

# Department of Statistics

## COURSE STATS 330

### Assignment 1, 2005

Instructions: Hand in your completed assignment to the Student Resource Centre by 4pm on Thursday 4<sup>th</sup> August.

#### **Question 1.**

The data set in the file `gradrate.csv` contains historical data on student graduation rates for 264 colleges in the United States. This file (in the form of a csv file) can be downloaded from the course web page. The data are also reproduced at the end of this assignment.

In the early 80's, there was concern over the graduation rates of student athletes. With some justification, it was thought that college admission boards were placing insufficient weight on the academic caliber of potential recruits, and admitting them purely on athletic ability. Accordingly, the National Collegiate Athletic Association (NCAA) introduced rules (Proposition 48) that set minimum admission standards for student athletes. These rules came into force in 1986.

The data in the file gives graduation rates (as percentages) for all students (`as`) and student athletes (`sa`) for students entering college in the indicated year, with the exception of `sa83` and `as83`, which refer to all students entering college between 1983 and 1985 inclusive. Thus the variables `sa83` and `as83` refer to students admitted **BEFORE** the new rules came into effect, and the other variables refer to students admitted **AFTER** the rules came into effect.

Load the data into R. Then answer the following by drawing suitable graphs. Do not fit any models for this question.

1. Is there any evidence that the rules have had the effect of raising the graduation rates of student athletes? Draw a graph to support your conclusion.
2. Is there any change in the relative graduation rates of student athletes (i.e. relative to all students)? Again, draw a graph to support your conclusion.
3. What is the relationship between student athlete graduation rates and all student graduation rates? Does this relationship change from year to year?

## Question 2.

The data in the data set `clocks.txt` relate to auction sales of antique clocks. The variables in the data set are the sale price in \$\$ (variable `price`), age in years of the clock (variable `age`) and number of bidders (variable `bidders`). Download the file (which is a text file); read the data into R and then answer the following questions by fitting a suitable regression model, and drawing any suitable graphs.

1. Is there any evidence that the number of bidders has an effect on the price? If so, how?
2. Is there any evidence that the age of the clock has an effect on the price? If so, how?
3. Do you think these data are suitable for a regression analysis (i.e. randomly scattered about a plane)?

