# Pyrazinamide (PZA)
## Notes and Assumptions

[1] N = 985.

[2] 5-Fold Cross-Validation is used to find the best Meta-Parameters for the Random Forest and the Neural Network Classifiers.

[3] Cross-Validation Criteria is ROC-AUC.

[4] 2 Hidden Layers are included in the Neural Network Classifier.

[5] Marginal Effects, ROC-AUC, Sensitivity and Specificity are computed 250 times (Boostraps).

[6] 2/3 of the Sample is Randomly Selected to Train the Classifiers in each Bootstrap. Marginal Effects, ROC-AUC, Sensitivity and Specifity are Computed on the 1/3 of the Sample left
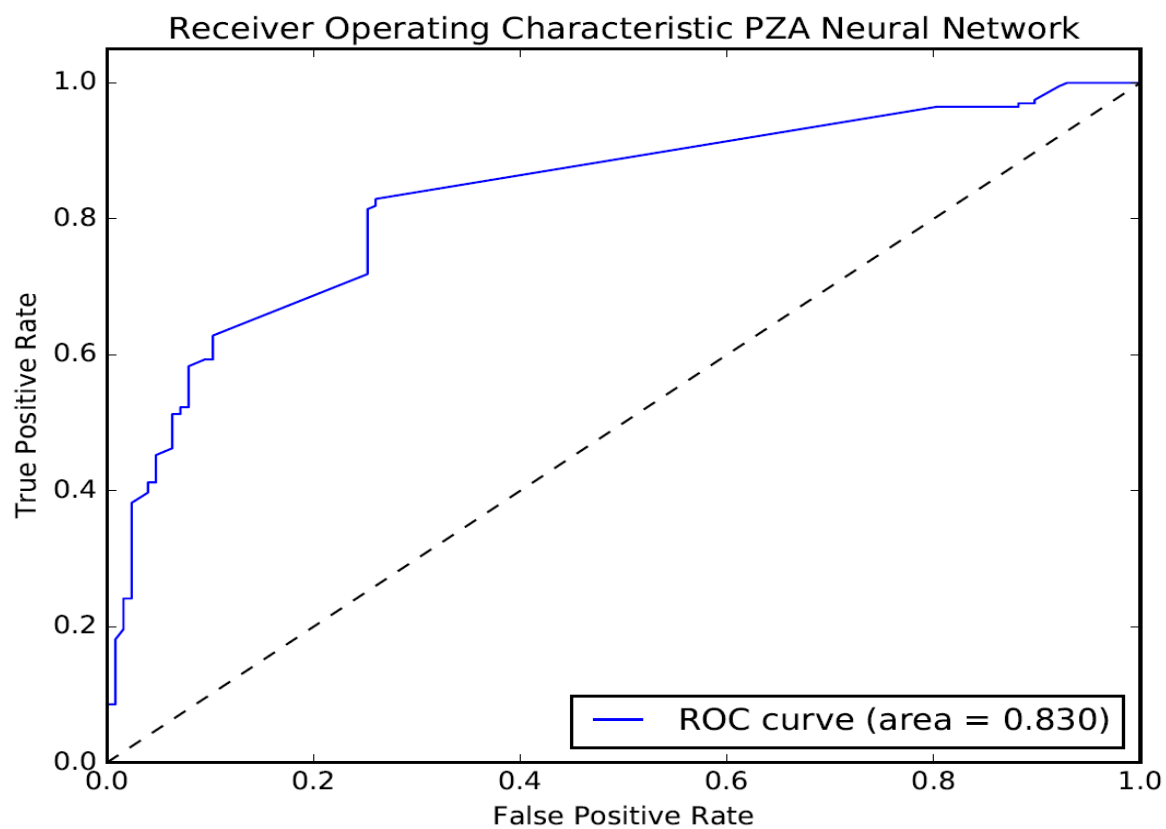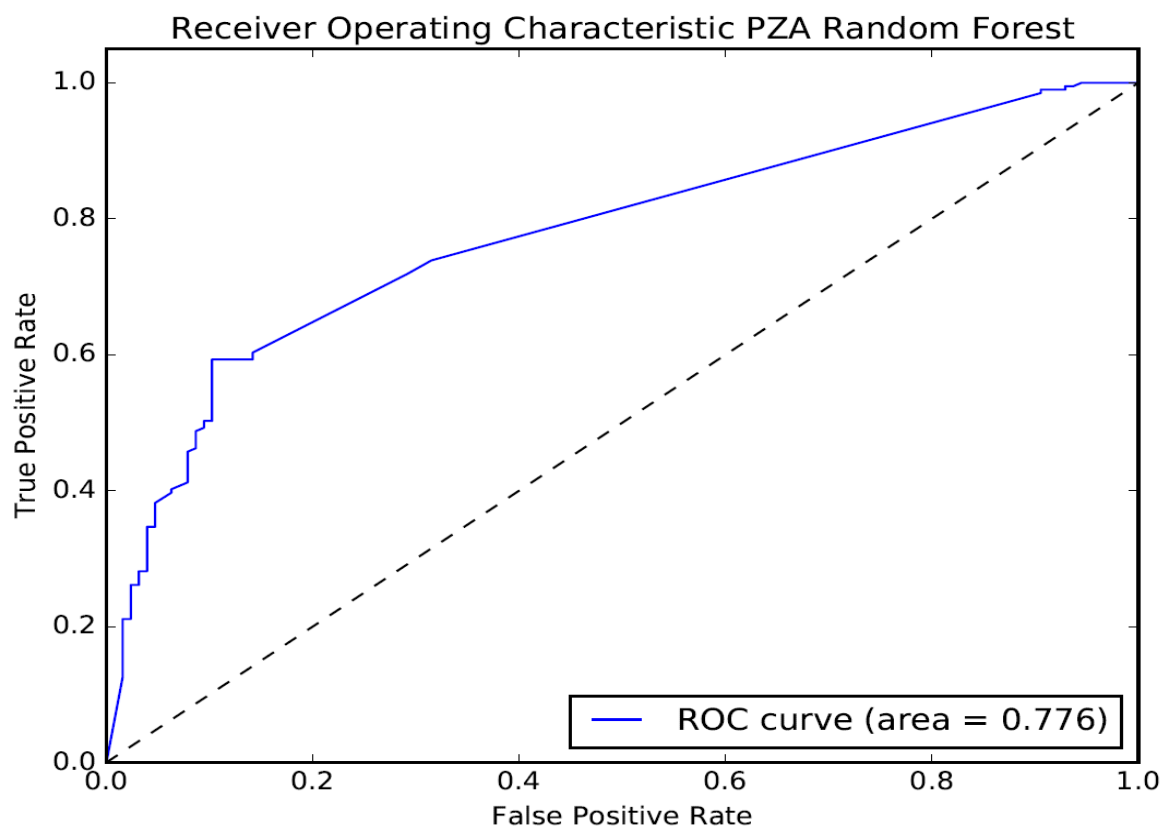
[7] The threshold used to predict the drug resistance maximizes Sensitivity + Specificity.

