

#### [Academic Script]

[Econometric Problem Solving using SPSS Software]

# **Business Economics** Subject: B. A. (Hons.), 5<sup>th</sup> **Course:** Semester, Undergraduate Paper - 502 Paper No. & Title: Computational Techniques for **Business Economics** Unit No. & Title: Unit – 3 Econometric Problem Solving Lecture No. & Title: Lecture – 1 Econometric Problem Solving using SPSS Software

### Academic Script

#### Econometric Problem Solving using SPSS software 1. Introduction

SPSS is user friendly software for statistical data analysis. SPSS includes almost features of statistical methods starting from descriptive statistics, graphs, Correlation and regression, multiple regressions, testing of hypothesis, time series analysis, non parametric tests etc. All the econometric techniques studied in Paper 304 can be implemented through data with the help of SPSS.

### 2. Data entry in SPSS

Let us see how to enter the data in SPSS. Either you open the SPSS software and directly enter the data or open the existing excel file in SPSS. To entre the data directly in SPSS adopt the following steps:

i) Click on the SPSS from the start menu, the following screen will display.



 ii) Click on 'variable view' in the bottom left hand side corner and enter the list of variables stating their types whether numeric , string etc. and fill up all the information then click on 'Data View' and enter the data in columns for each variables.

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Example: there are 20 salesmen in a big company. the sales man sale the product of the company in the three regions(1,2,3). In the data we have given gender, age and sales volume (in thousand

rupees) for each sale man.

### 3. Descriptive Statistics

Let us find descriptive statistics for age and sales volume.

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Then select ' Options' and choose the necessary measures like mean, Standard deviation etc. We get the following Table of outcomes.

**Descriptive Statistics** Ν Mean Std. Minimum Maximum Deviation 20 Age 19 30 24.60 2.836 43.55 Sales 20 11 77 19.975 45000.00 9948.68412 10000.00 Salary 20 24350.0000 Valid Ν 20 (listwise)

### 4. Testing of Hypothesis

In this section we will discuss how to carryout the tests like: t- test for mean, t- test for two means, F- test, and confidence interval for mean etc.

(a) Test for mean of the age of salesmen:
 H: Average age of sales men = 25 years
 V/S
 K: Average age of sales men ≠ 25 years

Perform the following steps:

Analyze  $\longrightarrow$  Compare Means  $\longrightarrow$  One Sample t-test we get the following box.



Enter age in the test variable box and enter the test value 25, on clicking OK we get the output as

### **One-Sample Test**

	Test V	alue = 2	25			
	Т	df	Sig. (2-	Mean	95%	Confidence
			tailed)	Differenc	Interval	of the
				е	Difference	
					Lower	Upper
Age	631	19	.536	400	-1.73	.93

Here Sig(2-tailed) value (P-value) is 0.536 which is greater than 5% level of significance, hence null hypothesis can not be rejected. Let us now perform a test for testing average age of male and female salesmen.

H: M1 = M2 versus K: M1  $\neq$  M2

Here M1 denotes the average age of Male and M2 for female.

First of all we have to recode the data of gender in to code using '1' for 'Male' and '0' for 'female' by following steps.

Select: Transform 

Recode into Different Variables

we get the box as



Transform 'gender' in the RHS box and give a name 'gender\_code' in output variable box then click on old and new values we get a new box as

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Now enter 'M' in old value box and 1 in new value box then click on " add", similarly enter 'F' in old value box and 0 in new value box and the click continue and then OK, we get a column of gender\_code in our data sheet as

Now to carryout t-test for two means do the following steps.

Analyze Compare means I Independent samples t-test

Transfer 'age' in to RHS box, and enter gender\_code in to grouping variables with 0 and 1 in define groups.



### Clicking OK we get the following output. Independent Samples Test

	Levene's Equality Variances	Test for of	t-test Equalit Means	for y of
	F	Sig.	t	df
Equal variances assumed	.170	.685	601	18

## **Independent Samples Test**

		t-test f	or Equal	ity of	Mear	าร	
		Sig.	Mean	( ) ( )	Std.	95%	
		(2-	Differen	ce	Error	Confi	denc
		tailed		[	Differ	e In	terval
		)		e	ence	of	the
						Differ	ence
						Lowe	r
Aa	Equal variances assumed	.555	792		1.317	-3.55	8
e	Equal variances not assumed	.542	792		1.272	-3.47	6
	Equal variand	ces				623	16.8 25

Here first two columns denote the results to test H:  $\sigma_1^2 = \sigma_2^2$  i.e. to test whether the two groups have equal variances or not.

This test of hypothesis is necessary to test the hypothesis for equality of two means in case of two independent samples.

Here sig. value 0.685 is greater than 0.05, so we can not reject the null hypothesis of equal variances of age in male and female groups.

Now sign value for t-test is 0.555 which is also greater than 0.05, and hence the equality of mean ages of the male and female groups cannot be rejected at 5% level of significance.

#### 5. Multiple regression equation.

Let us obtain regression equation to estimate salary of a salesman based on his age and sales volume.

