Saint Petersburg State University of Information Technologies,

Mechanics and Optics

Laboratory work report 1

Confidence interval for probabilities of discrete choice

on course: Discrete decision making

(course name)

Work completed by:

Bizhumanova A.

(last name, first name)

academic group C4215c

(group number)

Saint-Petersburg

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Part 1:

Find confidence interval for probabilities of passing exam for 1-5 Hours of studying using Delta Method and regularized logit fit function.

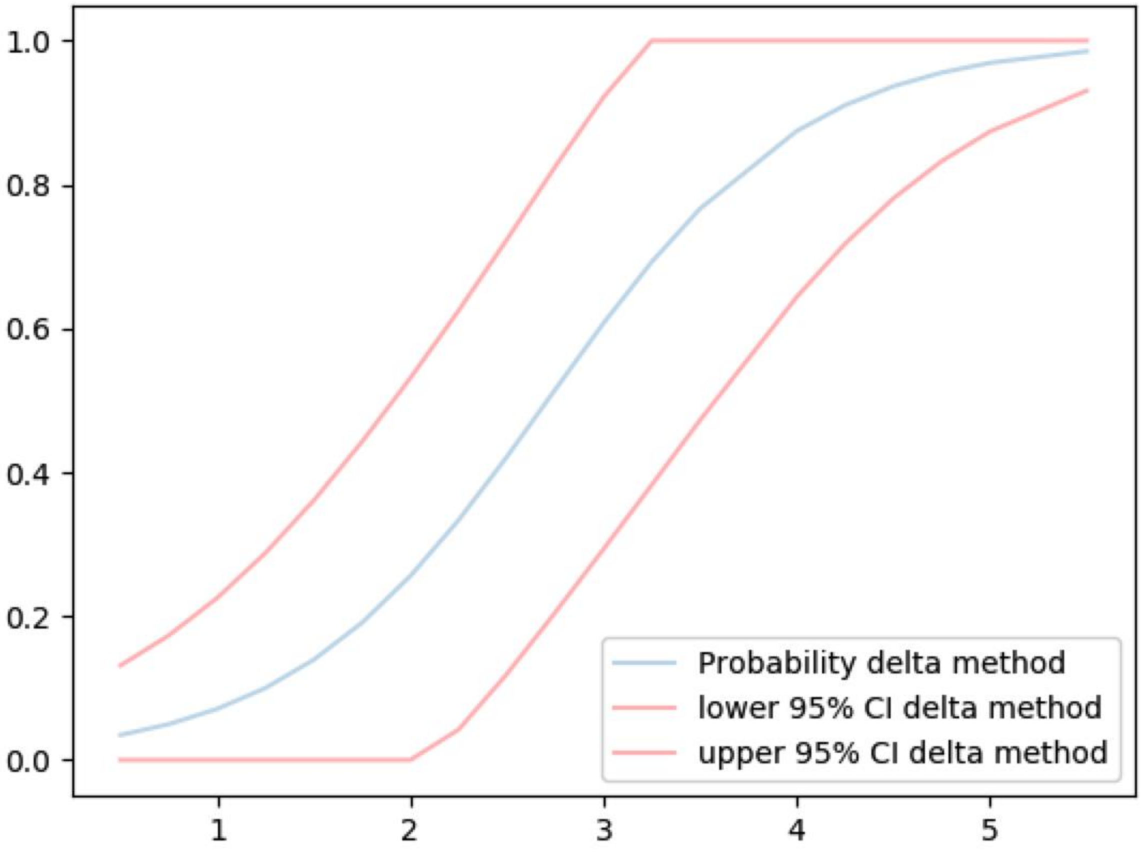
```
x = [0.50, 0.75, 1.00, 1.25, 1.50, 1.75, 1.75, 2.00, 2.25, 2.50, 2.75, 3.00, 3.25, 3.50, 4.00, 4.25, 4.50, 4.75, 5.00, 5.50]
y = [0,    0,    0,    0,    0,    0,    1,    0,    1,    0,    1,    0,    1,    0,    1,    1,    1,    1,    1,    1]


X = sm.add_constant(x)

logit = sm.Logit(y,X).fit_regularized(disp=False)
proba = (logit.predict(X))

# estimate confidence interval for predicted probabilities
cov = logit.cov_params()
gradient = (proba * (1 - proba) * X.T).T # matrix of gradients for each observation
std_errors = np.array([np.sqrt(np.dot(np.dot(g, cov), g)) for g in gradient])

c = 1.96 # multiplier for confidence interval
upper = np.maximum(0, np.minimum(1, proba + std_errors * c))
lower = np.maximum(0, np.minimum(1, proba - std_errors * c))
```



