

CIE 272
Civil Engineering Measurements

Exam #3
December 16, 2002

Directions:

1. Write your name on your exam book, NOW!
2. Read the questions carefully. Most errors on timed examinations are the result of not understanding what is being asked.
3. **DON'T PANIC!** Answer the easier questions first.

Good Luck!

1. **(35 Points)** “Jack” and “anchor” forces were measured for a pre-stressed concrete design to determine whether to use straight or curved cables in the project. The data in the table below show the ratio of the jack force to the anchor force. Is there a significant difference between the straight-cable design and the curved-cable design at the $\alpha = 0.01$ level of significance?

	Straight Cables	Curved Cables
	1.6609	2.0464
	1.5497	1.7496
	1.7190	2.0464
	1.6534	1.8487
	1.7446	2.1328
	1.4954	1.9250
	1.6836	2.5022
	1.4882	2.0830
	2.0811	2.4280
	1.9819	2.1375
	2.1898	2.6610
	2.0061	2.3679
		2.6045
		2.3011
		2.8134
		2.4206
Mean	1.8585	2.2543
Std. Deviation	0.3144	0.3063

2. **(35 Points)** A school system is planning the renovation of a number of older schools. Before asking voters to approve the projects, the district needs a rough estimate of the likely costs. After searching through recent issues of the *Engineering News-Record*, you compiled the following data:

	Rooms	Stories	Cost (\$M)
	40	4	4.20
	45	5	4.35
	16	3	2.18
	30	4	1.91
	28	3	1.46
	32	4	4.02
	41	5	5.18
	34	3	3.40
	19	3	2.48
	56	4	4.70
	26	3	2.37
Sum	367	41	36.25
Mean	33.4	3.7	3.3
Std. Dev.	11.6	0.8	1.3

Various squares and cross-products are given in the tables below:

	(Rooms-Rooms)	(Stories-Stories)	(Rooms-Rooms) (Cost-Cost)	(Stories-Stories) (Cost-Cost)
	1.81		6.00	0.25
	14.81		12.27	1.34
	12.63		19.37	0.81
	-0.92		4.66	-0.38
	3.90		9.84	1.33
	-0.37		-0.99	0.20
	9.72		14.39	2.40
	-0.46		0.07	-0.08
	10.45		11.71	0.59
	6.17		31.79	0.38
	5.36		6.81	0.67
Sum	63.09		115.94	7.53
Mean	5.74		10.54	0.68
Std. Dev.	5.54		9.28	0.78

	(Rooms) ²	(Stories) ²	(Cost) ²	Rooms × Stories	Rooms × Cost	Stories × Cost
	1600	16	17.6	160	168.0	16.8
	2025	25	18.9	225	195.8	21.8
	256	9	4.8	48	34.9	6.5
	900	16	3.6	120	57.3	7.6
	784	9	2.1	84	40.9	4.4
	1024	16	16.2	128	128.6	16.1
	1681	25	26.8	205	212.4	25.9
	1156	9	11.6	102	115.6	10.2
	361	9	6.2	57	47.1	7.4
	3136	16	22.1	224	263.2	18.8
	676	9	5.6	78	61.6	7.1
Sum	13599	159	135.5	1431	1325.4	142.6
Mean	1236.3	14.5	12.3	130.1	120.5	13.0
Std. Dev.	834.9	6.2	8.4	64.9	79.6	7.2

a. (10) Determine the correlation coefficient between

- i. Number of Rooms (x) vs. Cost (y)
- ii. Number of Stories (x) vs. Cost (y)

Which of these relationships is stronger?

b. (25) Use regression to estimate the cost of a renovation project involving 39 rooms.

3. (30 Points) A municipal water treatment plant was designed to supply 4.5 million gallons of water per day (MGD) to a small community in southern California. Water usage is greatest in the summer due to watering of lawns and gardens. Measured demands, in MGD, during July and August are shown in the table below. They have been ordered for convenience.

2.298	4.536	4.908
3.205	4.565	4.923
3.325	4.657	4.941
3.609	4.666	4.993
3.918	4.670	4.998
3.992	4.724	5.035
4.057	4.737	5.041
4.188	4.763	5.058
4.289	4.784	5.142
4.363	4.816	5.152
4.377	4.817	5.152
4.448	4.852	5.330
4.450	4.887	5.535
4.524	4.905	
Mean	4.577	
Std. Dev.	0.612	

a. (15) Perform a hypothesis test to determine whether the water demand in the summer exceeds the plant capacity. Use $\alpha = 0.05$ for your test.

b. (15) Write one or two paragraphs discussing your recommendations to the community.

If you found that demand DOES NOT exceed plant capacity: Does this mean that the community has nothing to worry about? If so, explain. If not, why not?

If you found that demand DOES exceed plant capacity: Does this mean that the community should increase the capacity? What are other options that the community could consider?

