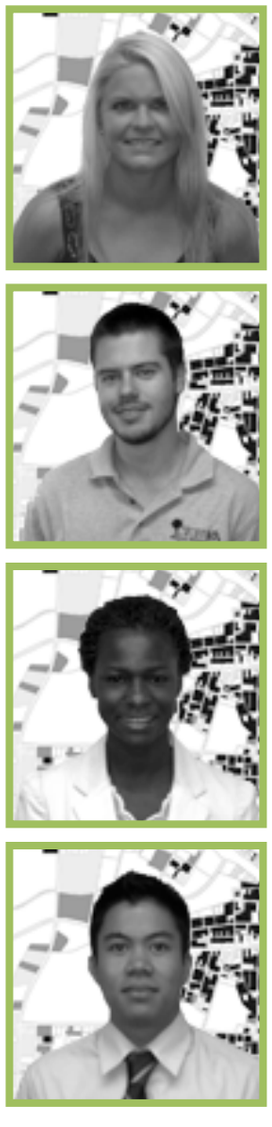
Impact of Race and Tobacco Use on Birthweight by Week of Gestation

by Eric C. Tassone, J.D., Ph.D., Alan E. Gelfand, Ph.D., Geeta Swamy, M.D.,& Marie Lynn Miranda, Ph.D.

Children's Environmental Health Initiative

Children's Environmental Health Initiative

- Focus on children
  - Focus on issues of environmental justice
    - Shift to preventive interventions
      - Emphasis on spatial analytic approaches



Outline of Talk

- Overview
- Data: North Carolina Detailed Birth Record Data
- Modeling Details
- Impact on Policy?
- Future Directions

Data

- NC Detailed Birth Record
  - Years 1999-2003, no congenital anomalies, firstborn singletons, no maternal alcohol use, at least 400g, and at least 26 weeks of gestation
- Maternal race:
  - African American (non-Hispanic), ~22.4%;
  - White (non-Hispanic), ~66.3%;
  - or Hispanic, ~11.2%
- Overall, N=220,709

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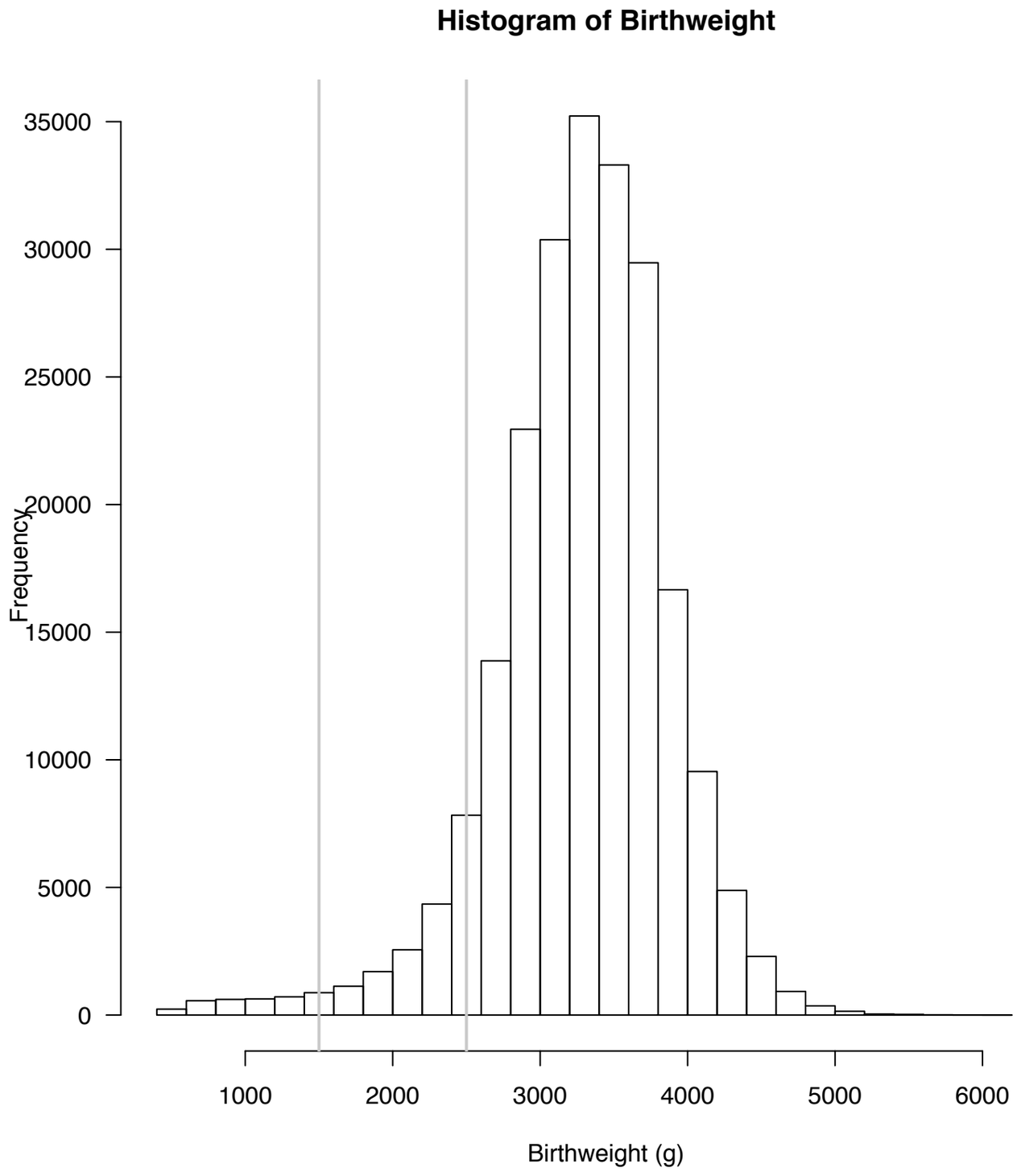
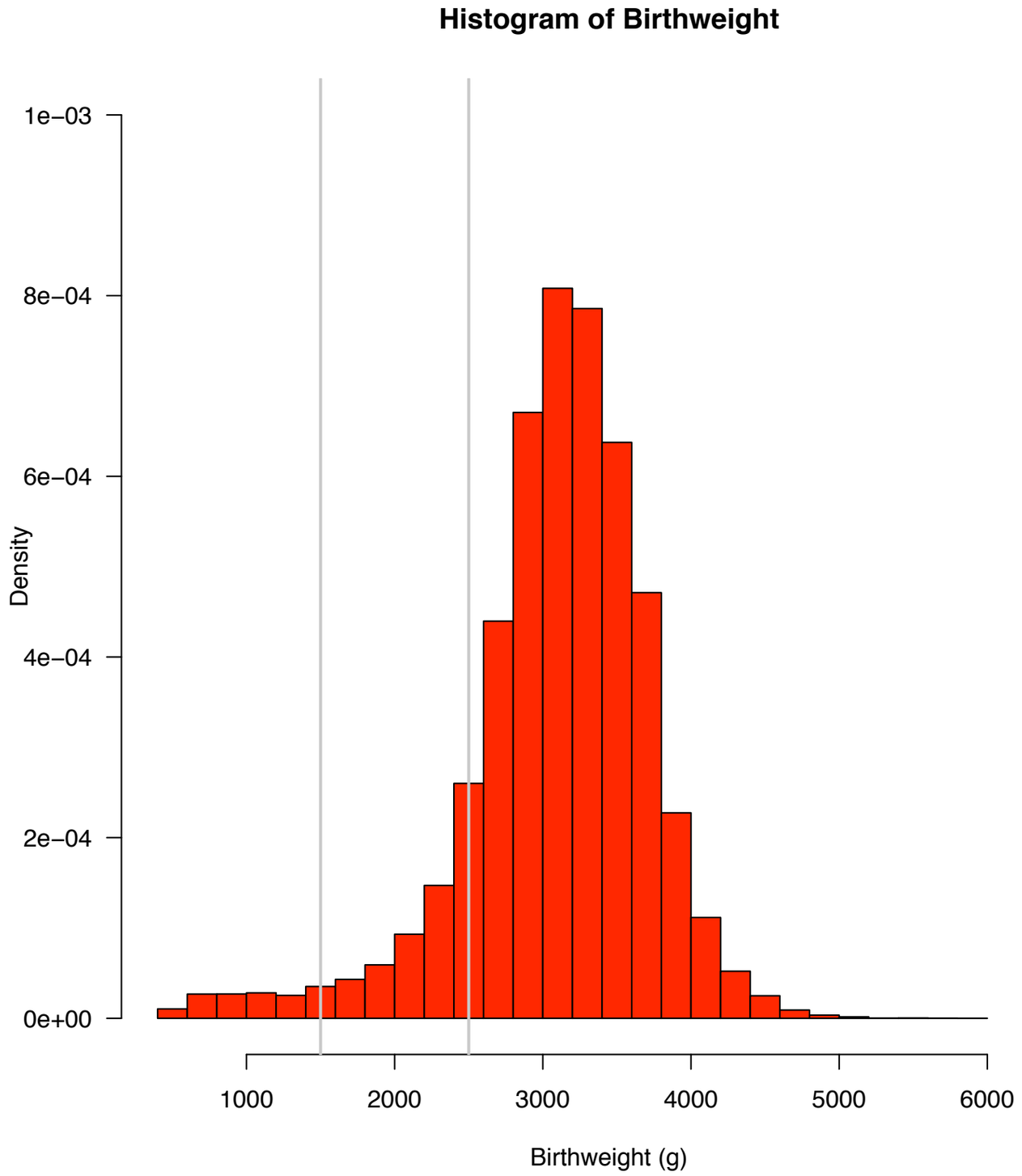
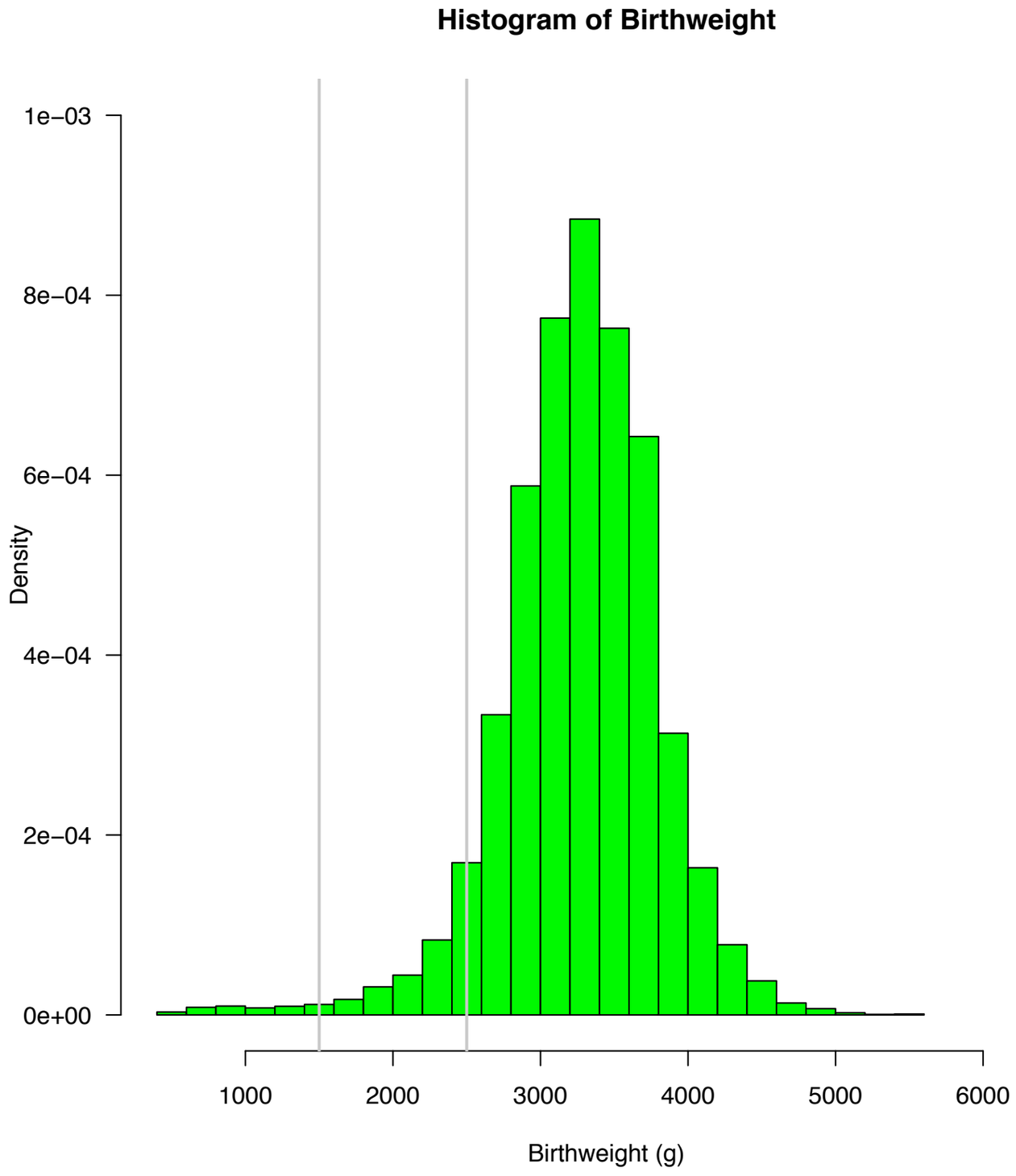
Birthweight



