기대수명 설명

원본은 R 패키지 형태 -> 파이썬으로 재구성
원본에서 기준 데이터프레임과 계산방법 활용.
통계모델 형식임.
추가적으로 다른 머신러닝 모델사용하여 계산결과의 오차를 줄여보는 방안 고민중.

계산 방법

1. **기준 데이터프레임 생성**
   - **AGE**: 각 사망 원인별 평균 사망 연령
   - **RISK**: (인구 100,000명당 사망자 수) ÷ (모든 사망 원인의 사망률 합) ⇒ 0~1 사이 확률로 정규화
   - **RATE**: 연간 각 사망 원인으로 사망하는 전체 인구 수
2. **위험 요인 영향 반영**
   - 두개의 데이터프레임에 연속형 · 이산형 위험 요인 파라미터별 **multiplier** 기록
   - multiplier > 1 → 기준 AGE/RISK/RATE ↑
   - multiplier < 1 → 기준 AGE/RISK/RATE ↓
   - **유익 요인**: AGE ↑ & (RISK, RATE) ↓
   - **해로운 요인**: AGE ↓ & (RISK, RATE) ↑

category	cause	var	value	multiplier
age	Cardiovascular Diseases	sex	Male	0.955
age	Cardiovascular Diseases	race	Asian	1.1
age	Cardiovascular Diseases	inc	Middle	1
age	Cardiovascular Diseases	edu	Doctoral degree	1.054

- 이런 형식

1. 기본 데이터 불러오기
   - `cod` 테이블: 각 사망 원인(cause)에 대한 평균 사망 연령(`age`), 위험도(`risk`), 인구수(`pop`) 정보
   - `factors.csv` : 범주형 변수(var, value)에 대응하는 각 원인별 승수(`multiplier`)
   - `factors_cont.csv` : 연속형 변수(var)에 따른 각 원인별 승수 식의 계수(`multiplier`)
2. 범주형 승수 구하기

```
def filter_df(df):
    mask = pd.Series(False, index=df.index)
    for var in df["var"].unique():
        val = inputs.get(var)
        if val is not None:
            mask |= (df["var"] == var) & (df["value"] == str(val))
    return df[mask]

filtered = filter_df(factors)
cat = filtered.groupby(["category","cause"], as_index=False)
["multiplier"].prod()
```

- `filter_df`가 `inputs` 값과 일치하는 행만 필터링
- 예: `("var"="sex","value"="Male")`인 행 → `multiplier=0.955` 등
- 그룹별 곱을 통해, 사망 연령·위험도·인구수 각각에 대한 최종 범주형 승수(`f_age`, `f_risk`, `f_pop`) 도출

3. 연속형 승수 구하기

```
def multiply_df(df):
    df2 = df.copy()
    df2["input_val"] = df2["var"].map(inputs)
    df2 = df2.dropna(subset=["input_val"])
    df2["multiplier"] = 1 + df2["input_val"] * df2["multiplier"]
    return df2.groupby(["category","cause"], as_index=False)
["multiplier"].prod()

cont = multiply_df(factors_cont)
```

- 입력값(예: 하루 음주량, 주당 운동분 등)에 대해

$$승수(multiplier) = 1 + (입력값 \times 계수)$$

- 예: `drk=0` → `1 + 0 × (-0.001570) = 1.0`, `mpa=120` → `1 + 120 × 0.000219 ≈ 1.02628` 등
- 같은 사망 원인끼리 곱해서 `f_cont_age`, `f_cont_risk`, `f_cont_pop` 도출

4. **피벗 및 접합(join)**

```
cat_pivot = cat.pivot(...).fillna(1).add_prefix("f_")
cont_pivot = cont.pivot(...).fillna(1).add_prefix("f_cont_")
df = cod.join(cat_pivot).join(cont_pivot).reset_index().fillna(1)
```

- `f_` 접두어가 붙은 범주형 승수, `f_cont_` 가 붙은 연속형 승수를 `cod` 에 합침

$$\text{조정된 age} = \text{age} \times f\_age \times f\_cont\_age$$

$$\text{조정된 risk} = \text{risk} \times f\_risk \times f\_cont\_risk$$

$$\text{조정된 pop} = \text{pop} \times f\_pop \times f\_cont\_pop$$

5. **최종 승수 곱셈 결과 (예: Cardiovascular Diseases)**

cause	age	risk	pop	f_age	f_cont_age	f_risk	f_cont_risk	f
Cardiovascular Diseases	67.3	224.4	813804	1.06552	1.08022	1.18096	0.49773	1

```
- 예를 들어, `age` 컬럼은
```

$67.3 \times f\_age(=1.06552) \times f\_cont\_age(=1.08022) \approx 77.49$

```
`risk`와 `pop`도 동일 방식으로 승수를 곱해 조정합니다.
```

원인 (cause)	adjusted_risk	adjusted_age
심혈관질환	100	75
암	50	70
당뇨병	25	65
교통사고	25	40

확률 계산 & 기대 사망 연령 산출

1. **원시 확률(raw probability) 계산**
   - 총 위험도 합:
     $\text{total\_risk} = 100 + 50 + 25 + 25 = 200$
   - 각 원인의 원시 확률: $\text{prob}_i = \frac{\text{adjusted\_risk}_i}{\text{total\_risk}}$
     - 심혈관질환: $100/200 = 0.50$

    - 암: $50/200 = 0.25$
    - 당뇨병: $25/200 = 0.125$
    - 교통사고: $25/200 = 0.125$
2. **원치 않는 사망 원인 제외**
    - “교통사고” 확률 0.125 제거 → 남은 합 $0.50 + 0.25 + 0.125 = 0.875$
3. **확률 정규화(normalization)**
    - 정규화 공식: $p\_norm_i = \frac{\text{prob}_i}{\sum_{j \neq \text{excluded}} \text{prob}_j} = \frac{\text{prob}_i}{0.875}$
    - 계산 결과:
        - 심혈관질환: $0.50/0.875 \approx 0.571$
        - 암: $0.25/0.875 \approx 0.286$
        - 당뇨병: $0.125/0.875 \approx 0.143$
4. **기대 사망 연령(expected age) 계산**
    - 공식: $\mathbb{E}[\text{age}] = \sum_i p\_norm_i \times \text{adjusted\_age}_i$
    - 각 원인별 기여도:
        - 심혈관질환: $0.571 \times 75 = 42.86$
        - 암: $0.286 \times 70 = 20.00$
        - 당뇨병: $0.143 \times 65 = 9.29$
    - 합산: $42.86 + 20.00 + 9.29 \ \approx \ 72.15$세
5. **한계**
    - 최신 통계로 데이터프레임 값을 주기적 업데이트 해야할 필요 있음

입력

- 사용자 인터페이스에 나열된 **위험 요인 파라미터 목록**
- 사용자는 자신의 프로필에 해당하는 파라미터(예: 성별, 흡연 여부, 운동량 등)를 선택
- 선택된 파라미터의 승수를 기준 데이터에 곱해 최종 AGE, RISK, RATE 계산

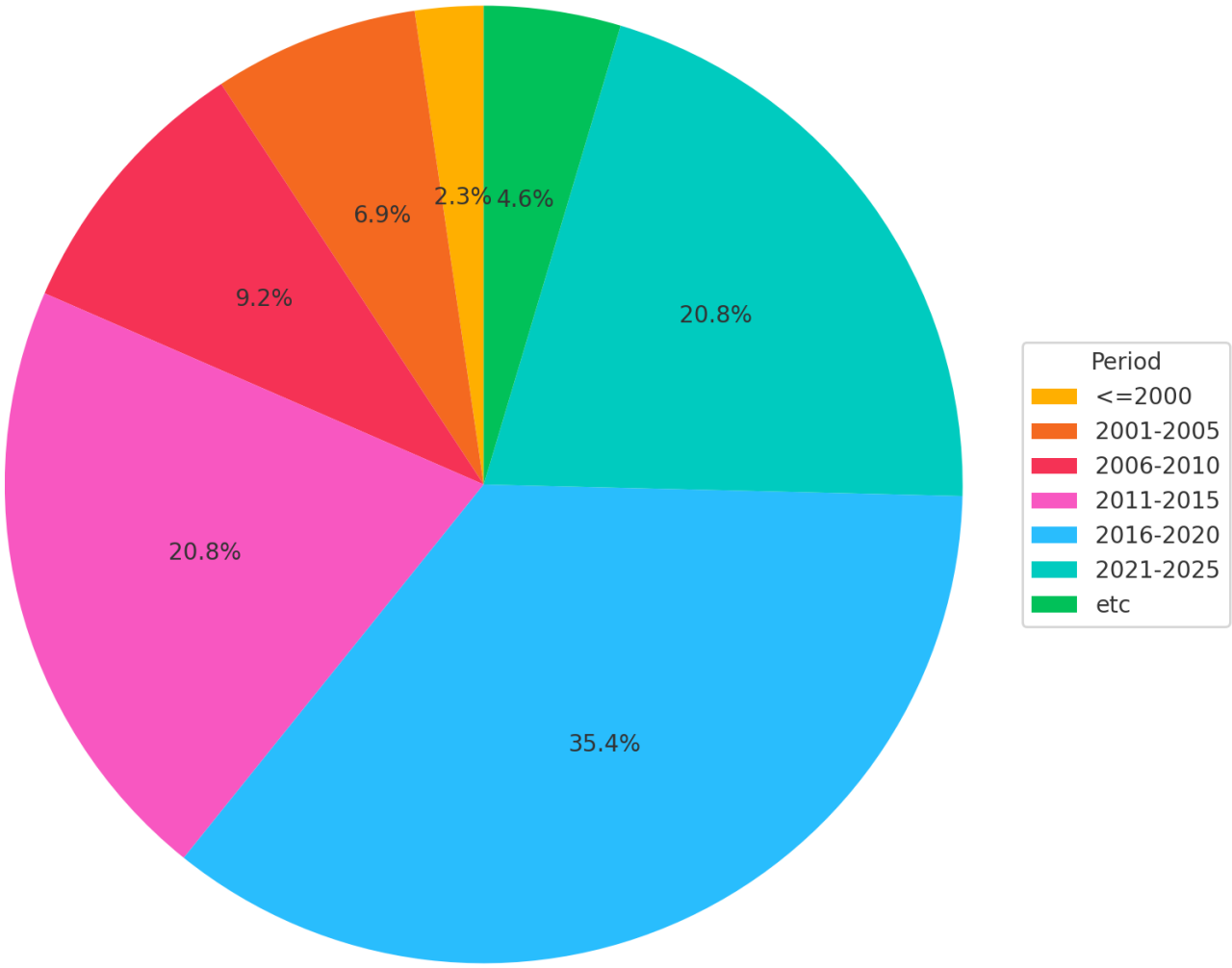
변수	타입	설명
cage	int	현재 나이 (years)
sex	str	성별 (`"Male"` 또는 `"Female"`)
race	str	인종 (예: `"Asian"` , `"White"` , `"Black"` , 등)
wbr	str	지역 분류 (예: `"East Asia & Pacific"` , `"Europe & Central Asia"` , 등)
drk	int	알코올 음주량 (주당 음주 횟수)
smk	int	흡연량 (주당 평균 흡연 횟수)