**Data sets follow overleaf**

**Data for Question 1** (also in file gradrate.csv)

	as83	sa83	as86	sa86	as87	sa87	as88	sa88	as89	sa89	as90	sa90	as91	sa91
Akron	42	63	41	58	40	49	39	47	36	41	34	53	37	43
Alabama-Birmingham	36	28	31	33	32	47	31	45	33	32	31	37	31	34
Alabama	52	36	55	57	57	52	57	55	57	39	57	59	57	56
Alabama State	18	29	16	22	14	21	20	39	20	23	21	50	18	26
American University	66	64	67	60	68	76	69	73	67	58	67	74	70	59
Appalachian State	54	55	59	58	64	60	66	59	61	71	64	60	62	44
Arizona	46	46	49	54	49	49	51	51	50	50	51	64	52	54
Arizona State	45	40	45	52	46	57	45	50	45	50	46	53	48	45
Arkansas	35	41	39	46	41	44	41	39	41	35	41	34	42	29
Arkansas State	30	27	29	37	26	26	31	32	30	38	31	49	27	33
Auburn	64	53	65	58	69	65	66	51	68	55	66	55	65	53
Austin Peay	29	31	32	29	29	34	25	35	33	39	35	50	29	40
Ball State	48	61	48	68	51	73	54	73	57	66	55	73	54	55
Baylor	69	63	71	66	71	53	71	55	70	61	69	60	70	66
Bethune-Cookman	37	32	36	57	38	50	23	67	36	71	30	44	38	23
Boise State	19	36	18	27	21	43	23	44	25	31	25	26	20	41
Boston College	85	86	88	94	87	92	91	87	87	84	86	90	85	71
Boston University	63	75	67	77	72	76	71	76	71	70	69	77	69	70
Bowling Green	54	54	63	61	60	56	65	59	64	67	62	71	60	69
Bradley	64	67	64	52	69	66	66	65	68	75	68	56	64	68
Brigham Young	39	41	48	42	51	55	52	50	56	56	58	59	67	40
Bucknell	90	93	94	97	89	85	95	92	92	91	92	96	89	87
Butler	58	72	66	80	66	77	65	61	66	73	62	80	60	63
California	73	67	77	61	76	71	79	76	79	57	80	64	81	57
Cal-Irvine	58	58	65	57	71	58	73	59	68	54	72	41	75	64
Cal-Santa Barbara	64	66	66	67	68	61	69	70	70	65	70	73	72	69
Cal State-Fullerton	41	29	45	38	45	38	45	31	44	35	42	24	40	18
Cal State-Sacramento	38	34	34	32	40	37	40	29	40	54	36	56	43	46
Canisius	55	58	59	76	58	56	66	84	55	82	55	64	54	63
Centenary	46	61	57	58	54	52	56	50	54	67	54	54	52	57
Central Florida	43	40	49	56	47	54	51	42	51	59	51	52	50	47
Central Michigan	53	63	56	60	61	57	57	65	53	58	51	63	54	63
Chicago State	11	20	8	25	20	38	22	18	23	39	16	27	12	31
Cincinnati	46	51	47	42	47	59	47	53	46	56	46	48	48	56
The Citadel	71	67	66	63	70	88	70	75	73	89	77	86	73	50
Clemson	70	50	70	47	71	64	72	53	72	53	70	41	70	50
Cleveland State	34	33	34	48	37	34	32	48	29	44	28	54	25	31
Coastal Carolina	31	47	34	62	30	62	32	46	35	56	31	43	34	32
Colgate	89	84	91	84	90	92	89	93	89	84	88	82	85	76
Colorado	60	56	66	58	64	43	66	51	66	54	66	51	65	49
Colorado State	55	60	57	55	58	58	55	58	56	45	56	33	58	61
Connecticut	68	55	68	70	72	71	68	55	70	58	68	70	68	62
Creighton	66	53	65	31	67	59	67	51	66	74	67	59	72	68
Davidson	88	81	91	66	87	57	88	50	92	100	89	79	89	73
Dayton	70	78	72	90	75	73	73	73	75	82	75	78	71	89
Delaware	69	61	71	57	73	75	73	64	72	67	71	63	70	82
Delaware State	30	41	26	38	26	31	22	26	29	44	30	52	30	50