Steps:

Analyze Regression Linear

we get the box as

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Transfer salary to the first row on RHS box as ' dependent' and age & sales volume in the second box on RHS as ' independent(s)'

Then select ' statistics from RHS upper most corner and click on ' estimates' and 'model fit' and click on continue and then click OK. We get the output as

### Model Summary

Model	R	R Square	Adjusted R	Std. Error of the
			Square	Estimate
1	.986 <sup>a</sup>	.973	.970	1731.02023

Here R square = 0.973 which is sufficiently large. Let us test it.

i.e. H: R = 0 versus K: R  $\neq$  0

From the following table we can get conclusion about this test. **ANOVA**<sup>a</sup>

Mode	əl	Sum of Squares	df	Mean Square	F	Sig.
	Regressi on	1829610672.638	2	914805336. 319	305.298	.000 <sup>b</sup>
1	Residual	50939327.362	17	2996431.02 1		
	Total	1880550000.000	19			

As Significant value = 0.000, which is < 0.05, so we say that the null hypothesis H: R = 0 is rejected at 5% level of significance.

That is the multiple regression model is appropriate for the given data. Now we prepare the multiple linear regression equation from the output. From the second column ( denoted as B)of the following table we get the regression coefficients.

Model		Unstandardized Coefficients		Standard ized Coefficie nts	t	Sig.
		В	Std. Error	Beta		
	(Cons tant)	2288.316	3497.126		.654	.522
1	Age	27.974	141.028	.008	.198	.845
	Sales	490.781	20.022	.985	24.5 12	.000

Hence the multiple regression equation can be written as

Salary = 2288.316 + 27.974(Age) +

490.781(Sales)

Now we test whether the age or sales or both have significant effect on salary or not.

Here from the last column of the table we see that significant value of age is 0.845 > 0.05, so it has no significant effect on salary, but for sales it is 0.000 < 0.05, so sales has significant effect on salary at 5% level of significant.

Let us check the effect of gender on salary , we introduce gender\_code as dummy variable in the model and add gender\_code as ` independent variable in the RHS box of regression and again click OK, as

sdiary	Cal Linear Regression		Weible 7 of 7 Varu
SalesE 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	Sales Executive (SalesExecutive) Gender Age Sales Region (SalesRegion) Sales gender_code (gender_code)	Desendent Salas Potecendent Potecendent Potecendent Sales S	Var
10		OK Pasta Resul Cancel Help	

# We get the output as

**Coefficients**<sup>a</sup>

Model		Unstandardized Coefficients		Standa rdized Coeffic ients	t	Sig.
		В	Std. Error	Beta		
	(Constan t)	2368.231	3690.711		.642	.530
	Age	25.781	146.959	.007	.175	.863
1	Sales	490.944	20.696	.986	23.722	.000
gender_ code		-82.705	824.856	004	100	.921

Again here significant value for gender is 0.921> 0.05, so it has no significant effect on sales volume.

Now we add sales region as independent variable in regression box by considering dummy variables for sales region as

DR1 = 1, if Region is 1 otherwise 0

DR2 = 1, if region is 2 otherwise 0

So first of all we enter the two new columns for these dummy variables in the data sheet as DR1 and DR2 which assume the values 1 or 0.

Again select linear regression from the data analysis we get the box as



Then transfer these two dummy variables in independent box of regression in which we have already transferred age, sales and gender\_code and salary in dependent box.

Then click on OK so we get the output as,

### Model Summary

Model	R	R	Adjusted R	Std. Error of
		Square	Square	the Estimate
1	.990 <sup>a</sup>	.980	.972	1657.52159

Here R-squared value increases from 0.973 to 0.980 and significant value is 0.000< 0.05 that is this model becomes more appropriate than the earlier models after adding the sales regions as dummy variables.

ANOV	A <sup>a</sup>					
Model		Sum of	df	Mean	F	Sig.
		Squares		Square		
	Regression	1842086 710.665	5	3684173 42.133	134.09 8	.000 <sup>b</sup>
1	Residual	3846328 9.335	14	2747377 .810		
	Total	1880550 000.000	19			

# 6. Collinearity Diagnostics:

In multiple regression equation sometimes independent variables may be correlated with each other. Such situation is called multicollinearity. Due to presence of multicolinearity the model wrongly gives a very high value of Multiple correlation coefficient R. It is necessary to remove if any multicollinearity in the independent variables.

The following steps are used to test multicollinearity

Steps:SelectAnalyzeRegressionLinearStatisticsCollinearityDiagnostics

	Type	1			-	(mar.)	
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### we get the output as

Coeffic	cients <sup>a</sup>				
Model		Unstandard Coefficients	ized	Collinearity Statistics	
		В	Std. Error	Tolerance	VIF
	(Constant)	204.225	4741.050		
1	Age	82.717	182.528	.540	1.853
	Sales	513.843	26.594	.512	1.952
	gender_code	-274.183	772.349	.960	1.042
	DR1	-1184.327	1330.098	.324	3.091
	DR2	1054.929	1294.690	.390	2.562

Here VIF values are less than 5 so there is no multicollinearity amo000000ng the independent variables. If any value of VIF is greater than 5 then we remove one by one independent variable from the correlated independent variables and decide the appropriate model.

## SUMMARY

In SPSS software we can easily perform, all the aspects of econometrics. First of all we have seen how to entre the data, then how to carry out the test for single mean, two mean, two variables. Next we have seen how to develop a general linear regression model with the help of number of independent variables and dependent variables. We have also see, which independent variables has a significant effect on dependent variable. Thank You.