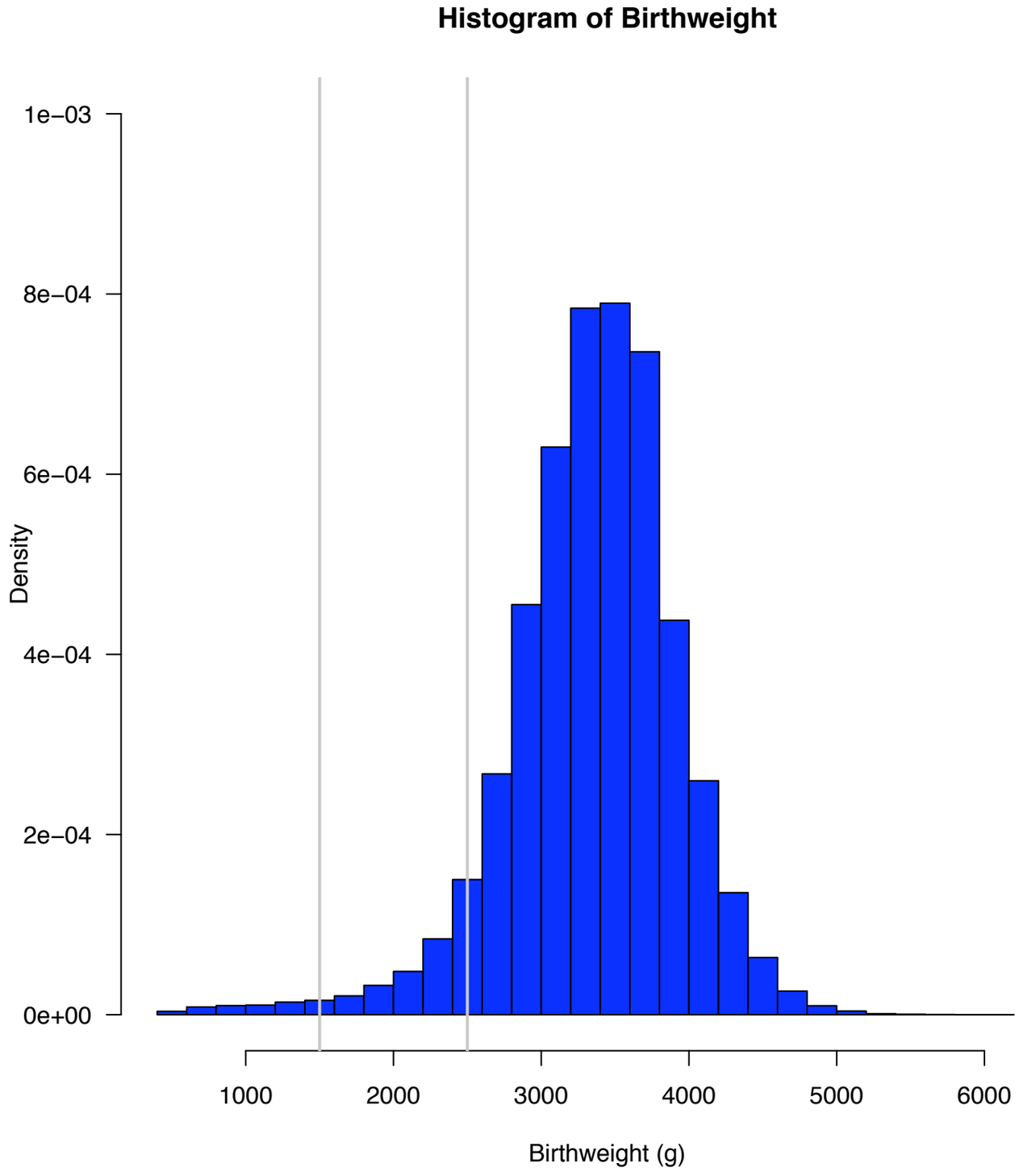
Birthweight, African Americans



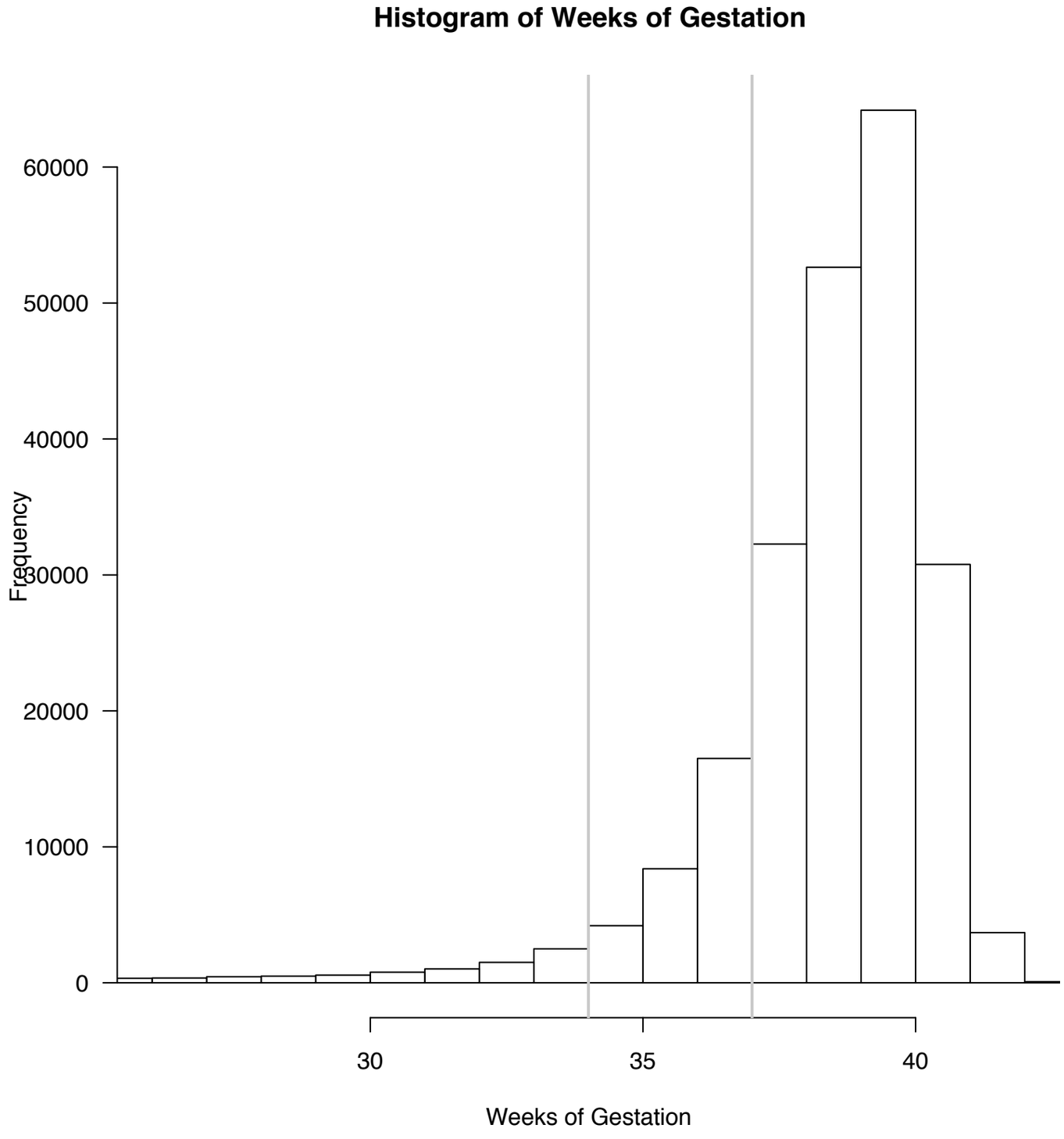
Birthweight, Hispanics



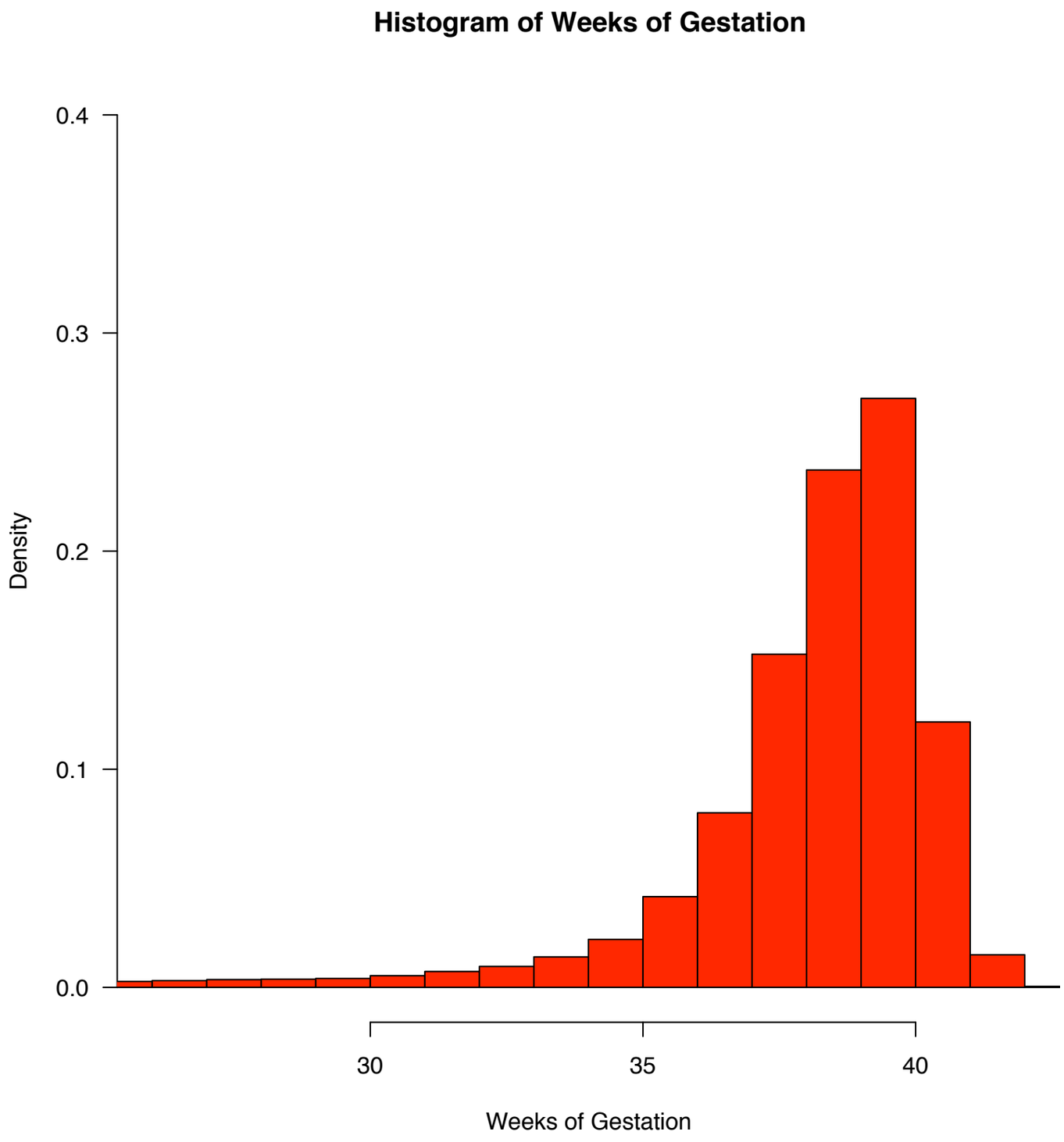
Birthweight, Whites



Weeks of Gestation



Weeks of Gestation, African Americans



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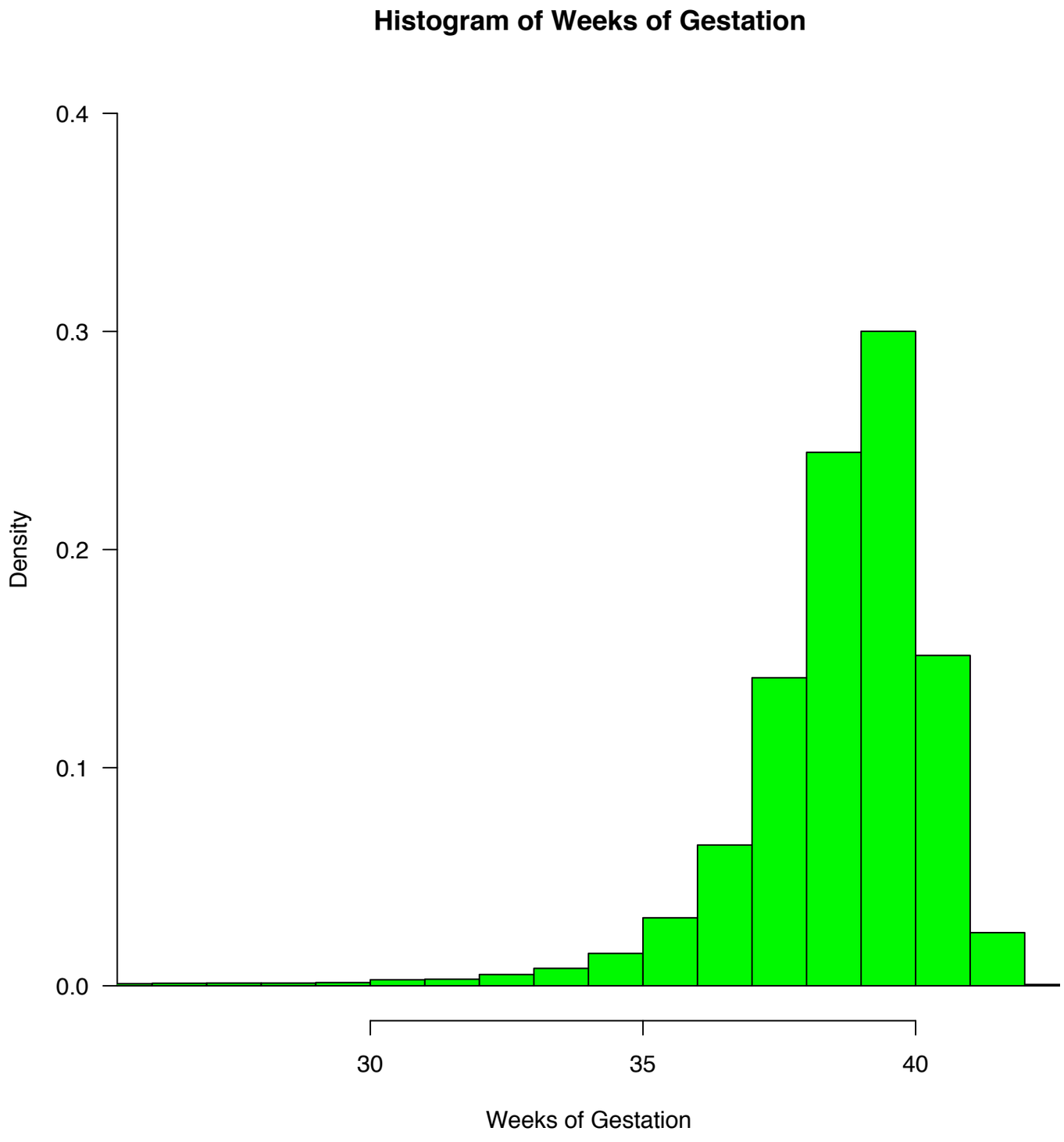
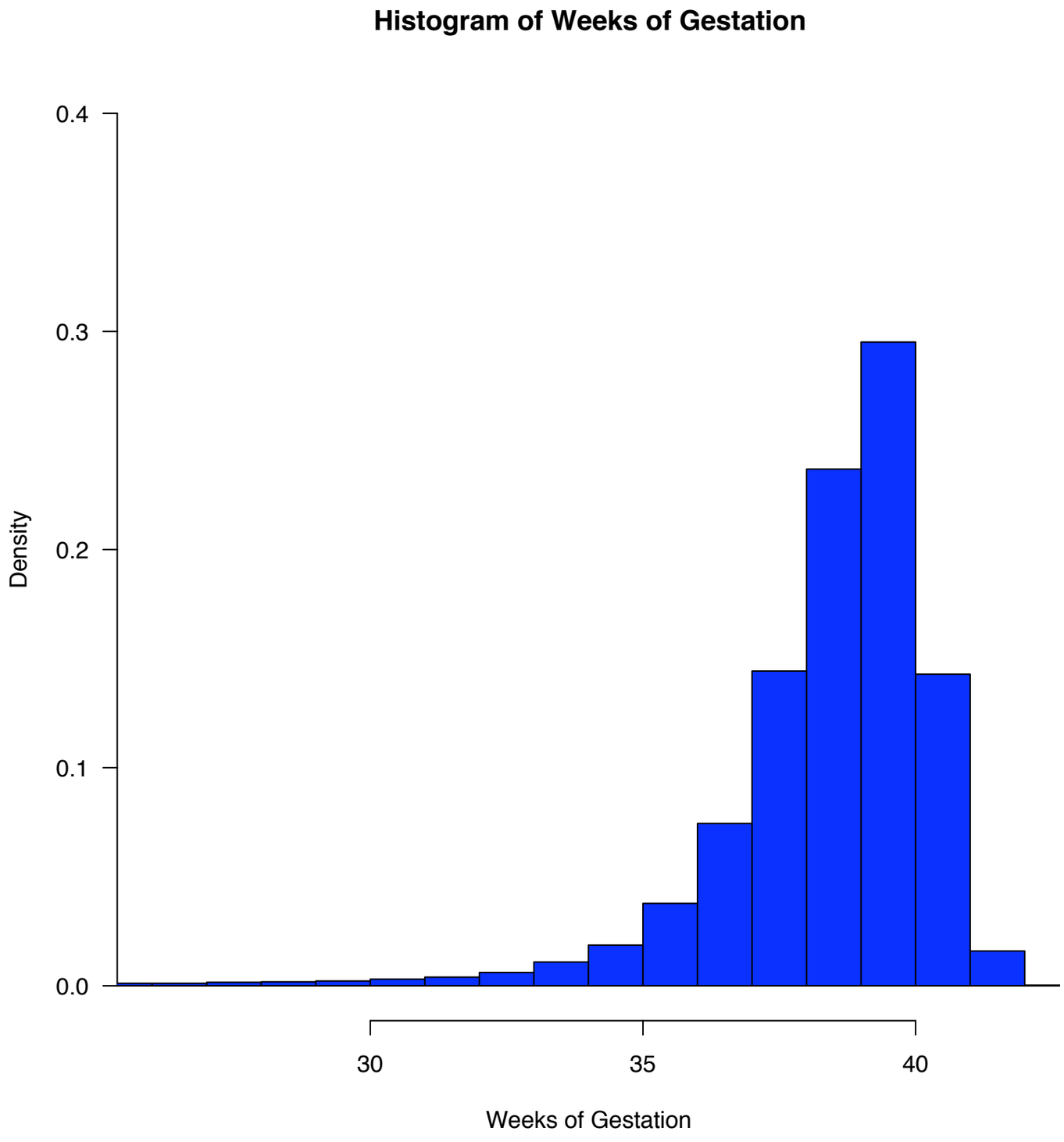
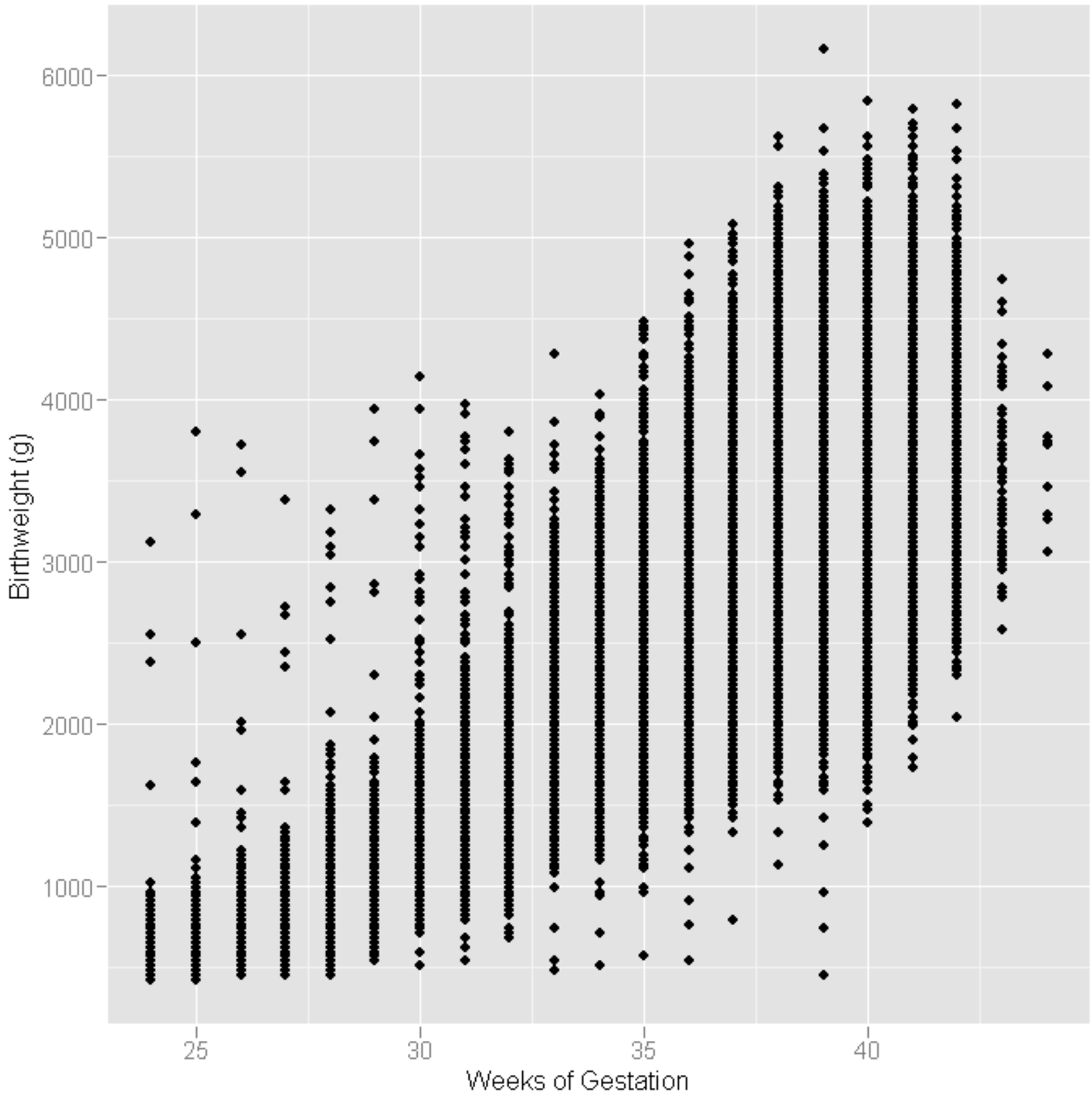


Weeks of Gestation, Whites



Weeks of Gestation by Birthweight



Standard OLS Regression Model Results

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	3342.2670	2.9300	1140.71	0.0000
GestC	179.4674	0.4120	435.57	0.0000
MaleYes	119.4120	1.7849	66.90	0.0000
MSmokeYes	−164.5108	3.0115	−54.63	0.0000
UnmarriedYes	−40.0675	2.3858	−16.79	0.0000
MAge15-19	−33.2194	3.3858	−9.81	0.0000
MAge20-24	−15.8883	2.6932	−5.90	0.0000
MAge30-34	−6.5947	2.8938	−2.28	0.0227
MAge35-39	−28.0034	4.3453	−6.44	0.0000
MAge40-44	−65.6573	9.7476	−6.74	0.0000
MEdu0-8	−41.7544	4.8003	−8.70	0.0000
MEdu9-11	−31.1827	3.0094	−10.36	0.0000
MEdu13-15	21.8638	2.6655	8.20	0.0000
MEdu16+	23.2178	2.9018	8.00	0.0000
MRaceAA	−167.6890	2.4622	−68.10	0.0000
MRaceH	−89.4750	3.3772	−26.49	0.0000

