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This study examined the effect on GPA of increased occupancy of double dormitory rooms. Seven groups of 50 students each were randomly selected: Group (1) freshmen, two per room; (2) freshmen, three per room; (3) freshmen living off campus, (4) seniors, two per room; (5) seniors, three per room; (6) seniors living off campus; (7) seniors in fraternity or sorority houses. First-term GPA's for all students were recorded. A one-tailed analysis of variance was computed for each group. A significant difference was revealed among the senior groups; multiple t-tests were computed for each independent group. Tables show the computation of the analyses and the t-tests. The t-tests for the seniors showed that Group 4 differed significantly from Group 5, 6, and 7, but that these did not differ significantly from one another. Group 4 achieved a higher GPA than the other three senior groups. The freshman t-tests showed no significant difference. Although Group 1 had a higher GPA than Group 2, and Group 2 than Group 3, the difference between any two of them was not statistically significant. Other factors that no doubt influence the GPA (student homogeneity, roommate compatability, favorable study conditions, past academic success, beneficial residual of attrition, increased motivation) should be studied further, examining more students over a longer period of time. The statistical formulas and the printouts for the various computations are appended. (HH)

State University
AGRICULTURAL AND TECHNICAL COLLEGE
Delhi, New York

A STATISTICAL ANALYSIS OF THE EFFECTS OF HOUSING ENVIRONMENT ON GRADE POINT AVERAGE

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Director of Housing

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INTRODUCTION

Delhi Tech is one of New York State's two year Agricultural and Technical Colleges. As a unit of the State University of New York, accredited by the Middle States Association, it grants the degree of Associate in Applied Science. The College has four degree-granting Technical Divisions, each served by the General Studies Division, and a certificate granting Vocational Education Division. The four Technical Divisions are: Agriculture, Business Management, Construction Technology, Hotel-Restaurant and Institutional Management. The Vocational Education Division, which began enrolling students during the 1968-69 academic year, offers a certificate stating that the student has completed a specific skills course and is now equipped with a marketable skill.

The Technical Divisions at Delhi presently operate on the philosophy that they are training technicians; therefore, the educational process is viewed as being terminal. Many students graduating from Delhi Tech do pursue further education at four year colleges, but the transfer credit they receive is regarded by this college as being merely incidental.

Delhi Tech is presently affecting a change in its philosophy in that it wants to become a comprehensive college by adding an Associate in Arts Degree to its present degree offerings. This program would be offered by the General Studies Division.

Due to its location in the Catskill Mountains, Delhi Tech is primarily a residential college with an enrollment of 1600 students. The present ratio of men to women is two to one.

STATEMENT OF THE PROBLEM

Many studies have been, and are presently being conducted in dormitories concerning fire hazards (Morris, 1958; Morris, 1959), dormitories as living-learning units (Campbell, Richards, 1964; Olson, 1964), and dormitory construction design (Christe, 1965; Tonigan, 1966). Yet, very few studies are being conducted in the area of student environment and its effect on his academic success, which presently can best be measured by student grade point average.

Perusal of research data did not reveal any published studies dealing with the effects of housing environment on grade point average; therefore, it is hoped that this study can be useful to further research in the field of housing.

Due to enrollment increases during the past few years, many colleges have found that they lacked adequate dormitory space. Many units of the State University of New York have found themselves in this dilemma. One of the most expedient and widely practiced, but questionable, solutions is to triple the existing dormitory rooms.

It seems logical that rooms designed to accommodate two students but programed for three, would not produce an adequate study environment. Accordingly one would expect the grade point average of students residing two per dormitory double room would be significantly different from those residing three per dormitory double room, and perhaps different from off-campus housing units and sorority-fraternity houses, as well.

The following study attempts to empirically test the effect of housing environment on grade point average.

STATISTICAL PROCEDURES

For this study the students at Delhi Tech were categorized into seven groups. A random sampling (1) of fifty students was selected from each group thereby making a total sample population of 350 students.

The students comprising the sample for this study (350) were chosen from the total Technical Division population of 1500.

The seven groups comprising this study were categorized as follows:

Group 1, Freshmen residing two per dormitory double room.
Group 2, Freshmen residing three per dormitory double room.
Group 3, Freshmen residing in off-campus housing.
Group 4, Seniors residing two per dormitory double room.
Group 5, Seniors residing three per dormitory double room.
Group 6, Seniors residing in off-campus housing
Group 7, Seniors residing in Sorority-Fraternity houses.

