

APPENDIX E

RESULTS OF SAS PLOT and NORMAL DISTRIBUTION COMMANDS

DEVICE: Durapoint

Variable=Pointing Time.

Moments

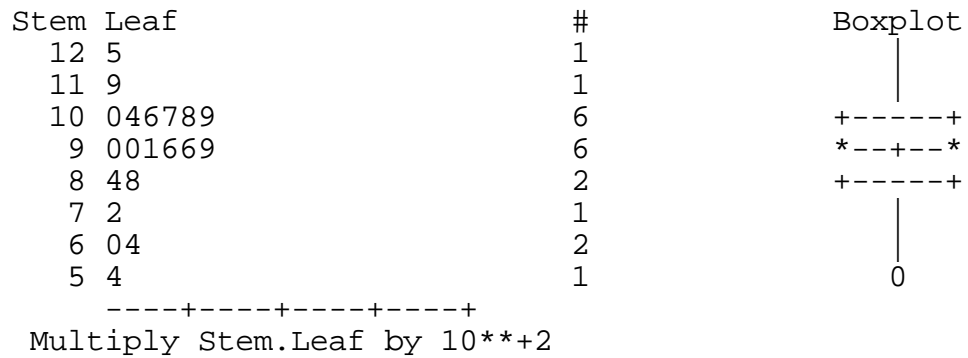
N	20	Sum Wgts	20
Mean	4123.801	Sum	82476.02
Std Dev	724.4929	Variance	524890
Skewness	1.022086	Kurtosis	0.938596
USS	3.5009E8	CSS	9972910
CV	17.56857	Std Mean	162.0015
T:Mean=0	25.45532	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.921185	Pr<W	0.1103

Stem Leaf	#	Boxplot
6 0	1	
5		
5 03	2	
4 566	3	
4 044	3	
3 555678999	9	
3 23	2	
-----+-----+-----+-----+		
Multiply Stem.Leaf by 10**+3		

Variable=Homing Time

Moments

N	20	Sum Wgts	20
Mean	930.933	Sum	18618.66
Std Dev	189.8876	Variance	36057.32
Skewness	-0.58657	Kurtosis	-0.03257
USS	18017814	CSS	685089
CV	20.39756	Std Mean	42.46017
T:Mean=0	21.92485	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.949416	Pr<W	0.3700



Variable=Accuracy

Moments

N	20	Sum Wgts	20
Mean	1.775	Sum	35.5
Std Dev	0.613287	Variance	0.376121
Skewness	0.457411	Kurtosis	0.066385
USS	70.1588	CSS	7.1463
CV	34.55139	Std Mean	0.137135
T:Mean=0	12.94343	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.954275	Pr<W	0.4464

Stem Leaf	#	Boxplot
3 2	1	
2 5	1	
2 00011234	8	+-----+
1 559	3	*---+---*
1 002224	6	+-----+
0 8	1	
-----+-----+-----+-----+		

Variable=Errors

Moments

N	20	Sum Wgts	20
Mean	0.06	Sum	1.2
Std Dev	0.058129	Variance	0.003379
Skewness	1.025404	Kurtosis	0.760874
USS	0.1362	CSS	0.0642
CV	96.88119	Std Mean	0.012998
T:Mean=0	4.616103	Pr> T	0.0002
Num ^= 0	16	Num > 0	16
M(Sign)	8	Pr>= M	0.0001
Sgn Rank	68	Pr>= S	0.0001
W:Normal	0.892355	Pr<W	0.0300

Stem Leaf	#	Boxplot
2 1	1	
1 5	1	
1 113	3	+-----+
0 66778	5	*---+---*
0 0000111444	10	+-----+
-----+-----+-----+-----+		
Multiply Stem.Leaf by 10**-1		

Stem Leaf	#	Boxplot
12 58	2	2
11 6	1	1
10 24	2	2
9 133389	6	6
8 123499	6	6
7 57	2	2
6 1	1	1