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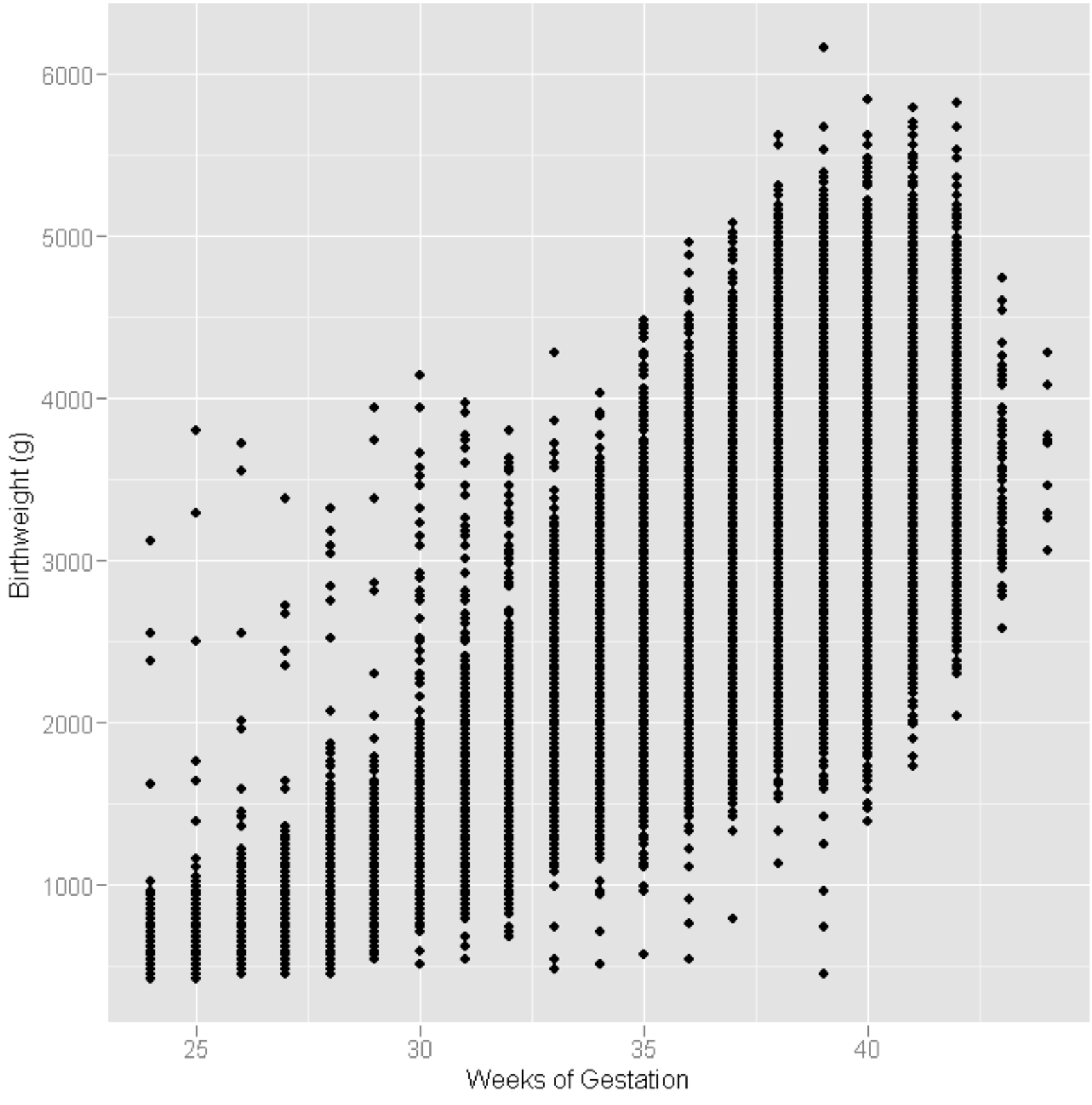
Weeks of Gestation by Birthweight



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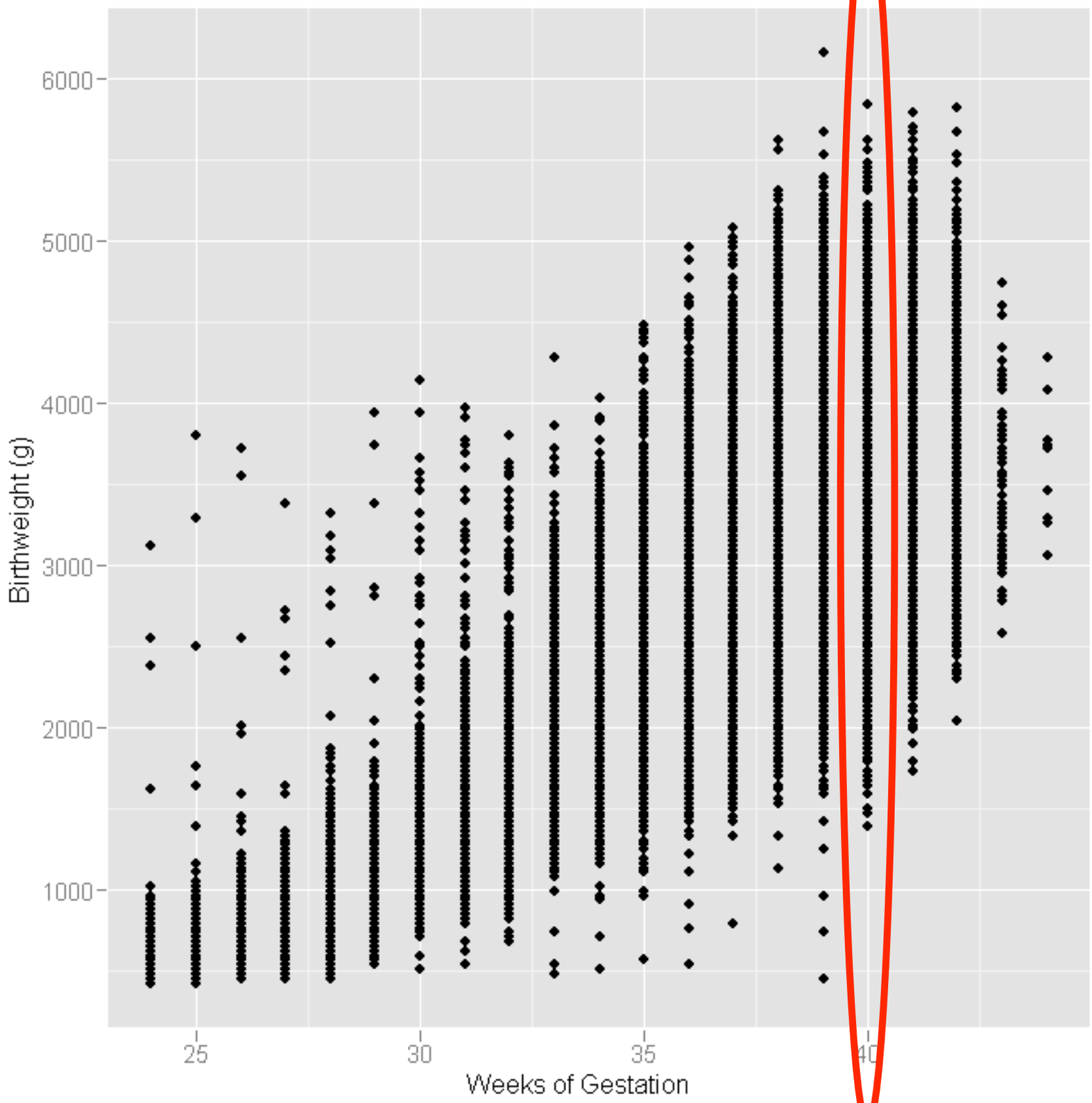

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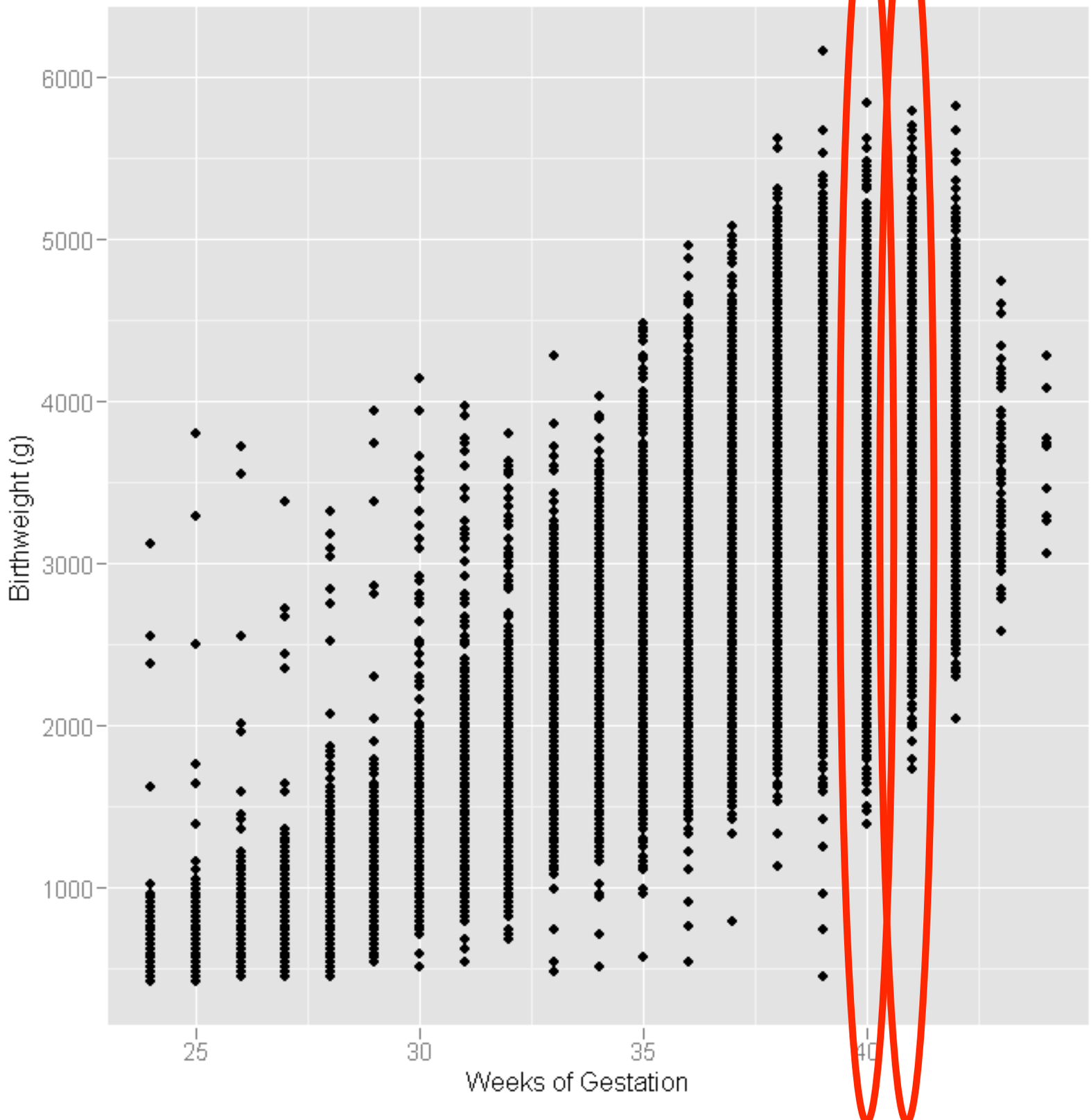

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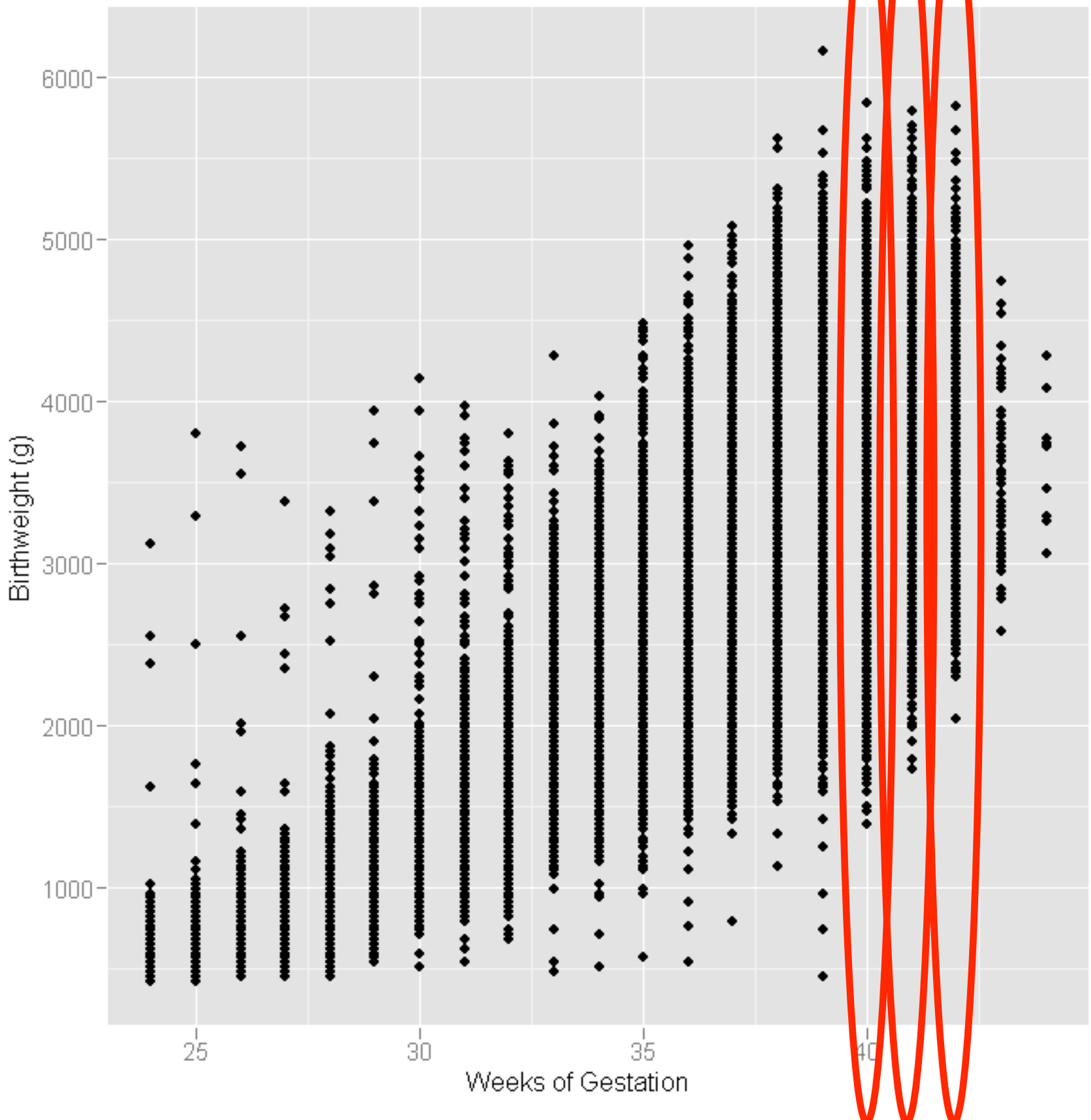
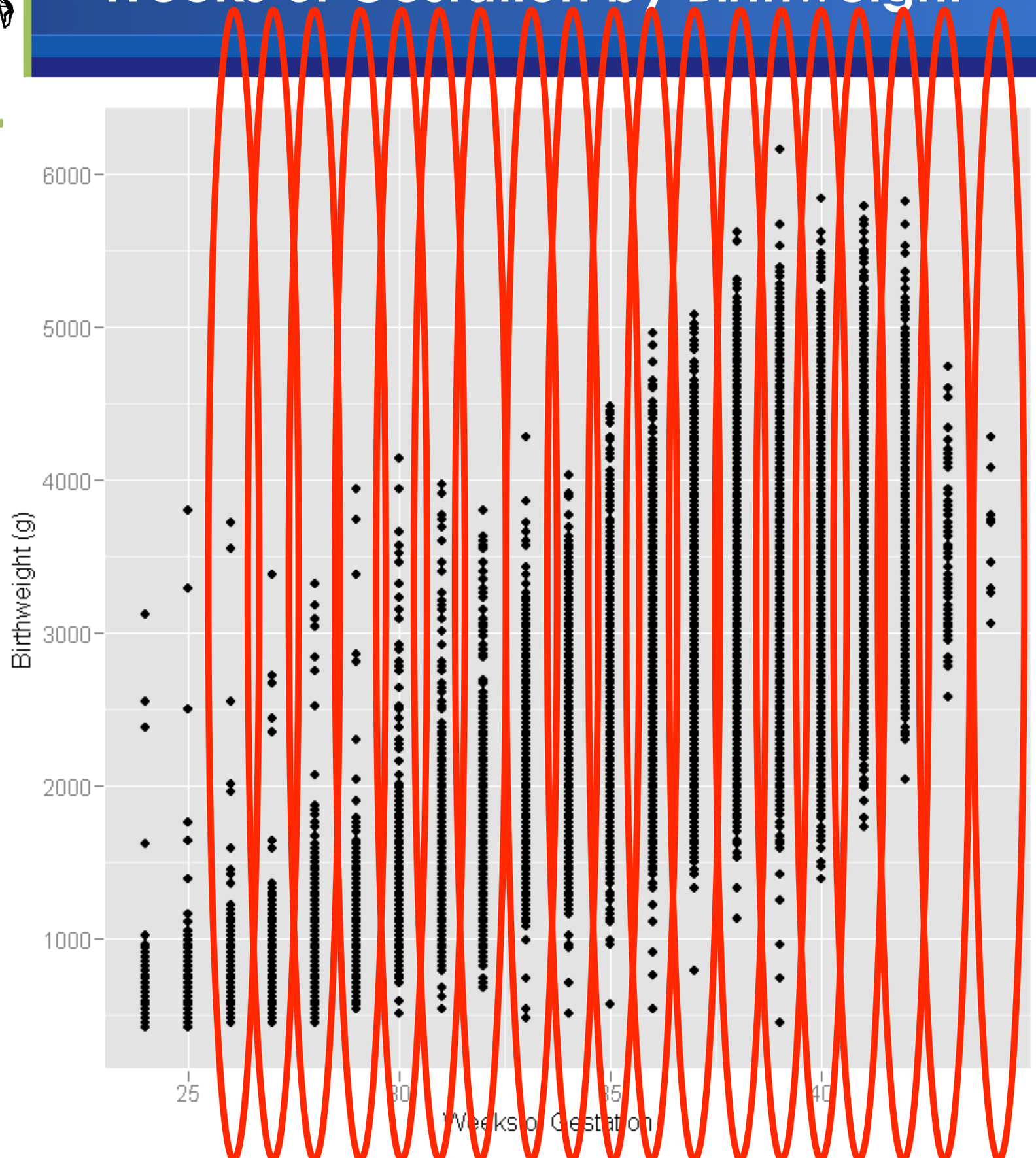


Children's Environmental Health Initiative

Weeks of Gestation by Birthweight



Modeling

- Fit regression model for weeks 26 to 42 independently
  - Instead of...$Y = X^T\beta + \epsilon$, where one beta is Weeks of Gestation (WoG), fit model w/o WoG beta 17 times
- In essence, interacting WoG w/ every other variable
- Similar to Gelman's "secret weapon" idea

