Stat 615/415 (Regression)   Homework #1

Review of Estimation and Hypothesis Testing (handouts, your old notes, ...)

When α is not given, use the p-value approach to make your conclusions. When it's difficult to conclude, use $\alpha = 0.05$. For two-sample problems, use the F-test to decide which t-test to use.

1. The manufacturer of a certain brand of household light bulbs claims that the bulbs produced by his factory have an average life of at least 2,000 hours. The mean and standard deviation of 20 light bulbs selected from the manufacturer's production process were calculated to be 2,160 and 142 hours, respectively.

    (a) Do the data represent sufficient evidence to support the manufacturer's claim? How can you interpret your answer?

    (b) Construct a 95% confidence interval for the mean lifetime of household light bulbs.

2. There are two manufacturing processes, old and new, that produce the same product. The defect rate has been measured for 20 days for the old process, and for 14 days for the new process, resulting in the following sample summaries.

	OLD	NEW
Average defect rate	4.7	2.3
Standard deviation	6.8	5.0

    The firm is interested in switching to the new process only if it can be demonstrated convincingly that the new process reduces the defect rate. Is there significant evidence of that? Use $\alpha = 5\%$; assume that the collected data represent two random samples from Normal distributions. Use the method of testing that is appropriate for this situation.

3. (Required for Stat-615, optional for Stat-415) An account on server A is more expensive than an account on server B. However, server A is faster. To see if whether it's optimal to go with the faster but more expensive server, a manager needs to know how much faster it is. A certain computer algorithm is executed 30 times on server A and 20 times on server B with the following results,

	Server A	Server B
Sample mean	6.7 min	7.5 min
Sample standard deviation	0.6 min	1.2 min

    (a) Is there a significant difference between the two servers?

    (b) Is server A significantly faster?

    State the null and alternative hypotheses, use the data to select the most appropriate procedure, and conduct the test. What assumptions are we making for this test to be valid?

4. **Micro-project**. Data on 522 recent home sales are available on our Blackboard web site The following variables are included.

Column	Variable
1	Identification number 1–522
2	Sales price of residence (×$1000 dollars)
3	Finished area of residence (square feet)
4	Total number of bedrooms in residence
5	Total number of bathrooms in residence
6	Air conditioning: present or absent
7	Number of cars that garage will hold
8	Swimming pool: present or absent
9	Year property was originally constructed
10	Quality of construction: high, medium, or low
11	Architectural style. Three styles are coded as 1, 2, and 3
12	Lot size (square feet)
13	Location near a highway: yes or no

Use software to find out if there is significant evidence that:

(a) The sales price depends on the air conditioner in the house.

(b) On the average, homes with an air conditioner are more expensive.

(c) On the average, homes with an air conditioner are larger.

(d) The sales price depends on the proximity to a highway.

(e) On the average, homes are cheaper when they are close to a highway.

(f) On the average, homes are cheaper when they are far from a highway.

Table of T-Distribution

Critical values t_α for the given right-tail probability α

degrees of freedom	α, the right-tail probability									
	.10	.05	.025	.02	.01	.005	.0025	.001	.0005	.0001
1	3.078	6.314	12.706	15.89	31.82	63.66	127.3	318.3	636.6	3185
2	1.886	2.920	4.303	4.849	6.965	9.925	14.09	22.33	31.60	70.71
3	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.21	12.92	22.20
4	1.533	2.132	2.776	2.999	3.747	4.604	5.598	7.173	8.610	13.04
5	1.476	2.015	2.571	2.757	3.365	4.032	4.773	5.894	6.869	9.676
6	1.440	1.943	2.447	2.612	3.143	3.707	4.317	5.208	5.959	8.023
7	1.415	1.895	2.365	2.517	2.998	3.499	4.029	4.785	5.408	7.064
8	1.397	1.860	2.306	2.449	2.896	3.355	3.833	4.501	5.041	6.442
9	1.383	1.833	2.262	2.398	2.821	3.250	3.690	4.297	4.781	6.009
10	1.372	1.812	2.228	2.359	2.764	3.169	3.581	4.144	4.587	5.694
11	1.363	1.796	2.201	2.328	2.718	3.106	3.497	4.025	4.437	5.453
12	1.356	1.782	2.179	2.303	2.681	3.055	3.428	3.930	4.318	5.263
13	1.350	1.771	2.160	2.282	2.650	3.012	3.372	3.852	4.221	5.111
14	1.345	1.761	2.145	2.264	2.624	2.977	3.326	3.787	4.140	4.985
15	1.341	1.753	2.131	2.249	2.602	2.947	3.286	3.733	4.073	4.880
16	1.337	1.746	2.120	2.235	2.583	2.921	3.252	3.686	4.015	4.790
17	1.333	1.740	2.110	2.224	2.567	2.898	3.222	3.646	3.965	4.715
18	1.330	1.734	2.101	2.214	2.552	2.878	3.197	3.610	3.922	4.648
19	1.328	1.729	2.093	2.205	2.539	2.861	3.174	3.579	3.883	4.590
20	1.325	1.725	2.086	2.197	2.528	2.845	3.153	3.552	3.850	4.539
22	1.321	1.717	2.074	2.183	2.508	2.819	3.119	3.505	3.792	4.452
24	1.318	1.711	2.064	2.172	2.492	2.797	3.091	3.467	3.745	4.382
26	1.315	1.706	2.056	2.162	2.479	2.779	3.067	3.435	3.707	4.324
28	1.313	1.701	2.048	2.154	2.467	2.763	3.047	3.408	3.674	4.276
30	1.310	1.697	2.042	2.147	2.457	2.750	3.030	3.385	3.646	4.234
32	1.309	1.694	2.037	2.141	2.449	2.738	3.015	3.365	3.622	4.198
34	1.307	1.691	2.032	2.136	2.441	2.728	3.002	3.348	3.601	4.168
36	1.306	1.688	2.028	2.131	2.434	2.719	2.990	3.333	3.582	4.140
38	1.304	1.686	2.024	2.127	2.429	2.712	2.980	3.319	3.566	4.115
40	1.303	1.684	2.021	2.123	2.423	2.704	2.971	3.307	3.551	4.094
45	1.301	1.679	2.014	2.115	2.412	2.690	2.952	3.281	3.520	4.049
50	1.299	1.676	2.009	2.109	2.403	2.678	2.937	3.261	3.496	4.014
55	1.297	1.673	2.004	2.104	2.396	2.668	2.925	3.245	3.476	3.985
60	1.296	1.671	2.000	2.099	2.390	2.660	2.915	3.232	3.460	3.962
70	1.294	1.667	1.994	2.093	2.381	2.648	2.899	3.211	3.435	3.926
80	1.292	1.664	1.990	2.088	2.374	2.639	2.887	3.195	3.416	3.899
90	1.291	1.662	1.987	2.084	2.368	2.632	2.878	3.183	3.402	3.878
100	1.290	1.660	1.984	2.081	2.364	2.626	2.871	3.174	3.390	3.861
200	1.286	1.653	1.972	2.067	2.345	2.601	2.838	3.131	3.340	3.789
∞	1.282	1.645	1.960	2.054	2.326	2.576	2.807	3.090	3.290	3.719

Table of F-distribution.

