TO 618

Team 1-2 HW2
Covid-19 Pooled Testing Case

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Task one: Base Model

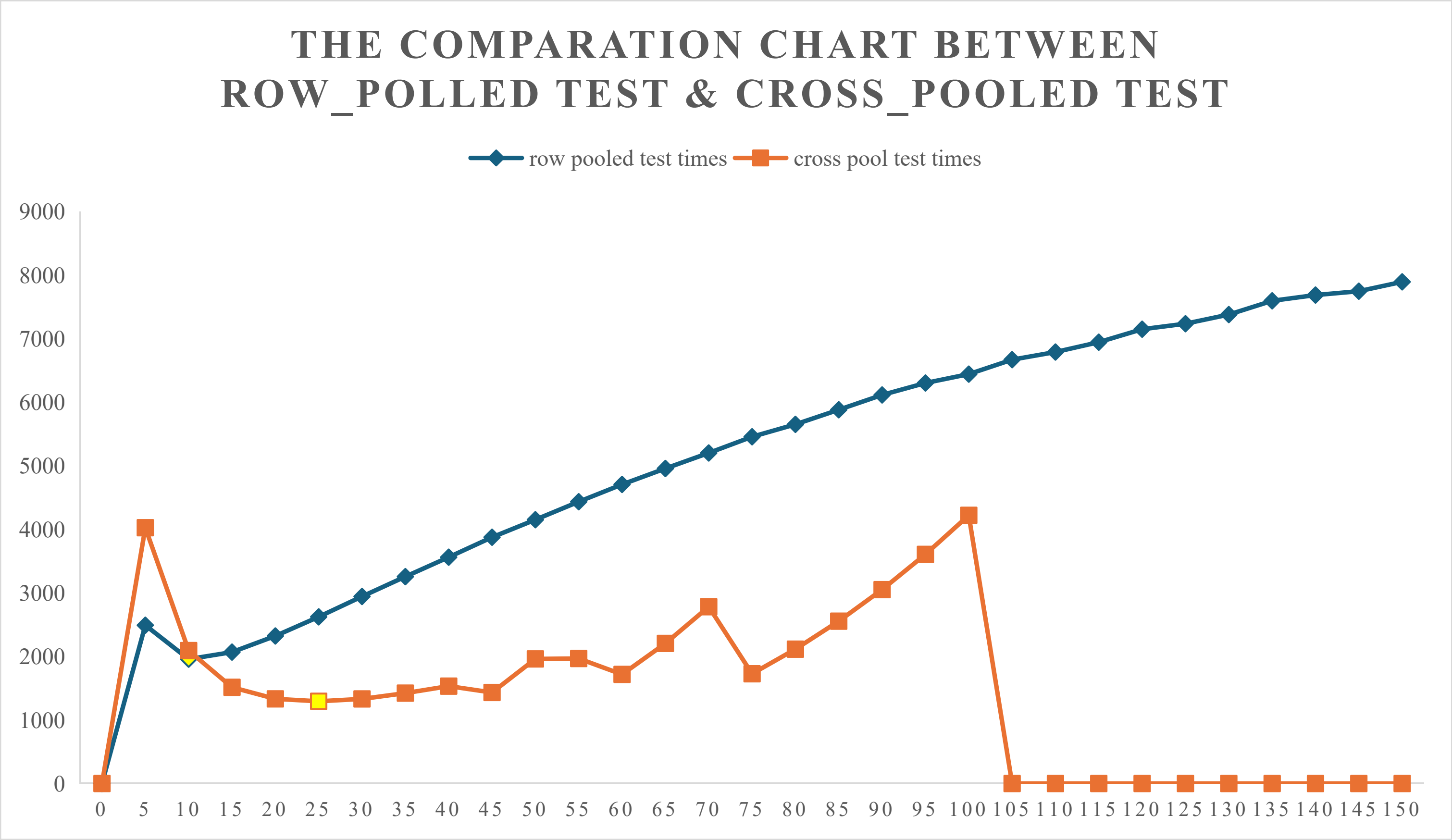
- Total test amount N:10000
- Prevalence: 1% (Infection rate)
- Accurancy: 100%

