

考 試 科 目	統計學 4211A	所 別	企業管理	考 試 時 間	12月28日(六) 第3節
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1. (18%) A recent study looked into the amount of debt accumulated by recent college graduates. The study found that among those who had graduated with debts from student loans, 33% had sold possessions since graduating. Among those who had graduated free of debt, only 17% had sold possessions since graduating.
- (1) Express these two percentages as conditional probabilities. (4%)
 - (2) Give a short description of the associated sample space. (2%)
 - (3) If the proportion of having debt after graduating is 15%, then determine the proportion of recent college graduates who sold possessions after college. (6%)
 - (4) Determine the proportion of recent college graduates having loan among those who sold possessions after college. (6%)

2. (16%) The following data present 209 secondary school students about height (short or not) and whether or not the student had ever been bullied in school.

	Ever Bullied?	
Height	Yes	No
Short	42	50
Not short	30	87

- (1) Use the z-test to verify whether the proportion of being bullied for short students is higher than that of students being not shorts. Use $\alpha=.05$. (8%)
 - (2) Use the chi-squared test to verify whether there is a relationship between height and the likelihood of having been bullied. Use $\alpha=.05$. (8%)
3. (16%) Suppose that we wish to test the hypothesis
- $$H_0: \mu = 65 \text{ kilograms,}$$
- $$H_1: \mu > 65 \text{ kilograms,}$$
- for the weights of male students at a certain college using an $\alpha=.05$ when it is assumed that the weights follow a normal distribution with known $\sigma=5$.
- (1) A random sample of 20 male students taken from this college yields a sample mean of 67.5 kilograms. Do the data support this hypothesis? (8%)
 - (2) Find the sample size required if the power of our test is to be 0.99 when the true mean is 66.5 kilograms. (8%)
4. (20%) Three different machines, M_1 , M_2 , and M_3 are to be considered in the assembling of a toy car. Four operators are to be used in a randomized block experiment to compare the machines. The machines are assigned in a random order to each operator. The operation of the machines requires a certain amount of

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physical dexterity, and it is anticipated that there will be a difference among the operators in the speed with which they operate the machines. The following times, in minutes, were recorded for assembling the toy car.

Operator 1	M ₂	35	M ₃	29	M ₁	26
Operator 2	M ₁	28	M ₃	31	M ₂	34
Operator 3	M ₃	27	M ₁	25	M ₂	31
Operator 4	M ₁	24	M ₂	35	M ₃	30

- (1) Test the hypothesis H_0 , at the 0.05 level of significance, that the machines perform at the same mean rate of speed. (10%)
 - (2) Test the hypothesis H_0 , at the 0.05 level of significance, that the operators perform at the same mean rate of speed. (10%)
5. (30%) The grades of a class of 9 students on a midterm report (independent variable) and on the final examination (dependent variable) are shown below:

Midterm	77	55	70	73	83	92	94	99	68
Final	82	67	78	56	69	87	98	97	65

Below shows the ANOVA results.

ANOVA

	Degree of freedom	SS	MS	F	p
Regression 1		(a)	(c)	10.45	
Error	7	(b)	(d)		
Total	8	1712			

	Coefficient	Standard error	T
Intercept	(e)	19.67	0.76
Midterm	(f)	0.25	

- (1) Please fill out cells (a) to (f) (calculate to two decimal points) (12%)
- (2) What is the critical value of F to be significant at $\alpha=0.05$? (3%)
- (3) Estimate the linear regression line (calculate to two decimal points). (3%)
- (4) Test the hypothesis that β (slope of the regression line) = 0 against the alternative that $\beta \neq 0$ at the 0.05 level of significance. (3%)
- (5) Use the data from ANOVA to calculate the coefficient of correlation between the midterm report and the final

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examination. (3%)

(6) Estimate the final examination grade of a student who received 80 on the midterm report. (3%)

(7) Construct a 95% confidence interval for the average final examination grade of students who make a 80 on the midterm report. (3%)