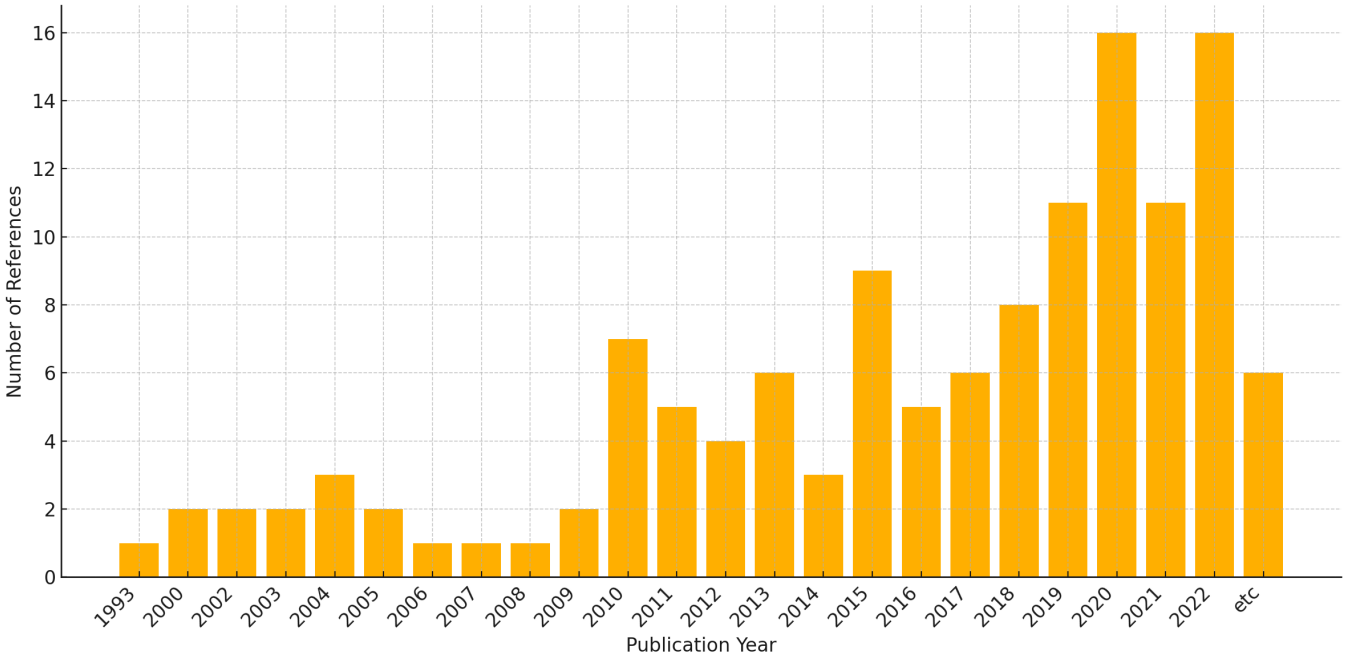
변수	타입	설명
mpa	int	중강도 신체 활동 시간 (주간 분 단위)
hpa	int	고강도 신체 활동 시간 (주간 분 단위)
hsd	int	수면 시간 (하루 평균 시간, hours)
sys	str	혈압 (예: `"Normal (SBP <120)"`, `"Elevated (120–129)"`, `"High (≥130)"` 등)
bmi	str	체질량지수(BMI) (예: `"Underweight (<18.5)"`, `"Normal (18.5–24.9)"`, `"Overweight (25–29.9)"` 등)
hbc	str	고혈중 콜레스테롤 병력 (`"Yes"` / `"No"`)
cvd	str	심혈관질환 병력 (`"Yes"` / `"No"`)
copd	str	만성폐쇄성폐질환 병력 (`"Yes"` / `"No"`)
dia	str	당뇨병 병력 (`"Yes"` / `"No"`)
dep	str	우울증 병력 (`"Yes"` / `"No"`)
can	str	암 병력 (`"Yes"` / `"No"`)
alz	str	알츠하이머 병력 (`"Yes"` / `"No"`)
fcvd	str	심혈관질환 가족력 (`"Yes"` / `"No"`)
fcopd	str	COPD 가족력 (`"Yes"` / `"No"`)
fdia	str	당뇨병 가족력 (`"Yes"` / `"No"`)
fdep	str	우울증 가족력 (`"Yes"` / `"No"`)
fcan	str	암 가족력 (`"Yes"` / `"No"`)
falz	str	알츠하이머 가족력 (`"Yes"` / `"No"`)

정리된 참고 문헌 목록

연도	건수
1993	1
2000	2
2002	2
2003	2
2004	3
2005	2

연도	건수
2006	1
2007	1
2008	1
2009	2
2010	7
2011	5
2012	4
2013	6
2014	3
2015	9
2016	5
2017	6
2018	8
2019	11
2020	16
2021	11
2022	16
기타	6
합계	**130**


2.3%
4.6%
6.9%
9.2%
20.8%
20.8%
35.4%
Period
<=2000
2001-2005
2006-2010
2011-2015
2016-2020
2021-2025
etc



All Causes

- ENLACE: Data Portal on Noncommunicable Diseases, Mental Health, and External Causes: https://www.paho.org/en/enlace
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