DePaul	61	69	61	81	58	85	56	71	56	71	58	88	58	74
Detroit Mercy	47	49	54	68	48	37	53	42	49	67	37	68	40	51
Drake	55	56	60	56	62	45	62	67	71	57	61	60	68	61
Drexel	65	75	54	64	59	73	55	70	53	70	47	75	40	56
Duke	92	91	94	89	95	94	94	90	94	91	93	91	92	97
Duquesne	69	78	71	72	69	69	65	78	68	74	69	71	64	74
East Carolina	46	56	50	52	49	52	49	56	49	52	49	64	48	58
East Tennessee State	34	49	34	58	34	58	34	53	36	56	37	48	34	48
Eastern Illinois	54	59	61	53	62	63	63	58	65	57	69	63	70	61
Eastern Kentucky	33	43	30	61	31	61	30	54	28	59	25	47	27	48
Eastern Washington	35	39	38	42	39	31	40	35	41	28	44	46	45	32
Evansville	52	61	59	55	61	72	57	64	59	61	59	67	60	68
Fairfield	82	76	86	69	86	88	84	100	87	93	83	88	83	88
Fairleigh Dickinson	39	37	39	53	36	40	34	58	31	41	22	47	31	32
Florida	56	45	61	52	63	54	61	55	63	59	63	57	64	39
Florida A&M	35	28	33	41	36	31	42	37	43	29	42	48	45	35
Florida International	56	47	55	50	54	34	61	55	58	28	55	45	51	33
Florida State	53	43	50	50	61	51	63	73	65	55	64	68	65	61
Fordham	77	87	77	84	78	81	78	89	77	75	74	69	77	75
Furman	73	74	81	82	80	80	81	77	77	78	76	73	75	78
George Mason	41	54	46	63	51	60	50	55	53	67	48	62	49	59
George Washington	67	79	70	76	72	63	68	71	69	72	65	79	68	79
Georgetown	89	86	92	95	92	95	92	89	90	77	90	88	89	92
Georgia	59	43	61	58	59	47	61	61	62	55	60	51	62	55
Georgia Tech	66	60	68	57	69	60	68	53	69	59	67	68	68	57
Georgia Southern	38	48	36	45	36	50	40	52	41	75	40	47	36	51
Georgia State	32	31	40	52	36	33	41	49	39	44	41	54	25	43
Gonzaga	55	58	61	62	61	75	57	60	62	63	64	50	63	75
Grambling State	49	47	45	35	47	36	50	45	37	43	33	47	33	72
Hartford	56	80	51	65	54	65	50	62	53	70	50	68	53	76
Hawaii	81	75	78	78	80	79	78	77	73	73	72	71	55	62
Hofstra	57	59	58	55	57	45	57	71	57	58	61	53	62	69
Howard	41	41	45	49	50	41	44	49	47	41	47	51	54	83
Idaho	44	41	43	47	43	54	42	51	48	59	47	41	49	45
Idaho State	46	41	59	36	32	46	36	33	39	50	36	43	24	44
Illinois	78	66	78	74	80	64	80	73	79	74	78	76	77	64
Illinois-Chicago	33	48	32	55	36	58	35	51	38	58	34	74	32	58
Illinois State	49	49	53	62	55	60	59	56	53	57	54	67	53	64
Indiana State	37	44	36	49	35	60	35	59	35	61	36	49	35	59
Indiana	56	61	65	62	67	62	70	65	68	65	70	65	67	73
Iona	61	66	56	38	62	69	54	39	60	67	59	59	51	47
Iowa	60	63	59	63	62	67	61	72	61	66	63	68	62	72
Iowa State	60	51	64	67	63	58	64	63	62	59	60	62	60	59
Jackson State	19	37	34	43	28	43	33	41	34	39	33	47	29	24
Jacksonville University	39	41	50	56	42	42	52	25	36	37	41	44	41	46
James Madison	79	68	82	69	81	72	82	74	83	76	82	84	81	74
Kansas	54	48	55	56	56	49	58	64	57	52	56	56	54	56
Kansas State	48	46	48	66	54	57	48	48	45	52	48	48	45	43
Kent State	42	52	43	48	48	53	47	55	45	59	43	61	45	54
Kentucky	45	56	50	59	50	52	50	50	49	43	50	48	48	60