F_α; critical values such that $P\{F > F_\alpha\} = \alpha$
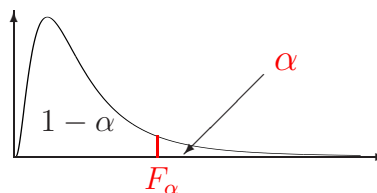
ν_2, denom. d.f.	α	ν_1, numerator degrees of freedom									
		1	2	3	4	5	6	7	8	9	10
2	0.25	2.57	3	3.15	3.23	3.28	3.31	3.34	3.35	3.37	3.38
	0.1	8.53	9	9.16	9.24	9.29	9.33	9.35	9.37	9.38	9.39
	0.05	18.5	19	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4
	0.025	38.5	39	39.2	39.2	39.3	39.3	39.4	39.4	39.4	39.4
	0.01	98.5	99	99.2	99.2	99.3	99.3	99.4	99.4	99.4	99.4
	0.005	199	199	199	199	199	199	199	199	199	199
	0.001	999	999	999	999	999	999	999	999	999	999
3	0.25	2.02	2.28	2.36	2.39	2.41	2.42	2.43	2.44	2.44	2.44
	0.1	5.54	5.46	5.39	5.34	5.31	5.28	5.27	5.25	5.24	5.23
	0.05	10.1	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79
	0.025	17.4	16	15.4	15.1	14.9	14.7	14.6	14.5	14.5	14.4
	0.01	34.1	30.8	29.5	28.7	28.2	27.9	27.7	27.5	27.3	27.2
	0.005	55.6	49.8	47.5	46.2	45.4	44.8	44.4	44.1	43.9	43.7
	0.001	167	149	141	137	135	133	132	131	130	129
4	0.25	1.81	2	2.05	2.06	2.07	2.08	2.08	2.08	2.08	2.08
	0.1	4.54	4.32	4.19	4.11	4.05	4.01	3.98	3.95	3.94	3.92
	0.05	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6	5.96
	0.025	12.2	10.6	9.98	9.6	9.36	9.2	9.07	8.98	8.9	8.84
	0.01	21.2	18	16.7	16	15.5	15.2	15	14.8	14.7	14.5
	0.005	31.3	26.3	24.3	23.2	22.5	22	21.6	21.4	21.1	21
	0.001	74.1	61.2	56.2	53.4	51.7	50.5	49.7	49	48.5	48.1
5	0.25	1.69	1.85	1.88	1.89	1.89	1.89	1.89	1.89	1.89	1.89
	0.1	4.06	3.78	3.62	3.52	3.45	3.4	3.37	3.34	3.32	3.3
	0.05	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74
	0.025	10	8.43	7.76	7.39	7.15	6.98	6.85	6.76	6.68	6.62
	0.01	16.3	13.3	12.1	11.4	11	10.7	10.5	10.3	10.2	10.1
	0.005	22.8	18.3	16.5	15.6	14.9	14.5	14.2	14	13.8	13.6
	0.001	47.2	37.1	33.2	31.1	29.8	28.8	28.2	27.6	27.2	26.9
10	0.25	1.49	1.6	1.6	1.59	1.59	1.58	1.57	1.56	1.56	1.55
	0.1	3.29	2.92	2.73	2.61	2.52	2.46	2.41	2.38	2.35	2.32
	0.05	4.96	4.1	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98
	0.025	6.94	5.46	4.83	4.47	4.24	4.07	3.95	3.85	3.78	3.72
	0.01	10	7.56	6.55	5.99	5.64	5.39	5.2	5.06	4.94	4.85
	0.005	12.8	9.43	8.08	7.34	6.87	6.54	6.3	6.12	5.97	5.85
	0.001	21	14.9	12.6	11.3	10.5	9.93	9.52	9.2	8.96	8.75
20	0.25	1.4	1.49	1.48	1.47	1.45	1.44	1.43	1.42	1.41	1.4
	0.1	2.97	2.59	2.38	2.25	2.16	2.09	2.04	2	1.96	1.94
	0.05	4.35	3.49	3.1	2.87	2.71	2.6	2.51	2.45	2.39	2.35
	0.025	5.87	4.46	3.86	3.51	3.29	3.13	3.01	2.91	2.84	2.77
	0.01	8.1	5.85	4.94	4.43	4.1	3.87	3.7	3.56	3.46	3.37
	0.005	9.94	6.99	5.82	5.17	4.76	4.47	4.26	4.09	3.96	3.85
	0.001	14.8	9.95	8.1	7.1	6.46	6.02	5.69	5.44	5.24	5.08