Best model - main terms and 2 way interactions

Model selection - forward (single)

The LOGISTIC Procedure

Model Information

Data Set   WORK.TIMESINCEVAX
Response Variable   breakthrough   breakthrough
Number of Response Levels   2
Model   binary logit
Optimization Technique   Fisher's scoring

Number of Observations Read   3084648
Number of Observations Used   3084648

Response Profile

Ordered Value	breakthrough	Total Frequency
1	1	29677
2	0	3054971

Probability modeled is breakthrough=1.

Forward Selection Procedure

Class Level Information

Class	Value	Design Variables	
gender_code	F	1	0
	M	0	1
	U	0	0

```
        vaccination_code       Janssen       1      0
                               Moderna       0      1
                               Pfizer        0      0


          The following effects will be included in each model:

Intercept  gender_code  vaccination_code  followup_time  time_since_vax  age  age*age

             Step  0. The INCLUDE effects were entered.


                      Model Convergence Status

          Convergence criterion (GCONV=1E-8) satisfied.
```

Best model - main terms and 2 way interactions

Model selection - forward (single)

The LOGISTIC Procedure

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	334698.88	9549.493
SC	334711.82	9665.971
-2 Log L	334696.88	9531.493

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	325165.390	8	<.0001
Score	1679665.60	8	<.0001
Wald	3214.6038	8	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
3970.7904	44	<.0001

Step 1. Effect followup_*time_since entered:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

```
                         Model Fit Statistics

                                         Intercept
                          Intercept            and
          Criterion            Only      Covariates

          AIC             334698.88        6614.048
          SC              334711.82        6743.468
          -2 Log L        334696.88        6594.048


            Testing Global Null Hypothesis: BETA=0

   Test               Chi-Square        DF      Pr > ChiSq

   Likelihood Ratio    328102.835         9        <.0001
   Score              1685598.38          9        <.0001
   Wald                 2356.3173         9        <.0001
```

Best model - main terms and 2 way interactions

Model selection - forward (single)

The LOGISTIC Procedure

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
465.7389	43	<.0001

Step 2. Effect time_since_vax*age entered:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	334698.88	6571.327
SC	334711.82	6713.689
-2 Log L	334696.88	6549.327

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	328147.556	10	<.0001
Score	1686062.27	10	<.0001
Wald	2416.5478	10	<.0001

```
                    Residual Chi-Square Test

        Chi-Square          DF      Pr > ChiSq

          398.2946          42         <.0001


    Step  3. Effect time_sinc*vaccinatio entered:



                    Model Convergence Status

    Convergence criterion (GCONV=1E-8) satisfied.
```

Best model - main terms and 2 way interactions

Model selection - forward (single)

The LOGISTIC Procedure

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	334698.88	6542.714
SC	334711.82	6710.959
-2 Log L	334696.88	6516.714

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	328180.169	12	<.0001
Score	1686237.92	12	<.0001
Wald	2355.3548	12	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
249.4421	40	<.0001

Step 4. Effect followup_*vaccinatio entered:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	334698.88	6497.973
SC	334711.82	6692.103
-2 Log L	334696.88	6467.973

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	328228.910	14	<.0001
Score	1687463.19	14	<.0001
Wald	2616.9296	14	<.0001

Best model - main terms and 2 way interactions

Model selection - forward (single)

The LOGISTIC Procedure

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
193.1954	38	<.0001

Step 5. Effect follow*time_s*vaccin entered:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	334698.88	6460.731
SC	334711.82	6680.744
-2 Log L	334696.88	6426.731

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	328270.152	16	<.0001
Score	1688017.59	16	<.0001
Wald	2525.1544	16	<.0001

```
                        Residual Chi-Square Test

              Chi-Square        DF       Pr > ChiSq

               151.0892         36          <.0001


     NOTE: No (additional) effects met the 0.001 significance level for entry into the model.


                        Summary of Forward Selection

           Effect                         Number        Score                 Variable
    Step   Entered             DF            In       Chi-Square    Pr > ChiSq    Label

      1    followup_*time_since     1         7        3467.8628       <.0001
      2    time_since_vax*age       1         8          52.3980       <.0001
      3    time_sinc*vaccinatio     2         9          38.1245       <.0001
      4    followup_*vaccinatio     2        10          50.1770       <.0001
      5    follow*time_s*vaccin     2        11          37.0781       <.0001
```

Best model - main terms and 2 way interactions

Model selection - forward (single)

The LOGISTIC Procedure

Joint Tests

Effect	DF	Wald Chi-Square	Pr > ChiSq
gender_code	2	5.8906	0.0526
vaccination_code	2	38.5012	<.0001
followup_time	1	1443.9560	<.0001
time_since_vax	1	1462.9245	<.0001
age	1	49.4451	<.0001
age*age	1	14.0620	0.0002
followup_*vaccinatio	2	9.0920	0.0106
time_sinc*vaccinatio	2	10.3344	0.0057
followup_*time_since	1	398.5053	<.0001
follow*time_s*vaccin	2	34.8436	<.0001
time_since_vax*age	1	48.5389	<.0001

NOTE: Under full-rank parameterizations, Type 3 effect tests are replaced by joint tests. The joint test for an effect is a test that all the parameters associated with that effect are zero. Such joint tests might not be equivalent to Type 3 effect tests under GLM parameterization.

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-22.3296	1.3870	259.1721	<.0001
gender_code	F	1	-0.5998	0.5710	1.1034	0.2935
gender_code	M	1	-0.8203	0.5742	2.0410	0.1531
vaccination_code	Janssen	1	3.3775	1.6418	4.2322	0.0397
vaccination_code	Moderna	1	-14.6169	2.8347	26.5879	<.0001
followup_time		1	-6.2478	0.1644	1443.9560	<.0001
time_since_vax		1	197.9	5.1730	1462.9245	<.0001
age		1	0.1288	0.0183	49.4451	<.0001

age*age	1	-0.00063	0.000168	14.0620	0.0002
followup_*vaccinatio Janssen	1	-1.3935	0.5958	5.4706	0.0193
followup_*vaccinatio Moderna	1	-0.7189	0.3259	4.8653	0.0274
time_sinc*vaccinatio Janssen	1	40.9238	18.6750	4.8021	0.0284
time_sinc*vaccinatio Moderna	1	27.8487	10.6208	6.8754	0.0087
followup_*time_since	1	-0.0291	0.00146	398.5053	<.0001
follow*time_s*vaccin Janssen	1	0.00651	0.00302	4.6530	0.0310
follow*time_s*vaccin Moderna	1	-0.0190	0.00379	25.0522	<.0001
time_since_vax*age	1	-0.0135	0.00193	48.5389	<.0001

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
gender_code F vs U	0.549	0.179	1.681
gender_code M vs U	0.440	0.143	1.357

Best model - main terms and 2 way interactions

Model selection - forward (single)

The LOGISTIC Procedure

Association of Predicted Probabilities and Observed Responses

Percent Concordant	99.7	Somers' D	0.994
Percent Discordant	0.3	Gamma	0.994
Percent Tied	0.0	Tau-a	0.019
Pairs	90662374367	c	0.997