[8] Models (1) include 124 mutations selected in "*genetic determinants of drug resistance in Mycobacterium Tuberculosis and their diagnostic value*".

[9] Models (2) include all potential 143 mutations.

**Pyrazinamide (PZA): Predictive Model Performance**

| | ROC-AUC | Sensitity [1] | Specificity [2] | [1] + [2] | Optimal Threshold |
|---|---|---|---|---|---|
| Original Random Forest | | 0.640 (0.030) | 0.920 (0.030) | 1.560 | |
| Random Forest (1) | 0.791 (0.019) | 0.622 (0.029) | 0.929 (0.019) | 1.550 | 0.506 (0.061) |
| Neural Network (1) | 0.856 (0.017) | 0.718 (0.027) | 0.946 (0.022) | 1.664 | 0.573 (0.050) |
| Random Forest (2) | 0.813 (0.018) | 0.649 (0.029) | 0.925 (0.020) | 1.573 | 0.505 (0.056) |
| Neural Network (2) | 0.883 (0.016) | 0.752 (0.028) | 0.943 (0.024) | 1.695 | 0.577 (0.050) |

Receiver Operating Characteristic PZA Random Forest

ROC curve (area = 0.776)

Receiver Operating Characteristic PZA Neural Network

ROC curve (area = 0.830)

