

FINAL PROJECT

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Group-09

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**STATISTICAL ANALYSIS OF
CREATENINE LEVELS
BEFORE AND AFTER
TREATMENT FOR PATIENTS
WITH KIDNEY IMPAIRMENT**

CHAPTER 1: BACKGROUND

In a clinical trial, researchers wanted to evaluate the efficacy of a new drug in treating renal problems in patients with different degrees of kidney impairment. The trial was done to assess the drug's ability to influence renal function over a specific period.

The study was done with 285 patients who had history of renal impairment. The patients were categorized into three groups based on the severity of their condition: Group 1 with mild renal impairment, Group 2 with moderate impairment, and Group 3 had severe impairment.

Creatinine levels can be crucial indicators of renal function, where elevated levels may indicate impaired kidney function. The researchers monitored the patients' renal function by measuring creatinine levels in their blood at two different time points: before treatment with the drug (creat_68) and after treatment (creat_69).

During collection of data, some challenges were faced. A few participants failed to complete the trial, resulting in missing data points. In some other cases, creatinine levels were recorded as "9.99," indicating values that were either extremely high or unavailable. These data were treated as corrupted and excluded from the study.

Analysis was done to evaluate the impact of the experimental drug on renal function within each group as well as between groups. It involved comparing creatinine levels before and after treatment within each group, as well as assessing differences in treatment outcomes among the three groups.

CHAPTER 2: DESCRIPTIVE STATISTICS

Group 1 (Mild Impairment)		Group 2 (Moderate Impairment)		Group3 (Severe Impairment)	
Before Treatment(C reate_68)	After Treatment(C reate_69)	Before Treatment(C reate_68)	After Treatment(C reate_69)	Before Treatment(C reate_68)	After Treatment(C reate_69)
0.97	0.95	0.7	0.94	1.48	0.42
0.88	1.17	0.84	1.05	0.78	0.92
0.96	0.9	0.47	0.65	0.79	1.04
0.74	0.71	0.81	1.07	0.8	0.74
0.85	0.73	0.75	0.67	0.84	0.65
1.06	1.1	0.76	0.79	0.94	0.75
0.65	0.68	0.91	1.12	0.86	0.98
0.65	0.83	0.87	1.05	0.8	0.7
0.94	0.8	0.99	0.98	0.88	0.62
0.86	0.76	0.85	0.73	0.78	0.67
0.78	0.84	0.66	0.62	1.2	1.4
0.84	1.28	0.85	0.93	1	0.75
0.75	0.83	0.77	0.86	0.72	0.8
0.82	0.92	0.74	0.68	0.76	0.8
0.76	0.72	0.89	1.08	0.66	0.64
2.1	1.7	0.9	0.75	0.71	0.98
1.38	1.07	0.61	0.84	0.75	0.8
1.8	0.8	0.75	0.73	0.72	0.75
0.77	0.83	1.04	0.71	1.19	0.76
0.76	0.75	0.8	0.88	0.9	0.98
1.2	0.68	0.66	0.77	0.66	0.72
0.99	0.85	0.75	1.29	0.65	0.83
0.71	0.72	0.72	0.74	0.65	0.72
0.92	0.84	0.96	0.86	0.81	0.82
0.75	0.7	0.73	0.72	0.56	0.68
0.85	0.95	0.82	0.81	0.84	0.71
3.25	4.2	0.68	0.7	0.72	1.05
1.25	1.43	0.74	0.79	0.85	1.17
1.07	1.01	1.41	1.15	1.01	1.71
0.85	0.99	0.77	1.08	0.71	1
1.48	1.33	0.71	0.64	0.83	0.77

0.84	1.6	0.98	0.78	0.83	1.6
0.95	1.6	0.58	0.6	0.82	0.87
0.68	1.3	0.9	2.25	0.81	0.66
0.75	1.2	0.87	0.68	0.87	0.8
0.95	1.45	1.03	0.81	0.71	0.66
0.75	1.5	0.82	0.62	0.77	0.69
1.9	1.49	0.82	0.83	0.67	0.8
0.85	2	0.86	0.74	1.22	1.39
1.17	1.44	1.29	1.1	0.73	0.9
0.75	0.7	1.45	0.45	1.24	0.9
0.87	1	1.05	1.45	0.82	0.87
1	1	1	0.66	0.62	0.65
0.75	0.82	0.86	1.15	0.75	0.68
1.15	0.7	0.67	1.16	0.93	0.7
1.45	0.7	1.55	1.47	0.9	0.73
1.35	0.86	0.75	1.14	0.93	0.82
0.95	0.65	0.8	1.2	0.67	0.63
1.05	0.65	0.88	0.64	0.87	0.68
1	0.65	0.89	0.8	0.68	0.63
0.8	0.74	0.72	0.8	0.7	0.62
2.05	1.2	0.96	0.93	0.87	0.69
1.25	0.96	0.85	0.71	0.92	0.7
1.75	0.76	0.95	0.79	0.94	0.83
0.95	0.7	0.95	0.76	0.9	0.66
1.45	0.95	1.55	0.88	0.77	0.67
1.15	0.85	0.65	0.6	0.9	0.91
1.2	0.86	0.95	0.73	0.71	0.6
1.02	1.13	1.1	0.88	0.93	0.76
1.15	0.95	1.05	0.7	0.72	0.65
0.9	0.84	0.95	0.81	1.15	0.73
1.15	2	1.25	0.84	0.76	1.42
1.4	1.9	1.35	0.95	1.5	1.3
0.7	0.85	0.85	0.88	0.99	1.57
0.7	1.34	0.8	0.65	0.85	1.03
0.75	1.15	0.85	0.7	1.23	1.27
1.36	0.85	0.45	0.4	1.5	0.81
0.81	0.79	1.1	0.7	1.2	1.02
0.98	0.56	0.9	0.8	0.69	0.83
0.7	1.56	0.75	0.86	0.71	0.9
0.7	0.78	0.85	1.67	1.2	1.05
0.79	0.58	0.75	0.72	0.94	0.7
0.78	1.1	1.03	0.85	0.84	0.64

0.85	1.02	1	0.84	0.94	0.75
0.9	1.42	0.95	1.53	0.93	1.45
0.94	0.94	0.8	1.61	1.28	0.54
1.05	0.66	0.83	0.71	0.9	1.15
3.83	2.45	0.96	1	1.09	1.05
1.2	0.85	0.85	0.95	0.84	1.25
0.96	1.68	0.98	0.91	1.25	1.8
1.04	1.66	0.69	0.76	0.83	1.4
0.75	1.27	0.73	0.61	0.94	1.32
0.71	1.43	0.85	1.15	0.55	0.98
1.56	1.38	1.23	1.33	0.85	1.74
0.92	1.5	0.91	0.75	0.76	0.6
1.19	1.55	1.57	0.74	0.95	1
1.26	1.26	1.48	0.85	0.9	0.85
0.87	0.57	1.63	0.75	0.72	0.65
1.24	1.16	1.28	0.63	0.8	0.58
1.39	1.38	0.99	1.59	0.95	0.94
0.85	0.87	0.94	0.75	0.92	1.05
1.16	0.88	0.89	1.4	1.8	0.76
1.5	0.99	0.67	1.4	0.8	0.7
0.96	0.57	1.25	1.2	0.7	0.7
0.69	0.8	0.74	1.18	1.2	0.95

Table Showing Descriptive Statistics of the 3 Groups:

	Group 1(Mild Impairment)		Group 2(Moderate Impairment)		Group 3(Severe Impairment)	
	Before treatment(create_68)	After Treatment(create_69)	Before treatment(create_68)	After Treatment(create_69)	Before treatment(create_68)	After Treatment(create_69)
Size of Data (n)	95	95	95	95	95	95
Mean(x)	1.074842	1.084947	0.913579	0.910105	0.889579	0.890105
Standard Deviation (S)	0.479419	0.494168	0.238099	0.296413	0.219656	0.289142
Variance (S^2)	0.229842	0.244202	0.056691	0.087861	0.048249	0.083603

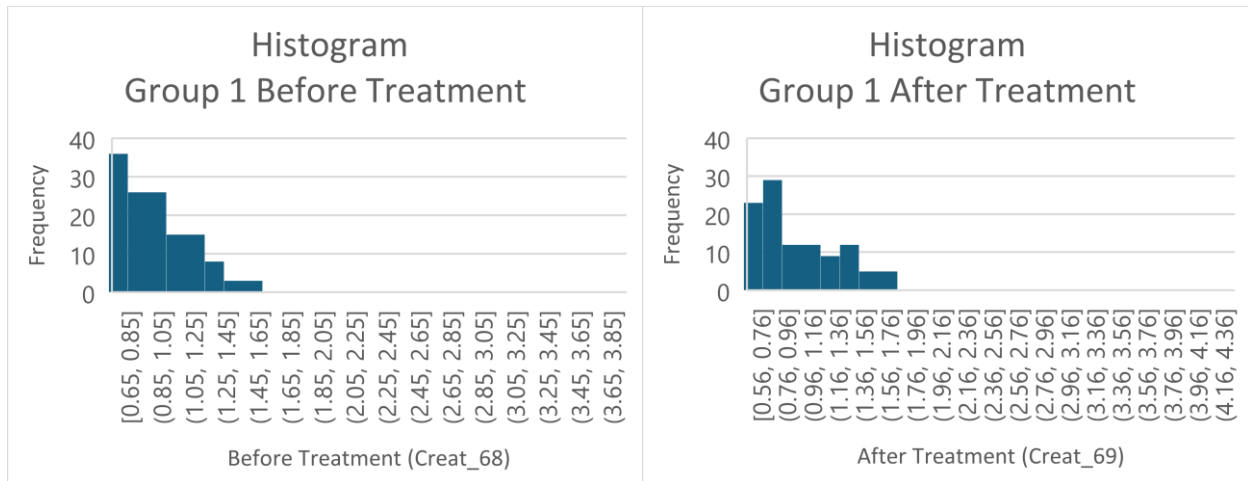
The formulas for calculation are as follows:

1. Mean, $\mu = \Sigma x / n$
2. Standard Deviation = $\sqrt{(\Sigma((x - \mu)^2) / n)}$
3. Variance = $\Sigma((x - \mu)^2) / n$

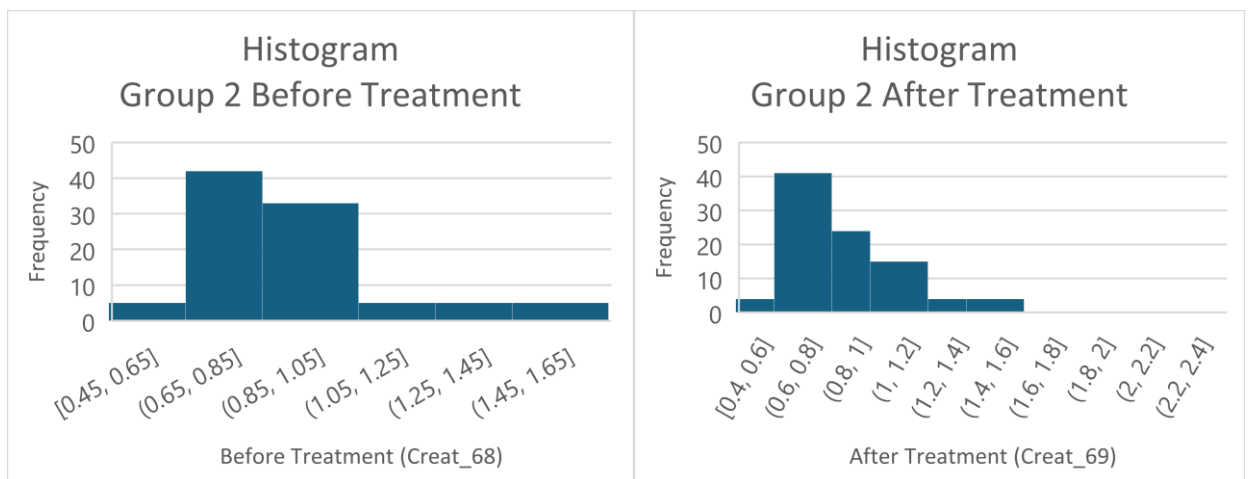
Graphical Representation of the Data:

1. Frequency Histogram: Frequency histogram is plotted for the different groups before and after treatment to graphically present the spread of the data and to see the shape.