-----+-----+-----+-----+

Multiply Stem.Leaf by 10**+2

0
+---+---+
---+---
+---+---+

Variable=Accuracy

Moments			
N	20	Sum Wgts	20
Mean	3.164	Sum	63.28
Std Dev	1.770258	Variance	3.133815
Skewness	1.895583	Kurtosis	3.415067
USS	259.7604	CSS	59.54248
CV	55.95001	Std Mean	0.395842
T:Mean=0	7.993092	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.774648	Pr<W	0.0002

Stem Leaf	#	Boxplot
8 4	1	*
7		
6 7	1	0
5 0	1	
4 6	1	
3 155	3	+---+---+
2 0222235578	10	*---+---*
1 578	3	

-----+-----+-----+-----+

Variable=Errors

Moments

N	20	Sum Wgts	20
Mean	0.0985	Sum	1.97
Std Dev	0.069379	Variance	0.004813
Skewness	0.423536	Kurtosis	-0.67849
USS	0.2855	CSS	0.091455
CV	70.43535	Std Mean	0.015514
T:Mean=0	6.349277	Pr> T	0.0001
Num ^= 0	19	Num > 0	19
M(Sign)	9.5	Pr>= M	0.0001
Sgn Rank	95	Pr>= S	0.0001
W:Normal	0.951372	Pr<W	0.3995

Stem Leaf	#	Boxplot
2 14	2	
1 88	2	
1 03444	5	+---+---+
0 77888	5	*-----*
0 011344	6	+-----+

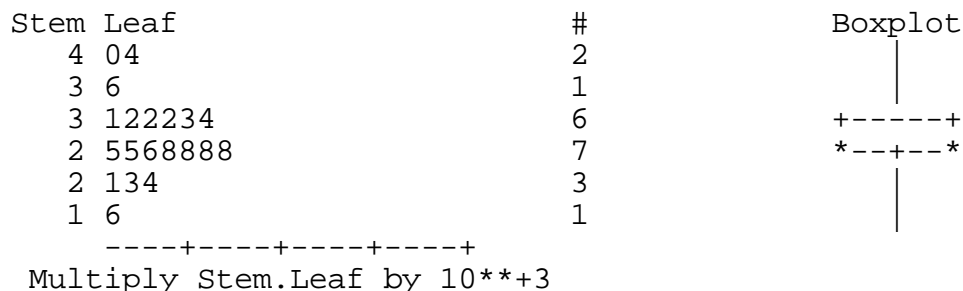
-----+-----+-----+-----+
Multiply Stem.Leaf by 10** -1

DEVICE: Trackball

Variable=Pointing Time.

Moments

N	20	Sum Wgts	20
Mean	2931.046	Sum	58620.92
Std Dev	654.5702	Variance	428462.1
Skewness	0.303548	Kurtosis	0.663165
USS	1.7996E8	CSS	8140781
CV	22.33231	Std Mean	146.3663
T:Mean=0	20.02541	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.982189	Pr<W	0.9446



Variable=Homing Time.

Moments

N	20	Sum Wgts	20
Mean	673.9145	Sum	13478.29
Std Dev	126.9449	Variance	16115.02
Skewness	-0.08059	Kurtosis	0.534547
USS	9389400	CSS	306185.3
CV	18.83695	Std Mean	28.38575
T:Mean=0	23.7413	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.975291	Pr<W	0.8451

Stem Leaf	#	Boxplot
9 6	1	
8 2	1	
7 012223579	9	+-----+
6 0067	4	+
5 358	3	+-----+
4 17	2	
-----+-----+-----+-----+		
Multiply Stem.Leaf by 10**+2		

Variable=Accuracy

Moments

N	20	Sum Wgts	20
Mean	1.4155	Sum	28.31
Std Dev	0.475001	Variance	0.225626
Skewness	0.127138	Kurtosis	-0.79211
USS	44.3597	CSS	4.286895
CV	33.55713	Std Mean	0.106213
T:Mean=0	13.32693	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.959375	Pr<W	0.5370

Stem Leaf	#	Boxplot
22 6	1	
20 08	2	
18 6	1	
16 040	3	+-----+
14 9345	4	*---+---*
12 44	2	
10 66	2	
8 900	3	+-----+
6 52	2	
-----+-----+-----+-----+		
Multiply Stem.Leaf by 10**-1		

