	Service quality	.000	.000	.000	.
N	Perceived ease of use	278	278	278	278
	System quality	278	278	278	278
	Information quality	278	278	278	278
	Service quality	278	278	278	278

Model Summary^d

Model	R	R Square	Adjusted R Square	Std.Error of the Estimates	Statistics Change					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. of F Change	
1	.549^a	.301	.299	.471758855541620	.301	118.931	1	276	.000	
2	.648^b	.420	.416	.430541023051139	.119	56.375	1	275	.000	
3	.659^c	.434	.428	.426120627876375	.014	6.735	1	274	.010	1.977

a. Predictors: (Constant), System quality

b. Predictors: (Constant), System quality, Information quality

c. Predictors: (Constant), System quality, Information quality, Service quality

d. Dependent variable: Perceived ease of use

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	26.469	1	26.469	118.931	.000^b
	Residual	61.426	276	.223		
	Total	87.894	277			
2	Regression	36.919	2	18.459	99.584	.000^c
	Residual	50.976	275	.185		
	Total	87.894	277			
3	Regression	38.142	3	12.714	70.019	.000^d
	Residual	49.753	274	.182		
	Total	87.894	277			

a. Dependent variable: Perceived ease of use

b. Predictors: (Constant), System quality

c. Predictors: (Constant), System quality, Information quality

d. Predictors: (Constant), System quality, Information quality, Service quality

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	β			Tolerance	VIF
1	(Constant)	1.264	.214		5.919	.000		
	System quality	.703	.064	.549	10.906	.000	1.000	1.000
2	(Constant)	.899	.201		4.474	.000		
	System quality	.363	.074	.283	4.883	.000	.627	1.594
	Information quality	.423	.056	.435	7.508	.000	.627	1.594
3	(Constant)	.893	.199		4.493	.000		
	System quality	.295	.078	.230	3.780	.000	.557	1.795
	Information quality	.377	.058	.389	6.461	.000	.571	1.751
	Service quality	.124	.048	.148	2.595	.010	.635	1.575

a. Dependent variable: Perceived ease of use

Residual Statistics[a]

	Max.	Min.	Mean	Std. Deviation	N
Estimates	2.284949779510498	4.562053680419922	3.571942446043166	.371074622916383	278
Standardized Estimates	-3.468	2.668	.000	1.000	278
Std. Error of Estimates	.026	.121	.049	.015	278
Adjusted Estimates	2.239697456359863	4.578445434570313	3.571301295005980	.372197100811625	278
Residuals	-1.097345113754273	1.279478192329407	-.000000000000001	.423806833610234	278
Standardized Residuals	-2.575	3.003	.000	.995	278
Studentized Residual	-2.607	3.131	.001	1.004	278
Deleted Residuals	-1.124909758567810	1.391576766967773	.000641151037187	.431545301757634	278
Studentized Deleted Residuals	-2.635	3.183	.001	1.008	278
Mahalanobis's Distance	.040	21.317	2.989	2.757	278

Cook's Distance	.000	.215	.005	.015	278
Centered Leverage Values	.000	.077	.011	.010	278

a. Dependent variable: Perceived ease of use