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Project 4

9.45 The federal government awarded grants to the agricultural departments of 9 universities to test the yield capabilities of two new varieties of wheat. Each variety was planted on a plot of equal area at each university, and the yields, in kilograms per plot, were recorded as follows:

	University								
Variety	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	38	23	35	41	44	29	37	31	38
2	45	25	31	38	50	33	36	40	43

Find a 95% confidence interval for the mean difference between the yields of the two varieties, assuming the differences of yields to be approximately normally distributed. Explain why pairing is necessary in this problem.

```
> data <- c(38,45,
+           23,25,
+           35,31,
+           41,38,
+           44,50,
+           29,33,
+           37,36,
+           31,40,
+           38,43)
>
>
> s <- sd(data)
> a <- mean(data)
> n <- 9
> error <- qt(0.975, df=n-1) * s/sqrt(n)
> left <- a - error
> right <- a + error
> left
[1] 31.10159
```

```
> right
[1] 41.89841
```
(31.1016, 41.8984)

9.68 In the study *Germination and Emergence of Broccoli*, conducted by the Department of Horticulture at Virginia Tech, a researcher found that at 5°C, 10 broccoli seeds out of 20 germinated, while at 15°C, 15 out of 20 germinated. Compute a 95% confidence interval for the difference between the proportions of germination at the two different temperatures and decide if there is a significant difference.

```
> p1 <- 10/20
> p2 <- 15/20
> n <- 20
> p <- p1-p2
> error <- qnorm(0.025) * sqrt((p1*(1-p1))/n + (p2*(1-p2))/n)
> right <- p-error
> left <- p+error
> qnorm(0.025)
[1] -1.959964
> left
[1] -0.5398826
> right
[1] 0.03988258
```
There is no significant difference

10.40 In a study conducted at Virginia Tech, the plasma ascorbic acid levels of pregnant women were compared for smokers versus nonsmokers. Thirty-two women in the last three months of pregnancy, free of major health disorders and ranging in age from 15 to 32 years, were selected for the study. Prior to the collection of 20 ml of blood, the participants were told to avoid breakfast, forgo their vitamin supplements, and avoid foods high in ascorbic acid content. From the blood samples, the following plasma ascorbic acid values were determined, in milligrams per 100 milliliters:

Plasma Ascorbic Acid Values

Nonsmokers		Smokers
0.97	1.16	0.48
0.72	0.86	0.71
1.00	0.85	0.98
0.81	0.58	0.68
0.62	0.57	1.18
1.32	0.64	1.36
1.24	0.98	0.78
0.99	1.09	1.64
0.90	0.92	
0.74	0.78	
0.88	1.24	
0.94	1.18	

Is there sufficient evidence to conclude that there is a difference between plasma ascorbic acid levels of smokers and nonsmokers? Assume that the two sets of data came from normal populations with unequal variances. Use a P-value.

9.77 Construct a 98% confidence interval for σ_1/σ_2 in Exercise 9.42 on page 295, where σ_1 and σ_2 are, respectively, the standard deviations for the distances traveled per liter of fuel by the Volkswagen and Toyota mini-trucks.

10.88 A random sample of 200 married men, all retired, was classified according to education and number of children:

	Number of Children		
Education	**0–1**	**2–3**	**Over 3**
Elementary	14	37	32
Secondary	19	42	17
College	12	17	10

Test the hypothesis, at the 0.05 level of significance, that the size of a family is independent of the level of education attained by the father.