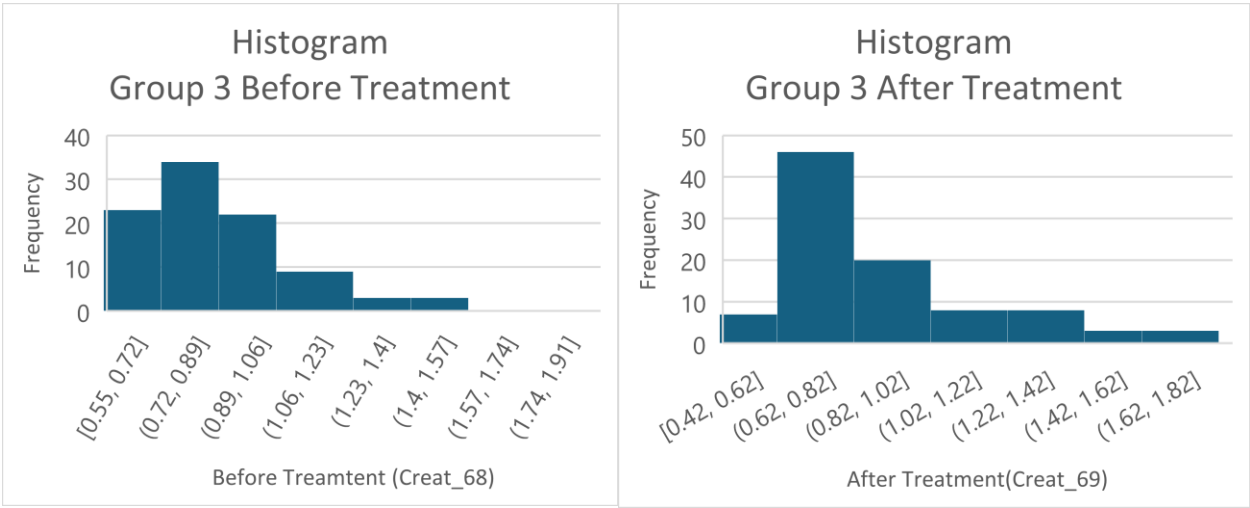
Frequency Histogram of Group 1



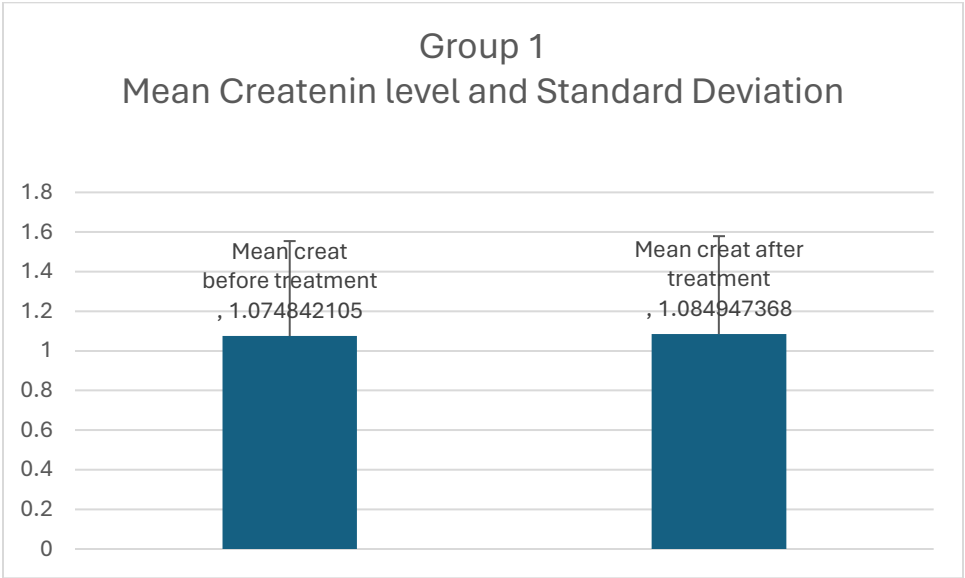
Frequency Histogram of Group 2

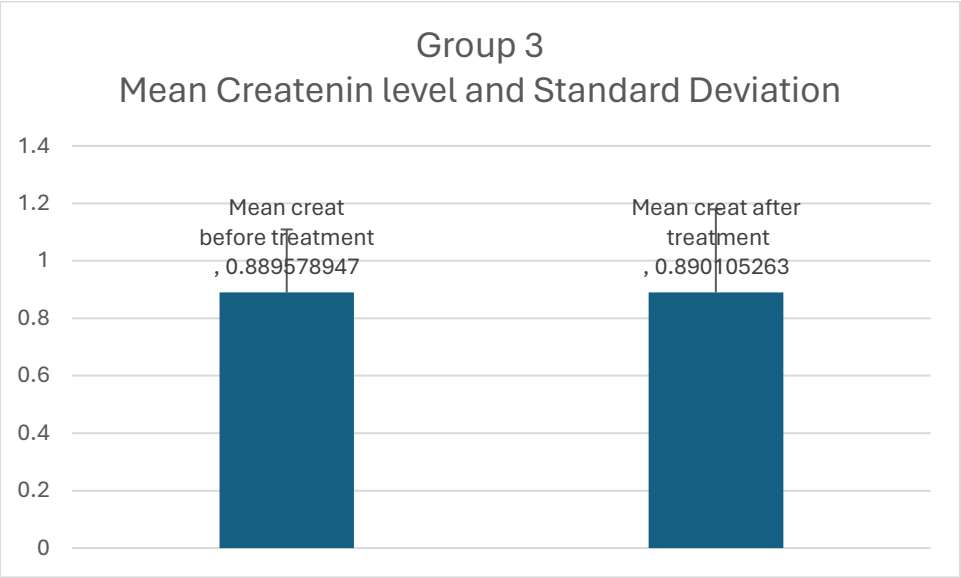
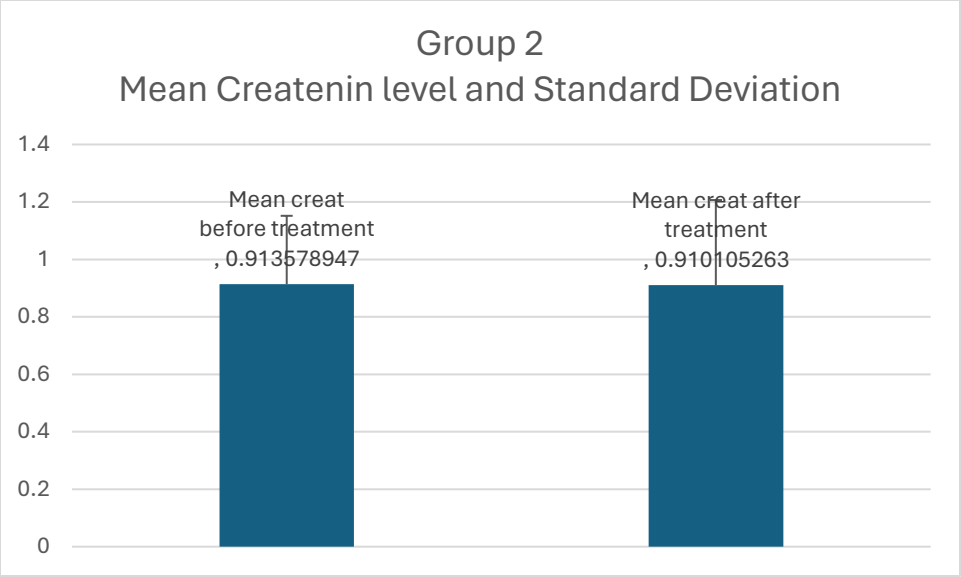


Frequency Histogram of Group 3

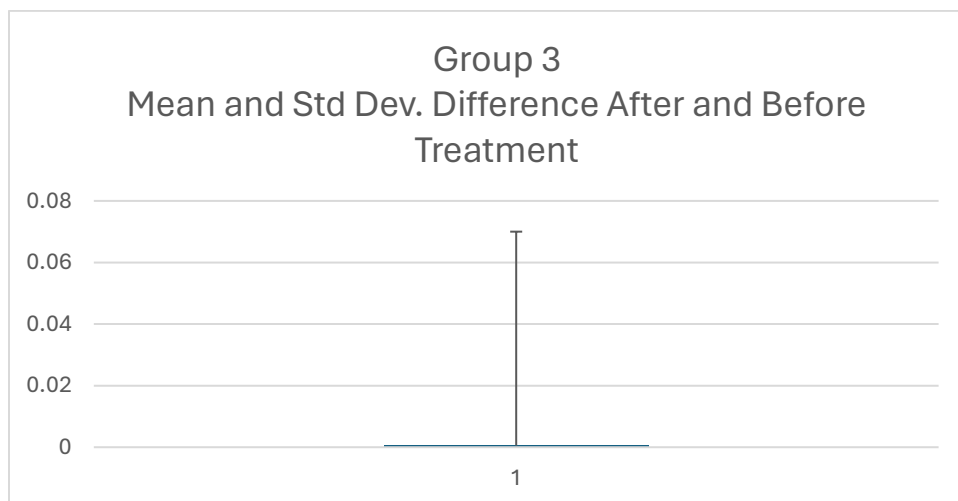
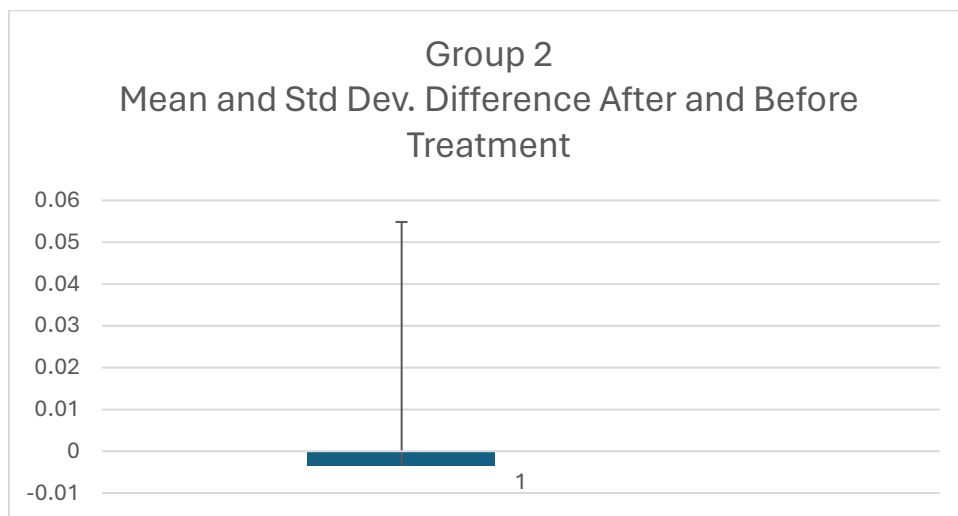
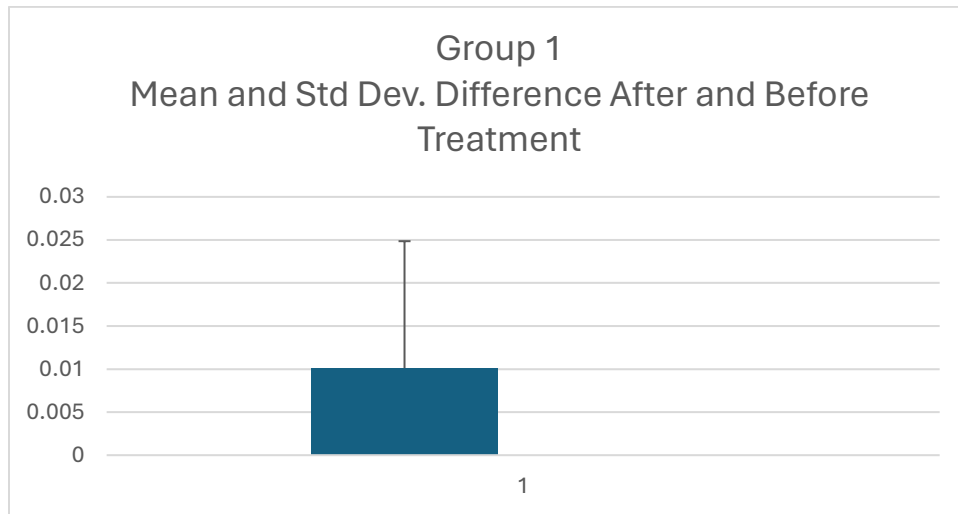


2. Graph showing Mean and Standard Deviation:





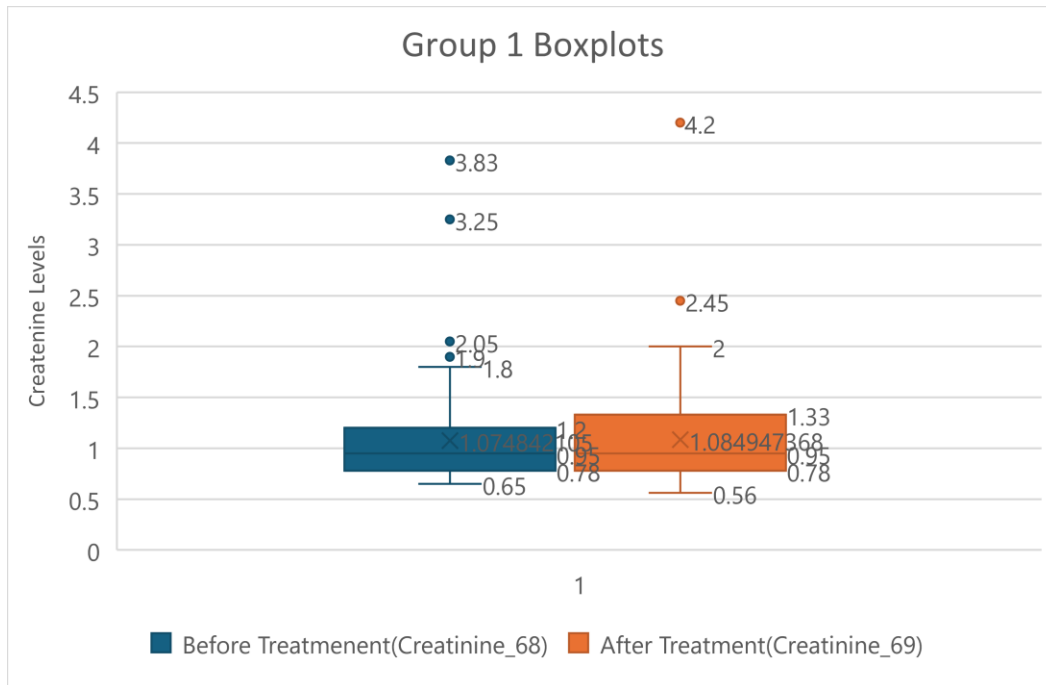
3. Graph showing difference between mean and standard deviation after and before treatment:



Outlier Analysis

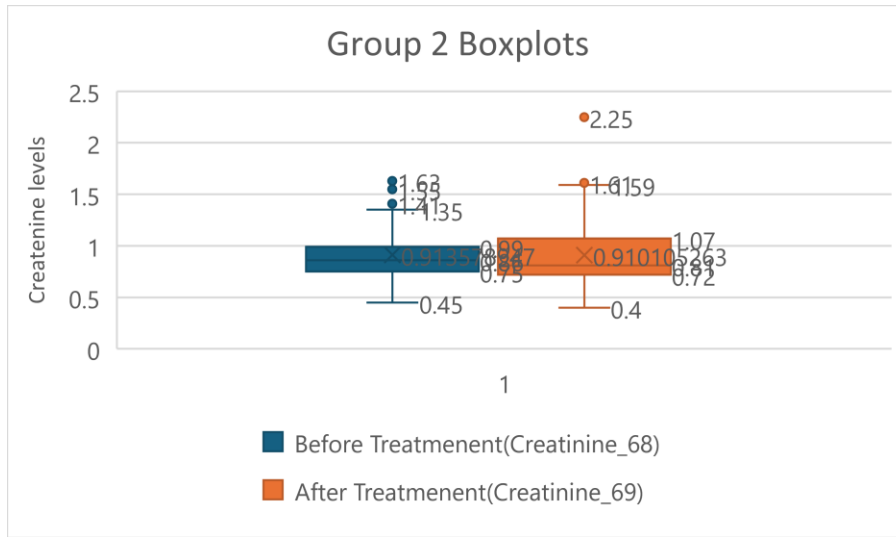
To determine any possible outliers in the dataset, boxplots were constructed, and potential outliers were identified and judgementally removed. The boxplots showing outliers of the different groups are shown below:

Outlier of Group 1:



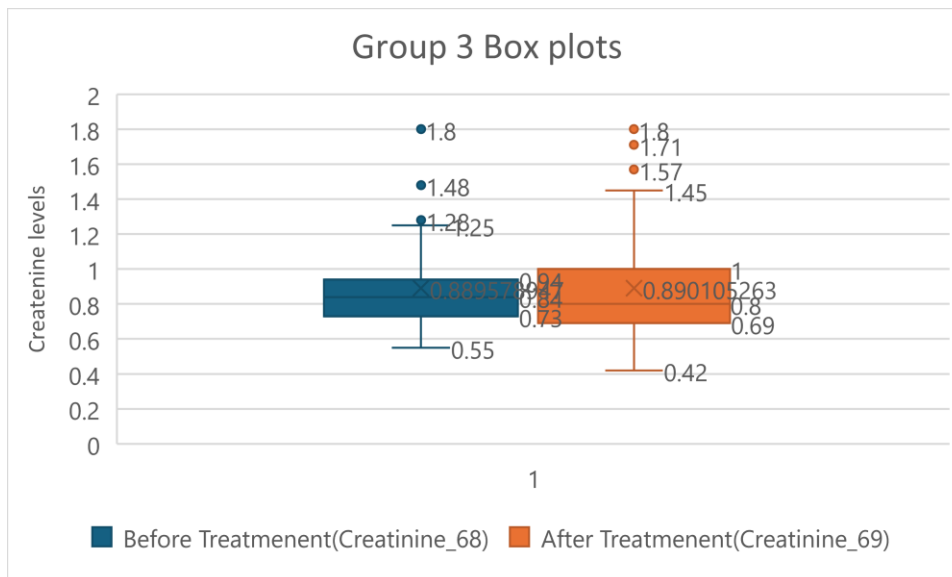
Here, the values 3.83, 3.25 can be considered outlier for before treatment and the values 2.45 and 4.2 can be considered for after treatment, since they lie well outside the whiskers.

Outlier of Group 2:



Here, the values 1.55, 1.63 can be considered outlier for before treatment and the values 1.67 and 2.25 can be considered for after treatment, since they lie well outside the whiskers.

Outlier of Group 3:



Here, the values 1.48, 1.8 can be considered outliers for before treatment and the values 1.57, 1.71 and 1.8 can be considered outliers for after treatment, since they lie well outside the whiskers.

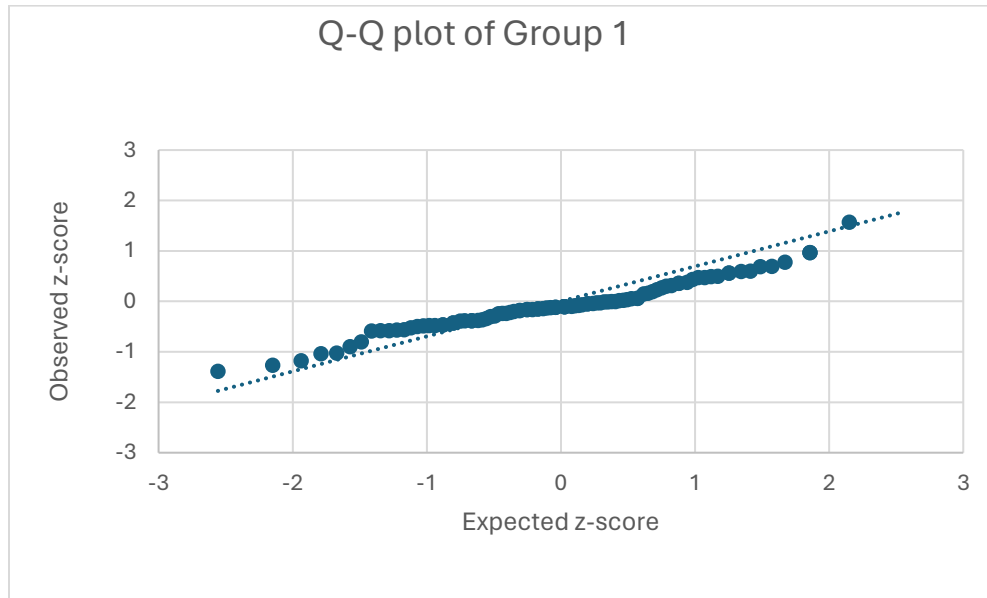
Normality Check

To check if the data is normal, the difference between the creat values after treatment and the creat values before treatment is utilized. The difference between the two data for each groups is plotted in a Q-Q plot to check for the normality. If the plotted values follow a trendline and is aligned with it, it can be said that the data is normally distributed. The calculations and the obtained graphs for each group is shown below in details:

Group 1:

Group No.	Before Tre:	After Treat	Observed z-score	Expected Z-score	Percentile	Rank	Difference	Sorted Diff
1	0.97	0.95	-1.388507324	-2.558042727	0.005263158	1	-0.02	-1.38
1	0.88	1.17	-1.267627122	-2.149700064	0.015789474	2	0.29	-1.25
1	0.96	0.9	-1.174642351	-1.937931511	0.026315789	3	-0.06	-1.15
1	0.74	0.71	-1.035165195	-1.78856927	0.036842105	4	-0.03	-1
1	0.85	0.73	-1.025866718	-1.670923232	0.047368421	5	-0.12	-0.99
1	1.06	1.1	-0.895688039	-1.572694933	0.057894737	6	0.04	-0.85
1	0.65	0.68	-0.802703268	-1.487654225	0.068421053	7	0.03	-0.75
1	0.65	0.83	-0.588838295	-1.412187579	0.078947368	8	0.18	-0.52
1	0.94	0.8	-0.579539818	-1.34400315	0.089473684	9	-0.14	-0.51
1	0.86	0.76	-0.579539818	-1.281551566	0.1	10	-0.1	-0.51
1	0.78	0.84	-0.570241341	-1.223733888	0.110526316	11	0.06	-0.5
1	0.84	1.28	-0.560942864	-1.169740876	0.121052632	12	0.44	-0.49
1	0.75	0.83	-0.523748956	-1.118958381	0.131578947	13	0.08	-0.45
1	0.82	0.92	-0.495853525	-1.070908605	0.142105263	14	0.1	-0.42
1	0.76	0.72	-0.486555048	-1.02521202	0.152631579	15	-0.04	-0.41
1	2.1	1.7	-0.477256571	-0.98156177	0.163157895	16	-0.4	-0.4
1	1.38	1.07	-0.477256571	-0.939705933	0.173684211	17	-0.31	-0.4
1	1.8	0.8	-0.467958094	-0.87983746	0.189473684	18.5	-1	-0.39
1	0.77	0.83	-0.467958094	-0.87983746	0.189473684	18.5	0.06	-0.39
1	0.76	0.75	-0.430764185	-0.80459638	0.210526316	20.5	-0.01	-0.35
1	1.2	0.68	-0.430764185	-0.80459638	0.210526316	20.5	-0.52	-0.35
1	0.99	0.85	-0.393570277	-0.751035022	0.226315789	22	-0.14	-0.31
1	0.71	0.72	-0.3842718	-0.7164975	0.236842105	23	0.01	-0.3
1	0.92	0.84	-0.3842718	-0.666231475	0.252631579	24.5	-0.08	-0.3
1	0.75	0.7	-0.3842718	-0.666231475	0.252631579	24.5	-0.05	-0.3
1	0.85	0.95	-0.374973323	-0.617595358	0.268421053	26	0.1	-0.29
1	3.25	4.2	-0.365674846	-0.585971396	0.278947368	27	0.95	-0.28
1	1.25	1.43	-0.337779415	-0.554922943	0.289473684	28	0.18	-0.25
1	1.07	1.01	-0.300585506	-0.524400513	0.3	29	-0.06	-0.21
1	0.85	0.99	-0.291287029	-0.494359046	0.310526316	30	0.14	-0.2
1	1.48	1.33	-0.244794644	-0.464757309	0.321052632	31	-0.15	-0.15
1	0.84	1.6	-0.235496167	-0.435557386	0.331578947	32	0.76	-0.14
1	0.95	1.6	-0.235496167	-0.406724252	0.342105263	33	0.65	-0.14
1	0.68	1.3	-0.216899213	-0.3782254	0.352631579	34	0.62	-0.12
1	0.75	1.2	-0.198302258	-0.350030525	0.363157895	35	0.45	-0.1
1	0.95	1.45	-0.179705304	-0.308246546	0.378947368	36.5	0.5	-0.08
1	0.75	1.5	-0.179705304	-0.308246546	0.378947368	36.5	0.75	-0.08
1	1.9	1.49	-0.16110835	-0.253347103	0.4	38.5	-0.41	-0.06
1	0.85	2	-0.16110835	-0.253347103	0.4	38.5	1.15	-0.06
1	1.17	1.44	-0.16110835	-0.212676949	0.415789474	40	0.27	-0.06
1	0.75	0.7	-0.151809873	-0.172355703	0.431578947	41.5	-0.05	-0.05
1	0.87	1	-0.151809873	-0.172355703	0.431578947	41.5	0.13	-0.05
1	1	1	-0.142511396	-0.132312852	0.447368421	43	0	-0.04
1	0.75	0.82	-0.133212919	-0.105738953	0.457894737	44	0.07	-0.03
1	1.15	0.7	-0.123914442	-0.079239527	0.468421053	45	-0.45	-0.02
1	1.45	0.7	-0.114615965	-0.03958868	0.484210526	46.5	-0.75	-0.01
1	1.35	0.86	-0.114615965	-0.03958868	0.484210526	46.5	-0.49	-0.01
1	0.95	0.65	-0.105317488	0.026388623	0.510526316	49	-0.3	0
1	1.05	0.65	-0.105317488	0.026388623	0.510526316	49	-0.4	0
1	1	0.65	-0.105317488	0.026388623	0.510526316	49	-0.35	0
1	0.8	0.74	-0.096019011	0.079239527	0.531578947	51	-0.06	0.01
1	2.05	1.2	-0.086720534	0.105738953	0.542105263	52	-0.85	0.02
1	1.25	0.96	-0.077422056	0.132312852	0.552631579	53	-0.29	0.03
1	1.75	0.76	-0.068123579	0.158980534	0.563157895	54	-0.99	0.04
1	0.95	0.7	-0.049526625	0.199201325	0.578947368	55.5	-0.25	0.06
1	1.45	0.95	-0.049526625	0.199201325	0.578947368	55.5	-0.5	0.06
1	1.15	0.85	-0.040228148	0.239747104	0.594736842	57	-0.3	0.07
1	1.2	0.86	-0.030929671	0.266994125	0.605263158	58	-0.34	0.08
1	1.02	1.13	-0.030929671	0.294440854	0.615789474	59	0.11	0.08
1	1.15	0.95	-0.012332717	0.322111243	0.626315789	60	-0.2	0.1
1	0.9	0.84	-0.012332717	0.350030525	0.636842105	61	-0.06	0.1
1	1.15	2	-0.00303424	0.3782254	0.647368421	62	0.85	0.11
1	1.4	1.9	-0.00303424	0.406724252	0.657894737	63	0.5	0.11
1	0.7	0.85	0.015562714	0.435557386	0.668421053	64	0.15	0.13
1	0.7	1.34	0.024861191	0.464757309	0.678947368	65	0.64	0.14
1	0.75	1.15	0.034159668	0.494359046	0.689473684	66	0.4	0.15
1	1.36	0.85	0.052756623	0.524400513	0.7	67	-0.51	0.17
1	0.81	0.79	0.0620551	0.570378435	0.715789474	68.5	-0.02	0.18
1	0.98	0.56	0.0620551	0.570378435	0.715789474	68.5	-0.42	0.18
1	0.7	1.56	0.145741393	0.617595358	0.731578947	70	0.86	0.27
1	0.7	0.78	0.164338347	0.649849449	0.742105263	71	0.08	0.29
1	0.79	0.58	0.192233779	0.682794284	0.752631579	72	-0.21	0.32
1	0.78	1.1	0.229427687	0.7164975	0.763157895	73	0.32	0.36
1	0.85	1.02	0.266621595	0.751035022	0.773684211	74	0.17	0.4
1	0.9	1.42	0.303815504	0.786492609	0.784210526	75	0.52	0.44
1	0.94	0.94	0.313113981	0.822967781	0.794736842	76	0	0.45
1	1.05	0.66	0.359606366	0.87983746	0.810526316	77.5	-0.39	0.5
1	3.83	2.45	0.359606366	0.87983746	0.810526316	77.5	-1.38	0.5
1	1.2	0.85	0.37820332	0.939705933	0.826315789	79	-0.35	0.52
1	0.96	1.68	0.433994183	0.98156177	0.836842105	80	0.72	0.58
1	1.04	1.66	0.471188091	1.02521202	0.847368421	81	0.62	0.62
1	0.75	1.27	0.471188091	1.070908605	0.857894737	82	0.52	0.62
1	0.71	1.43	0.489785045	1.118958381	0.868421053	83	0.72	0.64
1	1.56	1.38	0.499083522	1.169740876	0.878947368	84	-0.18	0.65
1	0.92	1.5	0.564172862	1.25211952	0.894736842	85.5	0.58	0.72
1	1.19	1.55	0.564172862	1.25211952	0.894736842	85.5	0.36	0.72
1	1.26	1.26	0.592068293	1.34400315	0.910526316	87	0	0.75
1	0.87	0.57	0.60136677	1.412187579	0.921052632	88	-0.3	0.76
1	1.24	1.16	0.685053064	1.487654225	0.931578947	89	-0.08	0.85
1	1.39	1.38	0.694351541	1.572694933	0.942105263	90	-0.01	0.86
1	0.85	0.87	0.778037834	1.670923232	0.952631579	91	0.02	0.95
1	1.16	0.88	0.964007376	1.858078308	0.968421053	92.5	-0.28	1.15
1	1.5	0.99	0.964007376	1.858078308	0.968421053	92.5	-0.51	1.15
1	0.96	0.57	1.568408385	2.149700064	0.984210526	94	-0.39	1.8
1	0.69	0.8	8.421385988	2.558042727	0.994736842	95	0.11	9.17