| Pyrazinamide (PZA) | | Marginal Effects (Standard Errors in Parentheses) | | | |
|---|---|---|---|---|---|
| Mutations | Random Forest Variable Importance | Random Forest (1) | Neural Network (1) | Random Forest (2) | Neural Network (2) |
| SNP_CN_2289090_T152C_H51R_pncA | 0.072 | 0.475 (0.016) | 0.381 (0.009) | 0.457 (0.016) | 0.383 (0.010) |
| SNP_P_2289252_T11C_promoter_pncA | 0.030 | 0.369 (0.042) | 0.297 (0.008) | 0.359 (0.041) | 0.298 (0.009) |
| SNP_CN_2289070_A172G_F58L_pncA | 0.024 | 0.394 (0.038) | 0.318 (0.008) | 0.383 (0.037) | 0.319 (0.009) |
| SNP_CN_2288883_A359G_L120P_pncA | 0.036 | 0.446 (0.017) | 0.342 (0.008) | 0.428 (0.016) | 0.345 (0.009) |
| SNP_CN_2289213_T29G_Q10P_pncA | 0.025 | 0.431 (0.018) | 0.322 (0.008) | 0.411 (0.016) | 0.326 (0.009) |
| SNP_CN_2288839_T403G_T135P_pncA | 0.029 | 0.443 (0.016) | 0.337 (0.008) | 0.430 (0.016) | 0.340 (0.009) |
| SNP_CN_2289081_G161A_P54L_pncA | 0.014 | 0.377 (0.050) | 0.269 (0.008) | 0.360 (0.050) | 0.277 (0.008) |
| SNP_CN_2288883_A359C_L120R_pncA | 0.000 | 0.350 (0.069) | 0.255 (0.008) | 0.331 (0.066) | 0.265 (0.008) |
| INS_CF_2288725_i517C_173_pncA | 0.019 | 0.426 (0.020) | 0.311 (0.008) | 0.410 (0.020) | 0.310 (0.009) |
| SNP_CN_2289016_T226G_T76P_pncA | 0.020 | 0.430 (0.018) | 0.317 (0.009) | 0.416 (0.018) | 0.321 (0.009) |
| SNP_CN_2288953_C289T_G97S_pncA | 0.013 | 0.407 (0.037) | 0.294 (0.007) | 0.392 (0.038) | 0.298 (0.008) |
| SNP_CN_2288934_T308C_Y103C_pncA | 0.006 | -0.243 (0.080) | -0.278 (0.012) | -0.301 (0.069) | -0.280 (0.012) |
| SNP_CN_2288818_T424C_T142A_pncA | 0.012 | 0.356 (0.060) | 0.253 (0.008) | 0.336 (0.058) | 0.263 (0.009) |
| SNP_CN_2288847_C395T_G132D_pncA | 0.004 | 0.260 (0.080) | 0.221 (0.007) | 0.249 (0.073) | 0.224 (0.008) |
| SNP_CN_2289212_C30G_Q10H_pncA | 0.004 | 0.320 (0.081) | 0.235 (0.010) | 0.301 (0.076) | 0.245 (0.008) |
| SNP_CN_2288841_G401A_A134V_pncA | 0.010 | 0.394 (0.040) | 0.283 (0.009) | 0.374 (0.039) | 0.291 (0.009) |
| INS_CF_2288851_i391CC_131_pncA | 0.003 | 0.231 (0.109) | 0.153 (0.013) | 0.204 (0.116) | 0.158 (0.012) |
| INS_CF_2288887_i355A_119_pncA | 0.008 | 0.366 (0.059) | 0.270 (0.008) | 0.350 (0.060) | 0.275 (0.009) |
| SNP_CN_2288848_C394T_G132S_pncA | 0.009 | 0.361 (0.058) | 0.261 (0.008) | 0.347 (0.054) | 0.267 (0.009) |
