## **VARIABLE CREATION**

To detect the candidates of fraudulent applications within the data, unusualness within the linkage variables count were used. Variables were built by linking the current application to previous ones by 5 base variables, ssn, address, phone, bdname and zipname:

Variable	Explanation
same_ssn	Number of times this SSN appears in the past
same_address	Number of times this address appears in the past
same_phone	Number of times this home phone number appears in the past
same_bdname	Number of times this date of birth and name appears in the past
same_zipname	Number of times this zip code and name appears in the past

Table 1. Table for Base Variables

Furthermore, if a value of a base valuable appears several times in the past but with different values of other base valuable, it's also considered to be fraudulent. Take ssn for example, if a snn appears several times in the past but with different address, home phone number, date of birth or zip code, this application seems to be abnormal.

Variable	Explanation
same_ssn	Number of times this SSN appears in the past
same_ssn_diff_address	Number of times this SSN with different address appears in the past
same_ssn_diff_phone	Number of times this SSN with different home phone number appears in
	the past
same_ssn_diff_bdname	Number of times this SSN with different date of birth and name appears in
	the past
same_ssn_diff_zipname	Number of times this SSN with different zip code and name appears in the
	past

Table 2. Table of ssn with different personal identifiable information (PII)

Finally, 5 time windows, 1 day, 3 days, 7 days, 14 days and 30 days, were used. Each of the 5 base variables has 5 situations regarding other PIIs in 5 different time windows. Therefore, a total of 125 variables were created.

Variable	Explanation
same_ssn_1	Number of times this SSN appears in the past 1 day
same_ssn_3	Number of times this SSN appears in the past 3 days
same_ssn_7	Number of times this SSN appears in the past 7 days
same_ssn_14	Number of times this SSN appears in the past 14 days
same_ssn_30	Number of times this SSN appears in the past 30 days
same_ssn_diff_address_1	Number of times this SSN with different address appears in the
	past 1 day
same_ssn_diff_address_3	Number of times this SSN with different address appears in the
	past 3 days
same_ssn_diff_address_7	Number of times this SSN with different address appears in the
	past 7 days
same_ssn_diff_address_14	Number of times this SSN with different address appears in the
	past 14 days

come con diff address 20	Number of times this CCN with different address are seen in the
same_ssn_diff_address_30	Number of times this SSN with different address appears in the past 30 days
same_ssn_diff_phone_1	Number of times this SSN with different home phone number
	appears in the past 3 days
same_ssn_diff_phone_3	Number of times this SSN with different home phone number
	appears in the past 3 days
same_ssn_diff_phone_7	Number of times this SSN with different home phone number
	appears in the past 7 days
same_ssn_diff_phone_14	Number of times this SSN with different home phone number
	appears in the past 14 days
same_ssn_diff_phone_30	Number of times this SSN with different home phone number
	appears in the past 30 days
same_ssn_diff_bdname_1	Number of times this SSN with different date of birth and name
	appears in the past 1 day
same_ssn_diff_bdname_3	Number of times this SSN with different date of birth and name
	appears in the past 3 days
same_ssn_diff_bdname_7	Number of times this SSN with different date of birth and name
	appears in the past 7 days
same_ssn_diff_bdname_14	Number of times this SSN with different date of birth and name
	appears in the past 14 days
same_ssn_diff_bdname_30	Number of times this SSN with different date of birth and name
	appears in the past 30 days
same_ssn_diff_zipname_1	Number of times this SSN with different zip code and name
	appears in the past 1 day
same_ssn_diff_zipname_3	Number of times this SSN with different zip code and name
	appears in the past 3 days
same_ssn_diff_zipname_7	Number of times this SSN with different zip code and name
d'# -! 4.4	appears in the past 7 days
same_ssn_diff_zipname_14	Number of times this SSN with different zip code and name
same see diff rinname 20	appears in the past 14 days  Number of times this SSN with different zip code and name
same_ssn_diff_zipname_30	appears in the past 30 days
same_address_1	Number of times this address appears in the past 1 day
same_address_3	Number of times this address appears in the past 1 day  Number of times this address appears in the past 3 days
same_address_7	Number of times this address appears in the past 3 days  Number of times this address appears in the past 7 days
same_address_14	Number of times this address appears in the past 7 days  Number of times this address appears in the past 14 days
same_address_30	Number of times this address appears in the past 14 days  Number of times this address appears in the past 30 days
same_address_diff_ssn_1	Number of times this address appears in the past 30 days  Number of times this SSN with different SSN appears in the past 1
34111E_84411E33_4111_3311_1	day
same_address_diff_ssn_3	Number of times this SSN with different SSN appears in the past 3
Janic_address_diii_55ii_5	days
same_address_diff_ssn_7	Number of times this SSN with different SSN appears in the past 7
5ac_aaare55_a55ii_7	days
same_address_diff_ssn_14	Number of times this SSN with different SSN appears in the past 14
<u></u>	days
same_address_diff_ssn_30	Number of times this SSN with different SSN appears in the past 30
<u></u>	days
same_address_diff_phone_1	Number of times this SSN with different home phone number
	appears in the past 1 day
same_address_diff_phone_3	Number of times this SSN with different home phone number
 	appears in the past 3 days
	- br - me me beene male