Statistical Modeling, Causal Inference, and Social Science

« Meritocracy won't happen: the problem's with the "ocracy" | Main | Still more on R software for matching for causal inference »

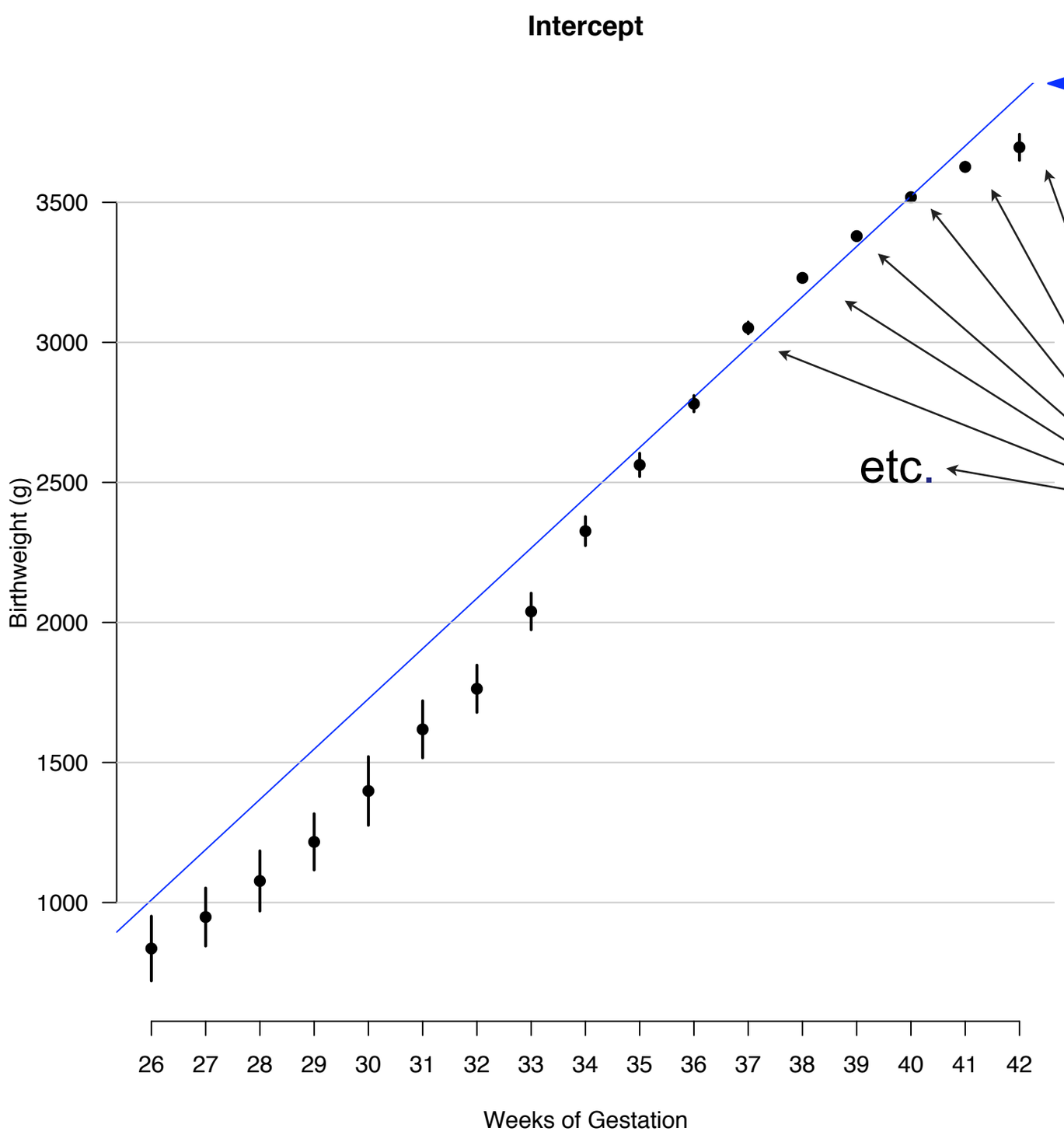
March 7, 2005

The secret weapon

An incredibly useful method is to fit a statistical model repeatedly on several different datasets and then display all these estimates together. For example, running a regression on data on each of 50 states (see here as discussed here), or running a regression on data for several years and plotting the estimated coefficients over time.

http://www.stat.columbia.edu/~cook/movabletype/archives/2005/03/the_secret_weap.html

Intercept



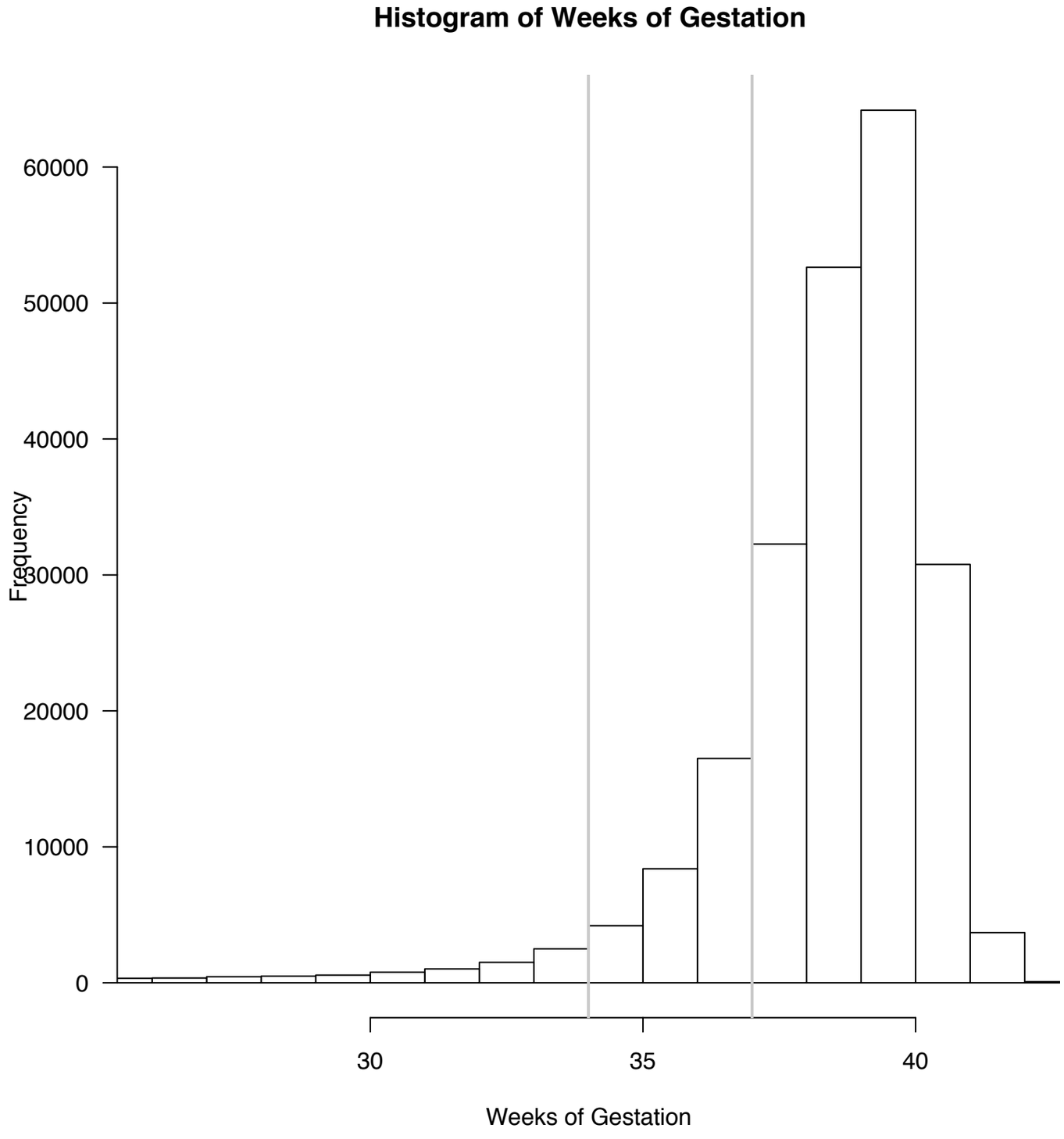
Blue line is from the "full" model

etc.

Black circles are estimates from the "secret weapon" models, with 95% CIs

Weeks of Gestation

Model “driven by” weeks 34 and up



Weeks of Gestation

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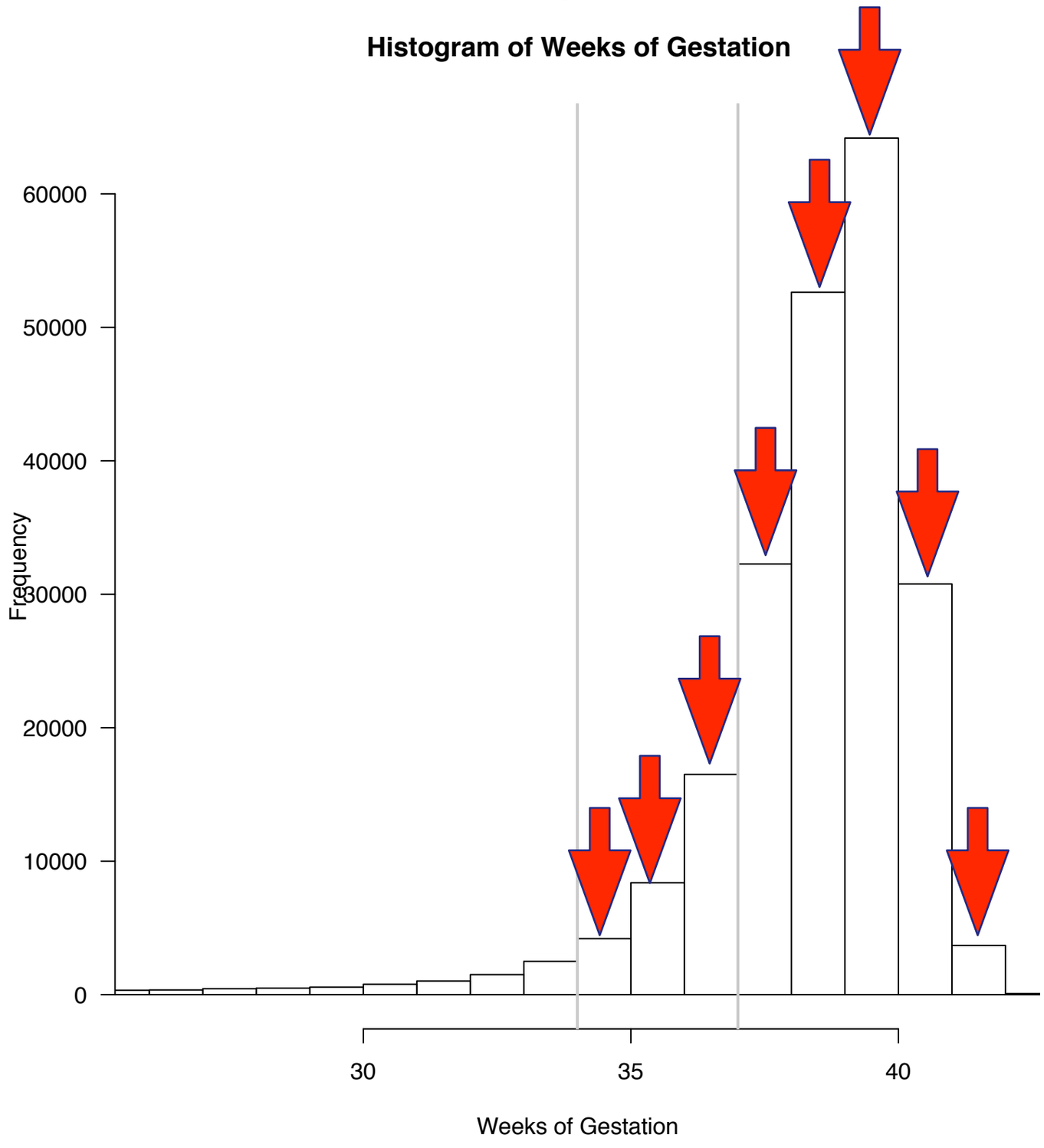
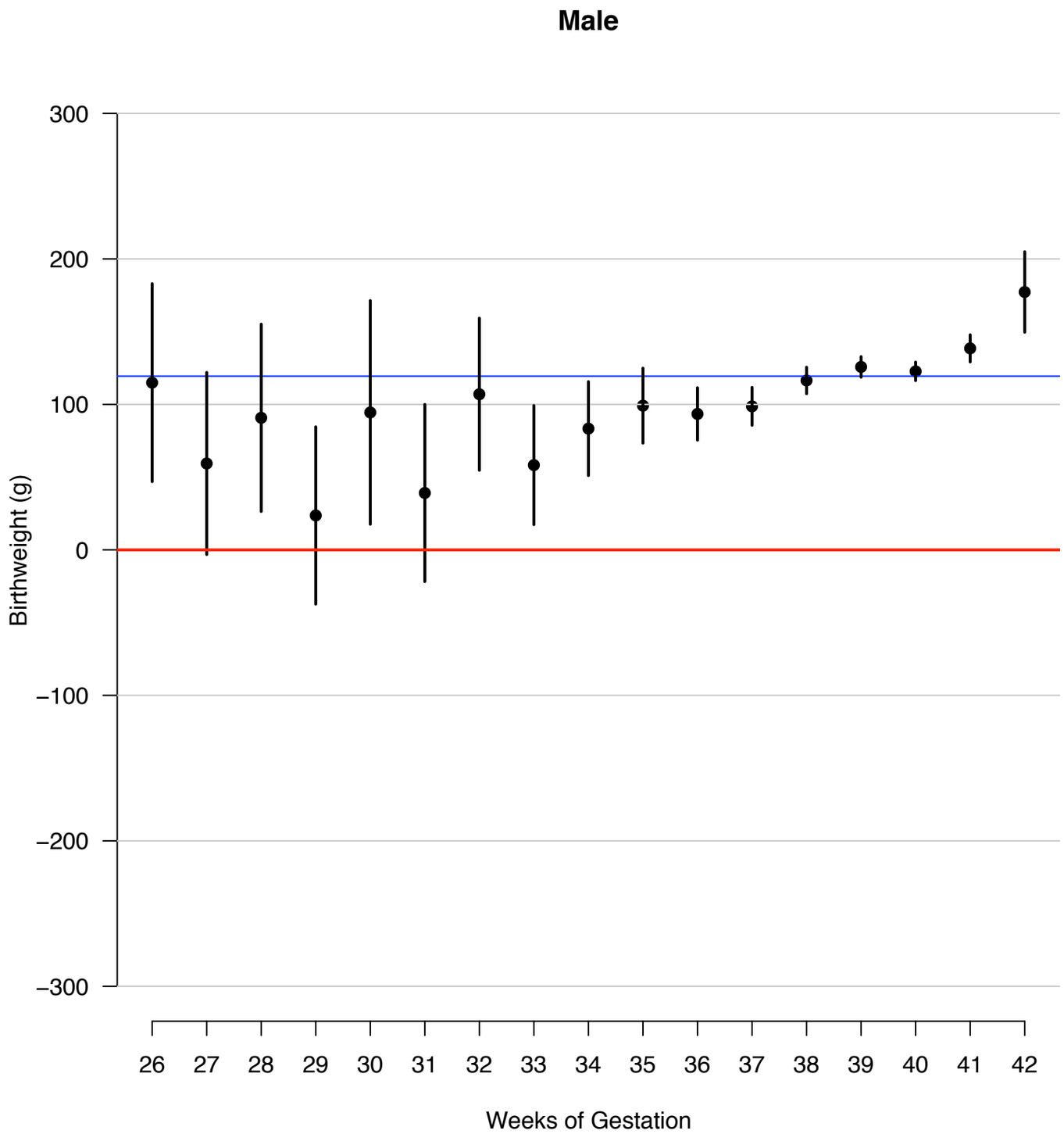


Effect of Infant's Sex

Again, blue line is from the "full" model...