For the simplicity of reporting, the students involved in the study will be referred to as group 1, group 2, etc.

After randomly selecting fifty students from each category, their grade point averages for the first academic term was obtained from the registrar and then recorded.

A one tailed analysis of variance was computed for the Freshmen group and a separate one tailed test for the Senior groups. Due to the indication of significant difference in the Senior group, a series of multiple t tests were computed for each independent group. The figures used in the computation of the analysis of variance and the multiple t tests are shown in tabular form on the preceding pages. The statistics used to compute the t tests were programed in Fortran and computed through a time sharing RAX terminal computer. The print out of the t test program and the computed statistics is contained in the addendum.

FRESHMAN ANALYSIS OF VARIANCE

Source	Degrees of Freedom	$\sum x^2$	Mean Square
Between	2	0.1727	.0863
Within	147	95.2632	.6480
Total	149	95.4359	F=.1331

Critical Level of F Value at the
.05 Level is 3.07
.01 Level is 4.78

SENIOR ANALYSIS OF VARIANCE

Source	Degrees of Freedom	$\sum x^2$	Mean Square
Between	3	3.9873	1.3291
Within	196	72.5653	.3702
Total	199	76.5526	F=3.590

Critical Level of F Value at the
.05 Level is 2.67
.01 Level is 3.91

FRESHMEN t TESTS

	Room Type		
	Double	Triple	Off Campus
Computed Statistics	Group 1	Group 2	Group 3
Number of Students	50	50	50
Mean Grade Point Average	2.19	2.16	2.12
Standard Deviation	0.83	0.79	0.76
Standard Error of Mean	0.12	0.11	0.11

	Groups		
Computed Statistics	1 & 2	1 & 3	2 & 3
Standard Error of Mean Difference	0.16	0.16	0.16
z Score	0.18	0.43	0.26
Critical Level of t Test	N.S.D.	N.S.D.	N.S.D.

N.S.D. = No Significant Difference

Critical Level of t Test for 40 Degrees of Freedom at the
.05 Level = 2.021
.01 Level = 2.704

SENIORS t TESTS

Computed Statistics	Room Type: Double Group 4	Triple Group 5	Off Campus Group 6	Greek Housing Group 7
Number of Students	50	50	50	50
Mean Grade Point Average	2.65	2.32	2.31	2.32
Standard Deviation	0.63	0.55	0.64	0.58
Standard Error of Mean	0.09	0.08	0.09	0.08

Computed Statistics	Groups: 4 & 5	4 & 6	4 & 7	5 & 6	5 & 7	6 & 7
Standard Error of Mean Difference	0.12	0.13	0.12	0.12	0.11	0.12
Z Score	2.74	2.67	2.74	0.08	0.00	0.08
Critical Level of t Test	.01	.05	.01	N.S.D.	N.S.D.	N.S.D.

N.S.D. - No Significant Difference

Critical Level of t Test for 40 Degrees of Freedom at the
.05 Level = 2.021
.01 Level = 2.704

RESULTS

The analysis of variance for the three Freshmen groups clearly shows that no significant difference exists because the F score is less than 1.0; therefore, the Null Hypothesis for the group is accepted.

Among the Senior groups the analysis of variance is significantly different; therefore, because of the distribution of the F score the Null Hypothesis for the group is rejected at the .05 level of confidence.

In computing the t tests for the Senior group, it was found that group 4 differed significantly from groups 5,6, and 7. Groups 5,6, and 7 did not differ significantly from one another.

The t tests conducted on the Freshmen groups resulted in no significant difference, which upholds the findings of the F test on this grouping.

It must be remembered that the levels of significant difference on the t tests are not as accurate as the level of significant difference on the analysis of variance. This is because the formula for computing the t does not take into account the elements of interaction. The t test is helpful in that it shows where, between which two groups, and at what level significant difference is occurring.

IMPLICATIONS

To restate the problem, it seems logical to assume that a significant difference in grade point average should exist between students residing two per room in dormitory double rooms, and students residing three per room in dormitory double rooms and perhaps in off campus housing.

The statistics, F test and t tests, clearly indicate that no significant difference exists between any of the three Freshmen groups. An "eyeball" inspection of the Freshmen mean grade point averages indicates that group 1 is higher than group 2 and 3; also, that group 2 is higher than group 3. Although there is a difference between the group mean grade point averages, it is not statistically significant.

On the other hand, the statistics F test and t tests, clearly indicate that a significant difference does exist among the four Senior groups. Senior students residing two per room in dormitory double rooms did achieve a higher grade point average than those residing three per room in dormitory double rooms and in off campus housing units.

Thus, the logical hypothesis is not statistically verified for Freshmen, but is verified for Seniors.

In the Senior grouping we are measuring some factors which make the grade point average significantly different. Probable factors influencing Senior grades are multitudinous such as student homogenity, roommate compatability, favorable study conditions, past academic success, beneficial residual of attrition, increased motivation, etc.

It is my recommendation that further studies such as this be carried out on a greater latitudinal and longititudinal basis, thereby verifying the validity and reliability of this study. Another possible area of study is the identification of dormitory factors that influence students to achieve academically.

It should be understood that the findings of this study are attributable only to Delhi Tech, and not necessarily to other institutions of higher learning.

FOOTNOTES

1. Downie, N.M., Heath, R. W., Basic Statistical Methods. New York, Evanston, London: Harper and Rowe, 1965. Ch. 10, pp. 118-127. Table XIV, pp. 316-317.

2. IBID., pp. 251-260.

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Morris, J., "Built to Burn," Safety Education, Vol. 38 (December 1958), pp. 14-15.

Morris, J., "Student Residence Fire Check List," Safety Education, Vol. 39 (October 1959), p.8.

Olson, L.A., "Living-Learning Units," Journal of Higher Education, Vol. 35, (February 1964), pp. 3-6.

Tonigan, R., "Directions in Dormitory Design and Finance," American School and University, Vol. 38 (May 1966), pp. 88-90.

ADDENDUM

STATISTICAL FORMULAS

Mean ----- $\bar{X} = \frac{\Sigma X}{N}$

Standard Deviation ----- $\sigma = \frac{1}{N}\sqrt{N\Sigma X^2 - (\Sigma X)^2}$

Standard Error of the Mean ----- $S_{\bar{X}} = \frac{\sigma}{\sqrt{N_1 - 1}}$

Standard Error of Mean Difference ----- $S_{D\bar{X}} = \sqrt{S_{\bar{X}_1}^2 + S_{\bar{X}_2}^2}$

Z Score ----- $\frac{\bar{X}_1 - \bar{X}_2}{S_{D\bar{X}}}$

t Score ----- Convert Z Score Using A Distribution of t Probability Table

Analysis of Variance -----

Total Sum Squares ----- $\Sigma_t^2 = \Sigma X^2 - \frac{(\Sigma X)^2}{N}$

Between Sum Squares ----- $\Sigma_b^2 = \left[\sum \frac{(\Sigma X)^2}{N}\right] - \frac{(\Sigma X_T)^2}{N}$

Within Sum Squares ----- $\Sigma_w^2 = \Sigma X^2 - \frac{(\Sigma X)^2}{N}$

$$F = \frac{\text{Mean Square for "Between" Groups}}{\text{Mean Square for "Within" Groups}}$$

```
/display pro85
m.0073 action in progress.
1.0001   /job go
1.0002   c      program for student residence study, delhi
1.0003   c      ----------------------------------------
1.0004   c
1.0005   c
1.0006   c      program for finding the standard error of
1.0007   c      difference of the means and for comparing
1.0008   c      significant difference
1.0009   c
1.0010   c
1.0011           read(5,1)xm1,xm2,se1,se2
1.0012   1       format(4f4.2)
1.0013           sedm=sqrt(se1*se1+se2*se2)
1.0014           zsco=(xm1-xm2)/sedm
1.0015           write(6,2)sedm,zsco
1.0016   2       format(////,5x,'standard error of the difference '
1.0017          1'of the mean is ',f4.2,//,5x,'zscore is ',38x,f4.2)
1.0018           stop
1.0019           end
m.0070 action complete.
```

```
/input
/display pro75
m.0073 action in progress.
1.0001  /job go
1.0002  c     program for student residence study, delhi
1.0003  c     ----------------------------------------
1.0004  c
1.0005  c     finding mean, standard deviation,and
1.0006  c     standard error of mean
1.0007  c
1.0008  c
1.0009        dimension x(100)
1.0010        sx=0.0
1.0011        sxx=0.0
1.0012        read(5,1)n
1.0013  1     format(i2)
1.0014        do 100 i=1,n,1
1.0015        read(5,2)x(i)
1.0016  2     format(f4.2)
1.0017        sx=sx+x(i)
1.0018        sxx=sxx+x(i)*x(i)
1.0019  100   continue
1.0020        an=n
1.0021        xm=sx/an
1.0022        sd=1./an*sqrt(an*sxx-sx*sx)
1.0023        se=sd/sqrt(an-1.0)
1.0024        write(6,3)n
1.0025  3     format(////,24x,'raw data',/,18x,'(random sample',
1.0026       1' of ',i2,')',//)
1.0027        do 200 i=1,50,5
1.0028        write(6,4)x(i),x(i+1),x(i+2),x(i+3),x(i+4)
1.0029  4     format(5f10.2)
1.0030  200   continue
1.0031        write(6,5)xm,sd,se,n
1.0032  5     format(//,5x,'the mean is',16x,f4.2,//,5x,'the'
1.0033       1' standard deviation is  ',f4.2,//,5x,'standard'
1.0034       2' error of mean is  ',f4.2,
1.0035       3/,5x,'no. of observations is ',i2)
1.0036        stop
1.0037        end
m.0070 action complete.
```