same_address_diff_phone_7	Number of times this SSN with different home phone number
	appears in the past 7 days
same_address_diff_phone_14	Number of times this SSN with different home phone number
	appears in the past 14 days
same_address_diff_phone_30	Number of times this SSN with different home phone number
	appears in the past 30 days
same_address_diff_bdname_1	Number of times this SSN with different date of birth and name
	appears in the past 1 day
same_address_diff_bdname_3	Number of times this SSN with different date of birth and name
	appears in the past 3 days
same_address_diff_bdname_7	Number of times this SSN with different date of birth and name
	appears in the past 7 days
same_address_diff_bdname_14	Number of times this SSN with different date of birth and name
	appears in the past 14 days
same_address_diff_bdname_30	Number of times this SSN with different date of birth and name
	appears in the past 30 days
same_address_diff_zipname_1	Number of times this SSN with different zip code and name
11 11/4	appears in the past 1 day
same_address_diff_zipname_3	Number of times this SSN with different zip code and name
	appears in the past 3 days
same_address_diff_zipname_7	Number of times this SSN with different zip code and name
cours address diff singulars 14	appears in the past 7 days
same_address_diff_zipname_14	Number of times this SSN with different zip code and name
same address diff singura 20	appears in the past 14 days
same_address_diff_zipname_30	Number of times this SSN with different zip code and name
sama nhana 1	appears in the past 30 days
same_phone_1	Number of times this home phone number appears in the past 1 day
same_phone_3	Number of times this home phone number appears in the past 3
Sume_phone_5	days
same_phone_7	Number of times this home phone number appears in the past 7
Same_pnone_2	days
same_phone_14	Number of times this home phone number appears in the past 14
	days
same_phone_30	Number of times this home phone number appears in the past 30
	days
same_phone_diff_address_1	Number of times this home phone number with different address
	appears in the past 1 day
same_phone_diff_address_3	Number of times this home phone number with different address
	appears in the past 3 days
same_phone_diff_address_7	Number of times this home phone number with different address
	appears in the past 7 days
same_phone_diff_address_14	Number of times this home phone number with different address
	appears in the past 14 days
same_phone_diff_address_30	Number of times this home phone number with different address
	appears in the past 30 days
same_phone_diff_ssn_1	Number of times this home phone number with different SSN
	appears in the past 1 day
same_phone_diff_ssn_3	Number of times this home phone number with different SSN
	appears in the past 3 days