Lafayette	87	84	89	82	89	79	86	80	84	83	87	86	87	86
Lamar	18	15	25	36	22	24	21	28	20	18	22	38	20	30
Lehigh	87	83	87	89	85	90	85	91	87	87	85	90	81	94
Liberty	26	48	35	49	37	54	36	48	37	47	37	49	39	52
Long Island University	32	43	28	44	27	41	24	70	28	45	27	73	20	64
Louisiana State	34	30	37	36	38	49	44	44	47	43	47	32	47	43
Louisiana Tech	39	41	36	59	41	55	40	46	38	38	39	35	38	51
Louisville	28	42	31	54	32	43	29	43	30	63	26	54	28	49
Loyola (MD)	69	82	74	71	79	78	76	77	76	71	78	78	77	88
Loyola Marymount	67	42	68	68	71	64	72	56	79	44	74	75	71	72
Loyola (IL)	59	87	63	77	65	73	63	61	62	88	66	83	63	81
Maine	49	53	56	59	57	56	53	63	52	53	54	43	53	60
Manhattan	70	83	70	100	72	93	71	87	66	86	71	93	73	96
Marist	60	50	63	67	62	100	61	50	66	60	61	54	64	63
Marquette	74	83	74	70	74	70	77	80	74	70	75	75	74	74
Marshall	39	39	39	51	39	43	38	46	35	47	41	41	32	39
Maryland-Baltimore Co.	36	61	35	66	42	71	42	62	46	58	45	59	46	54
Maryland	56	58	64	54	61	57	64	65	66	68	61	69	63	51
Maryland-Eastern Shore	19	23	21	25	22	33	30	43	27	48	30	50	32	5
Massachusetts	63	66	68	73	66	85	67	50	65	75	60	68	61	59
McNeese State	27	29	28	33	28	36	28	35	27	34	28	34	24	41
Memphis	34	37	33	64	26	59	35	58	34	51	34	59	32	30
Mercer	40	54	40	59	42	46	39	48	40	43	43	37	51	64
Miami (FL)	56	48	55	52	60	54	58	54	63	62	58	58	58	46
Miami (OH)	75	65	83	75	83	68	82	76	81	78	82	67	80	66
Michigan	82	65	85	79	85	76	85	71	85	80	84	71	82	68
Michigan State	66	64	69	62	72	52	70	74	69	51	66	74	66	67
Middle Tennessee State	33	31	36	44	36	48	36	40	38	46	38	31	33	47
Minnesota	34	47	42	53	49	52	51	46	48	62	52	56	52	48
Mississippi	48	48	49	57	51	59	49	58	48	55	47	60	49	50
Mississippi State	51	52	52	53	50	51	48	49	51	53	45	51	49	55
Mississippi Valley State	31	42	43	44	64	64	36	41	42	38	53	52	25	16
Missouri	55	53	55	54	58	51	60	55	60	53	57	58	58	63
Monmouth (NJ)	48	48	52	48	47	68	50	75	45	45	45	47	47	37
Montana	28	35	28	38	32	51	37	41	35	39	38	52	40	54
Morehead State	38	44	44	69	41	59	38	45	37	50	40	54	40	44
Morgan State	38	46	16	40	32	40	34	30	34	41	31	37	36	40
Mount St. Marys	71	70	73	70	73	85	72	74	67	71	65	83	63	76
Murray State	39	47	43	40	46	68	41	48	49	55	46	43	39	33
Nebraska	48	48	50	64	53	58	48	59	48	60	49	61	46	57
Nevada-Las Vegas	27	34	27	40	34	38	33	23	35	43	35	37	37	36
New Hampshire	67	72	74	75	73	64	73	77	74	78	73	75	74	80
New Mexico	28	36	33	47	33	50	38	53	37	48	33	37	37	51
New Mexico State	37	41	38	51	40	43	38	50	41	40	40	45	39	58
New Orleans	18	25	19	21	20	34	20	56	24	44	26	37	24	27
Niagara	55	78	56	82	53	69	54	79	52	64	48	61	53	69
Nicholls State	18	28	22	35	20	44	22	31	20	31	19	38	23	33
North Carolina-Asheville	34	43	35	47	42	65	43	70	42	42	41	32	45	100
North Carolina	78	74	82	67	83	75	85	76	84	74	82	63	84	66
North Carolina-Charlotte	49	50	49	64	53	54	61	57	58	61	53	51	51	41