raw data
(random sample of 50)

GROUP #1

1.31	3.73	0.94	3.50	2.03
1.70	1.77	2.80	2.23	2.32
0.0	0.69	2.57	1.78	2.56
1.87	3.29	3.23	2.50	2.50
1.97	1.18	2.33	2.77	3.00
1.77	1.47	3.90	1.97	1.67
3.82	1.26	2.13	3.09	1.67
2.41	1.72	1.73	1.53	0.97
2.80	2.63	2.18	2.32	2.12
3.72	2.10	1.53	1.76	3.10

the mean is 2.20

the standard deviation is 0.83

standard error of mean is 0.12
no. of observations is 50
stop 00000

raw data
(random sample of 50)

GROUP #2

2.35	1.42	1.47	2.31	1.87
3.23	2.24	3.63	3.23	2.79
1.97	1.70	2.07	3.13	1.63
2.41	0.0	1.88	0.23	1.50
2.43	1.41	3.13	1.31	2.90
2.03	2.78	2.83	1.53	2.50
1.93	3.07	2.33	1.41	2.12
1.84	1.72	0.0	2.50	3.53
1.81	2.50	2.43	1.83	3.33
2.83	2.09	2.17	2.23	2.47

the mean is 2.16

the standard deviation is 0.79

standard error of mean is 0.11
no. of observations is 50
stop 00000

raw data
(random sample of 50)

GROUP #3

3.13	3.20	2.80	2.03	3.33
1.83	2.29	2.30	2.04	2.28
1.97	1.59	3.40	2.70	2.31
2.07	1.84	2.50	2.56	1.84
1.44	2.21	2.00	2.43	1.38
2.43	1.50	1.84	2.74	0.0
2.24	2.04	3.00	1.87	1.90
2.00	2.63	0.63	2.26	1.27
0.65	3.67	2.77	2.22	0.40
2.17	0.82	3.34	1.82	2.09

the mean is 2.12

the standard deviation is 0.76

standard error of mean is 0.11
no. of observations is 50
stop 00000

raw data
(random sample of 50)

GROUP #4

1.44	2.68	3.30	2.30	2.73
2.80	2.69	2.61	3.41	1.77
2.03	2.28	2.88	2.32	3.68
2.67	2.90	1.72	2.38	3.44
3.75	3.23	2.79	1.75	3.50
2.67	1.85	2.91	3.03	2.25
2.50	3.44	2.63	2.72	1.91
2.78	2.10	2.50	2.86	2.76
2.42	1.36	2.10	3.44	2.81
3.50	1.00	3.67	3.22	2.78

the mean is 2.65

the standard deviation is 0.63

standard error of mean is 0.09
no. of observations is 50
stop 00000

GROUP # 5

raw data
(random sample of 50)

3.50	2.83	2.20	1.50	3.00
3.26	2.44	1.85	2.00	2.30
3.00	1.71	3.13	1.38	2.18
3.20	3.13	2.16	2.06	2.48
2.53	1.92	1.59	1.97	2.39
1.79	2.64	2.59	1.89	1.67
2.13	1.31	1.41	2.19	1.76
2.83	2.32	3.09	2.00	1.81
2.22	2.67	2.81	2.44	2.61
2.31	1.97	1.94	2.81	3.30

the mean is 2.32

the standard deviation is 0.55

standard error of mean is 0.08
no. of observations is 50
stop 00000

GROUP # 6

raw data
(random sample of 50)