| SNP_P_2289245_T4A_promoter_pncA | 0.012 | 0.383 (0.049) | 0.273 (0.008) | 0.362 (0.047) | 0.282 (0.008) |
| SNP_CN_2289207_T35C_D12G_pncA | 0.012 | 0.282 (0.081) | 0.205 (0.009) | 0.260 (0.084) | 0.208 (0.009) |
| SNP_CN_2288820_T422G_Q141P_pncA | 0.007 | 0.347 (0.065) | 0.262 (0.008) | 0.326 (0.064) | 0.267 (0.008) |
| SNP_CN_2288704_C538A_V180F_pncA | 0.009 | 0.354 (0.066) | 0.257 (0.008) | 0.335 (0.064) | 0.263 (0.009) |
| SNP_CN_2288805_G437T_A146E_pncA | 0.011 | 0.380 (0.043) | 0.273 (0.007) | 0.363 (0.043) | 0.278 (0.008) |
| SNP_CN_2289180_A62C_V21G_pncA | 0.017 | 0.035 (0.022) | 0.029 (0.007) | 0.045 (0.024) | 0.046 (0.006) |
| SNP_CN_2288973_A269G_I90T_pncA | 0.009 | 0.320 (0.082) | 0.234 (0.009) | 0.301 (0.078) | 0.245 (0.008) |
| INS_CF_2288851_i391C_131_pncA | 0.004 | 0.320 (0.085) | 0.239 (0.008) | 0.302 (0.081) | 0.249 (0.008) |
| SNP_CN_2289216_A26C_V9G_pncA | 0.004 | 0.261 (0.095) | 0.205 (0.008) | 0.244 (0.089) | 0.217 (0.009) |
| SNP_CN_2289072_T170A_H57L_pncA | 0.007 | 0.395 (0.033) | 0.283 (0.008) | 0.379 (0.034) | 0.289 (0.008) |
| SNP_CN_2288887_A355C_W119G_pncA | 0.004 | 0.332 (0.075) | 0.252 (0.008) | 0.313 (0.074) | 0.255 (0.009) |
| SNP_CN_2289097_C145T_D49N_pncA | 0.012 | 0.379 (0.044) | 0.274 (0.008) | 0.359 (0.043) | 0.281 (0.008) |
| SNP_CN_2288805_G437A_A146V_pncA | 0.007 | 0.298 (0.084) | 0.228 (0.016) | 0.280 (0.079) | 0.234 (0.017) |
| DEL_CF_2288939_d303TCCGGTGTAG_101_pncA | 0.003 | 0.304 (0.086) | 0.229 (0.009) | 0.286 (0.084) | 0.238 (0.009) |
| SNP_CN_2288988_A254G_L85P_pncA | 0.006 | 0.309 (0.071) | 0.233 (0.008) | 0.291 (0.070) | 0.243 (0.008) |
| SNP_CN_2289207_T35G_D12A_pncA | 0.009 | 0.207 (0.078) | 0.160 (0.016) | 0.189 (0.082) | 0.166 (0.012) |
| SNP_CN_2289228_A14G_I5T_pncA | 0.004 | 0.261 (0.096) | 0.202 (0.012) | 0.245 (0.090) | 0.214 (0.013) |
| SNP_CN_2289220_C22T_D8N_pncA | 0.004 | 0.318 (0.078) | 0.233 (0.008) | 0.299 (0.074) | 0.243 (0.008) |
| DEL_CF_2289069_d173A_58_pncA | 0.010 | 0.391 (0.044) | 0.285 (0.008) | 0.374 (0.042) | 0.292 (0.008) |
| DEL_CD_2288942_d300GGTGTA_100_pncA | 0.000 | 0.167 (0.112) | 0.143 (0.014) | 0.156 (0.104) | 0.155 (0.013) |
| SNP_CN_2289015_G227A_T76I_pncA | 0.004 | 0.153 (0.107) | 0.101 (0.011) | 0.124 (0.116) | 0.110 (0.009) |
| DEL_CF_2288776_d466GCACCCTG_156_pncA | 0.007 | 0.255 (0.105) | 0.203 (0.008) | 0.239 (0.099) | 0.213 (0.008) |