Variable=Errors

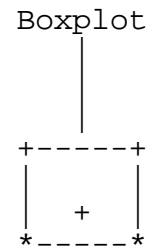
Moments

N	20	Sum Wgts	20
Mean	0.029	Sum	0.58
Std Dev	0.036835	Variance	0.001357
Skewness	1.351846	Kurtosis	1.32352
USS	0.0426	CSS	0.02578
CV	127.0184	Std Mean	0.008237
T:Mean=0	3.520857	Pr> T	0.0023
Num ^= 0	13	Num > 0	13
M(Sign)	6.5	Pr>= M	0.0002
Sgn Rank	45.5	Pr>= S	0.0002
W:Normal	0.786351	Pr<W	0.0003

Stem	Leaf	#
12	0	1
10		
8	0	1
6	0000	4
4		
2	00	2
0	00000000000000	12

-----+-----+-----+-----+

Multiply Stem.Leaf by 10** -2

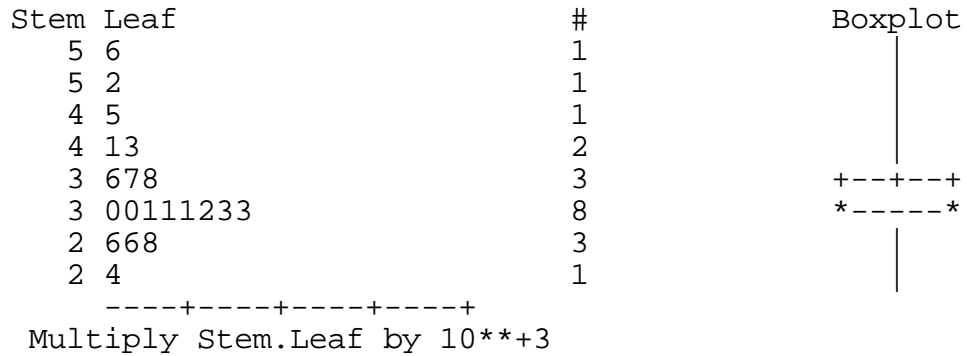


DEVICE: Thumbwheel

Variable=Pointing Time.

Moments

N	20	Sum Wgts	20
Mean	3517.203	Sum	70344.06
Std Dev	850.2808	Variance	722977.5
Skewness	1.048702	Kurtosis	0.674682
USS	2.6115E8	CSS	13736573
CV	24.17492	Std Mean	190.1286
T:Mean=0	18.49908	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.909796	Pr<W	0.0660



Variable=Homing Time.

Moments

N	20	Sum Wgts	20
Mean	509.1175	Sum	10182.35
Std Dev	78.05359	Variance	6092.363
Skewness	-0.1613	Kurtosis	-0.83839
USS	5299767	CSS	115754.9
CV	15.33115	Std Mean	17.45331
T:Mean=0	29.17025	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.951278	Pr<W	0.3981

Stem Leaf	#	Boxplot
6 222	3	
5 55799	5	+-----+
5 01	2	*---+---*
4 5567999	7	+-----+
4 1	1	
3 78	2	

-----+-----+-----+-----+

Multiply Stem.Leaf by 10**+2

Variable=Accuracy.

Moments

N	20	Sum Wgts	20
Mean	1.8905	Sum	37.81
Std Dev	0.523022	Variance	0.273552
Skewness	1.229504	Kurtosis	1.364366
USS	76.6773	CSS	5.197495
CV	27.66582	Std Mean	0.116951
T:Mean=0	16.16484	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.880385	Pr<W	0.0175

Stem Leaf	#	Boxplot
3 3	1	0
2 556	3	
2 04	2	+-----+
1 5567778999	10	*---+---*
1 3444	4	

-----+-----+-----+-----+

Variable=Errors.

Moments

N	20	Sum Wgts	20
Mean	0.0865	Sum	1.73
Std Dev	0.088215	Variance	0.007782
Skewness	1.63803	Kurtosis	3.203588
USS	0.2975	CSS	0.147855
CV	101.9824	Std Mean	0.019725
T:Mean=0	4.385205	Pr> T	0.0003
Num ^= 0	17	Num > 0	17
M(Sign)	8.5	Pr>= M	0.0001
Sgn Rank	76.5	Pr>= S	0.0001
W:Normal	0.836724	Pr<W	0.0026

Stem	Leaf	#	Boxplot
3	5	1	0
3			
2			
2	4	1	
1			
1	003444	6	+-----+
0	688	3	*---+---*
0	000133334	9	+-----+
-----+-----+-----+-----+			
Multiply Stem.Leaf by 10**-1			

DEVICE: Hand Mouse

Variable=Pointing Time.

