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Prob 1. （ANSM 4.17）A football team obtains the following results for a series of 12 matches:

$$W \quad W \quad W \quad D \quad D \quad W \quad W \quad L \quad L \quad L \quad L \quad W$$

where W, D and L indicate that they won, drew or lost respectively. Use the normal approximation for the distribution of the number of runs to look for evidence of clustering. If you have suitable software also use a simulation approach. The exact one-tail probability is $P = 0.0261$. Comment on the accuracy of your estimate(s) for P

Total number of observations: N

different outcomes, n_i observations of the i th kind, $i = 1, 2, \ldots, k$

The proportion of observations of type i : $p_i = \frac{n_i}{N}$

Mean: $E(R) = N\left(1 - \sum_{i=1}^{n} p_i^2\right) + 1$

Variance: $\operatorname{Var}(R) = N\left[\sum_{i=1}^{k}\left(p_i^2 - 2p_i^3\right) + \left(\sum_{i=1}^{n} p_i^2\right)^2\right]$

Barton and David (1957) suggest that the normal approximation is adequate for $N > 12$, no matter what n_i is. I think the accuracy of estimate for P is high.

Prob 2. （ANSM 4.2）The negative exponential distribution with mean 20 has the cumulative distribution function $F(x) = 1 - e^{-x/20}, 0 \leq x < \infty$. Use a Kolmogorov test to determine if it is reasonable to assume the excess parking times in Exercise 3.17 are a sample from this distribution.

```
x<-c(10, 42, 29 ,11 ,63 ,145 ,11 ,8 ,23 ,17, 5, 20 ,15 ,36 ,32 ,15)
ks.test(x,"pexp",1/20)
```

```
> ks.test(x,"pexp",1/20)

  One-sample Kolmogorov-Smirnov test

data:  x
D = 0.26847, p-value = 0.199
alternative hypothesis: two-sided
```

No substantial evidence against H_0.

Prob 3. （ANSM 4.3）Are the insurance claim data in Exercise 3.14 likely to have come from a normal distribution? Test using Lilliefors' test and the Shapiro-Wilk test.

```r
x<-c(1175 , 1183 , 1327 , 1581 , 1592 , 1624 , 1777 , 1924 , 2483 , 2642 , 2713 , 3419 , 5350 , 7615)
library("nortest")
lillie.test(x)

```

```
> lillie.test(x)

  Lilliefors (Kolmogorov-Smirnov) normality test

data:  x
D = 0.26108, p-value = 0.01048
> shapiro.test(x)

  Shapiro-Wilk normality test

data:  x
W = 0.74634, p-value = 0.001166
```

Both tests suggest strong evidence against normality.