... and black circles are estimates from the "secret weapon" models, with 95% CIs



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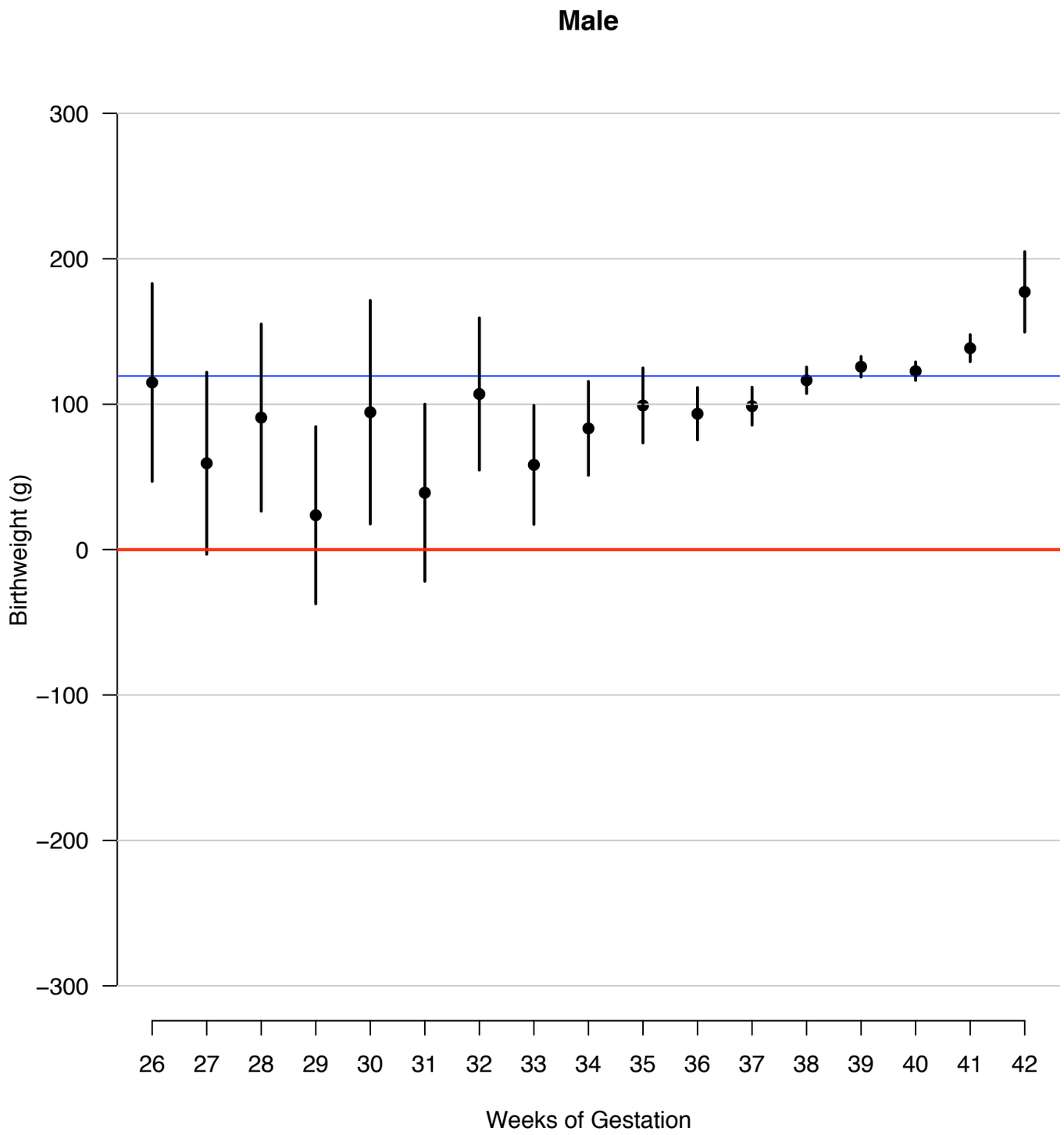
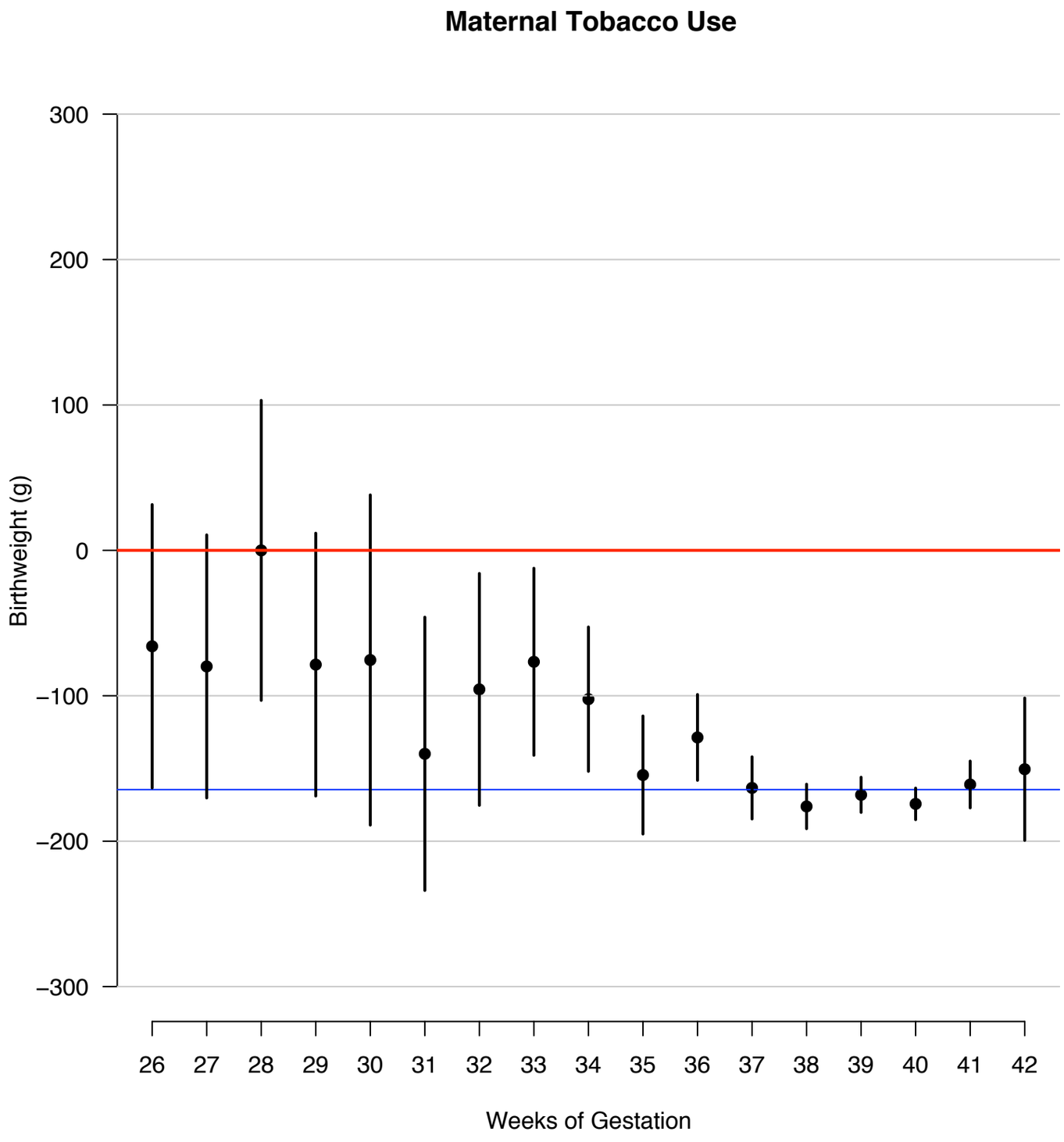
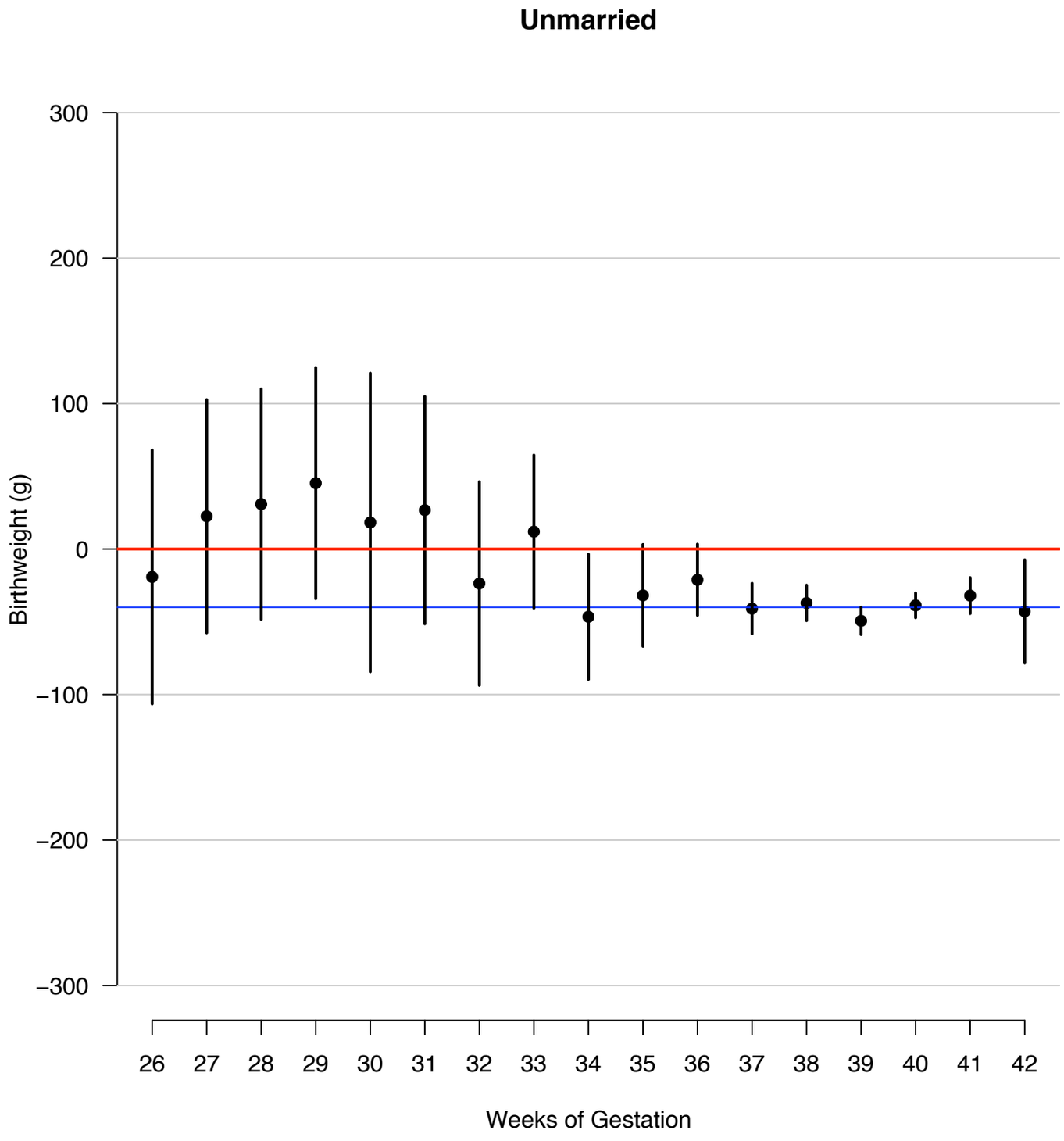