| SNP_CN_2288925_A317G_F106S_pncA | 0.000 | 0.189 (0.109) | 0.180 (0.014) | 0.179 (0.101) | 0.187 (0.013) |
| SNP_CN_2288835_T407C_D136G_pncA | 0.003 | 0.172 (0.121) | 0.114 (0.014) | 0.143 (0.129) | 0.119 (0.010) |
| SNP_CN_2289040_A202G_W68R_pncA | 0.007 | 0.258 (0.099) | 0.203 (0.007) | 0.242 (0.093) | 0.216 (0.007) |
| SNP_CN_2289099_T143G_K48T_pncA | 0.018 | -0.072 (0.083) | -0.087 (0.009) | -0.086 (0.070) | -0.074 (0.008) |
| SNP_CZ_2289214_G28A_Q10._pncA | 0.007 | 0.264 (0.095) | 0.203 (0.012) | 0.247 (0.090) | 0.215 (0.012) |
| SNP_CN_2288944_T298G_T100P_pncA | 0.004 | 0.260 (0.107) | 0.203 (0.007) | 0.244 (0.101) | 0.213 (0.007) |
| INS_CF_2288825_i417C_139_pncA | 0.007 | 0.322 (0.078) | 0.239 (0.007) | 0.303 (0.074) | 0.247 (0.007) |
| SNP_CZ_2289042_G200T_S67._pncA | 0.004 | 0.267 (0.099) | 0.202 (0.010) | 0.250 (0.093) | 0.213 (0.011) |
| SNP_CN_2288826_A416G_V139A_pncA | 0.004 | 0.391 (0.041) | 0.284 (0.008) | 0.373 (0.041) | 0.290 (0.009) |
| SNP_CN_2288869_C373A_V125F_pncA | 0.003 | 0.126 (0.121) | 0.094 (0.008) | 0.095 (0.131) | 0.102 (0.008) |
| SNP_CN_2288697_A545C_L182W_pncA | 0.007 | 0.259 (0.102) | 0.202 (0.009) | 0.243 (0.096) | 0.213 (0.009) |
| SNP_CN_2289073_G169A_H57Y_pncA | 0.009 | 0.305 (0.082) | 0.231 (0.007) | 0.287 (0.080) | 0.238 (0.007) |
| SNP_CN_2289150_A92C_I31S_pncA | 0.007 | 0.251 (0.107) | 0.198 (0.009) | 0.236 (0.101) | 0.210 (0.007) |
| SNP_CN_2288727_A515G_L172P_pncA | 0.004 | 0.259 (0.097) | 0.201 (0.008) | 0.243 (0.091) | 0.213 (0.007) |
| SNP_CN_2288919_C323T_G108E_pncA | 0.004 | 0.305 (0.084) | 0.233 (0.008) | 0.288 (0.082) | 0.240 (0.008) |
| SNP_CN_2288935_A307G_Y103H_pncA | 0.009 | 0.272 (0.102) | 0.215 (0.009) | 0.262 (0.094) | 0.224 (0.007) |
| INS_CF_2288835_i407T_136_pncA | 0.009 | 0.284 (0.083) | 0.231 (0.008) | 0.263 (0.079) | 0.237 (0.009) |
| SNP_CN_2288952_C290T_G97D_pncA | 0.007 | 0.301 (0.096) | 0.229 (0.017) | 0.283 (0.093) | 0.234 (0.018) |
| SNP_CN_2288697_A545G_L182S_pncA | 0.009 | 0.322 (0.079) | 0.239 (0.009) | 0.303 (0.075) | 0.250 (0.008) |
| SNP_CN_2288853_A389T_V130E_pncA | 0.004 | 0.093 (0.051) | 0.143 (0.006) | 0.129 (0.038) | 0.145 (0.007) |
| SNP_CN_2288730_G512A_A171V_pncA | 0.007 | 0.162 (0.116) | 0.103 (0.010) | 0.133 (0.125) | 0.117 (0.009) |