North Carolina-Wilmington	42	67	46	67	49	76	55	67	52	76	57	69	54	83
North Carolina A&T	38	40	37	44	44	50	40	29	44	48	44	31	45	50
North Carolina State	60	51	60	57	64	48	68	59	67	68	67	73	64	61
North Texas	32	29	34	42	36	15	36	48	38	33	35	41	35	45
Northeast Louisiana	27	36	32	43	27	36	31	46	34	39	30	32	28	36
Northeastern	47	67	46	60	43	67	42	64	39	64	40	67	42	56
Northern Illinois	52	52	52	57	54	63	57	65	55	52	51	50	50	60
Northern Iowa	56	61	62	58	62	64	60	71	62	74	59	70	60	69
Northwestern State	14	30	22	32	30	26	33	46	27	39	28	34	27	45
Northwestern	87	82	89	77	89	84	88	82	89	82	91	93	90	85
Notre Dame	92	83	94	84	95	82	93	85	94	86	93	93	93	88
Ohio State	52	60	54	69	59	59	61	61	60	67	55	49	57	54
Ohio University	53	69	61	70	65	59	66	76	70	76	58	66	66	69
Oklahoma	43	39	42	46	43	53	41	40	45	35	44	46	42	54
Oklahoma State	43	27	44	30	47	48	48	38	50	47	48	41	49	36
Old Dominion	47	44	45	38	47	38	47	57	45	50	40	44	41	68
Oregon	47	47	54	66	56	60	61	63	61	68	56	56	59	63
Oregon State	50	54	52	47	54	56	63	88	63	95	63	61	61	53
Pacific	62	65	62	63	63	64	56	81	58	46	59	70	62	53
Penn State	74	67	77	78	77	78	79	77	79	83	78	81	81	76
Pepperdine	59	42	68	50	64	48	65	50	63	54	69	79	72	80
Pittsburgh	61	55	62	56	62	75	65	65	65	59	62	49	61	64
Providence	83	84	95	93	87	100	92	98	57	84	93	86	83	82
Purdue	68	60	70	65	69	62	70	59	71	65	69	64	64	70
Radford	52	67	54	68	52	51	58	81	57	89	58	58	50	57
Rice	86	69	87	78	88	75	88	75	88	80	90	74	88	81
Richmond	82	75	81	73	79	76	82	68	77	87	83	83	83	79
Rider	62	60	63	74	61	64	63	63	60	68	55	74	54	57
Robert Morris	55	57	48	80	55	27	49	61	49	79	47	50	52	69
Rutgers	73	69	76	69	75	74	76	64	76	66	75	54	73	66
St. Bonaventure	68	76	70	83	73	63	72	73	65	50	72	80	76	76
St. Francis (NY)	34	57	34	27	44	67	40	70	45	45	39	53	39	66
St. Francis (PA)	55	61	64	80	53	53	55	58	52	56	53	62	55	65
St. Johns	64	78	62	73	64	58	66	79	65	62	63	75	66	66
St. Josephs	71	78	73	88	79	74	72	75	76	80	73	89	71	75
St. Louis U.	63	81	65	92	64	84	66	72	64	67	60	68	62	56
St. Marys	65	63	66	100	64	68	65	86	64	69	68	68	62	68
St. Peters	47	57	49	59	47	57	59	58	58	68	47	51	46	49
San Diego	53	72	60	81	67	59	68	88	70	90	67	70	65	75
San Diego State	37	31	41	40	39	39	41	39	36	37	34	40	36	31
San Francisco	56	61	58	100	63	71	58	62	56	62	61	68	61	92
San Jose State	30	33	39	36	39	38	36	38	35	56	39	46	34	47
Santa Clara	78	77	81	81	81	86	83	79	84	79	80	61	79	67
Seton Hall	59	59	61	71	65	64	64	73	65	72	65	70	64	71
Siena	79	67	81	75	82	83	79	100	81	100	81	83	84	88
South Alabama	25	33	23	48	36	63	32	47	30	42	30	42	30	39
South Carolina	59	56	61	49	61	67	62	63	62	64	63	73	56	62
South Carolina State	50	43	51	59	42	51	44	46	63	43	49	53	47	31
South Florida	38	46	46	54	42	58	43	45	47	64	46	39	47	50
Southeast Missouri State	34	33	34	48	35	41	36	49	34	52	37	53	36	47

