

BH3Homelabor

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Backgroud

Daily task reflashes several S+ tasks, Maximum hometown level requires 20 and 18 points of randomly selected two out of four abilities to complete S+ task. Original S rank Valkyries contribute 8, 10, 12 points in rank S, SS and SSS. Original A rank Valkyries contribute points in rank A to SSS, and original B rank Valkries contribute points from rank B to SSS. Free elves Jingwei's Wing contributes 1-4 Dexterity points for rank A to SSS and Blood embrace gives 1-4 points in Fitness.

Warning: package 'knitr' was built under R version 4.0.5

Same Valkyries usually have same ability except several newly added ones. Free and gatch elves also had abilities

1: First question What is the probability to complete the task

Given requirement, can I fullfill it.

Solution 1: randomly select two out of 4 abilities, check if I can fullfill the 2 requirement. randomly select one of the two to be higher and another to be lower. Is it same to select on higher and select one lower from remaining?

Possible combinations: 2-1: $\text{Choose}(4,2) = 6$ multiply 2 = 12 4-3: $\text{Choose}(4,1)$ multiply $\text{Choose}(3,1) = 12$

So they are the same and we have 12 possible combinations of tasks.

Then the probability to fullfill the tasks depends on the maximum value we have for each abilities.

For example, if we only had one ability M and another N, M and N is the requirement for tier X task. Then the probability to fullfill a tier X task is $1/12$. If we had k reflash chance, the probability increased to be $1-(11/12)^k = 0.2297454$. If we had one ability M, and another two N, then $p = 2/12$.

We can define $M > N$. To calculate the probability, first find the set A of ability we have at least N. Then find the set B of at least M.

If $A < 2$, $p=0$;

If $A \geq B \geq 2$, $p = (2! \text{choose}(B,2) + (A-B)*B)/12$;

If $A \geq B \geq 1$, $A \geq 2, B < 2$, $p = (A-B)*B)/12$;

Note1: $\text{choose}(0,2)$ and $\text{choose}(1,2)$ are both 0 Note2: If $A < 2$, B most < 2

So we can use $P = (2! \text{choose}(B,2) + (A-B)*B)/12$ for all conditions

Given a list of elves and their abilities, the final number of tasks can be fullfilled it the union of each new combinations after adding one elf with the max value for each ability.

The final set of task can be fulfilled is the union of four sets of valkyries plus one elf with the max value of one ability.

We can separate the final possibility calculation into following steps:

- 1: Find the max value of Valkyries for each ability: Order the values in decreasing order, add up the max two values, return as vector V. 2: Find the max value of elves for each ability, return as vector E.
- 3: Assign the requirement value as N, M, $N < M$. 4: Calculate the set VE_i of $V + E[i]$, $i=1:4$. 5: Calculate the union set VE, the probability P0 6: Calculate the final P1 as $1-(1-P0)^{(1+\text{reflash times})}$

For step 4 and 5:

Since we only add one elf a time, it affects one ability only. Thus any new set after adding one elf will be different than the new set adding another elf. We only need to add the number of new set Δ_{VE_i} after adding each elf E_i with the number of set V for the original Valkyries's abilities.