| Pyrazinamide (PZA) | | Marginal Effects (Standard Errors in Parentheses) | | | |
|---|---|---|---|---|---|
| Mutations | Random Forest Variable Importance | Random Forest (1) | Neural Network (1) | Random Forest (2) | Neural Network (2) |
| SNP_CN_2288775_A467G_L156P_pncA | 0.004 | 0.245 (0.112) | 0.197 (0.010) | 0.230 (0.106) | 0.208 (0.010) |
| SNP_CN_2288850_A392C_V131G_pncA | 0.000 | 0.301 (0.084) | 0.230 (0.008) | 0.282 (0.082) | 0.240 (0.008) |
| INS_CF_2289009_i233C_78_pncA | 0.006 | 0.299 (0.085) | 0.228 (0.011) | 0.282 (0.082) | 0.235 (0.011) |
| INS_CF_2289050_i192T_64_pncA | 0.007 | 0.260 (0.103) | 0.203 (0.009) | 0.244 (0.096) | 0.210 (0.009) |
| SNP_CN_2288964_A278C_V93G_pncA | 0.004 | 0.264 (0.103) | 0.203 (0.009) | 0.247 (0.097) | 0.215 (0.009) |
| SNP_CN_2288853_A389C_V130G_pncA | 0.001 | 0.010 (0.012) | 0.076 (0.008) | 0.050 (0.031) | 0.074 (0.007) |
| DEL_CF_2288697_d545AACT_182_pncA | 0.004 | 0.152 (0.116) | 0.134 (0.021) | 0.142 (0.108) | 0.140 (0.023) |
| SNP_CN_2289009_C233A_G78V_pncA | 0.000 | 0.260 (0.100) | 0.206 (0.007) | 0.244 (0.094) | 0.215 (0.007) |
| SNP_CN_2289043_A199G_S67P_pncA | 0.004 | 0.264 (0.101) | 0.202 (0.017) | 0.247 (0.095) | 0.213 (0.017) |
| SNP_CN_2288938_C304G_A102P_pncA | 0.004 | 0.158 (0.115) | 0.136 (0.012) | 0.148 (0.107) | 0.150 (0.013) |
| SNP_P_2289252_T11G_promoter_pncA | 0.004 | 0.263 (0.097) | 0.206 (0.010) | 0.246 (0.091) | 0.217 (0.010) |
| SNP_CN_2289073_G169C_H57D_pncA | 0.007 | 0.270 (0.099) | 0.208 (0.007) | 0.253 (0.094) | 0.218 (0.007) |
| SNP_CN_2289206_G36C_D12E_pncA | 0.004 | 0.150 (0.117) | 0.142 (0.009) | 0.140 (0.109) | 0.154 (0.008) |
| DEL_CF_2289060_d182GTGCCGGA_61_pncA | 0.004 | 0.156 (0.115) | 0.145 (0.016) | 0.146 (0.108) | 0.152 (0.018) |
| SNP_CN_2289202_A40G_C14R_pncA | 0.018 | 0.260 (0.047) | 0.213 (0.009) | 0.252 (0.047) | 0.212 (0.009) |
| SNP_CZ_2289050_A192T_Y64._pncA | 0.007 | 0.250 (0.114) | 0.199 (0.011) | 0.234 (0.107) | 0.208 (0.009) |
| SNP_CN_2289046_A196G_S66P_pncA | 0.004 | 0.150 (0.118) | 0.141 (0.007) | 0.140 (0.110) | 0.150 (0.007) |
| SNP_CN_2288784_G458T_T153N_pncA | 0.000 | 0.249 (0.110) | 0.199 (0.008) | 0.234 (0.103) | 0.214 (0.009) |
| SNP_CN_2289037_G205A_P69S_pncA | 0.003 | -0.017 (0.116) | -0.074 (0.015) | -0.067 (0.132) | -0.067 (0.013) |
| SNP_CN_2288718_A524C_M175R_pncA | 0.004 | 0.220 (0.106) | 0.193 (0.017) | 0.203 (0.100) | 0.198 (0.019) |
| SNP_CN_2289042_G200C_S67W_pncA | 0.004 | 0.143 (0.119) | 0.128 (0.011) | 0.134 (0.111) | 0.140 (0.011) |
| SNP_CN_2288956_T286G_K96Q_pncA | 0.003 | 0.108 (0.080) | 0.134 (0.017) | 0.094 (0.067) | 0.140 (0.018) |
| SNP_CN_2289142_A100C_Y34D_pncA | 0.000 | 0.107 (0.080) | 0.131 (0.010) | 0.093 (0.068) | 0.136 (0.010) |
| SNP_CN_2288844_A398G_I133T_pncA | 0.004 | 0.163 (0.113) | 0.138 (0.016) | 0.152 (0.106) | 0.157 (0.011) |
| SNP_CN_2289040_A202C_W68G_pncA | 0.009 | 0.262 (0.096) | 0.169 (0.013) | 0.244 (0.099) | 0.172 (0.015) |
| SNP_CN_2289054_T188G_D63A_pncA | 0.008 | 0.344 (0.063) | 0.259 (0.008) | 0.324 (0.064) | 0.261 (0.008) |
| SNP_CN_2289090_T152G_H51P_pncA | 0.000 | 0.001 (0.002) | 0.032 (0.006) | 0.015 (0.011) | 0.031 (0.005) |
| SNP_CN_2289186_A56G_L19P_pncA | 0.000 | 0.100 (0.083) | 0.128 (0.011) | 0.087 (0.069) | 0.134 (0.011) |
| SNP_CN_2288826_A416C_V139G_pncA | 0.007 | 0.256 (0.110) | 0.201 (0.017) | 0.240 (0.103) | 0.208 (0.017) |
| SNP_CN_2288818_T424G_T142P_pncA | 0.000 | 0.023 (0.030) | 0.070 (0.008) | 0.049 (0.040) | 0.070 (0.010) |
