Multimedia Appendix 5: Supplemental results from this study

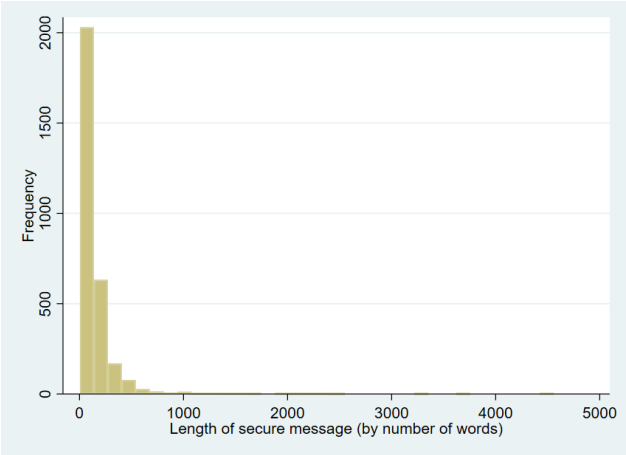


Figure A5-1. Distribution of the length of secure messages. 3000 messages in total, with a median length of 92 (interquartile range=(49, 168)). 2850 (95%) of the 3000 messages had fewer than 435 words.

Table A5-1. Performance of three variants of HypoDetect systems on the evaluation set, averaged by folds in 10-fold cross-validation.

Systems		AUC_ ROC	Precision	Sensitivity (Recall)	Specificity	F1	Accuracy
Rule-based		0.815 (0.068)	0.288 (0.090)	0.493 (0.160)	0.951 (0.010)	0.363 (0.113)	0.934 (0.014)
Linear SVMs							
	Baseline	0.944 (0.038)	0.629 (0.218)	0.378 (0.137)	0.991 (0.006)	0.462 (0.151)	0.967 (0.008)
	Class weighting	0.951 (0.034)	0.551 (0.154)	0.566 (0.154)	0.980 (0.010)	0.544 (0.118)	0.964 (0.010)
	RUS-ensemble[a]	0.949 (0.039)	0.199 (0.028)	0.921 (0.110)	0.852 (0.013)	0.326 (0.043)	0.855 (0.015)
	ROS-ensemble[b]	0.949 (0.035)	0.570 (0.160)	0.503 (0.156)	0.984 (0.007)	0.523 (0.135)	0.966 (0.009)
	SMOTE-ensemble[c]	0.950 (0.035)	0.573 (0.158)	0.503 (0.156)	0.985 (0.007)	0.525 (0.135)	0.966 (0.008)
Random Forest							

	Baseline	0.943 (0.031)	0.000 (0)	0.000 (0)	1.000 (0)	0.000 (0)	0.962 (0.002)
	Class weighting	0.927 (0.058)	0.435 (0.133)	0.574 (0.180)	0.970 (0.010)	0.490 (0.140)	0.955 (0.013)
	RUS-ensemble	0.929 (0.046)	0.145 (0.022)	0.905 (0.109)	0.787 (0.024)	0.249 (0.036)	0.791 (0.024)
	ROS-ensemble	0.932 (0.046)	0.321 (0.080)	0.733 (0.188)	0.938 (0.012)	0.444 (0.105)	0.930 (0.015)
	SMOTE-ensemble	0.942 (0.042)	0.490 (0.113)	0.600 (0.144)	0.975 (0.007)	0.535 (0.120)	0.961 (0.010)
Logistic Regression							
	Baseline	0.952 (0.037)	0.673 (0.267)	0.310 (0.138)	0.994 (0.005)	0.415 (0.167)	0.968 (0.009)
	Class weighting	0.953 (0.036)	0.540 (0.151)	0.696 (0.156)	0.974 (0.012)	0.593 (0.117)	0.963 (0.013)
	RUS-ensemble	0.947 (0.041)	0.193 (0.029)	0.913 (0.113)	0.849 (0.014)	0.319 (0.044)	0.851 (0.016)
	ROS-ensemble	0.950 (0.036)	0.553 (0.171)	0.528 (0.162)	0.982 (0.009)	0.528 (0.139)	0.965 (0.010)
	SMOTE-ensemble	0.951 (0.036)	0.586 (0.146)	0.563 (0.145)	0.983 (0.008)	0.561 (0.112)	0.967 (0.008)