Percentage Points of the t Distribution; $t_{v, \alpha}$

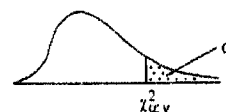
$$P(T > t_{v, \alpha}) = \alpha$$



v	α													
	0.40	0.30	0.20	0.15	0.10	0.05	0.025	0.02	0.015	0.01	0.0075	0.005	0.0025	0.0005
1	0.325	0.727	1.376	1.963	3.078	6.314	12.706	15.895	21.205	31.821	42.434	63.657	127.322	636.590
2	0.289	0.617	1.061	1.386	1.886	2.920	4.303	4.849	5.643	6.965	8.073	9.925	14.089	31.598
3	0.277	0.584	0.978	1.250	1.638	2.353	3.182	3.482	3.896	4.541	5.047	5.841	7.453	12.924
4	0.271	0.569	0.941	1.190	1.533	2.132	2.776	2.999	3.298	3.747	4.088	4.604	5.598	8.610
5	0.267	0.559	0.920	1.156	1.476	2.015	2.571	2.757	3.003	3.365	3.634	4.032	4.773	6.869
6	0.265	0.553	0.906	1.134	1.440	1.943	2.447	2.612	2.829	3.143	3.372	3.707	4.317	5.959
7	0.263	0.549	0.896	1.119	1.415	1.895	2.365	2.517	2.715	2.998	3.203	3.499	4.029	5.408
8	0.262	0.546	0.889	1.108	1.397	1.860	2.306	2.449	2.634	2.896	3.085	3.355	3.833	5.041
9	0.261	0.543	0.883	1.100	1.383	1.833	2.262	2.398	2.574	2.821	2.998	3.250	3.690	4.781
10	0.260	0.542	0.879	1.093	1.372	1.812	2.228	2.359	2.527	2.764	2.932	3.169	3.581	4.587
11	0.260	0.540	0.876	1.088	1.363	1.796	2.201	2.328	2.491	2.718	2.879	3.106	3.497	4.437
12	0.259	0.539	0.873	1.083	1.356	1.782	2.179	2.303	2.461	2.681	2.836	3.055	3.428	4.318
13	0.259	0.538	0.870	1.079	1.350	1.771	2.160	2.282	2.436	2.650	2.801	3.012	3.372	4.221
14	0.258	0.537	0.868	1.076	1.345	1.761	2.145	2.264	2.415	2.624	2.771	2.977	3.326	4.140
15	0.258	0.536	0.866	1.074	1.341	1.753	2.131	2.249	2.397	2.602	2.746	2.947	3.286	4.073
16	0.258	0.535	0.865	1.071	1.337	1.746	2.120	2.235	2.382	2.583	2.724	2.921	3.252	4.015
17	0.257	0.534	0.863	1.069	1.333	1.740	2.110	2.224	2.368	2.567	2.706	2.898	3.222	3.965
18	0.257	0.534	0.862	1.067	1.330	1.734	2.101	2.214	2.356	2.552	2.689	2.878	3.197	3.922
19	0.257	0.533	0.861	1.066	1.328	1.729	2.093	2.205	2.346	2.539	2.674	2.861	3.174	3.883
20	0.257	0.533	0.860	1.064	1.325	1.725	2.086	2.197	2.336	2.528	2.661	2.845	3.153	3.850
21	0.257	0.532	0.859	1.063	1.323	1.721	2.080	2.189	2.328	2.518	2.649	2.831	3.135	3.819
22	0.256	0.532	0.858	1.061	1.321	1.717	2.074	2.183	2.320	2.508	2.639	2.819	3.119	3.792
23	0.256	0.532	0.858	1.060	1.319	1.714	2.069	2.177	2.313	2.500	2.629	2.807	3.104	3.768
24	0.256	0.531	0.857	1.059	1.318	1.711	2.064	2.172	2.307	2.492	2.620	2.797	3.091	3.745
25	0.256	0.531	0.856	1.058	1.316	1.708	2.060	2.167	2.301	2.485	2.612	2.787	3.078	3.725
26	0.256	0.531	0.856	1.058	1.315	1.706	2.056	2.162	2.296	2.479	2.605	2.779	3.067	3.707
27	0.256	0.531	0.855	1.057	1.314	1.703	2.052	2.158	2.291	2.473	2.598	2.771	3.057	3.690
28	0.256	0.530	0.855	1.056	1.313	1.701	2.048	2.154	2.286	2.467	2.592	2.763	3.047	3.674
29	0.256	0.530	0.854	1.055	1.311	1.699	2.045	2.150	2.282	2.462	2.586	2.756	3.038	3.659
30	0.256	0.530	0.854	1.055	1.310	1.697	2.042	2.147	2.278	2.457	2.581	2.750	3.030	3.646
40	0.255	0.529	0.851	1.050	1.303	1.684	2.021	2.123	2.250	2.423	2.542	2.704	2.971	3.551
60	0.254	0.527	0.848	1.045	1.296	1.671	2.000	2.099	2.223	2.390	2.504	2.660	2.915	3.460
120	0.254	0.526	0.845	1.041	1.289	1.658	1.980	2.076	2.196	2.358	2.468	2.617	2.860	3.373
∞	0.253	0.524	0.842	1.036	1.282	1.645	1.960	2.054	2.170	2.326	2.432	2.576	2.807	3.291