Part 2:

1.Generate large sample from Exam task using uniform distribution generator and logit regression
2.Generate N samples of size len(hours) from main distribution
3.Estimate confidence interval for probabilities of passing exam for 1-5 Hours of studying using Bootstrapping
4.Compare results (confidence interval) with Task 1

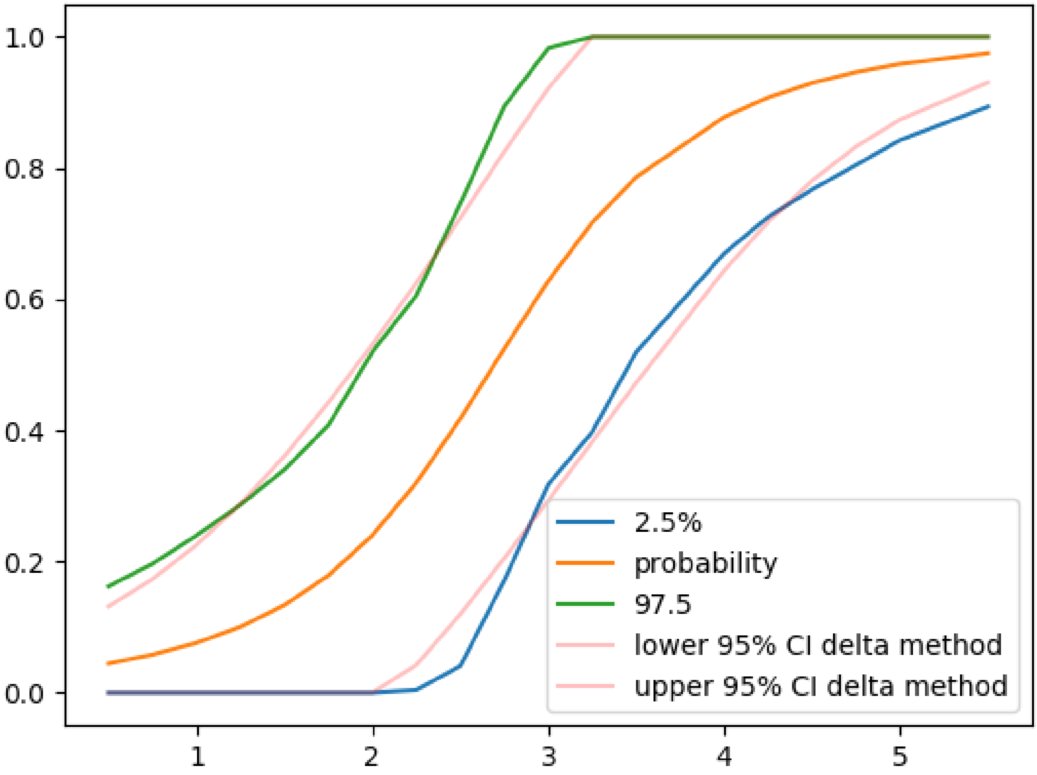
```
rnd_hrs = np.random.uniform(0,5,1000)
rnd_hrs = np.array(rnd_hrs)

# rnd_X = sm.add_constant(rnd_hrs)
# rnd_proba = (logit.predict(rnd_X))

preds = []

for i in range(1000):
    try:

        pred = logit.predict(X)
        new_y = [1 if np.random.random() < p else 0 for p in pred]
        new_logit = sm.Logit(new_y, X).fit_regularized(disp=False)
        proba_new = new_logit.predict(X)
        # print(proba_new)
        preds.append(proba_new)
```


probability
lower 95% CI delta method
upper 95% CI delta method