Southeastern Louisiana	19	35	22	33	28	29	29	40	28	46	27	46	20	45
Southern California	64	51	66	69	67	53	67	56	65	71	67	57	69	53
Southern Illinois	43	56	20	61	43	62	44	69	43	58	39	57	35	55
SMU	69	48	68	71	73	69	69	84	71	80	72	72	70	84
Southern Mississippi	40	41	40	43	46	55	44	54	47	42	46	57	40	46
Southern University	24	26	25	30	27	44	28	38	27	45	22	41	21	30
Southwest Missouri State	37	52	43	62	42	62	41	53	41	49	39	45	40	42
Southwest Texas State	29	33	30	44	32	33	30	32	31	50	30	43	32	49
Southwestern Louisiana	29	24	30	39	28	47	27	40	27	39	27	41	24	39
Stanford	92	84	92	86	93	81	93	89	93	78	94	91	92	88
Stephen F. Austin	40	41	40	58	41	61	42	53	42	55	41	39	38	58
Stetson	58	59	58	48	63	60	61	48	66	56	64	58	63	64
Syracuse	62	61	64	69	67	65	71	77	71	61	70	65	69	65
Temple	44	56	43	57	42	46	47	55	43	68	49	53	37	59
Tennessee-Chatt.	28	38	33	33	33	47	40	30	42	31	38	50	42	43
Tennessee	52	48	50	49	51	55	56	52	55	47	55	44	56	37
Tennessee Tech	45	58	41	53	40	47	40	36	46	50	44	48	42	42
UT-Arlington	28	23	28	30	25	34	28	39	28	28	27	42	28	48
Texas	59	43	63	55	62	52	62	49	65	57	63	58	65	59
UT-El Paso	25	23	26	38	25	36	23	32	24	21	24	32	22	28
UT-Pan Am	11	21	19	38	18	42	17	22	19	39	20	21	21	27
UT-San Antonio	21	32	22	26	23	22	23	30	23	22	24	32	24	39
Texas A&M	67	38	66	53	66	53	67	47	68	58	68	53	69	52
TCU	61	54	62	57	61	60	59	62	60	60	59	39	63	66
Texas Southern	9	13	10	24	10	15	11	23	13	32	12	24	8	23
Texas Tech	41	35	40	45	39	47	40	54	38	57	40	51	44	43
Toledo	39	45	47	52	31	47	41	65	39	53	37	51	37	53
Tulane	68	57	70	62	74	72	73	66	73	74	72	75	74	71
Tulsa	47	49	44	51	45	68	53	55	54	56	59	57	56	61
UCLA	70	60	74	60	77	66	77	51	77	61	77	57	79	63
Utah	33	49	34	50	42	51	41	51	44	62	38	55	38	59
Utah State	47	33	46	32	46	46	54	53	56	38	50	41	36	50
Valparaiso	69	67	74	75	74	85	71	83	73	69	72	76	68	59
Vanderbilt	78	71	81	82	82	69	81	89	83	83	82	79	81	83
Vermont	76	79	77	79	76	74	76	86	73	79	72	77	68	75
Villanova	83	83	86	76	68	83	85	77	84	81	84	77	86	84
Virginia	80	81	92	88	92	80	91	84	93	90	91	83	92	80
Virginia Commonwealth	41	58	46	55	45	64	46	45	46	51	43	50	45	46
Virginia Military	65	61	66	67	65	55	66	83	62	77	67	50	56	60
Virginia Tech	71	46	72	55	73	70	74	70	73	64	73	62	74	70
Wagner	36	57	48	50	50	64	57	76	69	40	70	68	70	52
Wake Forest	78	62	84	71	88	69	86	72	87	71	85	71	85	76
Washington	60	53	63	61	65	52	67	57	70	68	69	57	70	64
Washington State	52	48	55	49	55	49	61	57	62	50	63	58	63	60
Weber State	20	27	43	31	38	40	31	33	33	42	40	38	39	40
West Virginia	54	62	55	66	55	62	55	67	56	64	56	52	54	54
Western Carolina	42	44	45	62	47	59	47	51	50	51	48	49	48	57
Western Illinois	40	52	43	58	46	55	44	58	49	68	46	60	45	41
Western Kentucky	39	47	37	38	33	40	39	53	39	47	41	35	39	49
Western Michigan	46	50	54	49	51	46	55	63	52	57	52	47	52	48

Wichita State	45	27	44	33	32	57	31	41	28	44	27	50	24	46
William & Mary	84	83	89	85	92	87	90	84	92	87	91	73	89	90
Winthrop	51	44	50	49	48	52	50	45	51	51	57	70	51	54
Wisconsin	66	63	70	69	72	66	73	69	73	56	72	56	73	60
Wisconsin-Green Bay	32	53	37	67	40	60	40	70	39	60	41	53	42	70
Wright State	30	46	33	54	31	43	28	50	32	49	32	62	31	43
Wyoming	41	44	44	42	44	52	46	46	43	43	45	37	45	41
Xavier (OH)	66	78	65	77	64	92	66	83	66	71	69	83	67	100
Youngstown State	38	59	40	60	38	35	36	49	35	51	34	64	28	43

**Data for Question 2** (in file clocks.csv)

<b>age</b>	<b>bidders</b>	<b>price</b>
127	13	1235
115	12	1080
127	7	845
150	9	1522
156	6	1047
182	11	1979
156	12	1822
132	10	1253
137	9	1297
113	9	946
137	15	1713
117	11	1024
137	8	1147
153	6	1092
117	13	1152
126	10	1336
170	14	2131
182	8	1550
162	11	1884
184	10	2041
143	6	845
159	9	1483
108	14	1055
175	8	1545
108	6	729
179	9	1792
111	15	1175
187	8	1593
111	7	785
115	7	744
194	5	1356
168	7	1262