[a]RUS-ensemble: ensemble models using random under-sampling
[b]ROS-ensemble: ensemble models using random over-sampling
[c]SMOTE-ensemble: ensemble models using Synthetic Minority Over-sampling Technique

Table A5-2. Performance comparison between the best HypoDetect systems and other systems, as measured by F1 score.[a]

System A	System B		
	Linear SVMs: class weighting	Random Forest: SMOTE-ensemble	Logistic Regression: class weighting
Rule based	*P<.001*	*P<.001*	*P<.001*
Linear SVMs			
Baseline	*P=.004*		
RUS-ensemble[b]	*P<.001*		
ROS-ensemble[c]	*P=.09*		
SMOTE-ensemble[d]	*P=.1*		
Random Forest			
Baseline		*P<.001*	
RUS-ensemble		*P<.001*	

ROS-ensemble		*P<.001*	
Class weighting		*P=.06*	
Logistic Regression			
Baseline			*P=.002*
RUS-ensemble			*P<.001*
ROS-ensemble			*P=.02*
SMOTE-ensemble			*P=.08*

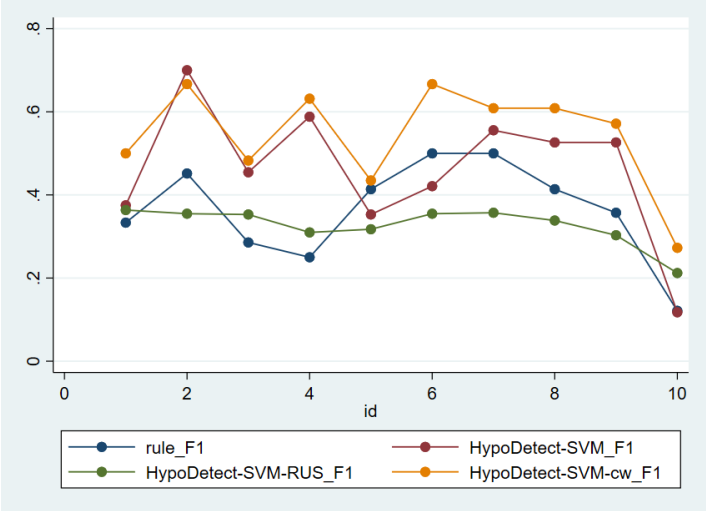
[a]one-sided paired t-test. Treating F1 score on each fold as an observation and paired the F1 scores of two systems for the same fold. H_0: F1 score of system A == F1 score of system B. H_a: F1 score of system A < F1 score of system B

[b]RUS-ensemble: ensemble models using random under-sampling

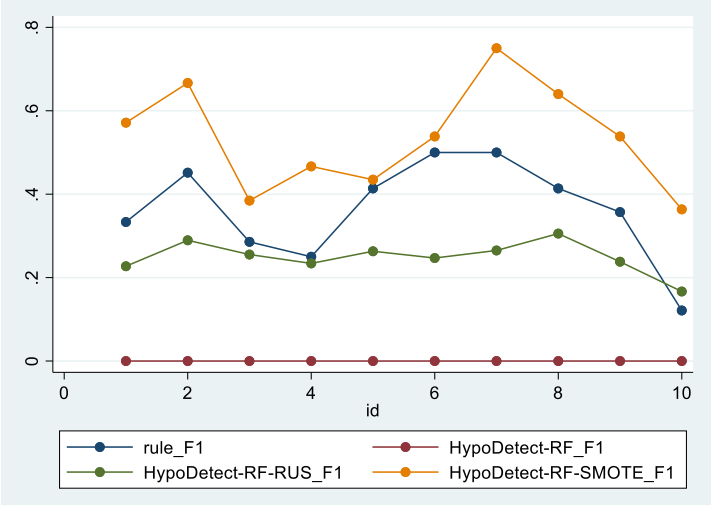
[c]ROS-ensemble: ensemble models using random over-sampling

[d]SMOTE-ensemble: ensemble models using Synthetic Minority Over-sampling Technique

(a)



(b)



(c)

