“I was told to buy a software or lose my computer. I ignored it”
A study of ransomware

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“For the past couple of years consumers have been the most likely victims of ransomware, usually accounting for two-thirds of all infections.”

[An ISTR Special Report: Ransomware and Businesses 2016, Symantec]

Current estimates

Current estimates are based on non-representative data, and often inconsistent:

FBI IC3 report, 2017

2,700 reports (2016)

ISTR Special Report, Symantec, 2017

405,000 consumer blocks globally (06/2016 - 06/2017)

Huang et al., 2018

20,000 potential victims globally, 22-month period (2016 - 2017)

Research questions

1. What are the prevalence and characteristics of ransomware infections in the general US population?

2. What (situational and behavioral) factors affect susceptibility to ransomware ?

Estimating the prevalence of ransomware

Identifying ransomware infections

- Representative sample of 1,180 U.S. adults
  - Weighting adjustment for each respondent
  - Matched to the 2010 American Community Survey (ACS)

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YouGov
What the world thinks

- Respondents progressed through (up to) 30 information and question pages
  - Definition of ransomware
  - Screenshots of common strains
  - 5 questions on specific tactics typical of ransomware
  - Free text description of the attack
  - Consequences of the attack

Victimization rate

	Victimization rate (06/2016 - 06/2017)
Self-reported	5%
Re-classified	3%

3% estimate corresponds to approximately 2.8 million victims in the U.S.

Dealing with the attack

- Almost half of attacks reported include police impersonation (46%)
- Encryption strains (36%) less common than locker strains (74%)
- The median and average ransom reported were $250 and $510, respectively (s.e. $390)
- Few victims paid ransom (4%) or notified authorities (11%)

Payment methods

Cryptocurrencies do not seem to be the driving factor for ransomware.

	Proportion
Pre-paid cash voucher	42%
Wire transfer	14%
Cryptocurrency	**12%**
Premium-rate text message	7%
Not displayed	15%
Do not remember	10%

Behavioral changes post-attack

	Proportion
More careful browsing	65%
Purchased AV product	44%
Updated AV product	31%
Started to backup data	26%
Enable automatic updates	24%
Backup data more regularly	22%
Changed OS configurations	20%
Changed OS	10%
Changed default browser	12%

Half of victims reported changing 2 or more security habits following the attack.

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Risk perceptions

Victims believe they are *more* at risk of a future attack and *less* likely to pay a ransom.

	Victims	**Non-victims**
Likelihood of experiencing a (future) ransomware attack	47 (sd=34)	30 (sd=25)
Likelihood of paying $300 ransom	2.9 (sd=11)	8.4 (sd=20)

Differences statistically significant using a t-test, 95% CI.

Susceptibility to ransomware

Predicting ransomware infection (next 12 months)

Model	Lasso	GBT
Demographics + SES	65	63
Demographics + SES + technology + computer skills	64	65
Security habits	66	67
Security habits + experienced scam	75	74
All features (saturated model)	76	76

Average AUC across (stratified) K=10 folds.

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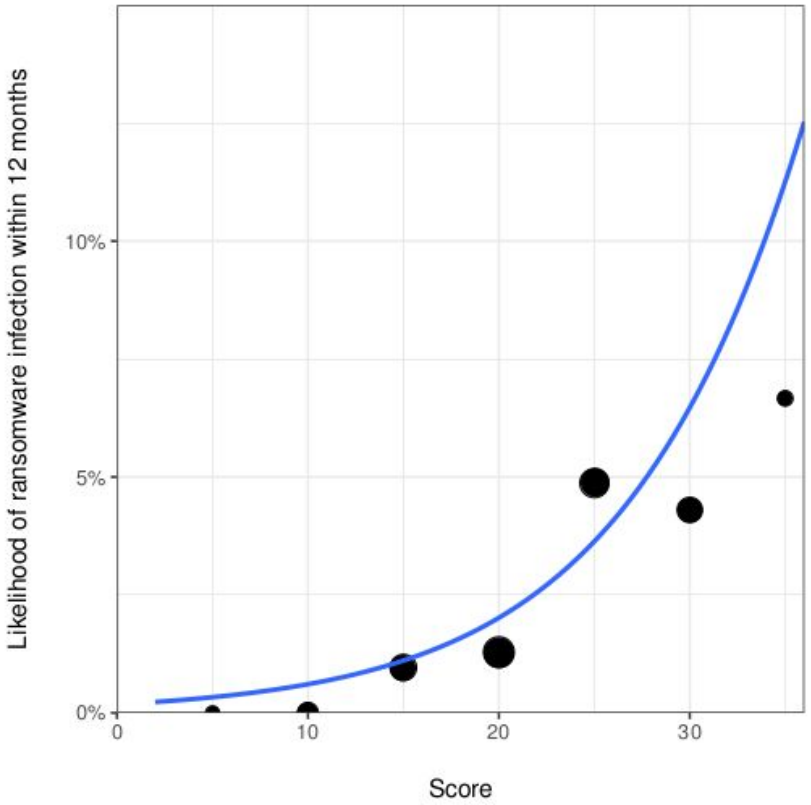
A simpler approach to risk-assessment

Question	Points
How frequently do you **download files from online torrent sites** such as the Pirate Bay or TorrentZ2?	
● I frequently download files from torrent sites	15
● I occasionally download files from torrent sites	10
● I rarely download files from torrent sites	5
● I never download files from torrent sites	0
Do you **backup your personal files** to an external hard drive or cloud-based storage device?	
● I do not have any of my files backed up.	6
● I backup my files once a year	4
● I backup my files every couple of weeks	2
● I backup my files every day.	0
Is your **hard drive encrypted**?	
● Yes, my hard drive is encrypted	0
● No, my hard drive is not encrypted	1

Question	Points
Have you ever downloaded -- or been asked to download-- an application that you suspect was malicious?	10
● Yes, I have.	0
● No, I haven't.	
Do you use **two-factor authentication** for at least one of your online personal accounts (i.e., not for a work-related account)?	
● Yes, I use two-factor authentication.	0
● No, I don't use two-factor authentication.	1
Is your computer **password-protected for login**?	
● Yes, my computer has a password.	0
● No, my computer doesn't have a password.	8

Calibration

Average AUC across K=10 folds is 78%, on par with the saturated model.



Conclusions & future work

- Estimate victimization rate for the U.S.: 3% per year (06/2016 - 06/2017).
- Susceptibility to ransomware infection can be estimated from self-reported security habits and exposure to online scams.
- Present a proof-of-concept approach for consumers to self-assess their risk of infection, that is fast, transparent, and requires limited information.

Questions?

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http://web.stanford.edu/~csimoiu/

Sample responses

Description of attack	System Lock	Encryption	Police impersonation	Inclusive	Conservative
"FBI - YOU HAVE BEEN WATCHING PORN OR GAMBLING OR BOTH, YOU MUST PAY $200 TO MONEYGRAM"	•	•	•	Ransomware	Ransomware
"I was working on my computer and a screen popped up stating that my files had been encrypted and to reverse this I had to buy a program. I do not remember the name it showed but it had a black background. I just shut the computer and took it in for repair."		•		Ransomware	Ransomware
"It popped up and stated that I had to pay to gain access back to my computer and I was unable to do anything."	•			Ransomware	False Positive
"A voice said to call a certain number and when we did someone insisted that we pay $300 and they would take care of the problem. We didn't pay. It was a mess for a while and my husband worked on it for a whole day."	•			False Positive	False Positive