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Table of the Chi-square Distribution



$\alpha =$	0.995	0.99	0.98	0.975	0.95	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10	0.05	0.025	0.02	0.01	0.005	0.001	$=\alpha$
$v = 1$	0.0000393	0.000157	0.000268	0.000382	0.000593	0.001158	0.00242	0.00462	0.00854	0.0158	0.0278	0.0484	0.0833	0.136	0.234	0.394	0.541	0.833	1.385	3.841	$v = 1$
2	0.0100	0.0201	0.0404	0.0506	0.103	0.211	0.446	0.708	1.064	1.386	1.676	2.008	2.366	2.708	3.007	3.571	3.841	4.605	5.024	5.412	2
3	0.0717	0.115	0.185	0.216	0.352	0.584	1.005	1.464	2.008	2.366	2.708	3.007	3.571	3.841	4.605	5.024	5.412	6.251	6.579	6.938	3
4	0.207	0.297	0.429	0.484	0.711	1.064	1.649	2.366	3.007	3.571	3.841	4.605	5.024	5.412	6.251	6.579	6.938	7.779	8.032	8.388	4
5	0.412	0.554	0.752	0.831	1.145	1.610	2.343	3.007	3.571	3.841	4.605	5.024	5.412	6.251	6.579	6.938	7.779	8.032	8.388	8.751	5
6	0.676	0.872	1.134	1.237	1.635	2.204	3.070	3.558	3.832	4.575	5.052	5.428	5.793	6.165	6.535	6.903	7.278	7.642	7.983	8.333	6
7	0.989	1.239	1.564	1.690	2.167	2.833	3.822	4.303	4.584	5.318	5.793	6.165	6.535	6.903	7.278	7.642	7.983	8.333	8.681	9.032	7
8	1.344	1.646	2.032	2.180	2.733	3.490	4.594	5.070	5.351	6.079	6.554	6.926	7.297	7.668	8.039	8.409	8.779	9.129	9.480	9.831	8
9	1.735	2.088	2.532	2.700	3.325	4.168	5.380	5.856	6.137	6.865	7.340	7.712	8.083	8.454	8.825	9.196	9.567	9.917	10.268	10.619	9
10	2.156	2.558	3.059	3.247	3.940	4.865	6.179	6.655	6.936	7.664	8.139	8.511	8.882	9.253	9.624	9.995	10.366	10.717	11.068	11.419	10
11	2.603	3.053	3.609	3.816	4.575	5.578	6.989	7.465	7.746	8.474	8.949	9.321	9.692	10.063	10.434	10.805	11.176	11.527	11.878	12.229	11
12	3.074	3.571	4.178	4.404	5.226	6.304	7.807	8.283	8.564	9.292	9.767	10.139	10.510	10.881	11.252	11.623	11.994	12.345	12.696	13.047	12
13	3.565	4.107	4.765	5.009	5.892	7.042	8.634	9.110	9.391	10.119	10.594	10.966	11.337	11.708	12.079	12.450	12.821	13.172	13.523	13.874	13
14	4.075	4.660	5.368	5.629	6.571	7.790	9.467	9.943	10.224	10.952	11.427	11.799	12.170	12.541	12.912	13.283	13.654	14.005	14.356	14.707	14
15	4.601	5.229	5.985	6.262	7.261	8.547	10.307	10.783	11.064	11.792	12.267	12.639	13.010	13.381	13.752	14.123	14.494	14.845	15.196	15.547	15
16	5.142	5.812	6.614	6.908	7.962	9.312	11.152	11.628	11.909	12.637	13.112	13.484	13.855	14.226	14.597	14.968	15.339	15.690	16.041	16.392	16
17	5.697	6.408	7.255	7.564	8.672	10.085	12.002	12.478	12.759	13.487	13.962	14.334	14.705	15.076	15.447	15.818	16.189	16.540	16.891	17.242	17
18	6.265	7.015	7.906	8.231	9.390	10.865	12.857	13.333	13.614	14.342	14.817	15.189	15.560	15.931	16.302	16.673	17.044	17.395	17.746	18.097	18
19	6.844	7.633	8.567	8.907	10.117	11.651	13.716	14.192	14.473	15.201	15.676	16.048	16.419	16.790	17.161	17.532	17.903	18.254	18.605	18.956	19
20	7.434	8.260	9.237	9.591	10.851	12.443	14.578	15.054	15.335	16.063	16.538	16.910	17.281	17.652	18.023	18.394	18.765	19.116	19.467	19.818	20
21	8.034	8.897	9.915	10.283	11.591	13.240	15.445	15.921	16.202	16.930	17.405	17.777	18.148	18.519	18.890	19.261	19.632	19.983	20.334	20.685	21
22	8.643	9.542	10.600	10.982	12.338	14.041	16.314	16.790	17.071	17.800	18.275	18.647	19.018	19.389	19.760	20.131	20.502	20.853	21.204	21.555	22
23	9.260	10.196	11.293	11.688	13.091	14.848	17.187	17.663	17.944	18.673	19.148	19.520	19.891	20.262	20.633	21.004	21.375	21.726	22.077	22.428	23
24	9.886	10.856	11.992	12.401	13.848	15.659	18.062	18.538	18.819	19.548	20.023	20.395	20.766	21.137	21.508	21.879	22.250	22.601	22.952	23.303	24
25	10.520	11.524	12.697	13.120	14.611	16.473	18.940	19.416	19.697	20.426	20.901	21.273	21.644	22.015	22.386	22.757	23.128	23.479	23.830	24.181	25