The Q-Q plot:

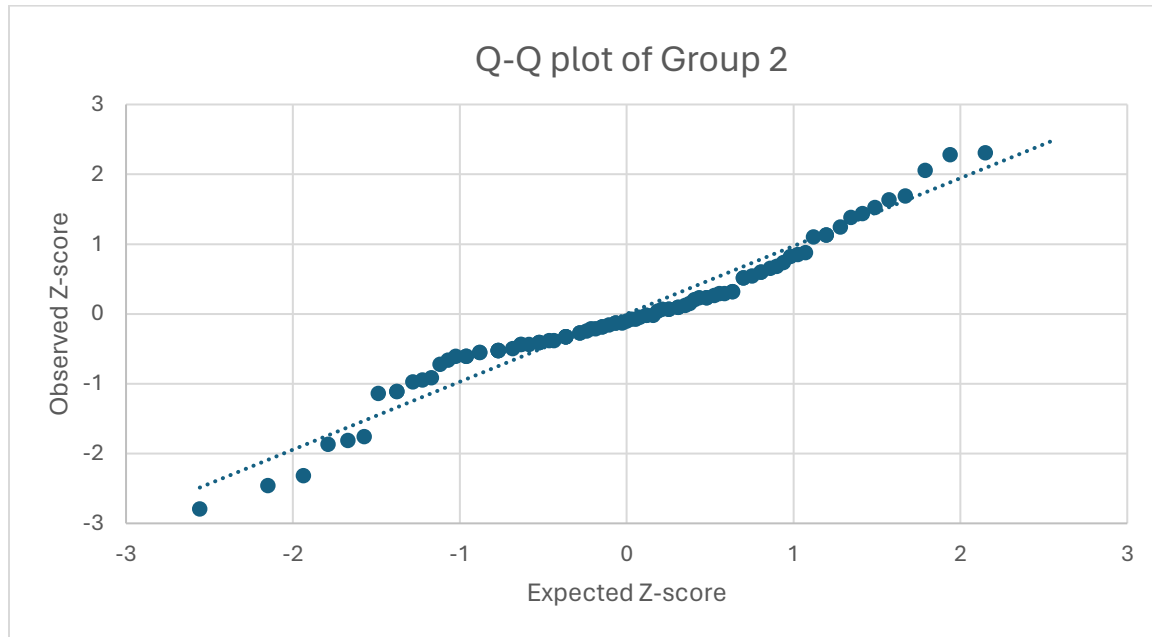


From the plot, it is seen that the data is mostly aligned with the trendline, with some minor discrepancies due to outliers. Hence, the data is considered to be normally distributed.

Group 2:

Group No.	Before Treat	After Treat	Observed z	Expected z	Percentiles	Rank	Difference
2	0.7	0.94	0.682616	0.899435	0.815789	78	0.24
2	0.84	1.05	0.598507	0.804596	0.789474	75.5	0.21
2	0.47	0.65	0.514397	0.699547	0.757895	72.5	0.18
2	0.81	1.07	0.738689	0.939706	0.826316	79	0.26
2	0.75	0.67	-0.21455	-0.18576	0.426316	41	-0.08
2	0.76	0.79	0.093849	0.308247	0.621053	59.5	0.03
2	0.91	1.12	0.598507	0.804596	0.789474	75.5	0.21
2	0.87	1.05	0.514397	0.699547	0.757895	72.5	0.18
2	0.99	0.98	-0.0183	0.119015	0.547368	52.5	-0.01
2	0.85	0.73	-0.3267	-0.36409	0.357895	34.5	-0.12
2	0.66	0.62	-0.10241	0	0.5	48	-0.04
2	0.85	0.93	0.234031	0.479506	0.684211	65.5	0.08
2	0.77	0.86	0.262068	0.524401	0.7	67	0.09
2	0.74	0.68	-0.15848	-0.10574	0.457895	44	-0.06
2	0.89	1.08	0.542433	0.751035	0.773684	74	0.19
2	0.9	0.75	-0.41081	-0.5244	0.3	29	-0.15
2	0.61	0.84	0.65458	0.860572	0.805263	77	0.23
2	0.75	0.73	-0.04633	0.07924	0.531579	51	-0.02
2	1.04	0.71	-0.91547	-1.16974	0.121053	12	-0.33
2	0.8	0.88	0.234031	0.435557	0.668421	64	0.08
2	0.66	0.77	0.318141	0.63364	0.736842	70.5	0.11
2	0.75	1.29	1.523713	1.487654	0.931579	89	0.54
2	0.72	0.74	0.065812	0.253347	0.6	57.5	0.02
2	0.96	0.86	-0.27063	-0.28069	0.389474	37.5	-0.1
2	0.73	0.72	-0.0183	0.119015	0.547368	52.5	-0.01
2	0.82	0.81	-0.0183	0.158981	0.563158	54	-0.01
2	0.68	0.7	0.065812	0.212677	0.584211	56	0.02
2	0.74	0.79	0.149922	0.378225	0.647368	62	0.05
2	1.41	1.15	-0.71921	-1.11896	0.131579	13	-0.26
2	0.77	1.08	0.878872	1.070909	0.857895	82	0.31
2	0.71	0.64	-0.18652	-0.14563	0.442105	42.5	-0.07
2	0.98	0.78	-0.55099	-0.87984	0.189474	18.5	-0.2
2	0.58	0.6	0.065812	0.253347	0.6	57.5	0.02
2	0.9	2.25	3.794673	2.558043	0.994737	95	1.35
2	0.87	0.68	-0.52296	-0.76864	0.221053	21.5	-0.19
2	1.03	0.81	-0.60707	-0.96042	0.168421	16.5	-0.22
2	0.82	0.62	-0.55099	-0.87984	0.189474	18.5	-0.2
2	0.82	0.83	0.037776	0.185762	0.573684	55	0.01
2	0.86	0.74	-0.3267	-0.36409	0.357895	34.5	-0.12
2	1.29	1.1	-0.52296	-0.76864	0.221053	21.5	-0.19
2	1.45	0.45	-2.79392	-2.55804	0.005263	1	-1
2	1.05	1.45	1.131201	1.196301	0.884211	84.5	0.4
2	1	0.66	-0.9435	-1.22373	0.110526	11	-0.34
2	0.86	1.15	0.822799	0.981562	0.836842	80	0.29
2	0.67	1.16	1.38353	1.344003	0.910526	87	0.49
2	1.55	1.47	-0.21455	-0.21268	0.415789	40	-0.08
2	0.75	1.14	1.103165	1.118958	0.868421	83	0.39
2	0.8	1.2	1.131201	1.196301	0.884211	84.5	0.4
2	0.88	0.64	-0.66314	-1.07091	0.142105	14	-0.24
2	0.89	0.8	-0.24259	-0.23975	0.405263	39	-0.09
2	0.72	0.8	0.234031	0.479506	0.684211	65.5	0.08
2	0.96	0.93	-0.07437	0.052796	0.521053	50	-0.03
2	0.85	0.71	-0.38277	-0.46476	0.321053	31	-0.14
2	0.95	0.79	-0.43885	-0.58597	0.278947	27	-0.16
2	0.95	0.76	-0.52296	-0.76864	0.221053	21.5	-0.19
2	1.55	0.88	-1.86871	-1.78857	0.036842	4	-0.67
2	0.65	0.6	-0.13044	-0.06601	0.473684	45.5	-0.05
2	0.95	0.73	-0.60707	-0.96042	0.168421	16.5	-0.22
2	1.1	0.88	-0.60707	-1.02521	0.152632	15	-0.22
2	1.05	0.7	-0.97154	-1.28155	0.1	10	-0.35
2	0.95	0.81	-0.38277	-0.43556	0.331579	32	-0.14
2	1.25	0.84	-1.13976	-1.48765	0.068421	7	-0.41
2	1.35	0.95	-1.11172	-1.3773	0.084211	8.5	-0.4
2	0.85	0.88	0.093849	0.308247	0.621053	59.5	0.03
2	0.8	0.65	-0.41081	-0.5244	0.3	29	-0.15
2	0.85	0.7	-0.41081	-0.5244	0.3	29	-0.15
2	0.45	0.4	-0.13044	-0.02639	0.489474	47	-0.05
2	1.1	0.7	-1.11172	-1.3773	0.084211	8.5	-0.4
2	0.9	0.8	-0.27063	-0.28069	0.389474	37.5	-0.1
2	0.75	0.86	0.318141	0.63364	0.736842	70.5	0.11
2	0.85	1.67	2.308736	2.1497	0.984211	94	0.82
2	0.75	0.72	-0.07437	0.026389	0.510526	49	-0.03
2	1.03	0.85	-0.49492	-0.68279	0.247368	24	-0.18
2	1	0.84	-0.43885	-0.63364	0.263158	25.5	-0.16
2	0.95	1.53	1.635859	1.572695	0.942105	90	0.58
2	0.8	1.61	2.2807	1.937932	0.973684	93	0.81
2	0.83	0.71	-0.3267	-0.36409	0.357895	34.5	-0.12
2	0.96	1	0.121885	0.350031	0.636842	61	0.04
2	0.85	0.95	0.290105	0.554923	0.710526	68	0.1
2	0.98	0.91	-0.18652	-0.14563	0.442105	42.5	-0.07
2	0.69	0.76	0.205995	0.406724	0.657895	63	0.07
2	0.73	0.61	-0.3267	-0.36409	0.357895	34.5	-0.12
2	0.85	1.15	0.850836	1.025212	0.847368	81	0.3
2	1.23	1.33	0.290105	0.585971	0.721053	69	0.1
2	0.91	0.75	-0.43885	-0.63364	0.263158	25.5	-0.16
2	1.57	0.74	-2.31729	-1.93793	0.026316	3	-0.83
2	1.48	0.85	-1.75656	-1.57269	0.057895	6	-0.63
2	1.63	0.75	-2.45748	-2.1497	0.015789	2	-0.88
2	1.28	0.63	-1.81264	-1.67092	0.047368	5	-0.65
2	0.99	1.59	1.691932	1.670923	0.952632	91	0.6
2	0.94	0.75	-0.52296	-0.76864	0.221053	21.5	-0.19
2	0.89	1.4	1.439603	1.412188	0.921053	88	0.51
2	0.67	1.4	2.056407	1.788569	0.963158	92	0.73
2	1.25	1.2	-0.13044	-0.06601	0.473684	45.5	-0.05
2	0.74	1.18	1.243347	1.281552	0.9	86	0.44