Function 1: Given reflash times f, your maximum two sums of each ability as vector V, your elf maximum bonus for each ability E, what is the probability to complete task in level X of requirement R

```
P1<-function(f=2,R=c(20,18),
             V=c("F"=18,"D"=18,"K"=18,"S"=18),
             E=c("F"=6,"D"=0,"K"=6,"S"=4))
){
  N<-min(R)
  M<-max(R)
  A1<-sum(V>=N)
  B1<-sum(V>=M)
  P0=(choose(B1,2)*factorial(2)+(A1-B1)*B1)/12
  P=P0
  print(paste("With original Valkyries set, the probability to complete the task is ",round(P,3),sep=""))
  if(A1>=1){# if none of them are at least N, it is impossible to fullfill the requirement
    for(a in names(V)){
      VE=V[a]+E[a]
      Vnew=V
      Vnew[a]<-VE
      A2<-sum(Vnew>=N)
      B2<-sum(Vnew>=M)
      P1=(choose(B2,2)*factorial(2)+(A2-B2)*B2)/12
      deltaP=P1-P0
      P=P+deltaP
      print(paste("Adding elf with ability ", a, ", ", A2, " and ", B2, " fullfill requirement ", R[1], ", ", R[2]))
    }
    P2<-1-(1-P)^(f+1)
    print(paste("With reflash times ",f," the probability to fullfill the requirement increased from ", P, " to ", P2))
  }
  else(print("No possible combinations to full fill the requirement"))
}
##test
P1()
```

```
## [1] "With original Valkyries set, the probability to complete the task is 0"
## [1] "Adding elf with ability F, 4 and 1 fullfill requirement 20, 18, 0.25 more likely to complete the task"
## [1] "Adding elf with ability D, 4 and 0 fullfill requirement 20, 18, 0 more likely to complete the task"
```

```
## [1] "Adding elf with ability K, 4 and 1 fullfill requirement 20, 18, 0.25 more likely to complete the t
## [1] "Adding elf with ability S, 4 and 1 fullfill requirement 20, 18, 0.25 more likely to complete the t
## [1] "With reflash times 2, the probability to fullfill the requirement increased from 0.75 to 0.984"
```

```
P1(f=0,V=c("F"=18,"D"=18,"K"=16,"S"=16),E=c("F"=0,"D"=0,"K"=0,"S"=0))
```

```
## [1] "With original Valkyries set, the probability to complete the task is 0"
## [1] "Adding elf with ability F, 2 and 0 fullfill requirement 20, 18, 0 more likely to complete the t
## [1] "Adding elf with ability D, 2 and 0 fullfill requirement 20, 18, 0 more likely to complete the t
## [1] "Adding elf with ability K, 2 and 0 fullfill requirement 20, 18, 0 more likely to complete the t
## [1] "Adding elf with ability S, 2 and 0 fullfill requirement 20, 18, 0 more likely to complete the t
## [1] "With reflash times 0, the probability to fullfill the requirement increased from 0 to 0"
```

```
P1(f=0,V=c("F"=18,"D"=18,"K"=16,"S"=16),E=c("F"=6,"D"=0,"K"=0,"S"=0))
```

```
## [1] "With original Valkyries set, the probability to complete the task is 0"
## [1] "Adding elf with ability F, 2 and 1 fullfill requirement 20, 18, 0.083 more likely to complete the t
## [1] "Adding elf with ability D, 2 and 0 fullfill requirement 20, 18, 0 more likely to complete the t
## [1] "Adding elf with ability K, 2 and 0 fullfill requirement 20, 18, 0 more likely to complete the t
## [1] "Adding elf with ability S, 2 and 0 fullfill requirement 20, 18, 0 more likely to complete the t
## [1] "With reflash times 0, the probability to fullfill the requirement increased from 0.083 to 0.083"
```

```
P1(f=0,V=c("F"=18,"D"=18,"K"=16,"S"=16),E=c("F"=6,"D"=0,"K"=6,"S"=0))
```

```
## [1] "With original Valkyries set, the probability to complete the task is 0"
## [1] "Adding elf with ability F, 2 and 1 fullfill requirement 20, 18, 0.083 more likely to complete the t
## [1] "Adding elf with ability D, 2 and 0 fullfill requirement 20, 18, 0 more likely to complete the t
## [1] "Adding elf with ability K, 3 and 1 fullfill requirement 20, 18, 0.167 more likely to complete the t
## [1] "Adding elf with ability S, 2 and 0 fullfill requirement 20, 18, 0 more likely to complete the t
## [1] "With reflash times 0, the probability to fullfill the requirement increased from 0.25 to 0.25"
```

1.2: The Final probability as a function of reflash times and the base probability

2: Second question: The minimum amount of Valkyries and elves to complete the task with probability P.

3: Third question: