1. All-cause, and prostate/breast cancer, death rates Québec 1971 *vs.* 2002

Refer to the data for females *or* males – under Resources.

i. Calculate and compare the crude all-cause mortality for 1971 and 2002.

ii. Calculate the "directly" standardized rates (and their standard errors) for all-cause mortality for 1971 and for 2002, using as weights (a) the European standard in Table 2.4 (b) the 1971 Québec age structure (c) the 2002 Québec age structure, (d) an average of the 1971 and 2002 structures (e) the width of the age-band. Comment on your findings – both substantive (the 1971 - 2002 difference) and technical (statistical).

iii. Derive equation 2.7.

iv. In equation 2.5, B&D wrote the CMF as a weighted average of *rate ratios*. Can you write the SMR (eqn. 2.8) as a (different) weighted average of *rate ratios*? [cf. Liddell FDK The measurement of occupational mortality. Br J Industrial Medicine 1960; 17:228-233. - under Resources]

v. People often have trouble remembering the difference between "*direct*" and "*indirect*". Is the distinction between them artificial? Can you come up with a better way to describe them?

vi. How well is the cumulative incidence (i.e., risk) of dying from breast/prostate cancer before age 85

$$Risk_{0-85} = 1 - \exp\{-\Lambda_{0-85}\} = 1 - \exp\left\{ - \int_0^{85} \lambda(a)da \right\}$$

approximated by Λ_{0-85}? How well would the approximation do in the case of all-cause mortality?

vii. As calculated, the risk of dying from breast/prostate cancer is *hypothetical* – it assumes that the person is not subject to the competing risks of all other-cause mortality. Can you think of a way to calculate the *real-world* risk (calculations themselves not needed)?

viii. Compare the $Risk_{0-85}$ estimates for *lung* cancer mortality derived from the 1971 vs. the 2002 data. Comment.

ix. Use the link between the Poisson and chi-square tail areas (déjà vu in 601 – section 2 of intensity rates:- models / inference / planning, as well as Fisher's 1935 paper) – and `R` or `SAS` or `Excel` or an actual chi-square table – to derive the exact limits in Table 2.11.

Progress against cancer (USA)? *cf. 1997 article under Resources*

Progress against Cancer: Bailar JC, Smith EM. : NEJM. **1986** May 8;314(19):1226-32. We assessed the overall progress against cancer during the years 1950 to 1982. In the United States, these years were associated with increases in the number of deaths from cancer, in the crude cancer-related mortality rate, in the age-adjusted mortality rate, and in both the crude and the age-adjusted incidence rates, whereas reported survival rates (crude and relative) for cancer patients also increased. **In our view, the best single measure of progress against cancer is change in the age-adjusted mortality rate associated with all cancers combined in the total population.** According to this measure, we are losing the war against cancer, notwithstanding progress against several uncommon forms of the disease, improvements in palliation, and extension of the productive years of life. A shift in research emphasis, from research on treatment to research on prevention, seems necessary if substantial progress against cancer is to be forthcoming.

Cancer Undefeated. Bailar and Gornik. NEJM **1997**; 336:1569-74
Background: Despite decades of basic and clinical research and trials of promising new therapies, cancer remains a major cause of morbidity and mortality. We assessed overall progress against cancer in the United States from 1970 through 1994 by analyzing changes in age-adjusted mortality rates.

Methods: We obtained from the National Center for Health Statistics data on all deaths from cancer and from cancer at specific sites, as well as on deaths due to cancer according to age, race, and sex, for the years 1970 through 1994. We computed **age-specific mortality rates and adjusted them to the age distribution of the U.S. population in 1990**.

Results: Age-adjusted mortality due to cancer in 1994 (200.9 per 100,000 population) was 6.0 percent higher than the rate in 1970 (189.6 per 100,000). After decades of steady increases, the age-adjusted mortality due to all malignant neoplasms plateaued, then decreased by 1.0 percent from 1991 to 1994. The decline in mortality due to cancer was greatest among black males and among persons under 55 years of age. Mortality among white males 55 or older has also declined recently. These trends reflect a combination of changes in death rates from specific types of cancer, with important declines due to reduced cigarette smoking and improved screening and a mixture of increases and decreases in the incidence of types of cancer not closely related to tobacco use.

Conclusions: The war against cancer is far from over. Observed changes in mortality due to cancer primarily reflect changing incidence or early detection. The effect of new treatments for cancer on mortality has been largely disappointing. The most promising approach to the control of cancer is a national commitment to prevention, with a concomitant rebalancing of the focus and funding of research.