PGDM(RM), 2013-15

Statistics for Business Analysis

RM-104

Trimester-I, End Term Examination: September 2013

Time allowed :2 hrs 30 min **Max Marks:50**

Roll No:----------------

Instruction: Students are required to write Roll No on every page of the question paper, writing anything except the Roll No will be treated as **Unfair Means**. In case of rough work please use answer sheet.

SECTION A

Attempt ANY three questions in this section. Each question carries 5 marks.

(3 X 5)

A1. A marketing research firm wants to estimate the share that foreign companies have in the American market for certain products. A random sample of 100 consumers is obtained, and it is found that 34 people in the sample are users of foreign-made products; the rest are users of domestic products. Give a 95% confidence interval for the share of foreign products in this market.

A2. The Wall Street Journal 1996 subscriber study showed data on the employment status of subscribers. Sample results corresponding to subscribers of the eastern and western editions are shown here.

	Region	
Employment Status	**Eastern Edition**	**Western Edition**
Full Time	1105	574
Part Time	31	15
Self Employed	229	186
Not Employed	485	344

Using $\alpha = 0.05$, test the hypothesis that employment status is independent of the region. What is your conclusion?

A3. In a experimental design, three brands of paper towels were tested for their ability to absorb water. Equal sized towels were used, with four sections of towels tested per brand. The absorbency rating data follow. At a 0.05 level of significance, does there appear to be a difference in the ability of the brands to absorb water?

	Brand X	Brand Y	Brand Z
	91	99	83
	100	96	88
	88	94	89
	89	99	76
Count	4.00	4.00	4.00
Average	92.00	97.00	84.00
St Dev	5.48	2.45	5.94
Variance	30.00	6.00	35.33

A4. List the reasons for sampling. Explain two methods of probability sampling with appropriate examples in market research.

A5. A fast food chain has developed a new process to ensure that orders at the drive-through are filled correctly.The previous process filled orders correctly 85% of the time. Based on a sample of 100 orders using the new process, 94 were filled correctly. At the 0.01 level of significance, can you conclude that the new process has increased the portion of orders filled correctly?

SECTION B

Attempt ANY two questions in this section. Each question carries 10 marks.

(2 X 10)

B1. According to the 1994 *World Almanac* the average wind speed in Honolulu, Hawaii is 18.2 km/h. Assume that the wind speed is normally distributed with a standard deviation of 5.6 km/h.

a. Calculate the probability that the wind speed on any one reading will exceed 26.2 km/h.
b. Calculate the probability that the mean of a random sample of 4 readings will exceed 26.2 km/h.
c. Calculate the probability that the mean of a random sample of 40 readings will be more than 4 km/h from the expected speed.
d. How would your answer in (a), (b), and (c) change if you could not assume that the wind speed in Honolulu is distributed normally?

B2. A small lawnmower company produced 1,500 lawnmowers in 1990. In an effort to determine how maintenance-free these units were, the company decided to conduct a multiyear study of the 1990 lawnmowers. A sample of 200 owners of these lawnmowers was drawn randomly from company records and contacted. The owners were given an 800 number and asked to call the company when the first major repair was required for the lawnmowers. Owners who no longer used the lawnmower to cut their grass were disqualified. After many years, 187 of the owners had reported. The other 13 disqualified themselves. The average number of years until the first major repair was 5.3 for the 187 owners reporting, and the sample standard deviation was 1.28 years. If the company wants to advertise an average number of years of repair- free lawn mowing for this lawnmower, what is the point estimate? Construct a 95% confidence interval for the average number of years until the first major repair.

B3. An instructor is interested in finding out how the number of students absent on a given day is related to the mean temperature that day. A random sample of ten days was used for the study. The following data indicates the number of students absent and the mean temperature for each day.

Absents:	8	7	5	4	2	3	5	6	8	9
Temperature:	10	20	25	30	40	45	50	55	59	60

a. Draw a scatter diagram of this data.
b. Is the relationship between the variables linear or curvilinear
c. Determine the equation that best describes this data.
d. Calculate the coefficient of determination

SECTION C

Compulsory Case Study (15 marks)

Case : Unemployment Study

Each month the U.S. Bureau of Labor Statistics publishes a variety of unemployment statistics, including the number of individuals who are unemployed and the mean length of time the individuals have been unemployed. For November 1998, the Bureau of Labor statistics reported that the national mean length of time of unemployment was 14.6 weeks.