Moments

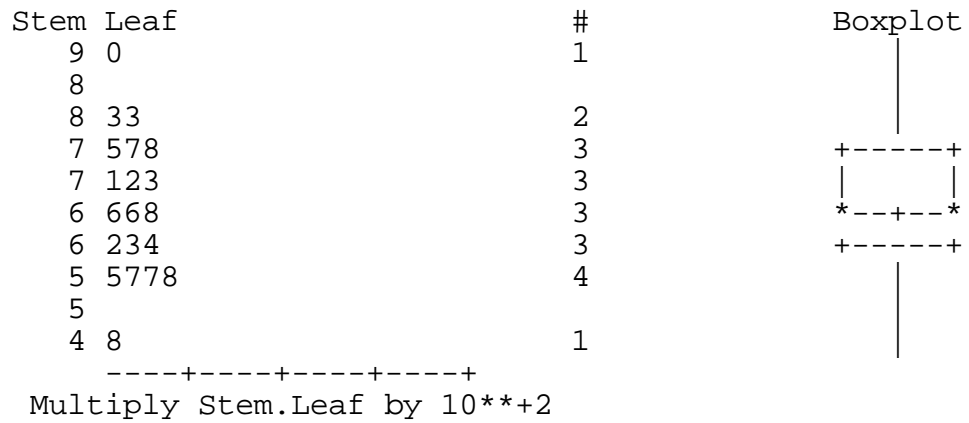
N	20	Sum Wgts	20
Mean	4205.4	Sum	84108
Std Dev	1079.909	Variance	1166204
Skewness	1.090667	Kurtosis	2.235614
USS	3.7587E8	CSS	22157876
CV	25.67911	Std Mean	241.475
T:Mean=0	17.41546	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.920565	Pr<W	0.1073

Stem Leaf	#	Boxplot
7 3	1	0
6		
5 1113	4	
4 013477	6	+---+---+
3 0134899	7	+-----+
2 78	2	
-----+-----+-----+-----+		
Multiply Stem.Leaf by 10**+3		

Variable=Homing Time.

Moments

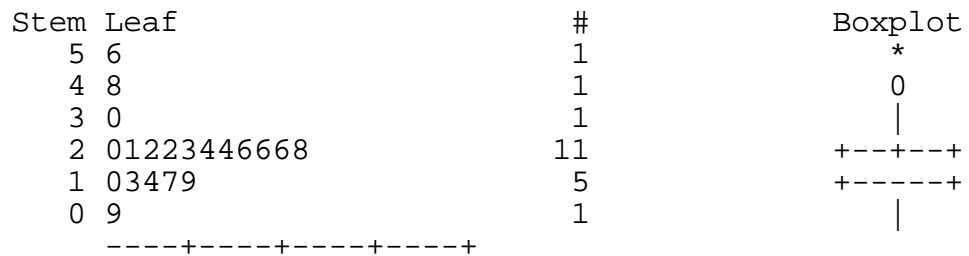
N	20	Sum Wgts	20
Mean	682.9955	Sum	13659.91
Std Dev	108.4066	Variance	11751.98
Skewness	0.161129	Kurtosis	-0.42962
USS	9552945	CSS	223287.6
CV	15.87222	Std Mean	24.24044
T:Mean=0	28.17587	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.986235	Pr<W	0.9790



Variable=Accuracy.

Moments

N	20	Sum Wgts	20
Mean	2.3865	Sum	47.73
Std Dev	1.113583	Variance	1.240066
Skewness	1.557778	Kurtosis	3.219821
USS	137.4689	CSS	23.56126
CV	46.66174	Std Mean	0.249005
T:Mean=0	9.584159	Pr> T	0.0001
Num ^= 0	20	Num > 0	20
M(Sign)	10	Pr>= M	0.0001
Sgn Rank	105	Pr>= S	0.0001
W:Normal	0.843531	Pr<W	0.0035



Variable=Errors.