Row-pooled Test	Number	Ilustration
# of people in a row (k_r)	10	
# of group	1000	
# of 1st test	1000	= # of groups
prevanlence	1%	
P(X>=1)(X: # of positive person in a certain group) X~B(k_r, prevanlence)	0.095617925	= 1-P(X=0)
E(Y) (Y: # of group which are tested positive) Y~B(N/k_r, P(X>=1))	95.61792499	=# of groups * p(X>=1)
# of 2nd test	956.1792499	= k_r * E(Y)
# of total test	1956.17925	= # of 1st test + # of 2nd test

Cross-Pooled Test	Number	Ilustration
# of order of a square(k_s)	10	
# of squares	100	= 10000/(10^2)
# of 1st test	2000	= # of squares * k_s*2
prevanlence	1%	
P(X1>=1)(X1: # of positive person in a certain row) X1~B(k_s, prevanlence)	0.095617925	= 1-P(X1=0)
P(X2>=1)(X2: # of positive person in a certain column) X2~B(k_s, prevanlence)	0.095617925	= 1-P(X2=0)
E(Y1) (Y1: # of column which are tested positive) Y~B(k_r, P(X1>=1))	0.95617925	= # of order of a square *P(X1>=1)
E(Y2) (Y2: # of row which are tested positive) Y~B(k_r, P(X2>=1))	0.95617925	= # of order of a square *P(X2>=1)
E(Z)=E(Y1*Y2)=E(Y1)E(Y2) (Z: # of person that need to test again) Y1, Y2 are independent	0.914278758	
# of 2nd test	91.4278758	= # of squares * E(Z)
# of total test	2091.427876	= # of 1st test + # of 2nd test

In summary, row-pooled test needs 1956.17925 times and cross-pooled needs 2091.42876 times

Task two: Recommendations



- When k_r = 10, the row-pooled method has the smallest total test times.
- When k_s = 25, the cross-pooled method has the smallest total test times.
- When k_r &k_s<=10, we choose row-pooled test, in in all other cases, we choose the cross-pooled test.

Task three: Change of prevalence test

Scenario Summary					
	Current Values:	default	2%	5%	10%
Changing Cells:					
prevalence	1%	1%	2%	5%	10%
Result Cells:					
Total times of row_pooled test	1956.17925	1956.17925	2829.271931	5012.630608	7513.215599
Total times of cross_pooled test	1293.633483	1293.633483	2372.402205	6021.65829	9415.741777

- Sensitivity Analysis Conclusion: As prevalence increases, the testing burden grows for both methods.
- Practical Application Recommendation: If prevalence is low, cross-pooled tests √ .When prevalence is high, although cross-pooled tests still have a slight advantage, the efficiency gap between the methods is minimal. Other factors √

Task four: Acbott Lab test (change of accuracy)

variable	number
Total amount	2000
# of people who has virus	1000
# of people who has virus and be tested positive	990
# of people who has no virus	1000
#of people who has no virus but be tested positive	50
P(positive) =P(positive|No virus)*P(No virus)+P(Positive| virus)*P(Virus)	0.0594

Changed model	Number
prevalence	5.94%
k_r	10
k_s	10
# of total times of row-pooled test	5579.370252
# of total times of cross-pooled test	6941.327276

Information		**Positive**					
	Priors	*Conditional Likelihoods*		*Joint*		*Posteriors*	
Virus	1%	P(Positive|Virus)=	0.99	P(Virus and Positive)=	0.0099	P(Virus|Positive)=	0.16667
No Virus	99%	P(Positive|No Virus)=	0.05	P(No Virus and Positive	0.0495	P(No Virus|Positive)=	0.83333
				P(Positive)=	0.0594		

- The result 0.0594 is the new **prevalence**.By incorporating this value into the base model, we can obtain the new total times as **5579.370252** for row-pooled test and **6941.327276** for cross-pooled test.