	Number of the selection
same_phone_diff_ssn_7	Number of times this home phone number with different SSN
come whome diff are 4.4	appears in the past 7 days
same_phone_diff_ssn_14	Number of times this home phone number with different SSN
	appears in the past 14 days
same_phone_diff_ssn_30	Number of times this home phone number with different SSN
some whome diff believes 1	appears in the past 30 days
same_phone_diff_bdname_1	Number of times this home phone number with different date of
some whome diff belooms 2	birth and name appears in the past 1 day  Number of times this home phone number with different date of
same_phone_diff_bdname_3	birth and name appears in the past 3 days
same_phone_diff_bdname_7	Number of times this home phone number with different date of
same_phone_uni_buname_/	birth and name appears in the past 7 days
same_phone_diff_bdname_14	Number of times this home phone number with different date of
same_phone_uni_buname_14	birth and name appears in the past 14 days
same_phone_diff_bdname_30	Number of times this home phone number with different date of
Jame_phone_ani_baname_30	birth and name appears in the past 30 days
same_phone_diff_zipname_1	Number of times this home phone number with different zip code
54e_p.io.ie_a.ii_zipiidiiie_1	and name appears in the past 1 day
same_phone_diff_zipname_3	Number of times this home phone number with different zip code
	and name appears in the past 3 days
same_phone_diff_zipname_7	Number of times this home phone number with different zip code
	and name appears in the past 7 days
same_phone_diff_zipname_14	Number of times this home phone number with different zip code
	and name appears in the past 14 days
same_phone_diff_zipname_30	Number of times this home phone number with different zip code
	and name appears in the past 30 days
same_bdname_1	Number of times this date of birth and name appears in the past 1
	day
same_bdname_3	Number of times this date of birth and name appears in the past 3
	days
same_bdname_7	Number of times this date of birth and name appears in the past 7
	days
same_bdname_14	Number of times this date of birth and name appears in the past
	14 days
same_bdname_30	Number of times this date of birth and name appears in the past
	30 days
same_bdname_diff_address_1	Number of times this date of birth and name with different
1 1 1100	address appears in the past 1 day
same_bdname_diff_address_3	Number of times this date of birth and name with different
	address appears in the past 3 days
same_bdname_diff_address_7	Number of times this date of birth and name with different
some halmone diff address 4.4	address appears in the past 7 days
same_bdname_diff_address_14	Number of times this date of birth and name with different
same belgame diff address 20	address appears in the past 14 days  Number of times this date of birth and name with different
same_bdname_diff_address_30	address appears in the past 30 days
same haname diff shore 1	Number of times this date of birth and name with different home
same_bdname_diff_phone_1	phone number appears in the past 1 day
same huname diff nhone 2	Number of times this date of birth and name with different home
same_bdname_diff_phone_3	phone number appears in the past 3 days
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b-d diffb 7	No contract of the contract of
same_bdname_diff_phone_7	Number of times this date of birth and name with different home
balances alter allows 4.4	phone number appears in the past 7 days
same_bdname_diff_phone_14	Number of times this date of birth and name with different home
1 1 1155 1 22	phone number appears in the past 14 days
same_bdname_diff_phone_30	Number of times this date of birth and name with different home
1.1	phone number appears in the past 30 days
same_bdname_diff_ssn_1	Number of times this date of birth and name with different SSN
	appears in the past 1 day
same_bdname_diff_ssn_3	Number of times this date of birth and name with different SSN
	appears in the past 3 days
same_bdname_diff_ssn_7	Number of times this date of birth and name with different SSN
	appears in the past 7 days
same_bdname_diff_ssn_14	Number of times this date of birth and name with different SSN
	appears in the past 14 days
same_bdname_diff_ssn_30	Number of times this date of birth and name with different SSN
	appears in the past 30 days
same_bdname_diff_zipname_1	Number of times this date of birth and name with different zip
	code and name appears in the past 1 day
same_bdname_diff_zipname_3	Number of times this date of birth and name with different zip
	code and name appears in the past 3 days
same_bdname_diff_zipname_7	Number of times this date of birth and name with different zip
	code and name appears in the past 7 days
same_bdname_diff_zipname_14	Number of times this date of birth and name with different zip
	code and name appears in the past 14 days
same_bdname_diff_zipname_30	Number of times this date of birth and name with different zip
	code and name appears in the past 30 days
same_zipname_1	Number of times this zip code and name appears in the past 1 day
same_zipname_3	Number of times this zip code and name appears in the past 3 days
same_zipname_7	Number of times this zip code and name appears in the past 7 days
same_zipname_14	Number of times this zip code and name appears in the past 14
	days
same_zipname_30	Number of times this zip code and name appears in the past 30
	days
same_zipname_diff_address_1	Number of times this zip code and name with different address
	appears in the past 1 day
same_zipname_diff_address_3	Number of times this zip code and name with different address
	appears in the past 3 days
same_zipname_diff_address_7	Number of times this zip code and name with different address
	appears in the past 7 days
same_zipname_diff_address_14	Number of times this zip code and name with different address
	appears in the past 14 days
same_zipname_diff_address_30	Number of times this zip code and name with different address
	appears in the past 30 days
same_zipname_diff_phone_1	Number of times this zip code and name with different home
	phone number appears in the past 1 day
same_zipname_diff_phone_3	Number of times this zip code and name with different home
<b>_</b>	phone number appears in the past 3 days
same_zipname_diff_phone_7	Number of times this zip code and name with different home
	phone number appears in the past 7 days
same_zipname_diff_phone_14	Number of times this zip code and name with different home
	phone number appears in the past 14 days
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same_zipname_diff_phone_30	Number of times this zip code and name with different home
	phone number appears in the past 30 days
same_zipname_diff_ssn_1	Number of times this zip code and name with different SSN
	appears in the past 1 day
same_zipname_diff_ssn_3	Number of times this zip code and name with different SSN
	appears in the past 3 days
same_zipname_diff_ssn_7	Number of times this zip code and name with different SSN
	appears in the past 7 days
same_zipname_diff_ssn_14	Number of times this zip code and name with different SSN
	appears in the past 14 days
same_zipname_diff_ssn_30	Number of times this zip code and name with different SSN
	appears in the past 30 days
same_zipname_diff_bdname_1	Number of times this zip code and name with different date of
	birth and name appears in the past 1 day
same_zipname_diff_bdname_3	Number of times this zip code and name with different date of
	birth and name appears in the past 3 days
same_zipname_diff_bdname_7	Number of times this zip code and name with different date of
	birth and name appears in the past 7 days
same_zipname_diff_bdname_14	Number of times this zip code and name with different date of
	birth and name appears in the past 14 days
same_zipname_diff_bdname_30	Number of times this zip code and name with different date of
	birth and name appears in the past 30 days

Table 3. Table for All Expert Variables