1. Obesity and Breast Cancer Study

Obesity is very common in American society and is a risk factor for breast cancer for postmenopausal women. One mechanism explaining why obesity is a risk factor is that it may raise the estrogen levels in women. In particular, one type of estrogen, serum estradiol, is a strong risk factor for breast cancer. To better assess these relationships, researchers studied a group of 151 African American and 60 Caucasian

premenopausal women. Adiposity was measured in two different ways

(i) by body mass index (BMI) = weight (kg)/height**2**(m**2**) and also (ii) by waist-hip ratio (WHR) = waist circumference / hip circumference. BMI is a measure of overall adiposity, whereas WHR is a measure of abdominal adiposity. In addition, a complete hormonal profile was obtained, including serum cholesterol (ES 1). Finally, other breast cancer risk factors were also assessed among these women, including (1) eth-

nicity (Ethnicity = 1 if African-American, = 0 if Caucasian), (2) age (Age ), (3) parity (Num child = number of children), (4) age at first birth (Agefbo), (5) any children (Anykids = 1 if yes, = 0 if no), (6) age at menarche (Agemenar = age when menstrual periods begin). The data are available in additional folder.

1. BMI is classified as: normal if < 25; overweight if $\geq $ 25, < 30, and obese if $\geq $ 30. Compare the distribution of BMI between Caucasian and African-American women using the above classification (use a two-tailed test) and report your findings.
2. Is there a crude association between either measure of adiposity (BMI, WHR), considered separately, and serum estradiol?
3. Are these relationships similar for Caucasian and African-American women?
4. Do the relationships between the adiposity measures and serum estradiol persist after controlling for other breast-cancer risk factors?
5. One debate in the breast-cancer literature is whether overall adiposity (BMI) or central adiposity (WHR) is a better indicator of breast-cancer risk. Perform analyses to inform the debate as to which measure of adiposity is more closely related to serum estradiol either crudely or after adjusting for other breast-cancer risk factors.
6. It is well-known that African-American women have higher levels of obesity than Caucasian women. Are there differences between estradiol levels for African-American women and Caucasian women after controlling for obesity?

In answering these questions, you may need to consider the following:

* There are a number of women for whom one or more variables have missing data. What should be done with these cases?