

Of the properties in a real estate agent's advertisement listing; two 1+1 (one bed room + one living room) houses, and one 2+1 house all of which are for rental; two 2+1 houses, and one 1+1 house all of which are for sale. What is the probability that the number of 2+1 houses for sale becomes equal to the number of 2+1 houses for rent when any two of these ads are removed?

Answer from Mathful

Let's define the problem clearly:

For rental:

Two 1+1 houses

One 2+1 house

For sale:

Two 2+1 houses

One 1+1 house

Total ads:

Rental ads = 2 (1+1) + 1 (2+1) = 3 ads

Sale ads = 2 (2+1) + 1 (1+1) = 3 ads

Overall total ads = 3 + 3 = 6 ads

Step 1: Define the variables and initial counts

Rental 2+1 houses = 1

Sale 2+1 houses = 2

We want the probability that after removing any two ads, the number of 2+1 houses for sale equals the number of 2+1 houses for rent.

Step 2: Possible 2+1 counts after removal

Initially:

Rental 2+1 = 1

Sale 2+1 = 2

We remove 2 ads from total 6.

Step 3: List of ads with identifiers

To make it easier:

Rental:

R1: 1+1 house

R2: 1+1 house

R3: 2+1 house

Sale:

S1: 2+1 house

S2: 2+1 house

S3: 1+1 house

Step 4: Count total ways to remove 2 ads from 6

Number of ways to choose 2 ads out of 6:

$$\binom{6}{2} = 15$$

Step 5: Consider the condition: after removing two ads, the number of 2+1 houses for sale equals the number of 2+1 houses for rent.

Start with initial counts:

Rental 2+1 = 1 (R3)

Sale 2+1 = 2 (S1, S2)

After removing two ads, let:

r = remaining rental 2+1 houses

s = remaining sale 2+1 houses

We want $r = s$.

Step 6: Possible values of r and s

Since we remove 2 ads total, and initially:

Rental 2+1: 1 house (R3)

Sale 2+1: 2 houses (S1, S2)

Possible values of r after removal:

If we remove R3, $r = 0$

If we keep R3, $r = 1$

Possible values of s after removal:

Remove none of S1, S2: $s = 2$

Remove one of S1 or S2: $s = 1$

Remove both S1 and S2: $s = 0$

Step 7: Find pairs (r, s) with $r = s$

Possible equal values:

$$r = s = 0$$

$$r = s = 1$$

Step 8: Calculate the number of ways to remove two ads such that after removal $r = s = 0$

This means:

$r = 0 \Rightarrow$ R3 (rental 2+1) is removed.

$s = 0 \Rightarrow$ Both S1 and S2 (sale 2+1) are removed.

We remove 2 ads total, so removing R3 + both S1 and S2 (3 ads) is impossible.

Thus, $r = s = 0$ not possible in removing only 2 ads.

Step 9: Calculate the number of ways for $r = s = 1$

This means:

$r = 1 \Rightarrow$ R3 is not removed.

$s = 1 \Rightarrow$ Exactly one of S1 or S2 is removed.

Since we remove 2 ads total, and one of them is one 2+1 sale house (S1 or S2), the other removed ad must not be R3 (otherwise $r = 0$).

So the other removed ad is either:

R1 or R2 (rental 1+1)

S3 (sale 1+1)

Step 10: Enumerate all possible pairs to remove for $r = s = 1$

Remove one sale 2+1 house (S1 or S2), and one non-2+1 ad excluding R3.

The possible pairs are:

(S1, R1)

(S1, R2)

(S1, S3)

(S2, R1)

(S2, R2)

(S2, S3)

Check that R3 is not removed in any of these pairs.

Step 11: Count favorable pairs

Step 12: Calculate the probability

Total pairs = 15

Favorable pairs = 6

$$P = \frac{6}{15} = \frac{2}{5} = 0.4$$

Final answer:

The probability that the number of 2+1 houses for sale becomes equal to the number of 2+1 houses for rent when any two ads are removed is $\boxed{\frac{2}{5}}$ or 0.4 (40%).

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