Age	Weeks	Age	Weeks	Age	Weeks	Age	Weeks
56	22	49	26	44	38	27	7
35	19	33	13	27	14	30	10
22	7	56	15	24	6	33	23
57	37	20	17	27	7	32	8
40	18	31	11	45	25	22	7
22	11	27	17	42	33	51	12
48	6	23	3	45	16	50	16
48	22	45	17	44	12	21	9
25	5	29	14	21	13	38	5
40	20	31	4	31	16	26	8
25	12	59	39	42	4	55	35
25	1	39	7	23	14		
59	33	35	12	51	31		

The mayor of Philadelphia requested a study on the status of unemployment in the Philadelphia area. A sample of 50 unemployed residents of Philadelphia included data on there age and the number of weeks without a job. A portion of the data collected in November 1998 follows. The complete data set is available in the data file BLS.

<u>Descriptive statistics to summarize the data.</u>

Age		Weeks	
Mean	36.6	Mean	15.54
Median	34	Median	13.5
Mode	27	Mode	7
Sample Variance	142.6939	Sample Variance	98.53918
Kurtosis	-1.14515	Kurtosis	0.053711
Skewness	0.357283	Skewness	0.910766
Range	39	Range	38
Minimum	20	Minimum	1
Maximum	59	Maximum	39
Sum	1830	Sum	777
Count	50	Count	50

Managerial Report

1. Develop a 95% confidence interval estimate of the mean age of unemployed individuals in Philadelphia.

2. Conduct a hypothesis test to determine whether the mean duration of unemployment in Philadelphia is greater than the national mean duration of 14.6 weeks. Use a .01 level of significance. What is your conclusion?

3. With the help of a scatter diagram find if there is a relationship between the age of an unemployed individual and the number of weeks of unemployment? Explain.

Standard Normal Probabilities

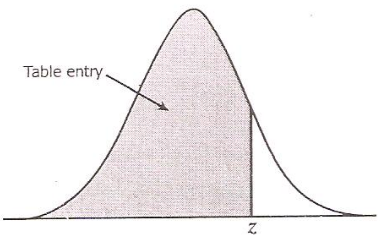


Table entry for z is the area under the standard normal curve to the left of z.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

Standard Normal Probabilities

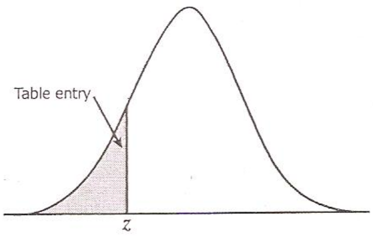
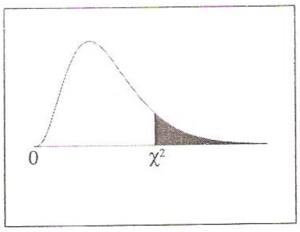


Table entry for z is the area under the standard normal curve to the left of z.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
−3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
−3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
−3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
−2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
−2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
−2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
−2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
−2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
−2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
−2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
−2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
−2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
−1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
−1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
−1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
−1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
−1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
−1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
−1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
−1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
−1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
−1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
−0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
−0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
−0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

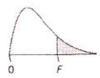
Chi-Square Distribution Table



The shaded area is equal to α for $\chi^2 = \chi^2_\alpha$.

df	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.000	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169

CRITICAL VALUES OF $F_{.05}$



This table shows the 5 percent right-tail critical values of F for the stated degrees of freedom (ν).

Denominator Degrees of Freedom (ν_2)	Numerator Degrees of Freedom (ν_1)										
	1	2	3	4	5	6	7	8	9	10	12
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00
50	4.03	3.18	2.79	2.56	2.40	2.29	2.20	2.13	2.07	2.03	1.95
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.83
200	3.89	3.04	2.65	2.42	2.26	2.14	2.06	1.98	1.93	1.88	1.80
∞	2.71	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83

Some important Formulae

$$\frac{\bar{X}-\mu}{\sigma/\sqrt{n}} \qquad \frac{\bar{X}-\mu}{s/\sqrt{n}} \qquad \frac{\hat{p}-p}{\sqrt{\frac{p(1-p)}{n}}}$$

$$\frac{\bar{X}-\mu_0}{\sigma/\sqrt{n}} \qquad \frac{\bar{X}-\mu_0}{s/\sqrt{n}} \qquad \frac{(\hat{p}-p_0)}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

$\sigma_{\bar{p}} = \sqrt{\frac{pq}{n}}$ $\quad z = \frac{\bar{p}-p}{\sigma_{\bar{p}}}$

$\bar{x} \pm z\frac{\sigma}{\sqrt{n}}$ $\quad \bar{x} \pm z\frac{\hat{\sigma}}{\sqrt{n}}$