| SNP_CN_2288817_G425A_T142M_pncA | 0.003 | 0.109 (0.080) | 0.140 (0.008) | 0.094 (0.067) | 0.144 (0.009) |
| SNP_CN_2289219_T23C_D8G_pncA | 0.004 | 0.173 (0.110) | 0.151 (0.007) | 0.162 (0.102) | 0.163 (0.007) |
| SNP_CN_2289072_T170C_H57R_pncA | 0.000 | 0.168 (0.112) | 0.150 (0.009) | 0.156 (0.105) | 0.160 (0.011) |
| SNP_CN_2289028_A214G_C72R_pncA | 0.007 | 0.256 (0.105) | 0.204 (0.007) | 0.239 (0.099) | 0.217 (0.008) |
| INS_CF_2288942_i300T_100_pncA | 0.004 | 0.158 (0.115) | 0.140 (0.014) | 0.147 (0.107) | 0.149 (0.015) |
| DEL_CF_2288923_d319C_107_pncA | 0.000 | 0.032 (0.032) | 0.075 (0.013) | 0.045 (0.037) | 0.077 (0.012) |
| SNP_CN_2288742_G500A_T167I_pncA | 0.004 | 0.010 (0.097) | 0.006 (0.013) | -0.030 (0.109) | 0.005 (0.014) |
| SNP_CN_2289095_G147C_D49E_pncA | 0.004 | 0.164 (0.114) | 0.144 (0.011) | 0.153 (0.106) | 0.161 (0.011) |
| SNP_CN_2288956_T286C_K96E_pncA | 0.004 | 0.161 (0.113) | 0.148 (0.009) | 0.150 (0.106) | 0.158 (0.009) |
| SNP_CN_2288703_A539C_V180G_pncA | 0.004 | 0.254 (0.110) | 0.198 (0.008) | 0.238 (0.103) | 0.213 (0.007) |
| SNP_CN_2289069_A173C_F58C_pncA | 0.004 | 0.271 (0.088) | 0.200 (0.017) | 0.254 (0.083) | 0.209 (0.017) |
| SNP_CN_2288955_T287G_K96T_pncA | 0.003 | 0.119 (0.077) | 0.139 (0.015) | 0.103 (0.064) | 0.141 (0.013) |
| SNP_CN_2288764_T478C_T160A_pncA | 0.000 | 0.160 (0.114) | 0.146 (0.007) | 0.149 (0.107) | 0.154 (0.008) |
| SNP_P_2289251_A10C_promoter_pncA | 0.000 | 0.254 (0.103) | 0.200 (0.010) | 0.238 (0.097) | 0.208 (0.010) |
| SNP_CN_2288696_C546A_L182F_pncA | 0.021 | -0.307 (0.105) | -0.281 (0.009) | -0.302 (0.076) | -0.271 (0.010) |
| SNP_CN_2288778_A464C_V155G_pncA | 0.004 | 0.247 (0.113) | 0.194 (0.010) | 0.231 (0.106) | 0.205 (0.009) |
| SNP_CN_2289103_T139C_T47A_pncA | 0.011 | -0.072 (0.100) | -0.100 (0.013) | -0.108 (0.093) | -0.088 (0.012) |
| SNP_CN_2288943_G299A_T100I_pncA | 0.000 | 0.143 (0.120) | 0.136 (0.012) | 0.134 (0.112) | 0.147 (0.015) |
| SNP_CN_2288718_A524G_M175T_pncA | 0.004 | 0.164 (0.114) | 0.146 (0.008) | 0.153 (0.106) | 0.157 (0.007) |
| SNP_CN_2289030_T212C_H71R_pncA | 0.000 | 0.161 (0.114) | 0.139 (0.021) | 0.150 (0.106) | 0.144 (0.022) |
| SNP_CN_2289162_A80G_L27P_pncA | 0.004 | 0.002 (0.091) | 0.007 (0.017) | -0.037 (0.105) | 0.017 (0.023) |
| SNP_CN_2289030_T212G_H71P_pncA | 0.004 | 0.164 (0.113) | 0.145 (0.007) | 0.153 (0.106) | 0.155 (0.008) |
| SNP_CN_2288827_C415T_V139M_pncA | 0.007 | 0.167 (0.114) | 0.105 (0.012) | 0.138 (0.124) | 0.110 (0.012) |
| SNP_CN_2289231_A11G_L4S_pncA | 0.012 | 0.302 (0.077) | 0.234 (0.009) | 0.286 (0.080) | 0.239 (0.009) |
| SNP_CN_2289213_T29C_Q10R_pncA | 0.005 | 0.222 (0.116) | 0.157 (0.014) | 0.195 (0.124) | 0.165 (0.013) |
| SNP_CN_2288965_C277A_V93L_pncA | 0.006 | 0.000 (0.122) | -0.048 (0.014) | -0.048 (0.139) | -0.037 (0.018) |
| SNP_CN_2289001_A241C_F81V_pncA | 0.001 | 0.077 (0.116) | 0.065 (0.009) | 0.053 (0.125) | 0.068 (0.009) |
| SNP_CN_2289054_T188C_D63G_pncA | 0.004 | 0.068 (0.122) | 0.009 (0.014) | 0.034 (0.136) | 0.020 (0.011) |
| SNP_CN_2288766_A476C_L159R_pncA | 0.004 | 0.074 (0.122) | 0.017 (0.015) | 0.039 (0.137) | 0.024 (0.016) |
| SNP_CN_2288859_A383C_V128G_pncA | 0.004 | 0.155 (0.116) | 0.139 (0.013) | 0.145 (0.108) | 0.146 (0.014) |
| SNP_CN_2289091_G151A_H51Y_pncA | 0.003 | 0.061 (0.115) | 0.015 (0.009) | 0.026 (0.128) | 0.021 (0.010) |
| SNP_CN_2288854_C388T_V130M_pncA | 0.021 | -0.375 (0.074) | -0.340 (0.008) | -0.376 (0.038) | -0.339 (0.008) |