And now, the red line is the "null value" from the standard hypothesis test

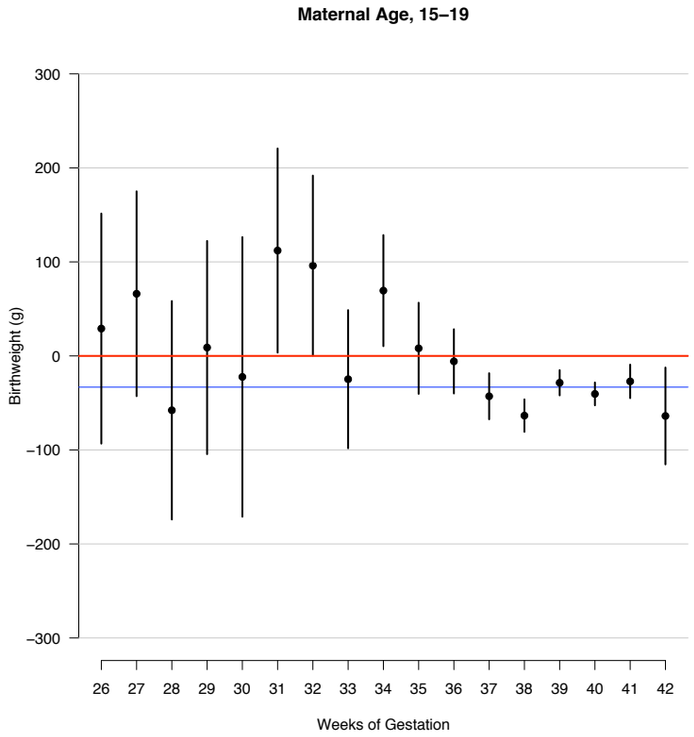
Effect of Maternal Tobacco Use

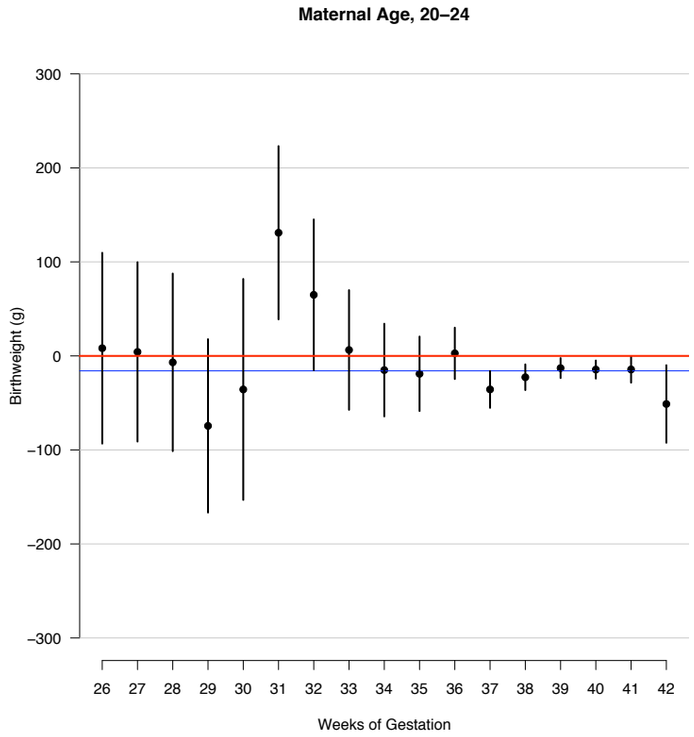


Effect of Maternal Marital Status

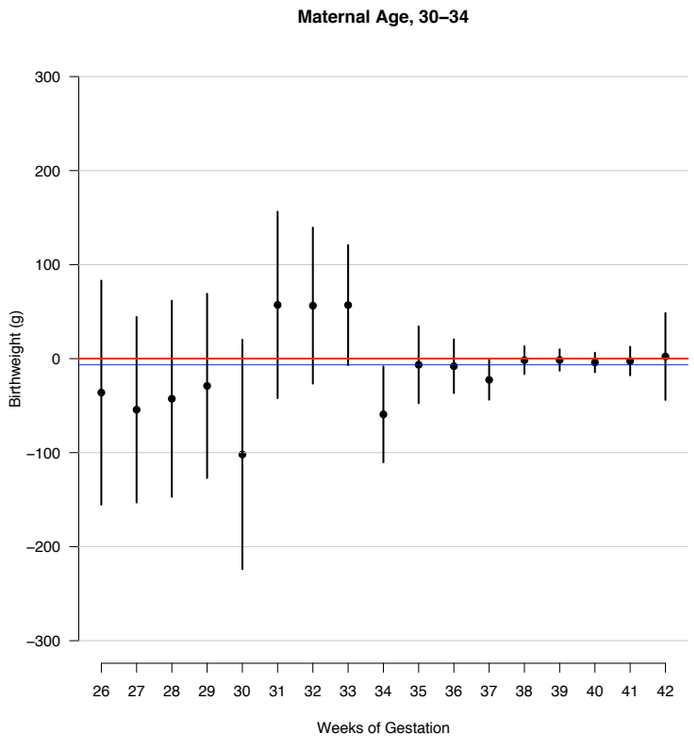


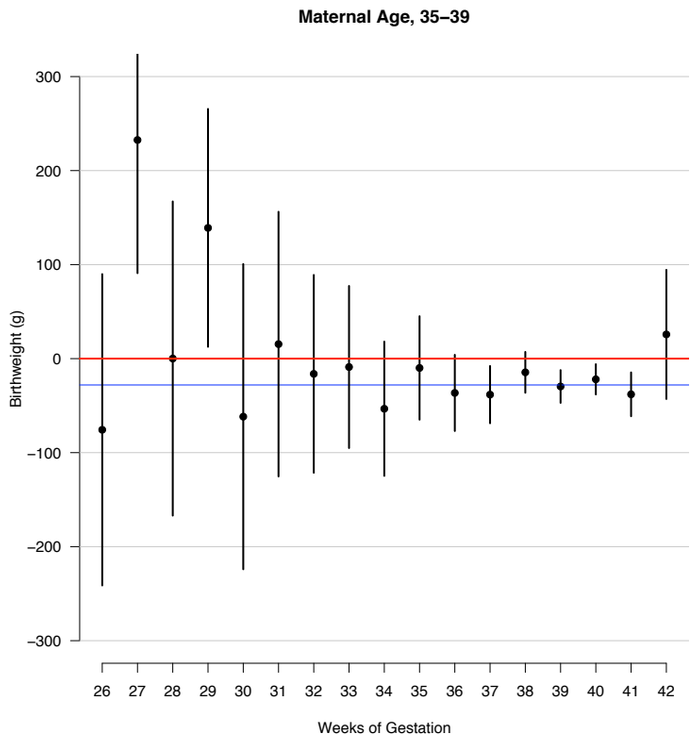
Effect of Maternal Age

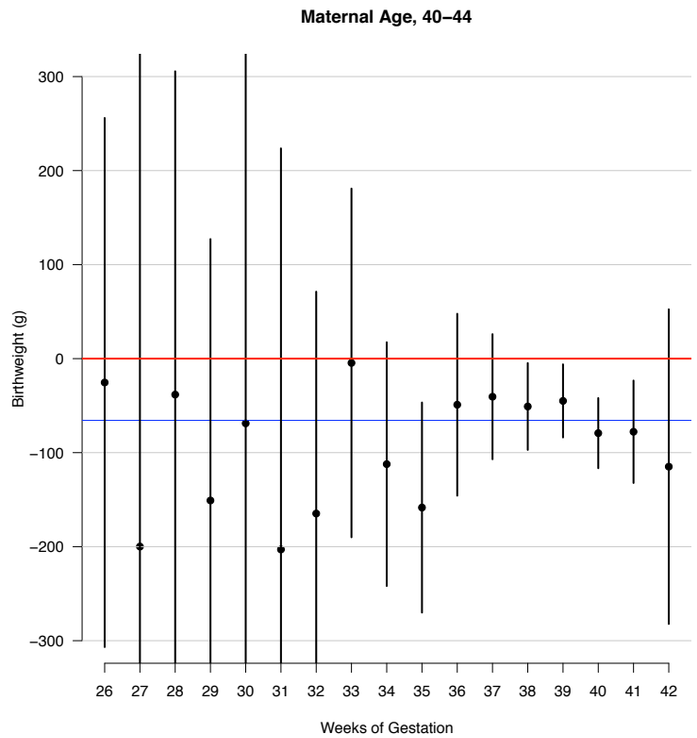




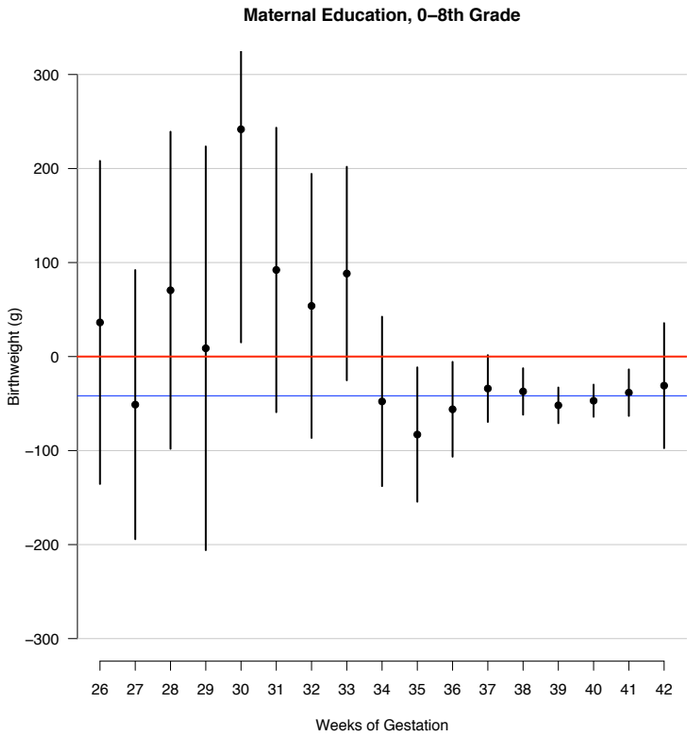
Age 25-29 is reference group

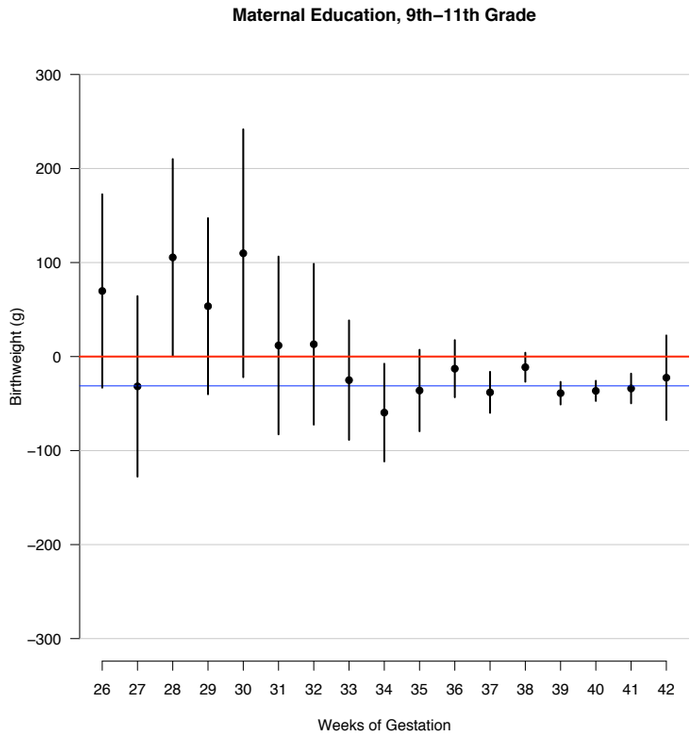


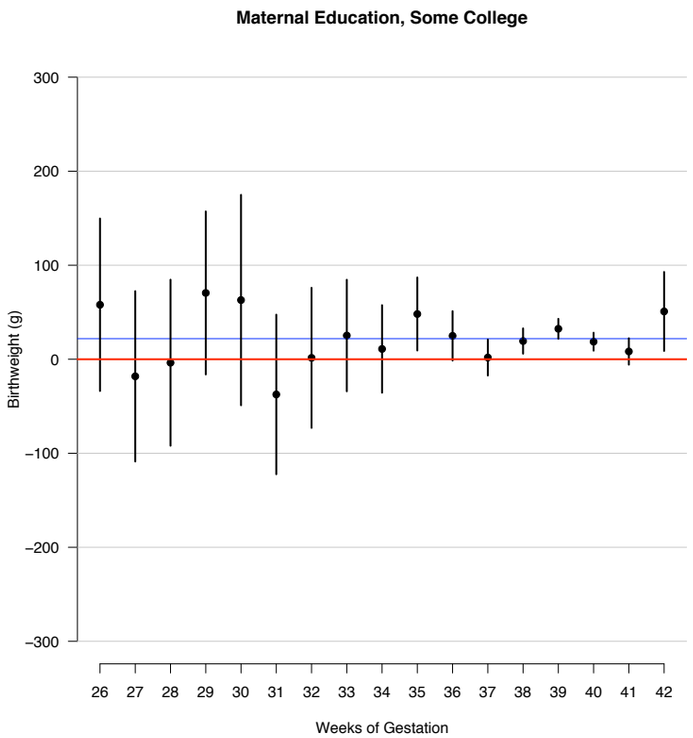


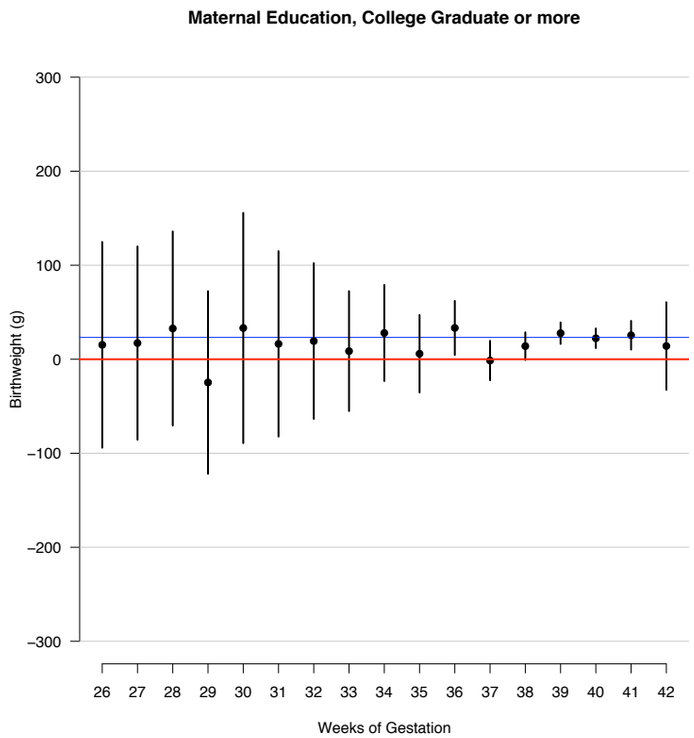


Effect of Maternal Education



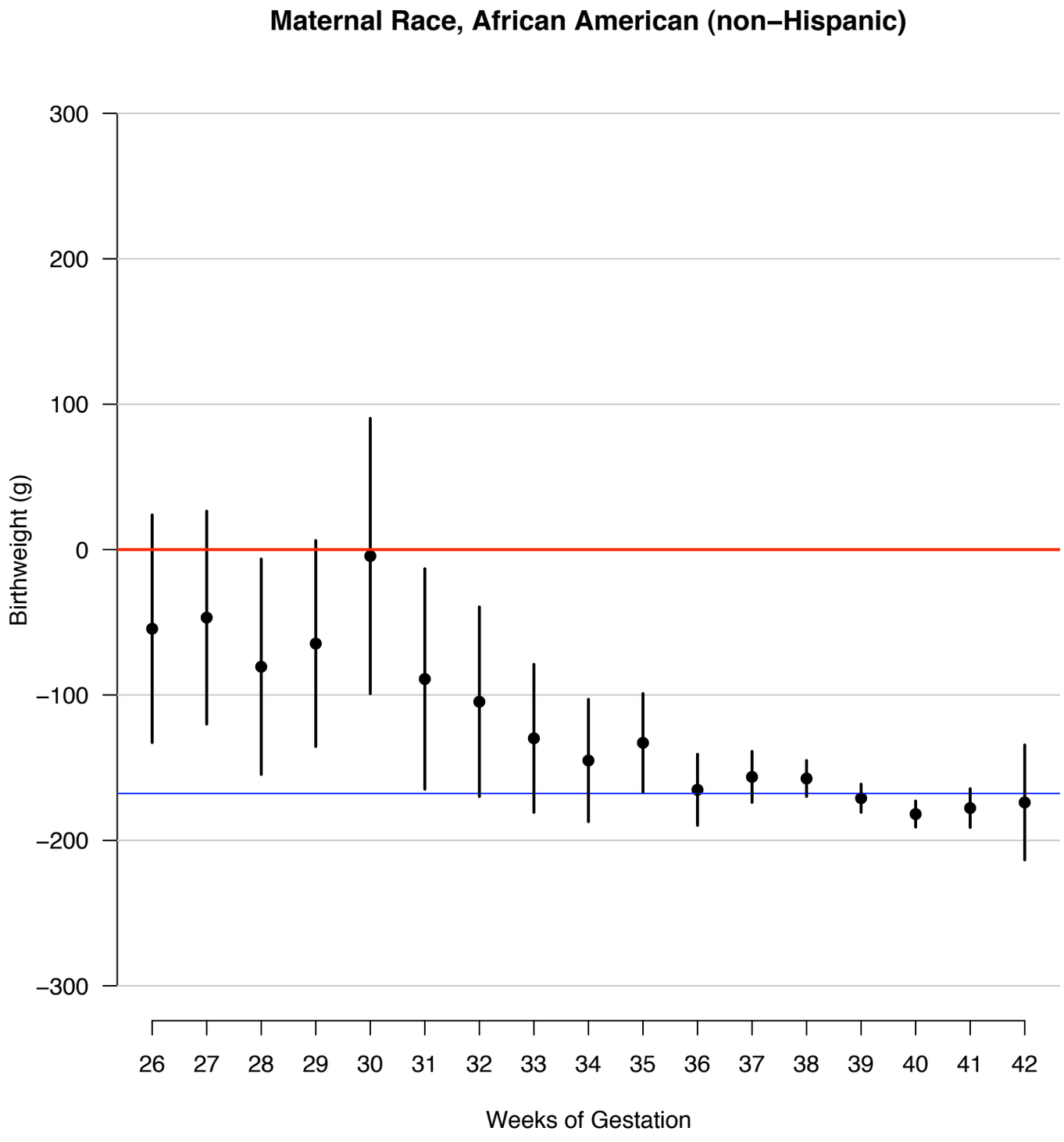




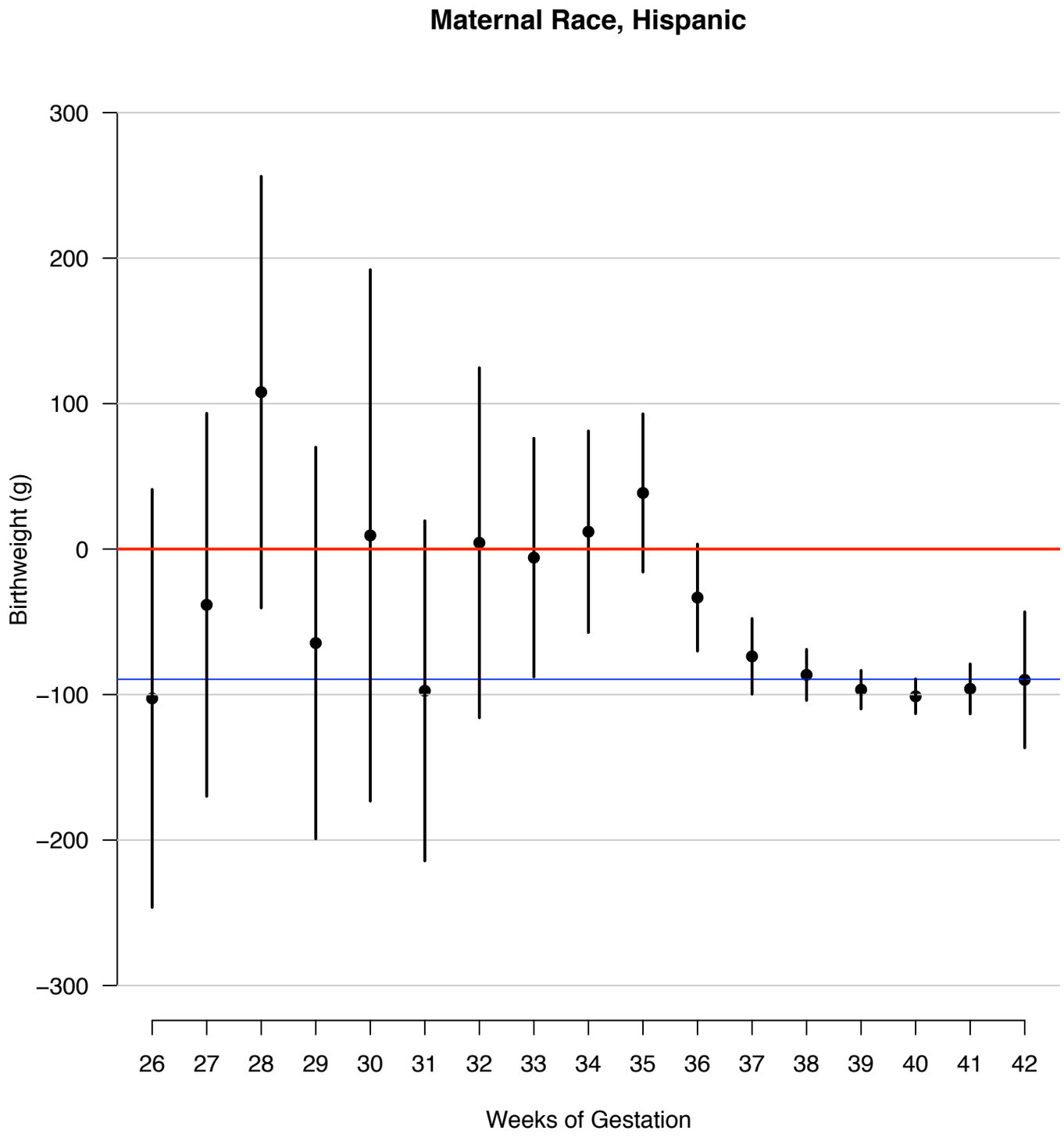


High school educated is reference group

Effect of Maternal Race, African American



Effect of Maternal Race, Hispanic



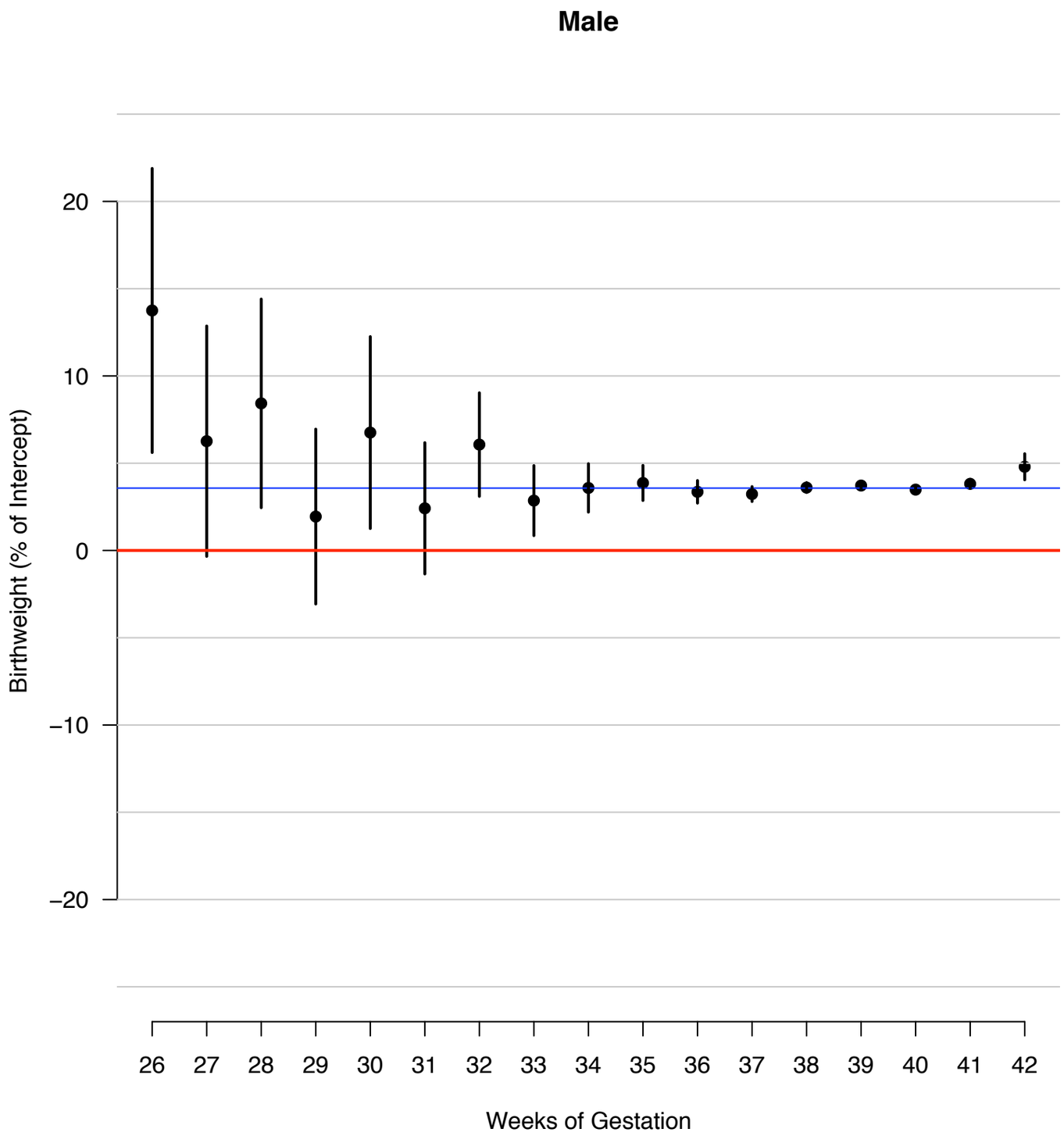
Different Way to View the Results

- So far, results presented in terms of additions or subtractions from the weekly intercept

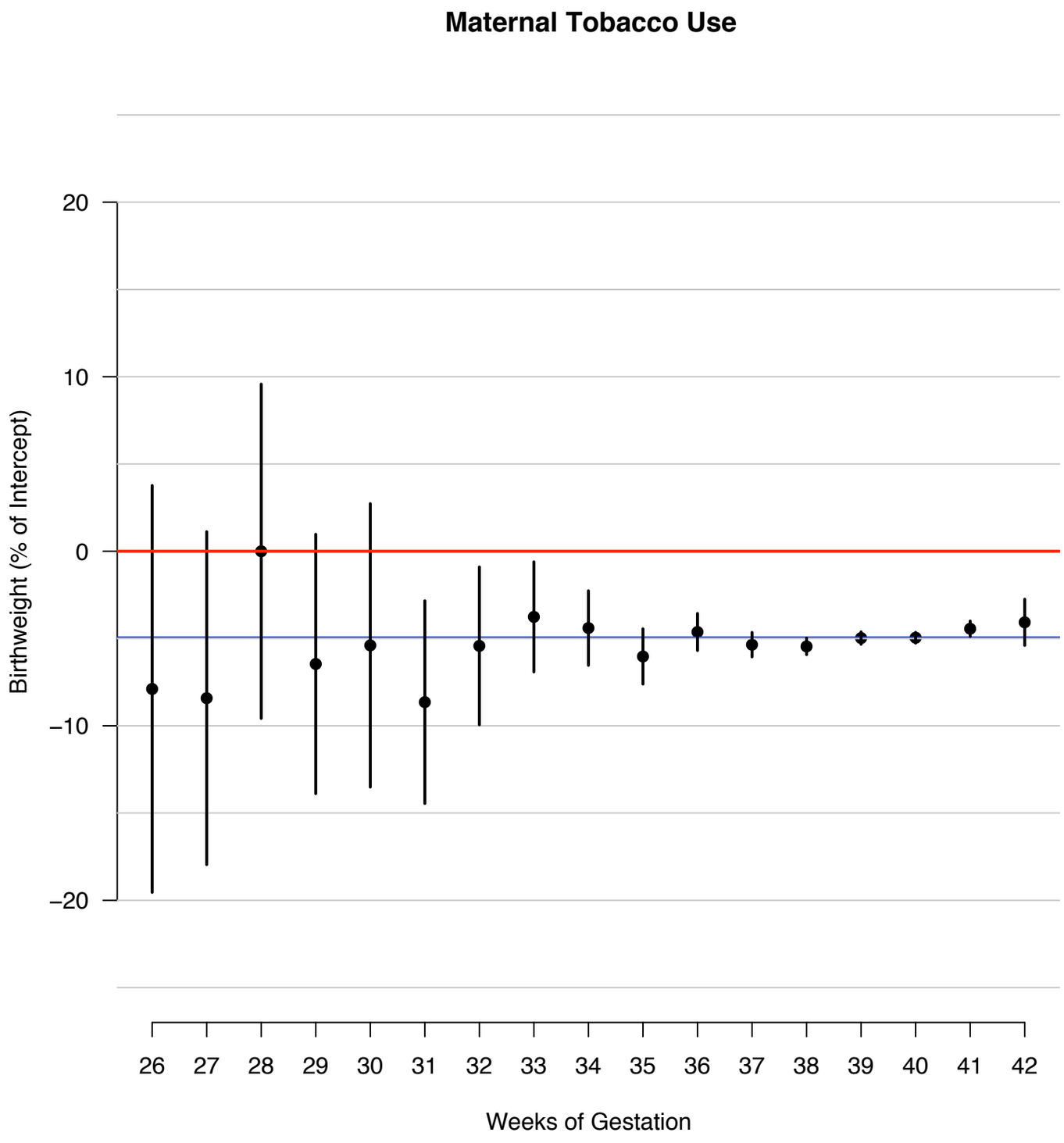
- Though we do not model differently, we can present results in terms of proportion of each week's intercept