F - Distribution ($\alpha = 0.05$ in the Right Tail)

		Numerator Degrees of Freedom									
Denominator Degrees of Freedom	df_2	df_1	1	2	3	4	5	6	7	8	9
1	1		161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54
2	2		18.513	19.000	19.164	19.247	19.296	19.330	19.353	19.371	19.385
3	3		10.128	9.5521	9.2766	9.1172	9.0135	8.9406	8.8867	8.8452	8.8123
4	4		7.7086	7.9443	6.5914	6.3882	6.2561	6.1631	6.0942	6.0410	6.9988
5	5		6.6079	5.7861	5.4095	5.1922	5.0503	4.9503	4.8759	4.8183	4.7725
6	6		5.9874	5.1433	4.7571	4.5337	4.3874	4.2839	4.2067	4.1468	4.0990
7	7		5.5914	4.7374	4.3468	4.1203	3.9715	3.8660	3.7870	3.7257	3.6767
8	8		5.3177	4.4590	4.0662	3.8379	3.6875	3.5806	3.5005	3.4381	3.3881
9	9		5.1174	4.2565	3.8625	3.6331	3.4817	3.3738	3.2927	3.2296	3.1789
10	10		4.9646	4.1028	3.7083	3.4780	3.3258	3.2172	3.1355	3.0717	3.0204
11	11		4.8443	3.9823	3.5874	3.3567	3.2039	3.0946	3.0123	2.9480	2.8962
12	12		4.7472	3.8853	3.4903	3.2592	3.1059	2.9961	2.9134	2.8486	2.7964
13	13		4.6672	3.8056	3.4105	3.1791	3.0254	2.9153	2.8321	2.7669	2.7144
14	14		4.6001	3.7389	3.3439	3.1122	2.9582	2.8477	2.7642	2.6987	2.6458
15	15		4.5431	3.6823	3.2874	3.0556	2.9013	2.7905	2.7066	2.6408	2.5876
16	16		4.4940	3.6337	3.2389	3.0069	2.8524	2.7413	2.6572	2.5911	2.5377
17	17		4.4513	3.5915	3.1968	2.9647	2.8100	2.6987	2.6143	2.5480	2.4943
18	18		4.4139	3.5546	3.1599	2.9277	2.7729	2.6613	2.5767	2.5102	2.4563
19	19		4.3807	3.5219	3.1274	2.8951	2.7401	2.6283	2.5435	2.4768	2.4227
20	20		4.3512	3.4928	3.0984	2.8661	2.7109	2.5990	2.5140	2.4471	2.3928
21	21		4.3248	3.4668	3.0725	2.8401	2.6848	2.5727	2.4876	2.4205	2.3660
22	22		4.3009	3.4434	3.0491	2.8167	2.6613	2.5491	2.4638	2.3965	2.3419
23	23		4.2793	3.4221	3.0280	2.7955	2.6400	2.5277	2.4422	2.3748	2.3201
24	24		4.2597	3.4028	3.0088	2.7763	2.6207	2.5082	2.4226	2.3551	2.3002