**Pyrazinamide (PZA)**               **Marginal Effects (Standard Errors in Parentheses)**

| Mutations | Random Forest Variable Importance | Random Forest (1) | Neural Network (1) | Random Forest (2) | Neural Network (2) |
|---|---|---|---|---|---|
| SNP_CZ_2288933_G309C_Y103._pncA | 0.019 | | | 0.373 (0.041) | 0.304 (0.009) |
| SNP_CN_2289202_A40C_C14G_pncA | 0.023 | | | -0.413 (0.025) | -0.389 (0.007) |
| SNP_CN_2288717_C525T_M175I_pncA | 0.000 | | | -0.104 (0.088) | -0.113 (0.019) |
| SNP_CN_2289098_C144G_K48N_pncA | 0.010 | | | -0.304 (0.067) | -0.278 (0.016) |
| SNP_CZ_2288878_G364A_Q122._pncA | 0.007 | | | 0.302 (0.077) | 0.247 (0.008) |
| SNP_CN_2288833_G409T_H137N_pncA | 0.003 | | | -0.097 (0.069) | -0.152 (0.012) |
| SNP_CN_2289000_A242G_F81S_pncA | 0.003 | | | -0.123 (0.083) | -0.140 (0.015) |
| SNP_CN_2289226_T16G_I6L_pncA | 0.003 | | | -0.120 (0.082) | -0.140 (0.009) |
| SNP_CN_2289132_T110A_E37V_pncA | 0.000 | | | 0.000 (0.000) | 0.000 (0.000) |
| SNP_CN_2288790_A452G_L151S_pncA | 0.003 | | | -0.125 (0.081) | -0.149 (0.008) |
| SNP_P_2289253_A12C_promoter_pncA | 0.000 | | | -0.120 (0.084) | -0.133 (0.011) |
| SNP_CN_2288895_A347C_L116R_pncA | 0.003 | | | 0.030 (0.135) | 0.021 (0.010) |
| SNP_CN_2289120_T122C_Y41C_pncA | 0.006 | | | -0.194 (0.096) | -0.189 (0.025) |
| SNP_CN_2289136_C106G_A36P_pncA | 0.006 | | | -0.182 (0.096) | -0.184 (0.012) |
| SNP_CN_2288998_G244A_H82Y_pncA | 0.003 | | | -0.108 (0.088) | -0.119 (0.022) |
| SNP_CN_2289066_G176A_S59F_pncA | 0.000 | | | 0.000 (0.000) | 0.000 (0.000) |
| SNP_CN_2289010_C232T_G78S_pncA | 0.003 | | | -0.194 (0.080) | -0.213 (0.007) |
| SNP_CZ_2289045_G197T_S66._pncA | 0.000 | | | 0.148 (0.108) | 0.155 (0.014) |
| SNP_CN_2289231_A11C_L4W_pncA | 0.004 | | | 0.147 (0.108) | 0.153 (0.016) |