- A 'relative' adjustment instead of 'absolute'

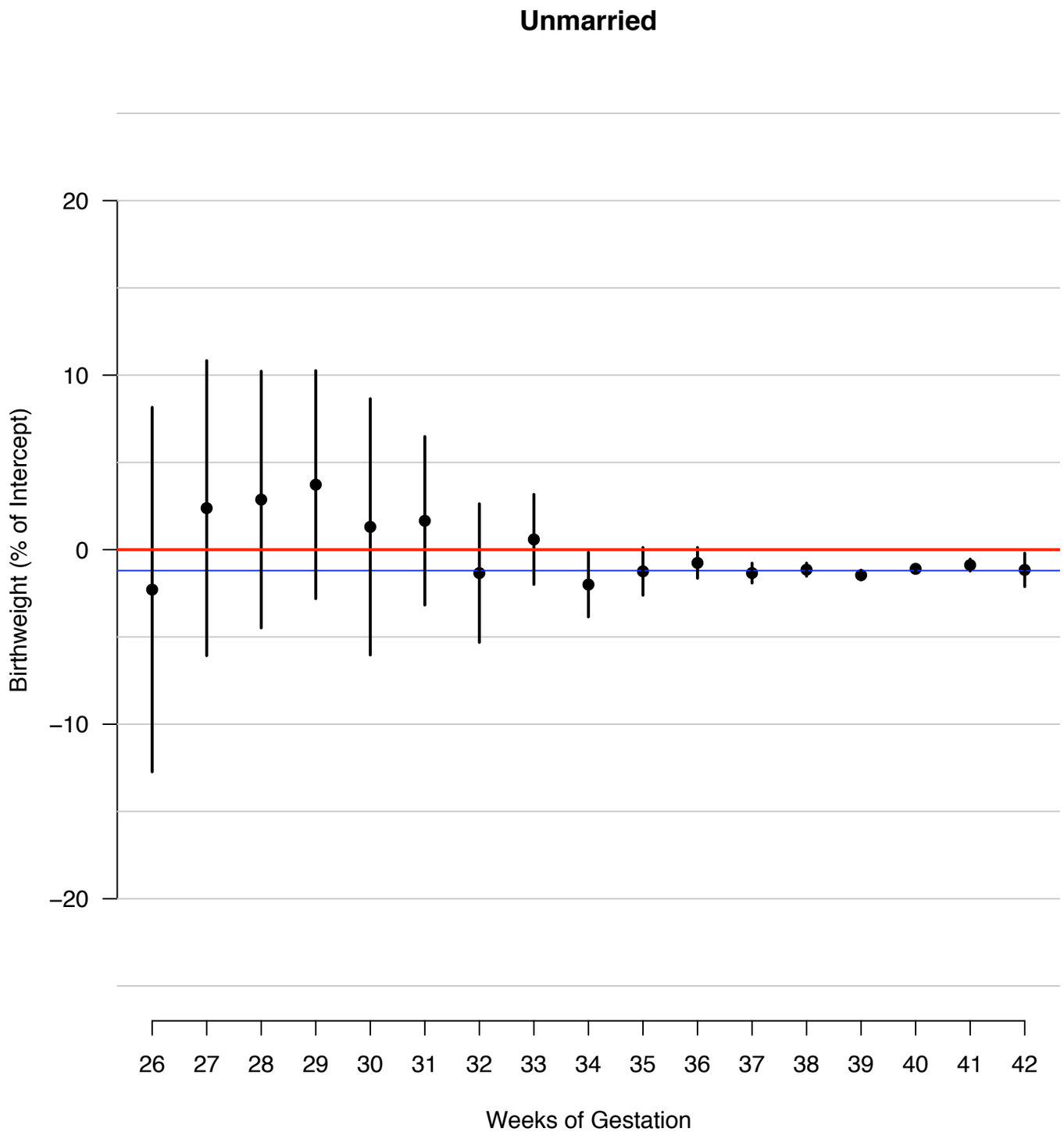
Effect of Infant's Sex (relative scale)



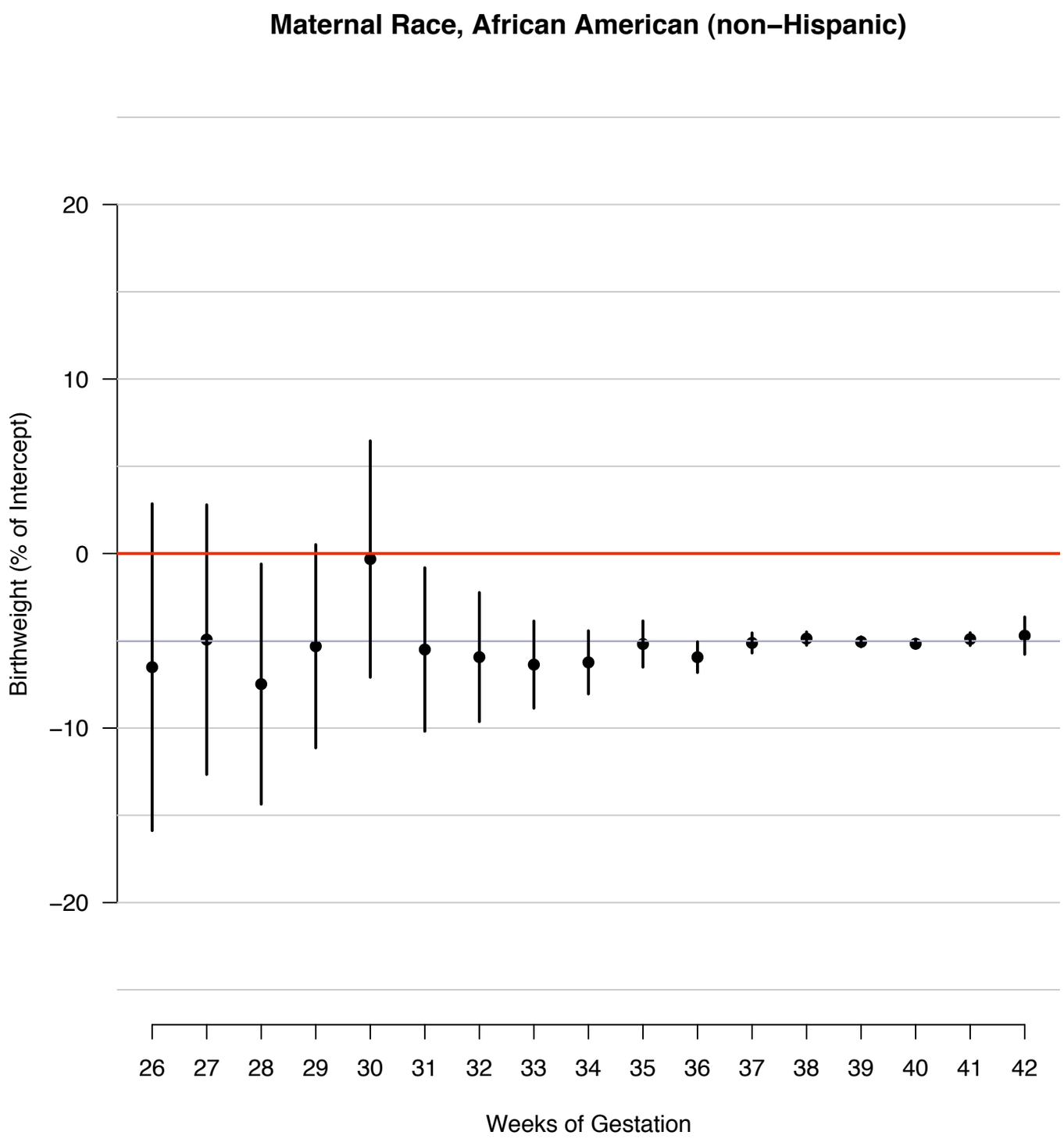
Effect of Maternal Tobacco Use (relative scale)



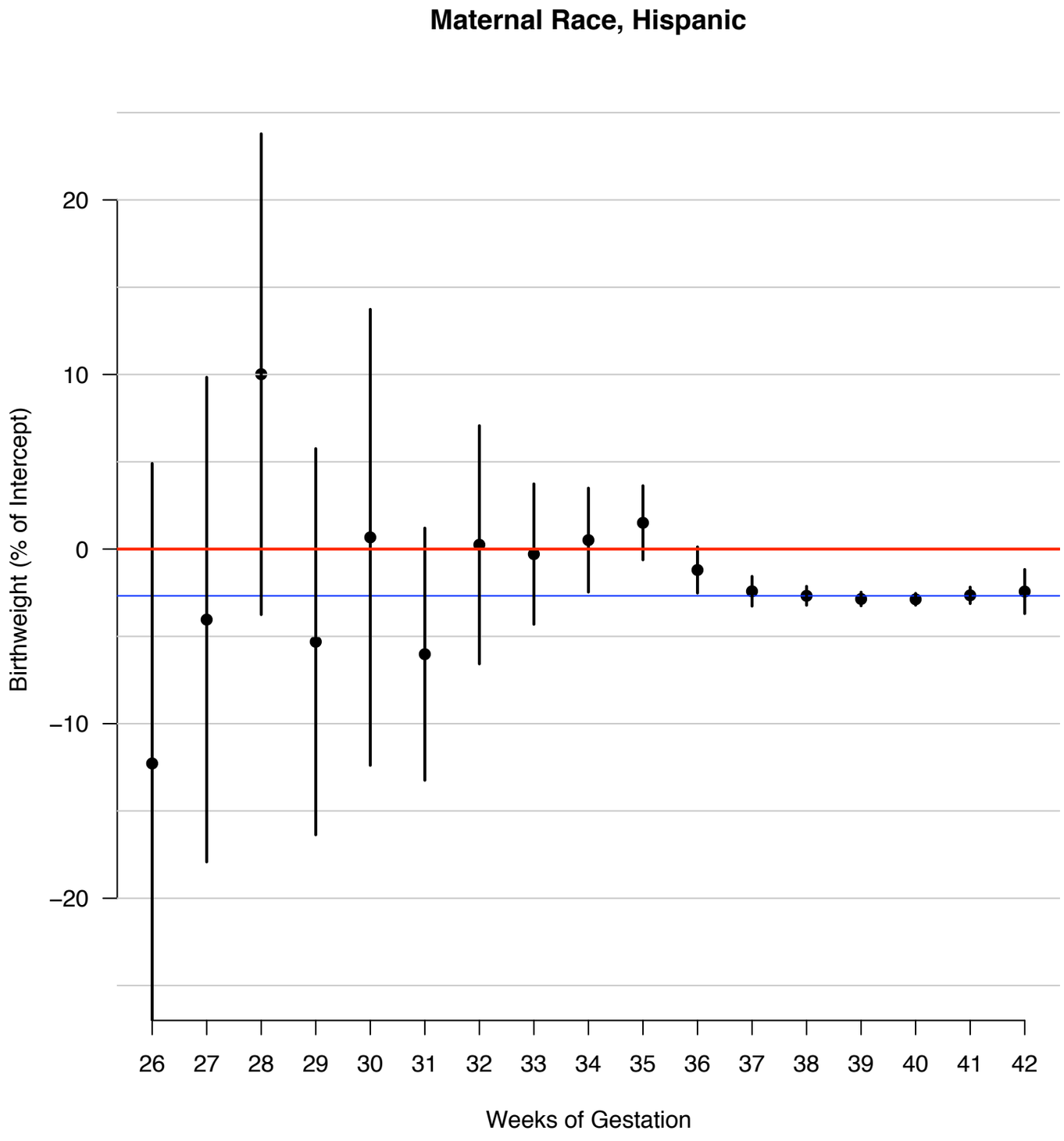
Effect of Marital Status (relative scale)



Effect of Maternal Race, African American (relative scale)



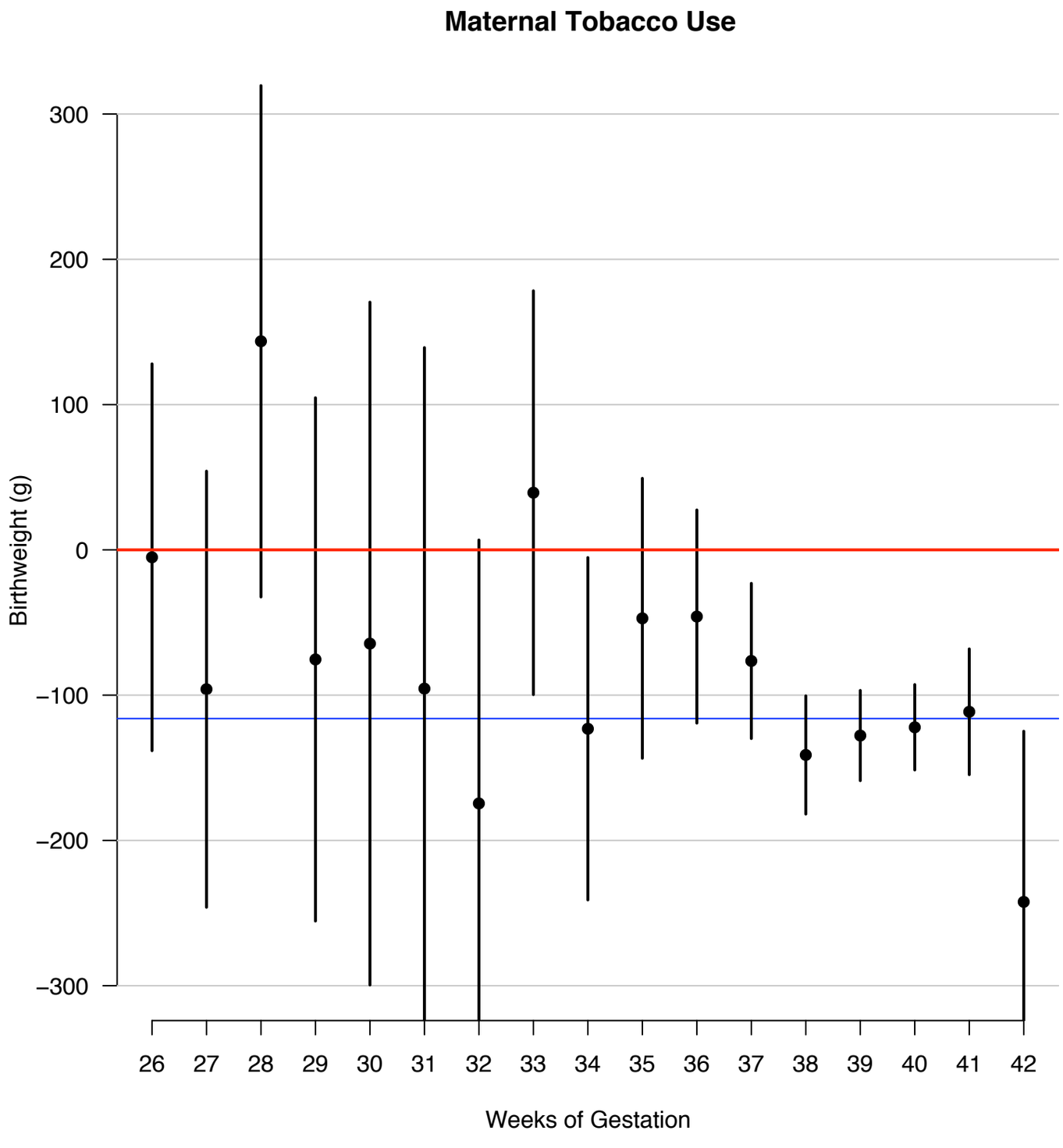
Effect of Maternal Race, Hispanic (relative scale)



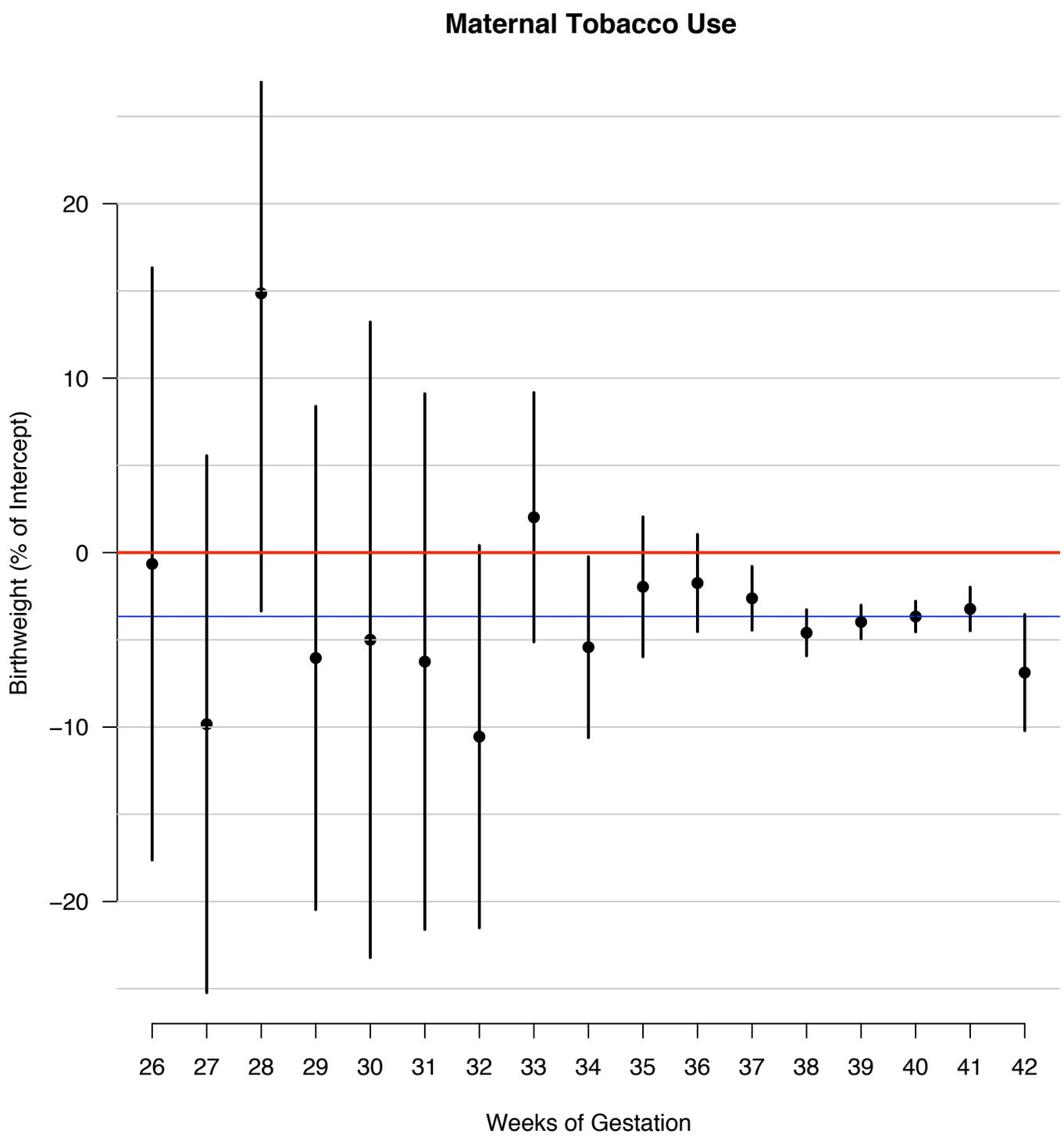
Modification of Model

- We also extend this approach by making the models not just week-specific but also race-specific
  - Two caveats:
    - 1) Could not fit this for Hispanic… small N's
    - 2) Had to combine upper maternal age range, so now 35-44 (instead of 35-39 and 40-44)
- Results focus on just tobacco use for these models

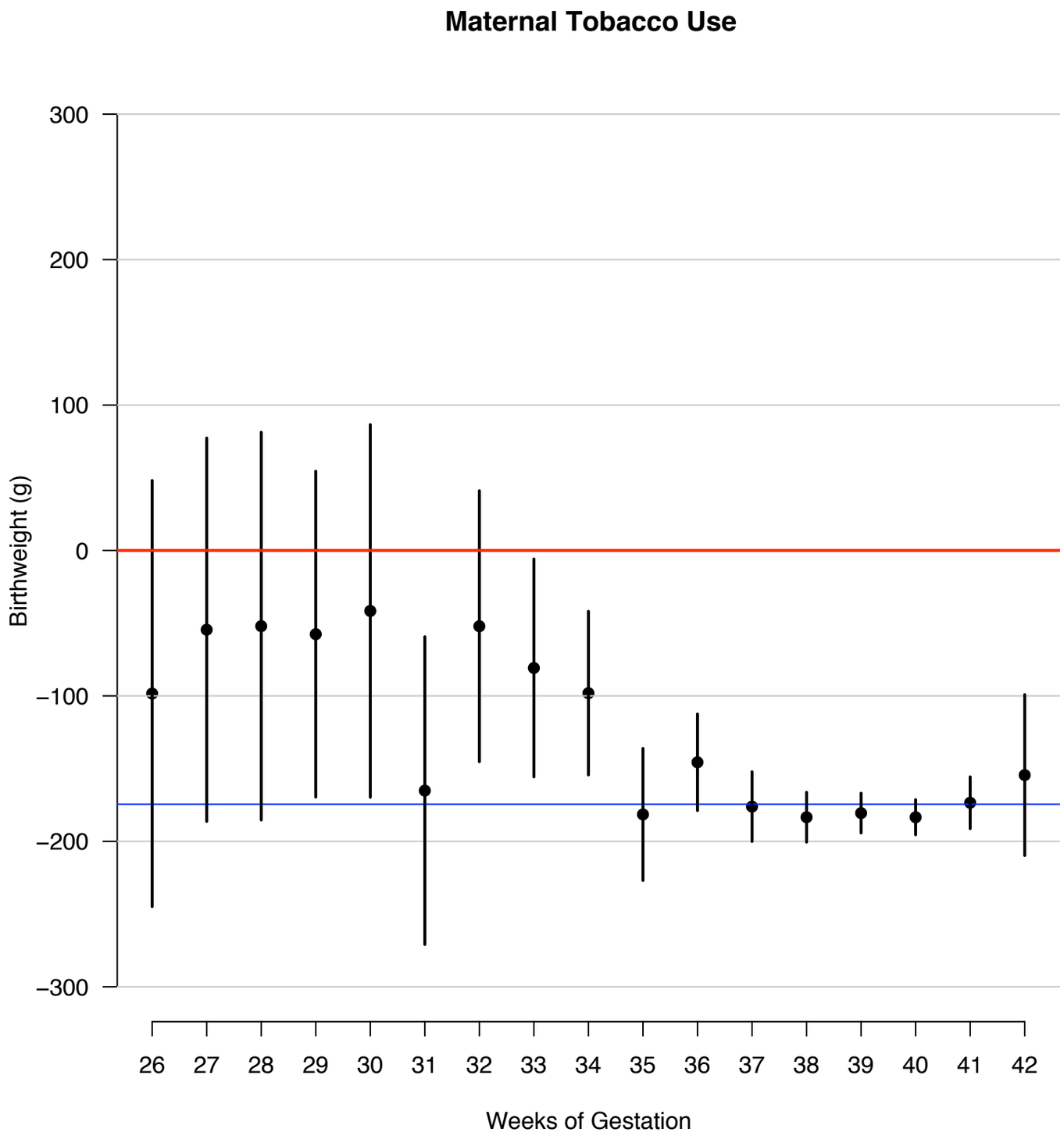
Effect of Maternal Tobacco Use by African American Mothers



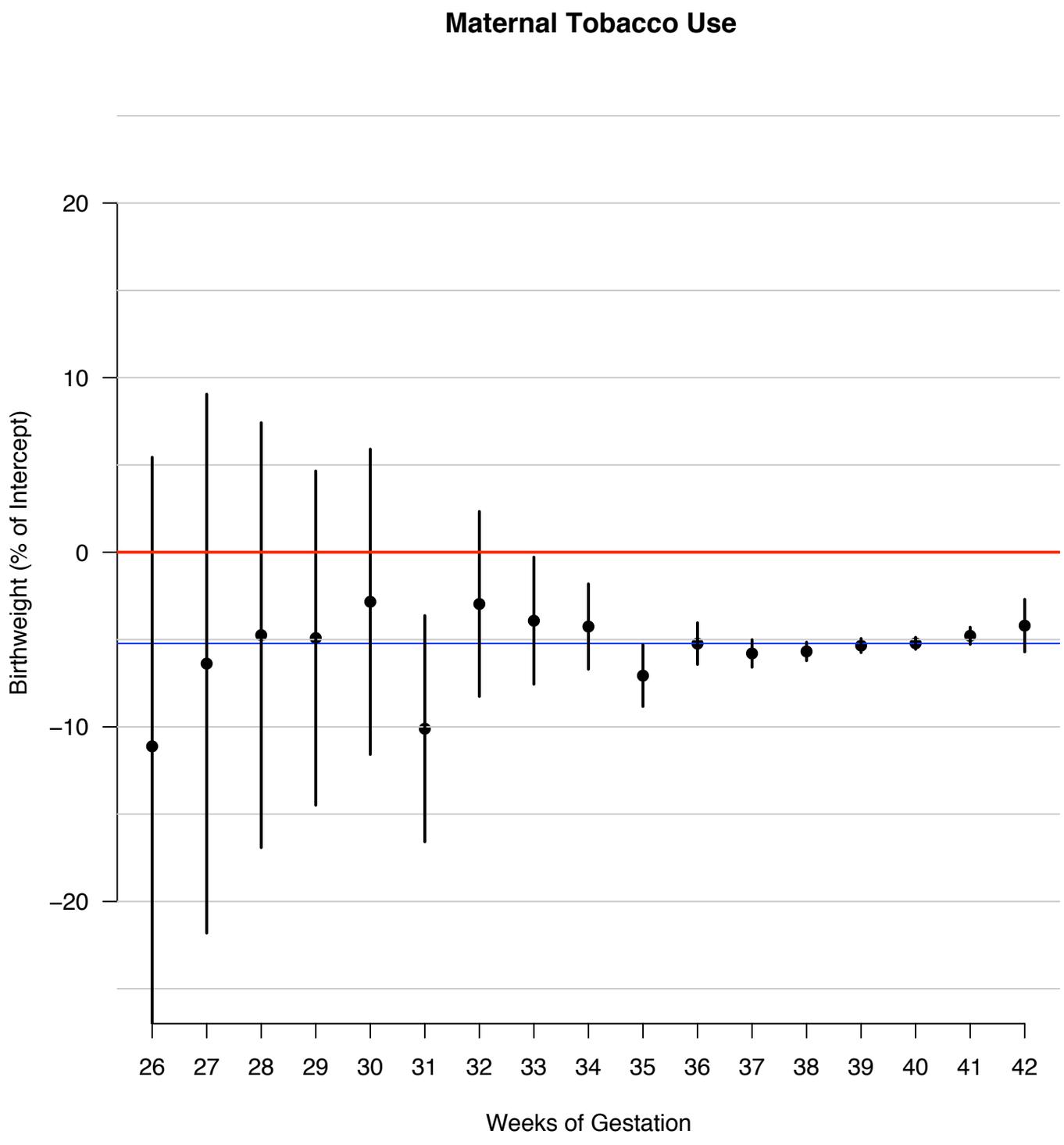
Effect of Maternal Tobacco Use by African American Mothers (relative scale)



Effect of Maternal Tobacco Use by White Mothers



Effect of Maternal Tobacco Use by White Mothers (relative scale)

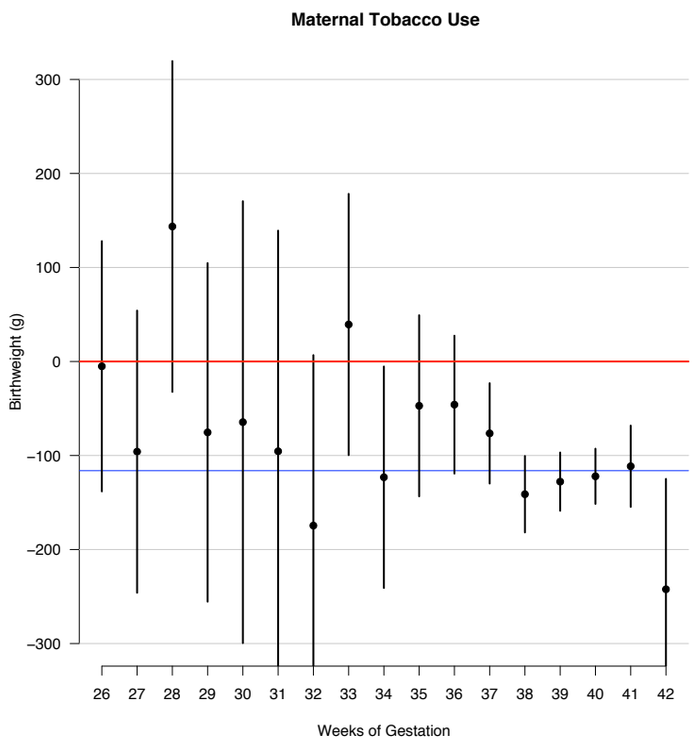


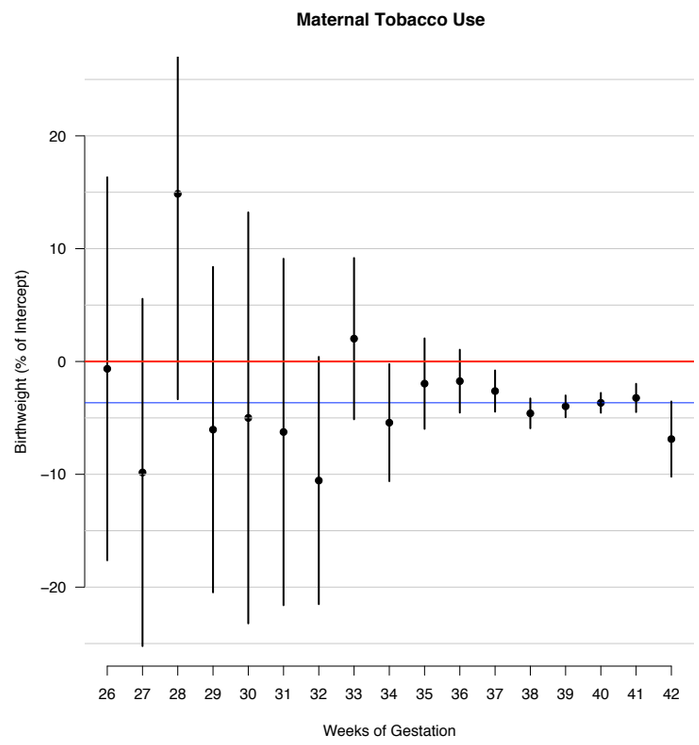
Race-specific models, compared

Absolute scale

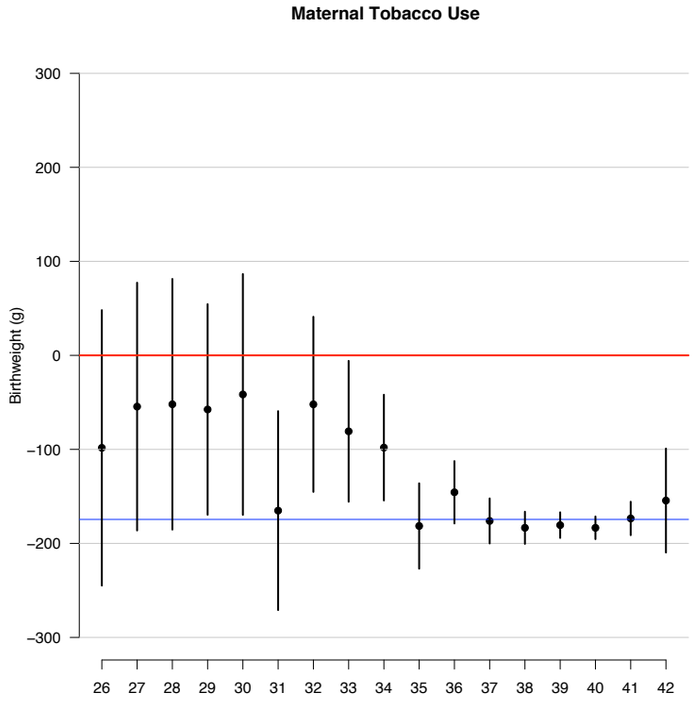
Relative scale

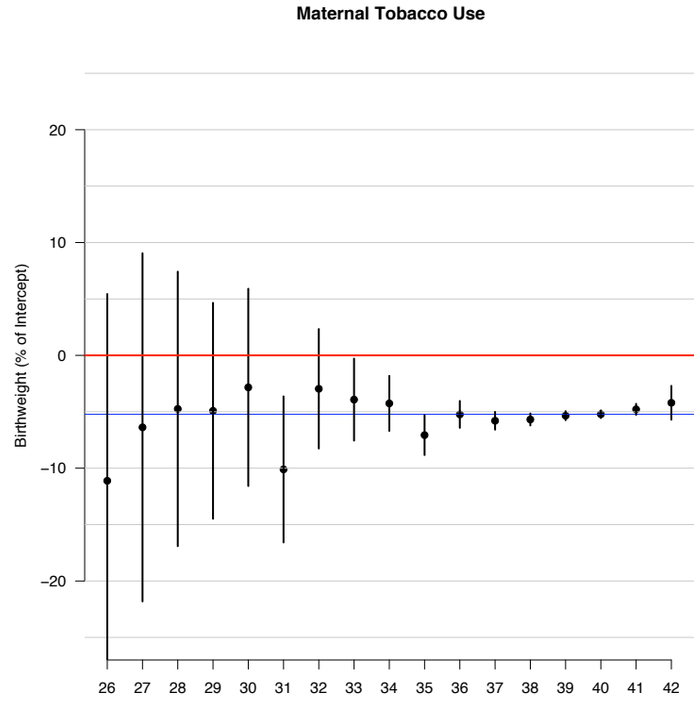
Maternal Race
African American





Maternal Race
White





Implications?

- Factors associated with reduced infant birthweight do not manifest effect until relatively late in gestation
  - These associations may differ by race both in terms of impact and timing of impact
- Third-trimester fetal surveillance indicated for at-risk populations? Perhaps due to late onset?
- Clinical practices?
- But how to get at windows of vulnerability? What data?
  - This is cross-sectional; seem to need longitudinal, e.g., fetal surveillance

Implications?

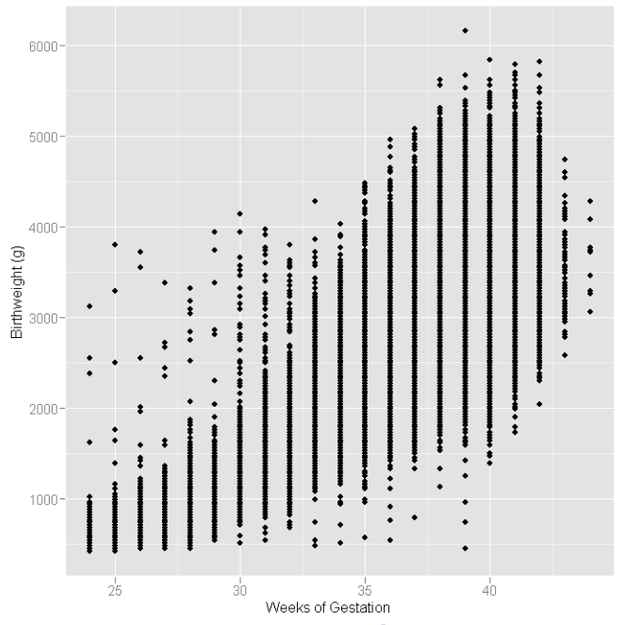
- Current variables: Many "fixed" or intrinsic
  - ... more 'exposure' variables, e.g., social stressors?

- What assumptions do modeling approaches make? Independent subgroups? Does this accord w/ reality?

- What about dynamic relationships about subgroups? Implications for subgroup-specific interventions? Unlikely to succeed?

Future Directions

- Dealing w/ conditioning of the secret weapon
  - Joint distribution of of birthweight, weeks of gestation?



- More formal multilevel modeling
- Multiplicative model for 'relative' changes?
- Spatial?
  - Either Bayesian modeling or simply (first cut?) with a "secret weapon"-like approach

Children's Environmental Health Initiative

- # Thank you very much!