2.53	1.59	2.50	2.72	1.50
2.22	1.50	3.23	2.14	1.90
1.83	2.00	2.61	1.38	2.89
1.07	2.53	3.03	1.38	1.94
1.83	2.00	1.81	2.46	3.06
1.19	3.86	1.47	2.70	3.10
1.93	2.75	3.35	1.46	3.80
2.56	2.41	2.14	2.69	1.94
2.83	2.70	2.22	2.26	2.32
3.16	2.58	1.83	2.53	2.20

the mean is 2.31

the standard deviation is 0.64

standard error of mean is 0.09
no. of observations is 50
stop 00000

GROUP # 7

raw data
(random sample of 50)

2.76	2.33	2.25	2.30	2.44
2.23	2.13	2.44	3.30	2.00
2.23	2.90	2.38	2.88	1.44
2.04	3.19	2.20	1.90	2.12
1.50	2.03	2.59	2.06	2.50
2.50	2.34	0.94	2.75	2.47
2.00	2.21	2.48	3.42	2.09
2.85	3.25	2.34	1.91	0.30
2.15	3.25	3.41	2.31	2.00
2.84	1.68	2.00	1.88	2.53

the mean is 2.32

the standard deviation is 0.58

standard error of mean is 0.08
no. of observations is 50

```
stop     00000
m.0070 shut down 1530.
m.0072 begin activity.
/off
m.0075 good-bye
--
```

```
 .n.0076 harpur says hello, sign on.
/id 10006003
n.0073 action in progress.
n.0155  in case of restart, use terminal no.  4
n.0072 begin activity.
/input
/insert pro85
m.0073 action in progress.
m.0070 action complete.
/data
2.192.160.120.11
/end run
m.0073 action in progress.
end of compilation  main
```

GROUP # 1 + 2

```
    standard error of the difference of the mean is 0.16

                                                     0.18
    zscore is
stop     00000
m.0072 begin activity.
```

```
/input
/insert pro85
m.0073 action in progress.
m.0070 action complete.
/data
2.192.120.120.11
/end run
m.0073 action in progress.
end of compilation  main
```

GROUP # 1 + 3

```
    standard error of the difference of the mean is 0.16

                                                     0.43
    zscore is
stop     00000
```

```
m.0072 begin activity.
/input
/insert pro85
m.0073 action in progress.
m.0070 action complete.
/data
2.162.120.110.11
/end run
m.0073 action in progress.
end of compilation  main
```

GROUP # 2 + 3

```
    standard error of the difference of the mean is 0.16

                                                     0.26
    zscore is
stop     00000
```

```
n.0072 begin activity.
 input
 insert pro85
n.0073 action in progress.
n.0070 action complete.
/data
2.652.320.090.08
/end run
m.0073 action in progress.
end of compilation  main
```

GROUP # 4+5

```
    standard error of the difference of the mean is 0.12

    zscore is                                          2.74
stop     00000
```

```
m.0072 begin activity.
/input
/insert pro85
m.0073 action in progress.
m.0070 action complete.
/data
2.652.310.090.09
/end run
m.0073 action in progress.
end of compilation  main
```

GROUP # 4+6

```
    standard error of the difference of the mean is 0.13

    zscore is                                          2.67
stop     00000
```

```
n.0072 begin activity.
/input
(insert pro85
n.0073 action in progress.
n.0070 action complete.
(data
2.652.320.090.08
/end run
m.0073 action in progress.
end of compilation  main
```

GROUP # 4+7

```
    standard error of the difference of the mean is 0.12

    zscore is                                          2.74
stop     00000
```

```
m.0072 begin activity.
/input
/insert pro85
m.0073 action in progress.
m.0070 action complete.
/data
2.322.310.080.09
/end run
m.0073 action in progress.
end of compilation  main
```

GROUP # 5+6

```
    standard error of the difference of the mean is 0.12

    zscore is                                       0.08
stop     00000
```

```
m.0072 begin activity.
/input
/insert pro85
m.0073 action in progress.
m.0070 action complete.
/data
2.322.320.080.08
/end run
m.0073 action in progress.
end of compilation  main
```

GROUP # 5+7

```
    standard error of the difference of the mean is 0.11

    zscore is                                       0.0
stop     00000
```

```
m.0072 begin activity.
/input
/insert pro85
m.0073 action in progress.
m.0070 action complete.
/data
2.312.320.090.08
/end run
m.0073 action in progress.
end of compilation  main
```

GROUP # 6+7

```
    standard error of the difference of the mean is 0.12

    zscore is                                       0.08
stop     00000
m.0072 begin activity.
```