Moments

N	20	Sum Wgts	20
Mean	0.1035	Sum	2.07
Std Dev	0.09138	Variance	0.00835
Skewness	0.901456	Kurtosis	0.336456
USS	0.3729	CSS	0.158655
CV	88.28964	Std Mean	0.020433
T:Mean=0	5.065301	Pr> T	0.0001
Num ^= 0	17	Num > 0	17
M(Sign)	8.5	Pr>= M	0.0001
Sgn Rank	76.5	Pr>= S	0.0001
W:Normal	0.915391	Pr<W	0.0850

Stem	Leaf	#	Boxplot
3	3	1	
2			
2	24	2	
1	788	3	
1	013	3	
0	66778	5	
0	000133	6	

-----+-----+-----+-----+
 Multiply Stem.Leaf by 10** -1

APPENDIX F

VITA

RONALD A. SPENCER

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EDUCATION

Virginia Polytechnic Institute and State University
Master of Science, Industrial and Systems Engineering
Graduation: August 2000

University of Maryland, University College
Bachelor of Science, Information Management Systems
Graduation: August 1988

EXPERIENCE

- 12/1994 — 5/1998 Team Leader, Human Research and Engineering Directorate of the U.S. Army Research Laboratory: Ldr, Soldier Systems Team responsible for the planning, prioritizing, coordination and execution of research programs relating to the development of virtual reality systems for the infantry soldier and exoskeleton technology for the special operation forces.
- 10/1993 — 11/1994 Project Leaders, Human Research and Engineering Directorate of the U.S. Army Research Laboratory: Served as project officer and computer scientist on a study team with responsibility for any of the major phases of a complex study requiring computer based approaches. Provides information technology expertise to the long range investigation of virtual reality technology. The work required in-depth knowledge of computer network methodologies and technology, the capabilities of various computer hardware and software systems, computer processing techniques, and familiarity with the basic human factors research objectives associated with integrating the soldier into a simulated battlefield.
- 02/1988 — 09/1992 Network Manager, Advance Computational & Information Science Directorate, U.S. Army Research Laboratory: Served as the Human Research and Engineering Directorate s computer neetwork manager responsible for the overall design, upgrade, implementation, administration

and maintenance of the HRED campus-wide area network. The network consisted of fiber optic backbone, which interconnects the various laboratory buildings as well as field detachments and liaison offices located in sixteen states throughout the U.S.

- 05/1985 — 01/1988 Computer Programmer/Analyst, Service & Support Division, U.S. Army Human Engineering Laboratory: Responsible for the design, implementation and management of the organizations Human Factors database with represents an automated, 30-year institutional memory of the laboratory. Assisted in the integration of all required ADP functions within the organization in line with higher headquarters guidelines.
- 05/1982 — 04/1985 Computer Programmer/Analyst, HHQ Company, NATO SHAPE, Belgium: Served as computer programmer responsible for maintaining two U.S. Army standard systems Vertical the Army Authorization Document and the Army Medical Department Accountability System. Also responsible for developing applications for local organizations using the COBOL programming language.

HONORS & AWARDS

Alpha Pi Mu Engineering Honor Society, Virginia Tech, 1999.
Performance Awards for Exceptional Service, ARL (7) — 06/90 — 09/98.
Special Act Award, ARL (2) — 01/93 and 07/92.
Meritorious Service Medal, U.S. Army, 1998.
Commander s Award, Human Engineering Laboratory, 1987.
Army Commendation Medal (2) — 1982 and 1987.
Army Achievement Medal (3) — 1984, 1985 and 1999.

MEMBERSHIP

Human Factors & Ergonomics Society
American Society of Safety Engineering
Institute of Industrial and Engineering (IIE)
U.S. Army Virtual Reality Reliance Panel
ARL Configuration Management Team
LABCOM Cooperative Program

PUBLICATIONS

Spencer, R. and Middlebrooks, S. Evaluation of Two Visual Displays for Wearable Computers. U.S. ARL Technical Report. (In print).