The Q-Q plot:

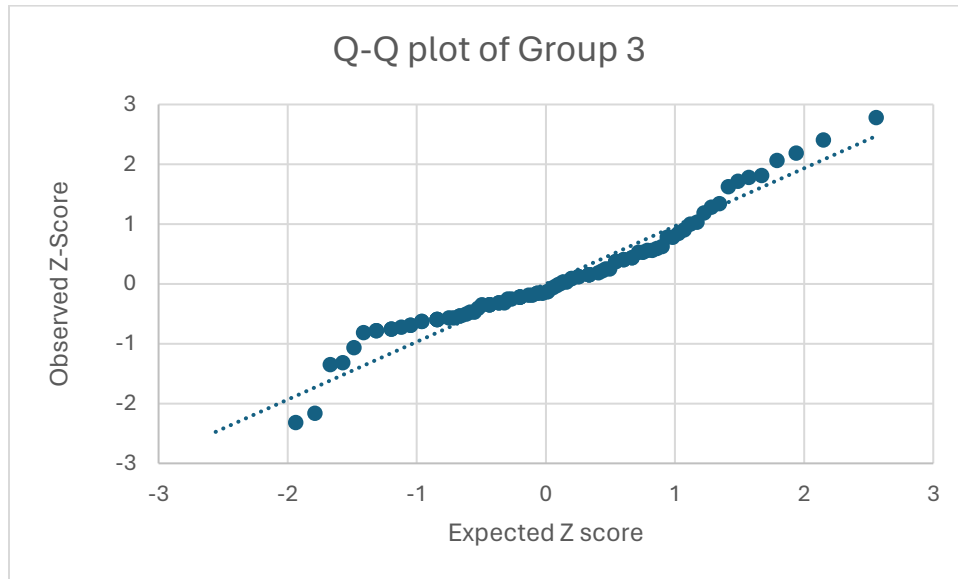


From the plot, it is seen that the data is mostly aligned with the trendline, with some minor discrepancies due to outliers. Hence, the data is considered to be normally distributed.

Group 3:

Group No.	Before Treat	After Treat	Observed z	Expected z	Percentile	Rank	Difference
3	1.48	0.42	-3.31865	-2.55804	0.005263	1	-1.06
3	0.78	0.92	0.436448	0.666231	0.747368	71.5	0.14
3	0.79	1.04	0.780665	0.981562	0.836842	80	0.25
3	0.8	0.74	-0.1894	-0.13231	0.447368	43	-0.06
3	0.84	0.65	-0.5962	-0.84162	0.2	19.5	-0.19
3	0.94	0.75	-0.5962	-0.84162	0.2	19.5	-0.19
3	0.86	0.98	0.373863	0.539599	0.705263	67.5	0.12
3	0.8	0.7	-0.31457	-0.36409	0.357895	34.5	-0.1
3	0.88	0.62	-0.81525	-1.41219	0.078947	8	-0.26
3	0.78	0.67	-0.34586	-0.43556	0.331579	32	-0.11
3	1.2	1.4	0.624203	0.899435	0.815789	78	0.2
3	1	0.75	-0.78396	-1.31214	0.094737	9.5	-0.25
3	0.72	0.8	0.248693	0.494359	0.689474	66	0.08
3	0.76	0.8	0.123523	0.253347	0.6	57.5	0.04
3	0.66	0.64	-0.06423	0.052796	0.521053	50	-0.02
3	0.71	0.98	0.84325	1.025212	0.847368	81	0.27
3	0.75	0.8	0.154816	0.336038	0.631579	60.5	0.05
3	0.72	0.75	0.092231	0.199201	0.578947	55.5	0.03
3	1.19	0.76	-1.34722	-1.67092	0.047368	5	-0.43
3	0.9	0.98	0.248693	0.464757	0.678947	65	0.08
3	0.66	0.72	0.186108	0.406724	0.657895	63	0.06
3	0.65	0.83	0.561618	0.786493	0.784211	75	0.18
3	0.65	0.72	0.217401	0.435557	0.668421	64	0.07
3	0.81	0.82	0.029646	0.132313	0.552632	53	0.01
3	0.56	0.68	0.373863	0.539599	0.705263	67.5	0.12
3	0.84	0.71	-0.40845	-0.5244	0.3	29	-0.13
3	0.72	1.05	1.031005	1.169741	0.878947	84	0.33
3	0.85	1.17	0.999713	1.118958	0.868421	83	0.32
3	1.01	1.71	2.188828	1.937932	0.973684	93	0.7
3	0.71	1	0.905835	1.070909	0.857895	82	0.29
3	0.83	0.77	-0.1894	-0.10574	0.457895	44	-0.06
3	0.83	1.6	2.407875	2.1497	0.984211	94	0.77
3	0.82	0.87	0.154816	0.336038	0.631579	60.5	0.05
3	0.81	0.66	-0.47103	-0.58597	0.278947	27	-0.15
3	0.87	0.8	-0.22069	-0.1992	0.421053	40.5	-0.07
3	0.71	0.66	-0.15811	-0.02639	0.489474	47	-0.05
3	0.77	0.69	-0.25199	-0.29444	0.384211	37	-0.08
3	0.67	0.8	0.405155	0.601708	0.726316	69.5	0.13
3	1.22	1.39	0.530325	0.716498	0.763158	73	0.17
3	0.73	0.9	0.530325	0.751035	0.773684	74	0.17
3	1.24	0.9	-1.06559	-1.48765	0.068421	7	-0.34
3	0.82	0.87	0.154816	0.336038	0.631579	60.5	0.05
3	0.62	0.65	0.092231	0.199201	0.578947	55.5	0.03
3	0.75	0.68	-0.22069	-0.1992	0.421053	40.5	-0.07
3	0.93	0.7	-0.72137	-1.11896	0.131579	13	-0.23
3	0.9	0.73	-0.53362	-0.66623	0.252632	24.5	-0.17
3	0.93	0.82	-0.34586	-0.49436	0.310526	30	-0.11
3	0.67	0.63	-0.12682	0.013193	0.505263	48.5	-0.04
3	0.87	0.68	-0.5962	-0.84162	0.2	19.5	-0.19
3	0.68	0.63	-0.15811	-0.06601	0.473684	45.5	-0.05
3	0.7	0.62	-0.25199	-0.26699	0.394737	38	-0.08
3	0.87	0.69	-0.56491	-0.75104	0.226316	22	-0.18
3	0.92	0.7	-0.69008	-1.04779	0.147368	14.5	-0.22
3	0.94	0.83	-0.34586	-0.43556	0.331579	32	-0.11
3	0.9	0.66	-0.75267	-1.1963	0.115789	11.5	-0.24
3	0.77	0.67	-0.31457	-0.32211	0.373684	36	-0.1
3	0.9	0.91	0.029646	0.158981	0.563158	54	0.01
3	0.71	0.6	-0.34586	-0.43556	0.331579	32	-0.11
3	0.93	0.76	-0.53362	-0.66623	0.252632	24.5	-0.17
3	0.72	0.65	-0.22069	-0.1992	0.421053	40.5	-0.07
3	1.15	0.73	-1.31593	-1.57269	0.057895	6	-0.42
3	0.76	1.42	2.063658	1.788569	0.963158	92	0.66
3	1.5	1.3	-0.6275	-0.96042	0.168421	16.5	-0.2
3	0.99	1.57	1.813318	1.670923	0.952632	91	0.58
3	0.85	1.03	0.561618	0.822968	0.794737	76	0.18
3	1.23	1.27	0.123523	0.253347	0.6	57.5	0.04
3	1.5	0.81	-2.16083	-1.78857	0.036842	4	-0.69
3	1.2	1.02	-0.56491	-0.7165	0.236842	23	-0.18
3	0.69	0.83	0.436448	0.666231	0.747368	71.5	0.14
3	0.71	0.9	0.59291	0.860572	0.805263	77	0.19
3	1.2	1.05	-0.47103	-0.55492	0.289474	28	-0.15
3	0.94	0.7	-0.75267	-1.1963	0.115789	11.5	-0.24
3	0.84	0.64	-0.6275	-0.96042	0.168421	16.5	-0.2
3	0.94	0.75	-0.5962	-0.84162	0.2	19.5	-0.19
3	0.93	1.45	1.625563	1.412188	0.921053	88	0.52
3	1.28	0.54	-2.31729	-1.93793	0.026316	3	-0.74
3	0.9	1.15	0.780665	0.939706	0.826316	79	0.25
3	1.09	1.05	-0.12682	0.013193	0.505263	48.5	-0.04
3	0.84	1.25	1.281345	1.281552	0.9	86	0.41
3	1.25	1.8	1.71944	1.487654	0.931579	89	0.55
3	0.83	1.4	1.782025	1.572695	0.942105	90	0.57
3	0.94	1.32	1.187468	1.223734	0.889474	85	0.38
3	0.55	0.98	1.34393	1.344003	0.910526	87	0.43
3	0.85	1.74	2.783385	2.558043	0.994737	95	0.89
3	0.76	0.6	-0.50233	-0.6176	0.268421	26	-0.16
3	0.95	1	0.154816	0.336038	0.631579	60.5	0.05
3	0.9	0.85	-0.15811	-0.06601	0.473684	45.5	-0.05
3	0.72	0.65	-0.22069	-0.1992	0.421053	40.5	-0.07
3	0.8	0.58	-0.69008	-1.04779	0.147368	14.5	-0.22
3	0.95	0.94	-0.03294	0.07924	0.531579	51	-0.01
3	0.92	1.05	0.405155	0.601708	0.726316	69.5	0.13
3	1.8	0.76	-3.25607	-2.1497	0.015789	2	-1.04
3	0.8	0.7	-0.31457	-0.36409	0.357895	34.5	-0.1
3	0.7	0.7	-0.00165	0.105739	0.542105	52	0
3	1.2	0.95	-0.78396	-1.31214	0.094737	9.5	-0.25

Q-Q plot:



From the plot, it is seen that the data is mostly aligned with the trendline, with some minor discrepancies due to outliers. Hence, the data is considered to be normally distributed.

CHAPTER 3: COMPARING MEANS' HYPOTHESIS FOR THE GROUPS

For Group 1

Paired t-test are conducted to see if there is any difference in the average values of creatinine level before and after treatment.

Paired t-test is chosen because the data is collected from the same group of people at two different times (Before and After Treatment) and it is the best method to assess the effectiveness of the treatment.

Null hypothesis, H_0 : The mean difference between before and after treatment is equal to zero.

$H_0: \mu_d = 0$, where μ_d is the population mean difference.

Alternative hypothesis, H_a : The mean difference between before and after treatment is not zero.

$H_a: \mu_d > 0$ -for one tailed

$H_a: \mu_d \neq 0$ -for two tailed.

The test statistics:

$$t = \frac{\bar{d} - 0}{s_d / \sqrt{n}} = \frac{\bar{d}}{s_d / \sqrt{n}}$$

Where,

n = Number of paired differences

\bar{d} = Mean of the sample differences

sd = Standard deviation of the sample differences

Calculation:

Group No.	Before Treat	After Treat	Difference
1	0.97	0.95	-0.02
1	0.88	1.17	0.29
1	0.96	0.9	-0.06
1	0.74	0.71	-0.03
1	0.85	0.73	-0.12
1	1.06	1.1	0.04
1	0.65	0.68	0.03
1	0.65	0.83	0.18
1	0.94	0.8	-0.14
1	0.86	0.76	-0.1
1	0.78	0.84	0.06
1	0.84	1.28	0.44
1	0.75	0.83	0.08
1	0.82	0.92	0.1
1	0.76	0.72	-0.04
1	2.1	1.7	-0.4
1	1.38	1.07	-0.31
1	1.8	0.8	-1
1	0.77	0.83	0.06
1	0.76	0.75	-0.01
1	1.2	0.68	-0.52
1	0.99	0.85	-0.14
1	0.71	0.72	0.01
1	0.92	0.84	-0.08
1	0.75	0.7	-0.05
1	0.85	0.95	0.1
1	3.25	4.2	0.95
1	1.25	1.43	0.18
1	1.07	1.01	-0.06
1	0.85	0.99	0.14
1	1.48	1.33	-0.15
1	0.84	1.6	0.76
1	0.95	1.6	0.65
1	0.68	1.3	0.62
1	0.75	1.2	0.45
1	0.95	1.45	0.5
1	0.75	1.5	0.75
1	1.9	1.49	-0.41
1	0.85	2	1.15
1	1.17	1.44	0.27
1	0.75	0.7	-0.05
1	0.87	1	0.13
1	1	1	0
1	0.75	0.82	0.07
1	1.15	0.7	-0.45
1	1.45	0.7	-0.75
1	1.35	0.86	-0.49
1	0.95	0.65	-0.3
1	1.05	0.65	-0.4
1	1	0.65	-0.35
1	0.8	0.74	-0.06
1	2.05	1.2	-0.85
1	1.25	0.96	-0.29
1	1.75	0.76	-0.99
1	0.95	0.7	-0.25
1	1.45	0.95	-0.5
1	1.15	0.85	-0.3
1	1.2	0.86	-0.34
1	1.02	1.13	0.11
1	1.15	0.95	-0.2
1	0.9	0.84	-0.06
1	1.15	2	0.85
1	1.4	1.9	0.5
1	0.7	0.85	0.15
1	0.7	1.34	0.64
1	0.75	1.15	0.4
1	1.36	0.85	-0.51
1	0.81	0.79	-0.02
1	0.98	0.56	-0.42
1	0.7	1.56	0.86
1	0.7	0.78	0.08
1	0.79	0.58	-0.21
1	0.78	1.1	0.32
1	0.85	1.02	0.17
1	0.9	1.42	0.52
1	0.94	0.94	0
1	1.05	0.66	-0.39
1	3.83	2.45	-1.38
1	1.2	0.85	-0.35
1	0.96	1.68	0.72
1	1.04	1.66	0.62
1	0.75	1.27	0.52
1	0.71	1.43	0.72
1	1.56	1.38	-0.18
1	0.92	1.5	0.58
1	1.19	1.55	0.36
1	1.26	1.26	0
1	0.87	0.57	-0.3
1	1.24	1.16	-0.08
1	1.39	1.38	-0.01
1	0.85	0.87	0.02
1	1.16	0.88	-0.28
1	1.5	0.99	-0.51
1	0.96	0.57	-0.39
1	0.69	0.8	0.11

The calculated values are summarized in the following table:

	Before Treatment(create_68)	After treatment(create_69)	Difference After-Before treatment	t-value	p-value
Data size	n=95	n=95	Pairs=95	0.220159	0.826225
Mean	1.074842	1.084947	0.010105		
Standard Deviation	0.479419	0.494168	0.447377		

Critical Value Approach:

At $\alpha=0.05$, and $df=94$ the critical t value is 1.660

Hence, the null hypothesis will be rejected if $t > 1.660$ or $t < -1.660$

Since the value of t does not fall within these ranges, the null hypothesis is not rejected.

P-value Approach:

Since the p-value (0.826225) is greater than the significance level, the null hypothesis cannot be rejected.

Double tail

$t = 0.220159$

$t_{\alpha/2} = \pm 1.9855$

Since t is not $> t_{\alpha/2}$ and not $< -t_{\alpha/2}$, the null hypothesis is not rejected.

Confidence Interval

Formula for calculation of confidence interval:

$$\bar{d} \pm t_{\alpha/2} \left(\frac{s_d}{\sqrt{n}} \right)$$

At 95% confidence interval:

Lower bound= -0.08103

Upper bound=0.101239

Since the interval contains 0, the null hypothesis cannot be rejected.

Single tail

t= 0.220159

$t_{\alpha}=1.66$

Since t is not $> t_{\alpha}$, the null hypothesis is not rejected.

Confidence Interval

At 95% confidence interval:

Lower bound= -0.06609

Upper bound= 0.086299

Since the interval contains 0, the null hypothesis cannot be rejected.

In summary, it can be said that there is not enough evidence to conclude that the means are significantly different.

For Group 2

Paired t-test are conducted to see if there is any difference in the average values of creatinine level before and after treatment.

Paired t-test is chosen because the data is collected from the same group of people at two different times (Before and After Treatment) and it is the best method to assess the effectiveness of the treatment.

Null hypothesis, H_0 : The mean difference between before and after treatment is equal to zero.

$H_0: \mu_d=0$, where μ_d is the population mean difference.

Alternative hypothesis, H_a : The mean difference between before and after treatment is not zero.

$H_a : \mu_d > 0$ -for one tailed

$H_a: \mu_d \neq 0$ -for two tailed.

The test statistics:

$$t = \frac{\bar{d} - 0}{s_d / \sqrt{n}} = \frac{\bar{d}}{s_d / \sqrt{n}}$$

Where,

n = Number of paired differences

\bar{d} = Mean of the sample differences

sd = Standard deviation of the sample differences

Calculation:

Group No.	Before Treat	After Treat	Difference
2	0.7	0.94	0.24
2	0.84	1.05	0.21
2	0.47	0.65	0.18
2	0.81	1.07	0.26
2	0.75	0.67	-0.08
2	0.76	0.79	0.03
2	0.91	1.12	0.21
2	0.87	1.05	0.18
2	0.99	0.98	-0.01
2	0.85	0.73	-0.12
2	0.66	0.62	-0.04
2	0.85	0.93	0.08
2	0.77	0.86	0.09
2	0.74	0.68	-0.06
2	0.89	1.08	0.19
2	0.9	0.75	-0.15
2	0.61	0.84	0.23
2	0.75	0.73	-0.02
2	1.04	0.71	-0.33
2	0.8	0.88	0.08
2	0.66	0.77	0.11
2	0.75	1.29	0.54
2	0.72	0.74	0.02
2	0.96	0.86	-0.1
2	0.73	0.72	-0.01
2	0.82	0.81	-0.01
2	0.68	0.7	0.02
2	0.74	0.79	0.05
2	1.41	1.15	-0.26
2	0.77	1.08	0.31
2	0.71	0.64	-0.07
2	0.98	0.78	-0.2
2	0.58	0.6	0.02
2	0.9	2.25	1.35
2	0.87	0.68	-0.19
2	1.03	0.81	-0.22
2	0.82	0.62	-0.2
2	0.82	0.83	0.01
2	0.86	0.74	-0.12
2	1.29	1.1	-0.19
2	1.45	0.45	-1
2	1.05	1.45	0.4
2	1	0.66	-0.34
2	0.86	1.15	0.29
2	0.67	1.16	0.49
2	1.55	1.47	-0.08
2	0.75	1.14	0.39
2	0.8	1.2	0.4
2	0.88	0.64	-0.24
2	0.89	0.8	-0.09
2	0.72	0.8	0.08
2	0.96	0.93	-0.03
2	0.85	0.71	-0.14
2	0.95	0.79	-0.16
2	0.95	0.76	-0.19
2	1.55	0.88	-0.67
2	0.65	0.6	-0.05
2	0.95	0.73	-0.22
2	1.1	0.88	-0.22
2	1.05	0.7	-0.35
2	0.95	0.81	-0.14
2	1.25	0.84	-0.41
2	1.35	0.95	-0.4
2	0.85	0.88	0.03
2	0.8	0.65	-0.15
2	0.85	0.7	-0.15
2	0.45	0.4	-0.05
2	1.1	0.7	-0.4
2	0.9	0.8	-0.1
2	0.75	0.86	0.11
2	0.85	1.67	0.82
2	0.75	0.72	-0.03
2	1.03	0.85	-0.18
2	1	0.84	-0.16
2	0.95	1.53	0.58
2	0.8	1.61	0.81
2	0.83	0.71	-0.12
2	0.96	1	0.04
2	0.85	0.95	0.1
2	0.98	0.91	-0.07
2	0.69	0.76	0.07
2	0.73	0.61	-0.12
2	0.85	1.15	0.3
2	1.23	1.33	0.1
2	0.91	0.75	-0.16
2	1.57	0.74	-0.83
2	1.48	0.85	-0.63
2	1.63	0.75	-0.88
2	1.28	0.63	-0.65
2	0.99	1.59	0.6
2	0.94	0.75	-0.19
2	0.89	1.4	0.51
2	0.67	1.4	0.73
2	1.25	1.2	-0.05
2	0.74	1.18	0.44

The calculated values are summarized in the following table:

	Before Treatment(create_68)	After treatment(create_69)	Difference After- Before treatment	t-value	p-value
Data size	n=95	n=95	Pairs=95	-0.09492	0.92457
Mean	0.913579	0.910105	-0.00347		
Standard Deviation	0.238099	0.296413	0.356677		

Critical Value Approach:

At $\alpha=0.05$, and $df=94$ the critical t value is 1.660

Hence, the null hypothesis will be rejected if $t > 1.660$ or $t < -1.660$

Since the value of t does not fall within these ranges, the null hypothesis is not rejected.

P-value Approach:

Since the p-value (0.924577) is greater than the significance level, the null hypothesis cannot be rejected.

Double tail

$t = -0.09492$

$t_{\alpha/2} = \pm 1.9855$

Since t is not $> t_{\alpha/2}$ and not $< -t_{\alpha/2}$, the null hypothesis is not rejected.

Confidence Interval

Formula for calculation of confidence interval:

$$\bar{d} \pm t_{\alpha/2} \left(\frac{s_d}{\sqrt{n}} \right)$$

At 95% confidence interval:

Lower bound= -0.07613

Upper bound=0.069184

Since the interval contains 0, the null hypothesis cannot be rejected.

Single tail

t= -0.09492

$t_{\alpha}=1.66$

Since t is not $> t_{\alpha}$, the null hypothesis is not rejected.

Confidence Interval

At 95% confidence interval:

Lower bound= -0.06422

Upper bound= 0.057273

Since the interval contains 0, the null hypothesis cannot be rejected.

In summary, it can be said that there is not enough evidence to conclude that the means are significantly different.

For Group 3

Paired t-test are conducted to see if there is any difference in the average values of creatinine level before and after treatment.

Paired t-test is chosen because the data is collected from the same group of people at two different times (Before and After Treatment) and it is the best method to assess the effectiveness of the treatment.

Null hypothesis, H_0 : The mean difference between before and after treatment is equal to zero.

$H_0: \mu_d=0$, where μ_d is the population mean difference.

Alternative hypothesis, H_a : The mean difference between before and after treatment is not zero.

$H_a : \mu_d > 0$ -for one tailed

$H_a: \mu_d \neq 0$ -for two tailed.

The test statistics:

$$t = \frac{\bar{d} - 0}{s_d / \sqrt{n}} = \frac{\bar{d}}{s_d / \sqrt{n}}$$

Where,

n = Number of paired differences

\bar{d} = Mean of the sample differences

s_d = Standard deviation of the sample differences

Calculation:

Group No.	Before Treat	After Treat	Difference
3	1.48	0.42	-1.06
3	0.78	0.92	0.14
3	0.79	1.04	0.25
3	0.8	0.74	-0.06
3	0.84	0.65	-0.19
3	0.94	0.75	-0.19
3	0.86	0.98	0.12
3	0.8	0.7	-0.1
3	0.88	0.62	-0.26
3	0.78	0.67	-0.11
3	1.2	1.4	0.2
3	1	0.75	-0.25
3	0.72	0.8	0.08
3	0.76	0.8	0.04
3	0.66	0.64	-0.02
3	0.71	0.98	0.27
3	0.75	0.8	0.05
3	0.72	0.75	0.03
3	1.19	0.76	-0.43
3	0.9	0.98	0.08
3	0.6	0.57	-0.03
3	0.66	0.72	0.06
3	0.65	0.83	0.18
3	0.65	0.72	0.07
3	0.81	0.82	0.01
3	0.56	0.68	0.12
3	0.84	0.71	-0.13
3	0.72	1.05	0.33
3	0.85	1.17	0.32
3	1.01	1.71	0.7
3	0.71	1	0.29
3	0.83	0.77	-0.06
3	0.83	1.6	0.77
3	0.82	0.87	0.05
3	0.81	0.66	-0.15
3	0.87	0.8	-0.07
3	0.71	0.66	-0.05
3	0.77	0.69	-0.08
3	0.67	0.8	0.13
3	1.22	1.39	0.17
3	0.73	0.9	0.17
3	1.24	0.9	-0.34
3	0.82	0.87	0.05
3	0.62	0.65	0.03
3	0.75	0.68	-0.07
3	0.93	0.7	-0.23
3	0.9	0.73	-0.17
3	0.93	0.82	-0.11
3	0.67	0.63	-0.04
3	0.87	0.68	-0.19
3	0.68	0.63	-0.05
3	0.7	0.62	-0.08
3	0.87	0.69	-0.18
3	0.92	0.7	-0.22
3	0.94	0.83	-0.11
3	0.9	0.66	-0.24
3	0.77	0.67	-0.1
3	0.9	0.91	0.01
3	0.71	0.6	-0.11
3	0.93	0.76	-0.17
3	0.72	0.65	-0.07
3	1.15	0.73	-0.42
3	0.76	1.42	0.66
3	1.5	1.3	-0.2
3	0.99	1.57	0.58
3	0.85	1.03	0.18
3	1.23	1.27	0.04
3	1.5	0.81	-0.69
3	1.2	1.02	-0.18
3	0.69	0.83	0.14
3	0.71	0.9	0.19
3	1.2	1.05	-0.15
3	0.94	0.7	-0.24
3	0.84	0.64	-0.2
3	0.94	0.75	-0.19
3	0.93	1.45	0.52
3	1.28	0.54	-0.74
3	0.9	1.15	0.25
3	1.09	1.05	-0.04
3	0.84	1.25	0.41
3	1.25	1.8	0.55
3	0.83	1.4	0.57
3	0.94	1.32	0.38
3	0.55	0.98	0.43
3	0.85	1.74	0.89
3	0.76	0.6	-0.16
3	0.95	1	0.05
3	0.9	0.85	-0.05
3	0.72	0.65	-0.07
3	0.8	0.58	-0.22
3	0.95	0.94	-0.01
3	0.92	1.05	0.13
3	1.8	0.76	-1.04
3	0.8	0.7	-0.1
3	0.7	0.7	0
3	1.2	0.95	-0.25

The calculated values are summarized in the following table:

	Before Treatment(create_68)	After treatment(create_69)	Difference After- Before treatment	t-value	p- value
Data size	n=95	n=95	Pairs=95	0.01605 3	0.98722 6
Mean	0.889579	0.890105	0.000526		
Standard Deviation	0.219656	0.289142	0.319565		

Critical Value Approach:

At $\alpha=0.05$, and $df=94$ the critical t value is 1.660

Hence, the null hypothesis will be rejected if $t>1.660$ or $t<-1.660$

Since the value of t does not fall within these ranges, the null hypothesis is not rejected.

P-value Approach:

Since the p-value (0.987226) is greater than the significance level, the null hypothesis cannot be rejected.

Double tail

$t=0.016053$

$t_{\alpha/2}=\pm 1.9855$

Since t is not $> t_{\alpha/2}$ and not $< -t_{\alpha/2}$, the null hypothesis is not rejected.

Confidence Interval

Formula for calculation of confidence interval:

$$\bar{d} \pm t_{\alpha/2} \left(\frac{s_d}{\sqrt{n}} \right)$$

At 95% confidence interval:

Lower bound= -0.06423

Upper bound=0.065284

Since the interval contains 0, the null hypothesis cannot be rejected.

Single tail

$t = 0.016053$

$t_{\alpha} = 1.66$

Since t is not $> t_{\alpha}$, the null hypothesis is not rejected.

Confidence Interval

At 95% confidence interval:

Lower bound= -0.05362

Upper bound= 0.054668

Since the interval contains 0, the null hypothesis cannot be rejected.

In summary, it can be said that there is not enough evidence to conclude that the means are significantly different.

CHAPTER 4: LARGE SAMPLE TEST

Taking large samples ($n=32$) at random from after treatment (create_69) values of Group 2 and Group 3 respectively, z-test are conducted to see if there is any difference in the average values of creatinine level after treatment for group 2 (moderately impaired renal functions) and group 3 (Severely impaired renal function).

Hypothesis:

Null hypothesis, H_0 : The mean difference between before and after treatment is equal to zero.

$H_0: D_0 = 0$, where D_0 is the population mean difference.

Alternative hypothesis, H_a : The mean difference between before and after treatment is not zero.

$H_a: D_0 > 0$ -for one tailed

$H_a: D_0 \neq 0$ -for two tailed.

For conduction of the test, the following values are obtained:

Group 2	Group 3	Difference
0.94	0.42	-0.52
1.05	0.92	-0.13
0.65	1.04	0.39
1.07	0.74	-0.33
0.67	0.65	-0.02
0.79	0.75	-0.04
1.12	0.98	-0.14
0.98	0.7	-0.28
0.73	0.62	-0.11
0.62	0.67	0.05
0.93	1.4	0.47
0.86	0.75	-0.11
0.68	0.8	0.12
1.08	0.8	-0.28
0.75	0.64	-0.11
0.84	0.98	0.14
0.73	0.8	0.07
0.71	0.75	0.04
0.88	0.76	-0.12
0.77	0.98	0.21
1.29	0.72	-0.57
0.86	0.72	-0.14
0.72	0.83	0.11
0.81	0.72	-0.09
0.7	0.82	0.12
0.79	0.68	-0.11
1.15	0.71	-0.44
1.08	1.05	-0.03
0.64	1.17	0.53
0.78	1.71	0.93
0.6	1	0.4
2.25	0.77	-1.48

Values are shown in the table below:

	Group 2 After Treatment(create _69)	Group 3 After treatment(create _69)	Difference (x2-x1)	z-value	p-value (two-tails)	p-value(one-tail)
Data size	n=32	n=32		0.666889	0.504843	0.2524
Mean	0.89125	0.845313	-0.04594			
Standard Deviation	0.304141	0.243589				

$$\text{Test statistic: } z \approx \frac{(\bar{x}_1 - \bar{x}_2) - D_0}{\text{SE}} = \frac{(\bar{x}_1 - \bar{x}_2) - D_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

The p-value is obtained from a standard normal distribution table.

Critical Value Approach:

At $\alpha=0.05$, the critical z value is 1.64.

Hence, the null hypothesis will be rejected if $z > 1.64$ or $z < -1.64$

Since the value of z does not fall within these ranges, the null hypothesis is not rejected.

P-value Approach:

Since the p-value is greater than the significance level 0.05, the null hypothesis cannot be rejected.

Double tail

$$z = 0.666889$$

$$z_{\alpha/2} = \pm 1.96$$

Since z is not $> z_{\alpha/2}$ and not $< -z_{\alpha/2}$, the null hypothesis is not rejected.

Confidence Interval

$$(\bar{x}_1 - \bar{x}_2) \pm 1.96 \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

At 95% confidence interval:

$$\text{Lower bound} = -0.18074$$

Upper bound= 0.088863

Since the interval contains 0, the null hypothesis cannot be rejected.

Single tail:

$z = 0.666889$

$z_{\alpha} = 1.64$

Since z is not $> z_{\alpha}$, the null hypothesis is not rejected.

At 95% confidence interval:

Upper bound= 0.066863

In summary, it can be said that there is not enough evidence to conclude that the means are significantly different between group 2 and group 3 after treatment.

CHAPTER 5: SMALL SAMPLE TEST

Taking small samples (n=9) at random from after treatment (create_69) values of group 2 and group 3 respectively, t-test is conducted to see if there is any difference in the average values of creatinine level after treatment for group 2 (moderately impaired renal functions) and group 3 (Severely impaired renal function).

Null hypothesis, H_0 : The mean difference between before and after treatment is equal to zero.

$H_0: \mu_d = 0$, where μ_d is the sample mean difference.

Alternative hypothesis, H_a : The mean difference between before and after treatment is not zero.

$H_a: \mu_d > 0$ -for one tailed

$H_a: \mu_d \neq 0$ -for two tailed.

For conduction of the test, the following values are obtained:

Group 2	Group 3	Difference
0.94	0.42	-0.52
1.05	0.92	-0.13
0.65	1.04	0.39
1.07	0.74	-0.33
0.67	0.65	-0.02
0.79	0.75	-0.04
1.12	0.98	-0.14
0.98	0.7	-0.28
0.73	0.62	-0.11

The values are shown in the table below:

	Group 2 After Treatment(create_69)	Group 3 After treatment(create_69)	S ²	t-value	p-value
			0.0354	-1.478	0.1
Data size	n1=9	n 2=9			
Mean	0.888889	1.681			

Standard Deviation	0.181345	0.194857			
--------------------	----------	----------	--	--	--

Formula for calculation of S^2

$$s^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

Formula for calculation of t:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{s^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

The degree of freedom, df: (9+9-2=16)

The p-value is obtained from chart.

Critical Value Approach:

At $\alpha=0.05$, and df=16 the critical t value is ± 1.7459

Hence, the null hypothesis will be rejected if $t > 1.74$ or $t < -1.74$

Since the value of t does not fall within these ranges, the null hypothesis is not rejected.

P-value Approach:

Since the calculated p-value (0.1) is greater than the significance level 0.05, the null hypothesis cannot be rejected.

Double tail

$t = -1.478$

$t_{\alpha/2} = \pm 2.1199$

Since t is not $> t_{\alpha/2}$ and not $< -t_{\alpha/2}$, the null hypothesis is not rejected.

Confidence Interval

Formula for calculation of confidence interval:

$$(\bar{x}_1 - \bar{x}_2) \pm t_{\alpha/2} \sqrt{s^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$$

At 95% confidence interval:

Lower bound= -0.31913

Upper bound=0.056903

Since the interval contains 0, the null hypothesis cannot be rejected.

Single tail

$t = -1.478$

$t_{\alpha} = 1.745$

Since t is not $> t_{\alpha}$, the null hypothesis is not rejected.

Confidence Interval

At 95% confidence interval:

Lower bound= -0.28588

Upper bound= 0.023653

Since the interval contains 0, the null hypothesis cannot be rejected.

In summary, it can be said that there is not enough evidence to conclude that the means are significantly different.

CHAPTER 6: COMPARISONS

The findings from the t-paired tests of the 3 groups can be summarized in the following table:

<u>T-pair test for Dataset</u>						
	<u>Group 1</u>		<u>Group 2</u>		<u>Group 3</u>	
	Before Treatment(Create_68)	After Treatment(Create_69)	Before Treatment(Create_68)	After Treatment(Create_69)	Before Treatment(Create_68)	After Treatment(Create_69)
<u>Mean</u>	1.074842	1.084947	0.913579	0.910105	0.889579	0.890105
<u>Varian ce</u>	0.229842	0.244202	0.056691	0.087861	0.048249	0.083603
<u>Obser vation s</u>	<u>95</u>	<u>95</u>	<u>95</u>	<u>95</u>	<u>95</u>	<u>95</u>
<u>Hypot hesize d Mean Differe nce</u>	<u>0</u>		<u>0</u>		<u>0</u>	
<u>t- value</u>	0.220159		-0.09492		0.016053	
<u>p- value</u>	0.826225		0.924577		0.987226	

From these tests, it can be concluded that there is not enough evidence to prove that there is difference in the mean of before and after treatment in the groups.

Z-Test for Large Dataset		
	Group 2 After Treatment(Create_69)	Group 3 After Treatment(Create_69)
<u>Mean</u>	0.89125	0.845313
<u>Variance</u>	0.092502	0.059335
<u>Observations</u>	<u>32</u>	<u>32</u>
<u>Hypothesized Mean Difference</u>	<u>0</u>	
<u>z-value</u>	0.666889	
<u>p-value (one tail)</u>	0.2524	
<u>p-value (Two tail)</u>	0.504843	

T-Test for Small Dataset		
	Group 2 After Treatment(Create_69)	Group 3 After Treatment(Create_69)
<u>Mean</u>	0.888889	1.681
<u>Variance</u>	0.032886	0.037969
<u>Observations</u>	<u>9</u>	<u>9</u>
<u>Hypothesized Mean Difference</u>	<u>0</u>	
<u>t-value</u>	-1.478	
<u>p-value (Two tail)</u>	0.1	

Taking large and small samples from the dataset, we find that there is no significant difference in the means. Hence, it can be said that the treatment did not cause significant changes.

CHAPTER 7: CORRELATION AND HYPOTHESIS TESTING

For Group 1

Hypothesis testing:

Ho=There is no relationship between before and after treatment.

Or, Ho: $r=0$

Ha=There is significant relation between before and after treatment.

Or, Ha: $r \neq 0$

Given Data:

Group 1(Mild Impairment)	
Before Treatment(Create_68)	After Treatment(Create_69)
0.97	0.95
0.88	1.17
0.96	0.9
0.74	0.71
0.85	0.73
1.06	1.1
0.65	0.68
0.65	0.83
0.94	0.8
0.86	0.76
0.78	0.84
0.84	1.28
0.75	0.83
0.82	0.92
0.76	0.72
2.1	1.7
1.38	1.07
1.8	0.8
0.77	0.83
0.76	0.75
1.2	0.68
0.99	0.85

0.71	0.72
0.92	0.84
0.75	0.7
0.85	0.95
3.25	4.2
1.25	1.43
1.07	1.01
0.85	0.99
1.48	1.33
0.84	1.6
0.95	1.6
0.68	1.3
0.75	1.2
0.95	1.45
0.75	1.5
1.9	1.49
0.85	2
1.17	1.44
0.75	0.7
0.87	1
1	1
0.75	0.82
1.15	0.7
1.45	0.7
1.35	0.86
0.95	0.65
1.05	0.65
1	0.65
0.8	0.74
2.05	1.2
1.25	0.96
1.75	0.76
0.95	0.7
1.45	0.95
1.15	0.85
1.2	0.86
1.02	1.13
1.15	0.95
0.9	0.84
1.15	2
1.4	1.9
0.7	0.85

0.7	1.34
0.75	1.15
1.36	0.85
0.81	0.79
0.98	0.56
0.7	1.56
0.7	0.78
0.79	0.58
0.78	1.1
0.85	1.02
0.9	1.42
0.94	0.94
1.05	0.66
3.83	2.45
1.2	0.85
0.96	1.68
1.04	1.66
0.75	1.27
0.71	1.43
1.56	1.38
0.92	1.5
1.19	1.55
1.26	1.26
0.87	0.57
1.24	1.16
1.39	1.38
0.85	0.87
1.16	0.88
1.5	0.99
0.96	0.57
0.69	0.8

From Excel, we generate the regression table to compare if there is relationship between after treatment and before treatment.

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.577794
R Square	0.333846
Adjusted R Square	0.326605

Standard Error	0.407528
Observations	94

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	7.657288	7.657288	46.10626	1.08E-09
Residual	92	15.27928	0.166079		
Total	93	22.93655			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	0.445667	0.103298	4.314378	4.02E-05	0.240508	0.650826	0.240508	0.650826
0.97	0.595484	0.087698	6.790159	1.08E-09	0.421308	0.769668	0.421308	0.769668

From the table, we obtain the r value as 0.577794. Since the p value .08E-09 is less than the significant level of 0.05, the null hypothesis is rejected. Hence, it can be said that there is significant relationship between after and before treatment creatinine levels.

For Group 2

Hypothesis testing:

Ho=There is no relationship between before and after treatment.

Or, Ho: $r=0$

Ha=There is significant relation between before and after treatment.

Or, Ha: $r \neq 0$

Given Data:

Group 2(Moderate Impairment)	
Before Treatment(Create_68)	After Treatment(Create_69)
0.7	0.94
0.84	1.05

0.47	0.65
0.81	1.07
0.75	0.67
0.76	0.79
0.91	1.12
0.87	1.05
0.99	0.98
0.85	0.73
0.66	0.62
0.85	0.93
0.77	0.86
0.74	0.68
0.89	1.08
0.9	0.75
0.61	0.84
0.75	0.73
1.04	0.71
0.8	0.88
0.66	0.77
0.75	1.29
0.72	0.74
0.96	0.86
0.73	0.72
0.82	0.81
0.68	0.7
0.74	0.79
1.41	1.15
0.77	1.08
0.71	0.64
0.98	0.78
0.58	0.6
0.9	2.25
0.87	0.68
1.03	0.81
0.82	0.62
0.82	0.83
0.86	0.74
1.29	1.1
1.45	0.45
1.05	1.45
1	0.66
0.86	1.15
0.67	1.16
1.55	1.47
0.75	1.14
0.8	1.2
0.88	0.64
0.89	0.8

0.72	0.8
0.96	0.93
0.85	0.71
0.95	0.79
0.95	0.76
1.55	0.88
0.65	0.6
0.95	0.73
1.1	0.88
1.05	0.7
0.95	0.81
1.25	0.84
1.35	0.95
0.85	0.88
0.8	0.65
0.85	0.7
0.45	0.4
1.1	0.7
0.9	0.8
0.75	0.86
0.85	1.67
0.75	0.72
1.03	0.85
1	0.84
0.95	1.53
0.8	1.61
0.83	0.71
0.96	1
0.85	0.95
0.98	0.91
0.69	0.76
0.73	0.61
0.85	1.15
1.23	1.33
0.91	0.75
1.57	0.74
1.48	0.85
1.63	0.75
1.28	0.63
0.99	1.59
0.94	0.75
0.89	1.4
0.67	1.4
1.25	1.2
0.74	1.18

From Excel, we generate the regression table to compare if there is relationship between after treatment and before treatment.

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.124318
R Square	0.015455
Adjusted R Square	0.004753
Standard Error	0.297277
Observations	94

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.127626	0.127626	1.444165	0.232551
Residual	92	8.130378	0.088374		
Total	93	8.257994			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	0.767437	0.122358	6.272045	1.14E-08	0.524423	1.010451	0.524423	1.010451
0.7	0.15543	0.129338	1.201734	0.232551	-0.101456	0.412306	-0.101456	0.412306

From the table, we obtain the r value as 0.124318. Since the p value 0.232551 is greater than the significant level of 0.05, the null hypothesis is not rejected. Hence, it can be said that there is no relationship between after and before treatment creatinine levels.

For Group 3

Hypothesis testing:

Ho=There is no relationship between before and after treatment.

Or, Ho: $r=0$

Ha=There is significant relation between before and after treatment.

Or, $H_a: r \neq 0$

Given Data:

Group 3(Severe Impairment)	
Before Treatmenent(Create_68)	After Treatmenent(Create_69)
1.48	0.42
0.78	0.92
0.79	1.04
0.8	0.74
0.84	0.65
0.94	0.75
0.86	0.98
0.8	0.7
0.88	0.62
0.78	0.67
1.2	1.4
1	0.75
0.72	0.8
0.76	0.8
0.66	0.64
0.71	0.98
0.75	0.8
0.72	0.75
1.19	0.76
0.9	0.98
0.66	0.72
0.65	0.83
0.65	0.72
0.81	0.82
0.56	0.68
0.84	0.71
0.72	1.05
0.85	1.17
1.01	1.71
0.71	1
0.83	0.77
0.83	1.6
0.82	0.87
0.81	0.66

0.87	0.8
0.71	0.66
0.77	0.69
0.67	0.8
1.22	1.39
0.73	0.9
1.24	0.9
0.82	0.87
0.62	0.65
0.75	0.68
0.93	0.7
0.9	0.73
0.93	0.82
0.67	0.63
0.87	0.68
0.68	0.63
0.7	0.62
0.87	0.69
0.92	0.7
0.94	0.83
0.9	0.66
0.77	0.67
0.9	0.91
0.71	0.6
0.93	0.76
0.72	0.65
1.15	0.73
0.76	1.42
1.5	1.3
0.99	1.57
0.85	1.03
1.23	1.27
1.5	0.81
1.2	1.02
0.69	0.83
0.71	0.9
1.2	1.05
0.94	0.7
0.84	0.64
0.94	0.75
0.93	1.45
1.28	0.54

0.9	1.15
1.09	1.05
0.84	1.25
1.25	1.8
0.83	1.4
0.94	1.32
0.55	0.98
0.85	1.74
0.76	0.6
0.95	1
0.9	0.85
0.72	0.65
0.8	0.58
0.95	0.94
0.92	1.05
1.8	0.76
0.8	0.7
0.7	0.7
1.2	0.95

From Excel, we generate the regression table to compare if there is relationship between after treatment and before treatment.

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.296881
R Square	0.088138
Adjusted R Square	0.078227
Standard Error	0.275096
Observations	94

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.672966	0.672966	8.892486	0.003665
Residual	92	6.962383	0.075678		
Total	93	7.635349			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	0.540819	0.122149	4.427541	2.62E-05	0.298221	0.783417	0.298221	0.783417
1.48	0.401096	0.134505	2.982027	0.003665	0.133959	0.668234	0.133959	0.668234

From the table, we obtain the r value as 0.296881. Since the p value 0.003665 is less than the significant level of 0.05, the null hypothesis is rejected. Hence, it can be said that there is significant relationship between after and before treatment creatinine levels.

CHAPTER 8: LINEAR REGRESSION MODEL AND GOODNESS OF FIT

Using Excel, the following data were obtained to construct a linear regression model before and after treatment.

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.461653
R Square	0.213124
Adjusted R Square	0.210343
Standard Error	0.338689
Observations	285

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	8.792508	8.792508	76.64983	1.89E-16
Residual	283	32.46295	0.11471		
Total	284	41.25546			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	0.469493	0.059695	7.864923	7.83E-14	0.351992	0.586995	0.351992	0.586995
Treatment(Before vs After)	0.513092	0.058606	8.754989	1.89E-16	0.397773	0.628455	0.397773	0.628455

Hypothesis testing:

H_0 = There is no relationship between before and after treatment.

Or, $H_0: r=0$

H_a = There is significant relation between before and after treatment.

Or, $H_a: r \neq 0$

Here, since the $r=0.461653$ and $p=1.89E-16$ which is very less than the significance level of 0.05, the null hypothesis can be rejected.

Hence, it can be said that there is significant relationship between after and before treatment creatinine levels.

Here, before treatment data has been taken as the independent variable X and after treatment data has been considered as the dependent variable Y on X.

Hence, taking the value from the table, the regression model can be constructed as follows:

$$Y = \text{constant} + B_1 \cdot X$$

$$\text{Or, } Y = 0.469493 + 0.513092X$$

Checking Goodness of Fit

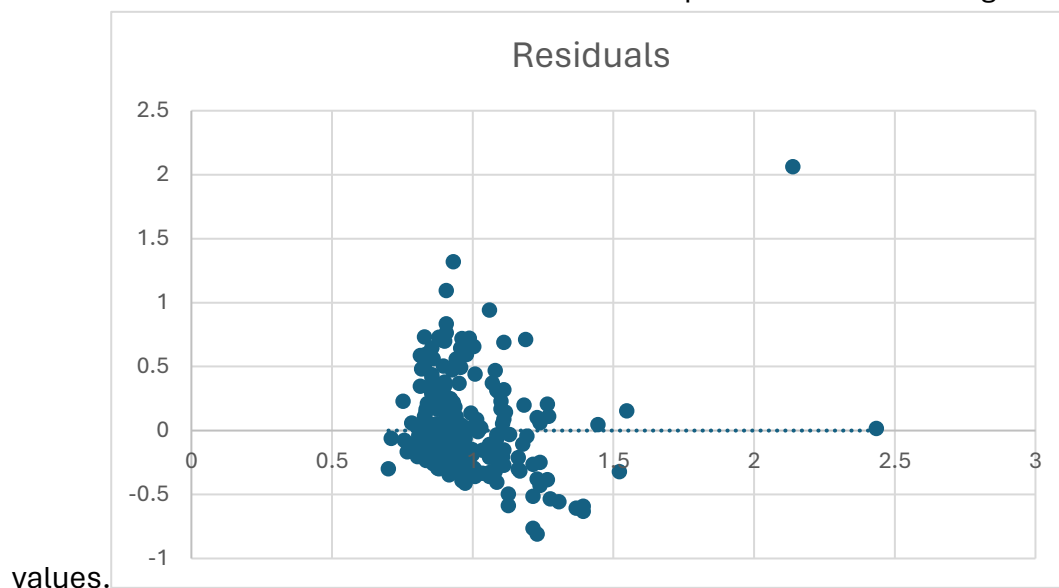
From coefficient of determination (R-squared): A higher R-squared value indicates a better fit. In the output, the R-squared value is 0.2131, which means that 21.31% of the variance in the dependent variable is explained by the independent variable.

From adjusted R-squared: In the output, the adjusted R-squared value is 0.2103. Higher adjusted R-squared value predicts better goodness of fit.

From P-value of the F-statistic: A low p-value indicates that the model is statistically significant. In the output, the p-value of the F-statistic is very close to zero ($1.89091E-16$), indicating that the model is statistically significant.

From Standard error of the regression: A lower standard error indicates a better fit. In the output, the standard error of the regression is 0.3387.

The Goodness of fit can be seen from the scatter plot of the residuals against the predicted



CHAPTER 9: ANOVA TABLE

ANOVA table has been obtained from excel.

Anova: Two-Factor With Replication

SUMMARY	Before Treatment(Creatinine_68)	After Treatment(Creatinine_69)	Total
<i>Group 1(Mild Impairment)</i>			
Count	95	95	190
Sum	102.11	103.07	205.18
Average	1.074842	1.084947	1.079895
Variance	0.229842	0.244202	0.235794
<i>Group 2(Moderate Impairment)</i>			
Count	95	95	190
Sum	86.79	86.46	173.25
Average	0.913579	0.910105	0.911842
Variance	0.056691	0.087861	0.071897
<i>Group 3(Severe Impairment)</i>			
Count	95	95	190
Sum	84.51	84.56	169.07
Average	0.889579	0.890105	0.889842
Variance	0.048249	0.083603	0.065577
<i>Total</i>			
Count	285	285	
Sum	273.41	274.09	
Average	0.959333	0.961719	
Variance	0.117599	0.145266	

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Sample	4.106894	2	2.053447	16.41777	1.17E-07	3.011701
Columns	0.000811	1	0.000811	0.006486	0.93584	3.857999
Interaction	0.004626	2	0.002313	0.018491	0.981679	3.011701
Within	70.54211	564	0.125075			
Total	74.65444	569				

Interpretation of the ANOVA Table:

Sample: The p-value (1.17406E-07) is less than the significance level of 0.05, indicating that there is a significant difference in mean creatinine levels between the groups (severity of impairment).

Columns: The p-value (0.935840013) is greater than the significance level of 0.05, indicating that there is no significant difference in mean creatinine levels between the time points (before and after treatment).

Interaction: The p-value (0.981679102) is greater than the significance level of 0.05, indicating that there is no significant interaction between the severity of impairment and the time point.

Hence, the results suggest that the severity of impairment (Group 1, Group 2, Group 3) has a significant effect on mean creatinine levels, but the time point (Before Treatment, After Treatment) and the interaction between severity of impairment and time point do not have a significant effect.