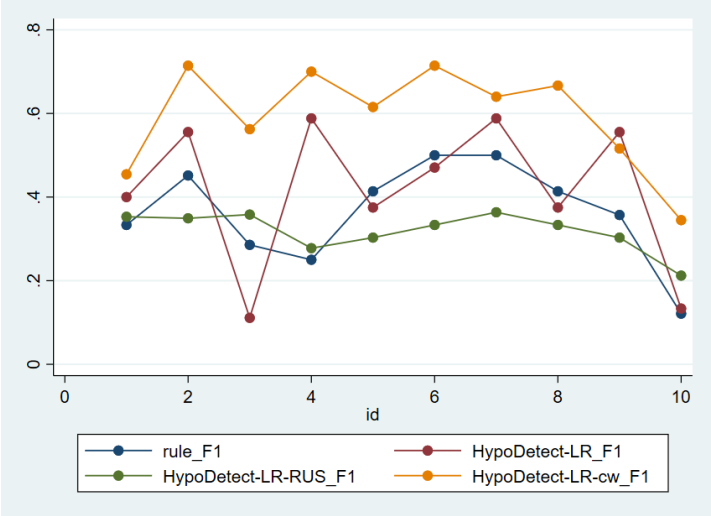


Figure A5-2. Comparing F1 scores of the best HypoDetect system and the baseline systems on each fold. (a): Linear SVMs, (b): Random Forest, and (c): Logistic Regression. Blue (baseline): rule-based method; Red (baseline): machine learning models without treating data imbalance; Green (baseline): ensemble models using random under-sampling (RUS); Orange (best): models using class weighting (cw) or ensemble models using Synthetic Minority Over-sampling Technique (SMOTE).

Table A5-3. Performance of individual classifiers used in ensembled over-sampling HypoDetect systems.

Performance Metrics		**Linear SVM**		**Random Forest**		**Logistic Regression**	
		ROS-ensemble[a]	**SMOTE-ensemble**[b]	**ROS-ensemble**	**SMOTE-ensemble**	**ROS-ensemble**	**SMOTE-ensemble**
AUC-ROC							
	Mean (SD)	0.951 (0.000)	0.951 (0.000)	0.930 (0.002)	0.941 (0.002)	0.951 (0.000)	0.951 (0.000)
	Minimum	0.950	0.950	0.927	0.938	0.951	0.951
	Maximum	0.951	0.951	0.934	0.944	0.951	0.952
Precision							
	Mean (SD)	0.560 (0.004)	0.567 (0.004)	0.302 (0.007)	0.470 (0.016)	0.541 (0.003)	0.565 (0.006)
	Minimum	0.554	0.560	0.290	0.450	0.531	0.557
	Maximum	0.564	0.574	0.313	0.500	0.544	0.577
Sensitivity (Recall)							

	Mean (SD)	0.502 (0.007)	0.504 (0.007)	0.711 (0.008)	0.601 (0.017)	0.534 (0.006)	0.561 (0.000)
	Minimum	0.491	0.491	0.693	0.588	0.526	0.561
	Maximum	0.509	0.518	0.719	0.640	0.544	0.561
Specificity							
	Mean (SD)	0.984 (0.000)	0.985 (0.000)	0.935 (0.002)	0.973 (0.002)	0.982 (0.000)	0.983 (0.000)
	Minimum	0.984	0.985	0.932	0.971	0.982	0.984
	Maximum	0.985	0.985	0.938	0.976	0.982	0.982
F1							
	Mean (SD)	0.529 (0.005)	0.533 (0.006)	0.425 (0.008)	0.527 (0.014)	0.538 (0.004)	0.563 (0.003)
	Minimum	0.521	0.523	0.409	0.511	0.531	0.559
	Maximum	0.535	0.544	0.436	0.548	0.544	0.569
Accuracy							
	Mean (SD)	0.966 (0.000)	0.967 (0.000)	0.927 (0.002)	0.959 (0.002)	0.965 (0.000)	0.967 (0.000)
	Minimum	0.966	0.966	0.924	0.957	0.965	0.966
	Maximum	0.966	0.967	0.929	0.962	0.965	0.968

[a]ROS-ensemble: ensemble models using random over-sampling
[b]SMOTE-ensemble: ensemble models using Synthetic Minority Over-sampling Technique