**10.2** Setup amounts to $Y \sim \text{Binomial}(20, p)$ to be tested with $H_0: p = .8$ vs. $H_A: p < .8$

RR is $\{y \leq 12\}$

a) Type I is reject in error is $p = .8$ but $y \leq 12$.

c) Type II is accept in error is $p < .8$ but $y > 12$.

b) $\alpha = \mathbb{P}(\text{Type I}) = \mathbb{P}(y \leq 12 / p = .8) = \sum_{y=0}^{12} \mathbb{P}(y | .8) =$ pbinom(12, 20, .8).

d) $\beta(.6) = \mathbb{P}(\text{Type II}) = \mathbb{P}(y > 12 | p = .6) = \sum_{y=13}^{20} \mathbb{P}(y | .6) =$

= pbinom(13, 20, .6, lower.tail = FALSE)

e) pbinom(13, 20, .4, lower.tail = FALSE)

10.3

a) To find a rejection region we could either tabulate all $\alpha$ and pick a value, or we could use the qbinom function in R.

| $c$ | 10 | 11 | 12 | 13 |
|---|---|---|---|---|
| $\alpha$ | .00259 | .00998 | .0321 | .0867 |

So $\{y \leq 11\}$ would work.

Alternative: qbinom(p) returns the smallest F such that $F(x) \geq p$. Since we will want at most p, we will instead need qbinom(p) - 1.

b) pbinom(11, 20, .6, lower.tail = FALSE)

c) pbinom(11, 20, .4, lower.tail = FALSE)

10.19

V specified as 130v.

40 readings gave $\bar{V} = 128.6$ and $s = 2.1$.

$H_0: V = 130$ $H_A: V < 130$ $\alpha = .05$.

By hand: $z = \dfrac{\bar{V} - V_0}{s/\sqrt{n}} = \dfrac{128.6 - 130}{2.1/\sqrt{40}}$

Reject if smaller than qnorm(.05) $\approx -1.645$

... better: use t-test and reject if smaller than qt(.05, 39) $\approx -1.685$.

In R: use the BSDA package and the function

BSDA::tsum.test(128.6, 2.1, 40, mu=130, alternative="less")

10.37 $V_0 = 130$ $V_A = 128$ $N = 40$ $S = 2.1$

Reject if $z < -1.645$

$\beta(128)$? Accept if $z \geq -1.645$

Rejection region is equivalent to rejecting if

$$\frac{\bar{V} - 130}{2.1/\sqrt{40}} < -1.645$$

ie $\bar{V} < 130 - 1.645 \cdot 2.1/\sqrt{40} \approx 129.45$

So $\beta(128) = P(\bar{V} \geq 129.45 \mid V = 128) =$
pnorm(129.45, mean = 128, sd = 2.1/$\sqrt{40}$, lower.tail = FALSE)

10.49 Upper confidence bound is given as $\bar{V} - z_\alpha s/\sqrt{n} =$
$= 128.6 + 1.645 \cdot 2.1/\sqrt{40} \approx 129.146.$