$\sigma_{\bar{p}_1-\bar{p}_2} = \sqrt{\frac{p_1q_1}{n_1} + \frac{p_2q_2}{n_2}}$

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

χ^2 (df (r-1)*(c-1)) = $\sum_i \frac{(O_i-E_i)^2}{E_i}$

SSB = $\sum_{i=1}^{k} n_i(\bar{x}_i - \bar{\bar{x}})^2$ d.f. = k-1

SST = $\sum_{i=1}^{k}\sum_{j=1}^{n_i}(x_{ij} - \bar{\bar{x}})^2$ d.f. = n-1

MSB = $\frac{SSB}{k-1}$

F (k-1),(n-k) d.f. = $\frac{MSB}{MSW}$

FPCF = $\sqrt{\frac{N-n}{N-1}}$

$\bar{x} \pm t\frac{\hat{\sigma}}{\sqrt{n}}$ $\quad \bar{p} \pm z\hat{\sigma}_{\bar{p}}$

$\sigma_{\hat{\bar{x}_1-\bar{x}_2}} = \sqrt{\frac{\hat{\sigma}_1^2}{n_1} + \frac{\hat{\sigma}_2^2}{n_2}}$

$t = \frac{\bar{x}_1-\bar{x}_2-(\mu_1-\mu_2)}{\sigma_{\hat{\bar{x}_1-\bar{x}_2}}}$

SSW = $\sum_{i=1}^{k}\sum_{j=1}^{n_i}(X_{ij} - \bar{x}_i)^2$ d.f. = n-k

SST = SSB + SSW SSW is also written as SSE

MSW (or MSE) = $\frac{SSW}{n-k}$

$$s_{b_1} = \frac{s}{\sqrt{\sum(x_i - \bar{x})^2}}$$

$$b_1 \pm t_{\alpha/2}s_{b_1}$$

$$b_1 = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sum(x-\bar{x})^2}$$

$$r^2 = \frac{SSR}{SST} = \frac{\text{regression sum of squares}}{\text{total sum of squares}}$$

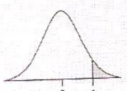
$$s = \sqrt{MSE} = \sqrt{\frac{SSE}{n-2}}$$

$$\hat{y}_i = b_0 + b_1 x$$

$$b_0 = \bar{y} - b_1\bar{x}$$

APPENDIX D

STUDENT'S *t* CRITICAL VALUES



This table shows the *t*-value that defines the area for the stated degrees of freedom (ν).

	Confidence Level				
	.80	.90	.95	.98	.99
	Significance Level for Two-Tailed Test				
	.20	.10	.05	.02	.01
	Significance Level for One-Tailed Test				
ν	.10	.05	.025	.01	.005
1	3.078	6.314	12.706	31.821	63.656
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
30	1.310	1.697	2.042	2.457	2.750
31	1.309	1.696	2.040	2.453	2.744
32	1.309	1.694	2.037	2.449	2.738
33	1.308	1.692	2.035	2.445	2.733
34	1.307	1.691	2.032	2.441	2.728
35	1.306	1.690	2.030	2.438	2.724
36	1.306	1.688	2.028	2.434	2.719
37	1.305	1.687	2.026	2.431	2.715
38	1.304	1.686	2.024	2.429	2.712
39	1.304	1.685	2.023	2.426	2.708
40	1.303	1.684	2.021	2.423	2.704
41	1.303	1.683	2.020	2.421	2.701
42	1.302	1.682	2.018	2.418	2.698
43	1.302	1.681	2.017	2.416	2.695
44	1.301	1.680	2.015	2.414	2.692
45	1.301	1.679	2.014	2.412	2.690
46	1.300	1.679	2.013	2.410	2.687
47	1.300	1.678	2.012	2.408	2.685
48	1.299	1.677	2.011	2.407	2.682
49	1.299	1.677	2.010	2.405	2.680
50	1.299	1.676	2.009	2.403	2.678
55	1.297	1.673	2.004	2.396	2.668
60	1.296	1.671	2.000	2.390	2.660
65	1.295	1.669	1.997	2.385	2.654
70	1.294	1.667	1.994	2.381	2.648
75	1.293	1.665	1.992	2.377	2.643
80	1.292	1.664	1.990	2.374	2.639
85	1.292	1.663	1.988	2.371	2.635
90	1.291	1.662	1.987	2.368	2.632
95	1.291	1.661	1.985	2.366	2.629
100	1.290	1.660	1.984	2.364	2.626
110	1.289	1.659	1.982	2.361	2.621
120	1.289	1.658	1.980	2.358	2.617
130	1.288	1.657	1.978	2.355	2.614
140	1.288	1.656	1.977	2.353	2.611
150	1.287	1.655	1.976	2.351	2.609
∞	1.282	1.645	1.960	2.326	2.576

Note: As n increases, critical values of Student's t approach the z-values in the last line of this table. A common rule of thumb is to use z when $n > 30$, but that is *not* conservative.